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NO. 246

Report of the ICES Advisory Committee on Fishery Management, 2001

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Copenhagen, 9 October – 17 October 2001

PART 1 OF 3

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Preface

The ICES Advisory Committee for Fishery Management met twice in 2001, 22-31 May and 9-17 October. The first meeting was held at Højstrupgård in Helsingør, Denmark while the other was held at the ICES Headquarters, Palægade 2–4, Copenhagen. Attendance is listed on the following pages.

ACFM in its advice includes a proposal for how the Precautionary Approach can be interpreted. This proposal is described in the Introduction and the advice given in Chapters 3-6 of the report is based on that proposal.

The reports are in response to requests from Management Commissions (EC, IBSFC, NEAFC, and NASCO) and from member countries. The management advice is presented stock by stock in Sections 3 to 6 where also the answers to special requests are given.

The requests from Management Commissions are divided into two parts: recurrent advice that is specified by Memorandum of Understanding between the Management Commissions and ICES and Special Requests. Recurrent advice includes assessment of stock status and management advice for the more important stocks in the Northeast Atlantic. This advice is provided in the same form as used by ICES Advisory Committee for Fishery Management in recent years.

ICES Fisheries Adviser
ICES Headquarters, Copenhagen
December 2001

ADVISORY COMMITTEE ON FISHERY MANAGEMENT

PARTICIPANTS AT MEETING, SPRING 2001

PARTICIPANTS	AFFILIATION	A	B
T. Jakobsen	Chair	X	X
F. van Beek	Vice-Chair	X	X
C. O'Brien	Chair, Resource Management Committee	X	X
A. Maucorps	Interim Chair of Consultative Committee	X	
	Belgium		
J. Rice	Canada	X	X
H. Hovgaard	Denmark	X	X
R. Aps	Estonia	X	X
J. Pönni	Finland	X	X
A. Forest	France	X	X
T. Gröhsler	Germany	X	X
S. Schopka	Iceland	X	X
J. Molloy	Ireland	X	X
G. Kornilovs	Latvia	X	X
H. Heessen	Netherlands	X	X
D. Skagen	Norway	X	X
J. Horbowy	Poland	X	X
F. Cardador	Portugal	X	X
V. Shlibanov	Russia	X	X
C. Porteiro	Spain	X	X
B. Sjöstrand	Sweden	X	X
P. Kunzlik	UK	X	X
S. Cadrin	USA	X	X
K. Patterson	Observer European Commission	X	
	Observer NAFO		
J. Boje (part time)	Chair of North-Western WG and Observer Faroe Islands and Greenland	X	X
J. Reinert (part time)	Observer Faroe Islands and Greenland	X	X
M. Plikshs	Chair of Baltic Fisheries Assessment WG		X
T. Pakarinen	Chair of Baltic Salmon and Trout Assessment WG		X
A. Gudmundsdottir	Chair of Northern Pelagic and Blue Whiting Fisheries WG		X
M. Basson	Chair of Herring Assessment WG for the Area South of 62°N		X
S. Mehl	Chair of Arctic Fisheries WG		X
O. A. Bergstad	Chair of SG on the Biology and Assessment of Deep-Sea Fisheries Resources		X
M. Pawson	Chair of SG on Sea Bass		X
C. Bannister	Chair of SG on the Further Development of the Precautionary Approach to Fishery Management		X
F. Redant	Chair of WG on *Nephrops* Stocks		X
H. Lassen	ICES Fisheries Adviser	X	X
H. Sparholt	ICES Fisheries Assessment Scientist	X	X

A **Plenary Sessions 22 May and 28-31 May 2001**
B **Sub-Groups 23-26 May 2001**

ADVISORY COMMITTEE ON FISHERY MANAGEMENT

PARTICIPANTS AT MEETING, AUTUMN 2001

PARTICIPANTS	AFFILIATION	A	B
T. Jakobsen	Chair	X	X
F. van Beek	Vice-Chair	X	X
C. O'Brien	Chair of Resource Management Committee and replacing Chair of Northern Shelf Demersal Stocks WG	X	X
W. Demaré	Belgium	X	X
	Canada		
S. Munch-Petersen	Denmark	X	X
T. Saat	Estonia	X	X
J. Pönni	Finland		
A. Biseau	France and Chair of Southern Shelf Demersal Stock WG	X	X
C. Hammer	Germany	X	X
E. Hjorleifsson	Iceland	X	X
C. Lordan	Ireland	X	X
M. Plikshs	Latvia	X	X
M. Pastoors	Netherlands and Chair of Demersal Stocks in the North Sea and Skagerrak WG	X	X
O. Smedstad	Norway	X	X
J. Horbowy	Poland	X	X
M. Azevedo	Portugal	X	X
Y. Efimov	Russia	X	X
C. Porteiro	Spain	X	X
B. Sjöstrand	Sweden and Chair of *Pandalus* WG	X	X
P. Kunzlik	UK	X	X
M. Terceiro	USA	X	X
E. Kirkegaard	Observer European Commission	X	
	Observer Greenland		
H.i. Jakupsstovu	Observer Faroe Islands	X	X
D. Skagen	Chair of Mackerel, Horse Mackerel, Sardine and Anchovy WG		X
W. Dekker	Chair of EIFAC/ICES WG on Eels		X
H. Lassen	ICES Fisheries Adviser	X	X
H. Sparholt	ICES Fisheries Assessment Scientist	X	X

A **Plenary Sessions 9 October and 15-17 October 2001**
B **Sub-Groups 10-13 October 2001**

ACFM REPORT 2001
PART 1 OF 3

1 ICES ADVICE

1.1 The Form of the ICES Advice

ICES recognises that "changes in fisheries systems are only slowly reversible, difficult to control, not well understood, and subject to change in the environment and human values" (FAO 1996). Therefore ICES agrees that a precautionary approach should be applied to fishery management. Reference points, stated in terms of fishing mortality rates or biomass and management plans are key concepts in implementing a precautionary approach. They should be regarded as signposts giving information of the status of the stock in relation to predefined limits that should be avoided to ensure that stocks and their exploitation remain within safe biological limits.

The concept of safe biological limits was introduced in ICES advice in 1981 and further developed in 1986 (Serchuk and Grainger, 1992). The concept of "safe biological limits" is explicitly referred to in the UN Agreement on Straddling Fish Stocks and Highly Migratory Fish Stocks. ICES uses it in an expanded way, consistent with the precautionary approach.

"Safe biological limits" has a specific meaning in ICES advice. A stock outside safe biological limits suffers increased risk of low recruitment, i.e. average recruitment will be lower than if the stock were at its full reproductive capacity. This causes a reduction of the potential catch fisheries can take from the stock. A stock that suffers severely reduced productivity is considered to be "collapsed". A stock "outside safe biological limits" is not, however usually at risk of extinction. A fish stock can be "outside safe biological limits" even if the number of spawners is several orders of magnitude larger than levels considered when evaluating whether stocks are at risk of extinction.

In order for stocks and fisheries exploiting them to be within safe biological limits, there should be a high probability that 1) the spawning stock biomass is above the threshold where recruitment is impaired, and 2) the fishing mortality is below that which will drive the spawning stock to the biomass threshold, which must be avoided. The biomass threshold is defined as $\mathbf{B}_{lim}$ ($_{lim}$ stands for limit) and the fishing mortality threshold as $\mathbf{F}_{lim}$. In order to have a high probability to avoid the thresholds, management action must be taken before the thresholds are approached. The precision with which the thresholds and current status of the stocks are known, and the risk which is tolerable, are important factors in determining the distance away from the threshold that management action is required. The greater the precision of the assessment, the smaller the distance between limit and precautionary reference points. If the assessment is less reliable, the distance will be greater. ICES has defined $\mathbf{B}_{pa}$ ($_{pa}$ stands for precautionary approach) as the biomass below which action should be taken and $\mathbf{F}_{pa}$ as the fishing mortality above which management action should be taken. The distance between the limit and the precautionary approach reference points is also related to the degree of risk that fishery management agencies are willing to accept. Therefore, although ICES sees its responsibility to identify limit reference points, it will suggest precautionary reference points for management use.

Formal definitions are provided below:

$\mathbf{F}_{lim}$ is the limit fishing mortality which should be avoided with high probability because it is associated with unknown population dynamics or stock collapse. There are very few stocks for which $\mathbf{F}_{lim}$ is accurately known. Some stocks in the ICES area have collapsed in the past when fishing mortality exceeded $\mathbf{F}_{lim}$, but generally speaking, the fishing mortality rate at which the probability of stock collapse becomes unacceptably high remains unknown. In order to have a high probability that fishing mortality will be below $\mathbf{F}_{lim}$, a precautionary reference point, $\mathbf{F}_{pa}$ lower than $\mathbf{F}_{lim}$, is defined. Used as a constraint on fishing, $\mathbf{F}_{pa}$ is designed to ensure that there is a high probability that $\mathbf{F}_{lim}$ will be avoided and that the spawning stock biomass will remain above the threshold below which the probability of good to average recruitment is decreased. In other words, $\mathbf{F}_{pa}$ is a device to ensure that recruitment overfishing does not take place. It is the upper bound on fishing mortality rate to be used by ICES in providing advice. $\mathbf{F}_{pa}$, given uncertainties, must have a high probability of being below $\mathbf{F}_{lim}$, and it must have a high probability of being sustainable based on the history of the fishery; i.e., it should be set in the range, and imply a biomass, within those previously perceived to be acceptable. Fishing mortality rates in excess of $\mathbf{F}_{pa}$ will be regarded as "overfishing".

$\mathbf{B}_{lim}$ is the limit spawning stock biomass, below which recruitment is impaired or the dynamics of the stock are unknown. Stocks may become depleted due to reduced recruitment even if fishing mortality is successfully maintained at or below $\mathbf{F}_{pa}$. Furthermore, efforts to restrain fishing below $\mathbf{F}_{pa}$ may not be successful and biomass may decline as a result. Clearly, therefore, in addition to a constraint on fishing mortality, it is desirable to have a biomass-based constraint to prevent stock decline to values where expected recruitment is low or unknown.

Whereas $\mathbf{F}_{pa}$ defines an "overfishing threshold", a definition of when the stock is regarded as being in a "depleted state" is also necessary. A threshold in this respect, $\mathbf{B}_{pa}$, needs to be set to ensure a high probability of avoiding reducing the stock to a point, $\mathbf{B}_{lim}$, below which recruitment is impaired or the dynamics of the stock are unknown. $\mathbf{B}_{lim}$ is in general equal to previously defined MBAL values for those stocks where MBAL has been based on considerations of stock-recruitment relationships. $\mathbf{B}_{pa}$ is the biomass below which the stock would be regarded as potentially depleted or overfished.

Framework for advice

Advice from ICES will be constrained by $\mathbf{F}_{pa}$ and $\mathbf{B}_{pa}$. If fishery management decisions lead to $\mathbf{F}_{pa}$ being exceeded, then this would be regarded as overfishing and management would not be regarded as consistent with a precautionary approach. The development of a management plan to reduce fishing mortality to no greater than $\mathbf{F}_{pa}$ would be advised. If no such plan were developed, ICES would generally advise that management was not consistent with a precautionary approach. Because $\mathbf{F}_{pa}$ would be set such that $\mathbf{B}_{pa}$ were unlikely to be reached, and because $\mathbf{B}_{pa}$ is chosen to provide a high probability of avoiding recruitment failure, if SSB were to fall below $\mathbf{B}_{pa}$, advice to reduce fishing mortality would be likely. This would depend, however, on whether or not $\mathbf{F}_{pa}$ were also being exceeded and on the prognosis for SSB trends and the probability of recovering to above $\mathbf{B}_{pa}$ in the short term. If SSB were predicted to remain below $\mathbf{B}_{pa}$ in the short to medium term, the development of a recovery plan would be advised. But in general, $\mathbf{B}_{pa}$ is the biomass threshold triggering advice for a reduction in F to a value below $\mathbf{F}_{pa}$.

$\mathbf{F}_{pa}$ and $\mathbf{B}_{pa}$ are thus the main devices in the ICES framework for providing advice. They are thresholds which constrain advice or which likely trigger advice for the implementation of management/recovery plans. If the development of plans were proposed, fishery management agencies, scientists and perhaps other parties would need to work together on their development. Such plans might involve explicit harvest control rules or sets of decision rules. If the development of plans were recommended, but not taken up, ICES would have to advise that management was not consistent with a precautionary approach. If plans were developed and not effectively implemented, again the advice would be that management was not consistent with a precautionary approach.

Note that if a stock is regarded as being in a depleted state, or even if overfishing is taking place, the development and effective implementation of a rebuilding plan which is regarded as sufficient to reduce fishing mortality to no higher than $\mathbf{F}_{pa}$ and to rebuild SSB to above $\mathbf{B}_{pa}$, within a "reasonable" period, would satisfy the condition that management were consistent with a precautionary approach.

ICES proposed a number of "lim" and "pa" reference points in 1998 as a provisional step to the implementation of a precautionary approach. ICES continues to keep the reference points under review and has revised some of the original proposals based on updated information on stock productivity. It was recognised that the estimates of thresholds could change as the concept evolved or with additional knowledge of stock and fishery dynamics. Further discussion of the implementation of the precautionary approach both within ICES (e.g. the 11[th] Dialogue Meeting in January 1999 and the Follow-up Meeting in February 2000) and elsewhere (NAFO, FAO, etc.), can be expected to result in further development and clarification of concepts and changes in terminology.

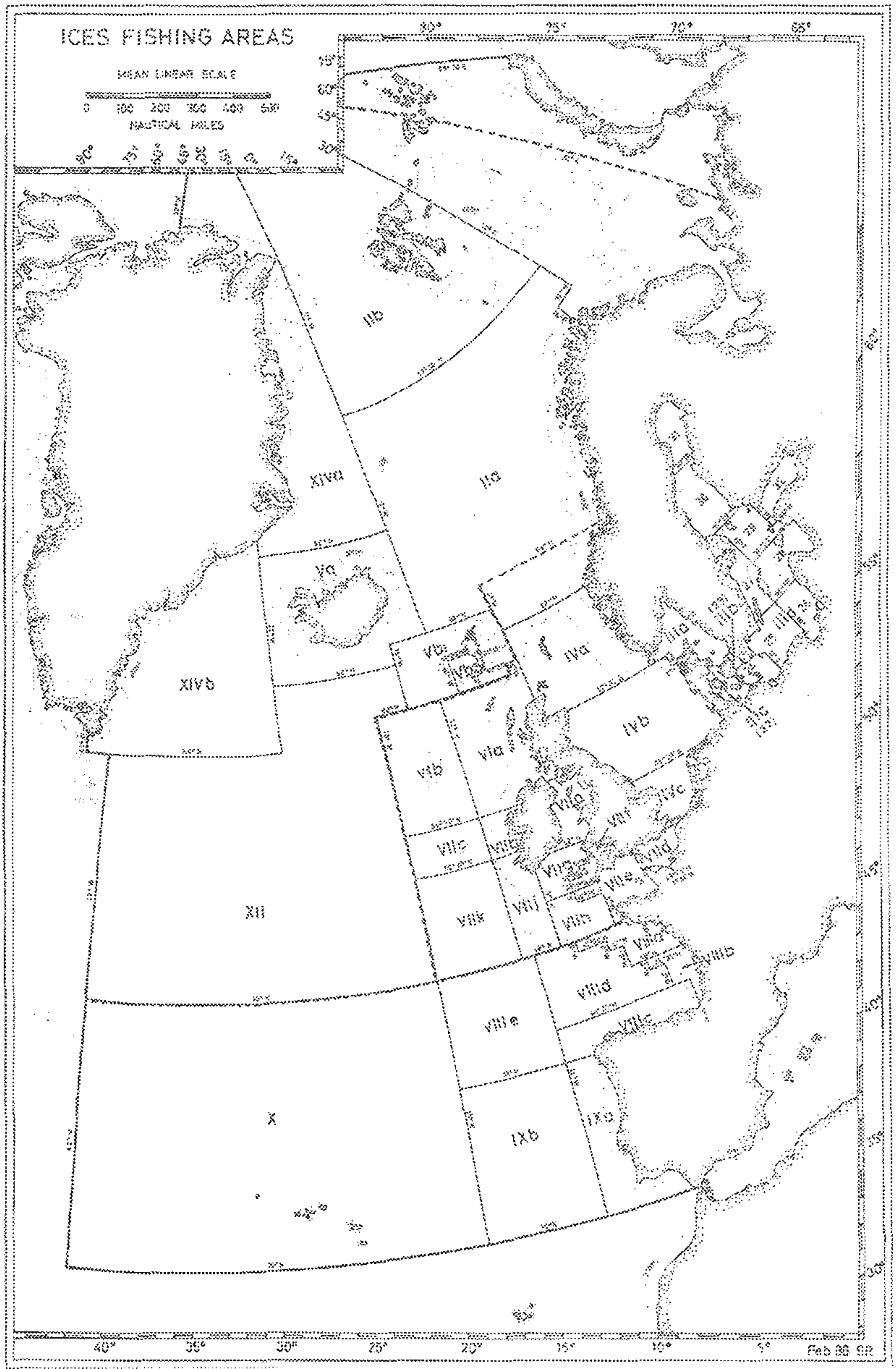
ICES 1997. Report of the Precautionary Approach to Fisheries Management. Copenhagen, 5–11 February 1997. ICES CM 1997/Assess:7.

ICES 1998. Report of the Precautionary Approach to Fisheries Management. Copenhagen, 3–6 February 1998. ICES CM 1998/ACFM:10.

Serchuk, F M. and Grainger, J. R. 1992. Development of the basis and form of ICES Fisheries Management Advice; Historical background (1976–1990) and the new form of ACFM Advice (1991 - ?). ICES CM 1992/Assess:20.

Report of the 11[th] Dialogue Meeting Nantes January 1999, ICES Coop. Res. Rep. 228 (1999)

Report of the Follow-up meeting of the 11[th] Dialogue Meeting, February 2000.


ICES FISHING AREAS
MEAN LINEAR SCALE
0 100 200 300 400 500
NAUTICAL MILES
IIb
IIa
XIVa
XIVb
Va
Vb
IVa
IVb
IVc
VIa
VIb
VIIa
VIIb
VIIc
VIIj
VIIk
VIIg
VIIh
VIIf
VIIe
VIId
VIIIa
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VIIId
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VIIIc
IXa
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5°
Feb 88

2 INTRODUCTORY ITEMS

2.1 Introduction

The assessments presented in this report are carried out using the best catch data available to ICES. These data are not necessarily identical with the official statistics but, where appropriate, include estimates of unreported landings as well as corrections for misallocation of catches by area and species. Despite considerable effort exerted on this problem, there is no guarantee that all instances of misreporting were discovered. Often the catch data used by ICES are collated on a stock rather than an area basis, and so straightforward comparisons between these figures and the official statistics, which are provided on an area basis, are not appropriate.

In the assessments, ICES tries to estimate the total catch taken, including slipped catches, discards, landings which are not officially reported, and the composition of the industrial by-catches. These amounts of different species, which have to be included in the estimates of what has been taken from a given stock in order for the assessments to be correct, thus appear in the tables and figures in this report. These discards, slipped fish, unreported landings, and industrial by-catches vary considerably between different stocks and fisheries, being negligible in some cases and constituting important parts of the total removal from other stocks.

The catch data used in the assessments are given in the "table" section of this report. In cases where there might be doubt, it has been indicated if discards, by-catches, and estimates of unreported landings are included in the assessments. Estimates of catches landed as by-catches, especially from the industrial fisheries, are included in the assessments wherever data allow it and are included in the catch options.

It should be noted that, in general, catches in the industrial fisheries of protected species above the minimum landing size which are sorted and landed for human consumption, are included in the estimates of human consumption landings, both in the catch input data and in the projected catch options. Estimates of industrial by-catches cover, in most cases, that part of the by-catch which is used for reduction purposes.

In the past there have been problems associated with discrepancies between the official landing figures reported to ICES by member countries and corresponding catch data used by ICES. ICES recognises the need for a clear identification of the categories of the catch data used for assessments and whenever possible specifies the composition of the catch data used to estimate fishing mortalities. ICES also attempts to identify factors contributing to the total fishing mortality in the various stocks, e.g.:

- recorded landings,
- discards at sea,
- slipping of unwanted catches,
- losses due to burst nets etc.,
- unreported landings,
- catch reported as other species,
- catch reported as taken in other areas,
- catch taken as by-catch in other fisheries.

It is recognised that it may not always be possible to reveal the sources of the data. It is, however, indicated whether the data originate from sampling programmes, field observations, interviews, etc., in order to allow ICES and other interested parties to evaluate the quality of the data, and hence the basis for the assessment.

The overall responsibility for obtaining reliable, adequate and timely fisheries statistics for publication in *ICES Fisheries Statistics* does not rest with ICES. It is the opinion of ICES that national offices for fisheries statistics are responsible for providing the catch data needed for assessments. These offices should ensure that catch statistics are collected on a gear basis and that the species composition of landings is determined in the case where landings are made unsorted by species.

2.2 Quality of Fishery Statistics

ICES expressed the greatest concern in past ACFM advice over the quality of catch and effort data from most of the important fisheries in the ICES area. ICES stressed that the immediate consequences of this are that ICES will be unable to provide reliable estimates of current stock sizes and forecasts that have been used to set TACs. Trends in stock size and the overall status of the stock can sometimes be evaluated from research vessel surveys, but such information alone cannot be used to give the short-term TAC advice usually required.

2.3 Catch projections for the current and following year

The Catch Option table is a basis part of the ICES advice and these catch options are based on assumptions about the total catch in the current or intermediate year. This value has been debated, especially when it is larger than the total TAC for the given year.

The catch assumption is a projection of trends in the fisheries and the projection is based on case specific conditions. In many cases, ICES considers two alternatives: 1) to assume that the catch will be equal to the TAC (a TAC constraint) or 2) to assume that the fishing mortality, F, will continue equal to that of previous year (a $F_{status\ quo}$ constraint). In some cases the stock unit used by ICES does not match the TAC area used by the management agencies. In those cases it can be difficult to establish how the TAC will restrict the catch from the stock and often the F *status quo* is used.

Calculation of the best estimate of the *status quo* fishing mortality by age varies between stocks. The form of the estimate depends of temporal trends in the fishing mortalities and in the exploitation pattern. Also the variance of the estimate in individual years needs to be considered. In several cases a mean over the last three years are used sometimes scaled to the level of fishing mortality in the most recent year.

Structure of the Report

Information and advice are provided on an area basis. Thus, all stocks belonging to a given area are placed in a separate section, together with an overview of the state of the stocks and fisheries in that area. Special requests from Commissions or member countries of ICES are placed in the section dealing with the respective area and stock.

Exceptions to this structure are that the report to the North Atlantic Salmon Conservation Organization and reports on *Nephrops* (section 3.14) and on European eel (Section 3.16) are provided as separate sections. Section 3.15 provides some preliminary information on the status of European Sea bass stocks.

3 Review of the Stocks

3.1 Stocks in the North-East Arctic (Sub-areas I and II)

3.1.1 Overview

Major Stocks and Landings

The total landings of fish and invertebrates in this area in 2000 were in the order of 2.8 million t. These catches were taken from a variety of demersal and pelagic stocks.

The major demersal stocks in the North-East Arctic include cod, haddock, saithe and northern shrimp. In addition, redfish, Greenland halibut and flatfishes (e.g., long rough dab, plaice) are common on the shelf and at the continental slope, with ling and tusk found also at the slope and in deeper waters. In 2000, landings of 0.7 million t were taken from the stocks of cod, haddock, saithe, redfish and Greenland halibut. An additional catch of about 100 000 t was taken from demersal stocks, including crustaceans, not assessed at present.

The major pelagic stocks are capelin, herring and polar cod. The highly migratory species blue whiting and mackerel extend their feeding migrations into this region. The international fishery for herring in 2000 was 1.21 million t. The capelin fishery in the Barents Sea in 2000 was 406 000 t. In addition, there were landings from Sub-areas I and II of 92 000 t mackerel (including Division Vb) and 276 000 t blue whiting (including Division Va).

Invertebrate species of krill, copepods and amphipods are considered to be important food resources for the fish stocks in this area. Marine mammals play an important role as predators on fish. Several other species of fish and invertebrates are found in the area. Species with relatively small landings include salmon, halibut, hake, pollack, whiting, Norway pout, anglerfish, wolffish, lumpsucker, argentines, grenadiers, flatfishes, horse mackerel, dogfishes, skates, crustaceans and molluscs.

Fleets and Fisheries

The fleets operating in this area are:

1. Factory and freezer trawlers operating in the whole area all year round targeting mainly cod, haddock and saithe and taking other species as by-catch. The number of these vessels has been stable in recent years, at a lower level than previously.

2. Fresh fish trawlers operating in Sub-area I and Division IIa all year round targeting mainly cod and haddock, taking other species as by-catch. The number of these vessels has been reduced in recent years.

3. Freezer trawlers operating in Sub-area I and Division IIb fishing shrimp. The number of these vessels has been stable.

4. Large purse seiners and pelagic trawlers targeting herring, mackerel, blue whiting, capelin and polar cod in seasonal fisheries in this region. These vessels fish some of the same species in other areas as well.

5. Small fresh fish trawlers targeting shrimp and capelin in near coast areas in Sub-area I. The size of this fleet has decreased in recent years.

6. A fleet of vessels using conventional gears (gillnet, longline, handline and Danish seine) mainly in near-shore fisheries targeting various demersal species all around the year. This fleet, together with fleets 7 and 8, accounts for approximately 30% of landings of demersal stocks. This share is maintained by quota allocation. When vessels in this fleet are modernised or replaced, there is a trend towards medium-sized (app. 15–20 m) multi-gear vessels with crews of 3–5.

7. Small purse seiners targeting saithe in coastal waters in a seasonal fishery, to a large extent vessels belonging to the group using conventional gears.

8. Longliners operating offshore targeting non TAC-restricted species, mainly ling, blue ling and tusk. These vessels are generally larger than those in the coastal fisheries and use technologically advanced auto-line systems.

Management Measures

The fisheries in Sub-areas I and II are managed by TAC constraints for the main stocks and by allocation of TAC shares amongst states with established fishing interests. These sub-areas consist mainly of waters within EEZs but also contain some waters outside EEZs.

For the main species the fisheries in the EEZs are regulated by quotas at a variety of scales (vessels, fleets, species, season). Management measures also regulate minimum landing size, mesh size, and use of sorting grids. Since January 1997 use of sorting grids in the trawl fisheries has been mandatory for most of the Barents Sea and Svalbard area. Minimum landing size is also a minimum catching size implying that vessels have to avoid fishing grounds with small-sized fish. Discarding is prohibited in some EEZs. Time and area closures may be implemented to protect small fish.

Compilation of effort data relevant to the different species is difficult when the fisheries are regulated by vessel quotas. In some cases the effort targeted at the main species, e.g., cod, may be calculated but it is almost impossible to calculate effort for non-target species.

Current status in the North-East Arctic

The recent developments in the stocks of cod, haddock, saithe, Greenland halibut, redfishes, herring and capelin are summarised in the following.

The stocks of cod and *Sebastes mentella* are outside safe biological limits, haddock is harvested outside safe biological limits while saithe is within safe biological limits.

The status of the Greenland halibut stock is not precisely known, but it is considered to be outside safe biological limits. SSB in 2001 is the lowest in the time series and recruitment in recent years is estimated to be among the lowest in the time series.

The available information on *Sebastes marinus* is insufficient to assess the stock properly, but there are signs in the surveys of reduced recruitment and the coastal survey also indicate a decrease for larger fish.

The capelin stock is within safe biological limits although the recent stock increase has culminated and the stock may decrease over the next few years.

The spawning stock of Norwegian spring-spawning herring is declining, but the stock is still considered to be within safe biological limits. High recruitment is infrequent and the adult stock is now dominated by two strong year classes.

Considerable effort has been devoted to investigate multispecies interactions. Some of these investigations have reached the stage where quantitative results are available for use in assessments. Growth of cod depends on availability of prey such as capelin, and variability in cod growth has had major impacts on the cod fishery. Cod are able to compensate only partially for low capelin abundance, by switching to other prey species. Low capelin abundance has caused high cannibalism on juvenile cod, and increased predation in impacts on other prey species, e.g. juvenile herring and haddock. Herring predation on capelin larvae is believed to be partially responsible for the recruitment failure of capelin when young herring are abundant in the Barents Sea.

The annual consumption of herring and capelin by marine mammals (particularly harp seals and minke whales) has been estimated to be in the order of 1.5-2.0 million t. The composition and distribution of species in the Barents Sea depend considerably on the position of the polar front which separates warm and salty Atlantic waters from colder and fresher waters of arctic origin. Variation in the recruitment of some species including cod and herring has been associated with changes in the influx of Atlantic waters into the Barents Sea.

3.1.2 Cod in Sub-areas I and II

3.1.2.a North-East Arctic cod

State of stock/fishery: The stock is outside safe biological limits. Fishing mortality in the last four years has been among the highest observed and well above $\mathbf{F}_{pa}$, even above $\mathbf{F}_{lim}$, and is not sustainable. SSB has been below $\mathbf{B}_{pa}$ since 1998. Surveys indicate below average 1998 and 2000 year classes and a very poor 1999 year class.

Management objectives: In recent years, the advice has been to reduce fishing mortality below $\mathbf{F}_{pa}$ (=0.42) and to keep the spawning stock above 500 000 t, which was considered to be the minimum value required to have a low probability of bad recruitment. This approach was incorporated into a management objective in the years 1997–1999. The latest agreement in the Russian-Norwegian Fisheries Commission sets a TAC of 435 000 t (including 40 000 t Norwegian coastal cod) for 2001, 2002, and 2003. The intention is that this TAC could be revised either if the stock situation is more serious than known at the time of the agreement, or if the stock is assessed to be within safe biological limits. ICES considers that TACs under this agreement are well above those that would correspond to the application of the precautionary approach.

Precautionary Approach reference points: The biological information on historic stock and recruitment sizes has been revised. These revisions have altered some of the historic values substantially, with two consequences. Spawning biomasses associated with some historic recruitment are now estimated to have been lower, suggesting that current reference points may be slightly too high. However, the new data appears better to separate the strong environmental impact on recruitment from the biological productivity of the stock. The pattern suggests that the biological productivity of the stock at low SSB may be lower than previously thought, and this may affect the selection of the reference points. This will allow a more robust analysis of the biological dependency of recruitment on SSB, the results of which would be the basis for yet further revisions to reference points. Rather than revising the reference points this year and again next year when the analysis will further separate environmental and biological contributions to stock productivity, ICES continues to advise using the previous reference points. The advice in the short term would be very similar using either the present or the candidate revised reference points, and the medium-term consequences can be re-evaluated when the further analyses are complete.

Precautionary Approach reference points (established in 1998):

ICES considers that:	ICES proposes that:
$\mathbf{B}_{lim}$ is 112 000 t, the SSB below which no above-average year classes have been observed	$\mathbf{B}_{pa}$ is set at 500 000 t, the value below which the probability of below-average year classes increases
$\mathbf{F}_{lim}$ is 0.70	$\mathbf{F}_{pa}$ be set at 0.42. This value is considered to have a 95% probability of avoiding the $\mathbf{F}_{lim}$

Technical Basis:

$\mathbf{B}_{lim} = \mathbf{B}_{loss}$	$\mathbf{B}_{pa}$ = examination of stock-recruit plot
$\mathbf{F}_{lim}$ = Median value of $\mathbf{F}_{loss}$	$\mathbf{F}_{pa} = 5^{th}$ percentile of $\mathbf{F}_{loss} = \mathbf{F}_{lim} \times 0.6$

Advice on management: ICES recommends a considerable reduction in fishing mortality to well below $\mathbf{F}_{pa}$ (0.42). A rebuilding plan for this stock is required. Rebuilding the spawning stock to above the $\mathbf{B}_{pa}$ (500 000 t) by 2003 requires a F in 2002 of less than 0.25. This corresponds to catches in 2002 of less than 181 000 t. The rebuilding plan should also include measures ensuring that all catches are reported fully and that the exploitation pattern be improved.

Relevant factors to be considered in management: The TAC for 2001 was set considerably higher than recommended by ICES. The agreed TAC for 2002 (435 000 t, including 40 000 t of Norwegian coastal cod) is expected to be taken with a fishing mortality well above $\mathbf{F}_{pa}$. As a result of this, SSB is expected to remain below $\mathbf{B}_{pa}$ in 2003.

Evidence of recent under-reporting of catches during the 1990s is accumulating. Both discards and unreported landings will reduce the effect of management measures and it is important that management agencies ensure that all catches are counted against the TAC regulations.

Since fishing mortality is still far above $\mathbf{F}_{max}$ (0.24) the stock is growth-overfished.

The majority of the spawning stock comprises first time spawners. Evidence has shown that the eggs and larvae of first-time spawners are less viable than those of other mature fish, but also that the overall spawning period is reduced when the spawning stock consists of fewer age groups. Both these factors can reduce the reproductive potential of the stock for the same biomass.

Comparison with previous assessment and advice: In previous assessments, fishing mortality F(5-10) in the most recent years was often underestimated and stock numbers overestimated in the annual assessments of the stock. The current assessment does not present such retrospective patterns, although it is too early to infer whether this over/underestimation has ceased to be a problem for this assessment.

In the past, ICES has presented a TAC-constrained forecast for the intermediate year in prediction, rather than assuming *status quo* fishing mortality. This year ICES presents a *status quo* forecast for the following reasons:

- It is believed that under-reporting of catches continues to be a problem for this stock, in which case a TAC constraint is inappropriate;
- For NEA cod, a TAC constraint requires a reduction in fishing mortality compared to *status quo*, whilst for NEA haddock, (mostly caught in association with cod), an increase in fishing mortality would be required for a TAC constraint. This inconsistency suggests that the TAC constraint is being used as an *ad hoc* "fix" for assessments that provide uncertain catch forecasts from year to year, rather than reflecting an actual constraint on fishing mortality;
- The practice is consistent with most other stocks in the ICES area. Experience with TACs suggest that precise and unbiased assessments, as well as compelling reasons to assume that TACs act as a constraint on catches, are needed before applying a TAC constraint on forecasts.

Catch forecast for 2002:

Basis: $\mathbf{F_{sq}}$= F(2001)=F(2000) = 0.91; Landings (2001) = 530; SSB(2002) = 272.

F(2002)	Basis	Landings (2002)	SSB (2003)	Comment
0		0	611	
0.09	0.10 * $\mathbf{F_{sq}}$	71	567	
0.12	0.13 * $\mathbf{F_{sq}}$	92	553	$\mathbf{F_{0.1}}$
0.18	0.20 * $\mathbf{F_{sq}}$	138	526	
0.22	0.24 * $\mathbf{F_{sq}}$	164	510	$\mathbf{F_{max}}$
0.25	0.27*$\mathbf{F_{sq}}$	182	500	$\mathbf{SSB_{2003}=B_{pa}}$
0.36	0.40 * $\mathbf{F_{sq}}$	259	453	
0.42	0.46 * $\mathbf{F_{sq}}$	292	434	$\mathbf{F_{pa}}$
0.54	0.60 * $\mathbf{F_{sq}}$	366	391	
0.60	0.66 * $\mathbf{F_{sq}}$	395	374	**Agreed TAC 2002***
0.63	0.70 * $\mathbf{F_{sq}}$	415	363	**Agreed TAC 2002****
0.68	0.75 * $\mathbf{F_{sq}}$	435	353	**Agreed TAC 2002*****
0.73	0.80 * $\mathbf{F_{sq}}$	460	338	
0.82	0.90 * $\mathbf{F_{sq}}$	504	315	
0.91	$\mathbf{F_{sq}}$	544	293	$\mathbf{F_{2000}}$

*assuming 40 000 t of the total quota taken as Norwegian Coastal cod.
**assuming 20 000 t of the total quota taken as Norwegian Coastal cod.
***assuming 0 t of the total quota taken as Norwegian Coastal cod.
Weights in '000 t.
Shaded scenarios considered inconsistent with the precautionary approach.

Elaboration and special comment: Changes in growth, maturity and cannibalism are linked to abundance of the capelin stock, which has increased since 1997 and is expected to stay at a high level in 2001. So far, a reduction in cannibalism has been observed. Models relating cannibalism and capelin abundance have been used to predict natural mortality for 2001 onwards.

The fishery for North-East Arctic cod is conducted both by an international trawler fleet operating in offshore waters, and by vessels using gillnets, longlines, handlines, and Danish seine operating both offshore and in the coastal areas. Quotas were introduced in the trawl fishery in 1978 and for the fisheries with conventional gears in 1989. In addition to quotas the fisheries are regulated by mesh size limitations (including sorting grids), a minimum catching size, a maximum by-catch of undersized fish, maximum by-catch of non-target species, closure of areas with high densities of juveniles, and by seasonal and area restrictions. Since January 1997 sorting grids have been mandatory for the trawl fisheries in most of the Barents Sea and Svalbard area. The fisheries are controlled by inspections of the trawler fleet at sea, by a requirement of reporting to catch control points when entering and leaving the EEZs, and by inspections for all fishing vessels when landing the fish. Keeping a detailed fishing log-book on board is mandatory for most vessels, and large parts of the fleet report to the authorities on a daily basis. There is some evidence that the present catch control and reporting systems are not sufficient to prevent under-reporting of catches.

The assessment is based on analysis of catch-at-age data, using two commercial cpue series and three survey series. Estimates of cannibalism are included in the natural mortality. Alternative assessment methods (Fleksibest) are in development.

While the area coverage of the surveys was incomplete in 1997, 1998, and the summer of 2000, the coverage was normal in 1999 and during the winter surveys in 2000 and 2001.

Source of information: Report of the Arctic Fisheries Working Group, May 2001 (ICES CM 2001/ACFM:19).

Yield and spawning biomass per Recruit
F-reference points

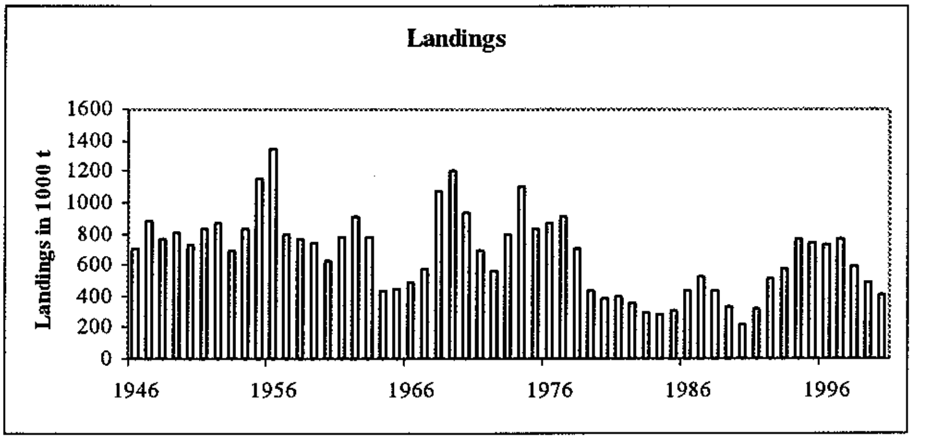
	Fish Mort Ages 5-10	Yield/R	SSB/R
Average Current	0.907	1.016	0.541
$\mathbf{F}_{max}$	0.210	1.288	4.357
$\mathbf{F}_{0.1}$	0.113	1.191	7.275
$\mathbf{F}_{med}$	0.840	1.032	0.621

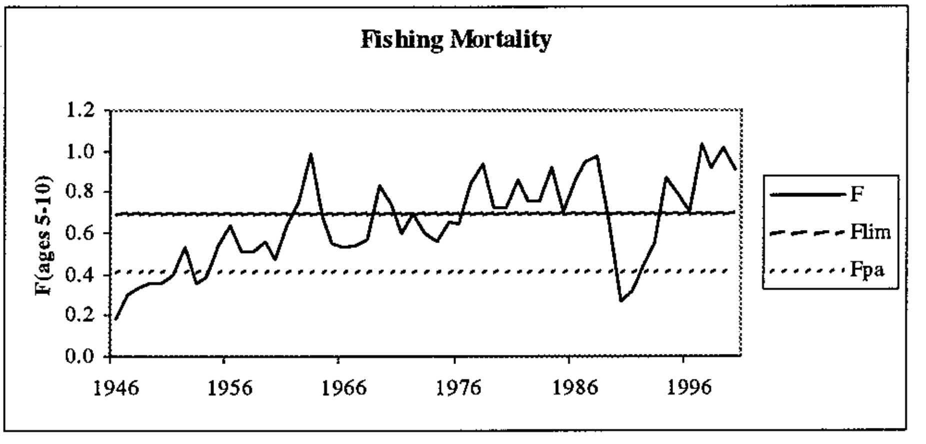
Catch data (Tables 3.1.2.a.1–3):

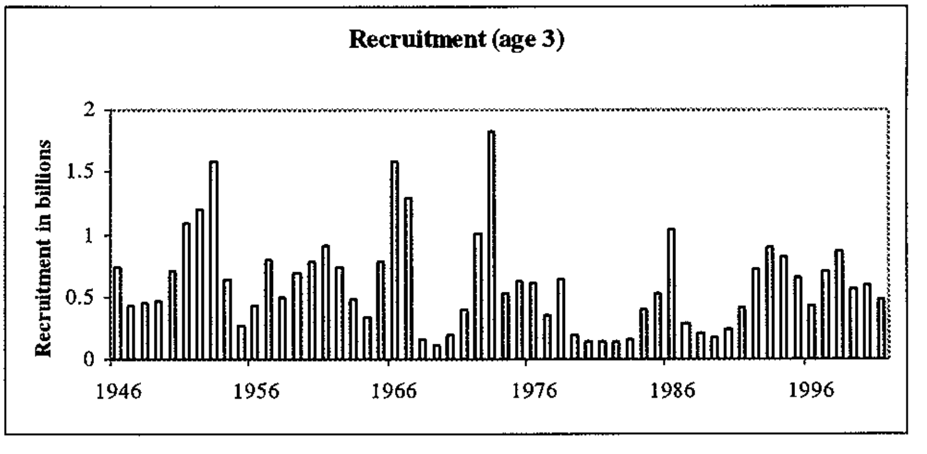
Year	ICES Advice	Predicted catch corresp. to advice[1]	Agreed TAC[1]	Official landings	ACFM landings[1]	Unreported landings
1987	Gradual reduction in F	595	560	552	523	
1988	F = 0.51; TAC (Advice November 87)	530	590	459	435	
	(Revised advice May 88)	(320-360)	451			
1989	Large reduction in F	335	300	348	332	
1990	F at $\mathbf{F}_{low}$; TAC	172	160	210	212	25
1991	F at $\mathbf{F}_{low}$; TAC	215	215	294	319	50
1992	Within safe biological limits	250[2]	356	421	513	130
1993	Healthy stock	256[2]	500	575	582	50
1994	No long-term gains in increased F	649[2]	700	795	771	25
1995	No long-term gains in increased F	681[2]	700	763	740	
1996	No long-term gains in increased F	746[2]	700	759	732	
1997	Well below $\mathbf{F}_{med}$	< 993	850	775[3]	762	
1998	F less than $\mathbf{F}_{med}$	514	654	597[4]	593	
1999	Reduce F to below $\mathbf{F}_{pa}$	360	480		485	
2000	Increase B above $\mathbf{B}_{pa}$ in 2001	110	390		414	
2001	High prob. of SSB>$\mathbf{B}_{pa}$ in 2003	<263	395			
2002	F well below 0.25	< 181	395			

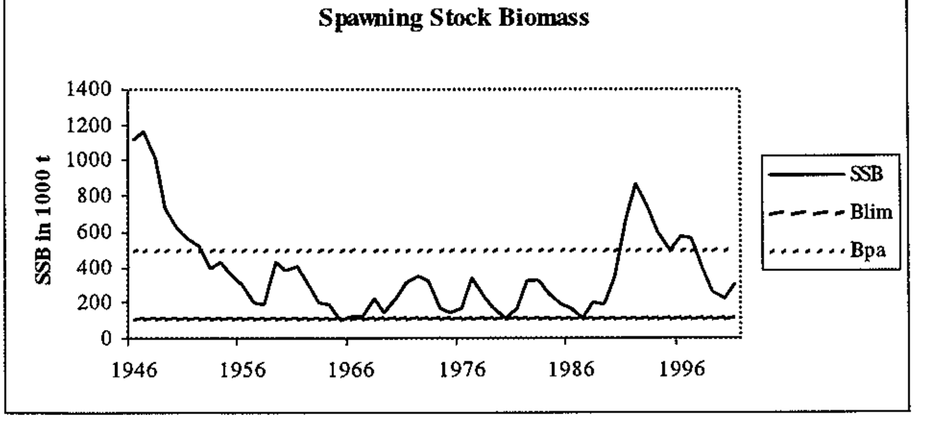
[1]Norwegian coastal cod not included. [2]Catch at *status quo* F. [3]Spain data not included. [4]Germany, Ireland, Spain not included. Weights in '000 t.

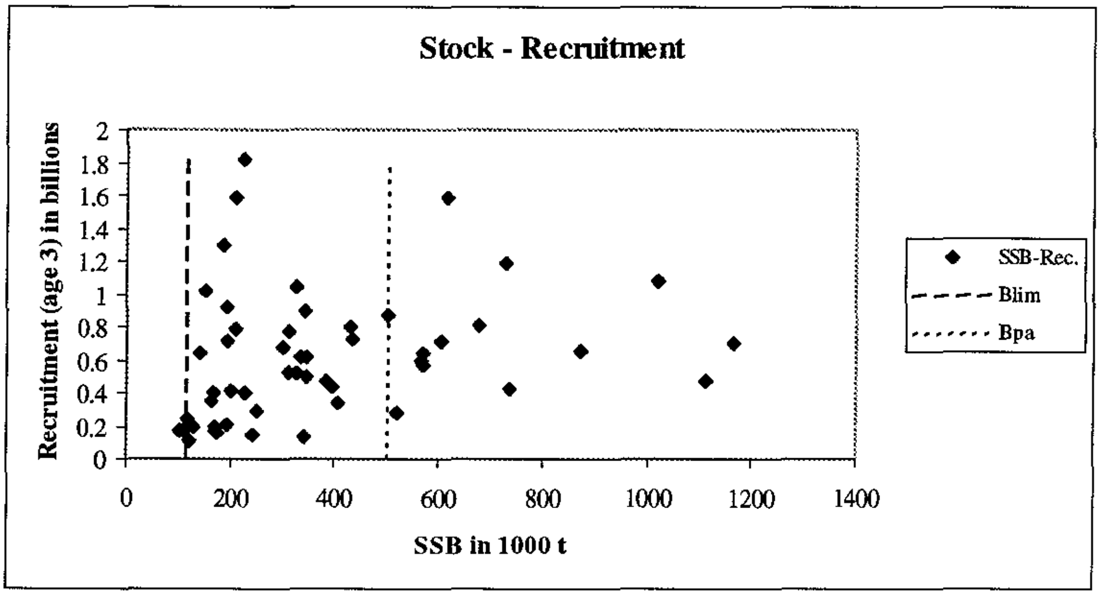
North-East Arctic cod (Sub-areas I and II)

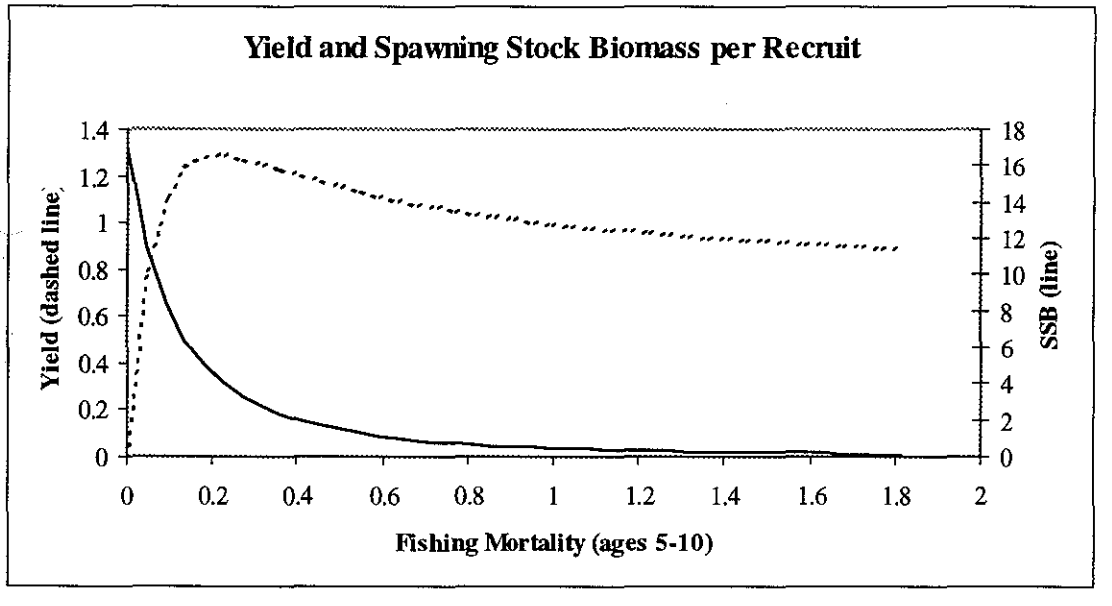









Stock - Recruitment
Recruitment (age 3) in billions
SSB in 1000 t
SSB-Rec.
Blim
Bpa
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
0
200
400
600
800
1000
1200
1400


Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
SSB (line)
Fishing Mortality (ages 5-10)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
0
2
4
6
8
10
12
14
16
18
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2

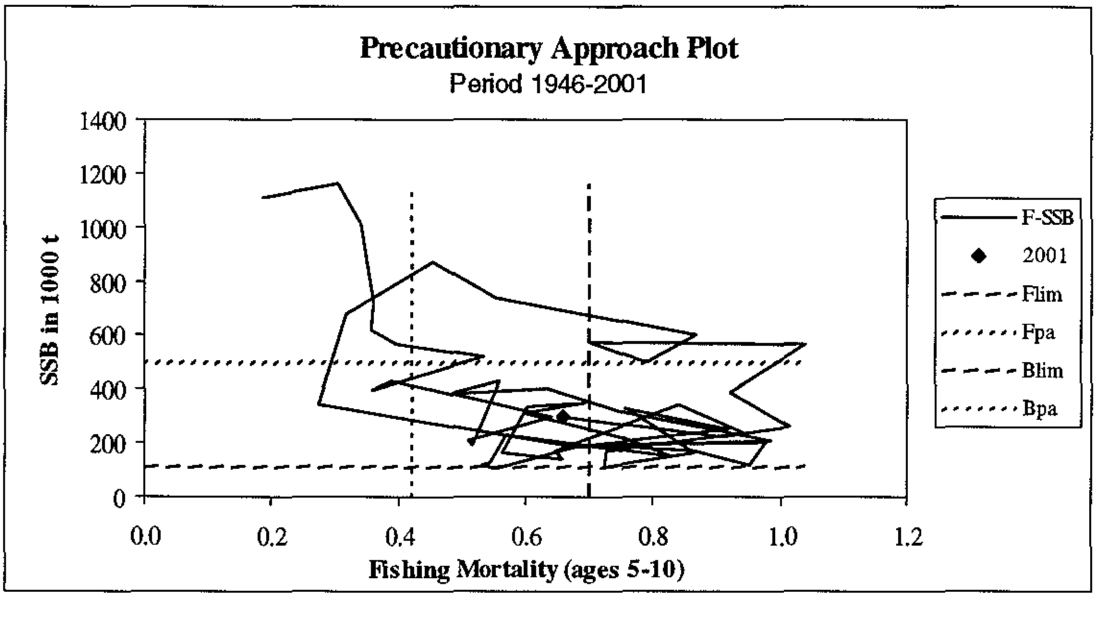

Precautionary Approach Plot
Period 1946-2001
SSB in 1000 t
Fishing Mortality (ages 5-10)
F-SSB
2001
Flim
Fpa
Blim
Bpa
0
200
400
600
800
1000
1200
1400
0.0
0.2
0.4
0.6
0.8
1.0
1.2

Table 3.1.2.a.1 North-East Arctic COD. Total catch (t) by fishing areas and unreported catch (Data provided by Working Group members.)

Year	Sub-area I	Division IIa	Division IIb	Unreported catches	Total catch
1961	409,694	153,019	220,508		783,221
1962	548,621	139,848	220,797		909,266
1963	547,469	117,100	111,768		776,337
1964	206,883	104,698	126,114		437,695
1965	241,489	100,011	103,430		444,983
1966	292,253	134,805	56,653		483,711
1967	322,798	128,747	121,060		572,605
1968	642,452	162,472	269,254		1,074,084
1969	679,373	255,599	262,254		1,197,226
1970	603,855	243,835	85,556		933,246
1971	312,505	319,623	56,920		689,048
1972	197,015	335,257	32,982		565,254
1973	492,716	211,762	88,207		792,685
1974	723,489	124,214	254,730		1,102,433
1975	561,701	120,276	147,400		829,377
1976	526,685	237,245	103,533		867,463
1977	538,231	257,073	109,997		905,301
1978	418,265	263,157	17,293		698,715
1979	195,166	235,449	9,923		440,538
1980	168,671	199,313	12,450		380,434
1981	137,033	245,167	16,837		399,037
1982	96,576	236,125	31,029		363,730
1983	64,803	200,279	24,910		289,992
1984	54,317	197,573	25,761		277,651
1985	112,605	173,559	21,756		307,920
1986	157,631	202,688	69,794		430,113
1987	146,106	245,387	131,578		523,071
1988	166,649	209,930	58,360		434,939
1989	164,512	149,360	18,609		332,481
1990	62,272	99,465	25,263	25,000	212,000
1991	70,970	156,966	41,222	50,000	319,158
1992	124,219	172,532	86,483	130,000	513,234
1993	195,771	269,383	66,457	50,000	581,611
1994	353,425	306,417	86,244	25,000	771,086
1995	251,448	317,585	170,966		739,999
1996	278,364	297,237	156,627		732,228
1997	273,376	326,689	162,338		762,403
1998	250,815	257,398	84,411		592,624
1999	158,501	218,393	106,719		483,613
2000[1]	136,470	204,364	73,310		414,144

[1]Provisional figures.

Table 3.1.2.a.2 North-East Arctic COD. Nominal catch (t) by countries (Sub-area I and Divisions IIa and IIb combined). (Data provided by Working Group members.)

Year	Faroe Islands	France	German Dem.Rep.	Fed.Rep. Germany	Norway	Poland	United Kingdom	Russia[2]		Others	Total all countries
1961	3,934	13,755	3,921	8,129	268,377	-	158,113	325,780		1,212	783,221
1962	3,109	20,482	1,532	6,503	225,615	-	175,020	476,760		245	909,266
1963	-	18,318	129	4,223	205,056	108	129,779	417,964		-	775,577
1964	-	8,634	297	3,202	149,878	-	94,549	180,550		585	437,695
1965	-	526	91	3,670	197,085	-	89,962	152,780		816	444,930
1966	-	2,967	228	4,284	203,792	-	103,012	169,300		121	483,704
1967	-	664	45	3,632	218,910	-	87,008	262,340		6	572,605
1968	-	-	225	1,073	255,611	-	140,387	676,758		-	1,074,084
1969	29,374	-	5,907	5,543	305,241	7,856	231,066	612,215		133	1,197,226
1970	26,265	44,245	12,413	9,451	377,606	5,153	181,481	276,632		-	933,246
1971	5,877	34,772	4,998	9,726	407,044	1,512	80,102	144,802		215	689,048
1972	1,393	8,915	1,300	3,405	394,181	892	58,382	96,653		166	565,287
1973	1,916	17,028	4,684	16,751	285,184	843	78,808	387,196		276	792,686
1974	5,717	46,028	4,860	78,507	287,276	9,898	90,894	540,801		38,453	1,102,434
1975	11,309	28,734	9,981	30,037	277,099	7,435	101,843	343,580		19,368	829,377
1976	11,511	20,941	8,946	24,369	344,502	6,986	89,061	343,057		18,090	867,463
1977	9,167	15,414	3,463	12,763	388,982	1,084	86,781	369,876		17,771	905,301
1978	9,092	9,394	3,029	5,434	363,088	566	35,449	267,138		5,525	698,715
1979	6,320	3,046	547	2,513	294,821	15	17,991	105,846		9,439	440,538
1980	9,981	1,705	233	1,921	232,242	3	10,366	115,194		8,789	380,434
						Spain					
1981	12,825	3,106	298	2,228	277,818	14,500	5,262	83,000		-	399,037
1982	11,998	761	302	1,717	287,525	14,515	6,601	40,311		-	363,730
1983	11,106	126	473	1,243	234,000	14,229	5,840	22,975		-	289,992
1984	10,674	11	686	1,010	230,743	8,608	3,663	22,256		-	277,651
1985	13,418	23	1,019	4,395	211,065	7,846	3,335	62,489		4,330	307,920
1986	18,667	591	1,543	10,092	232,096	5,497	7,581	150,541		3,505	430,113
1987	15,036	1	986	7,035	268,004	16,223	10,957	202,314		2,515	523,071
1988	15,329	2,551	605	2,803	223,412	10,905	8,107	169,365		1,862	434,939
1989	15,625	3,231	326	3,291	158,684	7,802	7,056	134,593		1,273	332,481
1990	9,584	592	169	1,437	88,737	7,950	3,412	74,609		510	187,000
1991	8,981	975		2,613	126,226	3,677	3,981	119,427[3]		3,278	269,158
			Greenland								
1992	11,663	2	3,337	3,911	168,460	6,217	6,120	182,315		1,209	383,234
									Iceland		
1993	17,435	3,572	5,389	5,887	221,051	8,800	11,336	244,860	9,374	3,907	531,611
1994	22,826	1,962	6,882	8,283	318,395	14,929	15,579	291,925	36,737	28,568	746,086
1995	22,262	4,912	7,462	7,428	319,987	15,505	16,329	296,158	34,214	15,742	739,999
1996	17,758	5,352	6,529	8,326	319,158	15,871	16,061	305,317	23,005	14,851	732,228
1997	20,076	5,353	6,426	6,680	357,825	17,130	18,066	313,344	4,200	13,303	762,403
1998	14,290	1,197	6,388	3,841	284,647	14,212	14,294	244,115	1,423	8,217	592,624
1999	13,700	2,137	4,300	3,019	223,390	10,034	8,819	210,374	1,942	5,898	483,613
2000[1]	13,350	2,621	5,787	3,136	192,717	8,694	9,085	166,202	7,437	5,115	414,144

[1]Provisional figures.

[2]USSR prior to 1991.

[3]Includes Baltic countries.

Table 3.2.1.a.3 North-East Arctic cod in Sub-areas I and II.

Year	Recruitment Age 3 thousands	SSB tonnes	Landings tonnes	Mean F Ages 5-10
1946	728139	1112776	706000	0.1857
1947	425311	1165059	882017	0.3047
1948	442592	1019114	774295	0.3398
1949	468348	729879	800122	0.3619
1950	704908	615339	731982	0.3566
1951	1083753	568705	827180	0.3966
1952	1193111	520599	876795	0.5348
1953	1590377	396417	695546	0.3572
1954	641584	429694	826021	0.3879
1955	272778	346919	1147841	0.5437
1956	439602	299823	1343068	0.6401
1957	804781	207840	792557	0.5089
1958	496824	195377	769313	0.5169
1959	683690	432489	744607	0.5596
1960	789653	383479	622042	0.4789
1961	916842	404228	783221	0.6348
1962	728338	311678	909266	0.7576
1963	472064	208207	776337	0.9866
1964	338678	186570	437695	0.6789
1965	776941	102315	444930	0.5533
1966	1582560	120722	483711	0.5302
1967	1295416	129784	572605	0.5439
1968	164955	227215	1074084	0.5704
1969	112039	151870	1197226	0.8292
1970	197105	224482	933246	0.7493
1971	404774	311662	689048	0.5956
1972	1015319	346511	565254	0.6928
1973	1818949	332913	792685	0.6020
1974	523916	164491	1102433	0.5633
1975	621616	142028	829377	0.6595
1976	613942	171238	867463	0.6457
1977	348054	341385	905301	0.8379
1978	638490	241536	698715	0.9406
1979	198489	174699	440538	0.7264
1980	137735	108253	380434	0.7241
1981	150863	166925	399038	0.8632
1982	151833	326131	363730	0.7583
1983	166679	327177	289992	0.7560
1984	398235	251075	277651	0.9162
1985	523847	193456	307920	0.7039
1986	1036839	170266	430113	0.8652
1987	286234	118371	523071	0.9517
1988	204635	202396	434939	0.9763
1989	172717	194764	332481	0.6607
1990	242677	340999	212000	0.2721
1991	411824	676607	319158	0.3184
1992	720592	872726	513234	0.4542
1993	892522	734528	581611	0.5521
1994	811816	602933	771086	0.8668
1995	658310	500996	739999	0.7895
1996	428641	570810	732228	0.7017
1997	711851	565236	762403	1.0384
1998	868506	388625	592624	0.9213
1999	564271	259355	484910	1.0127
2000	590531	222703	414144	0.9067
2001	474000	299537		0.6600
Average	609627	371623	671005	0.6472

3.1.2.b Norwegian Coastal cod

State of stock/exploitation: There are no reference points proposed for this stock. The SSB in 2001 is the lowest observed in the time series extending back to 1984. The stock has declined continuously since 1994, and fishing mortality has increased since 1991. Recruitment in recent years has been below average. The landings increased steadily from 1991 and up to 1997; since then they have decreased. The assessment reflects the general trends in the development of the stock, although it is not regarded as accurate.

Management objectives: There are no explicit management objectives for this stock. Management objectives should be defined, taking the status of the stock into consideration.

Advice on management: ICES advises that catches in 2002 should be reduced by the same proportion as for North-East Arctic cod.

Rebuilding plan: Although no precautionary reference points have been established for this stock a rebuilding plan is required. The rebuilding plan for this stock should complement the provisions taken in a similar plan developed for North-East Arctic cod as a result of ICES' advice for that stock.

Relevant factors to be considered in management: The SSB is at an historical low, and the year classes recruiting to the SSB over the next 4 years seem to be well below average. Unless fishing mortality is reduced considerably, a further decrease in the total stock biomass and SSB is expected. Management measures should be implemented to ensure that catches in particular are reduced in areas where, and in seasons when the proportion of Norwegian Coastal cod is large compared to North-East Arctic cod.

Norwegian Coastal cod is managed as part of the Norwegian North-East Arctic cod fishery. An expected yield of 40 000 t from the Coastal cod has been added annually since the mid-1970s to the quota for North-East Arctic cod. If this practice is followed in 2002 and the quota is taken, both the stocks (Norwegian Coastal cod and North-East Arctic cod) will continue to be overexploited. If Norwegian Coastal cod could be managed independently of North-East Arctic cod, ACFM would advise a reduction of at least 65% of the fishing mortality in 2000 in order to halt the decline in the spawning stock.

Comparison with previous assessment and advice: In this year's assessment the fishing mortalities ($\mathbf{F}_{4\text{-}7}$) for 1997–1999 are higher and the stock biomasses and the spawning stock biomasses are lower compared with last year's assessment.

Catch forecast for 2002:

Basis: TAC; F(2001) = 0.96 * F(2000) = 0.48; Landings (2001) = 34; SSB(2002) = 49.

F(2002 onwards)	Basis	Catch (2002)	Landings (2002)	SSB (2003)	
0.01	0.02 * $\mathbf{F}_{sq}$		1.0	72	SSB 2003 = SSB 1999
0.10	0.20 * $\mathbf{F}_{sq}$		7.4	66	SSB 2003 = SSB 2000
0.17	0.34 * $\mathbf{F}_{sq}$		12.0	61	SSB 2003 = SSB 2001
0.20	0.40 * $\mathbf{F}_{sq}$		14.0	59	
0.30	0.60 * $\mathbf{F}_{sq}$		19.9	53	
0.35	0.70 * $\mathbf{F}_{sq}$		23.0	50	SSB 2003 = SSB 2002
0.40	0.80 * $\mathbf{F}_{sq}$		25.1	48	
0.50	$\mathbf{F}_{sq}$		29.8	43	

Weights in '000 t.

Although a TAC-constrained prediction is presented, this is very close to the *status quo* forecast that would have been preferred by ACFM. Because the difference is so minor, the prediction has not been re-run.

Elaboration and special comment: The fishery for Norwegian Coastal cod is part of a directed fishery on cod in Norway using a variety of traditional gears, including trawl, and has been conducted for several decades. The catches include both North-East Arctic cod and Norwegian Coastal cod in some areas and in some periods of the year. In Finnmark 43 likely spawning areas for Norwegian Coastal cod have been identified. Among these 24 are closed for Danish seine fishery in the first five months of the year. Trawl fisheries for roundfish are not allowed at any time of the year within 4 nautical miles of the coast.

A method of catch separation by otolith pattern has been used in recent years to estimate landings from the Norwegian Coastal cod stock. The landings data are not considered to be estimated precisely.

The stock was assessed by XSA using commercial catch-at-age data and an acoustic survey series. The catch data used in analysis go back to 1984 and the survey series to 1995.

Source of information: Report of the Arctic Fisheries Working Group, May 2001 (ICES CM 2001/ACFM:19).

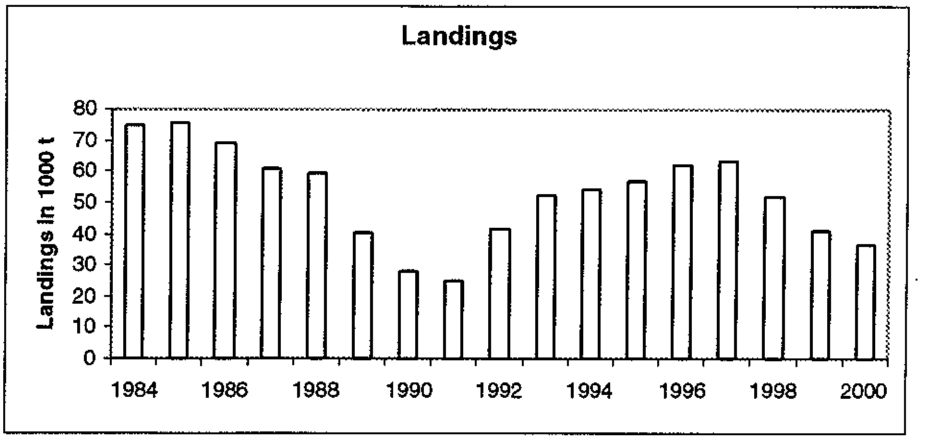
Yield and spawning biomass per Recruit F-reference points:

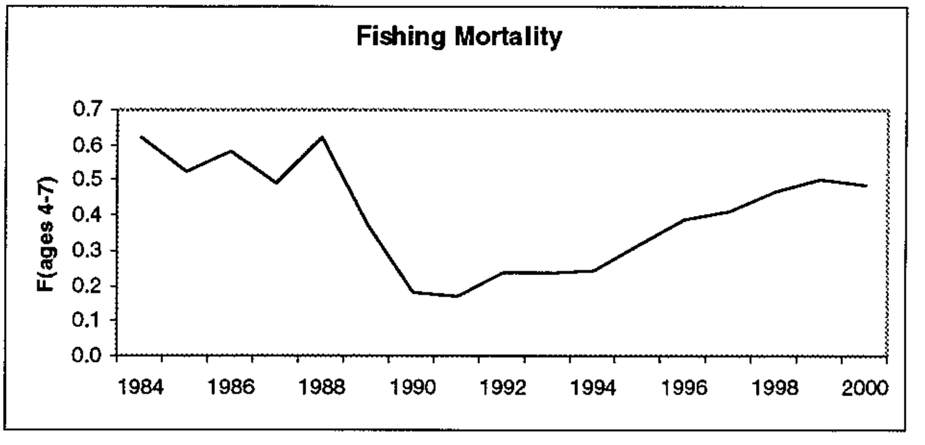
	Fish Mort Ages 4-7	Yield/R	SSB/R
Average Current	0.504	1180.676	1819.694
F_{max}	0.268	1230.929	3583.028
$F_{0.1}$	0.117	1106.197	7452.758
F_{med}	N/A		

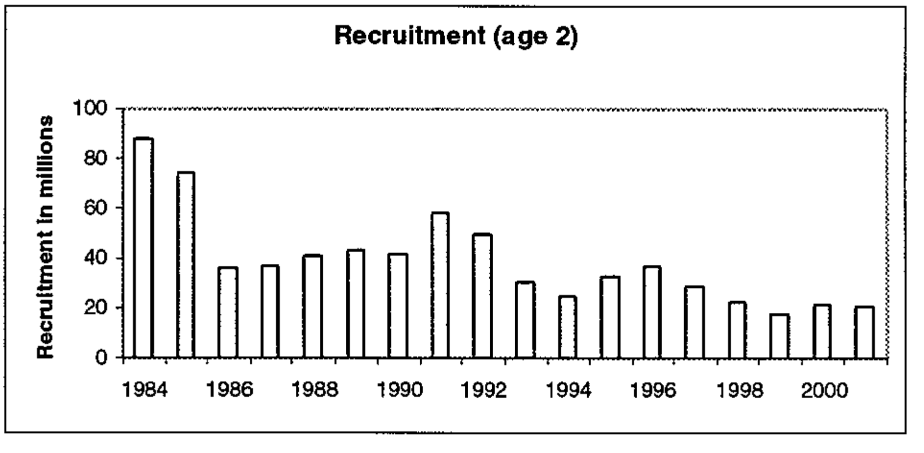
Catch data (Tables 3.1.2.b.1-2):

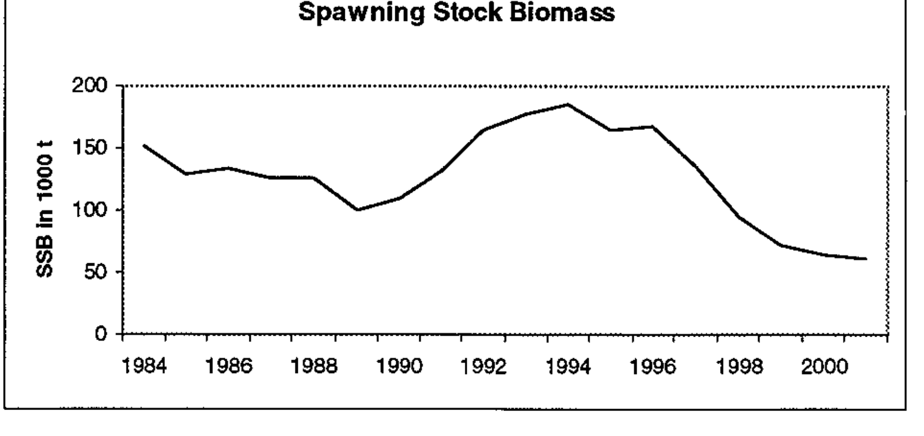
Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC[1]	Official landings	ACFM landings[2]
1987	Not assessed				61
1988	Not assessed				59
1989	No advice				40
1990	No advice				28
1991	Included in TAC for Sub-areas I and II				25
1992	Shot forecast included in TAC for I and II				42
1993	Shot forecast included in TAC for I and II				53
1994	No advice				55
1995	No advice				57
1996	No advice				62
1997	No advice				63
1998	No advice				52
1999	No advice				41
2000	No advice				37
2001	Reduce F considerably	22			
2002	catches should be reduced by the same proportion as for North-East Arctic cod				

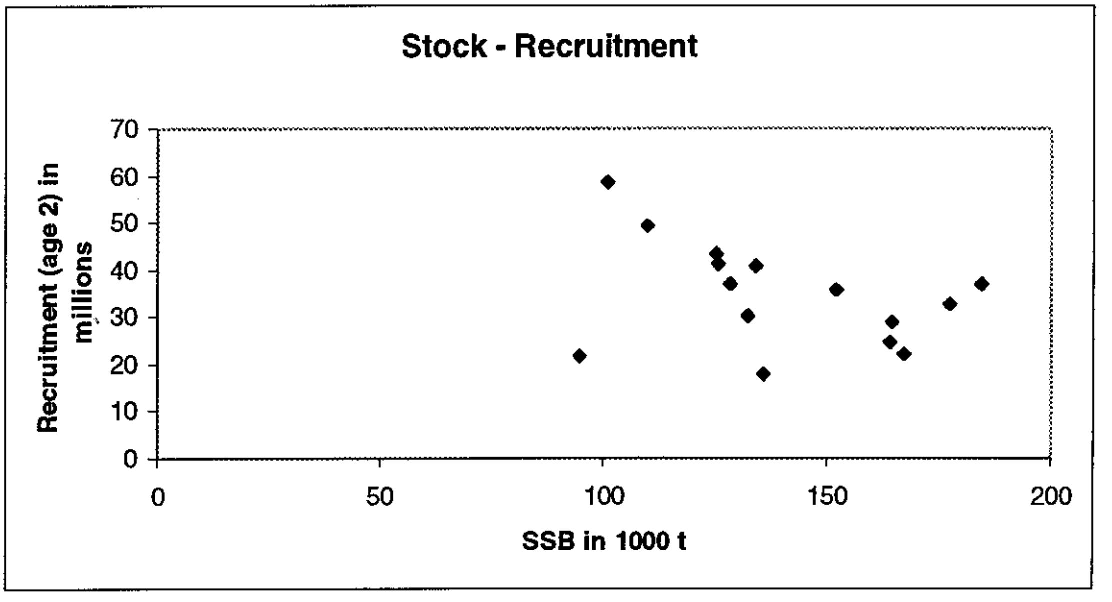
[1]40,000 tons has been added annually to the agreed TAC of North-East Arctic cod. [2]Estimated according to otolith type. Weights in '000 t.


Landings
Landings in 1000 t
80
70
60
50
40
30
20
10
0
1984
1986
1988
1990
1992
1994
1996
1998
2000


Fishing Mortality
F(ages 4-7)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1984
1986
1988
1990
1992
1994
1996
1998
2000


Recruitment (age 2)
Recruitment in millions
100
80
60
40
20
0
1984
1986
1988
1990
1992
1994
1996
1998
2000


Spawning Stock Biomass
SSB in 1000 t
200
150
100
50
0
1984
1986
1988
1990
1992
1994
1996
1998
2000


Stock - Recruitment
Recruitment (age 2) in millions
70
60
50
40
30
20
10
0
0
50
100
150
200
SSB in 1000 t

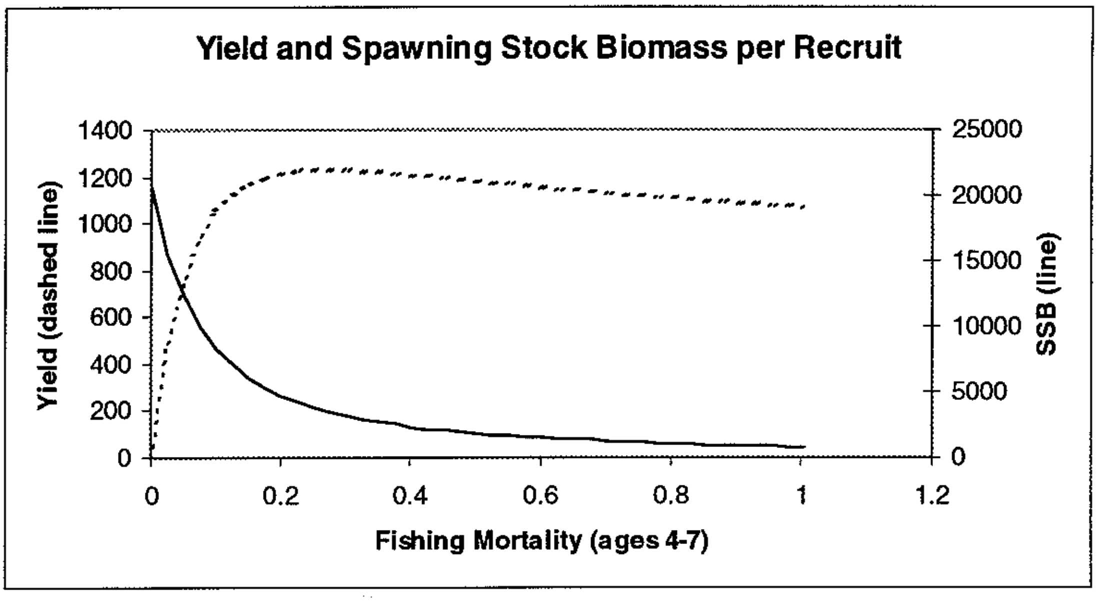

Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
1400
1200
1000
800
600
400
200
0
25000
20000
15000
10000
5000
0
SSB (line)
0
0.2
0.4
0.6
0.8
1
1.2
Fishing Mortality (ages 4-7)

Table 3.1.2.b.1 Landings of Norwegian Coastal cod in Sub-areas I and II.

Year	Landings in '000 t.	
	By otolith type	By area and time of capture
1960	-	43
1961	-	32
1962	-	30
1963	-	40
1964	-	46
1965	-	24
1966	-	29
1967	-	33
1968	-	47
1969	-	52
1970	-	49
1971	-	*)
1972	-	*)
1973	-	*)
1974	-	*)
1975	-	*)
1976	-	*)
1977	-	*)
1978	-	*)
1979	-	*)
1980	-	40
1981	-	49
1982	-	42
1983	-	38
1984	74	33
1985	75	28
1986	69	26
1987	61	31
1988	59	22
1989	40	17
1990	28	24
1991	25	25
1992	42	35
1993	53	44
1994	55	48
1995	57	39
1996	62	32
1997	63	36
1998	52	29
1999	41	23
2000	37	19**)
Average 1984–2000	53	30

*) No data.

**) Provisional data.

Table 3.1.2.b.2 Norwegian Coastal cod.

Year	Recruitment Age 2 thousands	SSB tonnes	Landings tonnes	Mean F Ages 4-7
1984	87941	152180	74824	0.6221
1985	74518	128256	75451	0.5275
1986	35638	134050	68905	0.5806
1987	36712	125248	60972	0.4916
1988	40546	125645	59294	0.6194
1989	43078	100718	40285	0.3751
1990	41234	109939	28127	0.1834
1991	58718	132231	24822	0.1700
1992	49210	164191	41690	0.2349
1993	30321	177315	52557	0.2346
1994	24650	184690	54562	0.2437
1995	32832	164516	57207	0.3159
1996	36901	167442	61776	0.3894
1997	28735	135866	63319	0.4110
1998	22147	94830	51572	0.4662
1999	17713	72224	40732	0.5035
2000	21773	64902	36715	0.4882
2001	20544	61129		0.4800
Average	39067	127521	52518	0.4076

3.1.3 North-East Arctic haddock (Sub-areas I and II)

State of stock/exploitation: The stock is harvested outside safe biological limits. Fishing mortality in 2000 is estimated to be well above the proposed $\mathbf{F_{pa}}$ and has been close to, or above $\mathbf{F_{lim}}$ since 1997. The SSB in 2001 (79 000 t) is estimated at $\mathbf{B_{pa}}$ (80 000 t). The 1998 and 1999 year classes are indicated to be above average.

Management objectives: There are no explicit management objectives for this stock. For management objectives to meet precautionary criteria, their aim should be to reduce or maintain F below $\mathbf{F_{pa}}$ and to increase or maintain spawning stock biomass above $\mathbf{B_{pa}}$.

Precautionary Approach reference points (unchanged since 2000):

ICES considers that:	ICES proposes that:
$\mathbf{B_{lim}}$ is 50 000 t, the SSB below which only poor year classes have been observed.	$\mathbf{B_{pa}}$ be set at 80 000 t, which is considered to be the minimum SSB required to provide a 95% probability of maintaining SSB above $\mathbf{B_{lim}}$, taking into account the uncertainty in the assessments and stock dynamics.
$\mathbf{F_{lim}}$ is 0.49, the fishing mortality associated with potential stock collapse.	$\mathbf{F_{pa}}$ is set at 0.35. This value is considered to have a high probability of keeping F below $\mathbf{F_{lim}}$.

Technical Basis:

$\mathbf{B_{lim}}$: only poor recruitment has been observed from 4 years of SSB < 50 000 t, and all moderate or large year classes have been produced at higher SSB.	$\mathbf{B_{pa}} = \mathbf{B_{lim}} * 1.67$.
$\mathbf{F_{lim}}$ = median value of $\mathbf{F_{loss}}$.	$\mathbf{F_{pa}} = \mathbf{F_{med}}$. The stock has sustained higher fishing mortality for most of the period after 1950 without collapsing; however, low SSB has often resulted in poor year classes.

Advice on management: In order to harvest the stock within safe biological limits, ICES recommends that fishing mortality be reduced to below $\mathbf{F_{pa}}$ = 0.35, corresponding to catches of less than 67 000 t in 2002.

Relevant factors to be considered in management: A substantial portion of the Northeast Arctic haddock catch is taken as by-catch in the NEA cod fishery. A reduction in North-East Arctic cod catches as advised for 2002 may help to achieve the advised reduction in fishing mortality for haddock as well.

Fishing mortality has been above $\mathbf{F_{lim}}$ a number of times during the 50-year time series. The stock has been able to withstand these periods of overfishing due to the occasional recruitment of exceptionally strong year classes. A lower fishing mortality would lead to better harvesting of the occasional strong year classes and would lead to more stable catches.

Comparison with previous assessment and advice: In recent years there appears to be a tendency to underestimate fishing mortality and to overestimate SSB.

Catch forecast for 2002:

Basis: F(2001)=F_{sq} = F(97-99 scaled to 00) = 0.46; Landings (2001) = 61; SSB(2002) = 76.

F (2002)	Basis	Catch (2002)	Landings (2002)	SSB (2003)
0	0.00 * $\mathbf{F_{sq}}$		0	156
0.09	0.20 * $\mathbf{F_{sq}}$		19	146
0.18	0.40 * $\mathbf{F_{sq}}$		37	136
0.26	0.56* $\mathbf{F_{sq}}$ ($\mathbf{F_{0.1}}$)		51	129
0.28	0.60 * $\mathbf{F_{sq}}$		54	127
0.35	0.76 * $\mathbf{F_{sq}}$ ($\mathbf{F_{pa}}$)		67	120
0.37	0.80 * $\mathbf{F_{sq}}$		70	119
0.46	$\mathbf{F_{sq}}$		85	111

Weights in '000 t.

Shaded scenarios considered inconsistent with the precautionary approach.

Medium-term projections not reliable.

In the past, ICES has presented a TAC-constrained forecast for the intermediate year in prediction rather than assuming *status quo* fishing mortality. This year it has presented a *status quo* forecast for the following reasons:

- For NEA cod, a TAC constraint requires a reduction in fishing mortality compared to *status quo*, whilst for NEA haddock, a species caught mostly in association with cod, an increase in fishing mortality would be required for a TAC constraint. This inconsistency suggests that the TAC constraint is being used as an *ad hoc* "fix" for assessments that provide uncertain catch forecasts from year to year, rather than reflecting an actual constraint on fishing mortality;

- The practice is consistent with most other stocks in the ICES area. Experience with TACs suggests that precise and unbiased assessments, as well as compelling reasons to assume that TACs act as a constraint on catches, are needed before applying a TAC constraint on forecasts.

Elaboration and special comment: In addition to exploitation at fishing mortality above the precautionary limits, SSB has decreased as the influence of the 1990 year class has reduced together with a decrease in individual growth and maturity. In addition, high levels of predation by cod have reduced recruitment to the SSB.

The results of the forecast are also sensitive to the estimates of variable maturity and natural mortality rates. The latter will very much depend on the development of the capelin and cod stocks in the near future.

The fishery is mainly a trawl fishery, in some periods only as by-catch in the fishery for cod. The fishery is regulated by TAC, minimum landing size, a minimum mesh size in trawls and Danish seine, a maximum by-catch of undersized fish, closure of areas with high density of juveniles, and other area and seasonal restrictions.

The analytical assessment is based on catch-at-age data, 3 surveys, and CPUE for one commercial fleet, and it includes predation by NEA cod.

Source of information: Report of the Arctic Fisheries Working Group, May 2001 (ICES CM 2001/ACFM:19).

Yield and spawning biomass per Recruit
F-reference points:

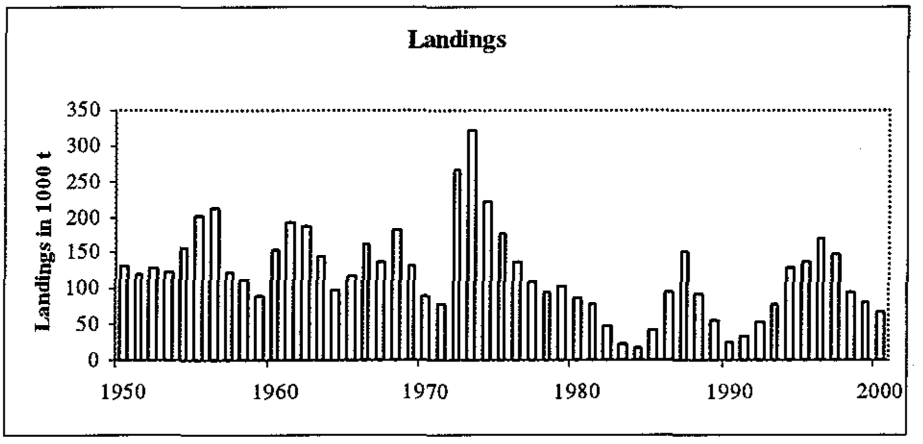
	Fish Mort Ages 4-7	Yield/R	SSB/R
Average Current	0.459	0.698	0.857
$\mathbf{F_{max}}$	1.204	0.738	0.239
$\mathbf{F_{0.1}}$	0.257	0.620	1.702
$\mathbf{F_{med}}$	0.346	0.666	1.215

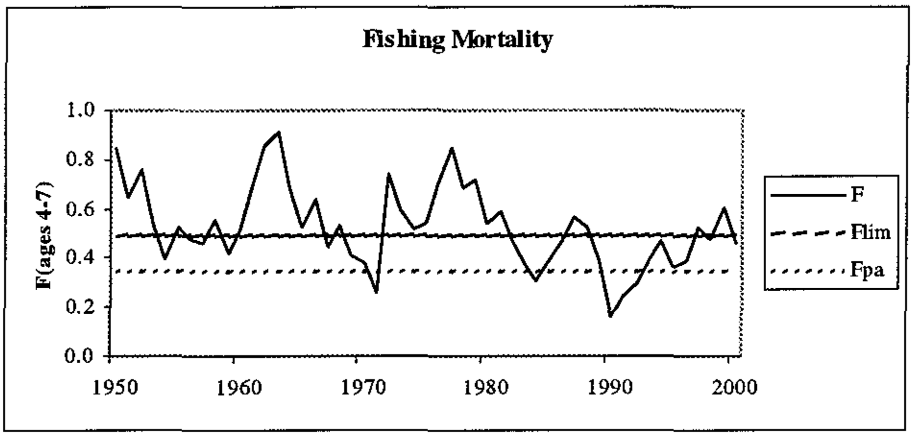
Catch data (Tables 3.1.3.1-3):

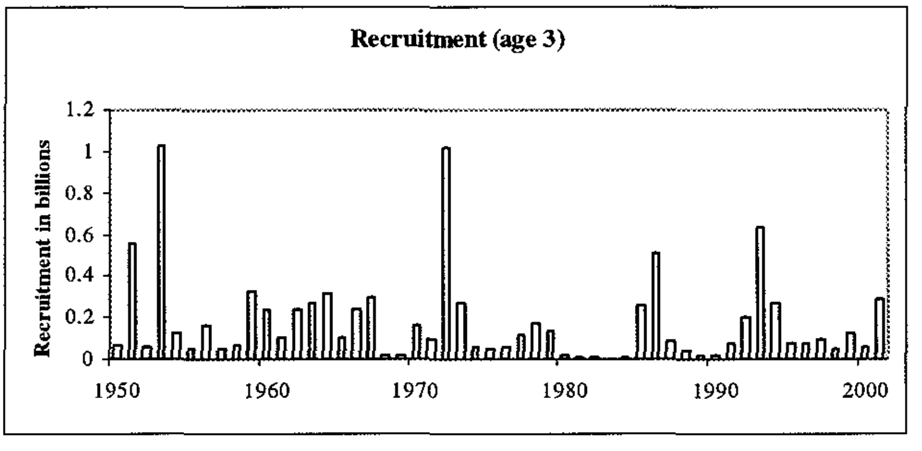
Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC[1]	Official landings	ACFM landings[1]
1987	No increase in F; TAC	160	250	155	151
1988	No increase in F	<240	240	95	92
1989	Large reduction in F	69	83	60	55
1990	No directed fishery	-	25	27	26
1991	No directed fishery	-	28	34	34
1992	Within safe biological limits	35[2]	63	58	54
1993	No long-term gains in increasing F	56[2]	72	83	78
1994	No long-term gains in F>$\mathbf{F}_{med}$	97[3]	120	125	121
1995	No long-term gains in F>$\mathbf{F}_{med}$	122[3]	130	139	138
1996	No long-term gains in F>$\mathbf{F}_{med}$	169[3]	170	177	173
1997	Well below $\mathbf{F}_{med}$	<242	210	152	149
1998	Below $\mathbf{F}_{med}$	120	130	100	94
1999	Reduce F below $\mathbf{F}_{pa}$	74	78	82	82
2000	Reduce F below $\mathbf{F}_{pa}$	37	62	68	68
2001	Reduce F below $\mathbf{F}_{pa}$	<66	85		
2002	Reduce F below $\mathbf{F}_{pa}$	<67			

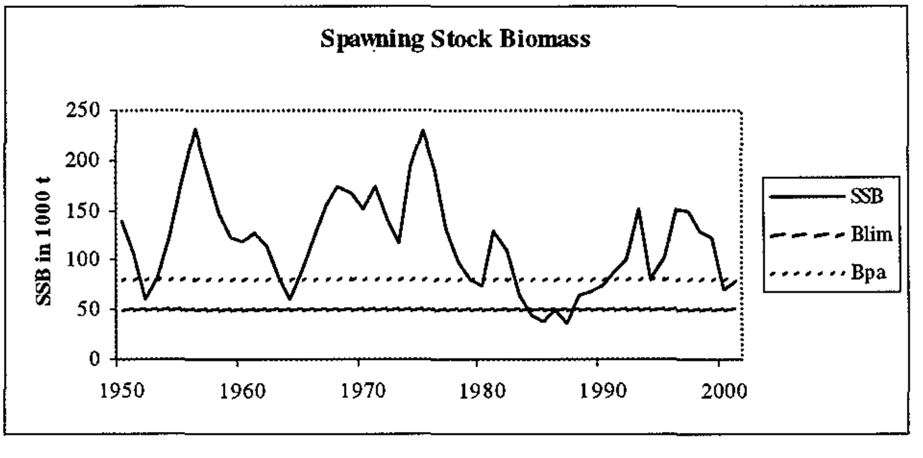
[1]Haddock in Norwegian coastal areas south of 67°N not included. [2]Predicted catch at *status quo* F. [3]Predicted landings at $\mathbf{F}_{med}$. Weights in '000 t.

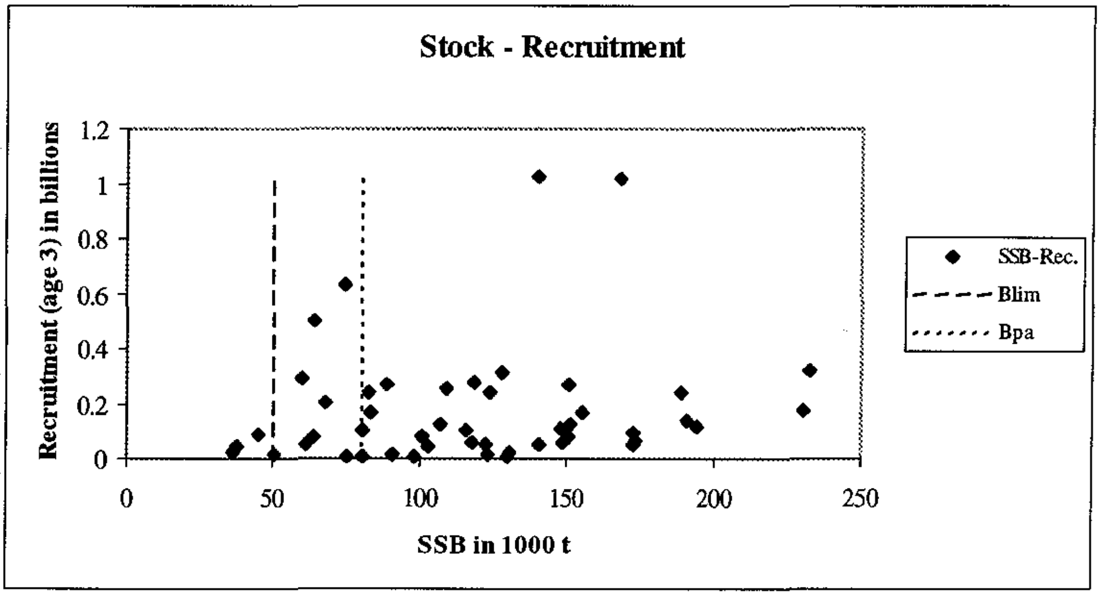
North-East Arctic haddock (Sub-areas I and II)

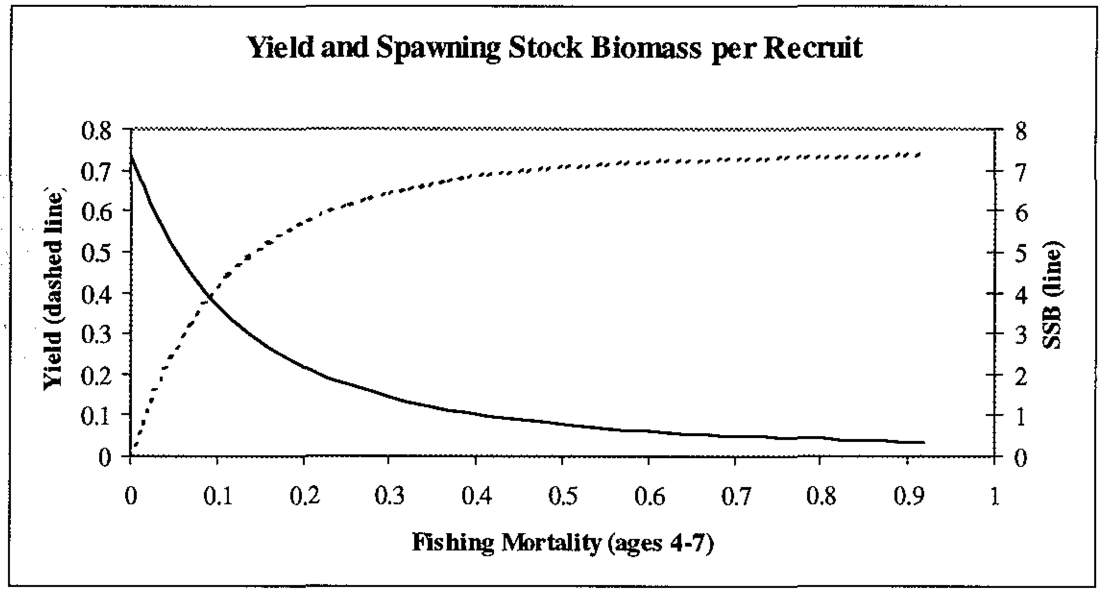









Stock - Recruitment
Recruitment (age 3) in billions
1.2
1
0.8
0.6
0.4
0.2
0
0
50
100
150
200
250
SSB in 1000 t
SSB-Rec.
Blim
Bpa


Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
SSB (line)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
8
7
6
5
4
3
2
1
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Fishing Mortality (ages 4-7)

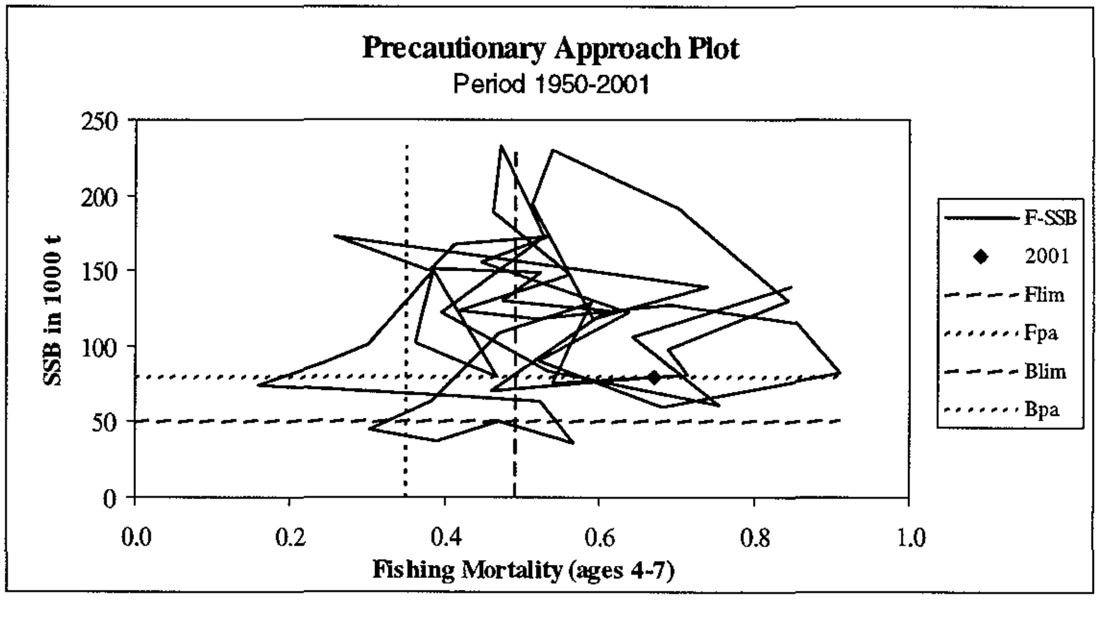

Precautionary Approach Plot
Period 1950-2001
SSB in 1000 t
250
200
150
100
50
0
0.0
0.2
0.4
0.6
0.8
1.0
Fishing Mortality (ages 4-7)
F-SSB
2001
Flim
Fpa
Blim
Bpa

Table 3.1.3.1 North-East Arctic HADDOCK. Total nominal catch (t) by fishing areas.

Year	Sub-area I	Division IIa	Division IIb	Total
1960	125 026	27 781	1 844	154 651
1961	165 156	25 641	2 427	193 224
1962	160 561	25 125	1 723	187 408
1963	124 332	20 956	936	146 224
1964	79 262	18 784	1 112	99 158
1965	98 921	18 719	943	118 578
1966	125 009	35 143	1 626	161 778
1967	107 996	27 962	440	136 397
1968	140 970	40 031	725	181 726
1969	89 948	40 306	566	130 820
1970	60 631	27 120	507	88 257
1971	56 989	21 453	463	78 905
1972	221 880	42 111	2 162	266 153
1973	285 644	23 506	13 077	322 226
1974	159 051	47 037	15 069	221 157
1975	121 692	44 337	9 729	175 758
1976	94 054	37 562	5 648	137 264
1977	72 159	28 452	9 547	110 158
1978	63 965	30 478	979	95 422
1979	63 841	39 167	615	103 623
1980	54 205	33 616	68	87 889
1981	36 834	39 864	455	77 153
1982	17 948	29 005	2	46 955
1983	7 550	13 872	185	21 607
1984	4 000	13 247	71	17 318
1985	30 385	10 774	111	41 270
1986	69 865	26 006	714	96 585
1987	109 425	38 181	3 048	150 654
1988	43 990	47 087	668	91 745
1989	31 116	23 390	353	54 859
1990	15 093	10 344	303	25 741
1991	18 772	14 417	416	33 605
1992	30 746	22 177	964	53 887
1993	47 574	27 010	3 037	77 621
1994	75 059	46 329	7 315	128 703
1995	69 064	53 149	13 852	136 064
1996	110 495	56 030	3 227	169 752
1997	77 495	67 188	2 477	147 160
1998	46 440	48 793	716	95 949
1999	36 096	42 036	4 214	82 346
2000[1]	25 626	39 101	3 226	67 953

[1]Provisional figures. Norwegian catches on Russian quotas are included.

Table 3.1.3.2 North-East Arctic HADDOCK. Nominal catch (t) by countries, Sub-area I and Divisions IIa and IIb combined.

Year	Faroe Islands	France	German Dem.Re.	Fed. Re. Germ.	Norway	Poland	United Kingdom	Russia[2]	Others	Total
1960	172	-	-	5 597	46 263	-	45 469	57 025	125	154 651
1961	285	220	-	6 304	60 862	-	39 650	85 345	558	193 224
1962	83	409	-	2 895	54 567	-	37 486	91 910	58	187 408
1963	17	363	-	2 554	59 955	-	19 809	63 526	-	146 224
1964	-	208	-	1 482	38 695	-	14 653	43 870	250	99 158
1965	-	226	-	1 568	60 447	-	14 345	41 750	242	118 578
1966	-	1 072	11	2 098	82 090	-	27 723	48 710	74	161 778
1967	-	1 208	3	1 705	51 954	-	24 158	57 346	23	136 397
1968	-	-	-	1 867	64 076	-	40 129	75 654	-	181 726
1969	2	-	309	1 490	67 549	-	37 234	24 211	25	130 820
1970	541	-	656	2 119	37 716	-	20 423	26 802	-	88 257
1971	81	-	16	896	45 715	43	16 373	15 778	3	78 905
1972	137	-	829	1 433	46 700	1 433	17 166	196 224	2 231	266 153
1973	1 212	3 214	22	9 534	86 767	34	32 408	186 534	2 501	322 226
1974	925	3 601	454	23 409	66 164	3 045	37 663	78 548	7 348	221 157
1975	299	5 191	437	15 930	55 966	1 080	28 677	65 015	3 163	175 758
1976	536	4 459	348	16 660	49 492	986	16 940	42 485	5 358	137 264
1977	213	1 510	144	4 798	40 118	-	10 878	52 210	287	110 158
1978	466	1 411	369	1 521	39 955	1	5 766	45 895	38	95 422
1979	343	1 198	10	1 948	66 849	2	6 454	26 365	454	103 623
1980	497	226	15	1 365	61 886	-	2 948	20 706	246	87 889
1981	381	414	22	2 398	58 856	**Spain**	1 682	13 400	-	77 153
1982	496	53	-	1 258	41 421	-	827	2 900	-	46 955
1983	428	-	1	729	19 371	139	259	680	-	21 607
1984	297	15	4	400	15 186	37	276	1 103	-	17 318
1985	424	21	20	395	17 490	77	153	22 690	-	41 270
1986	893	33	75	1 079	48 314	22	431	45 738	-	96 585
1987	464	26	83	3 106	69 333	99	563	76 980	-	150 654
1988	1 113	116	78	1 324	57 273	72	435	31 293	41	91 745
1989	1 218	125	26	171	31 825	1	590	20 903	-	54 859
1990	875	-	5	128	17 634	-	494	6 605	-	25 741
1991	1 117	60	**Greenld**	219	19 285	-	514	12 388	22	33 605
1992	1 093	151	1 719	387	30 203	38	596	19 699	1	53 887
1993	546	1 215	880	1 165	36 590	76	1 802	34 700	646	77 620
1994	2 761	678	770	2 412	64 688	22	4 673	51 822	877	128 703
1995	2 833	598	1 351	2 675	72 864	14	3 108	54 516	718	138 677
1996	3 743	537	1 524	942	89 500	669	2 275	73 857	217	173 264
1997	3 327	495	1 877	972	97 789	424	2 340	41 228	304	148 756
1998	1 566	241	854	385	68 747	257	1 241	20 559	96	93 946
1999	1 003	64	252	437	48 632	652	694	30 520	92	82 346
2000[1]	527	119	432	592	41 978	76	733	22 738	758	67 953

[1]Provisional figures. Norwegian catches on Russian quotas are included.
[2]USSR prior to 1991.

Table 3.1.3.3 North-East Arctic haddock in Sub-areas I and II.

Year	Recruitment Age 3 thousands	SSB tonnes	Landings tonnes	Mean F Ages 4-7
1950	66026	139644	132125	0.8469
1951	553019	106855	120077	0.6431
1952	60283	61418	127660	0.7546
1953	1023249	83400	123920	0.5336
1954	120542	122079	156788	0.3959
1955	50765	173462	202286	0.5270
1956	167878	232807	213924	0.4730
1957	51537	188884	123583	0.4623
1958	67410	147888	112672	0.5602
1959	322648	123389	88211	0.4185
1960	240840	118280	154651	0.5183
1961	108736	127639	193224	0.6925
1962	240221	115524	187408	0.8548
1963	273037	82499	146224	0.9107
1964	316145	59584	99158	0.6817
1965	100873	90813	118578	0.5207
1966	237489	122891	161778	0.6377
1967	293829	155342	136397	0.4462
1968	17580	172535	181726	0.5344
1969	17381	167715	130820	0.4139
1970	164310	150360	88257	0.3794
1971	94310	172424	78905	0.2589
1972	1020157	140197	266153	0.7409
1973	270142	117802	322226	0.5930
1974	52818	194143	221157	0.5132
1975	48635	230661	175758	0.5390
1976	55919	190902	137264	0.7009
1977	113935	130270	110158	0.8451
1978	171171	98151	95422	0.6881
1979	136906	80532	103623	0.7141
1980	19199	75198	87889	0.5376
1981	6201	129567	77153	0.5900
1982	8196	108554	46955	0.4692
1983	4609	64129	21607	0.3830
1984	8460	44745	17318	0.3045
1985	257025	37662	41270	0.3914
1986	505412	50227	96585	0.4698
1987	84455	36309	150654	0.5666
1988	41066	63716	91745	0.5227
1989	17480	67794	54859	0.3900
1990	22668	74408	25741	0.1585
1991	80793	88716	33605	0.2454
1992	205978	100607	53887	0.3015
1993	635562	150227	77621	0.3856
1994	272385	80443	128703	0.4666
1995	76433	103024	136064	0.3615
1996	79990	151161	169752	0.3864
1997	98518	148310	147160	0.5219
1998	45128	129771	95949	0.4743
1999	123821	123397	82346	0.6087
2000	58774	70367	67953	0.4591
2001	290368	79149		0.6700
Average	180775	116838	121862	0.5281

3.1.4 North-East Arctic saithe (Sub-areas I and II)

State of stock/exploitation: The stock is within safe biological limits. Fishing mortality in 2000 is at $\mathbf{F_{pa}}$ and SSB in 2001 is well above $\mathbf{B_{pa}}$. After a long period of low stock size, the stock recovered during the 1990s with the recruitment of several above-average year classes. The exploitation pattern is better than in the past.

Management objectives: There are no explicit management objectives for this stock. For management objectives to meet precautionary criteria, their aim should be to reduce or maintain fishing mortality below $\mathbf{F_{pa}}$ and to increase or maintain spawning stock biomass above $\mathbf{B_{pa}}$.

Precautionary Approach reference points (established in 1998):

ICES considers that:	ICES proposes that:
$\mathbf{B_{lim}}$ is 89 000 t, the lowest observed SSB in the 35-year time series	$\mathbf{B_{pa}}$ is set at 150 000 t, the SSB below which the probability of poor year classes increases
$\mathbf{F_{lim}}$ is 0.45, the fishing mortality associated with potential stock collapse	$\mathbf{F_{pa}}$ be set at 0.26. This value is considered to have a 95% probability of avoiding the $\mathbf{F_{lim}}$

Technical Basis:

$\mathbf{B_{lim}} = \mathbf{B_{loss}}$	$\mathbf{B_{pa}}$ = examination of stock-recruit plot
$\mathbf{F_{lim}}$ = Median value of $\mathbf{F_{loss}}$	$\mathbf{F_{pa}} = \mathbf{F_{lim}}$ * 0.6

Advice on management: ICES advises that fishing mortality should be below $\mathbf{F_{pa}}$, corresponding to a catch in 2002 of less than 152 000 t.

Comparison with previous assessment and advice: There has been a tendency to overestimate fishing mortality in recent years. Fishing mortality is now estimated to correspond to $\mathbf{F_{pa}}$, indicating a change from harvesting outside safe biological limits. The estimated SSB continues to remain above $\mathbf{B_{pa}}$. The estimate of the SSB in most recent years is about 30% higher than in last year's assessment.

Catch forecast for 2002:

Basis: F(2001)=F_{sq} = F(98-00 scaled) = 0.26; Landings (2001) = 135; SSB(2002) = 304.

F(2002 onwards)	Basis	Catch (2002)	Landings (2002)	SSB (2003)
0.05	0.20 * $\mathbf{F_{sq}}$		34	472
0.10	0.40 * $\mathbf{F_{sq}}$		67	441
0.11	0.42 * $\mathbf{F_{sq}}$ ($\mathbf{F_{0.1}}$)			
0.16	0.60 * $\mathbf{F_{sq}}$		97	413
0.21	0.80 * $\mathbf{F_{sq}}$		125	386
0.23	0.89 * $\mathbf{F_{sq}}$ ($\mathbf{F_{max}}$)			
0.26	$\mathbf{F_{sq}}$ ($\mathbf{F_{pa}}$)		152	360

Weights in '000 t.

Shaded scenarios considered inconsistent with the precautionary approach.

Medium-term projections not reliable

Elaboration and special comment: Since the early 1960s, the fishery has been dominated by purse seine and trawl fisheries, with a traditional gill net fishery for spawning saithe as the third major component. The purse seine fishery is conducted in coastal areas and fjords. Historically, purse seiners and trawlers have taken roughly equal shares of the catches. Recent regulation changes led to less relative amounts taken by purse seine in 2000.

Based on the TAC set and estimates of catches for other gears, quotas are set for purse seine and trawl fisheries. In the Norwegian fishery, quotas may be transferred between purse seiners and trawlers based on negotiations if it becomes clear that the quota allocated to one of the fleets will not be taken.

In addition to quotas, the fisheries are managed by minimum mesh size limitations, minimum landing size, by-catch regulations, and area closures. In 1999 the minimum landing size was increased to 45 cm, except for 40–42 cm for different areas for purse seine.

The analytical assessment is based on catch-at-age data, an acoustic survey data, and revised CPUE data from two commercial fleets.

Source of information: Report of the Arctic Fisheries Working Group, May 2001 (ICES CM 2001/ACFM:19).

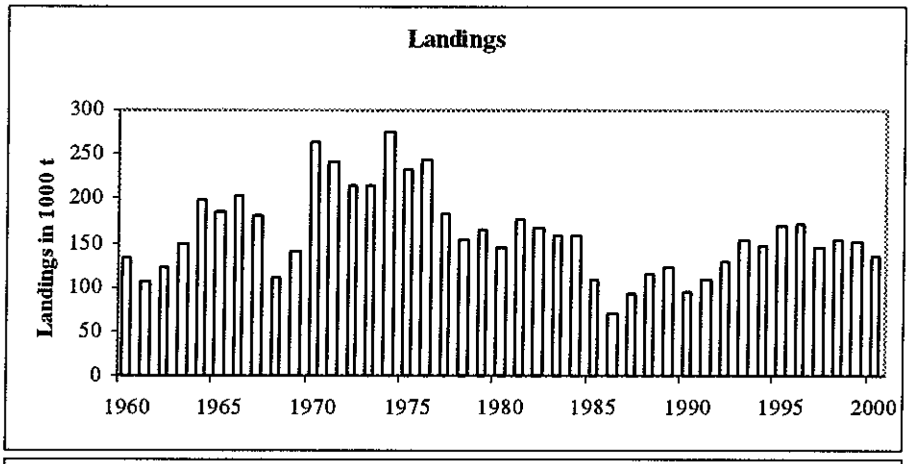
Yield and spawning biomass per Recruit F-reference points:

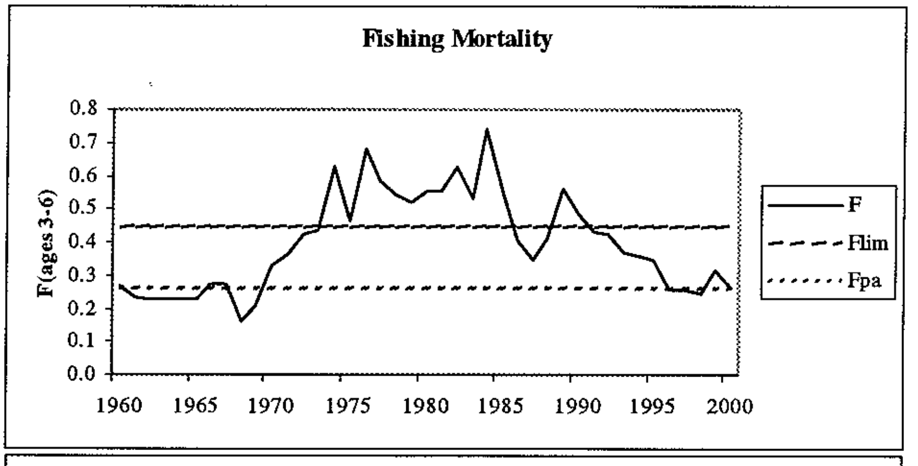
	Fish Mort Ages 3-6	Yield/R	SSB/R
Average Current	0.259	0.747	1.723
$\mathbf{F}_{max}$	0.230	0.748	1.980
$\mathbf{F}_{0.1}$	0.109	0.683	4.051
$\mathbf{F}_{med}$	0.345	0.735	1.198

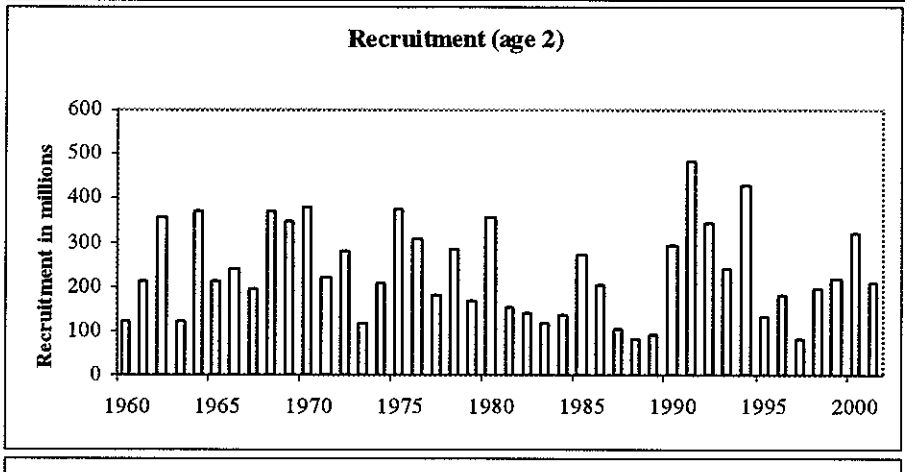
Catch data (Tables 3.1.4.1–2):

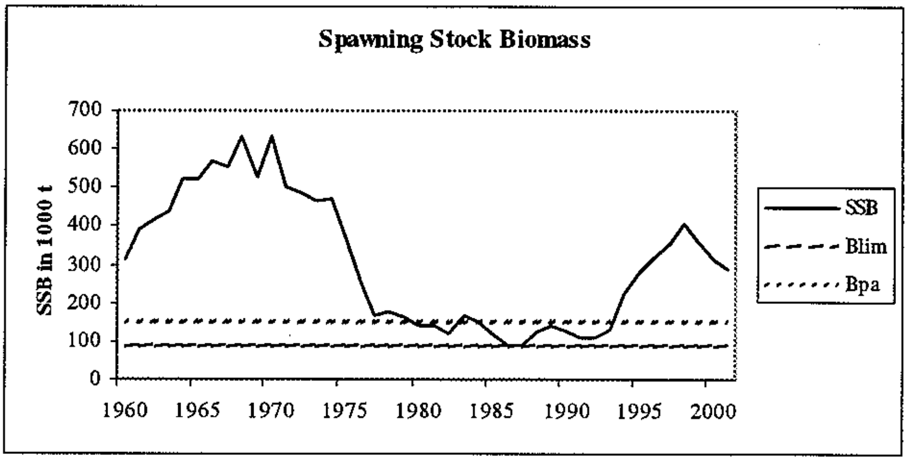
Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC[2]	Official landings	ACFM landings
1987	No increase in F; TAC; protect juveniles	90	-	92	92
1988	No increase in F	< 83	-	114	114
1989	*Status quo* F; TAC	120	120	122	122
1990	$F \leq \mathbf{F}_{med}$; TAC	93	103	96	96
1991	F at $\mathbf{F}_{low}$; TAC	90	100	107	107
1992	Within safe biological limits	115	115	128	128
1993	Within safe biological limits	132[1]	132	154	154
1994	No increase in F	158[1]	145	147	147
1995	No increase in F	221[1]	165	168	168
1996	No increase in F	158[1]	163	171	171
1997	Reduction of F to $\mathbf{F}_{med}$ or below	107	125	144	144
1998	Reduction of F to $\mathbf{F}_{med}$ or below	117	145[3]	154	154
1999	Reduce F below $\mathbf{F}_{pa}$	87	144[4]	150	150
2000	Reduce F below $\mathbf{F}_{pa}$	89	125[5]	135	135
2001	Reduce F below $\mathbf{F}_{pa}$	<115	135		
2002	Maintain F below $\mathbf{F}_{pa}$	< 152			

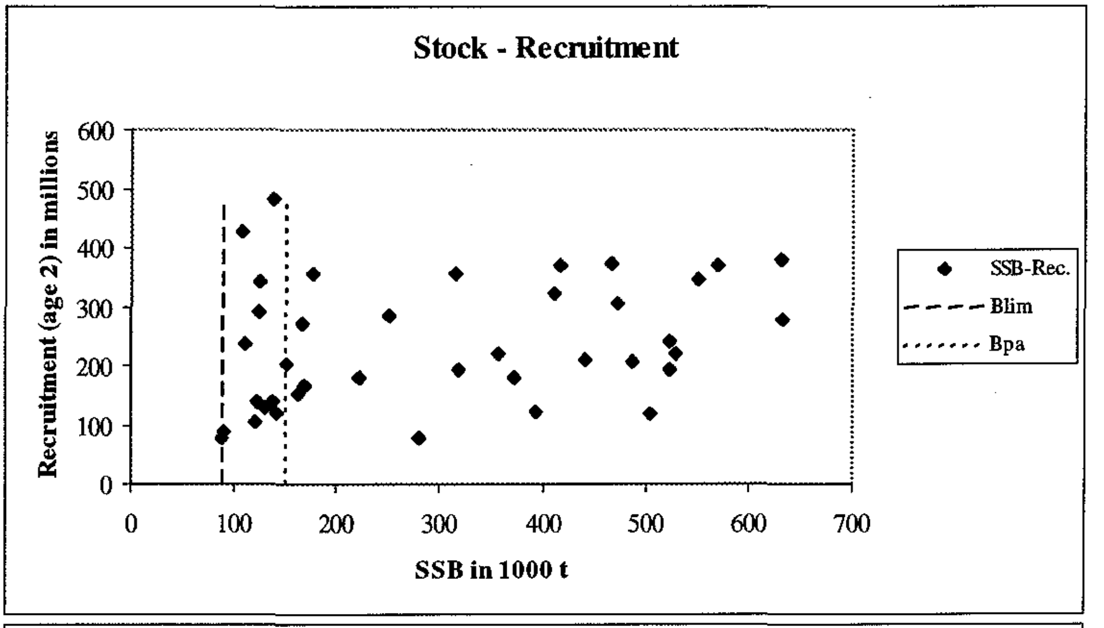
[1] Predicted catch at *status quo* F. [2]Set by Norwegian authorities. [3] TAC first set at 125 000 t, increased in May 1998 after an inter-sessional assessment. [4] TAC set after an inter-sessional assessment in December 1998. [5] TAC set after an inter-sessional assessment in December 1999. Weights in '000 t.

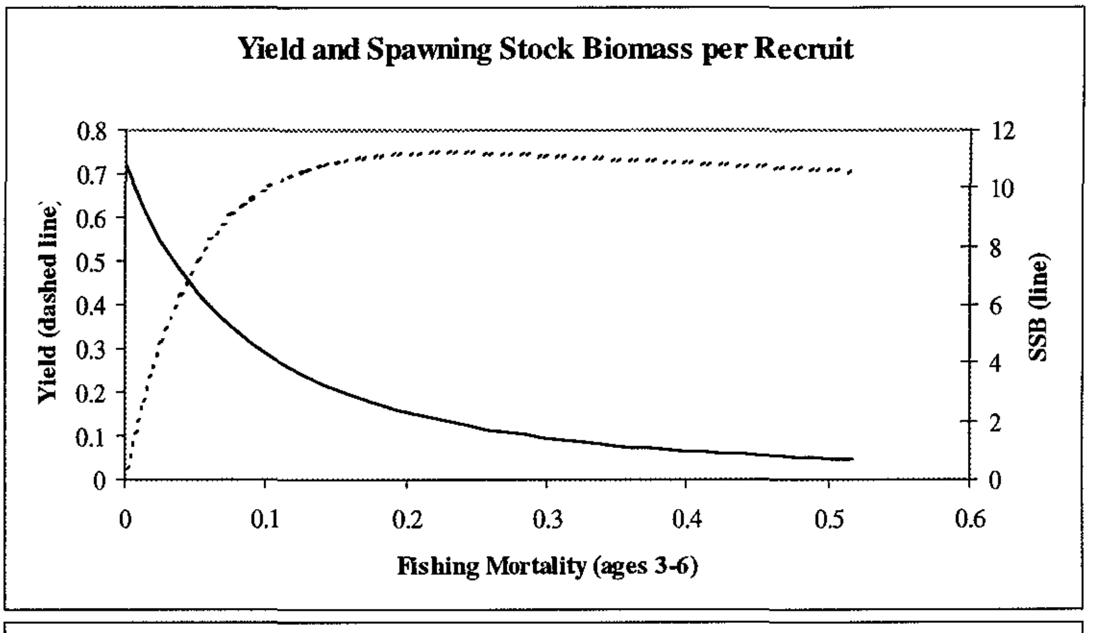

Landings
Landings in 1000 t
300
250
200
150
100
50
0
1960
1965
1970
1975
1980
1985
1990
1995
2000


Fishing Mortality
F(ages 3-6)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1960
1965
1970
1975
1980
1985
1990
1995
2000
F
Flim
Fpa


Recruitment (age 2)
Recruitment in millions
600
500
400
300
200
100
0
1960
1965
1970
1975
1980
1985
1990
1995
2000


Spawning Stock Biomass
SSB in 1000 t
700
600
500
400
300
200
100
0
1960
1965
1970
1975
1980
1985
1990
1995
2000
SSB
Blim
Bpa


Stock - Recruitment
Recruitment (age 2) in millions
600
500
400
300
200
100
0
0
100
200
300
400
500
600
700
SSB in 1000 t
SSB-Rec.
Blim
Bpa


Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
SSB (line)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
12
10
8
6
4
2
0
0
0.1
0.2
0.3
0.4
0.5
0.6
Fishing Mortality (ages 3-6)

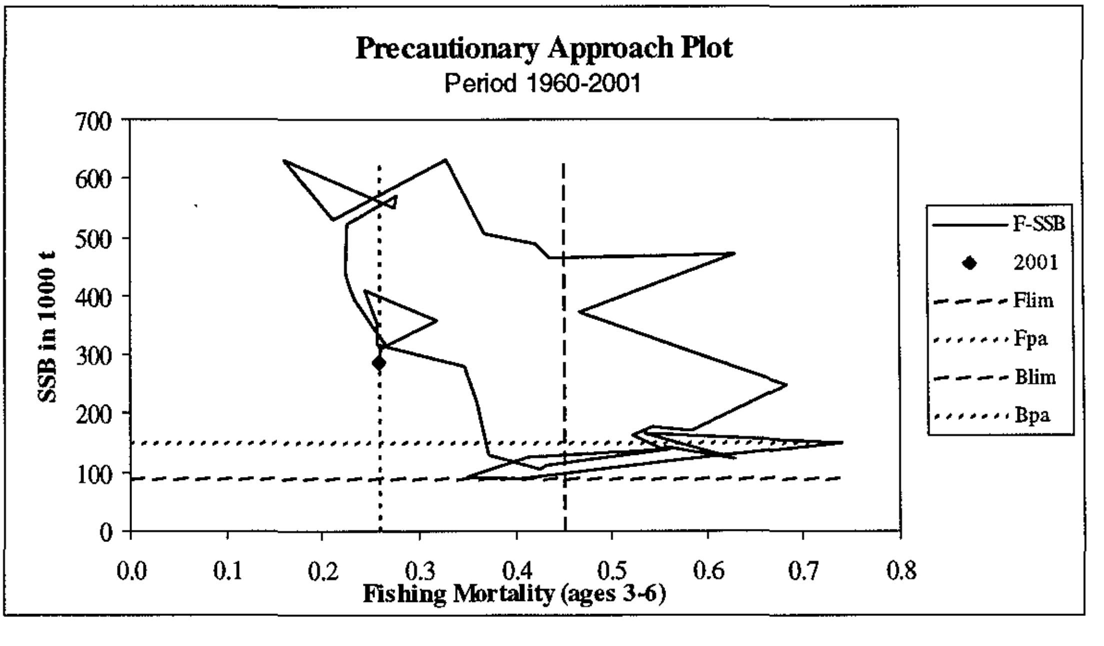

Precautionary Approach Plot
Period 1960-2001
SSB in 1000 t
700
600
500
400
300
200
100
0
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
Fishing Mortality (ages 3-6)
F-SSB
2001
Flim
Fpa
Blim
Bpa

Table 3.1.4.1 North-East Arctic saithe. Nominal catch (t) by countries, Sub-area I and Divisions IIa and IIb combined, as officially reported to ICES.

Year	Faroe Islands	France	German Dem.Rep.	Fed.Rep. Germany	Norway	Poland	Portugal	Russia[3]	Spain	UK (Eng. & Wales)	UK (Scotland)	Others[5]	Total all countries
1960	23	1,700	-	25,948	96,050	-	-	-	-	9,780	-	14	133,515
1961	61	3,625	-	19,757	77,875	-	-	-	-	4,595	20	18	105,951
1962	2	544	-	12,651	101,895	-	-	912	-	4,699	-	4	120,707
1963	-	1,110	-	8,108	135,297	-	-	-	-	4,112	-	-	148,627
1964	-	1,525	-	4,420	184,700	-	-	84	-	6,511	-	186	197,506
1965	-	1,618	-	11,387	165,531	-	-	137	-	6,741	5	181	185,600
1966	-	2,987	813	11,269	175,037	-	-	563	-	13,078	-	41	203,788
1967	-	9,472	304	11,822	150,860	-	-	441	-	8,379	-	48	181,326
1968	-	-	70	4,753	96,641	-	-	-	-	8,781	2	-	110,246
1969	20	193	6,744	4,355	115,140	-	-	-	-	13,585	-	23	140,033
1970	1,097	-	29,362	23,466	151,759	-	-	43,550	-	15,469	221	-	264,924
1971	215	14,536	16,840	12,204	128,499	6,017	-	39,397	13,097	10,361	106	-	241,272
1972	109	14,519	7,474	24,595	143,775	1,111	-	1,278	13,125	8,223	125	-	210,456
1973	7	11,320	12,015	30,338	148,789	23	-	2,411	2,115	6,593	248	-	213,769
1974	46	7,119	29,466	33,155	152,699	2,521	-	38,931	7,075	3,001	103	5	264,121
1975	28	3,156	28,517	41,260	122,598	3,860	6,430	13,389	11,397	2,,623	140	55	233,453
1976	20	5,609	10,266	49,056	131,675	3,164	7,233	9,013	21,661	4,651	73	47	242,486
1977	270	5,658	7,164	19,985	139,705	1	783	989	1,327	6,853	82	-	182,817
1978	809	4,345	6,484	18,190	121,069	35	203	381	121	2,790	37	-	154,464
1979	1,117	2,601	2,435	14,823	141,346	-	-	3	685	1,170	-	-	164,180
1980	532	1,016	-	12,511	128,878	-	-	43	780	794	-	-	144,554
1981	236	194	-	8,431	166,139	-	-	121	-	395	-	-	175,498
1982	339	82	-	7,224	159,643	-	-	14	-	731	1	-	168,034
1983	539	418	-	4,933	149,556	-	-	206	33	1,251	-	-	156,936
1984	503	431	6	4,532	152,818	-	-	161	-	335	-	-	158,786
1985	490	657	11	1,873	103,899	-	-	51	-	202	-	-	107,147
1986	426	308	-	3,470	66,152	-	-	27	-	54	21	-	67,396
1987	712	576	-	4,909	85,710	-	-	426	-	54	3	1	92,391
1988	441	411	-	4,574	108,244	-	-	130	-	436	6	-	114,242
1989	388	460[2]	-	606	119,625	-	-	23	506	-	702	-	122,310
1990	1,207	340[2]	-	1,143	92,397	-	-	52	-	681	28	-	95,848
1991	963	77[2]		2,003	103,283	-	-	504[4]	-	449	42	5	107,326
			Greenland										
1992	165	1,890[2]	734	3,451	119,765	-	-	964	6	516	25	-	127,606
1993	31	566[2]	78	3,687	139,288	-	1	9,509	4	408	7	5	153,584
1994	67	151[2]	15	1,863	141,589	-	1	1,640	655	548	9	6	146,544
1995	172[2]	222[2]	53	934	165,001	-	4	1,144	-	589	99	18	168,174
1996	248[2]	365[2]	176[2]	2,615	166,149	-	24	1,159	9[2]	690[2]	16	47[2]	171,498
1997	193[2]	560	363[2]	2,915	137,054	-	12	1,774	45[2]	676	123	45[2]	143,760
1998	366[2]	932	437[2]	2,936	144,468	-	49[2]	3,836	407[2]	355		36[2]	153,822
1999	181[2]	638[2]	655[2]	2,473	141,828	-	18[2]	3,929	35[2]	339		1786[2]	150,272
2000[1]	224[2]	237[2]	651[2]	2,570[6]	125,880		46	4,452	167[2]	453		43[2]	134,723

[1]Provisional figures.
[2]As reported to Norwegian authorities.
[3]USSR prior to 1991.
[4]Includes Estonia.
[5]Includes Denmark, Netherlands, Iceland, Ireland and Sweden.
[6]As reported by Working Group members.

Table 3.1.4.2 North-East Arctic saithe in Sub-areas I and II.

Year	Recruitment Age 2 thousands	SSB tonnes	Landings tonnes	Mean F Ages 3-6
1960	121650	314777	133515	0.2667
1961	213269	392583	105951	0.2338
1962	355505	415700	120707	0.2289
1963	121815	441021	148627	0.2244
1964	368899	523587	197426	0.2262
1965	210354	522884	185600	0.2254
1966	241202	568765	203788	0.2767
1967	191872	551179	181326	0.2751
1968	367843	631001	110247	0.1606
1969	347431	529248	140060	0.2117
1970	379815	633034	264924	0.3292
1971	219524	503856	241272	0.3671
1972	278465	487481	214334	0.4217
1973	117299	466089	213859	0.4369
1974	206220	471317	274121	0.6295
1975	373549	372735	233453	0.4665
1976	305466	250577	242486	0.6827
1977	178776	169207	182817	0.5849
1978	283591	175906	154464	0.5435
1979	167693	162681	164180	0.5219
1980	356254	138732	144554	0.5529
1981	152598	142438	175516	0.5567
1982	140068	121867	168034	0.6284
1983	118912	167567	156936	0.5338
1984	137543	151680	158786	0.7412
1985	271686	121134	107183	0.5620
1986	204400	89047	70458	0.4031
1987	103478	90564	92391	0.3486
1988	79261	124879	114242	0.4135
1989	88859	138950	122310	0.5619
1990	291666	124028	95848	0.4806
1991	480544	111461	107326	0.4325
1992	343495	107112	127516	0.4251
1993	237615	129833	153584	0.3719
1994	426830	222066	146544	0.3598
1995	128661	280721	168174	0.3479
1996	180151	319163	171498	0.2570
1997	79070	356503	143760	0.2579
1998	191980	409873	153822	0.2446
1999	218731	357950	150274	0.3182
2000	322000	311094	134723	0.2606
2001	208000	287730		0.2600
Average	233620	306858	160406	0.3960

3.1.5 Redfish in Sub-areas I and II

Table 3.1.5.1 REDFISH in Sub-areas I and II. Nominal catch (t) by countries in Sub-area I, Divisions IIa and IIb combined as officially reported to ICES.

Year	Canada	Denmark	Faroe Islands	France	Germany[4]	Greenland	Iceland	Ireland	Netherlands	Norway	Poland	Portugal	Russia[5]	Spain	UK (E&W)	UK (Scot.)	Total
1984	-	-	-	2,970	7,457	-	-	-	-	18,650	-	1,806	69,689	25	716	-	101,313
1985	-	-	-	3,326	6,566	-	-	-	-	20,456	-	2,056	59,943	38	167	-	92,552
1986	-	-	29	2,719	4,884	-	-	-	-	23,255	-	1,591	20,694	-	129	14	53,315
1987	-	+	450[3]	1,611	5,829	-	-	-	-	18,051	-	1,175	7,215	25	230	9	34,595
1988	-	-	973	3,349	2,355	-	-	-	-	24,662	-	500	9,139	26	468	2	41,494
1989	-	-	338	1,849[1]	4,245	-	-	-	-	25,295	-	340	14,344	5[2]	271	1	46,688
1990	-	37[3]	386	1,821[1]	6,741	-	-	-	-	34,090	-	830	18,918	-	333	-	63,156
1991	-	23	639	791[1]	981	-	-	-	-	49,463	-	166	15,354	1	336	13	67,754
1992	-	9	58	1,301	530	614	-	-	-	23,451	-	977	4,335	16	479	3	31,773
1993	8[3]	4	152	92	685	15	-	-	-	18,319	-	1,040	7,573	65	734	1	29,517
1994	-	28	26	77	1026	6	4	3	-	21,466	-	985	6,220	34	259	13	30,841
1995	-	-	30	748	692	7	1	5	1	16,162	-	936	6,985	67	252	13	25,899
1996	-	-	42[3]	746	618	37	-	2	-	21,675	-	523	1,641	408	305	121	26,118
1997	-	-	28[3]	1,011	538	39[2]	-	11	-	18,808[2]	1	535	4,556	308	235	29	26,099
1998	-	-	98	567	231	47[3]	-	28	-	26,249[2]	13	131	5,278	228	211	94	33,175
1999	-	-	108	61[3]	430	97	14	10	-	24,624[2]	6	68	4,422	36	247	62	30,185
2000[1]	-	-	67[3]	25[3]	205	51[3]	62	1[3]	-	18,897[2]	2	131	4,631	108[2]		204[6]	24,384

[1]Provisional figures.
[2]Working Group figure.
[3]As reported to Norwegian authorities.
[4]Includes former GDR prior to 1991.
[5]USSR prior to 1991.
[6]UK(E&W)+UK(Scot.)

3.1.5.a *Sebastes mentella* in Sub-areas I and II

State of stock/exploitation: The stock is considered to be outside safe biological limits. Although the current assessments are only indicative of the relative trends in stock size, they show that the spawning stock is close to its historical low. The 1991–2000 year classes are indicated to be well below those of the 1980s.

Management objectives: No explicit management objectives have been established for this stock. Consistent with the precautionary approach a management plan, including monitoring of the development of the stock and of the fishery, with corresponding regulations, should be developed and implemented.

Reference points: No precautionary reference points have been proposed for this stock.

Advice on management: ICES recommends that there be no directed fishery on this stock until a significant increase in spawning stock biomass has been detected in surveys with a following increase in the number of juveniles. In addition, the by-catch of redfish in other fisheries should be reduced to the lowest possible level.

Relevant factors to be considered in management: Recruitment failure has been observed in surveys since 1991, and this indicates that the stock will decrease unless immediate action is taken. In this connection it is of vital importance that the juvenile age classes be given the strongest protection from being caught as by-catch in any fishery, i.e., the shrimp fisheries in the Barents Sea and Svalbard area. This will ensure that the recruiting year classes can contribute as much as possible to the stock rebuilding.

The 1987–1990 year classes (approx. 27–34 cm) are currently about to recruit to the spawning stock. These year classes will be followed by at least 10 poor ones and consequently offer the last opportunity of increasing the spawning stock for a number of years to come. This opportunity will be lost unless the year classes are exploited with significantly reduced fishing mortality.

Based on estimates of current SSB and the size of year classes in the 1990s, this stock will not be able to support a directed fishery for at least several more years. Rather, it will be necessary to prevent the stock from declining further, to maintain measures to protect this stock from by-catch in other fisheries in the medium term to SSBs much below any previously observed.

Elaboration and special comment: The only directed fishery for *S. mentella* is a trawl fishery. In addition, by-catches are taken in cod and shrimp-trawl fisheries. After the introduction of sorting grids in 1993, discarding in the shrimp fishery was reduced. Small redfish less than 18-20 cm are, however, not sorted out by the grid, and criteria for the maximum number of redfish per kilogram shrimp are enforced (10 juvenile redfish per 10 kg shrimp). Additional protection for adult *S. mentella* comprise area closures.

Traditionally, the directed fishery was conducted by Russia and other East-European countries on grounds from south of Bear Island towards Spitsbergen. From the mid-1970s to the mid-1980s large catches were taken annually. From the mid-1980s Norwegian trawlers started fishing along the continental slope (around 500 m depth) further south, on grounds never harvested before, and inhabited primarily by mature fish. After a sharp decrease in the landings from the traditional area until 1987, this fishery on new grounds resulted in a temporary increase in the landings until 1991, after which the landings declined. Since 1991 the fishery has been dominated by Norway and Russia.

Because of the slow growth of this species, the surveys should detect improvements to incoming year classes for several years before they contribute to the fisheries or the spawning population.

Source of information: Report of the Arctic Fisheries Working Group, May 2001 (ICES CM 2001/ACFM:19).

Catch data (Tables 3.1.5.a.1–4):

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC	Official landings[1]	ACFM landings of *S. mentella*
1987	Precautionary TAC	70[1]	85	35	11
1988	$F \leq F_{0.1}$; TAC	11	-	41	16
1989	*Status quo* F; TAC	12	-	47	23
1990	*Status quo* F; TAC	18	-	63	35
1991	F at F_{med}; TAC	12	-	68	49
1992	If required, precautionary TAC	22	-	32	16
1993	If required, precautionary TAC	18	18	30	13
1994	If required, precautionary TAC	-	-	31	13
1995	Lowest possible F	-	-	26	10
1996	Catch at lowest possible level	-	-	26	8
1997	Catch at lowest possible level	-	-	26	9
1998	No directed fishery, reduce by-catch	-	-	33	14
1999	No directed fishery, reduce by-catch	-	-	30	11
2000	No directed fishery, by-catch at lowest possible level	-	-	24	8
2001	No directed fishery, by-catch at lowest possible level	-	-		
2002	No directed fishery, by-catch at lowest possible level				

[1] Includes both *S. mentella* and *S. marinus*. Weights in '000 t.

Sebastes mentella in Sub-areas I & II

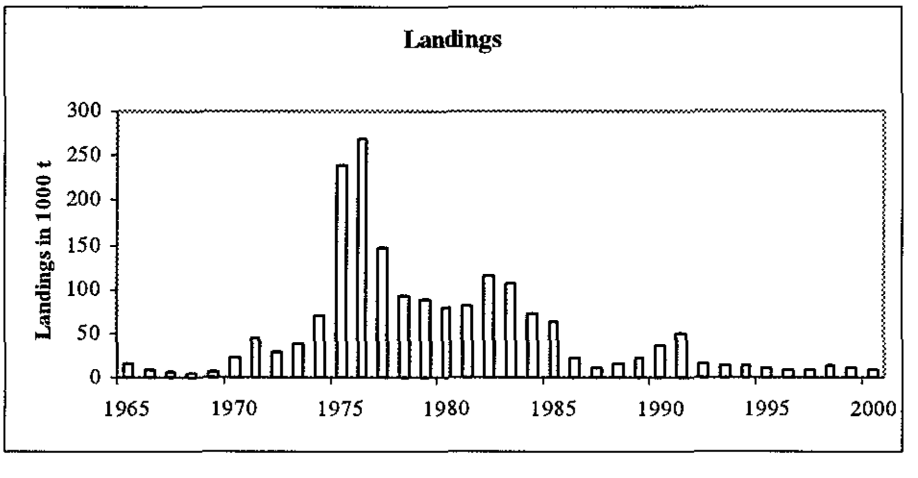


Table 3.1.5.a.1 *Sebastes mentella*. Nominal catch (t) by countries in Sub-area I, Divisions IIa and IIb combined.

Year	Canada	Denmark	Faroe Islands	France	Germany[3]	Greenland	Ireland
1986	-	-	-	-	1,252	-	-
1987	-	-	200	63	1,321	-	-
1988			No species specific data available by country.				
1989	-	-	335	1,093	3,833	-	-
1990	-	-	108	142	6,354	36	-
1991	-	-	487	85	-	23	-
1992	-	-	23	12	-	-	-
1993	8	4	13	50	35	1	-
1994	-	28	4	74	18	1	3
1995	-	-	3	16	176	2	4
1996	-	-	4	75	119	3	2
1997	-	-	17	37	80	16	6
1998	-	-	20	73	100	14	9
1999	Iceland	-	73	26	202	50	3
2000[1]	46	-	50	12	48	29	1

Year	Norway	Poland	Portugal	Russia[4]	Spain	UK (Eng. & Wales)	UK (Scotland)	Total
1986	1,274	-	1,273	17,815	-	84	-	23,112[2]
1987	1,488	-	1,175	6,196	25	49	1	10,518
1988		No species specific data available by country.						15,586
1989	4,633	-	340	13,080	5	174	1	23,494
1990	10,173	-	830	17,355	-	72	-	35,070
1991	33,592	-	166	14,302	1	68	3	48,727
1992	10,751	-	972	3,577	14	238	3	15,590
1993	5,182	-	963	6,260	5	293	-	12,866
1994	6,511	-	895	5,021	30	124	12	12,721
1995	2,646	-	927	6,346	67	93	4	10,284
1996	6,053	-	467	925	328	76	23	8,075
1997	4,570	1	474	2,972	272	71	7	8,523
1998	9,532	13	125	3,646	177	93	41	13,844
1999	7,777	6	65	2,731	29	112	28	11,102
2000[1]	4,177	2	115	3,519	99		130[5]	8,228

[1] Provisional figures.
[2] Including 1,414 tonnes in Division IIb not split on countries.
[3] Includes former GDR prior to 1991.
[4] USSR prior to 1991.
[5] UK(E&W)+UK(Scot.)

Table 3.1.5.a.2 *Sebastes mentella*. Nominal catch (t) by countries in Sub-area I.

Year	Faroe Islands	Germany[4]	Greenland	Norway	Russia[5]	UK(Eng. &Wales)	Iceland	Total
1986[3]	-	-	-	1,274	911	-	-	2,185
1987[3]	-	2	-	1,166	234	3	-	1,405
1988			No species specific data presently available					
1989	13	-	-	60	484	9[2]	-	566
1990	2	-	-	-	100	-	-	102
1991	-	-	-	8	420	-	-	428
1992	-		-	561	408	-	-	969
1993	2[2]	-	-	16	588	-	-	606
1994	2[2]	2	-	36	308	-	-	348
1995	2[2]	-	-	20	203	-	-	225
1996	-	-	-	5	101	-	-	106
1997	-	-	3[2]	13	174	1[2]	-	191
1998	-	-	-	26	378	-	-	404
1999	69[2]	-	-	64	489	-	-	622
2000[1]	-	-	-	54	406	-	46	506

[1] Provisional figures.
[2] Split on species according to reports to Norwegian authorities.
[3] Based on preliminary estimates of species breakdown by area.
[4] Includes former GDR prior to 1991.
[5] USSR prior to 1991.

Table 3.1.5.a.3 *Sebastes mentella*. Nominal catch (t) by countries in Division IIa.

Year	Faroe Islands	France	Germany[4]	Greenland	Ireland	Norway
1986[3]	-	-	1,252	-	-	-
1987[3]	200	63	970	-	-	149
1988		No species specific data presently available				
1989	312[2]	1,065[2]	3,200	-	-	4,573
1990	98[2]	137[2]	1,673	-	-	8,842
1991	487[2]	72[2]	-	-	-	32,810
1992	23[2]	7[2]	-	-	-	9,816
1993	11[2]	15[2]	35	1[2]	-	5,029
1994	2[2]	33[2]	16[2]	1[2]	2[2]	6,119
1995	1[2]	16[2]	176[2]	2[2]	2[2]	2,251
1996	-	75[2]	119[2]	3[2]	-	5,895
1997	13[2]	37[2]	77	12[2]	2[2]	4,366
1998	20[2]	73[2]	58[2]	14[2]	6[2]	9,363
1999	-	16[2]	160[2]	50[2]	3[2]	7,487
2000[1]	50[2]	11[2]	34[2]	29[2]	-	4,028

Year	Portugal	Russia[5]	Spain	UK(Eng.& Wales)	UK (Scotland)	Total
1986[3]	1,273	16,904	-	84	-	19,513
1987[3]	1,156	4,469	-	34	1	7,042
1988		No species specific data presently available				
1989	251	9,749	-	158[2]	1[2]	19,309
1990	824	6,492	-	9	-	18,075
1991	159[2]	7,596	-	23[2]	-	41,147
1992	824[2]	1,096	-	27[2]	-	11,793
1993	648[2]	5,328	-	2[2]	-	11,069
1994	687[2]	4,692	8[2]	4[2]	-	11,564
1995	715[2]	5,916	65[2]	41[2]	2[2]	9,187
1996	429[2]	677	5[2]	42[2]	19[2]	7,264
1997	410[2]	2,341	9[2]	48[2]	7[2]	7,322
1998	118[2]	2,626	55[2]	65[2]	41[2]	12,439
1999	56[2]	1,340	14[2]	94[2]	26[2]	9,246
2000[1]	98[2]	2,167	11[2]		103[6]	6,531

[1] Provisional figures.
[2] Split on species according to reports to Norwegian authorities.
[3] Based on preliminary estimates of species breakdown by area.
[4] Includes former GDR prior to 1991.
[5] USSR prior to 1991.
[6] UK(E&W)+UK(Scot.)

Table 3.1.5.a.4 *Sebastes mentella*. Nominal catch (t) by countries in Division IIb.

Year	Canada	Denmark	Faroe Islands	France	Germany[5]	Greenland	Ireland
1986[4]			Data not available on countries				
1987[4]	-	-	-	-	349	-	-
1988			No species specific data presently available				
1989	-	-	10	28	633	-	-
1990	-	-	8[2]	5[2]	4,681	36[2]	-
1991	-	-	-	13[2]	-	23	-
1992	-	-	-	5[2]	-	-	-
1993	8[2]	4[2]	-	35[2]	-	-	-
1994	-	28[2]	-	41[2]	-	-	1[2]
1995	-	-	-	-	-	-	2[2]
1996	-	-	4[2]	-	-	-	2[2]
1997	-	-	4[2]	-	3	1[2]	4[2]
1998	-	-	-	-	42[2]	-	3[2]
1999	-	-	4[2]	10[2]	42[2]	-	-
2000[1]	-	-	-	1[2]	14[2]	-	1[2]

Year	Norway	Poland	Portugal	Russia[6]	Spain	UK(Eng. & Wales)	UK (Scotland)	Total
1986[4]			Data not available on countries					1,414
1987[4]	173	-	19	1,493	25	12	-	2,071
1988			No species specific data presently available					
1989	-	-	89	2,847	5	7[2]	-	3,619
1990	1,331	-	6	10,763	-	63[2]	-	16,893
1991	774	-	7	6,286	1	45[2]	3[2]	7,152
1992	374	-	148[2]	2,073	14	211[2]	3[2]	2,826
1993	137	-	315[2]	344	57[3]	291[2]	-	1,191
1994	356	-	208[2]	21	22[3]	120[2]	12[2]	809
1995	375	-	212[2]	227	2[3]	52[2]	2[2]	872
1996	153	-	38[2]	147	323[2]	34[2]	4[2]	705
1997	191	1[2]	64[2]	457	263[2]	22[2]	-	1,010
1998	143	13[2]	7[2]	642	122[2]	28[2]	1[2]	1,001
1999	226	6[2]	9[2]	902	15[2]	18[2]	2[2]	1,234
2000[1]	95	2[2]	17[2]	946	88[2]		27[7]	1,191

[1] Provisional figures.
[2] Split on species according to reports to Norwegian authorities.
[3] Split on species according to the 1992 catches.
[4] Based on preliminary estimates of species breakdown by area.
[5] Includes former GDR prior to 1991.
[6] USSR prior to 1991.
[7] UK(E&W)+UK(Scot.)

3.1.5.b *Sebastes marinus* in Sub-areas I and II

State of stock/exploitation: It has not been possible to assess the status of this stock with respect to safe biological limits. Available data from the Barents Sea/Svalbard surveys and commercial CPUE on larger fish do not indicate any large recent changes in the adult stock, but the data are too noisy to detect moderate changes. However, results from the coastal and fjord survey series indicate a decrease also for larger fish since 1995. Indices from surveys in young fish areas in the Barents Sea and Svalbard waters indicate a declining trend in recruitment.

Reference points: No precautionary reference points have been proposed for this stock.

Management objectives: No explicit management objectives have been established for this stock.

Advice on management: Consistent with a precautionary approach, ICES recommends that a management plan, including monitoring of the development of the stock and of the fishery, with corresponding regulations, should be developed and implemented as a prerequisite to continued fishing.

Relevant factors to be considered in management: The low abundance of pre-recruit fish in the recent surveys suggests that a decline in the stock can be expected over the next few years.

Elaboration and special comment: The fishery is mainly conducted by Norway accounting for 80–90% of the total catch. Germany also has a long tradition of a trawl fishery for this species. The fish are caught mainly by trawl and gillnet, and to a lesser extent by longline, Danish seine, and handline, in that order. Some of the catches are taken in mixed fisheries together with saithe and cod. Important fishing grounds are the Møre area (Svinøy), Halten Bank, outside Lofoten and Vesterålen, and at Sleppen outside Finnmark.

Source of information: Report of the Arctic Fisheries Working Group, May 2001 (ICES CM 2001/ACFM:19).

Catch data (Tables 3.1.5.b.1-5):

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC	Official landings[1]	ACFM landings of *S. marinus*
1987	Precautionary TAC	-	-	35	24
1988	Reduction in F; TAC	15	-	41	26
1989	*Status quo* F; TAC	24	-	47	23
1990	*Status quo* F; TAC	23	-	63	28
1991	Precautionary TAC	24	-	68	19
1992	If required, precautionary TAC	25	-	32	16
1993	Precautionary TAC	12	12	30	17
1994	If required, precautionary TAC	-	-	31	18
1995	If required, precautionary TAC	-	-	26	16
1996	If required, precautionary TAC	-	-	26	18
1997	If required, precautionary TAC	-	-	26	18
1998	Management plan required as pre-requisite to continued fishing	-	-	33	19
1999	Management plan required as pre-requisite to continued fishing	-	-	30	19
2000	Management plan required as pre-requisite to continued fishing	-	-	24	16
2001	Management plan required as pre-requisite to continued fishing	-	-		
2002	Management plan required as pre-requisite to continued fishing	-			

[1]Includes both *S. mentella* and *S. marinus*. Weights in '000 t.

Sebastes marinus in Sub-areas I & II

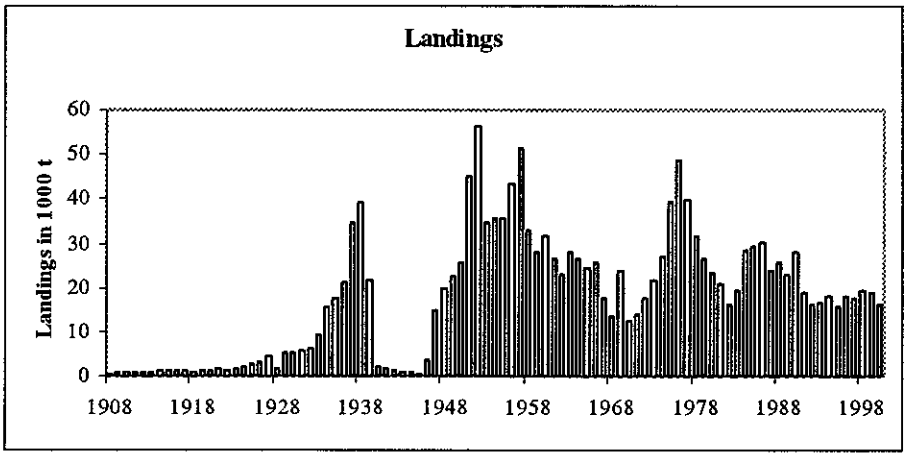


Table 3.1.5.b.1 *Sebastes marinus*. Nominal catch (t) by countries in Sub-area I and Divisions IIa and IIb combined.

Year	Faroe Islands	France	Germany[2]	Greenland	Iceland	Ireland	Netherlands
1986	29	2,719	3,369	-	-	-	-
1987	250	1,553	4,508	-	-	-	-
1988		No species specific data presently available on countries					
1989	3	784	412	-	-	-	-
1990	278	1,684	387	1	-	-	-
1991	152	706[1]	981	-	-	-	-
1992	35	1,289[1]	530	623	-	-	-
1993	139	871[1]	650	14	-	-	-
1994	22	697[1]	1,008	5	4	-	-
1995	27	732[1]	517	5	1	1	1
1996	38	671[1]	499	34	-	-	-
1997	11	974	457	23	-	5	-
1998	78	494	131	33	-	19	-
1999	35	35	228	47	14	7	-
2000[1]	17	13	157	22	16	-	-

Year	Norway	Portugal	Russia[3]	Spain	UK (Eng. & Wales)	UK (Scotland)	Total
1986	21,680	-	2,350	-	42	14	30,203
1987	16,728	-	850	-	181	7	24,077
1988		No species specific data presently available on countries					25,908
1989	20,662	-	1,264	-	97	-	23,222
1990	23,917	-	1,549	-	261	-	28,077
1991	15,872	-	1.052	-	268	10	19.041
1992	12,700	5	758	2	241	2	16,185
1993	13,137	77	1,313	8	441	1	16,651
1994	14,955	90	1,199	4	135	1	18,120
1995	13,516	9	639	-	159	9	15,616
1996	15,622	55	716	81	229	98	18,043
1997	14,239	61	1,584	36	164	22	17,576
1998	16,717	6	1,632	51	118	53	19,331
1999	16,847	3	1,691	7	135	34	19,083
2000[1]	14,270	16	1,112	9		74[4]	16,154

[1] Provisional figures.
[2] Includes former GDR prior to 1991.
[3] USSR prior to 1991.
[4] UK(E&W)+UK(Scot.)

Table 3.1.5.b.2 *Sebastes marinus.* Nominal catch (t) by countries in Sub-area I.

Year	Faroe Islands	Germany[4]	Greenland	Iceland	Norway	Russia[5]	UK(Eng &Wales)	UK (Scotland)	Total
1986[3]	-	50	-	-	2,972	155	32	3	3,212
1987[3]	-	8	-	-	2,013	50	11	-	2,082
1988				No species specific data presently available					
1989	-	-	-	-	1,763	110	4[2]	-	1,877
1990	5	-	-	-	1,263	14	-	-	1,282
1991	-	-	-	-	1,993	92	-	-	2,085
1992	-	-	-	-	2,162	174	-	-	2,336
1993	24[2]	-	-	-	1,178	330	-	-	1,532
1994	12[2]	72	-	4	1,607	109		-	1,804
1995	19[2]	1[2]	-	1[2]	1,947	201	1[2]	-	2,170
1996	7[2]	-	-	-	2,245	131	3[2]	-	2,386
1997	3	-	5[2]	-	2,643	160	2[2]	-	2,813
1998	-	5[2]	-	-	2,085	308	30[2]	-	2,428
1999	35[2]	18[2]	9[2]	14[2]	1,973	360	11[2]	-	2,420
2000[1]	-	1[2]	-	16[2]	2,068	146		13[6]	2243

[1] Provisional figures.
[2] Split on species according to reports to Norwegian authorities.
[3] Based on preliminary estimates of species breakdown by area.
[4] Includes former GDR prior to 1991.
[5] USSR prior to 1991.
[6] UK(E&W)+UK(Scot.)

Table 3.1.5.b.3 *Sebastes marinus.* Nominal catch (t) by countries in Division IIa.

Year	Faroe Islands	France	Germany[4]	Greenland	Ireland	Netherlands	Norway	Portugal	Russia[5]	Spain	UK (Eng. & Wales)	UK (Scotland)	Total
1986[3]	29	2,719	3,319	-	-	-	18,708	-	2,195	-	10	11	26,991
1987[3]	250	1,553	2,967	-	-	-	14,715	-	800	-	170	7	20,462
1988					No species specific data presently available								
1989	3[2]	784[2]	412	-	-	-	18,833	-	912	-	93[2]	-	21,037
1990	273	1,684	387	-	-	-	22,444	-	392	-	261	-	25,441
1991	152[2]	706[2]	678	-	-	-	13,835	-	534	-	268[2]	10[2]	16,183
1992	35[2]	1,294[2]	211	614	-	-	10,536	-	404	-	206[2]	2[2]	13,302
1993	115[2]	871[2]	473	14[2]	-	-	11,959	77[2]	940	-	431[2]	1[2]	14,881
1994	10[2]	697[2]	654[2]	5[2]	-	-	13,330	90[2]	1,030	-	129[2]	-	15,945
1995	8[2]	732[2]	328[2]	5[2]	1[2]	1	11,466	2[2]	405	-	158[2]	9[2]	13,115
1996	27[2]	671[2]	448[2]	34[2]	-	-	13,329	51[2]	449	5[2]	223[2]	98[2]	15,335
1997	8[2]	974[2]	438	18[2]	5[2]	-	11,558	61[2]	1,199	36[2]	162[2]	22[2]	14,481
1998	78[2]	494[2]	116[2]	33[2]	19[2]	-	14,603	6[2]	1,078	51[2]	85[2]	52[2]	16,615
1999	-	35[2]	210[2]	38[2]	7[2]	-	14,855	3[2]	976	7[2]	122[2]	34[2]	16,287
2000[1]	17[2]	13[2]	156[2]	22[2]	-	-	12,632	16[2]	658	9[2]		61[6]	13,583

[1] Provisional figures.
[2] Split on species according to reports to Norwegian authorities.
[3] Based on preliminary estimates of species breakdown by area.
[4] Includes former GDR prior to 1991.
[5] USSR prior to 1991.
[6] UK(E&W)+UK(Scot.)

Table 3.1.5.b.4 *Sebastes marinus*. Nominal catch (t) by countries in Division IIb.

Year	Faroe Islands	Germany[5]	Greenland	Norway	Portugal	Russia[6]	Spain	UK(Eng. & Wales)	UK (Scotland)	Total
1986	-									+
1987[4]	-	1533	-	-	-	-	-	-	-	1533
1988				No species specific data presently available						
1989	-	-	-	66	-	242	-	-	-	308
1990	-	-	1[2]	210	-	1157	-	-	-	1368
1991	-	303	-	44	-	426	-	-	-	773
1992	-	319	9[2]	2	5[2]	180	2	35[2]	-	552
1993	-	177	-	-	-	43	8[3]	10[2]	-	238
1994	-	282	-	18	-	60	4[3]	6[2]	1[2]	371
1995	-	187	-	103	7	33	-	-	-	330
1996	4	51[2]	-	27	5	136	76[2]	3[2]	-	302
1997	-	20	-	37	-	225	-	-	-	282
1998	-	10[2]	-	29	-	246	-	3[2]	-	288
1999	-	-	-	19	-	355	-	2[2]	-	376
2000[1]	-	-	-	20	-	308	-	-	-	328

[1] Provisional figures.
[2] Split on species according to reports to Norwegian authorities.
[3] Split on species according to the 1992 catches.
[4] Based on preliminary estimates of species breakdown by area.
[5] Includes former GDR prior to 1991.
[6] USSR prior to 1991.

Table 3.1.5.b.5 *Sebastes marinus* in Sub-areas I and II. Total international landings 1908-2000 (thousand tonnes).

Year	Landings '000 t	Year	Landings '000 t
1908	0.65	1957	51.61
1909	1.00	1958	33.12
1910	1.03	1959	28.07
1911	1.01	1960	31.77
1912	1.01	1961	26.73
1913	0.81	1962	22.82
1914	1.14	1963	28.10
1915	1.31	1964	26.55
1916	1.46	1965	24.31
1917	1.16	1966	25.63
1918	1.11	1967	17.73
1919	1.51	1968	13.35
1920	1.17	1969	24.07
1921	1.83	1970	12.82
1922	1.47	1971	13.82
1923	1.94	1972	17.73
1924	2.21	1973	21.44
1925	2.72	1974	27.27
1926	3.19	1975	39.13
1927	4.47	1976	48.58
1928	1.95	1977	39.51
1929	5.28	1978	31.74
1930	5.29	1979	26.48
1931	5.88	1980	23.41
1932	6.10	1981	20.83
1933	9.59	1982	16.37
1934	15.86	1983	19.26
1935	17.69	1984	28.38
1936	21.03	1985	29.48
1937	34.59	1986	30.20
1938	39.17	1987	24.08
1939	21.87	1988	25.91
1940	2.29	1989	23.22
1941	1.68	1990	28.08
1942	1.43	1991	19.04
1943	1.02	1992	16.19
1944	0.92	1993	16.65
1945	0.56	1994	18.12
1946	3.57	1995	15.62
1947	14.88	1996	18.04
1948	20.00	1997	17.58
1949	22.36	1998	19.32
1950	25.56	1999	19.09
1951	45.30	2000	16.15
1952	56.17	Average	17.62
1953	34.83		
1954	35.78		
1955	35.47		
1956	43.38		

3.1.6 Greenland halibut in Sub-areas I and II

State of stock/exploitation: The status of the stock is not precisely known, but it is considered to be outside safe biological limits. SSB in 2001 is the lowest in the time series. Fishing mortality is estimated to be above the long-term average, and recruitment in recent years is estimated to be amongst the lowest in the time series.

Management objectives: No explicit management objectives have been established for this stock.

Reference points: No limit or precautionary reference points for the fishing mortality or the biomass are proposed.

Advice on management: ICES recommends to reduce catches to below 11 000 t for 2002 in order to rebuild the stock. Furthermore, additional measures to control catch should be implemented.

Rebuilding plan: Although no precautionary reference points have been established for this stock a rebuilding plan is required. Precautionary reference points should also be defined.

Comparison with previous assessment and advice: In this year's assessment the fishing mortalities ($F_{6\text{-}10}$) for 1997–1999 are higher and the stock biomasses and the spawning stock biomasses are lower compared with last year's assessment. Reported landings from the fishery so far in 2001 indicate that the expected catch of Greenland halibut in 2001 will be much higher than the corresponding ICES advice.

Relevant factors to be considered in management: The exploitation history of this stock indicates that it is unable to withstand the current level of fishing mortality. Current management measures have not been effective in reducing fishing mortality. Additional management measures to control catches, e.g. TACs, area closures and reduced by-catch limits, need to be introduced and enforced effectively.

Based on the results of the Russian survey and experimental fishery for Greenland halibut Russian scientists consider that this stock has shown a positive trend in recent years.

In general during the 1990s, SSB increased when catches were *circa* 10 000 t or less, but decreased when catches were greater than 10 000 t.

Elaboration and special comment: The assessment is considered uncertain due to age-reading problems and evidence of unreported landings that could not be taken account of. Nevertheless, it is considered that the assessment reflects the status of the stock reasonably well.

The assessment indicates that, on average, recruitment has been lower after 1980 compared to previous years.

Since 1992, the fishery has been regulated by allowing a directed fishery only by small coastal longline and gill net vessels. By-catches of Greenland halibut in the trawl fisheries have been limited by permissible by-catch per haul and an allowable by-catch retention limit on board the vessel.

Analytical assessment was based on commercial catch-at-age data, two survey series, and one experimental commercial CPUE series.

Source of information: Report of the Arctic Fisheries Working Group, May 2001 (ICES CM 2001/ACFM:19).

Yield and spawning biomass per Recruit F-reference points:

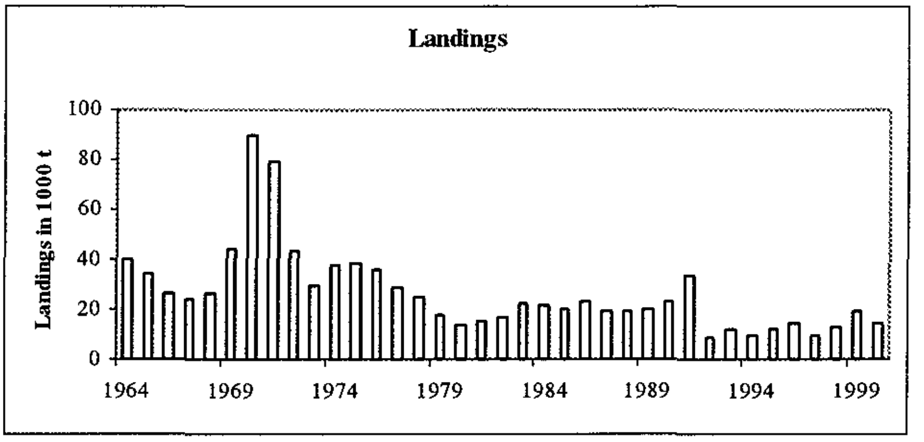
	Fish Mort Ages 6-10	Yield/R	SSB/R
Average Current	0.344	1.006	2.237
$\mathbf{F}_{max}$	0.182	1.055	4.008
$\mathbf{F}_{0.1}$	0.089	0.963	7.093
$\mathbf{F}_{med}$	0.162	1.053	4.437

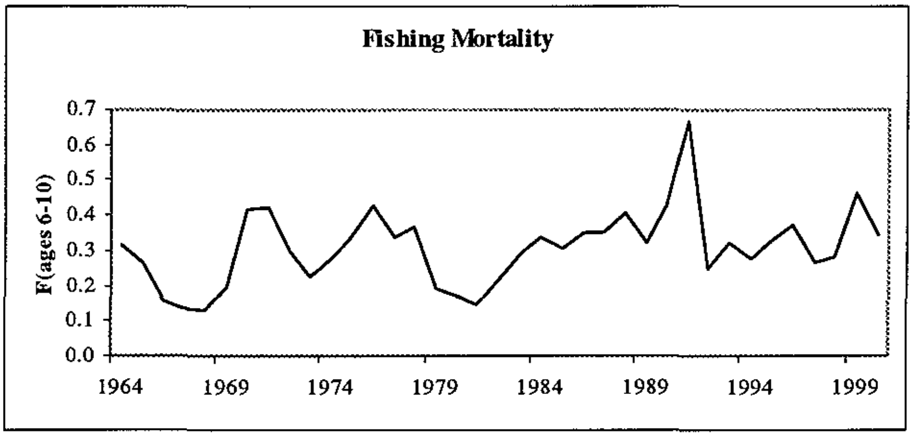
Catch data (Tables 3.1.6.1–5):

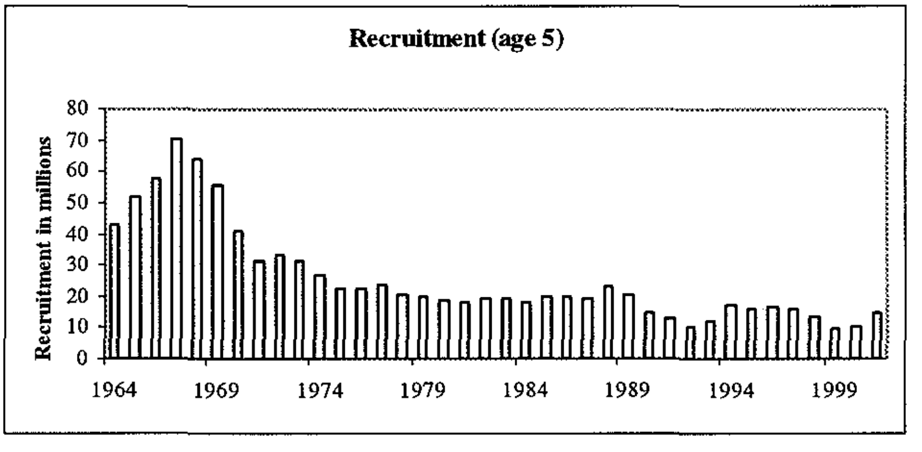
Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC	Official landings	ACFM landings
1987	Precautionary TAC	-	-	19	19
1988	No decrease in SSB	19	-	20	20
1989	F = F(87); TAC	21	-	20	20
1990	F = F (89); TAC	15	-	23	23
1991	F at $\mathbf{F}_{med}$; TAC; improved expl. pattern	9	-	33	33
1992	Rebuild SSB(1991)	6	7[1]	9	9
1993	TAC	7	7[1]	12	12
1994	F < 0.1	< 12	11[1]	9	9
1995	No fishing	0	2.5[2]	11	11
1996	No fishing	0	2.5[2]	14	14
1997	No fishing	0	2.5[2]	10	10
1998	No fishing	0	2.5[2]	13	13
1999	No fishing	0	2.5[2]	19	19
2000	No fishing	0	2.5[2]	14	14
2001	Reduce catch to rebuild stock	< 11	2.5[2]		
2002	Reduce F substantially	< 11			

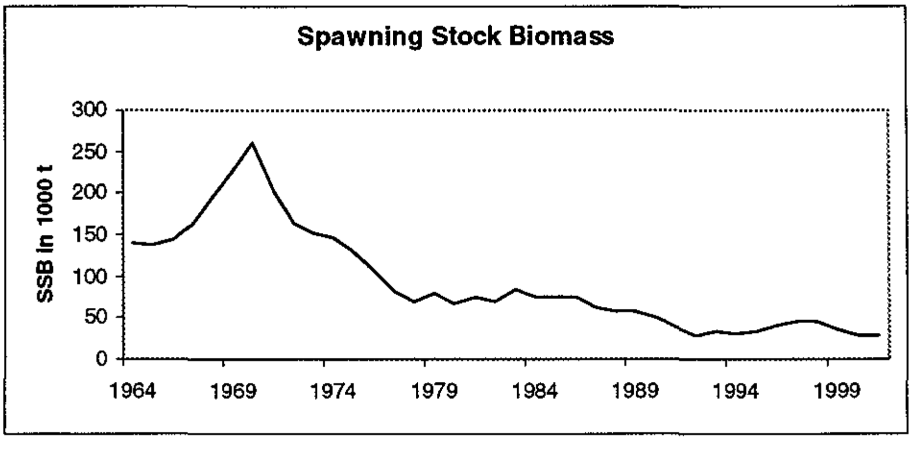
[1]Set by Norwegian authorities. [2]Set by Norwegian authorities for the non-trawl fishery; allowable by-catch in the trawl fishery is additional to this. Weights in '000 t.

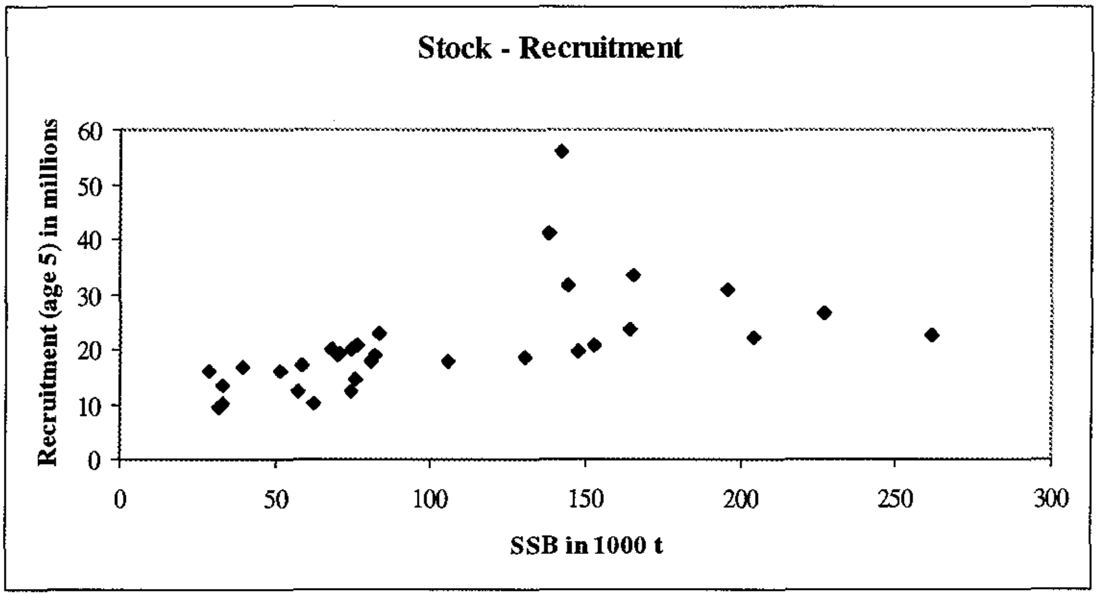
Greenland halibut in Sub-areas I & II










Stock - Recruitment
Recruitment (age 5) in millions
60
50
40
30
20
10
0
0
50
100
150
200
250
300
SSB in 1000 t

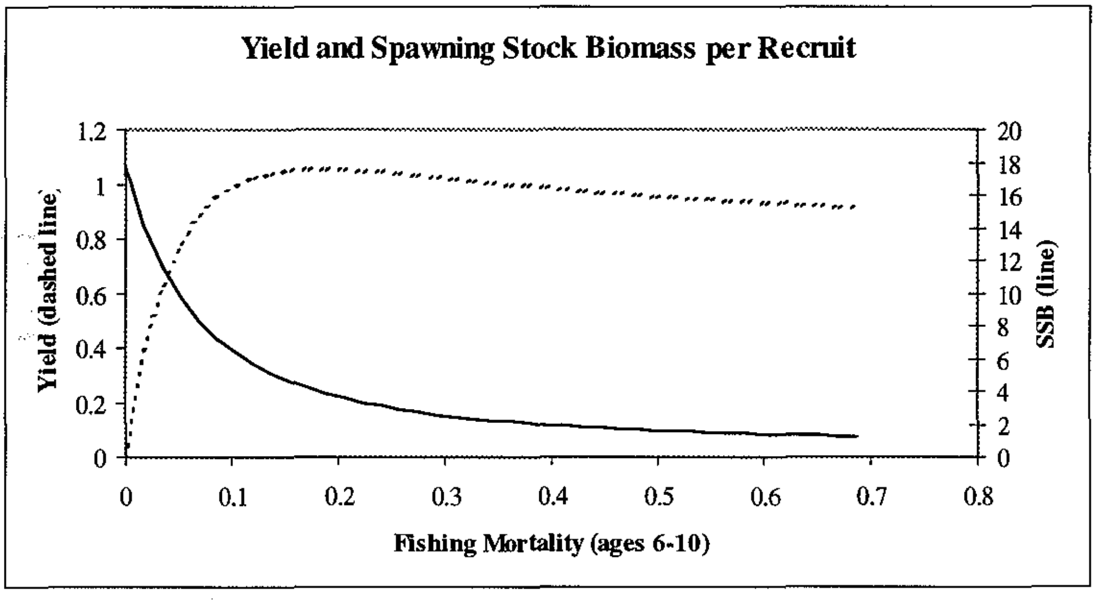

Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
1.2
1
0.8
0.6
0.4
0.2
0
SSB (line)
20
18
16
14
12
10
8
6
4
2
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
Fishing Mortality (ages 6-10)

Table 3.1.6.1 GREENLAND HALIBUT. Nominal catch (t) by countries (Sub-area I, Divisions IIa and IIb combined) as officially reported to ICES.

Year	Denmark	Estonia	Faroe Isl.	France	Germany	Greenland	Iceland	Ireland	Lithuania
1984	0	0	0	138	2,165	0	0	0	0
1985	0	0	0	239	4,000	0	0	0	0
1986	0	0	42	13	2,718	0	0	0	0
1987	0	0	0	13	2,024	0	0	0	0
1988	0	0	186	67	744	0	0	0	0
1989	0	0	67	31	600	0	0	0	0
1990	0	0	163	49	954	0	0	0	0
1991	11	2,564	314	119	101	0	0	0	0
1992	0	0	16	111	13	13	0	0	0
1993	2	0	61	80	22	8	56	0	30
1994	4	0	18	55	296	3	15	5	4
1995	0	0	12	174	35	12	25	2	0
1996	0	0	2	219	81	123	70	0	0
1997	0	0	27	253	56	0	62	2	0
1998	0	0	57	67	34	0	23	2	0
1999	0	0	94	0	34	38	7	2	0
2000[1]	0	0	0	0	15	0	42	0	0

Year	Norway	Poland	Portugal	Russia[3]	Spain	UK (E&W)	UK (Sco.)	Total
1984	4,376	0	0	15,181	0	23	0	21,883
1985	5,464	0	0	10,237	0	5	0	19,945
1986	7,890	0	0	12,200	0	10	2	22,875
1987	7,261	0	0	9,733	0	61	20	19,112
1988	9,076	0	0	9,430	0	82	2	19,587
1989	10,622	0	0	8,812	0	6	0	20,138
1990	17,243	0	0	4,764[2]	0	10	0	23,183
1991	27,587	0	0	2,490[2]	132	0	2	33,320
1992	7,667	0	31	718	23	10	0	8,602
1993	10,380	0	43	1,235	0	16	0	11,933
1994	8,428	0	36	283	1	76	2	9,226
1995	9,368	0	84	794	1,106	115	7	11,734
1996	11,623	0	79	1,576	200	317	57	14,347
1997	7,879[2]	12	50	1,038	157[2]	67	25	9,628
1998	9,236[2]	31	99	2,659	72[2]	182	45	12,507
1999	15,033[2]	8	49	3,823	123[2]	94	45	19,350
2000[1]	9,006[2]	3	19	4,568	375[2]	111	0	14,139

[1] Provisional figures.
[2] Working Group figures.
[3] USSR prior to 1991.

Table 3.1.6.2 GREENLAND HALIBUT. Nominal catch (t) by countries in Sub-area I as officially reported to ICES.

Year	Estonia	Faroe Islands	Fed. Rep. Germany	Greenland	Iceland	Norway	Russia[3]	Spain	UK (E & W)	UK (Sco.)	Total
1984	-	-	-	-	-	593	81	-	17	-	691
1985	-	-	-	-	-	602	122	-	1	-	725
1986	-	-	1	-	-	557	615	-	5	1	1,179
1987	-	-	2	-	-	984	259	-	10	+	1,255
1988	-	9	4	-	-	978	420	-	7	-	1,418
1989	-	-	-	-	-	2,039	482	-	+	-	2,521
1990	-	7	-	-	-	1,304	321[2]	-	-	-	1,632
1991	164	-	-	-	-	2,029	522[2]	-	-	-	2,715
1992	-	-	+	-	-	2,349	467	-	-	-	2,816
1993	-	32	-	-	56	1,754	867	-	-	-	2,709
1994	-	17	217	-	15	1,165	175	-	+	-	1,589
1995	-	12	-	-	25	1,352	270	84	-	-	1,743
1996	-	2	+	-	70	911	198	-	+	-	1,181
1997	-	15	-	-	62	606[2]	170	-	+	-	853
1998	-	47	+	-	23	810[2]	491	-	2	-	1,373
1999	-	91	-	13	7	1,094[2]	1,203	-	+	-	2,408
2000[1]	-	-	+	-	42	933[2]	1,169	-	1	-	2,145

[1]Provisional figures.
[2] Working Group figures.
[3] USSR prior to 1991.

Table 3.1.6.3 GREENLAND HALIBUT. Nominal catch (t) by countries in Division IIa as officially reported to ICES.

Year	Estonia	Faroe Islands	France	Fed. Rep. Germ.	Green land	Ireland	Norway	Port ugal	Russia[5]	Spain	UK (E & W)	UK (Sco.)	Total
1984	-	-	138	265	-	-	3,703	-	5,459	-	1	-	9,566
1985	-	-	239	254	-	-	4,791	-	6,894	-	2	-	12,180
1986	-	6	13	97	-	-	6,389	-	5,553	-	5	1	12,064
1987	-	-	13	75	-	-	5,705	-	4,739	-	44	10	10,586
1988	-	177	67	150	-	-	7,859	-	4,002	-	56	2	12,313
1989	-	67	31	104	-	-	8,050	-	4,964	-	6	-	13,222
1990	-	133	49	12	-	-	8,233	-	1,246[2]	-	1	-	9,674
1991	1,400	314	119	21	-	-	11,189	-	305[2]	-	+	1	13,349
1992	-	16	108	1	13[4]	-	3,586	15[3]	58	-	1	-	3,798
1993	-	29	78	14	8[4]	-	7,977	17	210	-	2	-	8,335
1994	-	-	47	33	3[4]	4	6,382	26	67	+	14	-	6,576
1995	-	-	174	30	12[4]	2	6,354	60	227	-	83	2	6,944
1996	-	-	219	34	123[4]	-	9,508	55	466	4	278	57	10,744
1997	-	-	253	23	-[4]	-	6,057[2]	41	334	1	21	25	6,755
1998	-	-	67	16	-[4]	1	7,495[2]	80	530	5	74	41	8,309
1999	-	-	-	20	25[4]	2	13,127[2]	33	734	1	63	45	14,050
2000[1]	-	-	-	10	-[4]	-	7,613[2]	-	690	1	64	-	8,378

[1]Provisional figures.
[2]Working Group figure.
[3]As reported to Norwegian authorities.
[4]Includes Division IIb.
[5] USSR prior to 1991.

Table 3.1.6.4 GREENLAND HALIBUT. Nominal catch (t) by countries in Division IIb as officially reported to ICES.

Year	Denmark	Estonia	Faroe Isl.	France	Fed. Rep. Germ.	Ireland	Lithuania	Norway	Poland	Portugal	Russia[4]	Spain	UK (E&W)	UK (Sco.)	Total
1984	-	-	-	-	1,900	-	-	80	-	-	9,641	-	5	-	11,626
1985	-	-	-	-	3,746	-	-	71	-	-	3,221	-	2	-	7,040
1986	-	-	36	-	2,620	-	-	944	-	-	6,032	-	+	-	9,632
1987	+	-	-	-	1,947	-	-	572	-	-	4,735	-	7	10	7,271
1988	-	-	-	-	590	-	-	239	-	-	5,008	-	19	+	5,856
1989	-	-	-	-	496	-	-	533	-	-	3,366	-	-	-	4,395
1990	-	-	23[2]	-	942	-	-	7,706	-	-	3,197[2]	-	9	-	11,877
1991	11	1,000	-	-	80	-	-	14,369	-	-	1,663[2]	132	+	1	17,256
1992	-	-	-	3[2]	12	-	-	1,732	-	16	193	23	9	-	1,988
1993	2[3]	-	-	2[3]	8	-	30[3]	649	-	26	158	-	14	-	889
1994	4	-	1[3]	8[3]	46	1	4[3]	881	-	10	41	1	62	2	1,061
1995	-	-	-	-	5	-	-	1,662	-	24	297	1,022	32	5	3,047
1996	+	-	-	-	47	-	-	1,204	-	24	912	196	39	+	2,422
1997	-	-	12	-	33	2	-	1,216[2]	12	9	534	156[2]	46	+	2,020
1998	-	-	10	-	18	1	-	931[2]	31	19	1,638	67[2]	106	4	2,825
1999	-	-	3	-	14	-	-	812[2]	8	16	1,886	122[2]	31	-	2,892
2000[1]	-	-	-	-	5	-	-	460[2]	3	19	2709	374[2]	46	-	3,616

[1]Provisional figures.

[2]Working Group figure.

[3]As reported to Norwegian authorities.

[4]USSR prior to 1991.

Table 3.1.6.5 Greenland halibut in Sub-areas I and II.

Year	Recruitment Age 5 thousands	SSB tonnes	Landings tonnes	Mean F Ages 6-10
1964	42840	141518	40391	0.3146
1965	51685	137647	34751	0.2643
1966	57828	144024	26321	0.1601
1967	70442	165407	24267	0.1376
1968	64280	196071	26168	0.1309
1969	55931	226750	43789	0.1988
1970	41112	261487	89484	0.4204
1971	31549	204071	79034	0.4223
1972	33554	164051	43055	0.3019
1973	31060	152282	29938	0.2252
1974	26640	147166	37763	0.2787
1975	22537	129984	38172	0.3361
1976	22095	105709	36074	0.4265
1977	23679	81877	28827	0.3410
1978	20588	69899	24617	0.3660
1979	19692	80867	17312	0.1912
1980	18581	68278	13284	0.1721
1981	17863	74412	15018	0.1446
1982	18908	70307	16789	0.2189
1983	18980	83497	22147	0.2915
1984	17796	76098	21883	0.3388
1985	19865	75622	19945	0.3059
1986	19822	74499	22875	0.3522
1987	19407	62590	19112	0.3504
1988	22926	57098	19587	0.4074
1989	20643	58610	20138	0.3203
1990	14467	51170	23183	0.4269
1991	12524	39277	33320	0.6656
1992	10327	28488	8602	0.2478
1993	12406	32774	11933	0.3229
1994	17067	31802	9226	0.2764
1995	15832	33343	11734	0.3287
1996	16765	40700	14347	0.3707
1997	16132	45209	9628	0.2647
1998	13294	45915	12507	0.2811
1999	9471	36755	19350	0.4615
2000	10217	30201	14139	0.3437
2001	14440	28406		
Average	25612	93523	26452	0.3083

3.1.7.a Norwegian spring-spawning herring

State of stock/exploitation: The stock is harvested slightly above $\mathbf{F}_{pa}$ = 0.15. The stock biomass is within safe biological limits. The recruitment of the very strong 1992 year class led to an increase in SSB in 1997 to 9 million t, but this has since declined to approximately 6.0 million t in 2001. Continued fishing under the present management agreement, and given the recruitment prospects, gives a low probability of the spawning stock falling below $\mathbf{B}_{pa}$ (5.0 million t) in the medium term.

Management objectives: EU, Faroe Islands, Iceland, Norway and Russia agreed in 1999 to implement a long-term management plan. This plan consists of the following elements:

1. Every effort shall be made to maintain a level of Spawning Stock Biomass (SSB) greater than the critical level ($\mathbf{B}_{lim}$) of 2 500 000 t.

2. For the year 2001 and subsequent years, the Parties agreed to restrict their fishing on the basis of a TAC consistent with a fishing mortality rate of less than 0.125 for appropriate age groups as defined by ICES, unless future scientific advice requires modification of this fishing mortality rate.

3. Should the SSB fall below a reference point of 5 000 000 t ($\mathbf{B}_{pa}$), the fishing mortality rate, referred under paragraph 2, shall be adapted in the light of scientific estimates of the conditions then prevailing. Such adoptions shall ensure a safe and rapid recovery of the SSB to a level in excess of 5 000 000 t.

4. The Parties shall, as appropriate, review and revise these management measures and strategies on the basis of any new advice provided by ICES.

ICES considers that the objectives of this agreement are consistent with the precautionary approach.

Precautionary Approach reference points (establised in 1998):

ICES considers that:	ICES proposes that:
$\mathbf{B}_{lim}$ is 2.5 million t	$\mathbf{B}_{pa}$ be set at 5.0 million t.
$\mathbf{F}_{lim}$ not considered relevant for this stock	$\mathbf{F}_{pa}$ be set at F = 0.15

Technical basis:

$\mathbf{B}_{lim}$: MBAL	$\mathbf{B}_{pa}$: $\mathbf{B}_{pa}$=$\mathbf{B}_{lim}$ * exp(0.4*1.645) (ICES Study Group 1998)
$\mathbf{F}_{lim}$:	$\mathbf{F}_{pa}$: ICES Study Group 1998

Advice on management: ICES advises that this fishery should be managed according to the agreed management plan corresponding to a catch of 853 000 t in 2002.

Comparison with previous assessment and advice: The present assessment is in accordance with the stock size that was estimated in 2000. The catch forecasted for 2002 is higher than was forecasted in 2000 for 2001. This is due to higher estimates of recruitment than was used earlier.

Catch forecast for 2002:

Basis: F(2001)= 0.135; Landings (2001) = TAC = 850 000 t; SSB (2002) = 5.7 million t.

F (2002 onwards)	Basis	Catch (2002)	Landings (2002)	SSB (2003)	Medium term effect of fishing at given level
0	0	0	0	7,814	Increasing spawning stock
0.05	$0.28*F_{W2000}$	351	351	7,491	Increasing spawning stock
0.08	$0.45*F_{W2000}$	548	548	7,312	Increasing spawning stock
0.1	$0.56*F_{W2000}$	689	689	7,184	Increasing spawning stock
0.125	$0.70*F_{W2000}$	853	853	7,035	Increasing spawning stock
0.15	$0.84*F_{W2000}$	1,002	1,002	6,901	Increasing spawning stock
0.2	$1.17*F_{W2000}$	1,315	1,315	6,621	Increasing spawning stock
	Stable catch of 850 000 t	850	850	7,038	Increasing spawning stock

Weights in '000 t.

For 2001 landings of 850 000 t were assumed to correspond to the agreed TAC. In recent years the actual catch was close to the TAC.

Medium- and long-term projections: The medium term view of the stock, based on simulations of stock development, is more optimistic than forecasted last year. The reason for this is an upgrade of the estimate of the 1999 year class, which will recruit to the spawning stock in 2004. Last year, the only data available for this year class was an abundance index from the 0-group survey in the Barents Sea in autumn 1999. This survey indicated a moderate to poor year class. However, the results from a Russian acoustic survey for young herring in the Barents Sea in May 2000 indicate that this is a strong year class. Thus the estimate of this year class in the medium term simulations has been adjusted accordingly, resulting in a more optimistic medium term view.

Elaboration and special comment: The main catches from the fishery in 2000 were taken by Norway (714 000 t), Iceland (186 000 t), Russia (163 000 t) and Faeroe Islands (69 000 t). Smaller catches were taken by a number of EU fleets. The fisheries in general follow closely the migration of the stock as it moves from the wintering and spawning grounds along the Norwegian coast to the summer feeding grounds in the Jan Mayen and international areas. The Norwegian fishery exploits the stock as it migrates to and remains on the wintering areas and during the spawning period. The Icelandic fishery takes place mainly in May and June and most catches are taken in the Jan Mayen EEZ. The main Russian catches are taken along the shelf region of the Norwegian EEZ in spring as the stock moves from the spawning grounds and also in August and September in the eastern part of the international area and in the Norwegian zone. The Faroese catches, taken mainly in spring and early summer, are from the Norwegian zone and from the Jan Mayen area. Most of the EU catches are taken in the international area and the Norwegian Sea.

A large increase in fishing effort, new technology and environmental changes contributed to the collapse of this stock around 1970. Recruitment failed when the SSB was reduced below 2.5 million t. In the years following the collapse the aim was to rebuild the spawning stock above this minimum limit. In order to reach this goal, fishing mortality was kept low. However, recruitment remained poor and SB increased only slowly until a very strong year class occurred in 1983. As this year class recruited, management between 1985 and 1993 aimed at restricting the fishing mortality to 0.05, although the actual F was much higher in some year. Year classes after 1983 were on average more than four times stronger than those produced between 1970 and 1982, and SSB continued to increase. Starting in 1989 a succession of above average to very strong year classes were produced, promoting full recovery of the SSB and allowing expansion of fisheries. Up to 1994, the fishery was almost entirely confined to Norwegian coastal waters. Since 1992 the coastal fishery has increased sharply. During the summer of 1994 there were also catches in the offshore areas of the Norwegian Sea for the first time in 26 years. The geographical extent of this fishery increased in 1995, with nine nations participating and a total catch exceeding 900 000 t. The fishery expanded further in 1996 and the annual level of the fishery was in the order 1.2-1.5 million t in the period 1996-2000. An international management agreement includes a TAC consistent with a maximum fishing mortality of F=0.125 from 2002.

There are indications from surveys that the 1998 and 1999 year class may be strong. This has yet to be confirmed as strong recruitment to the fishery.

Multispecies dimension: Juveniles and adults of this stock form an important part of the ecosystem in the Barents Sea and the Norwegian Sea. The herring has an important role as transformer of the plankton production to higher trophic levels (cod, seabirds and marine mammals). It is therefore important to facilitate a high production of the herring stock by allowing the stock to be kept above $\mathbf{B}_{lim}$. In the late 1950s the spawning stock was in the order of 5–10 million t.

A report based on the distribution of herring over the summer feeding areas in 2001 by an international ICES co-ordinated survey will be available in September 2001.

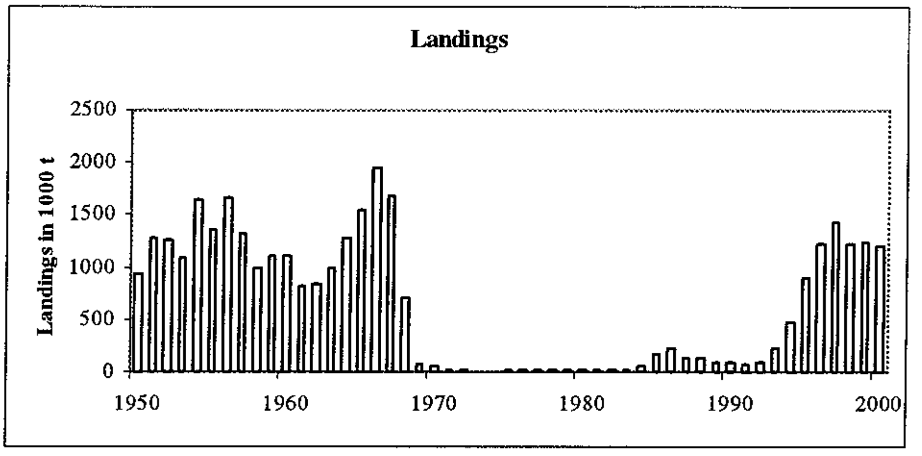
Data and assessment: Analytical assessment based on catch and survey data (acoustic estimates of adults and recruits, tagging estimates, larval index).

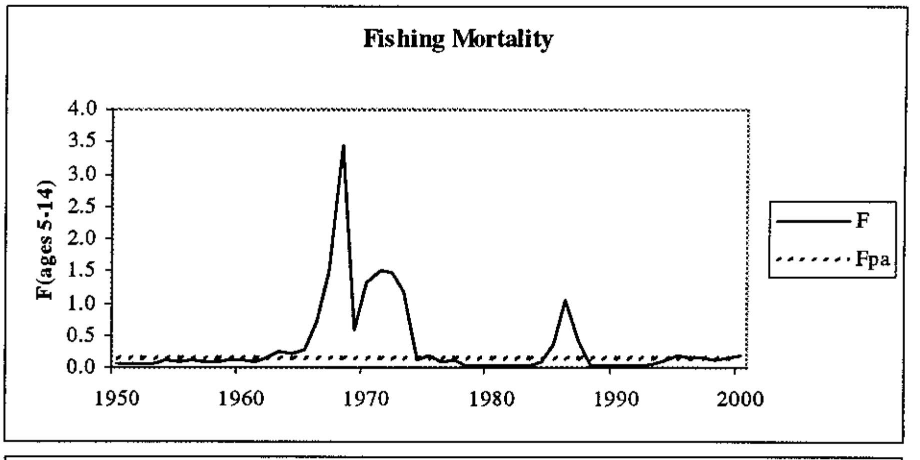
Source of information: Report of the Northern Pelagic and Blue Whiting Fisheries Working Group, April 2001 (ICES CM 2001/ACFM:17).

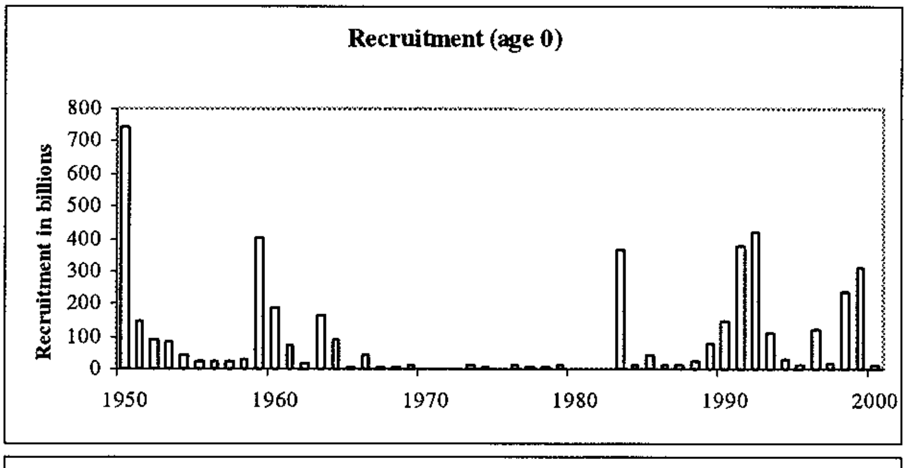
Catch data (Tables 3.1.7.a.1–3).

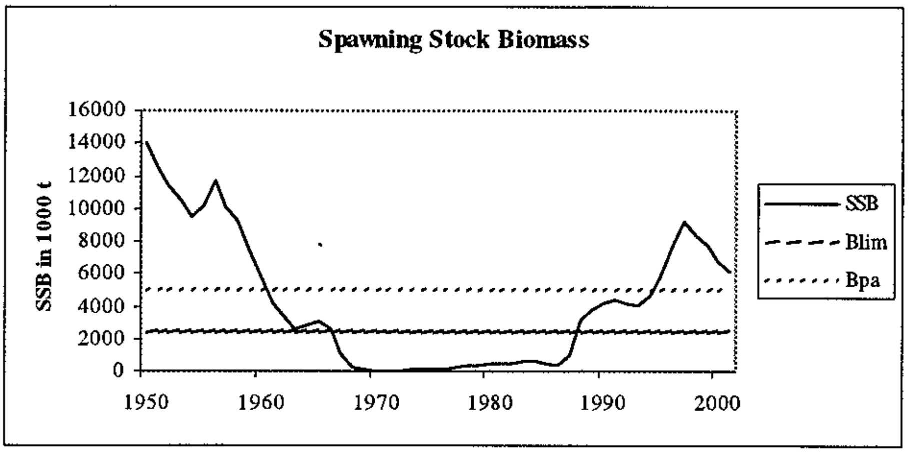
Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC	ACFM Catch
1987	TAC	150	115	127
1988	TAC	120–150	120	135
1989	TAC	100	100	104
1990	TAC	80	80	86
1991	No fishing from a biological point of view	0	76	85
1992	No fishing from a biological point of view	0	98	104
1993	No increase in F	119	200	232
1994	Gradual increase in F towards $\mathbf{F_{0.1}}$; TAC suggested	334	450	479
1995	No increase in F	513	None[1]	906
1996	Keep SSB above 2.5 million t	-	None[2]	1 217
1997	Keep SSB above 2.5 million t	-	1 500	1 420
1998	Do not exceed the harvest control rule	-	1 300	1 223
1999	Do not exceed the harvest control rule	1 263	1 300	1 235
2000	Do not exceed the harvest control rule	max 1 500	1 250	1 207
2001	Do not exceed the harvest control rule	753	850	
2002	Do not exceed the harvest control rule	853		

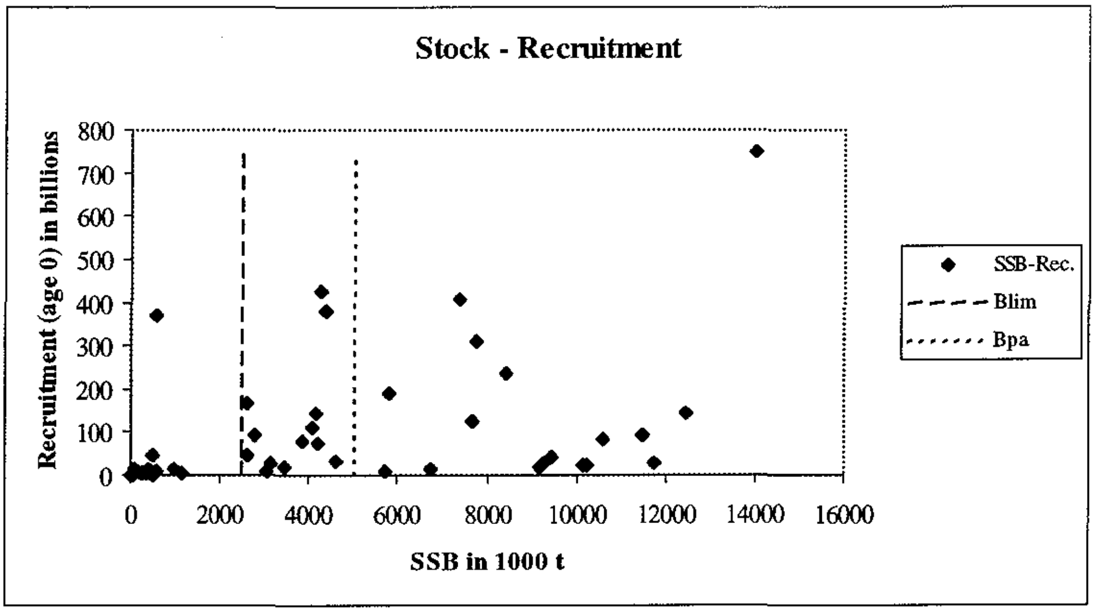
[1]Autonomous TACs totaling 900 000 t; [2]Autonomous TACs totaling 1 425 000 t were set by April 1996. Weights in '000 t.

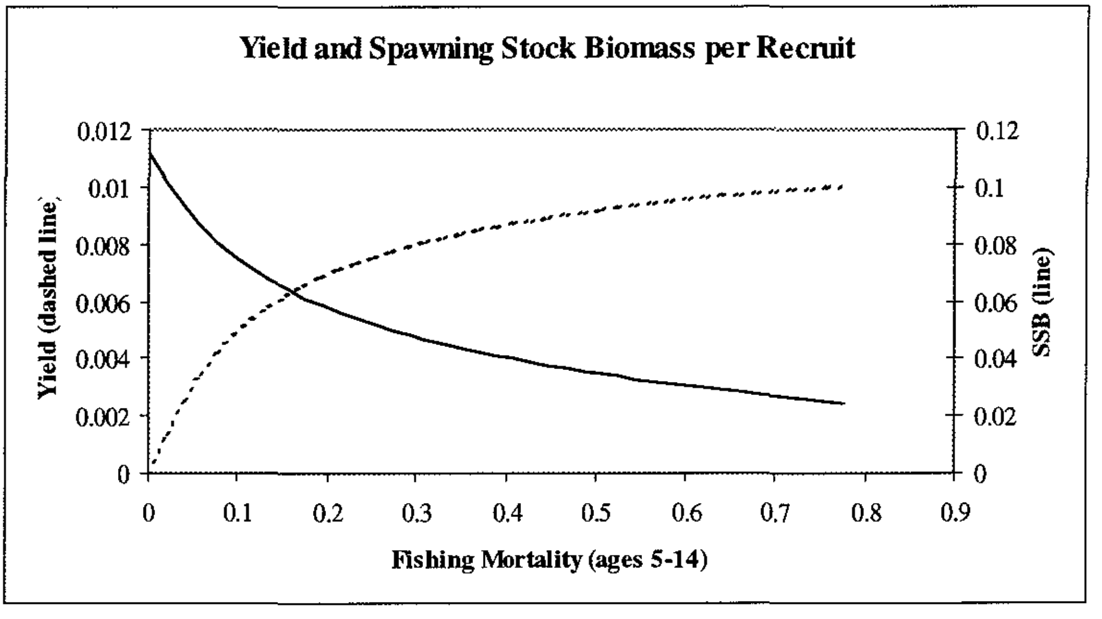

Landings
Landings in 1000 t
2500
2000
1500
1000
500
0
1950
1960
1970
1980
1990
2000


Fishing Mortality
F(ages 5-14)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1950
1960
1970
1980
1990
2000
F
Fpa


Recruitment (age 0)
Recruitment in billions
800
700
600
500
400
300
200
100
0
1950
1960
1970
1980
1990
2000


Spawning Stock Biomass
SSB in 1000 t
16000
14000
12000
10000
8000
6000
4000
2000
0
1950
1960
1970
1980
1990
2000
SSB
Blim
Bpa


Stock - Recruitment
Recruitment (age 0) in billions
SSB in 1000 t
SSB-Rec.
Blim
Bpa
0
100
200
300
400
500
600
700
800
2000
4000
6000
8000
10000
12000
14000
16000


Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
SSB (line)
Fishing Mortality (ages 5-14)
0
0.002
0.004
0.006
0.008
0.01
0.012
0.02
0.04
0.06
0.08
0.1
0.12
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9

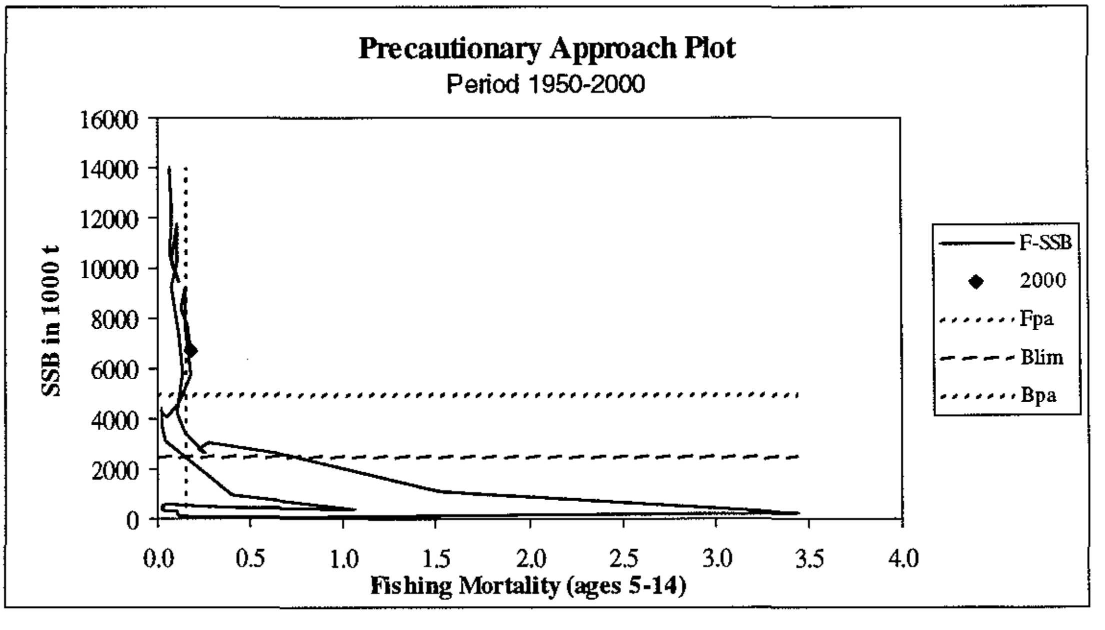

Precautionary Approach Plot
Period 1950-2000
SSB in 1000 t
Fishing Mortality (ages 5-14)
F-SSB
2000
Fpa
Blim
Bpa
0
2000
4000
6000
8000
10000
12000
14000
16000
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0

Table 3.1.7.a.1 Catches of Norwegian spring spawning herring (tonnes) since 1972.

Year	A	B[1]	C	D	Total	Total catch as used by the Working Group
1972	-	9.895	3,266[2]	-	13,161	13,161
1973	139	6,602	276	-	7,017	7,017
1974	906	6,093	620	-	7,619	7,619
1975	53	3,372	288	-	3,713	13,713
1976	-	247	189	-	436	10,436
1977	374	11,834	498	-	12,706	22,706
1978	484	9,151	189	-	9,824	19,824
1979	691	1,866	307	-	2,864	12,864
1980	878	7,634	65	-	8,577	18,577
1981	844	7,814	78	-	8,736	13,736
1982	983	10,447	225	-	11,655	16,655
1983	3,857	13,290	907	-	18,054	23,054
1984	18,730	29,463	339	-	48,532	53,532
1985	29,363	37,187	197	4,300	71,047	169,872
1986	71,122[3]	55,507	156	-	126,785	225,256
1987	62,910	49,798	181	-	112,899	127,306
1988	78,592	46,582	127	-	125,301	135,301
1989	52,003	41,770	57	-	93,830	103,830
1990	48,633	29,770	8	-	78,411	86,411
1991	48,353	31,280	50	-	79,683	84,683
1992	43,688	55,737	23	-	99,448	104,448
1993	117,195	110,212	50	-	227,457	232,457
1994	288,581	190,643	4	-	479,228	479,228
1995	320,731	581,495	0	-	902,226	902,226
1996	462,248	758,035	0	-	1,220,283	1,220,283
1997[5]			0	-	1,426,507	1,426,507
1998[6]			0	-	1,223,131	1,223,131
1999[6]			0	-	1,235,433	1,235,433
2000[7]			0	-	1,207,201	1,207,201

A = catches of adult herring in winter.
B = mixed herring fishery in remaining part of the year.
C = by-catches of 0- and 1-group herring in the sprat fishery.
D = USSR-Norway by-catch in the capelin fishery (2-group).

1 Includes also by-catches of adult herring in other fisheries.
2 In 1972, there was also a directed herring 0-group fishery.
3 Includes 26,000 t of immature herring (1983 year class) fished by USSR in the Barents Sea.
4 Preliminary, as provided by Working Group members.
5 Details of catches by fishery and ICES area given in ICES 1999.
6 Details of catches by fishery and ICES area given in ICES 2000.
7 Details of catches by fishery and ICES area given in Tables 3.2.3-3.2.5.

Table 3.1.7.a.2 Total catch of Norwegian spring spawning herring (tonnes) since 1972. Data provided by Working Group members.

Year	Norway	USSR/ Russia	Denmark	Faroes	Iceland	Ireland	Nether- lands	Greenland	UK	Germany	France	Sweden	Total
1972	13,161	-	-	-	-	-	-	-	-	-	-	-	13,161
1973	7,017	-	-	-	-	-	-	-	-	-	-	-	7,017
1974	7,619	-	-	-	-	-	-	-	-	-	-	-	7,619
1975	13,713	-	-	-	-	-	-	-	-	-	-	-	13,713
1976	10,436	-	-	-	-	-	-	-	-	-	-	-	10,436
1977	22,706	-	-	-	-	-	-	-	-	-	-	-	22,706
1978	19,824	-	-	-	-	-	-	-	-	-	-	-	19,824
1979	12,864	-	-	-	-	-	-	-	-	-	-	-	12,864
1980	18,577	-	-	-	-	-	-	-	-	-	-	-	18,577
1981	13,736	-	-	-	-	-	-	-	-	-	-	-	13,736
1982	16,655	-	-	-	-	-	-	-	-	-	-	-	16,655
1983	23,054	-	-	-	-	-	-	-	-	-	-	-	23,054
1984	53,532	-	-	-	-	-	-	-	-	-	-	-	53,532
1985	167,272	2,600	-	-	-	-	-	-	-	-	-	-	169,872
1986	199,256	26,000	-	-	-	-	-	-	-	-	-	-	225,256
1987	108,417	18,889	-	-	-	-	-	-	-	-	-	-	127,306
1988	115,076	20,225	-	-	-	-	-	-	-	-	-	-	135,301
1989	88,707	15,123	-	-	-	-	-	-	-	-	-	-	103,830
1990	74,604	11,807	-	-	-	-	-	-	-	-	-	-	86,411
1991	73,683	11,000	-	-	-	-	-	-	-	-	-	-	84,683
1992	91,111	13,337	-	-	-	-	-	-	-	-	-	-	104,448
1993	199,771	32,645	-	-	-	-	-	-	-	-	-	-	232,457
1994	380,771	74,400	-	2,911	21,146	-	-	-	-	-	-	-	479,228
1995	529,838	101,987	30,577	57,084	174,109	-	7,969	2,500	881	556	-	-	905,501
1996	699,161	119,290	60,681	52,788	164,957	19,541	19,664	-	46,131	11,978	-	22,424	1,220,283
1997	860,963	168,900	44,292	59,987	220,154	11,179	8,694	-	25,149	6,190	1,500	19,499	1,426,507
1998	743,925	124,049	35,519	68,136	197,789	2,437	12,827	-	15,978	7,003	605	14,863	1,223,131
1999	740,640	157,328	37,010	55,527	203,381	2,412	5,871	-	19,207	-	-	14,057	1,235,433
2000[1]	713,500	163,261	34,968	68,625	186,035	8,939	-	-	14,096	3,298	-	14,749	1,207,201

[1] Preliminary, as provided by Working Group members.

Table 3.1.7.a.3 Norwegian spring-spawning herring (1998-2000 year classes from survey estimates).

Year	Recruitment Age 0 thousands	SSB tonnes	Landings tonnes	Mean F Ages 5-14
1950	747374656	13984440	933000	0.058
1951	143907888	12440190	1278400	0.070
1952	93898752	11481773	1254800	0.073
1953	83577056	10613262	1090600	0.066
1954	39702936	9445040	1644500	0.112
1955	23753764	10222784	1359800	0.078
1956	27474770	11739808	1659400	0.110
1957	23650588	10128764	1319500	0.103
1958	27810502	9280374	986600	0.079
1959	405342656	7349922	1111100	0.113
1960	191338608	5817149	1101800	0.136
1961	73282680	4229869	830100	0.105
1962	17712448	3464778	848600	0.146
1963	164640160	2635414	984500	0.253
1964	90556040	2795131	1281800	0.227
1965	7932618	3067464	1547700	0.280
1966	45349292	2595274	1955000	0.700
1967	3582245	1145466	1677200	1.517
1968	4638550	219013	712200	3.450
1969	9607348	77541	67800	0.595
1970	620670	30718	62300	1.323
1971	209800	8231	21100	1.517
1972	907351	1854	13161	1.487
1973	12701698	74400	7017	1.172
1974	8500675	85341	7619	0.114
1975	2942588	91377	13713	0.190
1976	10018746	145980	10436	0.106
1977	5039343	283511	22706	0.111
1978	6133163	354752	19824	0.044
1979	12434718	385577	12864	0.024
1980	1539331	468611	18577	0.035
1981	1091881	502691	13736	0.022
1982	2329740	501560	16655	0.020
1983	369237184	572712	23054	0.029
1984	11404527	597396	53532	0.091
1985	45397528	495227	169872	0.379
1986	12069644	414411	225256	1.061
1987	14088709	990639	127306	0.399
1988	27090502	3152713	135301	0.039
1989	79019632	3870353	103830	0.025
1990	144784448	4166772	86411	0.019
1991	378655488	4369287	84683	0.021
1992	423814880	4244479	104448	0.024
1993	111677088	4076670	232457	0.055
1994	33072388	4629204	479228	0.113
1995	9297654	5733795	905501	0.185
1996	122766304	7671458	1220283	0.153
1997	19407624	9178836	1426507	0.148
1998	235115000	8423728	1223131	0.131
1999	311206000	7774226	1235433	0.158
2000	14932000	6725150	1207201	0.179
2001	0	6106000		0.000
Average	89473843	4208868	645638	0.339

3.1.7.b Answer to special request on Norwegian spring-spawning herring

Norway requested ICES to:

1. provide catch options for 2001 based on fishing mortalities in the range F=0.08 to 0.15 including F=0.125.

2. evaluate the probability that the SSB will fall below $\mathbf{B}_{pa}$ of 5,000,000 t and $\mathbf{B}_{lim}$ of 2,500,000 tonnes in a 5 and 10-year period at various levels of constant fishing mortalities while the SSB is above $\mathbf{B}_{pa}$, including values in the range of F=0.05, 0.08, 0.10, 0.125, 0.15, 0.2. From each of these combinations, ICES should evaluate the expected average percentage change in catches from year to year and the expected average catches over the same ten-year period.

3. continue to evaluate adaptive recovery strategies, including an option with linear reduction in F, in the event SSB falls below $\mathbf{B}_{pa}$ of 5 000 000 tonnes. The strategies should aim at preventing the SSB falls below $\mathbf{B}_{pa}$ of 5 000 000 t. The strategies should aim at preventing the SSB from falling below $\mathbf{B}_{lim}$ with a high probability and ensure the safe recovery of the stock to above $\mathbf{B}_{pa}$ at various time horizons.

ICES responses are given below:

1. The requested options are given in the Catch Option table.

2. **Table 3.1.7.b.1.** Average yield, probability of SSB falling below $\mathbf{B}_{pa}/\mathbf{B}_{lim}$ and average annual percentage change in catch for Norwegian spring spawning herring, 5 and 10 year periods.

		5 year				10 year			
Fishing Mortality	Catch limit	Yield	Risk of SSB below $\mathbf{B}_{lim}$	Risk of SSB below $\mathbf{B}_{pa}$	Stability (average annual percentage change in catch)	Yield	Risk of SSB below $\mathbf{B}_{lim}$	Risk of SSB below $\mathbf{B}_{pa}$	Stability (average annual percentage change in catch)
	Mill t	Mill t				Mill t			
0	1.50	0.17	0.00	0.00	25	0.08	0.00	0.00	11
0.05	1.50	0.70	0.00	0.00	18	0.74	0.00	0.00	11
0.08	1.50	0.95	0.00	0.00	14	1.01	0.00	0.02	9
0.1	1.50	1.07	0.00	0.00	15	1.12	0.00	0.03	9
0.125	1.50	1.18	0.00	0.00	17	1.21	0.00	0.07	9
0.15	1.50	1.24	0.00	0.00	19	1.26	0.00	0.10	9
0.20	1.50	1.32	0.00	0.02	19	1.34	0.00	0.13	8

3. Evaluation of adaptive recovering strategies in the event SSB falls below $\mathbf{B}_{pa}$.

Item 3) in the agreement on the long-term management of Norwegian spring-spawning herring considers management action in case the SSB falls below the agreed $\mathbf{B}_{pa}$ of 5 000 000 t. It is stated that if the SSB falls below a reference point of 5 000 000 t ($\mathbf{B}_{pa}$), the fishing mortality rate of 0.125 shall be adapted in the light of scientific estimates of the conditions then prevailing. Such adaptations shall ensure a safe and rapid recovery of the SSB to a level in excess of 5 000 000 t.

ICES previously has on several occasions evaluated consequences of adapting F in case of SSB falling below $\mathbf{B}_{pa}$. Two types of adaptive recovery strategies have been investigated:

a) Restoring SSB to above $\mathbf{B}_{pa}$ within a time constraint

A harvest control rule aiming at restoring SSB to above $\mathbf{B}_{pa}$ within a time constraint (strategies that would ensure a probability of 50 to 80% of restoring the SSB to above $\mathbf{B}_{pa}$ within 2 to 5 years) was evaluated in 2000. ICES made the following comment: "The request was regarded as relevant but it was pointed out that this type of general rebuilding approach may not be useful as a rule for stocks that show a highly variable recruitment, including the stock of Norwegian spring-spawning herring. There may be situations when the SSB is fairly low, but strong year classes are expected to recruit to the spawning stock in the near future. On the other hand there may be situations when SSB is expected to decline in the short and medium term to levels below $\mathbf{B}_{pa}$ since no strong year class has been observed among the recruiting year classes. In the latter case it may not be possible to restore the SSB to above $\mathbf{B}_{pa}$ within 2 to 5 years even if the fishery is stopped" (ICES 2001).

b) Linear reduction in F

This type of harvest control rule has been evaluated several times. Different reduction rates in F have been considered and the general conclusions can be summed up as follows: "Medium term simulations indicate that the probability of SSB falling below $\mathbf{B}_{lim}$ is almost halved when a reduction in F at SSB levels below $\mathbf{B}_{pa}$ =

5.0 million t is applied. An example of such a reduction would be to reduce F linearly to 0.05 as the SSB falls from 5.0 million t to 2.5 million t." (ICES 1999)

There are other advantages in applying a linear reduction in F in a harvest control rule in case SSB falls below $\mathbf{B_{pa}}$: "The fishery continues at a reduced level after the threshold is crossed, resulting in a continuity of yield; rather than open or close fisheries depending on the stock's position relative to $\mathbf{B_{lim}}$. At the same time, more stringent conservation measures are applied as the stock worsens; errors in the estimation of SSB become less critical; additional time and flexibility is obtained to evaluate whether the stock is in a transition phase from one stationary state to another; short term changes in biomass levels imply only small changes in F rather than permanent or large-scale changes in fishing operations; and small changes in F may be less contentious and more easily accepted than large ones". Further, NAFO has in many cases illustrated the role of a linear reduction in fishing mortality in its precautionary framework

The stock of Norwegian spring spawning herring has a highly dynamic recruitment, the development depending on the occurrence of strong year classes, whose probabilities are affected by both SSB and environmental conditions. The consequences of actions taken if SSB approaches $\mathbf{B_{pa}}$ will depend on the prospects of the recruitment of such year classes. Correspondingly, a suitable harvest control rule should allow for the possibility of a change in productivity, even if productivity regimes cannot be modelled accurately. Even in such a dynamic context, a linear reduction adapts the exploitation rate to the abundance of the spawning stock, and is regarded by ICES as an appropriate strategy which significantly lowers the risk for the spawning stock to come below $\mathbf{B_{lim}}$. This type of harvest control rule will in addition have some practical elements such as the continuation of fisheries even if the $\mathbf{B_{pa}}$ is crossed.

4. Medium-term projections with adaptation of F when SSB is below $\mathbf{B_{pa}}$

Medium term simulations were run with a linear reduction in F when SSB is below $\mathbf{B_{pa}}$, from F=0.125 (or other relevant levels) at $\mathbf{B_{pa}}$, to F=0.05 at $\mathbf{B_{lim}}$ and lower. In accordance with the evaluation given in the section above this type of adaptation will reduce the probability of falling below $\mathbf{B_{lim}}$ in the medium term to almost half the probability when not adapting the F when SSB is below $\mathbf{B_{pa}}$.

The projections that have been carried out are described in the table below:

Parameter	**Request from coastal states**	**Technical performance values**
Fishing mortality for SSB above $\mathbf{B_{pa}}$	0.05, 0.08, 0.10, 0.125, 0.15, 0.2	As requested; in addition a projection with no fishing (F=0) was run for illustrative purposes
Catch ceiling	None	1.5 million t. One run with catch ceiling of 850 000 t, the level of the TAC for 2001.
Value of $\mathbf{B_{pa}}$	5.0 million t	As requested
Value of $\mathbf{B_{lim}}$	2.5 million t	As requested
Time range	5 and 10 years	As requested
Fishing mortality for F below $\mathbf{B_{pa}}$	Evaluate adaptive recovery strategies, including an option with linear reduction in F, in the event SSB falls below $\mathbf{B_{pa}}$. The strategies should aim at preventing the SSB from falling below $\mathbf{B_{lim}}$ with a high probability and ensure recovery to above $\mathbf{B_{pa}}$ at various time horizons.	Linear decrease in F from 0.125 at $\mathbf{B_{pa}}$ to 0.05 at $\mathbf{B_{lim}}$ (Section 3.9) (similar decreases were also made with other requested F's (0.05, 0.08, 0.10, 0.15, 0.2)).
Measure of stability of catches	Average percentage change in catches from year to year	As requested
Yield	Average catches over the same ten year period	Average annual yield (tonnes) of the time range for the simulation run (5 or 10 years).
Risk	Probability that SSB will fall below $\mathbf{B_{pa}}$ and $\mathbf{B_{lim}}$ in a 5 and 10 year period	As requested, risk to fall below $\mathbf{B_{pa}}$ and $\mathbf{B_{lim}}$ within the time range for the simulation run (5 or 10 years).

It should be noted that, this year, the uncertainty in the initial stock is smaller than compared with last year. A constraint of 1000 billion 0-group fish was enforced, as was done last year. The Beverton-Holt recruitment model was used also this year with the modification that the largest year classes were treated separately. Figure 1 shows the spawning-stock recruitment points used together with the Beverton-Holt function fitted on these points with the largest year classes excluded. Russian data show (that good recruitment is associated with good egg production. Including egg production into the recruitment function gives some promise for explaining more of the observed variation.

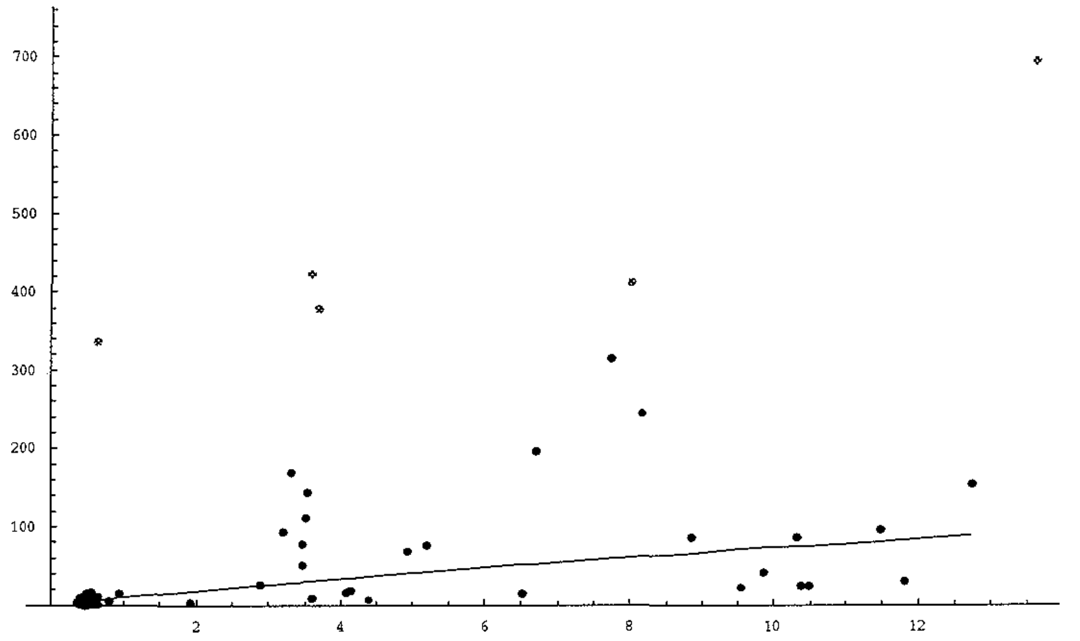


Figure 3.1.7.b.1 Spawning stock - recruitment points (million tonnes – billion) for Norwegian spring spawning herring based on Run 1 and the SeaStar VPA (F at oldest true age is calculated as a population weighted average of F for ages 8-13). The line shows a fitted Beverton-Holt relation based on the 90% smallest recruitment values (shown in black).

The projections started at January 1 2001 and the allocated catch for 2001 of 850 000 t was enforced for all simulations. The F-value by age applied during the simulation was obtained from the F-value in the harvest control rule and the exploitation pattern used last year.

500 simulations were performed for each harvest control rule. For various harvest control rule parameters, the average yields and probabilities for the SSB to fall below $\mathbf{B}_{pa}$ and $\mathbf{B}_{lim}$ for the 5-year period 2001-2005 and 10-year period 2002-2011 are given in Table 3.7.1.b.1 (see above). The average percentage change in annual catch over the 10-year period is also given. The medium term simulations give a more positive picture of the stock development compared to last year's results. The main reason for this is the high estimate (more than 100 billion individuals) of the 1999 year class obtained in the acoustic surveys in the Barents Sea in May 2000. However, as the estimates of this year class from different surveys is conflicting, the uncertainty associated with its abundance may be greater than expressed by the formal statistical estimate. Therefore the results should be interpreted with caution.

According to the table the following conclusions can be drawn:

1. Continued fishing at F=0.125 (international agreed maximum fishing mortality) and a reduction in F when SSB is below $\mathbf{B}_{pa}$ and a catch ceiling of 1.5 million t, gives a low probability (7%) of the stock falling below $\mathbf{B}_{pa}$ in the medium-term (10 years). This harvesting strategy results in a 9% average annual change in the TAC.

2. The medium term simulations give no reasons to reject the conclusions that the present agreed long time strategy for this stock is in accordance with the precautionary approach in fisheries.

Figures 3.7.1.b.2 and 3.7.1.b.3 show the development of SSB and yield for F=0.125 above $\mathbf{B}_{pa}$ =5.0 million t with a linear reduction to F=0.05 at $\mathbf{B}_{lim}$= 2.5 million t and a catch ceiling of 1.5 million t. 5, 25, 50, 75 and 95 percentiles are given to illustrate the uncertainty in the prognosis. The spawning stock rises to above 10 million t when the 1998 and 1999 year classes mature. The impression is that the harvest control rule corresponds to rational harvesting and stabilization of the stock above $\mathbf{B}_{pa}$.

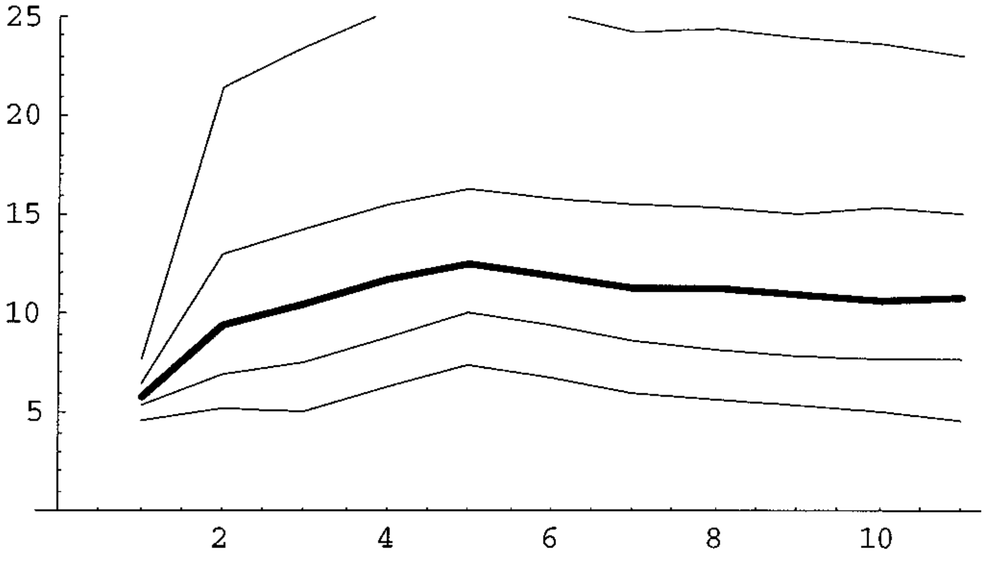


Figure 3.1.7.b.2 10-year stochastic projections of spawning stock biomass (million tonnes) of Norwegian spring spawning herring for F = 0.125 above $\mathbf{B}_{pa}$ = 5.0 million t with a linear reduction to F=0.05 at $\mathbf{B}_{lim}$= 2.5 million t and a catch ceiling of 1.5 million t. 5, 25, 50, 75 and 95 percentiles are given to illustrate the uncertainty in the prognosis.

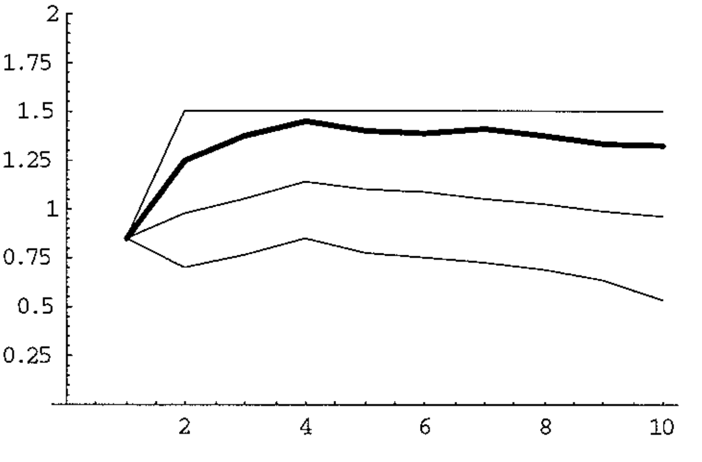


Figure.3.1.7.b.3 10-year stochastic projections of catch (million tonnes) of Norwegian spring spawning herring for F = 0.125 above $\mathbf{B}_{pa}$ = 5.0 million t with a linear reduction to F=0.05 at $\mathbf{B}_{lim}$= 2.5 million t and a catch ceiling of 1.5 million t. 5, 25, 50, 75 and 95 percentiles are given to illustrate the uncertainty in the prognosis.

3. Management considerations

The juveniles and adults of this stock form a central component of the ecosystem in the Barents Sea and Norwegian Seas, respectively. The herring has an important role as a transformer of the production of zooplankton biomass and energy to a form that is available to organisms at a higher level of the food chain.

The Coastal states (the European Union, Faeroe Islands, Iceland, Norway and Russia) have agreed on a long-term management plan and on precautionary reference point ($\mathbf{B}_{pa}$ = 5.0 million t) and limit reference point ($\mathbf{B}_{lim}$ = 2.5 million t) for this stock. The limit reference point (2.5 million t) is seen as a spawning stock threshold that, if crossed, can result in a high probability of impaired recruitment, and the $\mathbf{B}_{pa}$ as a safeguard measure.

A study on the population fecundity of the Norwegian spring-spawning stock that compared corresponding year classes and environmental factors concluded:

1. When the spawning stock level is at or above 6.9 million t the probability of resulting weak year classes is low.

2. When the spawning stock is above 3.4 million t, its reproductive success seems to be strongly influenced by environmental variability. In other words, strong year classes will likely be produced under favourable survival conditions,

3. medium year classes under average conditions and only poor year classes when survival conditions are unfavourable. In the 7-year period (1990-1996), when the SSB has been above the level of 3.4 million t, 2 strong, 3 medium and only 2 low abundance year classes of herring at age 3 appeared.

4. As the spawning stock drops below 3.4 million t, the probability of producing poor year classes increases. For a 27-year period (1963-1989), when the SSB was below 3.4 million t, 23 poor, 2 medium and only 1 abundant year class appeared.

5. If the SSB drops to or below 0.3 million t the probability of the appearance of a strong year class is extremely low.

The current stock assessment indicates a spawning stock in 2001of approximately 6 million t, stock abundance having declined from 9 million t since 1997. The future prospects indicate an increasing spawning stock if the stock is exploited at the agreed fishing mortality (F=0.125). However, this positive view is based on expectation of a strong 1999 year class from the Barents Sea. The survey series from this area gives different indications of the size of this year class and the estimate is uncertain.

3.1.8 Barents Sea capelin (Sub-areas I and II, excluding Division IIa west of 5°W)

State of stock/exploitation: The stock is within safe biological limits. The maturing component in autumn 2001 was estimated to be 2.0 million t, and is predicted to be 1.2 million t at the time of spawning in 2002 without fishing. This is above $\mathbf{B_{lim}}$ with a very high probability.

Management objectives: The fishery is managed according to a target escapement strategy, with a harvest control rule allowing (with 95% probability) the SSB to be above $\mathbf{B_{lim}}$, taking account of predation by cod.

Precautionary Approach reference points (established in 1998):

ICES considers that:	ICES proposes that:
$\mathbf{B_{lim}}$ is set equal to 200 000 t, which is above the SSB_{1989}, the lowest SSB that has produced a good year class.	$\mathbf{B_{pa}}$ not defined (not relevant).
$\mathbf{F_{lim}}$ not defined (not relevant).	$\mathbf{F_{pa}}$ not defined (not relevant).

Advice on management: In order for the SSB to stay above $\mathbf{B_{lim}}$ with more than 95% probability, the catch in 2002 should be less than 650 000 t. ICES further recommends that the fishery should be directed on the spawning stock in the period January-April.

Relevant factors to be considered in management: The estimated annual consumption of capelin by cod has varied between 0.2 and 3.0 million t over the period 1984-2000. Young herring consume capelin larvae, and this predation pressure is thought to be one of the causes for the poor year classes of capelin in the periods 1984–1987 and in 1992–1994. The quantity of young herring in the Barents Sea during 1999-2001 has again increased towards the same level as in those two periods of poor capelin recruitment. The 1999 year class of herring has been estimated to be above average, while the 2000 and 2001 year classes of herring seem to be poor. The abundance of herring in the Barents Sea is believed to decrease again from an intermediate level in 2001 to a low level in 2002.

For this stock, a $\mathbf{B_{lim}}$ equal to the 1989 spawning stock biomass, which is the lowest SSB having produced an outstanding year class, is considered a good basis for such a reference point in a non-herring situation. Such a situation is expected in 2002. The median value of the 1989 spawning stock biomass is 69 000 t. However, the assessment model may not yet account for all sources of uncertainty, and there are inconsistencies in the data series. Thus, it may be appropriate to use a somewhat higher $\mathbf{B_{lim}}$. In recent years ICES has used a $\mathbf{B_{lim}}$ of 200 000 t.

The $\mathbf{B_{lim}}$ rule is intended to be a safeguard against recruitment failure. However, it is possible that the recruitment would be larger at a larger spawning stock, especially for moderately good recruitment conditions. In such a situation a target-based control rule in addition to the $\mathbf{B_{lim}}$-based rule could be appropriate. The negative influence of herring on capelin recruitment should be included in the $\mathbf{B_{lim}}$-based rule if such a relationship can be described quantitatively. Adjustments of the harvest control rule should be investigated further to take the uncertainty in the predicted amount of spawners and the role of capelin as a prey item into account.

Catch forecast for 2002: The spawning stock in 2002 is predicted from the acoustic survey in September 2001, by a model, which estimates maturity, growth and mortality (including predation by cod). The model takes account of uncertainties both in the survey estimate and in other input data. For catches in 2002 below 650 000 t, the probability of having an SSB below 200 000 t is less than 5% and the expected amount left for spawning is 620 000 t. Only catches of mature fish have been considered. The proportion of large fish (suitable for human consumption) in the spawning stock is similar to the three previous years, but high compared to most years in the time series.

Elaboration and special comments: The spawning stock in 2002 will consist almost exclusively of fish from the 1998 and 1999 year classes. The survey estimate at age 1 of the 2000 year class is the lowest since the 1996 year class, and is below the long-term average. Observations during the international 0-group survey in August 2001 indicated that the 2001 year class is weaker than the 1997-2000 year classes. The stock size is thus expected to decrease in the next two years.

Since 1979 the fishery has been regulated by a bilateral agreement between Norway and Russia (formerly USSR). The catches have been very close to the advice in all years since 1987.

The assessment and stock history is based on joint Russian-Norwegian acoustic surveys during September each year. From 1998 onwards, a model incorporating predation from cod has been used for predicting SSB and for estimating the historical time series of SSB.

Source of information: Report from the 2001 joint Russian-Norwegian meeting to assess the Barents Sea capelin stock, Vadsø, October 5-7, 2001.

Report of the Northern Pelagic and Blue Whiting Fisheries Working Group, April 2001 (ICES CM 2001/ACFM:17).

Catch data (Tables 3.1.8.1–3):

Year	ICES Advice	Recommended TAC	Agreed TAC	ACFM catch
1987	Catches at lowest practical level	0	0	0
1988	No catch	0	0	0
1989	No catch	0	0	0
1990	No catch	0	0	0
1991	TAC	1000[1]	900	933
1992	SSB > 4–500,000 t	834	1100	1123
1993	A cautious approach, SSB > 4–500,000 t	600	630	586
1994	No fishing	0	0	0
1995	No fishing	0	0	0
1996	No fishing	0	0	0
1997	No fishing	0	0	1
1998	No fishing	0	0	1
1999	SSB> 500,000 t	79[1]	80	106
2000	5% probability of SSB< 200,000 t	435[1]	435	406
2001	5% probability of SSB< 200,000 t	630[1]	630	559
2002	5% probability of SSB< 200,000 t	650[1]		

[1]Winter-spring fishery.
Weights in '000 t.

Barents Sea capelin (Sub-areas I & II, excl. IIa west of 5°W)

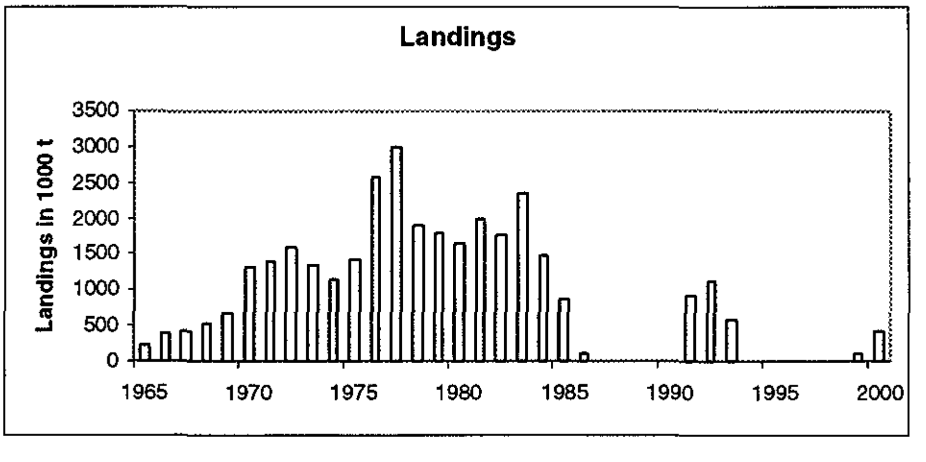


Table 3.1.8.1 Barents Sea CAPELIN. International catch ('000 t) as used by the Working Group.

Year	Winter				Summer-Autumn			Total
	Norway	Russia	Others	Total	Norway	Russia	Total	
1965	217	7	0	224	0	0	0	224
1966	380	9	0	389	0	0	0	389
1967	403	6	0	409	0	0	0	409
1968	460	15	0	475	62	0	62	537
1969	436	1	0	437	243	0	243	680
1970	955	8	0	963	346	5	351	1314
1971	1300	14	0	1314	71	7	78	1392
1972	1208	24	0	1232	347	13	360	1592
1973	1078	34	0	1111	213	12	225	1336
1974	749	63	0	812	237	99	336	1149
1975	559	301	43	903	407	131	538	1440
1976	1252	228	0	1480	739	368	1107	2587
1977	1441	317	2	1760	722	504	1227	2987
1978	784	429	25	1237	360	318	678	1915
1979	539	342	5	886	570	326	896	1783
1980	539	253	9	801	459	388	847	1648
1981	784	429	28	1240	454	292	746	1986
1982	568	260	5	833	591	336	927	1760
1983	751	373	36	1161	758	439	1197	2358
1984	330	257	42	629	481	368	849	1478
1985	340	234	17	590	113	164	278	868
1986	72	51	0	123	0	0	0	123
1987	0	0	0	0	0	0	0	0
1988	0	0	0	0	0	0	0	0
1989	0	0	0	0	0	0	0	0
1990	0	0	0	0	0	0	0	0
1991	528	159	20	707	31	195	226	933
1992	620	247	24	891	73	159	232	1123
1993	402	170	14	586	0	0	0	586
1994	0	0	0	0	0	0	0	0
1995	0	0	0	0	0	0	0	0
1996	0	0	0	0	0	0	0	0
1997	0	0	0	0	0	1	1	1
1998	0	0	0	0	0	1	1	1
1999	50	33	0	83	0	23	23	106
2000	283	95	0	378	0	28	28	406
2001*	367	192	0	559				

* Preliminary values.

Table 3.1.8.2 Barents Sea CAPELIN. Stock summary. Recruitment and total biomass are survey estimates back-calculated to 1 August (before the autumn fishing season). Maturing biomass is the survey estimate of fish above maturity length (14.0 cm). SSB is the median value of the modeled stochastic spawning stock biomass (after the winter/spring fishery). Biomass are in '000 t.

Year	Stock biomass August 1	Maturing biomass survey Oct. 1	Recruit-ment Age 1, August 1	Spawning stock biomass, assessment model	Landings	Herring biomass age 1 and 2
1965					224	
1966					389	
1967					409	
1968					537	
1969					680	
1970					1314	
1971					1392	
1972	5831	2182			1592	
1973	6630	1350	1140	137	1336	5
1974	7121	907	737	*	1149	160
1975	8841	2916	494	*	1439	280
1976	7584	3200	433	444	2587	153
1977	6254	2676	830	199	2987	162
1978	6119	1402	855	187	1916	199
1979	6576	1227	551	*	1783	143
1980	8219	3913	592	*	1648	233
1981	4489	1551	466	1216	1986	184
1982	4205	1591	611	602	1760	32
1983	4772	1329	612	*	2358	40
1984	3303	1208	183	*	1477	1598
1985	1087	285	47	*	868	1629
1986	157	65	9	*	123	483
1987	107	17	46	*	0	456
1988	361	200	22	*	0	334
1989	771	175	195	69	0	452
1990	4901	2617	708	114	0	737
1991	6647	2248	415	879	929	1456
1992	5371	2228	396	145	1123	2417
1993	991	330	3	*	586	3808
1994	259	94	30	27	0	2539
1995	189	118	8	*	0	777
1996	467	248	89	28	0	260
1997	866	312	112	83	1	727
1998	1860	931	188	92	1	924
1999	2580	1718	171	370	106	1457
2000	3840	2099	475	610[1]	406	2974
2001	3480	2019	128	383[2]	559	1723
Average	3796	1372	364		909	908

[1)] Vanishing spawning stocks.

[2)] Provisional calculations.

Table 3.1.8.3 Barents Sea CAPELIN. Larval abundance estimate (10^{12}) in June, and 0-group index in August.

Year	Larval abundance	0-group index
1981	9.7	570
1982	9.9	393
1983	9.9	589
1984	8.2	320
1985	8.6	110
1986	-	125
1987	0.3	55
1988	0.3	187
1989	7.3	1300
1990	13.0	324
1991	3.0	241
1992	7.3	26
1993	3.3	43
1994	0.1	58
1995	0.0	43
1996	2.4	291
1997	6.9[1]	522
1998	14.1[1]	428
1999	36.5[1]	722
2000	19.1[1]	303
2001	10.7[1]	221

[1]Is probably an underestimate, since the vessel was not allowed to work in Russian EEZ.

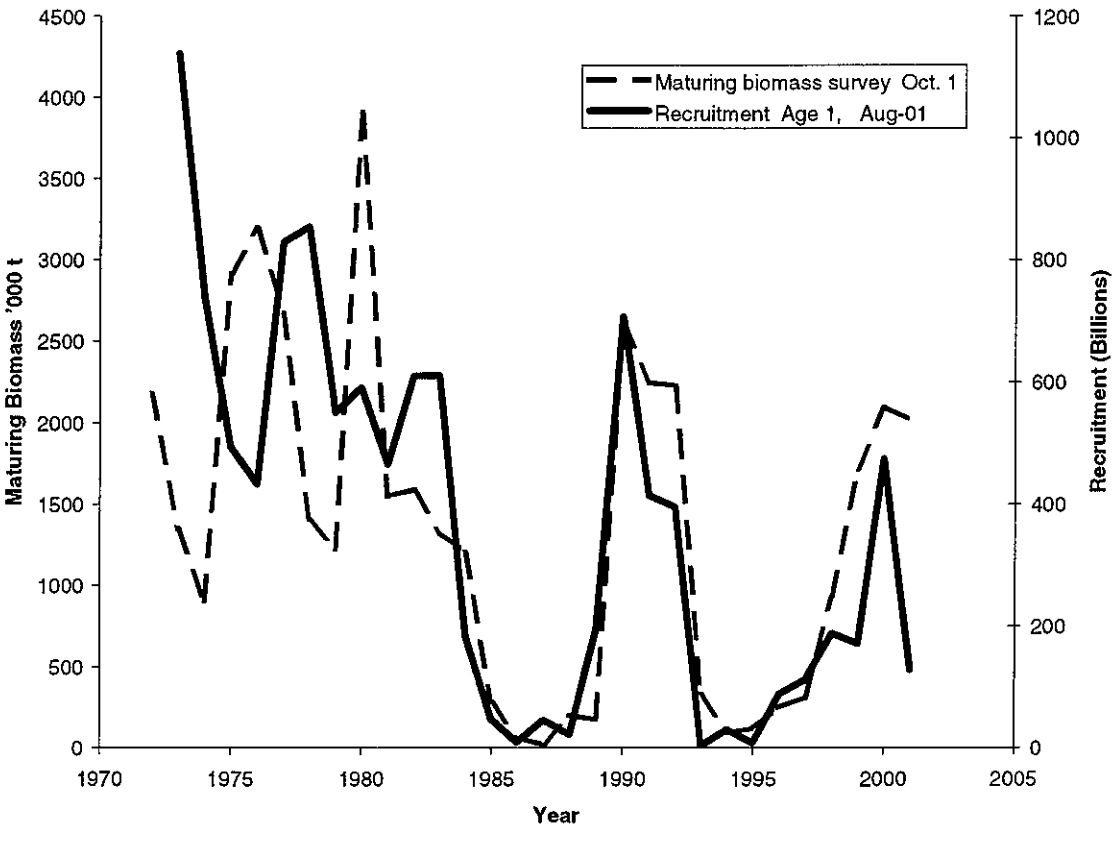


Figure 3.1.8.1 Maturing biomass and recruitment.

3.1.9 Shrimp (*Pandalus borealis*)

State of stock/exploitation: This stock is probably within safe biological limits. Surveys indicate that the biomass is close to the 1985–2000 average (Figure 3.1.9.1). No estimates of fishing mortality are available. Fishing effort for both Russia and Norway generally declined during the 1990s, but has increased in the most recent years and is also associated with an increase in efficiency through the use of multi-trawl fishing gears.

Management objectives: There are no explicit management objectives for this stock.

Reference points: No precautionary reference points have been proposed for this stock.

Advice on management: ICES advises that current catch rates are sustainable.

Relevant factors to be considered in management: Shrimp is an important prey for several fish species, especially cod. Consumption by cod significantly influences shrimp population dynamics and should be taken into account in management. Cod consumption estimates are on average much higher than shrimp landings (Figures 3.1.9.3 and 3.1.9.4). The biomass of shrimp consumed by cod increased in 2000 and is expected to contribute to a reduction of the shrimp stock biomass in 2001. However, survey indices since 1985 indicate that the shrimp biomass has varied cyclically without trend over that period.

Elaboration and special comment: Reported landings for all countries show a substantial increase in catches between 1996 (33 000 t) and 2000 (79 000 t) (Table 3.1.9.1 and Figure 3.1.9.4). Catch increases from 1994–1999 encouraged the fishery to invest in larger vessels and new technology. The adoption of multiple trawl gears, predominantly by Norway, is not accounted for in the Norwegian CPUE series (Figure 3.1.9.2).

In the Svalbard area the shrimp fisheries are regulated by number of effective fishing days and number of vessels by country. In the Barents Sea and Svalbard area, Norwegian rules stipulate that the fisheries are to be regulated by smallest allowable shrimp size (a maximum 10% of the catch weight may consist of shrimp less than 15 mm carapace length, CL) and by provisions of the fishing licenses. The Russian Economic Zone TAC is established each year by Russian authorities. In the Barents Sea and the Svalbard area fishing grounds are closed if by-catch limits for cod, haddock, redfish or Greenland halibut are exceeded.

No analytical assessment is available. Commercial CPUE series and survey series are considered to be of reasonable quality, although in the future account will have to taken of efficiency increases due to the use of multi-rig trawls.

Source of information: Report of the Arctic Fisheries Working Group, May 2001 (ICES CM 2001/ACFM:19).

Northern prawn (Pandalus borealis)

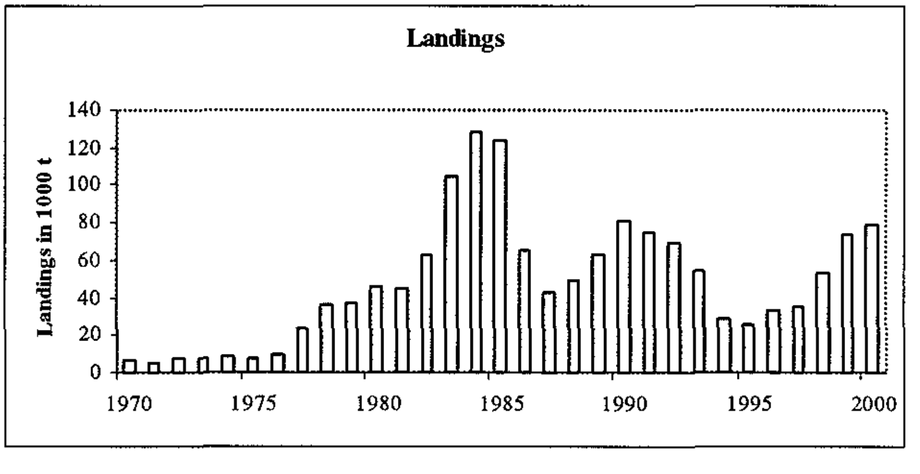


Table 3.1.9.1 Nominal shrimp catches (t) by country (Sub-areas I and II combined). Data provided by ICES and Working Group members.

Year	Norway	Russia	Others	Total
1970	5,508	0	0	6,000
1971	5,116	0	0	5,000
1972	6,772	0	0	7,000
1973	6,921	0	0	7,000
1974	8,008	992	0	9,000
1975	8,197	0	2	8,000
1976	9,752	548	0	10,000
1977	6,780	12,774	4,854	24,000
1978	20,484	15,859	0	36,000
1979	25,435	10,864	390	37,000
1980	35,061	11,219	0	46,000
1981	32,713	10,897	1,011	45,000
1982	43,451	15,552	3,835	63,000
1983	70,798	29,105	4,903	105,000
1984	76,636	43,180	8,246	128,000
1985	82.123	32,104	10,262	124,000
1986	48,569	10,216	6,538	65,000
1987	31,353	6,690	5,324	43,000
1988	32,021	12,320	4,348	49,000
1989	47,064	12,252	3,432	63,000
1990	54,182	20,295	6,687	81,000
1991	39,272	29,400	6,156	75,000
1992	39,603	20,900	8,021	69,000
1993	33,109	21,290	806	55,000
1994	20,116	8,110	1,063	29,000
1995	19,300	4,300	2,319	26,000
1996	25,000	5,731	1,998	33,000
1997	28,900	2,500	3,412	35,000
1998	43,950	4,895	4,197[1]	53,042
1999	53,197	10,765	9,615[2]	73,577
2000	54,574	19,462	5,003[3]	79,039

[1] catches reported by Faroe Island, Iceland, Portugal, Spain and UK(Eng.Wal.NI).
[2] catches reported by Faroe Islands, Germany, Greenland, Iceland, Portugal and UK(Eng.Wal.NI).
[3] catches reported by Estonia, Lithuania, Portugal, Spain and UK.

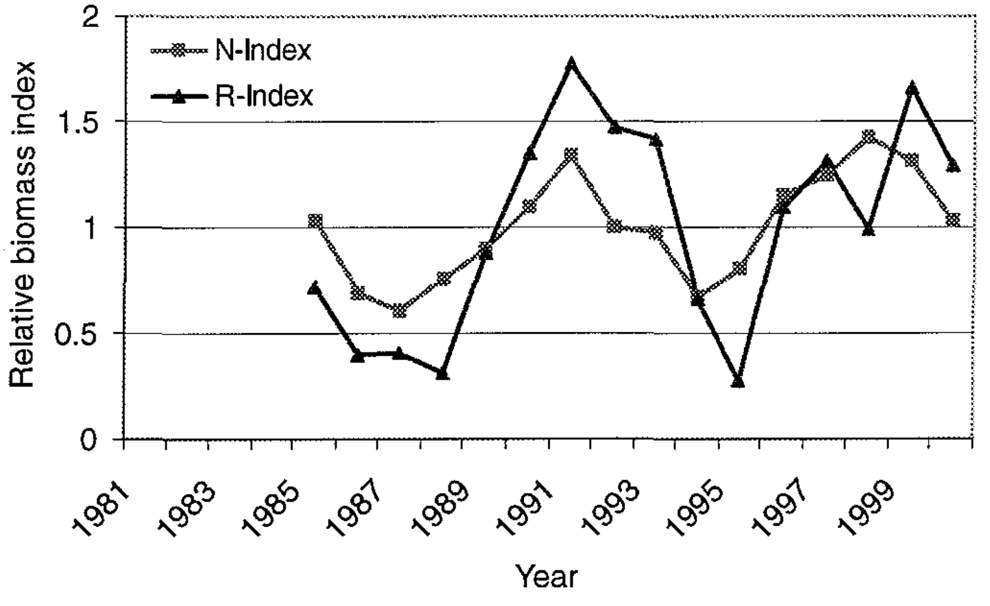


Figure 3.1.9.1 Shrimp biomass indices, from Norwegian and Russian surveys, scaled to the long-term mean (1985–2000).

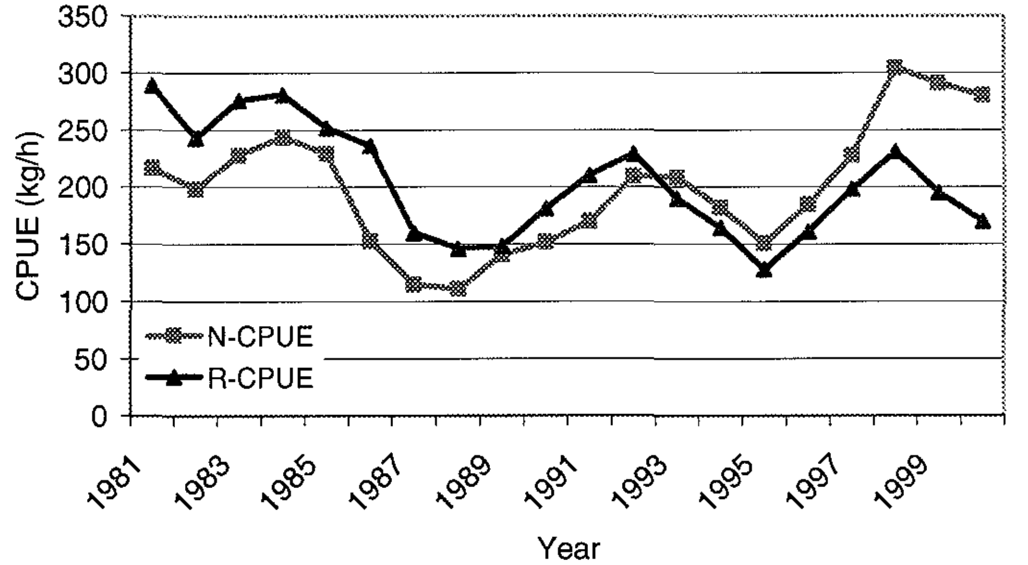


Figure 3.1.9.2 Shrimp CPUE indices for Norway and Russia (vessels < 1300hp) (Sub-areas I and II).

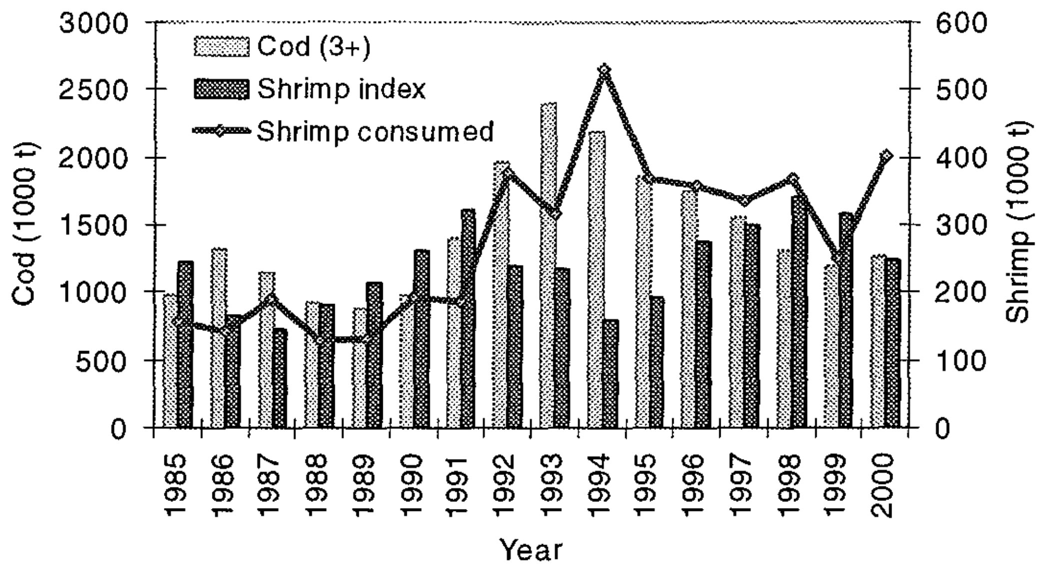


Figure 3.1.9.3 Biomass indices from the Norwegian surveys, biomass estimate for cod (age 3 years and older) and the shrimp consumed by the cod in the Barents Sea.

3.2 Stocks in North-Western Areas (Division Va and Sub-areas XII and XIV)

3.2.1 Overview

The fisheries

Stocks in the north-western areas have been exploited mainly by Icelandic vessels since the mid-seventies. However, vessels of other nationalities have also been operating in Sub-areas XII and XIV during this period. In the most recent years freezer and factory trawlers of various nationalities have been increasing in number in the pelagic deep-water fishery on redfish in Sub-areas XII and XIV. Norwegian vessels have also taken part in the capelin fishery, mainly in the Jan Mayen area.

The fisheries for the main pelagic species, Icelandic summer-spawning herring and capelin in the Iceland-East Greenland-Jan Mayen area, are almost exclusively carried out by purse seiners, although in recent years catches of herring by pelagic trawls have increased. The demersal species are mainly exploited by stern trawlers but considerable fisheries for cod are also carried out by gill nets, longline and handline. In general, effort is considered to be increasing or to have stabilised at high levels in recent years. Exceptions to this include the, herring and capelin, where harvest control rules have been implemented. Fisheries in these areas use the most up-to-date equipment both for navigation and in fish-detection. More effective fishing gears have been introduced in the fisheries, not least pelagic trawls but there have also been substantial improvements of other gears such as bottom trawl, longline and handline. New fishing technology permits fishing deeper with pelagic trawls.

Management measures

The demersal fisheries have been managed by TACs since 1984 and the pelagic fisheries since the seventies (except of pelagic redfish, which have been regulated since 1989). Fisheries in these areas are managed on a transferable quota system basis considered to lead to economic benefits in the long term. Each vessel (or factory) is allocated a proportion of the TAC of a fish stock and this proportion can be traded on a free-market. All fisheries are subject to a range of other management measures such as fishing gear regulations, closed areas and closed seasons. Efforts have been made to prohibit discards through the introduction of a minimum catching size instead of a minimum landing size. These measures, however, are partly counterbalanced by other constraints on the fisheries such as quotas.

The state of stocks

The fish stocks considered in this report include the largest stocks in these areas capelin, cod and redfish. These and other species spawn in the warmer regions of Atlantic water but they differ substantially in their distribution patterns during other periods of their life cycle. Greenland halibut and deep-sea *Sebastes mentella* are the only demersal deep-water species among the stocks considered. Saithe is migratory and migrations between Norway and Iceland have been observed. Pelagic redfish (both pelagic deep-sea and oceanic *Sebastes mentella*) constitute a vast resource although increasing effort is directed towards it. A number of other demersal commercial stocks inhabit both the continental shelf, e.g. flatfish species, and deeper waters, e.g. ling, blue ling and tusk. Most of these stocks are not regulated by TACs.

Most of the largest stocks have been at low levels during the most recent decades. Only deep-sea *S. mentella* on the shelf seem to rebuild slowly. The capelin stock is considered to be at a relatively high level of stock biomass. The Greenland halibut stock has been declining for more than a decade but seems now to have stabilised at a low level and starting to rebuild slowly. Both saithe and haddock are considered to be at a low level. The Icelandic summer-spawning herring has been increasing steadily during the last two decades and is at a higher level of stock size than observed in previous periods. Further information on the demersal stocks at Greenland and Iceland are given in a later section of this overview.

Other issues

The resources in the area have generally been managed on the basis of fairly long and detailed time series of data. There are well known difficulties with the assessments, for example age readings of slow growing species such as redfish and Greenland halibut. The problems are the same in these areas as elsewhere. Greenland halibut, pelagic redfish stocks in the Irminger Sea (Sub-areas XII and XIV) and deep-sea *S. mentella* on the shelf (Sub-areas V, XII and XIV) are the stocks with the most apparent need for improvements in data analysis and in the gathering of auxiliary information. Such auxiliary information required is trawl abundance or acoustic stock indices. Comprehensive assessment of these large and widely distributed stocks is a challenging task, which requires full scale international cooperation.

Interaction between commercially valuable species is frequently observed but appears to be most pronounced for few species. The most important predator-prey relationships are the cod-capelin and cod-*Pandalus* interactions. Cod growth depends of capelin abundance and cod predation influences the recruitment of *Pandalus*. The high abundance of deep-water *Pandalus* in Icelandic waters in recent years is considered to be a result of this interaction caused by the low of the cod stock. Baleen whales have not been harvested commercially for some time and a continued increase in the abundance of cetaceans is likely to result in increased natural mortality on stocks such as cod in Division Va.

Demersal stocks at Greenland and Iceland

The cod at Greenland and Iceland has four components spawning in different areas: A West Greenland offshore component spawning off South-west Greenland (now virtually non-existing), an inshore component found in various West Greenland fjords, a component spawning off East Greenland and a component spawning off Iceland. Eggs and larvae from the East Greenland-Iceland components are carried by the Irminger current to West Greenland. The inflow of larvae varies from year to year but for some year classes, such as those of 1973 and 1984, this $\mathbf{F}_{low}$ was very important.

Emigration of mature offshore cod from West Greenland is well known and most evident for year classes which were earlier observed as 0-group drifting from Iceland to Greenland.

The fishery off West Greenland has traditionally consisted of an offshore trawl fishery and an inshore fishery mostly using poundnets. The catches have fluctuated substantially, but declined dramatically after 1989 and the offshore fishery has now ceased.

Cod catches off East Greenland have also fluctuated widely and decreased sharply in 1993 when the directed cod fishery failed totally due to very low catch rates.

All available information confirms the severely depleted state of the cod stock off Greenland. The offshore stock may be considered to be almost non-existent at the present time. Strong year classes observed at Iceland as 0-group in 1997–1999 only appeared as moderate at age 1 in bottom trawl surveys in Greenland waters. A rise in water temperatures at East- and West Greenland may provide the basis for a higher recruitment to the West Greenland area.

The inshore stock component has historically been small and available information indicates that recruitment will be low during the next few years.

In Icelandic waters, the cod stock has not shown sign of recovery and is still at a low level due to poor recruitment since 1986 and due to a high and increasing fishing pressure. The management regime adopted in 1995 of harvesting 25% of the available biomass is previously considered likely to ensure rebuilding of the stock, but this harvesting regime has resulted in fishing mortalities well above what expected. The most recent year classes are somewhat below average size.

The Icelandic saithe stock is considered to be outside safe biological limits. Saithe is taken in mixed fisheries with cod.

The Icelandic haddock has for more than a decade been exploited at a very high fishing mortality. The stock is close to record low. Several strong year classes enter or are expected to enter the fishery.

The fishery for Greenland halibut in Sub-areas V and XIV is conducted by various nations but is still dominated by Icelandic trawlers in Division Va. The fishery in Divisions XIVb and Vb constitutes now about a third of the total fishery for Greenland halibut within Sub-areas V and XIV. Surveys have only recently been initiated for Greenland halibut. All indices, surveys as well as commercial CPUE's suggest that the stock has stabilised and may be rebuilding slowly.

3.2.2 Cod

3.2.2.a Greenland cod (ICES Sub-area XIV and NAFO Sub-area 1)

State of stock/exploitation: The stock is outside safe biological limits. The offshore component is severely depleted since 1990 with a very small recovery potential as derived from recent survey indices. The dramatic decrease in stock abundance was associated with changes in environmental conditions, emigration and high fishing mortalities. Inshore catches and CPUE are presently low and both have declined continuously since 1991. Recruitment to the inshore component has been poor since the 1993 year class and indices indicate that the inshore stock is still declining. Only the offshore catches in Greenland are subject to a TAC regulation. The inshore fishery is unregulated. This may give cause for concern about the exploitation rate of the inshore component.

Management objectives: Greenland and EU established an agreement on fisheries valid from 2001 to 2006. A variable TAC regulation has been agreed, with annual TACs adjusted to take account of ICES advice on stock status. The agreement also provides for a transfer of catches into future years, should a rapid increase in stock occur.

No reference points have been proposed for this stock, so the Agreement cannot be evaluated relative to the Precautionary Approach. However, TAC for 2002 is not consistent with the current ICES advice, and ICES stresses that any multi-year management plan should ensure that fisheries do not expand until a substantial increase in biomass and recruitment is evident.

Advice on management: ICES recommends that no fishery should take place until a substantial increase in biomass and recruitment is evident. A recovery plan for both the inshore and offshore components should be developed in order to take advantage of strong year classes when they occur and to protect all inshore spawning components.

Comparison with previous assessment and advice: An analytical assessment was performed in 1996, covering only the offshore component for the period 1955–1992. The most recent information available is based on a German groundfish survey, a Greenland trawl survey directed towards shrimp, and a Greenland inshore gillnet survey.

Medium- and long-term projections: *Not updated, last version from 1996.*

Elaboration and special comment: The historic fishery was mainly targeted at cod with some redfish as a by-catch. The fishery was international until the declaration of EEZs in the 1970s. During the 1980s EU vessels, mainly freezer trawlers, dominated the offshore fishery. During the late 1980s the offshore fishery was based almost exclusively on the 1984 and 1985 year classes. Thereafter, a total failure of the directed cod fishery indicated a stock collapse. Cod by-catch in the shrimp fishery is expected to be substantially reduced due to the mandatory use of sorting grids since October 2000.

In Greenland waters there are inshore fjord stocks and offshore stocks. Given suitable climatic conditions (water temperature) and prudent management, sustained production of offshore cod is possible. However, interaction between the East Greenland and Irminger currents during the early 1970s and 1980s has apparently rendered climatic conditions unsuitable for offshore cod in some years. Combined with high fishing mortality, this caused the offshore cod stock to be severely depleted. In order to take advantage of suitable climatic conditions, when they occur, it is necessary to protect the remaining biomass of offshore cod.

Source of information: Report of the North-Western Working Group, April/May 2001 (ICES CM 2001/ACFM:20).

Catch data (Tables 3.2.2.a.1–2):

Year	ICES advice for Sub-area XIV[1]	Pred. catch corresp. to advice	Agreed TAC			ACFM Inshore	ACFM total catch inshore + offshore		
			East	West	Total	Catch	East	West	Total
1987	TAC	5	11.5	12.5		8	7	12	19
1988	No increase in F	10[2]	11.5	53		23	9	63	72
1989	TAC	5	15	90		39	15	112	126
1990	No specific recommendation	-	15	110	125	30	34	98	132
1991	No advice	-	25	90	115	19	22	20	42
1992	No advice	-	17.25	66	99.25	6	11	6	17
1993	No fishing	0	17.25	66	83.25	2	1	2	3
1994	No fishing on offshore stock complex	0	17.25	66	83.25	2	< 1	2	3
1995	No fishing on offshore stock complex	0	17.25	66	83.25	2	< 1	2	2
1996	No fishing on offshore stock complex	0	17.25	66	83.25	1	< 1	1	1
1997	No fishing on offshore stock complex	0	17.25	66	83.25	1	< 1	1	1
1998	No fishing on offshore stock complex	0	17.25	66	83.25	< 1	< 1	< 1	< 1
1999	No fishing on offshore stock complex	0	17.25	66	83.25	< 1	< 1	< 1	< 1
2000	No commercial fishing	0	17.25	66	83.25	< 1	< 1	< 1	< 1
2001	No commercial fishing	0	17.25	66	83.25[3]				
2002	No commercial fishing	0	17.25	66	83.25[3]				

[1] Advice for NAFO Sub-area 1 provided by NAFO Scientific Council.

[2] Preliminary catch corresponding to advice. Weights in '000 t.

[3] Since 2001 the agreed TAC is based on a variable system accounting for the actual stock status and more flexibility between East and West Greenland. The given TAC figures represent maximum levels, which could be taken in case of stock recovery only. The EU quota for 2001 amounts to 2000 t.

Greenland cod (ICES Sub-area XIV & NAFO Sub-area 1)

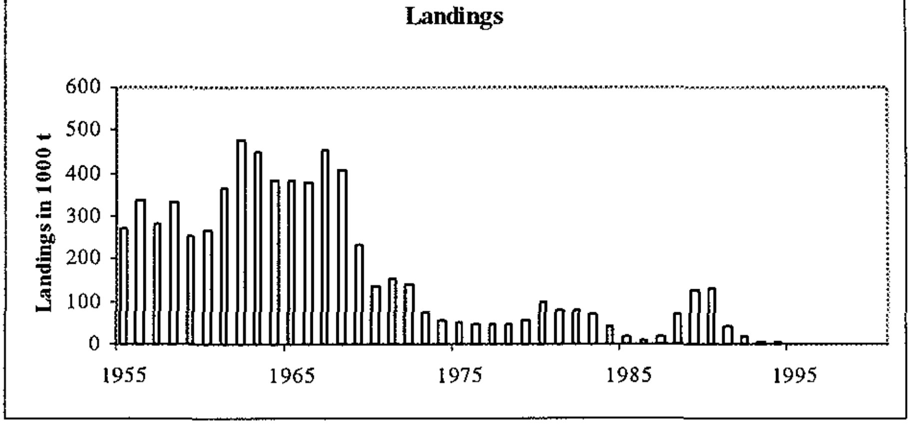


Table 3.2.2.a.1 Nominal catch (tonnes) of Cod in NAFO Sub-area 1, 1985–2000 as officially reported to NAFO.

Country	1985	1986	1987	1988	1989	1990	1991
Faroe Islands	-	-	-	-	-	51	1
Germany	2.170	41	55	6.574	12.892	7.515	96
Greenland	12.651	6.549	12.284	52.135	92.152	58.816	20.238
Japan	54	11	33	10	-	-	-
Norway	1	2	1	7	2	948	-
UK	-	-	-	927	3780	1.631	-
Total	14.876	6.603	12.373	59.653	108.826	68.961	20.335
WG estimate	-	-	-	62.653 [2]	111.567 [3]	98.474 [4]	-

Country	1992	1993	1994	1995	1996	1997	1998
Faroe Islands	-	-	-	-	-	-	
Germany	-	-	-	-	-	-	
Greenland	5.723	1.924	2.115	1.710	948	904	319
Japan	-	-	-	-	-	-	
Norway	-	-	-	-	-	-	
UK	-	-	-	-	-	-	
Total	5.723	1.924	2.115	1.710	948	904	319
WG estimate	-	-	-	-	-	-	-

Country	1999	2000[1]
Faroe Islands	-	
Germany	-	
Greenland	622	
Japan	-	
Norway	-	
UK	-	
Total		
WG estimate	-	-

[1]) Provisional data reported by Greenland authorities.
[2]) Includes 3,000 t reported to be caught in ICES Sub-area XIV.
[3]) Includes 2,741 t reported to be caught in ICES Sub-area XIV.
[4]) Includes 29,513 t caught inshore.

Table 3.2.2.a.2 Nominal catch (tonnes) of cod in ICES Sub-area XIV, 1985–1999 as officially reported to ICES.

Country	1985	1986	1987	1988	1989	1990	1991
Faroe Islands	-	86	-	12	40	-	-
Germany	2.006	4.063	5.358	12.049	10.613	26.419	8.434
Greenland	106	606	1.550	345	3.715	4.442	6.677
Iceland	-	-	1	9	-	-	-
Norway	-	-	-	-	-	17	828
Russia					-	-	-
UK (Engl.& Wales)	-	-	-	-	1.158	2.365	5.333
UK (Scotland)	-	-	-	-	135	93	528
United Kingdom	-	-	-	-	-	-	-
Total	2.112	4.755	6.909	12.415	15.661	33.336	21.800
WG estimate	-	-	-	9.457 [2]	14.669 [3]	33.513 [4]	21.818 [5]

Country	1992	1993	1994	1995	1996	1997	1998
Faroe Islands	-	-	1	-	-	-	
Germany	5.893	164	24	22	5	39	128
Greenland	1.283	241	73	29	5	32	37
Iceland	22	-	-	1	-	-	
Norway	1.032	122	14	+	1 [6]	15 [6]	1
Portugal	-	-	-	-	-	-	31
Russia	126	-	-	-	-	-	
UK (Engl. & Wales)	2.532	163	-	-	-	-	
UK (Scotland)	463	46	-	-	-	-	
United Kingdom	-	-	296	232	181	284	149
Total	11.351	736	408	284	192	370	346
WG estimate	-	-	-	-	-	-	-

Country	1999	2000 [6]
Faroe Islands	6	
Germany	13	3
Greenland	+	
Iceland	-	-
Norway	2	4
Russia	-	-
UK (Engl. & Wales)		
UK (Scotland)		
United Kingdom	95	149
Total	116	156
WG estimate	-	-

[1]) Includes estimates of discards and catches reported in Sub-area XII.
[2]) Excluding 3,000 t assumed to be from NAFO Division 1F and including 42 t taken by Japan.
[3]) Excluding 2,741 t assumed to be from NAFO Division 1F and including 1,500 t reported from other areas assumed to be from Sub-area XIV and including 94 t by Japan and 155 t by Greenland (Horsted, 1994).
[4]) Includes 129 t by Japan and 48 t additional catches by Greenland (Horsted, 1994).
[5]) Includes 18 t by Japan.
[6]) Provisional data.

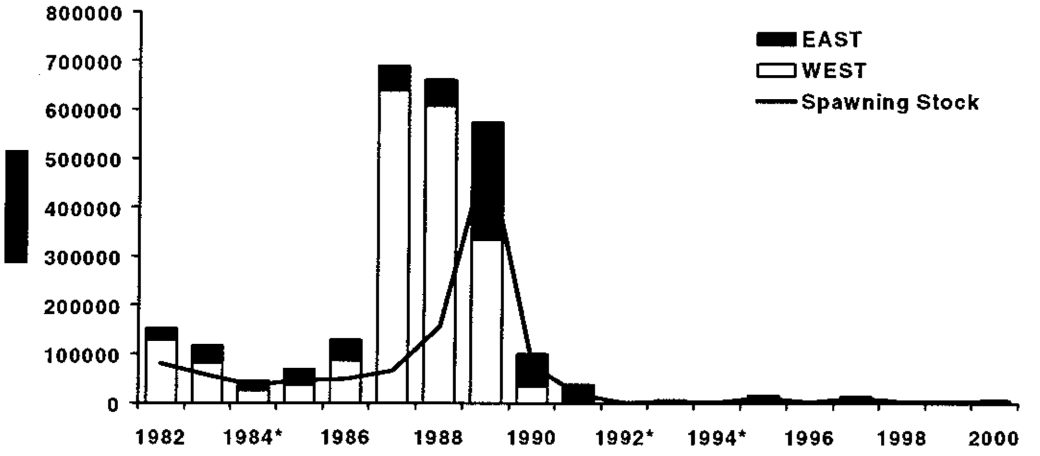


Figure 3.2.2.a.1 Cod off Greenland (offshore component). Aggregated survey biomass indices for West and East Greenland and spawning stock biomass, 1982-2000. *) incomplete survey coverage.

3.2.2.b Icelandic cod (Division Va)

State of stock/exploitation: SSB is currently estimated to be about 240 000 t, near its historic low of 220 000 t (1993) is currently below long term average and the current F of 0.77 exceeds $\mathbf{F_{med}}$. Recruitment was poor or below average for the year classes 1985–1996. The 1997 to 1999 year classes are estimated at about average size, and the first signs of the 2000 year class suggest that it is at least average. Fishing mortality dropped markedly in 1994 and 1995 in accordance with the measures taken by Iceland to reduce fishing effort against cod, but has increased since then. The very poor 1996 year class entered the fishable biomass in year 2000 and accelerated the decline in stock biomass and catch.

Management objectives: A formal Harvest Control Rule was implemented for this stock in 1995. The TAC for a fishing year is set as a fraction (25%) of the "available biomass" which is computed as the biomass of age 4 and older fish, -B(4+)-averaged over the two adjacent calendar years. In the long term, this corresponds to a fishing mortality of about 0.4. That harvest control rule was considered to be in accordance with the precautionary approach.

Last year the government introduced an amendment to the catch rule limiting interannual changes in catches to 30 kT. Limited studies, using a similar approach as when the initial catch rule was adopted were the basis for this amendment. ICES has not evaluated this amendment relative to the precautionary approach.

Advice on management: ICES advises to apply the Harvest Control Rule, which takes 25% of the 4+ biomass, corresponding to a projected catch of 164 000 t in 2002.

Relevant factors to be considered in management: Safe biological limits have not been defined for this stock.

The catch consistent with the application of the Harvest Control Rule results in an estimated F of 0.50 in 2002, which is well above the F expected from the Harvest Control Rule, as has been the case since the Harvest Control Rule was adopted.

The stock has been consistently overestimated in recent years and retrospective patterns indicate that the overestimation of the stock may not be fully accounted for in the current assessment. The overestimations have led to higher realized fishing mortality than intended when applying the Harvest Control Rule.

Evaluations of catch rules need to consider the effect of recurrent overestimations of stock size, which would result in the realized exploitation rate being consistently higher than the rate intended. Occurrence of a series of poor year classes in succession should also be considered. These and other potentially auto-correlated factors have to be taken into account when adopting a catch rule, particularly one with an interannual constraint on variation in TAC. If the real assessment and implementation errors are greater and more auto-correlated than those assumed in the simulations, then the catch rule may not be precautionary.

At present fishing mortality is high, and age 4 and younger fish account for most of the stock biomass. This situation makes discards (and possibly hidden mortality due to mesh penetration) a major concern as high fishing effort will be directed towards the small fish.

The amended Harvest Control Rule corresponds to a catch of 190 000 t in 2002, which would result in exploitation higher than what ICES would advise.

Catch forecast for 2002:

Assuming a catch in 2001 of 205 000 t (TAC-based), the following catch options were derived for 2002 (assuming catch=landings in all years):

Basis: Landings (2001) = 205; B(4+,2001) = 623; SSB(2001) = 245; B(4+,2002) = 689.

F(2002 onwards)	Basis	Catch (2002)	SSB(2002)	B(4+) (2003)	SSB (2003)	Medium-term effect of fishing at given level
0.30	0.4F(00)	104	307	907	429	
0.44	0.6F(00)	148	295	853	390	
0.50	25%rule1	164	291	833	368	
0.59	0.8F(00)	188	285	805	340	
0.60	25%rule2	190	284	802	348	
0.74	1.0F(00)	225	274	761	304	
0.89	1.2F(00)	257	265	721	275	

Weights in '000 t.

Shaded scenarios considered inconsistent with the precautionary approach.

Rule1: Original catch rule applied for advisory years 1996–2000.

Rule2: Amended catch rule applied for 2001.

Elaboration and special comment: In order to protect juvenile fish, fishing is prohibited in areas where the number of small cod (< 55 cm) in the catches exceeds 25%.

From 1977–1983, demersal fishing was limited to a certain number of days each year, but this system, as implemented, failed to meet the objective of limiting fishing mortality and a transferable boat quota system was introduced in 1984. TACs are set for each fishing year, which runs from 1 September through to 31 August in the following year. Catches have exceeded national advice and national TACs considerably for the past decade. ICES TAC advice on this stock was first given for 1993. In the most recent years catches have been close to the agreed TAC.

Based on extensive simulation work indicating that the biomass would grow under the catch rule, ICES concluded that the 25% catch rule adopted by Iceland for Icelandic cod was consistent with the precautionary approach. Realised fishing mortalities since the implementation of the catch rule have generally exceeded F_{med} = 0.52, while F=0.4 was expected from the long term application of the catch rule. The actual percentage biomass removed has been;

1995/96	1996/97	1997/98	1998/99	1999/2000	2000/2001
27%	27%	30%	35%	39%	37%

Consequently, the combination of harvest control rules and recent assessments with a substantial retrospective pattern, has resulted in the Harvest Control Rule not achieving the objective of constraining F < 0.40.

Modelling studies of multispecies interactions indicate that medium-term forecasts should include a higher natural mortality of cod, given the present trends in predator abundance.

In years of high recruitment a larval drift to Greenland is sometimes observed, resulting in a large year class at Greenland as well. In some other years an immigration of adult cod from Greenland has taken place, which has been taken into account in the assessment.

Data and assessment: The analytical assessment is based on catch and survey data using the XSA programme. An exploratory assessment using the TSA programme gave similar results. Catch-at-age data are considered reliable.

Source of information: Report of the North-Western Working Group, April/May 2001 (ICES CM 2001/ACFM:20).

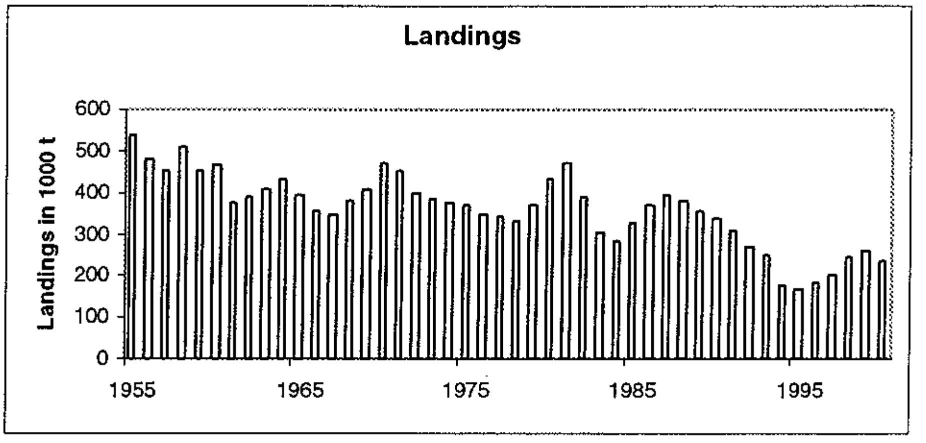
Yield and spawning biomass per Recruit
F-reference points:

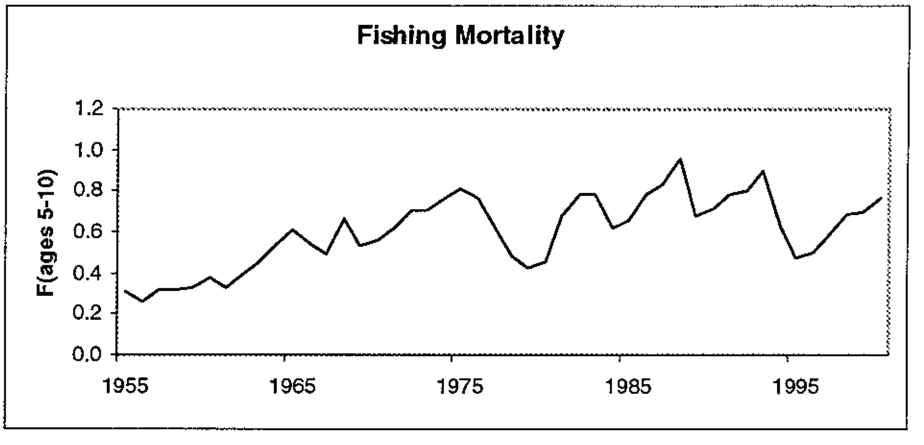
	Fish Mort Ages 5-10	Yield/R	SSB/R
Average Current	0.771	1.659	1.476
F_{max}	0.321	1.779	4.235
$F_{0.1}$	0.154	1.625	8.710
F_{med}	0.525	1.732	2.371

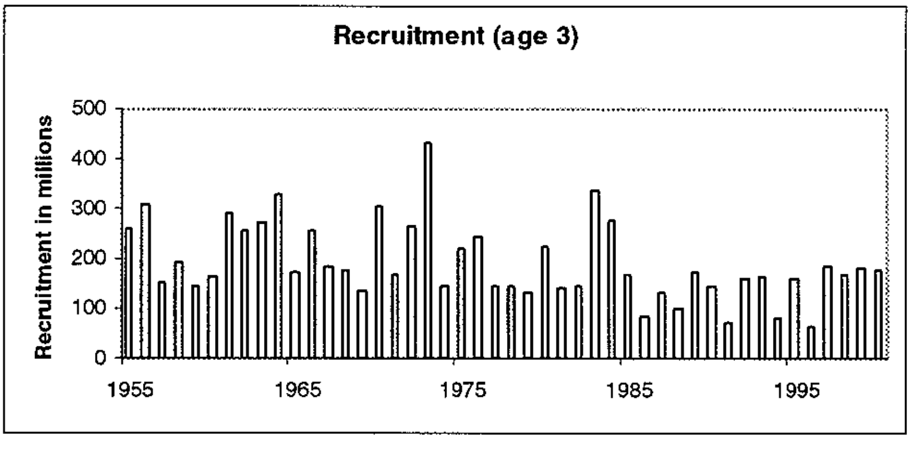
Catch data (Tables 3.2.2.b.1-2):

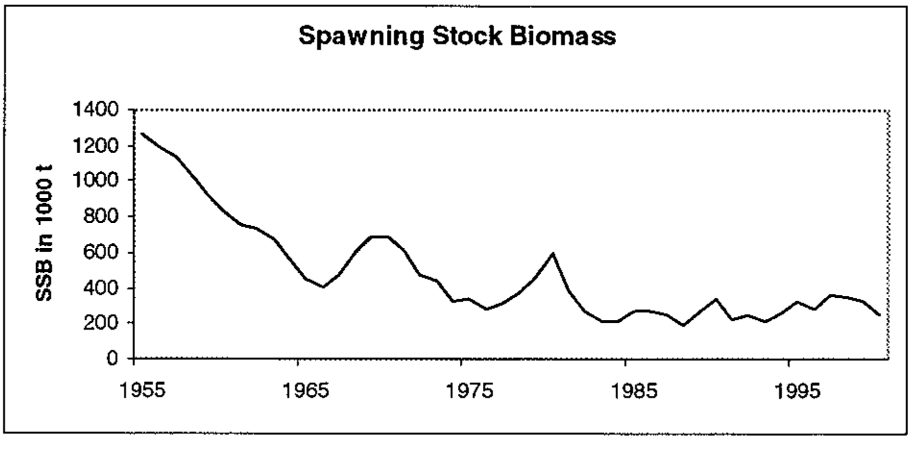
Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC	ACFM Catch
1988[1]	National advice	300[1]	350[1]	378[1]
1989[1]	National advice	300[1]	325[1]	356[1]
1990[1]	National advice	250[1]	300[1]	335[1]
1991[1]	National advice	240[1]	245[1]	309[1]
1992[2]	National advice	250[2]	265[2]	274[2]
1993[2]	TAC	190[2]	205[2]	241[2]
1994[2]	TAC	150[2]	165[2]	197[2]
1995[2]	TAC	130[2]	155[2]	169[2]
1996[2]	Apply catch rule	162[2]	155[2]	170[2]
1997[2]	Apply catch rule	186[2]	186[2]	202[2]
1998[2]	Apply catch rule	218[2]	218[2]	227[2]
1999[2]	Apply catch rule	250[2]	250[2]	254[2]
2000[2]	Apply catch rule	247[2]	250[2]	236[2]
2001[2]	Apply catch rule	203[2]	220[2]	
2002[2]	Apply catch rule	164		

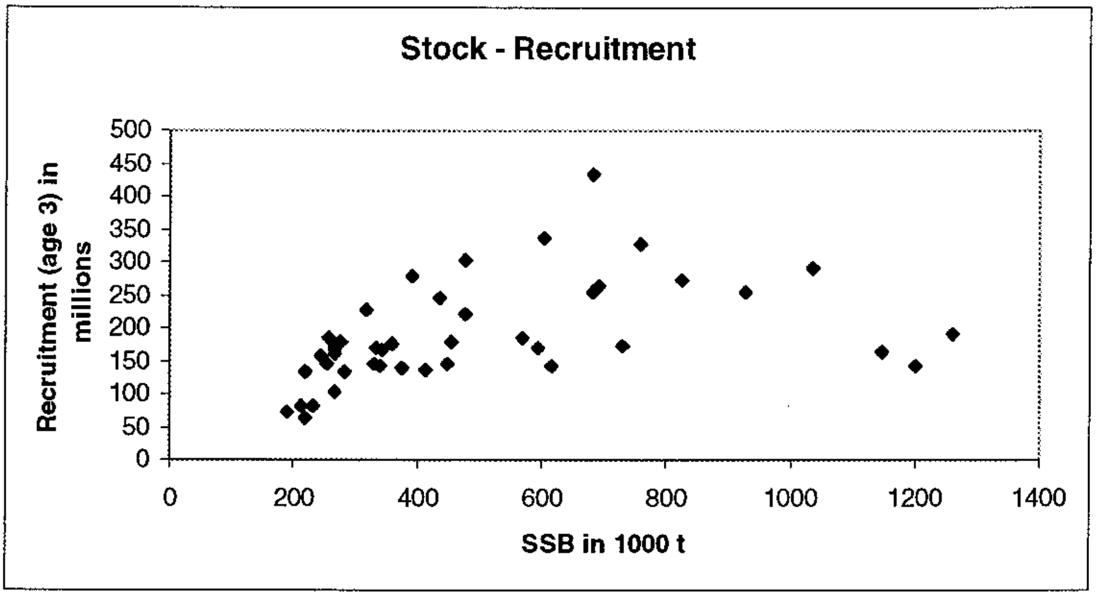
[1]Calendar year. [2]National fishing year ending 31 August; (Weights in '000 t).


Landings
Landings in 1000 t
600
500
400
300
200
100
0
1955
1965
1975
1985
1995


Fishing Mortality
F(ages 5-10)
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1955
1965
1975
1985
1995


Recruitment (age 3)
Recruitment in millions
500
400
300
200
100
0
1955
1965
1975
1985
1995


Spawning Stock Biomass
SSB in 1000 t
1400
1200
1000
800
600
400
200
0
1955
1965
1975
1985
1995


Stock - Recruitment
Recruitment (age 3) in millions
500
450
400
350
300
250
200
150
100
50
0
0
200
400
600
800
1000
1200
1400
SSB in 1000 t

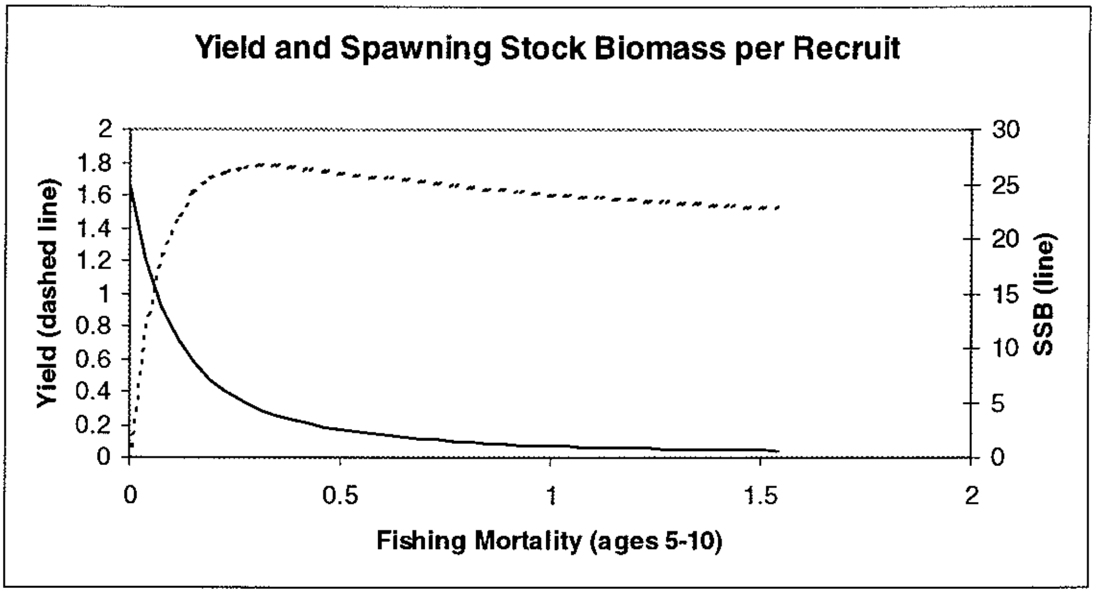

Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
SSB (line)
30
25
20
15
10
5
0
0
0.5
1
1.5
2
Fishing Mortality (ages 5-10)

Table 3.2.2.b.1 Nominal catch (tonnes) of cod in Division Va, by countries, 1987–2000 as officially reported to ICES.

Country	1987	1988	1989	1990	1991	1992	1993
Belgium	597	365	309	260	548	222	145
Faroe Islands	1,848	1,966	2,012	1,782	1,323	883	664
Germany	-	-	-	-	-	-	-
Greenland	-	-	-	-	-	-	-
Iceland	389,808	375,741	353,985	333,348	306,697	266,662	251,170
Norway	4	4	3	-	-	-	-
UK	-	-	-	-	-	-	-
Total	392,257	378,076	356,309	335,390	308,568	267,767	251,979
WG estimate	-	-	-	-	-	-	-

Country	1994	1995	1996	1997	1998	1999	2000 [1]
Belgium	136	-	-	-	-	-	-
Faroe Islands		739	599	408	1,078	1,247	1,176
Germany	-	-	-	-	9	21	15
Greenland	-	-	-	-	-	25	-
Iceland	177,919	168,685	181,052	202,745	241,545	258,658	232,272
Norway	-	-	7	-	-	85	101
UK	-	-	-	-	-	16	
Total	178,809	169,424	181,658	203,153	242,632	260,052	
WG estimate	-	-	-	-	-	-	235,199 [2]

1) Provisional.

2) Additional landings by Iceland of 1602 t, and Faroes of 33 t are included.

Table 3.2.2.b.2 Icelandic cod (Division Va).

Year	Recruitment Age 3 thousands	SSB tonnes	Landings tonnes	Mean F Ages 5-10
1955	260000	1261000	538130	0.31
1956	307000	1199000	480709	0.26
1957	153000	1145000	451909	0.32
1958	191000	1034000	508683	0.32
1959	143000	928000	452504	0.33
1960	163000	825000	465328	0.38
1961	292000	760000	374916	0.33
1962	255000	729000	386876	0.40
1963	273000	683000	410050	0.45
1964	328000	569000	433605	0.54
1965	174000	454000	393636	0.61
1966	255000	412000	356755	0.54
1967	186000	476000	345022	0.49
1968	178000	594000	381070	0.67
1969	136000	693000	406411	0.53
1970	303000	684000	470757	0.56
1971	170000	615000	453052	0.62
1972	265000	477000	398528	0.71
1973	432000	436000	383446	0.71
1974	143000	329000	374770	0.76
1975	222000	339000	370991	0.81
1976	246000	283000	347849	0.76
1977	144000	319000	340050	0.63
1978	143000	375000	330390	0.48
1979	134000	447000	368064	0.43
1980	226000	602000	434344	0.45
1981	139000	389000	468659	0.68
1982	144000	266000	388387	0.78
1983	336000	214000	300056	0.78
1984	278000	219000	283822	0.62
1985	168000	268000	325267	0.66
1986	83000	268000	368633	0.78
1987	132000	253000	392257	0.83
1988	102000	192000	378076	0.96
1989	174000	268000	355954	0.68
1990	146000	343000	335390	0.72
1991	74000	231000	308560	0.78
1992	161000	244000	267714	0.80
1993	166000	219000	251979	0.90
1994	81000	258000	178809	0.63
1995	159000	333000	169424	0.47
1996	63000	277000	181658	0.50
1997	185000	360000	203153	0.59
1998	170000	345000	242994	0.69
1999	180000	326000	260029	0.70
2000	175000	243000	235000	0.76
Average	192130	482261	359862	0.60

3.2.3 Icelandic haddock (Division Va)

State of stock/exploitation: The SSB has decreased since the early 1990s and is now the second lowest in the last two decades. Fishing mortality has increased in recent years and is above any candidate values for F_{pa}. Recruitment and spawning stock fluctuate widely. A strong year class from 1995 began entering the fishery in 1998 and there is evidence from the survey of strong year classes in 1998, 1999 and 2000, but the year class of 1996 is close to a historic low.

Management objectives: There is no explicit management objective for this stock.

Reference points: Work is ongoing to establish a longer data series. Such time series will be the basis for establishing biological reference points,. F_{pa} (= 0.47) equal to F_{med} has been provisionally proposed in 2000.

Advice on management: ICES advises that fishing mortality in 2002 should be reduced to below F_{pa} = 0.47, which corresponds to a catch of less than 30 000 t.

Relevant factors to be considered when managing this fishery: The SSB and recruitment are highly variable, and SSB is close to a record low. Fishing mortality is increasing.

Year classes 1998 and 1999 are estimated to be 84 and 72 million, compared to a geometric mean of 47 million from 1978-1999.

Data from 1960 to 2000 indicate that recruitment overfishing has not been a problem. Mortality of haddock slipping through gear meshes is potentially a problem, which, if taken into account, would lower the fishing mortality that maximises yield.

Comparison with previous assessment and advice: The present assessment is largely in line with last year's assessment, but indicates about 10% lower SSB estimates in the most recent years.

Catch forecast for 2002:

Basis: TAC/National estimates, Landings (2001) = 42, F(2001) = 0.86, SSB(2002) = 64.

F(2002)	Basis	Landings (2002)	SSB (2003)
0.31	$F_{0.1}$	21	92
0.47	F_{pa} (= 0.55*F(2000))	30	85
0.61	0.75 F(2000)	37	80
0.82	F(2000)	47	73
1.02	1.25 F(2000)	56	67

Weights in '000 t.

Shaded scenarios considered inconsistent with the precautionary approach.

Elaboration and special comment: Iceland extended its fisheries jurisdiction to 200 miles in 1975, resulting in a temporary reduction in fishing mortality. In the demersal fisheries, the mesh size in trawls increased from 120 mm to 135 mm in 1976 and to 155 mm the following year. From 1977-1983, demersal fishing was limited by a number of days each year. As this system failed to limit fishing mortality a transferable boat quota system was introduced in 1984. TACs are set for each fishing year (1 September to 31 August).

The Icelandic haddock stock is subject to substantial fluctuations in SSB and recruitment, with large year classes dominating the catch in some years. The data from the currently available time series do not indicate reduced recruitment at low SSB.

Data and Assessment: Assessments have reliably estimated stock numbers, but the estimated biomass has been consistently too high due to over-estimated weights at age. This has led to higher fishing mortalities than intended. A revision of the stock weights should have alleviated this problem.

The analytical assessment is based on catch and survey data.

Source of information: Report of the North-Western Working Group, April/May 2001 (ICES CM 2001/ACFM:20).

Yield and spawning biomass per Recruit
F-reference points

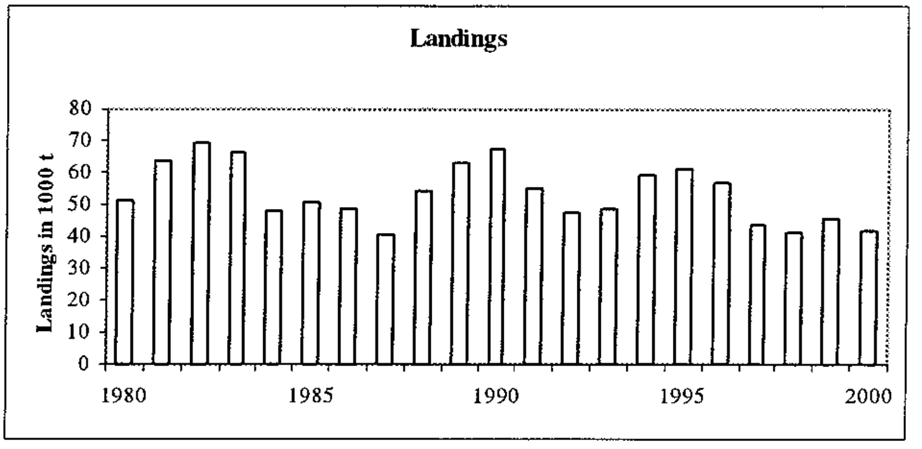
	Fish Mort Ages 4-7	Yield/R	SSB/R
Average Current	0.811	0.851	0.922
F_{max}	0.443	0.877	1.537
$F_{0.1}$	0.175	0.779	3.057
F_{med}	0.441	0.877	1.543

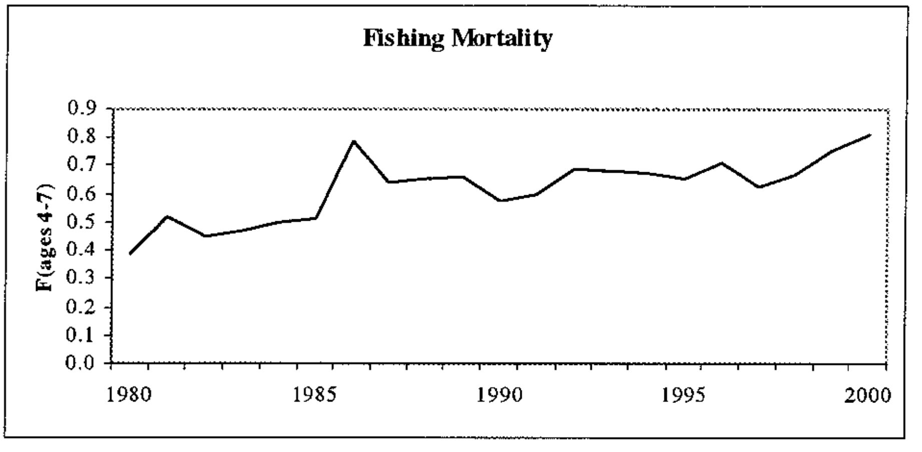
Catch data (Tables 3.2.3.1–2):

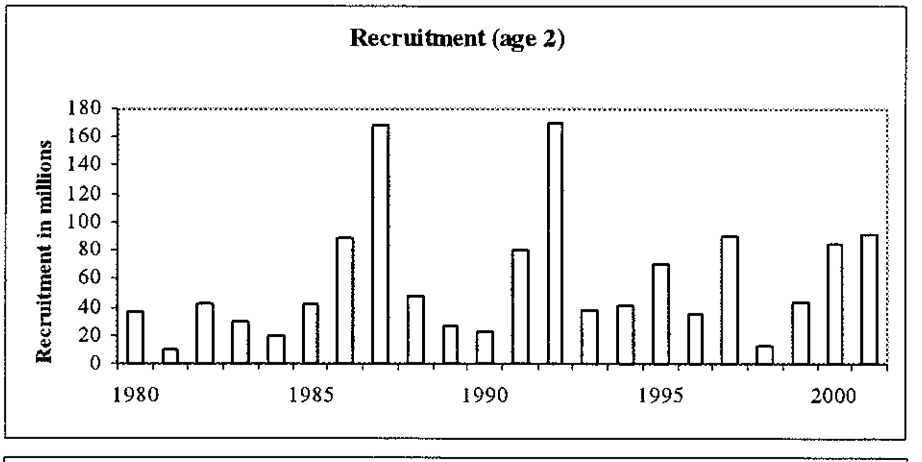
Year	ICES Advice	Advice[4]	Agreed TAC	Official Landings	ACFM catch
1987[1]		50	60	41	41
1988[1]		60	65	54	54
1989[1]		60	65	63	63
1990[1]		60	65	67	67
1991[2]		38	48	41	55
1992[3]		50	50	46	47
1993[3]		60	65	46	49
1994[3]		65	65	57	59
1995[3]		65	65	61	61
1996[3]		55	60	54	57
1997[3]		40	45	51	44
1998[3]		40	45	41	41
1999[3]		35	35	45	46
2000[3]	F reduced below $\mathbf{F}_{med}$	35	35	42	42
2001[3]	F reduced below provisional $\mathbf{F}_{pa}$	31	30		
2002[3]	F reduced below provisional $\mathbf{F}_{pa}$	30			

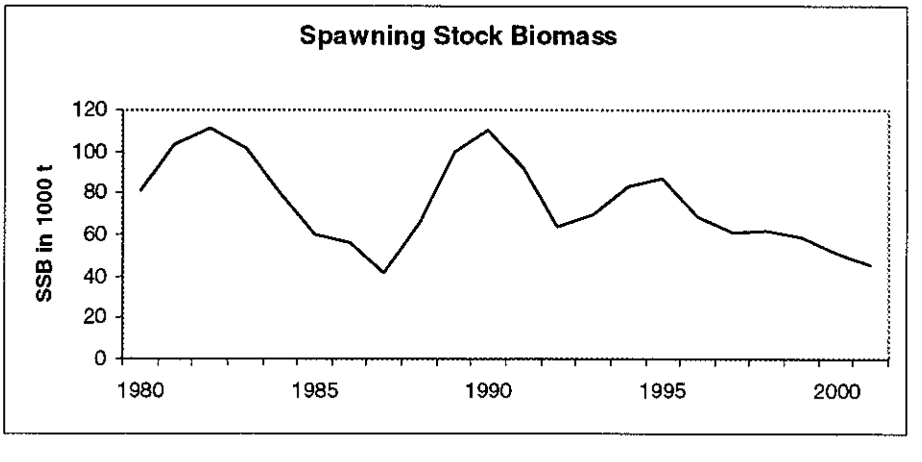
[1] Calendar year. [2] January/August. [3] National TAC for year ending 31 August. [4] National advice before 2000. Weights in '000 t.

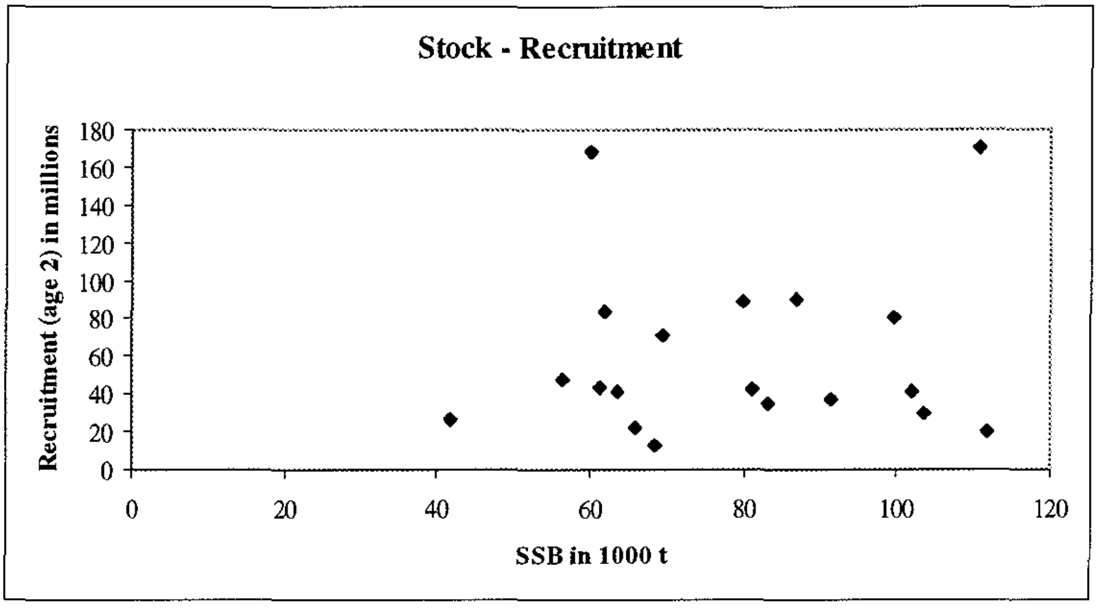
Icelandic haddock (Division Va)










Stock - Recruitment
Recruitment (age 2) in millions
180
160
140
120
100
80
60
40
20
0
0
20
40
60
80
100
120
SSB in 1000 t

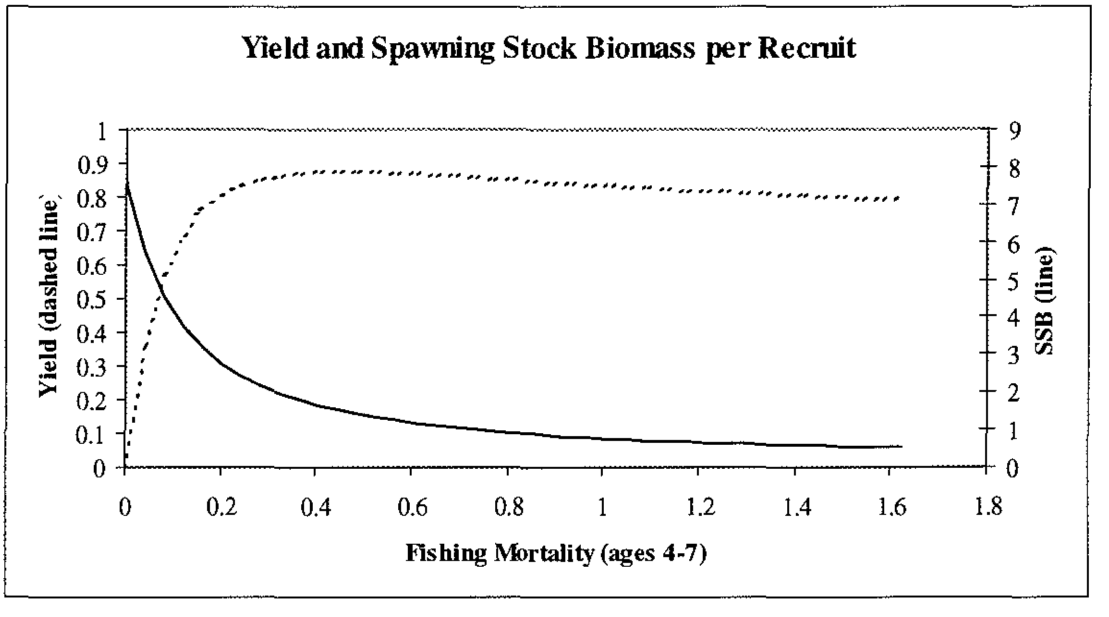

Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
SSB (line)
9
8
7
6
5
4
3
2
1
0
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
Fishing Mortality (ages 4-7)

Table 3.2.3.1 Haddock in Division Va. Landings by nation.

Country	1978	1979	1980	1981	1982	1983	1984	1985
Belgium	807	1010	1144	673	377	268	359	391
Faroe Islands	2116	2161	2029	1839	1982	1783	707	987
Iceland	40552	52152	47916	61033	67038	63889	47216	4955
Norway	13	11	23	15	28	3	3	+
UK								
Total	43488	55334	51112	63560	69425	65943	48285	5093

Country	1986	1987	1988	1989	1990	1991	1992	1993
Belgium	257	238	352	483	595	485	361	458
Faroe Islands	1289	1043	797	606	603	773	757	754
Iceland	47317	39479	53085	61792	66004	53516	46098	4693
Norway		1	+					
UK								
Total	48863	40761	54234	62881	67202	53774	47216	4814

Country	1994	1995	1996	1997	1998	1999	2000
Belgium	248						
Faroe Islands	911	758	664	340	639	624	968
Iceland	58408	60061	56223	43245	40795	44557	41199
Norway	1	+	4				
UK							
Total	59567	60819	56891	43585	41434	45481	42167

Table 3.2.3.2 Icelandic haddock (Division Va).

Year	Recruitment Age 2 thousands	SSB tonnes	Landings tonnes	Mean F Ages 4-7
1980	36896	81044	51112	0.3888
1981	9752	103592	63580	0.5214
1982	42215	111758	69325	0.4507
1983	30162	101975	65943	0.4734
1984	19932	79861	48285	0.4984
1985	41757	60011	50933	0.5142
1986	89225	56416	48863	0.7874
1987	168056	41660	40801	0.6393
1988	47662	65983	54236	0.6567
1989	26664	99640	62979	0.6591
1990	22362	110624	67200	0.5771
1991	80236	91510	54732	0.5954
1992	170295	63509	47212	0.6895
1993	37460	69575	48844	0.6793
1994	41153	83263	59345	0.6720
1995	70625	86908	61131	0.6548
1996	34477	68391	56958	0.7123
1997	89586	61278	44053	0.6247
1998	12889	61680	41434	0.6677
1999	43325	58687	45481	0.7512
2000	84111	50983	42167	0.8111
2001	92000	45222		
Average	58675	75162	53553	0.6202

3.2.4 Saithe in Icelandic waters (Division Va)

State of stock/exploitation: The stock is at present considered to be outside safe biological limits. SSB is below $\mathbf{B_{pa}}$ and close to $\mathbf{B_{lim}}$. Fishing mortality has been substantially above $\mathbf{F_{pa}}$ (0.30) for all years except two during the last two decades. SSB was at a historic low in 1998 to 2000; less than 50% of the 1962–1998 average. Recruitment has been below the long-term average since 1989.

Management objectives: There is no explicit management objective for this stock. However, for any management objective to meet precautionary criteria, F should be less than the proposed $\mathbf{F_{pa}}$ and spawning stock biomass should be greater than the proposed $\mathbf{B_{pa}}$.

Precautionary Approach reference points (unchanged since 1999):

ICES considers that:	ICES proposed in 1998 that:
$\mathbf{B_{lim}}$ is set tentatively at 90 000 t	$\mathbf{B_{pa}}$ be set at 150 000 t
$\mathbf{F_{lim}}$ is as yet undefined	$\mathbf{F_{pa}}$ be set at 0.3

Technical basis:

$\mathbf{B_{lim}}$: $\mathbf{B_{loss}}$ estimate in 1998	$\mathbf{B_{pa}}$:observed low SSB values in 1978–1993
$\mathbf{F_{lim}}$:	$\mathbf{F_{pa}}$ fishing mortality sustained for 3 decades

Advice on management: ICES advises that no directed fishing for saithe should take place and measures be implemented to keep by-catch of saithe in mixed demersal fisheries as small as possible. Directed fishing for saithe may be prevented by closing appropriate areas.

Relevant factors to be considered by management: Recruitment has been consistently low since 1989. The cause of this is unclear, but the possibility of a regime shift cannot be ruled out. There may be a need for adapting reference points to be in accordance with a situation with reduced productivity. Preliminary simulations indicate that a fishing mortality of 0.18 is necessary to reach the present $\mathbf{B_{pa}}$ within 10 years with a more than 80% probability.

A reduction in fishing mortality is advised both for cod and haddock in Division Va. To the extent that saithe is caught in mixed demersal fisheries, a general effort reduction will help to improve the exploitation also for saithe, but measures need to be taken to keep by-catches of saithe in mixed fisheries as low as possible.

Catch forecast for 2002:

Basis: National TAC gives F(2001) = 0.35 (=0.98F(2000)); Landings (2001) = 31; SSB(2002) = 88. No discards assumed.

F(2002 onwards)	Basis	Landings (2002)	SSB (2003)
0.00		0	117
0.07	0.2 F(2000)	7	110
0.14	0.4 F(2000)	14	104
0.21	0.6 F(2000)	20	99
0.27	0.75 F(2000)	25	95
0.35	F(2000)	31	89
0.42	1.2F(2000)	37	84

Weights in '000 t. Shaded scenarios considered inconsistent with the precautionary approach.

Medium- and long-term projections: Medium-term projections were done for the stock with input data on selectivity as the average in 1998–2000, and weight at age and maturity predicted with models used in the assessment. Recruitment values were drawn from two periods, from 1980–1998, and from the recent period of lower than long-term average recruitment in 1990–1998. Yield and SSB under constant fishing mortalities of a number of multipliers of *status quo* F ($\mathbf{F_{sq}}$ = 0.35), were brought forward in simulations for 20 years.

The simulations indicate that the probability of SSB reaching $\mathbf{B_{pa}}$ by 2010 is close to 50% when fishing at $\mathbf{F_{sq}}$ on a stock composed of recruitments as in the period 1980–98, but 80% when a 25% reduction in fishing mortality is imposed.

Assuming the recent lower recruitments (1989–1998), a fishing mortality at 0.5 $\mathbf{F_{sq}}$ (=0.18) gives an 80% probability that B>$\mathbf{B_{pa}}$ at 2010. In order to allow SSB to recover to $\mathbf{B_{pa}}$ already by 2005–2006 with 80%

probability, a fishing mortality of 0.12 is required with the lower recruitment level.

Elaboration and special comment: Saithe are taken in a mixed demersal fishery although they may be targeted at certain times, especially in times of high stock abundance. In order to protect juvenile fish, fishing is prohibited in areas where the number of small saithe in the catches exceeds a given percentage.

ICES recommends to evaluate the possibility of imposing closed areas to protect spawning aggregations of saithe.

Time series analysis (TSA) using catch at age data only, with an estimated linear trend in recruitment, was used to estimate fishing mortalities. Migrations from other stocks were included in the stock assessment for the second time.

Exploratory assessments using XSA gave terminal $F_{4\text{-}9}$ values similar to or a bit lower than TSA, in the range of 0.2–0.4 for both methods.

Source of information: Report of the North-Western Working Group, April/May 2001 (ICES CM 2001/ACFM:20).

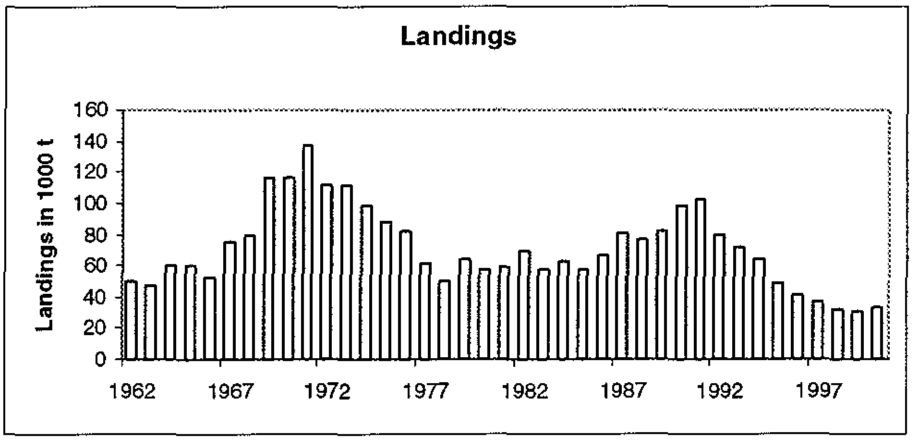
Yield and spawning biomass per Recruit
F-reference points:

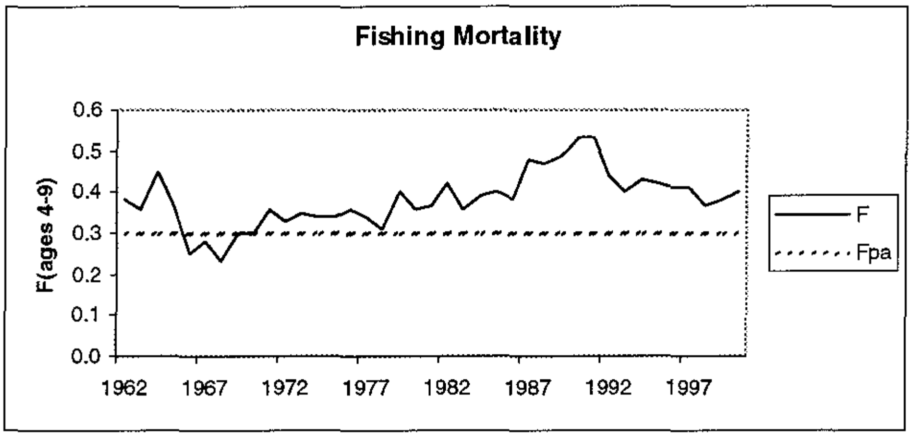
	Fish Mort Ages 4-9	Yield/R	SSB/R
Average Current	0.342	1749.955	4529.013
$\mathbf{F}_{max}$	0.409	1754.813	3908.899
$\mathbf{F}_{0.1}$	0.145	1549.049	8563.871
$\mathbf{F}_{med}$	N/A		

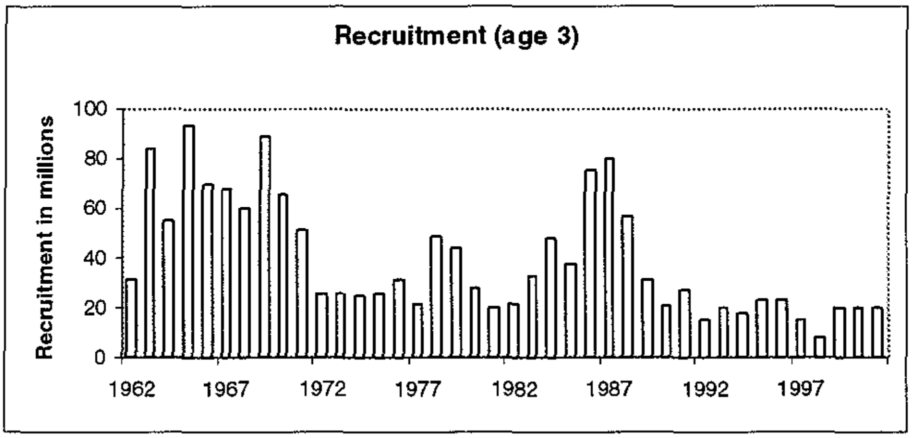
Catch data (Tables 3.2.4.1–2):

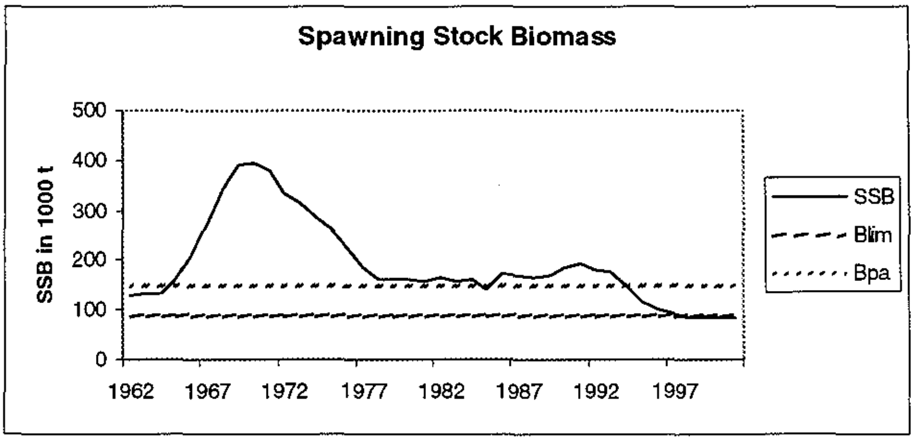
Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC	ACFM Catch
1987	TAC	64	70	81
1988	TAC	64	80	77
1989	TAC	80	80	82
1990	TAC	80	90	98
1991	TAC	87	65	103
1992	TAC	70	75[2]	80
1993	Marginal gains from increase in F	75[1]	95[2]	72
1994	No measurable gains from increase in F	84[1]	85[2]	64
1995	No measurable gains from increase in F	72[1]	75[2]	49
1996	No measurable gains from increase in F	65[1]	70[2]	41
1997	No measurable gains from increase in F	52[1]	50[2]	37
1998	F below $\mathbf{F}_{med}$ = 0.23	30[3]	30[2]	32
1999	F below 60% of F(97)	28	30[2]	31
2000	F below 60% of F(98)	24	30[2]	33
2001	F=70% of F(99)	25	30[2]	
2002	No directed fishing	-		

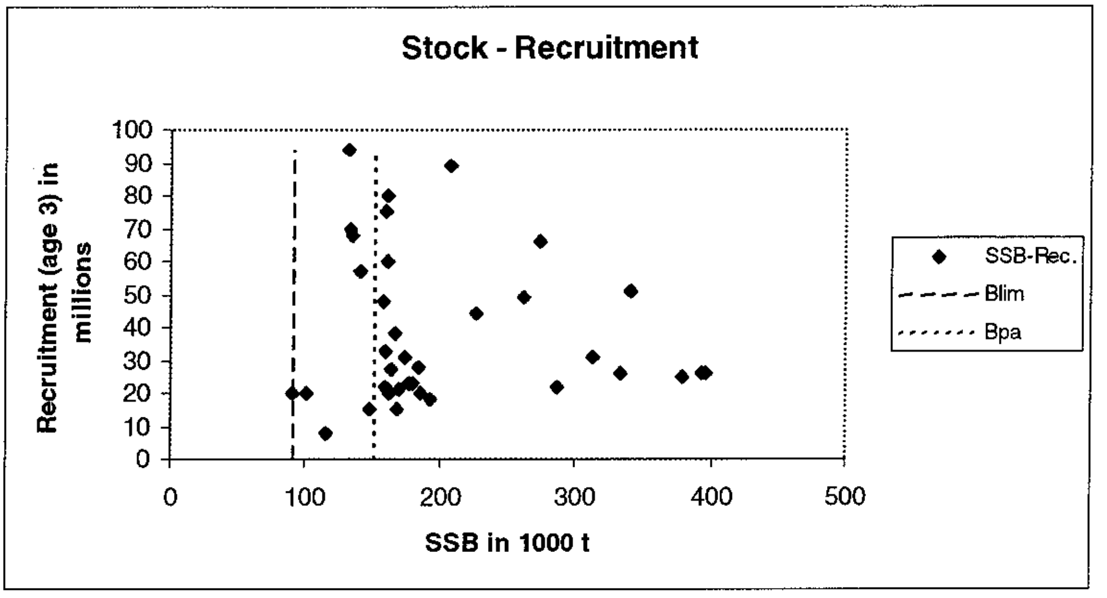
[1]Catch at *status quo* F. [2]For year ending 31 August. Weights in '000 t.


Landings
Landings in 1000 t
160
140
120
100
80
60
40
20
0
1962
1967
1972
1977
1982
1987
1992
1997

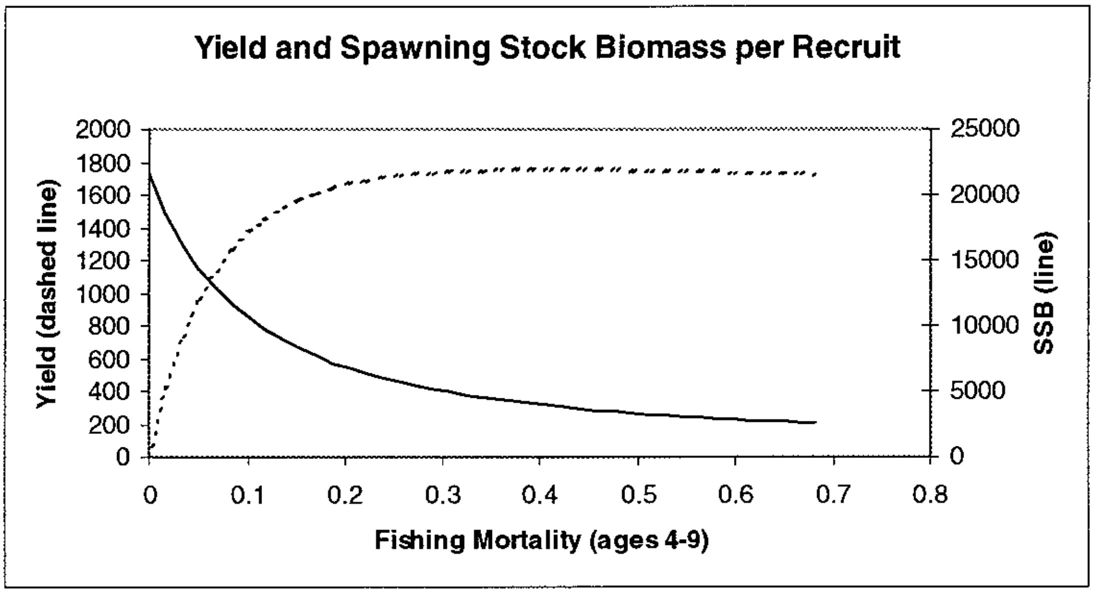

Fishing Mortality
F(ages 4-9)
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1962
1967
1972
1977
1982
1987
1992
1997
F
Fpa


Recruitment (age 3)
Recruitment in millions
100
80
60
40
20
0
1962
1967
1972
1977
1982
1987
1992
1997

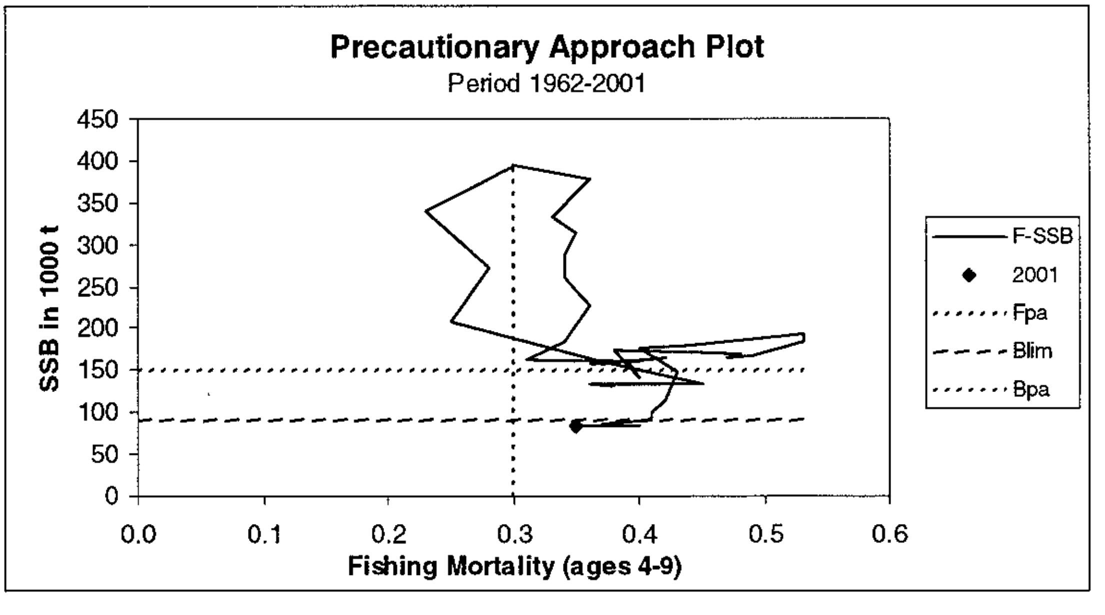

Spawning Stock Biomass
SSB in 1000 t
500
400
300
200
100
0
1962
1967
1972
1977
1982
1987
1992
1997
SSB
Blim
Bpa



Stock - Recruitment
Recruitment (age 3) in millions
SSB in 1000 t
SSB-Rec.
Blim
Bpa
0
10
20
30
40
50
60
70
80
90
100
0
100
200
300
400
500



Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
SSB (line)
Fishing Mortality (ages 4-9)
0
200
400
600
800
1000
1200
1400
1600
1800
2000
0
5000
10000
15000
20000
25000
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8



Precautionary Approach Plot
Period 1962-2001
SSB in 1000 t
Fishing Mortality (ages 4-9)
F-SSB
2001
Fpa
Blim
Bpa
0
50
100
150
200
250
300
350
400
450
0.0
0.1
0.2
0.3
0.4
0.5
0.6

Table 3.2.4.1 Nominal catch (tonnes) of SAITHE in Division Va by countries, 1982-2000, as officially reported to ICES.

Country	1982	1983	1984	1985	1986	1987	1988	1989
Belgium	201	224	269	158	218	217	268	369
Faroe Islands	3,582	2,138	2,044	1,778	783	2,139	2,596	2,246
France	23	-	-	-	-	-	-	-
Iceland	65,124	55,904	60,406	55,135	63,867	78,175	74,383	79,810
Norway	1	+	-	1	-	-	-	-
UK (Engl. and Wales)	-	-	-	29	-	-	-	-
Total	70,913	60,249	64,703	59,086	66,854	82,518	79,235	82,425
WG estimate	-	-	-	-	66,376[2)]	-	-	

Country	1990	1991	1992	1993	1994	1995	1996	1997	1998
Belgium	190	236	195	104	30	-	-	-	-
Faroe Islands	2,905	2,690	1,570	1,562	975	1,161	803	716	997
France	-	-	-	-	-	-	-	-	-
Germany	-	-	-	-	1	1	1	-	3
Iceland	95,032	99,390	77,832	69,982	63,333	47,466	39,297	36,548	30,531
Norway	-	-	-	-	-	1	-	-	-
UK (Engl. and Wales)	-	-	-	-	-	-	-	-	-
Total	98,127	102,316	79,597	71,648	64,339	48,629	40,101	37,264	31,531
WG estimate		102,737[3)]	-	-	-	-	-		

Country	1999[1)]	2000[1)]
Belgium	-	
Faroe Islands	706	228
France	-	
Germany	2	
Iceland	30560	32898
Norway	6	
UK (Engl. and Wales)	-	
Total		
WG estimate	31274	33126

1) Provisional.
2) Additional catch of 1,508 t. by Faroe Islands included.
3) Additional catch of 451 t by. Iceland included.

Table 3.2.4.2 Icelandic saithe (Division Va).

Year	Recruitment Age 3 thousands	SSB tonnes	Landings tonnes	Mean F Ages 4-9
1962	31000	131000	50000	0.38
1963	84000	133000	48000	0.36
1964	55000	134000	60000	0.45
1965	94000	161000	60000	0.37
1966	70000	208000	52000	0.25
1967	68000	273000	76000	0.28
1968	60000	341000	79000	0.23
1969	89000	393000	116000	0.30
1970	66000	396000	117000	0.30
1971	51000	378000	137000	0.36
1972	26000	333000	111000	0.33
1973	26000	313000	111000	0.35
1974	25000	287000	98000	0.34
1975	26000	262000	88000	0.34
1976	31000	227000	82000	0.36
1977	22000	184000	62000	0.34
1978	49000	163000	50000	0.31
1979	44000	160000	64000	0.40
1980	28000	160000	58000	0.36
1981	20000	158000	59000	0.37
1982	22000	166000	69000	0.42
1983	33000	159000	58000	0.36
1984	48000	161000	63000	0.39
1985	38000	141000	57000	0.40
1986	75000	174000	66000	0.38
1987	80000	169000	81000	0.48
1988	57000	164000	77000	0.47
1989	31000	168000	82000	0.49
1990	21000	185000	98000	0.53
1991	27000	193000	103000	0.53
1992	15000	180000	80000	0.44
1993	20000	177000	72000	0.40
1994	18000	148000	64000	0.43
1995	23000	115000	49000	0.42
1996	23000	101000	41000	0.41
1997	15000	91000	37000	0.41
1998	8000	85000	32000	0.37
1999	20000	83000	31000	0.38
2000	20000	83000	33000	0.40
2001	20000	84000		0.35
Average	39475	190550	71051	0.38

3.2.5 Greenland halibut in Sub-areas V and XIV

State of stock/exploitation: The stock is harvested outside safe biological limits. Recent Fs are estimated to be above the proposed $\mathbf{F}_{pa}$ and close to $\mathbf{F}_{MSY}$. Even though the recent historical development of SSB and fishing mortality are not well estimated, it is likely that fishing mortality has decreased and biomass increased in recent years. Survey biomass indices have remained relatively stable since 1996.

Management objectives: There are no explicit management objectives for this stock.

Precautionary Approach reference points: The ASPIC model provides estimates of the biomass relative to $\mathbf{B}_{MSY}$ and of F relative to $\mathbf{F}_{MSY}$. The ratio $F/\mathbf{F}_{MSY}$ equal to 0.67 is used in the advice as an upper boundary for F.

Advice on management: ICES recommends that the ratio $\mathbf{F/F_{MSY}}$ in 2002 be reduced to below 0.67, corresponding to catches in 2002 for the total stock of less than 21 000 t.

Relevant factors to be considered in management: For a number of years total catches have exceeded the advised TAC. There is no consistent management in the three areas (Divisions Va, Vb and XIVb). At present the fishery in Division Vb is subject to effort limitation and the fisheries in Divisions XIVb and Va are catch limited. The agreed TAC in Division Va has been close to the recommended TAC for the entire area. The combination of different management measures in different Sub-areas mean that there is no control over total fishing mortality for this stock.

Comparison with previous assessment and advice: The previous VPA-based assessment was considered provisional. Advice of this year is based on a production model. According to the results of this model an appropriate $\mathbf{F}_{pa}$ would be 0.25, which is 2/3 of the estimated $\mathbf{F}_{MSY}$. This fishing mortality will allow the stock to recover to $\mathbf{B}_{MSY}$ in the short term.

Medium- and long-term projections: Forward projections of population biomass and fishing mortality were made under three different harvesting regimes, including estimates of uncertainty, assuming a catch in 2001 of 30 000 t. Fishing at $\mathbf{F}_{pa}$ ($2/3\mathbf{F}_{MSY}$), it is expected that the biomass will increase and have a 50% probability of reaching $\mathbf{B}_{MSY}$ by 2004. Fishing at $\mathbf{F}_{sq}$ ($\sim\mathbf{F}_{MSY}$), biomass will increase more slowly, and it is expected to have at least a 50% probability of reaching $\mathbf{B}_{MSY}$ by 2010, although the confidence interval is wide. Fishing at 30 kt annually is expected have a high probability of $B > \mathbf{B}_{MSY}$ in the medium term, but also implies a considerable risk of a stock collapse.

Elaboration and special comment: Since the nursery grounds are not known and the juveniles therefore not monitored, and as Greenland halibut is a slow-growing species, which first appears in the catches at age 5, a possible recruitment failure will only be detected in the fishery some 5–10 years after it occurs.

Source of information: Report of the North-Western Working Group, April/May 2001 (ICES CM 2001/ACFM:20).

Catch data (Tables 3.2.5.1–6):

Year	ICES Advice	Predicted catch Corresp. To advice	Agreed TAC Va	Catch in Va	ACFM catch V,XIV
1987	No increase in F	28	30	45	47
1988	No increase in F	28	30	49	51
1989	TAC	33	30	59	61
1990	No advice	-	45	37	39
1991	TAC	40	30	35	38
1992	TAC	30	25	32	35
1993	No increase in effort	28[1]	30[2]	34	41
1994	No increase in effort	34[1]	30[2]	29	37
1995	TAC	32	30[2]	27	36
1996	TAC	21	20[2]	22	36
1997	60% reduction in F from 1995	13	15[2]	18	30
1998	70% reduction in F from 1996	11	10[2]	11	20
1999	65% reduction in F from 1997	11	10[2]	11	20
2000	60% reduction in F from 1998	11	10[2]	15	26
2001	catch less than 98-99 catch	20	20		
2002	F reduced below 0.67*F_{MSY}	21			

[1]Catch at *status quo* F. [2]Year ending 31 August. Weights in '000 t.

Greenland halibut in Sub-areas V and XIV

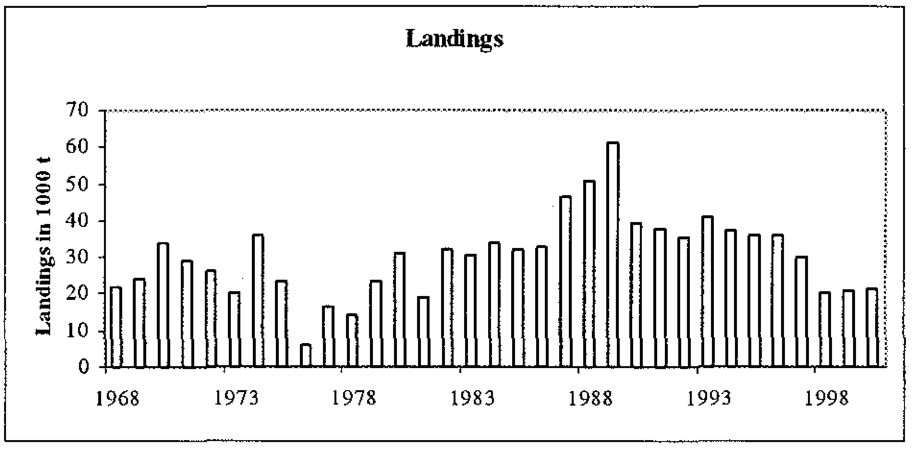


Table 3.2.5.1 Greenland halibut. Nominal catches (tonnes) by countries, in Sub-areas V, XII and XIV 1981-2000, as officially reported to ICES.

Country	1981	1982	1983	1984	1985	1986	1987	1988	1989
Denmark	-	-	-	-	-	-	6	+	-
Faroe Islands	767	1 532	1 146	2 502	1 052	853	1 096	1 378	2 319
France	8	27	236	489	845	52	19	25	-
Germany	3 007	2 581	1 142	936	863	858	565	637	493
Greenland	+	1	5	15	81	177	154	37	11
Iceland	15 457	28 300	28 360	30 080	29 231	31 044	44 780	49 040	58 330
Norway	-	-	2	2	3	+	2	1	3
Russia	-	-	-	-	-	-	-	-	-
UK (Engl. and Wales)	-	-	-	-	-	-	-	-	-
UK (Scotland)	-	-	-	-	-	-	-	-	-
United Kingdom	-	-	-	-	-	-	-	-	-
Total	19 239	32 441	30 891	34 024	32 075	32 984	46 622	51 118	61 156
Working Group estimate	-	-	-	-	-	-	-	-	61 396

Country	1990	1991	1992	1993	1994	1995	1996 [1]	1997 [1]	1998 [1]
Denmark	-	-	-	-	-	-	1	-	
Faroe Islands	1 803	1 566	2 128	4 405	6 241	3 763	6 148	4 971	3 817
France	-	-	3	2	-	-	29	11	8
Germany	336	303	382	415	648	811	3 368	3 342	3 056
Greenland	40	66	437	288	867	533	1 162	1 129	747
Iceland	36 557	34 883	31 955	33 987	27 778	27 383	22 055	18 569	10 728
Norway	50	34	221	846	1 173 [1]	1 810	2 164	1 939	1 367
Russia	-	-	5	-	-	10	424	37	52
UK (Engl. and Wales)	27	38	109	811	513	1 436	386	218	190
UK (Scotland)	-	-	19	26	84	232	25	26	43
United Kingdom									
Total	38 813	36 890	35 259	40 780	37 305	36 006	35 762	30 242	20 360
Working Group estimate	39 326	37 950	35 423	40 817	36 958	36 300	35 825	30 267	-

Country	1999 [1]	2000 [1]
Denmark		-
Faroe Islands	3 884	4 856
France	-	13
Germany	3 082	3 271
Greenland	200	-
Iceland	11 180	14 369
Norway	1 633	1 514
Russia	138	183
UK (Engl. and Wales)	261	-
UK (Scotland)	69	-
United Kingdom	-	413
Total	20 447	24 619
Working Group estimate	20 784	21 477

[1] Provisional data.

Table 3.2.5.2 Greenland halibut. Nominal catches (tonnes) by countries, in Division Va 1981-2000, as officially reported to ICES.

Country	1981	1982	1983	1984	1985	1986	1987	1988	1989
Faroe Islands	325	669	33	46			15	379	719
Germany									
Greenland									
Iceland	15 455	28 300	28 359	30 078	29 195	31 027	44 644	49 000	58 330
Norway			+	+	2				
Total	15 780	28 969	28 392	30 124	29 197	31 027	44 659	49 379	59 049
Working Group estimate									59 272 [2]

Country	1990	1991	1992	1993	1994	1995	1996	1997	1998
Faroe Islands	739	273	23	166	910	13	14	26	6
Germany					1	2	4		9
Greenland					1				[1]
Iceland	36 557	34 883	31 955	33 968	27 696	27 376	22 055	16 766	10 580
Norway								[1]	[1]
Total	37 296	35 156	31 978	34 134	28 608	27 391	22 073	16 792	10 595
Working Group estimate	37 308 [3]	35 413 [4]							

Country	1999	2000 [1]
Faroe Islands	9	5
Germany	13	22
Greenland	[1]	
Iceland	11 087	14 369
Norway	5 [1]	
UK (E/W/I)	26	
UK Scottland	3	
UK		
Total	11 143	14 396
Working Group estimate		14 519 [5]

[1] Provisional data.
[2] Includes 223 t catch by Norway.
[3] Includes 12 t catch by Norway.
[4] Includes additional catch of 257 t by Iceland.
[5] Includes additional 125 t by Iceland.

Table 3.2.5.3 Greenland halibut. Nominal catches (tonnes) by countries, in Division Vb, 1981-2000, as officially reported to ICES.

Country	1981	1982	1983	1984	1985	1986	1987	1988	1989
Denmark	-	-	-	-	-	-	6	+	-
Faroe Islands	442	863	1 112	2 456	1 052	775	907	901	1 513
France	8	27	236	489	845	52	19	25	...
Germany	114	142	86	118	227	113	109	42	73
Greenland	-	-	-	-	-	-	-	-	-
Norway	2	+	2	2	2	+	2	1	3
UK (Engl. and Wales)	-	-	-	-	-	-	-	-	-
UK (Scotland)	-	-	-	-	-	-	-	-	-
United Kingdom	-	-	-	-	-	-	-	-	-
Total	566	1 032	1 436	3 065	2 126	940	1 043	969	1 589
Working Group estimate	-	-	-	-	-	-	-	-	1 606 [2]

Country	1990	1991	1992	1993	1994	1995	1996	1997	1998
Denmark	-	-	-	-	-	-	-	-	
Faroe Islands	1 064	1 293	2 105	4 058	5 163	3 603	6 004	4750	3660
France [6]	...	...	3 [1]	2	1	28	29	11	8 [1]
Germany	43	24	71	24	8	1	21	41	
Greenland	-	-	-	-	-	-	-	-	
Norway	42	16	25	335	53	142	281	42 [1]	114 [1]
UK (Engl. and Wales)	-	-	1	15	-	31	122		
UK (Scotland)	-	-	1	-	-	27	12	26	43
United Kingdom	-	-	-	-	-				
Total	1 149	1 333	2 206	4 434	5 225	3 832	6 469	4 870	3825
Working Group estimate	1 282 [3]	1 662 [4]	2 269 [5]	-	-		-	-	3826 [7]

Country	1999	2000 [1]
Denmark		
Faroe Islands	3873	4812
France		13 [9]
Germany	22	6
Greenland		
Norway	87 [1]	110
UK (Engl. and Wales)	9	
UK (Scotland)	66	
United Kingdom		151
Total	4057	5092
Working Group estimate	4265 [8]	

[1] Provisional data.
[2] Includes 17 t taken by France.
[3] Includes 133 t taken in Division IIa.
[4] Includes 317 t taken in Division IIa (Faroese waters) + France 12 t.
[5] Includes 63 t taken in Division IIa (Faroese waters).
[6] Quantity unknown 1989-1991.
[7] Includes 3661 t taken in by Faroe Islands.
[8] Includes 4078 t by Faroe Islands, 3 t by France.
[9] Reported to Faroese authorities as Vb.

Table 3.2.5.4 Greenland halibut. Nominal catches (tonnes) by countries, in Sub-area XIV 1981-2000, as officially reported to ICES.

Country	1981	1982	1983	1984	1985	1986	1987	1988	1989
Faroe Islands	-	-	-	-	-	78	74	98	87
Germany	2 893	2 439	1 054	818	636	745	456	595	420
Greenland	+	1	5	15	81	177	154	37	11
Iceland	-	-	1	2	36	17	136	40	+
Norway	-	-	-	+	-	-	-	-	-
Russia	-	-	-	-	-	-	-	-	+
UK (Engl. and Wales)	-	-	-	-	-	-	-	-	-
UK (Scotland)	-	-	-	-	-	-	-	-	-
United Kingdom	-	-	-	-	-	-	-	-	-
Total	2 893	2 440	1 060	835	753	1 017	820	770	518
Working Group estimate	-	-	-	-	-	-	-	-	-

Country	1990	1991	1992	1993	1994	1995	1996	1997	1998
Denmark	-	-	-	-	-	-	1	+	+
Faroe Islands	-	-	-	181	168	147	130	148	151
Germany	293	279	311	391	639	808	3 343	3 301	3 399
Greenland	40	66	437	288	866	533	1 162	1 129	747 [1,10]
Iceland	-	-	-	19	82	7	-	1 803	148
Norway	8	18	196	511	1 120	1 668	1 881	1 897 [1]	1 253
Russia	-	-	5	-	-	10	424	37	52
UK (Engl. and Wales)	27	38	108	796	513	1405	264	218	190
UK (Scotland)	-	-	18	26	84	205	13		
United Kingdom	-	-	-	-	-	-	-		
Total	368	401	1 075	2 212	3 472	4 783	7 218	8 533	5940
Working Group estimate	736 [2]	875 [3]	1 176 [4]	2 249 [5]	3 125 [6]	5 077 [7]	7 283 [8]	8 558 [9]	

Country	1999	2000 [1]
Denmark		
Faroe Islands	2	39
Germany	3047	3243
Greenland	200 [1,12]	
Iceland	93	
Norway	1541	1404
Russia	138 [1]	183
UK (Engl. and Wales)	226	
UK (Scotland)		
United Kingdom		262
Total	5247	5131
Working Group estimate	5376 [11]	6958 [13]

[1] Provisional data.
[2] Includes 370 t taken by Japan.
[3] Includes 315 t catch taken by Japan and 159 t by other countries as reported to Greenland.
[4] Indicates additional catches taken by Germany (96 t) and UK (17 t) as reported to Greenland.
[5] Indicates additional catches taken by Germany (37 t), Norway (238 t) UK (182 t) and Japan (62 t) as reported to Greenland.
[6] Total reported to Greenlandic authorities are used in assessment: 159 t trawl (Norwegian charter), 205 t gillnets (Norwegian charter). 405 t from Norway not included in working group estimate.
[7] Includes 273 t offshore gillnets (Greenland charter).
[8] Working group estimates as in Table 6.1.5. Includes 72 t by Germany.
[9] Includes additional catch of 25t as reported by Norwegian authorities (1858 t inside 200 EEZ, 64 t outside EEZ).
[10] Includes 138 t reported as area unknown.
[11] Includes 125 t by Faroe Islands, 206 t by Greenland.
[12] Excluding 4732 t reported as area unknown.
[13] Includes: 1523 t by Norway 102 t by Faroe Islands, 3343 t by Germany, 1910 t by Greenland, 180 t by Russia, as reported to Greenland authorities.

Table 3.2.5.5 Greenland halibut. Nominal catches (tonnes) in Sub-area XII, as officially reported to ICES.

Country	1996	1997	1998	1999	2000
Faroe Islands	-	47	-	-	-
Norway	2	-	-	-	-
Total	2	47	-	-	-

Table 3.2.5.6 Greenland halibut in Sub-areas V and XIV

Year	Landings tonnes
1968	21872
1969	24237
1970	33823
1971	28973
1972	26473
1973	20463
1974	36280
1975	23494
1976	6045
1977	16578
1978	14349
1979	23616
1980	31252
1981	19239
1982	32441
1983	30891
1984	34024
1985	32075
1986	32984
1987	46622
1988	51118
1989	61396
1990	39326
1991	37950
1992	35423
1993	40817
1994	36958
1995	36300
1996	35825
1997	30267
1998	20360
1999	20784
2000	21477
Average	30416

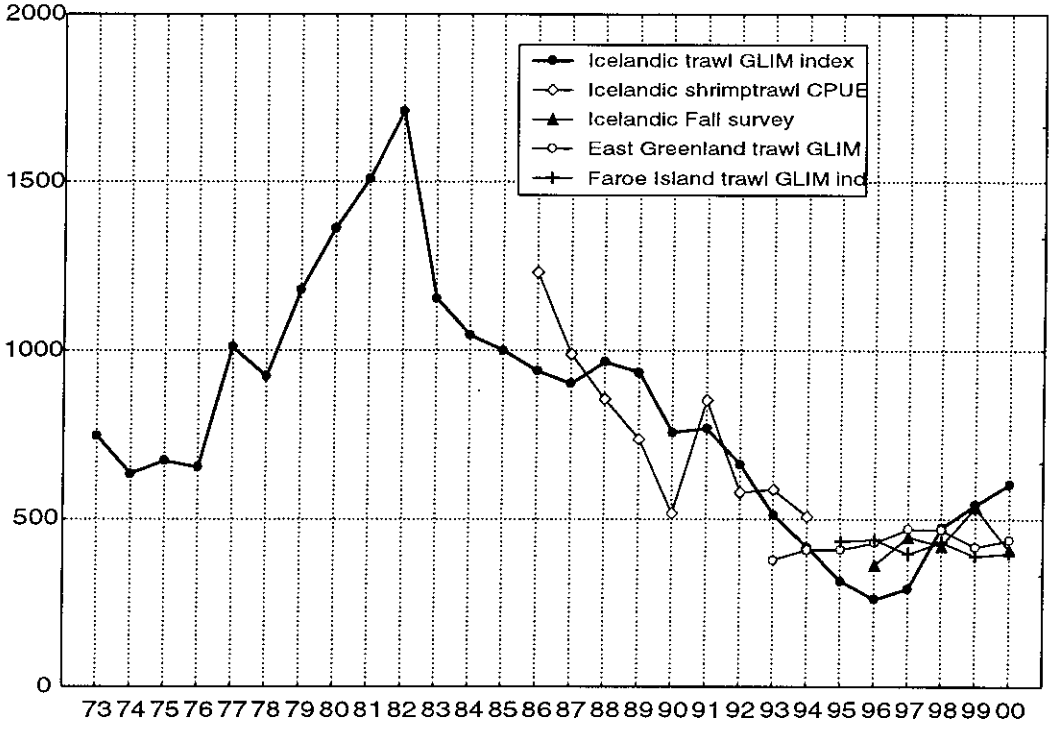
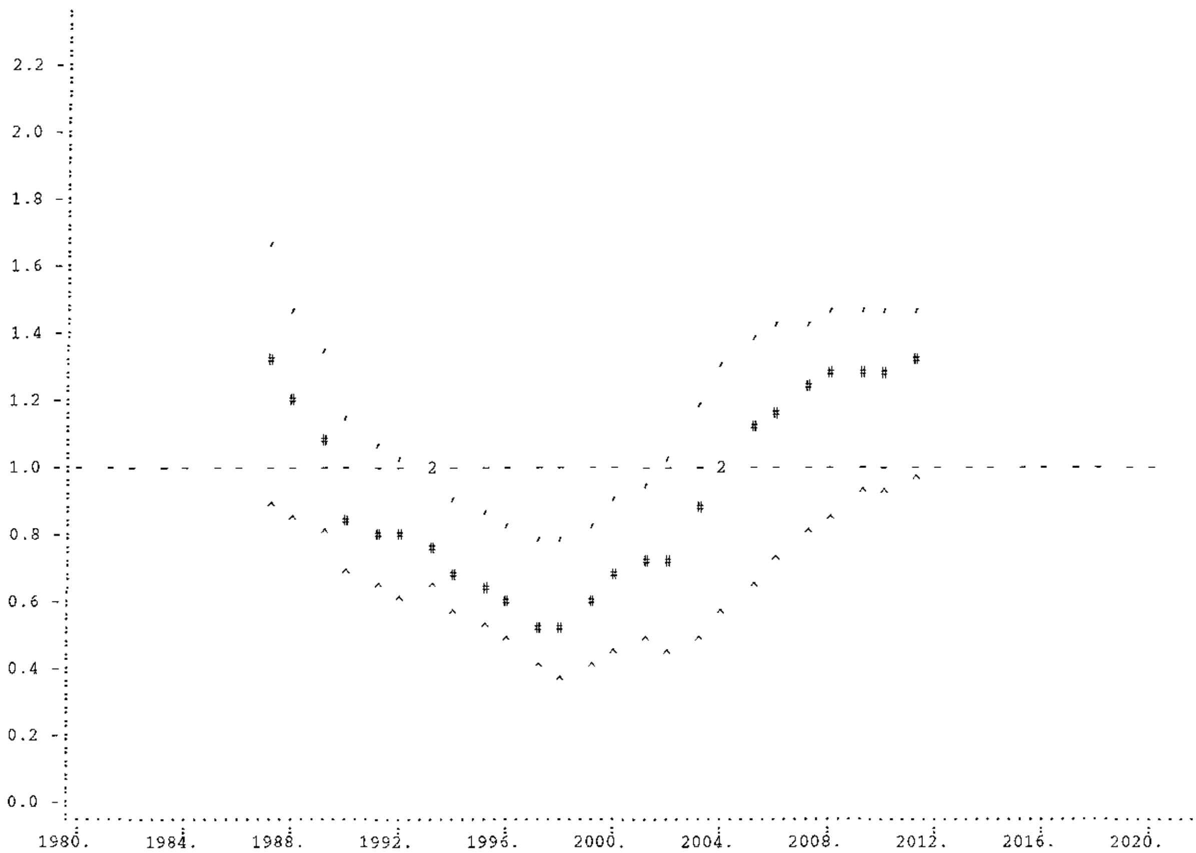


Figure 3.2.5.1 Various commercial and survey indices of Greenland halibut.



NOTE: The first 2 years are omitted per user request.

NOTE: Estimates beginning in 2002 depend on the user projection data listed on page 1.

Time Plot of Estimated F-Ratio and B-Ratio

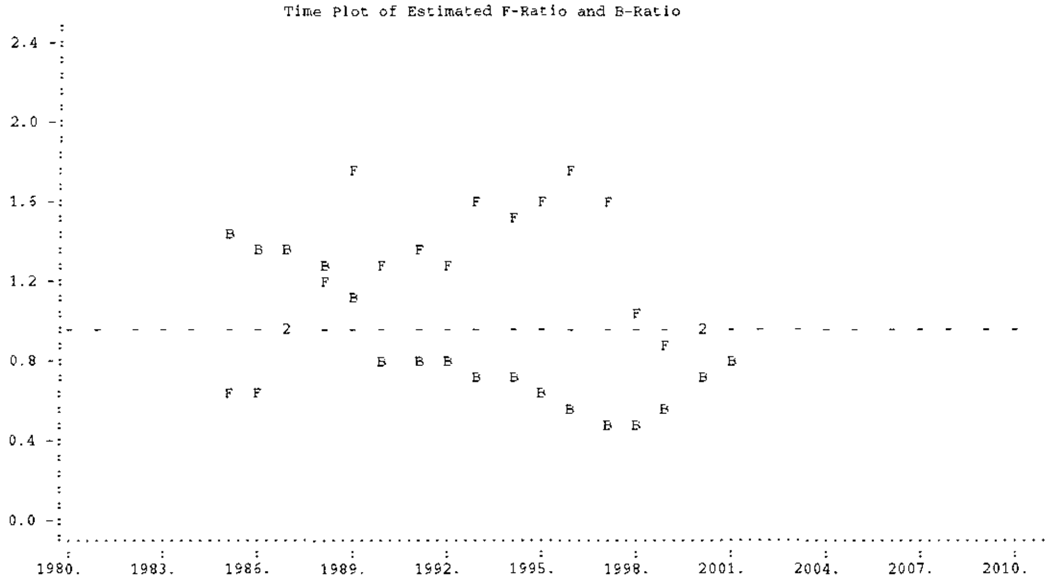


Figure 3.2.5.2 Bias-Corrected Time Plot of B-Ratio (#) with Approximate 80% Confidence Interval. **2001 catch =30kt and F(2002-2010)=F_{pa}(=2/3F_{MSY}) Dashed reference line is 1.0.**

3.2.6 Redfish in Sub-areas V, VI, XII and XIV

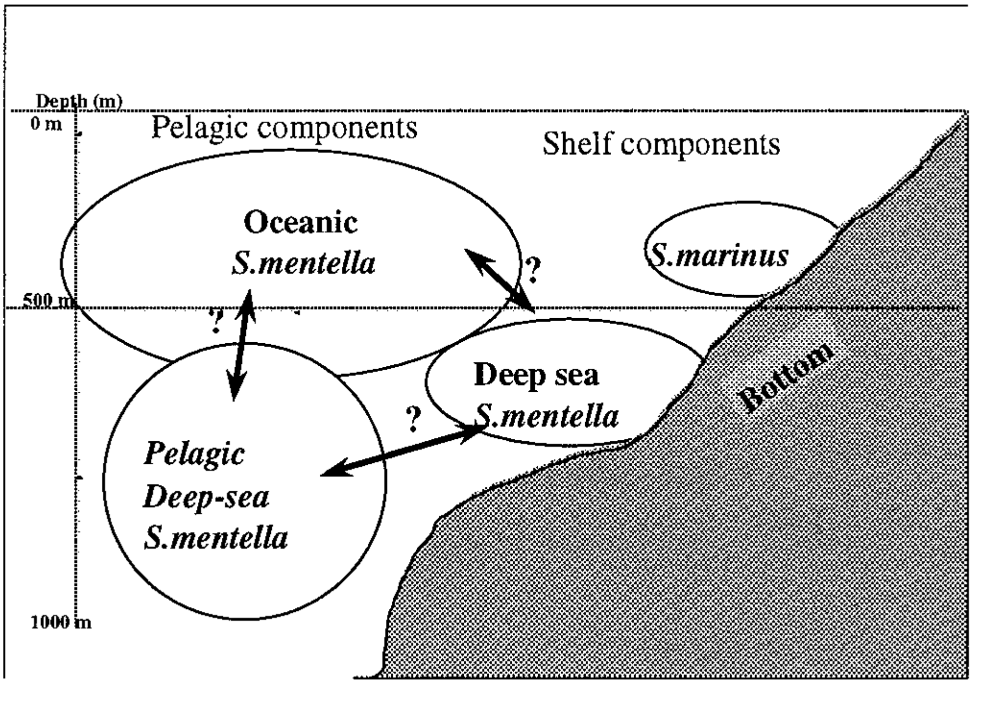
3.2.6.a Overview

Stocks: There are two main commercial species of redfish in Sub-Areas V, XII, and XIV, *Sebastes marinus* and *S. mentella*. In Division Va a small fishery has recently developed on the third redfish species, *S. viviparus*. There are indications that *S. marinus* includes a genetically distinct component "giant" *S. marinus*, with a different depth distribution than typical *S. marinus*. The stock structure of *S. mentella* is complex and uncertain, but there are indications that there may be at least "oceanic", "pelagic deep-sea" and "deep-sea" stocks or stock components. Both the "oceanic" and "pelagic deep-sea" forms in the Irminger Sea are sometimes referred to as pelagic redfish, to differentiate them from the redfish associated with the slope and shelf areas. Thus the redfish fisheries in Sub-areas V, XII, and XIV operate on several stocks.

Of these stocks, typical *S. marinus* is mainly distributed in the shallower shelf areas, down to about 500 m depth.

The relationships of the various forms of *S. mentella* are complex, and not clearly differentiated. "Oceanic" and "pelagic deep-sea" forms of *S. mentella* both have pelagic distributions in the open Irminger Sea, and both can be found in depths from 100 to 1000 m. The "pelagic deep-sea" form is much more common than the "oceanic" form at depths greater than 500 m, and is exploited primarily by pelagic trawls. The "oceanic" form has its highest concentrations at depths less than 500 m, where it is exploited by the same fishing gears as the "pelagic deep-sea" form. The "deep-sea" form has a distribution more closely associated with the continental shelf than either of the other forms, with a depth distribution from below 1000 m up to above 500 m, where it overlaps with typical *S. marinus*. The "deep-sea" form is exploited primarily by otter board trawls, although other gears are also used.

Genetic methods suggest that these three forms of *S. mentella* are genetically distinct, and that some types may even have additional substructure. However, in terms of distribution in the sea, there is substantial overlap of "pelagic deep-sea" and "oceanic" forms in the open sea. The distribution of the "pelagic deep-sea" form extends northward close enough to the continental shelf to overlap with the "deep-sea" form, and there may be exchange between the "oceanic" form and the "deep-sea" form at depths around 500 m near the continental slope as well. The figure below illustrates the complexities and uncertainties of the distributions of the species and forms of *Sebastes* in the Northwest area. Research continues to clarify the genetic relationships among the various forms, but regardless of future advances in that area, the morphological similarities among species and forms, and the overlapping distributions among them will continue to present difficulties for assessment and management of these resources.



Historic development of the fishery: Redfish in **Division Va** are mainly caught by trawlers using demersal and pelagic trawl. *S. marinus* is the predominant species down to depths of about 500 m, whereas deep-sea *S. mentella* contributes mostly to the catches at greater depths. The Icelandic fleet takes the major part of the catches, but vessels from Germany and Faroe Islands also fish in Division Va. In recent years the Icelandic fleet has also caught pelagic *S. mentella* in the deeper parts of Division Va using pelagic trawl.

In **Division Vb,** redfish are mainly caught by trawlers using demersal trawls. Down to about 500 m, *S. marinus* is the most important redfish species, and pair-trawlers are the most important fleet. Deeper than about 500 m, redfish catches consist almost exclusively of deep-sea *S. mentella* taken mostly by otter-board trawlers larger than 1 000 HP. The Faroese catches constitute more than 90% of the redfish catches in this division. Otter-board trawlers from Germany and France occasionally target these stocks. The remainder of the total catches is mainly by-catch in other demersal fisheries.

Redfish catches taken by several countries in **Sub-area VI** are considered to be mainly by-catch in demersal fisheries. These catches are negligible in comparison with redfish catches in Sub-areas V, XII and XIV.

Catches in **Sub-area XII** are mainly pelagic *S. mentella* and are taken by trawlers using pelagic trawls. At least 13 fleets have joined this fishery mainly from Russia, Germany, Iceland, Faroe Islands and Norway.

In **Sub-area XIV** both *S. marinus* and all *S. mentella* stocks are exploited. On the Greenland shelf and slopes, *S. marinus* dominates the trawl catches above 500 m, whereas deep-sea *S. mentella* dominates below 500 m. Most of the catches are taken by German freezer trawlers. In 1982 a pelagic trawl fishery started exploiting the oceanic *S. mentella* in the deeper parts of Sub-area XIV. Since 1990 the main fleets are from Russia, Norway, Iceland and Germany. In recent years, vessels from several other countries have joined this fishery, mainly outside the EEZs of Iceland and Greenland.

In **Sub-areas Va, XII and XIV**, a pelagic fishery has developed at depths greater than 500 m to target *S. mentella.* In 2000 a substantial proportion of the pelagic *S. mentella* catch was taken below 500 m depth. For the first time, there was significant fishing effort extended from ICES Division XII into NAFO Sub-area 1F in the autumn of 2000.

Landings: The total landings from the redfish stock complex (i.e. redfish in all sub-areas) are given in Tables 3.2.6.a.1–5.

Table 3.2.6.a.1 REDFISH. Nominal catches (tonnes) by countries, in Division Va 1986-2000, as officially reported to ICES.

Country	1986	1987	1988	1989	1990	1991	1992
Belgium	423	398	372	190	70	146	107
Faroe Islands	144	332	372	394	624	412	389
Germany	-	-	-	-	-	-	-
Iceland	85,992	87,768	93,995	91,536	90,891	96,770	94,382
Norway	2	7	7	1	-	-	-
Total	86,561	88,505	94,746	92,121	91,585	97,328	94,878
WG estimate	86,670	88,505	94,762	92,121	91,585	97,328	96,846

Country	1993	1994	1995	1996	1997	1998	1999[1]	2000[1]
Belgium	96	50	-	-	-	-	-	
Faroe Islands	438	202	521	309	242	280		210
Germany	-	46	229	233	-	284	428	513
Iceland [2]	96,577	95,091	89,474	67,757	73,976	108,830	67,132	84,870
Norway	-	-	-	134	-	-	18	50
Total	97,111	95,389	90,224	68,433	74,218	108,994	67,578	
WG estimate	99,714	110,861	91,767	72,909	89,519	110,498	104,938	88,837

[1]) Provisional.
[2]) Oceanic *S. mentella* not included in the officially reported catches.

Table 3.2.6.a.2 REDFISH. Nominal catches (tonnes) by countries, in Division Vb 1986-2000, as officially reported to ICES.

Country	1986	1987	1988	1989	1990	1991	1992
Denmark	36	176	8	-	+	-	-
Faroe Islands	15,224	13,477	12,966	12,636	10,017	14,090	15,279
France	752	819	582	996	909	473	114
Germany [2]	5,142	3,060	1,595	1,191	441	447	450
Iceland	-	-		21			
Norway	2	5	5	-	21	20	34
Russia							15
UK (E/W/NI)	-	-		-	+	3	21
UK (Scotland)							8
United Kingdom							
Total	21,156	17,537	15,156	14,844	11,388	15,033	15,921
WG estimates	21,476	17,538	15,508	15,068	11,737	15,037	15,993

Country	1993	1994	1995	1996	1997	1998	1999 [1]	2000 [1]
Denmark	-	-	-	-	-			
Faroe Islands	9,687	8,872	7,978	7,286	7,199	6,484	6191	5,748
France [1]	32	90	111	62	98	110		282
Germany [2]	239	155	91	189	36	-	207	79
Norway	16	34	36	33 [1]	25 [1]	39[1]	40	43
Russia	44	3	-	-	-	-	-	
UK (E/W/NI)	28	1	2	40	+	4	15	
UK (Scotland)	1	18	24	43	36	27	46	
United Kingdom								253
Total	10,047	9,173	8,242	7,653	7,394	6,664	308	
WG estimates	10,422	9,173	8,251	7,655	7,397	6,654	6,730	8,899

[1]) Provisional.
[2]) Former GDR and GFR until 1991.

Table 3.2.6.a.3 REDFISH. Nominal catches (tonnes) by countries, in Sub-area VI 1986-1999, as officially reported to ICES.

Country	1986	1987	1988	1989	1990	1991	1992
Faroe Islands	-	-	1	61	-	22	6
France	480	1,032	1,024	726	684	483	127
Germany	24	-	16	1	6	8	-
Ireland	-	-	-	-	-	-	1
Norway	14	2	1	2	5	+	4
UK (Engl. and Wales)	2	3	75	1	29	12	4
UK (Scotland)	10	17	6	6	6	40	32
Total	530	1,054	1,123	797	730	565	174
WG estimates	530	1,054	1,123	797	730	565	174

Country	1993	1994	1995	1996	1997	1998	1999	2000 [1]
Faroe Islands	-	-	2		12		44	0
France [1]	268	555	529	489	395	297		
Germany	77	87	5	9	1	1		
Ireland	1	-	4		10		34	
Norway	3	2	1	6[1]	5[1]	3[1]	8	11
Portugal						1		
Russia							243	461
UK (E/W/NI)	4	9	105	54	19	12	4	
UK (Scotland)	94	118	500	603	518	364	762	
United Kingdom								424
Total	447	771	1,146	1,161	960	678	1,016	
WG estimates	447	771	1,146	1,712	960	678	1,016	1,661

[1]) Provisional.

Table 3.2.6.a.4 REDFISH. Nominal catches (tonnes) by countries, in Sub-area XII 1986-2000, as officially reported to ICES and/or FAO.

Country	1986	1987	1988	1989	1990	1991	1992
Bulgaria	-	-	-	-	1,617	-	628
Estonia	-	-	-	-	-	-	1,810
Faroe Islands	-	-	-	-	-	-	-
France							
Germany	-	-	-	353	7	62	1,084
Greenland	-	-	-	567	-	-	9
Iceland	-	-	-	-	185	95	361
Latvia	-	-	-	-	-	-	780
Lithuania	-	-	-	-	-	-	6,656
Netherlands							-
Norway	-	-	-	-	249	726	380
Poland	-	-	-	112	-	-	-
Portugal							
Russia[2]	24,131	2,948	9,772	15,543	4,274	6,624	2,485
Spain							
UK(E/WNI)							
UK (Scotland)	-	-	-	-	-	-	-
Ukraine	-	-		-	-	-	-
Total	24,131	2,948	9,772	16,575	6,332	7,507	14,193
WG estimates	24,131	2,948	9,772	17,233	7,039	10,061	23,249

Country	1993	1994	1995	1996	1997	1998	1999	2000[1]
Bulgaria	3,216							
Estonia	6,365	17,875	16,854	7,092	3,720	3,968	2,108	4000
Faroe Islands	4,026	2,896	3,467	3,127	3,822	1,793	4,656	2833
France						3		
Germany	6,459	6,354	9,673	4,391	8,866	9,746	8,204	1128
Greenland	710	-	1,856	3,537	-	1,180		
Iceland	8,098	17,892	19,577	3,613	3,856	1,311	5,072	5100
Japan			1,148	416	31	31		
Latvia	6,803	13,205	5,003	1,084	-	-		
Lithuania	7,899	7,404	22,893	10,649		1,769		
Netherlands	-	-	13		-	-		
Norway	5,911	4,514	3,893	1,01[3]	2,699	263*	2,040	2238
Poland	-	-			662	12		
Portugal						503		
Russia	4,106	10,489	34,730	606	-	89	5,982	9243
Spain			20	410	1,155	1,814		
UK(E/WNI)				33	-			
UK(Scotland)				13	-			
UK	+	-				-		
Ukraine	2,782	5,561	3,185	518			188	
Total	56,375	86,190	122,312	45,590	49,103	22,482	28,250	
WG estimates	72,529	94,189	132,039	42,630	19,843	22,449	24,085	20,172

[1]) Provisional.

[2]) Former USSR until 1991.

Table 3.2.6.a.5 REDFISH. Nominal catches (tonnes) by countries, in Sub-area XIV 1986-2000, as officially reported to ICES and/or FAO.

Country	1986	1987	1988	1989	1990	1991	1992
Bulgaria	11,385	12,270	8,455	4,546	1,073	-	-
Denmark	-	-	-	-	-	-	-
Faroe Islands	5	382	1,634	226	-	115	3,765
Germany, Dem. Rep,	8,574	7,023	22,582	8,816			
Germany, Fed. Rep.	5,584	4,691					
Germany					11,218	9,122	7,959
Greenland	9,542	670	42	3	24	42	962
Iceland	-	-	-	814	3,726	7,477	12,982
Norway	-	-	-	-	6,070	4,954	14,000
Poland	149	25	-	-			
Russia [2]	60,863	68,521	55,254	7,177	3,040	2,665	1,844
UK (Engl. and Wales)	-	-	-	5	39	219	178
UK (Scotland)	-	-	-	-	3	+	28
United Kingdom			-	-	-	-	-
Total	96,102	93,582	87,967	21,587	25,193	24,594	41,718
WG estimates	96,102	95,824	91,676	24,520	31,261	28,400	48,513

Country	1993	1994	1995	1996	1997	1998	1999	2000[1]
Estonia								3,811
Bulgaria	-							
Denmark	-	-						
Faroe	3,095	164	8	298	123	47		4
Germany	26,969	22,406	9,702	16,996	11,610	9,709	8,935	7,840
Greenland	264	422	2,936	2,699	193	296		
Iceland [3]	11,650	29,114	8,947	49,381	33,820	6,441	43,062	23,500
Norway	8,351	2,546	2,890	6,286 [1]	433 [1]	864 [1]	4,205	3,698
Poland					114			
Portugal	-	1,887	5,125	2,379	3,674	4,133	4,302 [4]	3,731
Russia	6,560	13,917	9,439	45,142	36,930	25,748	11,571	14,851
Spain			4,534	3,897	7,552	2,763		
UK	241	138	48	247	28	43		
UK	8	4	10	6				
United	-						68	45
Total	57,138	70,598	43,639	127,331	94,477	50,044	72,143	
WG	57,269	59,776	43,141	134,594	88,070	55,395	49,407	42,295

[1]) Provisional data.
[2]) Former USSR until 1991.
[3]) Officially reported catches includes Oceanic redfish caught in Sub-division Va.
[4]) Reported as V/XII/XIV.

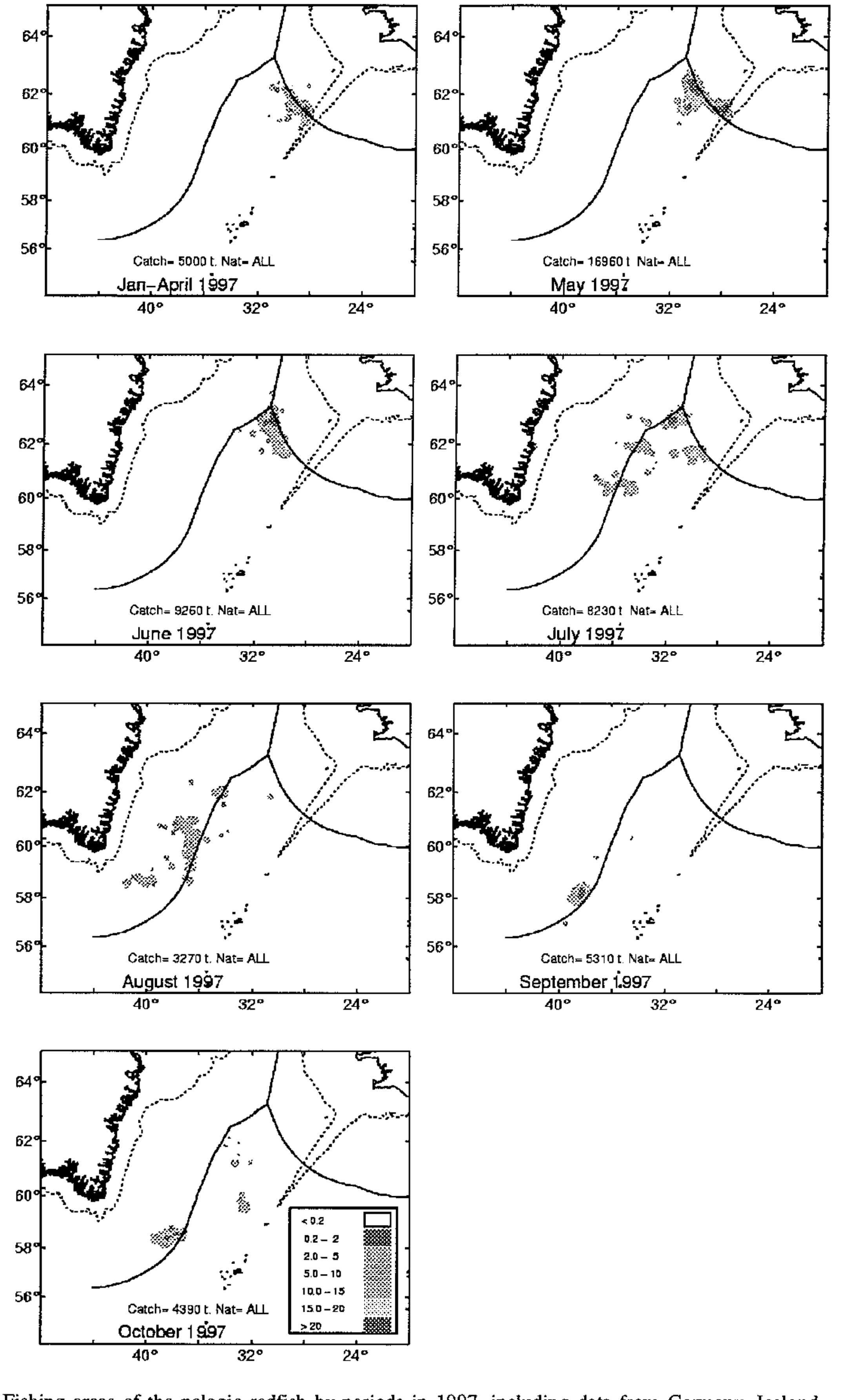


Figure 3.2.6.a.1 Fishing areas of the pelagic redfish by periods in 1997, including data from Germany, Iceland, Greenland and Norway. . The scale given on the pictures indicates the catches in tonnes per square nautical mile. Total catch registered for each period is also shown on the figures.

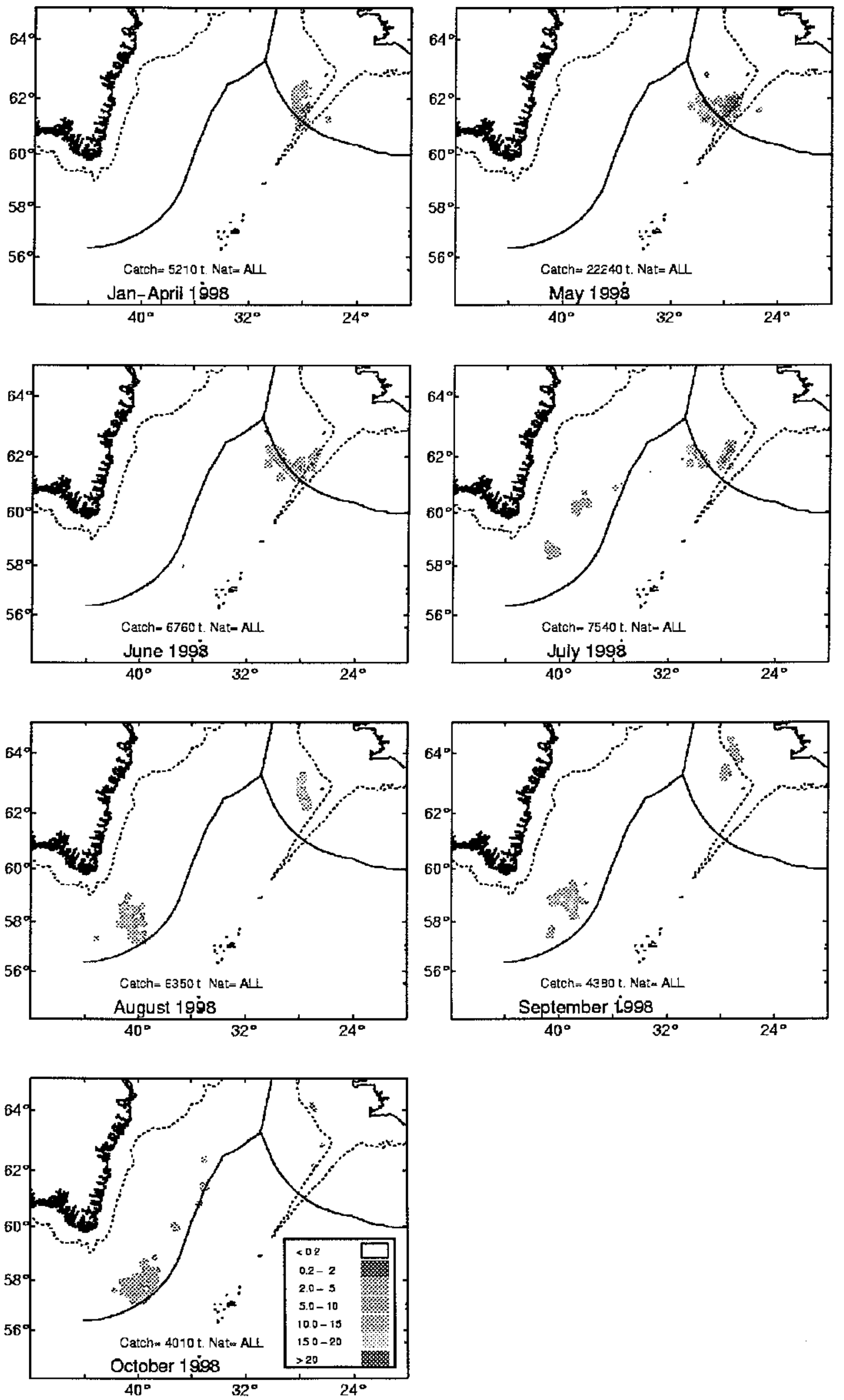


Figure 3.2.6a.2 Fishing areas of the pelagic redfish by periods in 1998, including data from Germany, Iceland, Greenland and Norway. The scale given on the pictures indicates the catches in tonnes per square nautical mile. Total catch registered for each period is also shown on the figures.

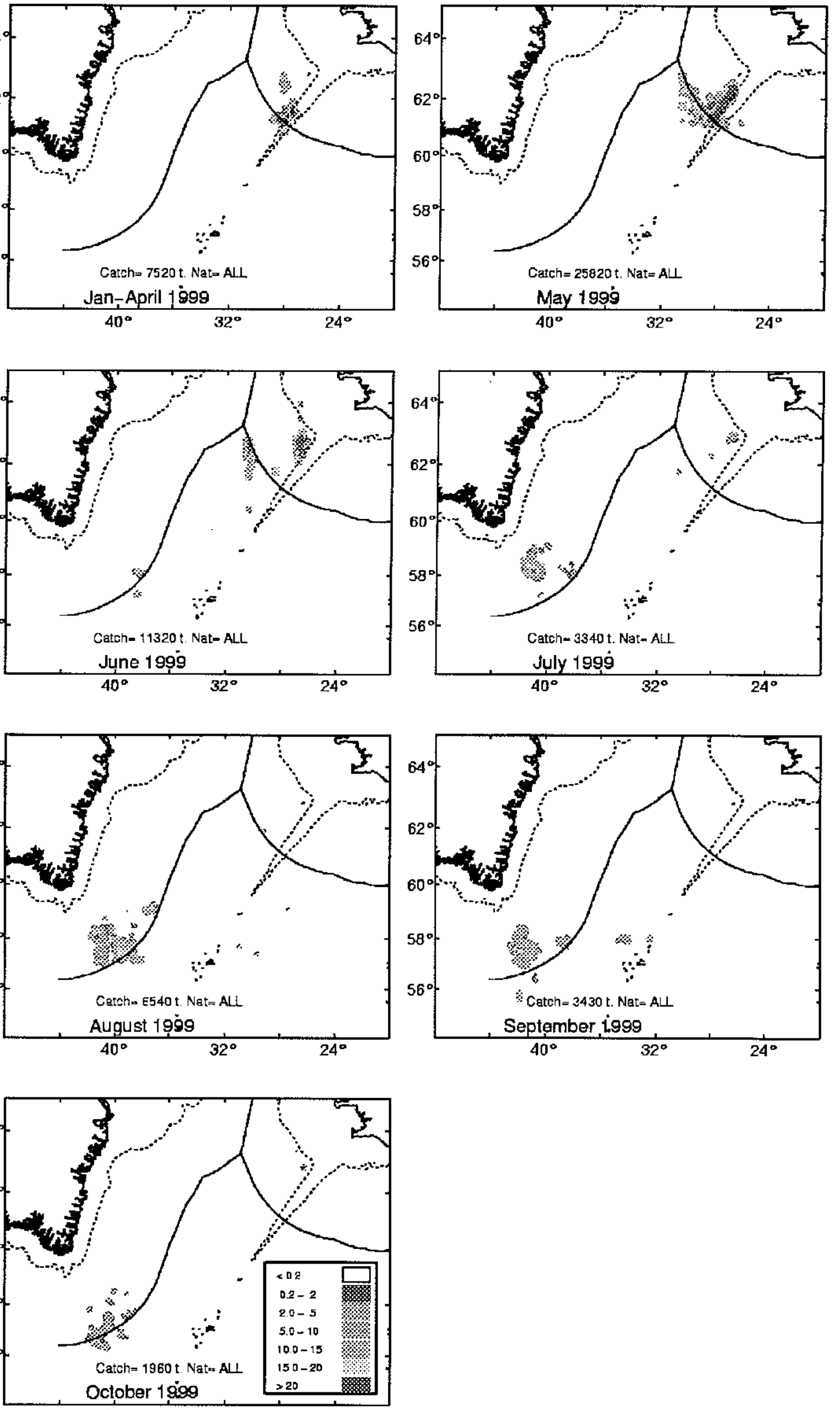


Figure 3.2.6.a.3 Fishing areas of the pelagic redfish by periods in 1999, including data from Germany, Iceland, Greenland and Norway. The scale given on the pictures indicates the catches in tonnes per square nautical mile. Total catch registered for each period is also shown on the figures.

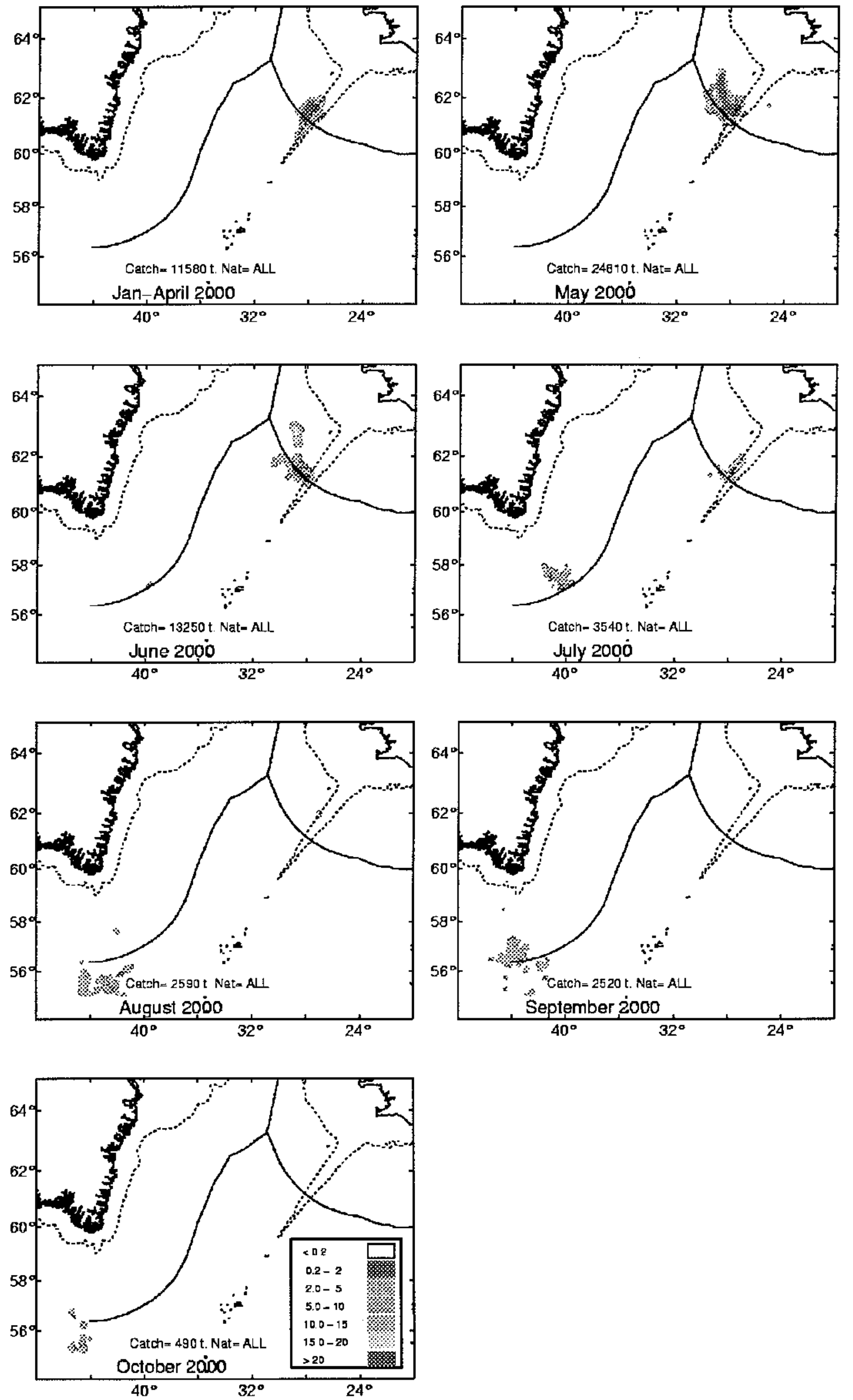


Figure 3.2.6.a.4 Fishing areas of the pelagic redfish by periods in 2000, including data from Germany, Iceland and Greenland. The scale given on the pictures indicates the catches in tonnes per square nautical mile. Total catch registered for each period is also shown on the figures.

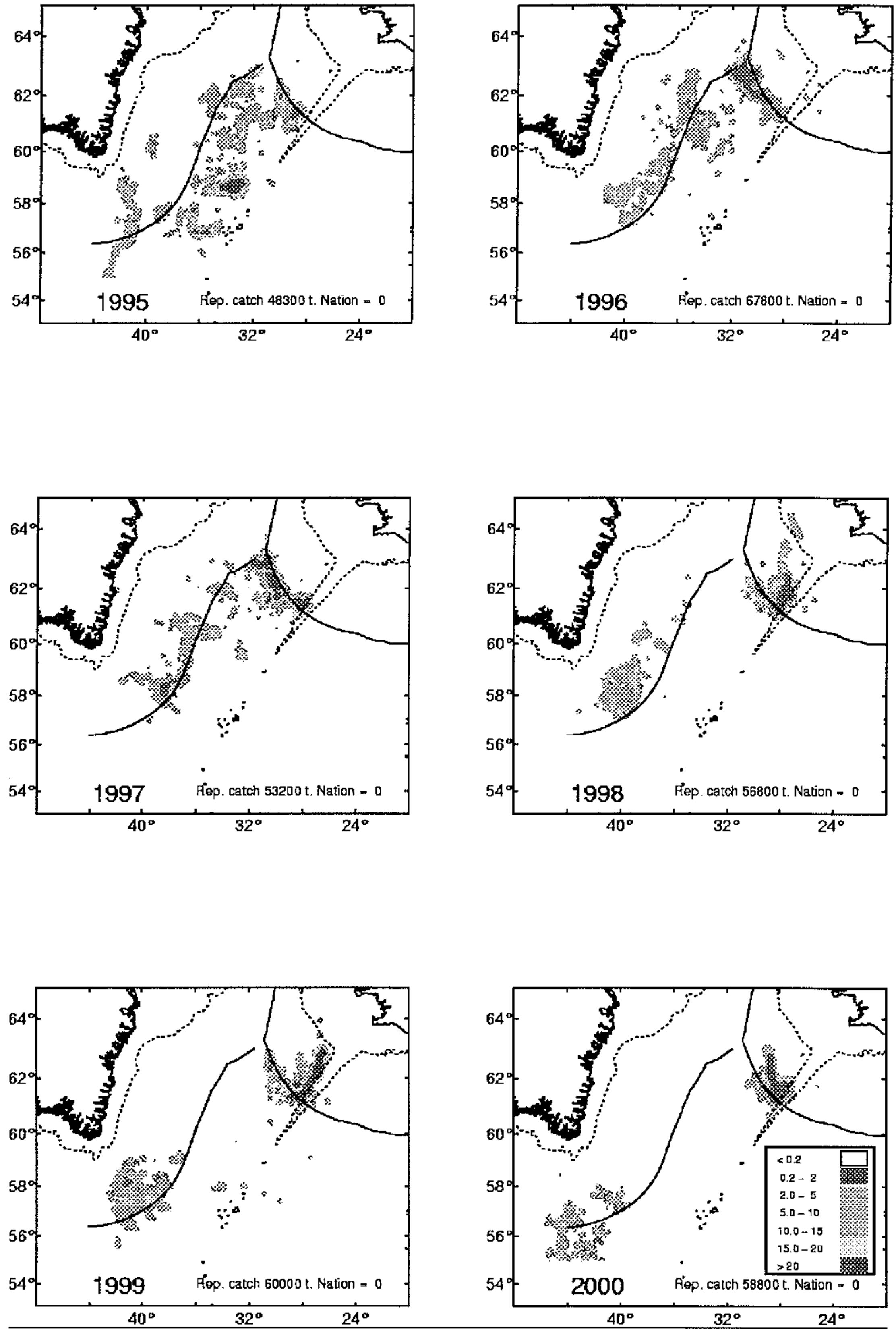


Figure 3.2.6.a.5 Fishing areas of the pelagic redfish by year from 1995–2000. Data from Germany (1995–2000), Norway (1995–1999) Greenland (1999–2000) and Iceland (1995–2000). The scale given on the pictures indicates the catches in tonnes per square nautical mile.

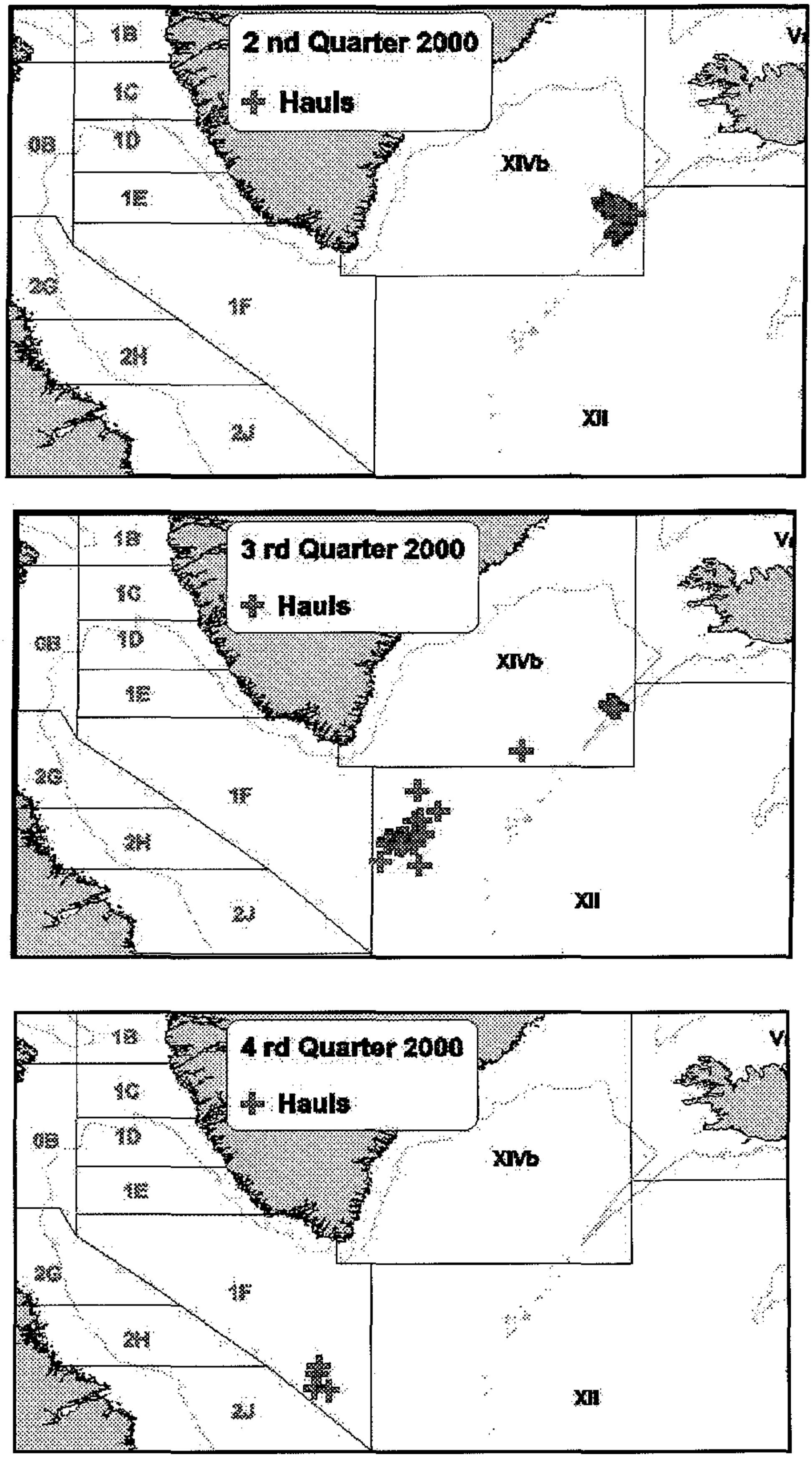


Figure 3.2.6.a.6 Fishing effort distribution by quarter in the Spanish oceanic redfish fishery in 2000.

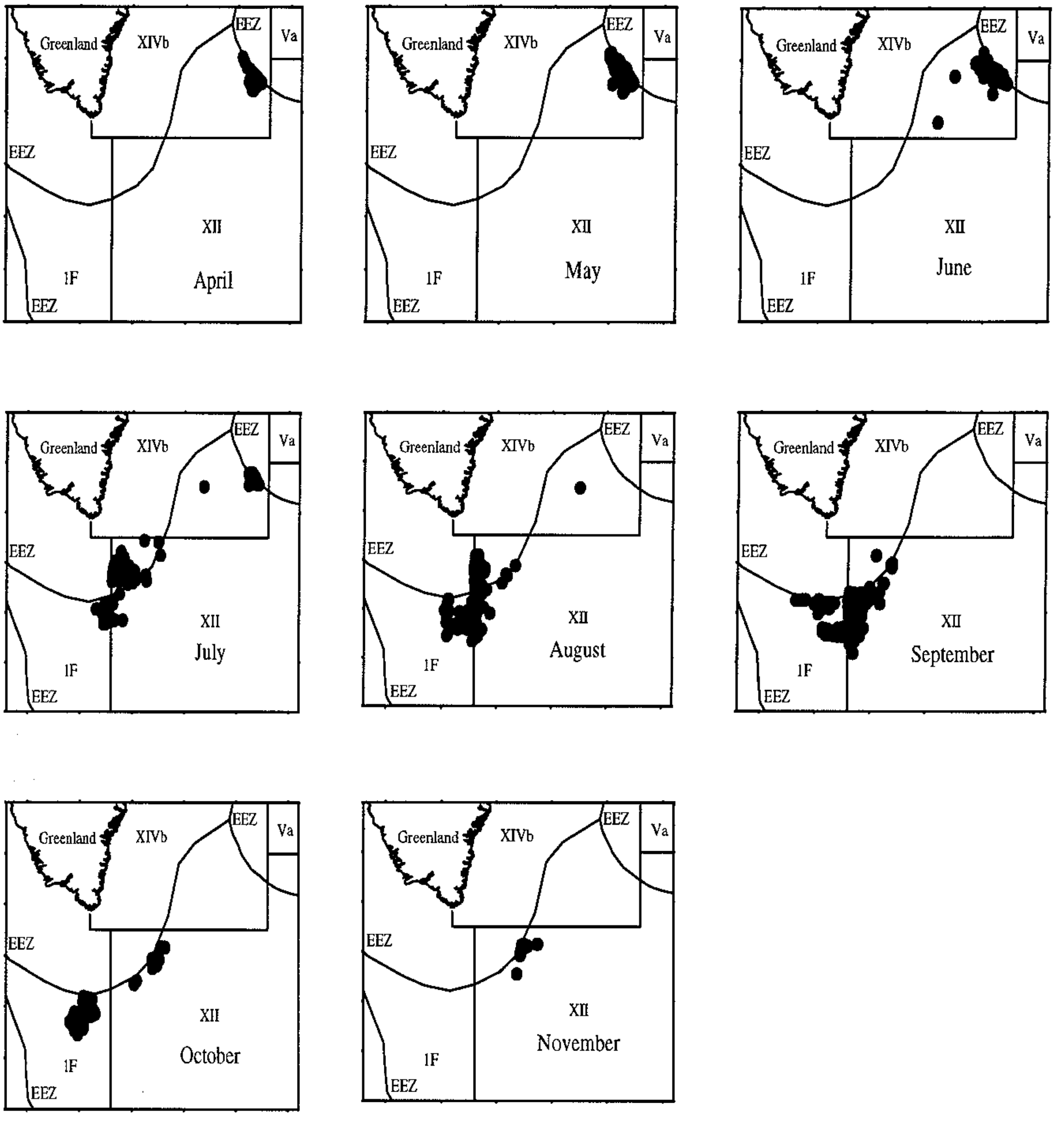


Figure 3.2.6.a.7 Russian fleet monthly position in the Irminger Sea in 2000.

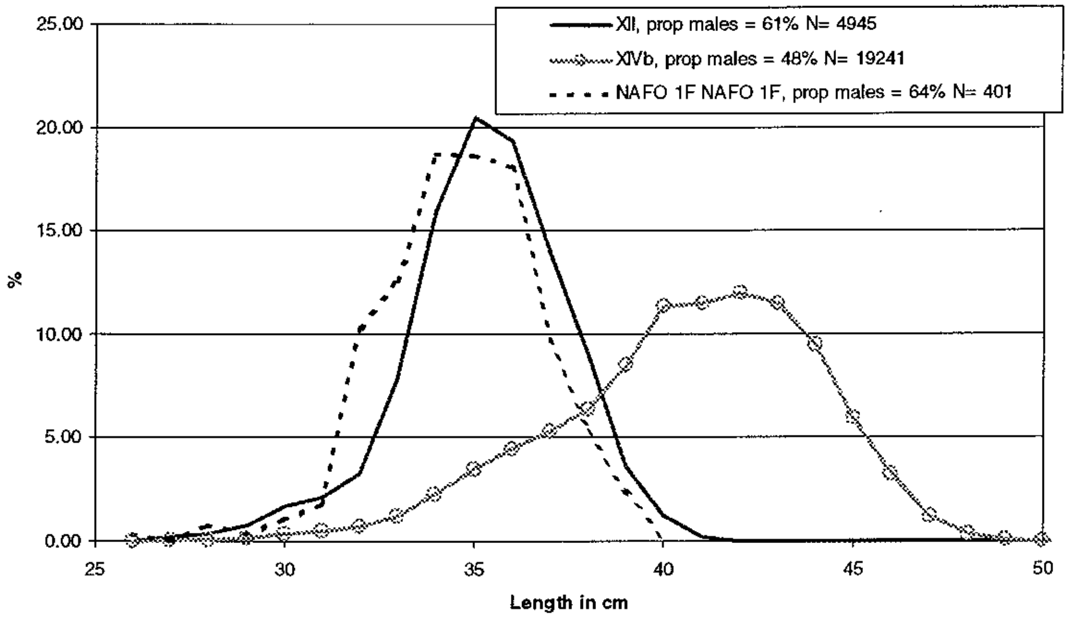


Figure 3.2.6.a.8 Length distribution of the Spanish oceanic redfish fishery in ICES Div. XII, XIV+Va and in NAFO Div. 1F in 2000. The proportion of males is also given.

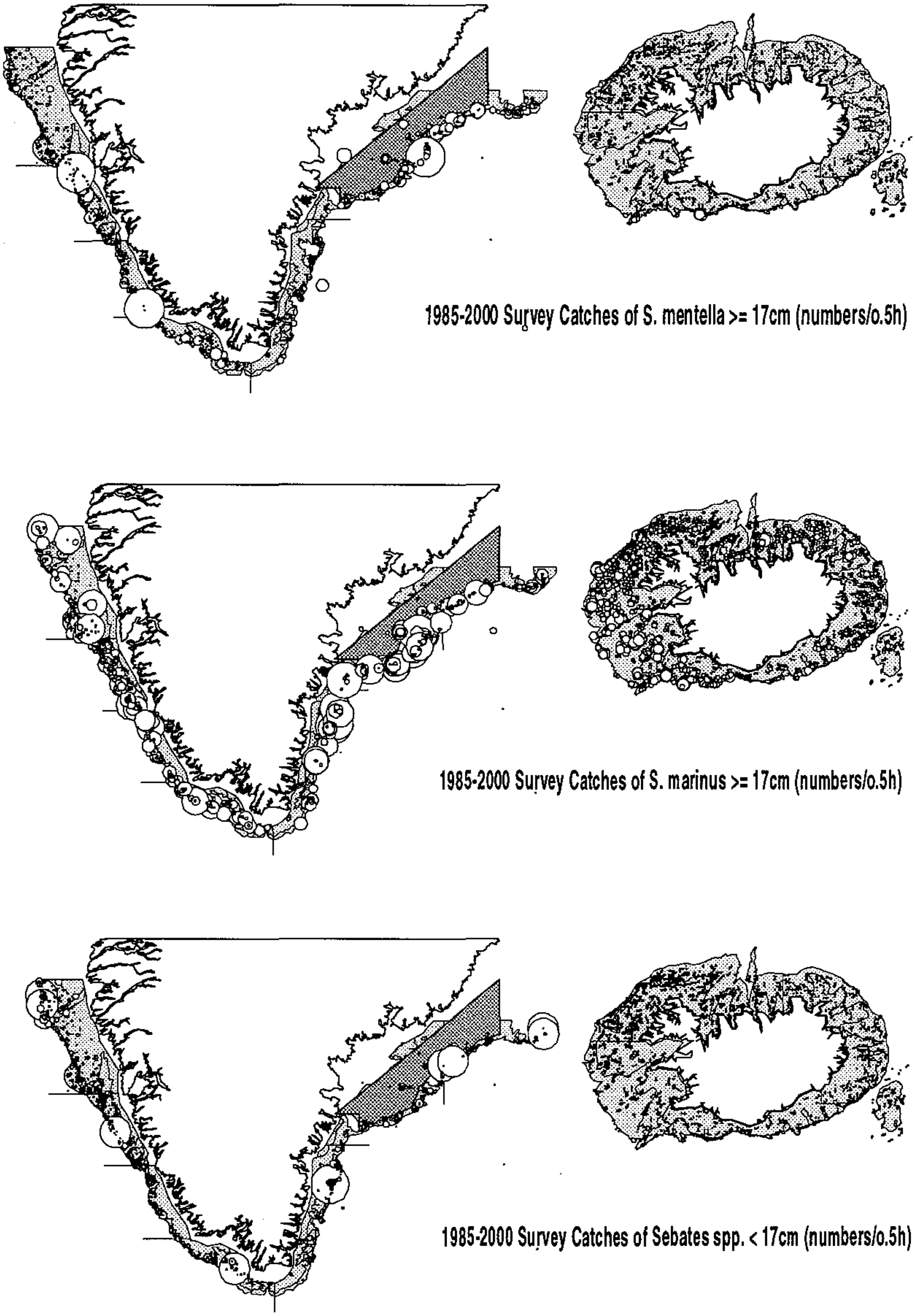


Figure 3.2.6.a.9 Distribution of 1985–2000 survey catches of *S. marinus* ≥17cm, *S. mentella* ≥17cm and unspecified juveniles redfish in numbers/0.5h around Greenland and Iceland at 0–400 m depth. The redfish box is dark shaded.

3.2.6.b *Sebastes marinus* in Sub-areas V, VI, XII and XIV

State of stock/fishery: The stock is considered to be outside safe biological limits. According to survey information, the stock in Division Va has fluctuated between $\mathbf{U_{pa}}$ and $\mathbf{U_{lim}}$ since 1990 (Figure 3.2.6.b.1). In Sub-area XIV the German groundfish survey has shown an almost continuous decrease in biomass indices by more than 90% since 1986, and *S. marinus* at East-Greenland has been nearly depleted in the most recent six years (Figure 3.2.6.b.2). In Division Vb catches have declined since 1985 to a low level in recent years, which is also reflected in the commercial CPUE (Figure 3.2.6.b.4). Research surveys indicate that the 1990/91 year class is the only year class likely to recruit as average or strong in the near future, but its size is uncertain.

Management objectives: There is no explicit management objective for this stock.

Precautionary Approach reference points (unchanged since 1999):
ICES suggests that the relative state of the stock be assessed through survey CPUE index series (U).

ICES considers that:	ICES proposes that:
$\mathbf{U_{lim}}$ = 20% of highest observed survey index.	$\mathbf{U_{pa}}$ be set at 60% of highest observed survey index.

Technical basis:

The basis for the calculation of the $\mathbf{U_{pa}}$ is a survey index series starting in 1985 (Figure 3.2.6.b.1). Since 1990 the average U has been around half of U_{max}. This has not resulted in any strong year classes compared to higher U's. A precautionary U_{pa} is therefore proposed at U_{max}*0.6, corresponding to the U's associated with the most recent strong year class.

Advice on management: ICES advises that effort should be reduced by 25%, corresponding to catches not exceeding a total of 29 000 t in ICES Divisions Va and Vb. As the fishable stock of *S. marinus* in Sub-area XIV is depleted, ICES advises that there be no direct fishery for *S. marinus* in that Sub-area. Fishing effort should not be allowed to expand on the incoming 1990/91 year class to keep the stock from decreasing in the near future.

Relevant factors to be considered in management: Apart from the 1990/1991 year class, no strong recruitment is expected for the stock for several years.

The effort in Division Va seems to have been reduced considerably since 1995, and a catch of 29 000 t corresponds to a 25% reduction in 2000 effort. In Sub-area XIV the fishable stock of *S. marinus* is depleted.

Comparison with previous assessment and advice: The assessment and advice are in line with those given last year.

Catch forecast for 2002: Catch in 2002 was estimated as a function of the average survey index 1999–2001 and the effort in 2000.

Elaboration and special comment: *S. marinus* are mainly taken by trawlers in depths down to 500 m. In Division Va the catch is mainly taken by Icelandic trawlers, while in Division Vb Faroese trawlers predominate. In Sub-area XIV the catches are mainly by-catch in shrimp fisheries. Total catches decreased almost continuously from 1983–1996, but have increased slightly since then. The decline occurred in all sub-areas. In order to reduce the catches of *S. marinus* in Division Va, an area closure was imposed in 1994 and the quotas have been reduced in the most recent years.

Icelandic survey data, data from a German groundfish survey in Sub-area XIV, and from the Faroes groundfish survey in Division Vb are used as indicators of the stock size in the respective areas.

Source of information: Report of the North-Western Working Group, April/May 2001 (ICES CM 2001/ACFM:20).

Catch data (Table 3.2.6.b.1):

Year	ICES Advice	Predicted catch Corresp. to advice	S. marinus ACFM catch	Combined ACFM catch[1]
1987	No increase in F	83	77	115
1988	No increase in F	84	90	121
1989	TAC[1]	117[1]	57	111
1990	TAC[1]	116[1]	67	111
1991	Precautionary TAC	77(117[1])	56	124
1992	Precautionary TAC	76(116[1])	56	119
1993	Precautionary TAC[1]	120[1]	50	124
1994	Precautionary TAC, if required	100[1]	43	127
1995	TAC	90[1]	45	101
1996	TAC for Va (28); precautionary TAC for Vb and XIV	32[2]	37	79
1997	Effort 75% of 1995 value	32[2]	40	83
1998	Effort reduced in steps of 25% from the 1995 level	37.2[2]	39	77
1999	Effort not increased compared to 1997	35[2]	42	77
2000	Catch not increased compared to 1998	35[2]	44	80
2001	Effort not increased compared to 1999	33[2,3]		
2002	25% reduction in effort	29[4]		

Weights in '000 t. [1] Deep-sea *S. mentella* and *S. marinus* combined. [2]*S. marinus* only. [3] In Va only. [4]Both Va and Vb and XIV.

Sebastes marinus in Sub-areas V, VI, XII and XIV

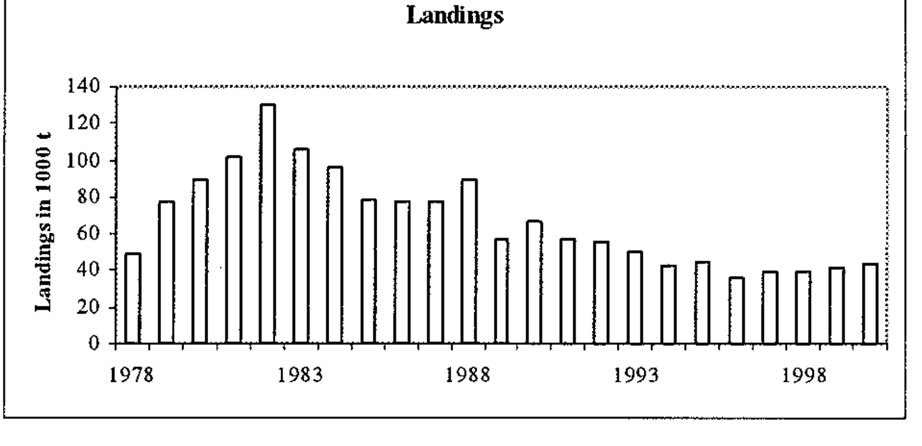


Table 3.2.6.b.1 *S. marinus*. Landings (in tonnes) by area used by the Working Group.

Year	Va	Vb	VI	XII	XIV	Grand Total
1978	31,300	2,039	313	0	15,477	49,129
1979	56,616	4,805	6	0	15,787	77,214
1980	62,052	4,920	2	0	22,203	89,177
1981	75,828	2,538	3	0	23,608	101,977
1982	97,899	1,810	28	0	30,692	130,429
1983	87,412	3,394	60	0	15,636	106,502
1984	84,766	6,228	86	0	5,040	96,120
1985	67,312	9,194	245	0	2,117	78,868
1986	67,772	6,300	288	0	2,988	77,348
1987	69,212	6,143	576	0	1,196	77,127
1988	80,472	5,020	533	0	3,964	89,989
1989	51,852	4,140	373	0	685	57,050
1990	63,156	2,407	382	0	687	66,632
1991	49,677	2,140	292	0	4,255	56,364
1992	51,464	3,460	40	0	746	55,710
1993	45,890	2,621	101	0	1,738	50,350
1994	38,669	2,274	129	0	1,443	42,515
1995	41,516	2,581	606	0	62	44,765
1996	33,558	2,316	664	0	59	36,597
1997	36,342	2,839	542	0	37	39,761
1998	36,771	2,565	379	0	109	39,825
1999	39,824	1,436	773	0	7	42,040
2000	41,110	1,558	776	0	89	43,533

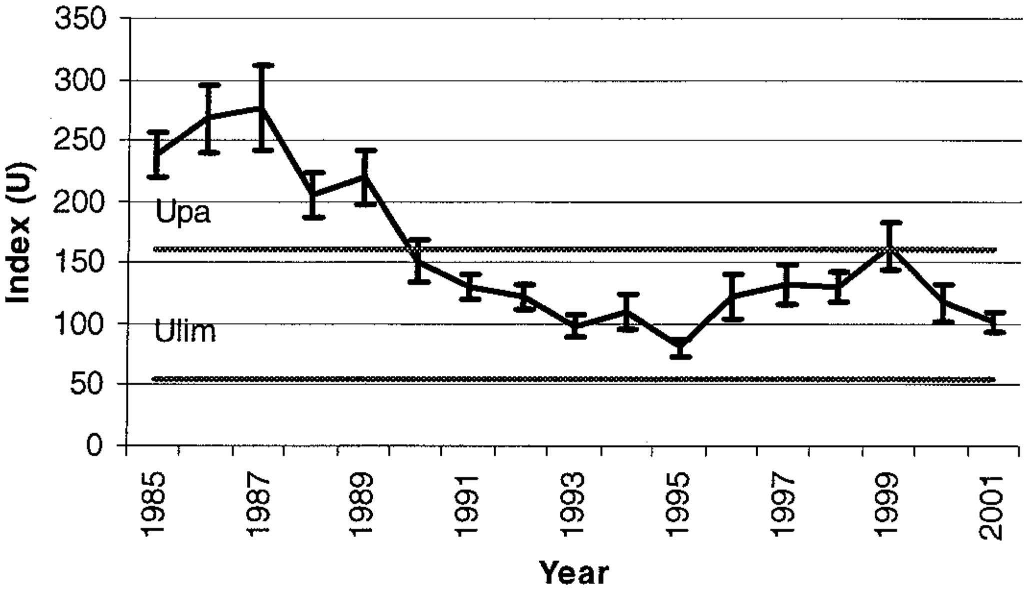


Figure 3.2.6.b.1. Index on fishable stock of *S. marinus* from Icelandic groundfish survey and 95% confidence intervals. The index is based on all strata at depths from 0–400 m.

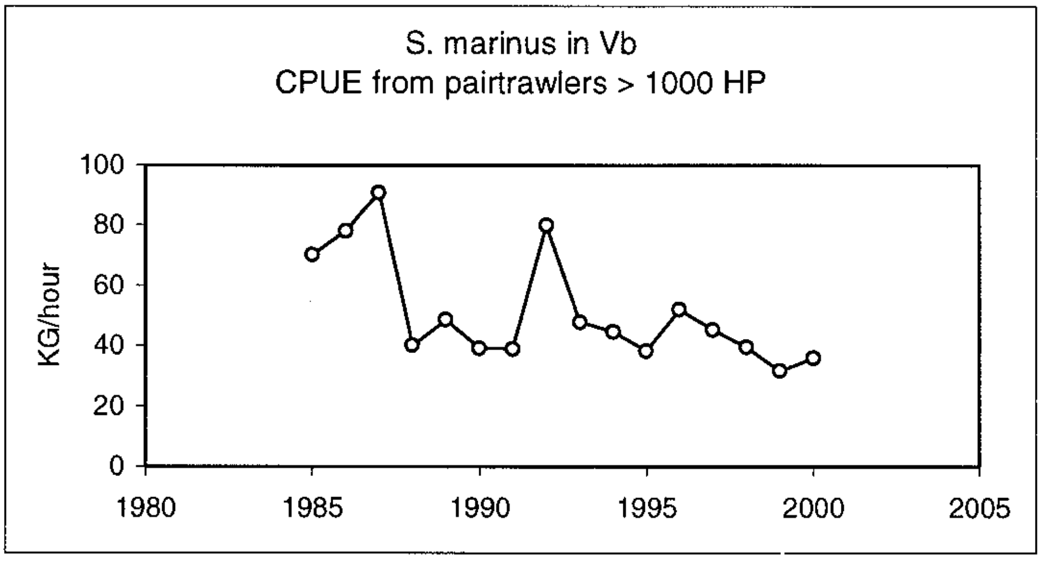


Figure 3.2.6.b.2 *S. marinus*. Faroese CPUE.

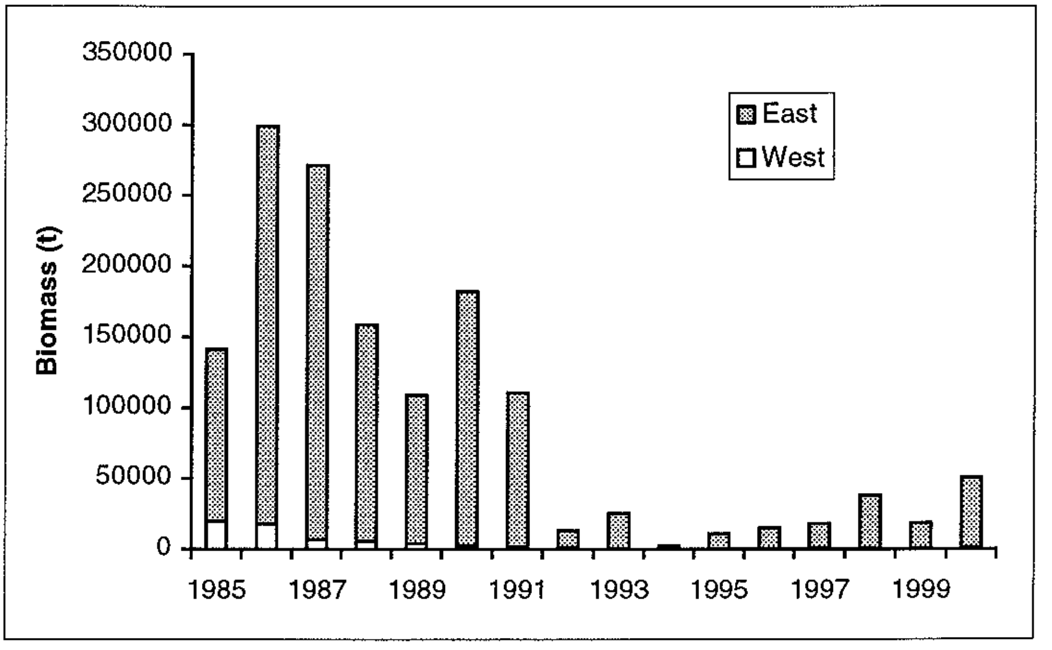


Figure 3.2.6.b.3 *S. marinus* (≥17 cm). Survey biomass indices for East and West Greenland, 1982–2000.

3.2.6.c Deep-sea *Sebastes mentella* on the continental shelf in Sub-areas V, VI and XIV

State of stock/exploitation: The stock as whole is considered to be inside safe biological limits although status varies among regions. All CPUE indices show a substantial reduction from a high in the late 1980s, but from the mid-1990s the CPUE index from the Icelandic bottom fishery has remained relatively stable, slightly above $\mathbf{U_{pa}}$.

Since 1994 total catches have declined by about 50%, although the decline is not completely the consequence of declining stock status. Some of the decline is due to catch restrictions which have substantially reduced effort since 1994.

Based on survey results the SSB of deep-sea *S. mentella* on the continental shelf in Sub-area XIV remains severely depleted (Figure 3.2.6.c.2).

Management objectives: There is no explicit management objective for this stock. However, for any management objectives to meet precautionary criteria U should be greater than $\mathbf{U_{pa}}$.

Precautionary Approach reference points:

ICES considers that:	ICES proposes that:
The maximum index in the CPUE series from the Icelandic commercial bottom trawl fishery set as $\mathbf{U_{max}}$.	$\mathbf{U_{pa}=U_{max}/2}$. $\mathbf{U_{lim}=U_{max}/5}$.

Technical basis:

The basis for the calculation of the $\mathbf{U_{pa}}$ is a CPUE data series from the commercial fishery in Division Va starting in 1985 (Figure 3.2.6.c.1).

Advice on management: ICES advises that the effort should not increase above the current level. Accordingly, the catch for the total stock should not exceed 36 000 t. As the fishable stock of *S. mentella* in Sub-area XIV is depleted ICES advises that there should be no direct fishery for *S. mentella* in that Sub-area.

Relevant factors to be considered in management: The German surveys in East Greenland cover nursery grounds for *S. mentella*. The survey observed strong cohorts in 1995–1998, with record high catches in 1997. The cohorts have emigrated from the survey area and coincide with strong incoming cohorts in both pelagic deep-sea *S. mentella* and oceanic *S. mentella*. Therefore, the nursery grounds of *S. mentella* on the continental shelf in Sub-area XIV probably supply recruits to both the pelagic redfish stocks in the Irminger Sea and the shelf stock in Divisions Va and Vb. The possible strong cohorts observed in the survey could enter the fishable stock 5–10 years after appearing in the surveys.

Comparison with previous assessment and advice: The CPUE series, which is the basis for the advice has been revised. This has changed the perception of the state of the stock from being somewhat below $\mathbf{U_{pa}}$ to being slightly above $\mathbf{U_{pa}}$. The advice given for 2001 (22 000 t) was for Division Va, but the advice for 2002 (36 000 t) is for the entire stock.

Catch forecast for 2002: Catch in 2002 was estimated as a function of an average standardized CPUE series 1998–2000 and the effort in 2000.

Elaboration and special comment: In Division Va deep-sea *S. mentella* are taken mainly by Icelandic trawlers in depths greater than 500 m. In Division Vb the fishery is carried out mainly by Faroese trawlers, though some by-catch is taken by other countries fishing demersal species. In Sub-area XIV the catch is taken largely by German freezer trawlers. The annual catches almost doubled in the early 1990s, but since then have decreased to the level of the 1980s. The increase was mainly caused by an increase in Division Va, both in the demersal and a temporarily developed pelagic fishery, and by an increase in Sub-area XIV in 1993–1994.

Data and assessment: No data were available to make an analytical assessment. CPUE data are available from Icelandic trawlers in Division Va (1986–2000), the Faroese fishery in Division Vb (1985-2000), and from the German groundfish survey in Sub-area XIV (1982–2000).

Source of information: Report of the North-Western Working Group, April/May 2001 (ICES CM 2001/ACFM:20).

Catch data (Table 3.2.6.c.1):

Year	ICES Advice	Predicted catch corresponding to advice	Deep-sea *S. mentella* ACFM catch	Combined ACFM catch[1]
1987	Precautionary TAC	41–58	38	115
1988	Precautionary TAC	41–58	31	121
1989	TAC[1]	117[1]	54	111
1990	TAC[1]	116[1]	44	111
1991	Precautionary TAC	(40) 117[1]	68	124
1992	Precautionary TAC	(40) 116[1]	63	119
1993	Precautionary TAC[1]	120[1]	74	124
1994	Precautionary TAC, if required	100[1]	84	127
1995	TAC	90[1]	56	101
1996	Precautionary TAC (45 in Va; 23 in VI and XIV)	68[2]	42	79
1997	Effort 75% of 95-value	39[2]	43	83
1998	Fishing mortality be further reduced towards the 86-90 levels		38	77
1999	Fishing mortality be further reduced towards the 86-90 levels		35	77
2000	Fishing effort be further reduced by 25%		37	80
2001	Fishing effort be reduced by 25% from 1998 level	22[3]		
2002	*Status quo* fishing effort	36[4]		

Weights in '000 t. [1] Deep-sea *S. mentella* and *S. marinus* combined. [2]Deep-sea *S. mentella* only. [3]In Va only. [4] For entire Sub-area V.

Deep-sea Sebastes mentella Sub-areas V, VI and XIV

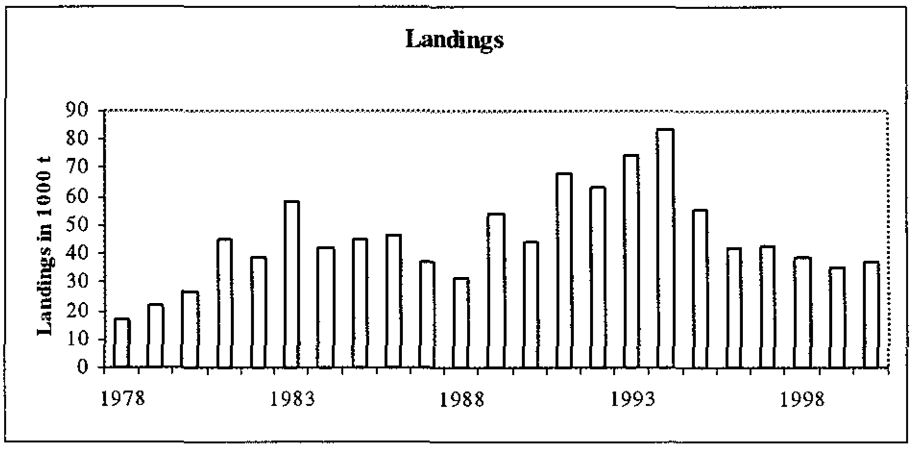


Table 3.2.6.c.1 Deep-sea *S. mentella* on the continental shelf. Landings (in tonnes) by area used by the Working Group.

Year	Va	Vb	VI	XII	XIV	Total
1978	3,902	7,767	18	0	5,403	17,090
1979	7,694	7,869	819	0	5,131	21,513
1980	10,197	5,119	1,109	0	10,406	26,831
1981	19,689	4,607	1,008	0	19,391	44,695
1982	18,492	7,631	626	0	12,140	38,889
1983	37,115	5,990	396	0	15,207	58,708
1984	24,493	7,704	609	0	9,126	41,932
1985	24,768	10,560	247	0	9,376	44,951
1986	18,898	15,176	242	0	12,138	46,454
1987	19,293	11,395	478	0	6,407	37,573
1988	14,290	10,488	590	0	6,065	31,433
1989	40,269	10,928	424	0	2,284	53,905
1990	28,429	9,330	348	0	6,097	44,204
1991	47,651	12,897	273	0	7,057	67,879
1992	43,414	12,533	134	0	7,022	63,103
1993	51,221	7,801	346	0	14,828	74,196
1994	56,720	6,899	642	0	19,305	83,566
1995	48,708	5,670	540	0	819	55,737
1996	34,741	5,337	1,048	0	730	41,856
1997	37,876	4,558	418	0	199	43,050
1998	33,125	4,089	298	3	1,376	38,890
1999	28,590	5,294	243	0	865	34,992
2000	30,696	4,893	885	0	994	37,468

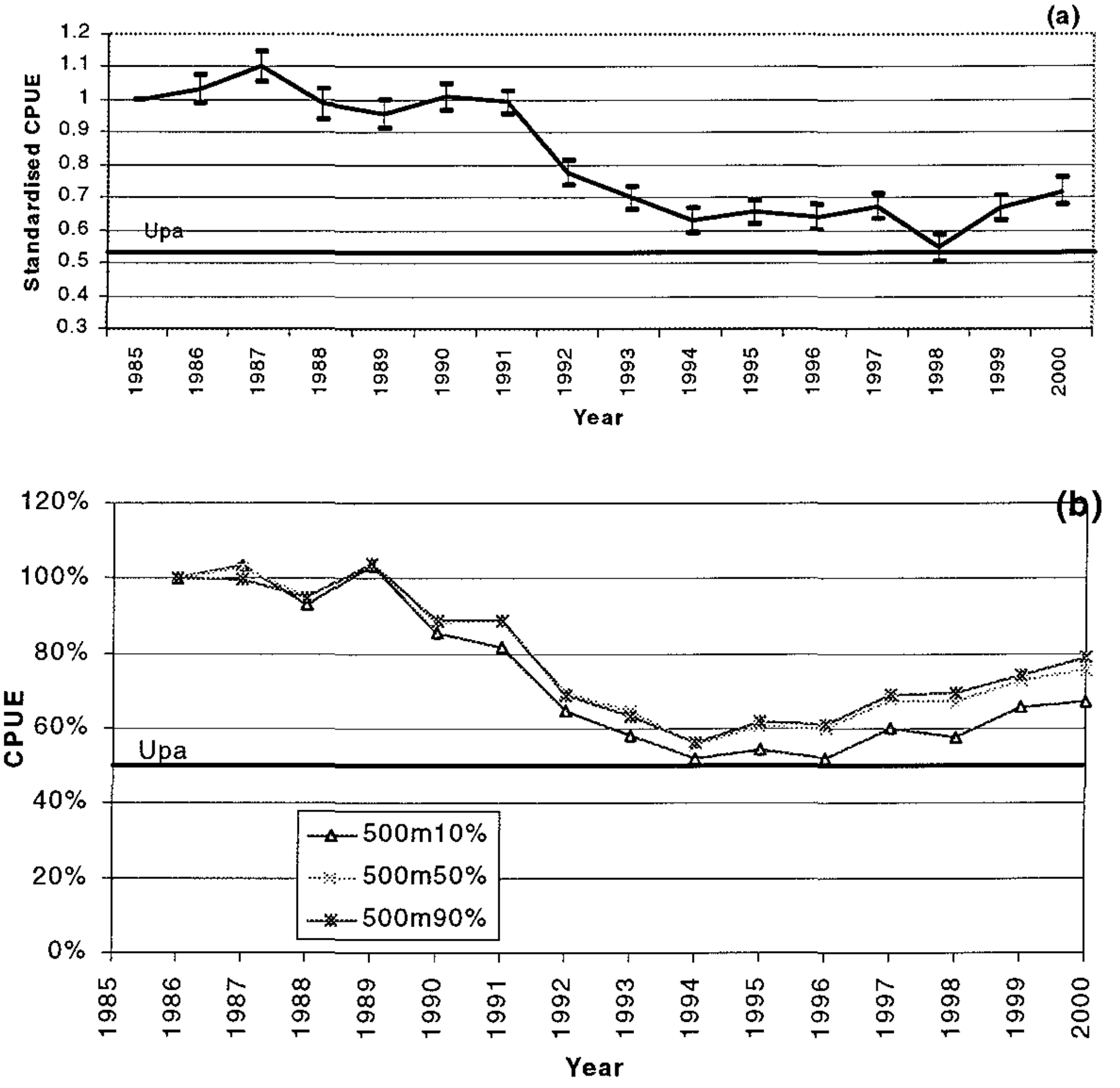


Figure 3.2.6.c.1 CPUE, relative to 1986, from the Icelandic bottom trawl fishery for deep-sea *S. mentella* on the continental shelf, based on a GLIM model (a) and based on simple mean (b). The GLIM model shows the modeled development using GLIM, including hauls where redfish deeper than 500 m compose 50% or more of the total catch in each haul. Simple mean means CPUE calculated on hauls where redfish deeper than 500 m compose 10% (50, 70, or 90% lines are also shown) or more of the total catch in each haul.

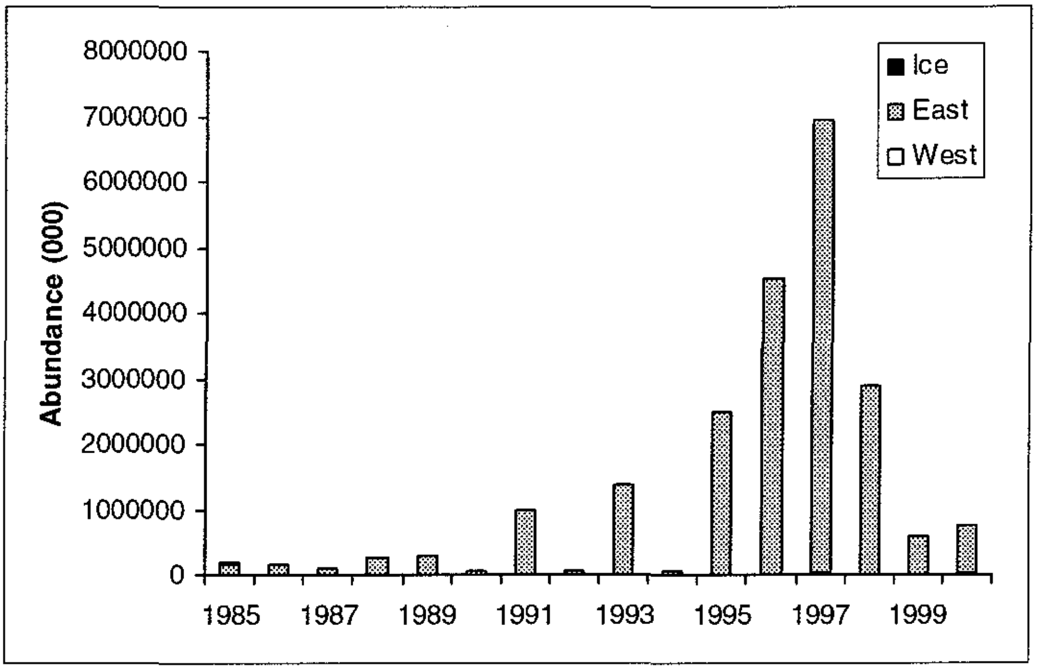


Figure 3.2.6.c.2 Deep-sea *S. mentella*, >=17 cm) on the continental shelf. Survey abundance indices for East and West Greenland and Iceland as derived from the German and Icelandic groundfish surveys, 1985–2000.

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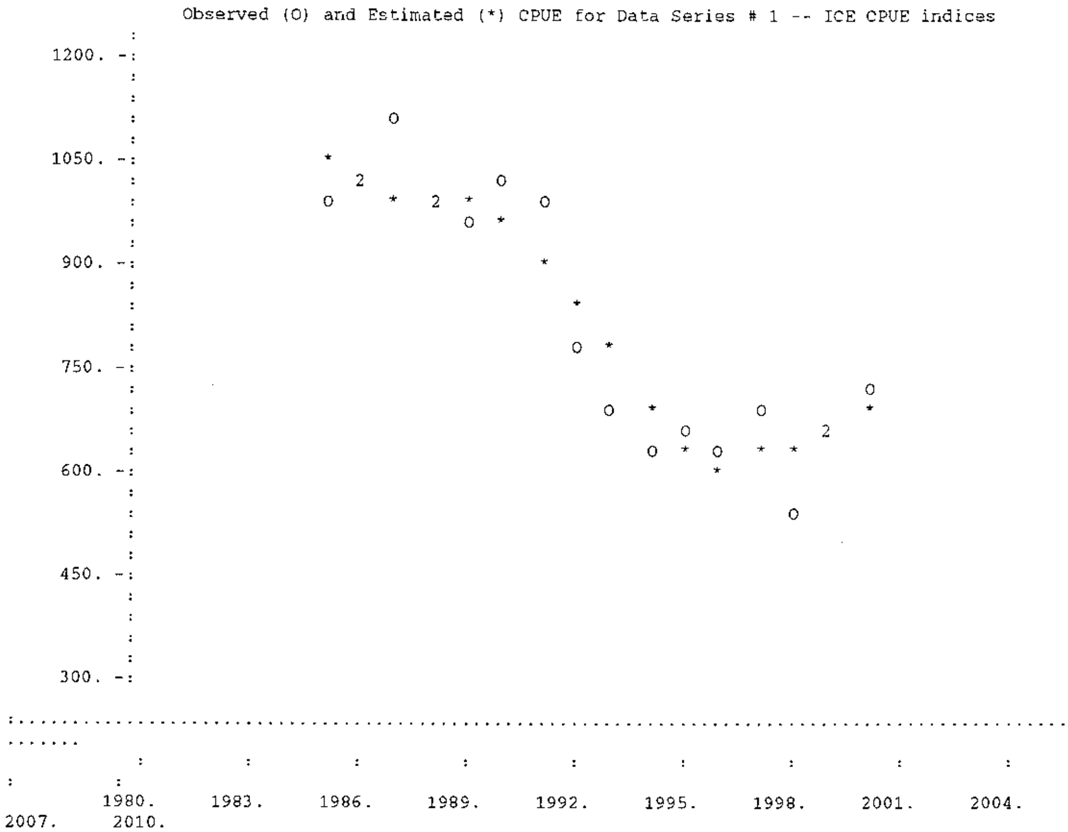
Page 4



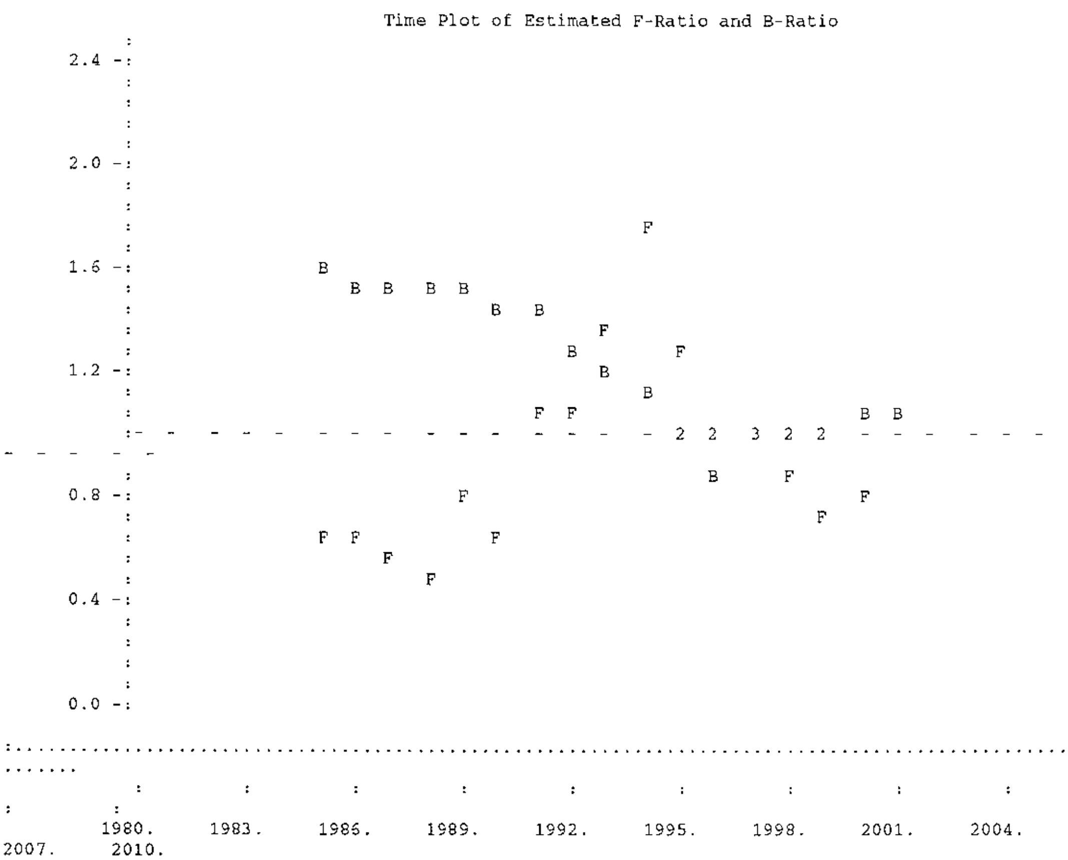


Figure 3.2.6.c.3 Observed and estimated CPUE and time plot of estimated F and B ratio for *S. mentella*, using the ASPIC production model.

3.2.6.d Pelagic fishery for *Sebastes mentella* in the Irminger Sea

The stock structure of deep-sea redfish *S. mentella* in Sub-area XII, Division Va and Sub-area XIV and NAFO Div. 1F remains generally uncertain. There is a difference in the depth distribution of the two pelagic redfish types, namely the 'oceanic *S. mentella*', mainly above 500 meters, and the 'pelagic deep-sea *S. mentella*', mainly below.

State of stock/exploitation: The stock appears to be at or below 50% of the biomass in the early the 1980s, which was estimated to be around 3 million tons, although stock indicators are uncertain. The 1999 survey indicated a continued reduction in the stock abundance and biomass above 500 m, with a major portion of the stock found in the NAFO Div. 1F for the first time. The survey estimated an additional biomass index of around 500 000 t below 500 m.

A negative trend is seen in the CPUE shallower than 500 m. A recruitment pulse to the fishable stock was observed in 1999, both below and above 500 m. The recent catches might be above the 5 % exploitation rate considered sustainable.

Management objectives: There is no explicit management objective for this stock. However, for any management objective to meet precautionary criteria, U (index for trawl-acoustic surveys) should be greater than the proposed U_{pa}.

Advice on management: ICES again advises a reduction of catches in 2002 to below 85 000 t (including NAFO Div. 1F). In addition, ICES advises that management measures are required to ensure that the possible stock components in the pelagic fishery in the Irminger Sea will not be overexploited. These measures are necessary because of the large decline in biomasses and CPUE during the 1990s, the low productivity of the stock, and the need to prevent further declines in the stock.

Comparison with previous assessment and advice: The most recent survey information is derived from 1999. The next international hydroacoustic survey is planned for June/July 2001.

Special requests:

NEAFC has requested ICES as follows:

- There are uncertainties about the stock structure of pelagic redfish in the Irminger Sea. Genetic studies suggest that *Sebastes mentella* in this area, like many other species of *Sebastes,* has a complex stock structure. However, the number of separable units, and the degree of exchange among them, both genetically and in terms of their population dynamics, is largely unknown. Moreover, their relative productivities are also unknown, but may not be equal. In light of these sources of uncertainty and the risk of local depletions of populations, which would recover very slowly, if at all, management should emphasize distributing effort widely, and monitoring local units for evidence of depletion. Associated risks in overexploitation of the different stock components managed under a common TAC cannot be quantified.

- Since 1998 a) the fisheries in the northeastern area in the first half of the year occurred at depths greater than 500 m and catching larger fish, and b) the fisheries in the southwestern area in the second half of the year occurred mainly at depths shallower than 500 m catching smaller fish.

Relevant factors to be considered in management: The advised catch of 85 000 t is 75% of the 1997–99 average, a period when catches were unsustainable.

The estimated biomass in the 1999 acoustic survey was between 10 and 20% of that estimated in the early 1990s. However, the 1999 acoustic survey estimate is considered an underestimate due to significant changes in horizontal and vertical stock distribution patterns.

Changes in fishery patterns in recent years forming 2 almost distinct fishing grounds in terms of geographic distribution and trawling depth, and unknown stock structure provide further cause for concern. In 2000, substantial catches were taken for the first time from the pelagic *S. mentella* aggregations discovered recently in NAFO Div. 1F. There are, as of yet, no indications that the pelagic *S. mentella* in NAFO Div. 1F are distinct from the stock(s) or components in the adjacent Irminger Sea, so these catches may represent an increase in exploitation of the stock that has supported the fishery in the Irminger Sea.

There may be a relationship between the demersal deep-sea *S. mentella* on the continental shelves of the Faroe Islands, Iceland, Greenland and the pelagic *S. mentella* components in the Irminger Sea and this should be kept in mind in the management of these components.

Management action should be taken to prevent a disproportional high exploitation rate of any one component.

Since this is a relatively new fishery on a long-lived, slow-growing species, ICES notes that monitoring of the stock is essential in order to keep track of biomass changes as they occur. Similarly, it is important to gather the information needed to evaluate the productivity of the stock. This includes information on recruitment, nursery areas, stock identification and biomass estimation.

Nursery areas for both of the pelagic stock components are likely to be found at the continental slope off East Greenland. The juvenile redfish in these areas should, therefore, be protected and appropriate measures to reduce the by-catches in the shrimp fishery need to be taken.

Elaboration and special comment: The pelagic fishery in the Irminger Sea is conducted only on the mature part (approximately 95% mature) of the stock. The fishery started in 1982. After decreasing from 1988–1991, landings increased. The decrease was mostly due to a reduction in Russian effort. The increase in the catches from 1991–1996 is a direct consequence of increased fishing effort due to new fleets entering the fishery. However, the catches have been significantly lower during the last 4 years; at the same time the fishery has expanded into deeper water and the season has expanded from March to December.

New survey information will be available after the June/July 2001 survey has been carried out.

Given the technical, seasonal, geographical and depth changes of the fishing activities, the relevance of the estimated reduction in CPUE as indicator of stock abundance remains difficult to assess both above and below 500 m.

Data on maturity at length, and at weight and some age-reading experiments were available from both the survey and from the fishery. CPUE series are available for some fleets (Figures 3.2.6.d.1–2).

Source of information: Report of the North-Western Working Group, April/May 2001 (ICES CM 2001/ACFM:20).

Catch data for oceanic and pelagic deep-sea *S. mentella* combined (Tables 3.2.6.d.1-2):

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC	ACFM Catch
1987	No assessment	-		91
1988	No assessment	-		91
1989	TAC	90–100		39
1990	TAC	90–100		32
1991	TAC	66		27
1992	Preference for no major expansion of the fishery	-		66
1993	TAC	50		116
1994	TAC	100		149
1995	TAC	100		176
1996	No specific advice	-	153[1]	180
1997	No specific advice	-	153–158[1]	123[2]
1998	TAC not over recent (1993-1996) levels of 150 000 t		153[1]	117[2]
1999	TAC to be reduced from recent (1993-1996) levels of 150 000 t		153[1]	110[2]
2000	TAC set lower than recent (1997-1998) catches of 120 000 t	85	120	127
2001	TAC less than 75% of catch 1997-1999	85	95	
2002	TAC less than 75% of catch 1997-1999	85		

[1]Set by NEAFC. [2]Preliminary. (Weights in '000 t).

Pelagic fishery for Sebastes mentella in the Irminger Sea

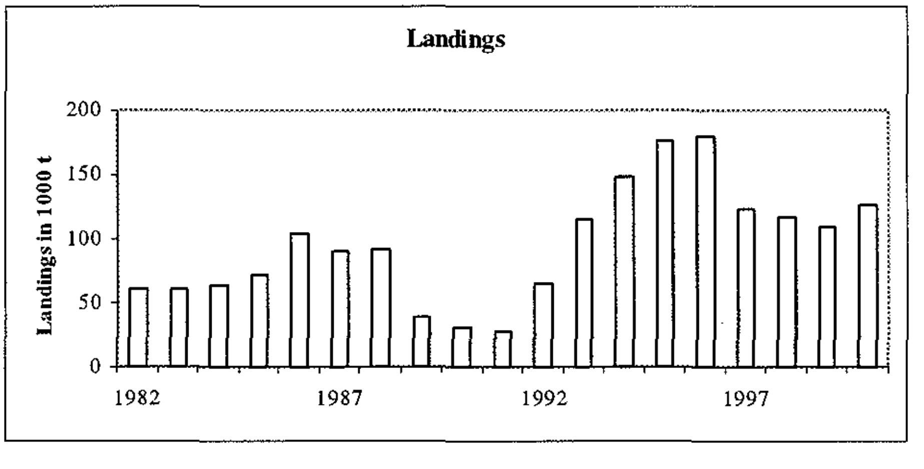


Table 3.2.6.d.1 Results of dividing the Icelandic pelagic redfish catch according to the Icelandic samples from the fishery.

Year	Total catch	Catch oceanic	Catch deep-sea	Not classified	% oceanic
1995	34631	24976	9521	134	72%
1996	62903	28361	32737	1805	46%
1997	41272	15001	26271	0	36%
1998	52284	5505	46780	446	10%
1999	43924	6765	37159	0	15%
2000	45232	2262	42970	0	5%

Table 3.2.6.d.2 Pelagic *S. mentella*. Landings (in tonnes) by area as used by the Working Group. Due to the lack of area reportings for some countries, the exact share in Divisions XII and XIV is approximate in latest years. The Table includes catches in NAFO Div. 1F.

Year	Va	Vb	VI	XII	XIV	NAFO 1F	Total
1978	0	0	0	0	0		0
1979	0	0	0	0	0		0
1980	0	0	0	0	0		0
1981	0	0	0	0	0		0
1982	0	0	0	39,783	20,798		60,581
1983	0	0	0	60,079	155		60,234
1984	0	0	0	60,643	4,189		64,832
1985	0	0	0	17,300	54,371		71,671
1986	0	0	0	24,131	80,976		105,107
1987	0	0	0	2,948	88,221		91,169
1988	0	0	0	9,772	81,647		91,419
1989	0	0	0	17,233	21,551		38,784
1990	0	0	0	7,039	24,477	385	31,901
1991	0	0	0	10,061	17,089	458	27,608
1992	1,968	0	0	23,249	40,745		65,962
1993	2,603	0	0	72,529	40,703		115,835
1994	15,472	0	0	94,189	39,028		148,689
1995	1,543	0	0	132,039	42,260		175,842
1996	4,744	0	0	42,603	132,975		180,322
1997	15,301	0	0	19,822	87,812		122,935
1998	40,612	0	0	22,446	53,910		116,968
1999	36,524	0	0	24,085	48,521	534	109,665
2000[1]	44,677	0	0	20,172	51,451	10,944	127,244

[1]) Provisional data

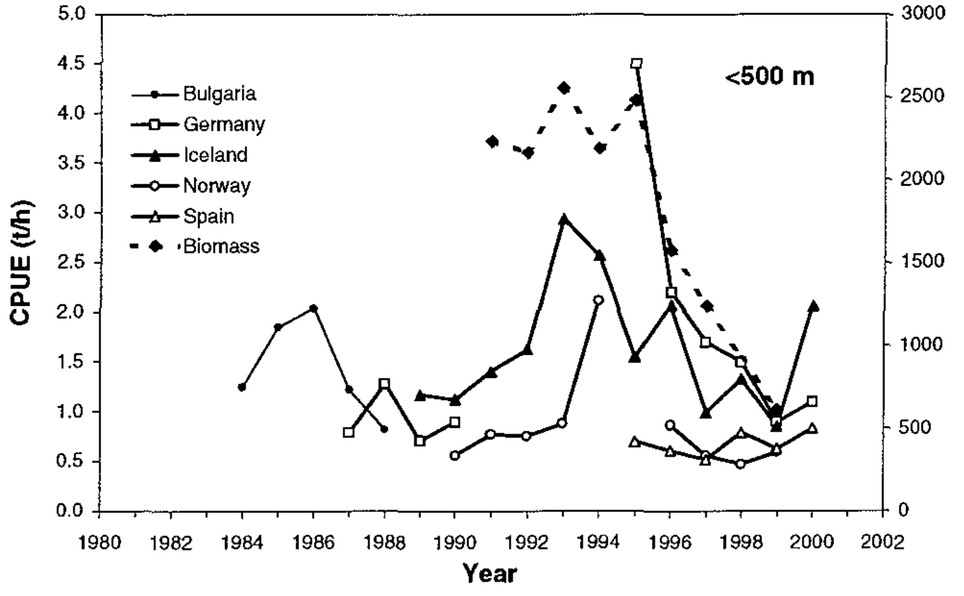


Figure 3.2.6.d.1 Trends in CPUE of pelagic *S. mentella* fishery in the Irminger Sea, shallower than 500m, and estimated acoustic biomass from surveys.

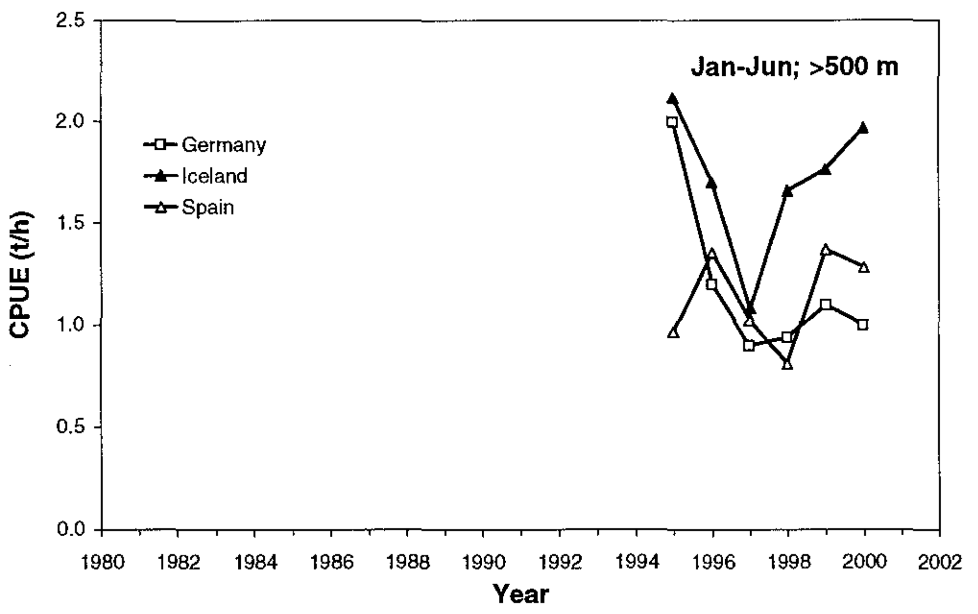


Figure 3.2.6.d.2 Trends in CPUE of pelagic *S. mentella* fishery in the Irminger Sea, deeper than 500m, and estimated acoustic biomass from surveys.

3.2.7 Icelandic summer-spawning herring (Division Va)

State of stock/exploitation: The stock is considered to be inside safe biological limits. The spawning stock biomass (SSB) in 2000 is estimated at its observed maximum (627 000 t). The current fishing mortality of 0.18 is well below the $\mathbf{F}_{pa}$.

Management objectives: The practice has been to manage this stock at F=$\mathbf{F}_{0.1}$ for more than 20 years. This fishing mortality is equal to $\mathbf{F}_{pa}$. However, no formal management strategy has been adopted.

Precautionary Approach reference points (proposed by ICES in 1999):

ICES considers that:	ICES proposed in 1998 that:
$\mathbf{B}_{lim}$ is 200 000 t	$\mathbf{B}_{pa}$ be set at 300 000 t
$\mathbf{F}_{lim}$ not defined	$\mathbf{F}_{pa}$ be set at 0.22

Technical basis:

$\mathbf{B}_{lim}$: SSB with a high probability of impaired recruitment	$\mathbf{B}_{pa}$: $\mathbf{B}_{pa} = \mathbf{B}_{lim}\, e^{1.645\,\sigma}$ $\sigma = 0.25$
$\mathbf{F}_{lim}$: -	$\mathbf{F}_{pa}$: $\mathbf{F}_{pa} = \mathbf{F}_{0.1}$=0.22 (based on a weighted average)

Advice on management: ICES recommends that this stock should be continued to be harvested at a fishing mortality rate of $\mathbf{F}_{0.1}$=0.22.

Relevant factors to be considered in management: Icelandic TACs apply to 1 September to 31 August. The TAC for the quota year 2001/2002 corresponding to the recommendation is 125 000 t. The 1992, 1993 and 1995 year classes are estimated to be below average, but the 1994 and 1996 – 1999 year classes are all estimated to be above average. In 2001/2002 it is expected that the 1996 year class will have the largest contribution to the catch in numbers.

Comparison with previous assessment and advice: There has been a general trend to overestimate SSB and underestimate F.

Catch forecast for 2002:

Basis: F(2001) = $F_{0.1}$ = 0.22; Landings (2001) = 125; SSB(2002) = 725.

F(2002)	Basis	Catch (2002)	Landings (2002)	SSB (2003)	Medium term effect of fishing at given level (calculated in 1995)
0.18	F_{2000}	113	113	820	Sustainable fishery
0.22	$\mathbf{F}_{0.1}$=$\mathbf{F}_{pa}$	139	139	795	ˮ
0.25	1.4*F_{2000}	153	153	780	

Weights in ´000 t.

Shaded scenarios considered inconsistent with the precautionary approach. For 2001 the fishing mortality $\mathbf{F}_{0.1}$ = 0.22 is assumed.

Medium- and long-term projections: Medium-term forecasts in 1995 showed that there was a low probability that the current harvest strategy will reduce the stock to below $\mathbf{B}_{pa}$.

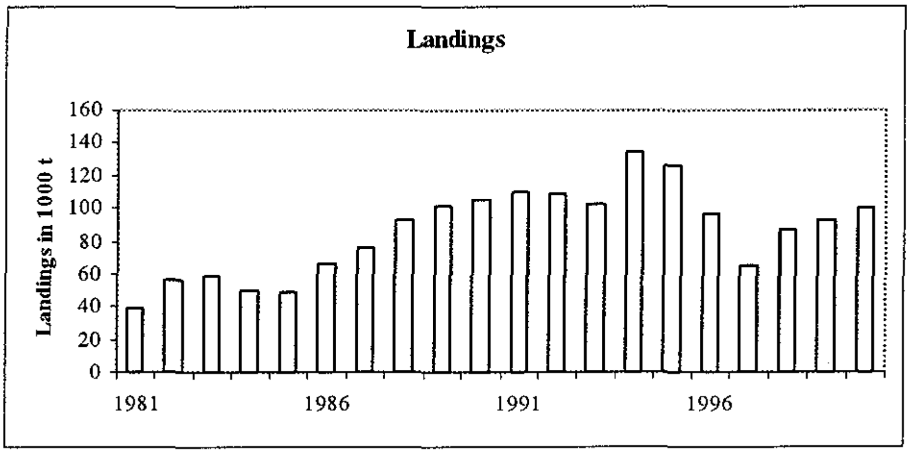
Elaboration and special comment: The catches of Icelandic summer-spawning herring increased rapidly in the early 1960s due to the development of the purse seine fishery off the south coast of Iceland. This resulted in a rapidly increasing exploitation rate until the stock collapsed in the late 1960s. A fishing ban was enforced during 1972–1975. Thereafter the catches have increased gradually to over 100 000 t. Previously the fleet consisted of multi-purpose vessels, mostly below 300 GRT, operating purse seines and drift nets. In recent years, larger vessels (up to 1500 GRT) have entered the fishery. These are combination purse seiners and pelagic trawlers operating in both the herring and capelin fisheries. In the past four seasons a considerable proportion of the catch has been taken with pelagic trawls.

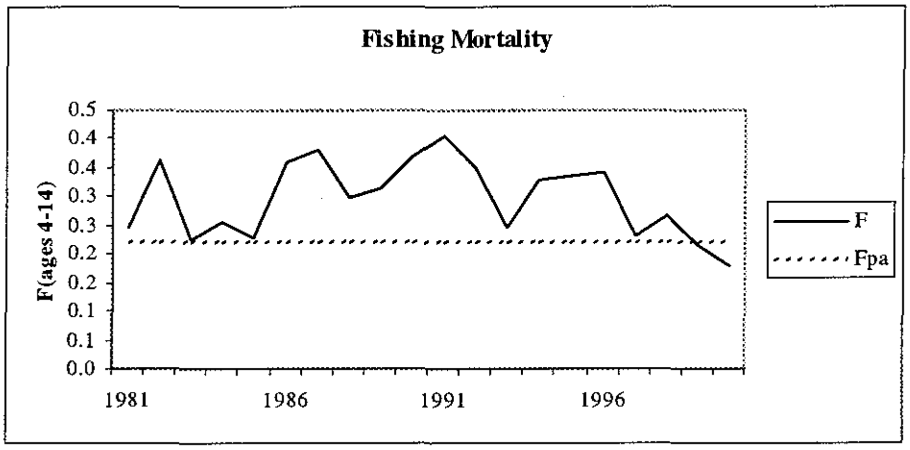
Source of information: Report of the Northern Pelagic and Blue Whiting Fisheries Working Group, April 2001 (ICES CM 2000/ACFM: 17).

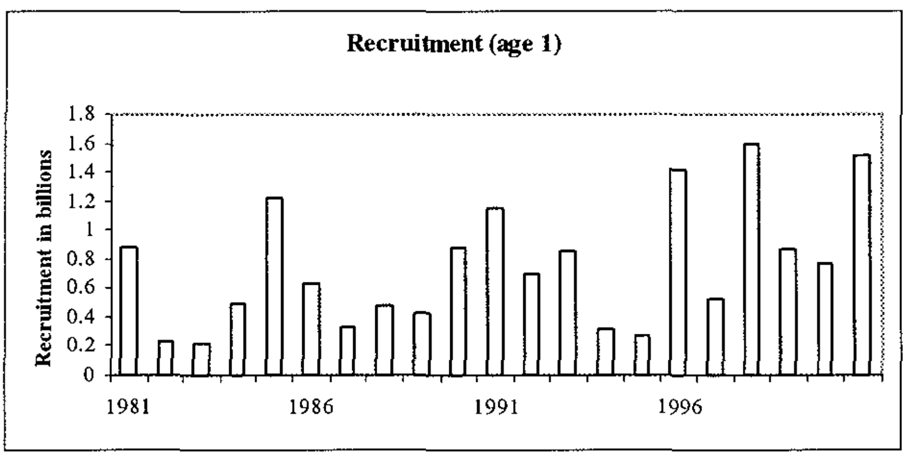
Catch data (Tables 3.2.7.1–2):

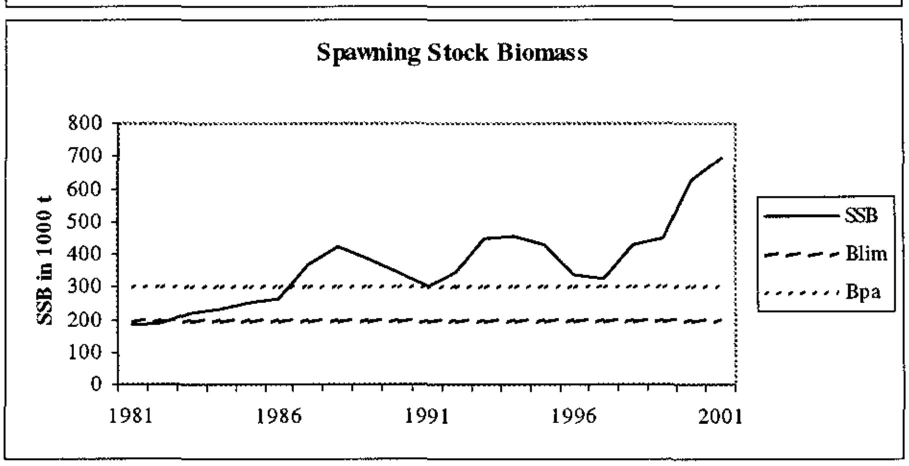
Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC	ACFM catch
1984		50	-	50.3
1985		50	-	49.4
1986		65	-	65.5
1987	$\mathbf{F}_{0.1}$	70	72.9	75.4
1988	$\mathbf{F}_{0.1}$	~100	90	92.8
1989	$\mathbf{F}_{0.1}$	95	90	97.3
1990/1991[2]	*Status quo* F	90	100	101.6
1991/1992[2]	$\mathbf{F}_{0.1}$	79	110	98.5
1992/1993[2]	$\mathbf{F}_{0.1}$	86	110	106.7
1993/1994[2]	No gain in yield by fishing higher than $\mathbf{F}_{0.1}$	110[1]	110	101.5
1994/1995[2]	No gain in yield by fishing higher than $\mathbf{F}_{0.1}$	83[1]	130	132
1995/1996[2]	No gain in yield by fishing higher than $\mathbf{F}_{0.1}$	120[1]	110	125
1996/1997[2]	No gain in yield by fishing higher than $\mathbf{F}_{0.1}$	97[1]	110	95.9
1997/1998	No gain in yield by fishing higher than $\mathbf{F}_{0.1}$	90[1]	100	64.7
1998/1999	No gain in yield by fishing higher than $\mathbf{F}_{0.1}$	90[1]	90	87.0
1999/2000	Current F is sustainable	100[1]	100	92.9
2000/2001	Current F is sustainable	110[1]	110	100.3
2001/2002	Current F is sustainable	125[1]		

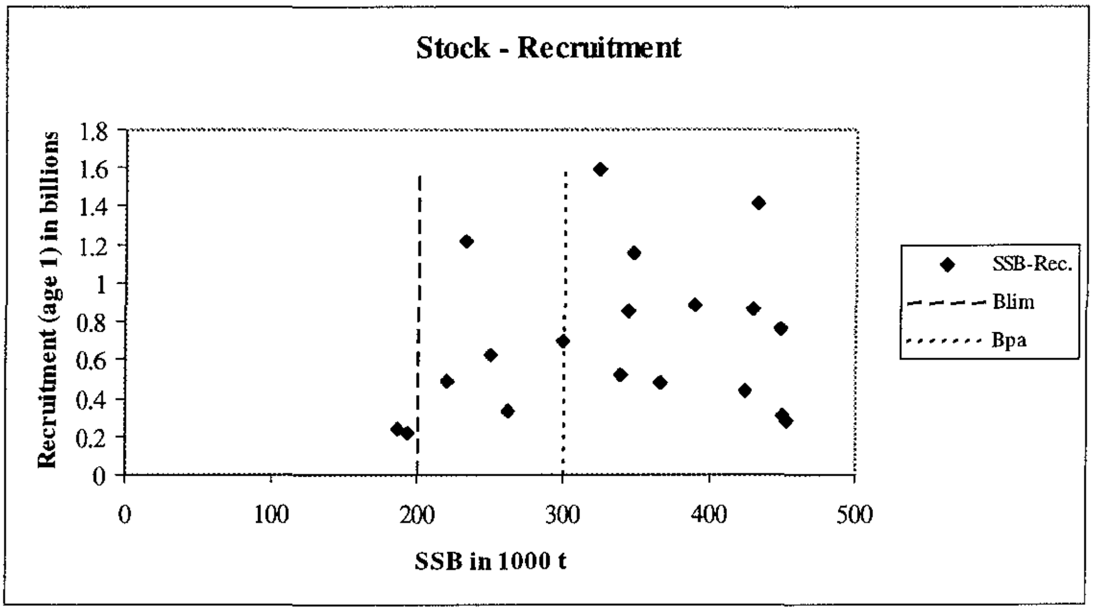
[1] Catch at $\mathbf{F}_{0.1}$.
[2] Season starting in October of first year.
Weights in '000 t.

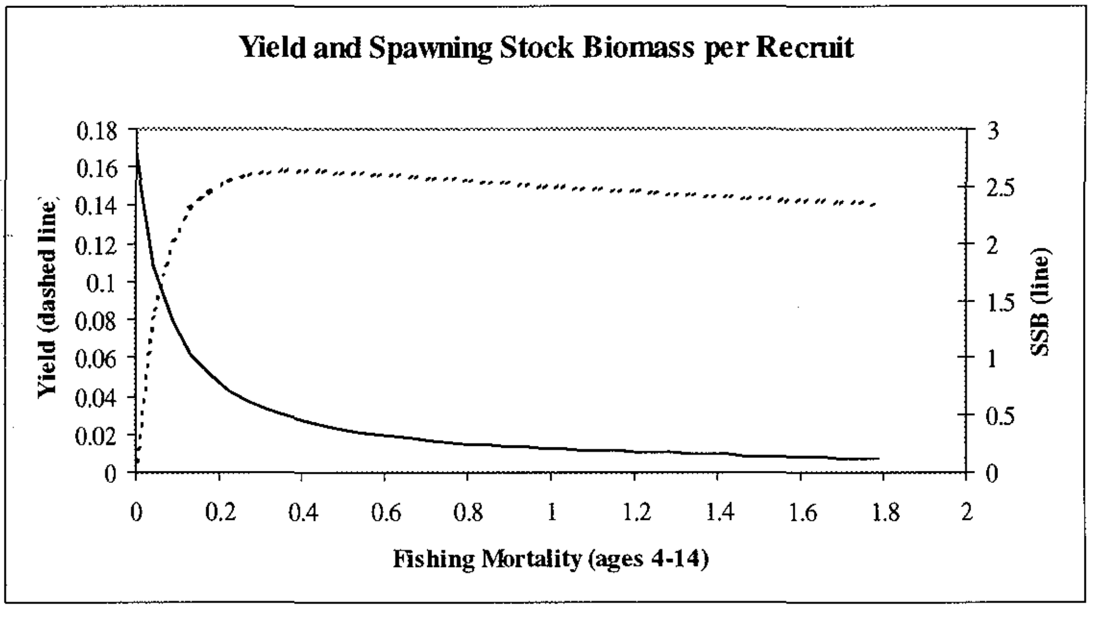

Landings
Landings in 1000 t
160
140
120
100
80
60
40
20
0
1981
1986
1991
1996


Fishing Mortality
F(ages 4-14)
0.5
0.4
0.4
0.3
0.3
0.2
0.2
0.1
0.1
0.0
1981
1986
1991
1996
F
Fpa


Recruitment (age 1)
Recruitment in billions
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1981
1986
1991
1996


Spawning Stock Biomass
SSB in 1000 t
800
700
600
500
400
300
200
100
0
1981
1986
1991
1996
2001
SSB
Blim
Bpa


Stock - Recruitment
Recruitment (age 1) in billions
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0
100
200
300
400
500
SSB in 1000 t
SSB-Rec.
Blim
Bpa


Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
3
2.5
2
1.5
1
0.5
0
SSB (line)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
Fishing Mortality (ages 4-14)

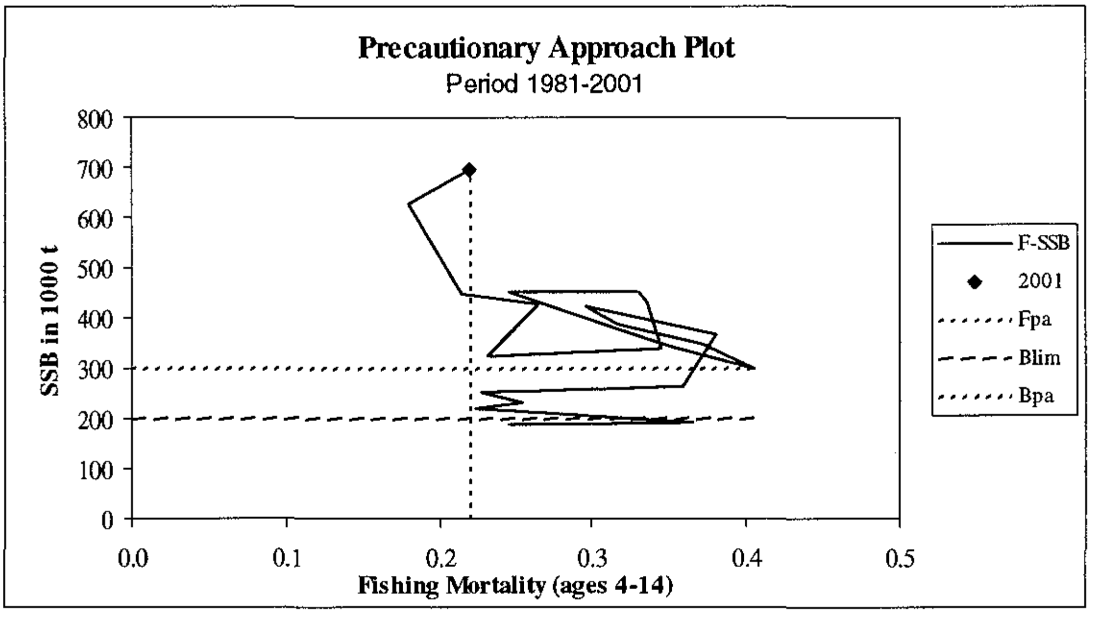

Precautionary Approach Plot
Period 1981-2001
SSB in 1000 t
800
700
600
500
400
300
200
100
0
0.0
0.1
0.2
0.3
0.4
0.5
Fishing Mortality (ages 4-14)
F-SSB
2001
Fpa
Blim
Bpa

Table 3.2.7.1 Icelandic summer spawners. Landings, catches and recommended TACs in thousand tonnes.

Year	Landings	Catches	Recommended TACs
1984	50.3	50.3	50.0
1985	49.1	49.1	50.0
1986	65.5	65.5	65.0
1987	73.0	73.0	70.0
1988	92.8	92.8	100.0
1989	97.3	101.0	90.0
1990/1991	101.6	105.1	90.0
1991/1992	98.5	109.5	79.0
1992/1993	106.7	108.5	86.0
1993/1994	101.5	102.7	90.0
1994/1995	132.0	134.0	120.0
1995/1996	125.0	125.9	110.0
1996/1997	95.9	95.9	100.0
1997/1998	64.7	64.7	100.0
1998/1999	87.0	87.0	90.0
1999/2000	92.9	92.9	100.0
2000/2001	100.3	100.3	110.0

*Preliminary

Table 3.2.7.2 Icelandic summer-spawning herring (Division Va).

Year	Recruitment Age 1 thousands	SSB tonnes	Landings tonnes	Mean F Ages 4-14
1981	880307	186451	39544	0.25
1982	237962	193274	56528	0.37
1983	219273	219983	58867	0.22
1984	488884	233061	50304	0.26
1985	1221030	250483	49368	0.23
1986	627117	262045	65500	0.36
1987	333067	366597	75439	0.38
1988	481689	423868	92828	0.30
1989	432423	389088	101000	0.32
1990	883851	346831	105097	0.37
1991	1151297	299632	109489	0.41
1992	696583	345083	108504	0.35
1993	852652	450592	102741	0.25
1994	311507	453267	134003	0.33
1995	280179	432139	125851	0.34
1996	1410802	338555	95882	0.34
1997	519236	324143	64395	0.23
1998	1590601	429163	86999	0.27
1999	861777	447980	92896	0.22
2000	764349	627167	100332	0.18
2001	1508000	696838		0.22
Average	750123	367440	85778	0.29

3.2.8 Capelin in the Iceland-East Greenland-Jan Mayen area (Sub-areas V and XIV and Division IIa west of 5°W)

State of stock/exploitation: The stock is considered to be inside safe biological limits. SSB is highly variable due to dependency on only 2 age groups.

Management objectives: The fishery is managed according to a two-part harvest control rule which allows for a minimum spawning stock biomass of 400 000 t by the end of the fishing season. ICES considers that the two-part harvest control rule is in accordance with the precautionary approach.

Advice on management: In order to ensure a spawning stock biomass of 400 000 t in March 2002, ICES advises in conformity with the harvest control rule, that the preliminary TAC for the first half of the 2001/2002 season should not exceed 700 000 t. This is two thirds of the total catch of 1 050 000 t predicted for the whole season and is designed to reduce the risk of overexploitation. ICES advises that the data from the surveys in October-November 2001 and/or January-February 2002 be used when the final TAC is set for the 2001/2002 season. ICES advises that, while the 2001 summer/autumn season could be opened on 20 June, areas of high juvenile abundance should be closed to commercial fishery in order to prevent harvesting a high proportion of juveniles. The authorities responsible for the management of this stock should make provisions for a quick and efficient process to close such areas to the fishery.

Relevant factors to be considered in management: In recent years, large capelin have dominated the catches in July and the first half of August. From the second half of August, the average weight in the catches has declined drastically due to the presence of juvenile fish and not increased again until late autumn.

The spawning stock fell below the minimum safe level of 400 000 t in the 1989/90 and 1990/91 seasons. The stock recovered quickly due to good recruitment and appears to be fairly strong at present.

Catch forecast: The basis for the forecast is acoustic surveys and a regression-based prediction model. The model gives a predictive figure for the maturing 2-group capelin of 78.1 billion. For the maturing 3 year olds the predictive value is 16.9 billion individuals. From these predictions a catch of 1 050 000 t for the 2001/2002 season is expected to leave 400 000 t for spawning.

Elaboration and special comment: The fishery is mainly an industrial fishery based on maturing capelin, i.e., the 2- and 3-group in the autumn, which spawn at ages 3 and 4 in March of the following year. After being low in the 1989/90 and 1990/91 seasons, catches have increased and have in recent years been more than 1 million t. A record catch of 1 571 000 t was taken during the 1996/97 fishing season.

Preliminary TAC computations are based on a method which involves the use of 1-group (N_1) indices from the October–November survey for predicting the mature 2-group ($N_{2\,mat}$) in the following year. The total 2-group ($N_{2\,tot}$) abundance from the same survey and the relationship between maturation ratios and year class abundance are used for predicting numbers of capelin in the 3-group ($N_{3\,mat}$).

Since 1989, the weight at age shows a significant negative correlation with the adult stock in number. A regression-based predictive model using data from the period 1989–1997 results in predicted mean weights of 16.1 and 22.4 g for age groups 2 and 3 respectively.

The stock size is assessed using acoustic survey data.

Source of information: Report of the Northern Pelagic and Blue Whiting Fisheries Working Group, April 2001 (ICES CM 2001/ACFM:17).

Catch data (Tables 3.2.8.1–2):

Year	ICES Advice	Predicted catch[1] corresp. to advice	Agreed 2 TAC	ACFM Catch[3]
1986	TAC	1,100	1,290	1,333
1987	TAC[1]	500	1,115	1,116
1988	TAC[1]	900	1,065	1,036
1989	TAC[1]	900	*	808
1990	TAC[1]	600	250	314
1991	No fishery pending survey results[1]	0	740	677
1992	Precautionary TAC[1]	500	900	788
1993	TAC[1]	900	1,250	1,179
1994	Apply the harvest control rule	950	850	842
1995	Apply the harvest control rule	800	1,390	930
1996	Apply the harvest control rule	1,100	1,600	1,571
1997	Apply the harvest control rule	850	1,265	1,245
1998	Apply the harvest control rule	950	1,200	1,100
1999	Apply the harvest control rule	866	1,000	934
2000	Apply the harvest control rule	650	1,090	1052
2001	Apply the harvest control rule	700		
2002	Apply the harvest control rule			

[1)]TAC advised for July–December part of the season. [2)]Final TAC recommended by national scientists for whole season. [3)]July–March of following year. (Weights in '000 t).
*All surveys of fishable stock abundance during the 1989/1990 season were unsuccessful.

Capelin, Iceland-East Greenland-Jan Mayen Area (V XIV IIa west 5°W)

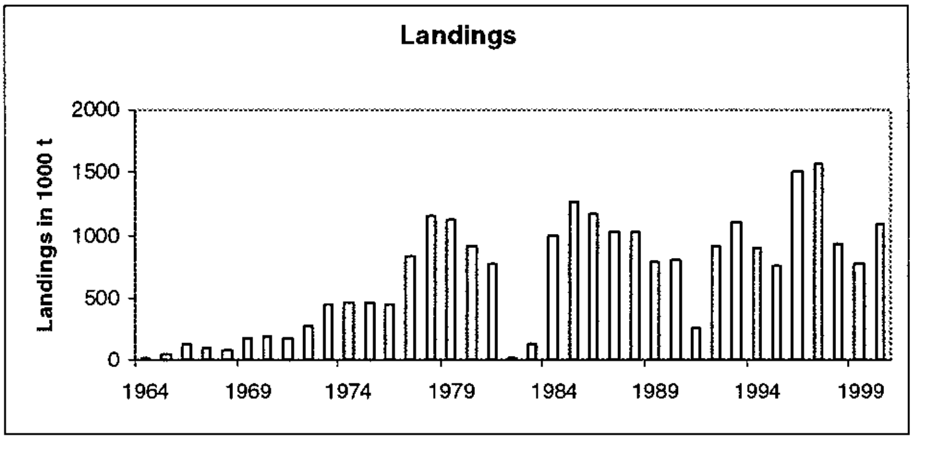


Table 3.2.8.1 The international capelin catch 1964–2001 (thousand tonnes). Iceland-East Greenland-Jan Mayen Area (V, XIV, IIa west 5°W).

Year	Winter season					Summer and autumn season						Total
	Ice-land	Nor-way	Far-oes	Green-land	Season total	Ice land	Nor-way	Far-oes	Green-land	EU	Season total	
1964	8.6	-	-		8.6	-	-	-		-	-	8.6
1965	49.7	-	-		49.7	-	-	-		-	-	49.7
1966	124.5	-	-		124.5	-	-	-		-	-	124.5
1967	97.2	-	-		97.2	-	-	-		-	-	97.2
1968	78.1	-	-		78.1	-	-	-		-	-	78.1
1969	170.6	-	-		170.6	-	-	-		-	-	170.6
1970	190.8	-	-		190.8	-	-	-		-	-	190.8
1971	182.9	-	-		182.9	-	-	-		-	-	182.9
1972	276.5	-	-		276.5		-	-		-	-	276.5
1973	440.9	-	-		440.9	-	-	-		-	-	440.9
1974	461.9	-	-		461.9	-	-	-		-	-	461.9
1975	457.1	-	-		457.1	3.1	-	-		-	3.1	460.2
1976	338.7	-	-		338.7	114.4	-	-		-	114.4	453.1
1977	549.2	-	24.3		573.5	259.7	-	-		-	259.7	833.2
1978	468.4	-	36.2		504.6	497.5	154.1	3.4		-	655.0	1,159.6
1979	521.7	-	18.2		539.9	442.0	124.0	22.0		-	588.0	1,127.9
1980	392.1	-	-		392.1	367.4	118.7	24.2		17.3	527.6	919.7
1981	156.0	-	-		156.0	484.6	91.4	16.2		20.8	613.0	769.0
1982	13.2	-	-		13.2	-	-	-		-	-	13.2
1983	-	-	-		-	133.4	-	-		-	133.4	133.4
1984	439.6	-	-		439.6	425.2	104.6	10.2		8.5	548.5	988.1
1985	348.5	-	-		348.5	644.8	193.0	65.9		16.0	919.7	1,268.2
1986	341.8	50.0	-		391.8	552.5	149.7	65.4		5.3	772.9	1,164.7
1987	500.6	59.9	-		560.5	311.3	82.1	65.2		-	458.6	1,019.1
1988	600.6	56.6	-		657.2	311.4	11.5	48.5		-	371.4	1,028.6
1989	609.1	56.0	-		665.1	53.9	52.7	14.4		-	121.0	786,1
1990	612.0	62.5	12.3		686,8	83.7	21.9	5.6		-	111.2	798.0
1991	202.4	-	-		202.4	56.0	-	-		-	56.0	258.4
1992	573.5	47.6	-		621.1	213.4	65.3	18.9	0.5		298.1	919.2
1993	489.1	-	-	0.5	489.6	450.0	127.5	23.9	10.2		611.6	1,101.2
1994	550.3	15.0	-	1.8	567.1	210.7	99.0	12.3	2.1		324.1	891.2
1995	539.4	-	-	0.4	539.8	175.5	28.0	-	2.2		205.7	745.5
1996	707.9	-	10.0	5.7	723.6	474.3	206.0	17.6	15.0	60.9	773.8	1,497.4
1997	774.9	-	16.1	6.1	797.1	536.0	153.6	20.5	6.5	47.1	763.6	1561.5
1998	457.0	-	14.7	9.6	481.3	290.8	72.9	26.9	8.0	41.9	440.5	921.8
1999	607.8	14.8	13.8	22.5	658.9	83.0	11.4	6.0	2.0		102.4	761.3
2000	761.4	14.9	32.0	22.0	830.3	126.5	80.1	30.0	7.5	21.0	265.1	1095.4
2001	767.2	-	10.0	28.6	805.8							

Table 3.2.8.2 Capelin in the Iceland-East Greenland-Jan Mayen area. Recruitment of 1 year old fish (unit 10^9) and stock biomass ('000 t) given at 1 August, spawning stock ('000 t) at the time of spawning (March next year). Landings ('000 t) are the sum of the total landings in the season starting in the summer/autumn of the year indicated ending in March of the following year.

Year	Recruitment	Total stock biomass	Landings	Spawning stock biomass
1978	164	2832	1195	600
1979	60	2135	980	300
1980	66	1130	684	170
1981	49	1038	626	140
1982	146	1020	0	260
1983	124	2070	573	440
1984	251	2427	897	460
1985	99	2811	1312	460
1986	156	3106	1333	420
1987	144	2639	1116	400
1988	81	2101	1037	440
1989	64	1482	808	115
1990	118	1293	314	330
1991	133	1975	677	475
1992	163	2058	788	499
1993	144	2363	1179	460
1994	224	2287	864	420
1995	197	3174	929	830
1996	191	3310	1571	430
1997	165	3014	1245	492
1998	168	2197	1100	500
1999	*138	*2314	934	650
2000	*166	*2234	1071	440

* Preliminary

3.2.9 Answer to Special Request on Redfish

NEAFC requested detailed information on a) stock identity, b) horizontal and vertical distribution of pelagic redfish stock components in the Irminger Sea and adjacent waters and as c) about the development of the pelagic redfish fishery for redfish with respect to seasonal and area distributions.

Greenland asked for information on the effectiveness of the "Redfish" box in Division XIV.

NEAFC a) On further information on stock identity of redfish

The answer to the request is presented as part of the introduction section 3.2.6.a.

NEAFC b) On the possible relationship between pelagic *Sebastes mentella* and the *Sebastes mentella* fished in demersal fisheries on the continental shelf and slope.

There are substantial uncertainties in the stock structure of *S. mentella* in this area. This causes concern about the current situation in the fishery related to the possible existence of more than one stock of *S. mentella*.

Prior to 1994, the stock mixing was considered minor as only a small proportion of the catches was taken at depths below 500–600 m. During the last few years as the fishery has shifted towards greater depths, a greater proportion of the catch might have originated from the deeper stock (deeper than 500 m). The difficulties of separating catches has increased as the oceanic type *S. mentella* also occurs deeper than 500 m in recent years. The problem of distinguishing between stock components increased even further, as the Icelandic oceanic fishery since 1998 was extended very close to the areas where the traditional shelf fishery has been ongoing for years.

Therefore, the future development of the stock(s) and catches are uncertain because it is at present not known how much of each component is actually caught. An attempt to improve the situation has been made by some nations to report the catches by depth and one country also by "stock".

Preliminary results from ongoing research on the stock structure of *S. mentella* have been evaluated by ICES Working Group on the Application of Genetics in Fisheries and Mariculture (ICES CM 2001/F:3). The results indicate that oceanic *S. mentella* and pelagic deep-sea *S. mentella* "represent separate genetic stocks". Also, "differences between Icelandic and Irminger Sea deep-sea *S. mentella* are less, but significant, indicating also probably distinct genetic stocks".

Strong year classes in *S. mentella* on the continental shelves seem to have recruited both to oceanic *S. mentella* and to pelagic deep-sea *S. mentella*. This is significant new information on the understanding of recruitment processes for the various redfish stocks.

Based on the information given above, ICES stresses that there are still uncertainties in the stock structure of *S. mentella* in ICES Divisions V, XII and XIV.

NEAFC c): Update information on the development of the pelagic fishery for redfish with respect to seasonal and area distribution to allow NEAFC to further consider the appropriateness of area and seasonal closures.

Observations indicate that in the last three years a) the fisheries in the northeastern area in the first half of the year are occurring at depths deeper than 500 m and catching larger fish, and b) the fisheries in the southwestern area in the second half of the year are mainly occurring at depths shallower than 500 m catching smaller fish. The following paragraphs give a detailed description of the fishery.

The geographical distribution of the catches by periods and years since 1995 are given in Figure 3.2.6a.5. The fishery of these four nations (Germany (1995–2000), Iceland (1989–2000), Norway (1990–1999) and Greenland (1999–2000)) indicate that there was a similar pattern in the fishery during the last three years. Fishing usually started in early April and up to the end of June it was prosecuted in areas east of 32°W and north of 61°N. In July and August, the fleet moves about 400–500 nautical miles to areas south of 60°N and west of about 34°W, where the fishery continues until October. There is very little fishing activity from November until late March. Figure 3.2.6a.6 gives the locations of part of the Spanish activity in the Irminger Sea, and it shows that they had a similar pattern in 2000 as the above-mentioned fleets. The same applies for the Russian fleet in 2000 (Figure 3.2.6a.7). In the third quarter of the year the fishing has, in general, moved towards the southern part of the area, fishing mostly at depths shallower than 500 m, within area XII as well as in NAFO area 1F, and both outside and inside the Greenlandic EEZ. However, it is important to note that the described fishing pattern of the fleet has changed significantly in the most recent 5 years, mainly in terms of area and depth expansion. The changes in the fishing pattern as described above does not necessarily reflect changes in stock distribution, maybe due to commercial reasons.

Although there is limited information on fishing depth, except for the Icelandic and the Greenlandic fisheries, the general pattern is that the fishing in the first and second quarter of the year is mostly conducted deeper than 500 m. The mean trawling depth (depth of the headline) of the Icelandic fleet in April–June 2001 was 656 m, with 8% of the hauls shallower than 500 m depth. Further, although there are no haul-by-haul data available for the German catches, the available information shows that the fishery in the first two quarters was characterised by a fishery deeper than 450 m, and at shallower depths during the third and fourth quarters in 1995–2000. There is similar pattern in the Spanish fishery. They were fishing deeper than 500 m in the second quarter of the year, and in the third quarter fishery continued at depths shallower than 500 m. The Greenland vessel participating in this fishery also report all its catches above 400 m after July, and show the same pattern as the Icelandic fleet in the first 2 quarters of the year.

Over 95% of all the fish caught in the pelagic redfish fishery are mature. The mean length of the redfish caught in the southwestern area is smaller than the fish caught in the northeastern area (Figure 3.2.6a.8).

As has been reported in earlier reports of the working group, Iceland has classified its pelagic catches between oceanic and pelagic deep-sea redfish according to a contentious method. The results of this classification have shown that the proportion of fish classified as oceanic type redfish has been very low during recent years, and only about 5% of the Icelandic catches were classified as oceanic type. Based on the samples, the results also indicate that shallower than 500–600 m depth, the proportion "oceanic" is between 85–100%, as the proportion deeper than 600 m is usually between 0–20%.

ICES recommends that NEAFC asks all nations participating in the pelagic redfish fishery to provide ICES with information on the trawling depth (headline depth for each haul as a log-book data), so ICES can have more detailed description of the fishery by season and areas as a basis for giving its advice on the resource.

Answer to Special request on the Effects of the Redfish-Box

ICES considered the following request from Denmark in respect of Greenland on regulatory measures on bottom trawling off the east coast of Greenland:

> 'Denmark (in respect of Greenland and Faroe Islands) requests ICES to provide advice on requirement on redfish regulatory measures in ICES Div. XIVb'

'The so-called "Redfish-box" on the East Greenland shelf was established in 1978 after a recommendation from ICES in order to protect nursery grounds for juvenile redfish. The box was based on high catch rates of small redfish in East Greenland waters as observed from bycatches in cod fisheries from the 1950s until the regulation. According to later occasional trial fishery in the box-area, there is a large variation in the by-catch inside as well as outside the box. The composition of the fisheries in East Greenland has changed since then, currently only comprising a directed Greenland halibut fishery (minimum meshsize 140 mm) and a shrimp fishery. The closure of such a large area for bottom trawl activity constitutes a management problem, if redfish by-catch from time to time is insignificant.

'The Greenland Home Rule Government has from 1 October 2000 introduced mandatory use of 22 mm sorting grids into the full geographic range of the Greenland shrimp fishery in order to minimise by-catch of fish.

'Greenland therefore requests ICES to provide information on the following: Is there a biological justification for maintaining an area within Sub-area XIV where bottom trawl activity is prohibited to protect redfish nursery grounds (the so-called "Redfish-Box"). Special emphasis must be put on:

'1) The present mandatory use of grids in the shrimp fishery.

'2) Influence of trawling activity on the nursery habitat, i.e. the ecosystem effect.'

The following sources of information were considered: a report on a recent experiment carried out in East Greenland waters to measure the effect of sorting grids on the performance of a shrimp trawl; data from German bottom-trawl surveys off East Greenland from 1985 through 2000. It was also noted that German bottom-trawl surveys and the Greenland shrimp survey alike show that small redfish are widely distributed and that the redfish box does not correspond to exceptional densities.

Most of the redfish, of all sizes, caught by the German bottom-trawl survey in the neighbourhood of the redfish box were caught east of the box, between it and the 400 m isobath (Figure 3.2.6a.9). This was true even of redfish shorter than 17 cm. However, the distribution of survey stations within the redfish box was somewhat limited (Figure 3.2.6a.9). Furthermore, in experimental shrimp fisheries in East Greenland in 1992 and 1998, mean by-catch rates within the box were no higher than elsewhere on the East Greenland shrimp grounds, which now stretch some 5° further to the south than they did when the redfish box was drawn in the early 1980s. The redfish box does not appear to correspond to the current distribution of small redfish, and there is no biological justification for maintaining it.

The results of experimental fishing showed that sorting grids gave nearly complete protection to redfish larger than about 20 cm, but only about 1/3 protection of a numerous class of 11–12 cm redfish. Qualitatively similar results—i.e. poor protection of the smallest fish—were obtained with other finfish. In spite of this, sorting grids significantly reduced the lifetime risk to a redfish that it would be by-caught.

There is a risk that large year classes of redfish could appear as significant by-catch in the shrimp fishery for as long as they are shorter than about 15 cm. Greenland shrimp trawling regulations already require ships to change grounds by at least 5 miles as soon as by-catch exceeds more than 10% the total catch in haul. In addition to this measure, **ICES recommends that standard regulatory measures of flexible and temporary area closures be applied** when, and also where, large year classes of redfish generate by-catch problems.

ICES was not able to answer the question of whether the ecosystem effect of bottom trawling *per se* on redfish nursery habitats would justify closing the area permanently. In order to answer this question, information is needed on nursery habitats and what effect bottom trawling has on these.

3.3 Demersal stocks at the Faroe Islands (Division Vb)

3.3.1 Overview

The fisheries and management measures: In 1977 an EEZ was introduced in the Faroe area. The demersal fishery by foreign nations has since decreased and Faroese vessels now take most of the catches. The fishery may be considered a multi-fleet and multi-species fishery. The longliners fish mainly cod and haddock; in addition, some longliners fish in deep water for ling and tusk. Most of the trawlers fish cod, haddock and saithe, while some large trawlers fish in deeper waters for redfish, blue ling, Greenland halibut, and occasionally grenadier and black scabbardfish. The jiggers fish mainly saithe and cod. Recently, gill net fisheries for Greenland halibut and anglerfish and a directed pair trawler fishery for Argentines have been introduced. The total demersal catches decreased from 120 000 t in 1985 to 65 000 t in 1993, but have since increased again to about 100 000 t in 1997–1999. The decrease was mainly due to lower catches of cod, haddock and saithe. The cod catches (Faroe Plateau cod and Faroe Bank cod combined) increased considerably from 6 000 t in 1993 to more than 42 000 t in 1996 but have since declined, and were in 2000 around 24 000 t. The catches of haddock also increased considerably from 4 000 t in 1993 to 22 000 t in 1998, but have since decreased to 16 000 t in 2000. The catches of saithe decreased from 33 000 t in 1993–1994 to 20 000 t in 1996, but have since increased again to 39 000 t in 2000.

During the 1980s and 1990s the Faroese authorities have regulated the fishery and the investment in fishing vessels. In 1987 a system of fishing licences was introduced. The demersal fishery at the Faroe Islands has been regulated by technical measures (minimum mesh sizes and closed areas). In order to protect juveniles and young fish, fishing is temporarily prohibited in areas where the number of small cod, haddock and saithe exceeds 30% in the catches; after 1–2 weeks the areas are again opened for fishing. A reduction of effort has been attempted through banning of new licences and buy-back of old licences.

A new quota system, based on individual quotas, was introduced in 1994. The fishing year started on 1 September and ended on 31 August the following year. The aim of the quota system was, through restrictive TACs for the period 1994–1998, to increase the SSBs of Faroe Plateau cod and haddock to 52 000 t and 40 000 t, respectively. The TAC for saithe was set higher than recommended scientifically. It should be noted that cod, haddock and saithe are caught in a mixed fishery and any management measure should account for this. Species under the quota system were Faroe Plateau cod, haddock, saithe, redfish and Faroe Bank cod.

The catch quota management system introduced in the Faroese fisheries in 1994 was met with considerable criticism and resulted in discarding and in misreportings of substantial portions of the catches. Reorganisation of enforcement and control did not solve the problems. As a result of the dissatisfaction with the catch quota management system, the Faroese Parliament discontinued the system as from 31 May 1996. In close cooperation with the fishing industry, the Faroese government has developed a new system based on individual transferable effort quotas in days within fleet categories. The new system entered into force on 1 June 1996. The fishing year from 1 September to 31 August, as introduced under the catch quota system, has been maintained.

The individual transferable effort quotas apply to 1) the longliners less than 100 GRT, the jiggers, and the single trawlers less than 400 HP, 2) the pair trawlers and 3) the longliners greater than 100 GRT. The single trawlers greater than 400 HP do not have effort limitations, but they are not allowed to fish within the 12 nautical mile limit and the areas closed to them, as well as to the pair trawlers, have increased in area and time. Their catch of cod and haddock is limited by maximum by-catch allocation. The single trawlers less than 400 HP are given special licences to fish inside 12 nautical miles with a by-catch allocation of 30% cod and 10% haddock. In addition, they are obliged to use sorting devices in their trawls. One fishing day by longliners less than 100 GRT is considered equivalent to two fishing days for jiggers in the same gear category. Longliners less than 100 GRT could therefore double their allocation by converting to jigging. Table 3.3.1.1 shows the number of fishing days used by fleet category for 1985–1995 and 1998–1999 and Table 3.3.1.2 shows the number of allocated days inside the outer thick line in Figure 3.3.1.1. Holders of individual transferable effort quotas who fish outside this line can fish for 3 days for each day allocated inside the line. Trawlers are generally not allowed to fish inside the 12 nautical mile limit. Inside the innermost thick line only longliners less than 100 GRT and jiggers less than 100 GRT are allowed to fish. The Faroe Bank shallower than 200 m is closed to trawling.

The effort quotas are transferable within gear categories. The allocations of number of fishing days by fleet categories was made such that together with other regulations of the fishery they should result in average fishing mortalities on each of the 3 stocks of 0.45, corresponding to average annual catches of 33% of the exploitable stocks in numbers. Built into the system is also an assumption that the day system is self-regulatory, because the fishery will move between stocks according to the relative availability of each of them and no stock will be overexploited.

In addition to the number of days allocated in the law, it is also stated in the law what percentage of total catches of cod, haddock, saithe and redfish, each fleet category on average is allowed to fish. These percentages are as follows:

Fleet category	Cod	Haddock	Saithe	Redfish
Longliners < 110GRT, jiggers, single trawl. < 400HP	51 %	58 %	17.5 %	1 %
Longliners > 110GRT	23 %	28 %		
Pairtrawlers	21 %	10.25 %	69 %	8.5 %
Single trawlers > 400 HP	4 %	1.75 %	13 %	90.5 %
Others	1 %	2 %	0.5 %	0.5 %

Technical measures such as area closures during the spawning periods, to protect juveniles and young fish and mesh size regulations as mentioned above are still in effect.

The marine environment: The waters around the Faroe Islands are in the upper 500 m dominated by the North Atlantic current, which to the north of the islands meets the East Icelandic current. Clockwise current systems create retention areas on the Faroe Plateau and on the Faroe Bank. In deeper waters to the north and east is deep Norwegian Sea water, and to the south and west is Atlantic water. From the late 1980s the intensity of the North Atlantic current passing the Faroe area decreased, but it has increased again in the most recent years. The productivity of the Faroese waters has been very low since the middle of the 1980s. This applies also to the recruitment of many fish stocks, and the growth of the fish has been poor as well. Measurements of phyto- and zooplankton production show that the situation has gradually improved since 1991. Since 1992 the recruitment of important prey such as sandeels and Norway pout has been good and the growth of fish such as cod, haddock and saithe has improved considerably. The 1992–1993 year classes of cod and the 1993–1994 year classes of haddock are estimated to be well above the long-term average.

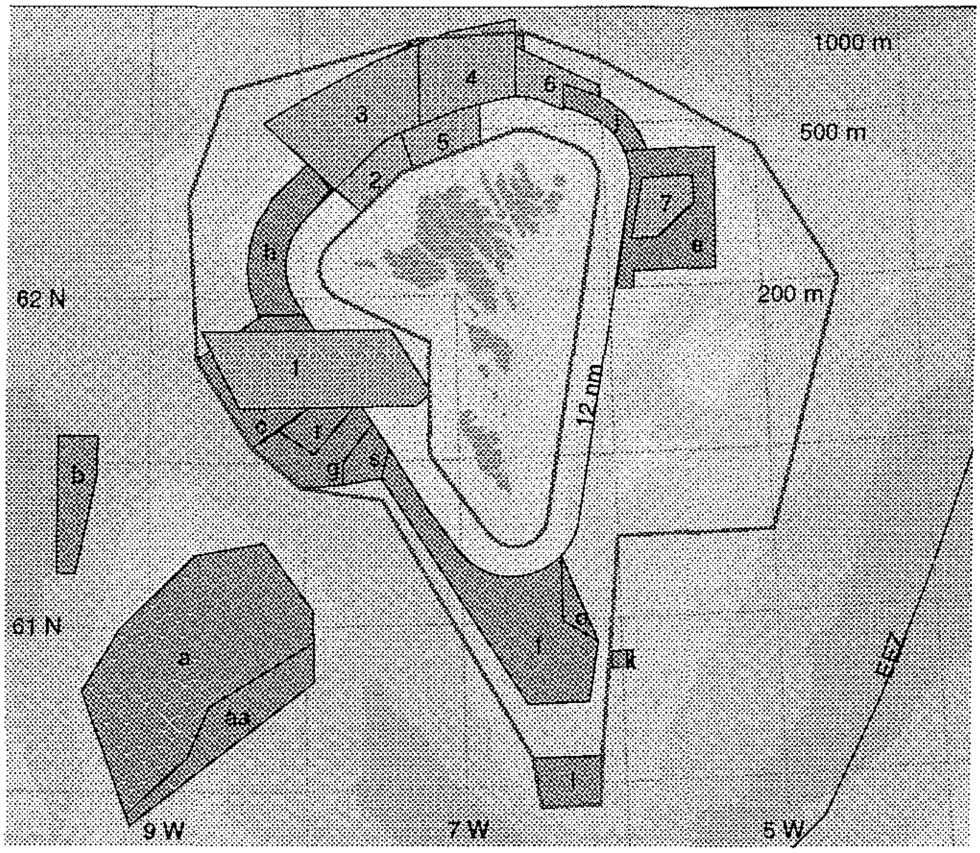
State of stocks: As a result of the combined effect of poor recruitment in the last decade and high fishing effort, the SSBs of Faroe Plateau cod and Faroe haddock were reduced to low levels. In the period 1993–1995 ICES considered them to be well below minimum biologically acceptable levels and consequently advised no fishing. Both stocks have since increased due to improved recruitment and growth with SSB above the precautionary SSB levels ($\mathbf{B}_{pa}$). In this years assessment, the SSB of Faroes haddock has, however, decreased to the $\mathbf{B}_{lim}$ level. The fishing mortality on both Faroe Plateau cod and Faroe haddock has been estimated to be well above the precautionary level ($\mathbf{F}_{pa}$) since 1996. The Faroe Bank cod stock seems to be at or slightly above average. The SSB of Faroe saithe has been increasing from the record low in 1992 to above the $\mathbf{B}_{pa}$ in 1998–2000. The fishing mortality is well above the precautionary level ($\mathbf{F}_{pa}$).

Table 3.3.1.1 Number of fishing days used by various fleet groups in Vb1 1985-1995 and 1998-2000. For other Fleets there are no effort limitations. Catches of saithe and redfish are regulated by the by-catch Percentages given in Section 2.1.1. In addition there are special fisheries regulated by license. (This is the real number of days fishing not affected by doubling or tripling of days by changing areas/gears).

Year	Longliner 0-110 GRT, jiggers, trawlers < 400 HP	Longliners > 110 GRT	Pairtrawlers > 400 HP
1985	13449	2973	8582
1986	11399	2176	11006
1987	11554	2915	11860
1988	20736	3203	12060
1989	28750	3369	10302
1990	28373	3521	12935
1991	29420	3573	13703
1992	23762	2892	11228
1993	19170	2046	9186
1994	25291	2925	8347
1995	33760	3659	9346
Average(85-95)	22333	3023	10778
1998	23971	2519	6209
1999	21040	2428	7135
2000	24820	2414	7167
Average(98-00)	23277	2454	6837

Table 3.3.1.2 Number of allocated days for each fleet group since the new management scheme was adopted and number of licenses per fleet.

	Fleets	1996/1997	1997/1998	1998/1999	1999/2000	2000/
Group 1	Single trawlers > 400 HP	Regulated by area and by-catch limitations				
Group 2	Pair trawlers > 400 HP	8225	7199	6839	6839	68
Group 3	Longliners > 110 GRT	3040	2660	2527	2527	25
Group 4	Longliners and jiggers 15-110 GRT, single trawlers < 400 HP	9320	9328	8861	8861	88
Group 5	Longliners and jiggers < 15 GRT	22000	23625	22444	22444	224



Closed areas to trawlings

Areas inside the 12 nm zone closed year round

Area	Period
a	1 jan- 31 des
aa	1 jun – 31 aug
b	20 jan- 1 mar
c	1 jan- 31 des
d	1 jan- 31 des
e	1 apr- 31 jan
f	1 jan- 31 des
g	1 jan- 31 des
h	1 jan- 31 des
i	1 jan- 31 des
j	1 jan- 31 des
k	1 jan- 31 des
l	1 jan- 31 des
m	1 feb- 1 jun
n	31 jan- 1 apr
o	1 jan- 31 des
p	1 jan- 31 des
r	1 jan- 31 des
s	1 jan- 31 des

Spawning area closures

Area	Period
1	15 feb-31 mar
2	15 feb- 15 apr
3	1 feb- 1 apr
4	15 jan- 15 mai
5	15 feb- 15 apr
6	15 feb- 15 apr
7	15 jan- 1 apr

Figure 3.3.1.1 Fishing area regulations in Division Vb. Allocation of fishing days applies to the area inside the outer thick line on the Faroe Plateau. Holders of effort quotas who fish outside this line can triple their numbers of days. Longliners larger than 110 GRT are not allowed to fish inside the inner thick line on the Faroe Plateau. If longliners change from longline to jigging, they can double their number of days. The Faroe Bank shallower than 200 m depths (a, aa) is regulated separate from the Faroe Plateau. It is closed to trawling and the longline fishery is regulated by individual day quotas.

3.3.2 Cod

3.3.2.a Faroe Plateau cod (Sub-division Vb_1)

State of stock/exploitation: The stock is harvested outside safe biological limits. The spawning biomass in 2001 is estimated to be above $\mathbf{B_{pa}}$, but the 2000 fishing mortality is well above $\mathbf{F_{pa}}$ and close to $\mathbf{F_{lim}}$. The 1997 and 1998 year classes are above average strength.

Management objectives: The effort management system implemented in the Faroese demersal fisheries in Division Vb since 1996 aims at harvesting on average 33% in numbers of the cod exploitable stock. This translates into an average F of 0.45. This is inconsistent with the precautionary approach with the $\mathbf{F_{pa}}$ of 0.35.

Precautionary Approach reference points (established in 1998).

ICES considers that:	ICES proposes that:
$\mathbf{B_{lim}}$ is 21 000 t, the lowest observed biomass	$\mathbf{B_{pa}}$ be set at 40 000 t
$\mathbf{F_{lim}}$ is 0.68	$\mathbf{F_{pa}}$ be set at 0.35

Technical basis:

$\mathbf{B_{lim}}$: $\mathbf{B_{lim}} = \mathbf{B_{loss}}$ (98)	$\mathbf{B_{pa}}$: $\mathbf{B_{pa}} = \mathrm{Blim}e^{1.645\sigma}$ assuming a σ of about 0.40 to account for the relatively large uncertainties in the assessment
$\mathbf{F_{lim}}$: $\mathbf{F_{lim}} = \mathrm{Fpa}e^{1.645\sigma}$ assuming a σ of about 0.40 to account for the relatively large uncertainties in the assessment	$\mathbf{F_{pa}}$: Close to $\mathbf{F_{max}}$ (0.34) and $\mathbf{F_{med}}$ (0.38) values from 1998 assessment

Advice on management: ICES advises that fishing mortality in 2002 should be reduced by at least 25% towards the $\mathbf{F_{pa}}$, corresponding to landings of no more than 22 000 t.

Relevant factors to be considered in management: Current fishing mortality is far above the $\mathbf{F_{pa}}$, but the basis for $\mathbf{F_{pa}}$ is under revision. Therefore a gradual reduction of the fishing mortality is suggested.

Close monitoring should be carried out in order to evaluate the effect of the effort regulation, in particular the possible changes in catchability and target species. Effort regulation systems may lead to investment aimed at increasing fishing efficiency in order to obtain the greatest benefits from the effort allocated. Management authorities should monitor vessel characteristics in order to evaluate potential increases in capacity as a result of technological changes.

Cod are taken in a mixed fishery with saithe and haddock. Given that Faroe saithe and haddock are outside safe biological limits, measures to minimise the mortality inflicted on these species while fishing for cod should be implemented.

Comparison with previous assessment and advice: The mean weights-at-age were higher than expected last year and the incoming year classes were adjusted up. It leads to slightly higher estimates of biomass in 2001–2002 and that allows for increase of catches relative to the catches corresponding to advice last year.

Catch forecast for 2002:

Basis: F(2001) = F(2000) = 0.61; Landings (2001) = 26200; SSB(2001) = 59000; SSB(2002) = 60600.

F(2002)	Basis	Landings (2002)	SSB (2003)
0.12	0.2F(2000)	6700	77000
0.24	0.4F(2000)	12900	70700
0.35	$\mathbf{F_{pa}}$	17700	65800
0.42	$\mathbf{F_{med}}$	20700	62700
0.46	0.75F(2000)	22300	61000
0.55	0.9F(2000)	25800	57400
0.61	F(2000)	28000	55200
0.68	$\mathbf{F_{lim}}$	30400	52800
0.73	1.2F(2000)	32300	50900

(Weights in '000 t)

Shaded scenarios considered inconsistent with the precautionary approach.

A short-term prediction of catches is given in the table above. The *status quo* F assumes the same fleet allocation as in 1999.

Medium- and long-term projections: Medium-term projections were made using the same input parameters as the short-term predictions and making alternative assumptions about recruitment. The results indicate a high probability that SSB will be less than $\mathbf{B_{pa}}$ at current fishing mortality, particularly if future recruitment follows a distribution similar to past observations. The results suggest that fishing mortality should indeed be reduced to $\mathbf{F_{pa}}$ to keep B above $\mathbf{B_{pa}}$ in the medium-term.

Elaboration and special comment: Due to the combined effect of high fishing mortality and poor recruitment of the 1984 to 1991 year classes, the SSB reached record lows in the early 1990s. SSB increased in 1994–1996/1997 due to the recruitment of the 1992 and 1993 year classes, which are estimated to be well above the long-term average. High fishing mortality in 1997 resulted in a 35% decrease in SSB between 1997 and 1998, and the SSB declined further by over 20% from 1998 to 1999.

Cod are taken in a mixed demersal fishery which was initially international. Following the declaration of EEZs in 1977, the fishery became largely Faroese. Most of the vessels involved are trawlers and longliners. Fishing mortality declined through the 1960s and was variable with an increasing trend until 1990. After a sharp decline from 1990 to 1994, F increased again in 1996/1997 to 0.66, and although lower during 1998–2000, it remains too high.

In 1995–1997 catch per unit effort increased considerably, both in the survey and for most fleets in the fishery. The CPUE increased for many age-groups compared to 1994, which suggests that the availability of the stock to both the fishery and the survey may have increased in 1995–1997, possibly because of a change in the behaviour or distribution of the stock. Such changes make analytical assessments difficult and uncertain. However, the two CPUE series used in the current assessment are not strongly affected by this.

In this analytical assessment catch at age data are tuned with two commercial CPUE series. The growth rate of fish in the stock has shown a declining trend over the last three decades, with a short-term increase in the mid-1990s. After a drop in 1998 the growth rate has increased again.

The survey database is being re-constructed and two survey indices will be evaluated for inclusion in the assessment next year. Medium-term projections and the updated spawners per recruit calculations suggest that the proposed $\mathbf{F_{pa}}$ may be too conservative. This will be more thoroughly evaluated in the 2002 assessment using the survey indices.

Source of information: Report of the North-Western Working Group, April/May 2001 (ICES CM 2001/ACFM:20).

Yield and spawning biomass per Recruit F-reference points:

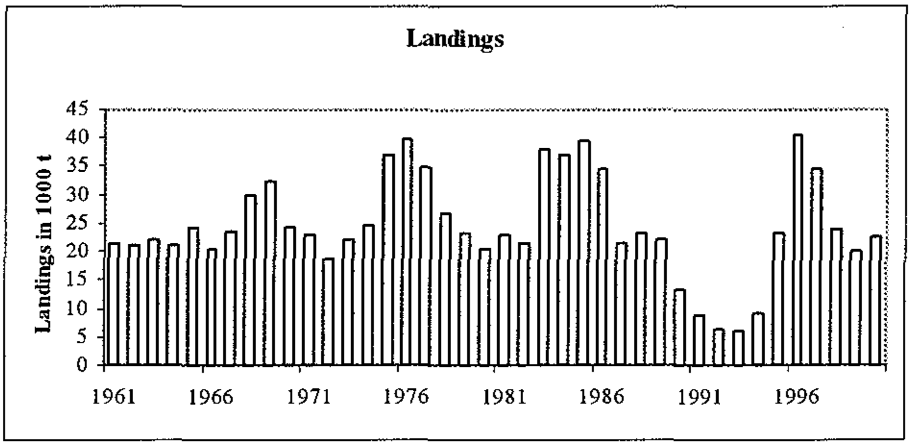
	Fish Mort Ages 3-7	Yield/R	SSB/R
Average Current	0.612	1.518	3.218
$\mathbf{F_{max}}$	0.317	1.587	5.628
$\mathbf{F_{0.1}}$	0.148	1.443	9.820
$\mathbf{F_{med}}$	0.419	1.572	4.470

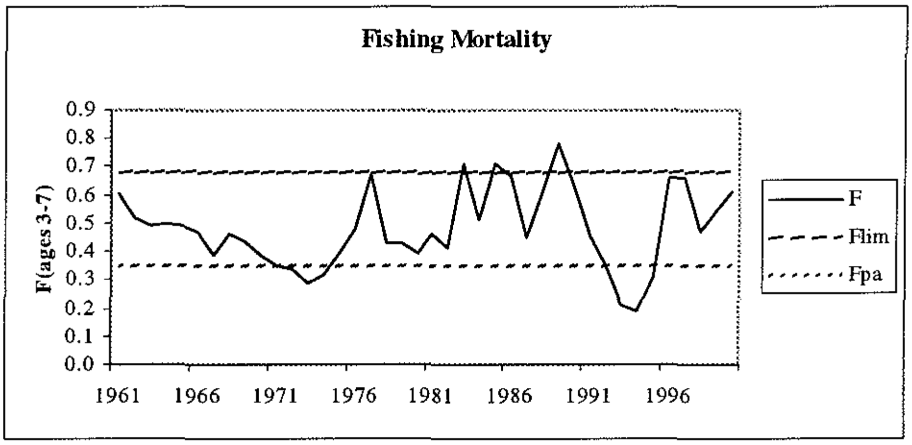
Catch data (Tables 3.3.2.a.1–3):

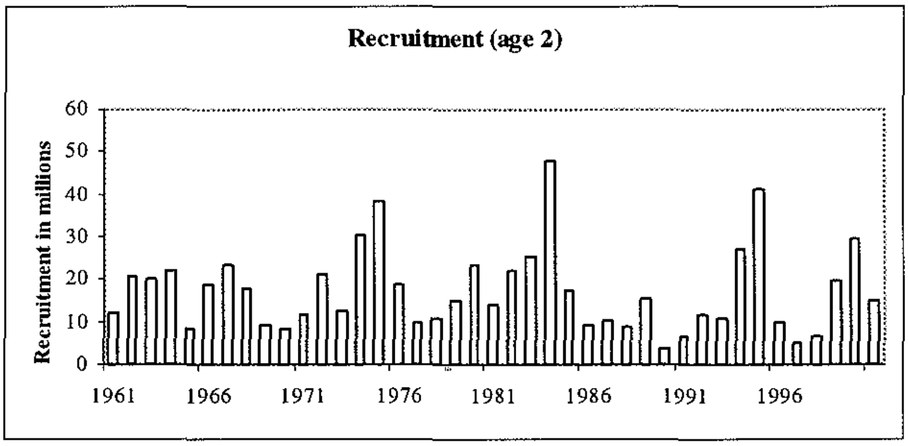
Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC	ACFM Catch
1987	No increase in F	31		21.4
1988	No increase in F (Revised estimate)	29 (23)		23.2
1989	No increase in F	19		22.1
1990	No increase in F	20		13.5
1991	TAC	16		8.7
1992	No increase in F	20		6.4
1993	No fishing	0		6.1
1994	No fishing	0	8.5/12.5[1,2]	9.0
1995	No fishing	0	12.5[1]	23.0
1996	F at lowest possible level	-	20[2]	40.4
1997	80% of F(95)	24	-	34.3
1998	30% reduction in effort from 1996/97	-	-	24.0
1999	F less than proposed $\mathbf{F_{pa}}$ (0.35)	19		20.0
2000	F less than proposed $\mathbf{F_{pa}}$ (0.35)	20		22.5
2001	F less than proposed $\mathbf{F_{pa}}$ (0.35)	16		
2002	75% of F(2000)	22		

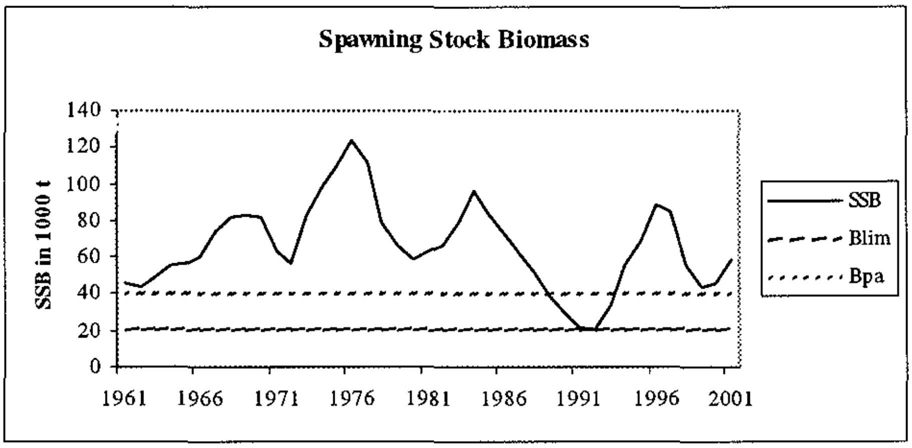
[1]In the quota year 1 September–31 August the following year. [2] The TAC was increased during the quota year. Weights in '000 t.

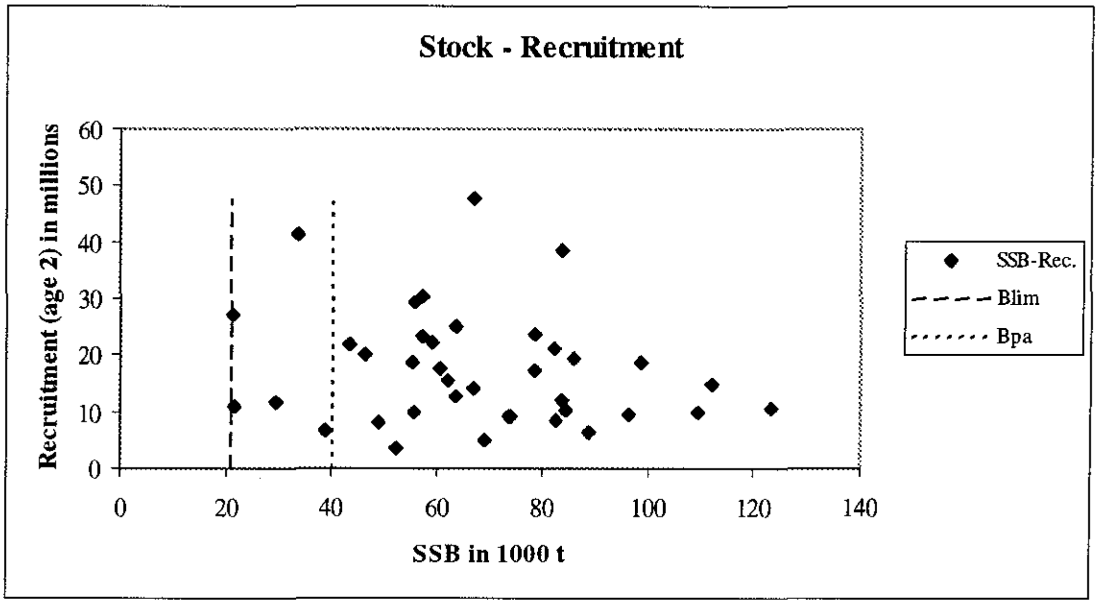
Faroe Plateau cod (Sub-division Vb_1)

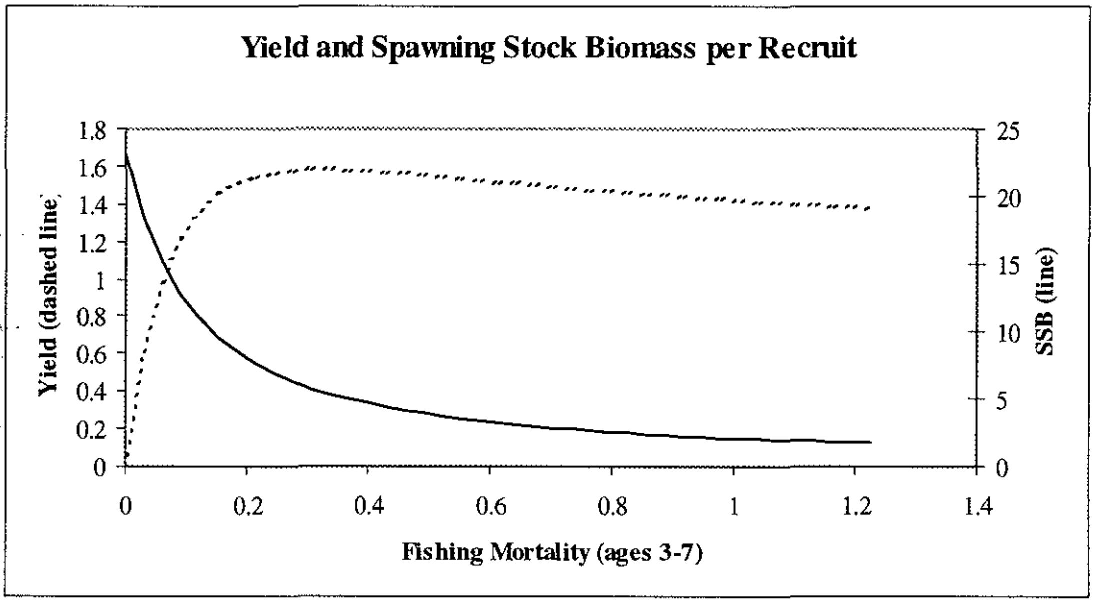









Stock - Recruitment
Recruitment (age 2) in millions
SSB in 1000 t
SSB-Rec.
Blim
Bpa


Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
SSB (line)
Fishing Mortality (ages 3-7)

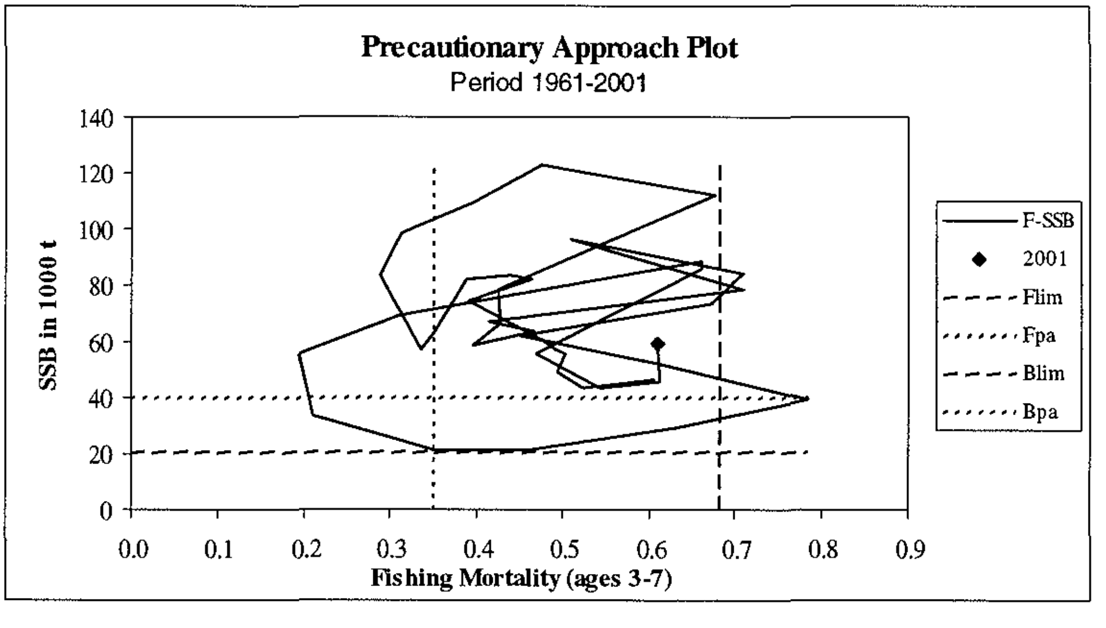

Precautionary Approach Plot
Period 1961-2001
SSB in 1000 t
Fishing Mortality (ages 3-7)
F-SSB
2001
Flim
Fpa
Blim
Bpa

Table 3.3.2.a.1 Faroe Plateau (Sub-division Vb_1) COD. Nominal landings (tonnes) by countries, 1986–2000, as officially reported to ICES.

	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000 *
Denmark	8	30	10	-	-	-	-	-	-	-	-	-	-	-	
Faroe Islands	34,492	21,303	22,272	20,535	12,232	8,203	5,938	5,744	8,724	19,079	39,406	33,556	23,308	19,156	21,793
France [1)]	4	17	17	-	-	- [2]	3 [3]	1 [3]	-	2 [3]	1 [3]	-	- *		3 [3]
Germany	8	12	5	7	24	16	12	+	2 [3]	2	+	+	-	39	2 [2]
Norway	83	21	163	285	124	89	39	57	36	38	507 *	410 *	405 *	557	429
Greenland	-	-	-	-	-	-	-	-	-	-	-	-	-		5 [3]
UK (Engl. and Wales)	-	8	-	-	-	1	74	186	56	43	126	61 [3]	27 [3]	51 [3]	
UK (Scotland)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
United Kingdom	-	-	-	-	-	-	-	-	-	-	-	-	-		264 [2]
Total	34,595	21,391	22,467	20,827	12,380	8,309	6,066	5,988	8,818	19,164	40,040	34,027	23,740	19,803	22,496

* Preliminary

1) Included in Vb2.

2 Quantity unknown 1991.

3 Reported as Vb.

Table 3.3.2.a.2. Faroe Plateau (Sub-division Vb_1) COD. Nominal catch (tonnes) 1986–2000, as used in the assessment.

	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Officially reported	34,595	21,391	22,467	20,827	12,380	8,309	6,066	5,988	8,818	19,164	40,040	34,027	23,740	19,803	22,496
Faroese catches in IIA within Faroe area jurisdiction			715	1,229	1,090	351	154								
Expected misreporting/discard										3330					
French catches as reported to Faroese authorities				12	17										
Catches reported as Vb2:															
UK (E/W/NI)					-	-	+	1	1	-	-	-	-	-	-
UK (Scotland)					205	90	176	118	227	551	382	277	265	210	-
Used in the assessment	34,595	21,391	23,182	22,068	13,487	8,750	6,396	6,107	9,046	23,045	40,422	34,304	24,005	20,013	22,496

*) Preliminary

Table 3.3.2.a.3 Faroe Plateau cod (Sub-division Vb_1).

Year	Recruitment Age 2 thousands	SSB tonnes	Landings tonnes	Mean F Ages 3-7
1961	12019	46439	21598	0.6059
1962	20654	43326	20967	0.5226
1963	20290	49054	22215	0.4944
1964	21834	55362	21078	0.5017
1965	8269	57057	24212	0.4909
1966	18566	60629	20418	0.4743
1967	23451	73934	23562	0.3900
1968	17582	82484	29930	0.4642
1969	9325	83487	32371	0.4375
1970	8608	82034	24183	0.3882
1971	11928	63307	23010	0.3526
1972	21320	57179	18727	0.3358
1973	12573	83547	22228	0.2886
1974	30480	98432	24581	0.3139
1975	38316	109563	36775	0.3947
1976	18574	123072	39799	0.4749
1977	9994	112049	34927	0.6758
1978	10745	78498	26585	0.4260
1979	14994	66709	23112	0.4274
1980	23520	58860	20513	0.3946
1981	14012	63497	22963	0.4652
1982	22083	66933	21489	0.4143
1983	25109	78389	38133	0.7073
1984	47766	96484	36979	0.5098
1985	17285	84521	39484	0.7084
1986	9510	73415	34595	0.6710
1987	10263	61843	21391	0.4508
1988	9124	52347	23182	0.6103
1989	15480	38938	22068	0.7835
1990	3604	29518	13487	0.6304
1991	6666	21627	8750	0.4585
1992	11490	21170	6396	0.3519
1993	10859	33680	6107	0.2104
1994	27160	55531	9046	0.1933
1995	41415	68941	23045	0.3110
1996	9943	88691	40422	0.6603
1997	5073	85738	34304	0.6595
1998	6378	55750	24005	0.4688
1999	19465	43411	20013	0.5436
2000	29465	45946	22496	0.6124
2001	14883	58940		0.6100
Average	17319	66106	24479	0.4850

3.3.2.b Faroe Bank cod (Sub-division Vb_2)

State of stock/exploitation: Although stock biomass is not known, it appears to be at or above average based on survey indices. The surveys indicate a steep increase of the stock in 1996–1998 compared with previous years, followed by a decline to average biomass in 1999–2000 (Figure 3.3.2.b.1). In 2001, the stock seems to have increased again and length distributions suggest strong incoming year classes.

Management objectives: There are no explicit management objectives for this stock and biological reference points have not been established.

Advice on management: ICES advises that fishing effort on the Faroe Bank should not exceed that exerted annually in recent years (1996–2000).

Relevant factors to be considered in management: The directed fishery is by a longline fleet that has been stable in size since 1996. The fleet is regulated by effort restrictions, so advice is provided in terms of effort.

The landing estimates are uncertain because since 1996 the vessels have been allowed to fish both on the Plateau and on the Faroe Bank during the same trip, making it difficult to assign landings to area. Given the relative size of the two fisheries, this causes greater uncertainty regarding catches for Faroe Bank cod than for Faroe Plateau cod, but the magnitude remains unquantified for both. The ability to provide advice depends on the reliability of input data. Because the cod landings from Faroe Bank are not known, it is not possible to provide catch advice on management. If the fishery management agency intends to manage the two fisheries to protect the productive capacity of each individual unit, then it is necessary to monitor and regulate the catch removed from each stock.

Comparison with previous assessment and advice: The advice is similar to advice from last year.

Elaboration and special comment: This fishery was an international fishery until the declaration of EEZs. Thereafter, primarily Faroese vessels have exploited the stock. The stock was the subject of a summer trawl fishery, but trawling inside the 200 m contour is now banned. The fishery is mainly carried out by longliners, and by trawlers, which are allowed to fish outside the 200 m contour.

The tentative analytical assessment presented last year could not be updated this year because the catches were poorly sampled. Exploratory analyses with a production model failed to produce reliable results.

Survey indices in the spring 2001 are most likely too optimistic, since the total catch was dominated by one very large haul.

Source of information: Report of the North-Western Working Group, April/May 2001 (ICES CM 2001/ACFM:20).

Catch data (Tables 3.3.2.b.1):

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC	Official Landings
1987	No assessment	-		3.5
1988	No assessment	-		3.1
1989	Addition to Faroe Plateau TAC	~2.0		1.4
1990	Access limitation may be required	-		0.6
1991	Access limitation may be required	-		0.4
1992	No fishing	0.3		0.3
1993	TAC	0.5		0.4
1994	TAC	0.5		1.0
1995	Precautionary TAC	0.5		1.2
1996	Precautionary TAC	0.5	1.0	2.5
1997	Effort at present levels	0.7		3.9
1998	Effort at present levels	-		3.5
1999	Effort not to exceed that exerted in 1996–1997	-		1.3
2000	Effort not to exceed that of 1996–1998	-		1.2
2001	Effort not to exceed that of 1996–1999	-		
2002	Effort not to exceed that of 1996–2000	-		

Weights in '000 t.

Faroe Bank cod (Sub-division Vb_2)

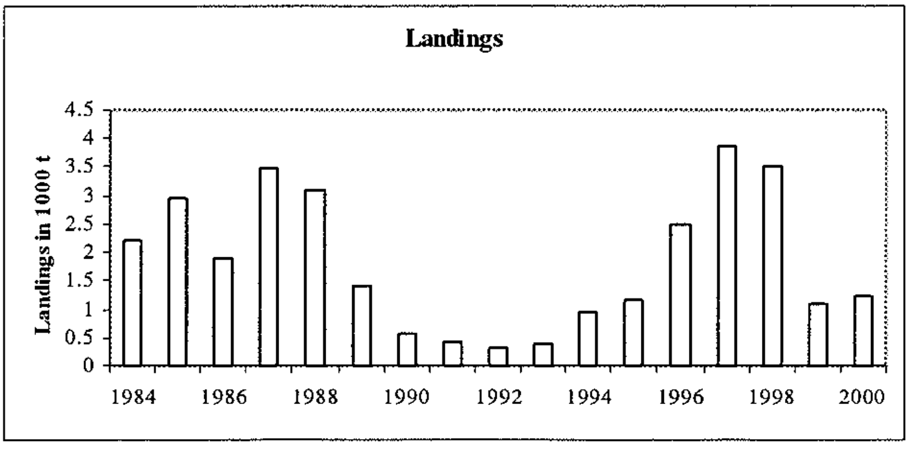


Table 3.3.2.b.1 Faroe Bank (Sub-division Vb_2) COD. Nominal catches (tonnes) by countries, 1986–2000. As officially reported to ICES.

	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Faroe Islands	1,836	3,409	2,960	1,270	289	297	122	264	717	561	2,051	3,459	3,092
Norway	6	23	94	128	72	38	32	2	8	40	55	135 *	148 *
UK (E/W/NI)	-	-	-	-	-	-	+	1	1	-	- [2]	- [2]	- [2]
UK (Scotland) [1]	63	47	37	14	205	90	176	118	227	551	382	277	265
United Kingdom													
Total	1,905	3,479	3,091	1,412	566	425	330	385	953	1,152	2,488	3,871	3,505
Used in assessment					361	335	154	266	725	601	2,106	3,594	3,240

	1999	2000 *
Faroe Islands	1,001	1,194
Norway	88 *	49
UK (E/W/NI)	-	
UK (Scotland)	210	
United Kingdom		- [2]
Total	1,299	1,243
Used in assessment	1,089	1,243

*) Preliminary.

1) Includes Vb1

2) Included in Vb1

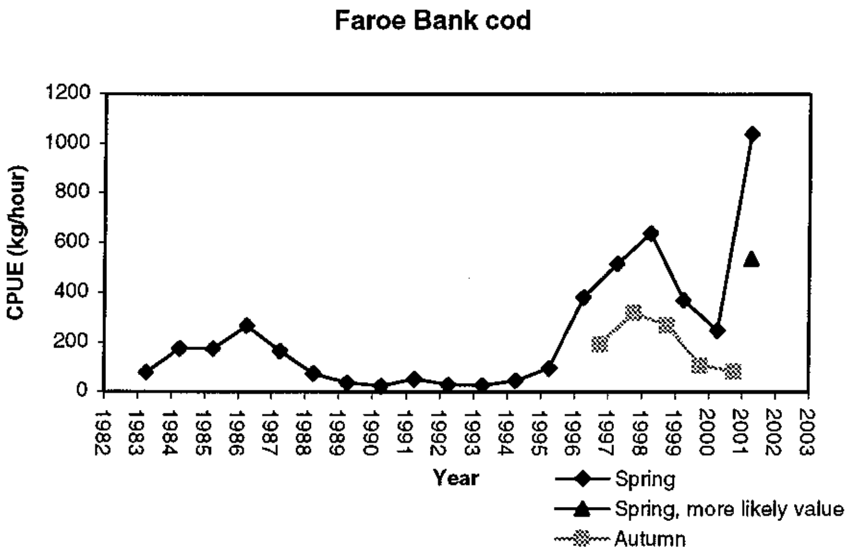


Figure 3.3.2.b.1 Faroe Bank (Sub-division Vb_2) COD. Catch per unit effort in the spring and autumn groundfish survey.

3.3.3 Faroe haddock (Division Vb)

State of stock/exploitation: The stock is outside safe biological limits. SSB in 2001 is estimated to be below $\mathbf{B_{pa}}$ and close to $\mathbf{B_{lim}}$. Fishing mortality in 2000 is estimated to be above the $\mathbf{F_{pa}}$ and $\mathbf{F_{lim}}$. The SSB increased significantly in 1996–1998 due to the recruitment of the very strong 1993 year class and the above average 1994 year class. The subsequent year classes have all been weak and SSB is expected to decline below $\mathbf{B_{lim}}$ in the short term, even with no fishery.

Management objectives: The effort management system implemented in the Faroese demersal fisheries in Vb since 1996 aims at harvesting on average 33% of the haddock exploitable stock. This translates into an average F of 0.45, higher than the proposed $\mathbf{F_{pa}}$ of 0.25. The harvest regime is expected to maintain fishing mortalities substantially in excess of $\mathbf{F_{lim}}$ in the medium term, resulting in a high probability that SSB will be less than $\mathbf{B_{lim}}$. ICES therefore considers this regime as inconsistent with the Precautionary Approach.

Precautionary Approach reference points (unchanged since 1999):

ICES considers that:	ICES proposed that:
$\mathbf{B_{lim}}$ is 40 000 t	$\mathbf{B_{pa}}$ be set at 55 000 t
$\mathbf{F_{lim}}$ is 0.40	$\mathbf{F_{pa}}$ be set at 0.25

Technical basis:

$\mathbf{B_{lim}}$: Former MBAL	$\mathbf{B_{pa}}$: 2 st. dev. above $\mathbf{B_{lim}}$ but reduced based on inspection of the SSB-R scatter plot
$\mathbf{F_{lim}}$: 2 *std. Dev. above $\mathbf{F_{pa}}$	$\mathbf{F_{pa}}$: $\mathbf{F_{med}}$ (1998) = 0.25

Advice on management: ICES recommends that there be no fishing in 2002 on this stock. ICES recommends that a rebuilding plan is developed, aiming at preventing a further decline in SSB below $\mathbf{B_{lim}}$. The rebuilding plan should take into account technical interactions with other gadoids and ensure that fisheries do not expand when good year classes do occur, until SSB has increased above $\mathbf{B_{pa}}$.

Relevant factors to be considered in management: The effect of the effort regulation should be closely monitored, in particular the possible changes in catchability and target species. Haddock are taken in a mixed fishery together with saithe and cod. Measures to minimise the mortality inflicted on haddock, while fishing for saithe and cod should be implemented.

Comparison with previous assessment and advice: In recent years the assessment has overestimated stock abundance and underestimated fishing mortality. This, together with a strong increase in fishing mortality has changed the perception of the state of the stock. Consequently, the stock has moved from being within safe biological limits to being outside safe biological limits both regarding biomass and harvest rate.

Catch forecast for 2002:

Basis: F(2001) = avgF(98-00) = 0.48; Landings (2001) = 20; SSB(2002) = 40.

F(2002 onwards)	Basis	Landings (2002)	SSB (2003)
0	0	0	34
0.12	0.25F(2000)	3.7	31
0.19	0.4F(2000)	6	28
F_{pa} (0.25)	0.5F(2000)	7	27
0.33	0.6F(2000)	8	26
0.38	0.8F(2000)	10	24
F_{sq} (0.48)	1.0F(2000)	12	22
0.53	1.2F(2000)	14	20

Weights in '000t.

Shaded scenarios considered inconsistent with the precautionary approach.

Medium- and long-term projections: Medium-term projections are not presented. They indicate that the average and above average year classes are less frequent since 1980 than in the previous 20 years. This suggests that medium term predictions may overestimate future SSBs at the chosen fishing mortality options.

Elaboration and special comment: The estimate of the recruiting year classes is poor as the survey indices were not available in the assessment.

The mean weights at age, which have been decreasing since the middle of the 1990s, have now increased again for most ages.

Haddock is mainly fished by longliners and pair-trawlers. At present there are closed areas to trawling, and this combined with the large minimum meshsize in the codend (145 mm) effectively reduces catches of juvenile and young haddock in trawl fisheries, whereas this is not the case for longliners.

Data and Assessment: The analytical assessment was performed using commercial trawl and longline CPUE data. No recruitment indices are available this year.

Source of information: Report of the North-Western Working Group, April/May 2001 (ICES CM 2001/ACFM:20).

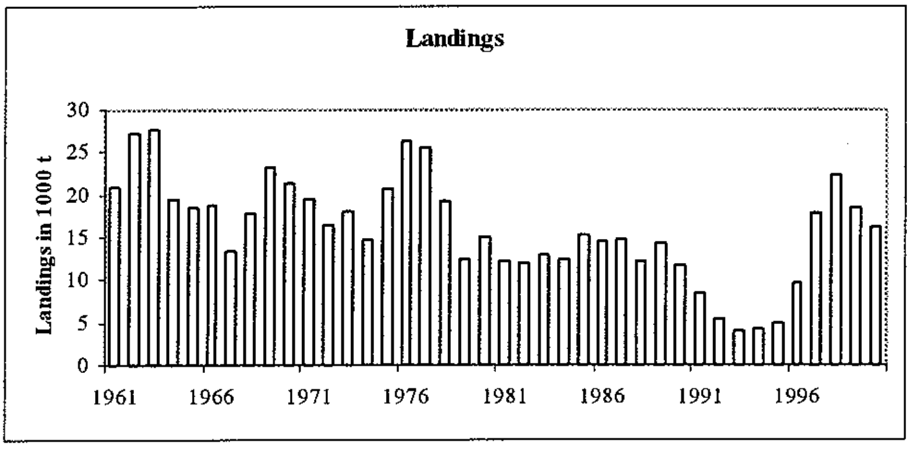
Yield and spawning biomass per Recruit F-reference points:

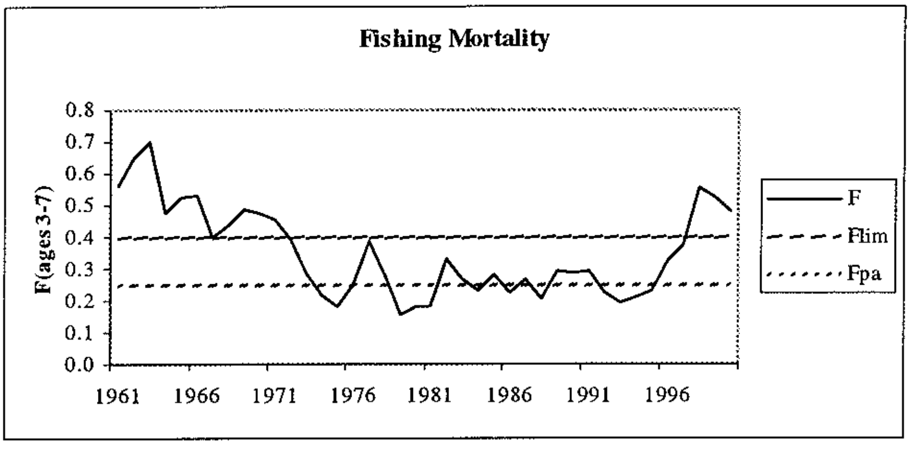
	Fish Mort Ages 3-7	Yield/R	SSB/R
Average Current	0.479	0.653	1.603
$\mathbf{F}_{max}$	0.420	0.655	1.792
$\mathbf{F}_{0.1}$	0.172	0.586	3.437
$\mathbf{F}_{med}$	0.239	0.628	2.769

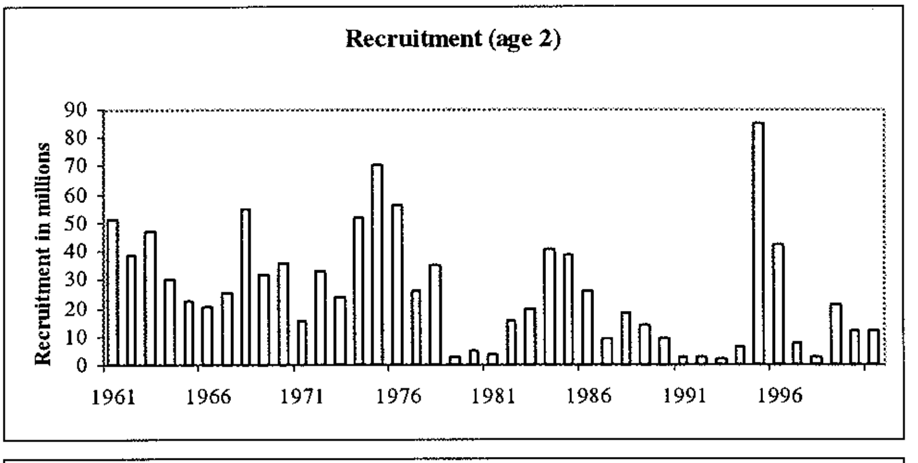
Catch data (Tables 3.3.3.1– 3):

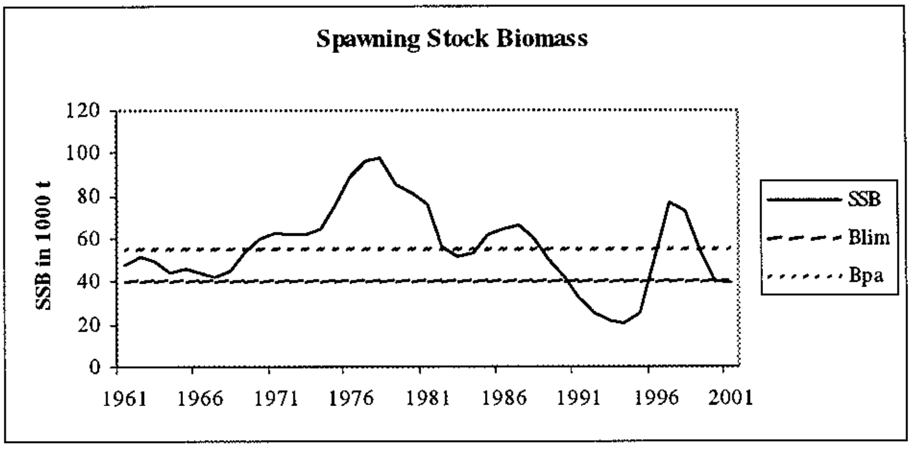
Year	ICES Advice	Predicted catch Corresp. to advice	Agreed TAC	ACFM Catch
1987	No increase in F	17		14.9
1988	No increase in F	18		12.2
1989	No increase in F	11		14.3
1990	No increase in F	11		11.7
1991	TAC	11		8.4
1992	TAC	13-15		5.5
1993	Reduction in F	8		4.0
1994	No fishing	0	6.2	4.3
1995	No fishing	0	6.2	4.9
1996	TAC	8.3	12.6[1]	9.6
1997	F= F(95)	9.3		17.9
1998	F =F(96)	16		22.2
1999	F < proposed $\mathbf{F}_{pa}$ (0.25)	9		18.5
2000	F < proposed $\mathbf{F}_{pa}$ (0.25)	22		16.3
2001	F < proposed $\mathbf{F}_{pa}$ (0.25)	20		
2002	No fishing	0		

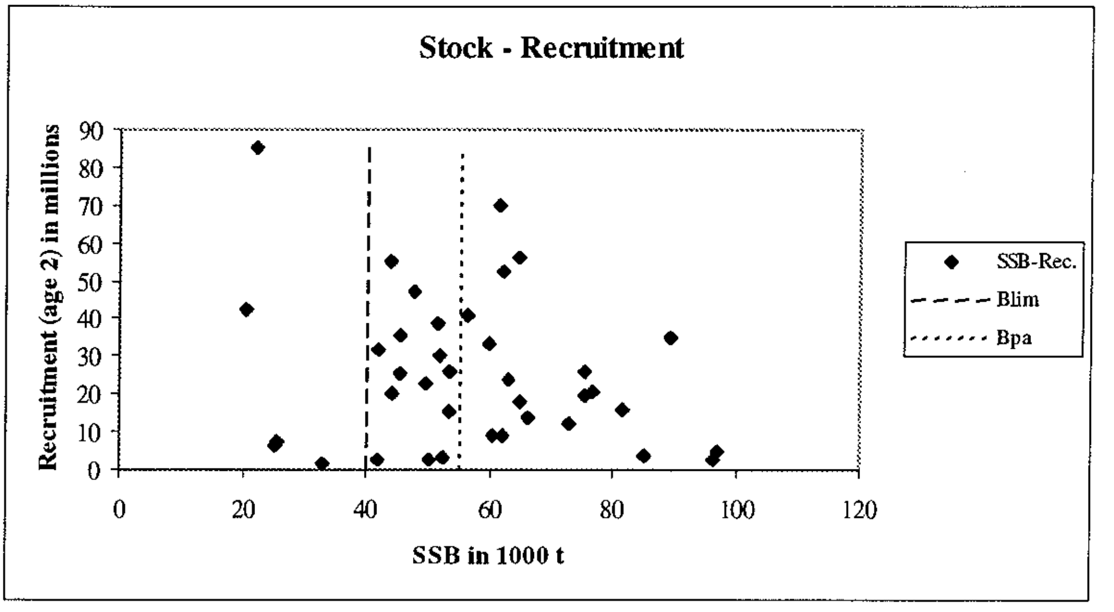
[1]For the period 1 September 1995 to 31 May 1996. Weights in '000 t.

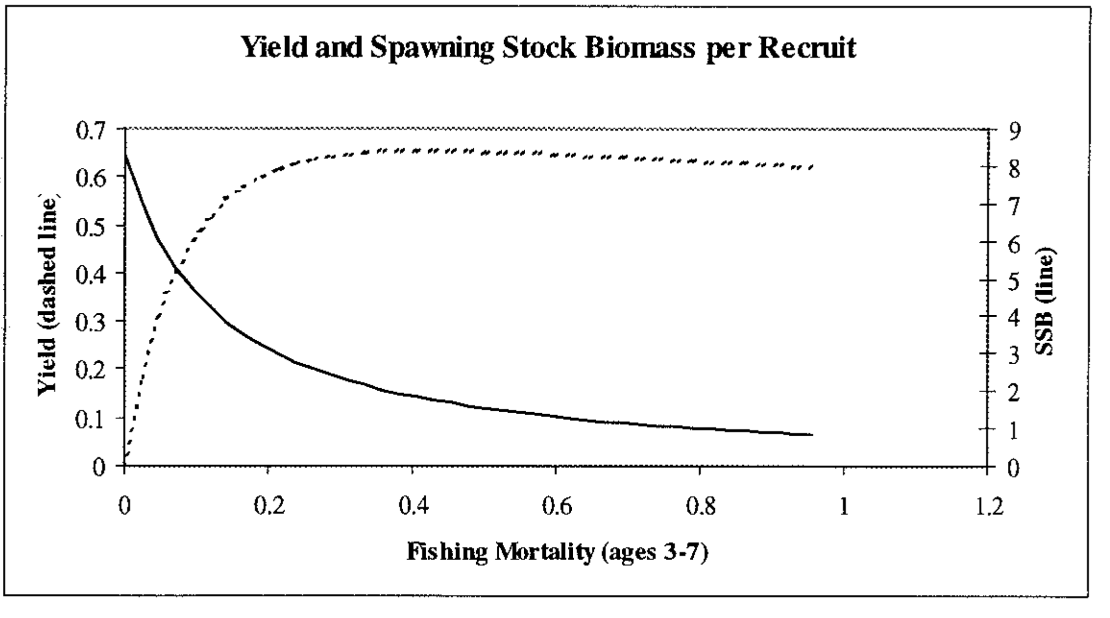

Landings
Landings in 1000 t
30
25
20
15
10
5
0
1961
1966
1971
1976
1981
1986
1991
1996


Fishing Mortality
F(ages 3-7)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1961
1966
1971
1976
1981
1986
1991
1996
F
Flim
Fpa


Recruitment (age 2)
Recruitment in millions
90
80
70
60
50
40
30
20
10
0
1961
1966
1971
1976
1981
1986
1991
1996


Spawning Stock Biomass
SSB in 1000 t
120
100
80
60
40
20
0
1961
1966
1971
1976
1981
1986
1991
1996
2001
SSB
Blim
Bpa


Stock - Recruitment
Recruitment (age 2) in millions
SSB in 1000 t
SSB-Rec.
Blim
Bpa
0
10
20
30
40
50
60
70
80
90
0
20
40
60
80
100
120


Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
SSB (line)
Fishing Mortality (ages 3-7)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0
1
2
3
4
5
6
7
8
9
0
0.2
0.4
0.6
0.8
1
1.2

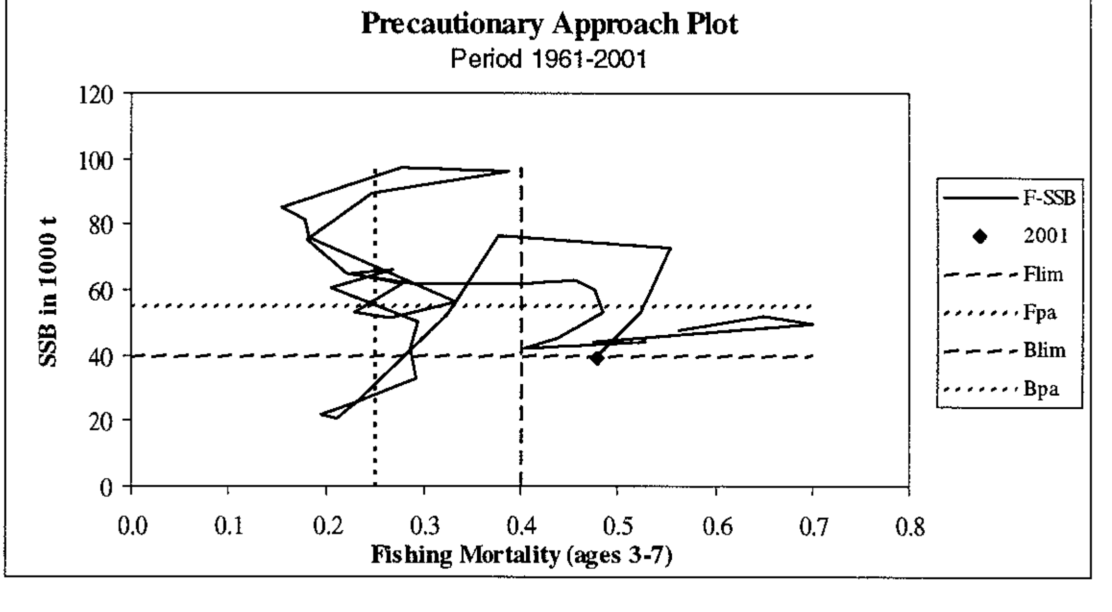

Precautionary Approach Plot
Period 1961-2001
SSB in 1000 t
Fishing Mortality (ages 3-7)
F-SSB
2001
Flim
Fpa
Blim
Bpa
0
20
40
60
80
100
120
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8

Table 3.3.3.1 Faroe Plateau (Sub-division Vb_1) Haddock. Nominal catches (tonnes) by countries 1982-2000, as officially reported to ICES, and the total Working Group estimate in Vb.

Country	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Denmark	-	-	-	-	1	8	4	-	-	-
Faroe Islands	10,319	11,898	11,418	13,597	13,359	13,954	10,867	13,506	11,106	8,074
France[1]	2	2	20	23	8	22	14	-	-	-
Germany	1	+	+	+	1	1	-	+	+	+
Norway	12	12	10	21	22	13	54	111	94	125
UK (Engl. and Wales)	-	-	-	-	-	2	-	-	7	-
UK (Scotland)[3]	1	-	-	-	-	-	-	-	-	-
United Kingdom										
Total	10,335	11,912	11,448	13,641	13,391	14,000	10,939	13,617	11,207	8,199
Working Group estimate[4,5]	11,937	12,894	12,378	15,143	14,477	14,882	12,178	14,325	11,726	8,429

Country	1992	1993	1994	1995	1996	1997	1998	1999	2000[2]
Faroe Islands	4,655	3,622	3,675	4,549	9,152	16,585	19,135	16,643	14,038
France[1]	164	-					2[2,7]	0	1[6]
Germany	-	-		5	-	-		33	1[7]
Greenland								30[6]	22[6]
Norway	71	28	22	28	45	45[2]	71[2]	415[2]	372
UK (Engl. and Wales)	54	81	31	23	5	22[1]	30[1]	59[7]	
UK (Scotland)[3]	-	-	-	-	...	...	...		
United Kingdom									204[7]
Total	4,944	3,731	3,728	4,605	9,202	16,652	19,238	17,180	14,638
Working Group estimate[4,5]	5,476	4,026	4,252	4,948	9,642	17,924	22,210	18,486	16,286

1) Including catches from Sub-division Vb2. Quantity unknown 1989-1991, 1993 and 1995-2000.

2) Provisional data

3)From 1983 to 1996 catches included in Sub-division Vb2.

4) Includes catches from Sub-division Vb2 and Division IIa in Faroese waters.

5)Includes French and Greenlandic catches from Division Vb, as reported to the Faroese coastal guard service

6) Reported as Division Vb, to the Faroese coastal guard service.

7) Reported as Division Vb.

Table 3.3.3.2 Faroe Bank (Sub-division Vb_2) Haddock. Nominal catches (tones) by countries, 1982-2000, as officially reported to ICES.

Country	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Faroe Islands	1,533	967	925	1,474	1,050	832	1,160	659	325	217
France[1]	-	-	-	-	-	-	-	-	-	-
Norway	1	2	5	3	10	5	43	16	97	4
UK (Engl. and Wales)	-	-	-	-	-	-	-	-	-	-
UK (Scotland)[3]	48	13	+	25	26	45	15	30	725	287
Total	1,582	982	930	1,502	1,086	882	1,218	705	1,147	508

Country	1992	1993	1994	1995	1996	1997	1998	1999	2000[2]
Faroe Islands	338	185	353	303	338	1,133	2,810	1,110	1,600
France[1]	-	-	-	-	-	-			
Norway	23	8	1	1[2]	40[2]	4[2]	60[2]	3[2]	48
UK (Engl. and Wales)	+	+	+	...[1]	...[1]	...[1]	...[1]	[1]	[1]
UK (Scotland)[3]	869	102	170	39	62	135[1]	102	193	[1]
Total	1,230	295	524	343	440	1,272	2,972	1,306	1,648

1) Catches included in Sub-division Vb1.

2) Provisional data

3)From 1983 to 1996 includes also catches taken in Sub-division Vb1 (see Table 2.4.1)

Table 3.3.3.3 Faroe haddock (Division Vb).

Year	Recruitment Age 2 thousands	SSB tonnes	Landings tonnes	Mean F Ages 3-7
1961	51279	47797	20831	0.5624
1962	38537	51875	27151	0.6506
1963	47362	49547	27571	0.7002
1964	30110	44128	19490	0.4753
1965	22644	45555	18479	0.5260
1966	20205	43953	18766	0.5288
1967	25355	41958	13381	0.4031
1968	54838	45378	17852	0.4377
1969	31966	53419	23272	0.4853
1970	35576	59853	21361	0.4763
1971	15447	62899	19393	0.4564
1972	33170	61963	16485	0.3965
1973	23686	61562	17976	0.2894
1974	52320	64610	14773	0.2207
1975	69980	75376	20715	0.1800
1976	55904	89167	26211	0.2477
1977	26154	96281	25555	0.3876
1978	35032	97091	19200	0.2785
1979	2773	85243	12418	0.1553
1980	4935	81732	15016	0.1783
1981	3484	75650	12233	0.1819
1982	15781	56240	11937	0.3320
1983	19450	51608	12894	0.2665
1984	40523	53507	12378	0.2298
1985	38798	62128	15143	0.2783
1986	25897	64910	14477	0.2263
1987	8993	66283	14882	0.2689
1988	18066	60622	12178	0.2058
1989	14023	50251	14325	0.2947
1990	9063	41988	11726	0.2866
1991	2906	33048	8429	0.2919
1992	2685	25400	5476	0.2249
1993	1823	21997	4026	0.1955
1994	6507	20578	4252	0.2109
1995	85204	25753	4948	0.2315
1996	42245	52425	9642	0.3242
1997	7396	76834	17924	0.3773
1998	3110	73069	22210	0.5551
1999	20769	53013	18486	0.5229
2000	12100	39904	16286	0.4786
2001	12100	39233		0.4800
Average	26054	56191	15994	0.3537

3.3.4 Faroe saithe (Division Vb)

State of stock/exploitation: The stock is at present harvested outside safe biological limits. SSB is above $\mathbf{B}_{pa}$ due to above average recruitment in the second half of the 1990s, but fishing mortality is high (F_{2000}= 0.41), well above $\mathbf{F}_{pa}$ (= 0.28) and also above $\mathbf{F}_{lim}$ (= 0.40). Although there has been high recruitment in the late 1990s, the stock is expected to decline in the medium term with the present exploitation pattern.

Management objectives: The effort management system implemented in the Faroese demersal fisheries (Division Vb) since 1996 aims at harvesting on average 33% of the saithe stock in numbers. This translates into an average F of 0.45, higher than $\mathbf{F}_{pa}$ of 0.28 and even above $\mathbf{F}_{lim}$. The harvest regime is expected to produce fishing mortalities substantially in excess of $\mathbf{F}_{lim}$ in the medium term. ICES considers this regime to be inconsistent with the precautionary approach.

Precautionary Approach reference points (unchanged since 1999):

ICES considers that:	ICES proposes that:
$\mathbf{B}_{lim}$ is 60 000 t	$\mathbf{B}_{pa}$ be set at 85 000 t
$\mathbf{F}_{lim}$ is 0.40	$\mathbf{F}_{pa}$ be set at 0.28

Technical basis:

$\mathbf{B}_{lim}$: lowest observed SSB	$\mathbf{B}_{pa}$: former MBAL
$\mathbf{F}_{lim}$:consistent with $\mathbf{B}_{lim}$ of 60 000 t	$\mathbf{F}_{pa}$: consistent with $\mathbf{F}_{lim}$ and $\mathbf{F}_{med}$

Advice on management: ICES advises that fishing effort in 2002 be reduced to correspond to fishing mortality below $\mathbf{F}_{pa}$, corresponding to landings less than 28 000 t. Current practice under the effort management system, to increase the number of fishing days allowed when moving into deeper waters, should be suspended until fishing mortality has decreased such that saithe is harvested within safe biological limits. The present spawning closures should be maintained.

Relevant factors to be considered in management: The effort of the effort regulations should be closely monitored, in particular the possible changes in catchability and target species. In addition, it should be noted that saithe are partly caught in a mixed trawl fishery together with haddock and cod. Hence management measures taken in 2000/2001 for cod and haddock should also ensure protection for the saithe stock.

Comparison with previous assessment and advice: This year's assessments show higher estimates of SSB than last year's assessment. This is due to higher estimates of 1995–1998 year classes. However, these year classes are still poorly estimated.

Catch forecast for 2002:

Basis: F(2001) = F(2000) = 0.41; Landings (2001) = 39.0; SSB(2002) = 92.9.

F(2002)	Basis	Catch (2002)	Landings (2002)	SSB (2003)
0.25	0.6 F(00)	25	25	104
$\mathbf{F}_{pa}$(0.28)	0.68 F(00)	28	28	101
0.33	0.8 F(00)	32	32	98
0.41	1.0 F(00)	38	38	92
0.49	1.2 F(00)	44	44	87

(Weights in '000 t)

Shaded scenarios considered inconsistent with the precautionary approach.

If the number of fishing days allocated is maintained, there is a high probability that fishing mortality will exceed $\mathbf{F}_{pa}$= 0.28 in 2002 and 2003.

Medium- and long-term projections: Medium-term projections are not presented. They were made using the same input parameters as the short-term predictions. The results indicate a high probability that SSB will be less than the proposed $\mathbf{B}_{pa}$ at current fishing mortality, particularly if future recruitment follows a distribution similar to past observations.

Elaboration and special comment: Saithe are taken in a mixed trawl fishery although they may be targeted with a small by-catch of other demersal species. The fishery was originally international, but for all practical purposes saithe has been fished only by Faroese vessels since the introduction of the 200 nm EEZ in 1977. The principal fleet consisting of large pair trawlers with engines larger than 1000 HP, accounted for 60% of the catches in 1994–2000. In the same period the smaller pair trawlers (<1000 HP) caught 20%, jiggers 9% and large single trawlers 9%. All other vessels had only small catches of saithe as by-catch. Growth rates have increased from the low level observed in 1990–1991 to higher values in 1994–1996 and have decreased again since 1997.

The assessment was tuned with commercial pair trawler catch and effort data from logbooks. No recruitment indices are available.

Source of information: Report of the North-Western Working Group, April/May 2001 (ICES CM 2001/ACFM:20).

Yield and spawning biomass per Recruit F-reference points:

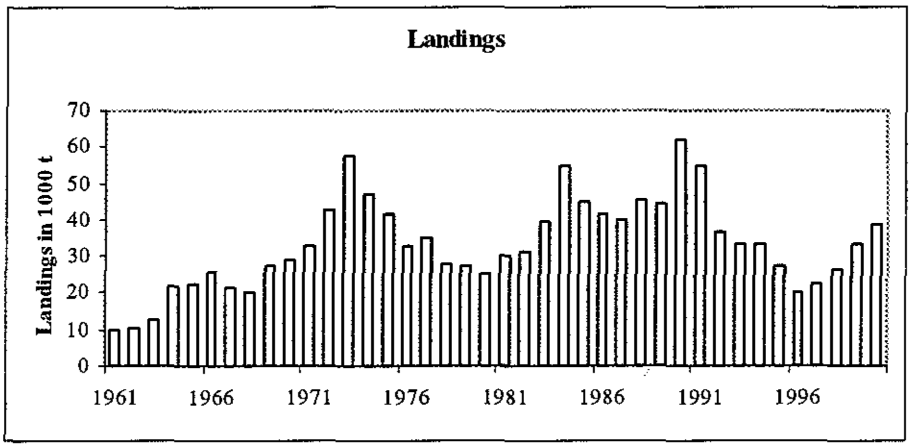
	Fish Mort Ages 4-8	Yield/R	SSB/R
Average Current	0.409	1.372	1.778
Fmax	0.291	1.389	2.879
F0.1	0.135	1.264	6.576
Fmed	0.235	1.381	3.756

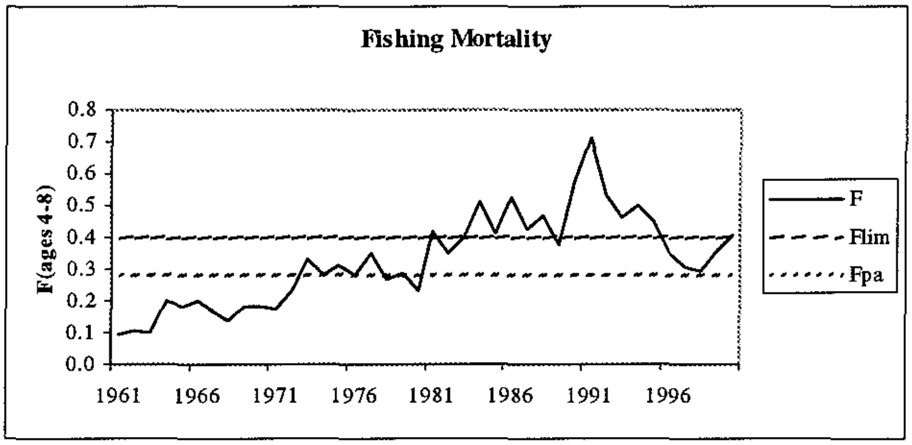
Catch data (Tables 3.3.4.1–2):

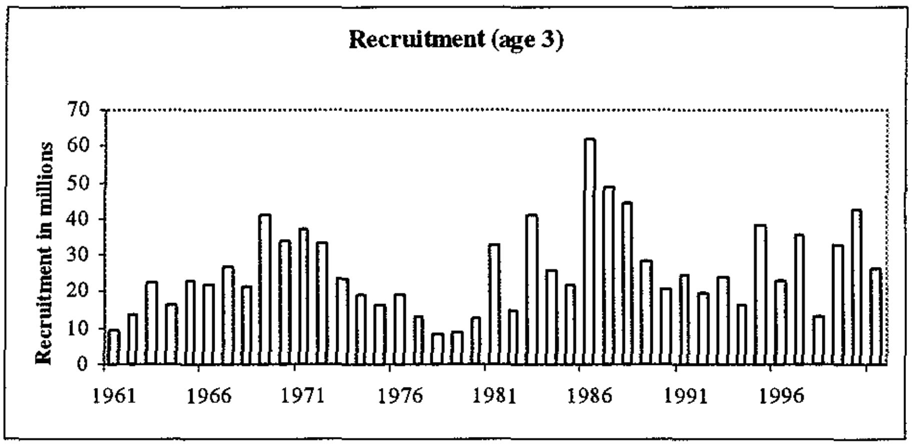
Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC	ACFM Landings
1987	No increase in F	32		40
1988	No increase in F	32		45
1989	Reduction in F	<40		44
1990	Reduction in F	41		62
1991	TAC	30		55
1992	Reduction in F	27		36
1993	Reduction in F	<37		34
1994	TAC	26	42[1]	33
1995	TAC	22	39[1]	27
1996	TAC	39	-	20
1997	20% reduction in F from 1995 level	21	-	22
1998	30% reduction in effort from 1996/97 level	-	-	26
1999	F below $\mathbf{F}_{pa}$ (0.28)	14		33
2000	F below than $\mathbf{F}_{pa}$ (0.28)	15		39
2001	Reduce fishing effort to generate F well below $\mathbf{F}_{pa}$ (0.28)	<17		
2002	Reduce fishing effort to generate F below $\mathbf{F}_{pa}$ (0.28)	28		

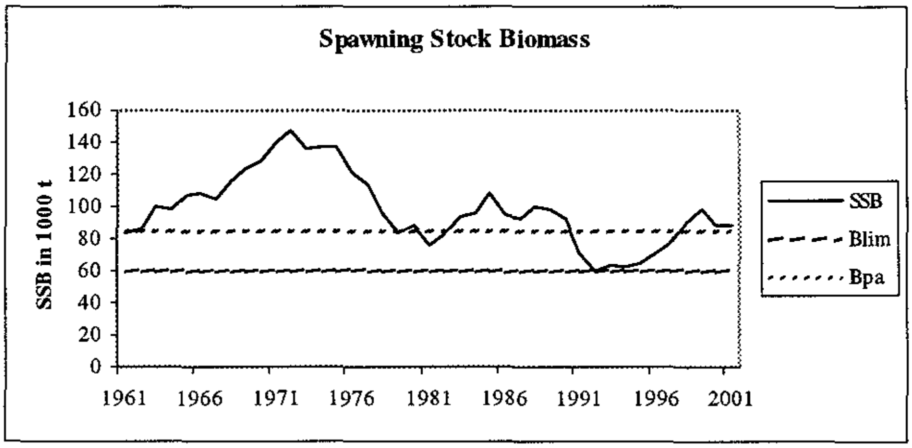
[1]In the quota year 1 September–31 August the following year. Weights in '000 t.

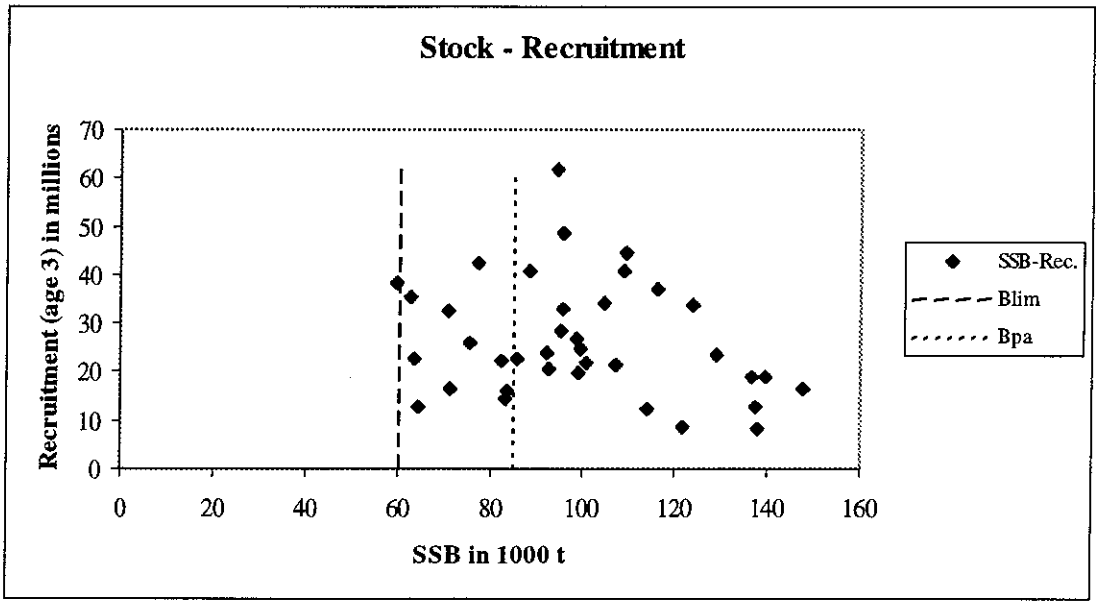
Faroe saithe (Division Vb)

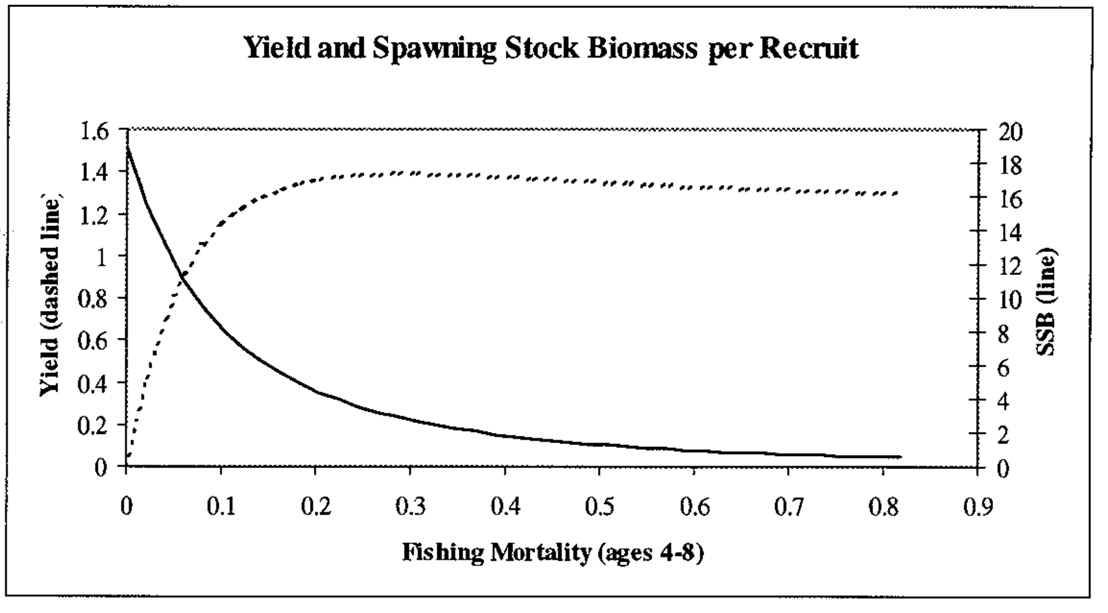









Stock - Recruitment
Recruitment (age 3) in millions
SSB in 1000 t
SSB-Rec.
Blim
Bpa
0
10
20
30
40
50
60
70
0
20
40
60
80
100
120
140
160


Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
SSB (line)
Fishing Mortality (ages 4-8)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
0
2
4
6
8
10
12
14
16
18
20
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9

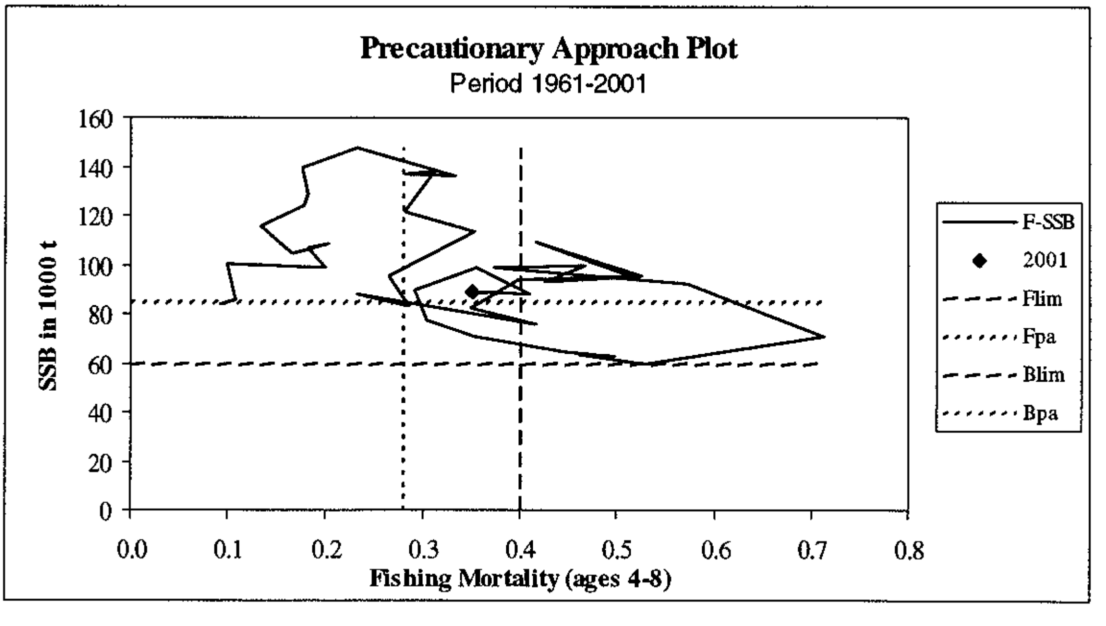

Precautionary Approach Plot
Period 1961-2001
SSB in 1000 t
Fishing Mortality (ages 4-8)
F-SSB
2001
Flim
Fpa
Blim
Bpa
0
20
40
60
80
100
120
140
160
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8

Table 3.3.4.1 Saithe in the Faroes (Division Vb). Nominal catches (t) by countries, 1987–2000 as officially reported to ICES.

Country	1987	1988	1989	1990	1991	1992	1993
Denmark	255	94	-	2	-	-	-
Faroe Islands	39,301	44,402	43,624	59,821	53,321	35,979	32,719
France [3]	153	313	-	-	-	120	75
German Dem.Rep.	-	-	9	-	-	5	2
German Fed. Rep.	49	74	20	15	32		-
Netherlands	-	-	22	67	65	-	32
Norway	14	52	51	46	103	85	279
UK (Eng. & W.)	108	-	-	-	5	74	425
UK (Scotland)	140	92	9	33	79	98	
USSR/Russia [2]	-	-	-	30	-	12	-
Total	40,020	45,027	43,735	60,014	53,605	36,373	33,532
Working Group estimate [4,5]	40,020	45,285	44,477	61,628	54,858	36,487	33,543

Country	1994	1995	1996	1997	1998	1999	2000 [1]
Estonia	-	-	-	16	-	-	-
Faroe Islands	32,406	26,918	19,297	21,721	25,995	32,439	38,073
France	19	10	12	9	17	-	58
Germany	1	41	3	5	-	100	230
Greenland	-	-	-	-	-	-	1
Norway	156	10	16	67	54	189	113
UK (Eng. & W.)	151	21	53	-	19	67	...
UK (Scotland)	438	200	580	460	337	441	...
United Kingdom							565
Russia	-	-	18	28	-	-	8
Total	33,171	27,200	19,979	22,306	26,422	33,236	39,048
Working Group estimate [4,5]	33,182	27,209	20,029	22,306	26,422	33,236	39,048

[1] Preliminary.

[2] As from 1991.

[3] Quantity unknown 1989-91.

[4] Includes catches from Sub-division Vb2 and Division IIa in Faroese waters.

[5] Includes French, Greenlandic, Russian catches from Division Vb, as reported to the Faroese coastal guard service.

Table 3.3.4.2 Saithe in the Faroes (Division Vb).

Year	Recruitment Age 3 thousands	SSB tonnes	Landings tonnes	Mean F Ages 4-8
1961	9046	83791	9592	0.0911
1962	13662	85627	10454	0.1083
1963	22427	100620	12693	0.0996
1964	16187	98370	21893	0.2007
1965	22797	107197	22181	0.1828
1966	21821	108753	25563	0.2030
1967	26865	104602	21319	0.1661
1968	21503	115916	20387	0.1350
1969	40779	123735	27437	0.1791
1970	34113	129066	29110	0.1833
1971	37260	139403	32706	0.1770
1972	33584	147448	42663	0.2331
1973	23272	136540	57431	0.3332
1974	18878	137431	47188	0.2815
1975	16276	137669	41576	0.3132
1976	18876	121784	33065	0.2827
1977	12896	113826	34835	0.3524
1978	8365	95715	28138	0.2667
1979	8594	83187	27246	0.2863
1980	12364	88372	25230	0.2342
1981	33085	75697	30103	0.4168
1982	14613	82329	30964	0.3501
1983	40806	94198	39176	0.3989
1984	25832	95777	54665	0.5140
1985	22046	109014	44605	0.4155
1986	61717	95256	41716	0.5250
1987	48566	92676	40020	0.4260
1988	44544	99411	45285	0.4672
1989	28533	98952	44477	0.3735
1990	20690	92184	61628	0.5719
1991	24858	71263	54858	0.7119
1992	19630	59945	36487	0.5286
1993	23899	63729	33543	0.4611
1994	16444	62712	33182	0.4971
1995	38482	64622	27209	0.4474
1996	22754	70952	20029	0.3523
1997	35436	77387	22306	0.3041
1998	12910	90198	26422	0.2917
1999	32644	98455	33236	0.3560
2000	42497	88490	39048	0.4093
2001	26164	89036		0.3520
Average	25749	98325	33242	0.3288

3.3.5 Answer to Special Request on Probability Profiles of Fishing Mortalities

The Faroese Government has requested ICES as follows:

for cod, haddock and saithe in Division Vb, where an effort control management system is in effect, estimate the probability profile of fishing mortalities which would be generated under the current effort control scheme and provide effort options which have a high probability (> 80%) that the realised fishing mortalities in 2002 would correspond to the fishing mortality identified as being within safe biological limits;

The probability profile of fishing mortalities presented in the 1999 report could not be provided in this years report.

In recent reports, the fishing mortality on cod, haddock and saithe that could be generated in the upcoming fishing year, given the number of fishing days allocated to each fishing fleet, was estimated, using partial fishing mortalities by age (3 to 7) and by year (1985 to 1995) to calculate catchability coefficients. Probability profiles for various combinations of effort allocations were then constructed from the effort allocated and the estimated catchabilities. Based on the 1999 assessment and the observed effort allocation, there was a high probability for all 3 stocks that fishing mortality was in excess of the proposed $\mathbf{F}_{pa}$'s.

The number of fishing days reported for 1996 to 1997 are not believed to be reliable because the number of days fished in trips landed at multiple landing sites were recorded at each landing site. This problem is believed to have been resolved from 1998 onwards. With the implementation of the fishing days system, it is expected that the mortality exerted by a single fishing day for the various fleet categories will have changed and therefore the basis for the calculation of the expected fishing mortality is probably no longer valid. Another problem is that the fleet definitions have changed since the introduction of the day system, and this makes comparisons back in time difficult. And the existing recent time-series is too short to be used in reliable evaluations.

However, the recent history and the present assessment indicate that fishing mortality on all three stocks is expected to be above the proposed $\mathbf{F}_{pa}$, unless the number of days are reduced substantially. Furthermore, medium-term projections indicate that with present fishing mortalities there is a high probability that SSB for all three stocks will be below $\mathbf{B}_{pa}$, for haddock even below $\mathbf{B}_{lim}$.

3.4 Stocks in the Skagerrak and Kattegat (Division IIIa)

3.4.1 Overview

Description of fisheries

The fleets operating in the Skagerrak and Kattegat (Division IIIa) include vessels targeting species for human consumption as well as vessels engaged in fisheries for reduction purposes. The human consumption fleets are diverse including gill netters and Danish seiners exploiting flatfish and cod and demersal trawlers involved in various human consumption fisheries (roundfish, flatfish, *Pandalus* and *Nephrops*). Demersal trawling is also used in the fisheries for Norway pout and sandeel which are landed for reduction purposes. Pelagic trawlers and purse seiners exploit herring, mackerel, horse mackerel and sprat.

The roundfish, flatfish and *Nephrops* stocks are mainly exploited by Danish and Swedish fleets consisting of bottom trawlers (*Nephrops* trawls with >70 mm meshes and bottom trawls with >90 mm mesh size), gill netters and Danish seiners. The number of vessels operating in Division IIIa has decreased in recent years. This is partly an effect of the EU withdrawal programme which until now has affected the Danish fleets only, but these fleets still dominate the fishery in Division IIIa. *Pandalus* is exploited by Danish, Swedish and Norwegian shrimp trawlers.

The industrial fisheries are carried out by trawlers mainly of a size above 20 m using small-mesh trawl. The main target species are sandeel, Norway pout, sprat and blue whiting. By-catches in these fisheries have decreased since 1996 mainly due to enforcement of by-catch regulations. Landings in the industrial fisheries in Division IIIa are given in Table 3.4.1.1.

There are important technical interactions between the fleets.

Misreporting and non-reporting of catches have occurred mainly in the cod fisheries. The amount is, however, not known. There are no discard data available for assessments. The time series of age samples from landings for industrial purposes is short.

Overview of resources

The Skagerrak-Kattegat area is to a large extent a transition area between the North Sea and the Baltic - both in terms of hydrography and topography and the identity of stocks. The exchange of water between the North Sea and the Baltic is the main hydrographic feature of the area.

When assessed as separate stocks, several of the stocks in the Skagerrak show close affinities to the North Sea stocks, in terms of both population dynamics (similar trends in recruitment and SSB) and biological indicators such as parasites or genetics. Tagging experiments have demonstrated extensive migration between the two areas for several species. Species with no clear stock boundary between the North Sea and Skagerrak include saithe, hake, cod (except for coastal populations in fjords), haddock, whiting and Norway pout. Sandeel in the North Sea and Skagerrak is probably a complex of several local populations rather than separate populations in the two areas. The landings of sandeel from the Skagerrak area have had a different composition of sandeel species from that in the North Sea.

The main herring stocks exploited in the area are the North Sea autumn spawners and the stock of spring-spawners spawning in the western Baltic and the southern part of Division IIIa. Both stocks have important components migrating into Division IIIa at some time during their life cycle. The juvenile herring in Division IIIa are mainly of North Sea stock origin while the mature fish are predominantly spring-spawners. The major part of the Western Baltic spring spawners migrates into Division IIIa outside the spawning season and is found in the Skagerrak in summer.

Cod in the Kattegat and Belt area are also associated with the western Baltic stock. The structure and extent of migrations is, however, not clear.

Most of the species are now assessed in conjunction with the stocks in the neighbouring areas – cod in the Skagerrak, haddock, saithe, Norway pout and autumn-spawning herring are assessed as part of the North Sea stocks, spring spawning-herring as part of the western Baltic stock. The state of these stocks is considered in the sections concerning the North Sea and Baltic respectively.

The cod in Skagerrak is assessed together with cod in the North Sea and the Eastern Channel. The stock is outside safe biological limits (see Section 3.5.2). The landings of cod in the Skagerrak in 2000 were 9 300 t in the human consumption fishery. No by-catch was observed in the small meshed industrial fisheries. Denmark and Sweden took the majority of catches.

The cod in Kattegat is outside safe biological limits. Landings in 2000 were 4 900 t, which is the lowest in the time series.

Haddock in Division IIIa is assessed together with haddock in the North Sea. The stock is outside safe biological limits. The landings of haddock in Division IIIa in the human consumption fisheries amounted to 1 485 t in 2000. By-catches in the industrial fisheries were estimated at 600 t. Most of the catches are taken in the Skagerrak.

Assessment of the state of the whiting in Division IIIa was not possible. The landings of whiting in Division IIIa were 600 t in 2000 and the major part was taken in the industrial fisheries. Most of the landings are taken in the Skagerrak.

The plaice in Division IIIa is harvested outside biological limits, as fishing mortality is higher than $\mathbf{F}_{pa}$. Landings amount to 8800 t in 2000. About 75% of the landings were taken in the Skagerrak.

Sole in Division IIIa is harvested outside safe biological limits. Landings in 2000 were 780 t, substantially lower than the 1 300 t in 1995.

The industrial fisheries yielded a total catch of 72 000 t in 2000, well below the mean catches of 120 000 t (1989-2000). Most of the catches consisted of sandeel, sprat and herring with smaller catches of Norway pout and blue whiting (Table 3.4.1.1) By-catches of cod, haddock and whiting in the industrial fisheries were all much reduced from 1996.

The landings of *Nephrops* and *Pandalus* in 2000 from Division IIIa amounted to 4 700 t and 7 300 t respectively. The stocks seem to be able to sustain the present fishing mortality.

Table 3.4.1.1 Catches of the most important species in the industrial fisheries in Division IIIa ('000 t), 1974–1999[1].

Year	Sandeel	Sprat[2]	Herring[3]	Norway pout	Blue whiting	Total
1974	8	71	76	13	-	168
1975	17	101	57	19	-	194
1976	22	59	38	42	-	161
1977	7	67	32	21	-	127
1978	23	78	16	25	-	142
1979	34	96	13	25	6	174
1980	39	84	25	26	14	188
1981	59	76	63	30	+	228
1982	25	40	54	44	5	168
1983	29	26	89	30	16	190
1984	26	36	112	46	15	235
1985	6	20	116	9	19	170
1986	73	11	65	6	9	164
1987	5	14	72	3	25	119
1988	23	9	97	8	15	152
1989	18	4	52	5	9	88
1990	16	2	51	27	10	106
1991	24	14	44	39	10	131
1992	39	4	66	45	19	173
1993	45	2	71	8	32	158
1994	55	58	30	7	12	162
1995	12	42	34	50	10	148
1996	53	10	26	36	15	140
1997	82	12	6	32	4	136
1998	11	11	5	15	7	49
1999[4]	13	26	11	7	16	73
2000[4]	17	19	18	10	7	72
Mean 1989–2000	32	17	35	23	13	120

[1]Data from 1974–1984 from Anon. (1986), 1985–2000 provided by Working Group members.
[2]Total landings from all fisheries.
[3]For years 1974–1985, human consumption landings used for reduction are included in these data.
[4] 1999-2000 data provided from Denmark and Sweden. Other years, only data from Denmark is presented.

3.4.2 Cod in the Kattegat

State of the stock/exploitation: The stock is at present considered to be outside safe biological limits. The present fishing mortality is above $\mathbf{F}_{pa}$ and even above $\mathbf{F}_{lim}$. The estimated SSB of 6 500 t in 2001 is close to the $\mathbf{B}_{lim}$.

The spawning stock declined steadily from 35 000 t in the early 1970s to about 10 000 t in the 1990s, with a concurrent drop in recruitment from 20–30 million in the 1970s to around 10 millions in the 1990s. The fishing mortality exceeded 1.0 during most of the 1980s and 1990s. In the present state the fishery is dependent on the strength of incoming year classes. The present assessment indicates that recruitment is low for the 1999 and 2000 year classes and close to the lowest observed.

Management objectives: There is no explicit management objective for this stock. However, for any management objective to meet the proposed precautionary criteria, F should be less than the proposed $\mathbf{F}_{pa}$ and spawning stock biomass should be maintained above the proposed $\mathbf{B}_{pa}$.

Precautionary Approach reference points (unchanged since 1999):

ICES considers that:	ICES proposes that:
$\mathbf{B}_{lim}$ is 6 400 t	$\mathbf{B}_{pa}$ be set at 10 500 t
$\mathbf{F}_{lim}$ is 1.0	$\mathbf{F}_{pa}$ be set at 0.6

Technical basis:

$\mathbf{B}_{lim}$: lowest observed SSB	$\mathbf{B}_{pa}$: $\mathbf{B}_{lim}$*exp(1.645*0.3)
$\mathbf{F}_{lim}$: The spawning stock has declined steadily since the early 1970s at fishing mortality rates averaging F = 1.0. $\mathbf{F}_{lim}$ is tentatively set equal to F = 1.0.	$\mathbf{F}_{pa}$: $\mathbf{F}_{lim}$*exp(-1.645*0.3)

Advice on management: ICES advises that there be no fishing on this stock in 2002 and a rebuilding plan should be implemented in order to rebuild SSB above $\mathbf{B}_{pa}$.

Rebuilding plan: The fishery should not be re-opened until a rebuilding plan is established, which aims at rebuilding the SSB to above $\mathbf{B}_{pa}$. Because a large part of cod is taken as by-catch in fisheries for flatfish and *Nephrops*, the necessary reduction in fishing mortality on cod cannot be achieved by a reduction in TAC alone.

The rebuilding plan should include measures to improve the selectivity in the directed fishery such as a significant increase of the legal minimum mesh size of 90 mm. By-catches in the fisheries directed to *Nephrops* and flatfish could be reduced by measures which improve species selectivity, e.g., escape windows or grids. The rebuilding plan could also include seasonal and area closures.

Relevant factors to be considered in management: The economically most important species in the Kattegat are cod, *Nephrops* and sole, which each account for about 25% of the value of the total annual landings. By-catches of cod occur in the fisheries targeting sole and *Nephrops*. Management measures in the Kattegat need to take account of technical interactions in the area. Changes in mesh regulations may be introduced with the aim of protecting mainly young cod.

Comparison with previous assessment and advice: The present assessment estimates last years SSB to be 10% lower than last years assessment.

Catch forecast for 2002:
Basis: F(2001) = F_{sq} = F(1998-2000) = 1.21; Landings (2001) = 5680; SSB(2002) = 5168.

F (2002)	Basis	Landings (2002)	SSB (2003)
0	0	0	9900
0.24	0.2 F_{sq}	1200	8200
0.49	0.4 F_{sq}	2200	6800
0.6	0.5 F_{sq} (F_{pa})	2600	6200
0.73	0.6 F_{sq}	3000	5700
0.97	0.8 F_{sq}	3700	4800
1.2	F_{sq}	4300	4100

Weights in t.
Shaded scenarios considered inconsistent with the precautionary approach.

Medium- and long-term projections: Medium-term projections use spreadsheet-based Monte Carlo simulations with stochastic noise associated with recruitment, weights at age, and maturities.

Recruitment is generated from a Ricker Stock-recruitment model.

The medium-term projections suggest that fishing at $\mathbf{F}_{pa}$ leads to a more that 75% probability of the stock exceeding $\mathbf{B}_{lim}$ in 2005.

Elaboration and special comment: Landings have decreased from 15 000 t in the 1970s to about 7 000 t in the 1990s. During the years 1991–1994 an unknown, but probably substantial amount has been either unreported or allocated to other areas. The quality of catch data from 1994 onward has improved, leading to improved reliability of the assessment.

The stock recruitment plot indicates that strong recruitment requires large spawning biomass, which will not occur at present exploitation rates, particularly on younger ages (1–3). There is evidence that the stock interacts with neighbouring cod stocks in the Skagerrak and the Baltic Sea by way of migrations. These interactions add uncertainty to the assessment.

Source of information: Report of the Baltic Fisheries Assessment Working Group, April 2001 (ICES CM 2001/ACFM:18).

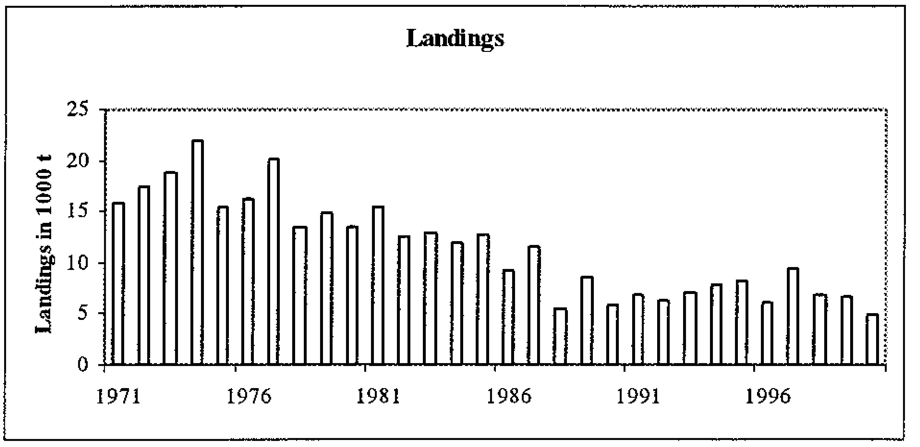
Yield and spawning biomass per Recruit F-reference points:

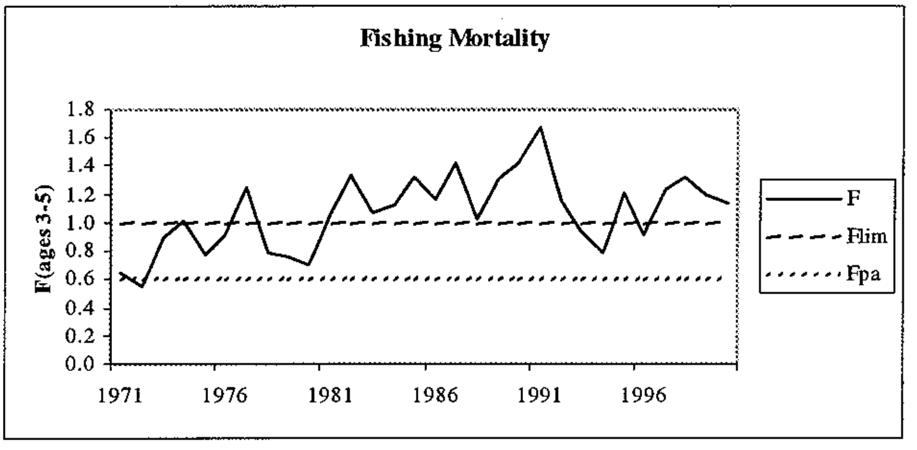
	Fish Mort Ages 3-5	Yield/R	SSB/R
Average Current	1.213	0.629	0.676
$\mathbf{F}_{max}$	0.228	1.008	5.029
$\mathbf{F}_{0.1}$	0.142	0.949	7.403
$\mathbf{F}_{med}$	0.762	0.740	1.219

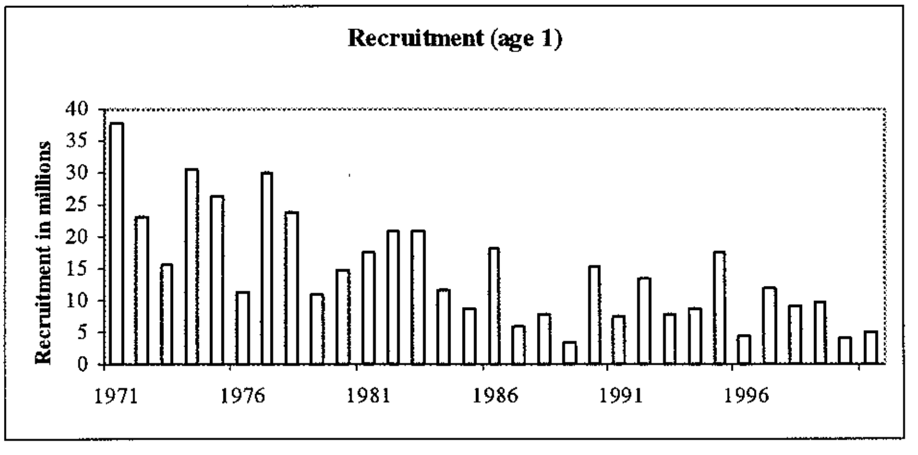
Catch data (Tables 3.4.2.1–2):

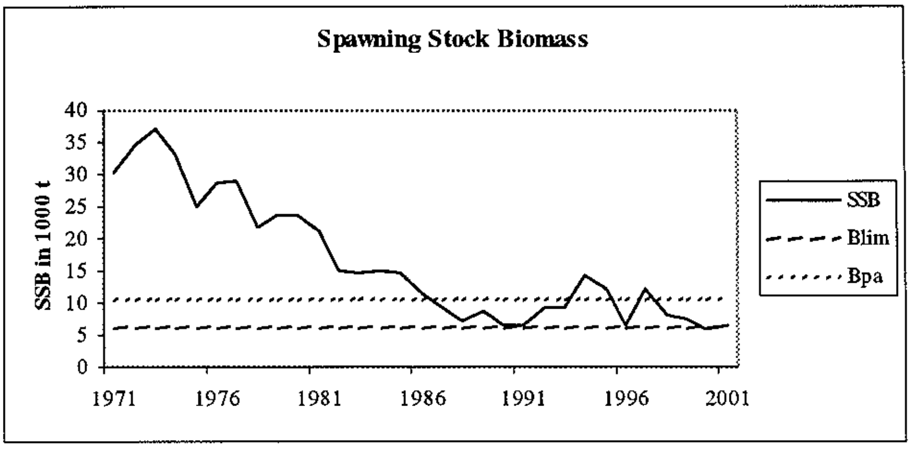
Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC	ACFM Catch
1987	Reduction in F	< 13.0	15.5	11.5
1988	Reduction in F	< 15.0	15.0	5.5
1989	TAC	10.0	12.5	8.6
1990	TAC	7.0	8.5	5.9
1991	TAC	6.3	6.65	6.8
1992	30% reduction in fishing effort	-	6.65	6.3
1993	Limit fishing effort to 70% of 1991 effort	-	6.8	7.2
1994	Reduction in catch from 1991–1992	< 6.3–6.8	6.7	7.8
1995	Precautionary TAC based on recent catches	6–7	6.7	8.2
1996	30% Reduction in fishing effort from 1994 level	-	7.7	6.1
1997	Fishing effort should not exceed 70% of the 1994 level	-	8.5	9.5
1998	Fishing effort should not exceed 70% of the 1994 level	-	7.5	6.8
1999	F = 0.6	4.5	6.3	6.6
2000	At least 40% reduction in F	6.4	7.0	4.9
2001	$F = \mathbf{F}_{pa} = 0.6$	4.7	6.2	
2002	No fishery	-		

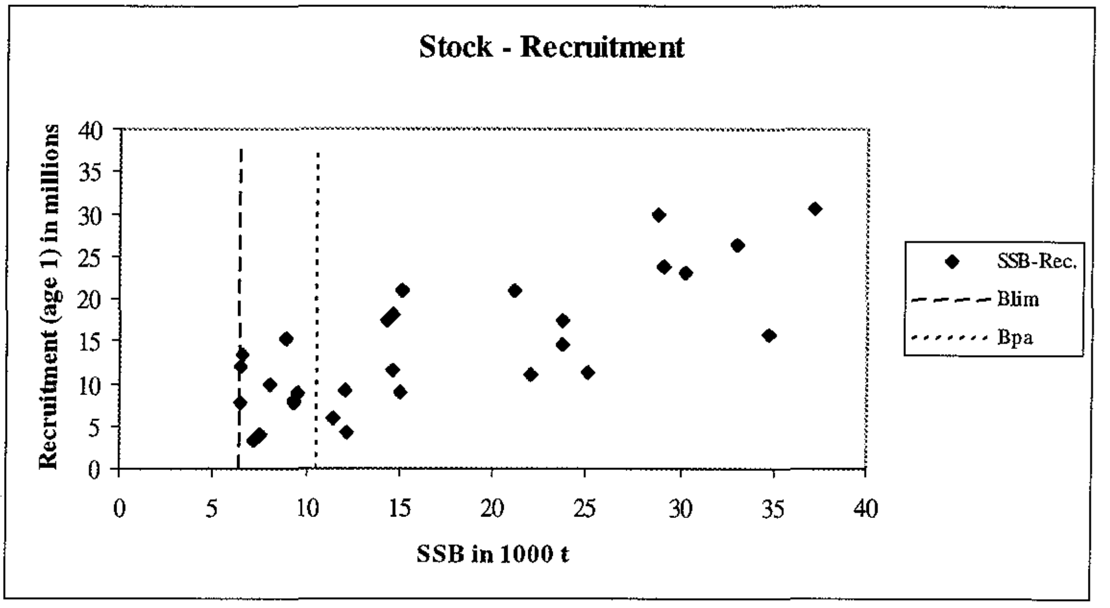
Weights in '000 t.

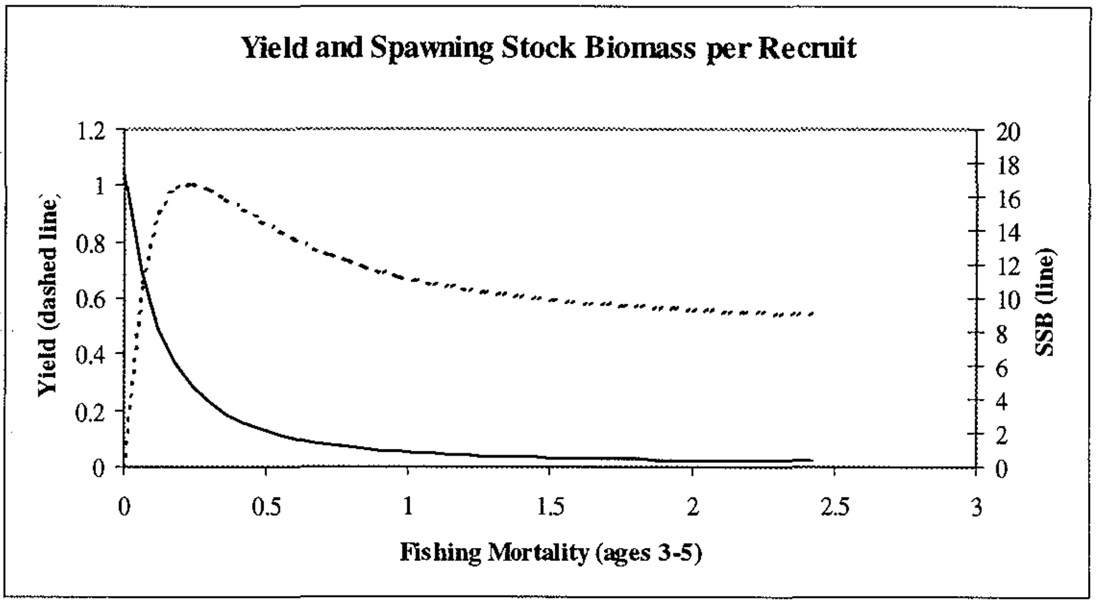

Landings
Landings in 1000 t
25
20
15
10
5
0
1971
1976
1981
1986
1991
1996


Fishing Mortality
F(ages 3-5)
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1971
1976
1981
1986
1991
1996
F
Flim
Fpa


Recruitment (age 1)
Recruitment in millions
40
35
30
25
20
15
10
5
0
1971
1976
1981
1986
1991
1996


Spawning Stock Biomass
SSB in 1000 t
40
35
30
25
20
15
10
5
0
1971
1976
1981
1986
1991
1996
2001
SSB
Blim
Bpa


Stock - Recruitment
Recruitment (age 1) in millions
SSB in 1000 t
SSB-Rec.
Blim
Bpa
0
5
10
15
20
25
30
35
40


Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
SSB (line)
Fishing Mortality (ages 3-5)
0
0.5
1
1.5
2
2.5
3

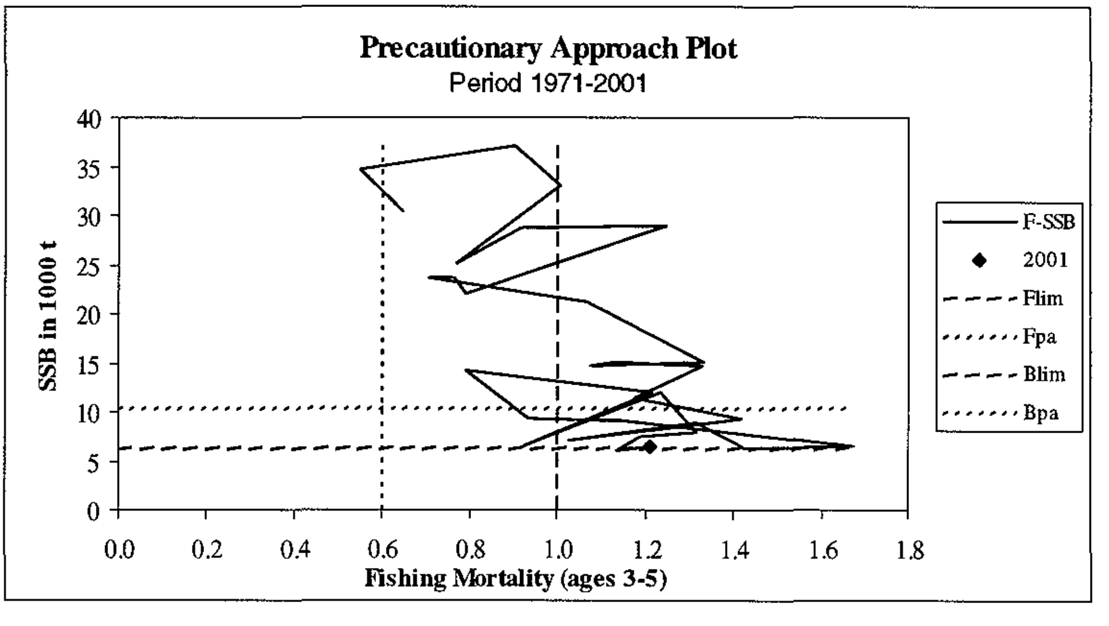

Precautionary Approach Plot
Period 1971-2001
SSB in 1000 t
Fishing Mortality (ages 3-5)
F-SSB
2001
Flim
Fpa
Blim
Bpa
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8

Table 3.4.2.1 Cod landings (in tonnes) from the Kattegat. 1971–2000.

Year	Kattegat			Total
	Denmark	Sweden	Gemany[2]	
1971	11.748	3.962	22	15.732
1972	13,451	3,957	34	17,442
1973	14,913	3,850	74	18,837
1974	17,043	4,717	120	21,880
1975	11,749	3,642	94	15,485
1976	12,986	3,242	47	16,725
1977	16,668	3,400	51	20,119
1978	10,293	2,893	204	13,390
1979	11,045	3,763	22	14,830
1980	9,265	4,206	38	13,509
1981	10,693	4,380	284	15,337
1982	9,320	3,087	58	12,465
1983	9,149	3,625	54	12,828
1984	7,590	4,091	205	11,886
1985	9,052	3,640	14	12,706
1986	6,930	2,054	112	9,096
1987	9,396	2,006	89	11,491
1988	4,054	1,359	114	5,527
1989	7,056	1,483	51	8,590
1990	4,715	1,186	35	5,936
1991	4,664	2,006	104	6,834
1992	3,406	2,771	94	6,271
1993	4,464	2,549	157	7,170
1994	3,968	2,836	98	7,802[3]
1995	3,789	2,704	71	8,164[4]
1996	4,028	2,334	64	6,126[5]
1997	6,099	3,303	58	9,460[6]
1998	4,207	2,509	38	6,835
1999	4,029	2,540	39	6,608
2000	3,285	1,568	45	4,897

[1]Preliminary.
[2]Landings statistics incompletely split on the Kattegat and Skagerrak.
The figures are estimated by the Working Group members.
[3]Including 900 t reported in Skagerrak.
[4]Including 1,600 t misreported by area.
[5]Excluding 300 t taken in Sub-divisions 22–24.
[6]Including 1,700 t reported in Sub-division 23.

Table 3.4.2.2 Cod in the Kattegat (part of Division IIIa).

Year	Recruitment Age 1 thousands	SSB tonnes	Landings tonnes	Mean F Ages 3-5
1971	37666	30315	15732	0.6485
1972	23121	34759	17442	0.5482
1973	15763	37176	18837	0.9064
1974	30669	33004	21880	1.0102
1975	26298	25130	15485	0.7677
1976	11215	28733	16275	0.9201
1977	29942	29050	20119	1.2447
1978	23823	21975	13390	0.7932
1979	11042	23750	14830	0.7632
1980	14654	23703	13509	0.7080
1981	17416	21128	15337	1.0660
1982	20913	15111	12465	1.3304
1983	20948	14633	12828	1.0748
1984	11524	15065	11886	1.1303
1985	8906	14648	12706	1.3276
1986	18215	11440	9096	1.1735
1987	5782	9340	11491	1.4183
1988	7904	7166	5527	1.0256
1989	3411	8885	8590	1.3134
1990	15382	6424	5936	1.4269
1991	7649	6521	6834	1.6720
1992	13490	9270	6271	1.1468
1993	7729	9479	7013	0.9357
1994	8858	14260	7802	0.7899
1995	17456	12135	8165	1.2161
1996	4244	6448	6126	0.9205
1997	11885	12098	9461	1.2352
1998	9148	8022	6835	1.3162
1999	9783	7471	6608	1.1896
2000	3966	6027	4897	1.1333
2001	5060	6495		1.2100
Average	14641	16441	11446	1.0762

3.4.3 Whiting in Division IIIa (Skagerrak – Kattegat)

State of stock/exploitation: Based on the available information it was not possible to assess the status of the stock or identify safe biological limits. It is likely that this stock is linked to the North Sea stock for which the assessment is very uncertain, but which is likely to be outside safe biological limits.

Management objectives: There are no specific management objectives for this stock.

Advice on management: ICES advises landings of 1 500 t in 2002 as a precautionary value to restrict the potential for re-expansion of the fishery and misreporting from other regions.

Elaboration and special comment: The major part of the catch is taken as a by-catch in small-mesh fisheries. Total landings in 2000 were the lowest historically observed. The landings value advised for 2002 is consistent with ICES advice provided in 2000, and is based on the average of the catch during 1996-1998.

Source of information: Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, June 2001, Hamburg, Germany (ICES CM 2002/ACFM: 01).

Catch data (Table 3.4.3.1):

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC	ACFM Catch[1]
1987	Precautionary TAC	-	17.0	16.7
1988	Precautionary TAC	-	17.0	11.8
1989	Precautionary TAC	-	17.0	13.3
1990	Precautionary TAC	-	17.0	19.4
1991	TAC	-	17.0	14.0
1992	No advice	-	17.0	12.3
1993	Precautionary TAC	-	17.0	4.6
1994	If required, precautionary TAC	-	17.0	6.0
1995	If required, precautionary TAC	-	15.2	9.6
1996	If required, precautionary TAC	-	15.2	2.9
1997	If required, TAC equal to recent catches.	-	15.2	0.7
1998	No advice		15.2	1.0
1999	TAC, average period 1993–1996	6.0	8.0	1.3
2000	TAC, average period 1996–1998	1.5	4.0	0.6
2001	TAC, average period 1996-1998	1.5	2.5	
2002	TAC, average period 1996-1998	1.5		

[1]Includes by-catch in small-mesh industrial fishery. Weights in '000 t.

Whiting in Division IIIa (Skagerrak - Kattegat)

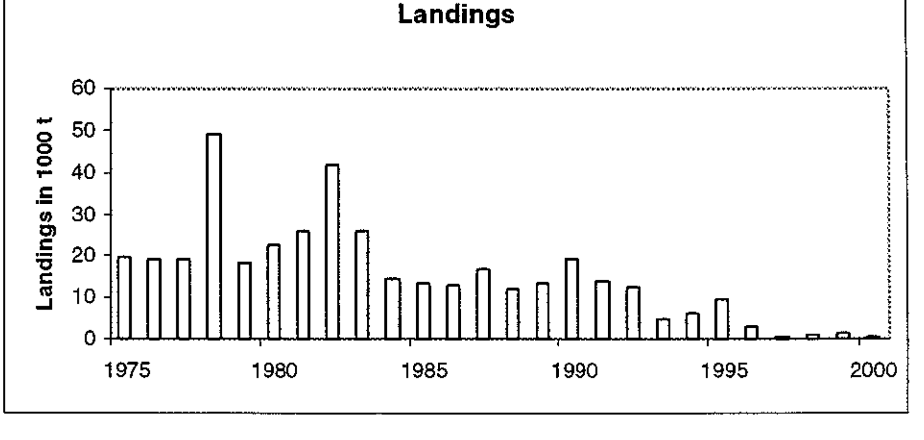


Table 3.4.3.1 Nominal landings (t) of Whiting from Division IIIa as supplied by the Study Group on Division IIIa Demersal Stocks (ICES 1992b) and updated by the Working Group.

Year	Denmark			Norway	Sweden	Others	Total
1975		19,018		57	611	4	19,690
1976		17,870		48	1,002	48	18,968
1977		18,116		46	975	41	19,178
1978		48,102		58	899	32	49,091
1979		16,971		63	1,033	16	18,083
1980		21,070		65	1,516	3	22,654
	Total consumption	Total industrial	Total				
1981	1,027	23,915	24,942	70	1,054	7	26,073
1982	1,183	39,758	40,941	40	670	13	41,664
1983	1,311	23,505	24,816	48	1,061	8	25,933
1984	1,036	12,102	13,138	51	1,168	60	14,417
1985	557	11,967	12,524	45	654	2	13,225
1986	484	11,979	12,463	64	477	1	13,005
1987	443	15,880	16,323	29	262	43	16,657
1988	391	10,872	11,263	42	435	24	11,764
1989	917	11,662	12,579	29	675	-	13,283
1990	1,016	17,829	18,845	49	456	73	19,423
1991	871	12,463	13,334	56	527	97	14,041
1992	555	10,675	11,230	66	959	1	12,256
1993	261	3,581	3,842	42	756	1	4,641
1994	174	5,391	5,565	21	440	1	6,027
1995	85	9,029	9,114	24	431	1	9,570
1996	55	2,668	2,723	21	182	-	2,926
1997	38	568	606	18	94	-	718
1998	35	847	882	16	81	-	979
1999	37	1,199	1,236	15	111	-	1,362
2000	59	386	445	17	159	1	622

Preliminary: Norway 1997-1999.

3.4.4 Plaice in Division IIIa (Skagerrak – Kattegat)

State of stock/exploitation: The stock is harvested outside safe biological limits. The estimated SSB in 2001 is above $\mathbf{B}_{pa}$.

Management objectives: No explicit management objectives are set for this stock.

Precautionary Approach reference points (unchanged since 1999):

ICES considers that:	ICES proposes that:
$\mathbf{B}_{lim}$ cannot be accurately defined	$\mathbf{B}_{pa}$ = 24 000 t
$\mathbf{F}_{lim}$ cannot be accurately defined	$\mathbf{F}_{pa}$ = 0.73

Technical basis:

	$\mathbf{B}_{pa}$ = smoothed $\mathbf{B}_{loss}$ (no sign of impairment)
	$\mathbf{F}_{pa} = \mathbf{F}_{med}$

Advice on management: ICES recommends that fishing mortality should be less than the proposed $\mathbf{F}_{pa}$ (0.73), corresponding to landings in 2002 of less than 8 500 t.

Comparison with previous assessment and advice: The perception of the state of this stock with regard to safe biological limits can change from year to year due to the uncertainty and variability in the estimates of fishing mortality in the most recent year. Successive assessments are consistent in estimating SSB to be above the proposed $\mathbf{B}_{pa}$.

Catch forecast for 2002:

Basis: $\mathbf{F}_{sq}$ = F(98-00) scaled to F(00)=0.82; Landings (2001) = 8.6; SSB(2002)= 33.2.

F (2002)	Basis	Landings (2002)	SSB (2003)
0	0	0	44.3
0.16	0.2 * $\mathbf{F}_{sq}$	2.3	41.7
0.33	0.4 * $\mathbf{F}_{sq}$	4.3	39.5
0.49	0.6 * $\mathbf{F}_{sq}$	6.2	37.6
0.73	0.89*$\mathbf{F}_{sq}$ = $\mathbf{F}_{pa}$	8.5	35.1
0.82	$\mathbf{F}_{sq}$	9.2	34.3
0.99	1.2 * $\mathbf{F}_{sq}$	10.6	32.9

Weights in '000t.

Shaded scenarios considered inconsistent with the precautionary approach.

Medium- and long-term projections: *Status quo* projections show a low probability of SSB falling below the proposed $\mathbf{B}_{pa}$ in the medium-term.

Elaboration and special comment: The estimates of fishing mortality and proposed $\mathbf{F}_{pa}$ for plaice in Division IIIa are substantially higher than the corresponding estimates for plaice in the North Sea (Sub-area IV). The difference may be caused by a difference in the exploitation pattern, with the fishing mortality of young ages (2-3) being much higher in the North Sea. It may also be caused by older, mature plaice emigrating from the Skagerrak to the North Sea for spawning, or by higher natural mortality due to possible parasitic infection. Reference points based on the estimated F will still be appropriate for use with this stock, but the values are not comparable to reference points for other plaice stocks.

The major plaice catches are taken in fisheries using Danish seine, trawl, and gillnet, targeting mixed species for human consumption. The fishery is more directed at older fish than for most other plaice fisheries. As noted above, the proportion of plaice younger than 3 years in the catches is lower than in the North Sea, which might partly explain the relative robustness of the stock to high fishing mortality levels.

The short-term predictions, and in particular those dealing with SSB, should be interpreted cautiously, as a result of the high contribution of recruitment in 2001 and 2002, which have been extrapolated using the geometric mean average.

The analytical assessment uses information from Danish commercial fleets and one survey series and is considered to be uncertain.

Source of information: Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, June 2001, Hamburg, Germany (ICES CM 2002/ACFM: 01).

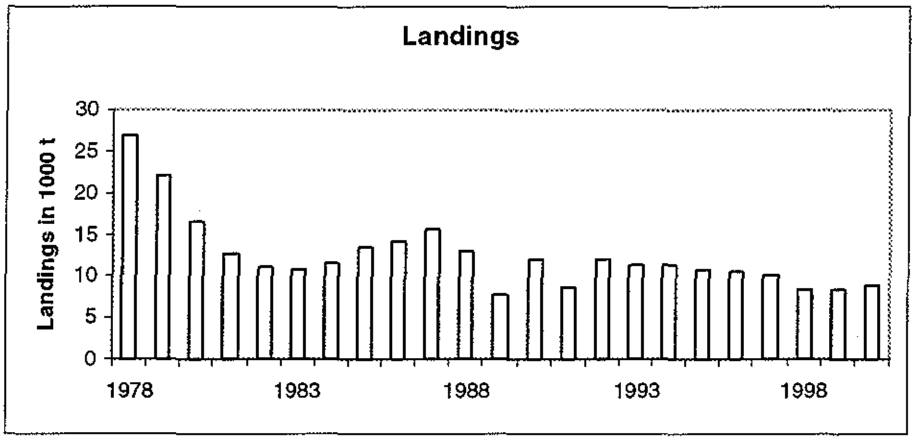
Yield and spawning biomass per Recruit F-reference points:

	Fish Mort Ages 4-8	Yield/R	SSB/R
Average Current	0.822	0.225	0.767
$\mathbf{F}_{max}$	0.216	0.246	1.573
$\mathbf{F}_{0.1}$	0.099	0.223	2.546
$\mathbf{F}_{med}$	0.940	0.224	0.726

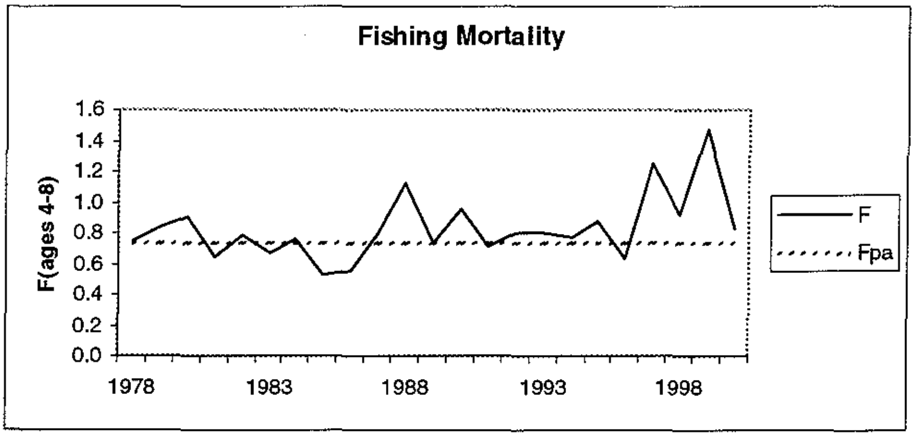
Catch data (Tables 3.4.4.1-2):

Year	ICES Advice	Predicted landings corresp. to advice[1] Kattegat	Skagerrak	Agreed TAC: Kattegat	Skagerrak	ACFM Landings
1987	Precautionary TAC	-	-	4.75	14.5	15.7
1988	No increase in F[3]; precautionary TAC[4]	3.7	-	4.75	15.0	12.9
1989	No increase in F[3]; precautionary TAC[4]	2.9	-	4.0	15.0	7.7
1990	80% of F(88)[3]; TAC[3]; TAC[4]	1.3	10.0	2.0	11.0	12.1
1991	TAC	1.1[2]	10.0[2]	1.3	10.0	8.7
1992	TAC	14.0		2.8	11.2	11.9
1993	Precautionary TAC	-		2.8	11.2	11.3
1994	If required, precautionary TAC	-		2.8	11.2	11.3
1995	If required, precautionary TAC	-		2.8	11.2	10.8
1996	If required, precautionary TAC	-		2.8	11.2	10.5
1997	No advice	-		2.8	11.2	10.1
1998	No increase in F from the present level	11.9		2.8	11.2	8.4
1999	No increase in F from the present level	11.0		2.8	11.2	8.5
2000	$F < \mathbf{F}_{pa}$	<11.8		2.8	11.2	8.8
2001	$F < \mathbf{F}_{pa}$	<9.4		2.35	9.4	
2002	$F < \mathbf{F}_{pa}$	<8.5				

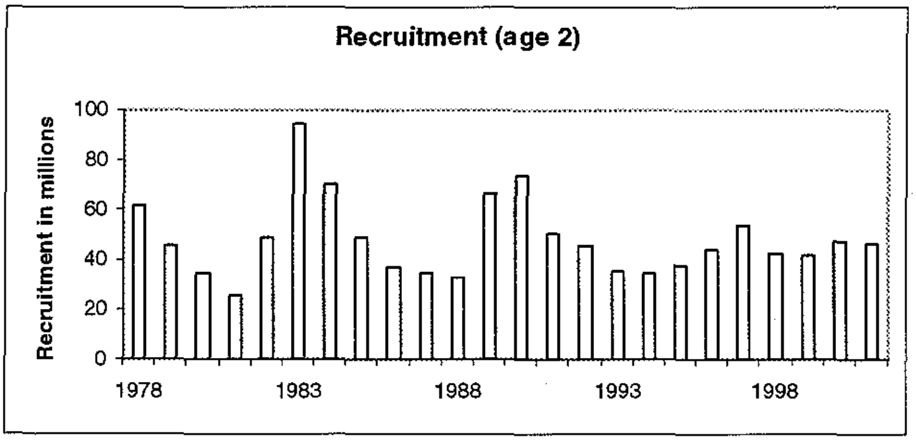
[1]From 1992 onwards predicted landings are for Kattegat and Skagerrak combined. [2]In May 1991 ACFM revised its advice to 12.0 for both areas combined. [3]Kattegat. [4]Skagerrak. Weights in '000 t.



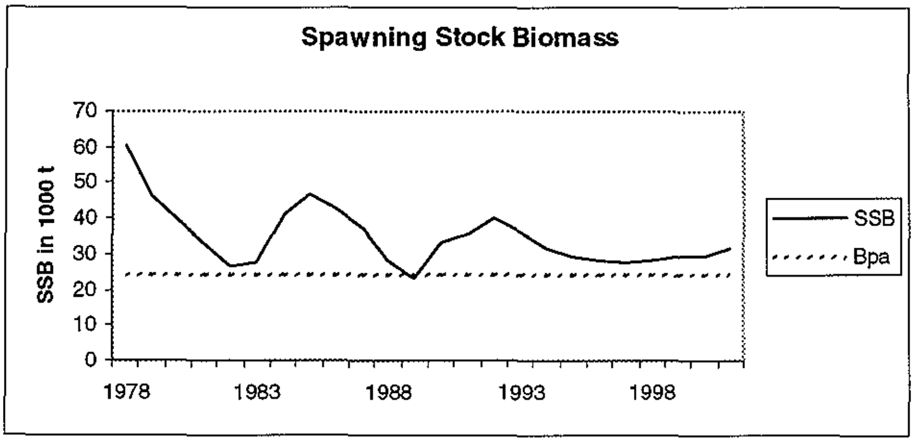
Landings
Landings in 1000 t
30
25
20
15
10
5
0
1978
1983
1988
1993
1998



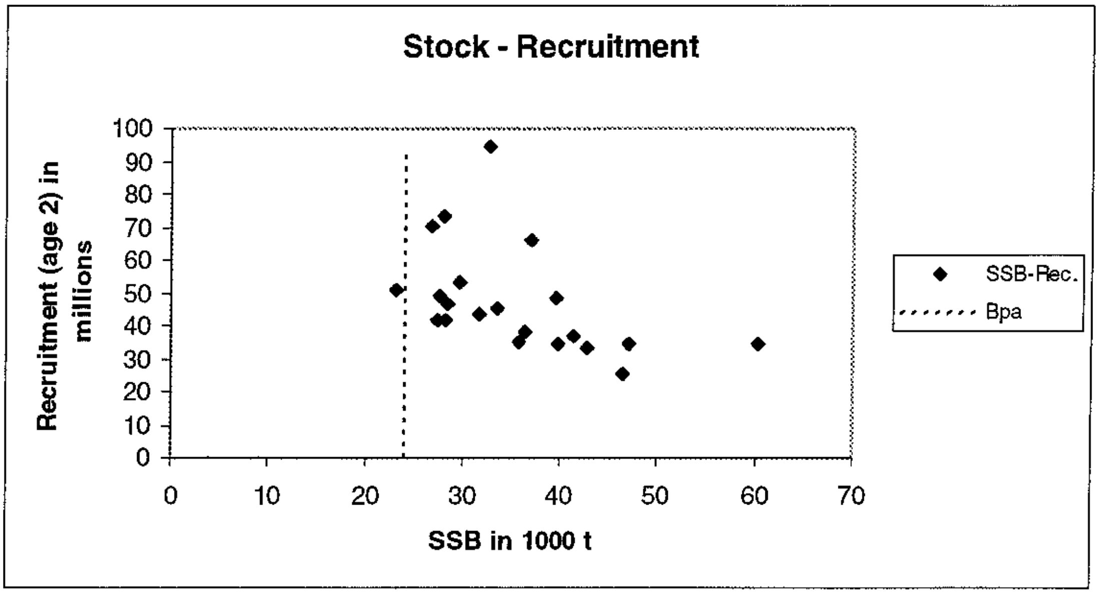
Fishing Mortality
F(ages 4-8)
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1978
1983
1988
1993
1998
F
Fpa



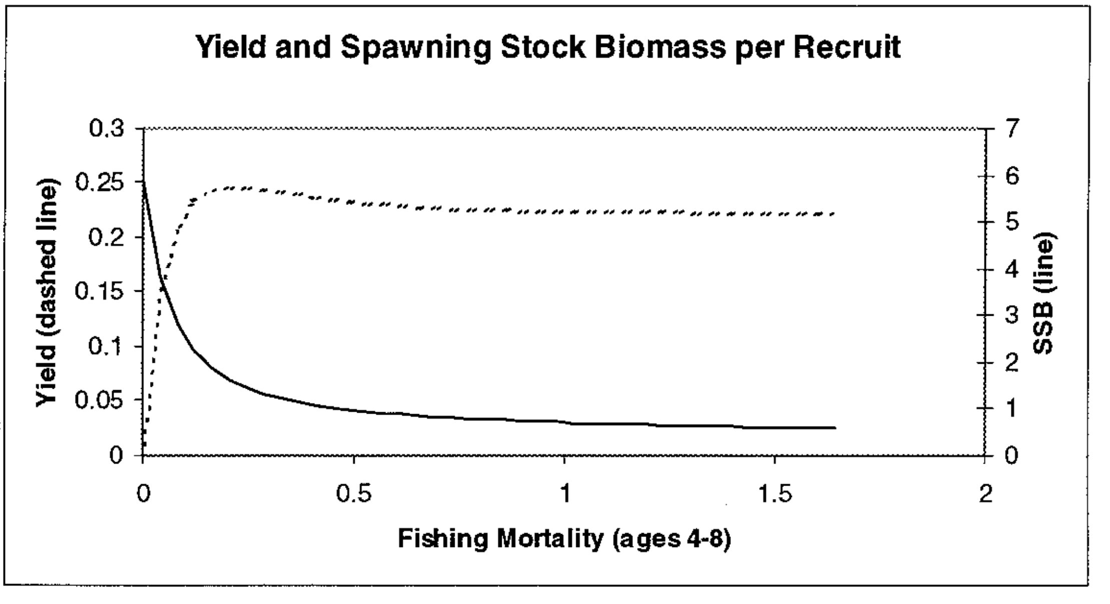
Recruitment (age 2)
Recruitment in millions
100
80
60
40
20
0
1978
1983
1988
1993
1998



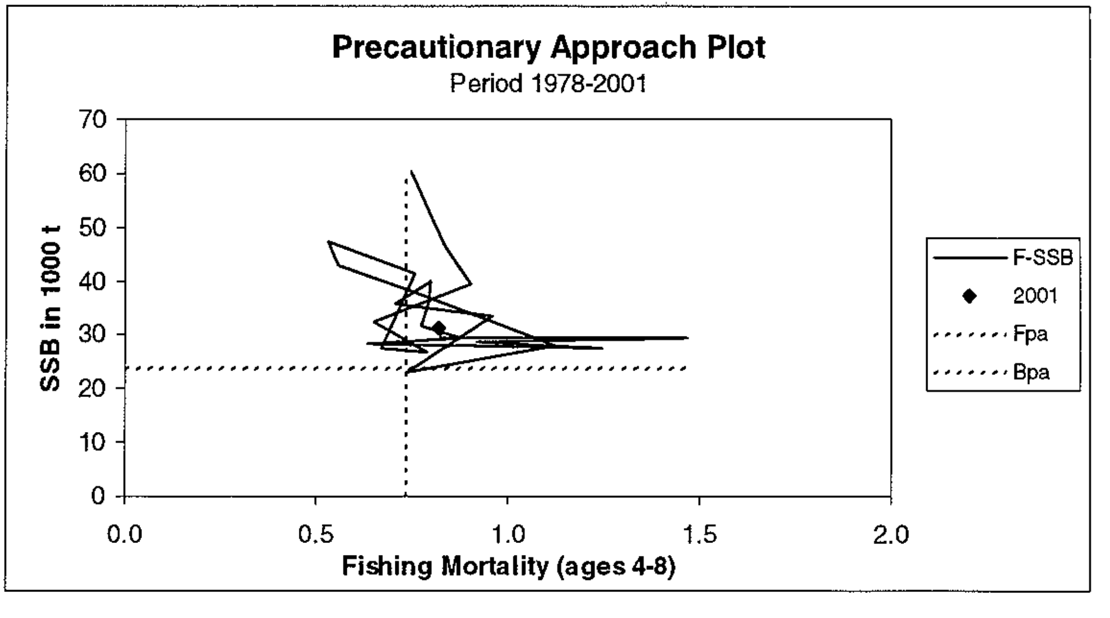
Spawning Stock Biomass
SSB in 1000 t
70
60
50
40
30
20
10
0
1978
1983
1988
1993
1998
SSB
Bpa



Stock - Recruitment
Recruitment (age 2) in millions
SSB in 1000 t
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
SSB-Rec.
Bpa



Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
SSB (line)
Fishing Mortality (ages 4-8)
0.3
0.25
0.2
0.15
0.1
0.05
0
7
6
5
4
3
2
1
0
0
0.5
1
1.5
2



Precautionary Approach Plot
Period 1978-2001
SSB in 1000 t
Fishing Mortality (ages 4-8)
70
60
50
40
30
20
10
0
0.0
0.5
1.0
1.5
2.0
F-SSB
2001
Fpa
Bpa

Table 3.4.4.1 Plaice landings (t) from Division IIIa (Kattegat and Skagerrak) as officially reported to ICES.

Year	Denmark		Sweden		Germany		Belgium	Norway	Total WG		
	Kattegat	Skagerrak	Kattegat	Skagerrak	Kattegat	Skagerrak	Skagerrak	Skagerrak	Kattegat	Skagerrak	Div. IIIa
1972	15,504	5,095	348	70	77			3	15,929	5,168	21,097
1973	10,021	3,871	231	80	48			6	10,300	3,957	14,257
1974	11,401	3,429	255	70	52			5	11,708	3,504	15,212
1975	10,158	4,888	296	77	39			6	10,493	4,971	15,464
1976	9,487	9,251	177	51	32		717	6	9,696	10,025	19,721
1977	11,611	12,855	300	142	32		846	6	11,943	13,849	25,792
1978	12,685	13,383	312	94	100		371	9	13,097	13,857	26,953
1979	9,721	11,045	333	67	38		763	9	10,092	11,884	21,976
1980	5,582	9,514	313	71	40		914	11	5,935	10,510	16,445
1981	3,803	8,115	256	110	42		263	13	4,101	8,501	12,602
1982	2,717	7,789	238	146	19		127	11	2,974	8,073	11,047
1983	3,280	6,828	334	155	36		133	14	3,650	7,130	10,780
1984	3,252	7,560	388	311	31		27	22	3,671	7,920	11,591
1985	2,979	9,646	403	296	4		136	18	3,386	10,096	13,482
1986	2,470	10,645	202	202	2		505	26	2,674	11,378	14,052
1987	2,846	11,327	307	241	3		907	27	3,156	12,502	15,658
1988	1,820	9,782	210	281	0		716	41	2,030	10,820	12,850
1989	1,609	5,414	135	320	0		230	33	1,744	5,997	7,741
1990	1,830	8,729	202	779	2		471	69	2,034	10,048	12,082
1991	1,737	5,809	265	472	19	15	315	68	2,021	6,679	8,700
1992	2,068	8,514	208	381	101	16	537	106	2,377	9,554	11,931
1993	1,294	9,125	175	287	0	37	326	79	1,469	9,854	11,323
1994	1,547	8,783	227	315	0	37	325	91	1,774	9,551	11,325
1995	1,254	8,468	133	337	0	48	302	224	1,387	9,379	10,766
1996	2,337	7,304	205	260	0	11		428	2,542	8,003	10,545
1997	2,198	7,306	255	244	25	14		93	2,478	7,657	10,135
1998	1,786	6,132	185	208	10	11		59	1,981	6,410	8,391
1999	1,510	6,473	161	233	20	7		66	1,691	6,779	8,470
2000	1,644	6,680	184	230	10	5		67	1,838	6,982	8,820

Table 3.4.4.2 Plaice in Division IIIa (Skagerrak and Kattegat).

Year	Recruitment Age 2 thousands	SSB tonnes	Landings tonnes	Mean F Ages 4-8
1978	61660	60329	26953	0.7460
1979	45789	46558	21976	0.8345
1980	34420	39475	16445	0.9044
1981	25718	32573	12602	0.6497
1982	48500	26708	11047	0.7883
1983	94319	27541	10780	0.6726
1984	70512	41486	11591	0.7603
1985	48967	47137	13482	0.5303
1986	37165	42880	14052	0.5592
1987	34610	36990	15658	0.7956
1988	33109	27977	12850	1.1224
1989	66180	23189	7741	0.7376
1990	73244	33576	12082	0.9581
1991	50740	35690	8700	0.7058
1992	45269	39799	11931	0.7998
1993	35082	36265	11323	0.7944
1994	34712	31704	11325	0.7745
1995	37926	29544	10766	0.8781
1996	43674	28231	10545	0.6326
1997	53406	27416	10135	1.2479
1998	42067	28489	8391	0.9166
1999	41712	29307	8470	1.4677
2000	46905	29522	8820	0.8222
2001	46053[1]	31427[2]		0.8200
Average	47989	34742	12507	0.8299

[1] GM 1978-1998.

[2] Based on 1998-2000 mean weight-at-age.

3.4.5 Sole in Division IIIa

State of the stock/exploitation: The stock is harvested outside safe biological limits. Fishing mortality in 2000 was above $\mathbf{F_{pa}}$ and landings increased by 20% in 2000 compared to 1999. Spawning biomass is estimated still to be well above $\mathbf{B_{pa}}$. The stock size was exceptionally high in the period 1992–1996 due to strong recruitment in the period 1989–1993. Recruitment has been near or below average since 1994.

Management objectives: There are no explicit management objectives for this stock. However, for any management objective to meet the proposed precautionary criteria, F should be less than the proposed $\mathbf{F_{pa}}$ and spawning stock biomass should be maintained above the proposed $\mathbf{B_{pa}}$.

Precautionary Approach reference points (unchanged since 1999):

ICES considers that:	ICES proposes that:
$\mathbf{B_{lim}}$ is 770 t	$\mathbf{B_{pa}}$ be set at 1 060 t
$\mathbf{F_{lim}}$ is 0.47	$\mathbf{F_{pa}}$ be set at 0.30

Technical basis:

$\mathbf{B_{lim}}$: $\mathbf{B_{pa}}$*exp(-1.645*0.2)	$\mathbf{B_{pa}}$: MBAL
$\mathbf{F_{lim}}$: $\mathbf{F_{med}}$ 98 excluding the abnormal years around 1990	$\mathbf{F_{pa}}$: consistent with $\mathbf{F_{lim}}$

Advice on management: ICES advises that current fishing mortality should be reduced to below $\mathbf{F_{pa}}$, corresponding to landings in 2002 of less than 500 t.

Relevant factors to be considered in management: This stock supported catches at 250–450 t for 35 years, prior to the occurrence of strong recruitments in the period of 1989 to 1993. These recruitments led to large increases in SSB, yield and fishing effort, with a decline in F through the 1990s. Since 1995, recruitment has returned to the earlier low values.

Regardless of short-term management measures, biomass and yield will decline over the next few years under the lower recruitment regime. Recruitments appear to have periods of generally high or low yearclasses that are not closely tied to the size of the spawning biomass. This suggests that environmental factors might be important for recruitment and therefore contribute uncertainty to medium-term projections and biological reference points.

Comparison with previous assessment and advice: This years analyses are consistent with last years assessment. However, the advice is changed because F now exceeds $\mathbf{F_{pa}}$.

Catch forecast for 2002:
Basis: F(2001) = F_{sq}= F(2000) = 0.39; Landings (2001) = 706; SSB(2002)= 2052.

F (2002)	Basis	Landings (2002)	SSB (2003)
0.23	0.6*F_{sq}	390	2110
0.30	0.8*F_{sq} ($\mathbf{F_{pa}}$)	500	1990
0.39	$\mathbf{F_{sq}}$	600	1880
0.46	1.2*F_{sq}	700	1770

Weights in t.
Shaded scenarios considered inconsistent with the precautionary approach.

Medium- and long-term projections: Medium-term projections rely heavily on input (e.g. maturity ogive, weights at age) that may be relatively uncertain. It appears that factors other than SSB contribute significantly to the variability in recruitment.

Elaboration and special comment: The analytical assessment is based on landings data and commercial CPUE series. Official catch statistics are considered unreliable for the early 1990s, but are thought to be fairly accurate since 1994.

Source of information: Report of the Baltic Fisheries Assessment Working Group, April 2001 (ICES CM 2001/ACFM:18).

Yield and spawning biomass per Recruit F-reference points:

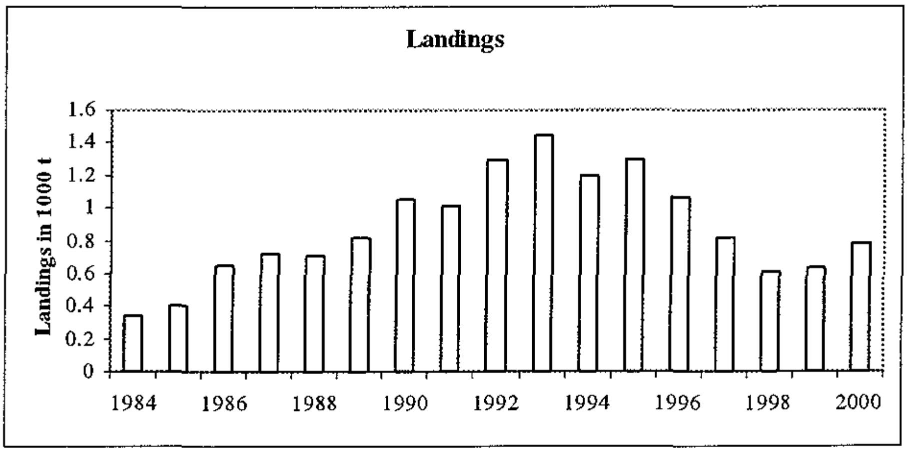
	Fish Mort Ages 4-8	Yield/R	SSB/R
Average Current	0.385	0.205	0.676
$\mathbf{F}_{max}$	0.566	0.209	0.493
$\mathbf{F}_{0.1}$	0.211	0.183	1.062
$\mathbf{F}_{med}$	0.509	0.209	0.538

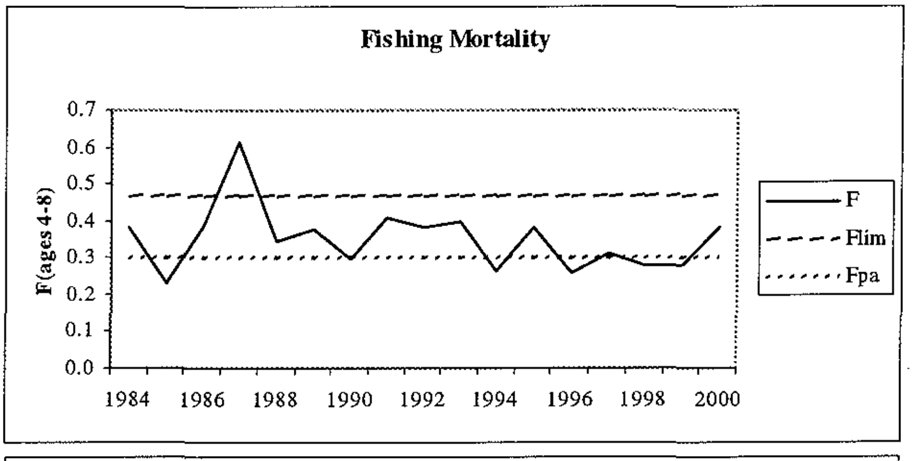
Catch data (Tables 3.4.5.1–2):

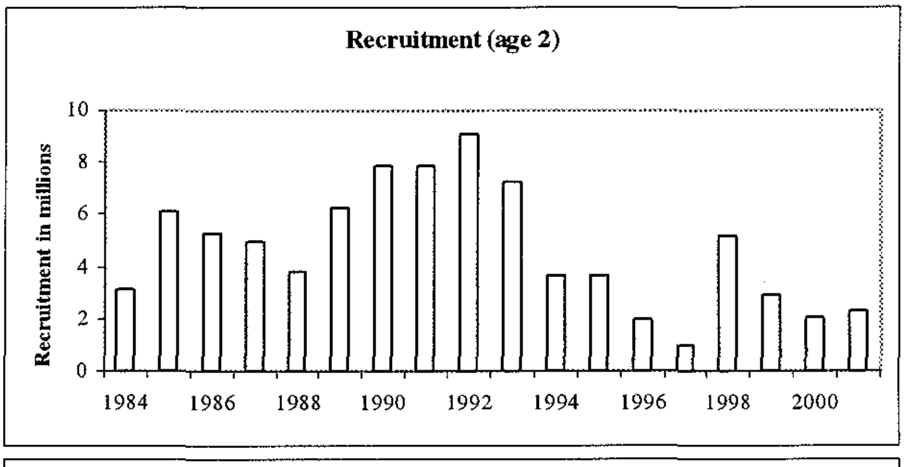
Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC	ACFM Catch
1987	-	-	0.85	0.72
1988	-	-	0.95	0.71
1989	TAC	<0.8	0.80	0.82
1990	Precautionary TAC	0.6	0.50	1.05
1991	TAC	1.0	1.00	-[1]
1992	TAC	1.0	1.40	-[1]
1993	TAC at recent catch levels	1.0	1.60	-[1]
1994	No advice due to uncertain catches	-	2.10	1.20
1995	No advice	-	2.25	1.30
1996	No advice	-	2.25	1.10
1997	No advice	-	2.25	0.82
1998	No advice	-	1.80	0.61
1999	No increase in F	0.8	1.35	0.64
2000	No increase in F	0.65	0.95	0.78
2001	No increase in F	0.7	0.70	
2002	F below $\mathbf{F}_{pa}$	0.5		

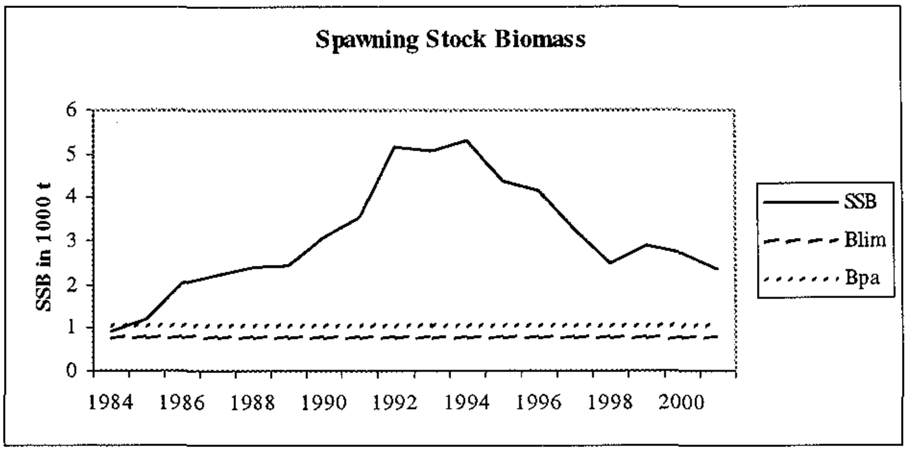
[1]Uncertain. Weights in '000 t.

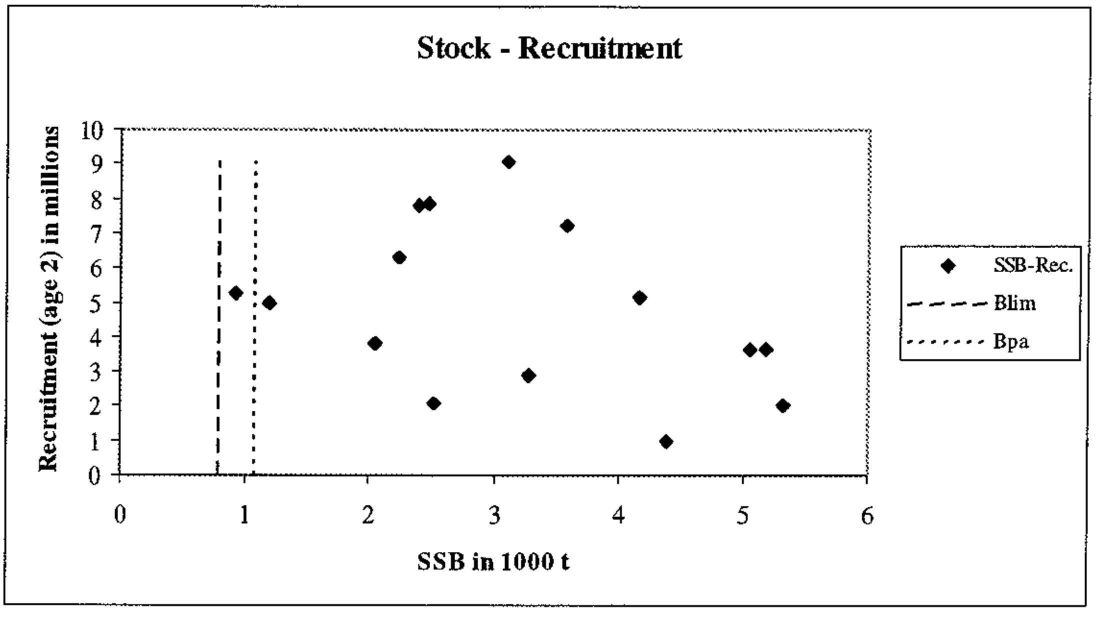
Sole in Division IIIa

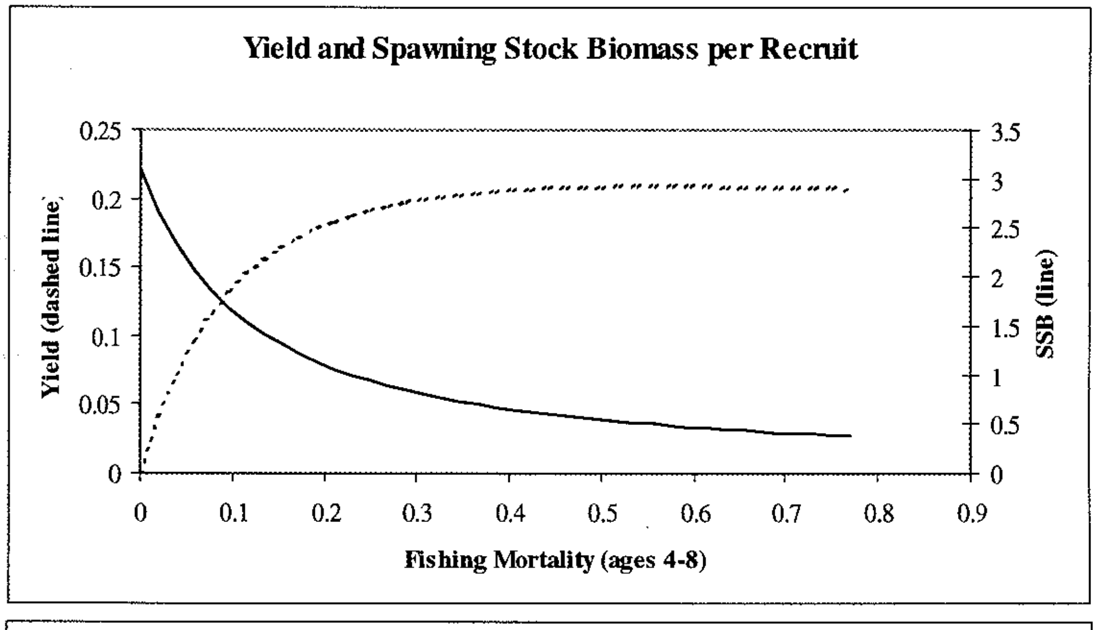









Stock - Recruitment
Recruitment (age 2) in millions
10
9
8
7
6
5
4
3
2
1
0
0
1
2
3
4
5
6
SSB in 1000 t
SSB-Rec.
Blim
Bpa


Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
0.25
0.2
0.15
0.1
0.05
0
3.5
3
2.5
2
1.5
1
0.5
0
SSB (line)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
Fishing Mortality (ages 4-8)

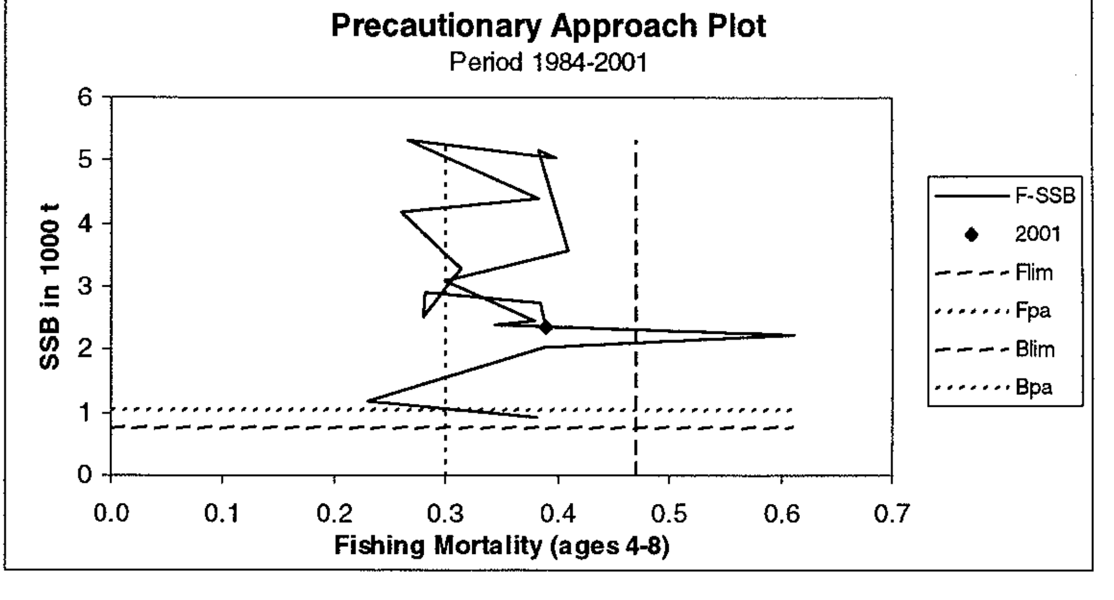

Precautionary Approach Plot
Period 1984-2001
SSB in 1000 t
6
5
4
3
2
1
0
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Fishing Mortality (ages 4-8)
F-SSB
2001
Flim
Fpa
Blim
Bpa

Table 3.4.5.1 Catches of sole in Division IIIa. Kattegat and Skagerrak Sole landings (tonnes) 1952–2000. Official statistics and Working Group corrections. Danish catches are given for Kattegat and Skagerrak combined 1952–1969. For Sweden there is no information 1962–1974.

Year	Denmark		Sweden	Germany	Belgium	Netherlands	Working Group	Total
	Kattegat	Skagerrak	Skag+Kat	Kat+Skag	Skagerrak	Skagerrak	Corrections	
1952	156		51	59				266
1953	159		48	42				249
1954	177		43	34				254
1955	152		36	35				223
1956	168		30	57				255
1957	265		29	53				347
1958	226		35	56				317
1959	222		30	44				296
1960	294		24	83				401
1961	339		30	61				430
1962	356			58				414
1963	338			27				365
1964	376			45				421
1965	324			50				374
1966	312			20				332
1967	429			26				455
1968	290			16				306
1969	261			7				268
1970	158	25						183
1971	242	32		9				283
1972	327	31		12				370
1973	260	52		13				325
1974	388	39		9				436
1975	381	55	16	16		9	-9	468
1976	367	34	11	21	2	155	-155	435
1977	400	91	13	8	1	276	-276	513
1978	336	141	9	9		141	-141	495
1979	301	57	8	6	1	84	-84	373
1980	228	73	9	12	2	5	-5	324
1981	199	59	7	16	1			282
1982	147	52	4	8	1	1	-1	212
1983	180	70	11	15		31	-31	276
1984	235	76	13	13		54	-54	337
1985	275	102	19	1	+	132	-132	397
1986	456	158	26	1	2	109	-109	643
1987	564	137	19		2	70	-70	722
1988	540	138	24		4			706
1989	578	217	21	7	1			824
1990	464	128	29	-	2		+427	1050
1991	746	216	38	+			+11	1011*
1992	856	372	54				+12	1294*
1993	1016	355	68	9			-9	1439*
1994	890	296	12	4			-4	1198
1995	850	382	65	6			-6	1297
1996	784	203	57	612			-597	1059
1997	560	200	52	2				814
1998	367	145	90	3				605
1999	431	158	45	3				637
2000[1]	399	320	34	11				764

*Considerable non-reporting assumed for the period 1991–1993.

Table 3.4.5.2 Sole in Division IIIa.

Year	Recruitment Age 2 thousands	SSB tonnes	Landings tonnes	Mean F Ages 4-8
1984	3103	921	337	0.381
1985	6142	1187	397	0.230
1986	5252	2041	643	0.389
1987	4943	2234	722	0.612
1988	3791	2398	706	0.344
1989	6288	2466	824	0.380
1990	7830	3109	1050	0.299
1991	7839	3576	1011	0.410
1992	9079	5183	1294	0.382
1993	7223	5055	1439	0.400
1994	3635	5326	1198	0.266
1995	3663	4389	1297	0.383
1996	1998	4168	1059	0.261
1997	1011	3279	814	0.314
1998	5158	2513	605	0.280
1999	2869	2898	638	0.282
2000	2063	2737	784	0.385
2001	2280	2365		0.390
Average	4676	3103	872	0.355

3.4.6 *Pandalus borealis* in Division IIIa and Division IVa East (Skagerrak and Norwegian Deeps)

State of stock/exploitation: The state of the stock is unknown, but the stock in 2001 is around the long-term (1984-2000) average as indicated by survey and commercial CPUE series. Fishing effort has remained relatively stable in recent years. Information on year classes relevant to the stock and exploitation in 2002 will become available from research vessel surveys in November 2001.

Management objectives: There are no explicit management objectives for this stock.

Precautionary Approach reference points (revised in 2001):

ICES considers that:	ICES proposes that:
No biological basis for defining $\mathbf{B}_{lim}$	No biological basis for defining $\mathbf{B}_{pa}$
No biological basis for defining $\mathbf{F}_{lim}$	No biological basis for defining $\mathbf{F}_{pa}$

ICES withdraws its previously proposed $\mathbf{B}_{pa}$ of reasons described below.

Advice on management: ICES recommends a TAC of 12 600 t in 2002, based on the 1985-2000 average landings. If the CPUE of the October 2001 survey indicates a substantial deviation from the average ICES will provide a revision of the advice.

Relevant factors to be considered in management: In the past, survey CPUE's between 7.5 and 15 kg/nm have been associated with approximate long-term average landings. Survey results outside this interval could justify a change in the recommended TAC.

The perception of the state of the stock in 2001 is based on the October survey in 2000. Catch opportunities in 2002 are to a large extent dependent on 1- and 2-year old shrimps. Over the period 1985-2000 these age groups comprised about 75% of the landings. The estimates of the abundance of these age groups are imprecise or not known yet. Information on the stock size and age composition in 2002 will become available after the October survey in 2001.

Sorting grids or other means of facilitating the escape of fish should be implemented in this fishery.

Comparison with previous assessment and advice: The previous analytical assessment for this stock is no longer considered reliable. In previous years, analytical assessments (XSA) have been applied in assessing this stock and to provide catch forecasts. However, since the natural mortality of this species most likely is several times higher than the fishing mortality, the methodology of cohort analyses is not well suited for this species. The few age groups in the stock further add to uncertainty of the XSA estimates.

ICES has been aware of these special facts and has in recent years been investigating assessment models, which include predator components (natural mortality). However, exploratory runs with such models indicate a dramatic shift (increases) in estimated total biomass, and ICES prefers further exploratory assessments by this model, before using its results as a basis for management advice.

Catch forecast: Not available.

Elaboration and special comments: *Pandalus borealis* is fished by bottom trawls at 150–400 m depth throughout the year by Danish, Norwegian, and Swedish fleets.

Strong fluctuations in the *Pandalus* stocks are frequently observed. Predator pressure as well as the low number of age groups in the stock contributes significantly to such fluctuations. The natural mortality for *Pandalus* is likely to be substantially higher than the fishing mortality and is likely to fluctuate considerable according to the abundance of predators.

Because of the potentially large impact of predation on stock dynamics, the biological consequences of any specific fishing mortality rate can be highly variable. At low predator abundance, even a low fishing mortality (F) may be a high proportion of total mortality (Z), whereas at high predator abundance, a higher F may still be a small part of Z. It is not yet possible to identify appropriate precautionary fishing mortality reference points ($\mathbf{F}_{lim}$, $\mathbf{F}_{pa}$) for such circumstances, and reference points based on total mortality may be more sound biologically.

ICES withdraws the previously proposed $\mathbf{B}_{pa}$ of 12 000 t for this stock. This PA reference point was based on a XSA type assessment, which is now considered to be unreliable. Alternative production models suggest that population levels may be about 3 times higher than estimated XSA. These alternative estimates have to be confirmed by further analyses.

Exploratory assessments were based on commercial catches, survey indices of available biomass, recruitment and amount of predators, but were not considered sufficiently reliable to base advice on.

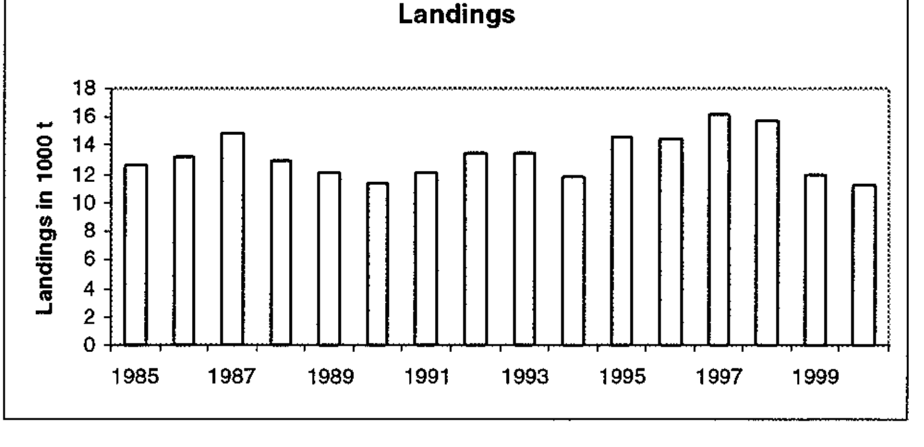
Source of information: Report of the *Pandalus* Assessment Working Group, Charlottenlund, Denmark, August 2001 (ICES CM 2002/ACFM:04).

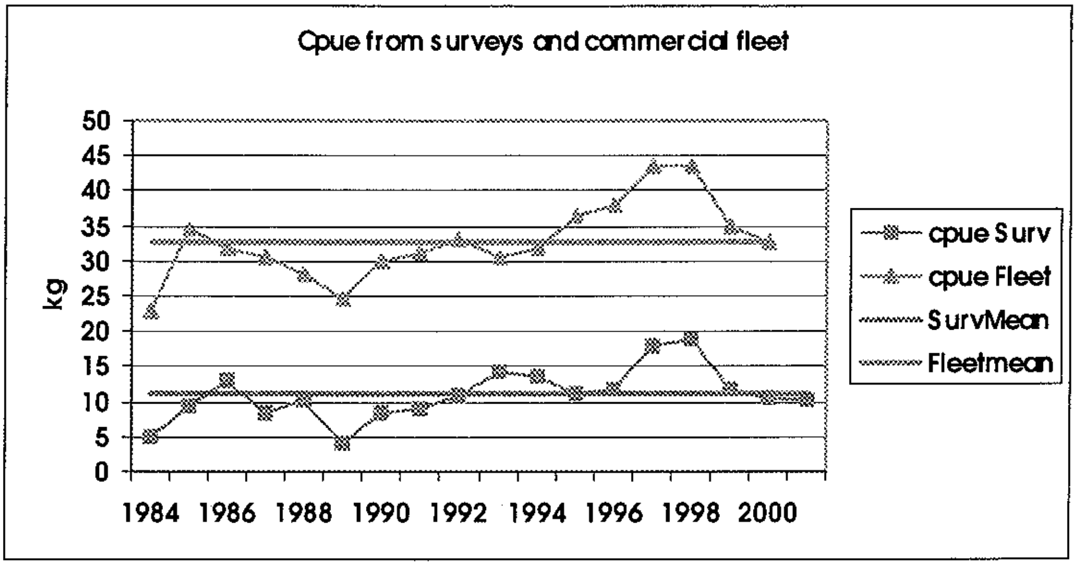
Catch data (Tables 3.4.6.1–2):

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC Skagerrak	Agreed TAC IIIa + IV	Dis-cards	ACFM landings	ACFM catch
1987	Not assessed				0.7	14.2	14.9
1988	Catches significantly below 1985–1986[3]				0.8	12.2	12.9
1989	No advice		3.1[1]		1.1	11.0	12.1
1990	F as F(pre-85)[3]; TAC[3]; No increase in F[4]; TAC[4]	10.0	2.75[1]		1.2	10.2	11.4
1991	No increase in F; TAC	12.0	8.55		0.5	11.6	12.1
1992	Within safe biological limits	15[2]	10.50	15.0	0.5	13.0	13.6
1993	Within safe biological limits	13[2]	10.50	15.0	0.9	12.6	13.5
1994	Within safe biological limits	19[2]	12.60	18.0	0.2	11.5	11.7
1995	Within safe biological limits	13[2]	11.20	16.0	0.3	14.2	14.5
1996	No advice	11[2]	10.50	15.0	0.3	14.2	14.5
1997	No advice	13[2]	10.50	15.0	1.0	15.1	16.1
1998	No increase in F; TAC	19[2]	13.16	18.8	0.4	15.4	15.8
1999	Maintain F	19[2]	13.16	18.8	0.6	11.2	11.9
2000	Maintain F	<11.5[2]	9.10	16.2	0.7	10.8	11.5
2001	Maintain F	13.4	10.15	15.9			
2002	long term average landings	12.6					

[1]EU zone only. [2] Catch at *status quo* F. [3] IIIa. [4]Norwegian Deep. Weights in '000 t.

Pandalus Divisions IIIa & IVa East (Skagerrak & Norwegian Deeps)




Cpue from surveys and commercial fleet
kg
50
45
40
35
30
25
20
15
10
5
0
1984 1986 1988 1990 1992 1994 1996 1998 2000
cpue Surv
cpue Fleet
SurvMean
Fleetmean

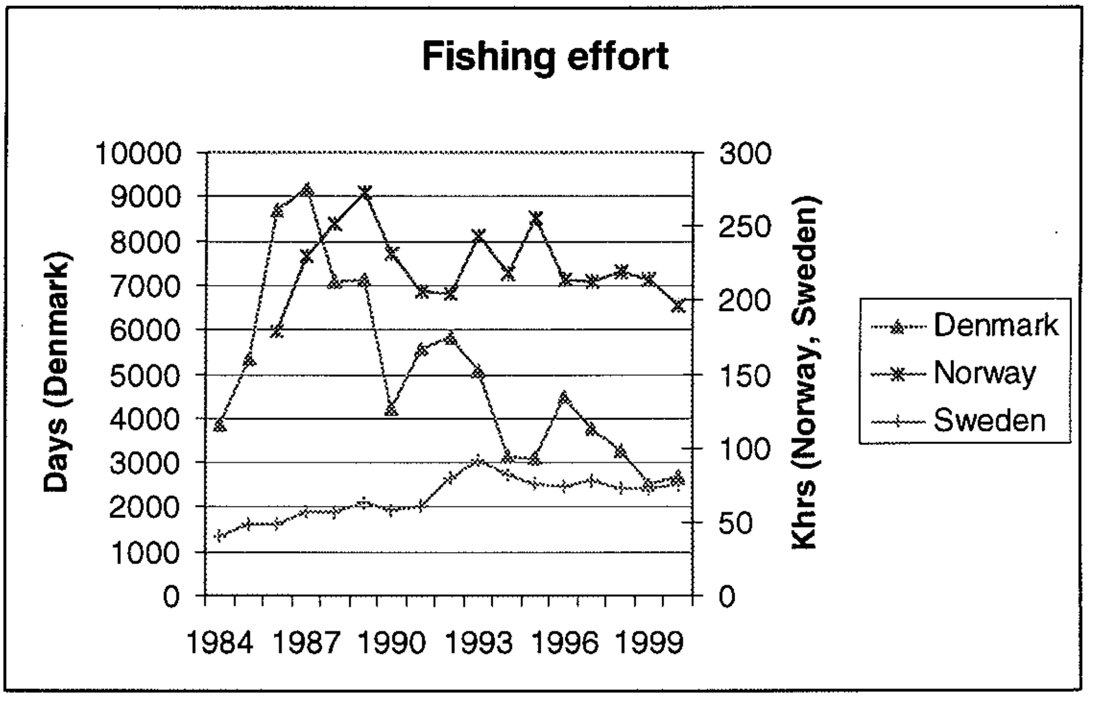

Fishing effort
Days (Denmark)
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
Khrs (Norway, Sweden)
300
250
200
150
100
50
0
1984 1987 1990 1993 1996 1999
Denmark
Norway
Sweden

Table 3.4.6.1 Nominal landings (t) of *Pandalus borealis* in ICES Division IIIa and Sub-area IV as officially reported to ICES.

	Division IIIa				Sub-area IV					
Year	Denmark	Norway	Sweden†	Total	Denmark	Norway	Sweden	UK (Engl.)*	UK (Scotl.)*	Total
1970	757	982	2740	4479	3460	1107	-	14	100	4681
1971	834	1392	2906	5132	3572	1265	-	-	438	5275
1972	773	1123	2524	4420	2448	1216	-	692	187	4543
1973	716	1415	2130	4261	196	931	-	1021	163	2311
1974	475	1186	2003	3664	337	767	-	50	432	1586
1975	743	1463	1740	3946	1392	604	261	-	525	2782
1976	865	2541	2212	5618	1861	1051	136	186	2006	5240
1977	763	2167	1895	4825	782	960	124	265	1723	3854
1978	757	1841	1529	4127	1592	692	78	98	2044	4504
1979	973	2489	1752	5214	962	594	34	238	309	2137
1980	1679	3498	2121	7298	1273	1140	38	203	406	3060
1981	2593	3753	2210	8556	719	1435	31	1	341	2527
1982	2920	3877	1421	8218	1069	1545	92	-	354	3060
1983	1571	3722	988	6281	5752	1657	112	65	1836	9422
1984	1717	3509	933	6159	4638	1274	120	277	25	6334
1985	4105	4772	1474	10351	4582	1785	128	415	1347	8257
1986	4686	4811	1357	10854	3896	1681	157	458	358	6550
1987	4140	5198	1085	10423	9223	3145	252	526	774	13920
1988	2278	3047	1075	6400	2647	4614	220	489	109	8098
1989	2527	3156	1304	6987	3298	3418	122	364	579	7802
1990	2277	3006	1471	6754	2079	3146	137	305	365	6083
1991	3256	3441	1747	8444	750	2715	161	130	54	3810
1992	3296	4257	2057	9610	1881	2945	147	69	116	5158
1993	2490	4089	2133	8712	1985	3449	167	29	516	6146
1994	1973	4388	2553	8914	1352	2426	176	41	35	4030
1995	2494	5181	2512	10187	4698	2879	166	217	1324	9284
1996	3664	5143	1985	10792	4063	2772	82	97	1899	8913
1997	3617	5460	2281	11358	3117	3112	316	52	365	6962
1998	2941	6519	2086	11546	3273	3092	187	55	1364	7971
1999	1398	3985	2114	7497	1679	2756	182	46	479	5142
2000	1898	3554	1890	7342	1956	2562	184	-	378	5080

* Includes small amounts of other Pandalid shrimp.
† 1970 to 1974 includes Sub-area IV.
Total 1988 - 1990 includes 19, 21 and 51 t by the Netherlands.
2000 figures are preliminary.

Table 3.4.6.2 *Pandalus borealis* landings (t) from Divisions IIIa (Skagerrak) and IVa (eastern part). (Norwegian Deeps) as estimated by the Working Group.

Year	Denmark	Norway	Sweden	Total	Estimated discards	TAC	Catch
1970	1102	1729	2742	5573	-		
1971	1190	2486	2906	6582	-		
1972	1017	2477	2524	6018	-		
1973	755	2333	2130	5218	-		
1974	530	1809	2003	4342	-		
1975	817	2339	2003	5159	-		
1976	1204	3348	2529	7081	-		
1977	1120	3004	2019	6143	-		
1978	1459	2440	1609	5508	-		
1979	1062	3040	1787	5889	-		
1980	1678	4562	2159	8399	-		
1981	2593	5183	2241	10017	-		
1982	3766	5042	1450	10258	-		
1983	1567	5361	1136	8064	-		
1984	1747	4783	1022	7552	200		7752
1985	3827	6646	1571	12044	558		12602
1986	4834	6490	1463	12787	414		13201
1987	4488	8343	1322	14153	723		14876
1988	3240	7661	1278	12179	750		12929
1989	3150	6411	1433	10994	1107		12101
1990	2479	6108	1608	10195	1226		11421
1991	3583	6119	1908	11610	497		12107
1992	3725	7136	2154	13015	541	15000	13556
1993	2915	7371	2300	12586	889	15000	13475
1994	3134	6813	2601	11532	214	18000	11745
1995	2465	8900	2882	14247	275	16000	14523
1996	3868	7878	2371	14229	318	15000	14548
1997	3909	8565	2597	15070	1039	18000	16109
1998	3330	9606	2469	15406	348	18800	15753
1999	2072	6726	2445	11243	639	18800	11882
2000	2435	6119	2225	10779	687	16200	11466
2001						15900	

3.4.7 Herring in Sub-divisions 22–24 and Division IIIa (spring-spawners)

State of stock/exploitation: The state of the stock is uncertain. However, the available information provides reason for concern. Fishing mortalities appear to be stable at a high level during the last 4 years while catches have declined over the same period. An improvement can be expected only if the indications that the year classes 1998 and 1999 are large can be confirmed in future. However, at the present fishing mortality-such an improvement would not be sustained in the long term.

Management objectives: There are no explicit management objectives for this stock.

Advice on management: ICES recommends that the fisheries on herring in Division IIIa should continue to be managed in accordance with the management advice given on autumn-spawning herring in Section 3.5.8. If a catch limit is required in Sub-divisions 22–24, ICES advises that it should not exceed recent catches in that area which are of the order of 50 000 t.

Relevant factors to be considered in management: A considerable part of the landings of juvenile herring in Division IIIa originates from the North Sea stock. An abundant 1999 year class of North Sea autumn-spawner herring is expected to be present in the area as one-year-olds in the year 2001. Recently, this fishery has been managed to be consistent with the management of the herring in the North Sea. As the North Sea stock recovers, the need for separate assessment of this herring stock increases. Failure to obtain reliable catch data for this area may place this stock at increasing risk of serious overexploitation.

In the Baltic the TACs for herring apply to several herring stocks including the component of this stock in Sub-divisions 22–24, and there is no specific instrument available that allows control over the exploitation of spring-spawning herring in Division IIIa and Sub-divisions 22–24. ICES reiterates its previous advice that the herring TAC for the Baltic should be split and individual TACs applied to the stocks, i.e. Sub-divisions 22–24, Sub-divisions 25–29 + 32, and Sub-divisions 30, 31.

It should also be stressed that, if fishing mortality for North Sea autumn-spawners is allowed to increase due to an increase in SSB of the North Sea autumn spawners, fishing mortalities on spring-spawners in Division IIIa is likely also to increase due to their being taken together in several fisheries. This is an additional threat to the stock.

Comparison with previous assessment and advice: The assessment continues to remain uncertain.

Catch forecast: The present assessment was not considered reliable to base a projection on.

Elaboration and special comments: The assessment of this stock is very uncertain and no population analysis was accepted.

Herring of this stock are taken in the Northeastern part of the North Sea, Division IIIa and Sub-divisions 22–24. Division IIIa has directed fisheries by trawlers and purse seiners (fleet C), while Sub-divisions 22–24 have directed trawl, gillnet and trapnet fisheries (fleet F). The herring by-catches taken in Division IIIa in the small mesh trawl fishery for Norway pout, sandeel and sprat (fleet D) are mainly autumn-spawners from the North Sea stock. After a period of high landings in the early 1980s the combined landings of all fleets have decreased to below the long-term average.

The TACs in Division IIIa in 2000 were 1) for the directed fishery 80 000 t and 2) for by-catch in the small mesh fisheries 21 000 t. The TAC comprises both the autumn- and spring-spawning stocks in the area. The spring-spawners are also fished in the Baltic, under the overall IBSFC herring TAC of 405 000 t (Sub-divisions 22–29S and 32). The agreed TACs in Div. IIIa for 2001 are 80 000 t for directed fishery and a total of 21 000 t for by-catches in the small mesh fisheries.

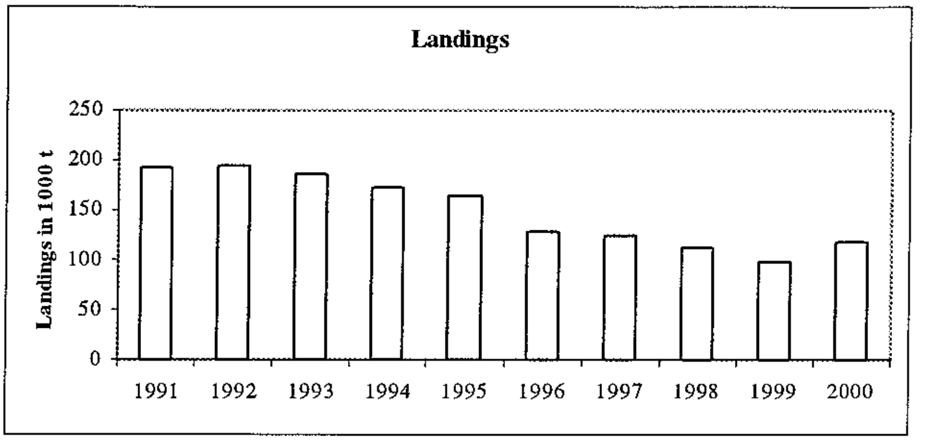
The recent attempt to assess the stock gives unreliable results due to the different signals from the diverse sources of information. In order to obtain a reliable assessment, a comprehensive survey covering the whole stock is required. As a new method to calculate the proportion of spring- and autumn-spawners caught in these areas has been implemented by the HAWG, all catch and IBTS data for the period 1991–1999 has been revised. Further application of methods to split the spawning components in the catch data before 1991 should be undertaken to provide a stable set of historical catch at age data.

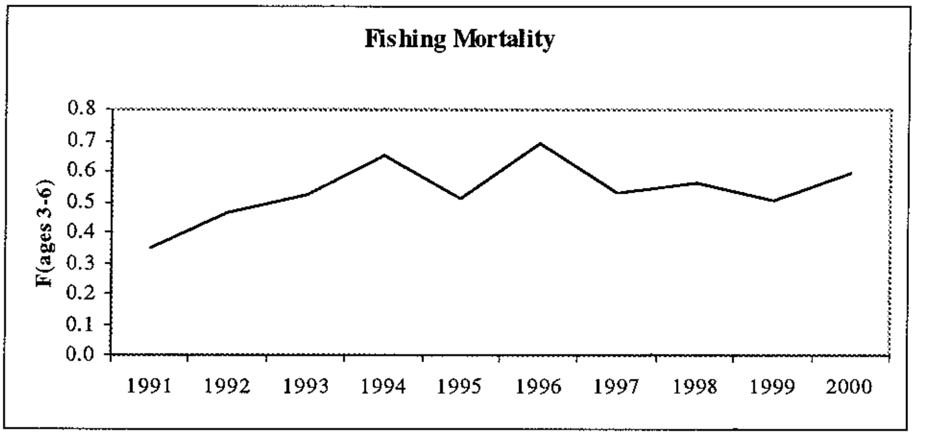
Source of information: Report of the Herring Assessment Working Group for the Area South of 62°N, March 2001 (ICES CM 2001/ACFM:12).

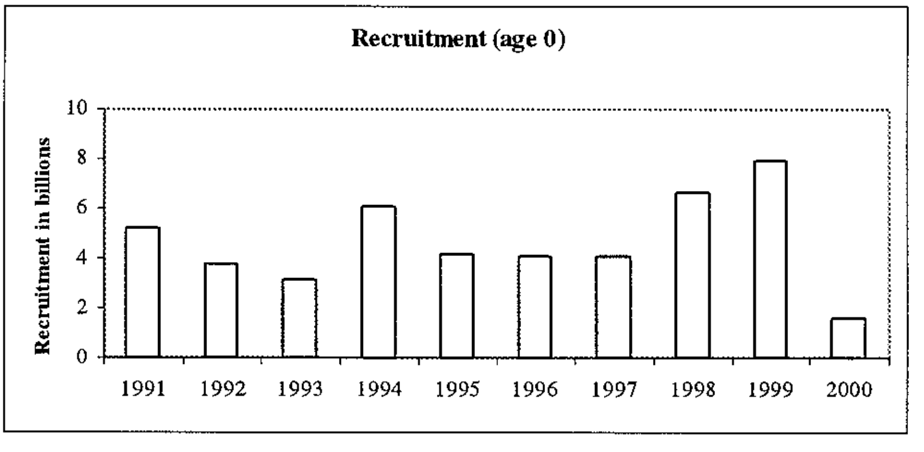
Catch data: (Tables 3.4.7.1-2)

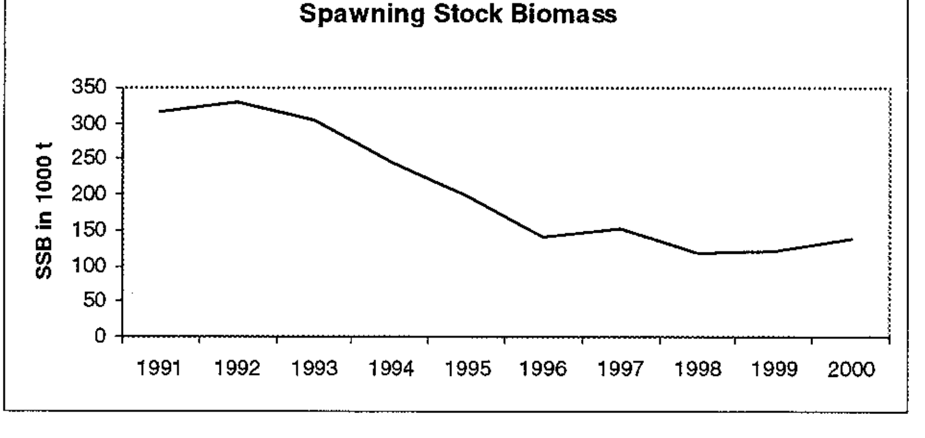
Year	ICES Advice	Pred. Catch corresp. to advice	Agreed TAC	ACFM catch of Stock			
				22–24	IIIa	IV	Total
1987	Reduction in F	224		102	59	14	175
1988	No increase in F	196		99	129	23	251
1989	TAC	174		95	71	20	186
1990	TAC	131		78	118	8	204
1991	TAC	180		70	112	10	192
1992	TAC	180		85	101	9	195
1993	Increased yield from reduction in F; reduction in juvenile catches	188		81	95	10	186
1994	TAC	130–180		66	92	14	172
1995	If required, TAC not exceeding recent catches	168–192		74	80	10	164
1996	If required, TAC not exceeding recent catches	164–171		58	71	1	130
1997	IIIa: managed together with autumn-spawners 22–24: if required, TAC not exceeding recent catches	66–85[1]		68	55	1	124
1998	Should be managed in accordance with North Sea autumn spawners	-		51	53	8	112
1999	IIIa: managed together with autumn-spawners 22–24: if required, TAC not exceeding recent catches	-		50	43	5	98
2000	IIIa: managed together with autumn-spawners 22–24: if required, TAC not exceeding recent catches	~60 for Sub-divs. 22–24		54	57	7	118
2001	IIIa: managed together with autumn-spawners 22–24: if required, TAC not exceeding recent catches	~50 for Sub-divs. 22–24					

[1]Catch in Sub-divisions 22–24. Weights in '000 t.


Landings
Landings in 1000 t
250
200
150
100
50
0
1991 1992 1993 1994 1995 1996 1997 1998 1999 2000


Fishing Mortality
F(ages 3-6)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1991 1992 1993 1994 1995 1996 1997 1998 1999 2000


Recruitment (age 0)
Recruitment in billions
10
8
6
4
2
0
1991 1992 1993 1994 1995 1996 1997 1998 1999 2000


Spawning Stock Biomass
SSB in 1000 t
350
300
250
200
150
100
50
0
1991 1992 1993 1994 1995 1996 1997 1998 1999 2000

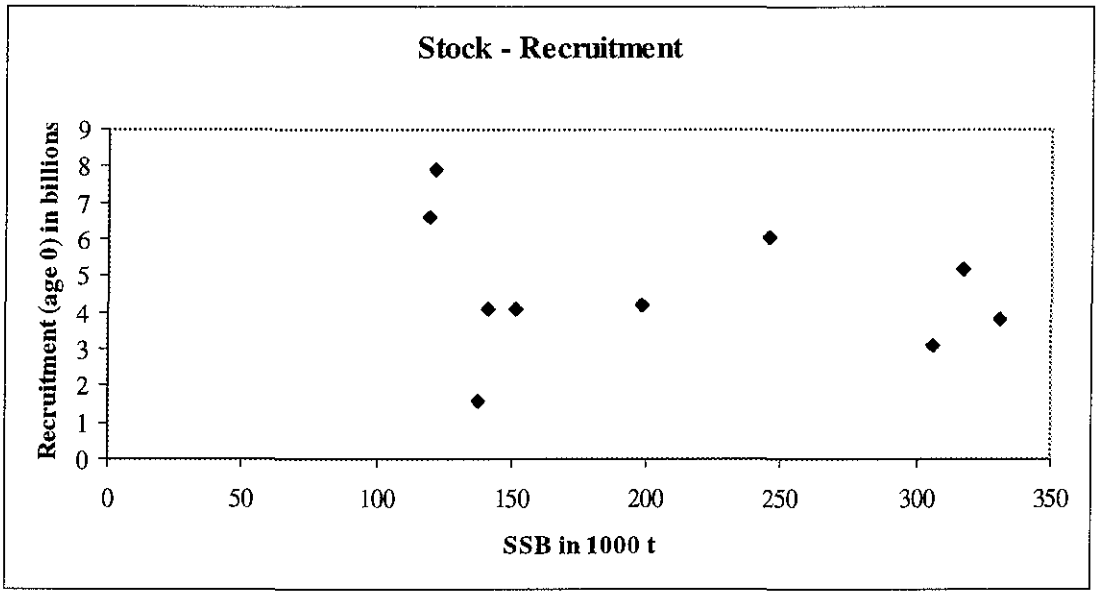

Stock - Recruitment
Recruitment (age 0) in billions
9
8
7
6
5
4
3
2
1
0
0
50
100
150
200
250
300
350
SSB in 1000 t

Table 3.4.7.1 HERRING in Division IIIa and Sub-divisions 22-24. 1986 – 2000. Landings in thousands of tonnes. (Data provided by Working Group members 2001).

Year	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Skagerrak										
Denmark	88.2	94.0	105.0	144.4	47.4	62.3	58.7	64.7	87.8	44.9
Faroe Islands	0.5	0.5								
Norway	4.5	1.6	1.2	5.7	1.6	5.6	8.1	13.9	24.2	17.7
Sweden	40.3	43.0	51.2	57.2	47.9	56.5	54.7	88.0	56.4	66.4
Total	133.5	139.1	157.4	207.3	96.9	124.4	121.5	166.6	168.4	129.0
Kattegat										
Denmark	69.2	37.4	46.6	76.2	57.1	32.2	29.7	33.5	28.7	23.6
Sweden	39.8	35.9	29.8	49.7	37.9	45.2	36.7	26.4	16.7	15.4
Total	109.0	73.3	76.4	125.9	95.0	77.4	66.4	59.9	45.4	39.0
Sub. Div. 22+24										
Denmark	15.9	14.0	32.5	33.1	21.7	13.6	25.2	26.9	38.0	39.5
Germany	54.6	60.0	53.1	54.7	56.4	45.5	15.8	15.6	11.1	11.4
Poland	16.7	12.3	8.0	6.6	8.5	9.7	5.6	15.5	11.8	6.3
Sweden	11.4	5.9	7.8	4.6	6.3	8.1	19.3	22.3	16.2	7.4
Total	98.6	92.2	101.4	99.0	92.9	76.9	65.9	80.3	77.1	64.6
Sub. Div. 23										
Denmark	6.8	1.5	0.8	0.1	1.5	1.1	1.7	2.9	3.3	1.5
Sweden	1.1	1.4	0.2	0.1	0.1	0.1	2.3	1.7	0.7	0.3
Total	7.9	2.9	1.0	0.2	1.6	1.2	4.0	4.6	4.0	1.8
Grand Total	349.0	307.5	336.2	432.4	286.4	279.9	257.8	311.4	294.9	234.4

Continued.......

Table 3.4.7.1 **(Continued)**

Year	1995	1996	1997	1998 [2]	1999 [2]	2000 [1]
Skagerrak						
Denmark	43.7	28.7	14.3	10.3	10.1	16.0
Faroe Islands						
Norway	16.7	9.4	8.8	8.0	7.4	9.7
Sweden	48.5	32.7	32.9	46.9	36.4	45.8
Total	108.9	70.8	56.0	65.2	53.9	71.5
Kattegat						
Denmark	16.9	17.2	8.8	23.7	17.9	18.9
Sweden	30.8	27.0	18.0	29.9	14.6	17.3
Total	47.7	44.2	26.8	53.6	32.5	36.2
Sub. Div. 22+24						
Denmark	36.8	34.4	30.5	30.1	32.5	32.6
Germany	13.4	7.3	12.8	9.0	9.8	9.3
Poland	7.3	6.0	6.9	6.5	5.3	6.6
Sweden	15.8	9.0	14.5	4.3	2.6	4.8
Total	73.3	56.7	64.7	49.9	50.2	53.3
Sub. Div. 23						
Denmark	0.9	0.7	2.2	0.4	0.5	0.9
Sweden	0.2	0.3	0.1	0.3	0.1	0.1
Total	1.1	1.0	2.3	0.7	0.6	1.0
Grand Total	231.0	172.7	149.8	169.4	137.2	162.0

[1] Preliminary data.

[2] Revised data for 1998 and 1999

Table 3.4.7.2 Herring in Sub-divisions 22-24 and Division IIIa (spring-spawners).

Year	Recruitment Age 0 thousands	SSB tonnes	Landings tonnes	Mean F Ages 3-6
1991	5168060	317074	191573	0.3486
1992	3791380	330876	194411	0.4625
1993	3122770	306225	185010	0.5237
1994	6048570	244929	172438	0.6485
1995	4197000	198703	164284	0.5114
1996	4104960	141257	128243	0.6872
1997	4093260	151503	123199	0.5266
1998	6620800	119045	112386	0.5596
1999	7891960	121217	98040	0.5059
2000	1578050	137684	118276	0.5943
Average	4661681	206851	148786	0.5368

3.4.8 Sprat in Division IIIa

State of stock/exploitation: The state of the stock is unknown. Sprat in this area is short-lived with large annual natural fluctuations in stock biomass.

Management objectives: There are no explicit management objectives for this stock.

Advice on management: As sprat is mainly fished together with juvenile herring the exploitation of sprat will be limited by the restrictions imposed on fisheries for juvenile herring.

Relevant factors to be considered in management: Sprat cannot be fished without significant by-catches of herring except in years with high sprat abundance. The most recent period when this occurred was 1994–1995. The available surveys are not reliable indicators of sprat abundance in Division IIIa. Therefore, fishing possibilities in 2002 cannot be projected.

Management of this stock should consider management advice given in Section 3.5.8 (Herring in Sub-area IV, Division VIId and Division IIIa).

Catch forecast 2002: None.

Elaboration and special comment: The directed sprat fishery serves a very small market. Most sprat catches are taken in an industrial fishery whose catches are limited by herring by-catch restrictions. This combination of factors has limited the expansion of harvests of this sprat stock to fully exploit the occasional strong year classes, which pass quickly through it.

Landings of sprat in Division IIIa averaged about 70 000 t in the 1970s, but since 1982 have typically been in the region of 20 000 t, except in 1994–1995.

Source of information: Report of the Herring Assessment Working Group for the Area South of 62°N, March 2001 (ICES CM 2001/ACFM:12).

Catch data (Table 3.4.8.1):

Year	ICES Advice	Pred. cat. corr. to adv.	Agreed TAC[1]	Official lndgs.[2]	ACFM catch
1987	-	-	80	68	14
1988	TAC for "mixed clupeoid" fishery	80[1]	80	63	9
1989	Sprat catch lowest possible level; TAC for "mixed clupeoid" fishery	80[1]	80	62	10
1990	Sprat catch lowest possible level; TAC for "mixed clupeoid" fishery	60[1]	65	43	10
1991	Sprat catch lowest possible level; Zero TAC for "mixed clupeoid" Fishery	-	50	44	14
1992	No advice for sprat; Zero TAC for "mixed clupeoid" fishery	-	50	40	11
1993	No advice for sprat	-	45	36	9
1994	Separate sprat TAC based on recent catches	10-14	43	67	96
1995	Separate sprat TAC based on recent catches	9-14	43	45	56
1996	No advice	-	43	28	18
1997	Reduce by-catch of herring	-	40	19	16
1998	Limited by restriction on juvenile herring catches	-	40	26	18
1999	Limited by restriction on juvenile herring catches	-	50	35	27
2000	Limited by restriction on juvenile herring catches	-	50	28	20
2001	Limited by restriction on juvenile herring catches	-	50		
2002	Limited by restriction on juvenile herring catches				

[1]TAC applies to all species in "mixed clupeoid" catch. [2]Includes other species in "mixed clupeoid" catches. Weights in '000 t.

Sprat in Division IIIa

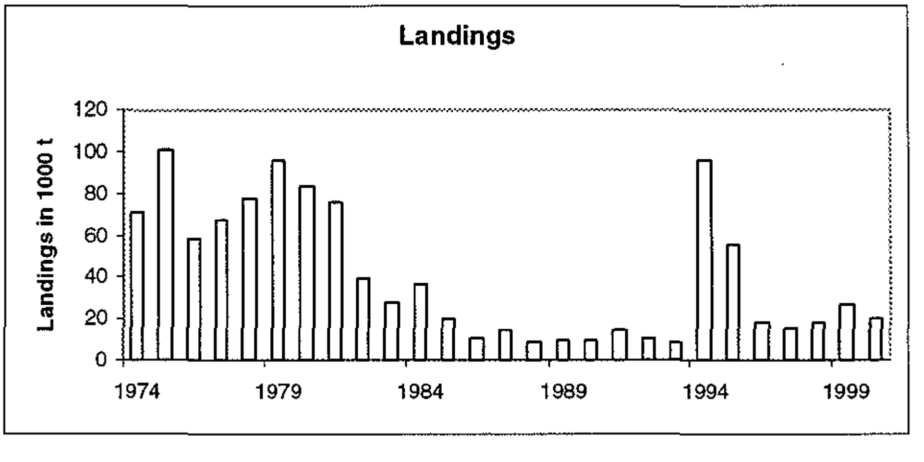


Table 3.4.8.1 Sprat in Division IIIa. Landings in (1000 tonnes) 1974-2000.
(Data provided by Working Group members). These figures do not in all cases correspond to the official statistics and cannot be used for management purposes.

	Skagerrak				Kattegat			Div. IIIa
Year	Denmark	Sweden	Norway	Total	Denmark	Sweden	Total	total
1974	17.9	2	1.2	21.1	31.6	18.6	50.2	71.3
1975	15	2.1	1.9	19	60.7	20.9	81.6	100.6
1976	12.8	2.6	2	17.4	27.9	13.5	41.4	58.8
1977	7.1	2.2	1.2	10.5	47.1	9.8	56.9	67.4
1978	26.6	2.2	2.7	31.5	37	9.4	46.4	77.9
1979	33.5	8.1	1.8	43.4	45.8	6.4	52.2	95.6
1980	31.7	4	3.4	39.1	35.8	9	44.8	83.9
1981	26.4	6.3	4.6	37.3	23	16	39	76.3

	Skagerrak			Kattegat		Div. IIIa	Division IIIa
Year	Denmark	Sweden	Norway	Denmark	Sweden	Sweden	Total
1982	10.5		1.9	21.4		5.9	39.7
1983	3.4		1.9	9.1		13.0	27.4
1984	13.2		1.8	10.9		10.2	36.1
1985	1.3		2.5	4.6		11.3	19.7
1986	0.4		1.1	0.9		8.4	10.8
1987	1.4		0.4	1.4		11.2	14.4
1988	1.7		0.3	1.3		5.4	8.7
1989	0.9		1.1	3.0		4.8	9.8
1990	1.3		1.3	1.1		6.0	9.7
1991	4.2		1.0	2.2		6.6	14.0
1992	1.1		0.6	2.2		6.6	10.5
1993	0.6	4.7	1.3	0.8	1.7		9.1
1994	47.7	32.2	1.8	11.7	2.6		96.0
1995	29.1	9.7	0.5	11.7	4.6		55.6
1996	7.0	3.5	1.0	3.4	3.1		18.0
1997	7.0	3.1	0.4	4.6	0.7		15.8
1998	3.9	5.2	1.0	7.3	1.0		18.4
1999	6.8	6.4	0.2	10.4	2.9		26.7
2001	5.1	4.3	0.9	7.7	2.1		20.1

3.4.9 Sandeel in Division IIIa (Skagerrak – Kattegat)

State of stock/exploitation: Based on the available information it was not possible to assess the status of the stock or identify safe biological limits.

Management objectives: There are no explicit management objectives for this stock.

Elaboration and special comment: ICES notes that this is an unregulated fishery on an important prey species.

The fishery is an extension of the North Sea fishery into Division IIIa, but with smaller vessels working closer inshore, mostly along the coast of Jutland.

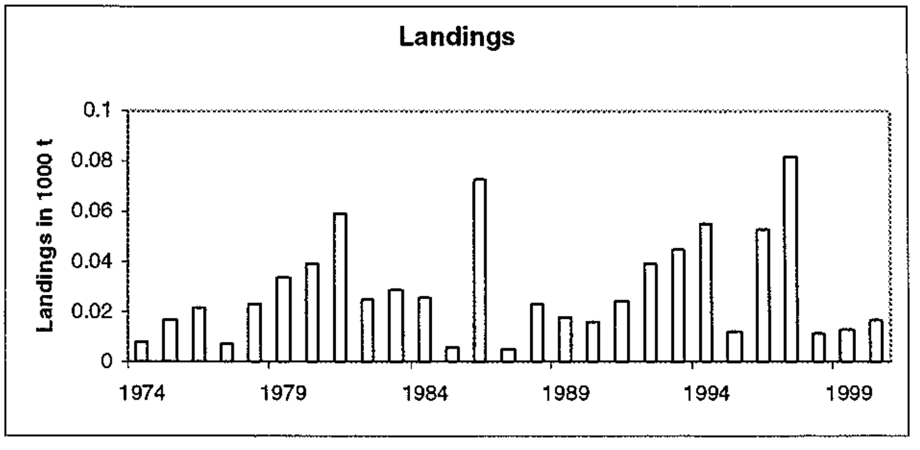
Source of information: Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, June 2001, Hamburg, Germany (ICES CM 2002/ACFM: 01).

Catch data (Table 3.4.1.1):

Year	ICES advice	ACFM Catch
1987	No advice	5
1988	No advice	23
1989	No advice	18
1990	No advice	16
1991	No advice	23
1992	No advice	39
1993	No advice	45
1994	No advice	55
1995	No advice	12
1996	No advice	53
1997	No advice	81
1998	No advice	11
1999	No advice	12
2000	No advice	15
2001	No advice	17
2002	No advice	

Weights in '000 t.

Sandeel in Division IIIa (Skagerrak - Kattegat)



3.4.10 Anglerfish in Division IIIa (Skagerrak – Kattegat)

Comments: Landings of anglerfish in Division IIIa are low compared to landings taken from the North Sea and Division VIa. Landings increased in the early 1990s and have since declined. Anglerfish caught in Division IIIa probably form part of the same stock as those in the North Sea and Division VIa. No assessment has been carried out on this stock. Landings from the North Sea are mis-reported into Division IIIa. If these misreportings compromise the effectiveness of management measures in the North Sea, then a TAC for Division IIIa may be appropriate.

Source of information: Report of the Working Group on the Assessment of Northern Shelf Demersal Stocks, August 2001 (ICES CM 2002/ACFM:02).

Anglerfish in Division IIIa (Skagerrak - Kattegat)

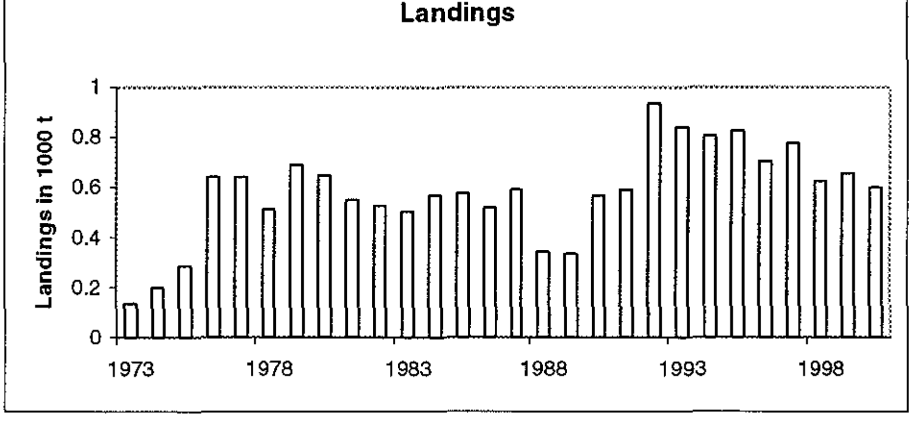


Table 3.4.10.1 Nominal catch (t) of Anglerfish in Division IIIa, 1989–2000, as officially reported to ICES.

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Belgium	12	22	15	48	34	21	35	-	-	-	-	-
Denmark	266	477	493	658	565	459	312	367	550	415	362	377
Germany	-	1	-	-	1	-	-	1	1	1	2	1
Norway	52	57	64	170	154	263	440	309	184*	177*	258*	197*
Sweden	4	13	23	62	89	68	36	25	39	33	36	27
Total	334	570	595	938	843	811	823	702	774	626	658	602

*Preliminary.

Table 3.4.10.2 Anglerfish in Division IIIa (Skagerrak - Kattegat).

Year	Landings
	tonnes
1973	140
1974	202
1975	291
1976	641
1977	643
1978	509
1979	687
1980	652
1981	549
1982	529
1983	506
1984	568
1985	578
1986	524
1987	589
1988	347
1989	334
1990	570
1991	595
1992	938
1993	843
1994	811
1995	823
1996	702
1997	774
1998	626
1999	658
2000	602
Average	580

3.5 Stocks in the North Sea (Sub-area IV)

3.5.1 Overview

Description of the fisheries

The fisheries in the North Sea can be grouped into demersal and pelagic human consumption fisheries and industrial fisheries which land their catch for industrial purposes. Demersal human consumption fisheries usually target a mixture of roundfish species (cod, haddock, whiting), or a mixture of flatfish species (plaice and sole) with a by-catch of roundfish. A fishery directed at saithe exists along the shelf edge. The catch of these fisheries is landed for human consumption. The pelagic fisheries mainly target herring, mackerel and horse mackerel. Although most of the landings of these species may be landed for human consumption purposes, part of the landings are used for fishmeal and fishoil. The catch of the industrial fisheries mainly consists of sandeel, Norway pout and sprat. The industrial catches also contain by-catches of other species including herring, haddock and whiting (Table 3.5.1.1). In addition to the finfish fisheries, smaller fleets exist which fish for crustaceans including *Nephrops*, *Pandalus* and brown shrimp (*Crangon crangon*).

Each fishery uses a variety of gears. Demersal fisheries: otter trawls, pair trawls, twin trawls, seines, gill nets, beam trawls. Pelagic fisheries: pelagic trawls and purse seines. Industrial fisheries: small-meshed otter trawls, pelagic trawls and purse seines.

Some major technological developments changed the fisheries in the North Sea during and after the 1960s such as the development of the beam trawl fishery for flatfish, purse seines in the pelagic fishery and large pelagic trawls to replace driftnets. In recent years twin trawls have been introduced in the fishery for flatfish and roundfish. The introduction of power blocks in the 1960s has enormously increased the possibilities for the purse seiners. Right up to the present further development of electronic equipment such as satellite navigation, fish finders and sonar has increased fishing efficiency of the fleets.

The trends in landings of the most important species landed by these fleets since 1970, together with the total international landings, are shown in Table 3.5.1.2 and in Figure 3.5.1.1. The demersal landings have steadily declined over the period. The pelagic landings, dominated by herring, decreased to a minimum in the late 1970s, when the fishery for herring was closed, but increased again up to over 1 million t in the period 1987-1995. In 1996 they were reduced by about half and remain stable since then. The landings in the industrial fisheries increased to approximately 1.8 million t in the mid 1970s, and have fluctuated between 1 and 1.5 million t in recent years. These landings show the largest annual variations, due to the short life span of the species. The total landings reached 3 million t in 1974, and have been around 2.5 million t since the 1980s.

Most commercial species are managed by TAC/quota regulations that apply to Sub-area IV or a combination of Sub-area IV with an adjacent area. The national management measures with regard to the implementation of the quota in the fisheries differ between species and countries. The industrial fisheries are subject to regulations for the by-catches of protected species.

Data

The biological data available from scientific sources for the assessment of roundfish, flatfish, herring and mackerel are relatively good. The level of biological sampling of most of the commercial landings has been maintained. Discard data are only used directly in assessments for haddock and whiting, but a historical series exists only for one country. Several countries now collect discard data on a recurrent basis although many of these data are yet to be incorporated in the assessments.

Data on landings, fishing effort and species composition are available from all industrial fisheries. There are catch and effort data available for many fisheries but it is uncertain how reliably these data reflect trends in effective effort, i.e. nominal effort after corrections for technological improvements. Restrictive management measures (TAC's) have also resulted in changes in fishing practice of some fleets and redirected effort to other species. In a number of cases this has lead to abandon the use of time series of commercial CPUE data in the assessments (cod, haddock, whiting, plaice). In some recent years there was misreporting of roundfish landings associated with restrictive quotas. Substantial underreporting of cod landings occurred in 1998.

Several series of research vessel survey indices are available for most species. Quarterly data were available from the International Bottom Trawl Survey for a period of 6 years (1991-1996) and these were used in the assessment of some stocks. This survey covers quarters 1 and 3 since then. For herring and mackerel the spawning stock sizes are estimated by annual larvae- and acoustic surveys (herring) or intermittent egg surveys (mackerel).

Analytical assessments were performed on cod, haddock, whiting, saithe, herring, mackerel, plaice, sole, sandeel and Norway pout.

Multispecies considerations are not incorporated in the assessments or the forecasts for the North Sea stocks. However, average natural mortalities estimated by multispecies assessments are incorporated in the assessments of cod, haddock, whiting, herring, sprat, sandeel and Norway pout.

Overview of resources

In the past 10 years the state of the stock for most roundfish and flatfish species in the North has further deteriorated. Some of these stocks have reached a historical low within this period. One of the major causes of this deterioration is the continuous very high level of exploitation. This exploitation has lead to a reduction in the number of age groups in the stocks and fishing opportunities have consequently become more dependent on the success of recruitment. Recruitment for most stocks is, however, very variable. For a number of species (cod, whiting, plaice) recruitment in most years has been lower than in previous decades. At the same time it is observed that a number of species (cod, haddock, whiting, sole, plaice) simultaneously show a reduction of growth. On the contrary, other (southern) species like sea bass and red mullet have increased and in some times attracted a fishery. There is considerable speculation on the reasons for the observed changes. The reduction in recruitment can be explained by a reduction in the production of eggs by the reduced spawning stocks, but it cannot be excluded that changes in the environment play a role. In the last 10 years the climate has changed not only on land but also in the sea and mean temperatures in the sea have increased. Also changes in the sea currents have been observed. The changes in environmental conditions may also be responsible for changes in the distribution and abundance of the different species.

In the North Sea all stocks of roundfish and flatfish species have been exposed to high levels of exploitation. The present assessments indicate that the fishing mortality in the last three years has been reduced for whiting and saithe, but not for cod and haddock. The cod stock is at a very low level and is presently in a region where the chance of collapse is high. The stock of whiting has shown a continued decline over time although the recent estimates of biomass are uncertain. It is considered likely that the whiting stock is still outside safe biological limits. The saithe stock is now considered to be within safe biological limits. The stock of haddock presently profits from a good year class recruiting into the spawning stock but the exploitation rate is still too high. Plaice is outside safe biological limits and fishing mortality on both plaice and sole are high and unsustainable in the longer term. The spawning stock biomass of sole is decreasing. Norway pout and sandeel are short living species and their biomass show large fluctuations in accordance with large variability of recruitment. The biomass of Norway pout and sandeel in 2001 were high and these stocks are both considered within safe biological limits.

The herring stock in the North Sea collapsed in the mid-1970s due to heavy exploitation, but has recovered after a closure of the fisheries between 1977 and 1981. In the mid-1990s it declined again. In 1996, effective management measures have been implemented to reduce the catches in both the human consumption and industrial fishery. These measures resulted in a considerable reduction in the fishing mortality in 1996-2000. The stock has been outside safe biological limits for a number of years, but is recovering. The spawning stock is expected to be close to safe biological limits in 2002. The herring stock is exploited in the North Sea and the Channel (Downs herring) by human consumption fisheries. Also by-catches of juvenile North Sea herring are taken in the industrial fishery for sprat in the North Sea and Division IIIa (Skagerrak). The sprat stock fluctuates considerably between years. The actual state of the sprat stock is not precisely known, but the biomass is thought to be high presently. The North Sea component of the mackerel stock collapsed in the early 1970s and shows no signs of recovery. Most of the mackerel catches taken in the northern North Sea in recent years originate from the western component.

Landings of **cod** in 1999 were 59 000 t. The spawning stock in 2001 has been estimated at 55 000 t, which is close to its historical observed level. Recruitment has been below average since 1985 in all years, with the exception of the 1996 year class. The present assessment indicates a constant high fishing mortality in recent years. A recovery plan is required to rebuild to the stock.

The spawning stock of **saithe** (assessed for the North Sea and West of Scotland combined) is at a low level compared to the 1970s when it was more lightly exploited and recruitment was higher. In recent years it has increased slightly. Landings in 2000 in the North Sea were 87 000 t. Fishing mortality has as almost continuously declined from the 1980s. The proportion of the stock available in area VI has been reduced from the 1980s.

Human consumption landings of **haddock** in 1999 were 47 000 t. Historically, the stock size has shown large variation due to the occasional occurrence of a very strong year class. The spawning stock size in 2001 has increased due to a large 1999 year class. Fishing mortality remains too high.

The assessment of **whiting** has a much lower precision than the assessment of many other stocks. Total landings have been gradually decreasing since 1976 and the landings in 2000, at 28 000 t, are the lowest observed in the time series. There are indications that the stock has increased in recent years but that it is likely still outside safe biological limits.

The spawning stock of **plaice** decreased in the early 1990s and in 1997 was at the lowest observed historically. Landings have decreased since 1990 and were 83 000 t in 2000. Fishing mortality has decreased but remains too high. At its present exploitation rate there is a high probability that the stock will remain below the levels observed in the 1970s and 1980s. An abundant 1996 year class was expected to increase the spawning stock but a slower growth of this year class and increased discarding has reduced the its contribution to the spawning stock.

Landings of **sole** were 23 000 t in 2000. The spawning stock is decreasing. The spawning stock in recent years mainly consisted of a large 1996 year class which has now mostly passed the fishery. Fishing mortality has reduced in recent years but is still too high.

Landings of **Norway pout** have increased in 2000 to 185 000 t. The spawning stock in 2001 was amongst the highest in the time series, due to the large 1999 year class. The 2000 year class, however, was poor and the stock is expected to decline fast. Fishing mortality has generally decreased between 1974-1995 and has fluctuated around a low level since.

Landings of **sandeel** in 2000 were 700 000 t which is close to the average yield over the period 1976-2000. Over the years, the spawning stock has been fluctuating without a trend. The spawning stock in 2001 was also around the long term average. There is insufficient information to forecast the development of the stock in the short term.

The **herring** has recently recovered from a low but is still considered to be outside safe biological limits. The stock is expected to increase in the short term by a large 1998 year class which matures in 2002. Catches in the human consumption and industrial fisheries in the North Sea remained stable in the last three years and were 330 000 t in 2000. Landings of **sprat** in 2000 were 196 000 t. The state of the sprat stock is not precisely known.

The spawning stock of **mackerel** in the North Sea remains small. Recruitment to this stock component has been very low for many years. An egg survey in 1999 estimated a spawning stock size of 68 000 t. The fisheries for mackerel in the North Sea rely on a much larger stock component, the western mackerel, which spawns outside the North Sea and which is present in the northern North Sea in the second half of the year.

The present state of the North Sea **horse mackerel** stock is not known. The last estimate from egg surveys in 1989–1991 indicates an SSB of about 240 000 t. The age composition of the relative small catches suggests that the exploitation rate of juvenile fish may have increased in recent years.

The stock of ***Pandalus borealis*** in Division IVa (Norwegian Deep) and Division IIIa remains stable. The state of the stocks in Division IVa (Fladen Ground) and Division IVb (Farn Deep) is not known, as only insufficient data for assessments were available. The fishery in the latter two areas is opportunistic, strongly influenced by stock abundance and market prices.

Management advice

Reductions in fishing mortalities have been advised for several stocks which are outside safe biological levels. Fishing mortality is generally high and reached for most stocks the highest historical values in recent decades. This is in itself a clear indication of excessive effort.

This, and the poor performance of TACs, as implemented, in reducing fishing mortality, leads ICES to reiterate that the required reductions in fishing mortality can only be achieved if reductions in effort are included in management.

Most fisheries on roundfish and flatfish in the North Sea are characterised by extensive discarding. Discarding and high-grading also take place in pelagic fisheries, but little and incomplete information on discarding practices in these fisheries is available. Management measures, which reduce the amount of juveniles caught, would contribute to the recovery of spawning stocks and benefit yields.

Specific advice is presented in the respective stock sections.

Information provided by fishing industry associations

In August 2001, the preliminary results of a number of assessments of stocks in the North Sea (cod, haddock, whiting, saithe, plaice and sole) were presented at a meeting held at ICES HQ of the North Sea Commission Fisheries Partnership. At this meeting ICES invited representatives from a number of fishing organisations around the North Sea, to provide written comments on the assessment presented and in particular to inform on the degree to which fishermen agree or disagree with the perception of the stock as indicated by the assessments. ICES received comments from the National Federation of Fishermen's Organisation and the Scottish Fishermen Federation in the UK, the Dutch fishermen's representatives and the Danish fishing industry. The comments were based on enquiry surveys among fishermen. They were in different format and it was not clear how representative they are. ICES welcomes the response and realizes that further discussion is needed to improve the quality of the enquiry and uniformity of the format in order to be able to make better use of the information.

Summary of Comments from the Fishing Industry

<u>Danish Fishermen's Association</u>: Comments were based on interviews with fishermen from the major

fishing harbours in the North Sea. The information was given as a first-hand impression of the abundance of cod, haddock, saithe, whiting, plaice and sole, based on recent developments in catches and landings to a number of fish auctions. DFF offered explanations of some of the reported trends and in particular noted that the Danish information would not be appropriate for an analysis of the state of the whiting stock. A table of the total landings in the period Jan. to Sep. in 2000 and 2001 to four of the major auctions in the North Sea and Skagerrak area was included. DFF pointed out that time constraints had prevented them from making a more thorough analysis of the catch data.

National Federation of Fishermen's Organisations (UK): The NFFO summarised the views of fishermen on the same six species covered by DFF. Similarly, NFFO felt that they would have been able to provide more systematic data if more time had been available. It was also commented that catch trends and CPUE data have been distorted by the restricting TAC allocations.

Scottish Fishermen's Federation: The SFO paper was based on the responses to a questionnaire seeking fishermen's views on abundance, size, size range, and geographical distribution of cod, haddock, whiting and saithe in ICES fishing areas IV and VI during the period January to August 2001 compared to 2000. Respondents were asked to indicate their answers on a scale of 1 to 5. "1" indicated respectively "much less", "much smaller", "mostly small", and "local clusters". "5" indicated respectively "much more", "much larger", "mostly large", and "widespread". The responses were summarised as a series of histograms (bar charts), and comprised the views of 84 fishermen (56 from North Sea ports, 28 from the West of Scotland). This represented 10% of the white fish fleet.

Dutch Fish Producers Board: The Dutch paper was in the form of a large spreadsheet, summarising the opinions (agree/disagree, with reasons), of 19 fishermen on the scientists preliminary views concerning (i) status of the plaice stock, (ii) discard rates in plaice fisheries, (iii) status of the sole stock, (iv) discard rates in the sole fisheries, (v) reduced biomass of the sole spawning stock, (vi) status of the whiting stock, (vii) discard rates in the whiting fisheries, (viii) existence of two whiting stocks (north and south of the Dogger Bank), (ix) status of the cod stock, (x) cod recovery measures, (xi) other comments. The regular fishing area used by the 19 fishermen was also indicated on the spreadsheet.

All four working papers stated an appreciation of the opportunity to make an input.

ACFM response

It is the policy of ICES to encourage and facilitate this sort of dialogue between scientists and the fishing industry. The documentation at this ACFM meeting is a very encouraging start to that process.

Just as the fishermen's organisations had found, however, ACFM likewise had insufficient time to fully evaluate the documents. Taking into account also that the information provided was mainly of a qualitative nature, ACFM could form only a preliminary view.

The enquiry indicates in some diversity of opinions. Impressions of stocks vary between individual fishermen but also between countries and areas.

The information on the status of fish stocks from the fishermen deals with abundance (in weight?) and with the size distribution in the catches. Comparisons are short term 1-3 years. There is only rarely a reference to the fishing mortality or a proxy thereof. The ICES assessment information is expressed differently, the SSB is often compared to $\mathbf{B}_{pa}$ or $\mathbf{B}_{lim}$ while the short-term trend is mostly not referred to. In order to compare the information these short-term trends have been inferred based on the graphs of SSB presented in the advisory report.

There is general agreement on the poor state of the **cod** stock, but the stock was considered in a better condition in the Northern North Sea than further south.

There is also general agreement that the stock of **haddock** has increased considerable over a large area and that fish size has decreased.

On **whiting**, responses were divided. Most responses indicate a higher stock size than indicated in recent assessments and point to the mismatch between TAC and catch opportunities. Considerable amounts of marketable size whiting were reported as discarded for legal reasons but also low market prices and low weight at length (poor condition) were mentioned as a reason for discarding.

Most responses on **saithe** indicate a larger stock than indicated in recent (unrealistic) assessments. The saithe is also said to be smaller and present in a wide area.

There was agreement that **plaice** catches in 2001 were better than in 2000, which was again better than 1999. A reduction in the condition of plaice was mentioned several times. Also small plaice seems to be more abundant in areas where they previously have been scarce. It was confirmed that discarding had increased but not in all areas.

There were only few responses on the **sole**. In general they report a decrease of larger fish, but a recent increase of small sole in coastal areas.

Final Comments

The material provided by the industry will be sent to the relevant ICES assessment Working Groups for their consideration in the 2002 round of meetings.

At present, the nature of the data provided means that they cannot be handled in a quantitative way, but the collection and reporting of quantitative data is a goal that both sides should work towards achieving. ACFM therefore welcomes the suggestion from the North Sea Commission Fisheries Partnership that appropriate methods of collecting and reporting data could be developed through the Partnership.

Table 3.5.1.1 Species composition in the Danish and Norwegian small meshed fisheries in the North Sea ('000t). (Data provided by Working Group members).

Year	Sandeel	Sprat	Herring	Norway pout	Blue whiting	Haddock	Whiting	Saithe	Other	Total
1974	525	314	-	736	62	48	130	42		1857
1975	428	641	-	560	42	41	86	38		1836
1976	488	622	12	435	36	48	150	67		1858
1977	786	304	10	390	38	35	106	6		1675
1978	787	378	8	270	100	11	55	3		1612
1979	578	380	15	320	64	16	59	2		1434
1980	729	323	7	471	76	22	46	-		1674
1981	569	209	84	236	62	17	67	1		1245
1982	611	153	153	360	118	19	33	5	24	1476
1983	537	88	155	423	118	13	24	1	42	1401
1984	669	77	35	355	79	10	19	6	48	1298
1985	622	50	63	197	73	6	15	8	66	1100
1986	848	16	40	174	37	3	18	1	33	1170
1987	825	33	47	147	30	4	16	4	73	1179
1988	893	87	179	102	28	4	49	1	45	1388
1989	1039	63	146	162	28	2	36	1	59	1536
1990	591	71	115	140	22	3	50	8	40	1040
1991	843	110	131	155	28	5	38	1	38	1349
1992	854	214	128	252	45	11	27	-	30	1561
1993	578	153	102	174	17	11	20	1	27	1083
1994	769	281	40	172	11	5	10	-	19	1307
1995	911	278	66	181	64	8	27	1	15	1551
1996	761	81	39	122	93	5	5	0	13	1119
1997	1091	99	15	126	46	7	7	3	21	1416
1998	956	131	16	72	72	5	3	3	24	1283
1999	678	166	23	97	89	4	5	2	40	1103
2000	655	191	24	176	98	8	8	6	21	1187
Mean 1974-2000	727	204	66	259	58	14	41	9	36	1398

Continued……

Table 3.5.1.1 **(Continued)**

Year-quarter	Sandeel	Sprat	Herring	Norway pout	Blue whiting	Haddock	Whiting	Saithe	Other	Total
1996 q1	3	34	5	21	4	0	1	0	0	68
1996 q2	479	3	1	7	28	1	1	0	1	521
1996 q3	256	7	11	54	30	2	1	0	1	362
1996 q4	22	37	22	41	31	1	1	0	1	156
1997 q1	37	7	1	11	4	0	1	0	2	65
1997 q2	802	1	2	7	11	3	2	0	4	833
1997 q3	238	28	5	59	16	3	2	2	11	363
1997 q4	13	63	7	49	14	1	1	0	5	155
1998 q1	37	7	7	13	11	1	0	0	5	80
1998 q2	754	1	2	8	12	2	1	0	4	784
1998 q3	153	60	4	29	38	2	1	2	9	298
1998 q4	12	63	4	23	12	0	0	0	6	121
1999 q1	14	14	4	8	23	1	1	1	8	74
1999 q2	507	2	4	22	30	1	2	1	8	577
1999 q3	139	129	10	41	18	1	2	0	7	347
1999 q4	17	21	6	25	17	1	1	0	18	106
2000 q1	10	42	1	9	13	1	0	0	5	82
2000 q2	581	2	4	17	32	3	2	0	4	646
2000 q3	63	133	10	30	39	2	3	6	5	291
2000 q4	0	15	8	119	14	2	3	0	8	169

Table 3.5.1.2 Landings of demersal, pelagic and industrial species from the North Sea. For some species Divisions IIIa, IVa and/or VIId have been included.

	Cod	Haddock	Haddock	Whiting	Whiting	Saithe	Saithe	Sole	Plaice	N pout	Sandeel	Sprat	Herring	Mackerel	Horse Mack.	Demersal	Pelagic	Industrial	Total
		hc	ib	hc	ib	hc	ib			i	i	i	p	p	p	Total	Total	Total	
Area	3a,4,7d	4	4	4,7d	4,7d	3a,4	3a,4	4	4	3a,4	4	4	3a,4,7d	3a,4	4				
1970	226	525	180	83	115	163	59	20	130	238	191	51	563	323	12	1147	898	834	2879
1971	328	235	32	61	72	218	35	24	114	305	382	95	520	243	32	980	795	921	2696
1972	354	193	30	64	61	218	28	21	123	445	359	92	498	189	8	973	695	1015	2683
1973	239	179	11	71	90	195	31	19	130	346	297	228	484	327	42	833	853	1003	2689
1974	214	150	48	81	130	231	42	18	113	736	524	314	275	298	31	807	604	1794	3205
1975	205	147	41	84	86	240	38	21	108	560	428	641	313	263	10	805	586	1794	3185
1976	234	166	48	83	150	253	67	17	114	435	488	622	175	304	9	867	488	1810	3165
1977	209	137	35	78	106	190	6	18	119	390	786	304	46	258	1	751	305	1627	2683
1978	297	86	11	97	55	132	3	20	114	270	787	398	11	149	5	746	165	1524	2435
1979	270	83	16	107	59	113	2	23	145	329	578	380	25	152	1	741	178	1364	2283
1980	294	99	22	101	46	120	0	16	140	483	729	323	71	87	2	770	160	1603	2533
1981	335	130	17	90	67	121	1	15	140	239	569	209	175	64	7	831	246	1102	2179
1982	303	166	19	81	33	161	5	22	155	396	612	153	275	35	3	888	313	1218	2419
1983	259	159	13	88	24	167	1	25	144	452	537	88	387	41	4	842	432	1115	2389
1984	228	128	10	86	19	192	6	27	156	393	669	77	429	39	25	817	493	1174	2484
1985	213	159	6	62	15	192	8	24	160	206	623	50	614	47	24	810	685	908	2403
1986	196	166	3	64	18	163	1	18	165	178	848	16	671	236	21	772	928	1064	2764
1987	210	108	4	68	16	145	4	17	154	149	825	32	792	291	21	702	1104	1030	2836
1988	176	105	4	56	49	106	1	22	154	110	893	87	888	309	62	619	1259	1144	3022
1989	140	76	2	45	43	92	2	22	170	172	1039	63	788	279	112	545	1179	1321	3045
1990	125	52	3	47	51	88	2	35	156	152	591	73	645	301	145	503	1091	872	2466
1991	102	45	5	53	38	98	1	34	148	193	843	112	658	359	78	480	1095	1192	2767
1992	114	70	11	52	27	92	0	29	125	300	855	124	717	364	114	482	1195	1317	2994
1993	122	80	11	53	20	105	1	31	117	184	579	200	671	388	140	508	1199	995	2702
1994	111	81	4	49	10	102	0	33	110	183	766	320	568	475	113	486	1156	1283	2925
1995	136	75	8	46	27	113	0	30	98	241	918	357	639	323	98	498	1060	1551	3109
1996	126	76	5	41	5	110	0	23	82	166	777	137	306	211	26	458	543	1090	2091
1997	124	79	7	36	6	103	0	15	83	169	1140	103	273	225	79	440	577	1425	2442
1998	146	77	5	28	3	100	0	21	72	80	1004	164	380	265	31	444	676	1256	2376
1999	96	64	4	30	5	107	0	23	81	93	735	188	372	300	65	401	737	1025	2163
2000	59	47	8	28	8	87	0	23	83	185	699	196	372	272	32	327	676	1096	2099

hc = human consumption, ib = industrial by-catch, i = industrial, p = pelagic

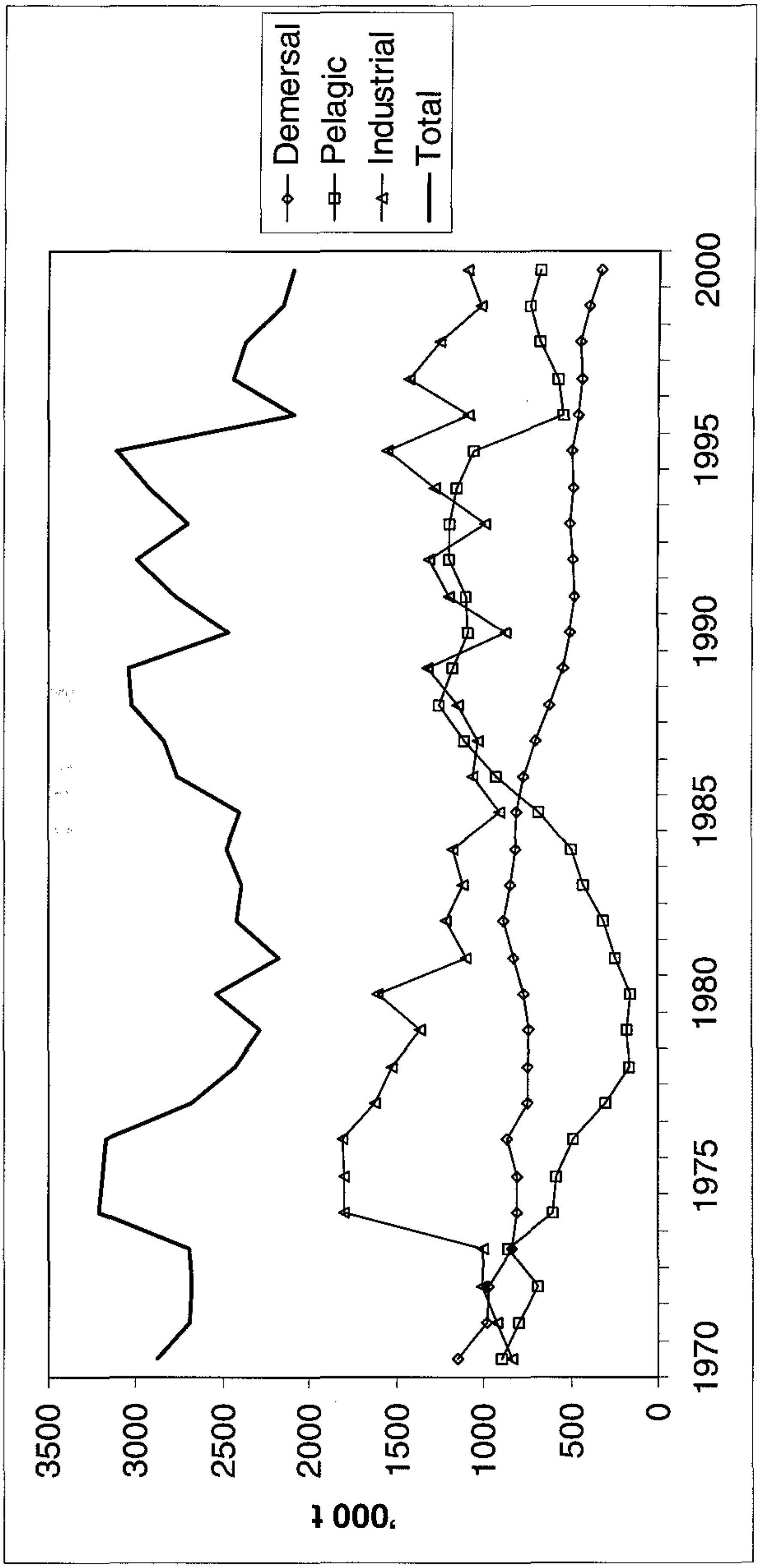


Figure 3.5.1.1 Landings from North Sea. Data from Table 3.5.1.2.

3.5.2 Cod in Sub-area IV (North Sea), Division VIId (Eastern Channel) and Division IIIa (Skagerrak)

State of stock/exploitation: The stock is outside safe biological limits. The spawning stock is estimated to have been below $\mathbf{B_{pa}}$ since 1984 and in the region of $\mathbf{B_{lim}}$ since 1990. SSB in 2001 is estimated at a new historic low and remains in a region where the risk of stock collapse is high. Fishing mortality has remained at about the historic high and above $\mathbf{F_{pa}}$ since the early 1980s and F in 2000 is estimated to be about $\mathbf{F_{lim}}$. Except for the 1996 year class, recruitment has been below average in all years since 1987. The 1997 and 2000 year classes are estimated to be the poorest on record.

Management objectives: In 1999 the EU and Norway have *"agreed to implement a long-term management plan for the cod stock, which is consistent with the precautionary approach and is intended to constrain harvesting within safe biological limits and designed to provide for sustainable fisheries and greater potential yield. The plan shall consist of the following elements:*

1. *Every effort shall be made to maintain a minimum level of SSB greater than 70 000 t ($\mathbf{B_{lim}}$).*

2. *For 2000 and subsequent years the Parties agreed to restrict their fishing on the basis of a TAC consistent with a fishing mortality rate of 0.65 for appropriate age groups as defined by ICES.*

3. *Should the SSB fall below a reference point of 150 000 t ($\mathbf{B_{pa}}$), the fishing mortality referred to under paragraph 2 shall be adapted in the light of scientific estimates of the conditions then prevailing. Such adaptation shall ensure a safe and rapid recovery of SSB to a level in excess of 150 000 t.*

4. *In order to reduce discarding and to enhance the spawning biomass of cod, the Parties agreed that the exploitation pattern shall, while recalling that other demersal species are harvested in these fisheries, be improved in the light of new scientific advice from, inter alia, ICES.*

5. *The Parties shall, as appropriate, review and revise these management measures and strategies on the basis of any new advice provided by ICES."*

ICES considers that the agreed Precautionary Approach reference points in the management plan are consistent with the precautionary approach, provided they are used as upper bounds on F and lower bounds on SSB, and not as targets.

Precautionary Approach reference points (unchanged since 1999):

ICES considers that:	ICES proposes that:
$\mathbf{B_{lim}}$ is 70 000 t, the lowest observed spawning stock biomass.	$\mathbf{B_{pa}}$ be set at 150 000 t. This is the previously agreed MBAL and affords a high probability of maintaining SSB above $\mathbf{B_{lim}}$, taking into account the uncertainty of assessments. Below this value the probability of below average recruitment increases.
$\mathbf{F_{lim}}$ is 0.86, the fishing mortality estimated to lead to potential stock collapse.	$\mathbf{F_{pa}}$ be set at 0.65. This F is considered to have a 95% probability of avoiding $\mathbf{F_{lim}}$, taking into account the uncertainty of assessments.

Technical basis:

$\mathbf{B_{lim}}$ = Rounded $\mathbf{B_{loss}}$ = 70 000 t.	$\mathbf{B_{pa}}$ = Previous MBAL and signs of impaired recruitment below: 150 000 t
$\mathbf{F_{lim}} = \mathbf{F_{loss}}$ = 0.86	$\mathbf{F_{pa}}$ = Approx. 5th percentile of $\mathbf{F_{loss}}$; implies an equilibrium biomass >$\mathbf{B_{pa}}$ and a less than 10% probability that (SSBMT<$\mathbf{B_{pa}}$)

Advice on management: ICES recommends a recovery plan that will ensure a safe and rapid recovery of SSB to a level in excess of 150 000 t. If a recovery plan is not implemented ICES recommends that fishing mortality on cod should be reduced to the lowest possible level in 2002. ICES has repeatedly stated that for various reasons, TACs alone are not effective in regulating fishing mortality.

Rebuilding plan: Rebuilding of the cod stock can be obtained by reducing the fishing mortality, by improving the exploitation pattern or by a combination of the two in a way that implies a trade-off between reductions in fishing effort and increases in effective mesh size. The results of simulations that include recent data on discards of cod are available (Anon 2001) and these have shown, for example, that a reduction of effort by 30% or an increase in mesh size of around 30 mm would yield the same results on the spawning biomass per recruit. (NB. These forecasts use data on both landed and discarded cod. ICES is unable to include discard data in its historical reconstruction of the cod stock size due to the lack of a sufficiently long and representative time-series of cod discard data).

Norway and the EU have agreed on a number of gears and mesh size changes.

ICES has not been able to quantify the likely impact of the agreed changes but they will not be sufficient to reduce exploitation to the level needed to rebuild the cod stock and additional reduction in mortality is needed."

A fishing mortality of zero in 2002 is not expected to rebuild SSB to $\mathbf{B}_{pa}$ by 2003, but fishing mortality of less than 0.25 in 2002 and 2003 are expected to rebuild it by 2004 (see text table below). The table also shows the options for rebuilding SSB by 2004, 2005 and 2006.

F(sq) = F(98–00) scaled to		Options for fishing mortality in 2002-2005		
F(00)=0.83		0.3 * $\mathbf{F}_{sq}$ =0.25	0.46 * $\mathbf{F}_{sq}$ =0.38	0.56 * $\mathbf{F}_{sq}$ =0.46
SSB in	2002	55.4	55.4	55.4
'000t	2003	100	88	81
	2004	**150**	117	101
	2005	208	**150**	123
	2006	276	186	**150**

Setting the TAC at low level may reduce fishing mortality, but past experience has shown that it is very difficult to control fishing mortality by TACs alone. ICES therefore recommends that in addition to setting the TAC at the lowest possible level, restrictions in effort of fleets exploiting cod should be implemented.

Large closed areas and seasons may contribute to stock recovery, but only if accompanied by major reductions in effort.

At recent exploitation rates, year classes suffer substantial fishing mortality before they mature and spawn. Given the low SSB and the expected poor recruitment, the action needed to rebuild the stock has to be severe in order to have any impact in the short term. Rebuilding of the stock could be accelerated if in the coming years average or above average year classes were generated and appropriate measures were already in place to allow a larger part of these year classes to recruit to the spawning stock.

Relevant factors to be considered in management: The stock is below $\mathbf{B}_{lim}$. Strong and efficient measures are needed to ensure a rapid rebuilding of the spawning stock biomass to at least $\mathbf{B}_{pa}$. Results of medium-term simulations indicate that a reduction in fishing mortality to around 0.25 is needed to ensure a high probability of rebuilding the stock to the agreed $\mathbf{B}_{pa}$.

Substantial under-reporting of cod landings occurred in 1998. There are no reasons to suspect substantial under-reporting in 1999 or 2000 because the 1999 and 2000 TACs were not restrictive. However, the TAC in 2001 is restrictive and there are indications that under-reporting is likely to occur.

The spawning stock in 2001 has remained in a situation where the probability of low recruitment is high and the potential for a recovery has been reduced. The relatively strong 1996 year class has been heavily exploited as juveniles and will not contribute significantly to the spawning stock beyond 2001.

The emergency measures agreed for 2001 and the agreed technical measures for 2002 and beyond should be further developed as soon as possible. The effect of the emergency closure implemented in 2001 has not been evaluated, but the closure is likely to have contributed little to the recovery of the stock. Increases in minimum codend mesh sizes and other gear modifications to be introduced on the 1 January 2002 are unlikely to result in any immediately detectable benefits to the spawning stock, but may result in an improvement in the exploitation pattern and a reduction in the proportion of the catch of 1-year old cod discarded, if implemented effectively.

Continued fishing at current rates is expected to lead to stock collapse (Figure 3.5.2.1). Fishing at $\mathbf{F}_{pa}$ the stock is expected to remain below $\mathbf{B}_{pa}$ after 2002 when the poorest year class (1997) observed so far will mature.

In recent years the growth rate of North Sea cod has declined. The reasons for this are not known, but if growth remains slow, the rate of recovery of SSB will be delayed. Lower growth may also expose juveniles longer to discarding.

The TAC for the portion of the stock in Division VIId incorporates information from the assessment of the stock in Division VIIb-k, and managers should take this advice into account when setting the quota for Division VII.

Comparison with previous assessment and advice: Fishing mortality has consistently been under-estimated and stock size over-estimated in assessments prior to 2000. In addition, weights-at-age in 2000 for age groups 4-6 have been lower than previously assumed.

Compared to previous assessments, the historical consistency of the present assessment appears to have improved. It is thought that this is caused by the exclusion of the commercial CPUE data from the assessment.

Catch forecast for 2002:

Basis: F(sq) = F(98–00) scaled to F(00) = 0.83; Landings (2001) = 80.7; SSB(2002) = 55.4.

F(2001)	Basis	Landings in combined area (2002)	Lndgs in IIIa (2002) Skagerrak	Lndgs in IV (2002)	Lndgs in VIId (2002)	SSB (2003)
0	0*F00	0	0	0	0	126.6
0.08	0.1*F00	10.3	1.3	8.8	0.3	116.7
0.17	0.2*F00	19.8	2.4	16.8	0.5	107.5
0.25	0.3*F00	28.6	3.5	24.3	0.8	99.1
0.33	0.4*F00	36.8	4.5	31.3	1.0	91.4
0.42	0.5*F00	44.4	5.4	37.8	1.2	84.3
0.50	0.6*F00	51.4	6.3	43.7	1.4	77.8
0.58	0.7*F00	57.9	7.1	49.3	1.6	71.9
0.65	0.78*F00 = F_{pa}	62.8	7.7	53.4	1.7	67.5
0.67	0.8*F00	64.0	7.8	54.5	1.7	66.4
0.75	0.9*F00	69.6	8.5	59.2	1.9	61.4
0.83	1.0*F00	74.8	9.1	63.7	2.0	56.8
0.92	1.1*F00	79.7	9.7	67.8	2.2	52.5

Weights in '000 t.

Shaded scenarios considered inconsistent with the precautionary approach.

Landings by Division or Sub-area are obtained by pro-rating the combind area catch by 0.122 for IIIa, 0.851 for IV and 0.027 for VIId. These factors are the ratio of the mean catches by area to the combined area for the period 1992–1996.

Medium- and long-term projections: The current high fishing mortality ($F_{2\text{-}8}$=0.83) implies a 90% probability that $\mathbf{B}_{pa}$ will not be reached by 2010. A reduction in the fishing mortality to $\mathbf{F}_{pa}$ (0.65) results in a 35% probability that the SSB will not have reached the $\mathbf{B}_{pa}$ of 150 000 t by 2010 (Figure 3.5.2.2).

Elaboration and special comment: Using information from the stock-recruit relationship it is possible to construct the expected equilibrium spawning stock biomass for a range of fishing mortality rates (Figure 3.5.2.1). As F increases the expected equilibrium declines. Also shown on the graph are the observed values of SSB over time (thin line with years indicated). Where a particular year lies above the solid line, the stock would be expected to decline. Where a point lies below the line, the stock would be expected to increase. Consistent with the analysis, it can be seen that as fishing mortality has increased, the SSB has declined. The diagram shows that the expected equilibrium at the estimated 1999 F is effectively zero, i.e. that the stock will collapse.

It was apparent that commercial CPUE data used in calibrating previous assessments had a strong tendency to give a much more optimistic estimate of the state of the stock than research vessel survey data. There are a number of reasons for believing that the commercial CPUE data may be biased. For example, there have been substantial changes in the distribution of commercial fleet effort and the nature of vessels in the fleet, which may affect abundance indices derived from these sources. In addition, commercial fleets may target areas of high cod abundance leading to artificially higher abundance estimates. It should be noted that differing signals between commercial CPUE data and survey data affected assessments of some Canadian cod stocks resulting in an over-optimistic decision on the management of these stocks before they collapsed. In view of these problems, the assessment of North Sea cod this year did not use commercial CPUE data from any commercial fleets.

A number of analyses were performed using a variety of different assessment models. All these approaches gave very similar results. While no method is without uncertainty, the fact that a variety of methods give comparable results increases confidence in the current assessment.

Cod are taken by towed gears in mixed roundfish fisheries, which include haddock and whiting. They are also taken in directed fisheries using fixed gears. By-catches of cod occur in flatfish and shrimp fisheries especially in the Southern North Sea and in *Nephrops* fisheries.

The assessment is based on analysis of catch at age data calibrated with data from three research vessel surveys.

Source of information: Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, June 2001, Hamburg, Germany (ICES CM 2002/ACFM: 01).

References: Anon (2001). Report of the scientific meeting on improvement of selectivity of fishing gears. Brussels, 5-9 March 2001.

Yield and spawning biomass per Recruit F-reference points:

	Fish Mort Ages 2-8	Yield/R	SSB/R
Average Current	0.832	0.524	0.381
$\mathbf{F}_{max}$	0.230	0.718	2.838
$\mathbf{F}_{0.1}$	0.140	0.675	4.560
$\mathbf{F}_{med}$	0.807	0.530	0.405

Landings for each of the three parts of this combined assessment area and for the combined area are given in Tables 3.5.2.1-2.

North Sea (Sub-area IV)

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC	Official landings	ACFM landings
1987	SSB recovery; TAC	100–125	175	167	182
1988	70% of F(86); TAC	148	160	142	157
1989	Halt SSB decline; protect juveniles; TAC	124	124	110	116
1990	80% of F (88); TAC	113	105	99	105
1991	70% of effort (89)		100	87	89
1992	70% of effort (89)		100	98	97
1993	70% of effort (89)		101	94	105
1994	Significant effort reduction		102	87	95
1995	Significant effort reduction		120	112	120
1996	80% of F(94) = 0.7	141	130	104	107
1997	80% of F(95) = 0.65	135	115	100	102
1998	F(98) should not exceed F(96)	153	140	114	122
1999	F = 0.60 to rebuild SSB	125	132	80	78
2000	F less than 0.55	<79	81	62	59
2001	lowest possible catch	0	48.6		
2002	lowest possible catch	0			

Skagerrak (Division IIIa)

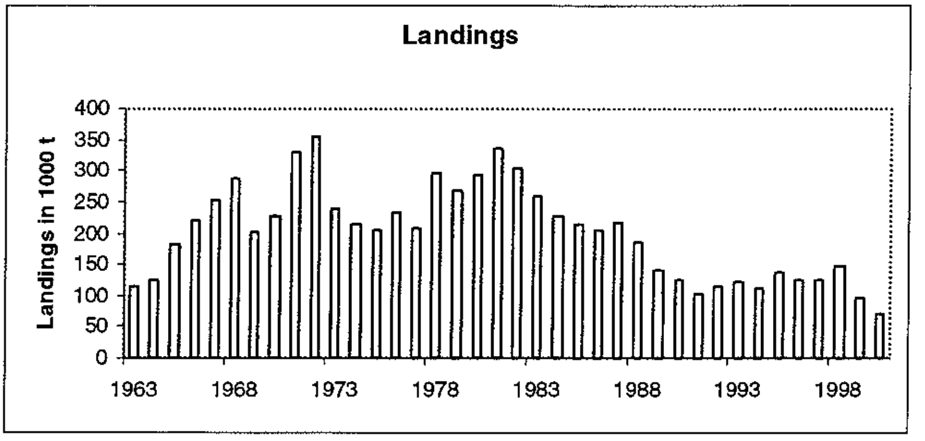
Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC[1]	ACFM Landings[1]
1987	$F = \mathbf{F}_{max}$	<21	22.5	20.9
1988	Reduce F		21.5	16.9
1989	F at $\mathbf{F}_{med}$	<23	20.5	19.6
1990	F at $\mathbf{F}_{med}$; TAC	21.0	21.0	18.6
1991	TAC	15.0	15.0	12.4
1992	70% of F(90)		15.0	14.8
1993	Precautionary TAC		15.0	15.3
1994	No long-term gain in increased F + precautionary TAC		15.5	13.9
1995	If required precautionary TAC; link to North Sea		20.0	12.1
1996	If required precautionary TAC; link to North Sea		23.0	16.4
1997	If required precautionary TAC; link to North Sea		16.1	14.9
1998	If required precautionary TAC; link to North Sea	21.9	20.0	15.3
1999	F = 0.60 to rebuild SSB	17.9	19.0	11.0
2000	F less than 0.55	<11.3	11.6	9.3
2001	lowest possible catch	0	7.0	
2002	lowest possible catch	0		

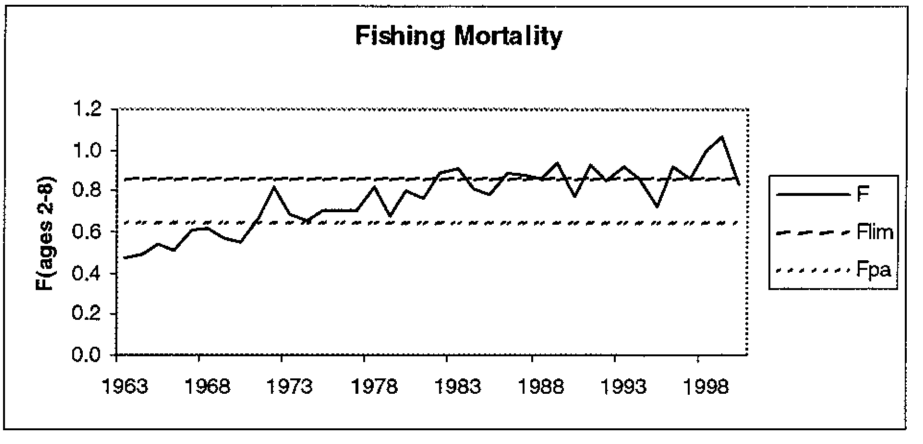
[1] Norwegian fjords not included. Weights in '000 t.

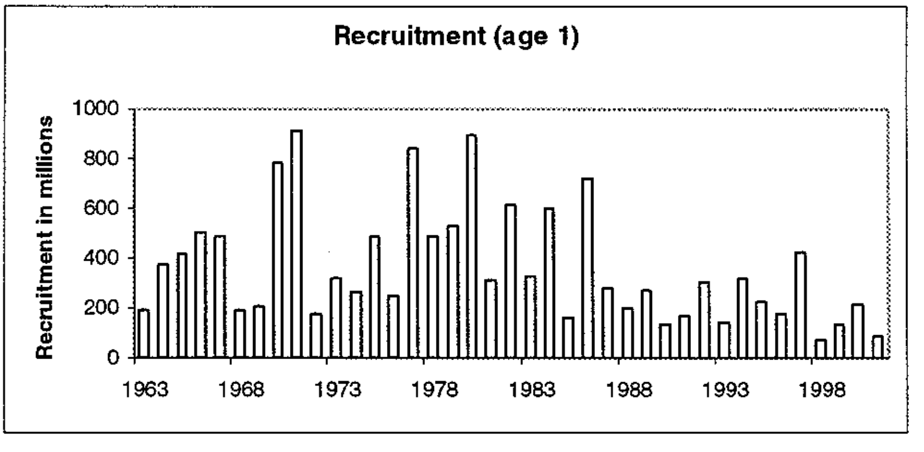
Eastern Channel (Division VIId)

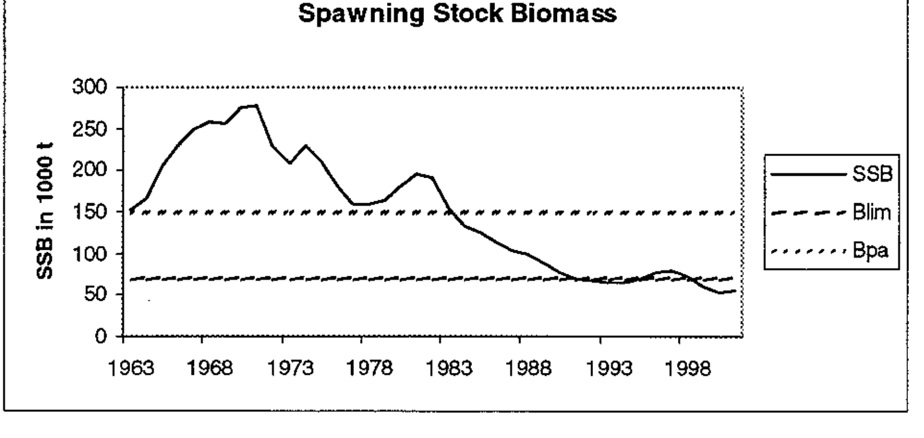
Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC[1]	Official landings	ACFM landings
1987	Not assessed	-	-	9.4	14.2
1988	Precautionary TAC	-	-	10.1	10.7
1989	No increase in F; TAC	10.0[2]	-	n/a	5.5
1990	No increase in F; TAC	9.0[2]	-	n/a	2.8
1991	Precautionary TAC	3.0[2]	-	n/a	1.9
1992	If required, precautionary TAC	5.5[2]	-	2.7	2.7
1993	If TAC required, consider SSB decline	-	-	2.5	2.4
1994	Reduce F+ precautionary TAC		-	2.9	2.9
1995	Significant effort reduction; link to North Sea		-	4.0	4.0
1996	Reference made to North Sea advice		-	3.5	3.5
1997	No advice		-	7.2	7.0
1998	Link to North Sea	4.9	-	8.7	8.6
1999	F = 0.60 to rebuild SSB	4.0	-	0.6	6.9
2000	F less than 0.55	<2.5	-	1.9	2.3
2001	lowest possible catch	0	-		
2002	lowest possible catch	0			

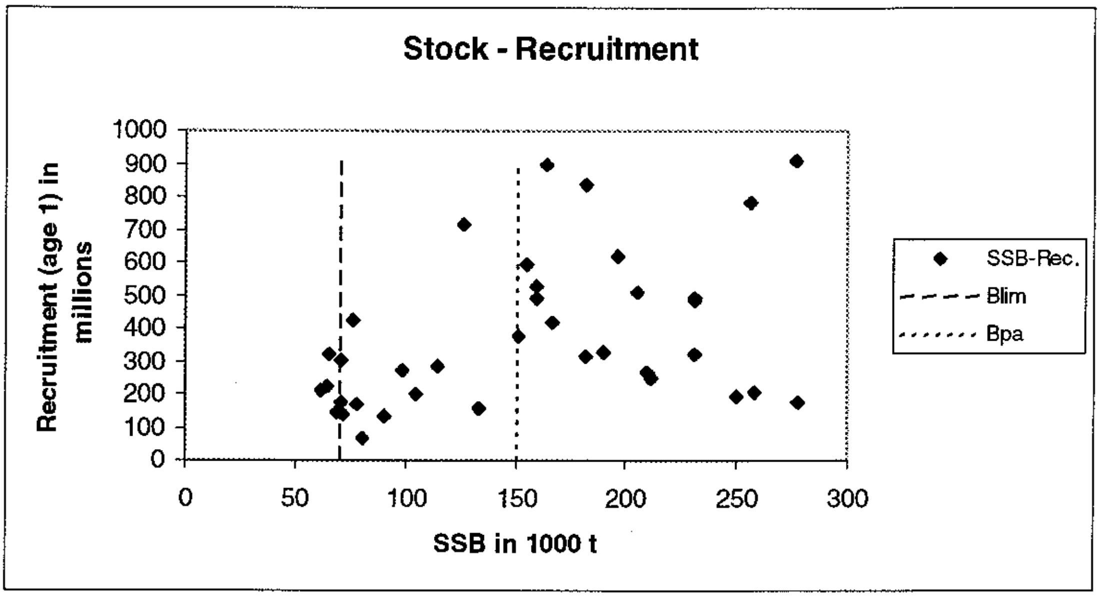
[1] Included in TAC for Sub-area VII (except Division VIIa). [2]Including VIIe. Weights in '000 t.

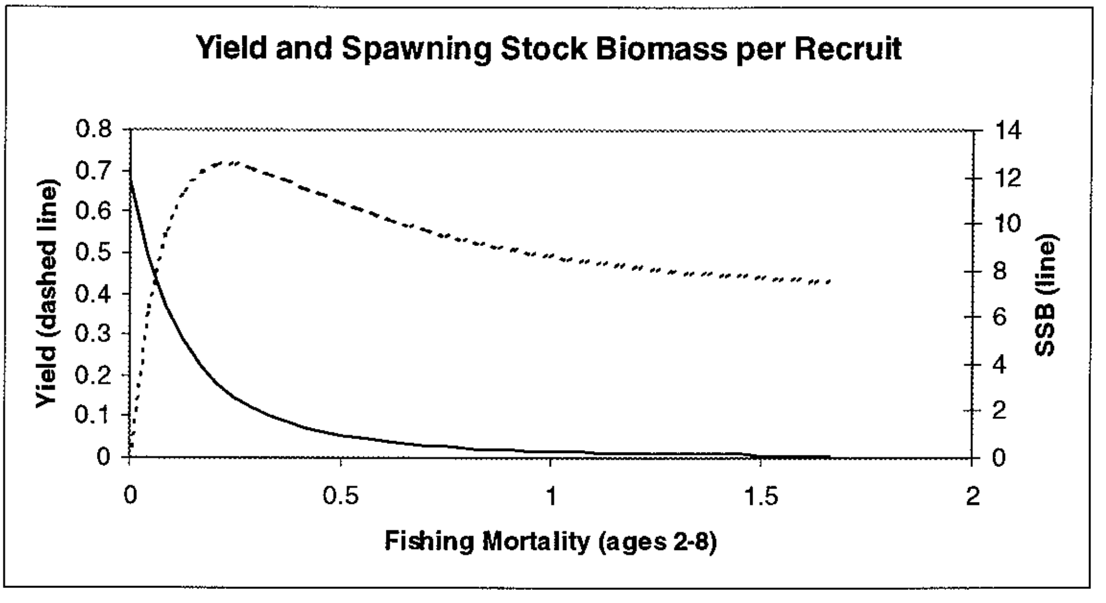

Landings
Landings in 1000 t
400
350
300
250
200
150
100
50
0
1963
1968
1973
1978
1983
1988
1993
1998


Fishing Mortality
F(ages 2-8)
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1963
1968
1973
1978
1983
1988
1993
1998
F
Flim
Fpa


Recruitment (age 1)
Recruitment in millions
1000
800
600
400
200
0
1963
1968
1973
1978
1983
1988
1993
1998


Spawning Stock Biomass
SSB in 1000 t
300
250
200
150
100
50
0
1963
1968
1973
1978
1983
1988
1993
1998
SSB
Blim
Bpa


Stock - Recruitment
Recruitment (age 1) in millions
SSB in 1000 t
SSB-Rec.
Blim
Bpa
0
100
200
300
400
500
600
700
800
900
1000
0
50
100
150
200
250
300


Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
SSB (line)
Fishing Mortality (ages 2-8)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0
2
4
6
8
10
12
14
0
0.5
1
1.5
2

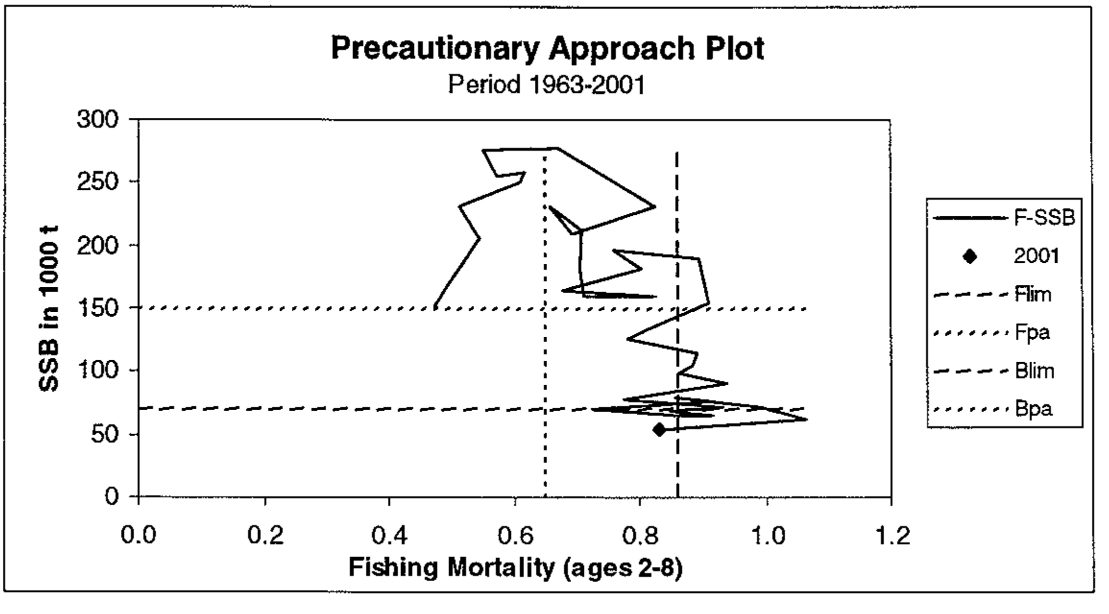

Precautionary Approach Plot
Period 1963-2001
SSB in 1000 t
Fishing Mortality (ages 2-8)
F-SSB
2001
Flim
Fpa
Blim
Bpa
0
50
100
150
200
250
300
0.0
0.2
0.4
0.6
0.8
1.0
1.2

Table 3.5.2.1 Nominal landings (in tonnes) of COD in IIIa (Skagerrak), IV and VIId, as officially reported to ICES and as used by the Working Group.

Sub-area IV

Country	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000**
Belgium	2,934	2,331	3,356	3,374	2,648	4,827	3,458	4,642	5,799	3,882	3,304
Denmark	21,601	18,998	18,479	19,547	19,243	24,067	23,573	21,870	23,002	19,697	14,000
Faroe Islands	96	23	109	46	80	219	44	40	102	96	
France	1,641	975	2,146	1,868	1,868	3,040	1,934	3,451	2,934	1,750	2,348
Germany	11,725	7,278	8,446	6,800	5,974	9,457	8,344	5,179	8,045	3,386	1,740
Netherlands	8,445	6,831	11,133	10,220	6,512	11,199	9,271	11,807	14,676	9,068	5,995
Norway	5,168	6,022	10,476	8,742	7,707	7,111	5,869	5,829	5,749	7,770	6,402
Poland	53	15	-	-	-	-	18	31	25	19	18
Sweden	620	784	823	646	630	709	617	832	540	625	622
UK (E/W/NI)	15,622	14,249	14,462	14,940	13,941	14,991	15,930	13,413	17,745	10,344	
UK (Scotland)	31,120	29,060	28,677	28,197	28,854	35,848	35,349	32,344	35,633	23,017	
United Kindom											27,541
Total Nominal Catch	99,025	86,566	98,107	94,380	87,457	111,468	104,407	99,438	114,250	79,654	61,970
Unallocated landings	5,726	1,967	-758	10,200	7,066	8,555	2,161	2,731	7,853	-1,262	-2,885
WG estimate of total landings	104,751	88,533	97,349	104,580	94,523	120,023	106,568	102,169	122,103	78,392	59,085
Agreed TAC	*105,000*	*100,000*	*100,000*	*101,000*	*102,000*	*120,000*	*130,000*	*115,000*	*140,000*	*132,400*	*81,000*

Division VIId

Country	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000**
Belgium	237	182	187	157	228	377	321	310	239	172	110
Denmark	-	-	1	1	9	-	-	-	-	-	
France	n/a	n/a	2,079	1,771	2,338	3,261	2,808	6,387	7,788		
Netherlands	-	-	2	-	-	-	+	-	19	3	4
UK (E/W/NI)	420	341	443	530	312	336	414	478	618	454	
UK (Scotland)	7	2	22	2	+	+	4	3	1	-	
United Kingdom											336
Total Nominal Catch	n/a	n/a	2,734	2,461	2,887	3,974	3,547	7,178	8,665	629	450
Unallocated landings	-	-	-65	-29	-37	-10	-44	-135	-85	6,229	1,875
WG estimate of total landings	2,763	1,886	2,669	2,432	2,850	3,964	3,503	7,043	8,580	6,858	2,325

Continued ...

Table 3.5.2.1 Continued

Division IIIa (Skagerrak)

Country	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000**
Denmark	15,788	10,396	11,194	11,997	11,953	8,948	13,573	12,164	12,340	8,734	7,683
Sweden	1,694	1,579	2,436	2,574	1,821	2,658	2,208	2,303	1608	1,909	1,350
Norway	143	72	270	75	60	169	265	348	303	345	301
Germany	110	12	-	-	301	200	203	81	16	54	9
Others	65	12	102	91	25	134	-	-	-	-	-
Total Nominal Catch	17,800	12,071	14,002	14,737	14,160	12,109	16,249	14,896	14,267	11,042	9,343
Unallocated landings	0	-12	0	0	-899	0	0	50	1,064	-68	-66
WG estimate of total landings	17,800	12,059	14,002	14,737	13,261	12,109	16,249	14,946	15,331	10,974	9,277
Agreed TAC	*21,000*	*15,000*	*15,000*	*15,000*	*15,500*	*20,000*	*23,000*	*16,100*	*20,000*	*19,000*	*11,600*

Sub-area IV, Divisions VIId and IIIa (Skagerrak) combined

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000**
Total Nominal Catch	n/a	n/a	114,843	111,578	104,504	127,551	124,203	121,512	137,182	91,325	71,763
Unallocated landings	-	-	-823	10,171	6,130	8,545	2,117	2,646	8,832	4,900	-1,076
WG estimate of total landings	125,314	102,478	114,020	121,749	110,634	136,096	126,320	124,158	146,014	96,225	70,687

* The Danish industrial by-catch and the Norwegian coast catches are not included in the (WG estimate of) total landings of Division IIIa (Skagerrak).
** Provisional.
n/a not available.

Division IIIa (Skagerrak) landings not included in the assessment

Country	*1990*	*1991*	*1992*	*1993*	*1994*	*1995*	*1996*	*1997*	*1998*	*1999*	*2000***
*Norwegian coast **	*846*	*854*	*923*	*909*	*760*	*846*	*748*	*911*	*976*	*788*	*624*
Danish industrial by-catch	*687*	*953*	*1,360*	*511*	*666*	*749*	*676*	*205*	*97*	*62*	*99*
Total	*1,533*	*1,807*	*2,283*	*1,420*	*1,426*	*1,595*	*1,424*	*1,116*	*1,073*	*850*	*723*

Table 3.5.2.2 Cod in Sub-area IV, Division VIId & Division IIIa (Skagerrak).

Year	Recruitment Age 1 thousands	SSB tonnes	Landings tonnes	Mean F Ages 2-8
1963	195099	151521	116457	0.4732
1964	374080	166149	126041	0.4928
1965	415425	205425	181036	0.5458
1966	506863	230759	221336	0.5145
1967	488789	250046	252977	0.6124
1968	194587	258219	288368	0.6158
1969	209061	255921	200760	0.5742
1970	782003	276848	226124	0.5514
1971	910808	277216	328098	0.6695
1972	173496	231011	353976	0.8246
1973	319648	209145	239051	0.6919
1974	263657	230838	214279	0.6589
1975	486359	211636	205245	0.7084
1976	246421	182050	234169	0.7045
1977	839198	159349	209154	0.7107
1978	488156	159354	297022	0.8247
1979	525424	164266	269973	0.6765
1980	899522	181876	293644	0.8020
1981	314766	195732	335497	0.7597
1982	618498	190227	303251	0.8931
1983	324686	154988	259287	0.9107
1984	596292	133415	228286	0.8173
1985	158611	126208	214629	0.7815
1986	716254	114215	204053	0.8909
1987	281821	104724	216212	0.8841
1988	197056	98643	184240	0.8634
1989	274078	90606	139936	0.9391
1990	133940	78046	125314	0.7748
1991	168570	71119	102478	0.9314
1992	305294	68904	114020	0.8483
1993	147325	65099	121749	0.9179
1994	323678	64828	110634	0.8621
1995	226904	71003	136096	0.7239
1996	173262	76361	126320	0.9179
1997	421717	80188	124158	0.8568
1998	69536	71542	146014	0.9920
1999	139369	61471	96225	1.0642
2000	215023	53744	70687	0.8324
2001	86000[1]	54700[2]		0.8300
Average	364392	149420	200442	0.7678

[1] RCT3 estimate.

[2] Based on 1998-2000 mean weight at age.

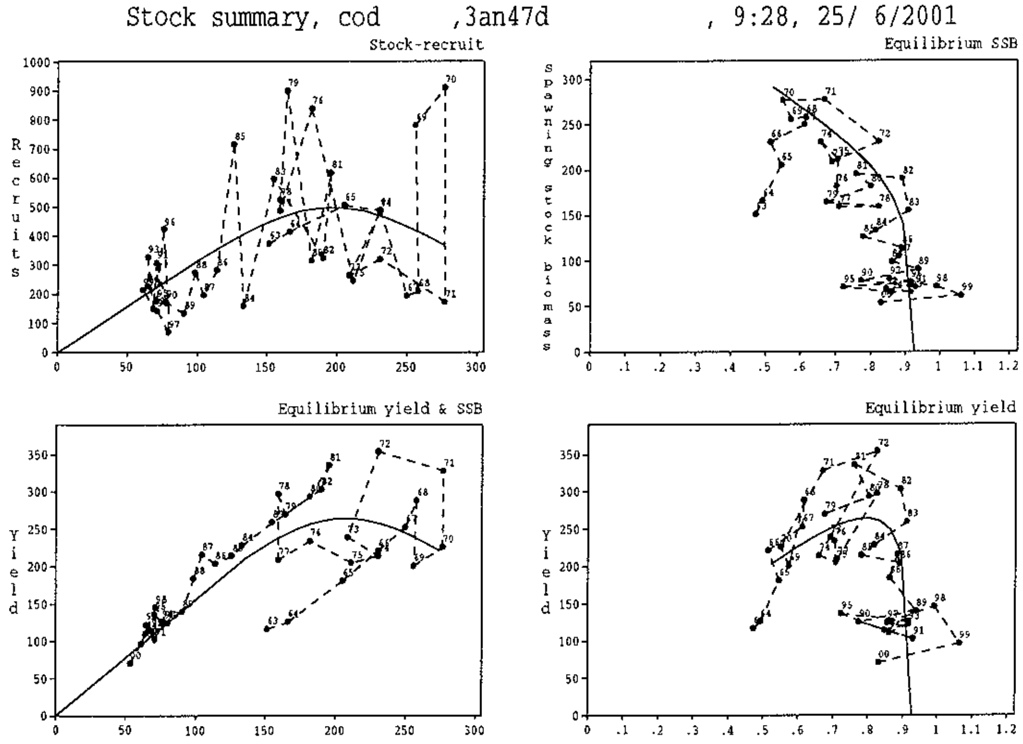


Figure 3.5.2.1 Long-term equilibrium analysis. Top right: SSB as a function of fishing mortality.

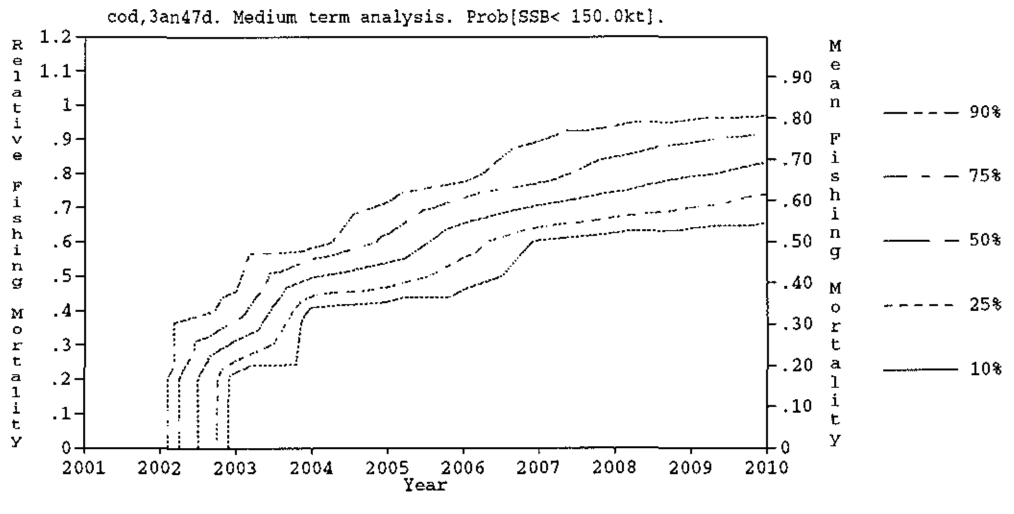


Figure 3.5.2.2 Cod in Sub-area IV and Divisions VIID and IIIA (Skagerrak). 10-year medium term projections. Probability of SSB below $\mathbf{B}_{pa}$ (150 kT) in any year given fixed mortality rates.

3.5.3 Haddock in Sub-area IV (North Sea) and Division IIIa (Skagerrak – Kattegat)

State of stock/exploitation: The stock is being harvested outside safe biological limits. SSB in 2001 is estimated to be above the $\mathbf{B}_{pa}$, and fishing mortality in 2000 is estimated to be above the $\mathbf{F}_{pa}$. The 1999 year class is estimated to be strong and should increase the SSB in the short-term, but it is the only year class above average size for a number of years and dominates both the stock biomass and the catches. The first indications of the 2001 year class suggest that it is poor, and if this is confirmed it means that the expected increase in SSB may be short-lived at the present fishing mortality rates.

Management objectives: In 1999 the EU and Norway have *"agreed to implement a long-term management plan for the haddock stock, which is consistent with the precautionary approach and is intended to constrain harvesting within safe biological limits and designed to provide for sustainable fisheries and greater potential yield. The plan shall consist of the following elements:*

1. *Every effort shall be made to maintain a minimum level of SSB greater than 100 000 t ($\mathbf{B}_{lim}$).*
2. *For 2000 and subsequent years the Parties agreed to restrict their fishing on the basis of a TAC consistent with a fishing mortality rate of 0.70 for appropriate age groups as defined by ICES.*
3. *Should the SSB fall below a reference point of 140 000 t ($\mathbf{B}_{pa}$), the fishing mortality referred to under paragraph 2 shall be adapted in the light of scientific estimates of the conditions then prevailing. Such adaptation shall ensure a safe and rapid recovery of SSB to a level in excess of 140 000 t.*
4. *In order to reduce discarding and to enhance the spawning biomass of haddock, the Parties agreed that the exploitation pattern shall, while recalling that other demersal species are harvested in these fisheries, be improved in the light of new scientific advice from, inter alia, ICES.*
5. *The Parties shall, as appropriate, review and revise these management measures and strategies on the basis of any new advice provided by ICES."*

ICES considers that the agreed Precautionary Approach reference points in the management plan are consistent with the precautionary approach, provided they are used as upper bounds on F and lower bounds on SSB, and not as targets.

Precautionary Approach reference points (unchanged since 1999):

ICES considers that:	ICES proposes that:
$\mathbf{B}_{lim}$ is 100 000 t, the bootstrapped median estimate of the lowest observed biomass.	$\mathbf{B}_{pa}$ be set at 140 000 t. This affords a high probability of maintaining SSB above $\mathbf{B}_{lim}$, taking into account the uncertainty of the assessments.
$\mathbf{F}_{lim}$ is 1.0, a fishing mortality historically associated with stock decline.	$\mathbf{F}_{pa}$ be set at 0.7. This F is considered to provide approximately 90% probability of avoiding a fishing mortality associated with stock collapse.

Technical basis:

$\mathbf{B}_{lim}$ = Smoothed $\mathbf{B}_{loss}$	$\mathbf{B}_{pa}$ = 1.4*$\mathbf{B}_{lim}$
$\mathbf{F}_{lim}$ = $\mathbf{F}_{loss}$ poorly defined; 1.4 $\mathbf{F}_{pa}$ which has historically led to decline: 1.0	$\mathbf{F}_{pa}$ = F_{lpg}[1] implies an equilibrium biomass > $\mathbf{B}_{pa}$ and a less than 10% probability that (SSB_{MT} < $\mathbf{B}_{pa}$).

[1]F_{lpg} is defined as the F value having a 10% probability of giving a replacement line above G_{loss}, which is the slope in the stock recruitment plot associated with the lowest observed SSB.

Advice on management: Fishing mortality in 2002 should be below $\mathbf{F}_{pa}$, corresponding to a human consumption landing of 97 000 t. However, due to the mixed nature of the fisheries the fishing mortality for haddock in 2002 may have to be reduced further to achieve consistency with the recovery plan for cod.

Relevant factors to be considered in management: Haddock, while a principal target for some fleets, are taken in a mixed roundfish fishery. This means it is important to take into account the impact of management of haddock on other stocks, notably cod and whiting. The reverse is, of course, also true. Recent measures to protect North Sea cod, such as the closed area, and agreements to increase mesh size, will affect the haddock fishery. Improvements in selectivity related to measures to protect cod should, if effectively implemented, benefit the haddock fishery by reducing discards and increasing landings in the long-term.

There is frequently debate about the extent to which the cod-haddock-whiting fisheries are linked. This linkage is not one-to-one, but it is also true that they are far from separate. It is possible for fishing vessels to increase their targeting of individual species, but there will always be a significant by-catch of other roundfish. Hence, for example, the need to protect cod will require at least some reduction in the fishing mortality for haddock and vice versa. This means that TACs for the three main roundfish species do need to be set in a way, which acknowledges the fishery linkage, but it remains difficult to judge how close this linkage should be.

The first indication of the strength of the 2001 haddock year class from the August English groundfish survey is that it is extremely poor, possibly the lowest on record. Although this requires confirmation, it implies that as the influence of the very strong 1999 year class diminishes in the haddock stock, the stock could decline very rapidly.

Square mesh panels have been introduced in the UK in 2000 in an attempt to reduce discarding. Further gear measures were introduced in Scotland during 2001. It is still too early to determine whether these have been effective. If implemented effectively, these measures should help in reducing discarding.

The forecast is extremely sensitive to the estimate of the strength of the 1999 year class, and factors affecting its survival and contribution to the catch and stock. This strong year class has already suffered substantial mortality due to discarding in 2000. Indications from observer trips in 2001 indicate continued very high discard rates.

The weight at age of the 1999 year class is below average which means that it has taken longer to reach the minimum landing size and is therefore exposed to discarding for longer. With the present exploitation pattern and fishing mortality rate, the expected catch in weight of discards is likely to be similar to the weight of human consumption landings over the lifetime of the year class.

Comparison with previous assessment and advice: Assessments carried out since 1997 showed a strong tendency to over-estimate SSB and under-estimate fishing mortality. The retrospective analysis of the current assessment indicates that this problem has been reduced.

Catch forecast for 2002:

Basis: $\mathbf{F}_{sq}$ = F(98–2000 - scaled) = 0.92; Catch (2001) = 285; Landings[1] (2001) = 65; SSB(2002) = 219.

F (2001 onwards)	Basis[2]	Catch (2002)	Human Consump. Lndgs (2002)	Discards (2001)	Industrial Bycatch IV + IIIa (2002)	HC Lndgs IV	HC Lndgs IIIa	SSB (2003)
0.32	**0.3 $\mathbf{F}_{sq}$**	87	46	20	20	44	2	223
0.40	0.4 $\mathbf{F}_{sq}$	105	59	26	20	57	2	207
0.49	0.5 $\mathbf{F}_{sq}$	122	71	32	19	69	2	192
0.58	0.6 $\mathbf{F}_{sq}$	138	82	37	19	79	3	178
0.70	$\mathbf{F}_{pa}$ (0.74 $\mathbf{F}_{sq}$)	160	97	44	18	94	3	160
0.75	0.8 $\mathbf{F}_{sq}$	167	102	47	18	99	3	153
0.92	$\mathbf{F}_{sq}$	192	120	55	17	116	4	132
1.09	1.2 $\mathbf{F}_{sq}$	214	135	63	16	131	4	114

Weights in '000 t, [1] North Sea + IIIa human consumption. [2]Multipliers on $\mathbf{F}_{sq}$ refer to human consumption and discard partial fishing mortality only. By-catch F is assumed constant at 0.06. The landings in Division IIIa are calculated as 3.3% of the combined area total. The figure 3.3% is the long-term average of the Division IIIa (human consumption) landings expressed as a percentage of the combined IIIa–IV (human consumption) landings.
Shaded scenarios considered inconsistent with the precautionary approach.

Medium- and long-term projections: At *status quo* F (0.92), the probability that SSB will be below $\mathbf{B}_{pa}$ in 10 years time is about 0.35.

Elaboration and special comment: The large majority of the catch is taken by Scottish trawlers, seiners and pair trawlers. Smaller quantities of haddock are taken by other vessels, including *Nephrops* trawlers which use 70 mm mesh. In Division IIIa, catches are taken by trawl, seine, and gill net in mixed fisheries.

Landings and SSB have varied considerably in response to large variations in year class strength. The 1999 year class is strong, but its current estimate is still not very precise. The observations of the year class by research vessel surveys are outside the range historically observed, and estimates by these surveys are extrapolations. Forecasts suggest that the 1999 year class will contribute to a rapid increase in the spawning stock in 2001-2002, but unless fishing mortality is reduced in 2002, the probability that SSB will be below $\mathbf{B}_{pa}$ in 2003 is about 0.3.

The analytical assessment is based on a long time series of catch-at-age data using CPUE from survey fleets.

Source of information: Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, June 2001, Hamburg, Germany (ICES CM 2002/ACFM: 01).

Yield and spawning biomass per Recruit F-reference points:

	Fish Mort Ages 2-6	Yield/R	SSB/R
Average Current	0.916	0.003	0.005
$\mathbf{F}_{max}$	0.247	0.004	0.019
$\mathbf{F}_{0.1}$	0.167	0.004	0.028
$\mathbf{F}_{med}$	0.458	0.004	0.010

Catch data (Tables 3.5.3.1–3):
Sub-area IV

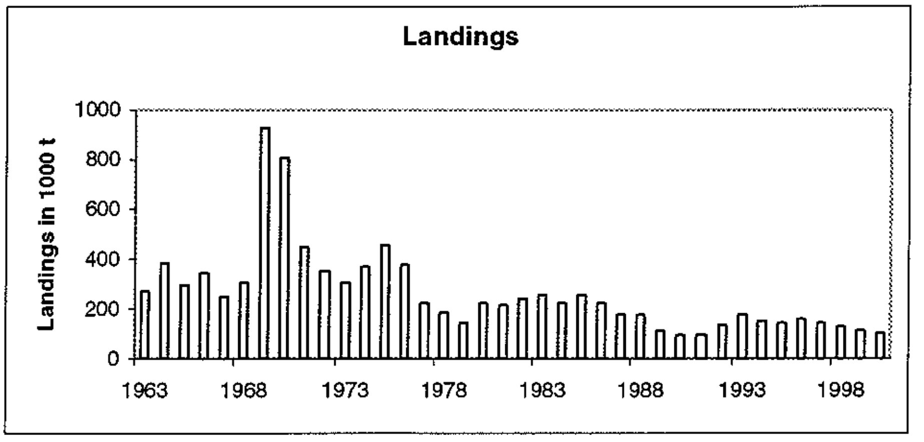
Year	ICES Advice	Predicted lndgs corresp. to advice[1]	Agreed TAC	Off. lndgs.	ACFM catches Hum. Cons.	Disc slip.	Indust. by-catch	Total
1987	80% of F(85)	105	140	109	108	59	4	172
1988	77% of F(86); TAC	185	185	105	105	62	4	171
1989	Reduce decline in SSB; TAC; protect juveniles	68	68	64	76	26	2	104
1990	80% of F(88); TAC	50	50	43	51	33	3	87
1991	70% of effort (89)		50	45	45	40	5	90
1992	70% of effort (89)		60	51	70	48	11	129
1993	70% of effort (89)		133	80	80	80	11	170
1994	Significant reduction in effort; mixed fishery		160	87	81	65	4	150
1995	Significant reduction in effort; mixed fishery		120	75	75	57	8	140
1996	Mixed fishery to be taken into account		120	75	76	73	5	154
1997	Mixed fishery to be taken into account		114	73	79	52	7	138
1998	No increase in F	100.3	115	72	77	45	5	128
1999	Reduction of 10% F(95–97)	72	88.6	64	64	43	4	111
2000	F less than $\mathbf{F}_{pa}$	<51.7	73.0	47	45	47	8	100
2001	F less than $\mathbf{F}_{pa}$	<58.0	61					
2002	F less than $\mathbf{F}_{pa}$	<94.0						

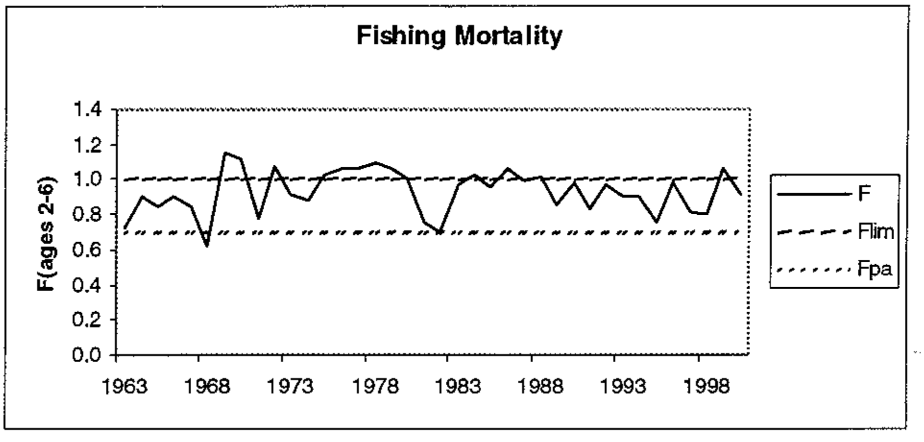
[1]Only pertaining to the North Sea. Weights in '000 t.

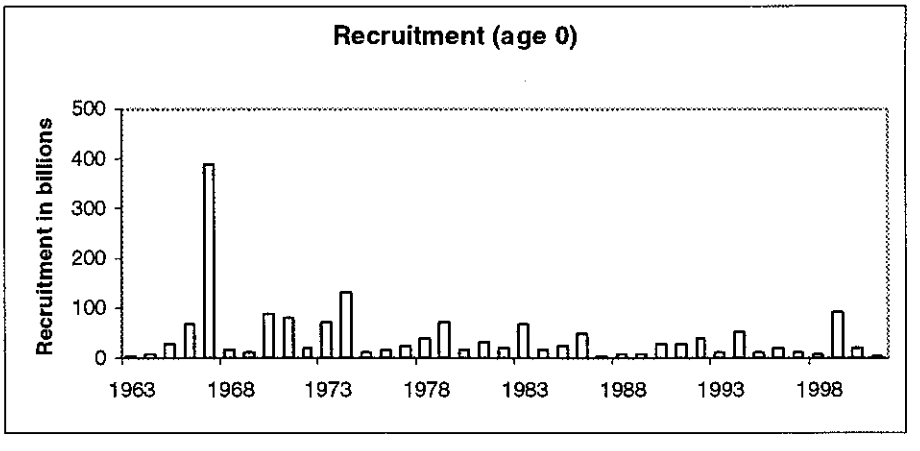
Division IIIa

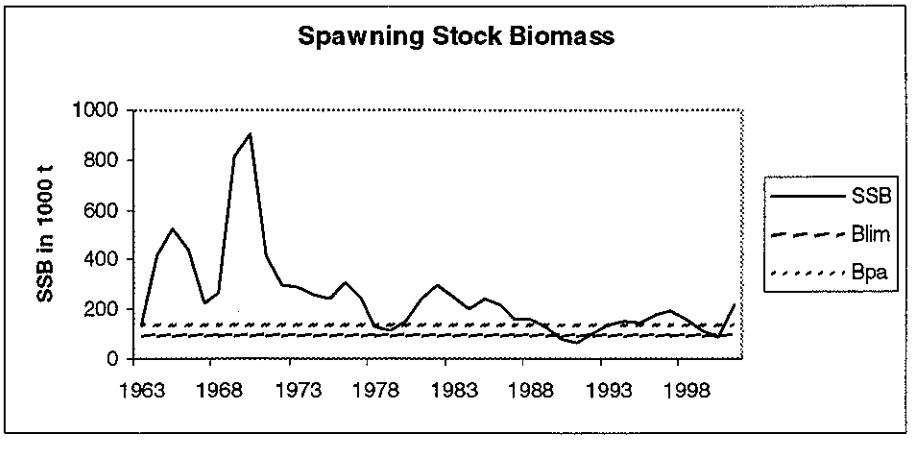
Year	ICES Advice	Predicted lndgs corresp. to advice	Agreed TAC	ACFM landings Hum. Cons.	Indust. bycatch	Total
1987	Precautionary TAC	-	11.5	3.8	1.4	5.3
1988	Precautionary TAC	-	10.0	2.9	1.5	4.3
1989	Precautionary TAC	-	10.0	4.1	0.4	4.5
1990	Precautionary TAC	-	10.0	4.1	2.0	6.1
1991	Precautionary TAC	4.6	4.6	4.1	2.6	6.7
1992	TAC	4.6	4.6	4.4	4.6	9.0
1993	Precautionary TAC	-	4.6	2.0	2.4	4.4
1994	Precautionary TAC	-	10.0	1.8	2.2	4.0
1995	If required, precautionary TAC; link to North Sea	-	10.0	2.2	2.2	4.4
1996	If required, precautionary TAC; link to North Sea	-	10.0	3.1	2.9	6.1
1997	Combined advice with North Sea	-	7.0	3.4	0.6	4.0
1998	Combined advice with North Sea	4.7	7.0	3.8	0.3	4.0
1999	Combined advice with North Sea	3.4	5.4	1.4	0.3	1.7
2000	Combined advice with North Sea	<1.8	4.5	1.5	0.6	2.1
2001	Combined advice with North Sea	<2.0	4.0			
2002	Combined advice with North Sea	<3.0				

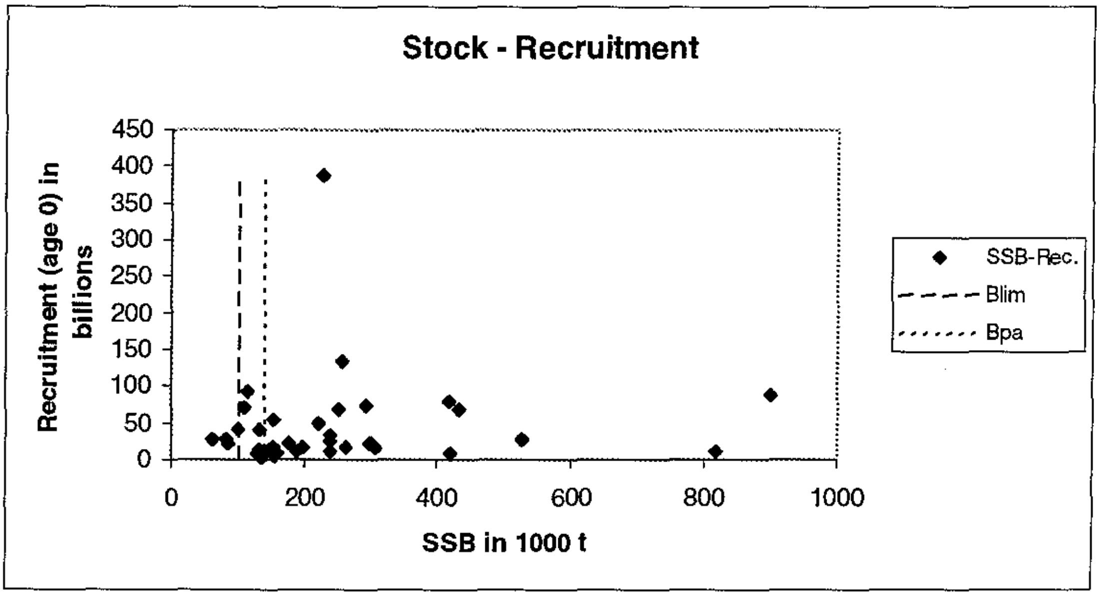
Weights in '000 t.

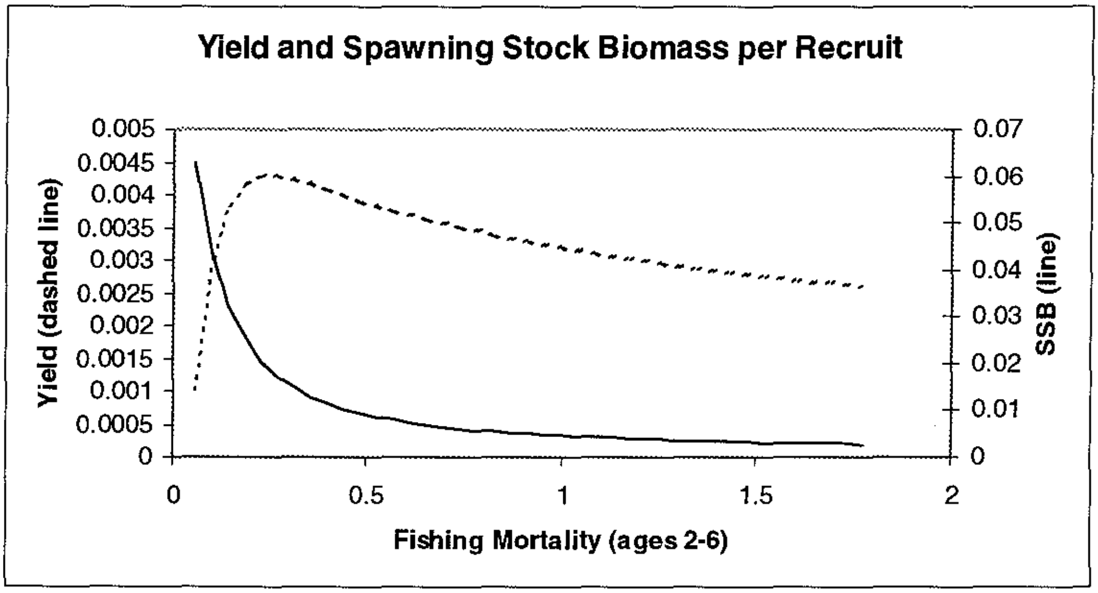

Landings
Landings in 1000 t
1000
800
600
400
200
0
1963
1968
1973
1978
1983
1988
1993
1998


Fishing Mortality
F(ages 2-6)
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1963
1968
1973
1978
1983
1988
1993
1998
F
Flim
Fpa


Recruitment (age 0)
Recruitment in billions
500
400
300
200
100
0
1963
1968
1973
1978
1983
1988
1993
1998


Spawning Stock Biomass
SSB in 1000 t
1000
800
600
400
200
0
1963
1968
1973
1978
1983
1988
1993
1998
SSB
Blim
Bpa


Stock - Recruitment
Recruitment (age 0) in billions
450
400
350
300
250
200
150
100
50
0
0
200
400
600
800
1000
SSB in 1000 t
SSB-Rec.
Blim
Bpa


Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
0.005
0.0045
0.004
0.0035
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
SSB (line)
0
0.5
1
1.5
2
Fishing Mortality (ages 2-6)

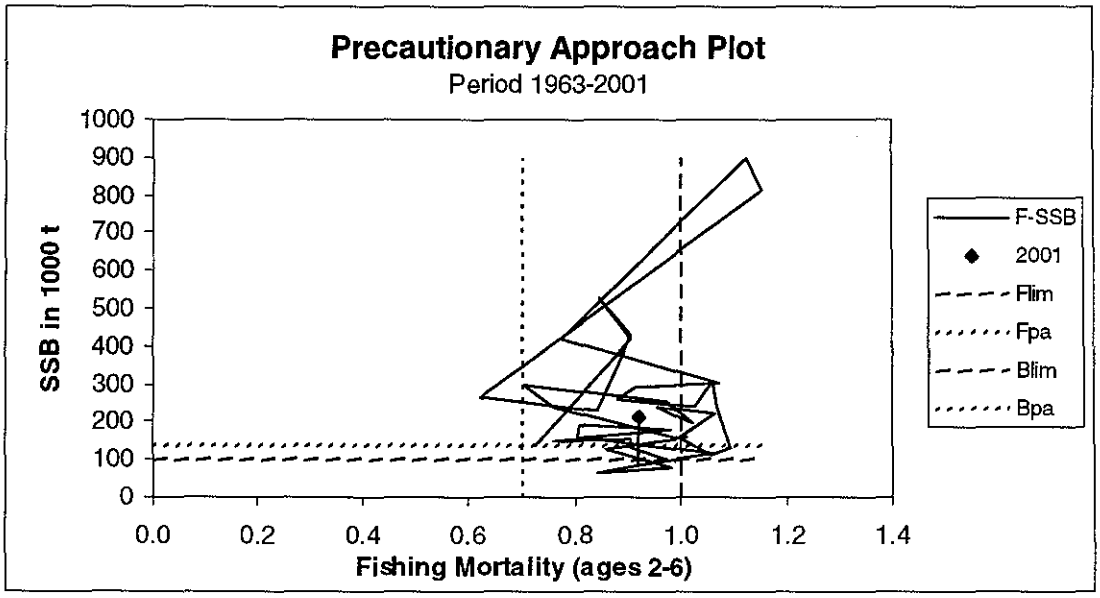

Precautionary Approach Plot
Period 1963-2001
SSB in 1000 t
1000
900
800
700
600
500
400
300
200
100
0
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
Fishing Mortality (ages 2-6)
F-SSB
2001
Flim
Fpa
Blim
Bpa

Table 3.5.3.1 Nominal catch (t) of Haddock from Division IIIa and the North Sea 1990–2000, as officially reported to ICES and estimated by ACFM.

Division IIIa

Country	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Belgium	4	14	9	4	18	-	-	-	-	-
Denmark	2,339	3,812	1,600	1,458	1,576	2,523	2,501	3,168	1,012	1,033
Germany	-	-	-	1	1	5	5	11	3	1
Norway	110	184	153	142	135	115	187	188	168	129
Sweden	69	744	436	408	498	536	835	529	212	372
Total reported	2,522	4,754	2,198	2,013	2,228	3,179	3,528	3,896	1,395	1,535
Unallocated	1,564	-358	-239	-180	-37	-37	-127	-137	-35	-50
WG estimate of H.cons. landings	4,086	4,396	1,959	1,833	2,191	3,142	3,401	3,759	1,360	1,485
WG estimate of industrial bycatch	2,593	604	2,415	2,180	2,162	2,925	610	275	334	617
WG estimate of total catch	6,679	9,000	4,374	4,013	4,353	6,067	4,011	4,034	1,694	2,102

Sub-area IV

Country	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Belgium	168	415	292	306	407	215	436	724	462	399
Denmark	1,330	1,476	3,582	3,208	2,902	2,520	2,722	2,608	2,104	1,670
Faroe Islands	15	13	25	43	49	13	9	43	-	-
France	631	508	960	587	441	369	548	427	742	1,152
Germany	535	764	348	1,829	1,284	1,769	1,462	1,314	565	342
Netherlands	100	148	192	96	147	110	480	275	110	119
Norway	2,069	3,273	2,655	2,355	2,461	2,295	2,351	3,010	3,846	3,115
Poland	-	-	-	-	-	18	8	7	17	13
Sweden	957	1,289	908	551	722	689	655	472	708	606
UK (Engl. & Wales)	2,173	2,926	4,259	4,043	3,616	3,379	3,330	3,280	2,398	
UK (Isle of Man)	-	11	-	-	-	-	-	-	-	
UK (N. Ireland)	48	73	18	9	-	-	-	-	-	
UK (Scotland)	36,474	39,896	66,799	73,793	63,411	63,542	61,098	60,234	53,486	
UK(all)										39,648
Total reported	44,500	50,792	80,038	86,820	75,440	74,919	73,099	72,394	64,438	47,064
Unallocated landings	145	19,426	-458	-5923	-127	1,115	5,996	4,917	-229	-1997
WG estimate of H.cons. landings	44,645	70,218	79,580	80,897	75,313	76,034	79,095	77,311	64,209	45,067
WG estimate of discards	40,276	47,967	79,601	65,392	57,360	72,522	52,105	45,175	42,562	46,798
WG estimate of industrial bycatch	5,421	10,816	10,741	3,561	7,747	5,048	6,689	5,101	3,834	8,133
WG estimate of total catch	90,342	129,001	169,922	149,850	140,420	153,604	137,889	127,587	110,605	99,998

Division IIIa and Sub-area IV

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2002
WG estimate of Total Catch	97,021	138,001	174,296	153,863	144,773	159,671	141,900	131,621	112,299	102,100

Table 3.5.3.2 Catches ('000 t) of Haddock from the North Sea and Division IIIa, 1963–2000. Figures are Working Group estimates.

	North Sea				Division IIIa			Total
Year	H.cons	Disc	Ind. BC	Total	H. cons.	Ind. BC	Total	
1963	68.4	189.0	13.7	271.1	0.4	0.1	0.5	271.6
1964	130.5	160.3	88.6	379.4	0.4	0.3	0.7	380.1
1965	161.6	62.2	74.6	298.4	0.7	0.3	1.0	299.4
1966	225.8	73.6	46.7	346.1	0.6	0.1	0.7	346.8
1967	147.4	78.1	20.7	246.2	0.4	0.1	0.5	246.7
1968	105.4	161.9	34.2	301.5	0.4	0.1	0.5	302.0
1969	330.9	260.2	338.4	929.5	0.5	0.5	1.0	930.5
1970	524.6	101.4	179.7	805.7	0.7	0.2	0.9	806.6
1971	235.4	177.5	31.5	444.4	2.0	0.3	2.3	446.7
1972	192.9	128.1	29.6	350.6	2.6	0.4	3.0	353.6
1973	178.6	114.7	11.3	304.6	2.9	0.2	3.1	307.7
1974	149.6	166.8	47.8	364.2	3.5	1.1	4.6	368.8
1975	146.6	260.4	41.4	448.4	4.8	1.3	6.1	454.5
1976	165.6	154.3	48.2	368.1	7.0	2.0	9.0	377.1
1977	137.3	44.3	35.0	216.6	7.8	2.0	9.8	226.4
1978	85.8	76.9	10.8	173.5	5.9	0.7	6.6	180.1
1979	83.1	41.7	16.4	141.2	4.0	0.8	4.8	146.0
1980	98.6	94.7	22.3	215.6	6.4	1.5	7.9	223.5
1981	129.6	60.1	17.1	206.8	9.1	1.2	10.3	217.1
1982	165.8	40.5	19.4	225.7	10.8	1.3	12.1	237.8
1983	159.3	65.9	13.1	238.3	8.0	7.2	15.2	253.5
1984	128.1	75.3	10.1	213.5	6.4	2.7	9.1	222.6
1985	158.5	85.4	6.0	249.9	7.2	1.0	8.2	258.1
1986	165.5	52.2	2.6	220.3	3.6	1.7	5.3	225.6
1987	108.0	59.2	4.4	171.6	3.8	1.4	5.2	176.8
1988	105.1	62.1	4.0	171.2	2.9	1.5	4.4	175.6
1989	76.2	25.7	2.4	104.3	4.1	0.4	4.5	108.8
1990	51.5	32.6	2.6	86.7	4.1	2.0	6.1	92.8
1991	44.6	40.3	5.4	90.3	4.1	2.6	6.7	97.0
1992	70.2	48.0	10.8	129.0	4.4	4.6	9.0	138.0
1993	79.6	79.6	10.7	169.9	2.0	2.4	4.4	174.3
1994	80.9	65.4	3.6	149.9	1.8	2.2	4.0	153.9
1995	75.3	57.4	7.7	140.4	2.2	2.2	4.4	144.8
1996	76.0	72.5	5.0	153.5	3.1	2.9	6.0	159.5
1997	79.1	52.1	6.7	137.9	3.4	0.6	4.0	141.9
1998	77.3	45.2	5.1	127.6	3.8	0.3	4.1	131.7
1999	64.2	42.6	3.8	110.6	1.4	0.3	1.7	112.3
2000	45.1	46.8	8.1	100.0	1.5	0.6	2.1	102.1
Min	44.6	25.7	2.4	86.7	0.4	0.1	0.5	92.8
Mean	134.4	90.9	32.6	258.0	3.7	1.3	5.0	263.0
Max	524.6	260.4	338.4	929.5	10.8	7.2	15.2	930.5

Table 3.5.3.3 Haddock in Sub-area IV (North Sea) and Division IIIa.

Year	Recruitment Age 0 thousands	SSB tonnes	Catch tonnes	Mean F Ages 2-6
1963	2338284	137272	271531	0.7251
1964	9172054	420015	380158	0.9064
1965	26336284	525929	299464	0.8462
1966	68992256	432383	346726	0.9041
1967	388112032	228948	246589	0.8414
1968	17102464	264741	302043	0.6197
1969	12195465	815882	930538	1.1516
1970	87763880	899321	806674	1.1212
1971	78284800	417858	446634	0.7756
1972	21539232	300943	353606	1.0701
1973	72898288	294262	307688	0.9146
1974	133493024	258429	368797	0.8789
1975	11542282	238190	454536	1.0268
1976	16483475	308018	377118	1.0604
1977	25751410	238405	226411	1.0650
1978	39548888	132111	180144	1.0925
1979	72152888	109269	146001	1.0560
1980	15652688	152957	223610	1.0049
1981	32480664	240263	217151	0.7604
1982	20622402	299650	237842	0.7046
1983	66983356	252894	253594	0.9737
1984	17273990	198906	222563	1.0232
1985	24052884	240970	258117	0.9547
1986	49884900	221747	225697	1.0623
1987	4201936	157356	176880	0.9986
1988	8441888	159160	175516	1.0119
1989	8706156	129234	108772	0.8566
1990	28140778	81425	92720	0.9810
1991	27425050	63516	97021	0.8407
1992	40611944	101113	138001	0.9746
1993	12698384	133402	174296	0.9049
1994	53550076	153235	153864	0.9064
1995	12878389	148507	144773	0.7614
1996	21021814	178333	159671	0.9804
1997	12125495	190562	141900	0.8084
1998	8824125	160244	131621	0.8054
1999	93773080	114860	112299	1.0591
2000	20563614	86983	102100	0.9159
2001	2439600[1]	215000[2]		0.9200
Average	42719493	248777	262965	0.9299

[1] RCT3 estimate.

[2] Based on 1998-2000 mean weight-at-age.

3.5.4 Whiting in Sub-area IV (North Sea) and Division VIId (Eastern Channel)

State of stock/exploitation: The stock is outside safe biological limits. SSB has declined over the last 20 years, reaching a historic low in 1998. Although the trends in SSB and fishing mortality in the most recent years cannot be determined precisely, the assessment indicates that SSB is now increasing and fishing mortality has decreased. Recruitment has fluctuated below the average (1980-2000) level since 1990, with the exception of the 1998 year class.

Management objectives: No explicit management objectives are set for this stock.

Precautionary Approach reference points (unchanged since 1999):

ICES considers that:	ICES proposes that:
$\mathbf{B_{lim}}$ is 225 000 t, the lowest observed biomass.	$\mathbf{B_{pa}}$ be set at 315 000 t. This affords a high probability of maintaining SSB above $\mathbf{B_{lim}}$, taking into account the uncertainty of assessments. Below this value the probability of below-average recruitment increases.
$\mathbf{F_{lim}}$ is 0.90, the fishing mortality estimated to lead to potential stock collapse.	$\mathbf{F_{pa}}$ be set at 0.65. This F is considered to provide approximately 95% probability of avoiding $\mathbf{F_{lim}}$, taking into account the uncertainty of the assessment.

Technical basis:

$\mathbf{B_{lim}}$=$\mathbf{B_{loss}}$=225 000 t.	$\mathbf{B_{pa}}$ =1.4*$\mathbf{B_{lim}}$, apparent impaired recruitment below this value: 315 000 t.
$\mathbf{F_{lim}}$=$\mathbf{F_{loss}}$=0.9.	$\mathbf{F_{pa}}$ ~ 0.7 $\mathbf{F_{lim}}$=0.65.

Advice on management: To bring SSB above $\mathbf{B_{pa}}$ in 2003, fishing mortality in 2002 should be below 0.37, corresponding to human consumption landings of less than 37 000 t. However, due to the mixed nature of the fisheries the fishing mortality for whiting in 2002 may have to be reduced further to achieve consistency with the recovery plan for cod.

Relevant factors to be considered in management: The current assessment is uncertain. However, it is likely that SSB is still well below $\mathbf{B_{pa}}$. The SSB is estimated to have increased since 1998, due mainly to lower fishing mortality.

ICES notes that some benefit for whiting may be achieved through implementation of technical conservation measures for cod, because whiting are taken in a mixed fishery with cod. Hence, the rebuilding of whiting SSB could be somewhat greater if the advice on North Sea cod and measures to reduce discarding are implemented effectively.

Because of the observation of a long period of poor recruitment, ICES has expressed concern that the productivity and distribution of this stock may have changed. Although recruitment is still well below average, the year classes 1998 and 1999 appear to be sufficient to rebuild SSB at the current levels of fishing mortality. Whether the productivity of the stock has changed cannot be determined unless SSB is allowed to rebuild substantially.

The recommended reduction in fishing mortality cannot be achieved by TAC management alone, because whiting is caught in mixed demersal fisheries, where discarding of whiting is sometimes high (commonly 60% by weight). In *Nephrops*, shrimp, and flatfish fisheries nearly all whiting are discarded. A reduction in TAC is likely to result in increased discarding which may counteract the desired reduction in fishing mortality. It is necessary that management plans for all fisheries, which take whiting for human consumption or industrial uses, or as significant amounts of by-catch, include provisions, which ensure lowest possible capture of whiting. For mixed demersal fisheries improvements to gear selectivity, such as increased mesh size or inclusion of square mesh panels, would contribute to this goal.

There is scope for investigating whether the geographical distribution for cod, haddock and whiting, based on surveys, may allow area specific measures to be devised.

Square mesh panels have been introduced in the UK in 2000 in an attempt to reduce discarding. It is still too early to determine whether this has been effective.

Catch forecast for 2002:

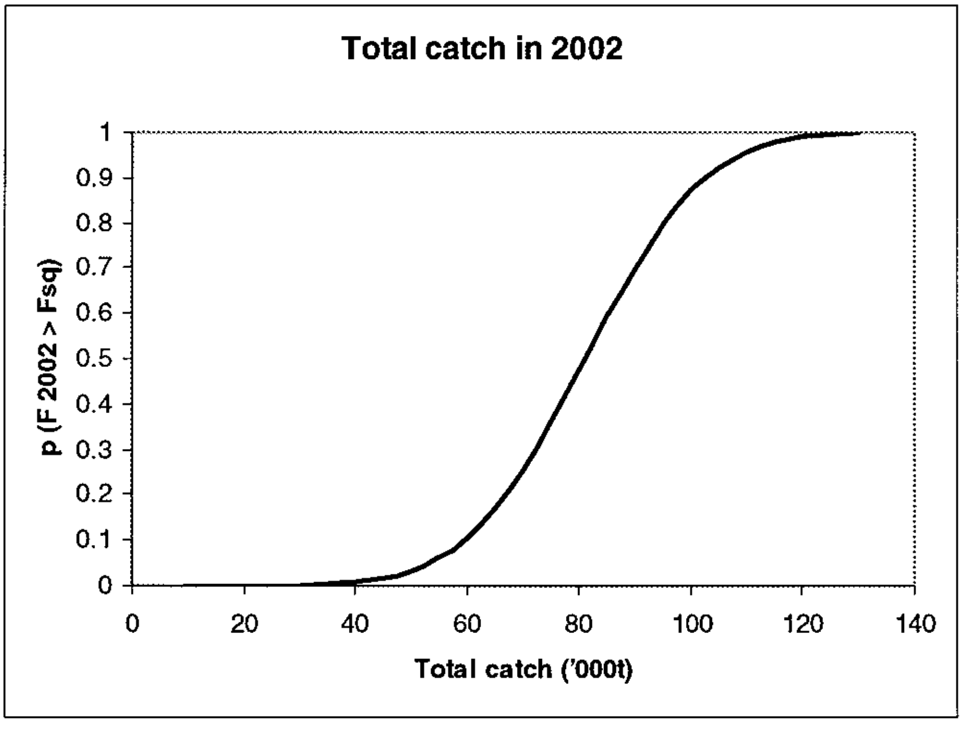
Basis: F(2001) = F_{sq} = F(98–00, scaled) = 0.46; SSB(2002) = 258; HC landings IV (2001) = 36; HC landings VIId (2001) = 5; Discards (2001) = 25; Industrial by-catch (2001) = 12.

F (2002)	Basis	Catch (2002)	HC (2002)	Discards (2002)	Industrial By-catch (2002)	HC IV (2002)	HC VIId (2002)	SSB (2003)
0.29	0.6*F_{sq}	58	29	17	12	26	3	327
0.33	0.7*F_{sq}	65	33	20	12	29	4	321
0.37	0.8*F_{sq}	72	37	22	12	33	4	315
0.42	0.9*F_{sq}	78	41	25	12	37	5	309
0.46	1.0*F_{sq}	84	45	27	12	40	5	303
0.50	1.1*F_{sq}	90	49	30	12	43	6	298
0.54	1.2*F_{sq}	96	53	32	12	47	6	292
0.58	1.3*F_{sq}	102	56	34	12	50	6	287
0.65	F_{pa} (1.41*F_{sq})	108	60	37	12	53	7	282

Weights in '000 t. The HC landings in Division VIId are calculated as 11.5% of the HC landings forecast for the area combined, 11.5% being the average of the VIId HC landings relative to the HC landings from the combined area for the years 1992–1996.

Shaded scenarios considered inconsistent with the precautionary approach.

Different assessment methods give different interpretations of the state of this stock. A probabilistic forecast based on continued fishing at *status quo* implies a total catch in 2002 of 81 000 t at *status quo*, but with approximate 95% confidence intervals from 48 000 t to 114 000 t.



Comparison with previous assessment and advice: The current assessment employs a different methodology (TSA) compared to last year. This assessment was taken forward to prediction because it characterises the uncertainty in the assessment better than the other approaches. The historic results of the current assessment are, however, generally consistent with last year's assessment.

Medium- and long-term projections: No medium- or long-term projections have been carried out.

Elaboration and special comment: At very low stock sizes, as experienced in recent years, catch opportunities in the short-term are very dependent on the strength of incoming year classes. However, the estimates of year class strength for whiting are very imprecise.

Analytical assessment is based on a twenty-one year time-series of catch-at-age data only. There are inconsistencies between information from commercial catch data and survey information. Discard information is available for about 50% of the catch since 1975, although discard estimates are imprecise due to low sampling effort.

Source of information: Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, June 2001, Hamburg, Germany (ICES CM 2002/ACFM: 01).

Yield and spawning biomass per Recruit F-reference points:

	Fish Mort Ages 2-6	Yield/R	SSB/R
Average Current	0.385	0.032	0.163
$\mathbf{F}_{max}$	0.952	0.034	0.109
$\mathbf{F}_{0.1}$	0.311	0.031	0.178
$\mathbf{F}_{med}$	0.621	0.034	0.133

Catch data (Tables 3.5.4.1–2):

North Sea (Sub-area IV)

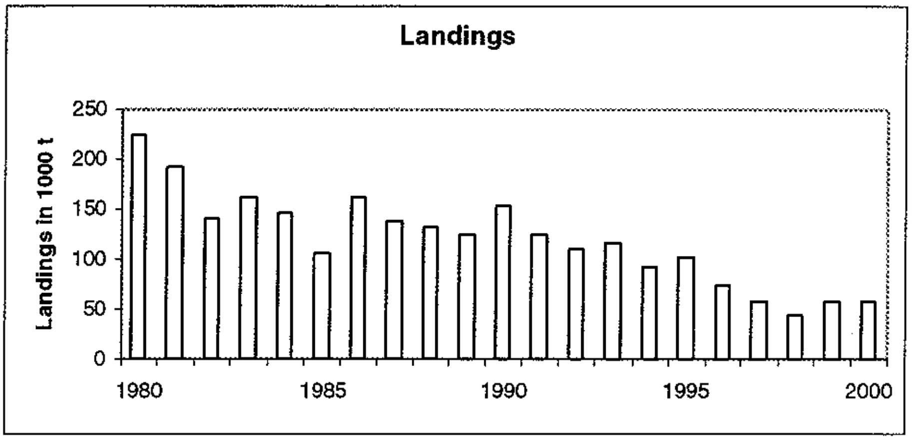
Year	ICES Advice	Predicted Landings Corresp. to advice	Agreed TAC	Off. Lndgs.	ACFM figures			
					Hum. Cons.	Indust. by-catch	Disc. slip.	Total catch
1987	Reduce F towards $\mathbf{F}_{max}$	120	135	65	64	16	54	134
1988	No increase in F; TAC	134	120	66	52	49	28	129
1989	Protect juveniles	-	115	40	41	43	36	120
1990	80% of F(88); TAC	130	125	41	43	51	56	150
1991	70% of effort (89)	-	141	47	47	38	34	119
1992	70% of effort (89)	-	135	47	46	27	31	104
1993	70% of effort (89)	-	120	47	48	20	43	111
1994	Significant reduction in effort; mixed fishery	-	100	42	43	10	33	86
1995	Significant reduction in effort; mixed fishery	-	81	41	41	27	30	98
1996	Mixed fishery; take into account cod advice	-	67	35	36	5	28	69
1997	Mixed fishery; take into account cod advice	-	74	32	31	6	17	54
1998	No increase from 1996 level	54	60	24	24	3	13	40
1999	at least 20% reduction of F(95–97)	40.4	44	25	26	5	24	55
2000	lowest possible catch	0	30	24	24	9	22	55
2001	60% reduction of F(97–99)	19.4	30					
2002	F not larger than 0.37	<=33						

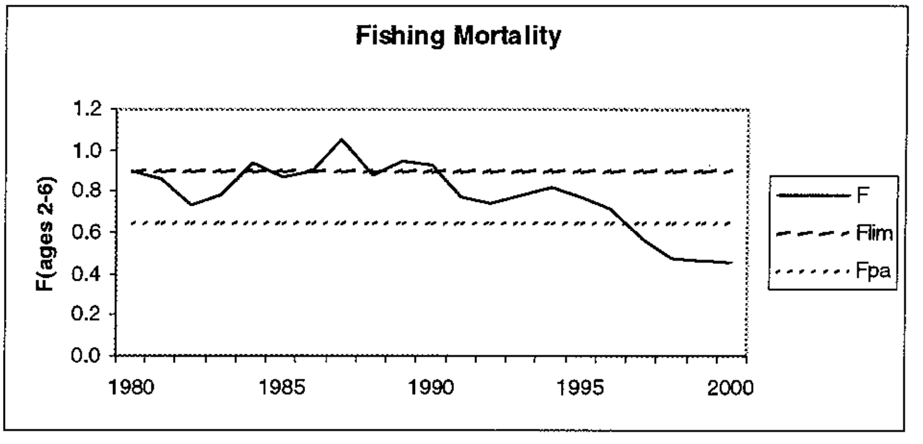
Weights in '000 t.

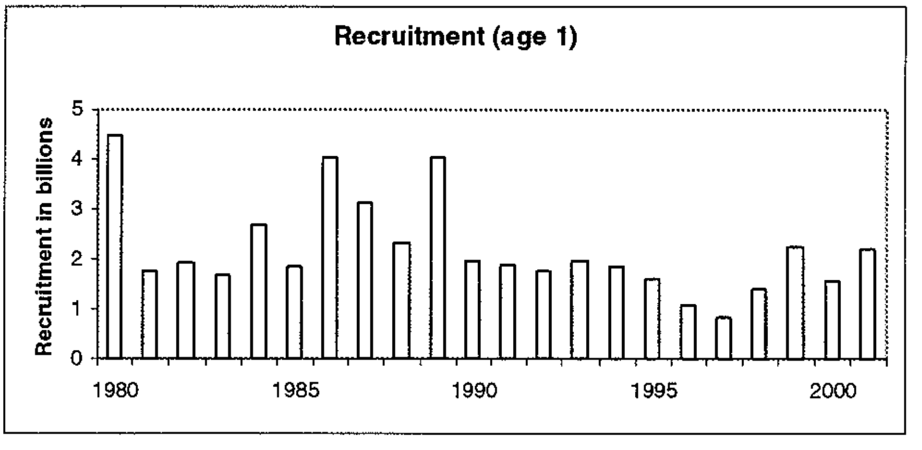
Eastern Channel (Division VIId)

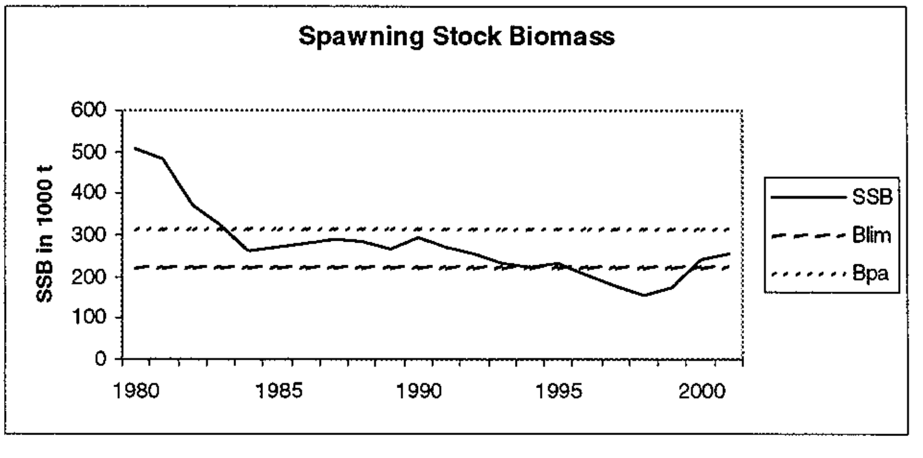
Year	ICES Advice	Predicted catch corresp. To advice	Agreed TAC[1]	Official landings	ACFM Catch
1987	Not assessed	-	-	7.2	4.7
1988	Precautionary TAC	-	-	7.8	4.4
1989	Precautionary TAC	-	-	n/a	4.2
1990	No increase in F; TAC	8.0[2]	-	n/a	3.5
1991	$\mathbf{F}_{sq}$;TAC	5.1	-	n/a	5.7
1992	If required, precautionary TAC	6.0[2]	-	5.9	5.7
1993	No basis for advice	-	-	5.4	5.2
1994	No long-term gains in increasing F	-	-	7.1	6.6
1995	Significant reduction in effort; link to North Sea	-	-	5.6	5.4
1996	Reference made to North Sea advice	-	-	5.1	5.0
1997	Reference made to North Sea advice	-	-	4.8	4.6
1998	Reference made to North Sea advice	5.8	-	4.8	4.6
1999	Reference made to North Sea advice	3.9	-	n/a	4.4
2000	Lowest possible catch	0	-	n/a	4.3
2001	60% reduction of $\mathbf{F}_{sq}$	2.5	-		
2002	F not larger than 0.37	<=4			

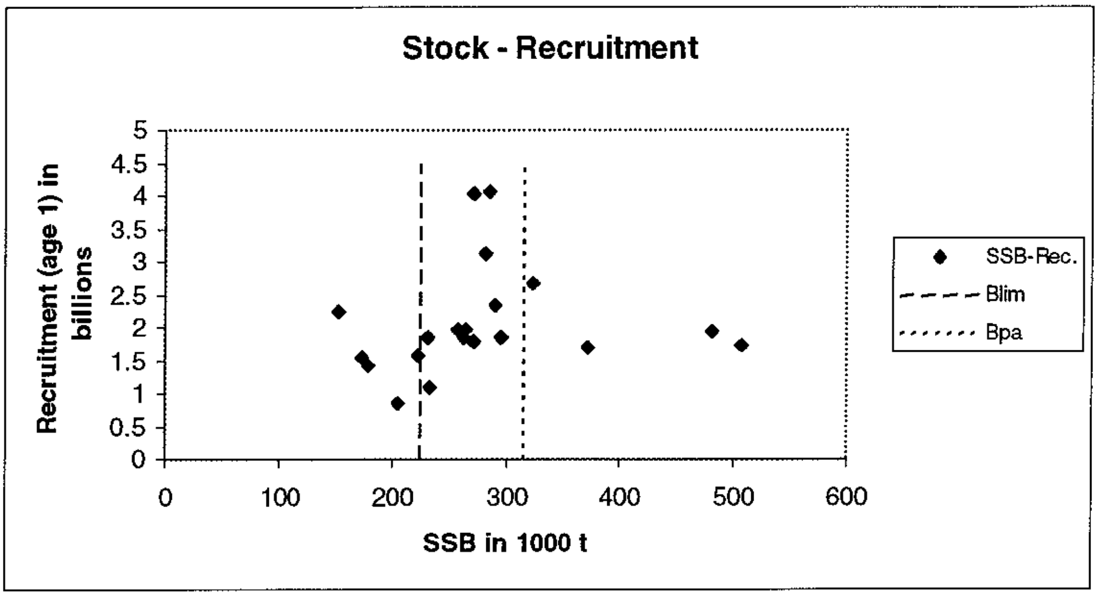
[1] Included in TAC for Sub-area VII (except Division VIIa). [2] Including VIIe. Weights in '000 t. n/a=Not available.

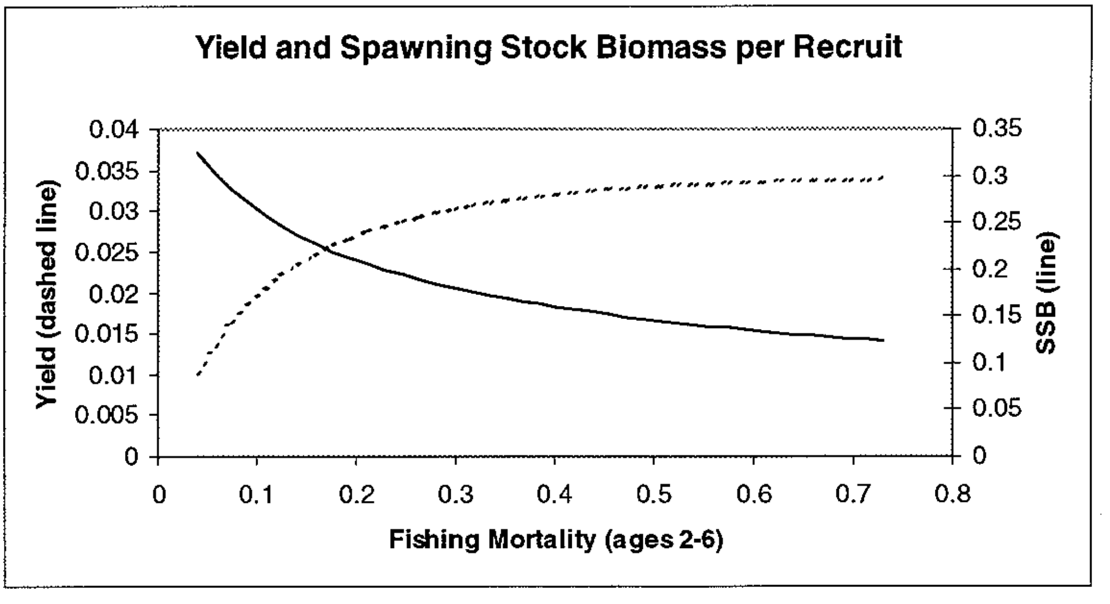

Landings
Landings in 1000 t
250
200
150
100
50
0
1980
1985
1990
1995
2000


Fishing Mortality
F(ages 2-6)
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1980
1985
1990
1995
2000
F
Flim
Fpa


Recruitment (age 1)
Recruitment in billions
5
4
3
2
1
0
1980
1985
1990
1995
2000


Spawning Stock Biomass
SSB in 1000 t
600
500
400
300
200
100
0
1980
1985
1990
1995
2000
SSB
Blim
Bpa


Stock - Recruitment
Recruitment (age 1) in billions
SSB in 1000 t
SSB-Rec.
Blim
Bpa
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
0
100
200
300
400
500
600


Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
SSB (line)
Fishing Mortality (ages 2-6)
0
0.005
0.01
0.015
0.02
0.025
0.03
0.035
0.04
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8

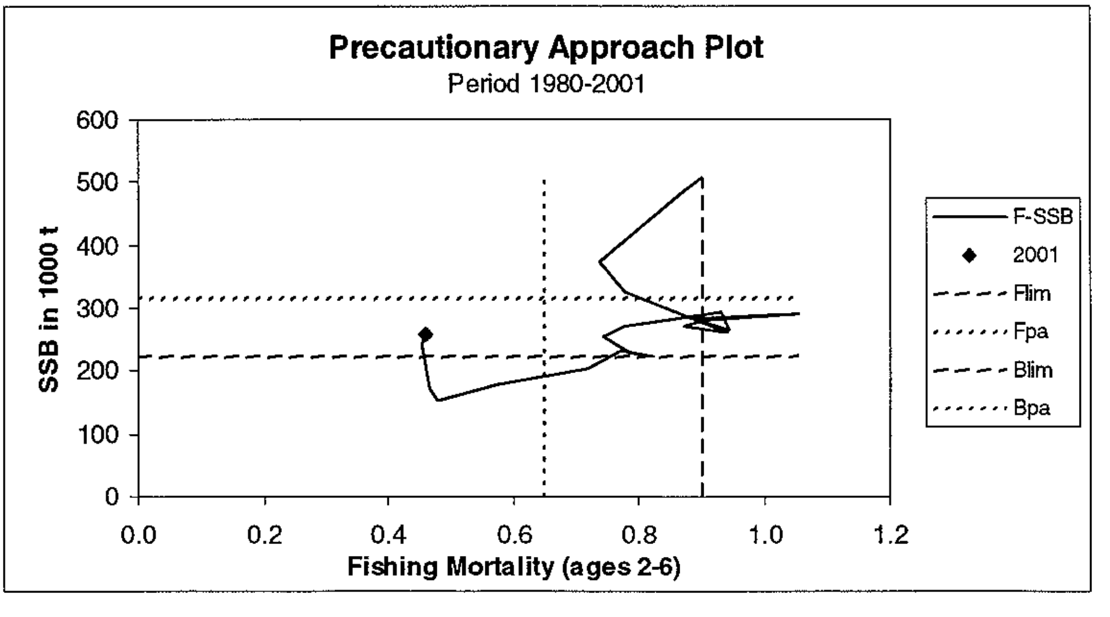

Precautionary Approach Plot
Period 1980-2001
SSB in 1000 t
Fishing Mortality (ages 2-6)
F-SSB
2001
Flim
Fpa
Blim
Bpa
0
100
200
300
400
500
600
0.0
0.2
0.4
0.6
0.8
1.0
1.2

Table 3.5.4.1 Nominal catch (in tonnes) of Whiting in Sub-area IV and Division VIId, as officially reported to ICES.

Sub-area IV

Country	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000*
Belgium	913	1,030	944	1,042	880	843	391	268	529	536
Denmark	1,529	1,377	1,418	549	368	189	103	46	58	105
Faroe Islands	-	16	7	2	21	-	6	1	1	-
France[2]	5,188	5,071	5,502	4,735	5,963	4,704	3,526	1,908	4,292	2,529
Germany, Fed.Rep.	865	511	441	239	124	187	196	103	176	424
Netherlands	4,028	5,390	4,799	3,864	3,640	3,388	2,539	1,941	1,795	1,884
Norway	103	232	130	79	115	66	75	64	68	33
Poland	-	-	-	-	-	-	-	1	-	-
Sweden	48	22	18	10	1	1	1	1	9	4
UK (E.&W)[3]	2,676	2,528	2,774	2,722	2,477	2,329	2,638	2,909	2,268	...
UK (Scotland)	31,257	30,821	31,268	28,974	27,811	23,409	22,098	16,696	17,206	...
United Kingdom										18,941
Total	46,607	46,998	47,301	42,216	41,400	35,116	31,573	23,938	26,402	24,456
Unallocated landings	701	-554	680	401	-348	1,006	-276	-72	-421	-412
WG estimate of H.Cons. landings	47,308	46,444	47,981	42,617	41,052	36,122	31,297	23,866	25,981	24,044
WG estimate of discards	33,639	30,615	42,871	33,010	30,264	28,181	17,217	12,708	23,584	22,360
WG estimate of Ind. By-catch	38,311	26,901	20,099	10,354	26,561	4,702	5,965	3,141	5,183	8,886
WG estimate of total catch	119,258	103,960	110,951	85,981	97,877	69,005	54,479	39,715	54,748	55,290

*Preliminary: year 2000, France 1998 & 1999, Norway 1997 & 1998.

[2]Includes Division IIa (EC).

[3]1989-1994 revised. N. Ireland included with England and Wales.

Division VIId

Country	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Belgium	83	66	74	61	68	84	98	53	48	65
France	-	5,414	5,032	6,734	5,202	4,771	4,532	4,495	-	-
Netherlands	-	-	-	-	-	1	1	32	6	14
UK (E.&W)	292	419	321	293	280	199	147	185	135	...
UK (Scotland)	1	24	2	-	1	1	1	-	-	...
United Kingdom										110
Total		5,923	5,429	7,088	5,551	5,056	4,779	4,765		
Unallocated		-178	-214	-463	-161	-104	-156	-167		
W.G. estimate	5,718	5,745	5,215	6,625	5,390	4,952	4,623	4,598	4,431	4,298

Sub-area IV and Division VIId

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
W.G. estimate	124,976	109,705	116,166	92,606	103,267	73,957	59,102	44,313	59,179	59,588

Table 3.5.4.2 Whiting in Sub-area IV and Division VIId.

Year	Recruitment Age 1 thousands	SSB tonnes	Catches tonnes	Mean F Ages 2-6
1980	4495080	507980	224000	0.9013
1981	1742330	481520	193000	0.8658
1982	1924990	371880	141000	0.7364
1983	1681860	324230	162000	0.7795
1984	2674280	262140	146000	0.9402
1985	1844000	270850	106000	0.8734
1986	4028600	281560	162000	0.9047
1987	3111760	290900	138000	1.0566
1988	2319420	285590	133000	0.8837
1989	4059640	265190	124000	0.9450
1990	1963970	294810	154000	0.9328
1991	1860660	271080	125000	0.7783
1992	1775790	256900	110000	0.7444
1993	1975730	230850	116000	0.7848
1994	1848740	222710	92000	0.8210
1995	1583560	233190	103000	0.7701
1996	1096560	204790	74000	0.7189
1997	837610	178290	59000	0.5739
1998	1414960	152620	44000	0.4774
1999	2244380	173690	59000	0.4675
2000	1551300	243400	59000	0.4535
2001	2191870[1]	257440		0.4600
Average	2192140	275528	120190	0.7668

[1] TSA estimate.

3.5.5 Saithe in Sub-area IV (North Sea), Division IIIa (Skagerrak) and Sub-area VI (West of Scotland and Rockall)

State of stock/exploitation: The stock is within safe biological limits. Fishing mortality has declined from 1986 to 2000, and is estimated below $\mathbf{F_{pa}}$ in 2000. SSB has remained near or below $\mathbf{B_{pa}}$ since 1984, but it has increased in the late 1990s and is estimated to be above $\mathbf{B_{pa}}$ in 2001.

Management objectives: In 1999 the EU and Norway have *"agreed to implement a long-term management plan for the saithe stock, which is consistent with the precautionary approach and is intended to constrain harvesting within safe biological limits and designed to provide for sustainable fisheries and greater potential yield. The plan shall consist of the following elements:*

1. *Every effort shall be made to maintain a minimum level of SSB greater than 106 000 t ($\mathbf{B_{lim}}$).*

2. *For 2000 and subsequent years the Parties agreed to restrict their fishing on the basis of a TAC consistent with a fishing mortality rate of 0.40 for appropriate age groups as defined by ICES.*

3. *Should the SSB fall below a reference point of 200 000 t ($\mathbf{B_{pa}}$), the fishing mortality referred to under paragraph 2 shall be adapted in the light of scientific estimates of the conditions then prevailing. Such adaptation shall ensure a safe and rapid recovery of SSB to a level in excess of 200 000 t.*

4. *The Parties shall, as appropriate, review and revise these management measures and strategies on the basis of any new advice provided by ICES."*

ICES considers that the agreed Precautionary Approach reference points in the management plan are consistent with the precautionary approach, provided they are used as upper bounds on F and lower bounds on SSB, and not as targets.

Precautionary Approach reference points (unchanged since 1999):

ICES considers that:	ICES proposes that:
$\mathbf{B_{lim}}$ is 106 000 t	$\mathbf{B_{pa}}$ be set at 200 000 t
$\mathbf{F_{lim}}$ is 0.60	$\mathbf{F_{pa}}$ be set at 0.40

Technical basis:

$\mathbf{B_{lim}}$=$\mathbf{B_{loss}}$=106 000 t.	$\mathbf{B_{pa}}$ Impaired recruitment at SSB less than 200 000 t. This affords a high probability of maintaining SSB above $\mathbf{B_{lim}}$, taking into account the uncertainty of assessments. Below this value the probability of below average recruitment increases.
$\mathbf{F_{lim}}$=$\mathbf{F_{loss}}$=0.6, the fishing mortality estimated to lead to potential stock collapse.	$\mathbf{F_{pa}}$=5th percentile of $\mathbf{F_{loss}}$ (0.45) implies that $B_{eq} < \mathbf{B_{pa}}$. F = 0.4 implies that $B_{eq} > \mathbf{B_{pa}}$ and $P(SSB_{MT} < \mathbf{B_{pa}}) < 10\%$. This F is considered to provide approximately 95% probability of avoiding $\mathbf{F_{lim}}$, taking into account the uncertainty of the assessment.

Advice on management: ICES advises that fishing mortality in 2002 should be below $\mathbf{F_{pa}}$ corresponding to landings in 2002 of less than 148 000 t.

Relevant factors to be considered in management: The assessment is considered to be uncertain as it is very sensitive to the addition of a single year's data and there are no survey data to confirm the stock trends as calibrated by commercial CPUE. The catch forecast is mainly driven by the assumption of average recruitment, with about one third of the forecast 2002 landings and 2003 SSB originating from this assumption. This means that the forecasts may not track fluctuations in the stock particularly well. Fishing at $\mathbf{F_{pa}}$ will at current recruitment levels make SSB fluctuate around $\mathbf{B_{pa}}$, and therefore the stock will in some years be slightly below $\mathbf{B_{pa}}$ and in other years, such as in 2001, be slightly above. Therefore, the ICES assessment of the state of the stock will move in and out of safe biological limits. Medium-term considerations indicate that continued fishing at $\mathbf{F_{sq}}$ implies low probability of falling below $\mathbf{B_{pa}}$.

The following table illustrates the proportional contribution of landings by area over different periods.

% landings by area over different periods		
Period	Area IIIa & IV	Area VI
1982-1998	86	14
1988-1998	87	13
1993-1998	91	9

Comparison with previous assessment and advice: The perception of the state of the stock is different from last year when the stock was considered to be outside safe biological limits. The general tendency of this assessment to overestimate F and underestimate SSB has persisted, and the current assessment indicates that the stock is within safe biological limits.

Catch forecast for 2002:

Basis: $\mathbf{F}_{sq}$ = F(98–00 scaled) = 0.29; Landings (2001) = 110; SSB(2002) = 233.

F(2001 onwards)	Basis	Total Landings	Landings IIIa & IV*) (2002)	Landings VI*) (2002)	SSB(2003)
0.12	0.4 $\mathbf{F}_{sq}$	51	46	5	294
0.17	0.6 $\mathbf{F}_{sq}$	74	67	7	272
0.23	0.8 $\mathbf{F}_{sq}$	95	86	9	252
0.29	1.0 $\mathbf{F}_{sq}$	115	105	10	234
0.35	1.2 $\mathbf{F}_{sq}$	133	121	12	217
0.40	$\mathbf{F}_{pa}$ = 1.38 $\mathbf{F}_{sq}$	148	135	13	203
0.44	1.5 $\mathbf{F}_{sq}$	158	144	14	194

Weights in '000 t.

Shaded scenarios considered inconsistent with the precautionary approach.

*Landings split according to average in 1993-1998.

Medium- and long-term projections: Results of the medium-term analysis indicate that under the *status quo* fishing mortality there is a low probability of falling below $\mathbf{B}_{pa}$ in the medium-term.

Elaboration and special comment: Saithe in the North Sea are mainly taken in a direct trawl fishery in deep water near the Northern Shelf edge and the Norwegian deeps. Norwegian, French and German trawlers take the majority of the catches. In the first half of the year the fishery is directed towards mature fish, while immature fish dominate in the catches the rest of the year. The main fishery was developed in the beginning of 1970s. In later years, the trawlers have also exploited deep-water fish. The fishery in Sub-area VI consists largely of a directed French, German and Norwegian deep-water fishery operating on the shelf edge, and a Scottish fishery operating inshore.

Analytical assessment is based on catch-at-age analysis using CPUE information from commercial fisheries. Lack of recruitment indices for recent and incoming year classes makes catch predictions imprecise.

Before 1999, saithe in Sub-area VI and saithe in Sub-area IV and Division IIIa were assessed as two separate stocks. The ICES advice applies to the combined areas IIIa, IV, and VI.

Source of information: Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, June 2001, Hamburg, Germany (ICES CM 2002/ACFM: 01).

Yield and spawning biomass per Recruit
F-reference points:

	Fish Mort Ages 3-6	Yield/R	SSB/R
Average Current	0.290	0.628	1.334
$\mathbf{F}_{max}$	0.162	0.660	2.559
$\mathbf{F}_{0.1}$	0.087	0.610	4.274
$\mathbf{F}_{med}$	0.371	0.604	0.965

Catch data (Tables 3.5.5.1-2):

Saithe in IV and IIIa

Year	ICES Advice	Predicted landings corresp. to advice	Agreed TAC	Official landings	ACFM landings
1987	Reduce F	<198	173	154	149
1988	60% of F(86); TAC	156	165	113	107
1989	No increase in F; TAC	170	170	92	92
1990	No increase in F; TAC	120	120	85	88
1991	No increase in F; TAC	125	125	93	99
1992	No increase in F; TAC	102	110	92	92
1993	70% of F(91) ~ 93 000 t	93	93	99	105
1994	Reduce F by 30%	72	97	90	102
1995	No increase in F	107	107	97	113
1996	No increase in F	111	111	96	110
1997	No increase in F	113	115	86	103
1998	Reduce F by 20%	97	97	86	100
1999	Reduce F to $\mathbf{F}_{pa}$	104	110	106	107
2000	Reduce F by 30 %	75	85	86	87
2001	Reduce F by 20 %	87	87		
2002	F < $\mathbf{F}_{pa}$	<135			

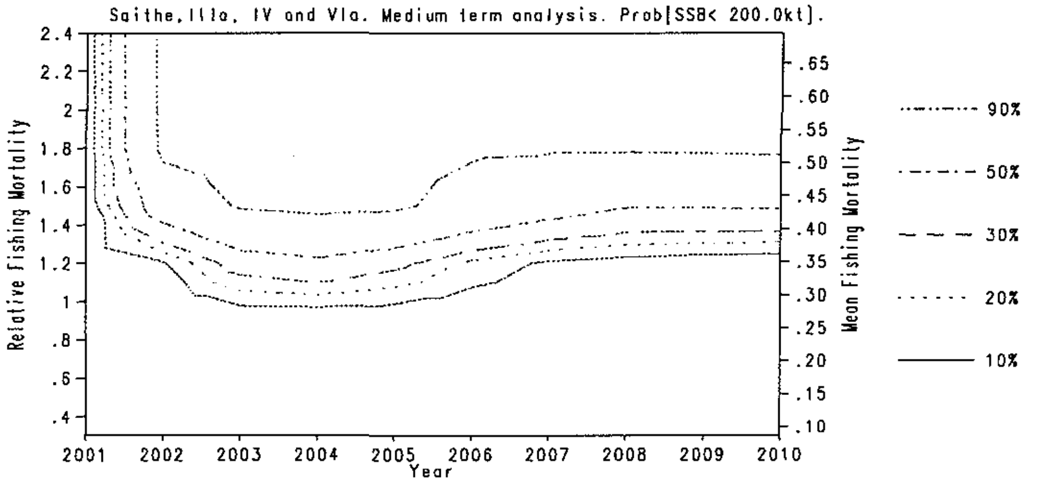
Weights in '000 t.

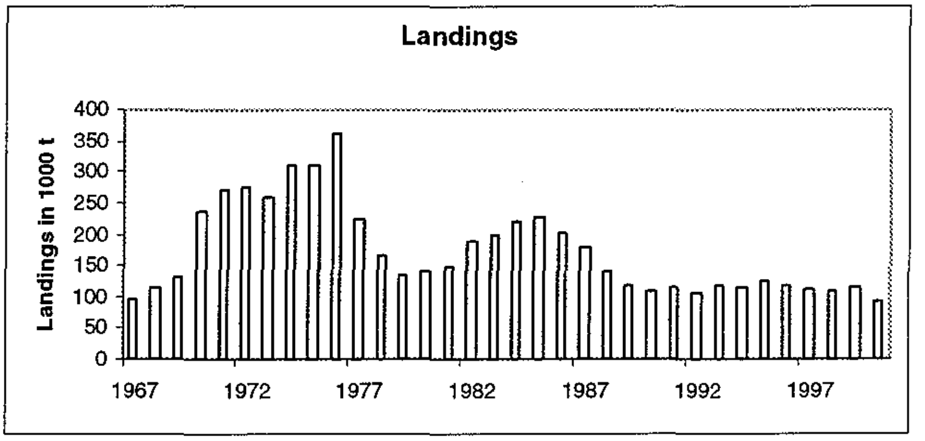
Saithe in VI

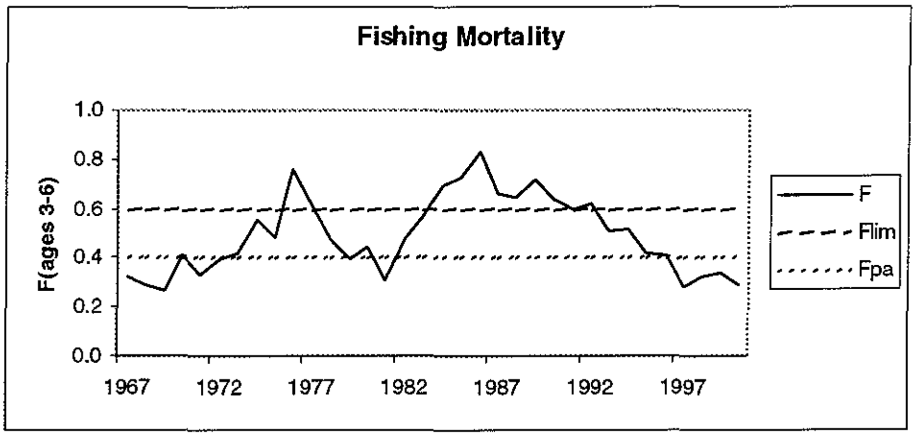
Year	ICES Advice	Predicted landings corresp to advice	Agreed TAC	Official landings	ACFM landings
1987	F reduced towards $\mathbf{F}_{max}$	19	27.8	32.5	31.4
1988	80% of F(86); TAC	35	35	32.8	34.2
1989	F < 0.3; TAC	20	30	22.4	25.6
1990	80% of F(88); TAC	24	29	18.0	19.9
1991	Stop SSB decline; TAC	21	22	17.9	17.0
1992	Avoid further reduction in SSB	<19	17	10.8	11.8
1993	F = 0.21	6.3	14	14.5	13.9
1994	Lowest possible F		14	13.0[2]	12.8
1995	Significant reduction in effort	-	16	10.6[2]	11.8
1996	No increase in F	10.2[1]	13	9.4[2]	9.4
1997	Significant reduction in F		12	8.6[2]	9.4
1998	60% Reduction in F	4.8	10.9	7.4[2]	8.4
1999	60% reduction in F	4.8	7.5	6.8	7.3
2000	Reduce F by 30 %	6.0	7	6.4	5.9
2001	Reduce F by 20 %	9.0	9		
2002	F< $\mathbf{F}_{pa}$	<13			

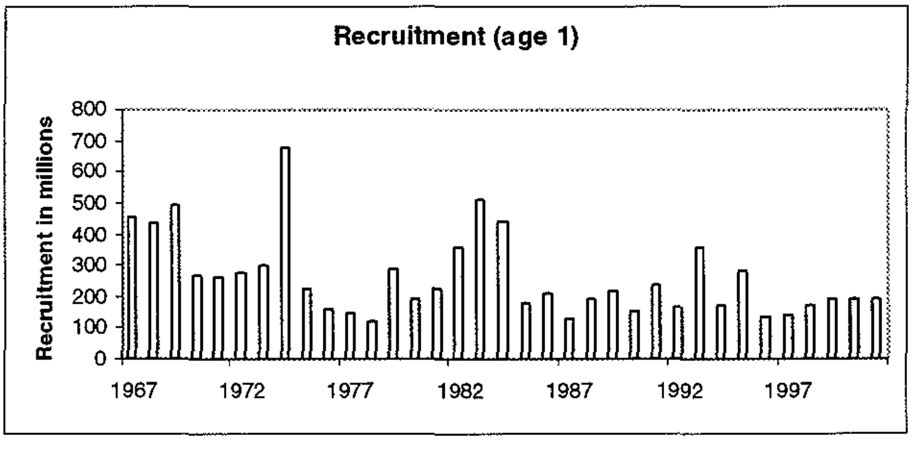
[1]*Status quo* catch. [2] Incomplete data. Weights in '000 t.

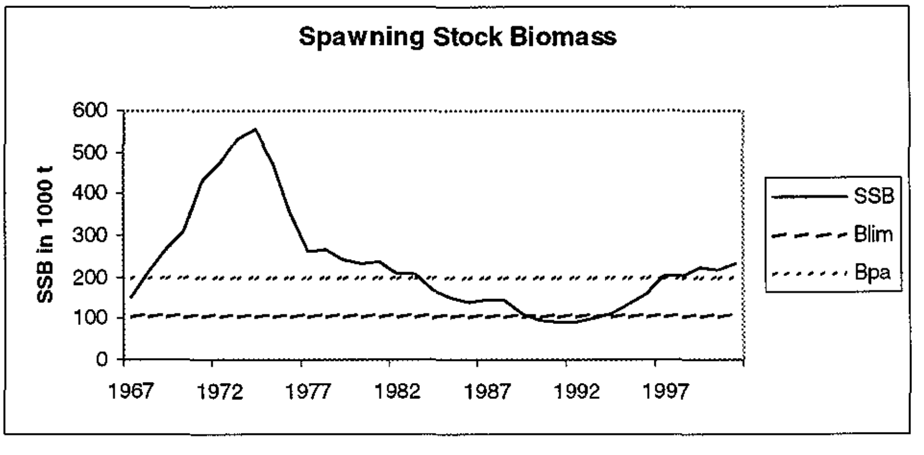
Saithe IV, VIa and IIIa. Summary of medium term analysis. Contours show the probability the SSB will be below $\mathbf{B}_{pa}$ for any combination of year and fishing mortality.

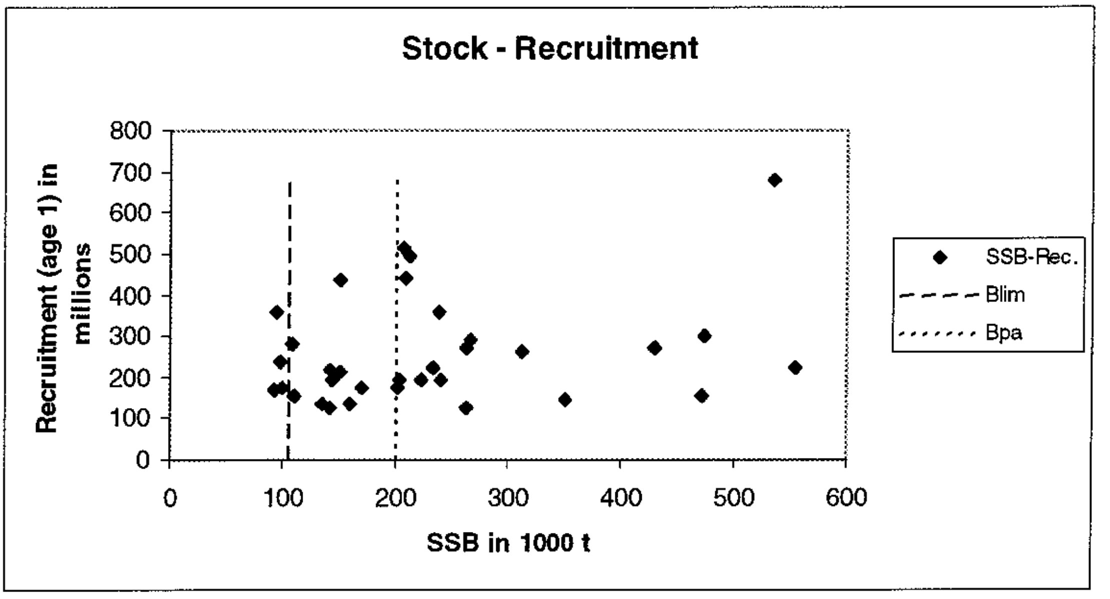


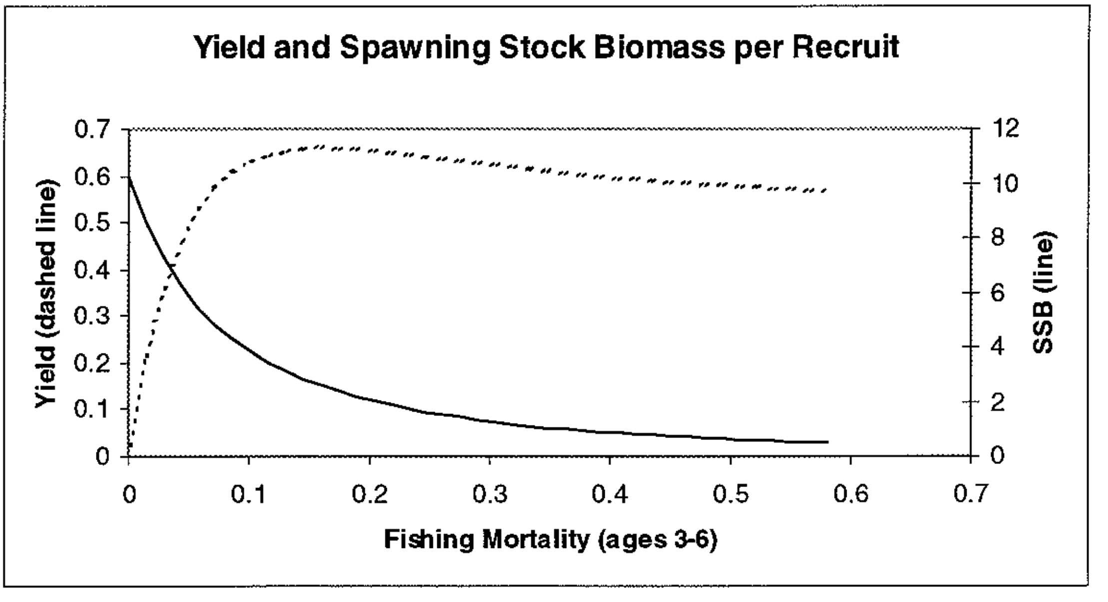

Landings
Landings in 1000 t
400
350
300
250
200
150
100
50
0
1967
1972
1977
1982
1987
1992
1997


Fishing Mortality
F(ages 3-6)
1.0
0.8
0.6
0.4
0.2
0.0
1967
1972
1977
1982
1987
1992
1997
F
Flim
Fpa


Recruitment (age 1)
Recruitment in millions
800
700
600
500
400
300
200
100
0
1967
1972
1977
1982
1987
1992
1997


Spawning Stock Biomass
SSB in 1000 t
600
500
400
300
200
100
0
1967
1972
1977
1982
1987
1992
1997
SSB
Blim
Bpa


Stock - Recruitment
Recruitment (age 1) in millions
SSB in 1000 t
0
100
200
300
400
500
600
700
800
SSB-Rec.
Blim
Bpa


Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
SSB (line)
Fishing Mortality (ages 3-6)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
2
4
6
8
10
12

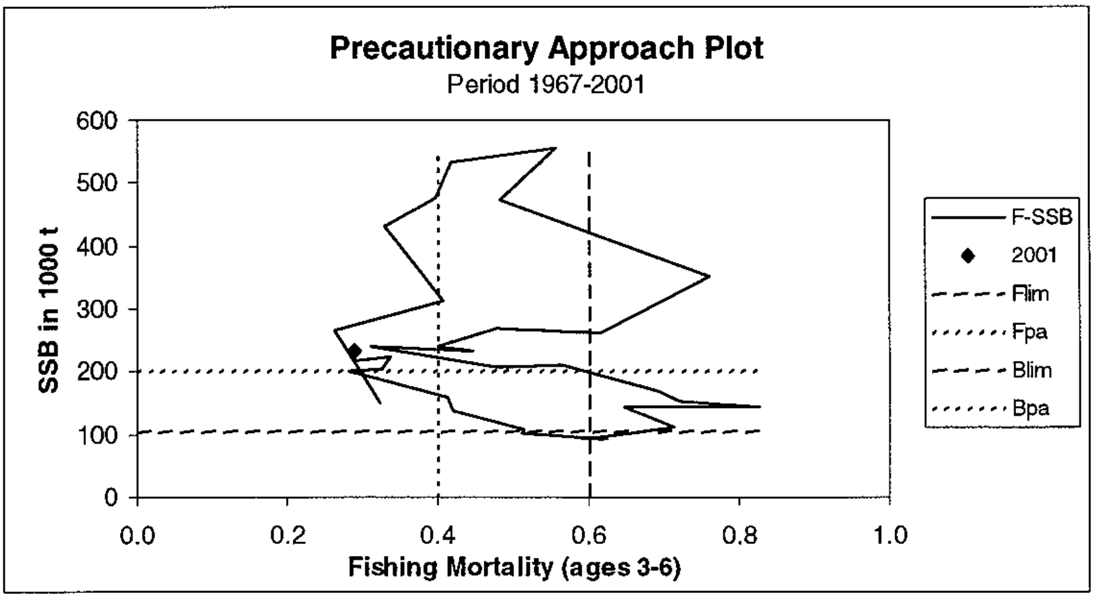

Precautionary Approach Plot
Period 1967-2001
SSB in 1000 t
Fishing Mortality (ages 3-6)
0.0
0.2
0.4
0.6
0.8
1.0
F-SSB
2001
Flim
Fpa
Blim
Bpa

Table 3.5.5.1 Nominal catch (in tonnes) of Saithe in Sub-area IV and Division IIIa and Sub-area VI, 1991-2000, as officially reported to ICES.

Sub-area IV and Division IIIa

Country	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Belgium	29	70	113	130	228	157	254	249	200	122
Denmark	6,314	4,669	4,232	4,305	4,388	4,705	4,513	3,967	4,494	3,529
Faroe Islands	671	2,480	2,875	1,780	3,808	617	158	1,298	1,101	-
France	14,795	9,061	15,258	13,612	11,224	12,336	10,932	11,786	24,305	20,399
Germany	19,574	13,177	14,814	10,013	12,093	11,567	12,581	10,117	10,481	9,273
Netherlands	199	180	79	18	9	17	40	7	7	11
Norway	36,240	48,205	47,669	47,042	53,793	55,531	46,484	49,540	55,816	43,224
Poland	1,336	1,238	937	151	592	365	822	813	862	747
Sweden	1,514	3,302	4,955	5,366	1,891	1,771	1,647	1,857	1,929	1,421
UK (E. & W.)	4,070	2,893	2,429	2,354	2,522	2,864	2,556	2,293	2,874	...
UK (Scotland)	8,602	6,881	5,929	5,566	6,341	5,848	6,329	5,353	5,420	...
United Kingdom										6,711
U.S.S.R.	116	-	-	-	-	-	-	-	-	67
Total reported	93,460	92,156	99,290	90,337	96,889	95,778	86,316	87,280	107,489	85,504
Unallocated	5,121	187	5,840	12,098	16,525	14,458	17,006	12,983	-175	1,945
W.G. estimate	98,581	92,343	105,130	102,435	113,414	110,236	103,322	100,263	107,314	87,449
TAC	125,000	110,000	93,000	97,000	107,000	111,000	115,000	97,000	110,000	85,000

Preliminary values for France (1989-1995, 1998-2000), Norway (1995, 1997-2000), Sweden (1999).
Includes IIa (EC), IIIa-d (EC) and IV: France (1989-1991, 1994, 1999-2000).
Includes Estonia: USSR (1991).

Sub-area VI

Country	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Belgium	6	2	2	-	-	-	-	-	-	-
Denmark	-	1	2	-	-	1	-	-	-	-
Faroe Islands	24	1	-	-	-	3	1	-	-	
France	12,423	6,534	10,216	8,423	6,145	4,781	4,662	3,635	3,467	3,314
Germany	590	685	222	524	321	1,012	492	506	250	305
Ireland	260	278	317	438	530	419	411	216	320	-
Norway	31	67	59	74	35	34	26	41	126	58
Portugal	-	-	-	-	-	-	1	-	-	-
Russia	-	-	-	-	-	-	-	-	3	6
Spain	49	-	-	-	-	-	13	54	23	-
UK (E. & W. & N.I.)	593	540	799	744	317	708	294	526	503	...
UK (Scotland)	3,885	2,708	2,903	2,828	3,279	2,435	2,659	2,402	2,084	...
United Kingdom										2,740
Total reported	17,861	10,816	14,520	13,031	10,627	9,393	8,559	7,380	6,776	6,423
Unallocated	-866	988	-577	-210	1,143	40	859	1,054	566	-533
W.G. estimate	16,995	11,804	13,943	12,821	11,770	9,433	9,418	8,434	7,342	5,890

Preliminary values: France (1998-2000), Norway (1994, 1997-1999).
Includes Division Vb (EC): France (1991).
Reported by TAC area, Vb (EC), VI, XII and XIV: France (1999-2000).

Sub-areas IV and VI and Division IIIa

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
W.G. estimate	115,576	104,147	119,073	115,256	125,184	119,669	112,740	108,697	114,656	93,339

Table 3.5.5.2 Saithe in Sub-area IV, Division IIIa and Sub-area VI.

Year	Recruitment Age 1 thousands	SSB tonnes	Landings tonnes	Mean F Ages 3-6
1967	453724	150833	94514	0.32
1968	438349	211714	116789	0.29
1969	492253	263945	131882	0.26
1970	270937	311985	236636	0.41
1971	260820	429523	272481	0.33
1972	273390	474019	275098	0.40
1973	301413	534364	259602	0.42
1974	678081	554727	309439	0.56
1975	222200	471828	308926	0.48
1976	157062	351239	361680	0.76
1977	145115	262744	223395	0.62
1978	124292	267277	166199	0.48
1979	288935	239979	135967	0.40
1980	192200	233565	142395	0.45
1981	221811	238349	146092	0.31
1982	358101	206218	189861	0.48
1983	514839	209086	197774	0.57
1984	440479	170172	219642	0.69
1985	176369	151686	226129	0.72
1986	212003	142255	202758	0.83
1987	128388	144467	180776	0.66
1988	192736	142808	140778	0.65
1989	218706	110296	117609	0.71
1990	156469	98015	107945	0.64
1991	235616	92269	115576	0.59
1992	168651	94091	104147	0.62
1993	356442	100674	119073	0.51
1994	173023	108963	115255	0.52
1995	279477	135806	125183	0.42
1996	136828	159236	119669	0.41
1997	138034	201705	112740	0.28
1998	174760	203613	108699	0.32
1999	194470	222837	114655	0.34
2000	194470	217544	93340	0.29
2001	194470[1]	232000[2]		0.29
Average	261855	232567	173315	0.49

[1] GM 1989-1998.

[2] Based on 1998-2000 mean weight at age.

3.5.6 Plaice in Sub-area IV (North Sea)

State of stock/exploitation: The stock is considered to be outside safe biological limits. SSB in 2001 is below $\mathbf{B_{pa}}$ and fishing mortality in 2000 was above $\mathbf{F_{pa}}$. Spawning stock biomass has declined from 1989 to 1997, where it reached its historical minimum. Fishing mortality increased from the 1960s to the 1990s, reaching a record high in 1997. Except for the 1996 year class, recruitment since 1993 has been below average. Surveys indicate that the 2001 year class measured as 0-group is strong.

Management objectives: In 1999, the EU and Norway have *"agreed to implement a long-term management plan for the plaice stock, which is consistent with the precautionary approach and is intended to constrain harvesting within safe biological limits and designed to provide for sustainable fisheries and greater potential yield. The plan shall consist of the following elements:*

1. *Every effort shall be made to maintain a minimum level of SSB greater than 210 000 t ($\mathbf{B_{lim}}$).*

2. *For 2000 and subsequent years the Parties agreed to restrict their fishing on the basis of a TAC consistent with a fishing mortality of 0.3 for appropriate age groups as defined by ICES.*

3. *Should the SSB fall below a reference point of 300 000 t ($\mathbf{B_{pa}}$), the fishing mortality referred to under paragraph 2 shall be adapted in the light of scientific estimates of the conditions then prevailing. Such adaptation shall ensure a safe and rapid recovery of SSB to a level in excess of 300 000 t.*

4. *In order to reduce discarding and to enhance the spawning biomass of plaice, the Parties agreed that the exploitation pattern shall, while recalling that other demersal species are harvested in these fisheries, be improved in the light of new scientific advice from, inter alia, ICES.*

The Parties shall, as appropriate, review and revise these management measures and strategies on the basis of any new advice provided by ICES."

ICES considers that the agreed Precautionary Approach reference points in the management plan are consistent with the precautionary approach, provided they are used as upper bounds on F and lower bounds on SSB, and not as targets.

Precautionary approach reference points (unchanged since 1998):

ICES considers that:	ICES proposes that:
$\mathbf{B_{lim}}$ is 210 000 t, the lowest observed biomass.	$\mathbf{B_{pa}}$ be set at 300 000 t. This is the previously agreed MBAL and affords a high probability of maintaining SSB above $\mathbf{B_{lim}}$, taking into account the uncertainty of assessments.
$\mathbf{F_{lim}}$ is 0.6.	$\mathbf{F_{pa}}$ be set at 0.30. This F is considered to provide approximately 95% probability of avoiding $\mathbf{F_{lim}}$, taking into account the uncertainty of the assessment.

Technical basis:

$\mathbf{B_{lim}}$=$\mathbf{B_{loss}}$=210 000 t.	$\mathbf{B_{pa}}$ Approximately 1.4 $\mathbf{B_{lim}}$, previous MBAL.
$\mathbf{F_{lim}}$=$\mathbf{F_{loss}}$=0.6.	$\mathbf{F_{pa}}$ = 5th % of $\mathbf{F_{loss}}$ (0.6) is 0.36, which implies that $\mathbf{B_{eq}} < \mathbf{B_{pa}}$. Therefore a lower value is required. F = 0.3 implies $\mathbf{B_{eq}} > \mathbf{B_{pa}}$ and a less than 10 % probability that $\mathbf{SSB_{MT}} < \mathbf{B_{pa}}$.

NB: As F increases above 0.3, P($\mathbf{SSB_{MT}} < \mathbf{B_{pa}}$) increases rapidly.

Advice on management: ICES recommends that the fishing mortality be less than $\mathbf{F_{pa}} = 0.3$, corresponding to landings of less than 77 000 t in 2002.

Relevant factors to be considered in management: In this stock, SSB is persistently over-estimated and F under-estimated, possibly as a result of not including discards in the assessment. The bias of the assessment suggests that the TAC for 2002 should be set lower than the 77 000 t.

The impact of the cod emergency measures in 2001 and of the agreed technical measures that will be implemented from 2002 onwards have not been evaluated. It has been observed that the closed area in 2001 has induced a change in the spatial distribution of the fleets. The implementation of a square mesh panel for beam trawl gears, which will be mandatory from 2002 onwards, is not expected to affect the exploitation of plaice.

Comparison with previous assessments: The assessment has changed because of a revision of the age compositions in the landings and because commercial CPUE series have been excluded. The new assessment gives a higher estimate of spawning biomass in recent years and also a higher estimate of fishing mortality compared to the previous assessment, but it has not resolved the retrospective bias, which is thought to originate from the catch data.

Catch forecast for 2002:

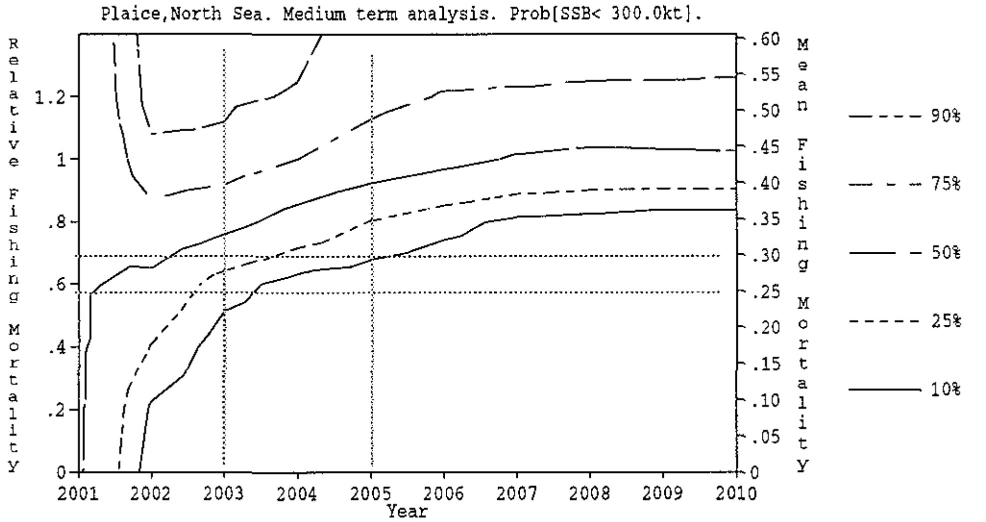
Basis: F(2001) = $\mathbf{F}_{sq}$ = F(98–00) scaled = 0.43; Landings(2001) = 117; SSB(2002) = 247.

F(2002 onwards)	Basis	Landings (2002)	SSB (2003)
0.17	0.4 * $\mathbf{F}_{sq}$	47	339
0.22	0.5 * $\mathbf{F}_{sq}$	58	328
0.25	0.58 * $\mathbf{F}_{sq}$	65	320
0.26	0.6 * $\mathbf{F}_{sq}$	68	317
0.30	$\mathbf{F}_{pa}$ = 0.7 * $\mathbf{F}_{sq}$	77	307
0.35	0.8 * $\mathbf{F}_{sq}$	86	297
0.39	0.9 * $\mathbf{F}_{sq}$	95	288
0.43	1.0 * $\mathbf{F}_{sq}$	103	280
0.48	1.1 * $\mathbf{F}_{sq}$	111	271
0.52	1.2 * $\mathbf{F}_{sq}$	119	264

Weights in '000 t.

Shaded scenarios considered inconsistent with the precautionary approach.

Medium- and long-term projections: Medium-term analysis indicates that fishing at $\mathbf{F}_{pa}$ (=0.3) would give a very low probability that SSB is below $\mathbf{B}_{pa}$ in year 2005. A fishing mortality rate of 0.25 would give a low probability of SSB still being below $\mathbf{B}_{pa}$ in 2003.



Elaboration and special comment: Due to the minimum mesh size (80 mm) in the mixed beam trawl fishery, south of 55°N, or 56°N east of 5°E, large numbers of (undersized) plaice are discarded. Estimates of discards are not included in the assessment since time series of discards are not available. Because discards are not included in the assessment the fishing mortality on juveniles is underestimated. Ongoing sampling programmes indicate that discarding in recent years has increased from about 50% in numbers historically to 70-80% in 2000 and 2001. The high estimates of discards in recent years may be caused by a reduction in growth, which extends the time the fish is undersized and subject to discarding. There is a need for continuous monitoring of discards and special attention should be given to reconstructing recent discard trends so as to improve the assessment of this stock.

Commercial CPUE series have been excluded from the assessment this year. There was accumulating evidence that the CPUE series may be biased by restrictive TACs and may thus not reflect the trends in the stock.

The strong 1996 year class has started to recruit to the fishery in the summer of 1999. The 1996 year class has increased the SSB less than expected. First indications of the 2001 year class are that it is also strong. If this year class follows a similar pattern of growth and maturation as the 1996 year class, it implies that it too may show delayed recruitment to the fishery and high discard rates over an extended period.

The stock-recruitment plot suggests that in recent years recruitment has declined at lower SSB. However, recruitment surveys at age zero do not indicate such a reduction, and it is possible that the lower estimated recruitment in the assessment may be explained by an increase in discarding.

Around 9% of the total cod landings in 1999 in the North Sea were taken by beam trawlers fishing for plaice and sole (Anon 2001).

North Sea plaice is taken mainly in a mixed flatfish fishery by beam trawlers in the southern and south-eastern North Sea. Directed fisheries are also carried out with seine and gillnet, and by beam trawlers in the central North Sea.

Since 1989, an area with high concentrations of small plaice ("Plaice Box") was closed to beam trawl fisheries with vessels > 300 hp during the second and third quarter and, since 1994, during the fourth quarter as well. Since 1995, the plaice box has been closed for the whole year. Beam trawlers < 300 hp are allowed to fish inside the box. Effort reductions have mainly been effective since 1994 when the fourth quarter was closed and when effort levels in the box decreased to around 10% of the pre-box level.

Analytical assessment uses catch-at-age and CPUE data from surveys only. Forecasts use indices from research vessel surveys, including one from 2001 surveys. No discards are used in the assessment.

Source of information: Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, June 2001, Hamburg, Germany (ICES CM 2002/ACFM: 01).

References: Anon (2001) Report of the scientific meeting on improvement of selectivity of fishing gears. Brussels, 5-9 March 2001.

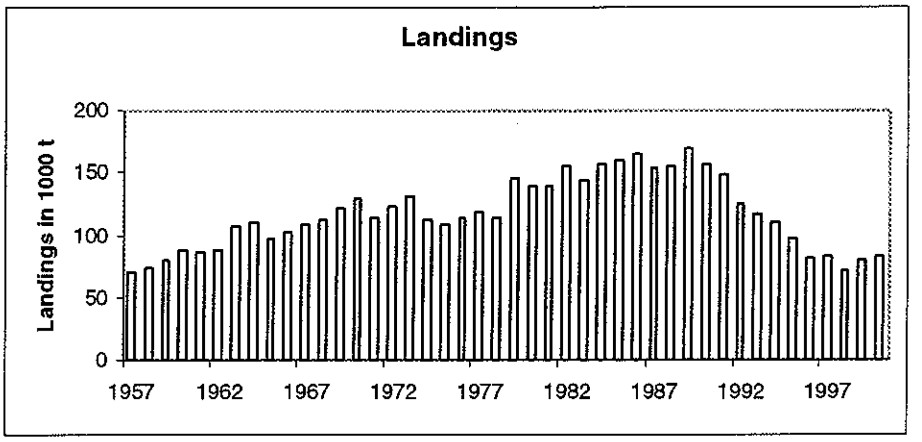
Yield and spawning biomass per Recruit F-reference points:

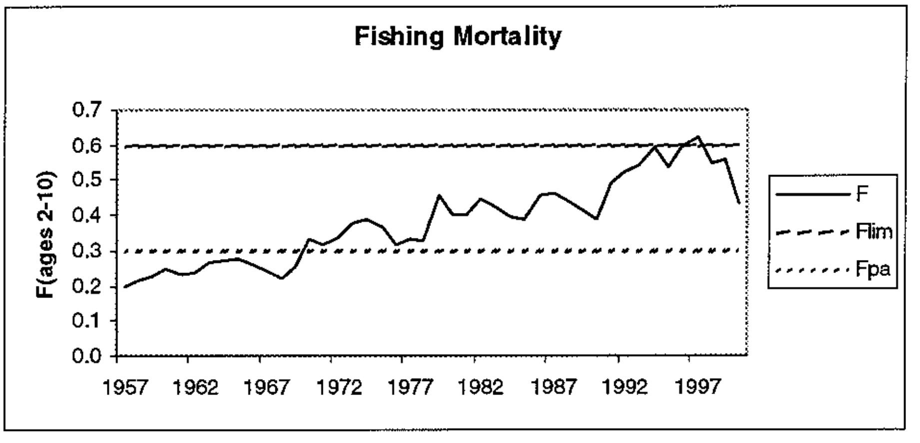
	Fish Mort Ages 2-10	Yield/R	SSB/R
Average Current	0.342	0.264	0.777
$\mathbf{F}_{max}$	0.295	0.265	0.915
$\mathbf{F}_{0.1}$	0.153	0.245	1.837
$\mathbf{F}_{med}$	0.338	0.264	0.786

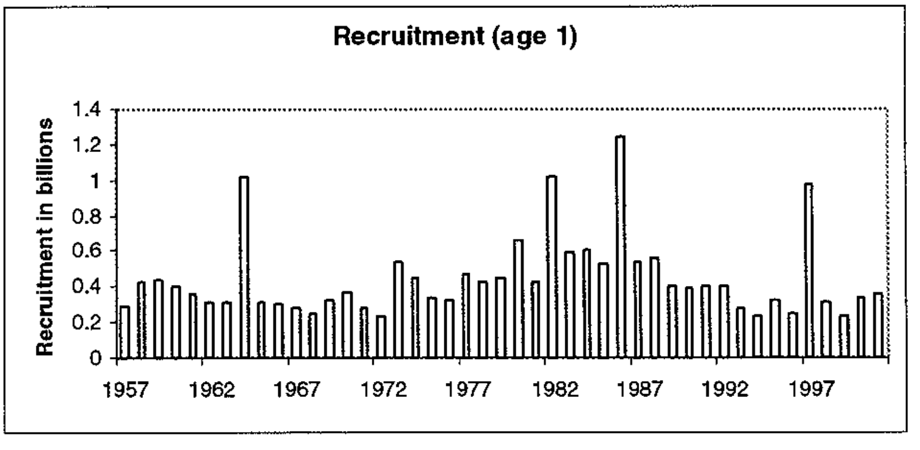
Catch data (Tables 3.5.6.1–2):

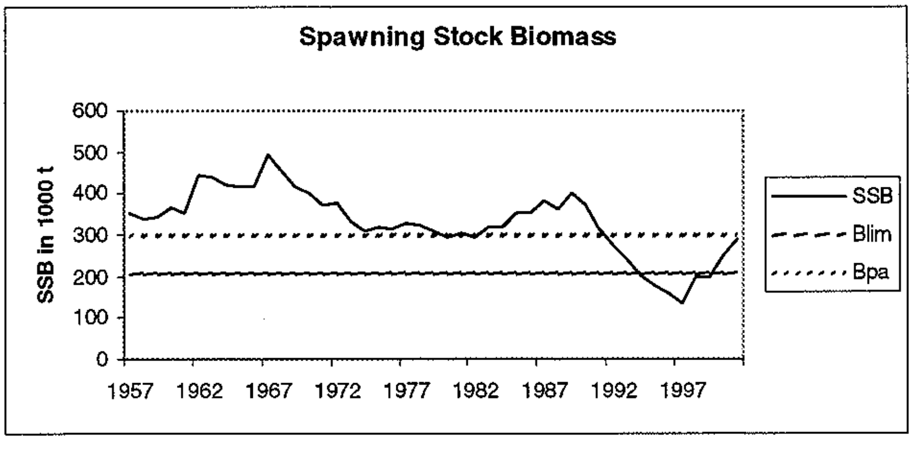
Year	ICES Advice	Predicted landings corresp. to advice	Agreed TAC	Official landings	ACFM Landings
1987	F < F(84); TAC	120	150	131	154
1988	70% of F(85); TAC	150	175	138	154
1989	Reduce F; buffer SSB	<175	185	152	170
1990	*Status quo* F; TAC	171	180	156	156
1991	No increase in F; TAC	169	175	144	148
1992	No long-term gains in increasing F	-[1]	175	123	125
1993	No long-term gains in increasing F	170[1]	175	115	117
1994	No long-term gains in increasing F	-[1]	165	110	110
1995	Significant reduction in F	87[2]	115	96	98
1996	Reduction in F of 40%	61	81	80	82
1997	Reduction in F of 20%	80	91[3]	82	83
1998	Fish at F = 0.3	82	87	70	72
1999	Fish at F = 0.3	106	102	79	81
2000	Fish at F = 0.3	95	97	84	83
2001	Fish at F = 0.26	78	78		
2002	F< $\mathbf{F}_{pa}$	<77			

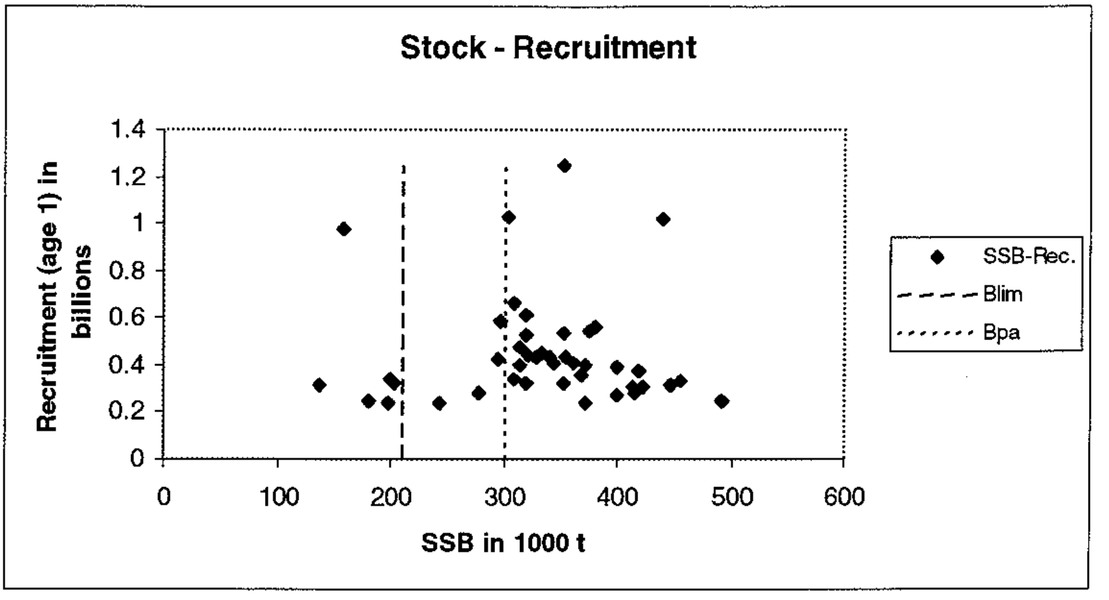
[1] Catch at *status quo* F. [2] Catch at 20% reduction in F. [3] After revision from 77 000 t. Weights in '000 t.

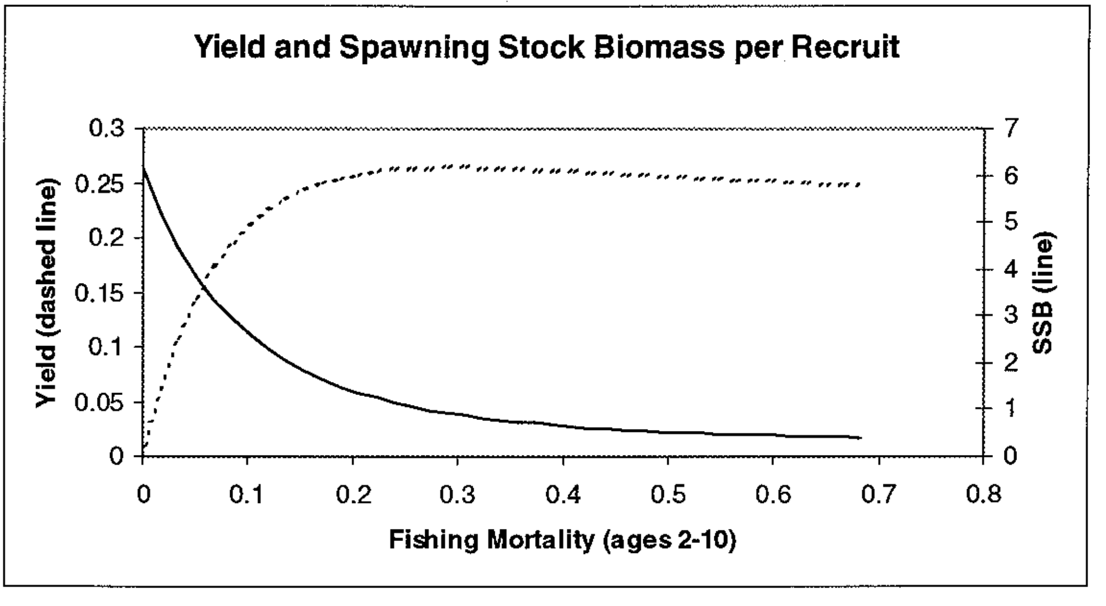

Landings
Landings in 1000 t
200
150
100
50
0
1957
1962
1967
1972
1977
1982
1987
1992
1997


Fishing Mortality
F(ages 2-10)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1957
1962
1967
1972
1977
1982
1987
1992
1997
F
Flim
Fpa


Recruitment (age 1)
Recruitment in billions
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1957
1962
1967
1972
1977
1982
1987
1992
1997


Spawning Stock Biomass
SSB in 1000 t
600
500
400
300
200
100
0
1957
1962
1967
1972
1977
1982
1987
1992
1997
SSB
Blim
Bpa


Stock - Recruitment
Recruitment (age 1) in billions
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0
100
200
300
400
500
600
SSB in 1000 t
SSB-Rec.
Blim
Bpa


Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
0.3
0.25
0.2
0.15
0.1
0.05
0
SSB (line)
7
6
5
4
3
2
1
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
Fishing Mortality (ages 2-10)

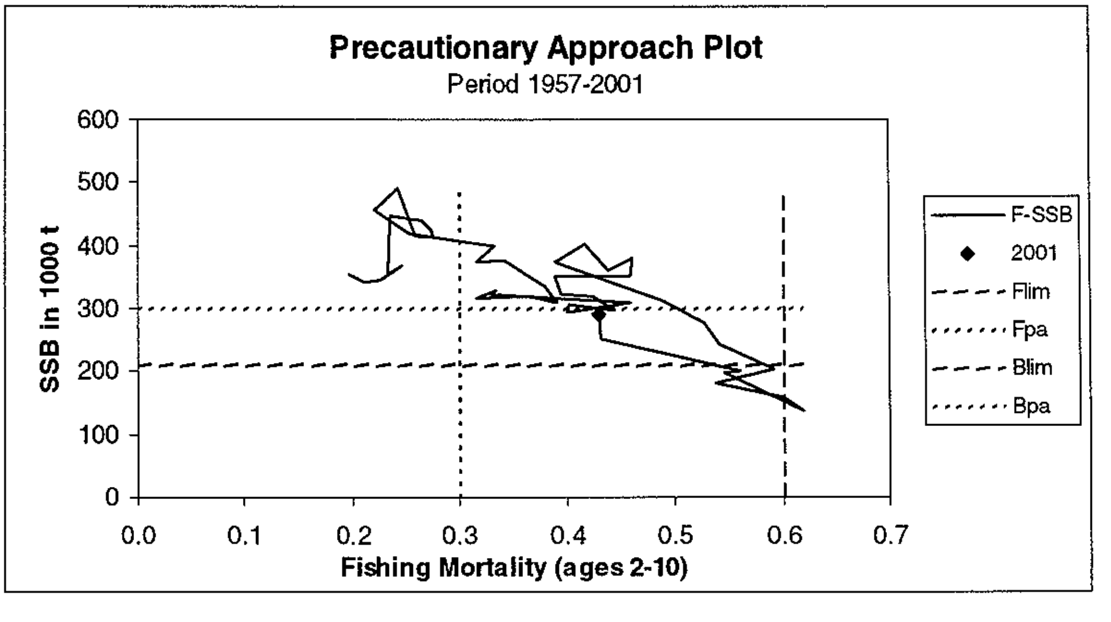

Precautionary Approach Plot
Period 1957-2001
SSB in 1000 t
600
500
400
300
200
100
0
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Fishing Mortality (ages 2-10)
F-SSB
2001
Flim
Fpa
Blim
Bpa

Table 3.5.6.1 North Sea plaice. Nominal landings (tonnes) in Sub-area IV as officially reported to ICES.

Country	1993	1994	1995	1996	1997	1998	1999	2000
Belgium	10,814	7,951	7,093	5,765	5,223	5,592	6,160	7,620
Denmark	16,452	17,056	13,358	11,776	13,940	10,087	13,468	13,408
France	603	407	442	379	254	489	624	836
Germany	6,895	5,697	6,329	4,780	4,159	2,773	3,144	4,310
Netherlands	48,552	50,289	44,263	35,419	34,143	30,541	37,513	35,030
Norway	827	524	527	917	1,775	1,004	913	835
Sweden	7	6	3	5	10	2	4	3
UK (E/W/NI)	20,586	17,806	15,801	13,541	13,789	11,473	9,743	...
UK (Scotland)	10,542	9,943	8,594	7,451	8,345	8,442	7,318	...
United Kingdom								20,711
Others						1		
Total	115,278	109,679	96,410	80,033	81,638	70,404	78,887	82,753
Unallocated	1,835	713	1,946	1,640	1,410	1,130	1,775	305
WG estimate	117,113	110,392	98,356	81,673	83,048	71,534	80,662	83,058
TAC	175,000	165,000	115,000	81,000	91,000	87,000	102,000	97,000

Table 3.5.6.2 Plaice in Sub-area IV (North Sea).

Year	Recruitment Age 1 thousands	SSB tonnes	Landings tonnes	Mean F Ages 2-10
1957	296163	354623	70563	0.1973
1958	429983	340635	73354	0.2118
1959	433434	345186	79300	0.2266
1960	405320	368309	87541	0.2469
1961	359379	352875	85984	0.2331
1962	318795	446567	87472	0.2345
1963	315179	439971	107118	0.2645
1964	1021861	422928	110540	0.2732
1965	309561	414346	97143	0.2761
1966	305362	416378	101834	0.2595
1967	277217	492995	108819	0.2427
1968	245490	456089	111534	0.2210
1969	327457	418262	121651	0.2539
1970	370424	399554	130342	0.3330
1971	275454	372328	113944	0.3156
1972	234542	375771	122843	0.3410
1973	541807	334687	130429	0.3807
1974	451868	308773	112540	0.3916
1975	335621	319972	108536	0.3658
1976	324479	314431	113670	0.3152
1977	471104	329119	119188	0.3351
1978	429718	322463	113984	0.3292
1979	444092	309150	145347	0.4588
1980	659427	294810	139951	0.3999
1981	424159	304858	139747	0.4029
1982	1024299	297234	154547	0.4447
1983	589367	320382	144038	0.4245
1984	607410	320807	156147	0.3959
1985	527093	352657	159838	0.3904
1986	1243815	352584	165347	0.4595
1987	538174	380713	153670	0.4611
1988	561857	361589	154475	0.4399
1989	406040	400767	169818	0.4175
1990	394258	372305	156240	0.3903
1991	399943	314350	148004	0.4890
1992	401431	277926	125190	0.5269
1993	283632	243691	117113	0.5417
1994	237772	204213	110392	0.5911
1995	321336	180697	98356	0.5389
1996	249406	159092	81673	0.6004
1997	977874	136791	83048	0.6197
1998	315648	198893	71534	0.5462
1999	236571	199980	80662	0.5597
2000	340136	250857	83058	0.4322
2001	359000[1]	289000[2]		0.4300
Average	444955	330436	116966	0.3824

[1] RCT3 estimate.

[2] Based on 1998-2000 mean weight at age.

3.5.7 Sole in Sub-area IV (North Sea)

State of stock/exploitation: The stock is being harvested outside safe biological limits. SSB in 2001 is above the proposed $\mathbf{B_{pa}}$ but fishing mortality in 2000 remains above $\mathbf{F_{pa}}$. The spawning stock reached an historic low in 1998 below $\mathbf{B_{lim}}$. It increased sharply following recruitment of the strong 1996 year class, but has since declined as this year class has passed through the fishery. Subsequent year classes have been about average.

Management objectives: No explicit management objectives are set for this stock.

Precautionary Approach reference points (unchanged since 1999):

ICES considers that:	ICES proposes that:
$\mathbf{B_{lim}}$ is 25 000 t, the lowest observed biomass.	$\mathbf{B_{pa}}$ be set at 35 000 t. This affords a high probability of maintaining SSB above $\mathbf{B_{lim}}$, taking into account the uncertainty of assessments.
$\mathbf{F_{lim}}$ is undefined.	$\mathbf{F_{pa}}$ be set at 0.4. This F is considered to provide a greater than 95% probability of avoiding $\mathbf{B_{lim}}$, taking into account the uncertainty of the assessment.

Technical basis:

$\mathbf{B_{lim}}$=$\mathbf{B_{loss}}$=25 000 t.	$\mathbf{B_{pa}} = 1.4 * \mathbf{B_{lim}}$
	$\mathbf{F_{pa}}$ 5th percentile (0.49) of $\mathbf{F_{loss}}$ implies $B_{eq} < \sim \mathbf{B_{pa}}$, F = 0.4 implies $\mathbf{B_{eq}} > \mathbf{B_{pa}}$ and P($\mathbf{SSB_{MT}} < \mathbf{B_{pa}}$) < 10%.

Advice on management: ICES recommends that fishing mortality on North Sea sole be reduced to below 0.37 corresponding to catches of less than 14 300 t in 2002 in order to maintain SSB at $\mathbf{B_{pa}}$ in the medium-term.

Relevant factors to be considered in management: The trend in SSB of this stock is heavily dependent on the occasionally occurring strong year classes. The SSB and landings in recent years has been dominated by the abundant 1996 year class which is no longer dominating in the stock and following year classes are of average strength. Consequently, the stock is decreasing and is expected to decrease further in 2003 below $\mathbf{B_{pa}}$, even if fishing mortality is reduced to $\mathbf{F_{pa}}$. A reduction in fishing mortality to well below $\mathbf{F_{pa}}$ is required to maintain SSB above $\mathbf{B_{pa}}$ in 2003. TACs in recent years have been agreed above the recommended $\mathbf{F_{pa}}$.

Two surveys indicate that the 2001 year class may be strong, but this year class will not affect SSB before 2004 and will not affect the short-term prediction. The size of this year class will be more precisely estimated by directed 0-group surveys. These results will become available in November 2001. The strength of the 2001 year class will affect medium-term prospects significantly.

Sole is mainly caught in a mixed beam trawl fishery with plaice using 80 mm mesh in the southern North Sea. This means it is important to take into account the impact of management measures for plaice when considering sole. There is not a simple one-to-one link between the catch of sole and plaice when considering effort reduction. The proposed reduction in fishing mortality for plaice is 30%, while the advice given above indicates a reduction of around 20%. These reductions are not considered to conflict.

Management measures, which produced a reduction in the mortality on juvenile sole would benefit the stock. The continued use of 80 mm mesh together with the minimum landing size of 24 cm results in a high proportion of sole being landed which are immature. The maintenance of the plaice box is a measure, which probably benefits sole by protecting juveniles in the main continental nursery areas.

The closed area in spring 2001 under the North Sea cod emergency regulations resulted in a redistribution of fishing activity for flatfish. The flatfish fishery was probably more impacted by this measure than the roundfish fishery. The consequences of these measures are not assessed or accounted for in the projections. Around 6% of the total cod landings in 1999 in the North Sea were taken by beam trawlers fishing for sole.

In relation to this, technical measures introduced in January 2000 may affect the exploitation of the sole and plaice. The area where fishing with 80 mm is allowed has extended from 55°N to 56°N east of 5°E. ICES is not able to assess the impact of this measure, but it is considered unlikely to have an impact on sole.

Comparison with previous assessment and advice: The assessment of North Sea sole appears to be relatively stable from year to year and comparison of the historical trends in F and SSB between this year and last show a close similarity.

Catch forecast for 2002:

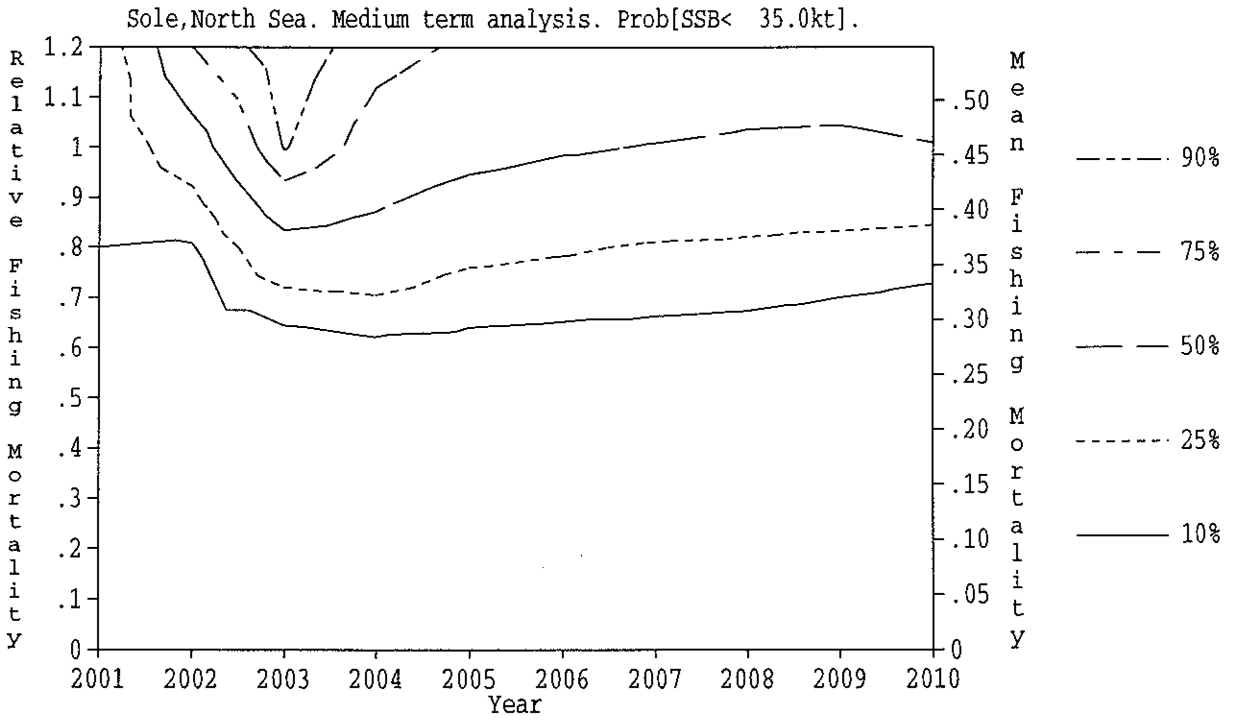
Basis: F(2001) = $\mathbf{F_{sq}}$ = F(1998-2000, scaled) =0.46; Landings (2001) = 19.8; SSB(2002)= 35.5.

F (2002)	Basis	Landings (2002)	SSB 2003)
0.27	0.6* $\mathbf{F_{sq}}$	11.1	36.1
0.32	0.7 * $\mathbf{F_{sq}}$	12.6	34.6
0.367	0.8* $\mathbf{F_{sq}}$	14.1	33.1
0.371	0.81 * $\mathbf{F_{sq}}$	14.3	33.0
0.40	0.87 * $\mathbf{F_{sq}}$ = $\mathbf{F_{pa}}$	15.1	32.1
0.46	$\mathbf{F_{sq}}$	16.9	30.4
0.55	1.2* $\mathbf{F_{sq}}$	19.4	27.9

Weights in '000 t.

Shaded scenarios considered inconsistent with the precautionary approach.

Medium and long-term projections: At $\mathbf{F_{sq}}$ (0.46), there is around 50% probability of the SSB falling below $\mathbf{B_{pa}}$ in the medium-term (10 years). A reduction of fishing mortality to $\mathbf{F_{pa}}$ will reduce the probability of falling below $\mathbf{B_{pa}}$ to around 25%.



Elaboration and special comment: Sole is mainly taken by beam trawl fleets in a mixed fishery for sole and plaice in the southern part of the North Sea. The minimum mesh size permitted when fishing for sole is 80 mm. Beam trawl fleets started to develop in the mid-1960s, and have expanded up to the 1990s. A relatively small part of the catch is taken in a directed fishery by gill-netters in coastal areas, mostly in the 2nd quarter of the year. Since 1989, the distribution pattern of the beam trawl fleets > 300 HP has changed due to the introduction of the 'Plaice Box' in the south-eastern part of the North Sea.

Source of information: Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, June 2001, Hamburg, Germany (ICES CM 2002/ACFM: 01).

References: Anon (2001) Report of the scientific meeting on improvement of selectivity of fishing gears. Brussels, 5-9 March 2001.

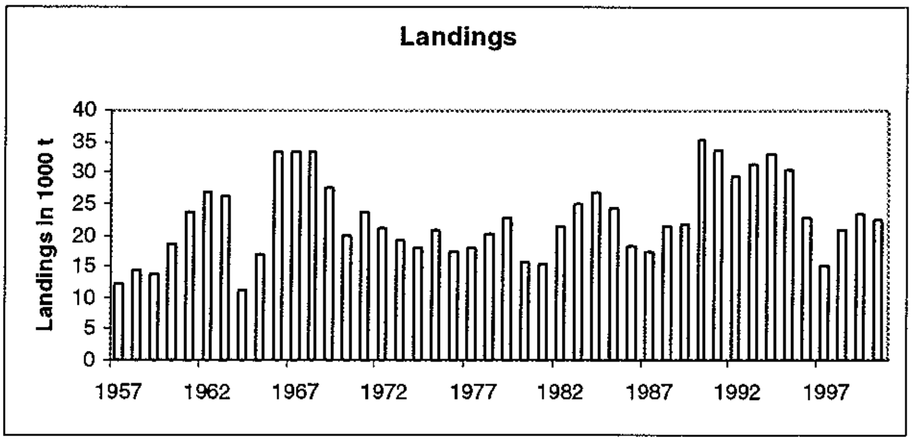
Yield and spawning biomass per Recruit F-reference points:

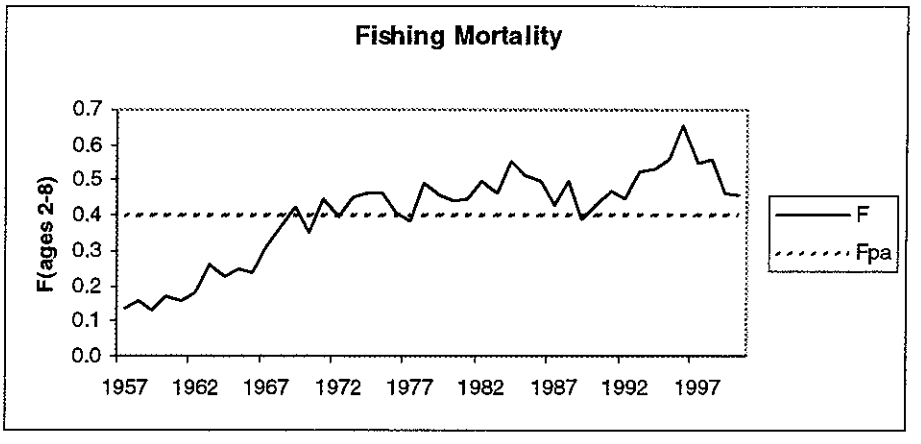
	Fish Mort Ages 2-8	Yield/R	SSB/R
Average Current	0.457	0.165	0.321
$\mathbf{F}_{max}$	0.329	0.166	0.448
$\mathbf{F}_{0.1}$	0.094	0.145	1.368
$\mathbf{F}_{med}$	0.282	0.165	0.524

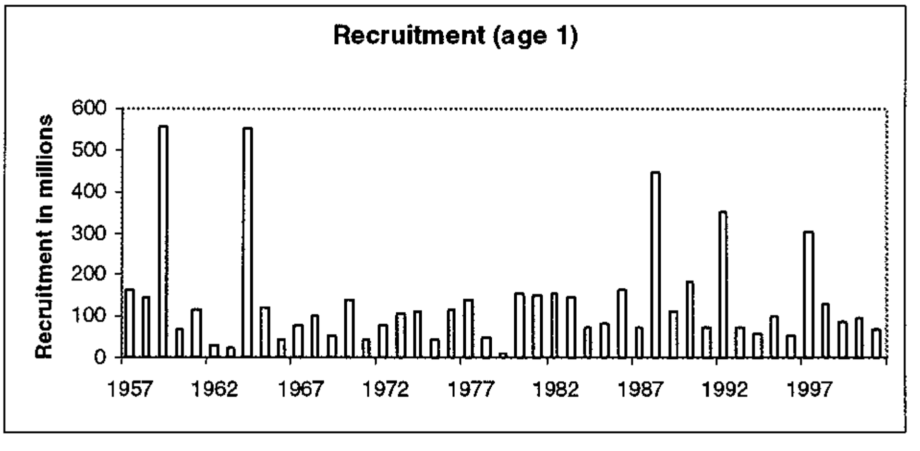
Catch data (Tables 3.5.7.1–2):

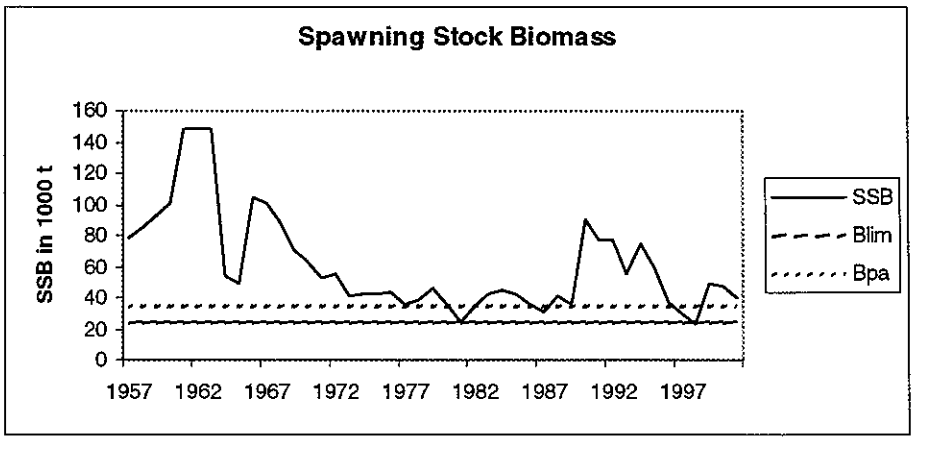
Year	ICES Advice	Predicted landings corresp. to advice	Agreed TAC	Official landings	ACFM Landings
1987	Rebuild SSB to 40 000 t; TAC	11.0	14.0	13.8	17.4
1988	Increase SSB towards 50 000 t; TAC	11.0	14.0	13.4	21.6
1989	Increase SSB towards 50 000 t; TAC	14.0	14.0	14.5	21.8
1990	80% of F(88); TAC	25.0	25.0	26.5	35.1
1991	SSB>50 000 t; TAC	27.0	27.0	27.6	33.5
1992	TAC	21.0	25.0	26.0	29.3
1993	No long-term gains in increased F	29.0[1]	32.0	29.8	31.5
1994	No long-term gains in increased F	31.0[1]	32.0	31.3	33.0
1995	No long-term gains in increased F; link to plaice	28.0[1]	28.0	28.8	30.5
1996	Mixed fishery, link plaice advice into account	23.0[1]	23.0	20.4	22.7
1997	<80% of F(95)	14.6	18.0	13.7	15.0
1998	75% of F(96)	18.1	19.1	19.7	20.9
1999	$F < \mathbf{F}_{pa}$ (80% of F(97))	20.3	22.0	22.0	23.5
2000	$F < \mathbf{F}_{pa}$	<19.8	22.0	20.7	22.5
2001	$F < \mathbf{F}_{pa}$	<17.7	19.0		
2002	F<0.37	<14.3			

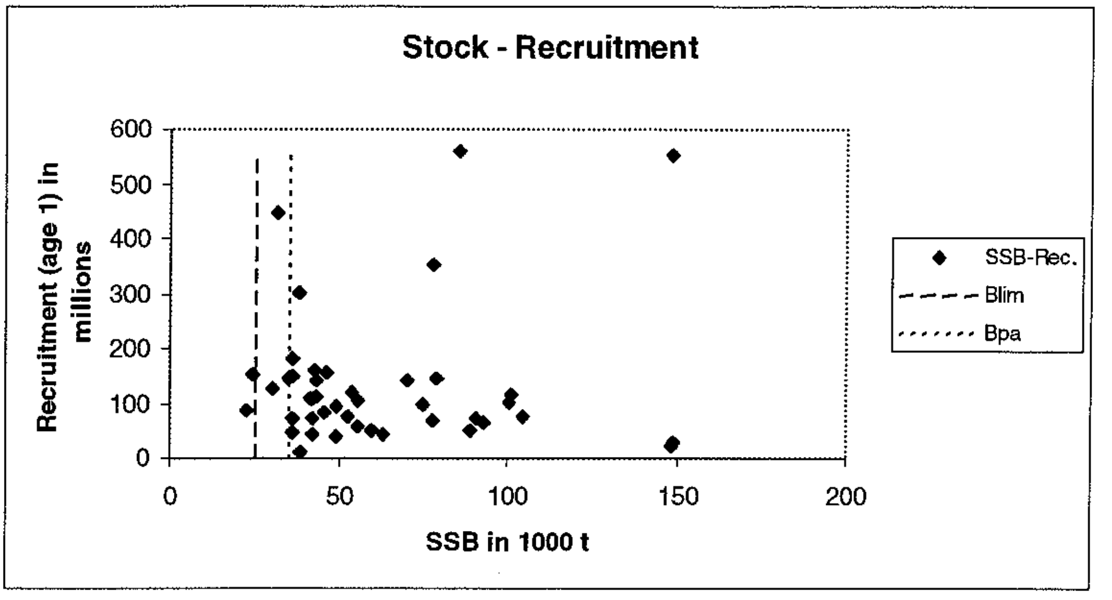
[1]Catch *status quo* F. Weights in '000 t.

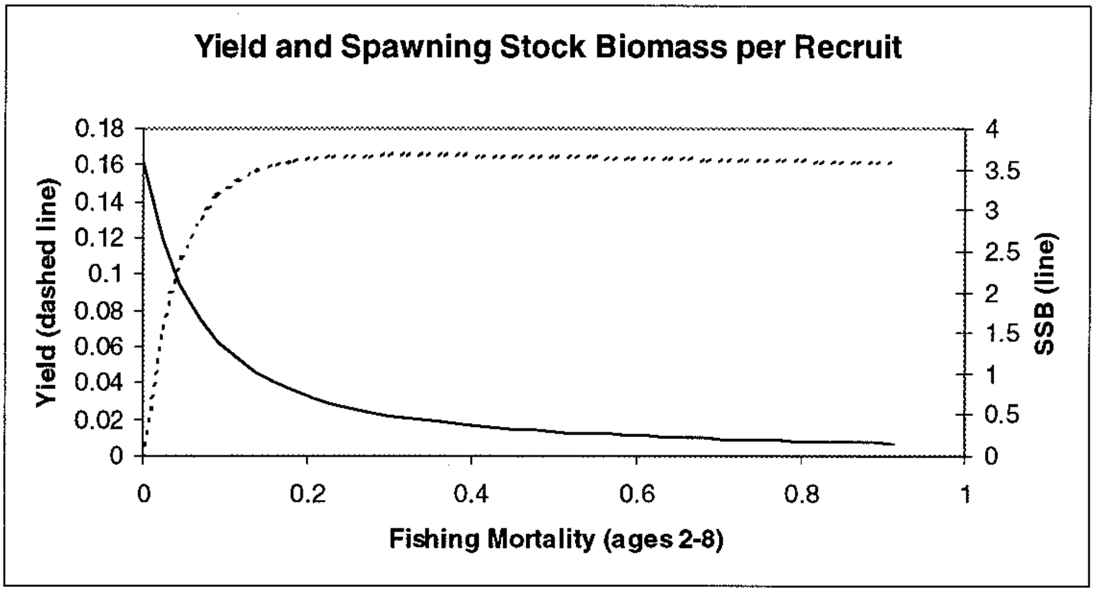

Landings
Landings in 1000 t
40
35
30
25
20
15
10
5
0
1957
1962
1967
1972
1977
1982
1987
1992
1997


Fishing Mortality
F(ages 2-8)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1957
1962
1967
1972
1977
1982
1987
1992
1997
F
Fpa


Recruitment (age 1)
Recruitment in millions
600
500
400
300
200
100
0
1957
1962
1967
1972
1977
1982
1987
1992
1997


Spawning Stock Biomass
SSB in 1000 t
160
140
120
100
80
60
40
20
0
1957
1962
1967
1972
1977
1982
1987
1992
1997
SSB
Blim
Bpa


Stock - Recruitment
Recruitment (age 1) in millions
SSB in 1000 t
0
50
100
150
200
600
500
400
300
200
100
0
SSB-Rec.
Blim
Bpa


Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
SSB (line)
Fishing Mortality (ages 2-8)
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
4
3.5
3
2.5
2
1.5
1
0.5
0
0
0.2
0.4
0.6
0.8
1

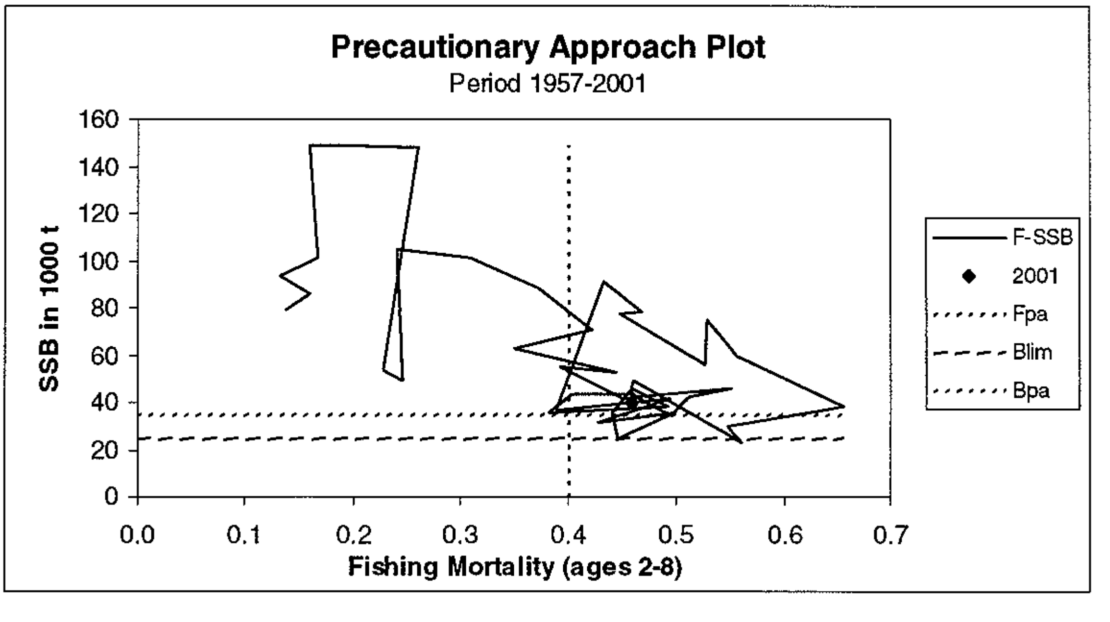

Precautionary Approach Plot
Period 1957-2001
SSB in 1000 t
Fishing Mortality (ages 2-8)
160
140
120
100
80
60
40
20
0
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
F-SSB
2001
Fpa
Blim
Bpa

Table 3.5.7.1 Nominal catch (tonnes) of Sole in Sub-area IV and landings as estimated by the Working Group.

Year	Belgium	Denmark	France	Germany Fed. Rep.	Netherlands	U.K. (E.& W.)	Other countries	Total reported	Unallocated landings	WG Total	TAC
1982	1,927	522	686	290	17,749	403		21,577	2	21,579	20,000
1983	1,740	730	332	619	16,101	435		19,957	4,970	24,927	20,000
1984	1,771	818	400	1,034	14,330	586	1	18,940	7,899	26,839	20,000
1985	2,390	692	875	303	14,897	774	3	19,934	4,314	24,248	22,000
1986	1,833	443	296	155	9,558	647	2	12,934	5,266	18,200	20,000
1987	1,644	342	318	210	10,635	676	4	13,829	3,539	17,368	14,000
1988	1,199	616	487	452	9,841	740	28	13,363	8,227	21,590	14,000
1989	1,596	1,020	312	864	9,620	1,033	50	14,495	7,311	21,806	14,000
1990	2,389	1,428	352	2,296	18,202	1,614	263	26,544	8,576	35,120	25,000
1991	2,977	1,307	465	2,107	18,758	1,723	271	27,608	5,905	33,513	27,000
1992	2,058	1,359	548	1,880	18,601	1,281	277	26,004	3,337	29,341	25,000
1993	2,783	1,661	490	1,379	22,015	1,149	298	29,775	1,716	31,491	32,000
1994	2,935	1,804	499	1,744	22,874	1,137	298	31,291	1,711	33,002	32,000
1995	2,624	1,673	640	1,564	20,927	1,040	312	28,780	1,687	30,467	28,000
1996	2,555	1,018	535	670	15,344	848	229	20,351	2,300	22,651	23,000
1997	1,519	689	99	510	10,241	479	204	13,741	1,160	14,901	18,000
1998	1,844	520	510	782	15,198	549	338	19,739	1,129	20,868	19,100
1999	1,919	828	357	1,458	16,283	645	501	21,991	1,440	23,431	22,000
2000	1,806	1,069	362	1,280	15,273	600	346	20,736	1,796	22,532	19,000

French data are provisional.

Table 3.5.7.2 Sole in Sub-area IV (North Sea).

Year	Recruitment Age 1 thousands	SSB tonnes	Landings tonnes	Mean F Ages 2-8
1957	165506	78903	12067	0.1369
1958	144954	85570	14287	0.1599
1959	559013	93193	13832	0.1324
1960	66859	101247	18620	0.1669
1961	115737	148957	23566	0.1599
1962	28346	148788	26877	0.1806
1963	23008	148406	26164	0.2612
1964	554360	53585	11342	0.2277
1965	121486	48955	17043	0.2464
1966	41182	104788	33340	0.2398
1967	75333	100877	33439	0.3081
1968	100100	88925	33179	0.3726
1969	50589	70377	27559	0.4229
1970	141510	62946	19685	0.3506
1971	41940	52381	23652	0.4439
1972	76963	55742	21086	0.3929
1973	106444	41877	19309	0.4518
1974	110847	42294	17989	0.4623
1975	41933	43038	20773	0.4615
1976	114287	43503	17326	0.4043
1977	140748	36075	18003	0.3813
1978	47084	38610	20280	0.4928
1979	11842	46255	22598	0.4600
1980	155177	36114	15807	0.4416
1981	149698	24811	15403	0.4467
1982	153499	34920	21579	0.4940
1983	144559	42345	24927	0.4636
1984	72015	45616	26839	0.5507
1985	82353	42868	24248	0.5135
1986	161400	36104	18200	0.4985
1987	72871	31458	17368	0.4280
1988	446608	41764	21590	0.4951
1989	109408	36337	21806	0.3900
1990	180779	90903	35120	0.4339
1991	73248	77918	33513	0.4687
1992	352367	77675	29341	0.4479
1993	70282	55831	31491	0.5272
1994	58255	74970	33002	0.5294
1995	99370	59888	30467	0.5562
1996	50978	37987	22651	0.6555
1997	303366	30143	14901	0.5482
1998	127288	22993	20868	0.5595
1999	86431	48968	23431	0.4605
2000	96000[1]	47698	22532	0.4584
2001	67000[1]	39600[2]		0.4600
Average	133178	61605	22661	0.4032

[1] RCT3 estimate.

[2] Based on 1998-2000 mean weight at age.

3.5.8 Herring in Sub-area IV, Division VIId and Division IIIa (autumn-spawners)

State of stock/exploitation: The stock is outside safe biological limits. SSB in 2000 was 772 000 t, which is below the $\mathbf{B}_{lim}$ of 800 000 t. SSB decreased slightly after the gradual increase since 1993. In 1996 the fishing mortality for the adult part of the stock was reduced to 0.45. It has fluctuated at that level in the subsequent years, being 0.42 in 2000. For juveniles the fishing mortality remained below 0.1 since 1996. The 1996 year class appears to be smaller than previously assumed, but is still above average. The 1997 year class is below average. The 1998 year class appears to be strong in all surveys and is already showing up in the catches. Early indications of the 1999 year class show that it may also be well above average.

Management objectives: According to the EU-Norway agreement (December 1997):

1. *Every effort shall be made to maintain a level of Spawning Stock Biomass (SSB) greater than the Minimum Biological Acceptable level (MBAL) of 800.000 tonnes.*

2. *A medium-term management strategy, by which annual quotas shall be set for the directed fishery and for by-catches in other fisheries as defined by ICES, reflecting a fishing mortality rate of 0.25 for 2-ringers and older and 0.12 for 0–1-ringers, shall be implemented.*

3. *Should the SSB fall below a reference point of 1.3 million tonnes, the fishing mortality rates referred to under paragraph 2, will be adapted in the light of scientific estimates of precise conditions then prevailing, to ensure rapid recovery of SSB to levels in excess of 1.3 million tonnes.*

The recovery plan referred to above may, inter alia, include additional limitations on effort in the form of special licensing of vessels, restrictions on fishing days, closing of areas and/or seasons, special reporting requirements or appropriate control measures.

4. *By-catches of herring may only be landed in ports where adequate sampling schemes to effectively monitor the landings have been set up. All catches landed shall be deducted from the respective quotas set, and the fisheries shall be stopped immediately in the event that the quotas are exhausted.*

5. *The allocation of the TAC for the directed fishery for herring shall be 29% to Norway and 71% to the Community. The by-catch quota for herring shall be allocated to the Community.*

6. *The Parties shall, if appropriate, consult and adjust management measures and strategies on the basis of any new advice provided by ICES including that from the assessment of the abundance of the most recent year class.*

7. *A review of this agreement shall take place no later than 31 December 2001.*

8. *This agreement shall enter into force on 1 January 1998.*

ICES considers the agreement to be consistent with the precautionary approach.

Precautionary Approach reference points (unchanged since 1999)

ICES considers that:	ICES proposed that:
$\mathbf{B}_{lim}$ is 800 000 t	$\mathbf{B}_{pa}$ be set at 1.3 mill t
$\mathbf{F}_{lim}$ is not defined	$\mathbf{F}_{pa}$ be set at $F_{ages\ 0\text{-}1} = 0.12$; at $F_{ages\ 2\text{-}6} = 0.25$

Technical basis:

$\mathbf{B}_{lim}$: below this value poor recruitment has been experienced	$\mathbf{B}_{pa}$: part of a harvest control rule based on simulations
$\mathbf{F}_{lim}$: Not defined	$\mathbf{F}_{pa}$: part of a harvest control rule based on simulations

Advice on management: ICES advises that catches in 2002 should be within the constraints on fishing mortality agreed by EC and Norway, i.e. $\mathbf{F}_{2\text{-}6} < 0.2$ and $\mathbf{F}_{0\text{-}1} < 0.1$. Several such options are presented in the Management Option table. Fishing mortality inrecent years is well in excess of the specified targets and ICES advises that additional measures to control the catches and ensure accurate reporting will be required to restrict catches.

Rebuilding plan: Management has in recent years intended to reduce the $F_{2\text{-}6}$ to 0.2 and an $F_{0\text{-}1}$ to < 0.1. These targets serve as a rebuilding plan.

Relevant factors to be considered in management: Overly optimistic assessments have contributed significantly to TACs that in retrospect have delayed stock rebuilding. There is no assurance that the revised assessment presented this year does not suffer also from being overly optimistic. Catches on adult herring have in recent years consistently exceeded the agreed TAC, partly due to misreporting from other ICES areas into and out of the North Sea; this gives rise to overshooting of the TAC.

Short-term forecasts indicate that a low fishing mortality (0.2) is necessary for the objective of attaining a high probability of SSB being above $\mathbf{B}_{lim}$.

The 1998 year class is strong and will comprise almost all the increase in SSB expected in 2002. In the past large year classes have tended to have a lower maturation rate than the long-term average. Different plausible assumptions about the maturation rate of the 1998 year class can produce forecasts of SSB in 2002 from slightly above $\mathbf{B}_{lim}$ to above $\mathbf{B}_{pa}$ at the advised fishing mortalities.

Continued fishing at *status quo* fishing mortality (Scenario I below) leads to a smaller increase in SSB in 2002 compared to other scenarios where adult mortality is reduced.

The ICES advice is based on the projected SSB in 2001 being below 1.3 million t. SSB in 2002 depends on the fisheries in 2001 and that part in 2002 that takes place before spawning. About 2/3 of the total mortality is expected to be realised before spawning each year.

The increase in SSB expected in 2002 depends strongly on the incoming 1998 year class. Observations from different surveys indicate that this year class is strong. However, historically the assessments have tended to overestimate the current stock abundance. The rebuilding regime should therefore be maintained until the SSB is clearly above 1.3 million t.

Comparison with previous assessment and advice: Assessments show a tendency to overestimate stock size and underestimate fishing mortality. Similarly, advice has the tendency to be too optimistic concerning stock status.

Catch Forecast for 2002: Catch options are given for 2002, for limits on the fishing mortality rate which reflect both the ICES recommendation and the EU-Norway agreement. Catch forecasts for 2002 assume **F** *status quo* (=F2000).

There are many possible permutations of catches by the four fleets that could result in the desired values of F_{0-1} and $\mathbf{F}_{2-6}$. Hence, there is some liberty within the framework set by the fishing mortalities for managers to decide the ratio of the total catch to be allocated to each of the fleets. This method is the same as that used last year, but other combinations are possible and can be evaluated using the spreadsheet prediction program.

Based on F status quo = F2000

Predictions for 2001, based on F values from 2000 (in '000t)

	Fjuv	*Fad*	*Fleet F's*		*Fleet Yields in '000t*				*TOTAL*	*SSB*
	(0-1 ring)	*(2-6 ring)*	*FB-D*	*FA*	*A*	*B*	*C*	*D*	*Yield*	*2001*
	0.047	0.415	0.046	0.396	463	20	41	13	537	1145

Prediction summary: Yields for 2002 (in '000t)

Scenario	*Fjuv*	*Fad*	*Fleet F's*		*Fleet Yields in '000t*				*TOTAL*	*SSB*
	(0-1 ring)	*(2-6 ring)*	*FB-E*	*FA*	*A*	*B*	*C*	*D*	*Yield*	*2002*
I	0.047	0.415	0.044	0.392	589	16	52	11	668	1453
II	0.050	0.200	0.049	0.184	303	23	29	15	370	1675
III	0.100	0.200	0.099	0.177	291	50	27	34	402	1653
IV	0.063	0.179	0.067	0.160	265	36	33	15	349	1676
V	0.120	0.250	0.119	0.222	357	59	34	40	490	1607

Assumptions for 2002

I	F status quo: Fjuv and Fad as in 2000	Maintain catch ratios for fleets A:C and B:D
II	Fjuv=0.05, Fad=0.20	Maintain catch ratios for fleets A:C and B:D
III	Fjuv=0.10, Fad=0.20	Maintain catch ratios for fleets A:C and B:D
IV		Maintain catches as agreed TACs for 2001
V	Fjuv=0.12, Fad=0.25	Maintain catch ratios for fleets A:C and B:D

Shaded scenarios considered inconsistent with the precautionary approach.

Fleet definitions:

A: Directed herring fisheries with purse seiners and trawlers in the North Sea;
B: All other vessels, which take herring as by-catch in the North Sea;

C: Directed fisheries with purse seiners and trawlers in Division IIIa;
D: Vessels fishing in Division IIIa for herring and sprat and other vessels participating in fisheries where herring is taken as by-catch in Division IIIa.

The following bullet points apply for all options (I-V) presented above:

- Catches of 3-ringers and older autumn-spawners in Division IIIa are assumed to be of North Sea origin and are included in projections;
- $F_{A,2-6}$ is the F for fleet A, averaged over 2–6-ringers;
- $F_{B-D,0-1}$ is the average F for 0–1-ringers, fleets B,C,D.
- The 1997 agreement between EU and Norway operates with a single TAC for small mesh fisheries in Division IIIa. Prior to 1999 this was termed Fleets D & E, but is now termed Fleet D.

Medium- and long-term projections: The projections are heavily dependent on the stock-recruitment relationship. The currently estimated parameters for the Beverton and Holt stock-recruitment tend to give very optimistic trends in SSB. However, when geometric mean recruitment is used the projections indicate that the stock is expected to remain approximately stable around $\mathbf{B}_{\text{lim}}$ at current fishing mortality.

Elaboration and special comment: The harvest control law, which forms the basis for advice, separates the mortality for adults and juveniles. Fleet A catches adults, fleets B and D catch juveniles, and fleet C catches both. Therefore, the harvest control law does not determine the catches uniquely, but offers some flexibility to the share of the catch between the fleets.

To obtain catch forecasts, projections by fleet are performed separately by area for juveniles. Such projections are complicated by year-to-year changes in the proportions of North Sea 0- and 1-ringers that occur in Division IIIa. These fluctuations depend on the relative year class strength of North Sea and Western Baltic spring-spawning herring.

The stock is exploited by two groups of fleets: one harvesting mainly the adult part of the stock in a human consumption fishery (fleets A and C) and the other exploiting the juvenile part of the stock as by-catch in the small mesh industrial fishery (fleets B and D). The by-catch of herring in the small mesh fishery has been low since 1998.

Stock depletion in the 1970s resulted in a four-year closure of the directed fishery. The stock recovered during the 1980s. Following the re-opening of the fishery, the fishing mortality rate steadily increased. By the 1990s this rate was no longer sustainable and the SSB fell below the MBAL of 800 000 t. Emergency regulations were introduced to reduce TACs which reduced the fishing mortality rate substantially.

The total catch of North Sea autumn-spawners, taken in all areas in 2000, comprises around 50% immature fish (in numbers), which is more than in recent years, but significantly lower than the 80% in 1995 and earlier years.

The directed fisheries (fleet A in the North Sea and fleet C in the Skagerrak/Kattegat area) have been managed by TACs since the re-opening of the North Sea herring fisheries in 1981. Fleet D, landing herring as by-catch, has also previously been managed by TAC. It has been managed by a by-catch ceiling since 1996. The catch of fleet A has been higher than the agreed TAC and in 2000 was about 1.2 times the agreed TAC of 265 000 t.

This stock complex also includes Downs herring (herring in Divisions IVc and VIId) which has shown independent trends in exploitation rate and recruitment, but cannot be assessed separately. Abundance indices from larvae and trawl surveys indicate that since 1995 the SSB has increased. The Downs fishery is concentrated on the spawning aggregations in a restricted area, which makes this stock component particularly vulnerable to excessive fishing pressure. EU splits its share of the total TAC (Sub-area IV and Division VIId) into TACs for Divisions IVa+IVb and for Divisions IVc+VIId. In response to ICES advice in May 1996 the IVc+VIId TAC was reduced by 50% in line with reductions for the whole North Sea. The TAC for Downs herring was reduced from 50 000 t to 25 000 t and has remained there since. TACs for this component have been significantly exceeded in all years. At current stock sizes there is no biological basis for not adjusting the TAC for Downs herring in harmony with overall adjustments of the total stock TAC.

Catches for recent years from Divisions IVc and VIId are found in Table 3.5.8.5.

Age-based assessment is based on landings and surveys. Incomplete discard data are available.

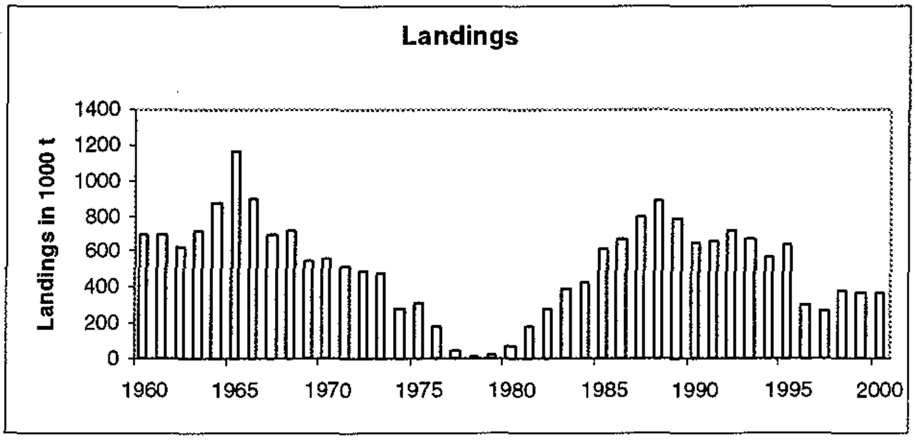
Source of information: Report of the Herring Assessment Working Group for the Area South of 62°N, March 2001 (ICES CM 2001/ACFM:12).

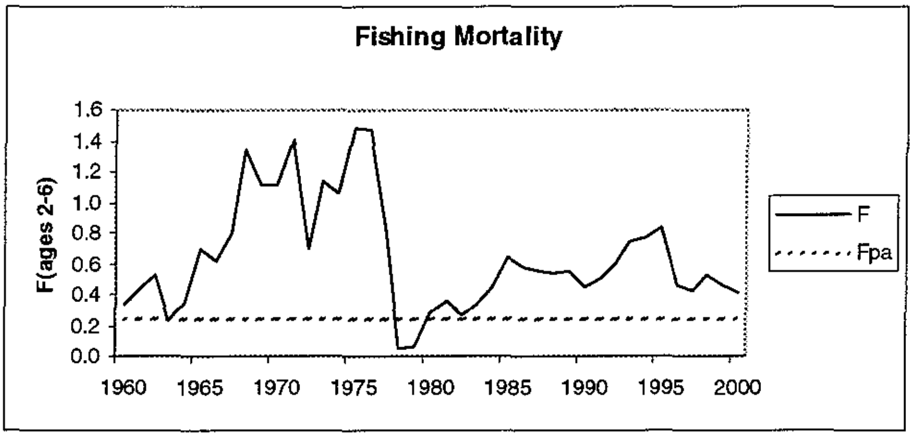
Catch data (Tables 3.5.8.1–7):

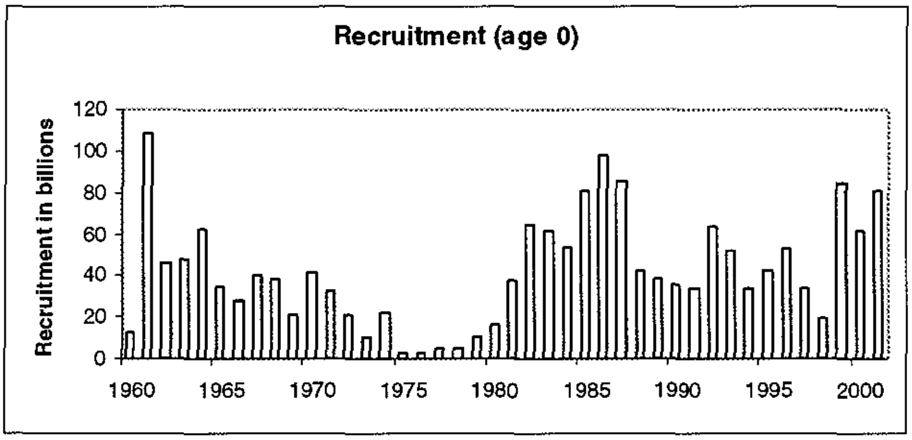
Catch data for Sub-area IV and Division VIId:

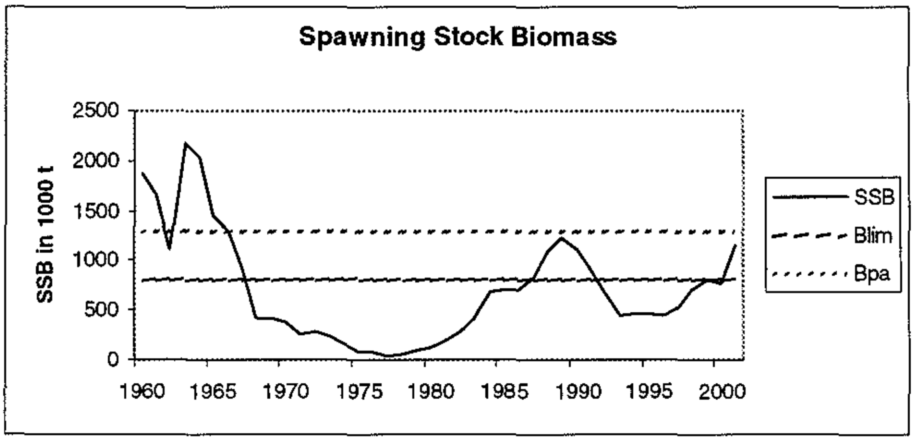
Year	ICES	Predicted catch Corresp. to advice	Agreed TAC[1]	By-catch ceiling Fleet B	ACFM Lndgs.[6]	ACFM Catch[6]
1987	TAC	610	600		625	625
1988	TAC	515	530		710	710
1989	TAC	514	514		713	717
1990	TAC	403	415		570	578
1991	TAC	423	420		583	588
1992	TAC	406	430		567	572
1993	No increase in yield at F > 0.3	340[1]	430		545	548
1994	No increase in yield at F > 0.3	346[1]	440		495	498
1995	Long-term gains expected at lower	429[1]	440		566	566
1996	50% reduction of agreed TAC[2]	156[1]	156[3]	44	263	265
1997	F = 0.2	159[1]	159	24	228[5]	234[5]
1998	F(adult) = 0.2, F(juv)< 0.1	254[1]	254	22	325	329
1999	F(adult) = 0.2, F(juv)< 0.1	265[1]	265	30	331	336
2000	F(adult) = 0.2, F(juv)< 0.1	265[1]	265	36	323	329
2001	F(adult) = 0.2, F(juv)< 0.1	See	265	36		
2002	F(adult) = 0.2, F(juv)< 0.1	See				

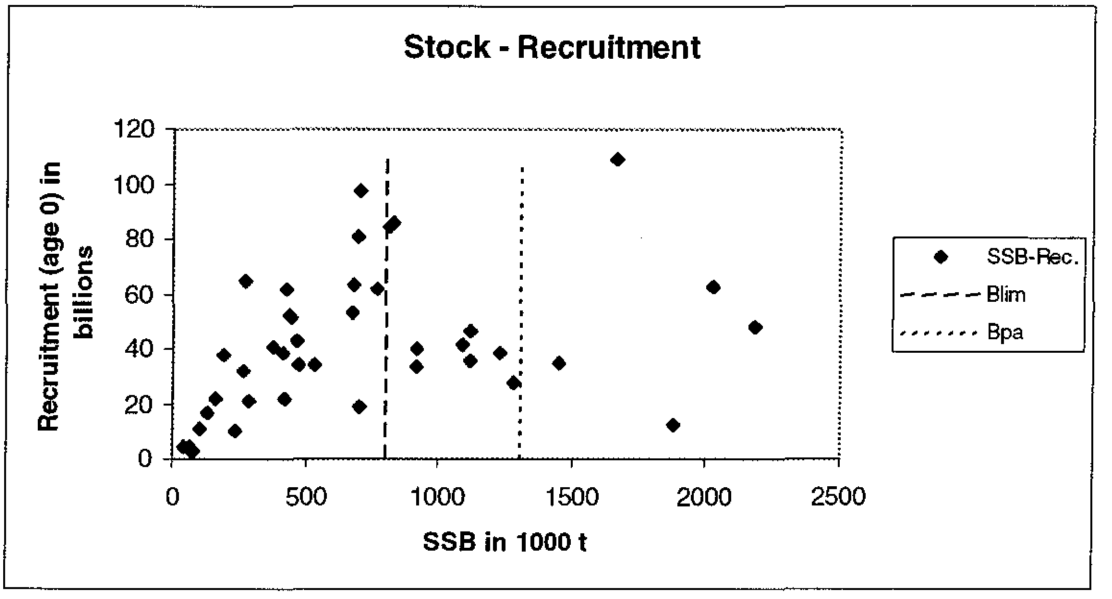
[1]Catch in directed fishery in IV and VIId. [2]Revision of advice given in 1995. [3]Revised in June 1996, down from 263. [4]TAC overshoot not calculated for years prior to 1993. Revised in 2000 [5]Based on revised estimates of misreporting by the WG. [6]Values revised to reflect catches and landings from area IV and Division VIId only. Weights in '000 t.


Landings
Landings in 1000 t
1400
1200
1000
800
600
400
200
0
1960
1965
1970
1975
1980
1985
1990
1995
2000

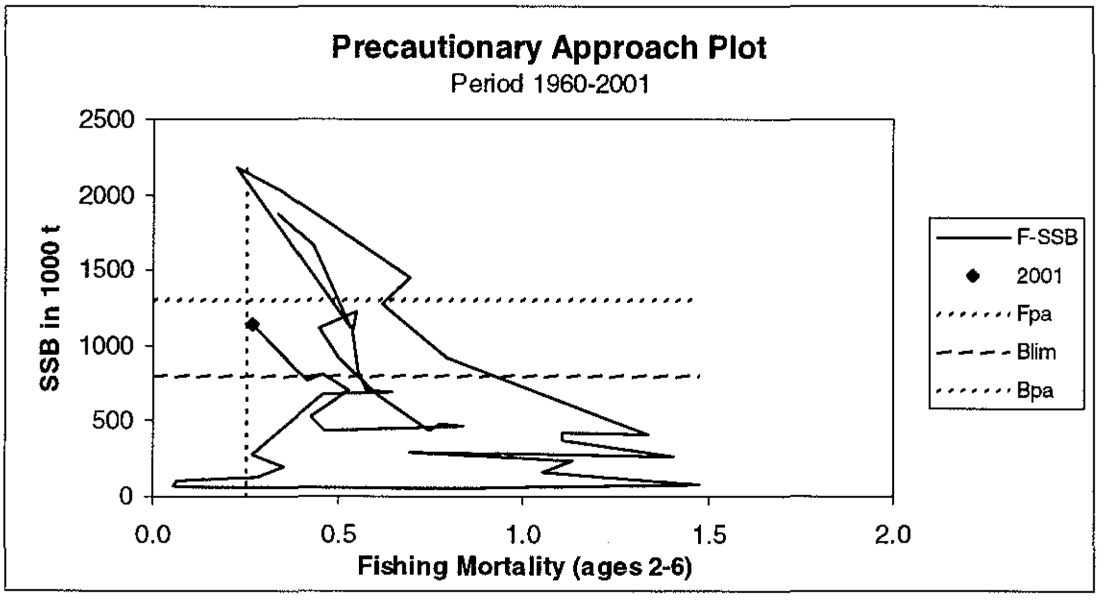

Fishing Mortality
F(ages 2-6)
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1960
1965
1970
1975
1980
1985
1990
1995
2000
F
Fpa


Recruitment (age 0)
Recruitment in billions
120
100
80
60
40
20
0
1960
1965
1970
1975
1980
1985
1990
1995
2000


Spawning Stock Biomass
SSB in 1000 t
2500
2000
1500
1000
500
0
1960
1965
1970
1975
1980
1985
1990
1995
2000
SSB
Blim
Bpa



Stock - Recruitment
Recruitment (age 0) in billions
120
100
80
60
40
20
0
0
500
1000
1500
2000
2500
SSB in 1000 t
SSB-Rec.
Blim
Bpa



Precautionary Approach Plot
Period 1960-2001
SSB in 1000 t
2500
2000
1500
1000
500
0
0.0
0.5
1.0
1.5
2.0
Fishing Mortality (ages 2-6)
F-SSB
2001
Fpa
Blim
Bpa

Table 3.5.8.1 HERRING in Sub-area IV, Division VIId and Division IIIa. Catch in tonnes by country, 1991–2000. These figures do not an all cases correspond to the official statistics and cannot be used for management purposes.

Country	1991	1992	1993	1994	1995
Belgium	163	242	56	144	12
Denmark	194358	193968	164817	121559	153363[8]
Faroe Islands	334	-	-	-	231[8]
France	24625	16587	12623	27941	29499[8]
Germany, Fed.Rep	41791	42665	41619[9]	38394	43798
Netherlands	75135	75683	79190	76155	78491
Norway[4]	124991	116863	122815	125522	131026
Sweden	5866	4939	5782	5425	5017
USSR/Russia					-
UK (England)	11548	11314	19853[9]	14216	14676
UK (Scotland)	57572	56171	55532	49919	44813
UK (N.Ireland)	92	-	-	-	-
Unallocated landings	24435	25867	18410	5749	33584[8]
Misreporting from VIaN	22079	22594	24397	30234	32146
Total landings	582969	566892	545094	495258	566656
Discards	4617	4950	3470	2510	-
Total catch	587606	571842	548564[8]	497768	566656[8]
Estimates of the parts of the catches which have been allocated to spring spawning stocks					
IIIa type (WBSS)	7894	7854	8928	13228	10315
Thames estuary[4]	252	202	201	215	203

Country	1996	1997	1998	1999	2000[1]
Belgium	-	1	1	2	-
Denmark[2,6]	67496	38431	58924	61268	64123
Faroe Islands[2]	-	-	25	1977	915
France[2]	12500	14524	20783	26962	20952
Germany	14215	13381	22259	26764	26687
Netherlands	35276	35129	50654	54318	54382
Norway[3]	43739	38745	68523	70718	72844
Sweden	3090	2253	3221	3241	3046
Russia	-	1619	-	-	-
UK (England)	6881	3421	7635	10598	11179
UK (Scotland)	17473	22914	32403	29911	30033
UK (N.Ireland)	-	-	-	-	915
Unallocated landings	24475	27583	27722	21653	36708
Misreporting from VIaN	38254	29763[5]	32446	23625	[7]
Total landings	263399	227763	324596	331036	321784
Discards	1469	6005	3918	4769	7354
Total catch	264868	233769[5]	328514	335805	329138
Estimates of the parts of the catches which have been allocated to spring spawning stocks					
IIIa type (WBSS)	855	979	7833	4732	6649
Thames estuary	168	202	88	88	76

[1] Preliminary.

[2] Working Group estimates.

[3] Catches of Norwegian spring spawners removed (taken under a separate TAC).

[4] Landings from the Thames estuary area are included in the North Sea catch figure for UK (England).

[5] Altered in 2000 based on revised estimates of misreporting into VIa (North).

[6] Including any by-catches in the industrial fishery.

[7] Catch misreported into VIaN could not be separated, they are included in unallocated.

[8] Figure altered in 2001.

[9] This figure is not in accordance with the official catch statistics and should be checked prior to next year's Working Group.

Table 3.5.8.2 Herring in Division IVa West. Catch in tonnes.
Do not in all cases correspond to the official statistics and cannot be used for management purposes

Country	1991	1992	1993	1994	1995
Denmark	5980	10751	10604	20017	17748
Faroe Islands	334	-	-	-	-
France	3393	4714[2]	3362	11658	10427
Germany	20608	21836	17342[2]	18364	17095
Netherlands	29563	29845	28616	16944	24696
Norway	37674	39244	33442	56422	56124
Sweden	1130	985	1372	2159	1007
UK (England)	4873	4916	4742	3862	3091
UK (Scotland)	42745	39269	36628[2]	44687	40159
UK (N. Ireland)	92	-	-	-	-
Unallocated landings	5492	4855	-8271[3]	3214[7]	26018
Misreporting from VIa North	22079	22593	24397	30234	32146
Total Landings	173963	179008	152234	207561	228511
Discards	883	850	825	550	-
Total catch	174846	179858	153059	208111	228511

Country	1996	1997	1998	1999	2000[1]
Denmark	3237	2667	4634	15359	25530
Faroe Islands	-	-	25	1977	205
France	3177	361	4757	6369	3210
Germany	2167	-	7752	11206	5811
Netherlands	2978	6904[7]	11851	17038	15117
Norway	22187	16485	27218	30585	32895
Sweden	2398	1617	245	859	1479
Russia	-	1619	-	-	-
UK (England)	2391	-	4306	7163	8859
UK (Scotland)	12762	17120	30552	28537	29055
UK (N. Ireland)	-	-	-	-	996
Unallocated landings	9959	7574	15952	3889	29581
Misreporting from VIa North	38254	29763[4]	32446	23625	[6]
Total Landings	99510	84110	139738	146607	152738
Discards	356	1138	730	654	6841
Total catch	99866	85248[4]	140468	147261	159579

[1] Preliminary.
[2] Including IVa East.
[3] Negative unallocated catches due to misreporting from other areas.
[4] Altered in 2000 on the basis of a Bayesian assessment on misreporting into VIa (North).
[5] Including any by-catches in the industrial fishery.
[6] Catch misreported into VIaN could not be separated, they are included in unallocated.
[7] Figure altered in 2001.

Table 3.5.8.3 Herring in Division IVa East. Catch in tonnes.
Do not in all cases correspond to the official statistics and cannot be used for management purposes.

Country	1991	1992	1993	1994	1995
Denmark [5]	48875	53692	43224	43787	45257
Faroe Islands	-	-	-	-	-
France	-	-[3]	4	14	+
Germany	-[3]	-[3]	-[3]	-	-
Netherlands	-	-	-	-	-
Norway [2]	77465	61379	56215	40658	62224
Sweden	114	508	711	1010	2081
UK (Scotland)	173	196	-[3]	-	-
Unallocated landings	-	-	-	-	-
Total landings	126627	115775	100154	85469	109562
Discards	-	-	-	-	-
Total catch	126627	115775	100154	85469	109562

Country	1996	1997	1998	1999	2000[1]
Denmark [5]	19166	22882	25750	18259	11300
Faroe Islands	-	-	-	-	710
France	-	3	-	115	-
Germany	-	4576	-	-	29
Netherlands	-	-	-	1965	38
Norway [1]	18256	18490	41260	37433	39696
Sweden	693	427	1259	772	1177
Unallocated landings	-	-	-	-1965[4]	-4[4]
Total landings	38115	46378	68269	56579	52946
Discards	-	-	-	-	-
Total catch	38115	46378	68269	56579	52946

[1] Preliminary.
[2] Catches of Norwegian spring spawners herring removed (taken under a separate TAC).
[3] Included in IVa West.
[4] Negative unallocated catches due to misreporting into other areas.
[5] Including any by-catches in the industrial fishery.

Table 3.5.8.4 Herring in Division IVb. Catch in tonnes.
Do not in all cases correspond to the official statistics and cannot be used for management purposes.

Country	1991	1992	1993	1994	1995
Belgium	3	13	-	-	-
Denmark[3]	138555	125229	109994	55060	87917
Faroe Islands	-	-	-	-	231[4]
France	4120	2313	2086	5492	7639
Germany	20479	20005	23628	14796	21707
Netherlands	26266	26987	31370	39052	30065
Norway	9852	16240	33158	28442	12678
Sweden	4622	3446	3699	2256	1929
UK (England)	2715	3026	3804	7337	9688
UK (Scotland)	14587	16707	18904	5101	4654
Unallocated landings[2]	3180	-13637	-16415	-26988	-10831[5]
Total landings	224376	200329	210228	130548	165677
Discards[1]	1072	1900	245	460	-
Total catch	225448	202229	210473	131008	165677[5]

Country	1996	1997	1998	1999	2000[1]
Belgium	-	-	-	1	-
Denmark[3]	43749	11636	26667	26211	26825
Faroe Islands	-	-	1	-	-
France	2373	6069	8944	7634	10863
Germany	11052	7456	13591	13529	18818
Netherlands	18474	14697	27408	22825	26845
Norway	3296	3770	45	2700	253
Sweden	-	209	1717	1610	390
UK (England)	2757	2033	1767	1641	669
UK (Scotland)	4449	5461	1851	1374	978
Unallocated landings[2]	-8826	-1615	-11270	-313	-13769
Total landings	77324	49716	70720	77212	71872
Discards[1]	592	1855	1188	873	317
Total catch	77916	51571	71908	78085	72189

[1] Preliminary.
[2] Negative unallocated catches due to misreporting from other areas.
[3] Including any by-catches in the industrial fishery.
[4] Figure inserted in 2001.
[5] Figure altered in 2001.

Table 3.5.8.5 Herring in Divisions IVc and VIId. Catch in tonnes
Do not in all cases correspond to the official statistics and cannot be used for management purposes.

Country	1991	1992	1993	1994	1995
Belgium	163	229	56	144	12
Denmark	948	4296	995	2695	2441
France	17112	9560	7171	10777	11433
Germany	704	824	649	4964	4996
Netherlands	19306	18851	19204	20159	23730
UK (England)	3960	3372	11307[3]	3016	1896
UK (Scotland)	67	-	-	131	-
Unallocated landings	15763	34649	43096	29792	18397
Total landings	58023	71781	82478	71678	62905
Discards[1]	2662	2200	2400	2400	-
Total catch	60685	73981	84878	74078	62905
Coastal spring spawners included above [2]	252	202	201	215	203

Country	1996	1997	1998	1999	2000[1]
Belgium	-	1	1	1	1
Denmark	1344	1246	1873	1439	468
France	6950	8091	7081	12844	6879
Germany	997	1349	916	2029	2029
Netherlands	13824	13528	11395	12490	12348
UK (England)	1733	1388	1562	1794	1537
UK (Scotland)	262	333	-	-	-
Unallocated landings	23934	21624	23040	20042	20966
Total landings	49044	47559	45868	50639	44228
Discards	521	3012	2000	3242	196
Total catch	49565	50571	47868	53881	44424
Coastal spring spawners included above [2]	168	143	88	88	76

[1] Preliminary.
[2] Landings from the Thames estuary area are included in the North Sea catch figure for UK (England).
[3] This figure is not in accordance with the official catch statistics and should be checked prior to next year's Working Group.

Table 3.5.8.6 HERRING in Sub-area IV, Division VIId and Division IIIa. Figures in '000 tonnes.

Year	1989	1990	1991	1992	1993	1994	1995 [18]
Sub-Area IV and Division VIId: TAC (IV and VIId)							
Recommended Divisions IVa, b [1]	484	373;332	363 [6]	352	290 [7]	296 [7]	389 [11]
Recommended Divisions IVc, VIId	30	30	50-60 [6]	54	50	50	50
Expected catch of spring spawners				10	8		
Agreed Divisions IVa,b [2]	484	385	370 [6]	380	380	390	390
Agreed Div. IVc, VIId	30	30	50 [6]	50	50	50	50
Bycatch ceiling in the small mesh fishery							
CATCH (IV and VIId)							
National landings Divisions IVa,b [3]	639	499	495	481	463	421	456
Unallocated landings Divisions IVa,b	-2	14	30	14	-1	6	47
Discard/slipping Divisions IVa,b [4]	3	4	2	3	1	1	0
Total catch Divisions IVa,b [5]	638	516	527	498	463	428	503
National landings Divisions IVc, VIId [3]	30	24	42	37	40	42	45
Unallocated landings Divisions IVc,VIId	48	32	16	35	43	30	18
Discard/slipping Divisions IVc, VIId	1	5	3	2	2	2	-
Total catch Divisions IVc, VIId	79	61	61	74	85	74	63
Total catch IV and VIId as used by ACFM [5]	717	578	588	572	548	498	566
CATCH BY FLEET/STOCK (IV and VIId) [10]							
North Sea autumn spawners directed fisheries (Fleet A)	N.a.	N.a.	446	441	438	447	506
North Sea autumn spawners industrial (Fleet B)	N.a.	N.a.	134	124	101	38	65
Baltic-IIIa-type spring spawners	20	8	8	8	9	13	10
Coastal-type spring spawners	2.3	1.1	0.3	0.2	0.2	0.2	0.2
North Sea autumn spawners in IV and VIId total	696	569	580	564	539	485	559

Continued.....

Table 3.5.8.6 Continued

Year	1989	1990	1991	1992	1993	1994	1995 [18]
Division IIIa: TAC (IIIa)							
Predicted catch of autumn spawners			96	153	102	77	98
Recommended spring spawners	84	67	91	90	93–113	- [9]	- [12]
Recommended mixed clupeoids	80	60	0	0	0	-	-
Agreed herring TAC	138	120	104.5	124	165	148	140
Agreed mixed clupeoid TAC	80	65	50	50	45	43	43
Bycatch ceiling in the small mesh fishery							
CATCH (IIIa)							
National landings	192	202	188	227	214	168	157
Catch as used by ACFM	162	195	191	227	214	168	157
CATCH BY FLEET/STOCK (IIIa) [10]							
Autumn spawners human consumption (Fleet C)	N.a.	N.a.	26	47	44	42	21
Autumn spawners mixed clupeoid (Fleet D)	N.a.	N.a.	13	23	25	12	6
Autumn spawners other industrial landings (Fleet E)	N.a.	N.a.	38	82	63	32	43
Autumn spawners in IIIa total	91	77 [8]	77	152	132	86	70
Spring spawners human consumption (Fleet C)	N.a.	N.a.	68	53	68	59	59
Spring spawners mixed clupeoid (Fleet D)	N.a.	N.a.	5	2	1	1	2
Spring spawners other industrial landings (Fleet E)	N.a.	N.a.	40	20	12	24	29
Spring spawners in IIIa total	71	118	113	75	81	84	90
North Sea autumn spawners Total as used by ACFM	787	646	657	716	671	571	629

Conntinued……

Table 3.5.8.6 Continued

Year	1996	1997	1998	1999	2000	2001
Sub-Area IV and Division VIId: TAC (IV and VIId)						
Recommended Divisions IVa, b [1]	156	159	254	265	265	265
Recommended Divisions IVc, VIId	- [14]	- [14]	- [14]	- [14]	- [14]	- [14]
Expected catch of spring spawners						
Agreed Divisions IVa,b [2]	263;131 [13]	134	229	240	240	240
Agreed Div. IVc, VIId	50;25 [13]	25	25	25	25	25
Bycatch ceiling in the small mesh fishery		24	22	30	36	36
CATCH (IV and VIId)						
National landings Divisions IVa,b [3]	176	144	241	255	263	
Unallocated landings Divisions IVa,b	39	36	37	25	16	
Discard/slipping Divisions IVa,b [4]	1	3 [16]	2	2	6	
Total catch Divisions IVa,b [5]	216	183 [16]	281	282	285	
National landings Divisions IVc, VIId [3]	25	26	23	31	23	
Unallocated landings Divisions IVc,VIId	24	22	23	20	21	
Discard/slipping Divisions IVc, VIId	1	3	2	3	0.2	
Total catch Divisions IVc, VIId	50	51	48	54	44	
Total catch IV and VIId as used by ACFM [5]	266	234 [16]	329	336	329	
CATCH BY FLEET/STOCK (IV and VIId) [10]						
North Sea autumn spawners directed fisheries (Fleet A)	226	220 [16]	306	316	304	
North Sea autumn spawners industrial (Fleet B)	38	13	14	15	18	
Baltic-IIIa-type spring spawners	0.9	0.9	8	5	7	
Coastal-type spring spawners	0.2	0.2	0.1	0.1	0.1	
North Sea autumn spawners in IV and VIId total	265	233 [16]	320	331	322	

Continued..

Table 3.5.8.6 Continued

Division IIIa: TAC (IIIa)						
Predicted catch of autumn spawners	48	35	58	43	53	67
Recommended spring spawners	- [12]	- [15]	- [15]	- [15]	- [15]	- [15]
Recommended mixed clupeoids	-	-	-	-	-	-
Agreed herring TAC	120	80	80	80	80	80
Agreed mixed clupeoid TAC	43					
Bycatch ceiling in the small mesh fishery		20	17	19	21	21
CATCH (IIIa)						
National landings	115	83	120 [16]	86	108	
Catch as used by ACFM	115	83	105 [16]	86	108	
CATCH BY FLEET/STOCK (IIIa) 10						
Autumn spawners human consumption (Fleet C)	23	34	54	31 [17]	37	
Autumn spawners mixed clupeoid (Fleet D)	12	4		8 [17]		
Autumn spawners other industrial landings (Fleet E)	7	2	5		13	
Autumn spawners in IIIa total	42	40	59	39 [17]	50	
Spring spawners human consumption (Fleet C)	69	34	43	44 [17]	53	
Spring spawners mixed clupeoid (Fleet D)	1	1		3 [17]		
Spring spawners other industrial landings (Fleet E)	3	1	3		5	
Spring spawners in IIIa total	73	37	46	47 [17]	58	
North Sea autumn spawners Total as used by ACFM	307	273 [16]	380	370 [17]	372	

[1] Includes catches in directed fishery and catches of 1-ringers in small mesh fishery up to 1992.
[2] IVa,b and EC zone of IIa.
[3] Provided by Working Group members.
[4] One country only.
[5] Includes spring spawners not included in assessment.
[6] Revised during 1991.
[7] Based on F=0.3 in directed fishery only; TAC advised for IVc, VIId subtracted.
[8] Estimated.
[9] 130-180 for spring spawners in all areas.
[10] Based on sum-of-products (number x mean weight at age).
[11] *Status quo* F catch for fleet A.
[12] The catch should not exceed recent catch levels.
[13] During the middle of 1996 revised to 50% of its original agreed TAC.
[14] Included in IVa,b.
[15] Managed in accordance with autumn spawners.
[16] Figure altered in 2000.
[17] Figure altered in 2001.
[18] Data for 1995 show some inconsistencies and need to be revised intersessionally.

Table 3.5.8.7 Herring in Sub-area IV, Division VIId and Division IIIa (autumn-spawners).

Year	Recruitment Age 0 thousands	SSB tonnes	Landings tonnes	Mean F Ages 2-6
1960	12096130	1877111	696200	0.336
1961	108859390	1662701	696700	0.434
1962	46273490	1116800	627800	0.533
1963	47657560	2185439	716000	0.226
1964	62785270	2028570	871200	0.343
1965	34894950	1449889	1168800	0.695
1966	27858810	1282053	895500	0.619
1967	40255900	920332	695500	0.798
1968	38698960	413571	717800	1.336
1969	21581390	424167	546700	1.105
1970	41069690	374627	563100	1.106
1971	32301770	265999	520100	1.407
1972	20860460	288255	497500	0.696
1973	10092480	233229	484000	1.136
1974	21690030	161859	275100	1.053
1975	2805610	81297	312800	1.478
1976	2714080	77437	174800	1.466
1977	4320960	46845	46000	0.821
1978	4587820	63931	11000	0.053
1979	10594450	106149	25100	0.065
1980	16695760	129979	70764	0.286
1981	37837120	194400	174879	0.355
1982	64697790	277124	275079	0.265
1983	61790670	430552	387202	0.339
1984	53414490	676658	428631	0.457
1985	80846800	696570	613780	0.647
1986	97560130	700145	671488	0.577
1987	85560240	828196	792058	0.556
1988	41792750	1084019	887686	0.541
1989	38731050	1224623	787899	0.550
1990	35564460	1115764	645229	0.449
1991	33697600	915372	658008	0.502
1992	63406250	684053	716799	0.606
1993	51762150	444981	671397	0.747
1994	33846110	473353	568234	0.773
1995	42561930	466975	639146	0.837
1996	52498710	434421	306157	0.466
1997	33891070	529153	272627	0.426
1998	18933160	701800	380178	0.527
1999	84306360	815482	372341	0.459
2000	61907350	771796	372420	0.415
2001	80554000	1145000		0.270
Average	41996551	709540	517895	0.637

3.5.9 Sprat in the North Sea (Sub-area IV)

State of stock/exploitation: The state of the stock is uncertain. Sprat in this area is short-lived with large annual natural fluctuations in stock biomass. The IBTS surveys (February) are a good indicator of the availability of the stock to the fishery for the year of the survey. The total IBTS (February) 2001-index decreased from last year but is still among the highest in the series.

Management objectives: There are no explicit management objectives for this stock.

Advice on management: For this stock only in-year advice is available. Based on the historic relationship between survey and catch, the 2001 survey value indicates that a catch of 225 000 t in 2001 would allow the SSB to remain stable or increase.

Relevant factors to be considered in management: The TAC has in recent years been set (for the EU zone) on the basis of considerations for herring and on the state of the sprat stock. Relevant biological information on the abundance of sprat becomes available early in the TAC year from the IBTS.

As the sprat fishery has a by-catch of juvenile herring, the exploitation of sprat will in some periods be limited by the restrictions imposed on fisheries catching juvenile herring, particularly if sprat abundance is low. In years of high abundance sprat can normally be caught with small herring by-catch.

Information from the fishery has shown that in recent years about 90% of the catch has been sprat and the percentage of herring by-catch about 6%.

It is important that existing by-catch restrictions are maintained.

Comparison with previous assessment and advice: State of stock similar.

Catch forecast: No reliable catch forecast is available for 2002.

Elaboration and special comment: The catches of sprat are mostly composed of young fish, particularly those of age one. This means that catch prognoses under the present assessment and TAC-setting regime, which requires a two-year forecast, are not realistic. However, abundance indices from surveys in February each year are reasonable predictors of the catch in the same year (Figure 3.5.9.1). It would be possible to provide information early in the year on which a TAC for the remainder of the year could be based. For example a provisional TAC could be set for the period January–March which is then updated at the beginning of April, based on contemporary survey data. Alternatively, the TAC year could run April–March, with an annual TAC being set in April of the year in question using the survey data. This might require some change in the process of setting TACs for sprat but would overcome the problem of the absence of appropriate data at the time ICES advice is given and would provide TACs, which more adequately reflected the true size of the sprat stock.

Source of information: Report of the Herring Assessment Working Group for the Area South of 62°N, March 2001 (ICES CM 2001/ACFM:12).

Catch data (Table 3.5.9.1):

Year	ICES Advice	Predicted catch Corresp. to advice	Agreed TAC[1]	Official Landings	ACFM Catch
1987	Catch at lowest practical level	0	57	78	32
1988	TAC < recent catches, preferably zero	0	57	93	87
1989	No advice	-	59	50	63
1990	No advice	-	59	49	73
1991	No advice	-	55	92	112
1992	No advice	-	55	72	124
1993	No advice	-	114	127	200
1994	No advice for sprat; maintain by-catch regulations	-	114	184	310
1995	No advice	-	175	190	357
1996	No advice	-	200	141	137
1997	Enforce by-catch regulations	-	150	123	103
1998	Limited by restrictions on juvenile herring	-	150	175	164
1999	Limited by restrictions on juvenile herring	-	225	167	188
2000	Limited by restrictions on juvenile herring	-	225	208	196
2001	TAC restricted		225		
2002	TAC restricted		225		

[1]EU zone

Sprat in the North Sea (Sub-area IV)

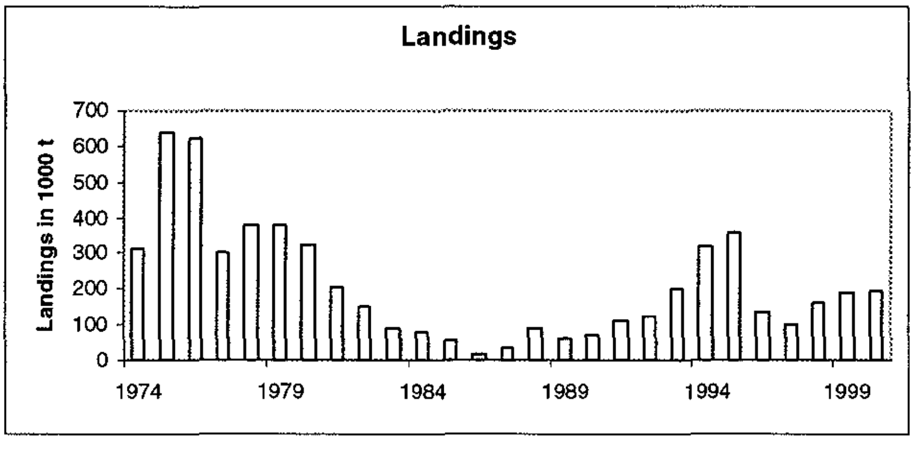


Table 3.5.9.1 Sprat in the North Sea, Sub-area IV.
(Data provided by Working Group members except where indicated). These figures do not in all cases correspond to the official statistics and cannot be used for management purposes.

Country	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Division IVa West														
Denmark	0.2	0.1				0.3	0.6						0.7	
Netherlands														
Norway					0.1									
UK(Scotland)								0.1						
Total	0.2	0.1			0.1	0.3	0.6	0.1					0.7	
Division IVa East (North Sea) stock														
Denmark										0.3				
Norway						0.5	2.5		0.1					
Sweden					2.5									
Total					2.5	0.5	2.5		0.1	0.3				
Division IVb West														
Denmark	3.4	1.4	2.0	10.0	9.4	19.9	13.0	19.0	26.0	1.8	82.2	21.1	13.2	18.8
Norway		3.5	0.1	1.2	4.4	18.4	16.8	12.6	21.0	1.9	2.3			
UK(Engl.&Wales)						0.5	0.5							
UK(Scotland)	0.1						0.5						0.8	
Total	3.5	4.9	2.1	11.2	13.8	38.8	30.8	31.6	47.0	3.7	84.5	21.1	14.0	18.8
Division IVb East														
Denmark	28.0	80.7	59.2	59.2	67.0	66.6	136.2	251.7	283.2	74.7	10.9	98.2	147.1	144.1
Germany														
Norway		0.6		0.6	25.1	9.5	24.1	19.1	14.7	50.9	0.8	15.3	13.1	0.9
Sweden				+	+				0.2	0.5		1.7	2.1	
UK(Scotland)													0.6	
Total	28.0	81.3	59.2	59.8	92.1	76.1	160.3	270.8	298.1	126.1	11.7	115.2	162.9	145.0
Division IVc														
Denmark		0.1	0.5	1.5	1.7	2.5	3.5	10.1	11.4	3.9	5.7	11.8	3.3	28.2
France									+					
Netherlands		0.4	0.4										0.2	
Norway							0.4	4.6	0.4		0.1	16.0	5.7	1.8
UK(Engl.&Wales)	0.7	0.6	0.9	0.2	1.8	6.1	2.0	2.9	0.2	2.6	1.4	0.2	1.6	2.0
Total	0.7	1.1	1.8	1.7	3.5	8.6	5.9	17.6	12.0	6.5	7.2	28.0	10.8	32.0
Total North Sea														
Denmark	31.6	82.3	61.7	70.7	78.1	89.2	153.3	280.8	320.6	80.7	98.8	131.1	164.3	191.1
France								+						
Germany														
Netherlands		0.4	0.4										0.2	
Norway		4.1	0.1	1.8	29.6	28.4	43.8	36.3	36.2	52.8	3.2	31.3	18.8	2.7
Sweden					2.5								2.7	
UK(Engl.&Wales)	0.7	0.6	0.9	0.2	1.8	6.6	2.5	2.9	0.2	2.6	1.4	0.2	1.6	2.0
UK(Scotland)	0.1						0.5	0.1					0.8	
Total	32.4	87.4	63.1	72.7	112.0	124.3	200.1	320.1	357.0	136.1	103.4	162.6	188.4	195.9

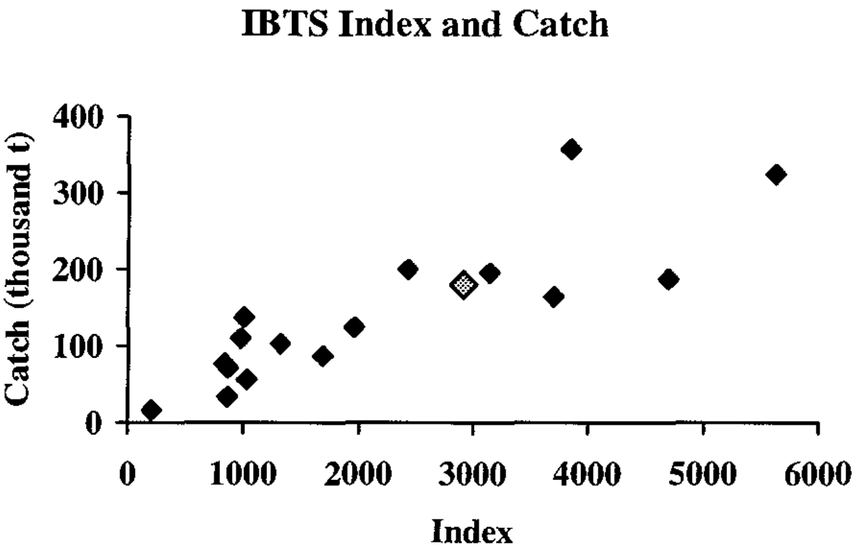


Figure 3.5.9.1 Prediction of sprat catch from survey results.

3.5.10 Mackerel (North Sea Component)

Evaluation of the North Sea mackerel component is given in Section 3.12.3 dealing with the combined mackerel assessment.

3.5.11 North Sea horse mackerel (*Trachurus trachurus*) (Division IIIa (eastern part), Divisions IVb,c, VIId)

State of stock/exploitation: The state of the stock is not known. There is no recent quantitative information on stock size. Egg surveys from 1989 to 1991 indicated a spawning stock biomass of about 240 000 t. The age composition of the relatively small catches until 1997 and the past biomass estimates suggest that the exploitation rate may have been low in the early 1990s. However, the catch increased from a long-term level of 18 000 t to the historic high in 2000 of 48 425 t, and the present level of exploitation is therefore uncertain, but may be increasing.

Management objectives: No explicit management objectives have been established for this stock.

Reference points: There is not sufficient information to estimate appropriate reference points.

Advice on management: ICES recommends that catches in 2002 be no more than the 1982-1997 average of 18 000 t, in order to avoid an expansion of the fishery until there is more information about the structure of horse mackerel stocks, and sufficient information to facilitate an adequate assessment.

Relevant factors to be considered in management: These fish migrate out of the North Sea to areas where they mix with the Western horse mackerel. The present agreed TAC is for the North Sea and Division IIa and this area does not correspond to the distribution area of the stock. The TAC should apply to all those areas where the North Sea horse mackerel are fished, i.e. Divisions IIIa, IVb,c and VIId.

Over the later years there has been a change in exploitation pattern of this stock. In 1998 about 55%, in 1999 40% and in 2000 41% of the catch in numbers were fish 1-4 years old, which represents a large increase since 1996 and 1997 (about 28%). Since it is not known how abundant recent year classes are, concern is expressed about this high exploitation of juvenile fish.

Comparison with previous assessment and advice: Advice in 1999 was to constrain expansion of the fishery until there was a scientific basis for advice. This was expressed due to concerns about unrestricted expansion on pelagic stocks in which high catch rates can be maintained even when the stock is in decline. The way in which the 1999 advice was framed failed to prevent catches of this stock increasing by 1/3, from 37 kt in 1999 to 48 kt in 2000. Consequently, ICES has revised its advice for this stock to reflect more closely its concern over the potential impact of the recent expansion of the fishery.

Elaboration and special comment: In earlier years the majority of the catch was taken as by-catch in the small-mesh industrial fishery. Only a small proportion of the catch was sampled. In recent years the fishery for human consumption has increased, and these catches are better sampled. A first attempt at exploratory assessments was made this year. In order to assess the state of the stock, adequate sampling for determination of catches-at-age, as well as new egg surveys are needed. The allocation of catches to the different horse mackerel stocks is based on the temporal and spatial distribution of the fishery. It is therefore important that the fishing nations report their catches by ICES rectangle and by quarter.

Source of information: Report of the Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine and Anchovy, September 2001 (ICES CM 2002/ACFM:06).

Catch data (Tables 3.5.11.1-2):

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC[1]	ACFM landings[2]
1987	Not assessed	-	30	12
1988	No advice	-	50	24
1989	No advice	-	45	33
1990	No advice	-	40	19
1991	No advice	-	45	12
1992	No advice	-	55	15
1993	No advice	-	60	14
1994	No advice	-	60	6
1995	No advice	-	60	17
1996	No advice	-	60	19
1997	No advice	-	60	20
1998	Develop and implement management plan	-	60	31
1999	Develop and implement management plan	-	60	37
2000	Develop and implement management plan	-	51	48
2001	No increase in catch	-	51	
2002	No increase in catch from 1982-1997 average	-18		

[1]Division IIa and Sub-area IV (EU waters only). [2]Catch of North Sea stock (Divisions IIIaE, IVb,c & VIId). (Weights in '000 t.

North Sea horse mackerel (Divisions IIIaE, IVb,c & VIId)

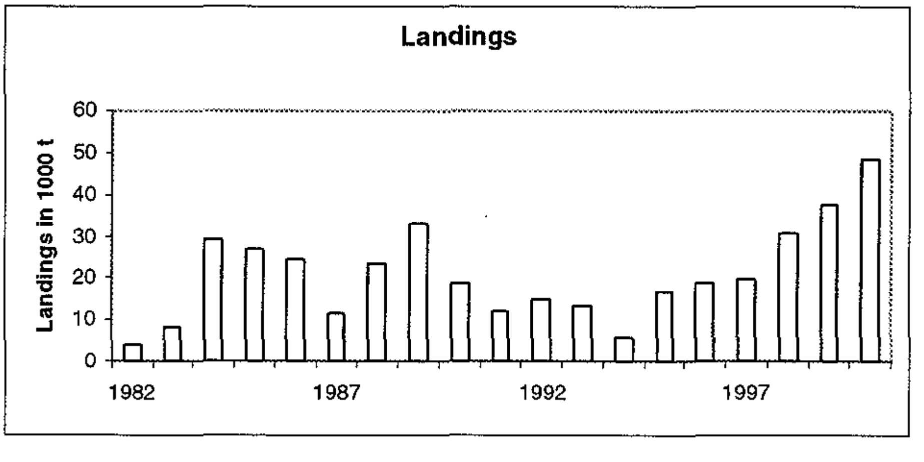


Table 3.5.11.1 Landings and discards of Horse mackerel (t) by year and division, for the North Sea, Western and Southern horse mackerel. (Data submitted by Working Group members.)

		North Sea			
Year	IIIa	IVb,c	Discards	VIId	Total
1982		2,788[3]		1,247	4,035
1983		4,420[3]		3,600	8,020
1984		25,893[3]		3,585	29,478
1985	1,138	22,897		2,715	26,750
1986	396	19,496		4,756	24,648
1987	436	9,477		1,721	11,634
1988	2,261	18,290		3,120	23,671
1989	913	25,830		6,522	33,265
1990	14,872[1]	17,437		1,325	18,762
1991	2,725[1]	11,400		600	12,000
1992	2,374[1]	13,955	400	688	15,043
1993	850[1]	3,895	930	8,792	13,617
1994	2,492[1]	2,496	630	2,503	5,629[9]
1995	240	7,948	30	8,666	16,756[10]
1996	1,657	7,558	212	9,416	18,843
1997	2,037[4]	15,504[5]	10	5,452	19,540
1998	3,693	10,530	83	16,194	30,500
1999	2,095[4]	9,335		27,889	37,224
2000	1,105[4]	25,954		22,471	48,425

				Western			
Year	IIa	IVa	VIa,b	VIIa-c,e-k	VIIIa,b,d,e	Discards	Total
1982			6,283	32,231	3,073		41,587
1983	412		24,881	36,926	2,643		64,862
1984	23	94	31,716	38,782	2,510	500	73,625
1985	79	203	33,025	35,296	4,448	7,500	80,551
1986	214	776	20,343	72,761	3,071	8,500	105,665
1987	3,311	11,185	35,197	99,942	7,605		157,240
1988	6,818	42,174	45,842	81,978	7,548	3,740	188,100
1989	4,809	85,304[2]	34,870	131,218	11,516	1,150	268,867
1990	11,414	112,753[2]	20,794	182,580	21,120	9,930	373,463
1991	4,487	63,869[2]	34,415	196,926	25,693	5,440	333,555
1992	13,457	101,752	40,881	180,937	29,329	1,820	370,550
1993	3,168	134,908	53,782	204,318	27,519	8,600	433,145
1994	759	106,911	69,546	194,188	11,044	3,935	388,875
1995	13,133	90,527	83,486	320,102	1,175	2,046	510,597[10]
1996	3,366	18,356	81,259	252,823	23,978	16,870	396,652
1997	2,617	63,647	40,145	318,101	11,677	2,921	442,571
1998	2,540[6]	17,011	35,043	232,451	15,662	830	303,537[9]
1999	2,557[7]	47,316	40,381	158,715	22,824		273,888
2000	1,169[8]	4,524	20,657	115,245	32,227		174,927

Continued ...

Table 3.5.11.1 Continued

Year	Southern VIIIc	Southern IXa	Southern Total	Total All stocks
1982	19,610	39,726	59,336	104,958
1983	25,580	48,733	74,313	147,195
1984	23,119	23,178	46,297	149,400
1985	23,292	20,237	43,529	150,830
1986	40,334	31,159	71,493	201,806
1987	30,098	24,540	54,638	223,512
1988	26,629	29,763	56,392	268,163
1989	27,170	29,231	56,401	358,533
1990	25,182	24,023	49,205	441,430
1991	23,733	21,778	45,511	391,066
1992	24,243	26,713	50,956	436,549
1993	25,483	31,945	57,428	504,190
1994	24,147	28,442	52,589	447,093[9]
1995	27,534	25,147	52,681	580,034
1996	24,290	20,400	44,690	460,185
1997	29,129	27,642	56,771	518,882
1998	22,906	41,574	64,480	398,517[9]
1999	24,188	27,733	51,921	363,033
2000	21,984	27,160	49,144	272,496

[1] Norwegian and Danish catches are included in the Western horse mackerel.
[2] Norwegian catches in Division IVb included in the Western horse mackerel.
[3] Divisions IIIa and IVb,c combined.
[4] Included in Western horse mackerel.
[5] Norwegian catches in IVb (1,426 t) included in Western horse mackerel.
[6] Includes 1,937 t from Vb.
[7] Includes 132 t from Vb.
[8] Includes 250 t from Vb.
[9] Minor corrections applied (-60 t for 1994, -6 t for 1995) during the 2001 Working Group.
[10] Obviously, 128 t have been moved in 1995 from the North Sea to the Western Horse mackerel catches.

Table 3.5.11.2 Landings (t) of HORSE MACKEREL in Sub-area IV and Division IIIa by country. (Data submitted by Working Group members).

Country	1980	1981	1982	1983	1984	1985	1986	1987	1988
Belgium	8	34	7	55	20	13	13	9	10
Denmark	199	3,576	1,612	1,590	23,730	22,495	18,652	7,290	20,323
Faroe Islands	260	-	-	-	-	-	-	-	-
France	292	421	567	366	827	298	231[2]	189[2]	784[2]
Germany, Fed.Rep.	+	139	30	52	+	+	-	3	153
Ireland	1,161	412	-	-	-	-	-	-	-
Netherlands	101	355	559	2,029[3]	824	160[3]	600[3]	850[4]	1,060[3]
Norway[2]	119	2,292	7	322	[3]	203	776	11,728[4]	34,425[4]
Poland	-	-	-	2	94	-	-	-	-
Sweden	-	-	-	-	-	-	2	-	-
UK (Engl. + Wales)	11	15	6	4	-	71	3	339	373
UK (Scotland)	-	-	-	-	3	998	531	487	5,749
USSR	-	-	-	-	489	-	-	-	-
Total	2,151	7,253	2,788	4,420	25,987	24,238	20,808	20,895	62,877

Country	1989	1990	1991	1992	1993	1994	1995	1996	1997
Belgium	10	13	-	+	74	57	51	28	-
Denmark	23,329	20,605	6,982	7,755	6,120	3,921	2,432	1,433	648
Estonia	-	-	-	293	-	275	17	-	-
Faroe Islands	-	942	340	-	360	1,014	-	-	296
France	248	220	174	162	302	415	-	-	-
Germany, Fed.Rep.	506	2,469[4]	5,995	2,801	1,570	1,329	1,600	7	7,603
Ireland	-	687	2,657	2,600	4,086	94,000	220	1,100	8,152
Netherlands	14,172	1,970	3,852	3,000	2,470	-	5,285	6,205	37,778
Norway	84,161	117,903	50,000	96,000	126,800	2,087	84,747	14,639	45,314
Poland	-	-	-	-	-	389	-	-	-
Sweden	-	102	953	800	697	7,582	-	95	232
UK (Engl. + Wales)	10	10	132	4	115	1,511	478	40	242
UK (N. Ireland)	-	-	350	-	-		-	-	-
UK (Scotland)	2,093	458	7,309	996	1,059		3,650	2,442	10,511
USSR / Russia (1992 -)	-	-	-	-278[6]	-3,270		-28	136	-31,615
Unallocated + discards	12,482[4]	-317[4]	-750[4]						
Total	112,047	145,062	77,904	114,133	140,383	112,580	98,452	26,125	79,161

Country	1998	1999	2000[1]
Belgium	19	21	19
Denmark	2,048	8,006	4,409
Estonia	22	-	-
Faroe Islands	28	908	24
France	379	60	49
Germany	4,620	4,071	3,115
Ireland	-	404	103
Netherlands	3,811	3,610	3,382
Norway	13,129	44,344	1,246
Poland	-	-	-
Russia	-	-	2
Sweden	3,411	1,957	1,141
UK (Engl. + Wales)	2	11	15
UK (N. Ireland)	-	-	-
UK (Scotland)	3,041	1,658	3,465
Unallocated + discards	737	-325	14613
Total	31,247	64,725	31583

[1] Preliminary. [2] Includes Division IIa. [3] Estimated from biological sampling. [4] Assumed to be misreported. [5] Includes 13 t from the German Democratic Republic. [6] Includes a negative unallocated catch of -4,000 t.

3.5.12 Norway pout in ICES Sub-area IV (North Sea) and Division IIIa (Skagerrak and Kattegat

State of stock/exploitation: The stock is within safe biological limits. Spawning stock biomass is currently above $\mathbf{B}_{pa}$, but is expected to decrease significantly during 2001 and 2002. Recruitment is highly variable and influences stock biomass rapidly due to the short life span of the species. Recruitment in 2001 is unknown at the time of the assessment. Fishing mortality has generally been lower than natural mortality and has decreased in recent years below the long-term average. The yield doubled in 2000 compared to 1999 due to exploitation of the strong 1999 year class in 2000 and in the 1st quarter of 2001.

Management objectives: There are no management objectives set for this stock. With present fishing mortality levels the status of the stock is more determined by natural processes and less by the fishery. However, there is a need to ensure that the stock remains high enough to provide food for a variety of predator species.

Precautionary Approach reference points (unchanged since 1997):

ICES considers that:	ICES proposes that:
$\mathbf{B}_{lim}$ is 90 000 t, the lowest observed biomass	$\mathbf{B}_{pa}$ be established at 150 000 t. This affords a high probability of maintaining SSB above $\mathbf{B}_{lim}$, taking into account the uncertainty of assessments. Below this value the probability of below average recruitment increases.
Note: With present fishing mortality levels the status of the stock is more determined by natural processes and less by the fishery. It may be more appropriate to formulate reference points based on total mortality, recruitment and stock biomass for use within management procedures using surveys (and real time monitoring of catches).	

Technical basis:

$\mathbf{B}_{lim} = \mathbf{B}_{loss} = 90\ 000$ t.	$\mathbf{B}_{pa}$ Below-average recruitment below: 150 000 t.
$\mathbf{F}_{lim}$ None advised.	$\mathbf{F}_{pa}$ None advised.

Advice on management: None.

Relevant factors to be considered in management: The stock can on average sustain current fishing mortality. The fishery targets both Norway pout and blue whiting. In managing this fishery, by-catches of haddock, whiting, and blue whiting should be taken into account and existing measures to protect the by-catch species should be maintained. Management should be implemented to regulate the catch of blue whiting in the directed Norway pout fishery, in accordance with the ICES advice for blue whiting. This fishery is mainly by Danish and Norwegian vessels using small mesh trawls in the northern North Sea.

The estimated fishing mortality for Norway pout is lower than the estimated natural mortality. This stock is important as a food source for other species, which means that the population dynamics for Norway pout in the North Sea and in the Skagerrak are very dependent on changes caused by recruitment variation and predation mortality (or other natural mortality causes) and less by the fishery.

The assessment indicates a high SSB in 2000. However, recruitment of the weak 2000 year class is expected to result in a decline in SSB in 2001. The size of the 2001 year class cannot be estimated with the precision required for a reliable catch prediction.

Comparison with previous assessment and advice: The assessment and advice are consistent with those from previous years.

Catch forecast for 2002: No forecast is possible for this stock, because catches in 2002 will consist primarily of recruiting year classes whose abundance cannot currently be estimated.

Medium- and long-term projections: No medium-term projections are given for this stock.

Elaboration and special comment: The assessment is analytical using catch-at-age analysis based on quarterly catch and CPUE data. The assessment is considered appropriate to indicate trends in the stock and immediate changes in the stock because of the seasonal assessment taking into account the seasonality in fishery.

Source of information: Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, June 2001, Hamburg, Germany (ICES CM 2002/ACFM: 01).

Catch data (Tables 3.5.12.1–2): **North Sea (Sub-area IV)**

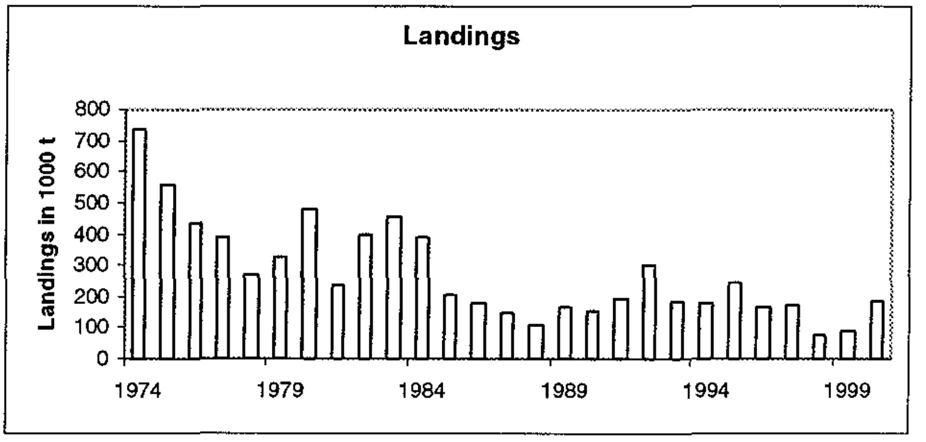
Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC[1]	Official Landings	ACFM landings
1987	No advice	-	200	215	147
1988	No advice	-	200	187	102
1989	No advice	-	200	276	167
1990	No advice	-	200	212	140
1991	No advice	-	200	223	155
1992	No advice	-	200	335	255
1993	No advice	-	220	241	176
1994	No advice	-	220	214	176
1995	Can sustain current F	-	180	289	191
1996	Can sustain current F; take by-catches into consid.	-	220	197	130
1997	Can sustain current F; take by-catches into consid.	-	220	155	140
1998	Can sustain current F; take by-catches into consid.	-	220	72	67
1999	Can sustain current F; take by-catches into consid.	-	220	90	85
2000	Can sustain current F; take by-catches into consid.	-	220	182	175
2001	Can sustain current F; take by-catches into consid.	-	211		
2002	Can sustain current F ;take by-catches into consid.	-			

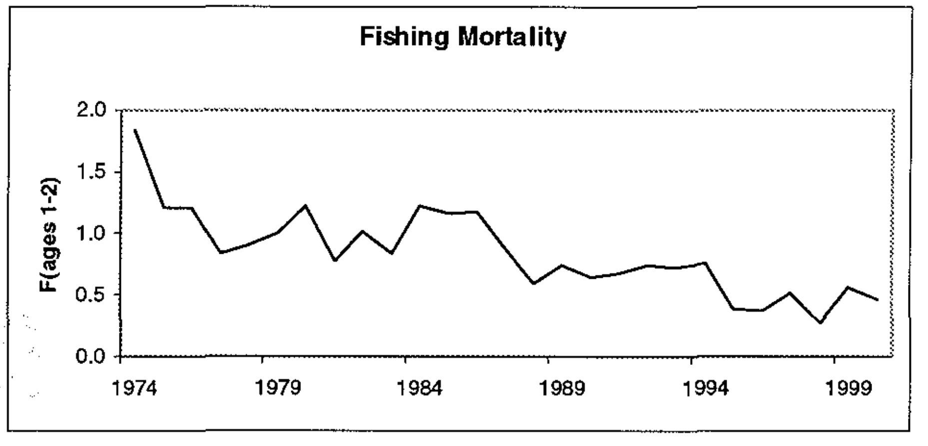
[1] IIa(EU), IIIa, IV(EU). Weights in '000 t.

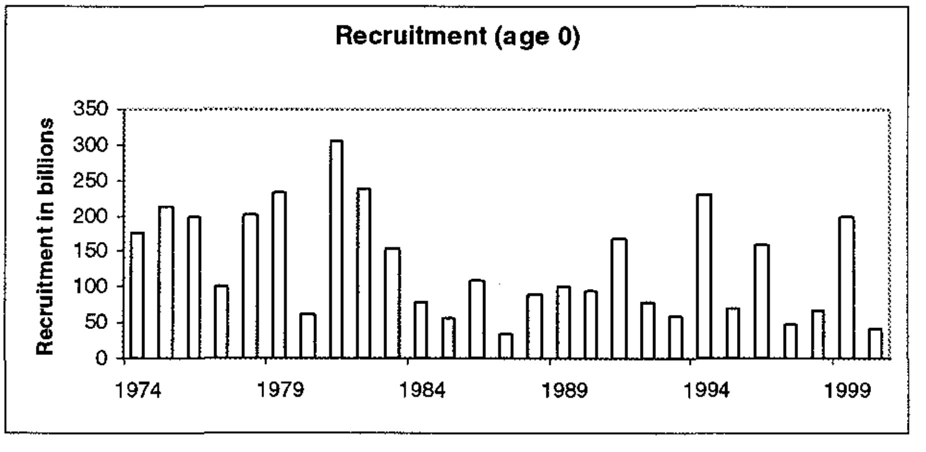
Skagerrak (Division IIIa)

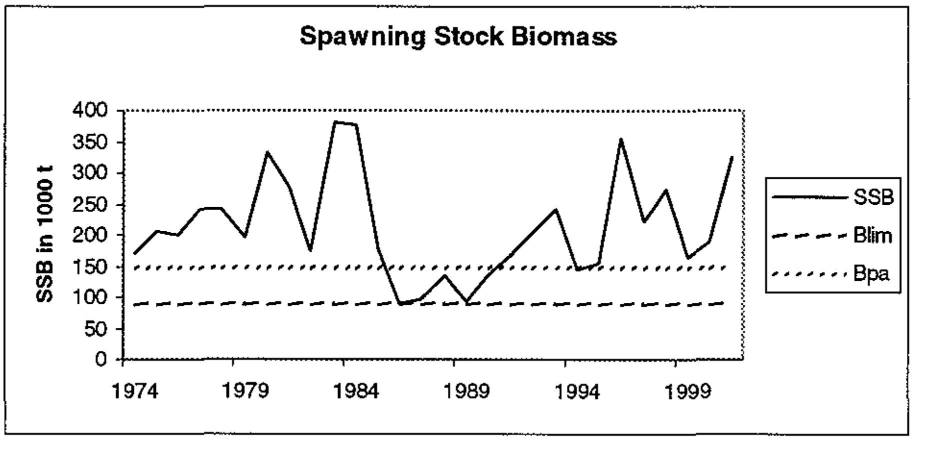
Year	ICES Advice	Official Landings	ACFM Catch
1987	No advice		2
1988	No advice		8
1989	No advice	17	5
1990	No advice	41	12
1991	No advice	49	38
1992	No advice	84	45
1993	No advice	37	8
1994	No advice	24	7
1995	No advice	68	50
1996	No advice	58	36
1997	See advice for North Sea	35	29
1998	See advice for North Sea	11	13
1999	See advice for North Sea	7	8
2000	See advice for North Sea	15	10
2001	See advice for North Sea		
2002	See advice for North Sea		

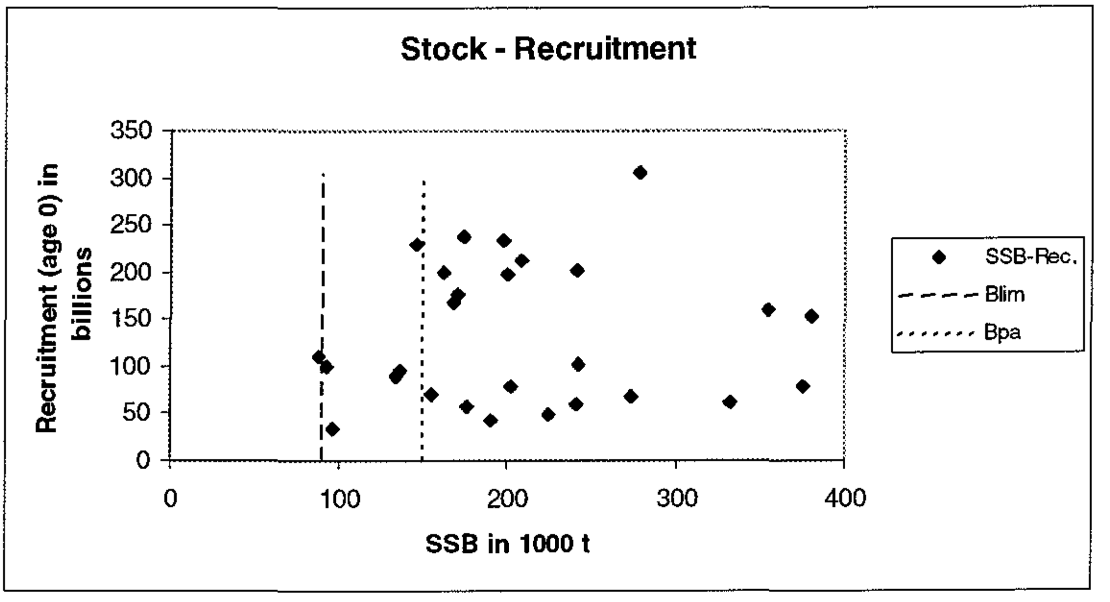
Weights in '000 t.


Landings
Landings in 1000 t
800
700
600
500
400
300
200
100
0
1974
1979
1984
1989
1994
1999


Fishing Mortality
F(ages 1-2)
2.0
1.5
1.0
0.5
0.0
1974
1979
1984
1989
1994
1999


Recruitment (age 0)
Recruitment in billions
350
300
250
200
150
100
50
0
1974
1979
1984
1989
1994
1999


Spawning Stock Biomass
SSB in 1000 t
400
350
300
250
200
150
100
50
0
1974
1979
1984
1989
1994
1999
SSB
Blim
Bpa


Stock - Recruitment
Recruitment (age 0) in billions
SSB in 1000 t
SSB-Rec.
Blim
Bpa
0
50
100
150
200
250
300
350
0
100
200
300
400

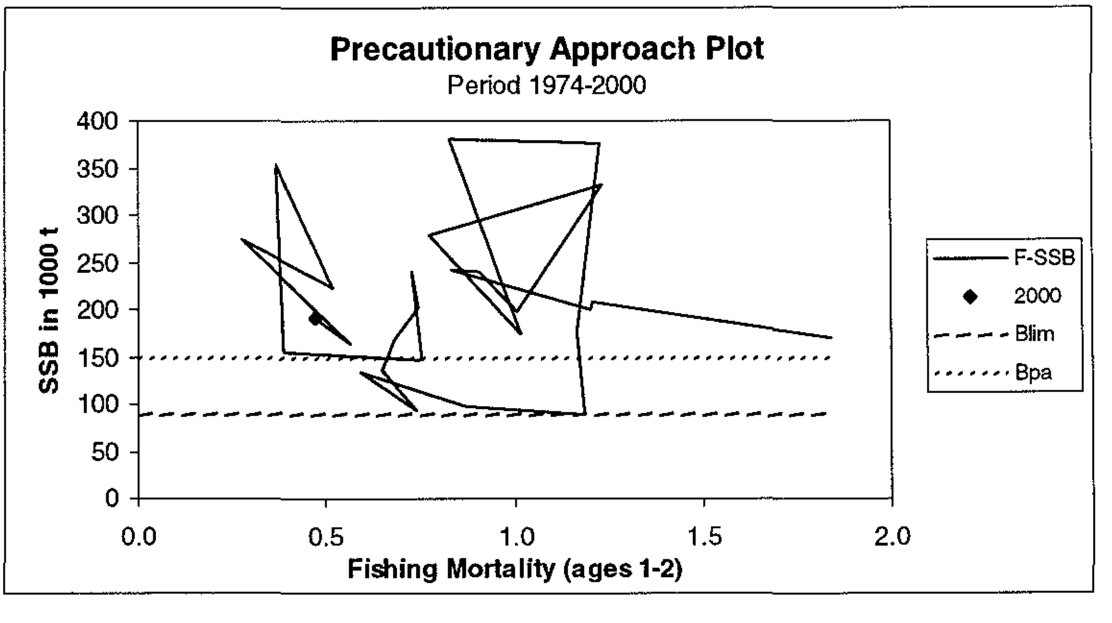

Precautionary Approach Plot
Period 1974-2000
SSB in 1000 t
Fishing Mortality (ages 1-2)
F-SSB
2000
Blim
Bpa
0
50
100
150
200
250
300
350
400
0.0
0.5
1.0
1.5
2.0

Table 3.5.12.1 Norway pout annual landings ('000 t) in the North Sea and Skagerrak, by country, for 1960-2000. (Data provided by Working Group members). (Norwegian data include landings of by-catches of other species).

Year	Denmark		Faroes Isl	Norway	Sweden	U.K.(Scot.)	Others	Total
	North Sea	Skagerrak						
1960	17.2	-	-	13.5	-	-	-	30.7
1961	20.5	-	-	8.1	-	-	-	28.6
1962	121.8	-	-	27.9	-	-	-	149.7
1963	67.4	-	-	70.4	-	-	-	137.8
1964	10.4	-	-	51.0	-	-	-	61.4
1965	8.2	-	-	35.0	-	-	-	43.2
1966	35.2	-	-	17.8	-	-	+	53.0
1967	169.6	-	-	12.9	-	-	+	182.5
1968	410.8	-	-	40.9	-	-	+	451.7
1969	52.5	-	19.6	41.4	-	-	+	113.5
1970	142.1	-	32.0	63.5	-	0.2	0.2	238.0
1971	178.5	-	47.2	79.3	-	0.1	0.2	305.3
1972	259.6	-	56.8	120.5	6.8	0.9	0.2	444.8
1973	215.2	-	51.2	63.0	2.9	13.0	0.6	345.9
1974	464.5	-	85.0	154.2	2.1	26.7	3.3	735.8
1975	251.2	-	63.6	218.9	2.3	22.7	1.0	559.7
1976	244.9	-	64.6	108.9	+	17.3	1.7	437.4
1977	232.2	-	50.9	98.3	2.9	4.6	1.0	389.9
1978	163.4	-	19.7	80.8	0.7	5.5	-	270.1
1979	219.9	9.0	21.9	75.4	-	3.0	-	329.2
1980	366.2	11.6	34.1	70.2	-	0.6	-	482.7
1981	167.5	2.8	16.6	51.6	-	+	-	238.5
1982	256.3	35.6	15.4	88.0	-	-	-	395.3
1983	301.1	28.5	24.5	97.3	-	+	-	451.4
1984	251.9	38.1	19.1	83.8	-	0.1	-	393.0
1985	163.7	8.6	9.9	22.8	-	0.1	-	205.1
1986	146.3	4.0	6.6	21.5	-	-	-	178.4
1987	108.3	2.1	4.8	34.1	-	-	-	149.3
1988	79.0	7.9	1.5	21.1	-	-	-	109.5
1989	95.6	5.4	0.8	65.3	+	0.1	0.3	167.5
1990	61.5	12.1	0.9	77.1	+	-	-	151.6
1991	85.0	38.3	1.3	68.3	+	-	+	192.9
1992	146.9	44.7	2.6	105.5	+	-	0.1	299.8
1993	97.3	7.8	2.4	76.7	-	-	+	184.2
1994	97.9	6.6	3.6	74.2	-	-	+	182.3
1995	138.4	50.3	8.9	43.1	0.1	+	0.2	241.0
1996	74.3	36.2	7.6	47.8	0.2	0.1	+	166.2
1997	94.2	29.3	7.0	39.1	+	+	0.1	169.7
1998	39.8	13.2	4.7	22.1	-	-	+	79.8
1999	41.0	7.5	-	44.2	+	-	-	92.7
2000	127.0	9.6	-	48.0	0.1	-	+	184.7

Table 3.5.12.2 Norway pout in Sub-area IV and Division IIIa.

Year	Recruitment Age 0 millions	Total Stock Biomass tonnes	SSB tonnes	Landings tonnes	Mean F Ages 1-2
1974	176000		171000	735800	1.840
1975	212000		208000	559700	1.206
1976	198000		200000	437400	1.204
1977	102000		242000	389900	0.835
1978	201000		241000	270100	0.907
1979	233000		198000	329200	1.006
1980	61000		332000	482700	1.233
1981	306000		278000	238500	0.777
1982	238000		174000	395300	1.016
1983	153000	1928000	380000	451400	0.832
1984	79000	1167000	376000	393000	1.227
1985	57000	642000	177000	205100	1.164
1986	110000	740000	89000	178400	1.184
1987	33000	621000	97000	149300	0.871
1988	89000	601000	135000	109500	0.594
1989	100000	825000	93000	167500	0.739
1990	95000	831000	137000	151600	0.652
1991	168000	1178000	168000	192900	0.680
1992	78000	1133000	202000	299800	0.747
1993	60000	725000	241000	184200	0.728
1994	230000	1254000	146000	182300	0.757
1995	70000	1358000	156000	241000	0.388
1996	159000	1210000	354000	166200	0.368
1997	49000	1072000	224000	169700	0.521
1998	68000	690000	274000	79800	0.280
1999	199000	1219000	163000	92700	0.569
2000	43000	1239000	191000	184700	0.475
2001			325000		
Average	132111		213286	275470	0.844

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3.5.13 Sandeel

3.5.13.a Sandeel in Sub-area IV

Catches for the total North Sea are given by country in Table 3.5.13.1 and by the Sub-areas shown in Figure 3.5.13.1 and Table 3.5.13.2.

State of stock/exploitation: The stock is within safe biological limits. SSB in 2001 is estimated to be above the proposed $\mathbf{B}_{pa}$. SSB has declined since the historical high SSB in 1998.

Management objectives: There are no management objectives set for this stock. There is a need to develop management objectives that ensure that the stock remains high enough to provide food for a variety of predator species.

Precautionary Approach reference points (unchanged since 1999):

ICES considers that:	ICES proposes that:
$\mathbf{B}_{lim}$ is 430 000 t	$\mathbf{B}_{pa}$ is 600 000 t

Technical basis:

$\mathbf{B}_{lim}$ is 430 000 t, the lowest observed biomass	$\mathbf{B}_{pa}$ is set to 1.4* $\mathbf{B}_{lim}$
$\mathbf{F}_{lim}$ None advised	$\mathbf{F}_{pa}$ None proposed

Advice on Management: None.

Relevant factors to be considered in management: The stock can sustain current fishing mortality. Sandeels are important prey for many marine predators. Fishing mortality should not be allowed to increase because the consequences of removing a larger fraction of the food-biomass for other biota are unknown. Management of fisheries should try to prevent local depletion of sandeel aggregations, particularly in areas where predators congregate.

Comparison with previous assessment and advice: The assessment and advice is consistent with those from previous years.

Catch forecast for 2002: No forecast is possible for this stock, because catches in 2002 will consist primarily of recruiting year classes whose abundance cannot currently be estimated.

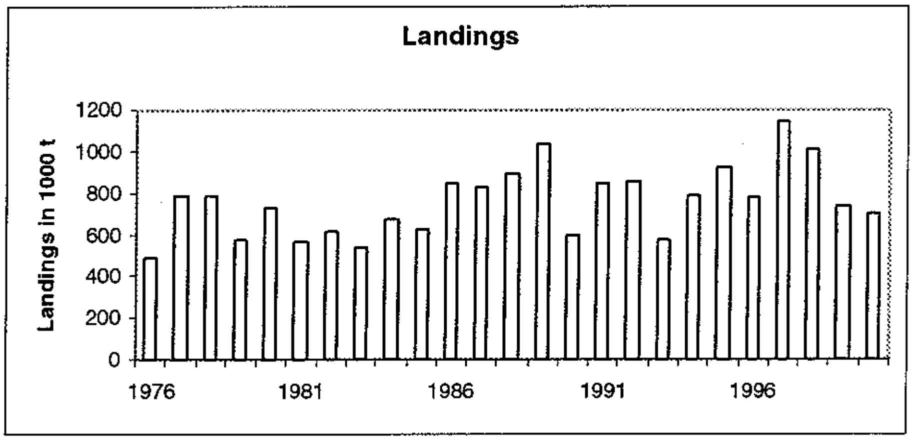
Elaboration and special comment: Sandeel is taken by trawlers using small mesh gear. The fishery is seasonal, taking place mostly in the spring and summer. Most of the catch consists of *Ammodytes marinus* and there is little by-catch of TAC species. Sandeels are largely stationary after settlement and the North Sea sandeel must be considered as a complex of local populations. Recruitment to local areas may not only be related to the local stock, as interchange between areas seems to take place during the early phases of life before settlement. The Shetland sandeel stock is assessed as a separate unit.

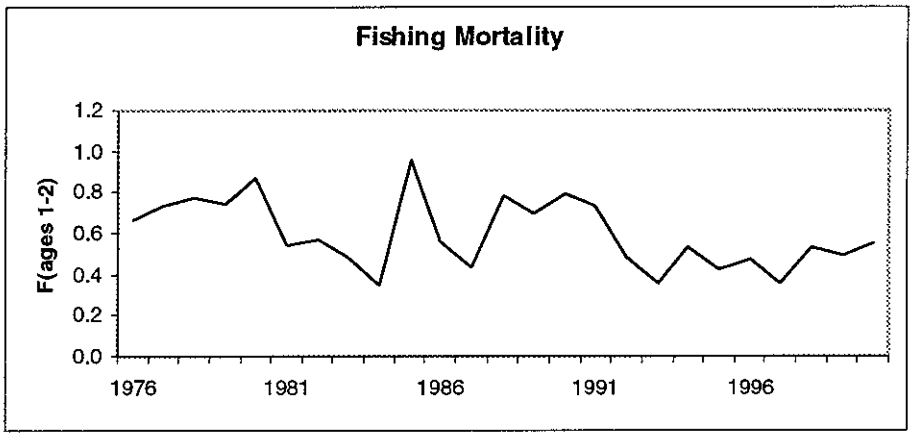
Source of information: Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, June 2001, Hamburg, Germany (ICES CM 2002/ACFM: 01).

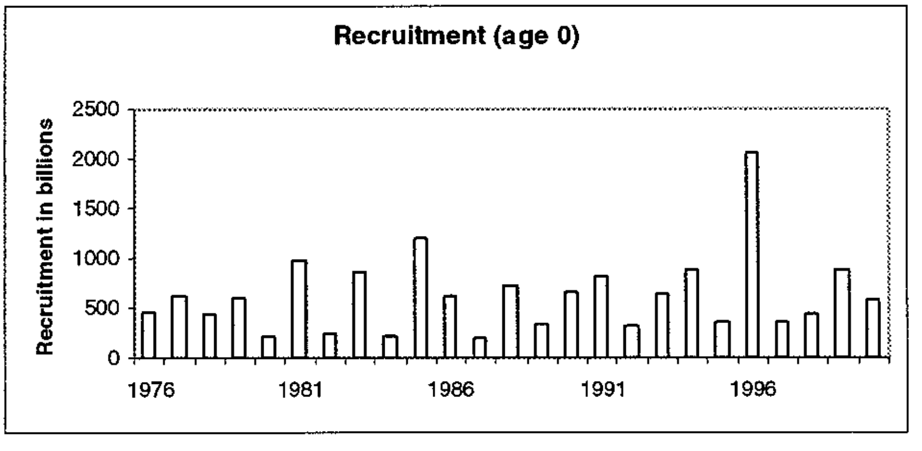
Catch data (Tables 3.5.13.1–3):

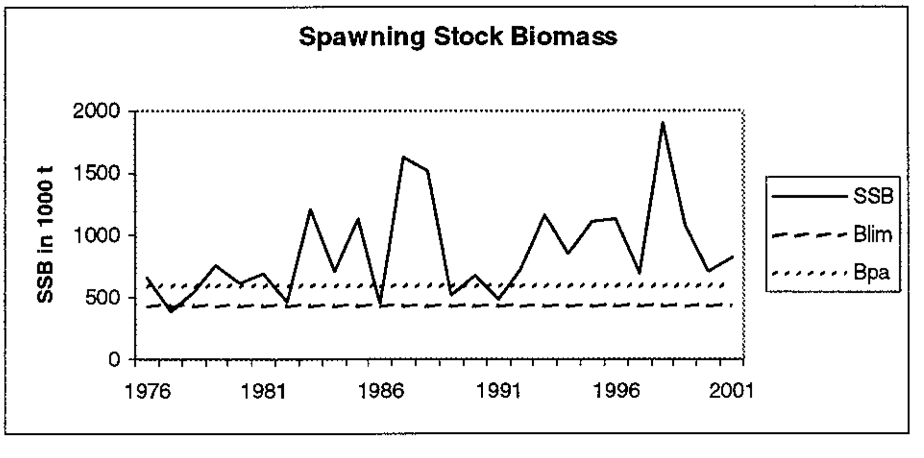
Year	ICES Advice	TAC	ACFM Catch
1987	No advice[1]; No advice[2]		825
1988	No advice[1]; No advice[2]		893
1989	No advice[1]; No advice[2]		1039
1990	No advice[1]; No advice[2]		591
1991	No advice[1]; No advice[2]		843
1992	No advice[1]; No advice[2]		855
1993	No advice[1]; No advice[2]		579
1994	No advice[1]; No advice[2]		786
1995	Can sustain current F[1]; No advice[2]		918
1996	Can sustain current F		777
1997	Can sustain current F		1138
1998	Can sustain current F	1000	1004
1999	Can sustain current F	1000	735
2000	Can sustain current F	1020	699
2001	Can sustain current F	1020	
2002	Can sustain current F		

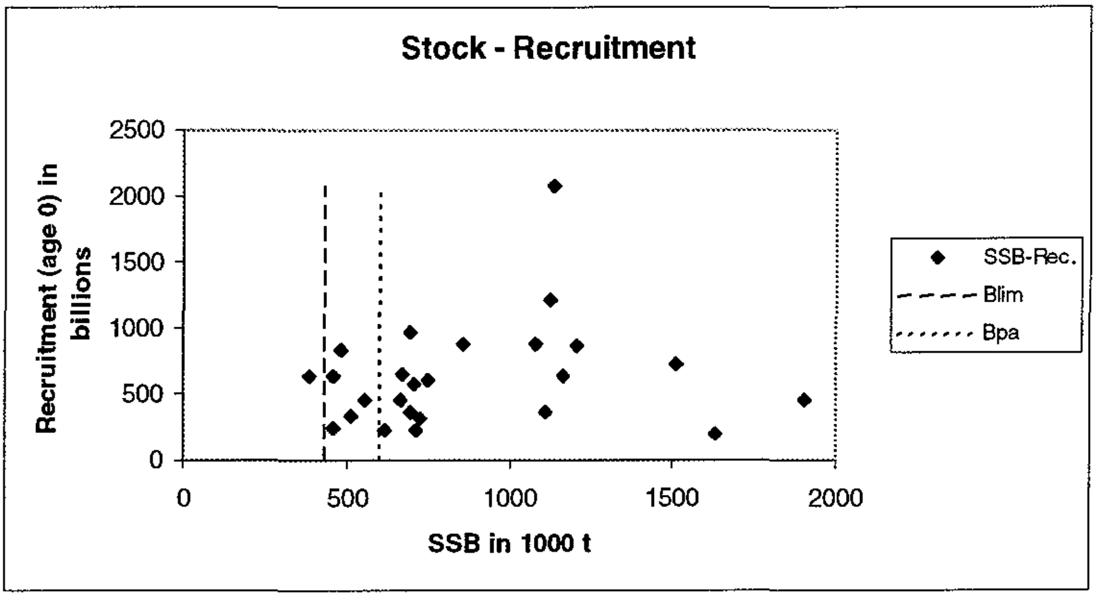
[1]Southern stock component. [2]Northern stock component. Weights in '000 t.


Landings
Landings in 1000 t
1200
1000
800
600
400
200
0
1976
1981
1986
1991
1996


Fishing Mortality
F(ages 1-2)
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1976
1981
1986
1991
1996


Recruitment (age 0)
Recruitment in billions
2500
2000
1500
1000
500
0
1976
1981
1986
1991
1996


Spawning Stock Biomass
SSB in 1000 t
2000
1500
1000
500
0
1976
1981
1986
1991
1996
2001
SSB
Blim
Bpa


Stock - Recruitment
Recruitment (age 0) in billions
2500
2000
1500
1000
500
0
0
500
1000
1500
2000
SSB in 1000 t
SSB-Rec.
Blim
Bpa

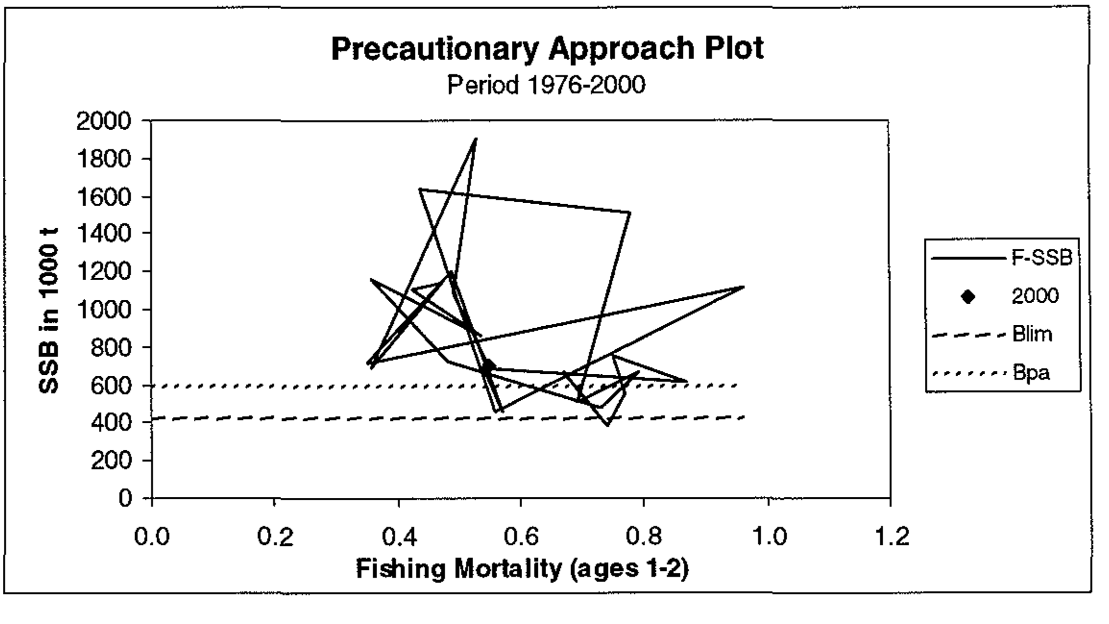

Precautionary Approach Plot
Period 1976-2000
SSB in 1000 t
2000
1800
1600
1400
1200
1000
800
600
400
200
0
0.0
0.2
0.4
0.6
0.8
1.0
1.2
Fishing Mortality (ages 1-2)
F-SSB
2000
Blim
Bpa

Table 3.5.13.1 Sandeel in the North Sea. Landings ('000 t), 1952-2000. (Data provided by Working Group members.)

Year	Denmark	Germany	Faroes I	Ireland	Netherlands	Norway	Sweden	U.K.	Total
1952	1.6	-	-	-	-	-	-	-	1.6
1953	4.5	+	-	-	-	-	-	-	4.5
1954	10.8	+	-	-	-	-	-	-	10.8
1955	37.6	+	-	-	-	-	-	-	37.6
1956	81.9	5.3	-	-	+	1.5	-	-	88.7
1957	73.3	25.5	-	-	3.7	3.2	-	-	105.7
1958	74.4	20.2	-	-	1.5	4.8	-	-	100.9
1959	77.1	17.4	-	-	5.1	8.0	-	-	107.6
1960	100.8	7.7	-	-	+	12.1	-	-	120.6
1961	73.6	4.5	-	-	+	5.1	-	-	83.2
1962	97.4	1.4	-	-	-	10.5	-	-	109.3
1963	134.4	16.4	-	-	-	11.5	-	-	162.3
1964	104.7	12.9	-	-	-	10.4	-	-	128.0
1965	123.6	2.1	-	-	-	4.9	-	-	130.6
1966	138.5	4.4	-	-	-	0.2	-	-	143.1
1967	187.4	0.3	-	-	-	1.0	-	-	188.7
1968	193.6	+	-	-	-	0.1	-	-	193.7
1969	112.8	+	-	-	-	-	-	0.5	113.3
1970	187.8	+	-	-	-	+	-	3.6	191.4
1971	371.6	0.1	-	-	-	2.1	-	8.3	382.1
1972	329.0	+	-	-	-	18.6	8.8	2.1	358.5
1973	273.0	-	1.4	-	-	17.2	1.1	4.2	296.9
1974	424.1	-	6.4	-	-	78.6	0.2	15.5	524.8
1975	355.6	-	4.9	-	-	54.0	0.1	13.6	428.2
1976	424.7	-	-	-	-	44.2	-	18.7	487.6
1977	664.3	-	11.4	-	-	78.7	5.7	25.5	785.6
1978	647.5	-	12.1	-	-	93.5	1.2	32.5	786.8
1979	449.8	-	13.2	-	-	101.4	-	13.4	577.8
1980	542.2	-	7.2	-	-	144.8	-	34.3	728.5
1981	464.4	-	4.9	-	-	52.6	-	46.7	568.6
1982	506.9	-	4.9	-	-	46.5	0.4	52.2	610.9
1983	485.1	-	2.0	-	-	12.2	0.2	37.0	536.5
1984	596.3	-	11.3	-	-	28.3	-	32.6	668.5
1985	587.6	-	3.9	-	-	13.1	-	17.2	621.8
1986	752.5	-	1.2	-	-	82.1	-	12.0	847.8
1987	605.4	-	18.6	-	-	193.4	-	7.2	824.6
1988	686.4	-	15.5	-	-	185.1	-	5.8	892.8
1989	824.4	-	16.6	-	-	186.8	-	11.5	1,039.1
1990	496.0	-	2.2	-	0.3	88.9	-	3.9	591.3
1991	701.4	-	11.2	-	-	128.8	-	1.2	842.6
1992	751.1	-	9.1	-	-	89.3	0.5	4.9	854.9
1993	482.2	-	-	-	-	95.5	-	1.5	579.2
1994	603.5	-	10.3	-	-	165.8	-	5.9	785.5
1995	647.8	-	-	-	-	263.4	-	6.7	917.9
1996	601.6	-	5.0	-	-	160.7	-	9.7	776.9
1997	751.9	-	11.2	-	-	350.1	-	24.6	1,137.8
1998	617.8	-	11.0	-	+	343.3	8.5	23.8	1,004.4
1999	500.1	-	13.2	0.4	+	187.6	22.4	11.5	735.1
2000	541.0	-	-	-	+	119.0	28.4	10.8	699.1

+ = less than half unit.

- = no information or no catch.

Table 3.5.13.2 Annual landings ('000 t) of Sandeel by area of the North Sea (Denmark, Norway and Scotland). Data provided by Working Group members.

	Area										Assessment area		
Year	1A	1B	1C	2A	2B	2C	3	4	5	6	Shetland	Northern	Southern
1972	98.8	28.1	3.9	24.5	85.1	0.0	13.5	58.3	6.7	28.0	0	130.6	216.3
1973	59.3	37.1	1.2	16.4	60.6	0.0	8.7	37.4	9.6	59.7	0	107.6	182.4
1974	50.4	178.0	1.7	2.2	177.9	0.0	29.0	27.4	11.7	25.4	7.4	386.6	117.1
1975	70.0	38.2	17.8	12.2	154.7	4.8	38.2	42.8	12.3	19.2	12.9	253.7	156.5
1976	154.0	3.5	39.7	71.8	38.5	3.1	50.2	59.2	8.9	36.7	20.2	135.0	330.6
1977	171.9	34.0	62.0	154.1	179.7	1.3	71.4	28.0	13.0	25.3	21.5	348.4	392.3
1978	159.7	--50.2--		346.5	--70.3--		42.5	37.4	6.4	27.2	28.1	163.0	577.2
1979	194.5	0.9	61.0	32.3	27.0	72.3	34.1	79.4	5.4	44.3	13.4	195.3	355.9
1980	215.1	3.3	119.3	89.5	52.4	27.0	90.0	30.8	8.7	57.1	25.4	292.0	401.2
1981	105.2	0.1	42.8	151.9	11.7	23.9	59.6	63.4	13.3	45.1	46.7	138.1	378.9
1982	189.8	5.4	4.4	132.1	24.9	2.3	37.4	75.7	6.9	74.7	52.0	74.4	479.2
1983	197.4	-	2.8	59.4	17.7	-	57.7	87.6	8.0	66.0	37.0	78.2	419.0
1984	337.8	4.1	5.9	74.9	30.4	0.1	51.3	56.0	3.9	60.2	32.6	91.8	532.8
1985	281.4	46.9	2.8	82.3	7.1	0.1	29.9	46.6	18.7	84.5	17.2	79.7	513.5
1986	295.2	35.7	8.5	55.3	244.1	2.0	84.8	22.5	4.0	80.3	14.0	375.1	457.4
1987	275.1	63.6	1.1	53.5	325.2	0.4	5.6	21.4	7.7	45.1	7.2	395.9	402.8
1988	291.1	58.4	2.0	47.0	256.5	0.3	37.6	35.3	12.0	102.2	4.7	384.8	487.6
1989	228.3	31.0	0.5	167.9	334.1	1.5	125.3	30.5	4.5	95.1	3.5	492.4	526.3
1990	141.4	1.4	0.1	80.4	156.4	0.6	61.0	45.5	13.8	85.5	2.3	219.5	366.7
1991	228.2	7.1	0.7	114.0	252.8	1.8	110.5	22.6	1.0	93.1	+	372.9	458.9
1992	422.4	3.9	4.2	168.9	67.1	0.3	101.2	20.1	2.8	54.4	0	176.7	668.6
1993	196.5	21.9	0.1	26.2	164.9	0.3	88.0	26.6	3.9	48.7	0	276.0	301.9
1994	157.0	108.6	-	61.7	203.4	2.7	175.0	16.0	2.8	42.0	0	489.7	279.5
1995	322.4	43.9	147.4	86.7	169.5	1.0	59.4	26.6	5.3	55.8	1.3	421.2	496.8
1996	310.5	18.6	31.2	40.8	153.0	4.5	134.1	12.7	3.0	52.5	1.0	341.2	419.5
1997	352.0	53.3	8.9	92.8	390.5	1.2	112.9	18.1	4.7	88.6	2.4	566.8	535.8
1998	282.2	58.3	2.0	90.3	395.3	1.0	40.6	34.5	4.2	63.4	5.2	497.2	480.7
1999	266.7	32.6	0.1	132.8	167.9	0.0	48.0	16.9	2.7	27.2	4.2	248.7	446.4
2000	226.1	29.2	0.0	87.2	139.9	0.3	111.7	20.4	8.3	43.3	4.3	281.0	385.4

Assessment areas: Northern - Areas 1B, 1C, 2B, 2C, 3.
Southern - Areas 1A, 2A, 4, 5, 6.

Table 3.5.13.3 Sandeel in Sub-area IV.

Year	Recruitment Age 0 thousands	Total Stock Biomass tonnes	SSB tonnes	Landings tonnes	Mean F Ages 1-2
1976	456000000		665000	487600	0.670
1977	629000000		387000	785600	0.740
1978	448000000		556000	786800	0.770
1979	605000000		751000	577800	0.750
1980	225000000		619000	728500	0.870
1981	976000000		692000	568600	0.540
1982	241000000		461000	610900	0.570
1983	869000000	1704000	1207000	536500	0.488
1984	228000000	2265000	711000	668500	0.351
1985	1206000000	1549000	1121000	621800	0.961
1986	630000000	2687000	457000	847800	0.559
1987	201000000	2940000	1633000	824600	0.435
1988	723000000	1904000	1509000	892800	0.780
1989	332000000	1904000	512000	1039100	0.692
1990	651000000	1296000	670000	591300	0.791
1991	830000000	1702000	484000	842600	0.731
1992	325000000	2176000	724000	854900	0.482
1993	634000000	1800000	1164000	579200	0.356
1994	877000000	2524000	858000	785500	0.536
1995	358000000	3918000	1109000	917900	0.423
1996	2070000000	2203000	1137000	776900	0.473
1997	358000000	5800000	692000	1137800	0.357
1998	449000000	2700000	1903000	1004400	0.531
1999	880000000	2072000	1081000	735100	0.491
2000	572000000	3086000	707000	699200	0.549
2001			825000		
Average	630920000		870577	756068	0.596

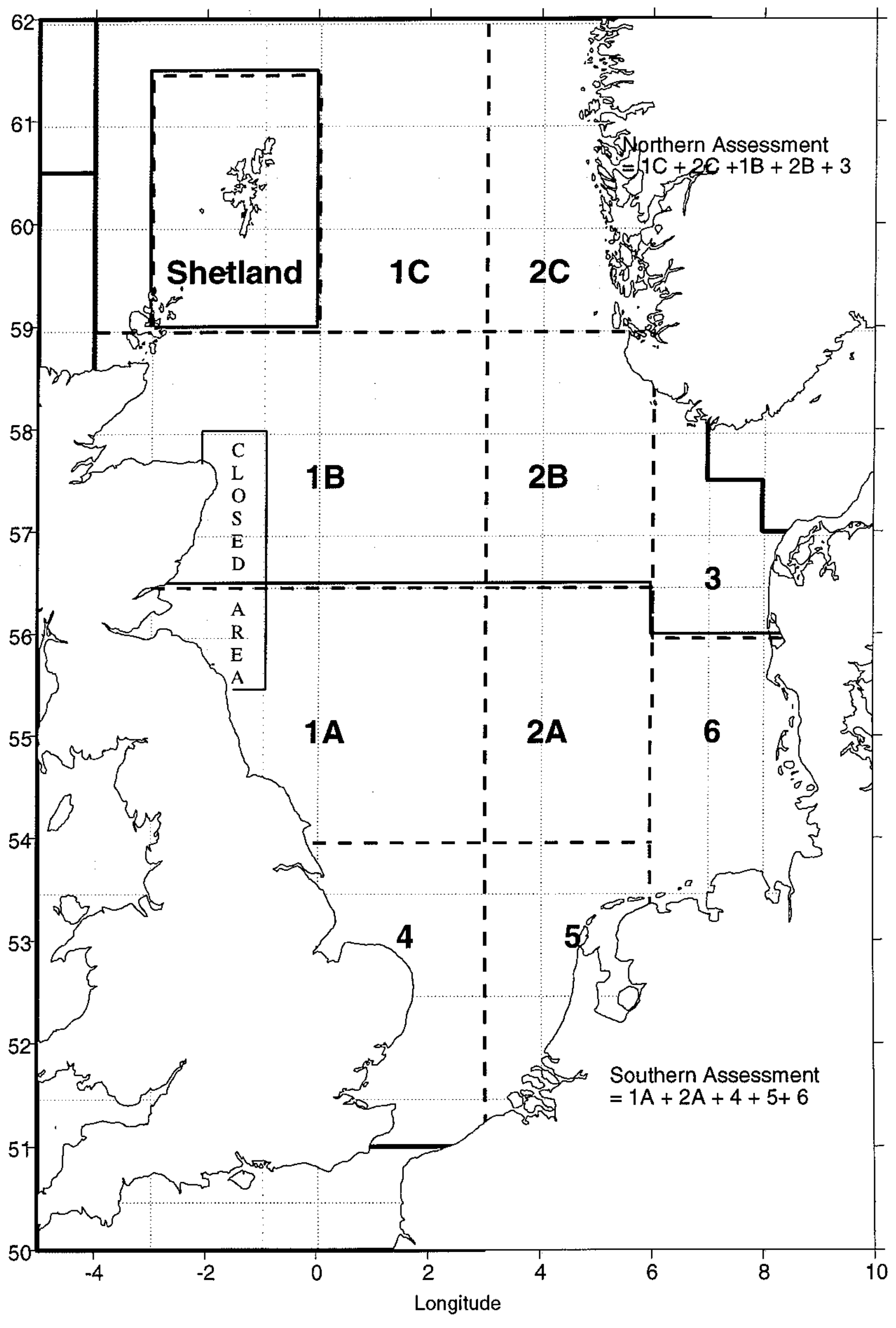


Figure 3.5.13.1 North Sea sandeel. Sampling areas and assessments area used by ICES.

3.5.13.b Sandeel in the Shetland area

State of stock/exploitation: Safe biological limits have not been defined for this stock. An assessment based on survey data alone suggests that the SSB in 2000 is close to its lowest observed value and that recent recruitment has been weak. It is believed that fishing mortality is well below natural mortality. This means that natural processes largely drive stock variations. Landings in 2000 were 4 871 t, slightly higher than in 1999, but below the TAC of 7 000 t.

Management objectives: The Shetland sandeel fishery re-opened in 1995 subject to a multi-annual management regime. This was revised for the 1998 fishing season onwards. The new regime consists of an annual TAC of 7 000 t and a closure during the months of June and July. The seasonal closure is to avoid any possibility of direct competition between the fishery and seabirds during the chick-rearing season. There is also a limit on vessel size to boats of 20 m or less. These arrangements were renewed in 2001 for another three years.

Advice on management: None.

Relevant factors to be considered in management: Due to the low SSB and recent poor recruitment, ICES considers that it is appropriate to review the current management agreement before 2004.

Fishing grounds are close inshore and often adjacent to large colonies of seabirds for which the sandeel population is an important food supply, especially during the breeding season. For some seabird species the availability of 0-group sandeel as prey is very important.

In some years most of the recruitment comes from spawning areas away from Shetland. The availability of 0-group sandeel is, therefore, not closely linked to the local spawning population. The sandeel population is also an important food source for other predator species in the Shetland area.

Elaboration and special comment: The previous assessment was undertaken in 1997 and was based on survey and commercial age composition data. Because fishing mortality appears to be very low compared with natural mortality, the current assessment uses a model, which only attempts to estimate total mortality. The model calculates age-dependent total mortality from survey data alone. This assessment is consistent with the 1997 assessment, but is subject to high uncertainty. It indicates that SSB has declined recently and that recent recruitment has been poor. If these indications are correct then the SSB is likely to decline further in the short-term.

The sandeel population at Shetland is not a separate stock, but forms part of a larger complex of sub-populations. Estimates of the consumption of sandeel by seabirds and other predators greatly exceed the quantities taken by the fishery in recent years.

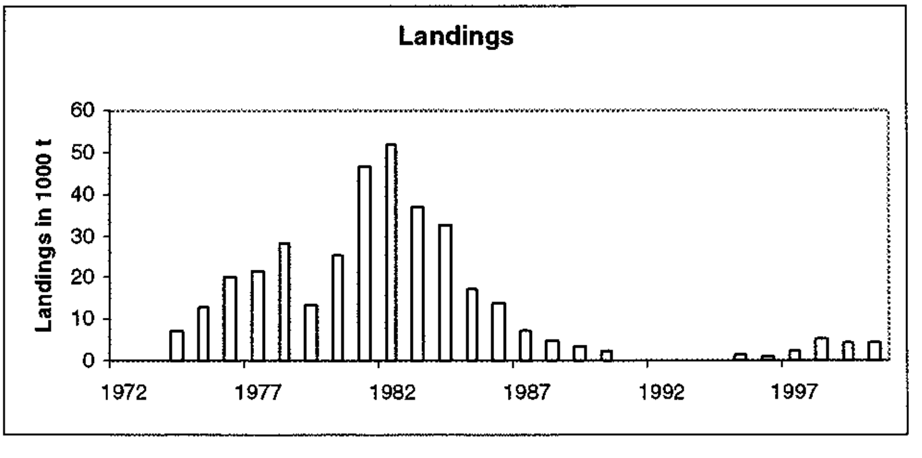
Source of information: Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, June 2001, Hamburg, Germany (ICES CM 2002/ACFM: 01).

Catches in the total North Sea are given in Table 3.5.13.1. For the Shetland Area see Table 3.5.13.2.

Year	ICES Advice	Predicted Catch corresp. to advice	Agreed TAC	ACFM Catch
1987	No advice	-		7.2
1988	No advice	-		4.7
1989	No advice	-		3.5
1990	No advice	-		2.3
1991	Low fishing	-		+
1992	No fishing prudent	-		-
1993	No fishing prudent	-		-
1994	TAC	3		-
1995	TAC	3	3	1.2
1996	No advice	-	3	1.0
1997	No advice	-	3	2.1
1998	No advice	-	7	5.2
1999	No advice	-	7	4.2
2000	No catch advice	-	7	4.9
2001	No advice	-	7	
2002	No advice	-		

Weights in '000 t.

Sandeel in the Shetland Area



3.5.14 *Pandalus borealis*

3.5.14.a *Pandalus borealis* in Division IVa (Fladen Ground)

State of stock/exploitation: The current state of the stock is unknown. During the last 10 years total landings fluctuated between a low of around 500 t to a high of about 6 000 t. Total effort has been at a relatively low level in 1999 and 2000.

Relevant factors to be considered in management: The fishery is highly dependent on year class strength. Only age groups 2 and 3 at the beginning of the year and age groups 1 and 2 at the end of the year are caught. There is no basis for defining biological reference points for this stock.

Elaboration and special comment: No assessment was conducted in 2001.

A main characteristic of the Fladen stock of *Pandalus* is that the catches consist of mainly 2 age groups. During the first two quarters of the year age groups 2 and 3 normally dominate the catches. During quarter 4 age group 3 usually disappears from the catches, while age group 1 adds to the catches. Because of the few age groups constituting this stock predictions for the Fladen fishery are possible only if very reliable information on recruitment is available.

The Fladen stock is mainly exploited by Danish and UK trawlers normally using 35 mm cod-end mesh size. It is a targeted fishery on *Pandalus* with low by-catches of other species. In recent years the by-catch in the Danish fishery of other species was estimated to be 11% of the total landings.

Source of information: Report of the *Pandalus* Assessment Working Group, Charlottenlund, Denmark, August 2001 (ICES CM 2002/ACFM:04).

Catch data(Table 3.5.14.a.1):

Year	ICES Advice	TAC (EC part of Div. IV)	ACFM landings
1987	Not assessed		8.0
1988	Large fluctuations of stock at current F and mesh size		1.2
1989	Large fluctuations of stock at current F		3.0
1990	No advice		2.1
1991	No advice		0.5
1992	No advice	4.5	1.6
1993	No advice	4.5	2.1
1994	No advice	5.4	1.2
1995	No advice	4.8	5.9
1996	No advice	4.5	5.8
1997	No advice	4.5	3.3
1998	No advice	5.2	4.3
1999	No advice	5.2	1.6
2000	No advice	7.1	1.9
2001	No advice	5.7	
2002	No advice		

Weights in '000 t.

Pandalus borealis in Division IVa (Fladen Ground)

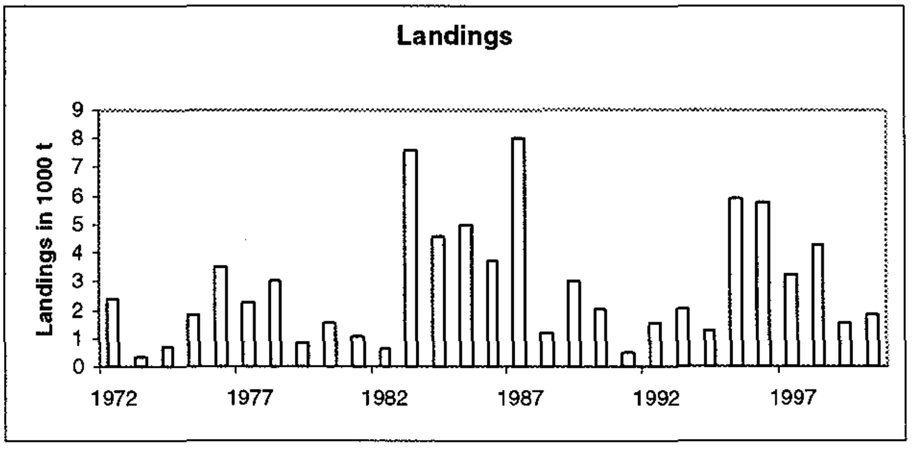


Table 3.5.14.a.1 Landings in tonnes of *Pandalus borealis* from the Fladen Ground (Division IVa) as estimated by the Working Group.

Year	Denmark	Norway	Sweden	UK (Scotland)	Total
1972	2204	-	-	187	2391
1973	157	-	-	163	320
1974	282	-	-	434	716
1975	1308	-	-	525	1833
1976	1552	-	-	1937	3489
1977	425	112	-	1692	2229
1978	890	81	-	2027	2998
1979	565	44	-	268	877
1980	1122	76	-	377	1575
1981	685	1	-	347	1033
1982	283	-	-	352	635
1983	5729	8	-	1827	7564
1984	4553	13	-	25	4591
1985	3649	-	-	1341	4990
1986	3416	-	-	301	3717
1987	7326	-	-	686	8012
1988	1077	2	-	84	1163
1989	2438	25	-	547	3010
1990	1681	3	4	365	2053
1991	422	31	-	53	506
1992	1448	-	-	116	1564
1993	1521	38	-	509	2068
1994	1207	0	-	35	1242
1995	4578	30	-	1298	5906
1996	3858	32	-	1893	5783
1997	2892	9	-	365	3266
1998	2900	3	-	1365	4268
1999	1090	9	-	456	1555
2000	1482	-	-	378	1860

3.5.14.b *Pandalus borealis* in Division IVb (Farn Deeps)

State of stock/exploitation: The state of the stock is unknown.

In recent years this fishery has yielded very low annual landings (0-5 t) and in 2000 no landings were reported.

Elaboration and special comment: ICES has never assessed the stock.

There is no basis for defining biological reference points for this stock.

Source of information: Report of the *Pandalus* Assessment Working Group, Charlottenlund, Denmark, August 2001 (ICES CM 2002/ACFM:04).

Catch data (Table 3.5.14.b.1):

Year	ICES Advice	TAC (EC Div. IV)	ACFM landings
1987	No advice		0.39
1988	No advice		0.50
1989	No advice		0.25
1990	No advice		0.15
1991	No advice		0.00
1992	No advice		0.00
1993	No advice		0.00
1994	No advice		0.00
1995	No advice		0.17
1996	No advice		0.06
1997	No advice		0.01
1998	No advice		0.01
1999	No advice		0
2000	No advice		0
2001	No advice		
2002	No advice		

Weights in '000 t.

Pandalus borealis in Division IVb (Farn Deeps)

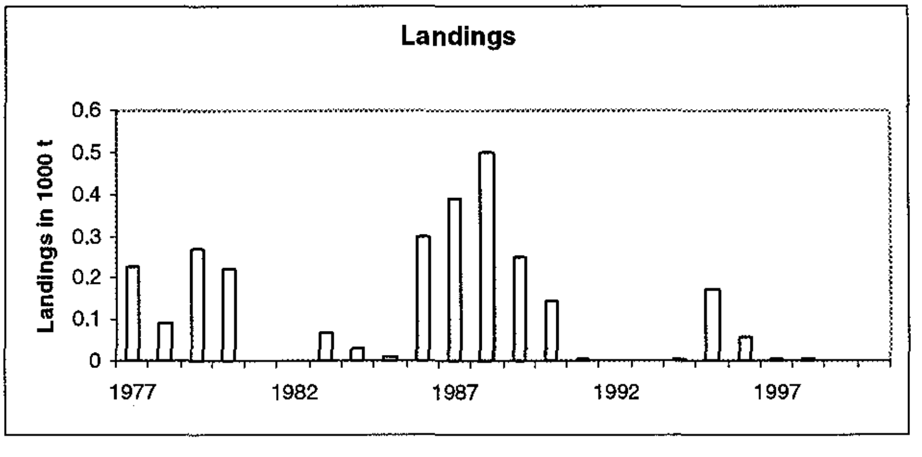


Table 3.5.14.b.1 Landings (t) of *Pandalus borealis* from Division IVb, the Farn Deeps as estimated by the Working Group.

Year	UK (England)	UK (Scotland)	Denmark	Total
1977	227	-	No data	227
1978	91	2	-	93
1979	235	34	-	269
1980	203	17	-	220
1981	1	-	-	1
1982	-	-	-	0
1983	65	-	-	65
1984	30	-	-	30
1985	2	6	-	8
1986	137	57	106	300
1987	212	86	92	390
1988	91	25	384	500
1989	168	8	72	248
1990	144	+	1	145
1991	3	-	-	3
1992	1	-	-	1
1993	-	-	-	0
1994	4	-	-	4
1995	171	-	-	171
1996	58	2	-	60
1997	5	-	-	5
1998	5	-	-	5
1999	-	-	-	0
2000	-	-	-	0

3.5.15 Anglerfish in Sub-area IV

Anglerfish was previously assessed separately for the North Sea (Sub-area IV) and the area west of Scotland (Sub-area VI). These components have now been combined and the assessment is presented in Section 3.7.7.

3.6 Stocks in the Eastern Channel (Division VIId)

3.6.1 Overview

Major fleets

A large proportion of the Eastern Channel is in the coastal zones (12 miles zone) which are exploited by small-scale fisheries. The major fleets operating in this area are: a French inshore fleet, mainly comprising small vessels using various gears, an English inshore fleet using fixed gear, English and Belgian offshore beam trawlers and French offshore otter trawlers.

Both beam trawl fleets mainly target sole and take a significant amount of plaice as a by-catch. Sole is also taken in directed inshore UK fisheries using trammels and in French fisheries using trammels and otter trawl. The major part of the plaice landings originates from a seasonal fishery in winter by French offshore otter trawlers taking sole as by-catch. The major part of the cod landings originates from French offshore trawlers and inshore gill-netters. Cod is also taken as a by-catch in other fisheries. Whiting are caught by inshore and offshore French trawlers in the Channel in mixed fisheries.

A pelagic trawl fishery takes place in the winter during the herring spawning season.

Effort directed at flatfish increased consistently and considerably in all fleets from 1975 and reached a peak during 1989–1990, after which it has remained at that level.

There are no separate TACs for cod and whiting in Division VIId but they are part of a total TAC for the whole of Sub-area VII excluding Division VIIa. Sole is managed by a TAC for the Division VIId and plaice is managed by a TAC for VIId and VIIe combined. TACs for cod, whiting, plaice and sole in recent years have generally not been restrictive.

Cod and whiting are assessed together with the North Sea stocks; reference is made to Sections 3.5.1, 3.5.2 and 3.5.4.

In plaice, the spawning stock has been fairly constant since 1992 although the estimates of fishing mortality are rather variable. The stock is harvested outside of safe biological limits. Although the spawning biomass of the sole stock is above the proposed $\mathbf{B}_{pa}$, the exploitation rate is high and unsustainable.

Pelagic species caught in Division VIId are herring (Downs herring), horse mackerel, mackerel, and sprat. These species are subject to TACs set over larger areas. There are no separate estimates of the state of the stocks in this area. Also no separate statistics on catches and landings are available.

3.6.2 Sole in Division VIId (Eastern Channel)

State of stock/exploitation: The stock is within safe biological limits. The SSB in 2001 is above $\mathbf{B}_{pa}$, and the fishing mortality in 2000 was below $\mathbf{F}_{pa}$.

Management objectives: No explicit management objectives are set for this stock.

Precautionary Approach reference points (unchanged since 1999):

ICES considers that:	ICES proposes that:
There is currently no biological basis for defining $\mathbf{B}_{lim}$	$\mathbf{B}_{pa}$ be set at 8 000 t. This is the lowest observed biomass, at which there is no indication of impaired recruitment.
$\mathbf{F}_{lim}$ is 0.55. This is a fishing mortality at or above which the stock has shown continued decline.	$\mathbf{F}_{pa}$ be set at 0.4. This F is considered to provide approximately 95% probability of avoiding $\mathbf{F}_{lim}$.

Technical basis:

$\mathbf{B}_{lim}$: Poor biological basis for definition.	$\mathbf{B}_{pa}$: Smoothed $\mathbf{B}_{loss}$ (no sign of impairment): 8 000 t.
$\mathbf{F}_{lim}$ is set equal to $\mathbf{F}_{loss}$, but poorly defined; analogy to North Sea and setting of 1.4 $\mathbf{F}_{pa}$ = 0.55.	$\mathbf{F}_{pa}$: Between $\mathbf{F}_{med}$ and 5^{th} % of $\mathbf{F}_{loss}$; SSB>$\mathbf{B}_{pa}$ and probability ($\mathbf{SSB}_{mt}$<$\mathbf{B}_{pa}$), 10%: 0.4

Advice on management: ICES recommends that fishing mortality should be maintained below the proposed $\mathbf{F}_{pa}$, corresponding to landings in 2002 of less than 5 200 t.

Fishing mortality for this stock has recently tended to fluctuate around the proposed $\mathbf{F}_{pa}$. For this reason, the state of the stock with respect to the proposed $\mathbf{F}_{pa}$ fluctuates correspondingly.

Relevant factors to be considered in management: Due to the large 1998 year class, SSB is expected to remain above the proposed $\mathbf{B}_{pa}$ in the short-term, providing fishing mortality does not exceed $\mathbf{F}_{pa}$.

Comparison with previous assessment and advice: The 2001 assessment is consistent with previous assessments.

Catch forecast for 2002:

Basis: F(sq) = F(98–00, scaled) = 0.34; Landings(2001) = 4.43; SSB(2002) = 13.1.

F(2002 onwards)	Basis	Catch (2002)	Landings (2002)	SSB (2003)
0.21	0.6 $\mathbf{F}_{sq}$		2.9	13.9
0.28	0.8 $\mathbf{F}_{sq}$		3.8	13.1
0.34	1.0 $\mathbf{F}_{sq}$		4.6	12.3
0.40	$\mathbf{F}_{pa}$ = 1.17 $\mathbf{F}_{sq}$		5.2	11.7
0.45	1.3 $\mathbf{F}_{sq}$		5.6	11.2

Weights in '000 t

Shaded scenarios considered inconsistent with the precautionary approach.

Medium- and long-term projections: There is a low probability of SSB falling below the proposed $\mathbf{B}_{pa}$ (8 kt) if fished at $\mathbf{F}_{sq}$ (0.34) in the medium-term.

Elaboration and special comment: There are 5 main commercial fleets fishing for sole in Division VIId. Belgian and English offshore beam trawlers (> 300 HP) fish mainly for sole, but can switch to scallops or move to adjacent areas. French offshore trawlers target roundfish and take sole as by-catch. Numerous inshore (under 10 m vessels) on the English and French coasts using mainly fixed nets target sole in the spring and autumn. The inshore vessels take over half the reported landings and sole forms their main source of income. The minimum mesh size in the sole fishery with towed gears is 80 mm and in the fishery with static gears 90 mm.

Analytical assessment using catch-at-age and CPUE data from commercial fleets and surveys. Under-reporting from the inshore fleet and mis-reporting by beam trawlers, fishing in adjacent management areas is thought to be significant. The lack of information on this phenomenon contributes to the uncertainty of the stock assessment and forecasts.

About 50% of the predicted SSB in 2003 consists of year classes whose strength is poorly defined.

Source of information: Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, June 2001, Hamburg, Germany (ICES CM 2002/ACFM: 01).

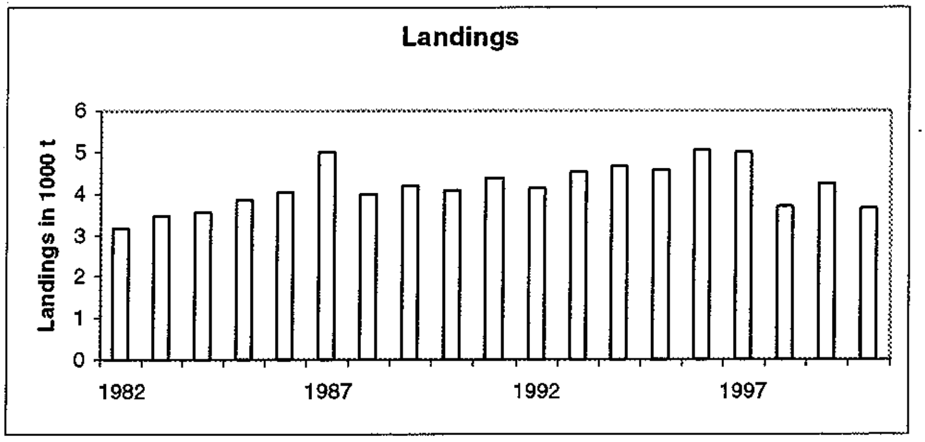
Yield and spawning biomass per Recruit F-reference points:

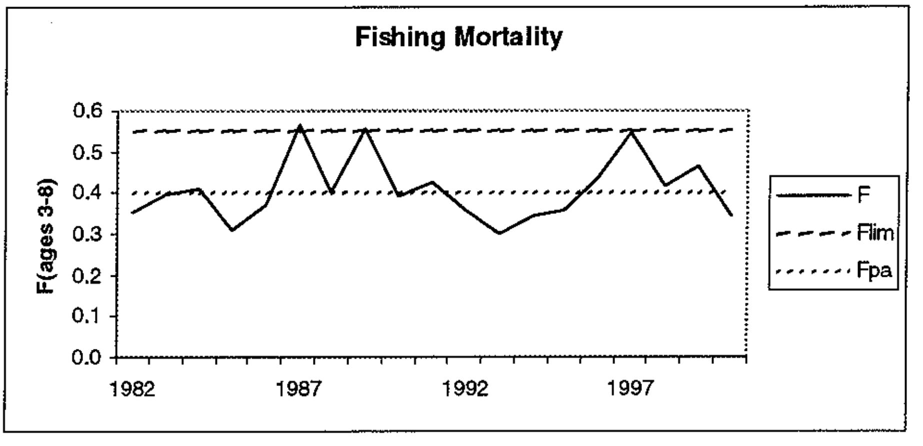
	Fish Mort Ages 3-8	Yield/R	SSB/R
Average Current	0.345	0.162	0.467
$\mathbf{F}_{max}$	0.262	0.163	0.619
$\mathbf{F}_{0.1}$	0.118	0.148	1.258
$\mathbf{F}_{med}$	0.393	0.160	0.408

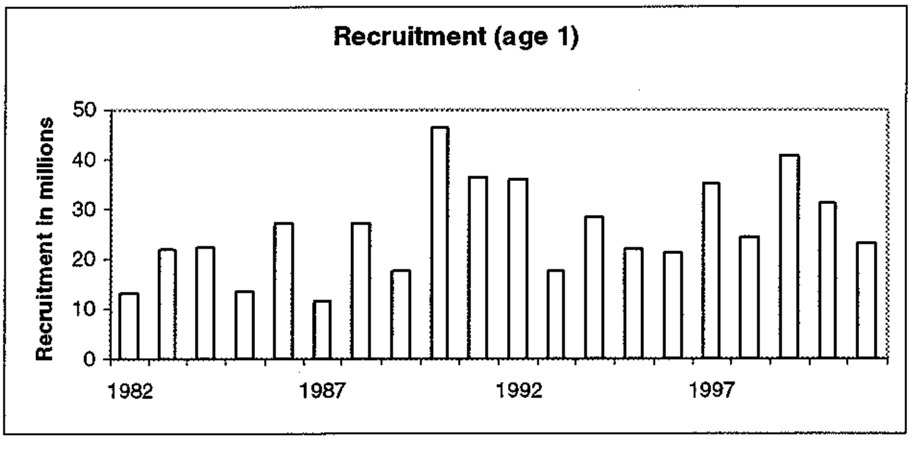
Catch data (Tables 3.6.2.1–2):

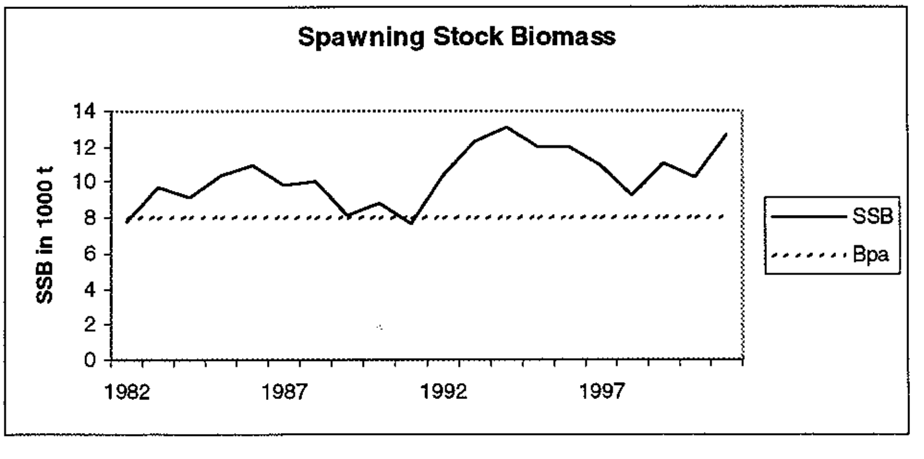
Year	ICES advice	Predicted catch corresp. to advice	Agreed TAC	Official landings	ACFM landings
1987	Precautionary TAC	3.1	3.85	3.8	5.0
1988	*Status quo* (Shot) TAC	3.4	3.85	3.3	4.0
1989	*Status quo* (Shot) TAC	3.8	3.85	2.9	4.2
1990	No effort increase; TAC	3.7	3.85	3.0	4.1
1991	*Status quo* F; TAC	3.4	3.85	3.8	4.4
1992	TAC	≤2.7	3.5	3.8	4.1
1993	70% of F(91)~2 800 t	2.8	3.2	3.4	4.5
1994	Reduce F	<3.8	3.8	3.7	4.6
1995	No increase in F	3.8	3.8	3.7	4.5
1996	No long-term gain in increasing F	4.7	3.5	4.1	5.0
1997	No advice	-	5.23	3.8	5.0
1998	No increase in effort	4.5	5.23	3.0	3.7
1999	Reduce F to $\mathbf{F}_{pa}$	3.8	4.7	3.9	4.2
2000	$F < \mathbf{F}_{pa}$	<3.9	4.1	3.8	3.6
2001	$F < \mathbf{F}_{pa}$	<4.7	4.6		
2002	$F < \mathbf{F}_{pa}$	<5.2			

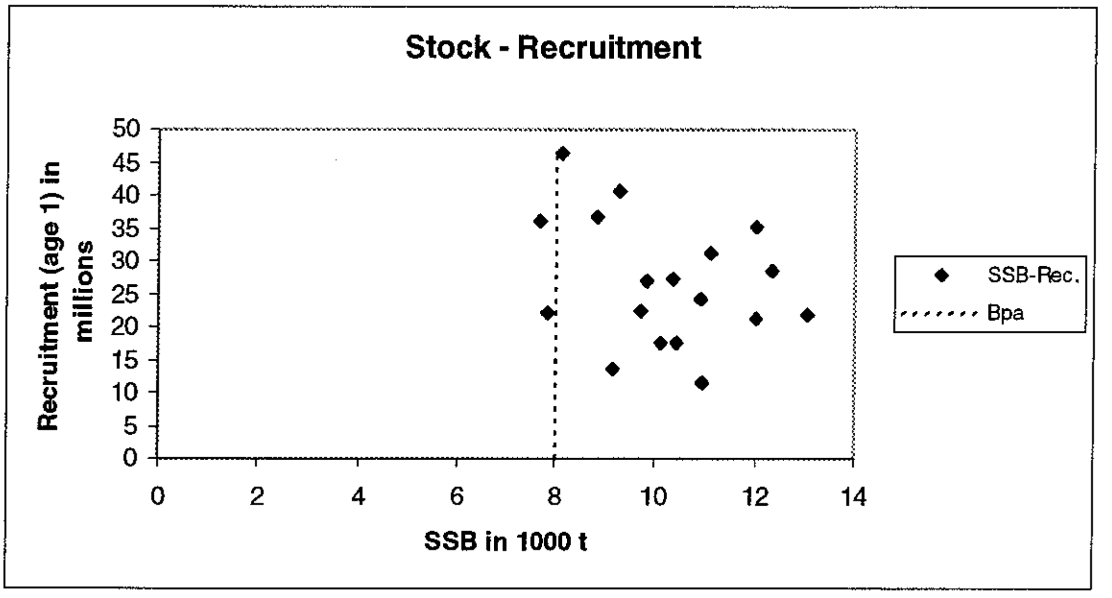
Weights in '000 t. [1]Catch *status quo* F.


Landings
Landings in 1000 t
0
1
2
3
4
5
6
1982
1987
1992
1997

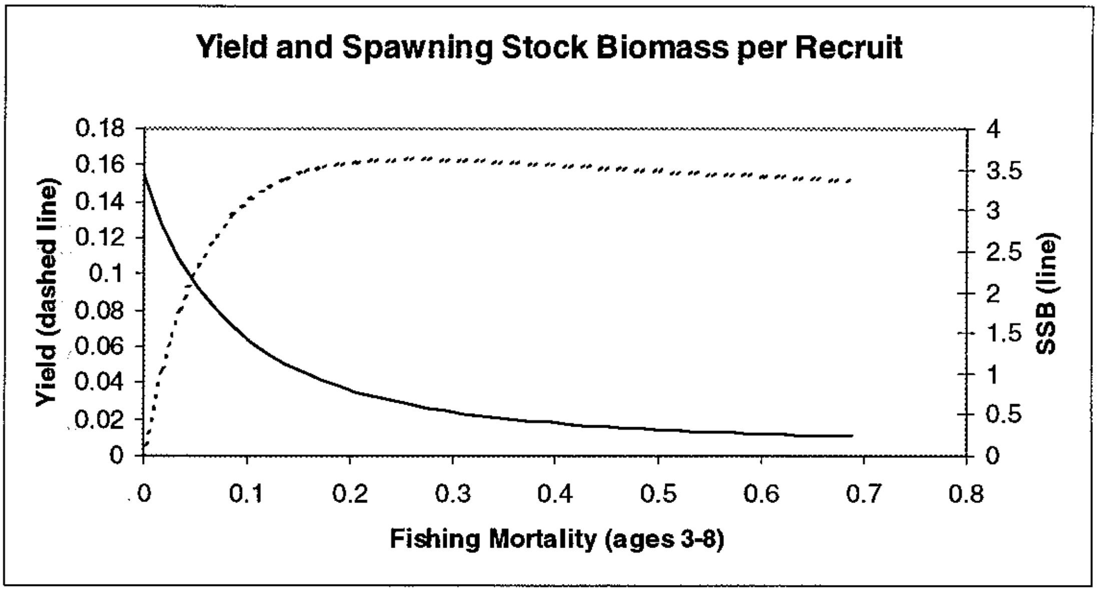

Fishing Mortality
F(ages 3-8)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
1982
1987
1992
1997
F
Flim
Fpa


Recruitment (age 1)
Recruitment in millions
0
10
20
30
40
50
1982
1987
1992
1997

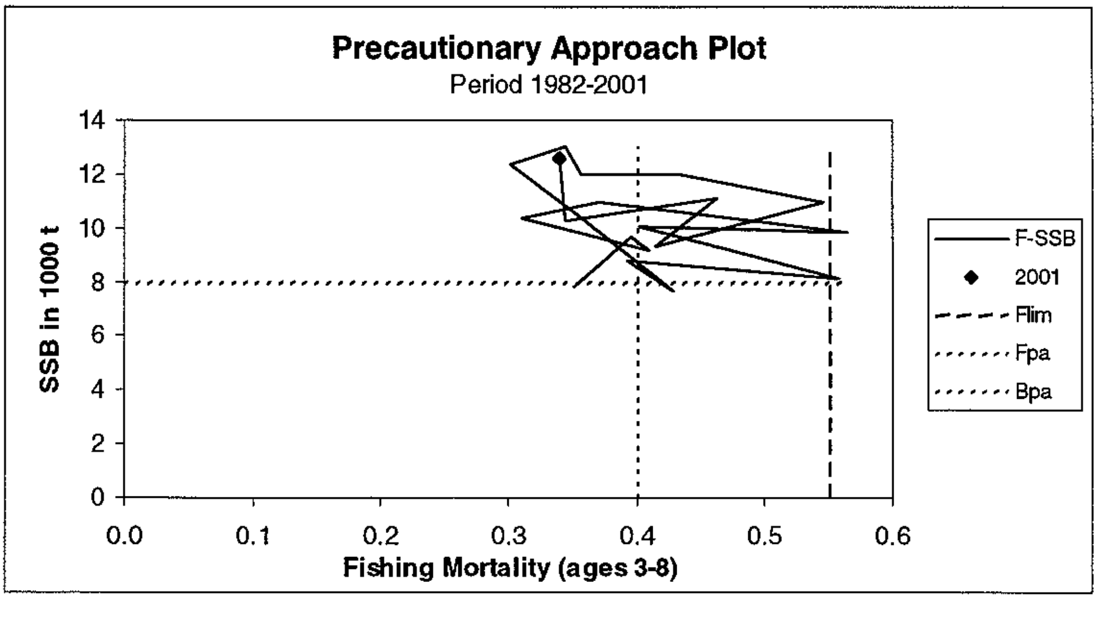

Spawning Stock Biomass
SSB in 1000 t
0
2
4
6
8
10
12
14
1982
1987
1992
1997
SSB
Bpa



Stock - Recruitment
Recruitment (age 1) in millions
SSB in 1000 t
SSB-Rec.
Bpa
0
5
10
15
20
25
30
35
40
45
50
0
2
4
6
8
10
12
14



Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
SSB (line)
Fishing Mortality (ages 3-8)
0
0.02
0.04
0.06
0.08
0.1
0.12
0.14
0.16
0.18
0
0.5
1
1.5
2
2.5
3
3.5
4
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8



Precautionary Approach Plot
Period 1982-2001
SSB in 1000 t
Fishing Mortality (ages 3-8)
F-SSB
2001
Flim
Fpa
Bpa
0
2
4
6
8
10
12
14
0.0
0.1
0.2
0.3
0.4
0.5
0.6

Table 3.6.2.1 Sole in Division VIId. Nominal landings (tonnes) as officially reported to ICES and used by the Working Group.

Year	Belgium	France	UK (E&W)	Others	Total reported	Unallocated*	Total used by WG	TAC
1974	159	469	309	3	940	-56	884	
1975	132	464	244	1	841	41	882	
1976	203	599	404	.	1,206	99	1,305	
1977	225	737	315	.	1,277	58	1,335	
1978	241	782	366	.	1,389	200	1,589	
1979	311	1,129	402	.	1,842	373	2,215	
1980	302	1,075	159	.	1,536	387	1,923	
1981	464	1,513	160	.	2,137	340	2,477	
1982	525	1,828	317	4	2,674	516	3,190	
1983	502	1,120	419	.	2,041	1,417	3,458	
1984	592	1,309	505	.	2,406	1,169	3,575	
1985	568	2,545	520	.	3,633	204	3,837	
1986	858	1,528	551	.	2,937	1,087	4,024	
1987	1,100	2,086	655	.	3,841	1,133	4,974	3,850
1988	667	2,057	578	.	3,302	680	3,982	3,850
1989	646	1,610	689	.	2,945	1,242	4,187	3,850
1990	996	1,255	742	.	2,993	1,067	4,060	3,850
1991	904	2,054	825	.	3,783	599	4,382	3,850
1992	891	2,187	706	10	3,794	348	4,142	3,500
1993	917	1,907	610	13	3,447	1,064	4,511	3,200
1994	940	2,001	701	15	3,657	984	4,641	3,800
1995	817	2,248	669	9	3,743	840	4,583	3,800
1996	899	2,335	877	.	4,111	914	5,025	3,500
1997	1,306	1,609	933	.	3,848	1,135	4,983	5,230
1998	541	1,703**	803	.	3,047	647	3,694	5,230
1999	880	2,239**	769	.	3,888	350	4,238	4,700
2000	1,021	2,171	615	.	3,807	-158	3,649	4,100

* Unallocated mainly due to late reporting by some countries; also includes minor unreported landings estimated by the Working Group.

** Preliminary.

Table 3.6.2.2 Sole in Division VIId (Eastern Channel).

Year	Recruitment Age 1 thousands	SSB tonnes	Landings tonnes	Mean F Ages 3-8
1982	13069	7827	3190	0.3518
1983	22191	9704	3458	0.3966
1984	22298	9149	3575	0.4098
1985	13498	10346	3837	0.3110
1986	27134	10952	4024	0.3715
1987	11616	9843	4974	0.5651
1988	27099	10083	3982	0.4023
1989	17439	8108	4187	0.5583
1990	46478	8810	4060	0.3934
1991	36519	7686	4382	0.4279
1992	36098	10422	4142	0.3559
1993	17660	12327	4511	0.3011
1994	28363	13044	4643	0.3453
1995	21835	12009	4583	0.3567
1996	21223	12019	5025	0.4347
1997	35223	10910	4983	0.5453
1998	24216	9286	3694	0.4152
1999	40624	11095	4238	0.4629
2000	31277[1]	10271	3649	0.3446
2001	23152[2]	12600[3]		0.3400
Average	25851	10325	4165	0.4045

[1] RCT3 estimate.
[2] GM 1982-1998.
[3] Based on 1998-2000 mean weight at age.

3.6.3 Plaice in Division VIId (Eastern Channel)

State of stock/exploitation: The stock is harvested outside safe biological limits. SSB in 2001 is estimated to be above the proposed $\mathbf{B_{pa}}$, and has fluctuated near this level since 1992. However, fishing mortality in 2000 is estimated to have been well above the proposed $\mathbf{F_{pa}}$.

Management objectives: No explicit management objectives are set for this stock. However, for any management objectives to meet precautionary criteria, their aim should be to reduce or maintain F below the proposed $\mathbf{F_{pa}}$ and to increase or maintain the spawning stock biomass above the proposed $\mathbf{B_{pa}}$.

Precautionary Approach reference points (unchanged since 1999):

ICES considers that:	ICES proposes that:
$\mathbf{B_{lim}}$ is 5 600 t, the lowest observed biomass.	$\mathbf{B_{pa}}$ be set at 8 000 t. This affords a high probability of maintaining SSB above $\mathbf{B_{lim}}$, taking into account the uncertainty of the assessment.
$\mathbf{F_{lim}}$ is 0.54, the fishing mortality estimated to lead to stock collapse.	$\mathbf{F_{pa}}$ be set at 0.45. This F is considered to provide approximately 95 % probability of avoiding $\mathbf{F_{lim}}$, taking into account the uncertainty of the assessment.

Technical basis:

B_{lim}: B_{loss}: 5 600 t.	**B_{pa}: 1.4 B_{lim} : 8 000 t.**
F_{lim}: F_{loss}: 0.54	**F_{pa}: 5^{th} % of F_{loss}; $B^*>B_{pa}$ and $P(SSB_{MT}<B_{pa})<10$ %:0.45**

$\mathbf{B^*}$ is equilibrium SSB at $\mathbf{F_{pa}}$.

Advice on management: ICES recommends that fishing mortality in 2002 be reduced to less than the proposed $\mathbf{F_{pa}}$ (0.45), corresponding to landings in 2002 of less than 5 800 t.

Relevant factors to be considered in management: The TAC is set for Divisions VIId and VIIe combined. The plaice stock in Division VIIe is also harvested outside safe biological limits and the advice for the two stocks is consistent.

Comparison with previous assessment and advice: The current assessment is consistent with previous assessments. The increase in the forecast landings for 2002 corresponding to the proposed $\mathbf{F_{pa}}$, compared to the advice last year, is attributable to the projected increase in stock size in 2002.

Catch forecast for 2002:

Basis: F(2001) = $\mathbf{F_{sq}}$(98-00, scaled) = 0.52; Landings(2001) = 6.37; SSB(2002) =9.85.

F(2002 onwards)	Basis	Catch (2002)	Landings (2002)	SSB (2003)
0.31	0.6 $\mathbf{F_{sq}}$	4.3	4.3	11.9
0.42	0.8 $\mathbf{F_{sq}}$	5.5	5.5	10.8
0.45	$\mathbf{F_{pa}}$ = (0.87*$\mathbf{F_{sq}}$)	5.8	5.8	10.5
0.52	1.0 $\mathbf{F_{sq}}$	6.5	6.5	9.9
0.62	1.2 $\mathbf{F_{sq}}$	7.4	7.4	9.0

Weights in '000 t.

Shaded scenarios considered inconsistent with the precautionary approach.

Medium- and long-term projections: At *status quo* fishing mortality or lower, there is a high probability of remaining above $\mathbf{B}_{pa}$ in the medium-term.

Elaboration and special comments: In the Channel, plaice are taken mainly in a mixed flatfish fishery by otter and beam trawlers. There is a directed fishery in winter by French offshore otter trawlers. Large numbers of plaice are discarded.

The analytical assessment uses CPUE data from 3 commercial fleets and 3 surveys. The time series is short and data prior to 1985 are considered to be unreliable. The estimates of fishing mortality and SSB are not very precise. Discards are not included in the assessment. Anecdotal information from the fishery suggests that catch rates in 2001 have been lower than in 2000, which may indicate that the assessment may be too optimistic. Unfortunately, the information from the fishery was not substantiated or verifiable.

Source of information: Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, June 2001, Hamburg, Germany (ICES CM 2002/ACFM: 01).

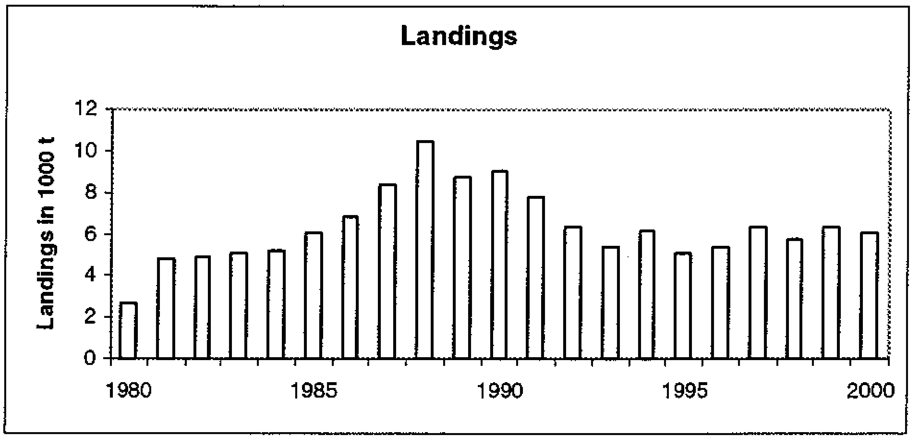
Yield and spawning biomass per Recruit F-reference points:

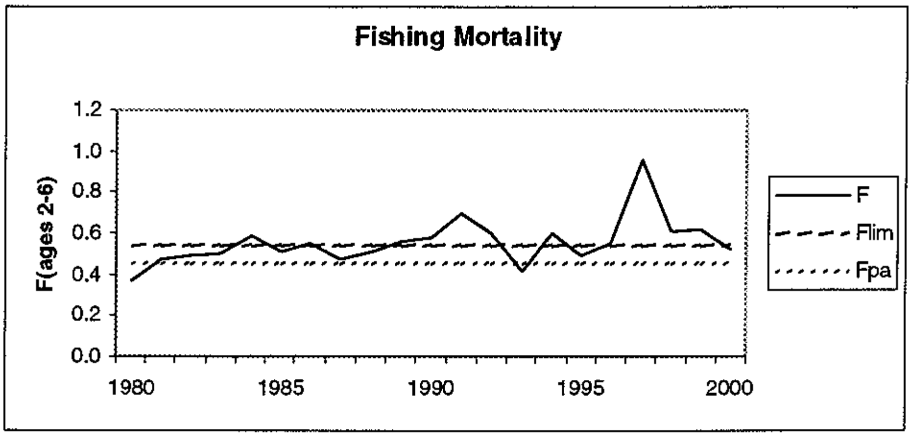
	Fish Mort Ages 2-6	Yield/R	SSB/R
Average Current	0.519	0.257	0.399
$\mathbf{F}_{max}$	0.190	0.301	1.465
$\mathbf{F}_{0.1}$	0.110	0.281	2.488
$\mathbf{F}_{med}$	0.572	0.251	0.351

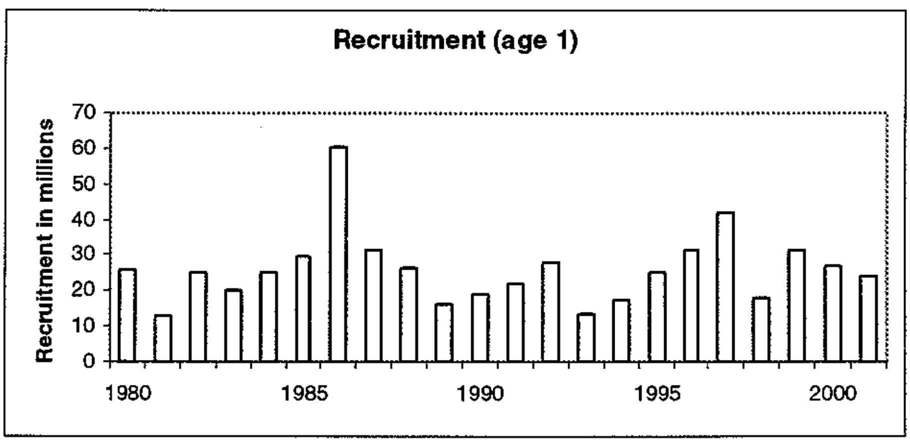
Catch data (Tables 3.6.3.1–2):

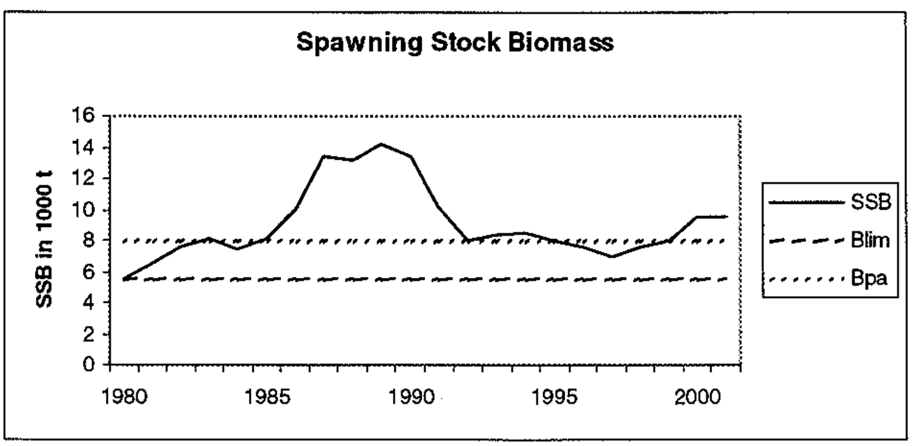
Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC[1]	Official landings	ACFM landings
1987	Precautionary TAC[1]	6.8[1]	8.3	7.9	8.4
1988	Precautionary TAC[1]	6.9[1]	9.96	9.1	10.4
1989	No increase in effort[1]	11.7[1]	11.7	6.7[2]	8.8
1990	No increase in F; TAC	10.7[1]	10.7	7.8[2]	9.0
1991	TAC	8.8[1]	10.7	7.4[2]	7.8
1992	Status quo F gives mean SSB	7.6[3]	9.6	6.2	6.3
1993	Within safe biological limits	6.4[3]	8.5	4.8	5.3
1994	No long-term gains in increased F	-	9.1	5.6	6.1
1995	No increase in F	5.6	8.0	4.6	5.1
1996	No long-term gains in increasing F	6.5	7.53	4.6	5.4
1997	No advice	-	7.09	5.3	6.3
1998	Reduce F in 98 by 30% from 96 value	4.3	5.7	4.8	5.8
1999	Fishing at $\mathbf{F}_{pa}$	6.3	7.4	5.4	6.3
2000	Fishing at $\mathbf{F}_{pa}$	4.9	6.5	5.6	6.0
2001	Fishing at $<\mathbf{F}_{pa}$	<4.4	6.0		
2002	Fishing at $<\mathbf{F}_{pa}$	<5.8			

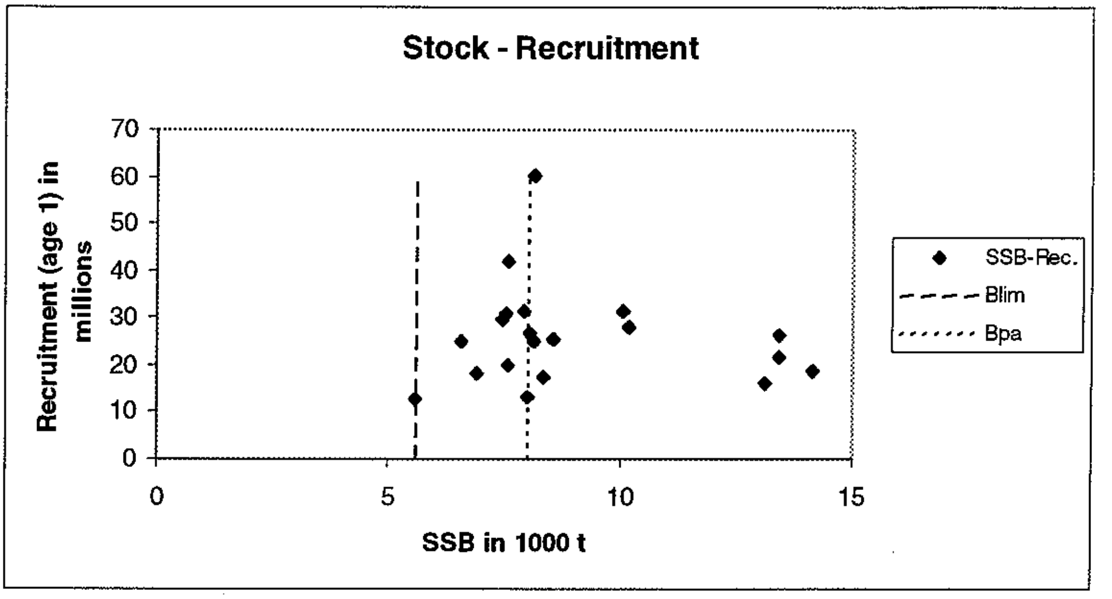
[1]TACs for Divisions VIId,e. [2]For France Division VIId landings are estimated by ICES from combined VIId,e landings
[3] Catch at *status quo* F. Weights in '000 t.

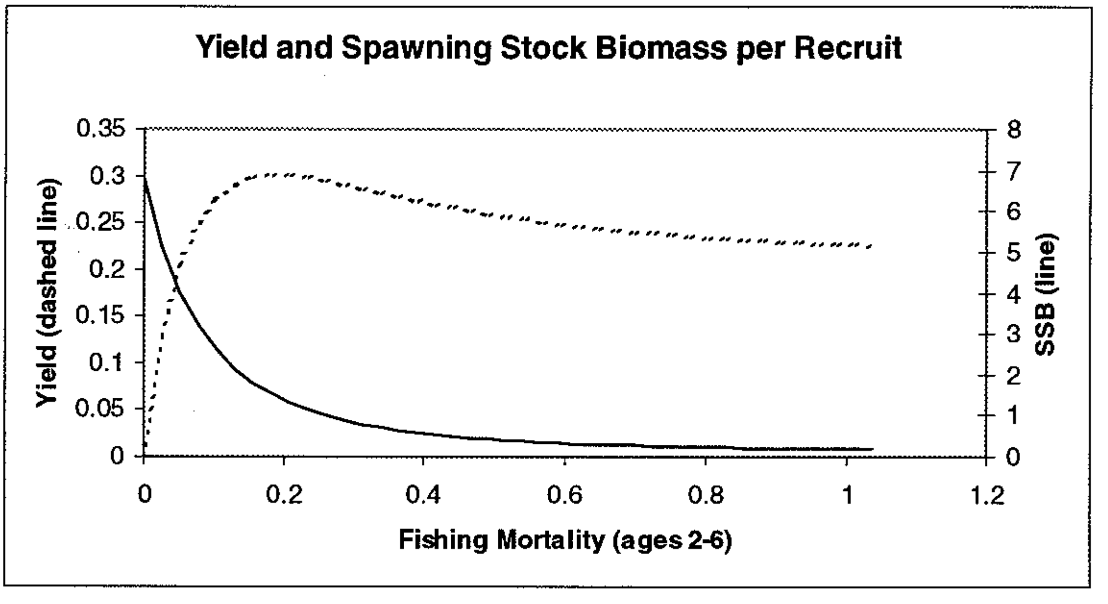

Landings
Landings in 1000 t
0
2
4
6
8
10
12
1980
1985
1990
1995
2000


Fishing Mortality
F(ages 2-6)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1980
1985
1990
1995
2000
F
Flim
Fpa


Recruitment (age 1)
Recruitment in millions
0
10
20
30
40
50
60
70
1980
1985
1990
1995
2000


Spawning Stock Biomass
SSB in 1000 t
0
2
4
6
8
10
12
14
16
1980
1985
1990
1995
2000
SSB
Blim
Bpa


Stock - Recruitment
Recruitment (age 1) in millions
SSB in 1000 t
SSB-Rec.
Blim
Bpa
70
60
50
40
30
20
10
0
0
5
10
15


Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
SSB (line)
Fishing Mortality (ages 2-6)
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
8
7
6
5
4
3
2
1
0
0
0.2
0.4
0.6
0.8
1
1.2

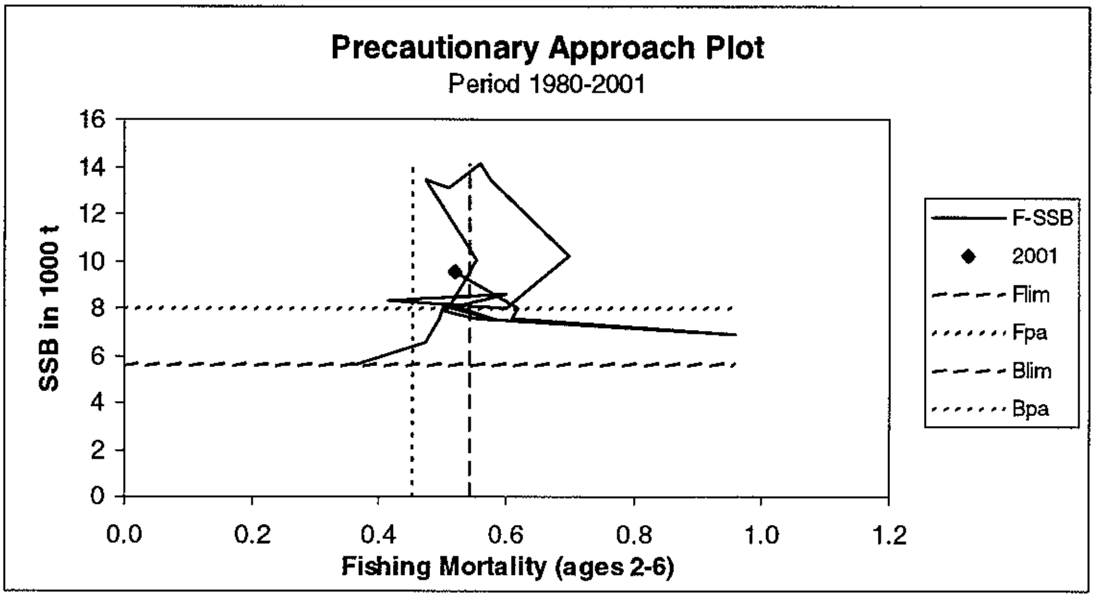

Precautionary Approach Plot
Period 1980-2001
SSB in 1000 t
Fishing Mortality (ages 2-6)
F-SSB
2001
Flim
Fpa
Blim
Bpa
16
14
12
10
8
6
4
2
0
0.0
0.2
0.4
0.6
0.8
1.0
1.2

Table 3.6.3.1 Plaice in Division VIId (Eastern Channel). Nominal landings (tonnes) as officially reported to ICES.

Year	Belgium	Denmark	France	UK (E&W)	Others	Total reported	Un-allocated	Total as used by WG
1976	147	1 [1]	1,439	376	-	1,963	-	1,963
1977	149	81 [2]	1,714	302	-	2,246	-	2,246
1978	161	156 [2]	1,810	349	-	2,476	-	2,476
1979	217	28 [2]	2,094	278	-	2,617	-	2,617
1980	435	112 [2]	2,905	304	-	3,756	-1,106	2,650
1981	815	-	3,431	489	-	4,735	34	4,769
1982	738	-	3,504	541	22	4,805	60	4,865
1983	1,013	-	3,119	548	-	4,680	363	5,043
1984	947	-	2,844	640	-	4,431	730	5,161
1985	1,148	-	3,943	866	-	5,957	65	6,022
1986	1,158	-	3,288	828	488 [2]	5,762	1,072	6,834
1987	1,807	-	4,768	1,292	-	7,867	499	8,366
1988	2,165	-	5,688 [2]	1,250	-	9,103	1,317	10,420
1989	2,019	-	3,265 [1]	1,383	-	6,667	2,091	8,758
1990	2,149	-	4,170 [1]	1,479	-	7,798	1,249	9,047
1991	2,265	-	3,606 [1]	1,566	-	7,437	376	7,813
1992	1,560	1	3,099	1,553	19	6,232	105	6,337
1993	877	-	2,792	1,075	27	4,771	560	5,331
1994	1,418	-	3,199	993	23	5,633	488	6,121
1995	1,157	-	2,598 [2]	796	18	4,569	561	5,130
1996	1,112	-	2,630 [2]	856	-	4,598	795	5,393
1997	1,161	-	3,077	1,078	-	5,316	991	6,307
1998	854	-	3,276 [2,3]	700	-	4,830	932	5,762
1999	1,306	-	3,388 [2,3]	743	-	5,437	889	6,326
2000	1,315	-	3,513 [2]	752	-	5,580	434	6,014

[1]Estimated by the Working Group from combined Division VIId,e.
[2]Includes Division VIIe.
[3]Provisional.

Table 3.6.3.2 Plaice in Division VIId (Eastern Channel).

Year	Recruitment Age 1 thousands	SSB tonnes	Landings tonnes	Mean F Ages 2-6
1980	25542	5584	2650	0.3632
1981	12855	6558	4769	0.4743
1982	25207	7574	4865	0.4935
1983	19960	8123	5043	0.4995
1984	25040	7454	5161	0.5869
1985	29732	8136	6022	0.5140
1986	60327	10064	6834	0.5537
1987	31298	13429	8366	0.4738
1988	26480	13126	10420	0.5113
1989	16300	14169	8758	0.5599
1990	18856	13432	9047	0.5760
1991	21749	10199	7813	0.6989
1992	27966	8011	6337	0.6014
1993	13235	8359	5331	0.4142
1994	17357	8572	6121	0.5996
1995	25475	7937	5130	0.4967
1996	31404	7577	5393	0.5494
1997	41838	6916	6307	0.9588
1998	18156	7558	5762	0.6078
1999	31167	8040	6326	0.6171
2000	26793	9519	6015	0.5188
2001	23946[1]	9520[2]		0.5200
Average	25940	9084	6308	0.5540

[1] GM 1980-1998.
[2] Based on 1998-2000 mean weight at age.

3.7 Stocks in Sub-area VI

3.7.1 Overview

Fisheries

To a large extent, the roundfish fishery in Division VIa is an extension of the similar fishery in the North Sea. The demersal fisheries in Division VIa are predominantly conducted by otter-trawlers fishing for cod, haddock, anglerfish and whiting, with by-catches of saithe, megrim and lemon sole. These trawlers use mesh sizes of 80–100 mm depending on area and may at times discard considerable amounts of young haddock and whiting. The majority of these vessels are locally-based Scottish trawlers using 'light-trawls', but trawlers from Ireland, Northern Ireland, England, France and Germany also participate in this fishery. The importance of Scottish seiners essentially targeted at haddock has been declining in recent years as many of these vessels have been converted to trawlers. A part of the fleet of light trawlers has diversified into a fishery for anglerfish that has been expanding into deeper water off the northern coast of Scotland. By-catches in this fishery include megrim and cod.

The larger Scottish trawlers and Irish trawlers fish for haddock at Rockall when opportunities arise for good catches from the Division VIb stock. Although young saithe are caught by coastal trawlers, the fishery for saithe essentially takes place on the shelf edge to the west and northwest of Scotland. Traditionally, this fishery has largely been operated by the larger deep-sea French trawlers. However, the number of these vessels has declined in recent years. Since the late 1980s, some of these vessels diverted their activity toward deep-sea species, notably orange roughy, and some medium-sized trawlers also participate in the fishery for deep-sea species during summer in some years.

Some 200 Scottish trawlers also take part in fisheries for *Nephrops* on inshore grounds. Some use 70mm mesh with 80mm square mesh panel, but others use 100mm mesh to avoid the by-catch limitations associated with the smaller mesh size. These boats also land small quantities of haddock, cod, whiting and small saithe, but discard large amounts of whiting and haddock.

The pelagic fishery for herring is mainly operated by UK vessels in the north, and by Irish vessels in a roe fishery in the south. Substantial misreporting of catches from the North Sea and between the northern and southern stocks occurred in the past, but UK licensing regulations are thought to have reduced misreporting since 1997. The Clyde herring fishery has declined sharply in recent years as the stock has suffered from a series of low recruitments. Recent TACs have not been taken and the catches have been less than 1 000 t since 1991.

There is a directed trawl fishery for mackerel and horse mackerel in the area. The mackerel fishery mainly takes place in the fourth and first quarter of the year, when the mackerel is returning from the feeding area to the spawning area. The horse mackerel is mainly fished in the second half of the year. In addition, there are fisheries for blue whiting in the area.

The industrial fisheries in Division VIa are much smaller than in the North Sea. The Scottish sandeel fishery started in the early 1980s, peaking in 1986 and 1988. It is irregular, depending on the availability of the resource and of processing facilities at Shetland, Denmark and Faroe. By-catches in this fishery are very small. The Norway pout fishery is conducted mainly by Danish vessels.

State of stocks

The assessments of demersal and herring stocks in Sub-area VI continued to be hampered by the poor quality of catch data due to misreporting, although this has become less of a problem for roundfish species in recent years. Quantities misreported during 1992-1995 were estimated for Division VIa cod, and estimates of area misreporting since 1987 were made for anglerfish and megrim. The distribution of reported catch data were also examined to estimate the likely extent of misreporting of herring between the North Sea and Division VIa North.

It is likely that the stocks of haddock, saithe, anglerfish and megrim in Division VIa are closely related to those of the same species in the North Sea. The saithe stock is now assessed as part of the North Sea stock, and the pattern of haddock recruitment in the two areas is very similar.

All roundfish stocks in Sub-area VI are outside safe biological limits and ICES advice points to the need of reducing fishing mortality in the relevant fisheries.

The stock of cod is outside safe biological limits and the spawning stock size in 2000 is at a record low. Analysis indicates that with current rates of exploitation it is very unlikely to achieve safe limits in the medium-term. Due to the poor state of the cod in Division VIa, emergency measures were enacted by the EU for 2001 prior to the agreement and implementation of a five year cod recovery plan to start in 2002. The principal regulatory measure for 2001 other than the TAC, was the establishment of three controlled areas from 6 March – 30 April 2001. The regulations sought to minimise cod catches but also to minimise the effect of the measures on certain pelagic and shellfish fisheries. Consequently, derogations existed for: purse seine and pelagic trawls targeting pelagic fish species; dredges, pots and creels; and for the inner Clyde area, *Nephrops* trawls. The aim of the controlled areas was to allow as many cod as possible to spawn before the end of April 2001 when the spawning season finishes (Commission Regulation (EC) No. 456/2001). Consequently, the regulation targeted areas where high catch rates of cod are usually experienced during March and April. The controlled areas were not defined for the purposes of regulating fishing effort on the cod stock in this area. No measures were applied to regulate effort displaced during the period of the control.

The haddock spawning stock in Division VIa is above $\mathbf{B}_{pa}$, but fishing mortality is above $\mathbf{F}_{pa}$. The spawning biomass in Division VIb is below $\mathbf{B}_{pa}$ for this stock, and fishing mortality is in excess of $\mathbf{F}_{pa}$.

The whiting stock in Division VIa is outside safe biological limits, with spawning biomass in 2001 below $\mathbf{B}_{pa}$, and fishing mortality above $\mathbf{F}_{pa}$.

Concerns that catch-rates of megrim and anglerfish are being sustained by continual expansion into new areas mean that assessments of these species are not considered sufficiently reliable to be used as the basis of advice. However, there are indications that fishing mortality on anglerfish may not be sustainable in the long term. The fish are exploited at an early age due to their size and shape, and are subject to considerable fishing mortality prior to first maturity. The expansion of this fishery has been further accelerated by diversion of fishing effort from other stocks subject to more restrictive quotas in recent years and by market opportunities. Fishing mortality on megrim appears to be sustainable. However, this may not remain the case if the fishery expands further into deeper water.

The assessment of the stock of herring in Division VIa North has been impossible due to low precision in the data on catches, acoustic surveys and larvae surveys. The state of the stock is uncertain and it has not been possible to assess the status of this stock with respect to safe biological limits. The catches from this stock have been stable since 1991. The state of the herring stock in Division VIa South is also uncertain and the fishery appears to be dependent on occasional strong year classes. There are indications that this stock may have declined considerably in recent years, and that levels of fishing mortality may be comparatively high. There is evidence that the Clyde herring stock remains low.

When last assessed (in 1996) the level of exploitation on sandeel was moderate and the SSB of this stock appears to be high. The stock is, however, subject to large variations depending on recruitment. Precautionary management has been put in place on a three-year basis, including a TAC and fishery closures after 31 July each year, in order to reduce the interaction with breeding seabirds.

The fisheries for mackerel and horse mackerel exploit the southern and western components of mackerel and the western horse mackerel stock. Information on these widely distributed stocks is presented in Section 3.12. The mackerel stock is considered to be inside safe biological limits: the spawning biomass is above $\mathbf{B}_{pa}$, and fishing mortality is just below $\mathbf{F}_{pa}$. Following the outstanding 1982 year class, which for more than a decade contributed a significant part of the catches, recruitment of horse mackerel has been weak. SSB is bound to be low as this year class is fished out and the sustainable yield is unlikely to be higher than about 130 000 t per year.

The *Nephrops* stocks are assessed every two years. The overall catches of *Nephrops* from Division VIa North have remained stable since the mid 1980s, and catch-rates of the different stocks have fluctuated without trend.

3.7.2 Cod

3.7.2.a Cod in Division VIa (West of Scotland)

State of stock/exploitation: The stock remains outside safe biological limits. SSB has been declining since the early 1980s and is currently at a record low, well below $\mathbf{B_{pa}}$ and $\mathbf{B_{lim}}$. Fishing mortality in 2000 was far above $\mathbf{F_{pa}}$ and $\mathbf{F_{lim}}$, and at the current rate of exploitation the chance of a stock collapse is high. Fishing mortality increased progressively over the period 1966 to 1987, rising significantly between 1982 and 1985, and has since remained high. In the last ten years, only one year class has been above average and the 3 poorest year classes have been recruited since 1995.

Management objectives: Due to the poor state of the cod stock in Division VIa, emergency measures were enacted by the EU for 2001 prior to the agreement and implementation of a five-year cod recovery plan to start in 2002.

Precautionary Approach reference points (established in 1998):

ICES considers that:	ICES proposes that:
$\mathbf{B_{lim}}$ is 14 000 t	$\mathbf{B_{pa}}$ be set at 22 000 t. This is considered to be the minimum SSB required to ensure a high probability of maintaining SSB above $\mathbf{B_{lim}}$, taking into account the uncertainty of assessments. This also corresponds with the lowest range of SSB during the earlier, more productive, historical period.
$\mathbf{F_{lim}}$ is 0.8. Fishing mortalities above this have historically led to stock decline.	$\mathbf{F_{pa}}$ be set at 0.60. This F is considered to have a high probability of avoiding $\mathbf{F_{lim}}$.

Technical basis:

$\mathbf{B_{lim}}$ = smoothed estimate of $\mathbf{B_{loss}}$ **(as enumerated in 1998)**	$\mathbf{B_{pa}}$ = previously set at 25 000 t at which good recruitment is probable. Reduced to 22 000 t due to an extended period of stock decline
$\mathbf{F_{lim}}$ = F's above 0.8 have led to stock decline in early 1980's	$\mathbf{F_{pa}}$ consistent with $\mathbf{B_{pa}}$

Advice on management: ICES recommends a rebuilding plan that will ensure a safe and rapid recovery of SSB to a level in excess of 22 000 tons. If a rebuilding plan is not implemented, ICES recommends that fishing mortality on cod should be reduced to the lowest possible level in 2002. ICES has repeatedly stated that for various reasons, TACs alone are not effective in regulating fishing mortality.

Relevant factors to be considered in management: The EC regulation No. 456/2001 of the Commission targeted areas where high catch rates of cod are usually experienced during March and April. The controlled areas were not defined for the purposes of regulating fishing effort on the cod stock in this area. No measure was applied to regulate effort displaced during the period of the control. It is unlikely that the controlled areas in Division VIa will significantly have affected fishing mortality on cod in 2001. Up until 1999, discard rates have been low, but have increased in 2000.

Even with no directed harvest or by-catch of cod in 2002, SSB is forecast in the short-term to remain below $\mathbf{B_{pa}}$ and close to $\mathbf{B_{lim}}$. All possible measures should be considered for implementation in the recovery plan. Fishing effort displaced due to the cod rebuilding plan in Division VIIa, should not be permitted to target cod in Division VIa, or any other stocks considered to be outside safe biological limits.

Cod is taken with whiting and haddock in a mixed demersal fishery. Scottish *Nephrops* trawlers take a by-catch of cod. A by-catch of cod is taken by French vessels fishing for saithe. Management needs to take this into account.

Comparison with previous assessment and advice: Retrospective analysis indicates that the over-estimation of the stock may not be fully accounted for in the current assessment and catch forecast. There are substantial changes in the assessment compared to that of last year; however, the status of the stock has remained unchanged.

Catch forecast for 2002:

Basis: F(2001) = $\mathbf{F}_{sq}$ = F(98-00 unscaled) = 0.95; Landings (2001) = 4.2; SSB(2002) = 5.7

F(2002 onwards)	Basis	Catch (2002)	Landings (2002)	SSB (2003)	Probability (%)SSB < $\mathbf{B}_{pa}$ in 2003	Probability (%)SSB < $\mathbf{B}_{pa}$ in 2010
0.00	0.0	0.0	0.0	14.0	<25	<25
0.19	0.2*$\mathbf{F}_{sq}$	1.4	1.4	11.8	<25	<25
0.38	0.4*$\mathbf{F}_{sq}$	2.6	2.6	10.1	50	<25
0.57[1]	0.6*$\mathbf{F}_{sq}$	3.5	3.5	8.6	>75	25
0.76	0.8*$\mathbf{F}_{sq}$	4.3	4.3	7.4	>75	>75
0.95	1.0*$\mathbf{F}_{sq}$	5.0	5.0	6.4	>75	>75

[1] $\mathbf{F}_{pa}$ = 0.60

Weights in '000 t

Shaded scenarios considered inconsistent with a precautionary approach.

Medium- and long-term projections: Although the short-term forecast suggests some improvement in SSB, medium-term analyses indicates that with current rates of exploitation, this improvement is very unlikely ever to be sufficient to achieve $\mathbf{B}_{pa}$.

Elaboration and special comment: The directed fishery consists mainly of Scottish vessels using towed gears. Since 1976, effort by Scottish heavy trawl and seine effort has decreased, whilst that of light trawlers has generally increased, particularly in more offshore areas.

Immature cod in Division VIa are subject to high fishing mortality. The fish are not fully mature until age group 4, increasing the susceptibility of the stock to collapse.

Analytical assessment is based on landings-at-age and survey CPUE data. Discard rates have been low for about 20 years and the data are variable. Discards of one year old fish increased significantly in 2000. Because discard data are noisy there is a need to carefully examine the sensitivity on the assessment before these data can be included. Discard data have not been taken into account in the assessment model and the youngest age groups are therefore likely underestimated. The quantities of fish mis-reported during 1992–1995 are estimated in the assessment, but the true quantities caught in those years remain uncertain.

Source of information: Report of the Working Group on the Assessment of Northern Shelf Demersal Stocks, August 2001 (ICES CM 2002/ACFM:02).

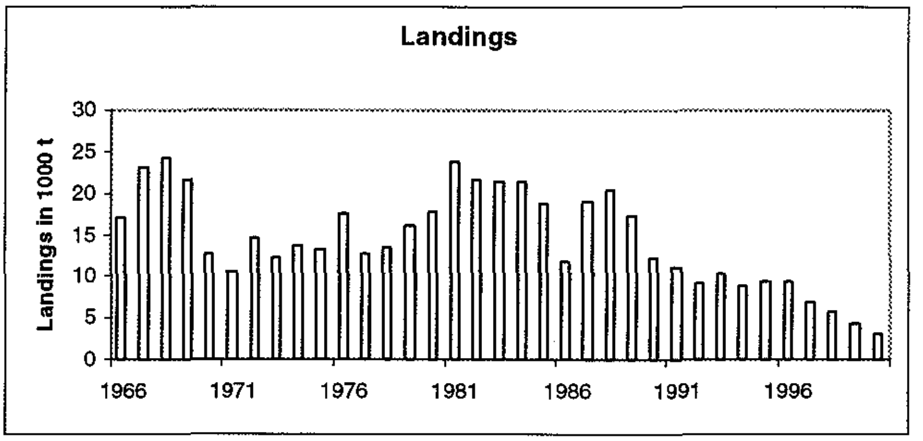
Yield and spawning biomass per Recruit F-reference points:

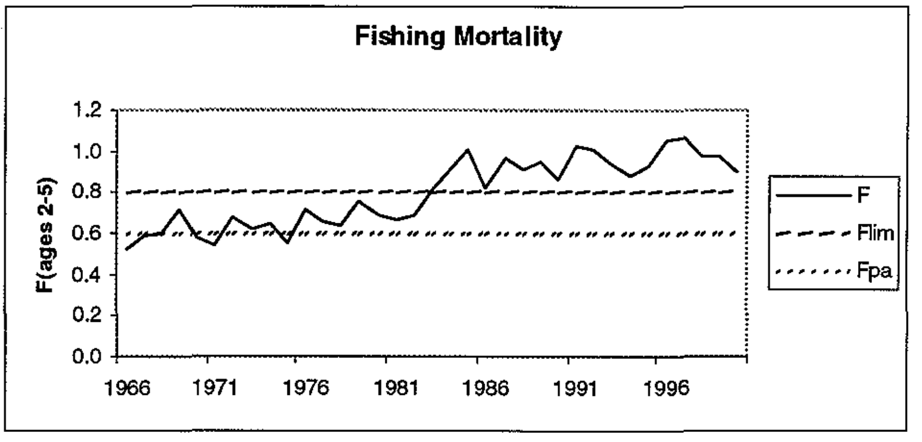
	Fish Mort Ages 2-5	Yield/R	SSB/R
Average Current	0.951	1.118	1.361
$\mathbf{F}_{max}$	0.268	1.588	6.864
$\mathbf{F}_{0.1}$	0.166	1.494	10.338
$\mathbf{F}_{med}$	0.593	1.357	2.668

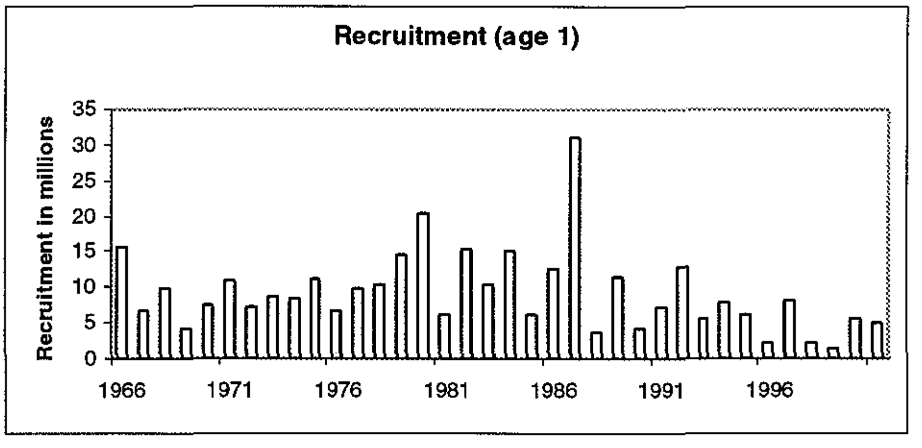
Catch data (Tables 3.7.2.a.1-2):

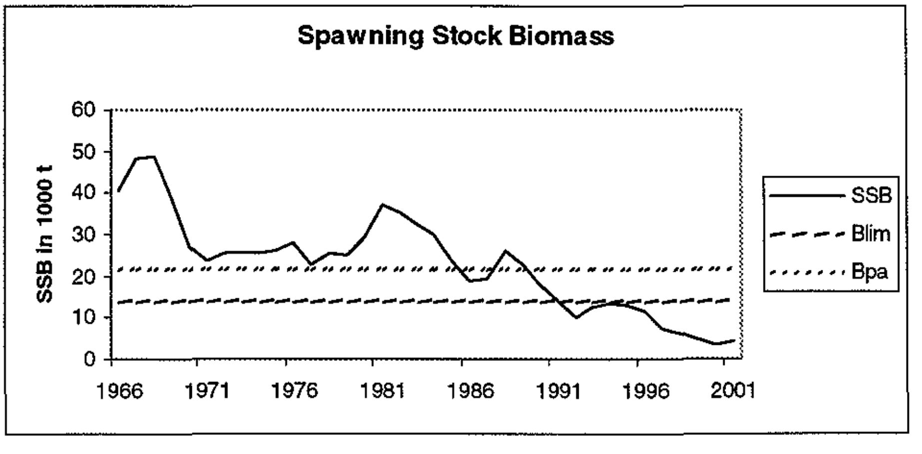
Year	ICES advice	Predicted catch corresp. to advice	Agreed TAC[1]	Official landings	ACFM landings
1987	Reduce F towards $\mathbf{F}_{max}$	18.0	22.0	19.2	19.0
1988	No increase in F; TAC	16.0	18.4	19.2	20.4
1989	80% of F(87); TAC	16.0	18.4	15.4	17.2
1990	80% of F(88); TAC	15.0	16.0	11.8	12.2
1991	70% of effort (89)	-	16.0	10.6	10.9[2]
1992	70% of effort (89)	-	13.5	9.0	9.3[3]
1993	70% of effort (89)	-	14.0	10.5	10.8[3]
1994	30% reduction in effort	-	13.0	9.1	10.1[3]
1995	Significant reduction in effort	-	13.0	9.6	9.6[3]
1996	Significant reduction in effort	-	13.0	9.6	9.4
1997	Significant reduction in effort	-	14.0	7.0	7.0
1998	20% reduction in F	9.5[5]	11.0	5.7	5.7
1999	F reduced to below $\mathbf{F}_{pa}$	<9.7[5]	11.8	4.3	4.2
2000	Recovery plan, 60 % reduction in F	<4.2	7.48	2.8[4]	3.1
2001	Lowest possible F, recovery plan	-	3.70		
2002	Recovery plan or lowest possible F,	-			

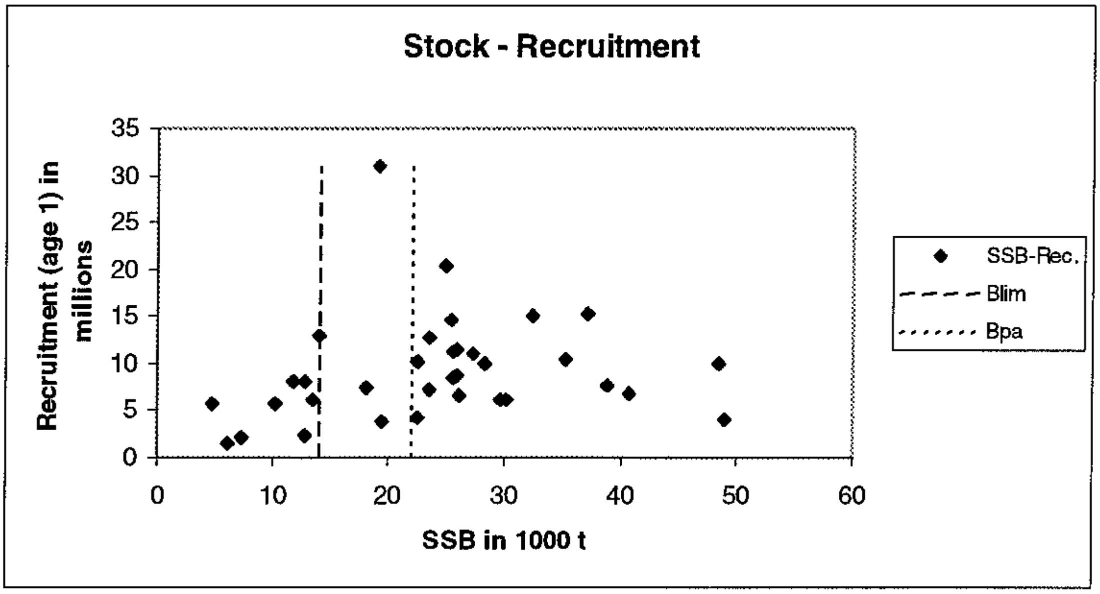
[1]TAC is for the whole of Sub-area Vb1, VI, XII and XIV. [2]Not including misreporting. [3]Including ACFM estimates of misreporting. [4]Incomplete data. [5]For VIa only. Weights in '000 t.


Landings
Landings in 1000 t
30
25
20
15
10
5
0
1966
1971
1976
1981
1986
1991
1996

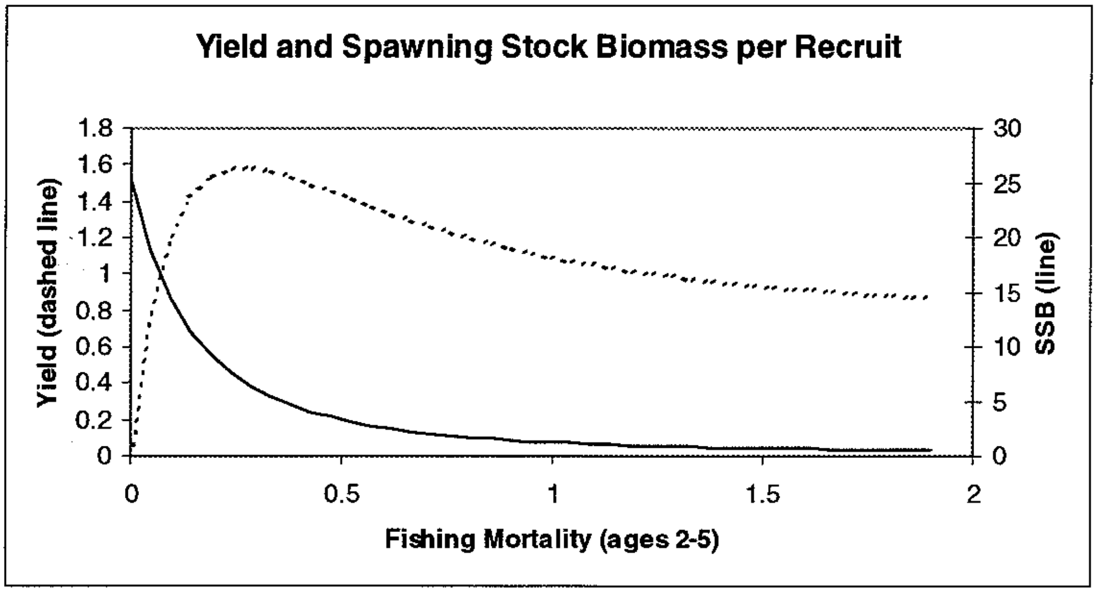

Fishing Mortality
F(ages 2-5)
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1966
1971
1976
1981
1986
1991
1996
F
Flim
Fpa


Recruitment (age 1)
Recruitment in millions
35
30
25
20
15
10
5
0
1966
1971
1976
1981
1986
1991
1996

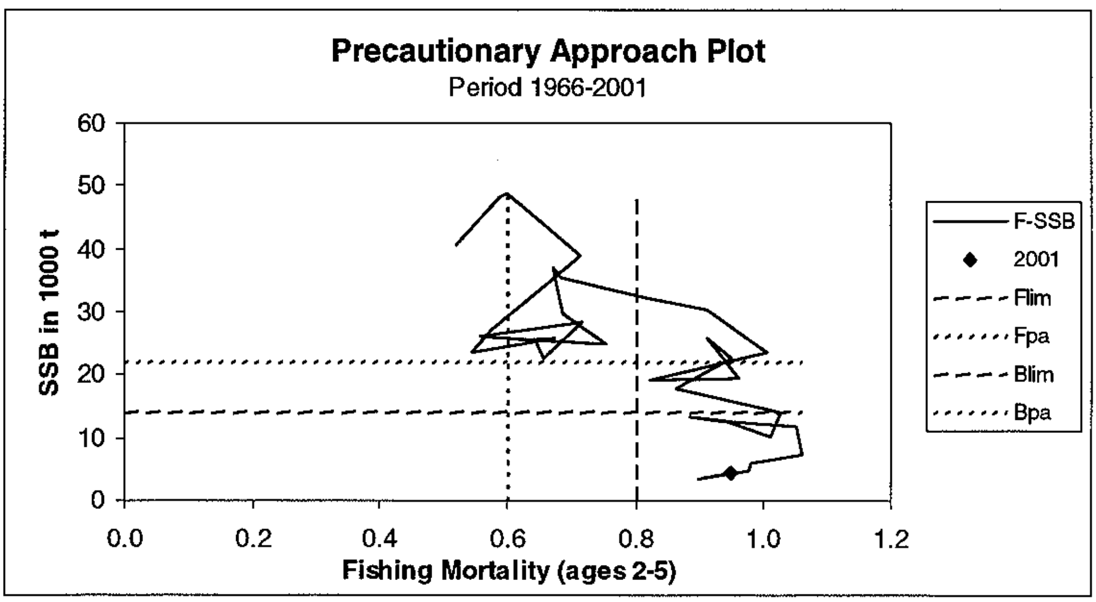

Spawning Stock Biomass
SSB in 1000 t
60
50
40
30
20
10
0
1966
1971
1976
1981
1986
1991
1996
2001
SSB
Blim
Bpa



Stock - Recruitment
Recruitment (age 1) in millions
SSB in 1000 t
SSB-Rec.
Blim
Bpa



Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
SSB (line)
Fishing Mortality (ages 2-5)



Precautionary Approach Plot
Period 1966-2001
SSB in 1000 t
Fishing Mortality (ages 2-5)
F-SSB
2001
Flim
Fpa
Blim
Bpa

Table 3.7.2.a.1 COD in Division VIa (West of Scotland).

	1984	1985	1986	1987	1988	1989	1990	1991	1992
Belgium	22	48	88	33	44	28	-	6	-
Denmark	-	-	-	4	1	3	2	2	3
Faroes Islands	-	-	-	-	11	26	-	-	-
France	7,637	7,411	5,096	5,044	7,669	3,640	2,220	2,503	1,957
Germany	75	66	53	12	25	281	586	60	5
Ireland	2,316	2,564	1,704	2,442	2,551	1,642	1,200	761	761
Netherlands	-	-	-	-	-	-	-	-	-
Norway	231	204	174	77	186	207	150	40	171
Spain	64	28	-	-	-	85	-	-	-
UK (E. & W. & N.I.)	724	260	160	444	230	278	230	511	577
UK (Scotland)	9,483	8,032	4,251	11,143	8,465	9,236	7,389	6,751	5,543
Total	20,552	18,613	11,526	19,199	19,182	15,426	11,777	10,634	9,017
Unallocated	720	-6	294	-228	1,231	1,743	399	293	240
As used by W.G.	21,272	18,607	11,820	18,971	20,413	17,169	12,176	10,927	9,257[1]

	1993	1994	1995	1996	1997	1998	1999	2000
Belgium	22	1	2	+	11	1	+	+
Denmark	2	+	4	2	-	+	+	-
Faroes Islands	-	-	-	-	-	-	-	n/a
France	3,047	2,488	2,533	2,253	956	714*	842*	310*
Germany	94	100	18	63	5	6	8	6
Ireland	645	825	1,054	1,286	708	478	223	n/a
Netherlands	-	-	-	-	2	1	-	-
Norway	72	51	61	137	36*	36*	79*	114*
Spain	-	-	16	+	6	42	45	n/a
UK (E. & W. & N.I.)	524	419	450	457	779	474	381	280
UK (Scotland)	6,069	5,247	5,522	5,382	4,489	3,919	2,711	2,057
Total	10,475	9,131	9,660	9,580	6,992	5,671	4,289	2,767
Unallocated	281	883	-38	-153	42	43	-88	349
As used by W. G.	10,756[1]	10,014[1]	9,622[1]	9,427	7,034	5,714	4,201	3,116

* Preliminary.
[1] Estimated by TSA (2001 WG meeting).

Table 3.7.2.a.2 Cod in Division VIa (West of Scotland).

Year	Recruitment Age 1 thousands	SSB tonnes	Landings tonnes	Mean F Ages 2-5
1966	15678	40660	17102	0.521
1967	6684	48333	22978	0.587
1968	9900	48892	24338	0.600
1969	4114	38845	21599	0.714
1970	7618	27246	12652	0.576
1971	10941	23569	10657	0.543
1972	7200	25885	14695	0.673
1973	8676	25629	12262	0.620
1974	8411	25588	13636	0.646
1975	11274	26154	13162	0.556
1976	6654	28251	17406	0.718
1977	9925	22515	12619	0.655
1978	10221	25430	13521	0.642
1979	14615	24940	16089	0.756
1980	20323	29595	17879	0.687
1981	6125	37131	23865	0.671
1982	15286	35275	21511	0.685
1983	10447	32325	21305	0.816
1984	15148	30169	21272	0.911
1985	6151	23606	18607	1.004
1986	12694	19037	11820	0.824
1987	30973	19384	18971	0.963
1988	3752	25936	20413	0.911
1989	11437	22554	17169	0.950
1990	4192	18008	12176	0.864
1991	7420	13932	10927	1.027
1992	12839	10262	9086	1.010
1993	5697	12708	10314	0.939
1994	7955	13444	8928	0.884
1995	6211	12834	9439	0.928
1996	2312	11823	9427	1.053
1997	8119	7392	7034	1.060
1998	2136	6073	5714	0.981
1999	1500	4825	4201	0.976
2000	5650	3445	3086	0.896
2001	5072	4480		0.950
Average	9260	22949	14453	0.800

*Short term geometric mean (1988-1999).

3.7.2.b Cod in Division VIb (Rockall)

Catch data are given in Table 3.7.2.b.1.

Special comments: There is no information on the status of cod in Division VIb. Official catch data are incomplete. To set a TAC for this Division compatible with management measures for Division VIa cod, it is proposed to adopt the most recent recorded landings. The average recorded catch over 1997-1999 is 760 t. 2000 data are incomplete.

Relevant factors to be considered in management: TAC set for Division VIb cod should not jeopardise a rebuilding plan for cod in Division VIa.

Source of information: Report of the Working Group on the Assessment of Northern Shelf Demersal Stocks, August 2001 (ICES CM 2002/ACFM:02).

Cod in Division VIb (Rockall)

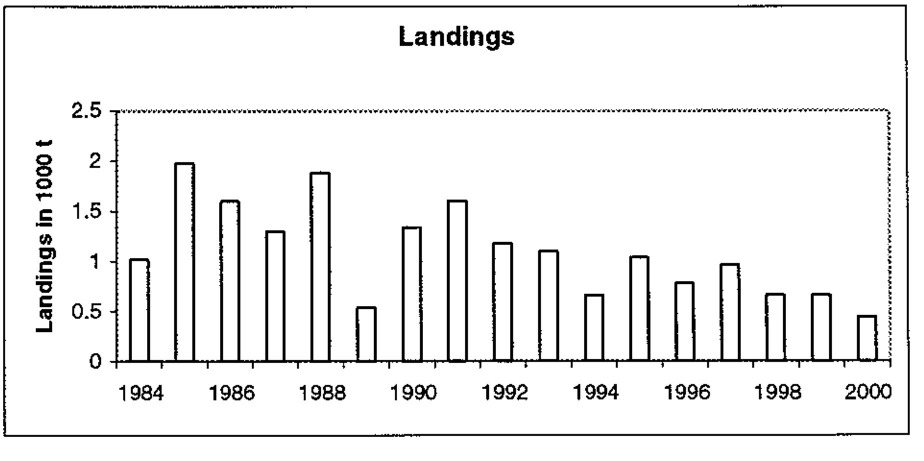


Table 3.7.2.b.1 COD in Division VIb (Rockall).

Country	1984	1985	1986	1987	1988	1989	1990	1991	1992
Faroes Islands	18	-	1	-	31	5	-	-	-
France	9	17	5	7	2	-	-	-	-
Germany	-	3	-	-	3	-	-	126	2
Ireland	-	-	-	-	-	-	400	236	235
Norway	373	202	95	130	195	148	119	312	199
Portugal	-	-	-	-	-	-	-	-	-
Russia	-	-	-	-	-	-	-	-	-
Spain	241	1200	1219	808	1345	-	64	70	-
UK (E. & W. & N.I.)	161	114	93	69	56	131	8	23	26
UK (Scotland)	221	437	187	284	254	265	758	829	714
Total	1,023	1,973	1,600	1,298	1,886	549	1,349	1,596	1,176

Country	1993	1994	1995	1996	1997	1998	1999	2000
Faroes Islands	1	-	-	-	-	-	-	n/a
France	-	-	-	-	-	-	-	-
Germany	-	-	-	10	22	3	11	1
Ireland	472	280	477	436	153	227	148	n/a
Norway	199	120	92	91	55*	51*	85*	152*
Portugal	-	-	-	-	5	-	-	-*
Russia	-	-	-	-	-	-	-	7*
Spain	-	-	2	5	1	6	4	n/a
UK (E. & W. & N.I.)	103	25	90	23	20	32	22	4
UK (Scotland)	322	236	370	210	706	341	389	286
Total	1,097	661	1,031	775	962	660	659	450

* Preliminary.

3.7.3 Haddock

3.7.3.a Haddock in Division VIa (West of Scotland)

State of stock/exploitation: This stock is harvested outside safe biological limits. SSB in 2001 is above $\mathbf{B}_{pa}$, and the fishing mortality in 2001 was above $\mathbf{F}_{pa}$. The recruitment estimate of the 1999 year class is greater than twice the average based on the last four years.

Management objectives: No explicit management objectives are set for this stock.

Precautionary Approach reference points (established in 1998):

ICES considers that:	ICES proposes that:
$\mathbf{B}_{lim}$= 22 000 t	$\mathbf{B}_{pa}$ be set at 30 000 t
$\mathbf{F}_{lim}$= not defined	$\mathbf{F}_{pa}$ be set at 0.50

Technical basis:

$\mathbf{B}_{lim}$ = lowest observed SSB	$\mathbf{B}_{pa} = \mathbf{B}_{lim}$*1.4
$\mathbf{F}_{lim}$ = not defined	$\mathbf{F}_{pa}$ = high probability of avoiding SSB<$\mathbf{B}_{pa}$ in long term

Advice on management: Advice on management: Fishing mortality in 2002 should be below $\mathbf{F}_{pa}$, corresponding to a human consumption landing of 14 100 t. However, due to the mixed nature of the fisheries the fishing mortality for haddock in 2002 may have to be reduced further to achieve consistency with the recovery plan for cod.

Relevant factors to be considered in management: Haddock are taken with cod and whiting in a mixed demersal fishery. The area closures for cod in Division VIa in 2001 have had no measurable impact on the haddock fishery in Division VIa.

A high proportion (up to 42% in weight, 1991–2000) of the total haddock catch is discarded. The amount of discard of the large 1999 year class (51 mill.) is already around the estimated recruitment in the immediately preceding years. The proposed mesh size increases that are part of the cod recovery plan are likely to reduce discards. Square mesh panels have been introduced in the UK in 2000 in an attempt to reduce discarding. Further gear measures were introduced in Scotland during 2001. It is still too early to determine whether these have been effective. If implemented effectively, these measures should help in reducing discarding. Measures to control by-catch and discarding of cod should be implemented within a directed haddock fishery.

Comparison with previous assessment and advice: The estimates of fishing mortality in 1999 is 22% higher and SSB in 2000 38% lower in this year's assessment compared to last year's assessment. The principal change to the catch forecast compared with that of last year is in part due to 65% higher estimates of the 1999 year class in the current assessment compared to the previous assessment. The basis for a single stock fishery advice is the same as last year.

Catch forecast for 2002:

Basis: F(2001) = $\mathbf{F}_{sq}$ = F(98–00) = 0.72; Catch(2001) = 31.7; Landings(2001) = 16.4; SSB(2002) = 53.1.

F(2002 onwards)[1]	Basis	Catch (2002)	Discards (2002)	Landings (2002)	SSB (2003)	Medium term (10 year) Probability (%) of SSB < $\mathbf{B}_{pa}$
0.36	0.5* $\mathbf{F}_{sq}$	16.5	5.8	10.7	57.7	<25%
0.50	$\mathbf{F}_{pa}$ (0.69* $\mathbf{F}_{sq}$)	21.8	7.6	14.1	51.7	<25%
0.57	0.8* $\mathbf{F}_{sq}$	24.3	8.6	15.7	48.8	<25%
0.72	1.0* $\mathbf{F}_{sq}$	28.8	10.3	18.6	43.7	25%
0.86	1.2* $\mathbf{F}_{sq}$	32.9	11.8	21.1	39.2	25%
1.00	1.4* $\mathbf{F}_{sq}$	36.5	13.1	23.4	35.2	<50%
1.15	1.6* $\mathbf{F}_{sq}$	39.8	14.4	25.4	31.6	<75%

Weights in '000 t.

Shaded scenarios considered inconsistent with the precautionary approach.

Elaboration and special comment: The fishery is dominated by Scottish light trawlers. Effort by Scottish seiners and heavy trawlers has declined since 1976. Haddock in Division VIa are fully exploited by age group 3, and also reach full maturity at that age. Immature fish are subject to comparatively high fishing mortality, and comprise a large fraction of the discarded catch. High fishing mortality on immature haddock increases the susceptibility of the stock to over-exploitation.

Analytical age-based assessment uses landings-at-age data, discard-at-age data, and indices from research vessel surveys. Some misreporting of landings has occurred in recent years, but this is not considered to have significantly affected the results of the current assessment.

Source of information: Report of the Working Group on the Assessment of Northern Shelf Demersal Stocks, August 2001 (ICES CM 2002/ACFM:02).

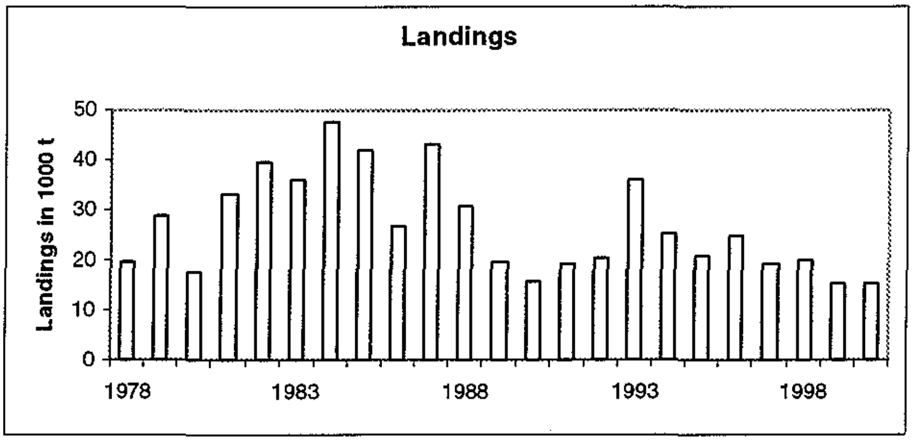
Yield and spawning biomass per Recruit F-reference points:

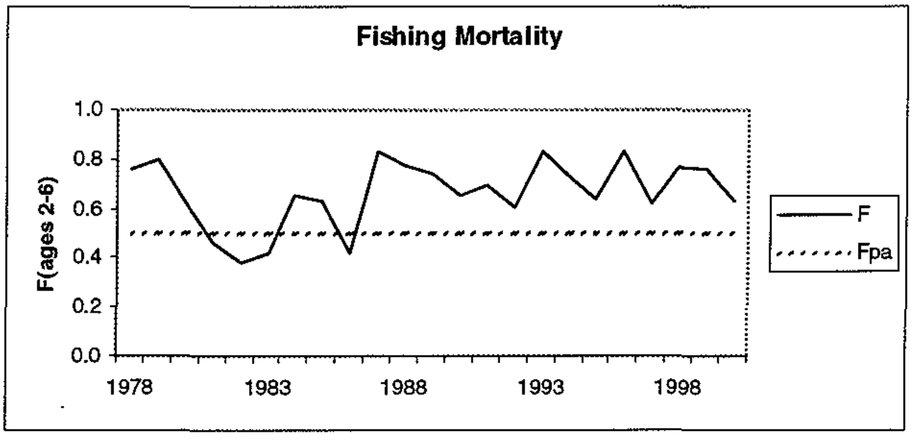
	Fish Mort Ages 2-6	Yield/R	SSB/R
Average Current	0.718	0.127	0.322
$\mathbf{F}_{max}$	0.245	0.169	0.900
$\mathbf{F}_{0.1}$	0.149	0.158	1.281
$\mathbf{F}_{med}$	0.581	0.140	0.404

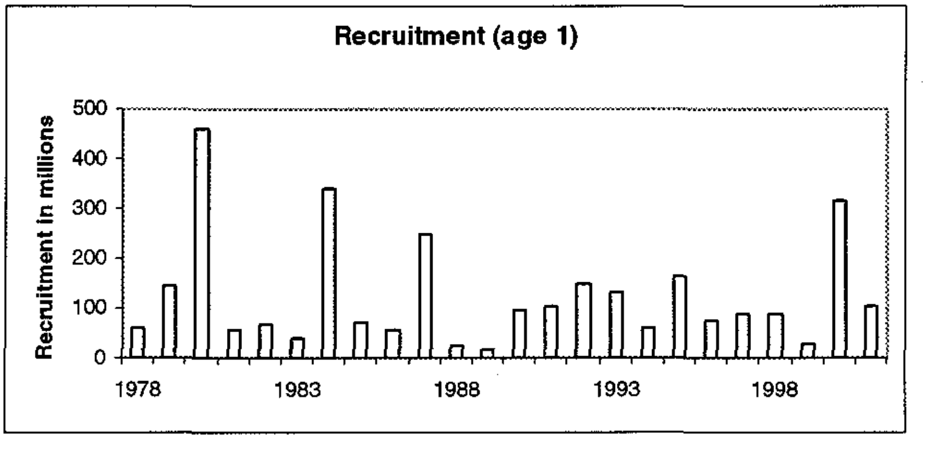
Catch data (Tables 3.7.3.a.1-2):

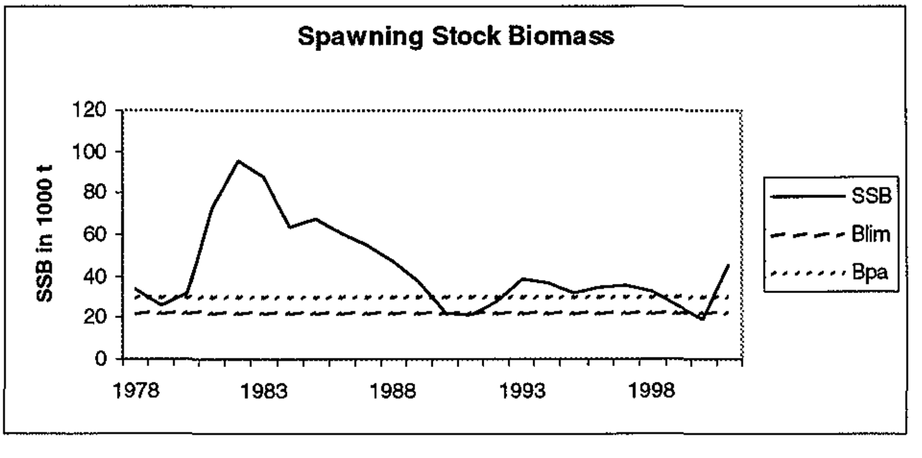
Year	ICES Advice	Predicted landings corresp. to advice	Agreed TAC[1]	Official Landings	ACFM Landings	Discard Slip.	ACFM Catch
1987	Reduce F towards $\mathbf{F}_{max}$	20.0	32.0	27	27.0	16.2	43.2
1988	No increase in F; TAC	25.0	35.0	21	21.1	10.2	31.3
1989	80% of F(87); TAC	15.0	35.0	24	16.7	3.2	19.9
1990	80% of F(88); TAC	14.0	24.0	13	10.1	5.4	15.5
1991	70% of effort (89)	-	15.2	10	10.6	9.2	19.8
1992	70% of effort (89)	-	12.5	7	11.4[2]	9.4[2]	20.8[2]
1993	70% of effort (89)	-	17.6	13	19.1[2]	16.9[2]	36.0[2]
1994	30% reduction in effort	-	16.0	9	14.2[2]	11.2[2]	25.4[2]
1995	Significant reduction in effort	-	21.0	13	12.4	8.8	21.2
1996	Significant reduction in effort	-	22.9	13	13.4	11.8	25.3
1997	Significant reduction in effort	-	20.0	13	12.9	6.6	19.5
1998	No increase in F	20.8[3]	25.7	14	14.4	5.7	20.1
1999	F reduced to $\mathbf{F}_{pa}$	14.3[3]	19.0	10	10.4	5.1	15.6
2000	Maintain F below $\mathbf{F}_{pa}$	<14.9[3]	19.0	7	7.1	8.5	15.6
2001	Reduce F below $\mathbf{F}_{pa}$	<11.2[3]	13.9				
2002	Reduce F below $\mathbf{F}_{pa}$	<14.1[3]					

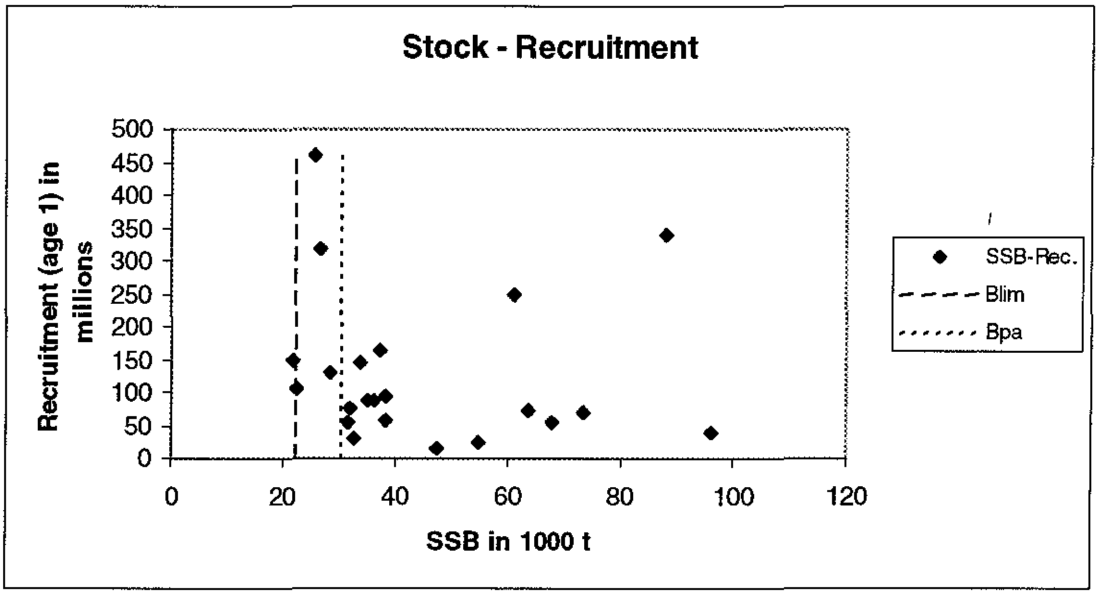
[1]TAC is set for Divisions VIa and VIb (plus Vb1, XII & XIV) combined with restrictions on quantity that can be taken in VIa from 1990. [2]Adjusted for misreporting. [3] For VIa only. Weights in '000 t.

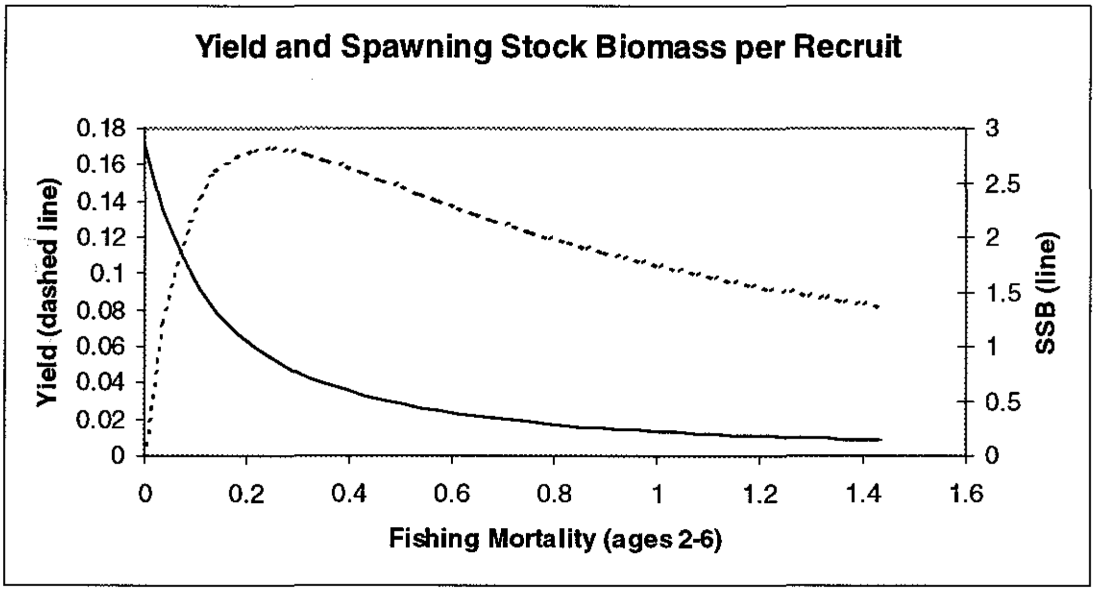

Landings
Landings in 1000 t
50
40
30
20
10
0
1978
1983
1988
1993
1998


Fishing Mortality
F(ages 2-6)
1.0
0.8
0.6
0.4
0.2
0.0
1978
1983
1988
1993
1998
F
Fpa


Recruitment (age 1)
Recruitment in millions
500
400
300
200
100
0
1978
1983
1988
1993
1998


Spawning Stock Biomass
SSB in 1000 t
120
100
80
60
40
20
0
1978
1983
1988
1993
1998
SSB
Blim
Bpa


Stock - Recruitment
Recruitment (age 1) in millions
SSB in 1000 t
SSB-Rec.
Blim
Bpa
500
450
400
350
300
250
200
150
100
50
0
0
20
40
60
80
100
120


Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
SSB (line)
Fishing Mortality (ages 2-6)
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
3
2.5
2
1.5
1
0.5
0
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6

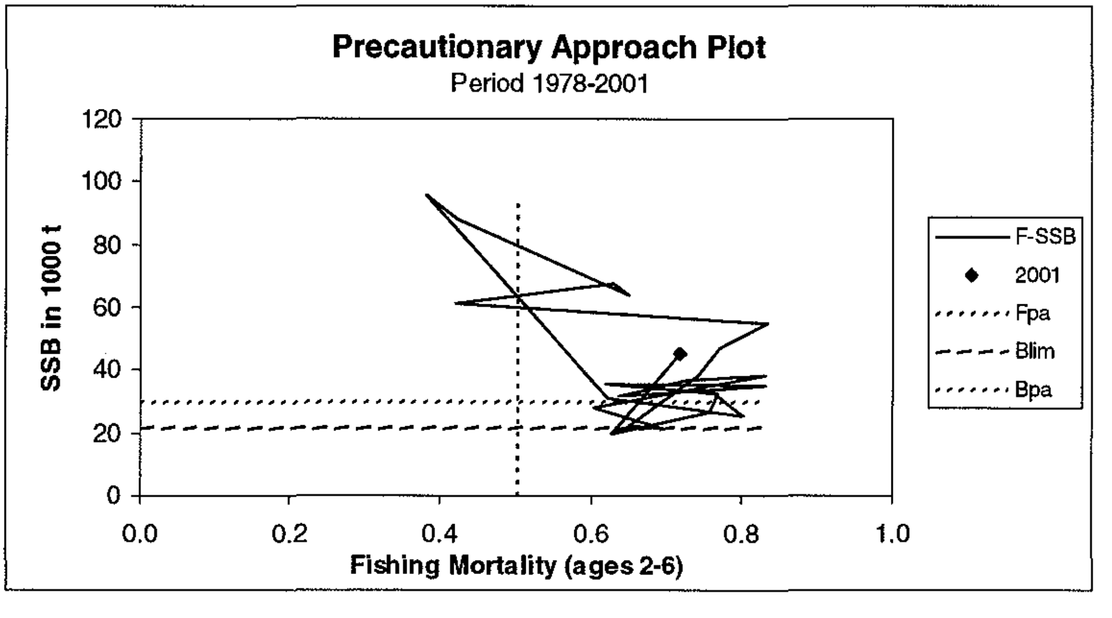

Precautionary Approach Plot
Period 1978-2001
SSB in 1000 t
Fishing Mortality (ages 2-6)
F-SSB
2001
Fpa
Blim
Bpa
120
100
80
60
40
20
0
0.0
0.2
0.4
0.6
0.8
1.0

Table 3.7.3.a.1 Nominal catch (t) of HADDOCK in Division VIa, 1986–2000, as officially reported to ICES.

Country	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Belgium	-	29	8	9	-	9	1	7	1	+
Denmark	+	+	+	+	+	+	1	1	-	1
Faroe Islands	1	-	-	13	-	1	-	-	-	-
France	4,956	5,456	3,001	1,335[1,2]	863[1,2]	761[1,2]	761	1,132	753	671
Germany	25	21	4	4	15	1	2	9	19	14
Ireland	2,026	2,628	2,731	2,171	773	710	700	911	746	1,406
Norway	45	13	54	74	46	12	72	40	7	13
Spain	-	-	-	-	-	-	-	-	-	-
UK (E&W)[3]	222	425	114	235	164	137	132	155	254	322
UK (N.I.)	155	1	35	...	...	...	...	...	...	...
UK (Scot.)	12,955	18,503	15,151	19,940	10,964	8,434	5,263	10,423	7,421	10,367
Total	20,385	27,076	21,098	23,781	12,825	10,065	6,932	12,678	9,201	12,794
Landings as used by W.G.	19,574	27,004	21,137	16,693	10,136	10,560	11,353	19,067	14,243	12,372
Discards	7,352	16,218	10,164	3,178	5,406	9,192	9,398	16,904	11,192	8,794
Unallocated landings	-811	-72	39	-7,088	-2,689	495	4,421	6,389	5,042	-423
Total as used by W.G.	26,926	43,222	31,301	19,871	15,542	19,752	20,752[1]	35,971	25,435	21,166

Country	1996	1997	1998	1999	2000
Belgium	1	3	2	2	1
Denmark	1	-	+	-	-
Faroe Islands	-	-	-	-	n/a
France	445	270	394[1]	788	358[1]
Germany	2	1	1	2	1
Ireland	1,399	1,447	1,352	1,054	n/a
Norway	16[1]	21[1]	28	18	70[1]
Spain	-	-	n/a	4	n/a
UK (E&W)[3]	448	493	458	315	199
UK (N.I.)	...	...	...	...	...
UK (Scot.)	10,790	10,352	12,125	8,630	5,933
Total	13,102	12,587	14,360	9.755	6,562
Landings as used by W.G.	13,452	12,866	14,401	10,424	7,129
Discards	11,838	6,623	5,712	5,131	8,479
Unallocated landings	350	279	41	669	567
Total as used by W.G.	25,290	19,489	20,114	15,555	15,608

[1]Preliminary.

[2]Includes Divisions Vb(EC) and VIb.

[3]1989–2000 N. Ireland included with England and Wales.

n/a = Not available.

Table 3.7.3.a.2 Haddock in Division VIa (West of Scotland).

Year	Recruitment Age 1 thousands	SSB tonnes	Catch tonnes	Mean F Ages 2-6
1978	61273	33577	19526	0.75954
1979	145270	25714	28703	0.80234
1980	461781	31562	17474	0.62300
1981	54040	73284	33281	0.46358
1982	68952	96038	39698	0.38078
1983	40371	88045	36197	0.42142
1984	340475	63565	47416	0.65002
1985	72305	67766	41922	0.62916
1986	55346	61177	26714	0.42014
1987	248955	54896	43205	0.83432
1988	22758	47293	30690	0.77052
1989	14871	38098	19669	0.74156
1990	94714	22563	15537	0.65036
1991	105751	21618	19249	0.69426
1992	148896	28380	20512	0.60454
1993	131484	38341	35883	0.83164
1994	58862	37134	25381	0.72856
1995	164682	31759	20920	0.63848
1996	75551	35102	24830	0.83136
1997	88971	36029	19357	0.61930
1998	88921	32512	19936	0.76920
1999	29787	26534	15390	0.75722
2000	317560	19710	15305	0.62694
2001	105975	45260		0.72000
Average	124898	43998	26817	0.66534

3.7.3.b Haddock in Division VIb (Rockall)

State of stock/exploitation: The stock remains outside safe biological limits. Fishing mortality in 2000 was above $\mathbf{F}_{pa}$, and SSB is below $\mathbf{B}_{pa}$ in 2001.

Management objectives: No explicit management objectives are set for this stock.

Precautionary Approach reference points (established in 1999):

ICES considers that:	ICES proposes that:
$\mathbf{B}_{lim}$ is 6 000 t, the lowest observed spawning stock.	$\mathbf{B}_{pa}$ be set at 9 000 t. This is considered to be the minimum SSB required to have a high probability of maintaining SSB above $\mathbf{B}_{lim}$, taking into account the uncertainty of assessments.
$\mathbf{F}_{lim}$ is not defined.	$\mathbf{F}_{pa}$ be set at 0.4. This F provides a small probability that SSB will fall below $\mathbf{B}_{pa}$ in the long term.

Technical basis:

$\mathbf{B}_{lim} = \mathbf{B}_{loss}$ as estimated in a previous assessment	$\mathbf{B}_{pa} = \mathbf{B}_{loss} * 1.4$
$\mathbf{F}_{lim}$ = could not be defined, due to uninformative stock recruitment data	$\mathbf{F}_{pa}$ = adopted by analogy with other haddock stocks.

Advice on management: ICES recommends that fishing mortality in 2002 should be reduced to below 0.2, corresponding to landings of less than 1 300 t in 2002 in order to rebuild the SSB to $\mathbf{B}_{pa}$ within 4 years.

Relevant factors to be considered in management: The TAC applies to Sub-area VI, with a limit on how much of the catch may be taken in Division VIa, but no such limit for Division VIb. In addition, part of Division VIb now falls within international waters where non EU-vessels are not subject to TAC. This allows for an unregulated fishery in that area. A separate TAC applicable only to Division VIb, including international waters, would ensure sustainable fishery in Division VIb.

Following the NEAFC agreement in March 2001, an area of the NEAFC zone around Rockall was closed to haddock. It is too early to quantify the effect this closure has on the fishery on the stock.

It is difficult to predict actual fishing mortality as fleet behaviour will depend on fishing opportunities elsewhere.

Comparison with previous assessment and advice: The estimates of fishing mortality in 1999 is 27% lower and SSB in 2000 15% higher in this years assessment compared to last years assessment.

Catch forecast for 2002:

Basis F(2001) = F(98-00) = 0.39; Landings(2001) = 2.7; SSB(2002) = 4.9.

F(2002)	Basis	Catch (2002)	Landings (2002)	SSB (2003)
0.16	0.4 F(98-00)	1.1	1.1	6.9
0.20	Advice	1.3	1.3	6.6
0.23	0.6 F(98-00)	1.5	1.5	6.4
0.31	0.8 F(98-00)	1.9	1.9	6.0
0.39	F(98-00)	2.3	2.3	5.7
0.47	1.2 F(98-00)	2.6	2.6	5.3

Weights in '000 t.

Shaded scenarios considered inconsistent with the precautionary approach.

Elaboration and special comment: The Rockall fishery is dominated by Scottish vessels and until recently has taken place largely in the summer if fishing at Rockall is more profitable than in the North Sea or West of Scotland. A few Irish vessels exploit this stock on a more regular basis. It is largely a haddock fishery, with relatively little catch of other species.

During 1999 a substantial spring fishery developed for the first time, fishing on concentrations of haddock in a different area of the Rockall bank than previously. An unregulated fishery on part of the bank which now falls outside of the EU EEZ also started during 1999 and has led to opportunities for other nations to exploit the fishery, notably Russia. The table on official statistics has included Russian catches from the Rockall area for the last two years.

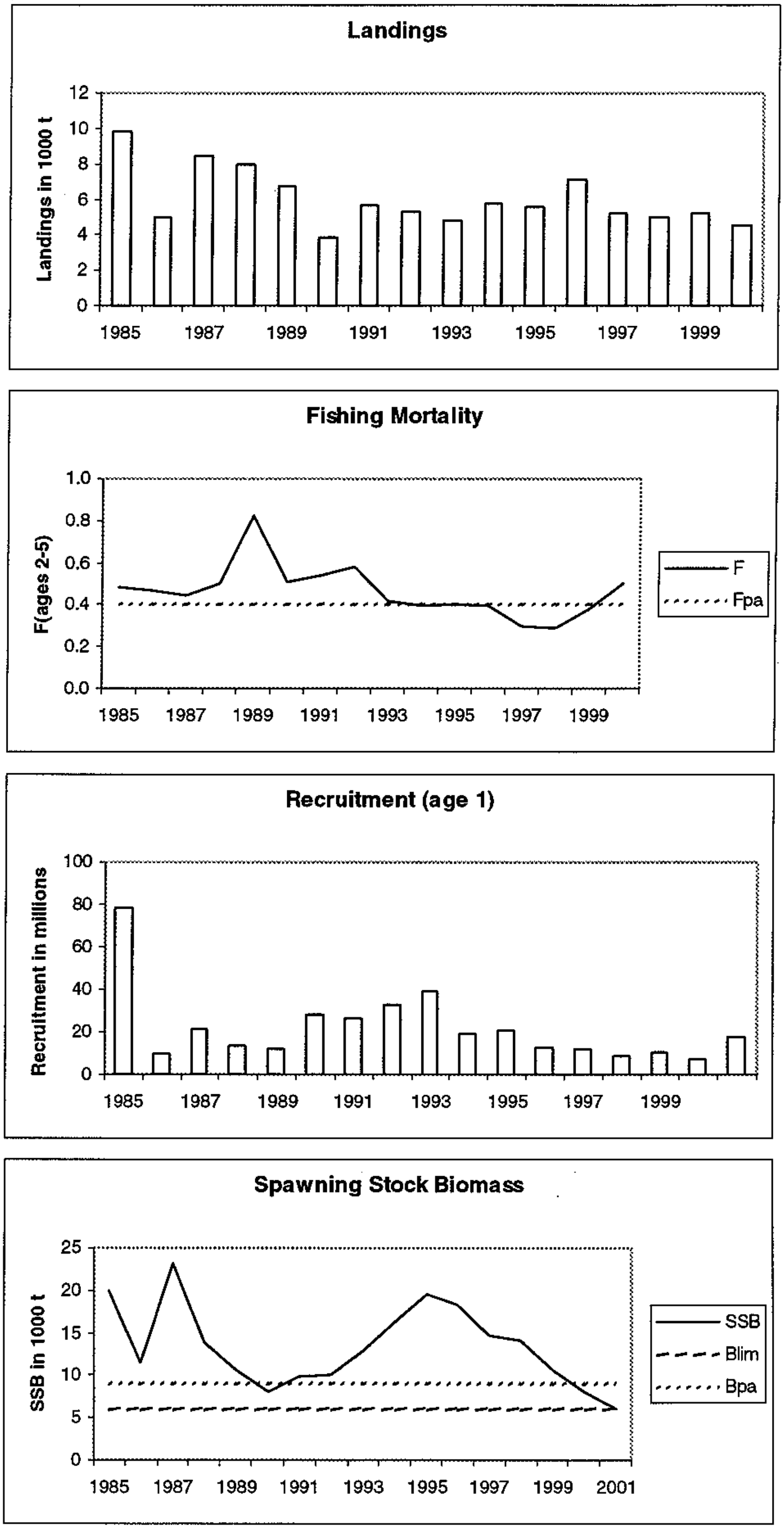
The analytical, age-based assessment uses landings-at-age data and research vessel survey data. Although no discard data are available, there is likely to be substantial discarding of younger fish. The short time series, variable fishing effort and mis-reporting of landings limit the precision of the assessment. The time series is too short to estimate the stock recruitment relationship for medium-term projections and estimation of fishing mortality reference points. Maturity is assumed to be attained at age 3, but information from surveys in 2001 indicates that fish may be maturing at an earlier age.

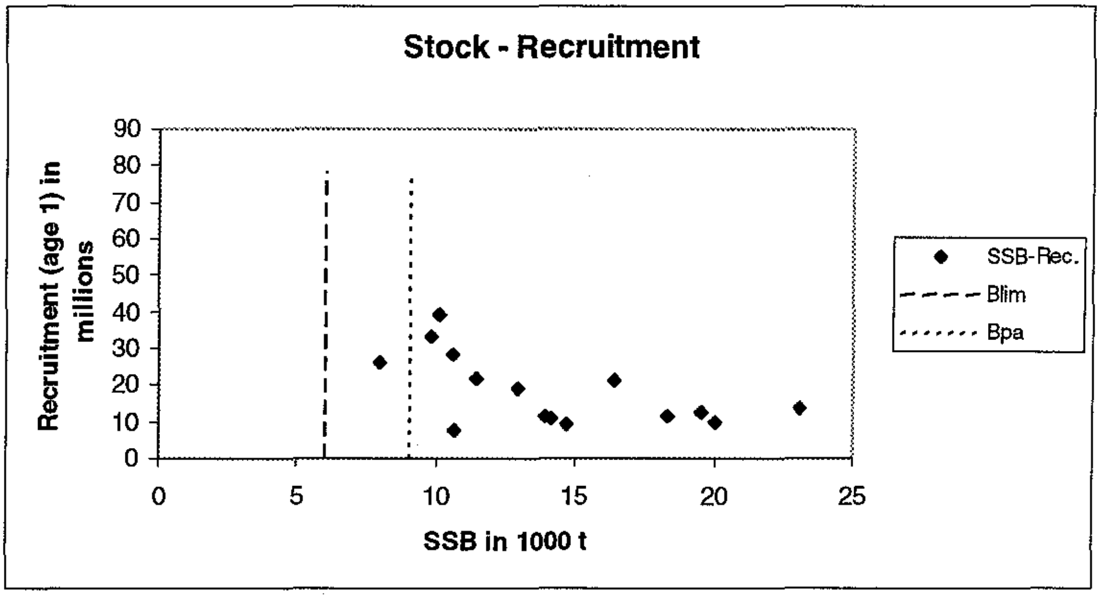
Source of information: Report of the Working Group on the Assessment of Northern Shelf Demersal Stocks, August 2001 (ICES CM 2002/ACFM:02).

Catch data (Tables 3.7.3.b.1–2):

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC[1]	Official Landings	ACFM Landings
1987	Precautionary TAC	10.0		8.0	8.4
1988	Precautionary TAC	10.0		7.6	7.9
1989	*Status quo* F; TAC	18.0		6.6	6.7
1990	Precautionary TAC	5.5		8.2	3.9
1991	Precautionary TAC	5.5		5.9	5.7
1992	Precautionary TAC	3.8		4.5[4]	5.3
1993	80% of F(91)	3.0		4.1[4]	4.8
1994	If required, precautionary TAC	-		3.7[4]	5.7[2]
1995	No long-term gain in increasing F	5.1[3]		5.5[4]	5.6
1996	No long-term gains in increasing F	6.9[3]		6.8[4]	7.1
1997	No advice given	4.9[3]		5.2[4]	5.2
1998	No increase in F	4.9		5.1[4]	5.0
1999	Reduce F below $\mathbf{F}_{pa}$	3.8		4.8[4]	5.4
2000	Reduce F below $\mathbf{F}_{pa}$	< 3.5		4.5[4]	4.5
2001	Reduce F below $\mathbf{F}_{pa}$	< 2.7			
2002	Reduce F below 0.2	<1.3			

[1]TAC is set for Divisions VIa and VIb (plus Vb1, XII & XIV) combined with restrictions on quantity that can be taken in VIa from 1990. [2]Including misreporting. [3]Landings at *status quo* F. [4]Incomplete data. Weights in '000 t.


Landings
Landings in 1000 t
12
10
8
6
4
2
0
1985
1987
1989
1991
1993
1995
1997
1999
Fishing Mortality
F(ages 2-5)
1.0
0.8
0.6
0.4
0.2
0.0
F
Fpa
Recruitment (age 1)
Recruitment in millions
100
80
60
40
20
0
Spawning Stock Biomass
SSB in 1000 t
25
20
15
10
5
0
2001
SSB
Blim
Bpa


Stock - Recruitment
Recruitment (age 1) in millions
90
80
70
60
50
40
30
20
10
0
0
5
10
15
20
25
SSB in 1000 t
SSB-Rec.
Blim
Bpa

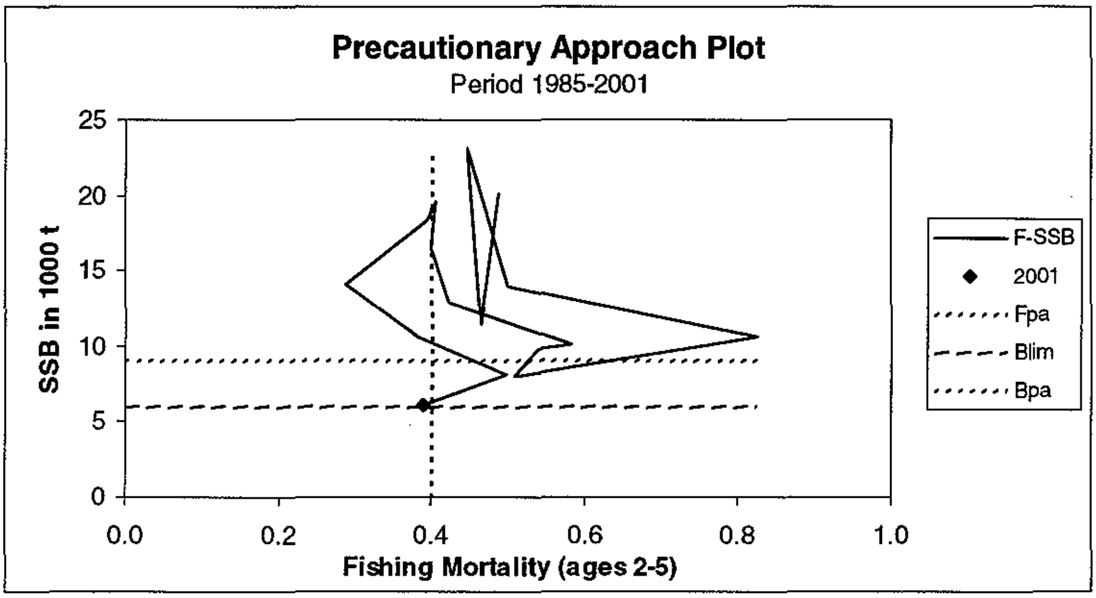

Precautionary Approach Plot
Period 1985-2001
SSB in 1000 t
25
20
15
10
5
0
0.0
0.2
0.4
0.6
0.8
1.0
Fishing Mortality (ages 2-5)
F-SSB
2001
Fpa
Blim
Bpa

Table 3.7.3.b.1 Nominal catch (tonnes) of HADDOCK in Division VIb, 1986–2000, as officially reported to ICES.

Country	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Faroe Islands	-	-	5	-	-	-	-	-	-	-	-	-	-	-	n/a
France	103	99	5	...[2]	...[2]	...[2]	...[2]	...[2]	...[2]	...[2]	...[2]	...[2]	...[2]	...[2]	...[2]
Germany	-	-	4	1	-	-	-	-	-	-	-	-	-	-	-
Iceland	-	-	-	-	-	-	-	-	-	-	-	+	-	167	3[1]
Ireland	-	-	-	-	620	640	571	692	956	677	747	895	704	1,021	n/a
Norway	83	33	20	47	38	69	47	68	75	29	24	24[1]	40[1]	61[1]	152[1]
Portugal	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-
Russia	-	-	-	-	-	-	-	-	-	-	-	-	-	458	1,872[1]
Spain	756	371	245	337	178	187	51	-	-	28	1	22	21	25	n/a
UK (E&W)[3]	703	1,271	753	272	238	165	74	308	169	318	293	165	561	288	36
UK (N.I.)	157	-	-	...	...	...	...	...	...	...	...	...	...	...	...
UK (Scot.)	2,961	6,221	6,542	5,986	7,139	4,792	3,777	3,045	2,535	4,439	5,753	4,114	3,768	3,970	2,470
Total	4,763	7,995	7,574	6,643	8,213	5,853	4,520	4,113	3,735	5,491	6.818	5,220	5,098	5,990	4,533
Unallocated	251	437	355	85	-4,329	-198	800	671	1,998	96	257	-54	-93	-769	25
WG estimate	5,014	8,432	7,929	6,728	3,884	5,655	5,320	4,784	5,733	5,587	7,075	5,166	4,984	5,221[4]	4,558[4]

[1]Preliminary.

[2]Included in Division VIa.

[3]1989–2000 N. Ireland included with England and Wales.

[4] Includes a reduction in Russian catch data to approximate to "landings-equivalent values" (see Working Group Report Section 4.2.3)

n/a = Not available.

Table 3.7.3.b.2 Haddock in Division VIb (Rockall).

Year	Recruitment Age 1 thousands	SSB tonnes	Landings tonnes	Mean F Ages 2-5
1985	78752	20030	9810	0.4878
1986	9907	11453	5014	0.4641
1987	21682	23114	8433	0.4448
1988	13786	13900	7929	0.4994
1989	11666	10614	6728	0.8249
1990	28218	7965	3884	0.5083
1991	26303	9811	5655	0.5394
1992	33039	10081	5320	0.5814
1993	39479	12909	4784	0.4223
1994	18821	16431	5733	0.3989
1995	21125	19538	5587	0.4045
1996	12806	18336	7075	0.3934
1997	11669	14677	5166	0.3009
1998	9055	14128	4984	0.2885
1999	10800	10680	5221	0.3820
2000	7400	8081	4558	0.4977
2001	17326	6060		0.3900
Average	21873	13400	5993	0.4605

3.7.3.c Meeting to address Request from NEAFC to ICES on Rockall haddock

Terms of reference of the meeting:

To evaluate the spatial distribution of the fishery, the spawning stock and the juvenile fish of the stock of haddock around Rockall, to allow NEAFC to consider the appropriateness of area and seasonal closures among other measures. Evaluation of the consequences of fishing with larger mesh sizes (within a range considered appropriate by ICES) is also requested.

Dates of meeting: 30 January to 1 February 2001
Venue: FRS Marine Laboratory, Victoria Road, Aberdeen.

Participants

Mike Armstrong	(UK, Northern Ireland; Chair)
Rick Officer	(Ireland)
Phil Kunzlik	(UK, Scotland)
Vladimir Vinnichenko	(Russia)
Nikolai Timoshenko	(Russia)

The meeting was also attended by Tore Jakobsen (Norway; ACFM Chair), Coby Needle (FRS, Scotland), Robin Cook (FRS, Scotland) and Dick Ferro (FRS, Scotland).

The following Working Documents were submitted to the meeting, and are appended to this report:

WD1. Vinnichenko, V.I., Gorchinskiy, K.V., Lisovsky, S.F., Khlivnoy, V.N., Gerber, E.M. The Russian haddock fishery (*Melanogrammus aeglefinus*) on Rockall Bank (Division VIb). 7pp.

WD2. Vinnichenko, V.I., Gorchinskiy, K.V., Khlivnoy, V.N., Timoshenko, N.M. Russian researches of haddock (*Melanogrammus aeglefinus L.*) on Rockall Bank. 26pp.

1 INTRODUCTION

1.1 Structure of the Report

This report is divided into two sections: the first dealing with spatial and temporal patterns in the fishery and stock of haddock on Rockall, the second with the consequences of fishing with different mesh sizes. Information was available from the three main countries presently exploiting haddock at Rockall: UK(Scotland), Russia and Ireland. Fishing activities by Russian vessels recommenced at Rockall in 1999 following the change in fisheries jurisdiction to include the southwestern region of Rockall in international waters.

The recent patterns in the fisheries are described in terms of officially reported landings and fishing effort by month, and where available, by ICES rectangle. Information on discarding was available for only a few Irish and Scottish trips and was considered inadequate for inclusion in any analyses. Data on Russian landings in 1999, and provisional figures for 2000, were available by month for the total area of the Russian fishery, which operated mainly within four ICES rectangles beyond the 200 mile EU EEZ at southwest Rockall. Information on distribution of juvenile and adult haddock was available only from the Scottish groundfish survey carried out annually in September, and from Russian surveys of SW Rockall carried out in March and August-September 2000. Catch-rates of adults in the surveys were specified as catches per hour for fish of 30cm and above. This length also corresponds to the minimum landing size for haddock in EU legislation.

The ability to make forecasts of catch and spawning biomass under a range of mesh-size scenarios was limited by the paucity of data on discards at Rockall. Hence, analyses were carried out using composite data from the Division VIa and Rockall stocks. Selection ogives were estimated for two fleet sectors with different mesh-size and net construction. Selection ogives from Russian mesh selection experiments were also used. Vectors of population numbers, partial fishing mortality and mean weight and length at age in landings were obtained from data files and assessment results from the June 2000 ICES assessment of the VIa and Rockall haddock stocks (ICES CM 2001/ACFM: 01). Short-term changes in yield and SSB, and in long-term yield per recruit (YPR) and spawning biomass per recruit (SPR) were computed for a range of mesh sizes and combination of mesh sizes.

1.1 State of stock

The ICES ACFM view is that the haddock stock in Division VIb (Rockall) is outside safe biological limits (ACFM Report: November 2000). Fishing mortality in 1999 (F = 0.52) was above the proposed precautionary fishing mortality (F_{pa}) of 0.40. Spawning stock biomass (SSB) has declined since 1996 to 7,000 t in 2000 and is now below the proposed precautionary biomass reference point (B_{pa}) of 9,000 t. Total international landings in 1999 were estimated at 5,400 t. Reported landings have been relatively stable since 1997. No explicit management objectives are set for this stock. The ICES recommendation in 2000 was for fishing mortality in 2001 to be reduced below the proposed F_{pa}. This corresponded to landings in 2001 of less than 2,700 t. The TAC covers ICES Sub-Area VI, with a limit on how much of the catch may be taken in Division VIa. No such limit is set for Division VIb within the TAC for Sub-Area VI. In addition, part of Division VIb now falls within international waters where non-EU vessels are not subject to TAC. This allows for an unregulated fishery in that area. It is difficult to make short-term forecasts of fishing mortality Rockall, as the activities of fleets in this area can be unpredictable depending on fishing opportunities elsewhere.

2 SPATIAL AND SEASONAL PATTERNS IN FISHING ACTIVITY AND HADDOCK STOCK

2.1 Development of fishing activities at Rockall

The sea area at Rockall within which fishing activities were recorded in 1998 to 2000 is shown in Figure 1.

Russian fleets

The first Russian (Soviet) scouting/research expeditions to the Rockall area were undertaken in 1958-1959, and made commercial catches of blue whiting, haddock, argentine and other species. Scouting/research investigations were repeated in June 1966. In the latter period, catches consisted mostly of blue whiting, argentine and ling. Haddock was caught in small quantities.

Strong haddock year classes in 1968 and 1972 provided the basis for a directed haddock fishery from 1972 to 1976. The fishery was carried out in the area 56-58°N and 13°30' to 15°00'W, mainly at depths of 140-250 m. Dense concentrations of haddock were frequently observed over hard bottom (corals, rocks), where bottom trawl fishing was hampered or impossible.

In 1972 the fishing season at Rockall started late in April. During the first ten days of May the average catch rate of haddock was 25.2 t live weight per vessel per day. The haddock concentrations then dispersed and the fishing fleet left the area. In August the haddock fishery was more successful, with catch rates of about 39 t per vessel day. In 1972 the total catch at Rockall was 8,800 t, of which haddock comprised 7,300 t.

In 1973 fishing operations at Rockall were carried out for a short period around the middle of April before the haddock concentrations were dispersed. Average catch rate was 6 t per vessel day. Total catch was 3,400 t, including 3,300 t haddock.

In 1974 the fishery took place from August to December. The catches were stable and catch rates were 34 -50 t per vessel day. Haddock made up 48,900 t of a total catch of 50,200 t.

The Russian haddock fishery peaked in 1975 with a catch of 49,800 t. The fishery took place in March-April and August-September. The fishing was stopped in September because of large by-catches of small haddock.

In 1976 the fishing took place in July–October on mixed concentrations of haddock, saithe and cod. The total catch of 45,300 t included 40,700 t haddock.

During 1977-1998 Russian fishing operations on the Rockall Bank were not carried out because of the introduction of 200-mile exclusive economic zones.

In 1999 the Russian trawl fleet was fishing in international waters at south-west Rockall. Fishing operations started with one vessel during 26 May - 24 June. Most of the catch was small redfish *(Sebastes viviparus)* and haddock. From late July to the middle of August, two trawlers were fishing on mixed concentrations of small redfish, haddock and blue whiting. From the middle of August to October one or two vessels operated at Rockall. The catches were dominated by grey gurnard, and haddock were caught only in small numbers. The catch of haddock taken by Russian vessels at Rockall in 1999 was 458 t, representing only 3.6 % of the total Russian catch of all species from the area.

In 2000 the Russian fleet continued to trawl in international waters at south-west Rockall. Fishing operations started with one vessel in late March, and in April one to four trawlers were fishing. Along with haddock, blue whiting made up an important share (up to 50 %) of the catches. By the middle of April catch rates were declining, but four to seven trawlers were fishing until June. In July, five to ten vessels were operating and at the beginning of the month took mixed catches of small redfish, haddock and blue whiting. At the end of the month grey gurnard dominated the catches, attaining a share of 80-100 %. This species continued to dominate the catches during the rest of the year.

Total catch of haddock by Russian trawlers from Rockall in 2000 was 1,811 t (provisional figures), corresponding to 3 % of the total Russian catch of all species from the area.

UK fleets

The Scottish haddock fishery at Rockall commenced in the early 1980s. Until the early 1990s, the fishery was opportunistic and targeted occasional strong year classes of haddock in relatively shallow water in the northern region of Rockall. The dominant fishing gear was single-vessel otter trawl and the fishery was considered a mid to late-summer operation in waters less than 200m deep. With the adoption of restrictive TACs in the early 1990s, some vessels began targeting monkfish and megrim as well as haddock at Rockall. During 1994 to1996, two designs of trawl net were used at Rockall, both constructed with heavy rock-hopper ground gear. Some vessels fished so-called scraper trawls with long wings, low headline and short tapered body panels to target monkfish and megrim, whereas haddock was targeted using so-called hopper trawls with short wings, high headline and long tapered body panels. From 1996 onwards many of the vessels fishing at Rockall were replaced by new, more powerful ones. Because of the success of the twin rig for monkfish and megrim, the new vessels entering the fleet were also being rigged for twin trawling. By 1999, the twin-rig trawl had become the main fishing method at Rockall. Trawl nets used during this period combined the design characteristics of both scraper and hopper nets to enable haddock, monkfish and megrim to be targeted at the same time. Double 6mm twine was used in the cod-end construction. The current minimum mesh size in the fishery is 100mm stretched-mesh.

In 1997, a few vessels began developing the haddock fishery in deeper water to the west of Rockall, at depths between 200m and 400m. This fishery is believed to operate below the 200m isobath in ICES rectangles 43D5, 44D5 and 42D4. In 1998 and 1999, more vessels joined this late spring to early summer fishery, indicating a substantial shift in effort both seasonally and spatially. Anecdotal evidence from the fishery is that high catch rates were obtained in 1997 and 1998. The catch rates then declined but were still good in 1999. However, catch rates in 2000 were reported to be poor in the deeper water. Further anecdotal evidence is that increased discarding has been associated with the deeper-water fishery compared to the more traditional fishery at northern Rockall. The average fish size is reported to be smaller in the deeper water, even though fish aggregating at this time may well include spawning fish.

Irish fleets

Otter trawlers from Killybegs, and Greencastle have traditionally carried out the Irish haddock fishery at Rockall. This is generally a mixed fishery targeting haddock, megrim and monkfish. Irish vessels are now exploiting this stock on a more regular basis and take about 19% of the reported European landings of haddock from Rockall. The fishery is extremely important to the larger whitefish vessels operating out of Killybegs and Greencastle in County Donegal. In 1999, Ireland took about 1,020 t of the total reported international landings of Rockall haddock of 5,400t. This represented an increase of 316 t from the landings reported in 1998. Irish landings of Rockall haddock appear to have been relatively stable since 1997. There have been substantial changes in targeting practices in the fishery in recent years. In 1999, peak landings of both the Irish and Scottish fleets were recorded in April from deeper water to the west of Rockall. The fishery, which in earlier years took place almost exclusively in summer, now takes place throughout the year.

Between 10 and 14 Irish vessels participated in the fishery between 1997 and 2000. Twin-rig otter trawlers using rock-hopper ground gear now take the bulk of the catch. A few vessels use high-opening, single rock-hopper nets. The most common cod-end mesh size is 100 mm. The recent addition of new, larger vessels to the Irish fleet has increased the ability of Ireland to participate in the fishery.

2.2 Seasonal patterns of fishing

Data on monthly total catch and catch per unit of effort of Russian trawlers were available for 1999-2000. Monthly landings and landings per unit of effort were available for the Irish fleet in 1998 – 2000. UK (Scotland) provided only landings data by month for 1998 – 2000, as not all Scottish vessels record fishing effort. All data for 2000 are provisional.

The Russian fishery in 1999 (Table 2.1) lasted from May to November. Most of the catch and effort was from June to October with a peak in August. Catch rates, however, were highest from May to August, declining markedly in the rest of the season.

The Russian fishery in 2000 (Table 2.2) lasted from March to December. The effort was lowest in March and December and highest from August to September. The catches, however, were highest from April to July, peaking in April. Catches were very low between August and December (only 3 t out of a total of 1811 t). Consequently, catch rates were also highest from March to July, although they declined markedly after April.

The Scottish fishery in 1998-2000 (Table 2.3) was conducted throughout the year. Landings were lowest in the period December to February. Peak landings were reported in April, May in August.

The Irish fishery in 1998-2000 (Table 2.4) was conducted throughout most of the year. Catch and effort were generally highest between May and August. In 1998 and 1999 catch rates show peaks in April and July, the former clearly the highest. The corresponding peaks seem to have occurred in May and August in 2000, but the highest values occurred in January and February. Relatively high catch rates were also reported towards the end of the year.

The drop in Russian catches and catch rates after August is not reflected in the other fleets, but the Russian fleet operates in international waters and is therefore more restricted. There was a shift in the fishing strategy of Russian vessels midway through the season. The target species changed from haddock, redfish and blue whiting to grey gurnard. However, there also seemed to be reduced abundance of haddock in the area on the southwestern part of the bank where the Russian fleet was fishing.

Both the Irish and the Scottish fishery indicate a peak in availability in April/May, possibly connected with spawning aggregations, and another less marked peak in July/August.

Spatial patterns of fishing

Data on the spatial distribution of catches, by ICES rectangles and quarter (Tables 2.5-2.7), were available for 1999-2000 from Russia and for 1998-2000 from U.K. (Scotland) and Ireland. Data for 2000 are provisional. Russia also provided monthly maps of the distribution of catches (Figure 2.1). For the purposes of discussion, the "Bank" at Rockall is defined as the area shallower than 200m.

There are clear differences in the spatial distribution of the catches between the three fleets.

The Russian fishery was conducted in international waters at south-west Rockall. The Irish fishery also mostly took place on the Rockall Bank, but to a larger extent in the European waters farther northeast. The Scottish fishery had the widest distribution. Most of the landings by Scottish vessels were from the Bank. The fishing area extended further northeast and further west than the Irish fishery, with a higher proportion of the catches from depths greater than 200 m. Overall, the landings from the six rectangles covering virtually all of the area shallower than 200 m were 59% of the total for 1998-2000.

There were some differences in the spatial distribution of catches between seasons. The Russian fishery moved slightly to the southeast in the 3rd quarter. The Irish fishing area expanded in the 2nd quarter, was more restricted again in the 3rd quarter and moved towards northeast in the 3rd and 4th quarters. The Scottish fishery started more to the northeast than the other fisheries. In the 2nd quarter the spatial extent of the fishery expanded and the centre of activities moved southwest. In the 3rd and 4th quarter the fishery moved back northeast.

Over the period examined there was no clear trend in the spatial distribution in the Irish fishery. In the Scottish fishery, however, there was a tendency towards a more southwesterly distribution of the activity.

2.3 Size and age compositions of catches

2.3.1 Length and age compositions of Russian landings in 2000

Data were available from observers on board Russian vessels at Rockall in March, April and June 2000 (Fig. 2.2), and represent all haddock caught. The vessels sampled fished with cod-end meshes ranging from 40mm to 100mm stretched mesh (mainly 70mm). The 70mm and 100mm mesh nets retained haddock down to 25-26cm, with modal length around 30-31 cm in spring and 32-34cm in June. The net with 40mm cod-end retained haddock down to around 22cm, with modal length 28cm. Age compositions were available only for April 2000 and are given below as percentage by number:

2.3.2 Length and age compositions of Scottish landings in 1998 and 1999

No data were available for discards. Scottish landings rarely included fish below the minimum legal size of 30 cm. The length distribution of Scottish landings was similar in the first quarters of 1998 and 1999 (Fig. 2.3). Age compositions are shown in Table 2.8 and show considerable variation from quarter to quarter, and between years.

2.3.3 Length and age compositions of Irish landings in 1998 and 1999

Insufficient data were available to examine length composition of discards. The length distribution of Irish landings was much broader than the Scottish length distribution despite the use of 100mm mesh cod-ends in both fleets, and indicates differences in discarding practices. Quarterly age compositions are shown in Table 2.9.

2.4 Spatial patterns of distribution from survey data

2.4.1 Scottish groundfish survey

A groundfish survey of Rockall is carried out by UK(Scotland) in autumn. The survey was annual up to 1997 and was carried out using the old R.V. Scotia deploying an Aberdeen 48-foot trawl fitted with a fine-mesh cover on the cod-end. Subsequent surveys are every two years, and are carried out using a GOV trawl with ground-gear deployed from the new R.V. Scotia. Most stations are within the 200m depth contour (Fig. 2.5). During 1999, some additional stations were fished in deeper water to the west of the Bank. Catch rates of haddock are shown in Figures 2.5 and 2.6 as fish less than 30cm in length, and 30cm and longer. A cut-off point of 30cm was chosen as this approximately separates mature fish of three years and older from younger, immature fish, and also corresponds to the EU minimum landing size for haddock. The highest catch rates of haddock <30cm were on the shallowest regions of the Bank at NE Rockall (Figure 2.5). Very high catch rates up to 16,500 fish per hour were recorded, comprising mainly fish of the 1999 year-class. The highest catch rates of adult haddock were also towards the northern part of Rockall, but farther west than the area of highest juvenile concentrations (Figure 2.6). Very few haddock were caught at the deep-water stations to the west of Rockall. This was surprising in view of anecdotal evidence for heavy discarding of small haddock by vessels extending their range into deeper water. It is possible that there are localised high densities of haddock in deep-water areas not covered by the survey, or that there is a movement of haddock into deeper water at other times of year. The survey may not provide an accurate picture of the full distribution of haddock at Rockall throughout the year.

2.4.2 Russian groundfish survey

A Russian survey of SW Rockall was carried out in spring and autumn 2000. The surveys were carried out at random stations using a bottom trawl with 25m ground-rope and 20mm cod-end mesh. The opening shape of the trawl was rectangular with 17m width and 6m height. Data on catch-rates per station were available only for the autumn survey. The spring survey data were available only as species and sample length compositions. The data from the autumn survey are shown in Figures 2.7 and 2.8 as numbers of haddock caught per tow in the length categories <30cm and 30cm+. Tow duration was mostly half an hour. The highest concentrations of haddock <30cm in autumn were recorded in the shallower regions of the survey area, at depths of around 200m or less (Fig. 2.7). Juvenile haddock of recent year classes appeared comparatively abundant in the survey area. Adult haddock were located in two patches, one at the northwest boundary of the survey area, and the other in deeper water in the southwest region (Fig. 2.8).

Hauls made in the deeper regions of the survey area in autumn tended to have the lowest contribution of haddock by weight (Fig. 2.9). During spring, hauls made between the 200m and 500m isobaths at south-west Rockall had large quantities of haddock relative to other species (Fig. 2.10). It is not clear if this represents a movement of haddock into deeper water in spring. The share of haddock and red-fish in the survey catches in spring and autumn was higher than recorded in Russian surveys in the 1960s and 1970s, whilst the relative contribution of argentine has decreased. Much of the haddock was found on coral grounds, which are difficult to trawl. The total area covered by coral appears to have increased in comparison with the 1970s, and some locations where the seabed was suitable for trawling have now become colonised by corals.

Both spring and autumn surveys demonstrated full sexually maturity of haddock (males and females) by 25cm total length (see WD2). Half of specimens investigated were mature by length 22cm.

3 ANALYSIS OF SHORT AND MEDIUM-TERM EFFECT OF CHANGES IN MESH SIZE ON HADDOCK CATCHES AND SSB

3.1 Theoretical selectivity curves of gears used at Rockall

Experimental work in Scotland over the period 1992–1998 has led to the formulation of a general model of haddock selectivity (Ferro and Graham 1998), the components of which are as follows. Building on this work, the length at which 50% of haddock will be retained by a given gear configuration can be expressed as:

$$L_{50} = NF \times LF \times PF \times (13.55 + 0.3343\, MS - 0.1193\, MR - 1.576\, TD), \qquad (1)$$

where

$$\text{Nylon factor } NF = \begin{cases} 1.2 & \text{if nylon twine is used} \\ 1.0 & \text{if polyethylene twine is used} \end{cases}$$

$$\text{Lifting - bag factor } LF = \begin{cases} 0.895 & \text{if a lifting bag is used} \\ 1.0 & \text{if a lifting bag is not used} \end{cases}$$

Panel factor $PF = 1.0$ for analyses discussed here

MS = wedge - measured mesh size in mm = $1.04 \times$ ICES mesh size

MR = number of meshes around the circumference of the codend

TD = nominal twine diameter = $1.13 \times$ actual twine diameter

Model settings for typical current Scottish and Russian (Working Document 1) vessels are given in Table 3.1. The Scottish settings can also be applied to Irish vessels as a first approximation.

Observed selection ogives for haddock caught with Russian gear types with measured inside-mesh of 82.4 and 107.7 mm were presented by Vinnichenko *et al* (Working Document 2). These ogives were obtained from covered-codend experiments carried out by Russia in spring 1972 on the shelf to the east of Rockall. Figure 3.1 compares these empirical results with theoretical ogives derived from the application of the Scottish model of selection (Equation 1) to typical gear types in current use by Scottish and Russian vessels, while Table 3.2 gives modelled values of L_{50} for each of these analyses. Note that the model used assumes that selection range is fixed at 5 cm: there is no statistical evidence that selection range is affected by codend design (Ferro and Graham 1998). Both survey and theoretical results suggest that the Russian gear is considerably more selective for haddock than the Scottish equivalent, possibly due to the use of relatively thin nylon twine in cod-ends.

3.2 Mesh change simulations

The ICES assessment of the Rockall haddock stock is undertaken using landings-at-age data that are implicitly assumed to correspond to the true catch-at-age. However, it is known that in recent years at least, haddock have been discarded from European member State vessels fishing at Rockall, sometimes in considerable quantities. However, due to the relatively low probability of fishing trips to Rockall being selected for observation, insufficient data on rates of discarding of haddock by size or age were available for this meeting. Consequently, the necessary age distributions or length distributions of the Rockall catches required to evaluate the effects of changing gear selectivity were also unavailable. Information provided by other nations on catches in international waters at Rockall was also insufficient to permit an evaluation of the effects of changing fishing gear selectivity.

Due to these problems, two approaches were considered:

(i) examination of an earlier ICES evaluation of gear selectivity changes for haddock in both the North Sea and in ICES Division VIa;

(ii) evaluation of the potential effects of gear selectivity changes on a haddock stock adjacent to Rockall, for which a catch-at-age analysis and age distributions of landings and discards were available (*ie* haddock in Division VIa).

3.2.1 Previous ICES studies

The ICES Roundfish Working Group of 1990 (ICES CM 1991/Assess:4) had, as a term of reference, to assess the short term effects of an increase in the minimum mesh size to 100mm, 110mm and 120mm in the North Sea roundfish fishery taking into account all available information on the 1990 year classes. In fact, that working group broadened the scope of its activities to include Division VIa roundfish stocks as well, and to address other issues that also contribute to fishing gear selectivity, for example, the number of meshes around the circumference of the cod end. In doing so, the working group evaluated the short term catch and stock development for five mesh sizes (90, 100, 110, 120 and 130 mm) and three values for number of meshes around the codend (120, 100 and 75). The evaluation of 90mm mesh with 120 meshes around the codend was considered the baseline result, and gains or losses from other combinations were expressed relative to this. The analysis was highly fleet disaggregated, and used experimental selectivity data and models developed at the Aberdeen Marine Laboratory. The results for mesh sizes in excess of 100mm were based on extrapolation of the experimental results, which at that time were only available for meshes up to 100mm.

Fleet specific results are not available in the working group report of that meeting although summaries of the overall results are available. For haddock, these are presented in Tables 3.3 and 3.4. Medium term and long term results were not presented so it is not possible to draw inferences for the optimum mesh size and gear configuration. However, the analysis indicates the overall direction of short-term changes when varying the gear configuration, and these can be compared with the results presented in the following section.

3.2.2 The current fishery at Rockall and in Division VIa

Because insufficient data are available to evaluate the effects of changes in fishing gear selectivity at Rockall, a composite analysis has been undertaken that includes elements from the current fisheries at Rockall and in Division VIa. This sought to combine stock number and mortality estimates from Division VIa haddock with the biological characteristics of Rockall haddock (eg, weights-at-age and maturity ogive). The values used were taken from the inputs to prediction table from the 2000 meeting of the Northern Shelf assessment Working Group (ICES CM 2001/ACFM:01)

Similarities between the stocks are illustrated in Figure 3.2. Recruitment in the two stocks is positively correlated if an outlying value for the 1984 year-class is disregarded. The age compositions of the stocks in 2000 (Fig 3.2b), from the ICES assessment, will differ due to the absence of discards in the Rockall assessment, and the assumption of geometric mean recruitment in 1999 for the Rockall stock. The correlation in recruitment between the two regions suggests that the strong 1999 year-class estimated for VIa, which will strongly affect the short-term forecast for this region, could also be reflected in recruitment at Rockall. Mean weights at age in the landings are similar in VIa and Rockall up to age 3, but diverge from age 4 (Fig. 3.2c). The patterns of fishing mortality attributed to landings in both stocks are very similar over 1997-1999 (Fig. 3.2d).

For a given set of fishing gear characteristics, the population numbers and partial fishing mortality at age (landings and discards) from the most recent assessment of the haddock stock in Division VIa were used to generate short term catch and stock trajectories in numbers. As the most recent assessment using Extended Survivors Analysis gives numbers at age surviving to the start of 2000, any changes in mesh size were imposed from the start of that year. (It is emphasized that this exercise was carried out to illustrate the potential short-term effect of a change in mesh size in a haddock fishery with similar characteristics of that at Rockall, given a specified starting population, rather than to give an actual forecast.) Equilibrium ("per recruit") estimates were calculated using the VIa partial fishing mortality values assuming no changes in growth.

The mean weight-at-age of landed fish was taken from the Division VIb assessment because older haddock in this area are smaller than fish of the corresponding age in Division VIa. The mean weight-at-age of discarded fish was taken as the landings mean-weight-at-age from Division VIb multiplied by the ratio of the discard to landings mean weights-at-age from Division VIa. The weighted mean of landings and discard weights-at-age were used as stock weights-at-age and catch weights-at-age. The maturity ogive was taken from inputs to the Division VIb assessment. These biological characteristics were then applied to the catch in number and stock in number estimates from the catch forecasts to convert the outputs to yield and biomass estimates.

The mesh assessment method used here is an elaboration of an age-based mesh change analysis of the sort illustrated in, for example, Sparre, P., and Venema, S.C. (1992. Introduction to tropical fish stock assessment. Part 1 – manual. FAO Fisheries Technical Paper 306, Rev 1. 376 p.) The method was modified to account for fleet-specific partial fishing mortality values.

The raised, recent fishing mortality at each age from the Division VIa haddock assessment was partitioned between a nominal "European" 100mm mesh fleet and a nominal "International" 70mm fleet for carrying out the forecast. This was done arbitrarily on the basis of, *eg* a 80:20 split or 70:30 split (the sensitivity of the results to this choice was evaluated). (Whilst varying mesh sizes from 40mm to 100mm have been used by Russian vessels fishing haddock at Rockall, the majority of the vessels used 70mm mesh.) Partial F values for the European fleet were further partitioned between landings and discards on the basis of rates of discarding at age estimated from the Scottish discard sampling scheme in Division VIa. Such a split is also possible for the International fleet, but for this analysis it was assumed that all the catch of that fleet was retained. The partial Fs-at-age for the International fleet were further adjusted according to the relative values of the selection coefficient at age for 100mm mesh (using European selectivity values) and 70mm mesh (using the theoretical Russian selectivity values shown in Table 3.2). This was done to modify the exploitation pattern imposed on the International fleet to correspond to its current gear characteristics.

For the results presented here, only mesh size was varied in the simulations. Other important gear configuration parameters, for example, meshes around the circumference and cod-end twine diameter, were kept constant at values typical of the Scottish trawl fleet for the case of the European fleet. For the International fleet, the Scottish model of gear selectivity for haddock was used to calculate selectivity at age using gear characteristics typical of the Russian fleet. This means that for a given mesh size, the selectivity characteristics of the European and International fleets will differ considerably (see Table 3.2). It was further assumed that all vessels catching haddock are trawlers to which the applied selectivity values are appropriate.

Baseline calculations were made assuming a European 100mm mesh fleet and an International 70mm mesh fleet. Simulations were then undertaken that assumed both fleets changed to:

- 70mm mesh
- 100mm mesh
- 110mm mesh
- 120mm mesh

It must be borne in mind that although the mesh sizes changes were applied to both the European and the International fleets concurrently, for a given mesh size the selectivity of their respective fishing gears will differ markedly due to the different construction of the nets.

Results are illustrated as percentage changes in the expected landings and discards of the European fleet, the expected catch of the international fleets, total landings (European landings plus International catch), total discards (equal to European discards in this context) and spawning stock biomass. The percentage change was calculated as: [New Value x 100 /Baseline] – 100.

Simulation results for an initial split of partial fishing mortality at age of 70% European and 30% are presented in Figures 3.3 - 3.8. Changing the initial split of fishing mortality of the European 100mm and International 70mm fleet from 70:30 to 80:20 and 60:40 did not affect the results in terms of directions or patterns of change, only the magnitude of change was affected, and in general such changes were small.

Because of the deficiencies in the data required for these simulations, all results should be considered only as indicative of the direction of change likely as a result of the change in mesh size. The magnitude of these changes will be subject to considerable uncertainty.

Where gains or losses to yield are discussed, it is well known that they must be considered in the context of competing fleets. In isolation, an individual fleet may well be advantaged by increasing the selectivity of its fishing gear, and on that basis its expected yield would increase. However, due to technical interactions with other fleets, such an advantage may not accrue. Indeed, other fleets using less selective gear may be placed at a competitive advantage by the actions of an individual fleet improving its selection pattern. Similarly, if all fleets change their gear selectivity in some way, it does not follow that all fleets would be similarly advantaged. Some may experience gains whilst others may incur losses having been placed at a competitive disadvantage.

70mm mesh

Changing the mesh size of both fleets to 70mm gave short and long term increases in discarding in the European fleet (Figure 3.3). This is not unexpected and is offset by a decrease in the expected European landings, International catch and spawning stock biomass. The order of magnitude of changes after the first year is around 15%-20% and at equilibrium, around 20%-30%. Although this result is not meaningful in the sense that a 70mm mesh size for the European fleet is unrealistic, it does indicate a potential benefit in not fishing with that mesh size in the European fleet.

100mm mesh

Simulations in which both fleets used 100mm mesh gave increases in both landings and discards of the European fleet and spawning biomass, but considerable losses for the International fleet using more selective fishing gear (40%-50% losses in catch in the short term, and 40% at equilibrium). (Fig. 3.4)

A bigger difference was exhibited if empirical information on the selectivity of the International fleet provided by early Russian selectivity experiments is incorporated in the simulations. The results from this simulation are presented in Figure 3.5. Much more severe short and long term reductions in the International catch of the order of 60%-70% are indicated, along with positive enhancement of European landings (20%-40%) and a lesser increase in European discarding. The spawning stock biomass also shows positive change associated with this.

If the change to 100mm mesh was made using gear characteristics in the International fleet corresponding to those in the European fleet (i.e. as shown in the top panel of Figure 3.1), then only marginal changes occur. In this case the International fleet makes small gains to its catch whilst the European fleet and spawning biomass suffer small losses (Figure 3.6).

These three sets of results for a move to 100mm mesh size are given to provide an indication of the sensitivity of these results to the assumption of selectivity in the International fleet. The incorporation of Scottish selectivity parameters, theoretical Russian selectivity parameters or empirical Russian selectivity ogives in the simulations has major implications for interpreting the results.

110mm mesh

Changing the mesh size of both fleets to 110mm gave improved landings in the European fleet, and an increase in SSB, after a short transitional period (40 - 60% after the second year). However, there was a considerable reduction of 50 - 60% in the International catch after the second year (Fig. 3.7).

120mm mesh

Similar results to the 110mm simulation were found for increasing mesh size in both fleets to 120mm. Again, after a short transitional period, landings of the European fleet were significantly enhanced, as was the SSB. However, this was offset by considerable losses in the International fleet catch (Fig. 3.8).

References

Ferro, R. S. T. and G. N. Graham. (1998) Recent Scottish data on demersal fish selectivity. ICES CM 1998/OPEN:3 Poster.

Table 2.1 Monthly landings, fishing effort and catch per unit effort for Russian vessels fishing at Rockall (Division VIb) in 1999. Weights in metric tonnes, catches in live weight.

Month	Tonnage class of vessel	Quantity of fishing days	Quantity of fishing hours	Catch weight	Catch per fishing day	Catch per hour
May	10	6	84	24	4.0	0.29
June	10	25	346	139	5.6	0.40
July	10	12	219	47	3.9	0.22
August	10	58	844	209	3.6	0.25
September	10	22	230	2	0.09	0.01
October	10	30	309	35	1.2	0.11
November	10	7	95	2	0.3	0.02
Total		160	2127	458	2.9	0.22

Table 2.2 Monthly landings, fishing effort and catch per unit effort for Russian vessels fishing at Rockall (Division VIb) in 2000. Weights in metric tonnes, catches in live weight. Data are provisional.

Month	Tonnage class of vessel	Quantity of fishing days	Quantity of fishing hours	Catch weight	Catch per fishing day	Catch per hour
March	10	12	223	74.8	6.2	0.3
April	10	83	1238	599.9	7.2	0.5
	9	14	185	48.6	3.5	0.3
	10	31	477	124.9	4.0	0.3
May	9	26	487	98.2	3.8	0.2
	6	22	335	79.4	3.6	0.2
	10	28	440	117.2	4.2	0.3
June	9	55	958	180.4	3.3	0.2
	6	70	935	157.0	2.2	0.2
	10	83	1307	146.1	1.8	0.1
July	9	30	621	66.0	2.2	0.1
	6	85	1332	133.1	1.6	0.1
	10	218	2472	0.2	0.009	0.0004
August	6	62	556	0.5	0.008	0.0009
	9	38	635	1.6	0.04	0.003
	10	184	2541	0.5	0.003	0.0002
September	9	45	403	-	-	-
	6	41	393	-	-	-
	10	78	979	-	-	-
October	6	42	351	-	-	-
	9	51	428	-	-	-
	10	20	266	-	-	-
November	9	65	576	-	-	-
	6	20	224	-	-	-
December	9	15	110	0.5	0.03	0.005
	6	10	146	-	-	-
Total		1415	18425	1811.4		

Table 2.3 Landings in Scotland by UK vessels from haddock fishery on the Rockall bank, by month and year.

Month	Landings (landed weight, tonnes)		
	1998	1999	2000*
Jan	20	1	25
Feb	10	82	0
Mar	256	242	46
April	307	809	521
May	519	689	377
June	310	447	328
July	507	239	177
Aug	553	262	310
Sept	392	208	109
Oct	144	137	152
Nov	161	88	33
Dec	61	36	7
Total	3240	3239	2083

*Data are provisional.

Table 2.4 Monthly fishing effort, landings of haddock, and landings per unit effort reported by Irish vessels fishing at Rockall between 1998 and 2000. Data are hours fished and tonnes liveweight. Data for 2000 are provisional.

Year	Month	Effort (h)	Landings (t)	LPUE (kg/h)
1998	January	220	17.2	78.1
	February	290	21.3	73.3
	March	427	20.2	47.4
	April	293	55.3	188.6
	May	754	112.4	149.0
	June	1241	101.4	81.7
	July	924	127.3	137.7
	August	896	97.2	108.4
	September	792	50.0	63.1
	October	385	13.8	35.9
	November	267	6.7	25.1
	December	0	0	
	1998 Total	6489	622.7	96.0
1999	January	215	3.7	17.3
	February	167	8.5	51.1
	March	188	19.0	100.9
	April	484	165.5	341.9
	May	1362	225.2	165.4
	June	1789	100.0	55.9
	July	1929	299.0	155.0
	August	1256	115.8	92.2
	September	405	15.4	38.1
	October	255	14.0	54.9
	November	0	0	
	December	0	0	
	1999 Total	8050	966.2	120.0
2000	January	350	50.7	144.7
	February	217	22.1	101.6
	March	102	3.9	38.5
	April	604	46.4	76.8
	May	1444	121.9	84.4
	June	1071	80.4	75.1
	July	1078	64.1	59.5
	August	644	58.4	90.7
	September	389	32.5	83.7
	October	291.5	12.4	42.5
	November	539.5	45.7	84.7
	December	112	8.2	73.2
	2000 Total	6842	546.8	79.9

Table 2.5 Reported landings of haddock by Russian vessels fishing at Rockall in 1999 and 2000, by quarter and ICES rectangle. Tonnes liveweight. Data for 2000 are provisional.

1999 Q1

	D2	D3	D4	D5	D6	D7
48						
47						
46						
45						
44						
43						
42						
41						
40						
39						

2000 Q1

	D2	D3	D4	D5	D6	D7
48						
47						
46						
45						
44						
43				4		
42			31	24		
41			14	1		
40						
39						

1999 Q2

	D2	D3	D4	D5	D6	D7
48						
47						
46						
45						
44						
43				27		
42			4	125		
41						
40						
39						

2000 Q2

	D2	D3	D4	D5	D6	D7
48						
47						
46						
45						
44						
43			4	227		
42			458	594		
41			109	13		
40						
39			1			

1999 Q3

	D2	D3	D4	D5	D6	D7
48						
47						
46						
45						
44						
43						
42			48	96		
41			55	65		
40			3			
39						

2000 Q3

	D2	D3	D4	D5	D6	D7
48						
47						
46						
45						
44						
43				34		
42			23	188		
41			33	50		
40			1			
39						

1999 Q4

	D2	D3	D4	D5	D6	D7
48						
47						
46						
45						
44						
43						
42						
41				23		
40			10	2		
39						

2000 Q4

	D2	D3	D4	D5	D6	D7
48						
47						
46						
45						
44						
43						
42						
41			1			
40						
39						

Table 2.6 Reported Scottish landings of haddock from Rockall, by ICES rectangle and quarter, 1998-2000 (2000 data are provisional). Tonnes landed weight.

1998 Q1

	D2	D3	D4	D5	D6	D7
48			3			69
47				3		30
46						103
45						10
44				24	13	19
43				11	1	
42						0
41						
40						
39						

1999 Q1

	D2	D3	D4	D5	D6	D7
48						22
47						17
46						102
45					9	
44			1	8	59	32
43					51	1
42					24	
41						
40						
39						

2000 Q1

	D2	D3	D4	D5	D6	D7
48						
47						
46						8
45		4			3	
44				0	31	10
43				8	4	
42						
41		1		1		
40						
39						

1998 Q2

	D2	D3	D4	D5	D6	D7
48						58
47						
46				2	6	116
45				40	25	42
44				238	178	34
43				140	123	7
42				109	1	
41			17		0	
40						
39						

1999 Q2

	D2	D3	D4	D5	D6	D7
48						50
47			17			71
46					4	211
45				27	25	54
44				76	187	61
43			5	81	207	56
42	7		191	291	34	26
41			88	139	29	
40				10		
39						

2000 Q2

	D2	D3	D4	D5	D6	D7
48						19
47				2		
46					12	
45				0	12	
44			17	64	161	4
43		4	9	132	184	46
42		3	109	210	63	1
41			102	65	2	5
40						
39						

1998 Q3

	D2	D3	D4	D5	D6	D7
48						26
47				33		30
46		1			27	353
45					26	68
44				25	292	169
43				33	177	9
42			52	42	3	
41			68	21		
40						
39						

1999 Q3

	D2	D3	D4	D5	D6	D7
48						66
47						41
46					1	95
45					47	25
44				23	96	90
43			0	16	140	14
42				6	36	8
41				5	0	
40						
39						

2000 Q3

	D2	D3	D4	D5	D6	D7
48						8
47					0	
46					4	
45				18	37	
44				8	175	23
43				48	90	11
42			2	34	96	19
41		0	2	16	0	4
40						
39						

1998 Q4

	D2	D3	D4	D5	D6	D7
48						
47						41
46					2	65
45					1	21
44				15	74	30
43					91	0
42					18	
41					8	
40						
39						

1999 Q4

	D2	D3	D4	D5	D6	D7
48						9
47			5		3	
46						17
45					31	
44				3	46	20
43			1	3	26	
42					76	
41				8		
40						
39				11		

2000 Q4

	D2	D3	D4	D5	D6	D7
48						
47						
46				2		0
45				10	22	0
44				23	25	19
43				10	26	
42				4	47	
41		0		4		
40						
39						

Table 2.7 Reported Irish landings of haddock from Rockall, by ICES rectangle and quarter, 1998-2000 (2000 data are provisional). Tonnes liveweight.

1998 Q1

	D2	D3	D4	D5	D6	D7
48						
47						
46						
45						
44					27	
43				12	11	
42				8	1	
41						
40						
39						

1999 Q1

	D2	D3	D4	D5	D6	D7
48						
47						
46						
45						
44					10	
43					8	
42					13	
41						
40						
39						

2000 Q1

	D2	D3	D4	D5	D6	D7
48						
47						
46						
45						
44				14	37	
43				9	6	
42				11		
41						
40						
39						

1998 Q2

	D2	D3	D4	D5	D6	D7
48						
47						
46						
45						
44				17	2	
43				97	57	
42				73		
41				20		
40				3		
39						

1999 Q2

	D2	D3	D4	D5	D6	D7
48						
47						
46						
45					0	
44			14	5	24	
43			6	38	54	
42			124	175	6	
41			14	31		
40						
39						

2000 Q2

	D2	D3	D4	D5	D6	D7
48						
47						
46						
45						
44				6	22	
43			8	44	73	
42			38	36	10	
41				5	7	
40						
39						

1998 Q3

	D2	D3	D4	D5	D6	D7
48						
47						
46					0	
45						
44					23	
43				58	87	0
42				107		0
41						
40						
39						

1999 Q3

	D2	D3	D4	D5	D6	D7
48						
47						
46						
45					1	
44				2	154	
43			31	101	18	
42			25	83		0
41			18			
40						
39						

2000 Q3

	D2	D3	D4	D5	D6	D7
48						
47						
46						
45						
44					94	
43				24	28	
42				7	2	
41						
40						
39						

1998 Q4

	D2	D3	D4	D5	D6	D7
48						
47						
46					1	
45						
44					12	
43				1	7	0
42						
41						0
40						
39						

1999 Q4

	D2	D3	D4	D5	D6	D7
48						
47						
46						
45						
44					11	
43				3	1	
42						
41						
40						
39						

2000 Q4

	D2	D3	D4	D5	D6	D7
48						
47						
46						
45						
44					31	
43				1	32	
42				2		
41					0	
40						
39						

Table 2.8 Quarterly landings at age by Scottish vessels fishing at Rockall in 1998 and 1999. Data are estimated numbers landed by the fleet, in thousands of fish.

	1998				1999			
Age	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Quarter 1	Quarter 2	Quarter 3	Q4
1	0	0	0	0	0	0	0	0
2	24	74	0	0	0	89	199	148
3	174	641	444	99	70	739	287	115
4	64	327	556	124	85	689	208	87
5	87	385	873	195	74	596	140	38
6	140	555	936	209	135	1027	44	14
7	27	174	444	99	141	1129	144	18
8	11	50	233	52	34	336	37	5
9+	1	3	5	1	0	26	57	7

Table 2.9 Quarterly landings at age by Irish vessels fishing at Rockall in 1998 and 1999. Data are estimated numbers landed by the fleet, in thousands of fish.

	1998				1999			
Age	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Quarter 1	Quarter 2	Quarter 3	Q4
1	0	0	0	3	0	0	12	7
2	22	89	119	20	7	16	257	14
3	47	155	69	9	29	326	272	5
4	19	57	57	4	14	293	161	3
5	8	71	92	1	3	209	25	1
6	6	80	135	1	6	261	38	1
7	3	32	29	2	3	168	34	0
8	2	3	1	1	2	21	4	0
9+	1	2	0	0	1	0	1	0

Table 3.1 Model settings used to generate theoretical selection ogives for representative Scottish and Russian gear types.

	Scottish		Russian	
NF	1.00	Non-nylon twine	1.20	Nylon twine
LF	0.895	Lifting bag	1.00	No lifting bag
PF	1.00	No panel	1.00	No panel
MS	70, 100, 120		70, 100, 120	
MR	100		100	
TD	6		3.1	

Table 3.2 Theoretically-derived values of L_{50} for representative Scottish and Russian gear types. The model used is discussed in detail by Ferro and Graham (1998).

Mesh size (mm)	Scottish L_{50} (cm)	Russian L_{50} (cm)
70	13.9	24.2
100	22.9	36.2
120	28.9	44.2

Table 3.3 Short term effects of varying gear parameters on haddock catch and spawning stock biomass for the North Sea. Baseline results are for 90mm mesh size and 120 meshes around the cod-end. Results are expressed as percentage change relative to baseline. Simulations commenced assuming population numbers as of 1 January 1990, and results are expressed for catches in 1991 and spawning biomass at 1 January 1992.

North Sea haddock

Human consumption landings

No.	Mesh Size				
Meshes	90	100	110	120	130
120	Baseline	0	0	-2	-9
100	0	0	-2	-10	-24
75	0	-3	-12	-29	-47

Discards

No.	Mesh Size				
Meshes	90	100	110	120	130
120	Baseline	-15	-40	-65	-81
100	-14	-39	-65	-82	-91
75	-39	-67	-84	-91	-94

Industrial by-catch

No.	Mesh Size				
Meshes	90	100	110	120	130
120	Baseline	5	2	4	5
100	1	2	4	5	7
75	0	4	6	8	9

Spawning biomass

No.	Mesh Size				
Meshes	90	100	110	120	130
120	Baseline	2	6	11	17
100	2	6	11	18	24
75	6	12	19	26	32

Table 3.4 Short term effects of varying gear parameters on haddock catch and spawning stock biomass for Division VIa. Baseline results are for 90mm mesh size and 120 meshes around the cod-end. Results are expressed as percentage change relative to baseline. Simulations commenced assuming population numbers as of 1 January 1990, and results are expressed for catches in 1991 and spawning biomass at 1 January 1992.

Division VIa haddock

Human consumption landings

No.	Mesh Size				
Meshes	90	100	110	120	130
120	Baseline	0	0	-2	-9
100	0	0	-3	-10	-22
75	0	-3	-13	-26	-40

Discards

No.	Mesh Size				
Meshes	90	100	110	120	130
120	Baseline	-16	-41	-65	-80
100	-14	-41	-66	-82	-89
75	-41	-69	-84	-90	-92

Spawning biomass

No.	Mesh Size				
Meshes	90	100	110	120	130
120	Baseline	6	15	25	33
100	5	15	26	35	41
75	15	27	36	43	48

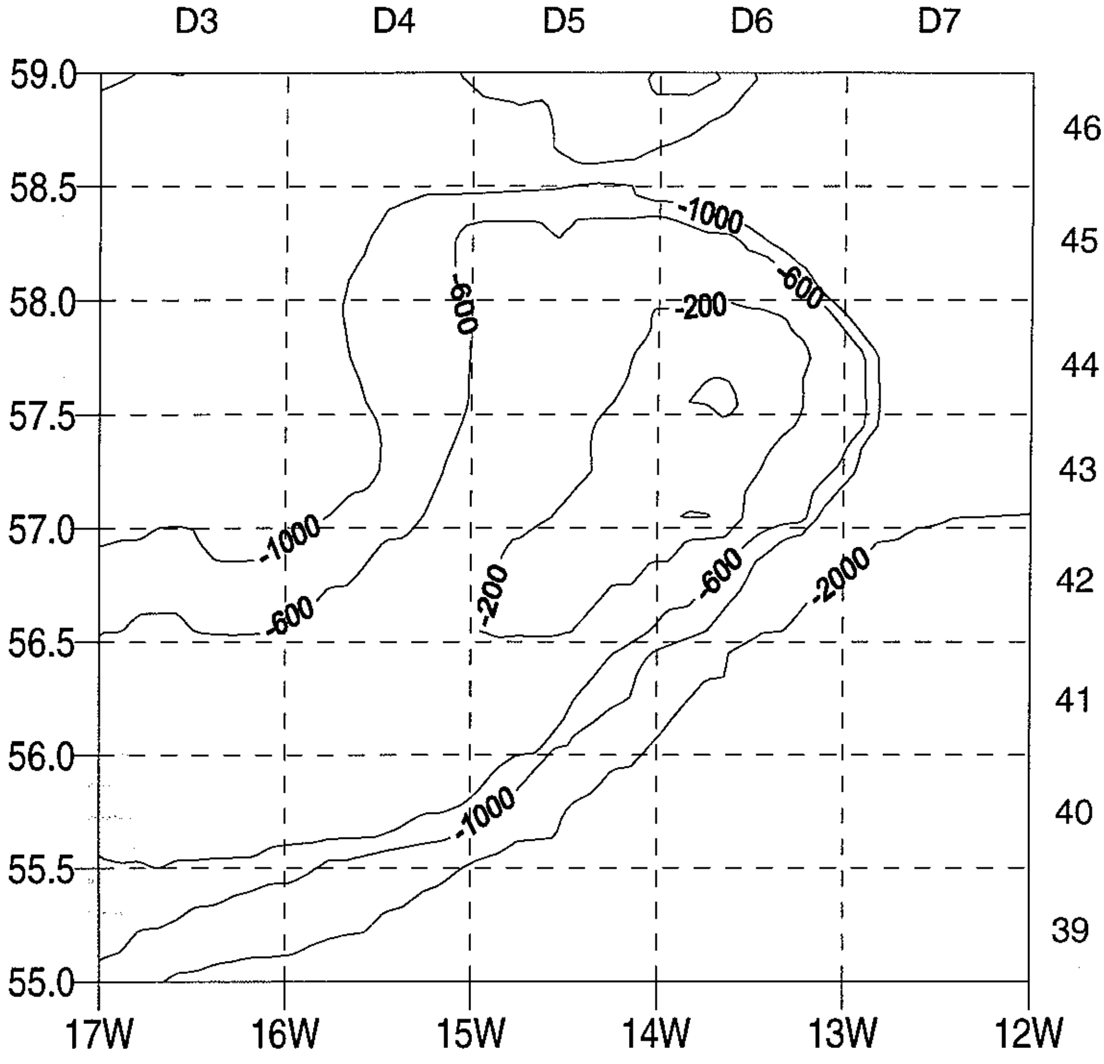
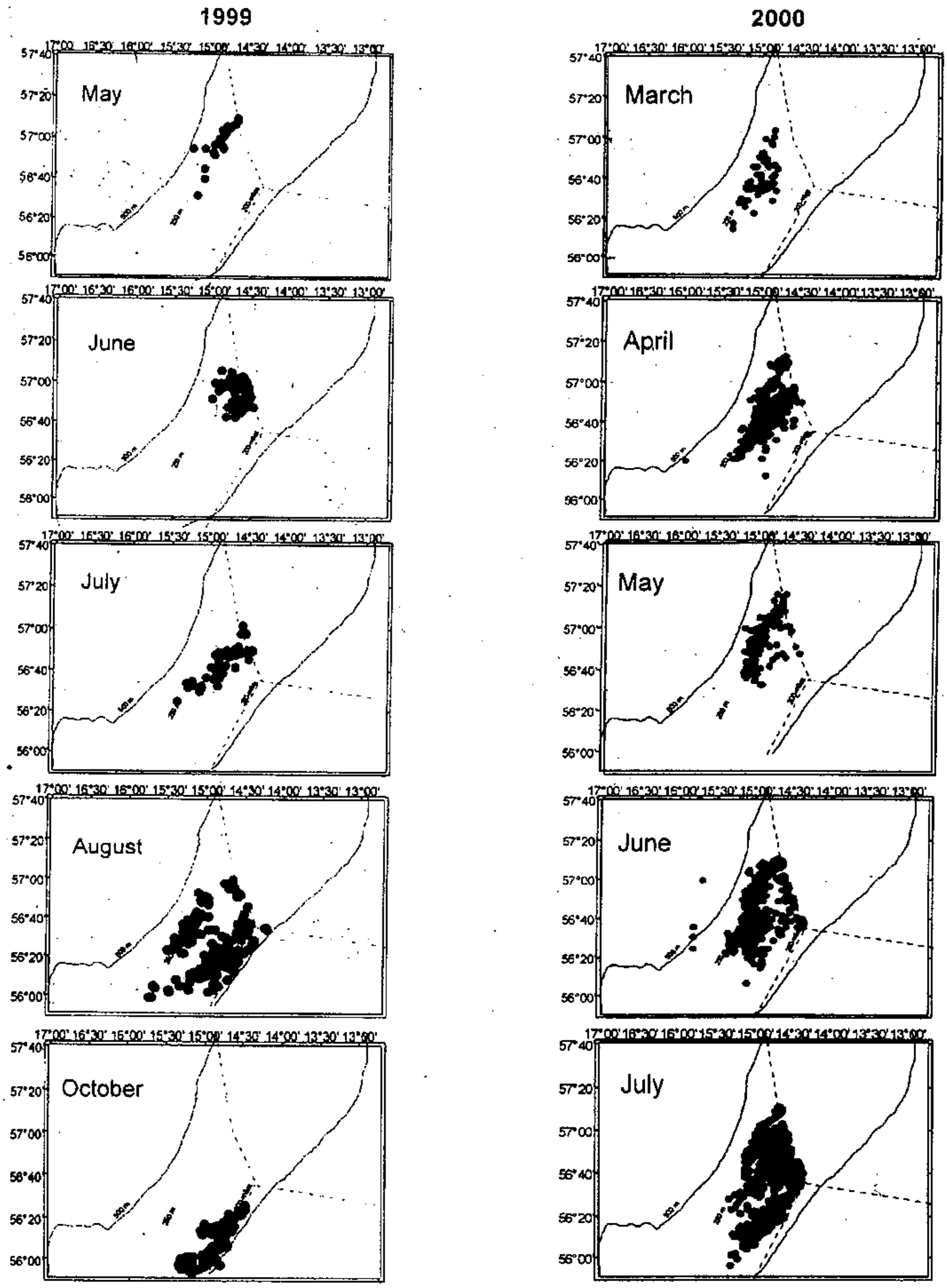


Figure 1 Map of the Rockall area showing ICES rectangles and depth contours (m).



Haddock catch distribution in 1999-2000

Figure 2.1 Daily reported positions of Russian vessels fishing at Rockall in 1999 and 2000, only for vessels which caught haddock during each day.

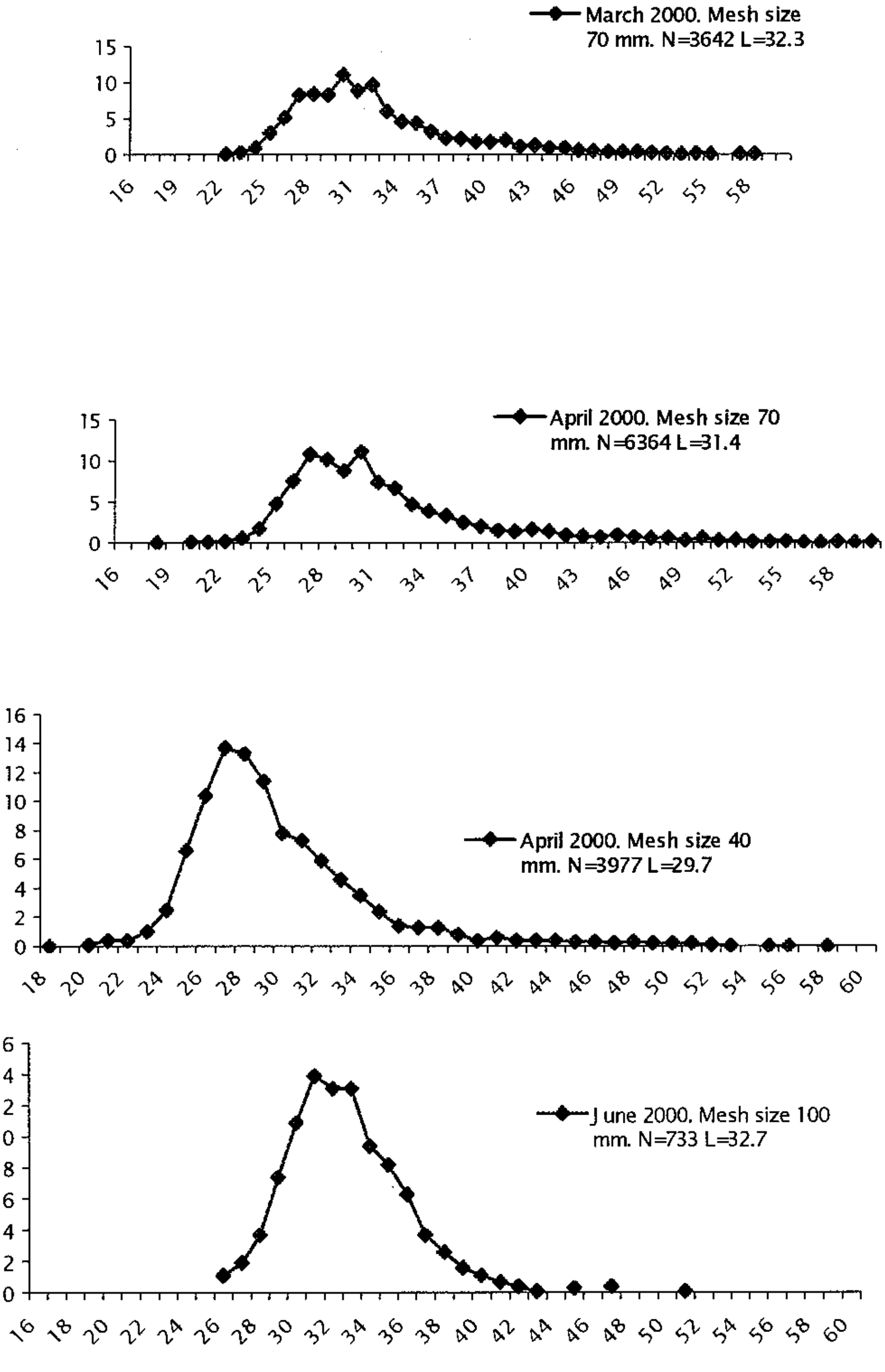


Figure 2.2 Total catch length frequencies of haddock recorded by observers on Russian trawlers at Rockall during March to June 2000, for trips using different mesh sizes. Data are for samples, not raised to total catches for sampled trips. Lengths in cm; y-axis gives % composition.

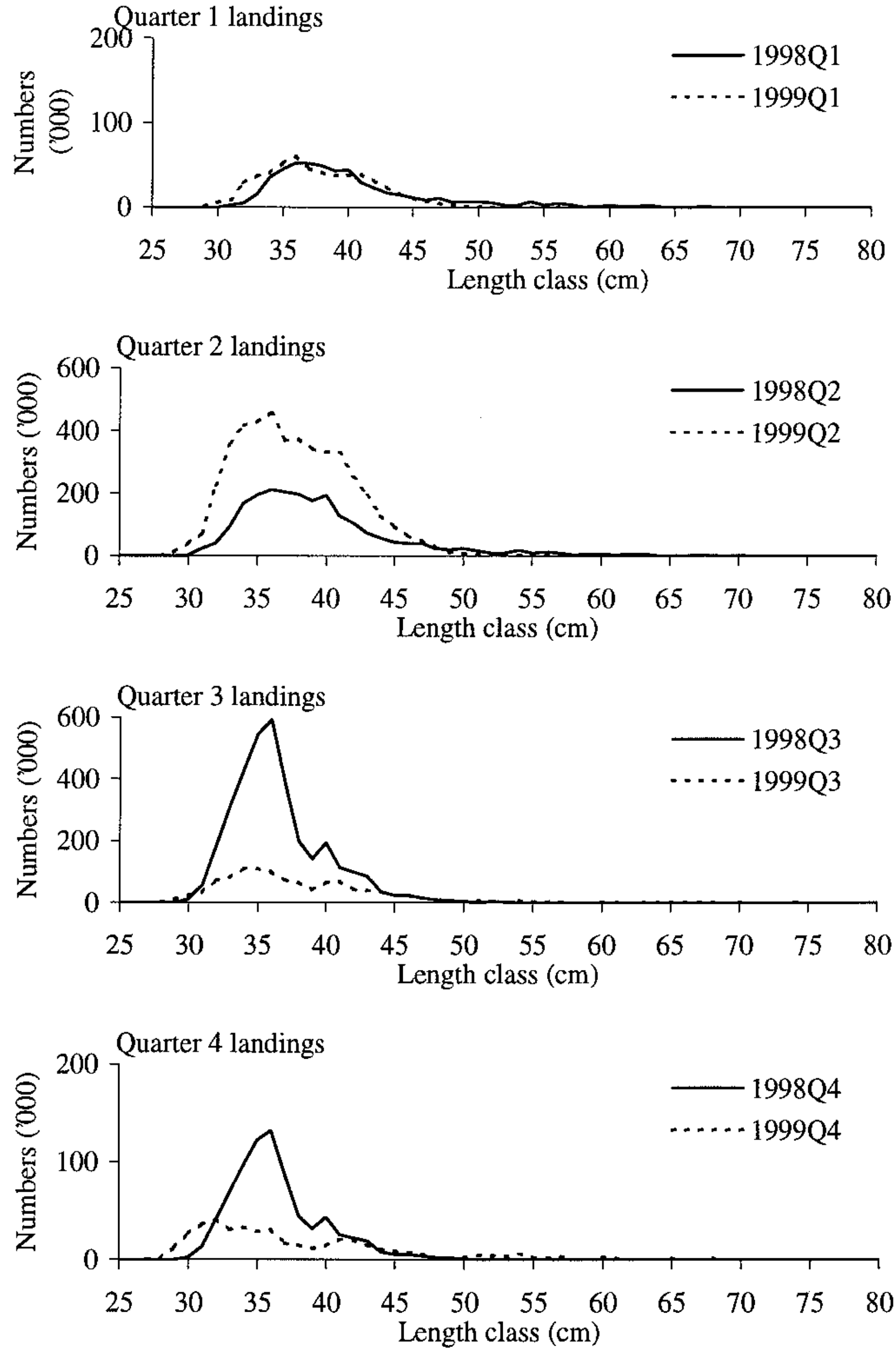


Figure 2.3 Quarterly length frequencies of haddock landed by Scottish vessels fishing at Rockall in 1998 and 1999. Data are sample numbers raised to fleet landings.

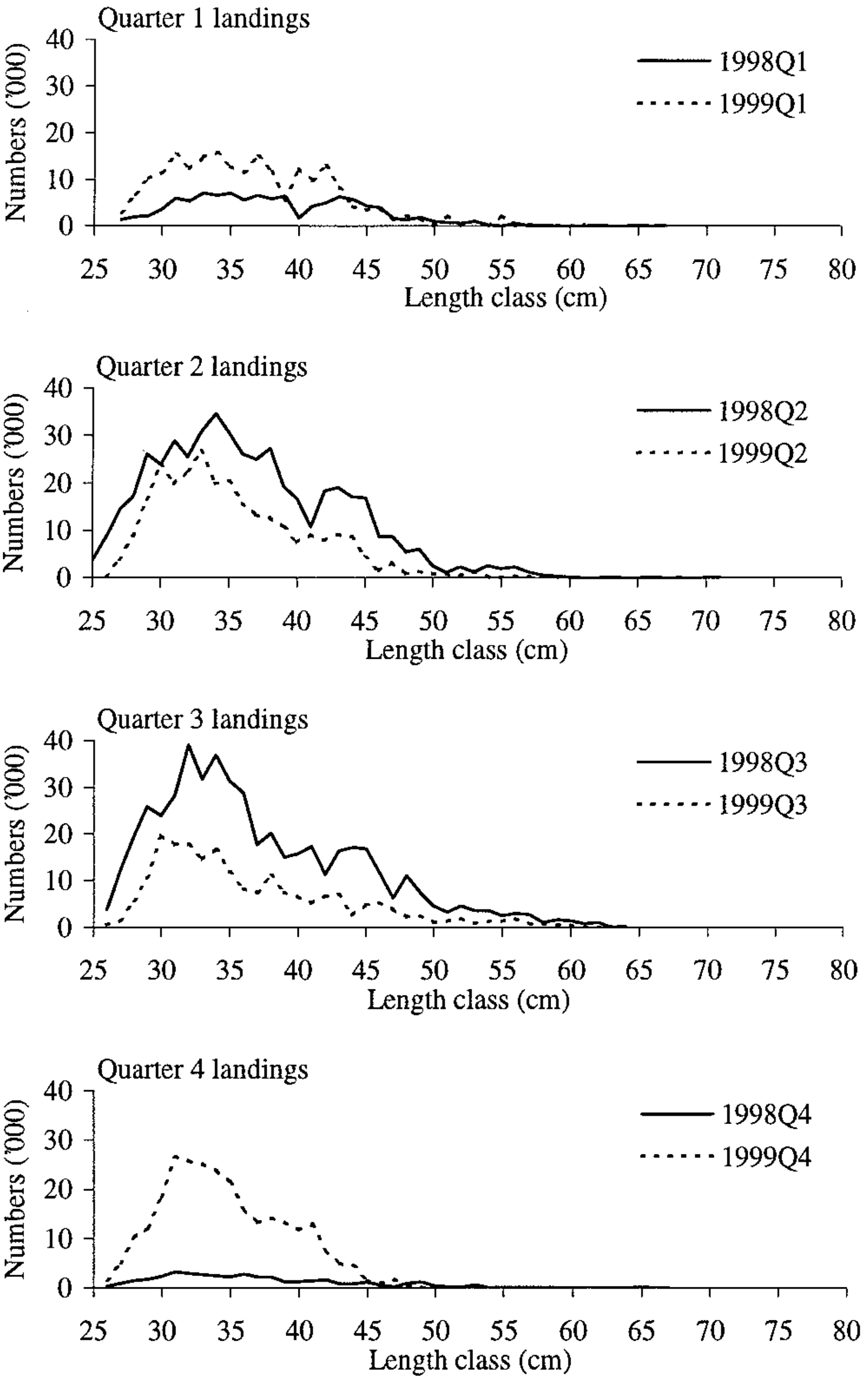


Figure 2.4 Quarterly length frequencies of haddock landed by Irish vessels fishing at Rockall in 1998 and 1999. Data are sample numbers raised to fleet landings.

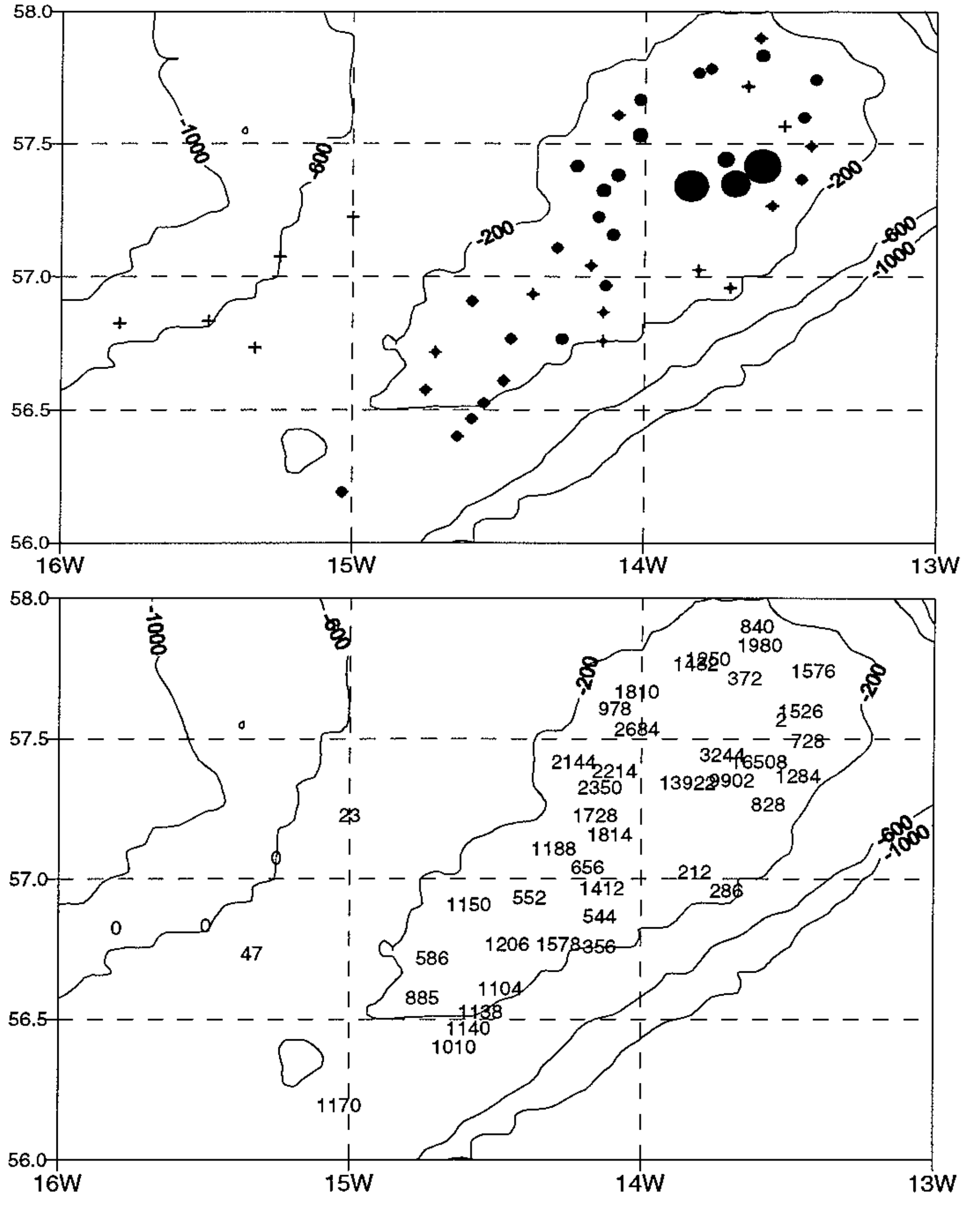


Figure 2.5 Catch rates of haddock < 30 cm long during the Scottish groundfish survey of Rockall in September 1999. Top Panel: Sizes of elipses proportional to square root of numbers of fish caught per hour (maximum catch rate 16,508 fish per hour). Bottom panel: Numbers per hour.

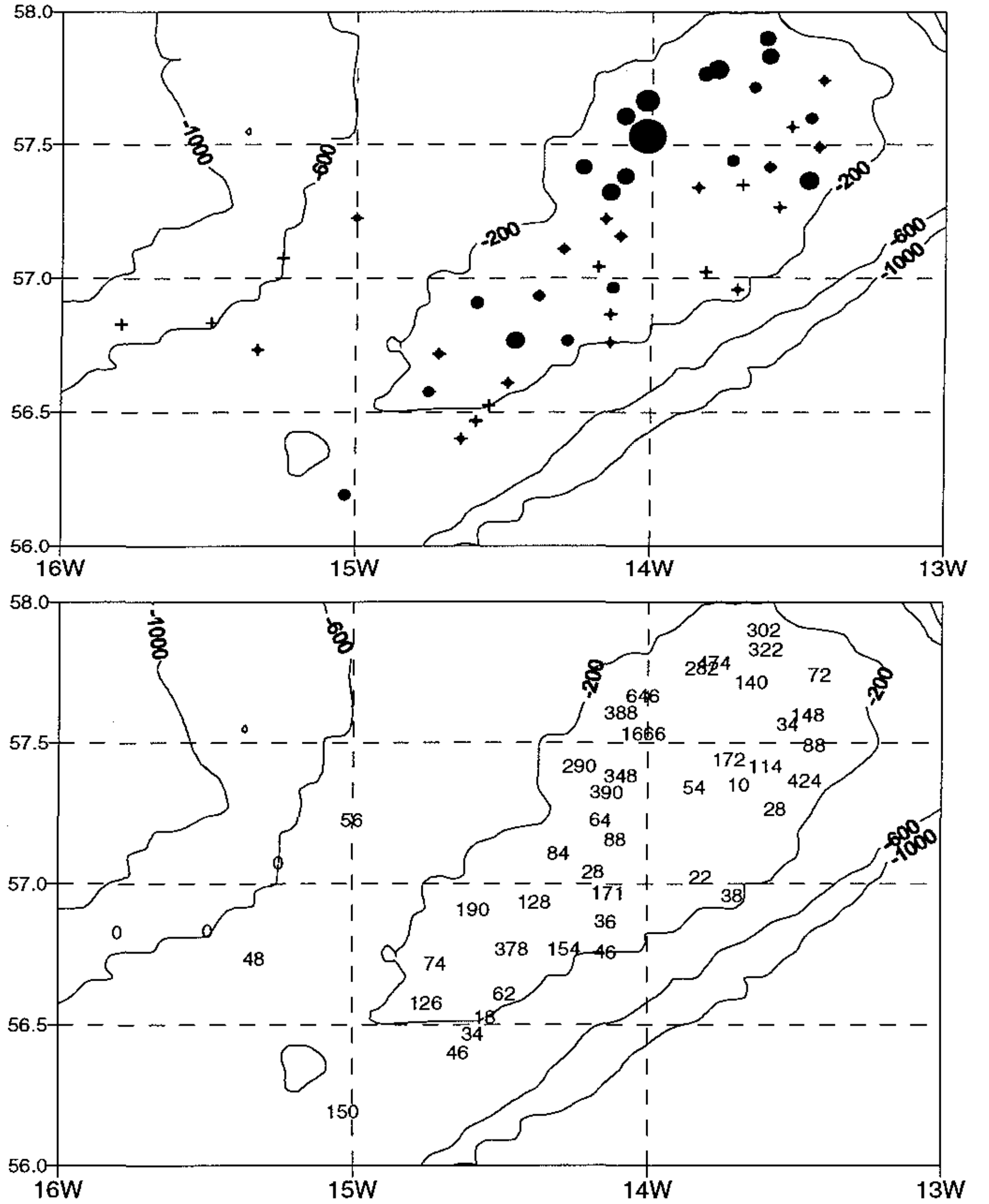


Figure 2.6 Catch rates of haddock < 30 cm long during the Scottish groundfish survey of Rockall in September 1999. Top Panel: Sizes of elipses proportional to square root of numbers of fish caught per hour (maximum catch rate 1,666 fish per hour). Bottom panel: Numbers per hour.

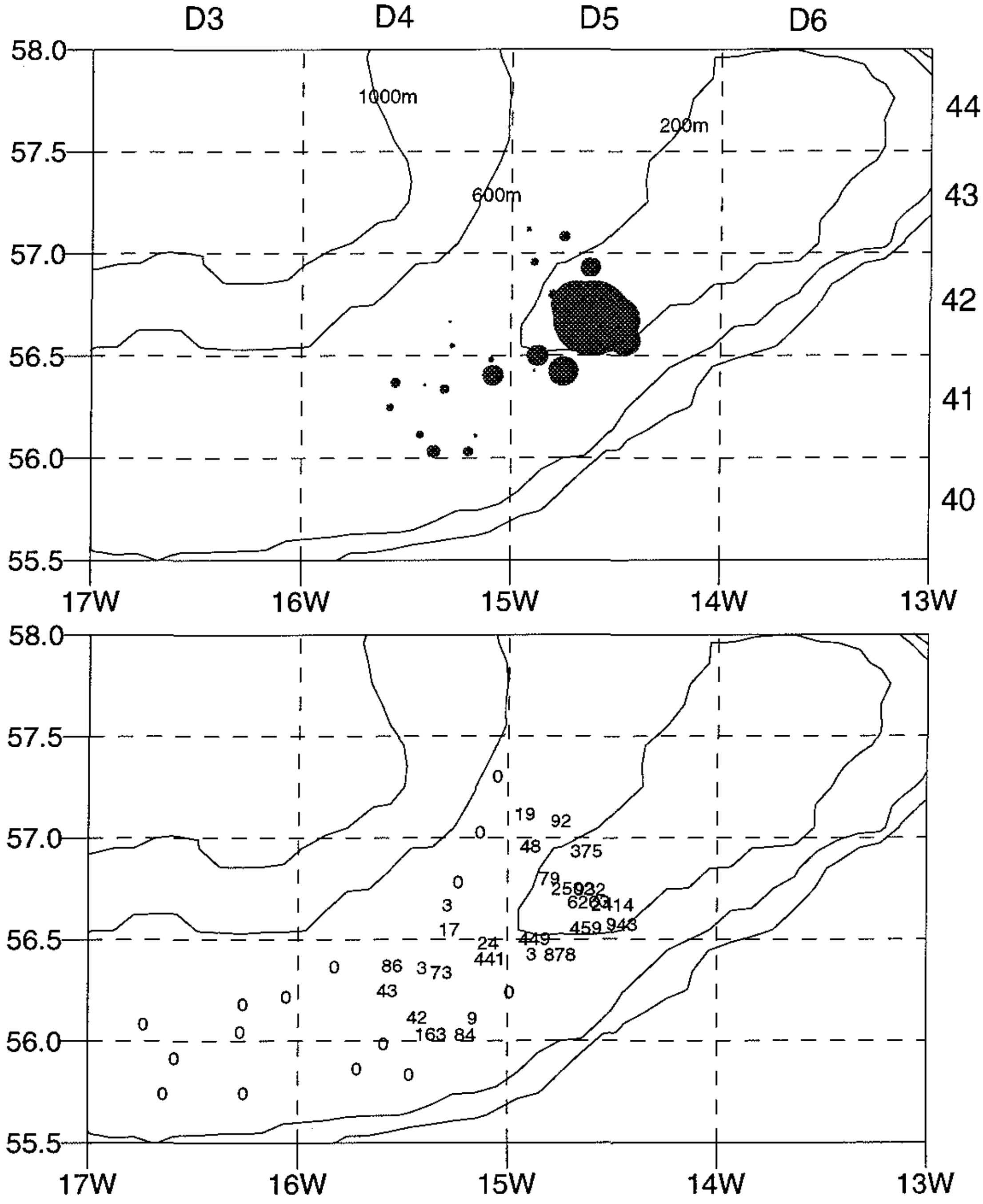


Figure 2.7 Catch rates of haddock < 30 cm in the Russian groundfish survey of SW Rockall in August-September 2000. Top Panel: Sizes of elipses proportional to square root of catch rate (maximum 6,263 fish). Bottom panel: Numbers caught per tow. Tows are mainly of half hour duration.

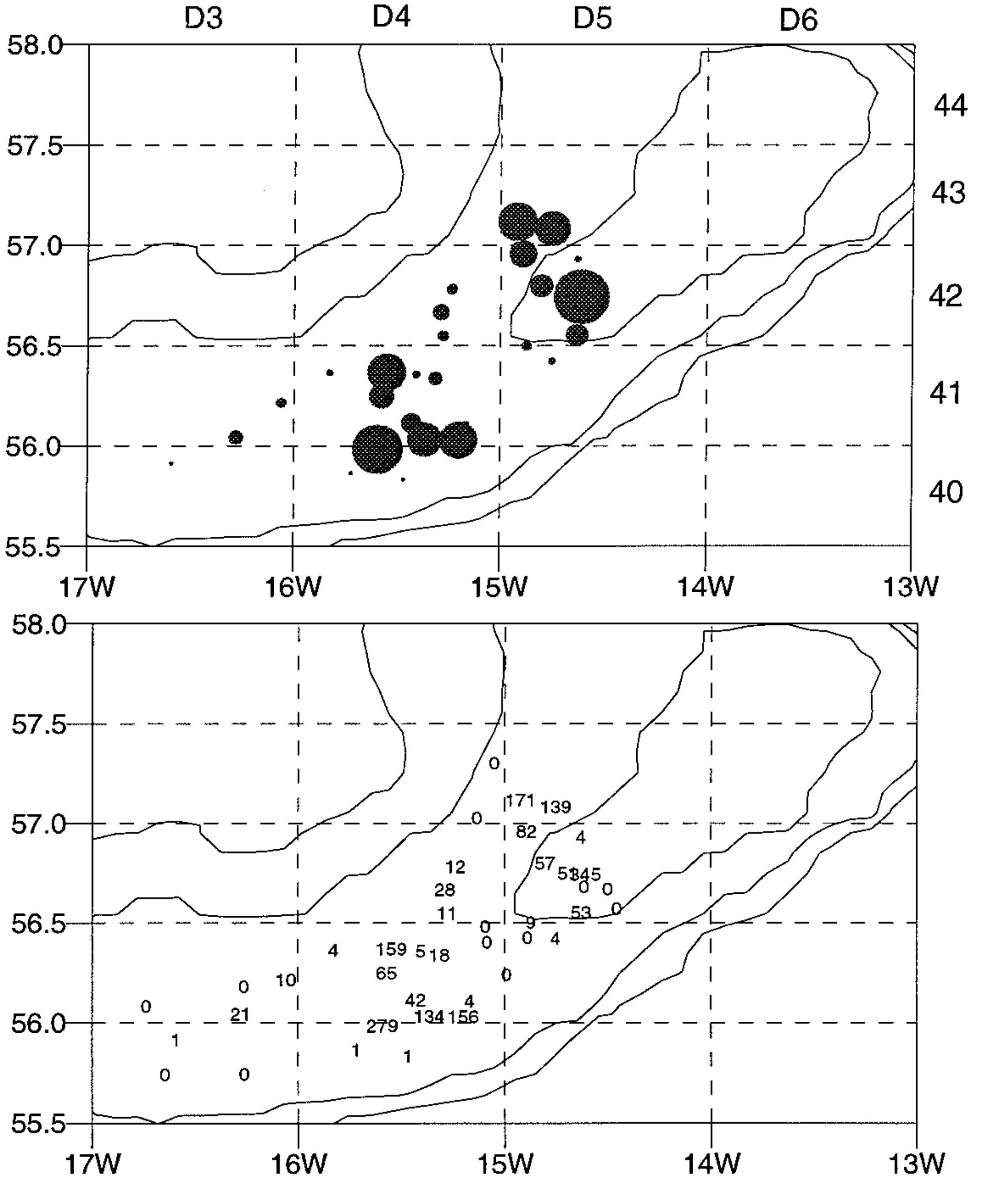


Figure 2.8 Catch rates of haddock < 30 cm in the Russian groundfish survey of SW Rockall in August-September 2000. Top Panel: Sizes of elipses proportional to square root of catch rate (maximum 354 fish). Bottom panel: Numbers caught per tow. Tows are mainly of half hour duration.

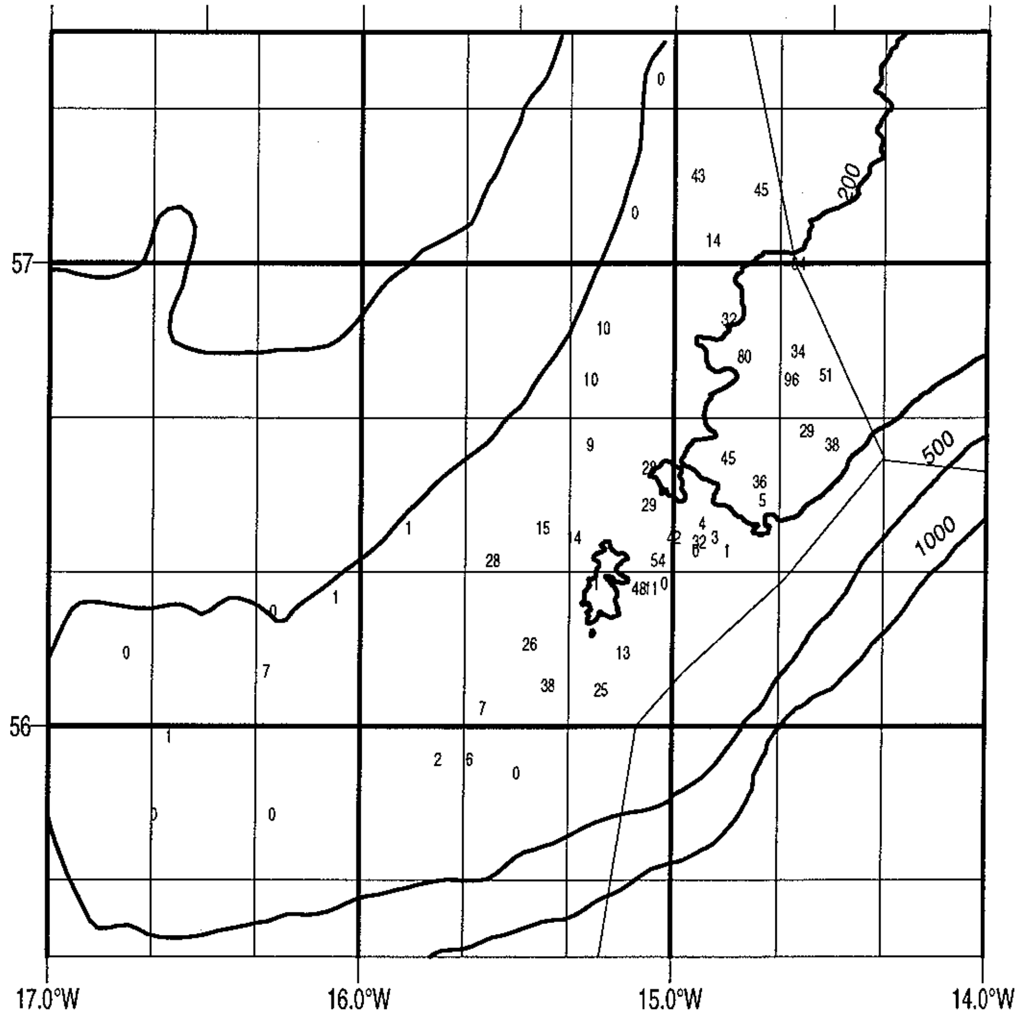


Figure 2.9 Percentage of catch comprising haddock, by weight, in the Russian groundfish survey of SW Rockall in autumn 2000 by station.

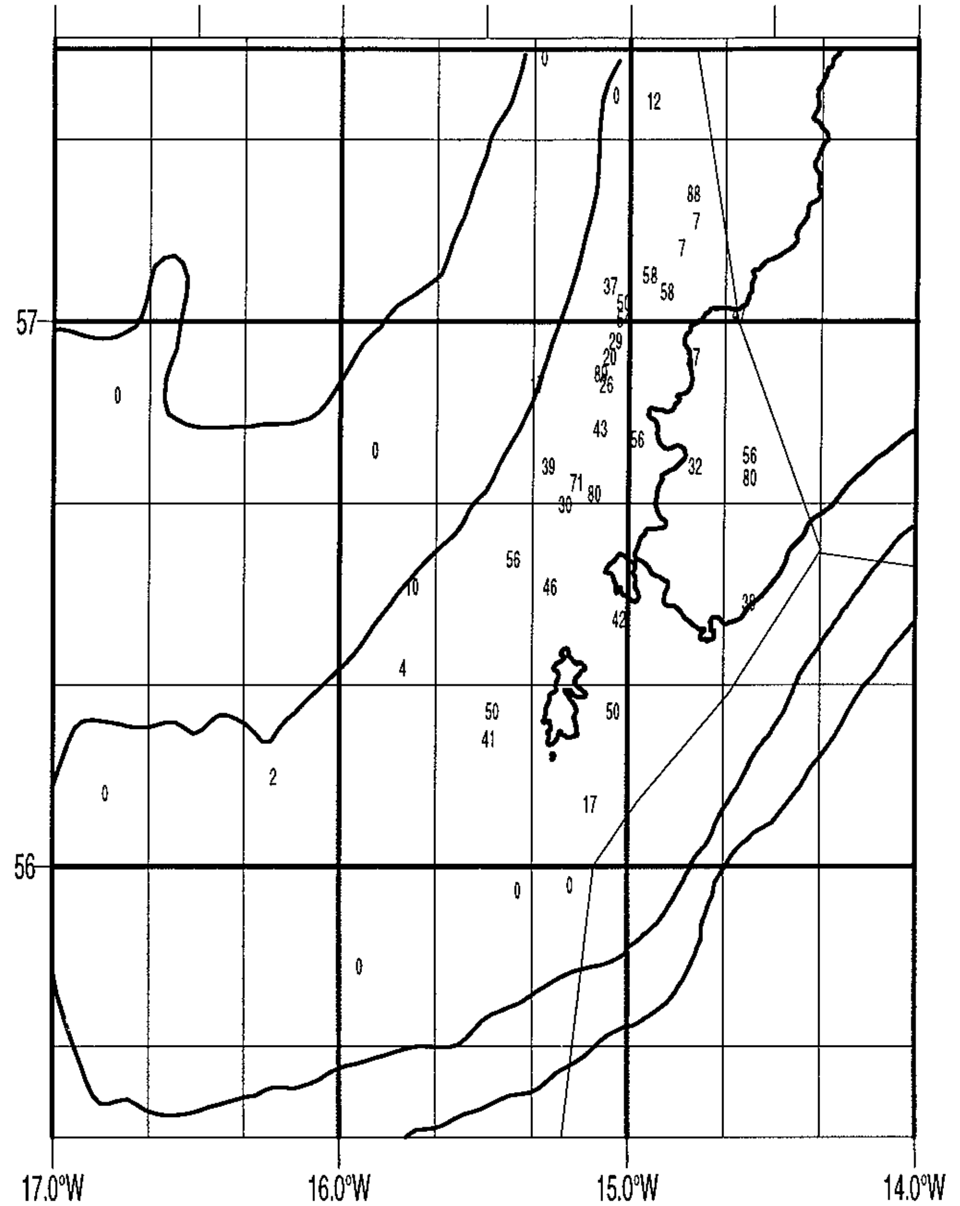


Figure 2.10 Percentage of catch comprising haddock, by weight, in the Russian groundfish survey of SW Rockall in spring 2000 by station.

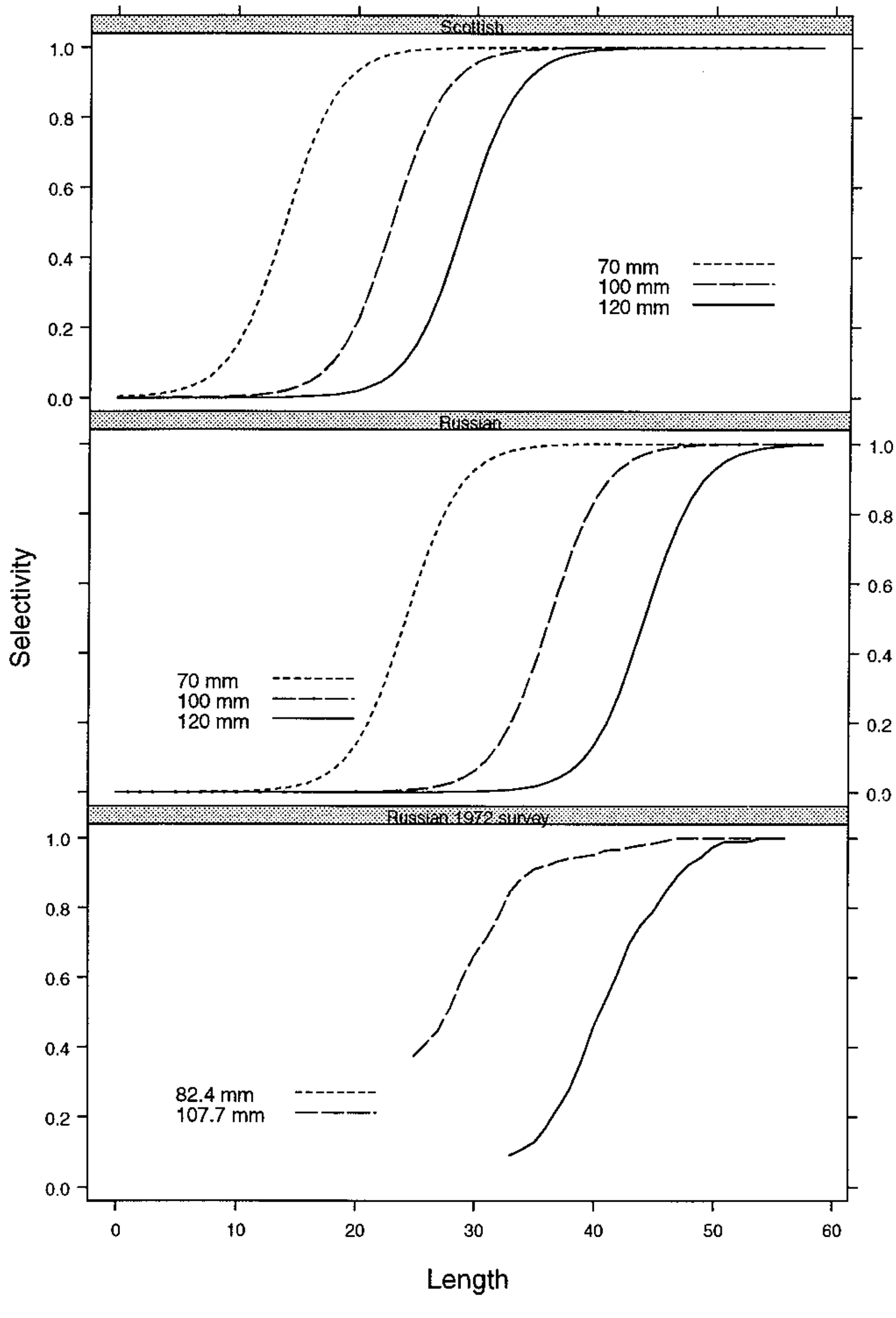


Figure 3.1 Comparison of theoretical haddock selection ogives, for typical Scottish and Russian gear types, and selection estimates obtained from a 1972 Russian survey (Working Document 2).

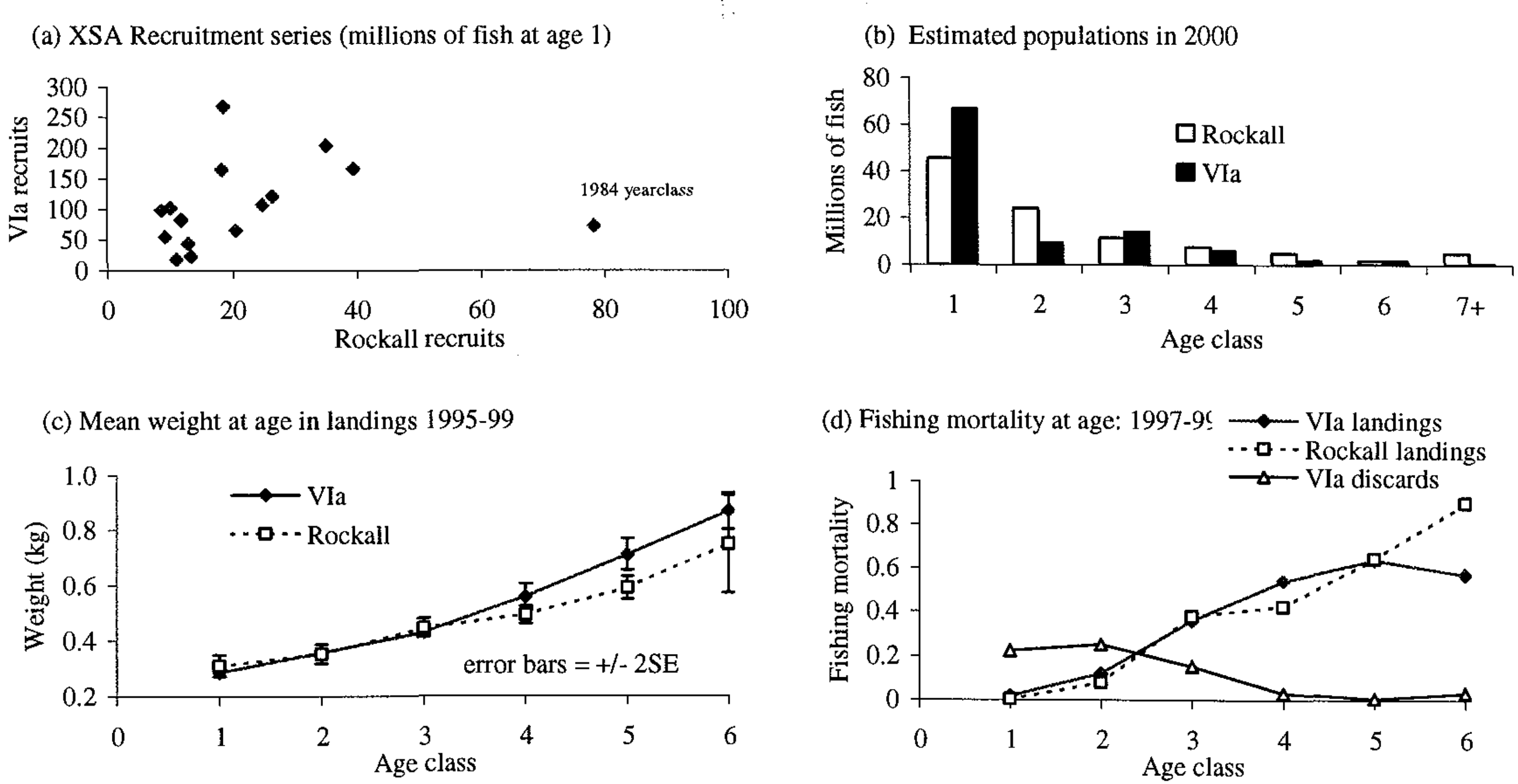


Figure 3.2 Comparison between recruitment, XSA population numbers in 2000, weight at age in landings and fishing mortality at age between Rockall and Area VIa haddock. Source ICES CM 2001/ACFM:1.
Note that the XSA population numbers for young Rockall haddock are under-estimated as no discards are included, and that the number of Rockall haddock at age 1 in 2000 is the geometric mean value.

"European" Fleet initially allocated	70	% of F
"International" Fleet initially allocated	30	% of F

"European" Fleet OLD mesh =	100	mm
"International" Fleet OLD mesh =	70	mm

Change to: 70 mm mesh in European fleet, according to Scottish selectivity results
Change to: 70 mm mesh in International fleet, according to Russian selectivity results

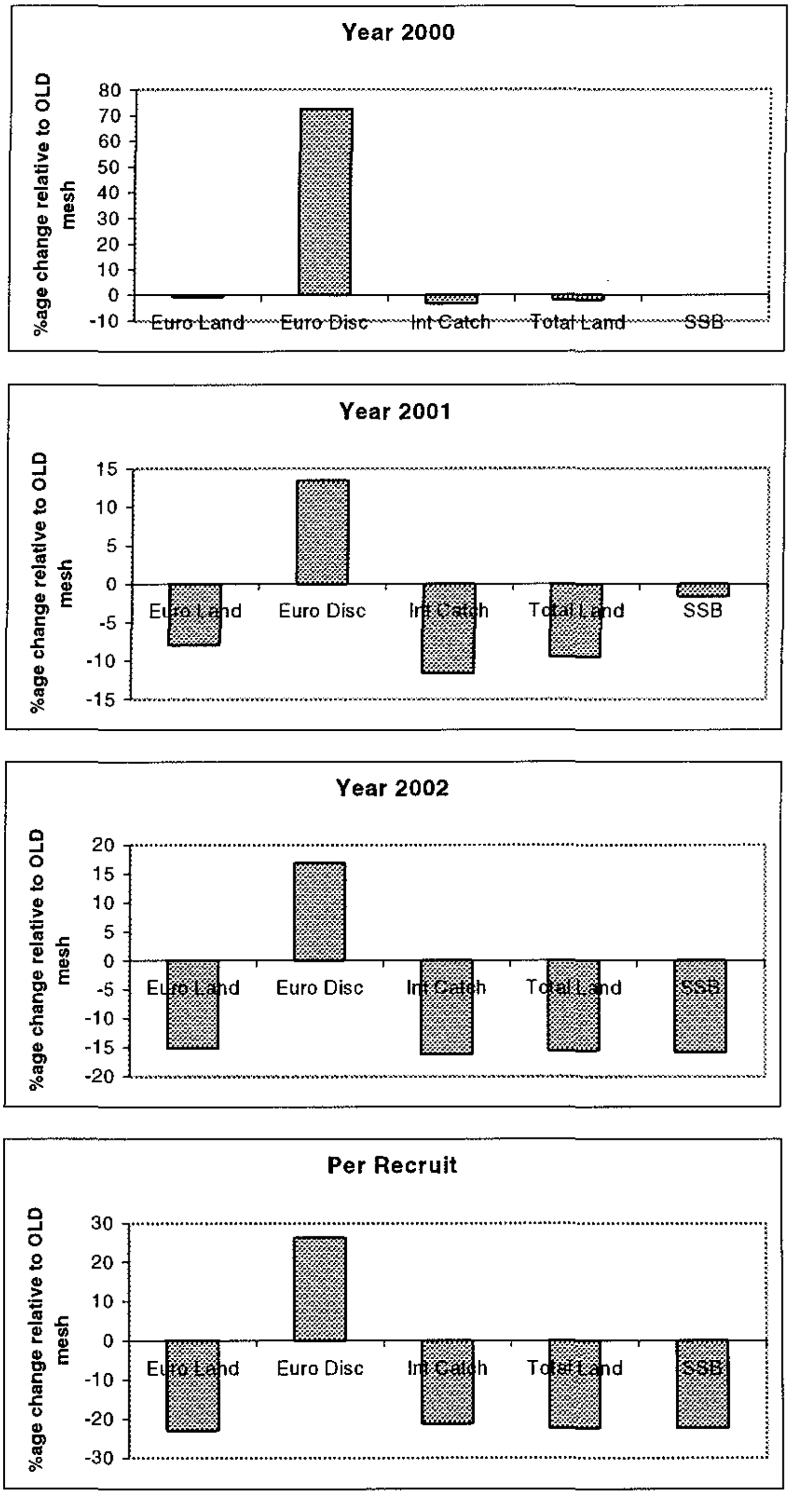


Figure 3.3 Rockall haddock mesh selection changes incorporating both Scottish and Russian selectivity ogives – fishing at 70mm mesh.

"European" Fleet initially allocated 70 % of F
"International" Fleet initially allocated 30 % of F

"European" Fleet OLD mesh = 100 mm
"International" Fleet OLD mesh = 70 mm

Change to: 100 mm mesh in European fleet, according to Scottish selectivity results
Change to: 100 mm mesh in International fleet, according to Russian selectivity results

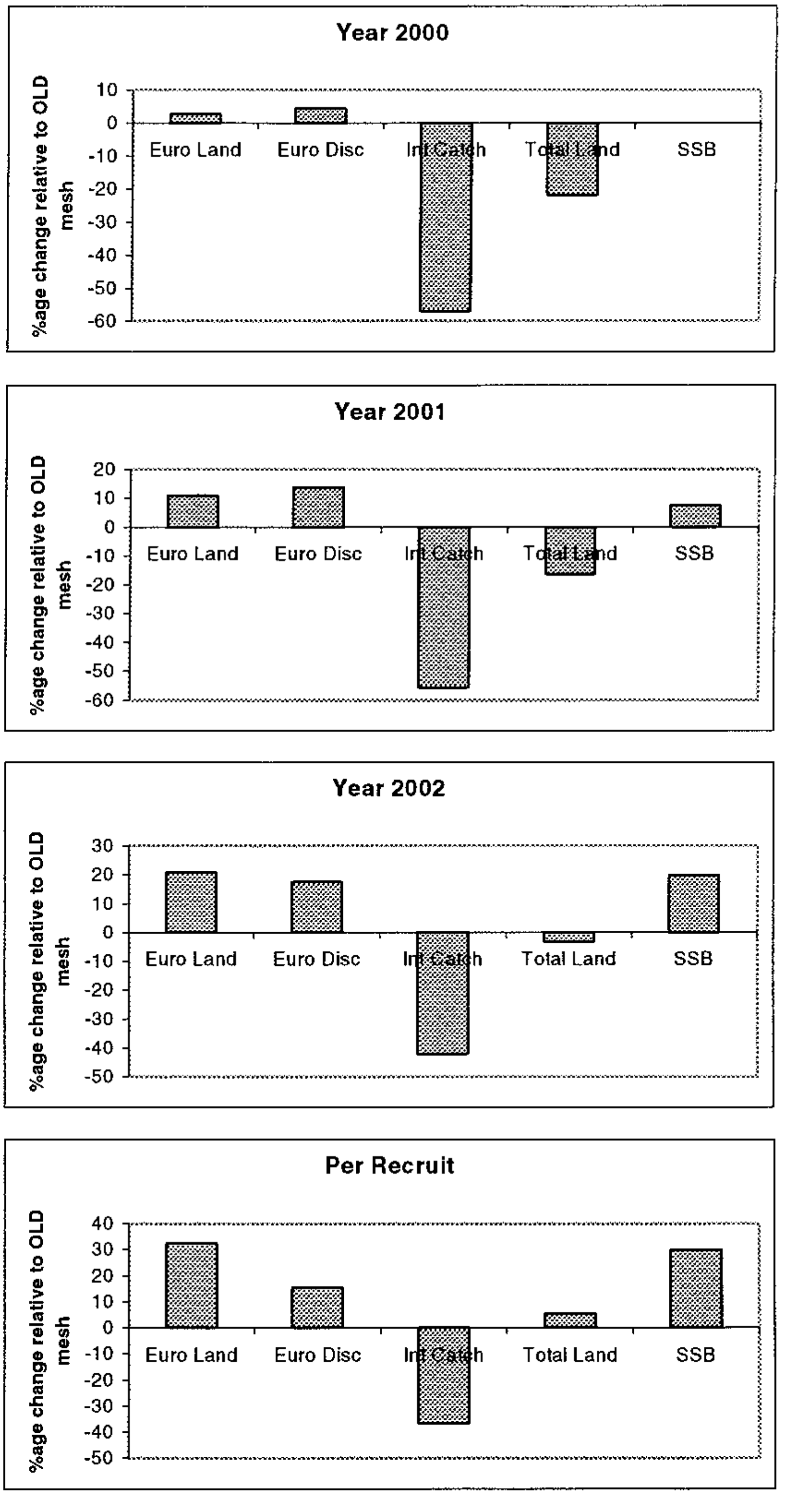


Figure 3.4 Rockall haddock mesh selection changes incorporating both Scottish and Russian selectivity ogives – fishing at 100mm mesh (**NB <u>theoretical</u> Russian ogive**).

"European" Fleet initially allocated 70 % of F
"International" Fleet initially allocated 30 % of F

"European" Fleet OLD mesh = 100 mm
"International" Fleet OLD mesh = 70 mm

Change to: 100 mm mesh in European fleet, according to Scottish selectivity results
Change to: 100 mm mesh in International fleet, according to Russian selectivity results

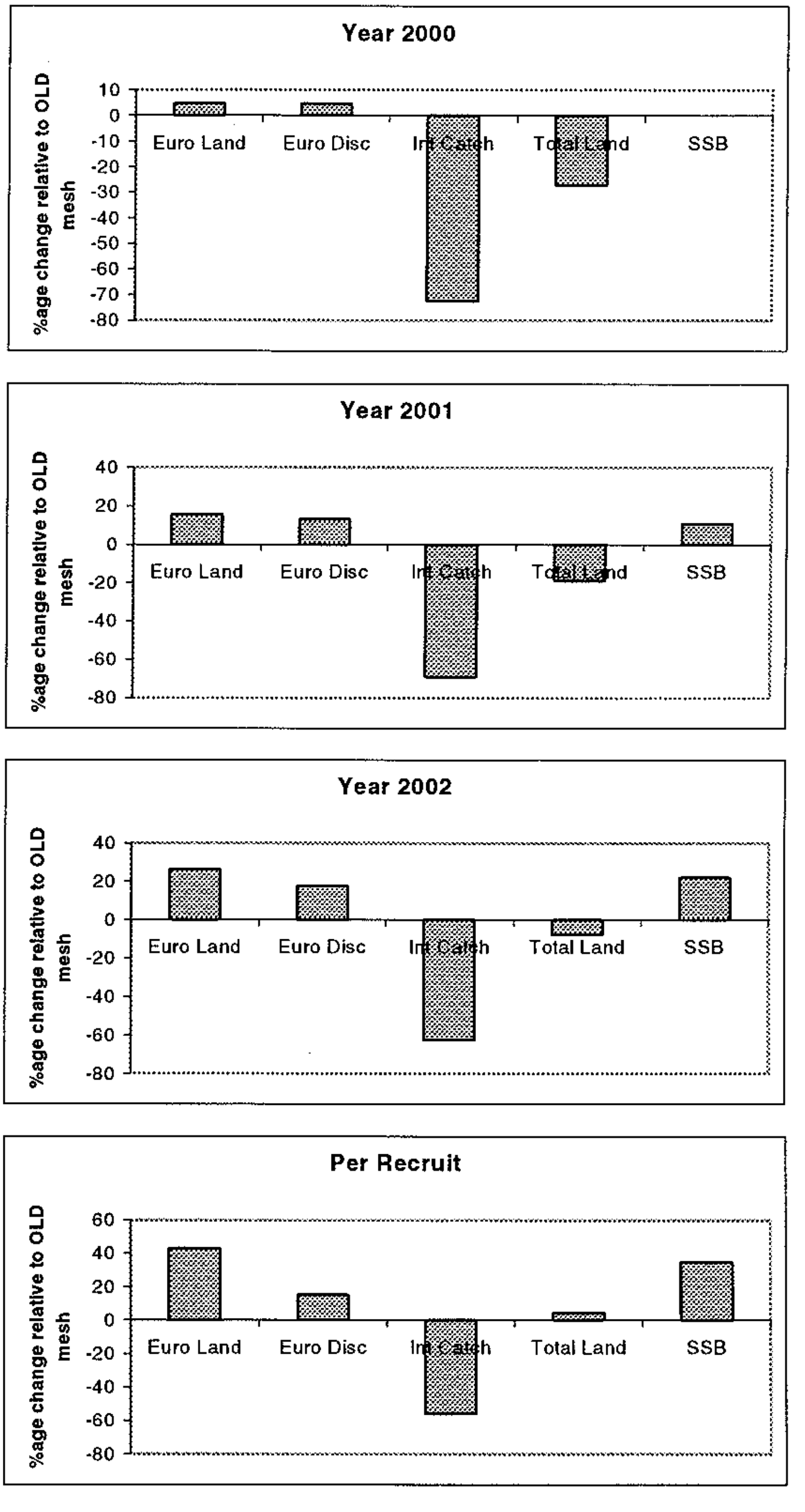


Figure 3.5 Rockall haddock mesh selection changes incorporating both Scottish and Russian selectivity ogives – fishing at 100mm mesh (**NB <u>empirical</u> Russian ogive**).

"European" Fleet initially allocated 70 % of F
"International" Fleet initially allocated 30 % of F

"European" Fleet OLD mesh = 100 mm
"International" Fleet OLD mesh = 70 mm

Change to: 100 mm mesh in both fleets, according to Scottish selectivity results

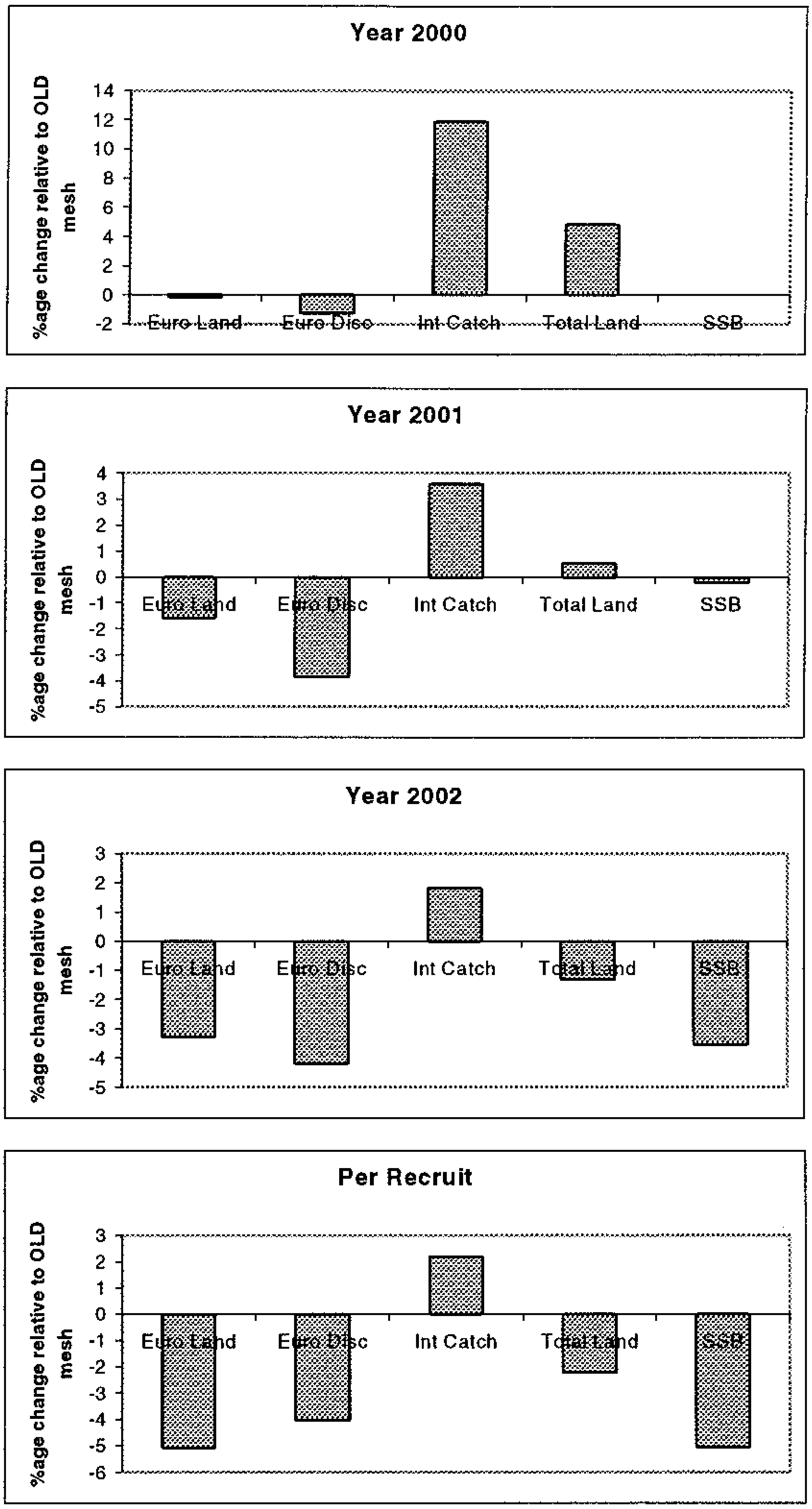


Figure 3.6 Rockall haddock mesh selection changes incorporating only a Scottish Selectivity ogive – fishing at 100mm mesh.

"European" Fleet initially allocated		70	% of F
"International" Fleet initially allocated		30	% of F

"European" Fleet OLD mesh =	100	mm
"International" Fleet OLD mesh =	70	mm

Change to:	110	mm mesh in European fleet, according to Scottish selectivity results
Change to:	110	mm mesh in International fleet, according to Russian selectivity results

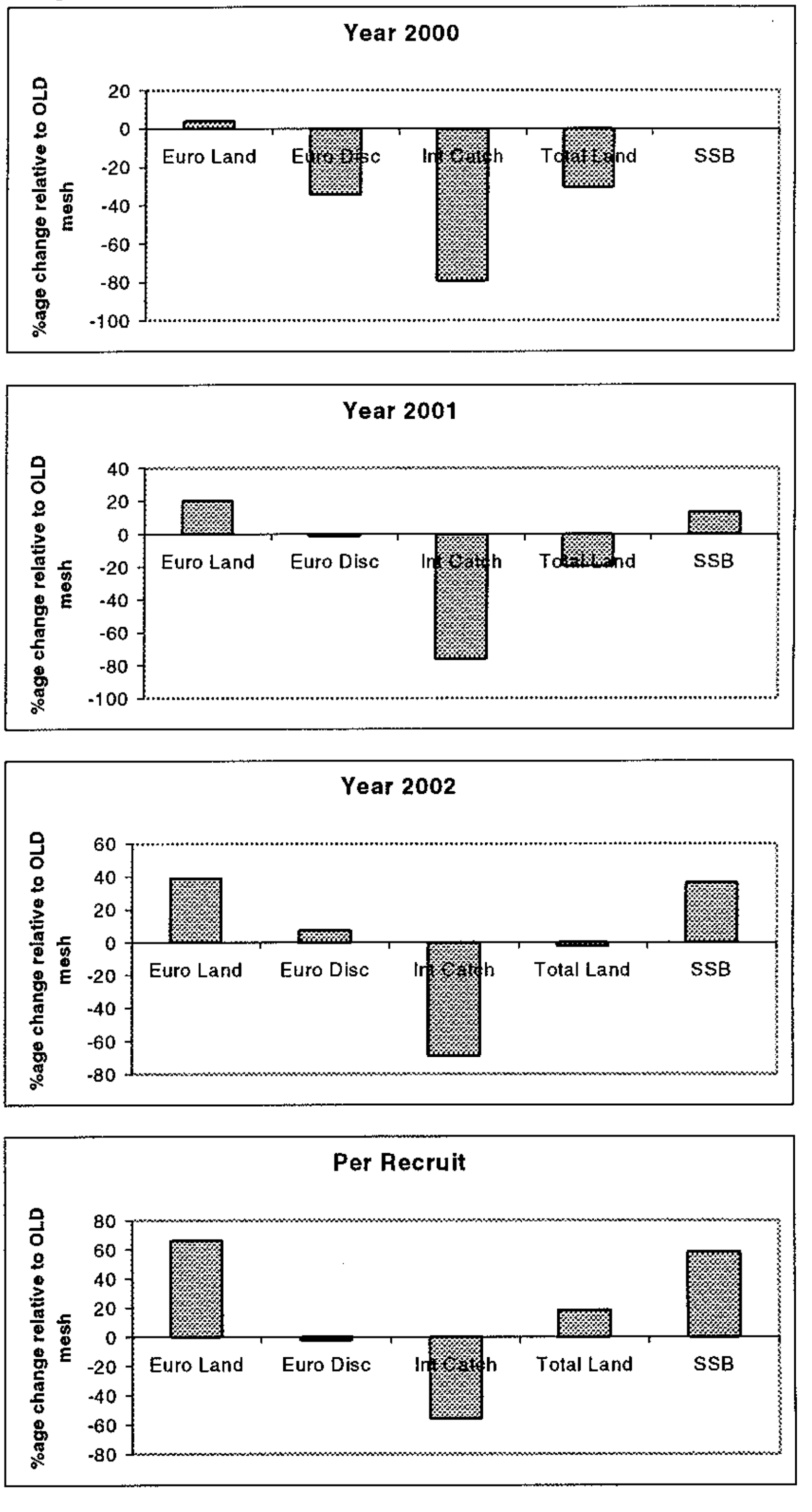


Figure 3.7 Rockall haddock mesh selection changes incorporating both Scottish and Russian selectivity ogives – fishing at 110mm mesh.

"European" Fleet initially allocated	70 % of F	
"International" Fleet initially allocated	30 % of F	
"European" Fleet OLD mesh =	100	mm
"International" Fleet OLD mesh =	70	mm

Change to: 120 mm mesh in European fleet, according to Scottish selectivity results
Change to: 120 mm mesh in International fleet, according to Russian selectivity results

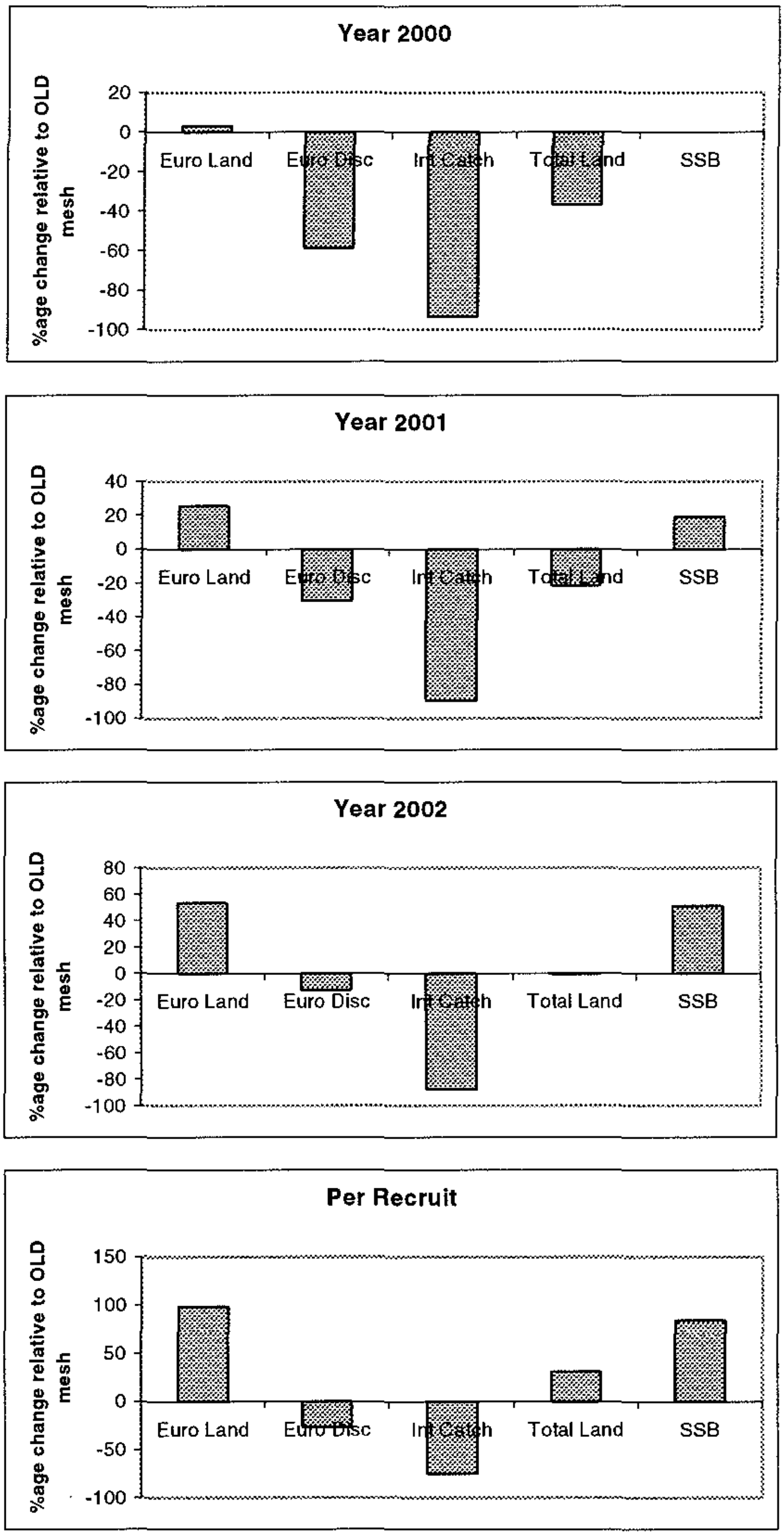


Figure 3.8 Rockall haddock mesh selection changes incorporating both Scottish and Russian selectivity ogives – fishing at 120mm mesh.

ANNEX 1

Some comments of Russian delegation to Report of ICES Expert group on Rockall haddock

Results of the Russian research and fishery of Rockall haddock in 2000 allow to do some following provisional conclusions:

1. Length composition of haddock caught on Rockall Bank by trawls with mesh minimum size of 70 mm to 100 mm did not considerably differ. However, with larger mesh size the fishing efficiency substantially decreased. At the same time, traumatism and mortality of escapes will probably increase. Therefore, it shall not be indisputable to increase mesh minimum size as a measure for protecting haddock stock. It is required that additional studies are undertaken to obtain more detailed data on different mesh selectivity and on haddock escapes survival.

2. Majority of haddock individuals shall attain sexual maturity being of 25 cm in length and at the age of 2 years. Immature fish share in catches by trawlers with 70 mm to 100 mm mesh minimum size was not large, not exceeding 2% (0.8% at an average). Thus, catching with this mesh shall not considerably affect reproductive potential of population provided observation of catch limits.

3. Existence of vast areas useless for bottom trawl fishing in the southern bank and spatial-temporal separation of fishing grounds from young fish habitat are major factors providing for safe exploitation to haddock stocks.

4. Results of research carried out in 2000 are the basis for making an assumption that haddock stock state on Rockall Bank is satisfactory. It is expedient that an additional trawl survey is carried out within the whole bank water area during haddock spawning season to obtain more detailed data.

3.7.4 Whiting

3.7.4.a Whiting in Division VIa (West of Scotland)

State of stock/exploitation: The stock remains outside safe biological limits. Fishing mortality exceeds $\mathbf{F}_{pa}$ and is estimated to be close to $\mathbf{F}_{lim}$ in the last two years. Spawning stock is below $\mathbf{B}_{pa}$. There has been no trend in recruitment during the 1990s, but a gradual increase in F has reduced SSB, which has been below $\mathbf{B}_{lim}$ since 1998. Although the estimate of the discards is uncertain, discard of the 1999 year class was high.

Management objectives: No explicit management objectives are set for this stock.

Precautionary Approach reference points (established in 1998):

ICES considers that:	ICES proposes that:
$\mathbf{B}_{lim}$ is 16 000 t, the lowest observed spawning stock estimated in previous assessments.	$\mathbf{B}_{pa}$ be set at 22 000 t. This is considered to be the minimum SSB required to have a high probability of maintaining SSB above $\mathbf{B}_{lim}$, taking into account the uncertainty of assessments.
$\mathbf{F}_{lim}$ is 1.0, above which stock decline has been observed.	$\mathbf{F}_{pa}$ be set at 0.6. This F is considered to have a high probability of avoiding $\mathbf{F}_{lim}$.

Technical basis:

$\mathbf{B}_{lim} = \mathbf{B}_{lim}(1998) = 16\,000$ t	$\mathbf{B}_{pa} = \mathbf{B}_{lim} * 1.4$
$\mathbf{F}_{lim}$ = see above	$\mathbf{F}_{pa} = 0.6 * \mathbf{F}_{lim}$

Advice on management: To bring SSB above $\mathbf{B}_{pa}$ in 2003, fishing mortality in 2002 should be below 0.29, corresponding to a human consumption landing of less than 2 000 t. However, due to the mixed nature of the fisheries the fishing mortality for whiting in 2002 may have to be reduced further to achieve consistency with the recovery plan for cod.

Relevant factors to be considered in management: Whiting are taken as a by-catch with cod and haddock in a mixed demersal fishery. The rebuilding plan for cod in Division VIa has had no measurable effect on the stock and fishery for whiting in Division VIa. A reduced whiting fishery should have a positive impact on the rebuilding of the cod stock in Division VIa.

Over 80% of the SSB in 2003 is comprised of the 2000 and 2001 year classes for which short-term geometric mean recruitment has been assumed. Retrospective analysis indicates that the over-estimation of the stock may not be fully accounted for in the current assessment and catch forecast.

Fishing effort displaced due to the cod rebuilding plan in Division VIIa, should not be permitted to target whiting in Division VIa, or any other stocks considered to be outside safe biological limits.

The proportion of fish discarded is very high and appears to have increased in recent years. Measures to improve the exploitation pattern would be beneficial to the stock and to the fishery. National technical measures introduced to help protect the 1999 year class of haddock may also be beneficial to the whiting.

Comparison with previous assessment and advice: The estimates of fishing mortality in 1999 is 5% higher and SSB in 2000 35% lower in this years assessment compared to last years assessment. The basis for the single stock fishery advice is the same as last year.

Catch forecast for 2002:

Basis F(2001) = $\mathbf{F_{sq}}$ = F(2000) = 0.95; Catch(2001) = 8.82; Landings(2001) = 4.44; SSB(2002) = 13.9.

F(2001 onwards)	Basis	Catch (2002)	Discards (2002)	Landings (2002)	SSB (2003)
0.19	0.2*$\mathbf{F_{sq}}$	2.5	1.1	1.4	23.4
0.29	0.3*$\mathbf{F_{sq}}$	3.6	1.6	2.0	22.0
0.38	0.4*$\mathbf{F_{sq}}$	4.6	2.1	2.6	20.5
0.60	0.63*$\mathbf{F_{sq}}$ = $\mathbf{F_{pa}}$	6.7	3.0	3.7	17.7
0.76	0.8*$\mathbf{F_{sq}}$	8.0	3.6	4.4	15.9
0.95	1.0*$\mathbf{F_{sq}}$	9.4	4.3	5.1	14.1
1.14	1.2*$\mathbf{F_{sq}}$	10.5	4.9	5.7	12.5

Weights in '000 t.

Shaded scenarios considered inconsistent with the precautionary approach.

Elaboration and special comment: Whiting in Division VIa are caught mainly by Scottish trawlers. Since 1976, Scottish heavy trawl and seine effort has declined, whilst that of light trawlers has generally increased. Approximately 50% of the total catch in weight is discarded, so restricted landings alone will not achieve the necessary increase in SSB. Analytical age-based assessment uses landings-at-age data, discard-at-age data and indices from research vessel surveys.

Source of information: Report of the Working Group on the Assessment of Northern Shelf Demersal Stocks, August 2001 (ICES CM 2002/ACFM:02).

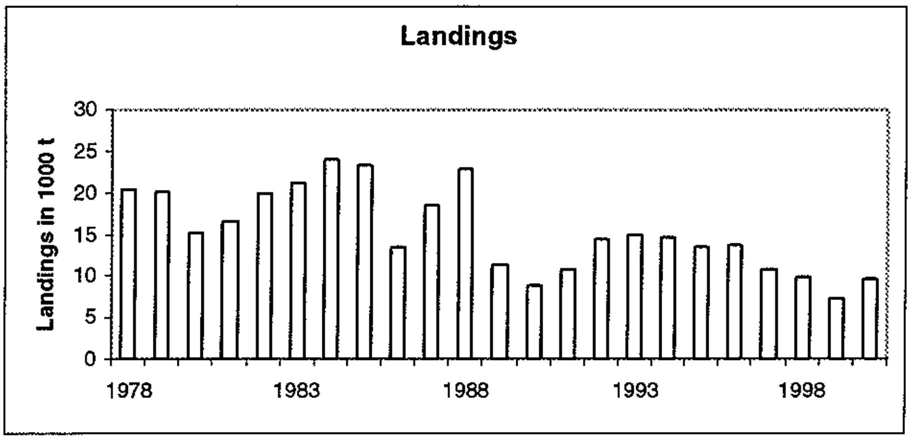
Yield and spawning biomass per Recruit F-reference points:

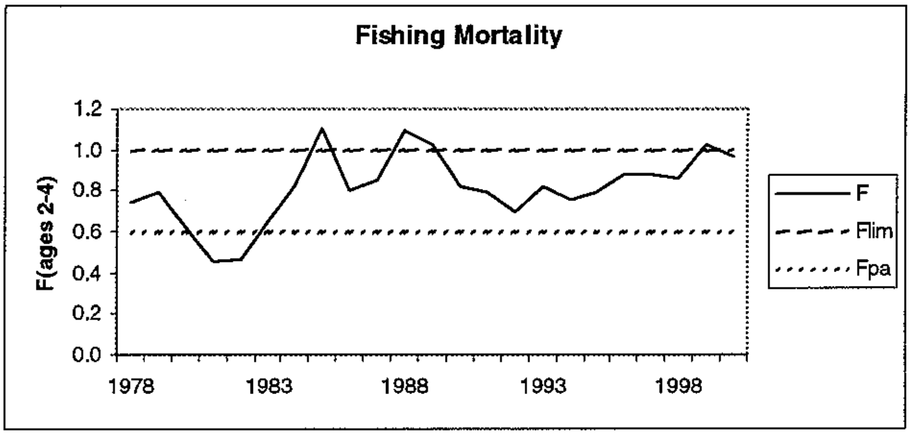
	Fish Mort Ages 2-4	Yield/R	SSB/R
Average Current	0.953	0.073	0.195
$\mathbf{F_{max}}$	0.241	0.113	0.631
$\mathbf{F_{0.1}}$	0.141	0.106	0.885
$\mathbf{F_{med}}$	0.730	0.085	0.252

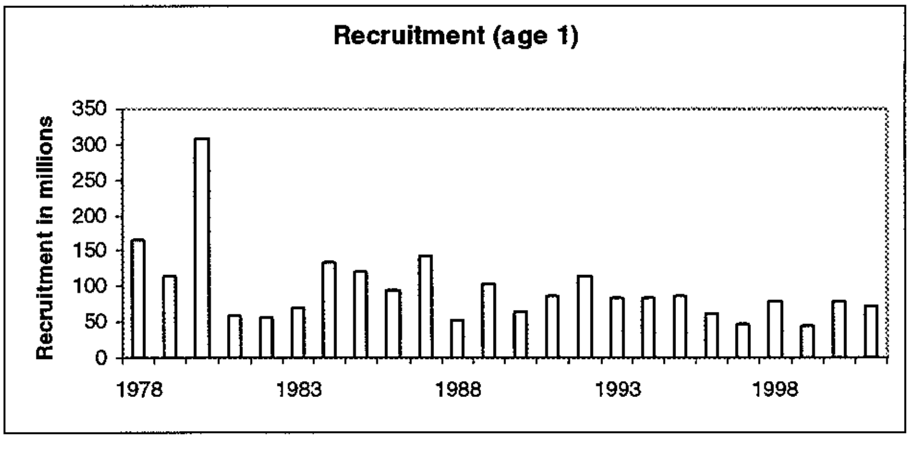
Catch data (Tables 3.7.4.a.1-2):

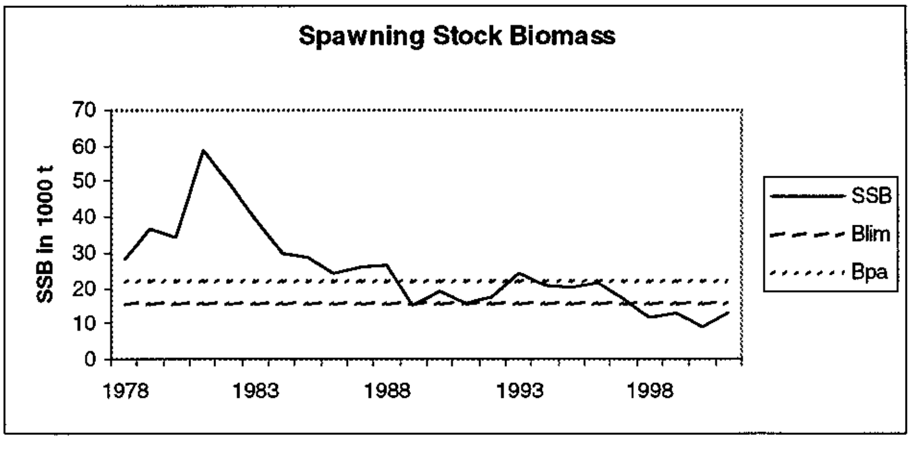
Year	ICES Advice	Predicted landing corresp. to advice	Agreed TAC[1]	Official Landings	ACFM Landings	Discards slip	ACFM catch
1987	No increase in F	15.0	16.4	12.4	11.5	6.9	18.4
1988	No increase in F; TAC	15.0	16.4	11.9	11.4	11.5	22.9
1989	No increase in F; TAC	13.0	16.4	7.7	7.5	3.7	11.3
1990	No increase in F; TAC	11.0	11.0	6.0	5.6	3.4	9.0
1991	70% of effort (89)	-	9.0	6.9	6.7	4.0	10.7
1992	70% of effort (89)	-	7.5	6.0	6.0	8.4	14.3[4]
1993	70% of effort (89)	-	8.7	6.8	6.9	8.0	14.9[4]
1994	30% reduction in effort	-	6.8	5.8	5.9	8.6	14.5[4]
1995	Significant reduction in effort	-	6.8	6.3	6.1	7.3	13.4[4]
1996	Significant reduction in effort	-	10.0	6.6	7.2	6.6	13.7
1997	Significant reduction in effort	-	13.0	6.2	6.3	4.6	10.9
1998	No increase in F	6.5	9.0	4.7	4.7	5.2	9.9
1999	Reduce F below $\mathbf{F_{pa}}$	4.3	6.3	4.7	4.6	2.6	7.2
2000	Reduce F below $\mathbf{F_{pa}}$	<4.3	4.3	2.5[2]	3.3	6.3	9.6
2001	Reduce F below $\mathbf{F_{pa}}$	<4.2	4.0				
2002	SSB>$\mathbf{B_{pa}}$ in short term	<2.0					

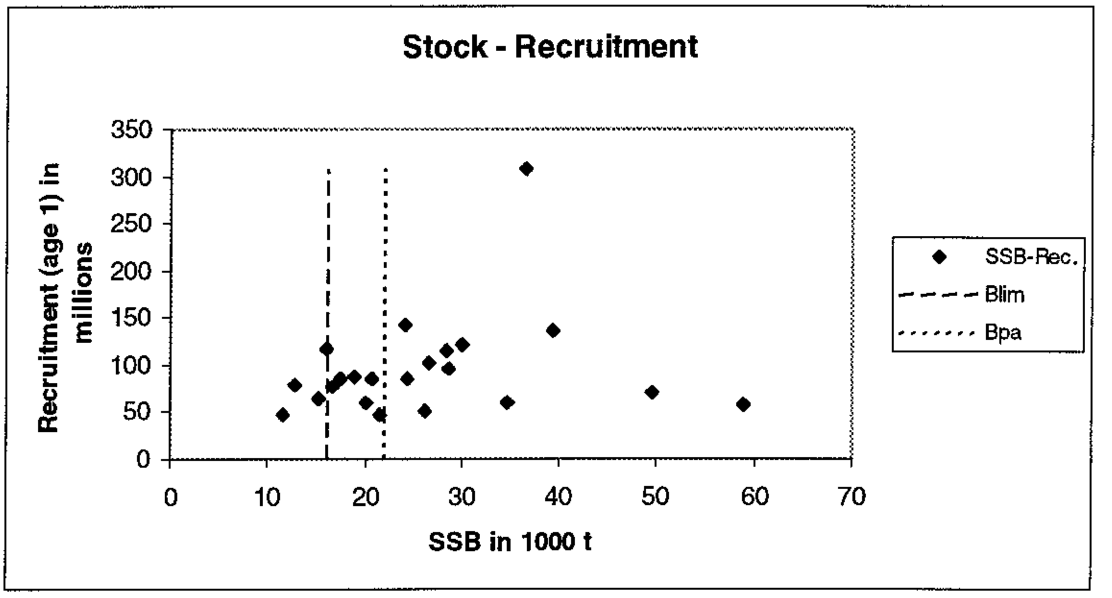
[1]TAC is set for Divisions VIa and VIb combined. [2]Incomplete. [3]Not including misreporting. [4]Including ACFM estimates of misreporting. Weights in '000 t.

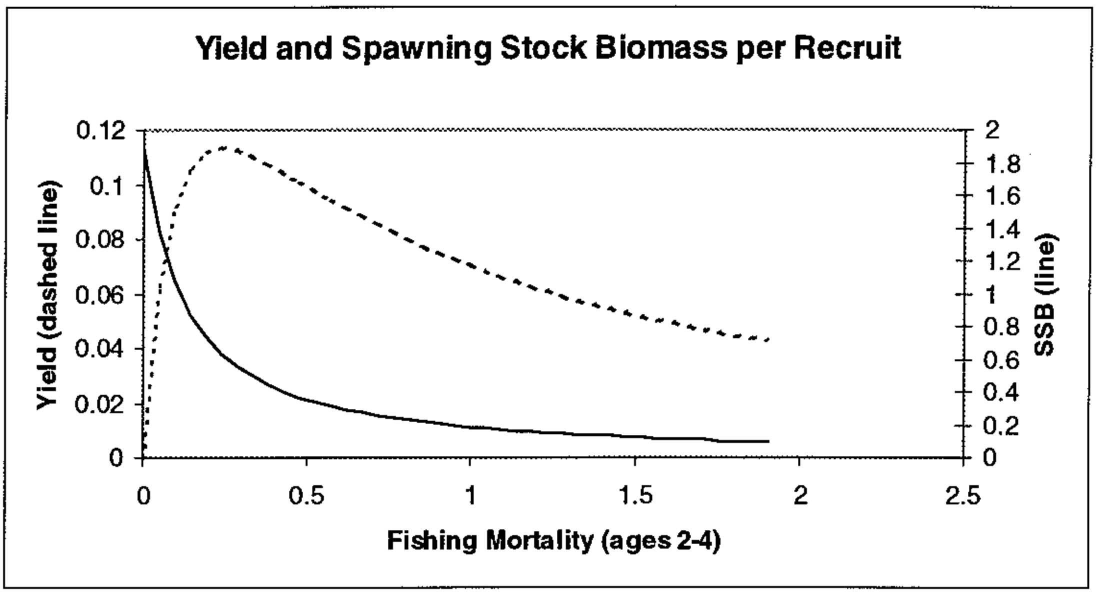

Landings
Landings in 1000 t
30
25
20
15
10
5
0
1978
1983
1988
1993
1998


Fishing Mortality
F(ages 2-4)
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1978
1983
1988
1993
1998
F
Flim
Fpa


Recruitment (age 1)
Recruitment in millions
350
300
250
200
150
100
50
0
1978
1983
1988
1993
1998


Spawning Stock Biomass
SSB in 1000 t
70
60
50
40
30
20
10
0
1978
1983
1988
1993
1998
SSB
Blim
Bpa


Stock - Recruitment
Recruitment (age 1) in millions
SSB in 1000 t
350
300
250
200
150
100
50
0
0
10
20
30
40
50
60
70
SSB-Rec.
Blim
Bpa


Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
SSB (line)
Fishing Mortality (ages 2-4)
0.12
0.1
0.08
0.06
0.04
0.02
0
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0
0.5
1
1.5
2
2.5

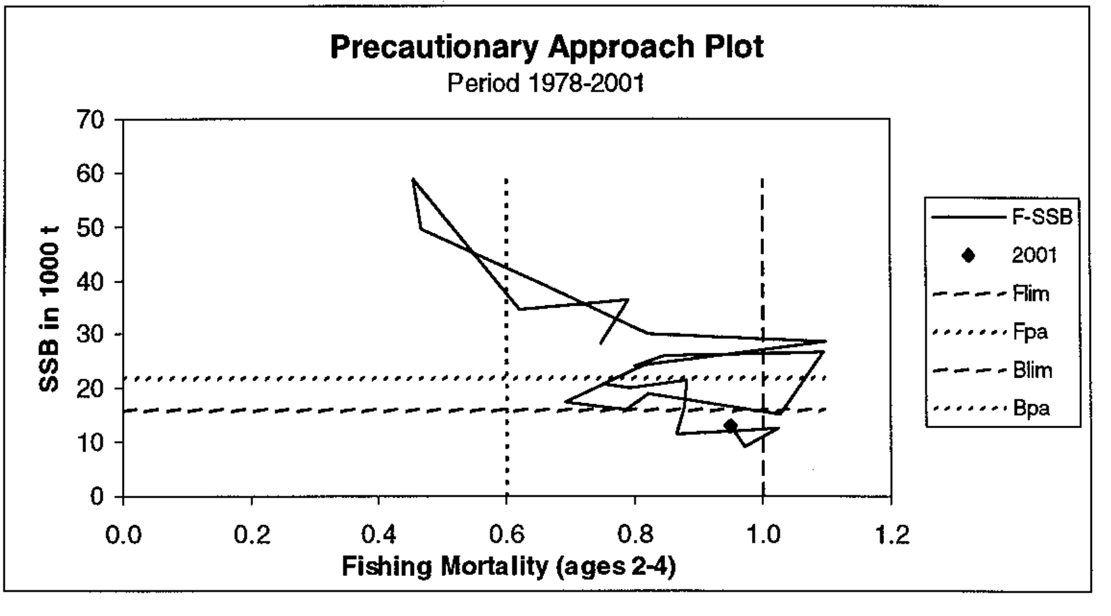

Precautionary Approach Plot
Period 1978-2001
SSB in 1000 t
Fishing Mortality (ages 2-4)
70
60
50
40
30
20
10
0
0.0
0.2
0.4
0.6
0.8
1.0
1.2
F-SSB
2001
Flim
Fpa
Blim
Bpa

Table 3.7.4.a.1 Nominal catch (t) of WHITING in Division VIa, 1986–2000, as officially reported to ICES.

Country	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999[1]	2000[1]
Belgium	4	3	1	-	+	-	+	+	+	-	1	1	+	+
Denmark	5	-	1	+	3	1	1	+	+	+	+	-	-	-
France	1,644	1,249	199[1,2]	180	352[1,2]	105	149	191	362	202	108	82	300	164
Germany	+	4	+	+	+	1	1	+	-	-	-	-	+	-
Ireland	2,868	2,640	1,315	977	1,200	1,377	1,192	1,213	1,448	1,182	977	952	1,121	n/a
Netherlands	-	-	-	-	-	-	-	-	-	-	-	-		
Spain	-	-	-	-	-	-	-	-	1	-	1	2	+	n/a
UK (E&W)[3]	62	30	44	50	218	196	184	233	204	237	453	251	210	104
UK (N.I.)	13	89	...	...	...	...	...	...	...	...	...	...	...	...
UK (Scot.)	7,803	7,864	6,109	4,819	5,135	4,330	5,224	4,149	4,263	5,021	4,638	3,369	3,046	2,258
Total	12,399	11,879	7,669	6,026	6,908	6,010	6,751	5,786	6,278	6,642	6,178	4,657	4,677	2,526
Unallocated landings	-857	-530	-142	-382	-234	-5	122	177	-199	527	113	38	-49	730
Discards	6,875	11,460	3,713	3,356	4,044	8,360	8,017	8,570	7,272	6,568	4,571	5,211	2,567	6,273
Landings as used by W.G.	11,542	11,349	7,527	5,644	6,674	6,005	6,873	5,963	6,079	7,169	6,291	4,695	4,628	3,256

[1]Preliminary.
[2]Includes Divisions Vb (EC) and VIb.
[3]1989–2000 N. Ireland included with England and Wales.
n/a = Not available.

Table 3.7.4.a.2 Whiting in Division VIa (West of Scotland).

Year	Recruitment Age 1 thousands	SSB tonnes	Landings tonnes	Mean F Ages 2-4
1978	165106	28368	20436	0.75
1979	115462	36617	20159	0.79
1980	308321	34696	15101	0.62
1981	58552	58883	16462	0.45
1982	56505	49435	20025	0.47
1983	70112	39312	21150	0.66
1984	135285	30067	24007	0.82
1985	120494	28575	23390	1.10
1986	95519	24144	13373	0.80
1987	142558	26119	18453	0.85
1988	51888	26678	22845	1.10
1989	102495	15293	11248	1.03
1990	64065	18935	8981	0.82
1991	86956	15994	10739	0.79
1992	116030	17348	14332	0.69
1993	84391	24436	14881	0.82
1994	84163	20692	14532	0.75
1995	85734	20104	13372	0.80
1996	60336	21499	13706	0.88
1997	46637	16711	10857	0.88
1998	77210	11583	9864	0.87
1999	45633	12839	7202	1.03
2000	79228	9199	9529	0.97
2001	72400	13100		0.95
Average	96878	25026	15419	0.82

[1)] short term geometric mean (1988-1999).

3.7.4.b Whiting in Division VIb (Rockall)

Catch data in Tables 3.7.4.b.1-2.

Elaboration and special comments: Landings of whiting from Division VIb are negligible. No assessment has been carried out on this stock.

Source of information: Report of the Working Group on the Assessment of Northern Shelf Demersal Stocks, August 2001 (ICES CM 2002/ACFM:02).

Whiting in Division VIb (Rockall)

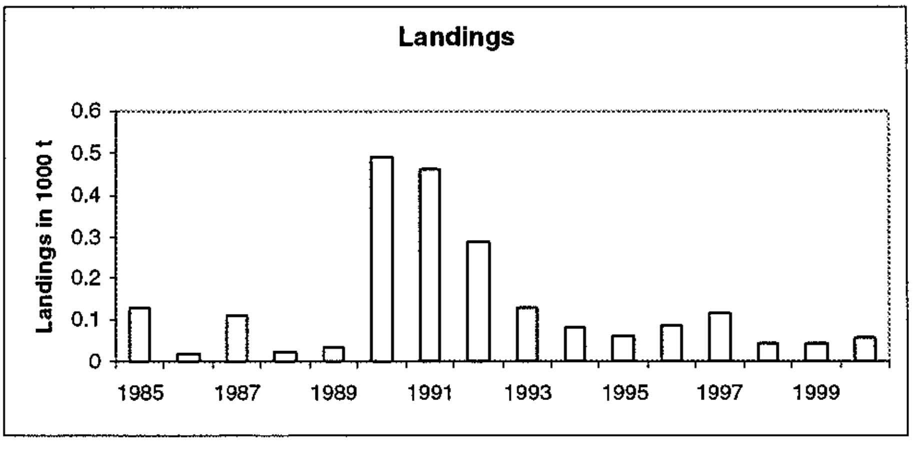


Table 3.7.4.b.1 Nominal catch (t) of WHITING in Division VIb, 1986–2000, as officially reported to ICES.

Country	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999[1]	2000
France	-	-	-	...[2]	...[2]	...[2]	...[2]	...[2]	...[2]	...[2]	...[2]	...[2]	...[2]		
Ireland	-	-	-	-	-	-	-	32	10	4	23	3	1	-	n/a
Spain	-	-	-	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	+	n/a
UK (E & W)[3]	5	4	-	16	6	1	5	10	2	5	26	49	20	+	+
UK (N.Ireland)	-	-	-	...	...	...	...	...	...	...	...	...	...	...	...
UK (Scotland)	13	108	23	18	482	459	283	86	68	53	36	65	23	44	58
Total	18	112	23	34	488	460	288	128	80	62	85	117	44	44	58

[1]Preliminary.
[2]Included in Division VIa.
[3]1989–2000 N. Ireland included with England and Wales.
n/a = not available.

Table 3.7.4.b.2 Whiting in Division VIb (Rockall)

Year	Landings tonnes
1985	131
1986	18
1987	112
1988	23
1989	34
1990	488
1991	460
1992	288
1993	128
1994	80
1995	62
1996	85
1997	117
1998	44
1999	44
2000	58
Average	136

3.7.5 Saithe in Sub-area VI (West of Scotland and Rockall)

Saithe in Sub-area VI has previously been assessed as a separate stock. This component has now been combined with saithe in the North Sea (Sub-area IV) and saithe in Skagerrak and Kattegat (Division IIIa), see Section 3.5.5.

3.7.6 Megrim in Sub-area VI (West of Scotland and Rockall)

State of stock/exploitation: When last assessed (1999) the stock was within safe biological limits. The historical perspective of SSB, fishing mortality and recruitment is not well estimated, although it is likely that fishing mortality has increased since the 1980s as the fishery for anglerfish, (in which megrim is taken as a by-catch) has expanded into progressively deeper water.

Management objectives: No explicit management objectives are set for this stock.

Reference points: There is not sufficient information to estimate appropriate reference points.

Advice on management: ICES advises that catches in 2002 be no more than the recent TAC.

Relevant factors to be considered in management: Megrim are caught as part of a targeted anglerfish fishery, which has expanded rapidly in recent years. Maintenance of the existing megrim TAC should help to prevent expansion of the fishery for anglerfish that is considered to be outside safe biological limits. The megrim in Sub-area VI consists of two species, *Lepidorhombus whiffiagonis* and *L. boscii*. The large majority of the landings are *L. whiffiagonis*. Although total landings are less than the TAC, some national quotas are restrictive and this has led to mis-reporting. Previously, the adjacent fishery in the North Sea was not subject to a TAC for megrim, and catch controls on anglerfish in Sub-area VI have led to mis-reporting of landings, including the megrim component, into the North Sea.

The landings from Division VIa showed a marked increase from 1991 to 1996 (4 400 t), but have subsequently fallen to the recent low of 1 780 t in 2000.

Elaboration and special comment: Until recently, megrim was taken mainly as a by-catch in bottom trawl groundfish fisheries. The expansion of the fishery for anglerfish has led to increased fishing pressure on megrim in the area, where they are now caught as a by-catch in the targeted anglerfish fishery. Previous analyses have indicated that megrim are more robust to exploitation than anglerfish, hence management of the fishery should primarily reflect concerns for the anglerfish stock.

Length frequency and age composition data are only available for 1992–1999. Incomplete data were available for 1990 and 1991. Preliminary assessments have previously indicated that F may be rather low, but this impression may be due to the expansion of the area fished.

Source of information: Report of the Working Group on the Assessment of Northern Shelf Demersal Stocks, August 2001 (ICES CM 2002/ACFM:02).

Catch data (Tables 3.7.6.1-2)

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC[1]	Official landings	ACFM landings[3]
1987	Not assessed	-	4.4	3.9	-
1988	Not assessed	-	4.84	4.5	-
1989	Not assessed	-	4.84	2.7	-
1990	Not assessed	-	4.84	2.7	2.9
1991	No advice	-	4.84	3.2	2.7
1992	No advice	-	4.84	3.2	3.7
1993	No long-term gain in increased F	-	4.84	3.0	3.4
1994	No long-term gain in increased F	-	4.84	3.0	3.3
1995	No advice	-	4.84	3.3	3.8
1996	No advice	-	4.84	2.9	4.4
1997	No advice	-	4.84	2.8	3.6
1998	Adequate catch controls	-	4.84	2.2	3.1
1999	Maintain current TAC	4.84	4.84	2.5	1.7
2000	Maintain current TAC	4.84	4.84	1.3[2]	1.8
2001	Maintain current TAC	4.84	4.36		
2002	Maintain current TAC	4.36			

[1]Vb(EC), VI, XII and XIV. [2] Incomplete data. [3] Landings in VIa. Landings in Vb (EC), XII, and XIV negligible. Weights in '000 t.

Megrim in Sub-area VI (West of Scotland and Rockall)

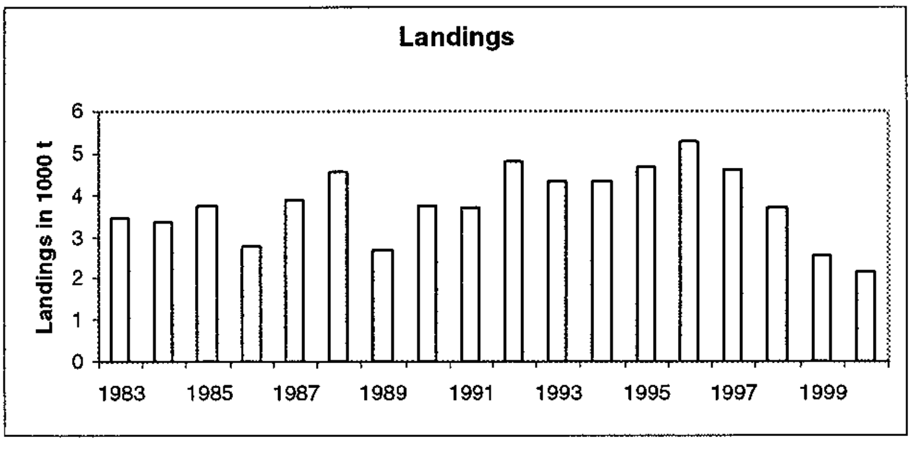


Table 3.7.6.1 Nominal catch (t) of MEGRIM in Sub-area VI (West of Scotland and Rockall), as officially reported to ICES.

Megrim in Division VIa (West of Scotland)

	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999*	2000*
Belgium	-	1	1	1	-	1	-	-	1	-	-	-	-	-	+
Denmark	-	-	-	1	-	-	-	-	-	-	-	-	-		
France	777	997	1,295	457	398	455	504	517	408	618	462	192	172	203	167
Germany	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-
Ireland	243	403	685	474	317	260	317	329	304	535	460	438	433	438	n/a
Spain	137	102	121	43	91	48	25	7	1	24	22	87	111	83	n/a
UK(E&W&NI)	55	380	354	122	25	167	392	298	327	322	156	123	65	42	20
UK(Scotland)	660	991	1,068	1,169	1,093	1,223	887	896	866	952	944	954	841	831	754
Total	1,872	2,874	3,526	2,267	1,924	2,154	2,125	2,047	1,907	2,451	2,044	1,794	1,622	1,597	941
Unallocated					1,000	518	1,595	1,356	1,373	1,375	2,381	1,795	1,522	104	839
As used by WG					2,924	2,672	3,720	3,403	3,280	3,826	4,425	3,589	3,144	1,701	1,780

Megrim in Division VIb (Rockall)

	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999*	2000*
France	11	2	1	-	-	-	-	-	-	-	-	-	-	-	-
Ireland	-	-	-	-	196	240	139	128	176	117	124	141	218	127	n/a
Spain	730	583	751	205	363	587	683	594	574	520	515	628	n/a	404	n/a
UK(E&W&NI)	88	261	77	18	19	14	53	56	38	27	92	76	116	57	57
UK(Scotland)	79	174	185	178	226	204	198	147	258	152	112	164	208	278	309
Total	908	1,020	1,014	401	804	1,045	1,073	925	1,046	816	843	1,009	542	866	366

Total Megrim in Sub-area VI (West of Scotland and Rockall)

Year	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999*	2000*
Total	2,780	3,894	4,540	2,668	2,728	3,199	3,198	2,972	2,953	3,267	2,887	2,803	2,164	2,463	1,307
As used by WG					3,728	3,717	4,793	4,328	4,326	4,642	5,268	4,598	3,686	2,567	2,146

* Preliminary.

Table 3.7.6.2 Megrim in Sub-area VI (West of Scotland and Rockall).

Year	Landings
	tonnes
1983	3469
1984	3384
1985	3753
1986	2780
1987	3894
1988	4540
1989	2668
1990	3728
1991	3717
1992	4793
1993	4328
1994	4326
1995	4642
1996	5268
1997	4598
1998	3686
1999	2567
2000	2146
Average	3794

3.7.7 Anglerfish in Sub-area IV (North Sea) and Sub-area VI (West of Scotland and Rockall)

State of stock/exploitation: The stock is harvested outside of safe biological limits. Although highly uncertain, an assessment for the combined area indicates that the recent F's have been well above $\mathbf{F_{pa}}$. Even though the historical perspective of SSB, fishing mortality and recruitment is not well estimated, it is likely that fishing mortality has increased since the 1980s as the fishery has expanded into deeper water with an associated increase in catches, although these have shown a sharp drop over 1997–1999. The fishery has expanded into areas, which are believed to have been refugia for adult anglerfish, increasing the vulnerability of the stock to over-exploitation. Immature fish are subjected to exploitation for a number of years prior to first maturity.

Management objectives: No explicit management objectives are set for this stock. However, for any management objectives to meet precautionary criteria, their aim should be to reduce or maintain F below $\mathbf{F_{pa}}$.

Precautionary Approach reference points (unchanged since 1998):

ICES considers that:	ICES proposes that:
There is currently no biological basis for defining $\mathbf{B_{lim}}$ or $\mathbf{F_{lim}}$	$F_{35\%SPR}$= 0.30 be chosen as $\mathbf{F_{pa}}$. This fishing mortality corresponds to 35% of the unfished SSB/R. It is considered to be an approximation of $\mathbf{F_{MSY}}$.

Advice on management: The highest catch that may have been sustainable was around 15 000 t and occurred in the period 1973-1990, before the recent expansion in the fisheries. The stock has since been depleted and the sustainable catch at present is likely to be lower. The assessment is too imprecise to give exact guidance on what the reduction in fishing should be. ICES continues to recommend catches no higher than 2/3 of the sustainable catches identified in the period 1973-1990. This corresponds to landings no greater than 10 000 t in 2002.

Relevant factors to be considered in management: Catches for the combined area are believed to be adequately estimated. However, due to a long history of mis-reporting, the correct allocation of catches to Sub-areas IV and VI is not possible. Estimates which take into account mis-reporting indicate that the percentage of the catch taken in Sub-area VI in the years 1992-2000 (the period used in the assessment) has ranged between 25%-36%, with a mean of 30%. These values may be used as a basis to allocate the 2002 TAC between the management units.

The lack of TAC regulation in the adjacent Sub-area IV before 1998 encouraged mis-reporting of landings into that area and undermined management for Sub-area VI. The agreed TACs in 1998 and 1999 for Sub-area IV were based on recent landings reported from that area. Because those landings included misreporting in the preceding years these TACs are unlikely to have prevented further mis-reporting or to have improved conservation in either area.

Anglerfish are subject to significant fishing mortality before attaining full maturity, and this means the stock is particularly vulnerable to depletion of the spawning component. Their body shape means that at a young age they are easily retained by the minimum mesh size currently in force. They are known to be discarded, although no routine discard sampling is undertaken. There is also a by-catch of small anglerfish associated with scallop dredging.

In past assessments the existence of a large unexploited reservoir of mature females was assumed to exist in deep waters. In recent years, surveys and fisheries have explored deep water areas widely, without locating any such aggregations of mature anglerfish.

Two species occur, *Lophius piscatorius* and *L. budegassa*, although catches are almost exclusively of the former.

Elaboration and special comment: The fishery for anglerfish in the North Sea is closely associated with the fishery to the West of Scotland, and catch trends from the two areas are similar, with a steady increase from around 1984 due to the development of a directed Scottish fishery, and a sharp decline from 1997 to 2000. It is likely that catches from two areas come from the same biological stock.

The sharp reduction in landings since 1996, and the scarcity of mature females in the catches may indicate that the stock is heavily over-exploited.

Until the mid-1980s, anglerfish was taken mainly as a by-catch in bottom trawl groundfish fisheries. Restrictive TACs for other species in Division VIa have led to increased fishing pressure on anglerfish in that area, where they are now caught in a targeted anglerfish fishery. Species such as cod, haddock and saithe form a significant by-catch in the anglerfish fishery.

The North Sea catch at length distribution is derived solely from Scottish market sampling. Information for catch composition is unavailable from other countries and this contributes to the imprecision of the assessment.

Source of information: Report of the Working Group on the Assessment of Northern Shelf Demersal Stocks, August 2001 (ICES CM 2002/ACFM:02).

Catch data (Tables 3.7.7.1 and 3):

Sub-area IV - North Sea

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC	Official landings	ACFM Landings
1989	Not assessed	-	-	10.1	9.3
1990	Not assessed	-	-	10.6	9.5
1991	Not assessed	-	-	11.8	10.6
1992	Not assessed	-	-	13.3	11.7
1993	Not assessed	-	-	15.5	13.1
1994	Not assessed	-	-	18.2	15.4
1995	Not assessed	-	-	20.9	15.8
1996	Not assessed	-	-	27.3	16.2
1997	Not assessed	-	-	25.8	18.2
1998	Not assessed	-	22.1	19.0	14.0
1999	Not assessed	-	22.1	14.9	11.7
2000	40% reduction in catches	<9.7	17.66	14.0	11.6
2001	2/3 of the catches in 1973-1990	5.7	14.13		
2002	2/3 of the catches in 1973-1990	5.7			

Weights in '000 t.

Catch data (Tables 3.7.7.2 and 3):

Sub-area VI - West of Scotland and Rockall

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC[1]	Official landings	ACFM landings[2]
1987	Not assessed	-	7.8	5.2	5.6
1988	Not assessed	-	8.6	7.7	7.7
1989	Not assessed	-	8.6	6.0	7.3
1990	Not assessed	-	8.6	6.4	6.6
1991	No advice	-	8.6	6.0	6.3
1992	No advice	-	8.6	6.6	9.2
1993	No long-term gain in increased F	-	8.6	6.2	10.1
1994	No long-term gain in increased F	-	8.6	6.0	8.8
1995	A precautionary TAC not exceeding recent catch levels	-	8.6	7.2	12.3
1996	A precautionary TAC not exceeding recent catch levels	-	8.6	7.0	18.2
1997	Reduction in fishing effort	-	8.6	6.2	13.7
1998	Reduction in fishing effort	-	8.6	5.4	10.6
1999	Reduce fishing effort, effective implementation of the TAC	-	8.6	5.3	8.4
2000	40% reduction in catches	<7.4	8.0	4.2	7.2
2001	2/3 of the catches in 1973-1990	4.3	6.4		
2002	2/3 of the catches in 1973-1990	4.3			

[1]Vb(EC), VI, XII and XIV. [2]Division VIa only. [3]Incomplete data. Weights in '000 t.

Anglerfish Sub-areas IV (North Sea) and VI (W.Scotland & Rockall)

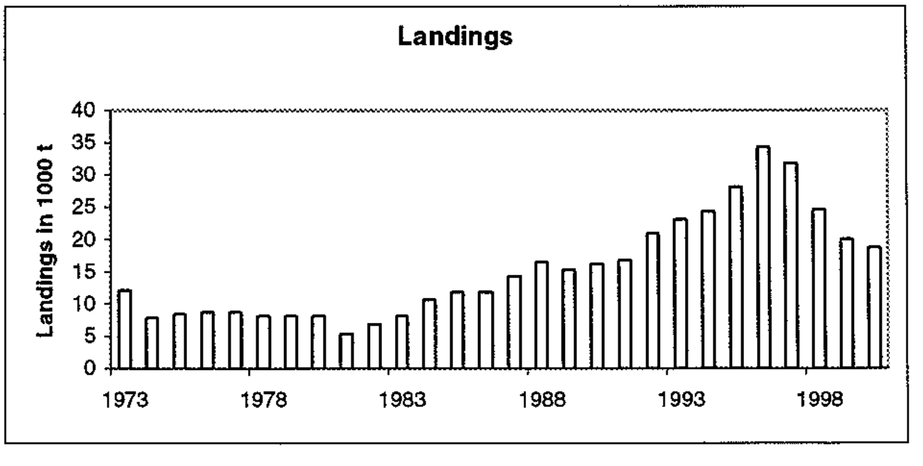


Table 3.7.7.1 Nominal catch (t) of ANGLERFISH in the North Sea, 1989–2000, as officially reported to ICES.

Northern North Sea (IVa)

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Belgium	1	8	2	9	3	3	2	8	4	1	5	12
Denmark	835	984	1,245	1265	946	1,157	732	1,239	1,155	1,024	1,128	1,087
Faroes	1	7	1	-	10	18	20	-	15	10	6	n/a
France	-	-	124	151	69	28	18	7	7	3*	18[1*]	19[1*]
Germany	187	70	71	68	100	84	613	292	601	873	454	182
Netherlands	70	18	23	44	78	38	13	25	12	-	15	12
Norway	309	421	587	635	1,224	1,318	657	821	672*	941*	1,218*	1,182*
Sweden	9	5	14	7	7	7	2	1	2	8	8	78
UK (E&W&NI)	99	91	129	143	160	169	176	439	2,174	668	781	218
UK (Scotland)	6,366	6,788	7,039	7,887	9,712	11,683	15,658	22,344	18,783	13,319	9,710	9,559
Total	7,877	8,392	9,235	10,209	12,309	14,505	17,891	25,176	23,425	16,847	13,343	12,349

* Preliminary. [1]Includes IVb,c.

Central North Sea (IVb)

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Belgium	209	216	357	538	558	713	579	287	336	371	270	449
Denmark	211	278	345	421	347	352[1]	295	225	334	432	368	260
Faroes	-	-	-	-	2	-	-	-	-	-	-	n/a
France	-	-	-	1	-	2	-	-	-	-*	...[2*]	...[2*]
Germany	2	1	4	2	13	15	10	9	18	19	9	14
Netherlands	574	267	285	356	467	510	335	159	237	223	141	141
Norway	2	27	17	4	3	11	15	29	7*	13*	19*	9*
Sweden	-	-	-	-	-	3	2	1	3	3	4	3
UK (E&W&NI)	628	754	669	998	1,285	1,277	919	662	664	603	364	423
UK (Scotland)	495	634	845	733	469	564	472	475	574	424	344	318
Total	2,121	2,177	2,522	3,053	3,144	3,447	2,627	1,847	2,173	2,088	1,519	1,617

* Preliminary. [1]Includes 2 tonnes reported as Sub-area IV. [2]Included in IVa.

Southern North Sea (IVc)

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Belgium	54	21	13	12	34	37	26	28	17	17	11	15
Denmark	-	-	2	-	-	-	-	-	-	+	+	+
France	-	-	-	-	-	-	-	-	-	10	...[1*]	...[1*]
Germany	-	-	-	-	-	-	-	-	-	-	-	+
Netherlands	2	7	5	10	14	20	15	17	11	15	10	15
UK (E&W&NI)	30	6	6	17	18	136	361	256	131	36	3	1
UK (Scotland)	-	-	-	-	-	17	-	3	1	+	+	+
Total	86	34	26	39	66	210	402	304	160	78	24	31

* Preliminary. [1]Included in IVa.

Total North Sea

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Total	10,084	10,603	11,783	13,301	15,519	18,162	20,920	27,327	25,758	19,013	14,886	13,997
WG estimate	9,342	9,491	10,566	11,728	13,078	15,432	15,794	16,240	18,217	14,027	11,719	11,564
Unallocated	-742	-1,112	-1,217	-1,573	-2,441	-2,730	-5,126	-11,087	-7,541	-4,986	-3,167	-2,433

* Preliminary.

Table 3.7.7.2 Anglerfish in Sub-area VI. Nominal landings (t) as officially reported to ICES.

Anglerfish in Division VIa (West of Scotland)

	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Belgium	2	15	2	8	-	3	2	9	6	5	+	5	2	+	+
Denmark	-	4	-	34	-	1	3	4	5	10	4	1	2	1	+
France	1,505	1,601	2,329	1,901	2,182	1,910	2,308	2,467	2,382	2,648	2,899	2,058	1,634*	1,814[1*]	1,843[1*]
Germany	3	4	9	10		1	2	60	67	77	35	72	137	50	39
Ireland	295	187	324	556	398	250	403	428	303	720	717	625	749	617	n/a
Netherlands	-	-	-	-	-	-	-	-	-	-	-	27	1	-	-
Norway	6	3	8	27	8	6	14	8	6	4	4	1*	3*	1*	3*
Spain	142	130	269	15	35	7	11	8	1	37	33	63	86	53	n/a
UK(E&W&NI)	38	243	433	153	71	270	351	223	370	320	201	156	119	60	44
UK(Scotland)	1,099	1,768	2,629	3,024	2,921	2,613	2,385	2,346	2,133	2533	2,515	2,322	1,773	1,688	1,496
Total	3,090	3,955	6,003	5,728	5,615	5,061	5,479	5,553	5,273	6,354	6,408	5,330	4,506	4,284	3,425
Unallocated					184	296	2,638	3,816	2,766	5,112	11,148	7,506	5,234	3,799	3,000
As used by WG					5,799	5,357	8,117	9,369	8,039	11,466	17,556	12,836	9,654	7,413	6,425

*Preliminary. [1]Includes VIb.

Anglerfish in Division VIb (Rockall)

	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Faroe Islands	-	-	6	1	-	-	2	-	-	-	15	4	2	2	n/a
France	19	4	4	-	-	-	-	29	-	-	-	1	1	...[1*]	...[1*]
Germany	-	-	-	-	-	-	-	103	73	83	78	177	132	144	119
Ireland	-	-	-	-	400	272	417	96	135	133	90	139	130	75	n/a
Norway	9	11	7	13	16	18	10	17	24	14	11	4*	6*	5*	11*
Portugal	-	-	-	-	-	-	-	-	-	-	-	-	+	-	20
Spain	990	730	1340	81	138	333	263	178	214	296	196	171	252	291	n/a
UK(E&W&NI)	112	253	123	17	19	99	173	76	50	105	144	247	188	111	272
UK(Scotland)	196	296	250	201	249	201	224	182	281	199	68	156	189	344	374
Total	1,326	1,294	1,730	313	822	923	1,089	681	777	830	602	899	900	972	796

*Preliminary. [1]Included in VIa.

Total Anglerfish in Sub-area VI (West of Scotland and Rockall)

Year	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Total official	4,416	5,249	7,733	6,041	6,437	5,984	6,568	6,234	6,050	7,184	7,010	6,229	5,406	5,256	4,221
Total ICES	4,416	5,249	7,733	6,041	6,621	6,280	9,206	10,050	8,816	12,296	18,158	13,735	10,554	8,385	7,221

*Preliminary.

Table 3.7.7.3 Anglerfish in Sub-areas IV (North Sea) and VI (West of Scotland and Rockall).

Year	Sub-area IV	Sub-area VI	Total
1973	2.894	9.348	12.242
1974	4,231	3,652	7,883
1975	5,106	3,198	8,304
1976	5,272	3,455	8,727
1977	4,854	3,954	8,808
1978	4,627	3,627	8,254
1979	4,871	3,195	8,066
1980	5,263	2,834	8,097
1981	3,562	1,718	5,280
1982	3,169	3,608	6,777
1983	4,405	3,850	8,255
1984	6,096	4,642	10,738
1985	6,801	5,056	11,857
1986	7,608	4,416	12,024
1987	9,236	5,249	14,485
1988	8,744	7,733	16,477
1989	9,342	6,041	15,383
1990	9,491	6,621	16,112
1991	10,566	6,280	16,846
1992	11,728	9,206	20,934
1993	13,078	10,050	23,128
1994	15,432	8,816	24,248
1995	15,794	12,296	28,090
1996	16,240	18,158	34,398
1997	18,217	13,735	31,952
1998	14,027	10,554	24,581
1999	11,719	8,385	20,104
2000	11,564	7,221	18,785

3.7.8 Herring West of Scotland

3.7.8.a Herring in Division VIa (North)

State of stock/exploitation: It has not been possible to access the status of this stock with respect to safe biological limits. F is at present considered to be low and close to the value of $\mathbf{F_{0.1}}$. The stock has remained stable and fishing mortality has decreased in recent years.

Management objectives: There are no explicit management objectives for this stock.

Advice on management: ICES recommends catches in 2002 should not exceed the 1991–2000 average of 30 000 t.

Relevant factors to be considered in management: In recent years TACs have not been restrictive, presumably because of low effort and a weak market. There has been substantial misreporting of catches into this area from the North Sea and Division VIa(S).

Comparison with previous assessment and advice: The perception of stock status and management advice has not changed.

Catch forecast for 2002: No projections were carried out given the uncertainty in the assessment.

Elaboration and special comment: There are three main fleets operating, 1) the Scottish inshore paired midwater trawl fleet, which operates in the Minches and around the Isle of Barra in the southern part of the area, 2) the Scottish purse-seine fleet, which operates in the northern part of VIa, and 3) the offshore (mainly Dutch and German freezer trawlers) fleet, which operates in the deeper waters near the edge of the continental shelf.

Information on misreporting in the catches has improved, but biological sampling of catches has deteriorated and the assessment remains uncertain. Satellite data has improved knowledge of vessel behaviour. The assessment is uncertain based on uncertain catches and a noisy survey series, but analyses in recent years have consistently pointed towards the stock being exploited at a sustainable rate. Acoustic surveys and the assessment indicate that spawning biomass is reasonably stable or may be increasing. Yield per recruit analysis with geometric mean recruitment suggests that an F of 0.25 would provide a yield of 32 000 t.

Source of information: Report of the Herring Assessment Working Group for the Area South of 62°N, March 2001 (ICES CM 2001/ACFM:12).

Catch data (Tables 3.7.8.a.1-2):

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC	Disc. slip	ACFM Catch[1]
1987	Reduce F to $\mathbf{F}_{0.1}$/*status quo* F	38-55	49.7		44
1988	TAC	46	49.8		36
1989	TAC	58	58	1.6	34
1990	TAC	61	75	1.3	45
1991	TAC	57	62	1.2	29
1992	TAC	62	62	0.2	29
1993	Catch at *status quo* F	54-58	62	0.8	32
1994	Catch at *status quo* F	50-60	62	0.7	24
1995	No specific advice	60[2]	77		30
1996	No advice because of misreporting	-	83.57		26
1997	Catch at *status quo* F		83.57	0.1	33[3]
1998	Catch at *status quo* F	59	80.37	0.9	33
1999	Average catches, 1991–1996	28	68		30
2000	Average catches, 1991–1996	28	42		23
2001	Average catches, 1991–1999	30	36.36		
2002	Average catches, 1991–1999	30			

[1]Adjusted for misreporting. [2]Catch at *status quo* F. Weights in '000 t. [3]Revised down from 60 in 1999.

Herring in Division VIa (North)

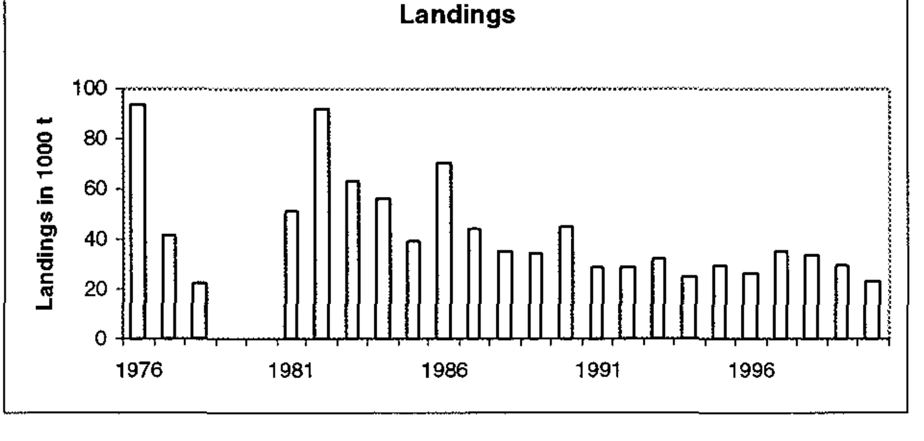


Table 3.7.8.a.1 Herring in VIa(N). Catch in tonnes by country, 1980-2000. These figures do not in all cases correspond to the official statistics and cannot be used for management purposes.

Country	1980	1981	1982	1983	1984	1985	1986
Denmark		1580			96		
Faroes			74	834	954	104	400
France	2	1243	2069	1313		20	18
Germany	256	3029	8453	6283	5564	5937	2188
Ireland							6000
Netherlands		5602	11317	20200	7729	5500	5160
Norway		3850	13018	7336	6669	4690	4799
UK	48	31483	38471	31616	37554	28065	25294
Unallocated		4633	18958	-4059	16588	-502	37840
Discards							
Total	306	51420	92360	63523	75154	43814	81699
Area-Misreported					-19142	-4672	-10935
WG Estimate	306	51420	92360	63523	56012	39142	70764
Source (WG)	1982	1983	1984	1985	1986	1987	1988

Country	1987	1988	1989	1990	1991	1992	1993
Denmark							
Faroes				326	482		
France	136	44	1342	1287	1168	119	818
Germany	1711	1860	4290	7096	6450	5640	4693
Ireland	6800	6740	8000	10000	8000	7985	8236
Netherlands	5212	6131	5860	7693	7979	8000	6132
Norway	4300	456		1607	3318	2389	7447
UK	26810	26894	29874	38253	32628	32730	32602
Unallocated	18038	5229	2123	2397	-10597	-5485	-3753
Discards			1550	1300	1180	200	
Total	63007	47354	53039	69959	50608	51578	56175
Area-Misreported	-18647	-11763	-19013	-25266	-22079	-22593	-24397
WG Estimate	44360	35591	34026	44693	28529	28985	31778
Source (WG)	1989	1990	1991	1992	1993	1994	1995

Country	1994	1995	1996	1997	1998	1999	2000
Denmark							
Faroes							
France	274	3672	2297	3093	1903	463	870
Germany	5087	3733	7836	8873	8253	6752	4615
Ireland	7938	3548	9721	1875	11199	7915	4841
Netherlands	6093	7808	9396	9873	8483	7244	4647
Norway	8183	4840	6223	4962	5317	2695	
UK	30676	42661	46639	44273	42302	36446	22816
Unallocated	-4287	-4541	-17753	-8015	-11748	-8155	
Discards	700			62	90		
Total	54664	61271	64359	64995	65799	61514	37789
Area-Misreported	-30234	-32146	-38254	-29766	-32446	-23623	-14626
WG Estimate	24430	29575	26105	35233*	33353	29736	23163
Source (WG)	1996	1997	1997	1998	1999	2000	2001

*WG estimate for 1997 has been revised according to the Bayesian assessment (see text section 5.1.3).

Table 3.7.8.a.2 Herring in Division VIa (North).

Year	Landings
	tonnes
1976	93642
1977	41341
1978	22156
1979	60
1980	306
1981	51420
1982	92360
1983	63523
1984	56012
1985	39142
1986	70764
1987	44360
1988	35591
1989	34026
1990	44693
1991	28529
1992	28985
1993	31778
1994	24430
1995	29575
1996	26105
1997	35233
1998	33353
1999	29736
2000	23163
Average	39211

3.7.8.b Clyde herring (Division VIa)

State of stock/exploitation: In the absence of surveys, and no stock separation of catches, little is currently known about the state of the Clyde spring-spawning stock or the immigrant autumn-spawning component from elsewhere within Division VIa. The fishing mortality is not known. The catch in 2000 was the lowest on record.

Advice on management: ICES recommends that until new evidence is obtained on the state of the stock, existing time and area restrictions on the fishery should be continued in 2002.

Relevant factors to be considered in management: Traditionally, the fishery has taken place in October and November. In 2000 there was no fishery. The absence of a fishery might be explained by the low price of herring in 2000 compared to other pelagic species available to the vessels to which the quota is assigned.

Elaboration and special comments: There are two stock components present on the fishing grounds, resident spring-spawners and immigrant autumn-spawners. The spring-spawning stock supported a strong and locally important fishery from 1955–1974 at catch levels ranging from 4 000 to 15 000 t. Since 1988 catches have been below the TAC.

No assessment possible. No independent survey data are available for recent years.

Source of information: Report of the Herring Assessment Working Group for the Area South of 62°N, March 2001 (ICES CM 2001/ACFM:12).

Catch data (Table 3.7.8.b.1):

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC	Disc. slip.	ACFM Catch
1987	Fishing at $F_{0.1}$	3.5	3.5	0.4	3.6
1988	TAC	3.2	3.2	0.2	1.9
1989	Stabilise catch at recent levels	2.9–3.4	3.2		2.3
1990	TAC	2.6	2.6		2.3
1991	TAC	2.9	2.9		0.7
1992	TAC	1.6	2.3		0.9
1993	Lowest possible level	-	1.0		0.9
1994	Lowest possible level	-	1.0		0.6
1995	Lowest possible level	-	1.0		0.4
1996	Lowest possible level	-	1.0		0.9
1997	Lowest possible level	-	1.0		0.5
1998	Continue existing restrictions	-	1.0		1.0
1999	Continue existing restrictions	-	1.0		0.3
2000	Continue existing restrictions	-	1.0		0.0
2001	Continue existing restrictions	-	1.0		
2002	Continue existing restrictions	-			

Weights in '000 t.

Clyde herring (Division VIa)

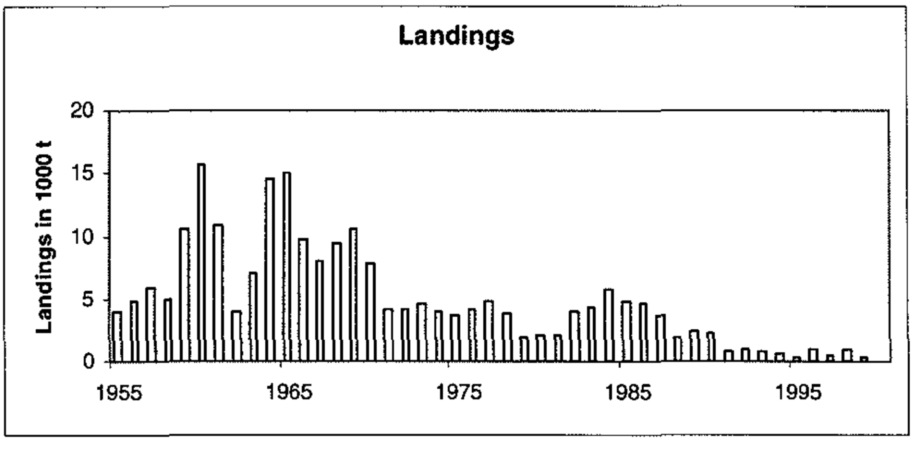


Table 3.7.8.b.1 Catches of HERRING from the Firth of Clyde. Spring and autumn-spawners combined. Catch in tonnes by country, 1955–2000.

Year	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971
All Catches																	
Total	4,050	4,848	5,915	4,926	10,530	15,680	10,848	3,989	7,073	14,509	15,096	9,807	7,929	9,433	10,594	7,763	4,088

Year	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
All Catches										
Total	4,226	4,715	4,061	3,664	4,139	4,847	3,862	1,951	2,081	2,135

Year	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Scotland	2,506	2,530	2,991	3,001	3,395	2,895	1,568	2,135	2,184	713	929	852
Other UK	-	273	247	22	-	-	-	-	-	-	-	-
Unallocated[1]	262	293	224	433	576	278	110	208	75	18	-	-
Discards	1,253	1,265	2,308[3]	1,344[3]	679[3]	439[4]	245[4]	-[2]	-[2]	-[2]	-[2]	-[2]
Agreed TAC			3,000	3,000	3,100	3,500	3,200	3,200	2,600	2,900	2,300	1,000
Total	4,021	4,361	5,770	4,800	4,650	3,612	1,923	2,343	2,259	731	929	852

Year	1994	1995	1996	1997	1998	1999	2000
Scotland	608	392	598	371	779	16	1
Other UK	-	-	283	119	213	240	0
Unallocated[1]	-	-	-	-	-	-	-
Discards	-[2]	-[2]	-	-	-	-	-
Agreed TAC	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Total	608	392	881	490	992	256	1

[1]Calculated from estimates of weight per box and in some years estimated by-catch in the sprat fishery
[2]Reported to be at a low level, assumed to be zero.
[3]Based on sampling.
[4]Estimated assuming the same discarding rate as in 1986.

3.7.9 Norway pout in Division VIa (West of Scotland)

State of the stock/exploitation: There is no current information on which to evaluate the state of the stock.

Management objectives: There are no specific management objectives for the fisheries exploiting this stock.

Elaboration and special comment: The fishery is a small mesh trawl fishery operated by Danish vessels. Catches are highly variable. The only data available are official landings statistics. There is no information available on which to base scientific advice. By-catches in this fishery should be quantified and made available to ICES.

Source of information: Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, June 2001 (ICES CM 2002/ACFM:01).

Catch data (Tables 3.7.9.1-2):

Year	ICES advice	Official Landings
1987	No advice	38.3
1988	No advice	6.7
1989	No advice	28.2
1990	No advice	3.3
1991	No advice	4.3
1992	No advice	5.2
1993	No advice	7.3
1994	No advice	14.1
1995	No advice	24.4
1996	No advice	6.3
1997	No advice	9.6
1998	No advice	7.2
1999	No advice	4.6
2000	No advice	2.0
2001	No advice	
2002	No advice	

Weights in '000 t.

Norway pout in Division VIa (West of Scotland)

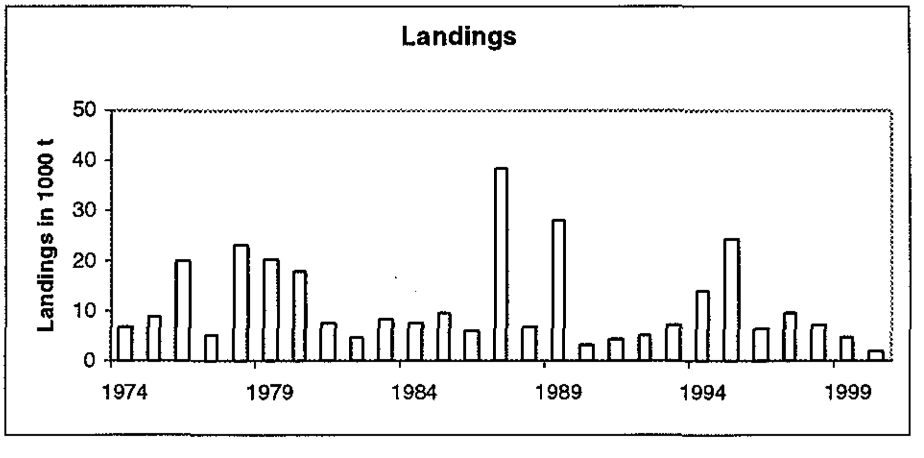


Table 3.7.9.1 Norway pout in Division VIa (West of Scotland). Landings officially reported to ICES.

Country	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Denmark	37,714	5,849	28,180	3,316	4,348	5,147	7,338	14,147	24,431	6,175	9,549	7,186
Faroes Islands	-	376	11	-	-	-	-	-	-	-	-	-
Germany	-	-	-	-	-	-	-	-	1	-	-	-
Netherlands	-	-	-	-	-	10	-	-	7	7	-	-
UK (E & W)	-	-	-	-	-	1	-	1	-	-	-	-
UK (Scotland)	553	517	5	-	-	-	-	+	-	140	13	-
Total	38,267	6,742	28,196	3,316	4,348	5,158	7,338	14,148	24,439	6,322	9,562	7,186

Country	1999	2000
Denmark	4,624	2005
Faroes Islands	-	-
Germany	-	-
Netherlands	1	-
UK (E & W)	-	-
UK (Scotland)	-	-
Total	4,625	2005

Table 3.7.9.2 Norway pout in Division VIa (West of Scotland).

Year	Landings tonnes
1974	6721
1975	8655
1976	19933
1977	5206
1978	23250
1979	20502
1980	17870
1981	7757
1982	4911
1983	8325
1984	7794
1985	9697
1986	5832
1987	38267
1988	6742
1989	28196
1990	3316
1991	4348
1992	5158
1993	7338
1994	14148
1995	24439
1996	6322
1997	9562
1998	7186
1999	4625
2000	2005
Average	11411

3.7.10 Sandeel in Division VIa

State of the stock/exploitation: There is no current information on which to evaluate the state of the stock.

Management objectives: The current management regime uses a multi-annual TAC of 12 000 t per year with the fishery closed from 31 July. Access is limited to vessels with a track record. These arrangements took effect in 1998 for a period of three years and were renewed in 2001.

Relevant factors to be considered in management: Fishing grounds are close inshore and often adjacent to large colonies of seabirds for which the sandeel population is an important food supply, especially during the breeding season.

Elaboration and special comment: The stock was last assessed in 1996 and a new assessment has not been made. At that time it was considered to be within safe biological limits.

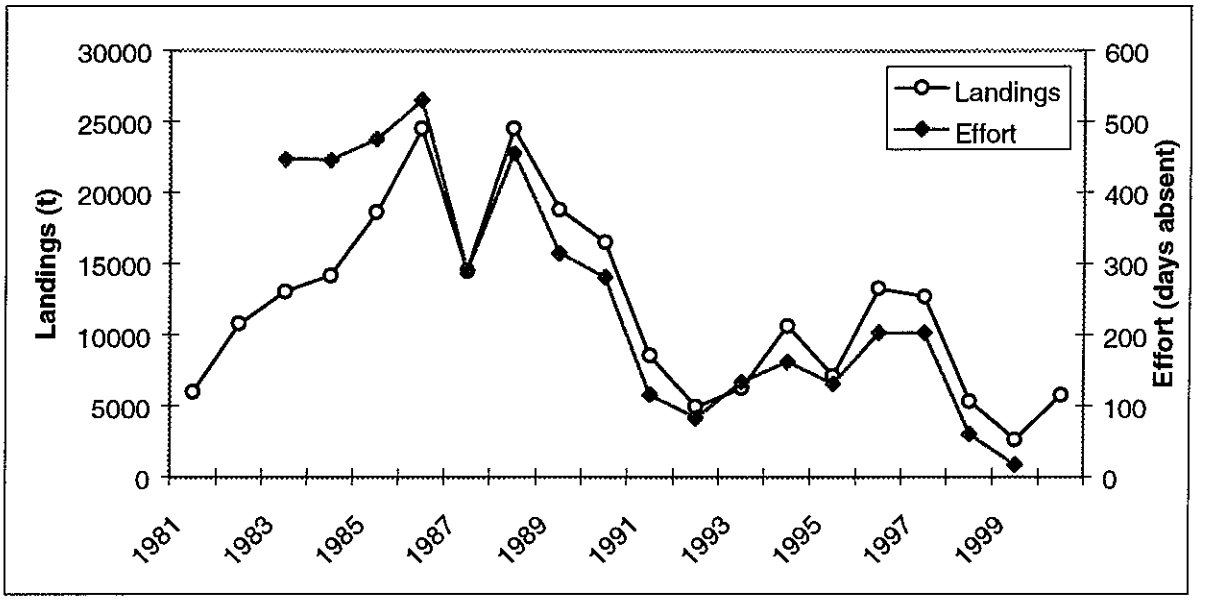
Source of information: Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, June 2001, Hamburg, Germany (ICES CM 2002/ACFM: 01).

Catch data (Table 3.7.10.1):

Year	ICES Advice	Agreed TAC	Official landings	ACFM catch
1987	No advice		14.5	14.5
1988	No advice		24.5	24.5
1989	No advice		18.8	18.8
1990	No advice		16.5	16.5
1991	No advice		8.5	8.5
1992	No advice		4.9	4.9
1993	No advice		6.2	6.2
1994	No advice		10.6	10.6
1995	No advice		7.1	7.1
1996	No advice		13.3	13.3
1997	No advice		12.7	12.7
1998	No advice	12	5.3	5.3
1999	No advice	12	2.6	2.6
2000	No advice	12	5.8	5.8
2001	No advice	12		
2002	No advice			

Weights in '000 t.

Sandeel in VIa. Trends in landings and effort.



Sandeel in Division VIa

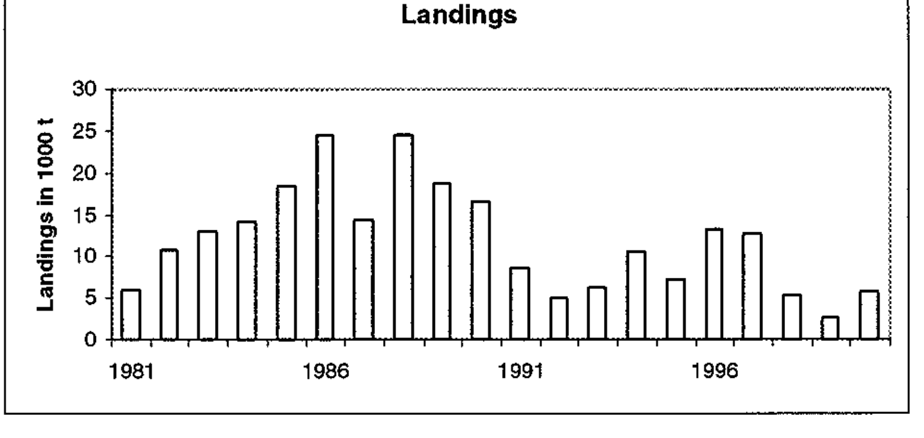


Table 3.7.10.1 Sandeel in Division VIa. Landings as officially reported to ICES.

Country	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
UK (Scotland)	5,972	10,786	13,051	14,166	18,586	24,469	14,479	24,465	18,785	16,515
Total	5,972	10,786	13,051	14,166	18,586	24,469	14,479	24,465	18,785	16,515

Country	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000*
Denmark	-	-	80	-	-	-	-	-	-	-
UK (Scotland)	8,532	4,935	6,156	10,627	7,111	13,257	12,679	5,320	2,627	...
United Kingdom										5,771
Total	8,532	4,935	6,236	10,627	7,111	13,257	12,679	5,320	2,627	5,771

*Preliminary.

3.8 Stocks in the Irish Sea (Division VIIa)

3.8.1 Overview

Fisheries

The roundfish fisheries in the Irish Sea are conducted primarily by vessels from the bordering countries (UK and Ireland). The majority of vessels are otter-trawlers fishing for cod, whiting and plaice, with by-catches of haddock, anglerfish, hake and sole. The mesh size is 80mm and 80mm square mesh panels have been mandatory for UK otter-trawlers since 1993, and for Irish trawlers since 1994. The number of Irish vessels operating in this region has declined in recent years. Fishing effort in the England and Wales fleet of vessels longer than 12.2m declined rapidly after 1989, and over 1992–1995 was about 40% of the effort reported in the 1980s, although it has increased again in recent years. Since the early 1980s there has been a development of semi-pelagic trawling for cod and whiting, predominantly by vessels from Northern Ireland. Some of these vessels switch between pelagic trawling and twin-trawl fishing for *Nephrops* depending on fishing opportunities and market demands.

Although some of the otter-trawlers also take part in the fishery for sole, there has been a growing number of beam-trawlers, particularly from southern England and from Belgium, exploiting this stock. The most important by-catches of this fleet are plaice, rays, brill, turbot and anglerfish. The fishing effort of the Belgian beam-trawl fleet varies according to the catch-rates of sole in the Irish Sea compared with other areas in which the fleet operates. Fishing effort peaked in the late 1980s following a series of strong year classes of sole, but is presently only about 60% of the peak value.

A fleet of vessels, primarily from Ireland and Northern Ireland, takes part in a targeted *Nephrops* fishery using 70mm nets and 75mm square-mesh panels. The larger vessels, including some that normally target roundfish, may use twin trawls with 80mm mesh. Decommissioning has reduced the size of the Northern Ireland fleet in recent years. All boats take a considerable by-catch of whiting, much of which is discarded. Discards comprise mainly juveniles because the distribution of *Nephrops* coincides with the main nursery grounds for whiting. In this fishery as well as in the roundfish fishery in the western Irish Sea, the by-catch of haddock has increased substantially in recent years because of strong year classes in the 1990s.

The other gears employed to catch demersal species are gill-nets, notably by inshore boats targeting cod, bass, grey mullet, sole and plaice.

The main pelagic fishery in the Irish Sea is for herring. In recent years, it has been predominantly operated by pair-trawlers from Northern Ireland. The size of this fleet has declined to a very low level in recent years.

State of the Stocks

The stock of cod is outside safe biological limits and at risk of collapse: The spawning biomass is below $\mathbf{B}_{\text{lim}}$ and fishing mortality is close to $\mathbf{F}_{\text{lim}}$. Fishing mortality on cod increased progressively throughout the 1980s. During the early 1990s, the spawning stock declined rapidly and is presently dominated by one age class. As a consequence, it is sensitive to variations in recruitment and in 1995 reached a historical low following entry of the very weak 1992 year class. The 1997 and 1998 year classes are very weak and the 1999 year class is estimated to be about average. In 2000, the EU introduced a recovery plan for Irish Sea cod (Council Regulation (EC) No. 304/2000) and subsequently established technical measures for the recovery of the stock of cod in the Irish Sea (Council Regulation (EC) No. 2549/2000). This recovery plan consisted of spawning box closures from 14 February to 30 April 2000. Within the closure it was prohibited to use any demersal trawl, seine or similar towed net, any gill net, trammel net, tangle net or similar static net or any fishing gear incorporating hooks. Derogations were permitted for certain demersal otter trawls and for certain beam trawls. The closure was continued in 2001, but was restricted to the western Irish Sea west of 4°50'W on the evidence that the abundance of adult cod in the eastern Irish Sea was too low to justify the restrictions on fishing for other species.

The stock of whiting is also outside safe biological limits, both in terms of biomass (below $\mathbf{B}_{\text{lim}}$ since 1997) and of fishing mortality (above $\mathbf{F}_{\text{pa}}$ since 1980). The Irish Sea whiting fishery has been characterised by high levels of fishing mortality throughout the 1980s and 1990s. At such high fishing mortalities, the spawning stock contains few age classes and is vulnerable to poor recruitment, and the stock has been in more or less continuous decline since the early 1980s. Discarding of whiting is considered a major problem in the *Nephrops* directed fishery.

A notable phenomenon in the Irish Sea, and also in the Celtic Sea, during the 1990s has been a substantial growth in the stock of haddock, particularly following the recruitment of above-average 1991 and 1993 year classes and a very strong 1994 year class. The 1996 year class is confirmed to be still stronger and will result in increased catches in the short term. The fish are confined mainly to the western Irish Sea where established roundfish and *Nephrops* fisheries take place. Due to the present TAC arrangements, some national quotas have proved limiting, causing substantial misreporting. To alleviate this problem, a separate TAC allocation for Irish Sea haddock has operated since 1999.

The stock of plaice is within safe biological limits. The landings declined in the 1990s, and in 1998 were close to the lowest recorded. This resulted from a combination of declining fishing effort and a succession of below-average year classes recruited since 1987. The spawning stock in currently above $\mathbf{B}_{pa}$ and fishing mortality in 2000 was below $\mathbf{F}_{pa}$. The stock is expected to increase and will have a low probability of falling outside safe biological limits in the medium-term.

The sole stock is within safe biological limits. It has benefited several times since 1970 from very strong year classes, and as a consequence has sustained fishing mortalities that are considered high for a sole stock. In 2000, fishing mortality was at $\mathbf{F}_{pa}$. The frequency of strong year classes has decreased since the mid-1980s, leading to a decline in spawning stock to a historical low in 1996. The stocks of *Nephrops* in the Irish Sea are considered to be fully exploited. There is some concern that fishing mortality may rise from the current high level if the use of twin trawls expands. Account should also be taken of the impact of this fishery on the stocks of protected species. There has been no assessment in recent years of the effects on *Nephrops* of predation by cod, but the low abundance of the latter has probably reduced its impact.

The stock of Irish Sea herring is presently subject to low fishing mortality exerted by a small fleet of trawlers from Northern Ireland. The stock has recovered from the collapse which followed high fishing mortalities in the 1970s. However its present state is uncertain because the series of survey estimates remains too short to establish the recent trends in biomass.

3.8.2 Cod in Division VIIa (Irish Sea)

State of stock/exploitation: The stock remains outside of safe biological limits. Fishing mortality in 2000 was estimated to be close to $\mathbf{F_{lim}}$, and SSB in 2000 to below $\mathbf{B_{lim}}$. For the past ten years F has been in the region of $\mathbf{F_{lim}}$, whilst SSB has remained in the region of $\mathbf{B_{lim}}$. The probability of good recruitment appears to have been reduced at the SSBs observed in the 1990s.

Management objectives: To rebuild the SSB of the stock, a spawning closure was introduced in 2000 for ten weeks from mid-February to maximize the reproductive output of the stock (EU Regulations 304/2000 and 2549/2000). The measures were revised in 2001, involving a continued, but smaller spawning ground closure, coupled with protection of juvenile fish.

Precautionary Approach reference points (established in 1998):

ICES considers that:	ICES proposes that:
$\mathbf{B_{lim}}$ is 6 000 t (agreed by ACFM in 1998)	$\mathbf{B_{pa}}$ be set at 10 000 t. This is the previously agreed MBAL and affords a high probability of maintaining the SSB above $\mathbf{B_{lim}}$, taking into account the uncertainty of assessments. Below this value the probability of below average recruitment increases.
$\mathbf{F_{lim}}$ is 1.0. This is the fishing mortality above which there is a reduced probability that the stock can sustain itself.	$\mathbf{F_{pa}}$ be set at 0.72. This F is considered to have a high probability of avoiding $\mathbf{F_{lim}}$. Fishing mortalities above $\mathbf{F_{pa}}$ have been associated with observed stock decline.

Technical basis:

$\mathbf{B_{lim}} = \mathbf{B_{loss}}$	$\mathbf{B_{pa}} =$ Previous MBAL and signs of reduced recruitment
$\mathbf{F_{lim}} = \mathbf{F_{med}}$	$\mathbf{F_{pa}} = \mathbf{F_{med}} * 0.72$

Advice on management: ICES recommends a recovery plan that will ensure a safe and rapid recovery of SSB to a level in excess of 10 000 t. If a recovery plan is not implemented ICES recommends that fishing mortality on cod should be reduced to the lowest possible level in 2002.

Relevant factors to be considered in management: The lower TAC and the closure of spawning ground appear to have resulted in a reduced fishing mortality on older age groups in 2000. It is not possible to identify the relative contribution of these measures. There is also an indication that fishing mortality on two-year-olds in 2000 may have increased. The average F in Table 3.8.2.2 does not show these effects. It is important that management action being taken to reduce fishing mortality on the adult component of the stock is not compensated for by an increase in fishing mortality on the juveniles.

In view of the state of the cod stock in Division VIIa, diversion of effort from the cod spawning grounds to other vulnerable stocks should also be prevented.

Comparison with previous assessment and advice: The estimates of fishing mortality in 1999 is 15% lower and SSB in 2000 the same in this years assessment compared to last years assessment. The basis for the advice is the same as last year.

Catch forecast for 2002:

Basis: F(2001) = F(98-00) = 0.97; Landings (2001) = 5.9; SSB(2002) = 5.8.

F (2002) Onwards	Basis	Catch (2002)	Landings (2002)	SSB (2003)
0.00	0.0 F(98-00)	0	0	13.7
0.19	0.2 F(98-00)	1.6	1.6	11.2
0.29	0.3 F(98-00)	2.3	2.3	10.1
0.39	0.4 F(98-00)	3.0	3.0	9.1
0.58	0.6 F(98-00)	4.0	4.0	7.5
0.72	F_{pa}	4.8	4.8	6.4
0.78	0.8 F(98-00)	4.9	4.9	6.2
0.97	1.0 F(98-00)	5.6	5.6	5.1

Weights in '000 t.

Shaded scenarios are considered inconsistent with the precautionary approach.

The catch forecast is made on the assumption of an average exploitation pattern 1998-2000, due to a poorly determined exploitation pattern in the last year of the assessment.

Elaboration and special comment: The cod fishery has traditionally been carried out by otter trawlers targeting spawning cod in spring and juvenile cod in autumn and winter. Activities of these vessels have decreased in recent years, whilst a fishery for cod and hake using large pelagic trawls increased substantially during the 1980s. In recent years the pelagic fishery has also targeted cod during the summer. Cod are also taken as a by-catch in fisheries for *Nephrops*, plaice and sole.

Analytical assessment is based on landings-at-age and recruitment indices from surveys in Division VIIa. Estimates of mis-reported landings are included from 1991 onwards. Successive assessments have revised the estimates of recent fishing mortality upwards.

Although landings in 2000 were half those in 1999, the fishing mortality still remains high, due in part to the lowest observed year class passing through the fishery.

Source of information: Report of the Working Group on the Assessment of Northern Shelf Demersal Stocks, August 2001 (ICES CM 2002/ACFM:02).

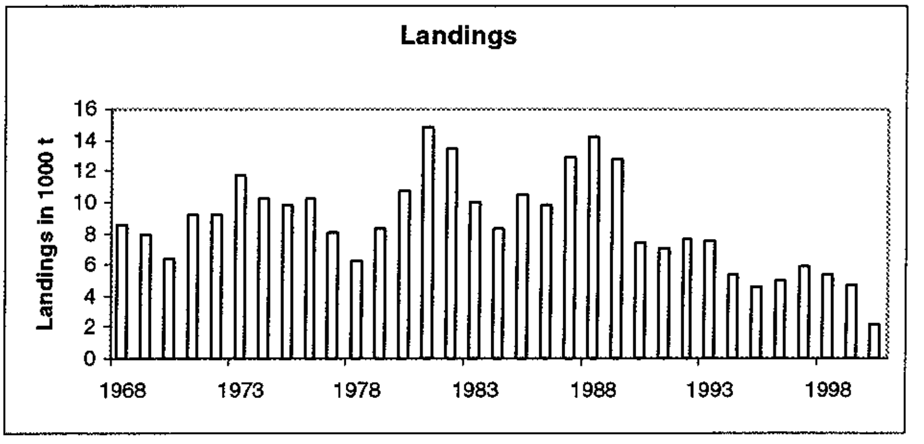
Yield and spawning biomass per Recruit F-reference points:

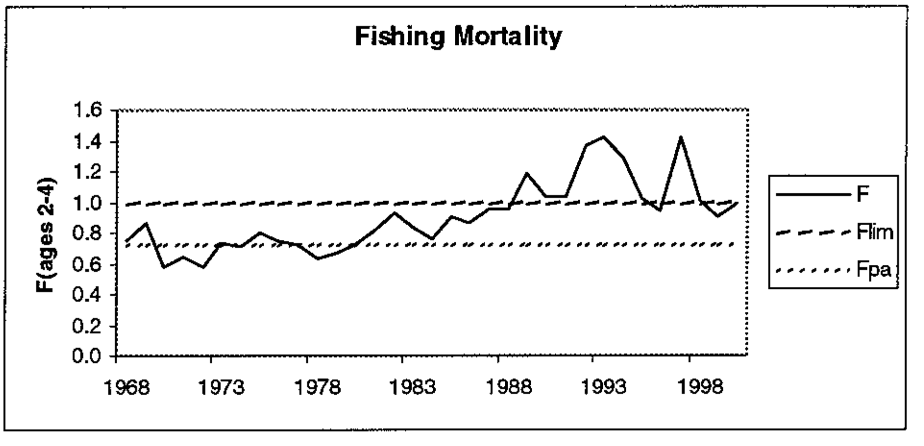
	Fish Mort Ages 2-4	Yield/R	SSB/R
Average Current	0.971	1.274	1.321
$\mathbf{F}_{max}$	0.271	1.688	6.811
$\mathbf{F}_{0.1}$	0.157	1.574	10.697
$\mathbf{F}_{med}$	0.845	1.332	1.629

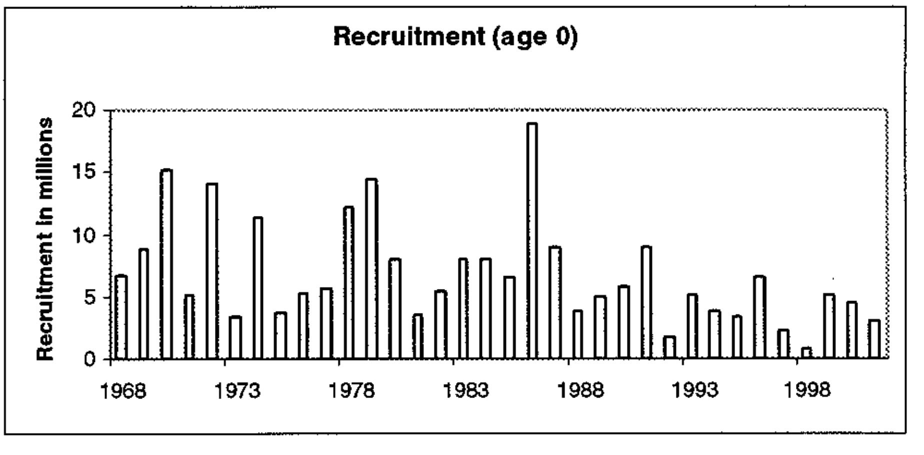
Catch data (Tables 3.8.2.1–2):

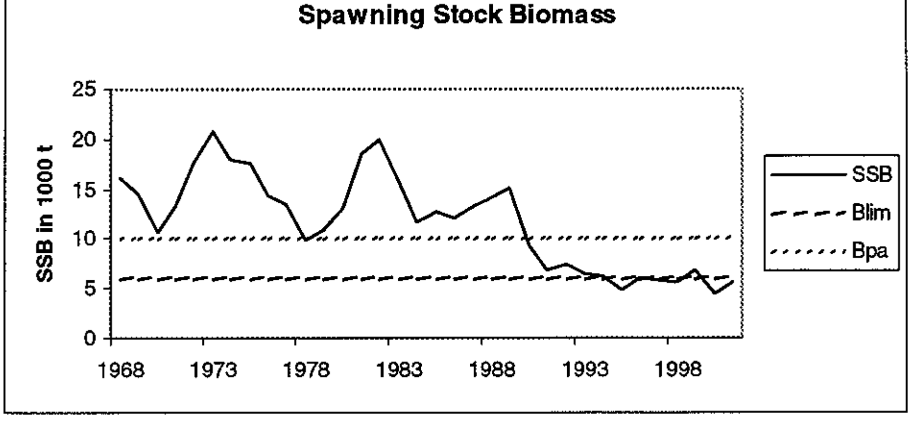
Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC	Official landings	ACFM Landings
1987	No increase in F; interaction with *Nephrops*	10.3	15.0	13.2	12.9
1988	No increase in F; interaction with *Nephrops*	10.1	15.0	15.8	14.2
1989	No increase in F	13.4	15.0	11.3[1]	12.8
1990	F at $\mathbf{F}_{med}$; TAC	15.3	15.3	9.9[1]	7.4
1991	Stop SSB decline; TAC	6.0	10.0	7.0[1]	7.1[2]
1992	20% of F(90) ~ 10 000 t	10.0	10.0	7.4	7.7[2]
1993	$\mathbf{F}_{med}$ ~ 10 200 t	10.2	11.0	5.9	7.6[2]
1994	60% reduction in F	3.7	6.2	4.5	5.4[2]
1995	50% reduction in F	3.9	5.8	4.5	4.6[2]
1996	30% reduction in F	5.4	6.2	5.30	4.96[2]
1997	30% reduction in F	5.9	6.2	4.44	5.86[2]
1998	No increase in F	6.2	7.1	4.96	5.32[2]
1999	Reduce F below $\mathbf{F}_{pa}$	4.9	5.5	1.98[3]	4.77[2]
2000	Lowest possible F	0	2.1	0.96[3]	2.19[2]
2001	Lowest possible F	0	2.1		
2002	Establish rebuilding plan	-			

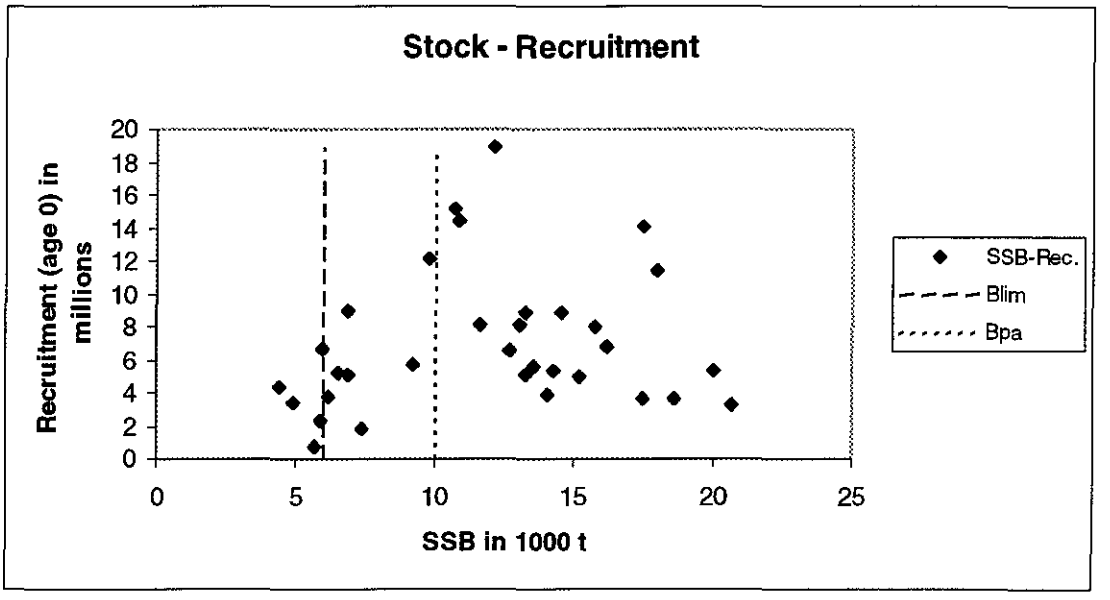
[1]Preliminary. [2]Including estimates of mis-reporting. [3]Incomplete data. Weights in '000 t.

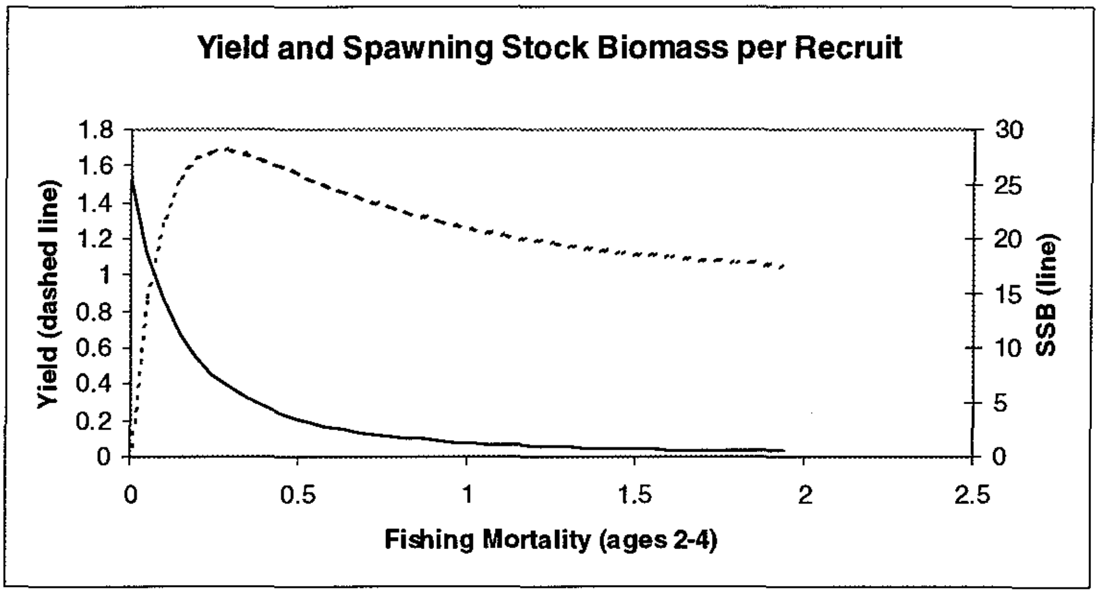

Landings
Landings in 1000 t
16
14
12
10
8
6
4
2
0
1968
1973
1978
1983
1988
1993
1998


Fishing Mortality
F(ages 2-4)
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1968
1973
1978
1983
1988
1993
1998
F
Flim
Fpa


Recruitment (age 0)
Recruitment in millions
20
15
10
5
0
1968
1973
1978
1983
1988
1993
1998


Spawning Stock Biomass
SSB in 1000 t
25
20
15
10
5
0
1968
1973
1978
1983
1988
1993
1998
SSB
Blim
Bpa


Stock - Recruitment
Recruitment (age 0) in millions
SSB in 1000 t
SSB-Rec.
Blim
Bpa
0
2
4
6
8
10
12
14
16
18
20
0
5
10
15
20
25


Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
SSB (line)
Fishing Mortality (ages 2-4)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
0
5
10
15
20
25
30
0
0.5
1
1.5
2
2.5

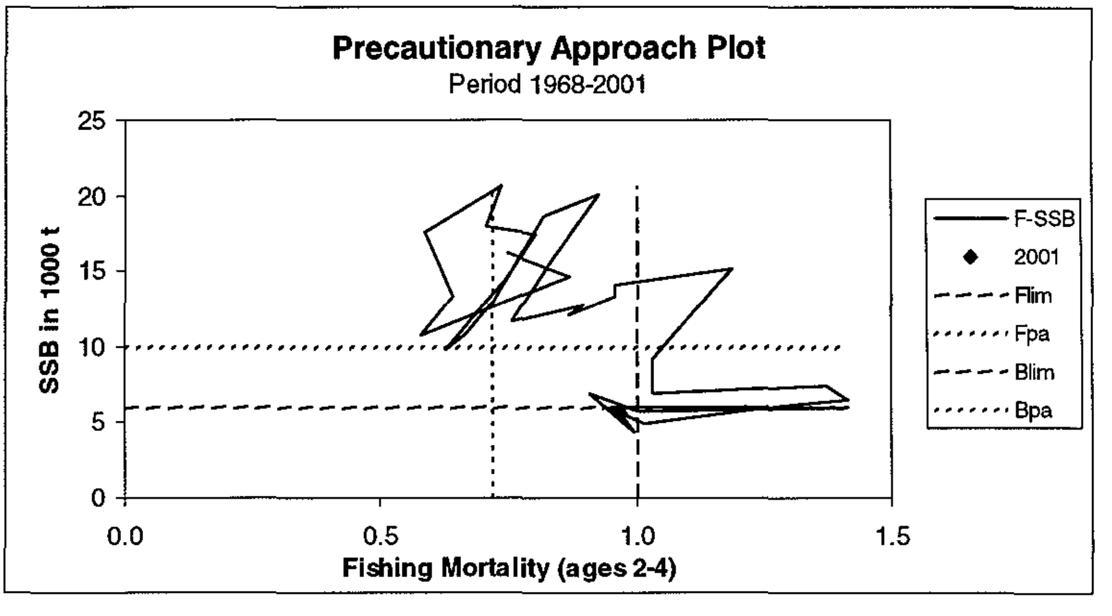

Precautionary Approach Plot
Period 1968-2001
SSB in 1000 t
Fishing Mortality (ages 2-4)
F-SSB
2001
Flim
Fpa
Blim
Bpa
0
5
10
15
20
25
0.0
0.5
1.0
1.5

Table 3.8.2.1 Nominal catch (t) of COD in Division VIIa as officially reported to ICES, and Working Group estimates of annual landings.

Country	1986	1987	1988	1989	1990	1991	1992	1993
Belgium	222	344	269	467	310	78	174	169
France	1,480	1,717	2,406	352[1]	201[1]	320[1]	916	686
Ireland	3,991	5,017	5,821	3,656	2,800	2,364	2,260	1,328
Netherlands	-	-	-	-	-	-	-	-
UK (England & Wales)[3]	847	1,922	2,667	6,320	4,752	3,562	3,529	3,244
UK (Isle of Man)	80	44	118	39	48	175	129	57
UK (N. Ireland)	2,992	3,565	4,080	...	...	...	...	...
UK (Scotland)	446	574	472	465	1,767	515	393	453
Total	10,058	13,183	15,833	11,299	9,878	7,014	7,401	5,937
Unallocated	-206	-289	-1,665	1,452	-2,499	81	334	1,618
Total figures used by Working Group for stock assessment	9,852	12,894	14,168	12,751	7,379	7,095[2]	7,735[2]	7,555[2]

Country	1994	1995	1996	1997	1998	1999	2000
Belgium	129	187	142	183	316	150	60
France	208	166	148	268	269[1]	85[1]	66[1]
Ireland	1,506	1,414	2,476	1,492	1,739	966	n/a
Netherlands	-	-	25	29	20	5	1
UK (England & Wales)[3]	2,274	2,330	2,359	2,370	2,517	1,665	799
UK (Isle of Man)	26	22	27	19	34	9	n/a
UK (N. Ireland)	...	...	...	...	...	...	...
UK (Scotland)	326	414	126	80	67	80	38
Total	4,469	4,533	5,303	4,441	4,962	2,960	964
Unallocated	933	54	-339	1,418	355	1,821	1,224
Total figures used by Working Group for stock assessment	5,402[2]	4,587	4,964	5,859	5,317	4,781	2,188

[1]Preliminary.
[2]Revised.
[3]1989–2000 N. Ireland included with England and Wales.
n/a = not available.

Table 3.8.2.2 Cod in Division VIIa (Irish Sea).

Year	Recruitment Age 0 thousands	SSB tonnes	Landings tonnes	Mean F Ages 2-4
1968	6790	16226	8541	0.7487
1969	8803	14570	7991	0.8688
1970	15209	10719	6426	0.5783
1971	5085	13313	9246	0.6432
1972	14035	17507	9234	0.5858
1973	3285	20667	11819	0.7367
1974	11350	17998	10251	0.7067
1975	3615	17464	9863	0.8035
1976	5355	14270	10247	0.7433
1977	5593	13553	8054	0.7237
1978	12093	9801	6271	0.6304
1979	14374	10897	8371	0.6686
1980	8074	13056	10776	0.7238
1981	3578	18573	14907	0.8192
1982	5364	20014	13381	0.9278
1983	7951	15741	10015	0.8345
1984	8071	11652	8383	0.7593
1985	6548	12716	10483	0.8970
1986	18861	12143	9852	0.8704
1987	8901	13303	12894	0.9582
1988	3867	14096	14168	0.9592
1989	4988	15216	12751	1.1868
1990	5741	9230	7379	1.0311
1991	8928	6898	7095	1.0317
1992	1774	7397	7735	1.3722
1993	5178	6542	7555	1.4141
1994	3793	6180	5402	1.2922
1995	3374	4868	4587	1.0167
1996	6632	5979	4964	0.9469
1997	2304	5923	5859	1.4168
1998	770	5710	5317	1.0063
1999	5137	6905	4781	0.9075
2000	4408	4381	2188	0.9987
2001	3030	5583		0.9700
Average	6849	11738	8690	0.9052

[1)] Short term (92-99) geometric mean.

3.8.3 Haddock in Division VIIa (Irish Sea)

State of stock/exploitation: The stock continues to be harvested outside safe biological limits. Fishing mortality has been well above $\mathbf{F}_{pa}$ since 1993. Occasional pulses of strong recruitment have resulted in opportunistic fisheries lasting only for relatively short periods. In the 1990s a more sustained population existed, with strong year classes in 1994 and 1996 causing an increase in both spawning biomass and catches. Subsequently, the SSB has declined.

Management objectives: No explicit management objectives are set for this stock.

Precautionary Approach reference points (established in 1998):

ICES considers that:	ICES proposes that:
$\mathbf{B}_{lim}$ not defined	$\mathbf{B}_{pa}$ not set
$\mathbf{F}_{lim}$ not defined	$\mathbf{F}_{pa}$ be set at 0.5

Technical basis:

$\mathbf{B}_{lim}$ = not defined	$\mathbf{B}_{pa}$ = not set
$\mathbf{F}_{lim}$ = not defined	$\mathbf{F}_{pa}$ set by in analogy with other haddock stocks

Advice on management: ICES recommends that fishing mortality in 2002 should be reduced to below $\mathbf{F}_{pa}$, corresponding to a catch of less than 1 200 t in 2002.

Relevant factors to be considered in management: A TAC is set for haddock for the whole of Sub-areas VII, VIII, IX and X. The present high availability of haddock in Division VIIa has resulted in substantial mis-reporting and/or discarding due to large by-catches of haddock taken by fleets with restrictive allocations available to them. To alleviate this problem, a separate TAC allocation has been made for Division VIIa since 1999.

The haddock stock in the Irish Sea could be sustained if recent strong year classes are allowed to realise their potential for growth, and contribute to SSB. This would only occur if fishing mortality were reduced substantially.

The haddock stock is mainly confined to the western Irish Sea where important mixed-species fisheries for *Nephrops*, whiting and cod take place. A directed fishery has developed for haddock during the 1990s. Large catches of haddock are taken in the *Nephrops* fishery during periods of high haddock abundance.

The current directed fishery for haddock in the Irish Sea is likely to generate by-catches of cod in the same area.

Comparison with previous assessment and advice: The estimates of fishing mortality in 1999 is 53% higher and SSB in 2000 48% lower in this years assessment compared to last years assessment. The basis for a single stock fishery advice is the same as last year.

Catch forecast for 2002:

Basis: F(2001) = $\mathbf{F}_{sq}$ = F(98–00) = 1.45; Catch(2001) =2.29; Landings(2001) =2.29; SSB(2002) = 2.15.

F(2002 onwards)	Basis	Catch (2002)	Landings (2002)	SSB (2003)
0.29	0.2 F(98-00)	0.78	0.78	3.76
0.5	$\mathbf{F}_{pa}$	1.20	1.20	3.22
0.58	0.4 F(98-00)	1.35	1.35	3.03
0.87	0.6 F(98-00)	1.78	1.78	2.51
1.16	0.8 F(98-00)	2.10	2.10	2.10
1.45	1.0 F(98-00)	2.34	2.34	1.83
1.74	1.2 F(98-00)	2.53	2.53	1.61

Weights in '000 t.

Shaded scenarios considered inconsistent with the precautionary approach.

Elaboration and special comment: Haddock production in the Irish Sea has been irregular, with one productive period in the late 1950s, two in the early 1970s, and a recent one in the latter half of the 1990s. Production in the 1990s has exceeded that in the earlier periods and also coincides with increased abundance of haddock in the Celtic Sea. Previous productive periods, other than the recent one, are believed to have coincided with strong year classes in Sub-Area VI. Whilst the 1994 year class was relatively strong in Divisions VIa, VIIa and VIIb-k, patterns of recruitment in subsequent years have differed markedly between areas. Growth rates of individual haddock also differ between areas, and haddock grow fastest in the Irish Sea.

Analytical age-based assessment uses landings at age and indices from research surveys. The time series of data is short and recent F is likely to be poorly estimated.

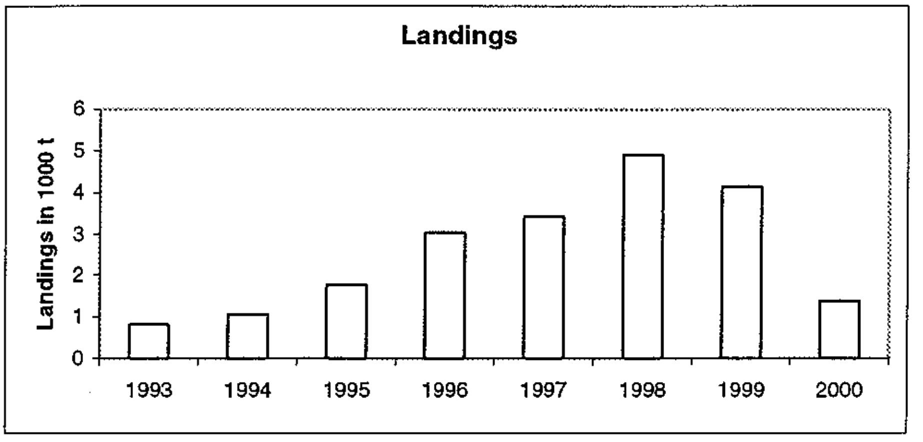
Source of information: Report of the Working Group on the Assessment of Northern Shelf Demersal Stocks, August 2001 (ICES CM 2002/ACFM:02).

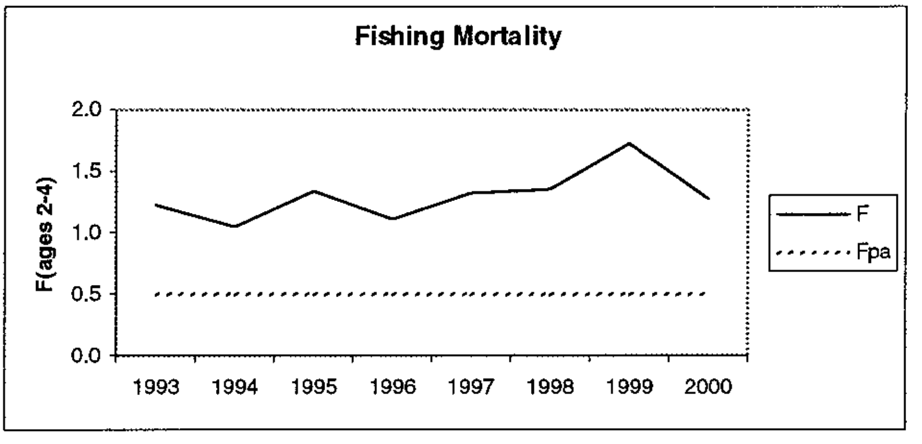
Yield and spawning biomass per Recruit F-reference points:

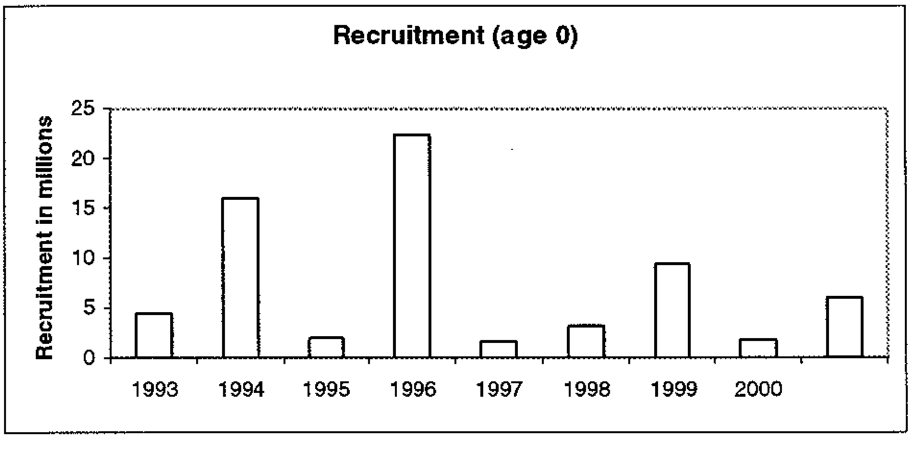
	Fish Mort Ages 2-4	Yield/R	SSB/R
Average Current	1.454	0.386	0.363
$\mathbf{F_{max}}$	0.325	0.550	1.520
$\mathbf{F_{0.1}}$	0.178	0.508	2.425
$\mathbf{F_{med}}$	0.921	0.449	0.553

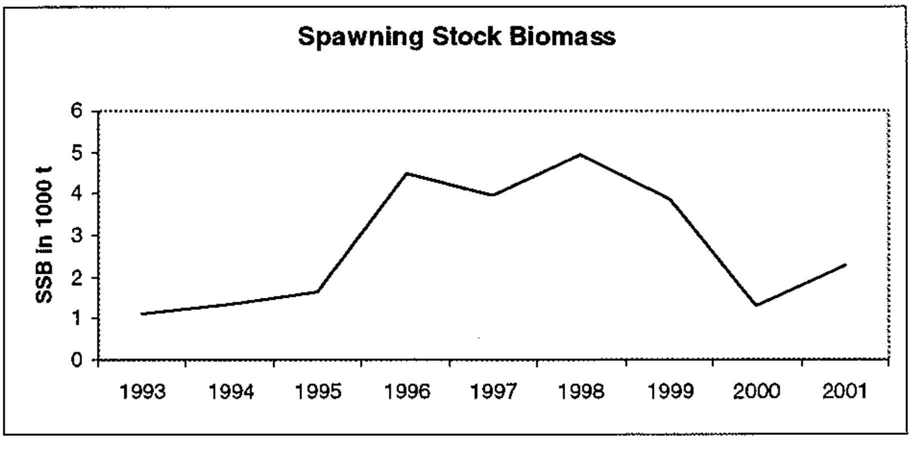
Catch data (Tables 3.8.3.1–2):

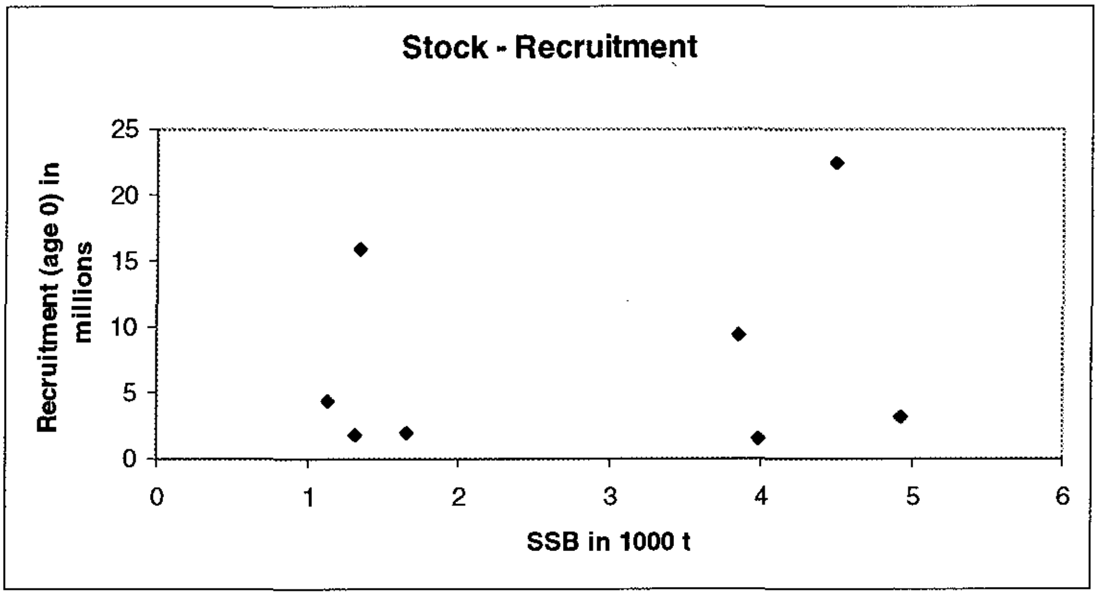
Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC	Official Landings[7]	ACFM landings
1987	Not dealt with			1.287	1.287
1988	Not dealt with			0.747	0.747
1989	Not dealt with			0.560	0.560
1990	Not dealt with			0.582	0.582
1991	Not dealt with			0.616	0.616
1992	Not dealt with			0.656[6]	0.703
1993	Not dealt with			0.730	0.813
1994	Not dealt with			0.681	1.043
1995	Not dealt with		6[1]	0.841	1.753
1996	No advice		7[1]	1.453	3.023
1997	Means of setting catch limits required		14[1]	1.925	3.391[6]
1998	Catch limit for VIIa	3.0	20[1]	3.015	4.902
1999	No increase in F; Catch limit for VIIa	7.0	4.99	1.596[4]	4.109
2000	Reduce F below $\mathbf{F_{pa}}$	<2.8	3.4	1.141	1.395
2001	Reduce F below $\mathbf{F_{pa}}$	<1.71	2.7		
2002	Reduce F below $\mathbf{F_{pa}}$	<1.20			


Landings
Landings in 1000 t
0
1
2
3
4
5
6
1993
1994
1995
1996
1997
1998
1999
2000


Fishing Mortality
F(ages 2-4)
0.0
0.5
1.0
1.5
2.0
1993
1994
1995
1996
1997
1998
1999
2000
F
Fpa


Recruitment (age 0)
Recruitment in millions
0
5
10
15
20
25
1993
1994
1995
1996
1997
1998
1999
2000


Spawning Stock Biomass
SSB in 1000 t
0
1
2
3
4
5
6
1993
1994
1995
1996
1997
1998
1999
2000
2001


Stock - Recruitment
Recruitment (age 0) in millions
25
20
15
10
5
0
0
1
2
3
4
5
6
SSB in 1000 t

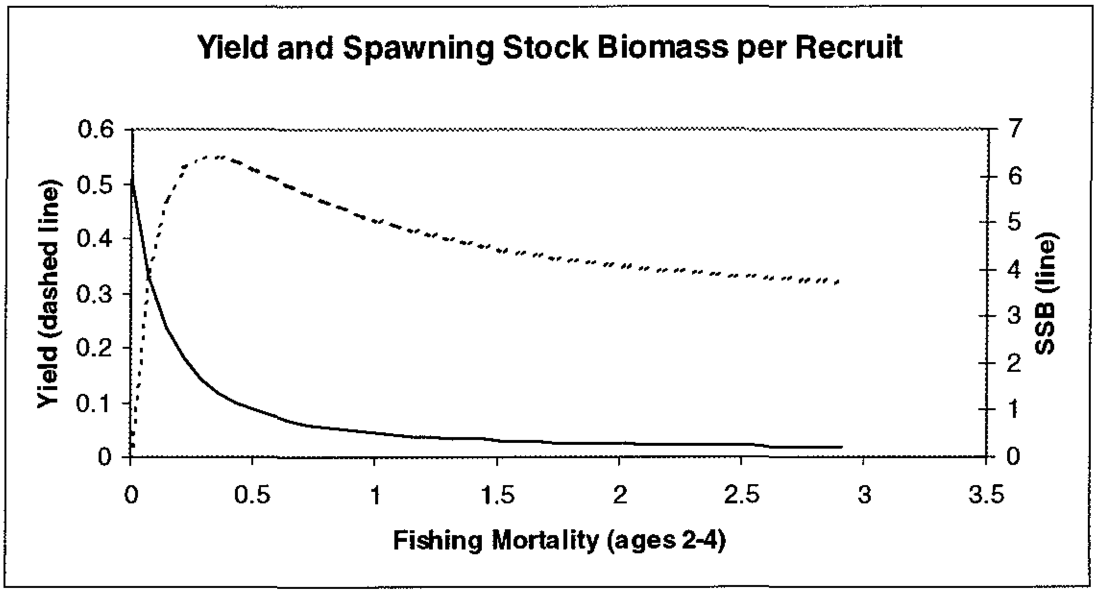

Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
0.6
0.5
0.4
0.3
0.2
0.1
0
SSB (line)
7
6
5
4
3
2
1
0
0
0.5
1
1.5
2
2.5
3
3.5
Fishing Mortality (ages 2-4)

Table 3.8.3.1 Nominal landings (t) of HADDOCK in Division VIIa, 1984–2000, as officially reported to ICES.

Country	1984	1985	1986	1987	1988	1989	1990	1991
Belgium	3	4	5	10	12	4	4	1
France	38	31	39	50	47	n/a	n/a	n/a
Ireland	199	341	275	797	363	215	80	254
Netherlands	-	-	-	-	-	-	-	-
UK (England & Wales)[1]	29	28	22	41	74	252	177	204
UK (Isle of Man)	2	5	4	3	3	3	5	14
UK (N. Ireland)	38	215	358	230	196	...	...	...
UK (Scotland)	78	104	23	156	52	86	316	143
Total	387	728	726	1,287	747	560	582	616
Unallocated	0	0	0	0	0	0	0	0
Total figures used by Working Group	387	728	726	1,287	747	560	582	616

Country	1992	1993	1994	1995	1996	1997	1998	1999
Belgium	8	18	22	32	34	55	104	53
France	26	41	22	58	105	74	86	n/a
Ireland	251	252	246	320	798	1,005	1,699	759
Netherlands	-	-	-	-	1	14	10	5
UK (England & Wales)[1]	244	260	301	294	463	717	1,023	1,479
UK (Isle of Man)	13	19	24	27	38	9	13	7
UK (N. Ireland)	...	...	...	...	...	...	...	...
UK (Scotland)	114	140	66	110	14	51	80	67
Total	656	730	681	841	1,453	1,925	3,015	2,370
Unallocated	47	83	362	912	1,570	1,466	1,887	1,749
Total figures used by Working Group	703	813	1,043	1,753	3,023	3,391	4,902	4,119

Country	2000
Belgium	22
France	n/a
Ireland	n/a
Netherlands	2
UK (England & Wales)[1]	1,061
UK (Isle of Man)	n/a
UK (N. Ireland)	...
UK (Scotland)	56
Total	1,141
Unallocated	254
Total figures used by Working Group	1,395

*Preliminary.
[1]1989–2000 Northern Ireland included with England and Wales.
n/a = not available.

Table 3.8.3.2 Haddock in Division VIIa (Irish Sea).

Year	Recruitment Age 0 thousands	SSB tonnes	Landings tonnes	Mean F Ages 2-4
1993	4324	1135	813	1.225
1994	15902	1340	1043	1.043
1995	2026	1665	1753	1.335
1996	22448	4500	3023	1.111
1997	1583	3988	3391	1.317
1998	3172	4930	4902	1.362
1999	9459	3854	4119	1.732
2000	1891	1322	1395	1.267
2001	5977	2287		1.450
Average	7420	2780	2555	1.316

3.8.4 Whiting in Division VIIa (Irish Sea)

State of stock/exploitation: The stock remains outside safe biological limits. The current assessment indicates that fishing mortality has been above $\mathbf{F}_{pa}$ since 1980. SSB has declined since 1980 to a very low level, and has been below $\mathbf{B}_{lim}$ since 1997. Catches have declined progressively since the early 1980s, but the proportion discarded has increased. Estimates for 2000 indicate that three quarters of the catch was discarded.

Management objectives: No explicit management objectives are set for this stock. However, for any management objectives to meet precautionary criteria, their aim should be to reduce or maintain F below $\mathbf{F}_{pa}$ and to increase or maintain spawning stock biomass above $\mathbf{B}_{pa}$.

Precautionary Approach reference points (unchanged since 1999):

ICES considers that:	ICES proposes that:
$\mathbf{B}_{lim}$ is 5 000 t, the lowest observed spawning stock biomass as estimated in previous assessment. There is no clear evidence of reduced recruitment at the lowest observed SSB's.	$\mathbf{B}_{pa}$ be set at 7 000 t, which is considered to be the minimum SSB required to ensure a high probability of maintaining SSB above its lowest observed value, taking into account the uncertainty of assessments.
$\mathbf{F}_{lim}$ is 0.95. This is the fishing mortality estimated to lead to a potential stock collapse.	$\mathbf{F}_{pa}$ be set at 0.65. This F is considered to have a high probability of avoiding $\mathbf{F}_{lim}$ and is consistent with a high probability of remaining above $\mathbf{B}_{pa}$ in the long run.

Technical basis:

$\mathbf{B}_{lim} = \mathbf{B}_{loss}$	$\mathbf{B}_{pa} = \mathbf{B}_{loss} * 1.4$
$\mathbf{F}_{lim} = \mathbf{F}_{loss}$ as estimated in an earlier assessment	$\mathbf{F}_{pa}$ = 0.65, implies an equilibrium SSB of 10.6 kt, and a relatively low probability of SSB < $\mathbf{B}_{pa}$ (= 7 kt), and is within the range of historic Fs.

Advice on management: ICES recommends that fishing mortality on whiting should be reduced to the lowest possible level in 2002. A rebuilding plan, including provisions to effectively reduce directed harvest, discards and by-catch in other fisheries should be developed and implemented in order to rebuild SSB above $\mathbf{B}_{pa}$.

Relevant factors to be considered in management: A *Nephrops* directed fishery operates on the main whiting nursery areas in the Irish Sea. Recent levels of discards in this *Nephrops* directed fishery during the late 1990s have been at around 43% by weight of the estimated catch of whiting, rising to approximately 73% in the most recent assessment year 2000. This means that the fishing mortality on whiting cannot be effectively controlled by restrictions on landings alone, but would also require measures to reduce discards. Square mesh panels have been mandatory for all UK trawlers (excluding beam trawlers) in the Irish Sea since 1993, and for Irish trawlers since 1994. While the effects of this technical measure have not been formally evaluated, the *Nephrops* fishery still generates substantial quantities of whiting discards, indicating that further measures are necessary. Management measures for the *Nephrops* fishery should also take into account the effect on whiting.

Over 80% of the SSB in 2003 is comprised of the 2000 and 2001 year classes, which are poorly determined. Recruitment and SSB have been over-estimated in recent years. Retrospective analysis indicates that the over-estimation of the stock may not be fully accounted for in the current assessment and catch forecast.

Comparison with previous assessment and advice: The estimates of fishing mortality in 1999 is 27% higher and SSB in 2000 the same in this year's assessment compared to last year's assessment. The basis for the advice is the same as last year.

Catch forecast for 2002:

Basis: F(2001) = $\mathbf{F}_{sq}$ = F(98–00) = 1.09;, Catch(2001) = 5.0; Landings(2001) = 3.2; SSB(2002) = 3.9.

F(2002) (landings)	F(2002) (discards)	F(2002) (Total)	Basis[1]	Catch (2002)	Landings (2002)	SSB (2003)
0.00	0.55	0.55	0.0F (98-00)	1.9	0	4.5
0.11	0.55	0.66[2]	0.2F (98-00)	2.69	0.87	4.0
0.22	0.55	0.77	0.4F (98-00)	3.36	1.60	3.6
0.32	0.55	0.87	0.6F (98-00)	3.93	2.20	3.3
0.43	0.55	0.98	0.8F (98-00)	4.40	2.71	3.0
0.54	0.55	1.09	1.0F (98-00)	4.80	3.15	2.8
0.65	0.55	1.20	1.2F (98-00)	5.14	3.52	2.6

Weights in '000 t.

[1]F multipliers applied to human consumption fishery only.

[2] $\mathbf{F}_{pa}$ = 0.65.

Shaded scenarios are considered inconsistent with the precautionary approach.

Elaboration and special comment: Whiting is taken mainly as a by-catch in mixed species otter trawl fisheries for *Nephrops*, cod and other demersal species, and in the pelagic fishery for cod.

Analytical assessment is based on catch-at-age, commercial CPUE and indices from surveys in Division VIIa. Estimates of discards in the *Nephrops* fisheries are included in the assessment, and estimates of mis-reported landings have been included since 1991. Discarding by whitefish fleets is presently being studied, but there are insufficient data for inclusion in the assessment.

Uncertainties in the assessment are related to a strong conflict between the indices from the Eastern and Western Irish Sea. Reconciling the conflicting signals in the assessment will necessitate understanding dispersal of whiting between the two areas. This will require spatially disaggregated catch and survey data.

Source of information: Report of the Working Group on the Assessment of Northern Shelf Demersal Stocks, August 2001 (ICES CM 2002/ACFM:02).

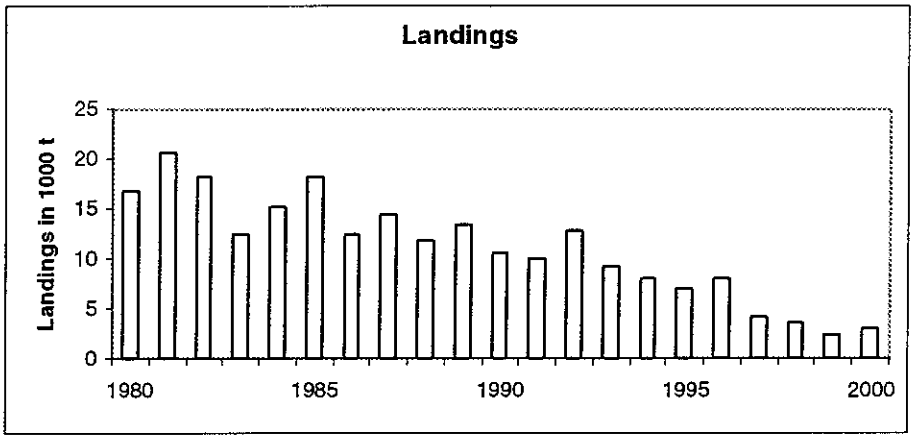
Yield and spawning biomass per Recruit F-reference points:

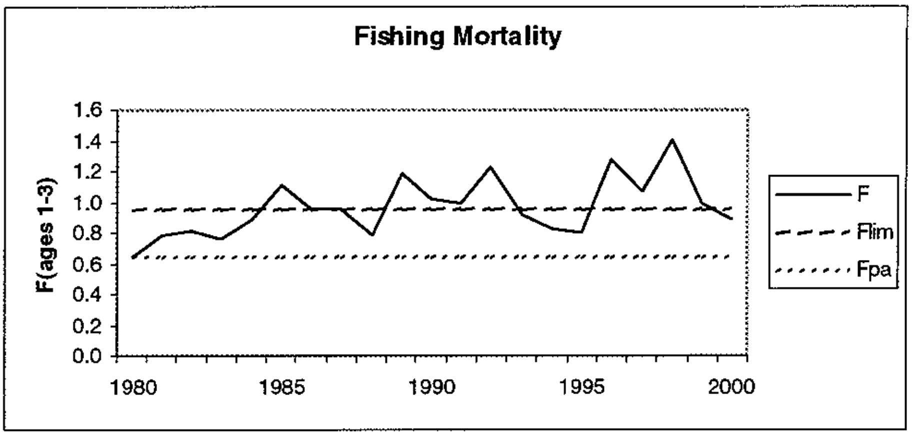
	Fish Mort Ages 1-3	Yield/R	SSB/R
Average Current	1.093	0.036	0.042
$\mathbf{F}_{max}$	0.229	0.088	0.291
$\mathbf{F}_{0.1}$	0.141	0.082	0.423
$\mathbf{F}_{med}$	0.686	0.058	0.085

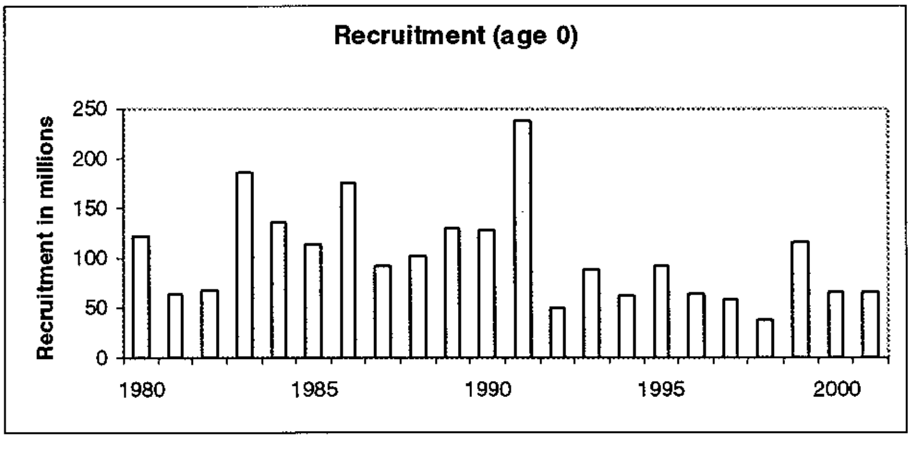
Catch data (Tables 3.8.4.1-2):

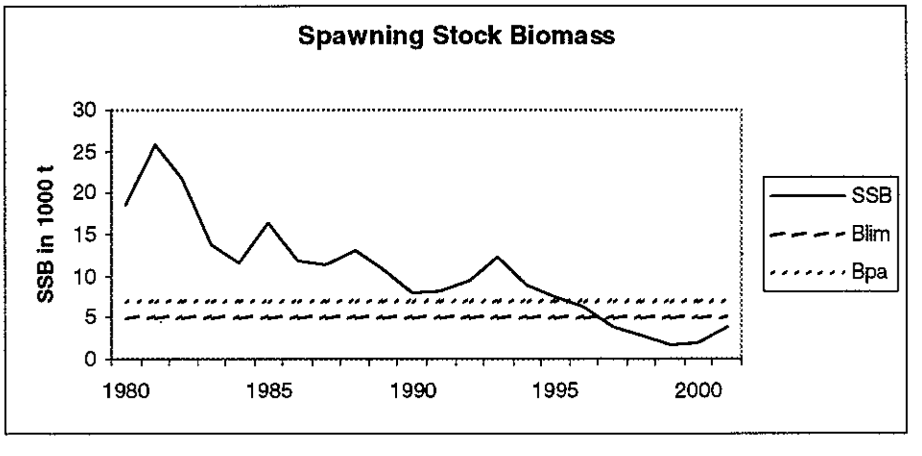
Year	ICES Advice	Predicted catches corresp. to advice	Agreed TAC	Official Landings	Disc.[2]	ACFM catch
1987	Reduce F	16.0	18.2	11.7	3.8	14.4
1988	No increase in F; enforce mesh regulations	12.0	18.2	11.5	1.9	11.9
1989	F = $\mathbf{F}_{high}$; enforce mesh regulation	11.0	18.2	11.3	2.0	13.4
1990	No increase in F; TAC	8.3[1]	15.0	8.2	2.7	10.7
1991	Increase SSB to SSB(89); TAC	6.4[1]	10.0	7.4	2.7	9.9
1992	80% of F(90)	9.7[1]	10.0	7.1	4.3	12.8[3]
1993	70% of F(91) ~ 6 500 t	6.5	8.5	6.0	2.7	9.2[3]
1994	Within safe biological limits	-	9.9	5.6	1.2	7.9[3]
1995	No increase in F	8.3[1]	8.0	5.5	2.2	7.0[3]
1996	No increase in F	9.8[1]	9.0	5.6	3.5	8.0[3]
1997	No advice given	-	7.5	4.5	1.9	4.2
1998	20% reduction in F	3.8[5]	5.0	2.1	1.3	3.5
1999	Reduce F below $\mathbf{F}_{pa}$	3.5[5]	4.41	1.5[6]	1.1	2.4
2000	Reduce F below $\mathbf{F}_{pa}$	<1.6[5]	2.64	0.8[6]	2.1	2.9
2001	Lowest possible F	~0	1.39			
2002	Lowest possible F	~0				

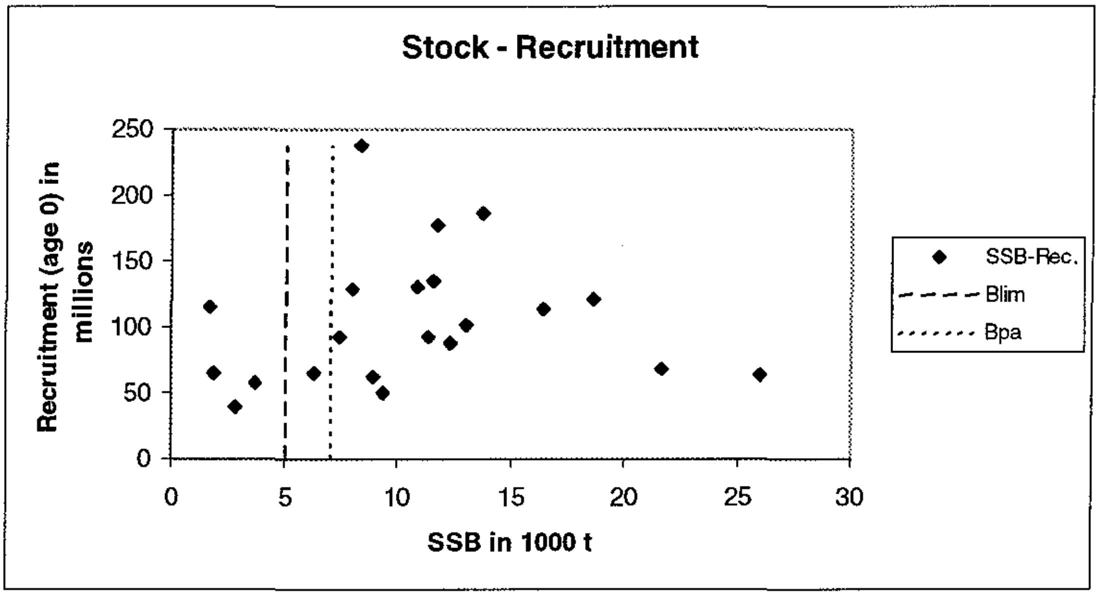
[1]Not including discards from the *Nephrops* fishery. [2]From *Nephrops* fishery. [3]Including estimates of misreporting. [5]Landings only, no discards included. [6]Incomplete statistics. Weights in '000 t.

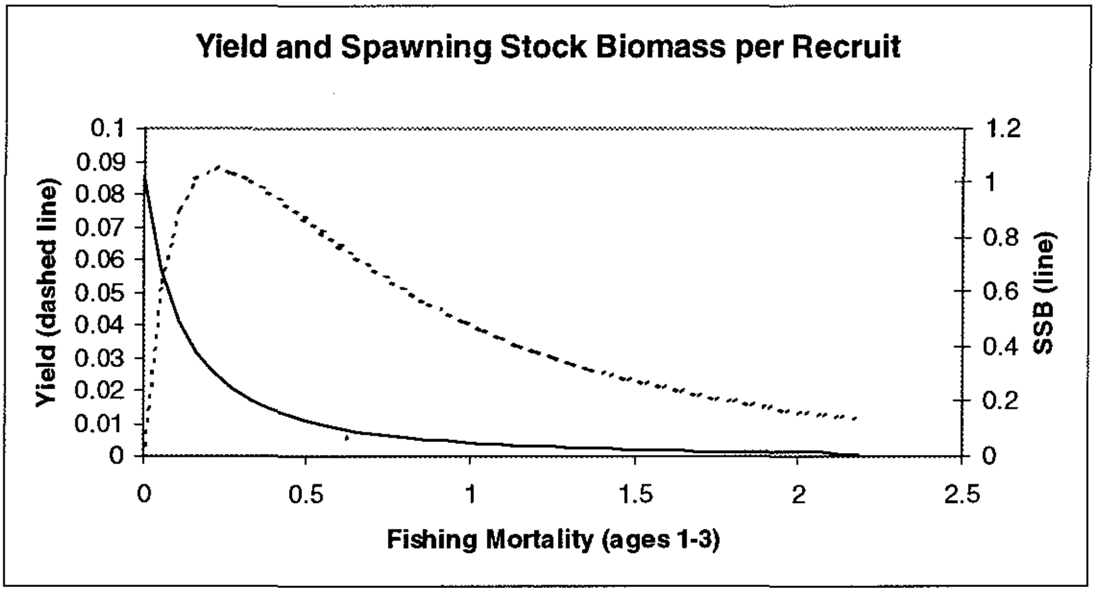

Landings
Landings in 1000 t
25
20
15
10
5
0
1980
1985
1990
1995
2000


Fishing Mortality
F(ages 1-3)
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1980
1985
1990
1995
2000
F
Flim
Fpa


Recruitment (age 0)
Recruitment in millions
250
200
150
100
50
0
1980
1985
1990
1995
2000


Spawning Stock Biomass
SSB in 1000 t
30
25
20
15
10
5
0
1980
1985
1990
1995
2000
SSB
Blim
Bpa


Stock - Recruitment
Recruitment (age 0) in millions
SSB in 1000 t
SSB-Rec.
Blim
Bpa
0
50
100
150
200
250
0
5
10
15
20
25
30


Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
SSB (line)
Fishing Mortality (ages 1-3)
0
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.08
0.09
0.1
0
0.2
0.4
0.6
0.8
1
1.2
0
0.5
1
1.5
2
2.5

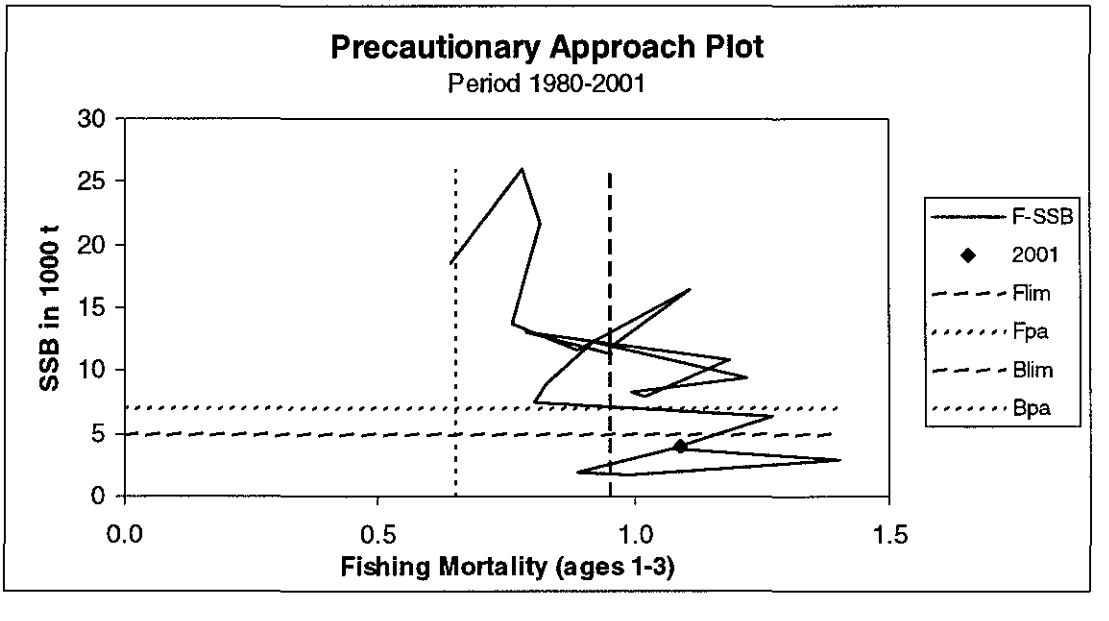

Precautionary Approach Plot
Period 1980-2001
SSB in 1000 t
Fishing Mortality (ages 1-3)
F-SSB
2001
Flim
Fpa
Blim
Bpa
0
5
10
15
20
25
30
0.0
0.5
1.0
1.5

Table 3.8.4.1 Nominal catch (t) of WHITING in Division VIIa, 1987–2000, as officially reported to ICES and Working Group estimates of human consumption and discards.

Country	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998[a]	1999[a]	2000[b]
Belgium	109	90	92	142	53	78	50	80	92	80	47	52	46	30
France	826	1,063	533	528	611	509	255	163	169	78	86	81	150[1]	96[1]
Ireland	4,067	4,394	3,871	2,000	2,200	2,100	1,440	1,418	1,840	1,773	1,119	1,260	n/a	n/a
Netherlands	-	-	-	-	-	-	-	-	-	17	14	7	6	1
UK (Engl.& Wales)[3]	1,529	1,202	6,652	5,202	4,250	4,089	3,859	3,724	3,125	3,557	3,152	1,900	1,229	670
UK (Isle of Man)	14	15	26	75	74	44	55	44	41	28	24	33	5	
UK (N. Ireland)	4,858	4,621	...	...	...	...	...	...	...	...	...	...	...	...
UK (Scotland)	281	107	154	236	223	274	318	208	198	48	30	22	44	15
UK														
Total human consumption	11,684	11,492	11,328	8,183	7,411	7,094	5,977	5,637	5,465	5,581	4,472	3,355	1,480	812
Unallocated human consumption	-1,020	-1,537	65	-211	-129	1,447	551	1,119	-574	-1,109	-2,193	-1,129	-147	-11
Estimated discards from Nephrops fishery[2]	3,754	1,901	2,015	2,684	2,664	4,250	2,702	1,180	2,153	3,494	1,926	1,307	1,092	2,117
Total figures used by the Working Group for stock assessment	14,418	11,856	13,408	10,656	9,946	12,791	9,230	7,936	7,044	7,966	4,205	3,533	2,425	2,918

[a] Revised.
[b]Preliminary.
[2]Based on UK (N. Ireland) and Ireland data.
[3]1989–1999 Northern Ireland included with England and Wales.
n/a = Not Available.

Table 3.8.4.2 Whiting in Division VIIa (Irish Sea).

Year	Recruitment Age 0 thousands	SSB tonnes	Landings tonnes	Mean F Ages 1-3
1980	121108	18578	16785	0.6422
1981	63565	25984	20606	0.7809
1982	67631	21670	18112	0.8175
1983	186532	13761	12345	0.7606
1984	135504	11579	15235	0.8899
1985	113692	16412	18236	1.1084
1986	176738	11748	12415	0.9515
1987	92935	11362	14418	0.9546
1988	101807	13045	11856	0.7881
1989	130797	10842	13408	1.1856
1990	128614	7993	10656	1.0223
1991	237443	8336	9946	0.9935
1992	49438	9380	12791	1.2230
1993	87517	12330	9230	0.9195
1994	62351	8993	7936	0.8280
1995	92034	7469	7044	0.8041
1996	64705	6358	7966	1.2716
1997	57741	3758	4205	1.0762
1998	38654	2836	3533	1.4020
1999	115680	1703	2425	0.9890
2000	65841	1955	2918	0.8886
2001	65841	3921		1.0900
Average	102553	10455	11051	0.9721

[1] Short term geometric mean (1992-2000).

3.8.5 Plaice in Division VIIa (Irish Sea)

State of stock/exploitation: The stock remains within safe biological limits. SSB in 2001 is above $\mathbf{B}_{pa}$, and fishing mortality in 2000 was below $\mathbf{F}_{pa}$. Consistent with an overall decline in fishing effort on flatfish in the Irish Sea, the exploitation rate on this stock has declined in recent years.

Recruitment has been below average since the mid-1980s, but this period of reduced recruitment started at a time of relatively high SSB, and there is no indication that it has resulted from reduced spawning biomass.

Management objectives: No explicit management objectives are set for this stock.

Precautionary Approach reference points (established in 1998):

ICES considers that:	ICES proposes that:
There is no biological basis for defining $\mathbf{B}_{lim}$ or $\mathbf{F}_{lim}$	$\mathbf{B}_{pa}$ be set at 3 100 t. There is evidence of high recruitment at the lowest biomass observed and $\mathbf{B}_{pa}$ can therefore be set equal to the lowest observed SSB
	$\mathbf{F}_{pa}$ be set at 0.45. This is considered to provide a high probability that SSB remains above $\mathbf{B}_{pa}$ in the long term.

Technical basis:

$\mathbf{B}_{lim}$ and $\mathbf{F}_{lim}$: stock-recruitment data uninformative; $\mathbf{F}_{loss}$ poorly defined	$\mathbf{B}_{pa} = \mathbf{B}_{loss}$
	$\mathbf{F}_{pa} = \mathbf{F}_{med}$ in a previous assessment, and long term considerations

Advice on management: ICES recommends that fishing mortality on plaice in 2002 should be maintained below the proposed $\mathbf{F}_{pa}$, corresponding to landings of less than 2 800 t in 2002.

Comparison with previous assessment and advice: The current assessment is in accordance with last year's assessment. The basis for a single stock fishery advice is the same as last year.

Catch forecast for 2002:

Basis: F(2001) = $\mathbf{F}_{sq}$ = F(98-00) = 0.31; Landings(2001) = 2.0; SSB(2002) = 5.7.

F(2002) onwards	Basis	Catch (2002)	Landings (2002)	SSB (2003)
0.31	1.0*F(00)	2.0	2.0	5.7
0.37	1.2*F(00)	2.4	2.4	5.4
0.45	$\mathbf{F}_{pa}$ (=1.45*$\mathbf{F}_{sq}$)	2.8	2.8	5.0

Weights in '000 t.

Elaboration and special comment: Plaice are taken mainly in long-established UK and Irish otter trawl fisheries for demersal fish. They are also taken as a by-catch in the beam trawl fishery for sole. The main fishery is concentrated in the North-east Irish Sea. Effort in the UK and Belgian beam trawl fleets increased in the late 1980s, but declined in the early 1990s.

The analytical assessment is based on a tuned catch-at-age analysis with CPUE data from two commercial fleets and two surveys, which does not include discard information.

The assumed average recruitment of the 1999 year class may be conservative, but indices from two autumn surveys will only be available later in the year.

Reported landings in recent years are likely to be more accurate than in the past.

Source of information: Report of the Working Group on the Assessment of Northern Shelf Demersal Stocks, August 2001 (ICES CM 2002/ACFM:02).

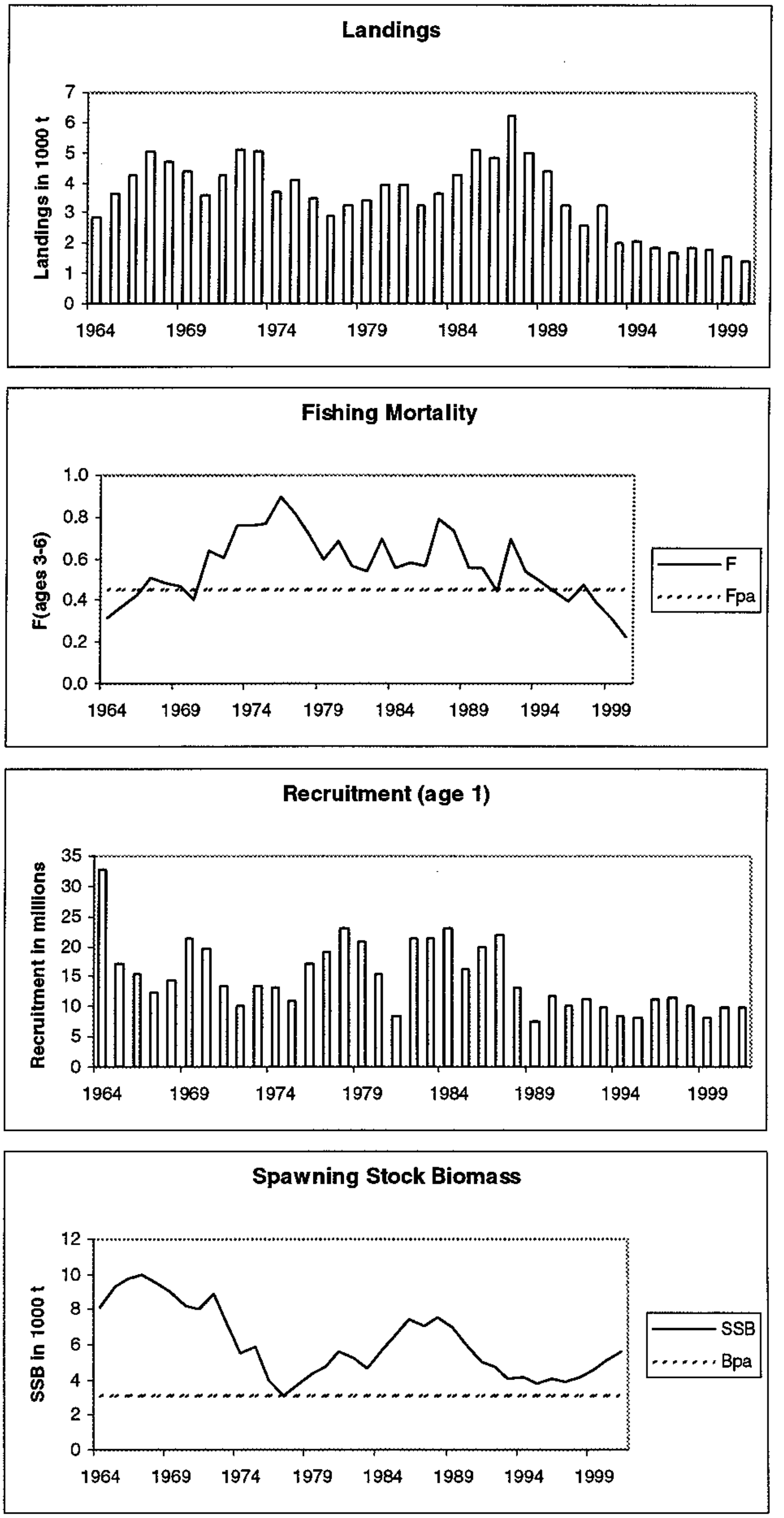
Yield and spawning biomass per Recruit F-reference points:

	Fish Mort Ages 3-6	Yield/R	SSB/R
Average Current	0.308	0.209	0.577
$\mathbf{F}_{max}$	0.211	0.212	0.785
$\mathbf{F}_{0.1}$	0.086	0.189	1.488
$\mathbf{F}_{med}$	0.394	0.206	0.469

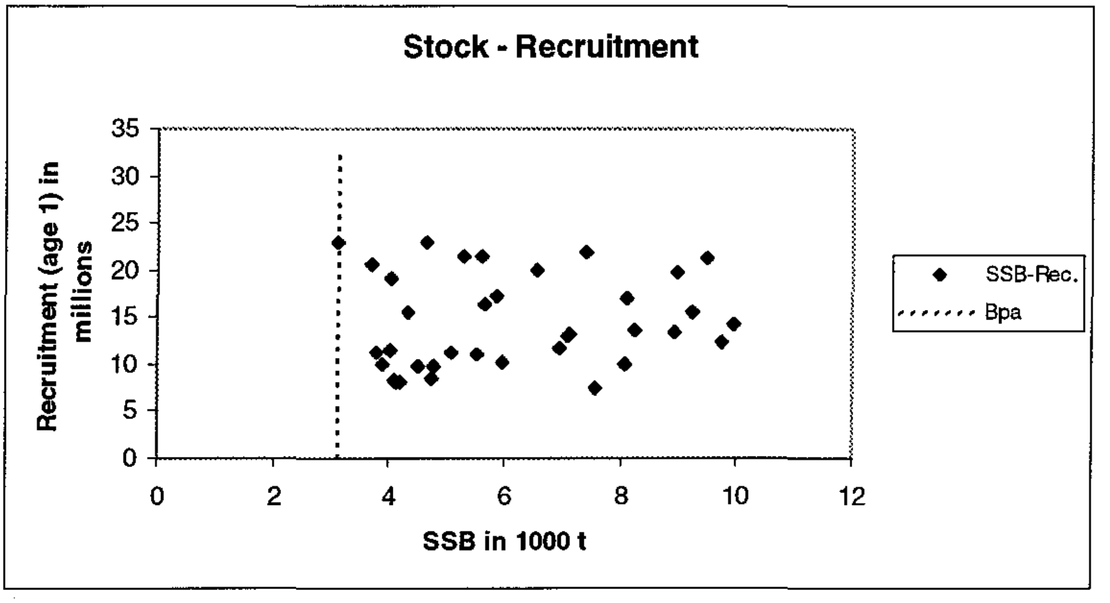
Catch data (Tables 3.8.5.1-2):

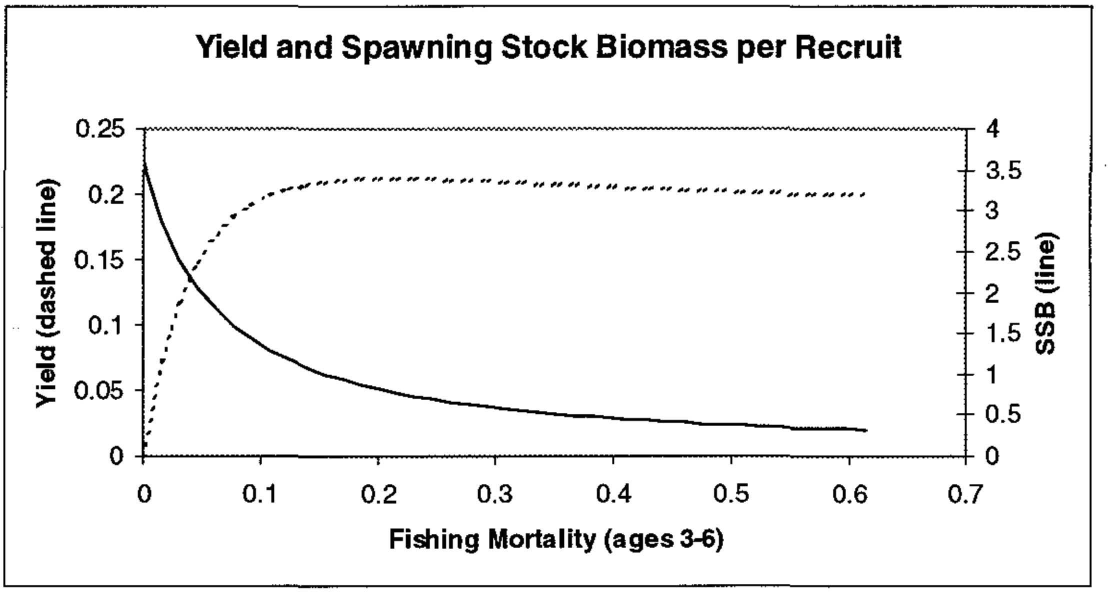
Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC	Official landings	ACFM Landings
1987	F high; no long-term gains in increasing F	5.0	5.0	5.6	6.2
1988	No increase in F	4.8	5.0	4.4	5.0
1989	80% of F(87); TAC	5.8	5.8	4.2	4.4
1990	Halt decline in SSB; TAC	5.1	5.1	4.0	3.3
1991	Rebuild SSB to SSB(90); TAC	3.3	4.5	2.8	2.6
1992	70% of F(90)	3.0	3.8	3.2	3.3
1993	F = 0.55 ~ 2 800 t	2.8	2.8	2.0	2.0
1994	Long-term gains in decreasing F	<3.7	3.1	2.1	2.1
1995	Long-term gains in decreasing F	2.4[1]	2.8	2.0	1.9
1996	No long-term gain in increasing F	2.5	2.45	1.9	1.7
1997	No advice	-	2.1	2.0	1.9
1998	No increase in F	2.4	2.4	1.8	1.8
1999	Keep F below $\mathbf{F}_{pa}$	2.4	2.4	1.6	1.6
2000	Keep F below $\mathbf{F}_{pa}$	<2.3	2.4	1.0[2]	1.4
2001	Keep F below $\mathbf{F}_{pa}$	<2.4	2.0		
2002	Keep F below $\mathbf{F}_{pa}$	<2.8			

Weights in '000 t. [1]Catch at *status quo* F. [2] Incomplete statistics.



Landings
Landings in 1000 t
7
6
5
4
3
2
1
0
1964
1969
1974
1979
1984
1989
1994
1999
Fishing Mortality
F(ages 3-6)
1.0
0.8
0.6
0.4
0.2
0.0
F
Fpa
Recruitment (age 1)
Recruitment in millions
35
30
25
20
15
10
5
Spawning Stock Biomass
SSB in 1000 t
12
10
8
SSB
Bpa


Stock - Recruitment
Recruitment (age 1) in millions
SSB in 1000 t
SSB-Rec.
Bpa
35
30
25
20
15
10
5
0
0
2
4
6
8
10
12


Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
SSB (line)
Fishing Mortality (ages 3-6)
0.25
0.2
0.15
0.1
0.05
0
4
3.5
3
2.5
2
1.5
1
0.5
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7

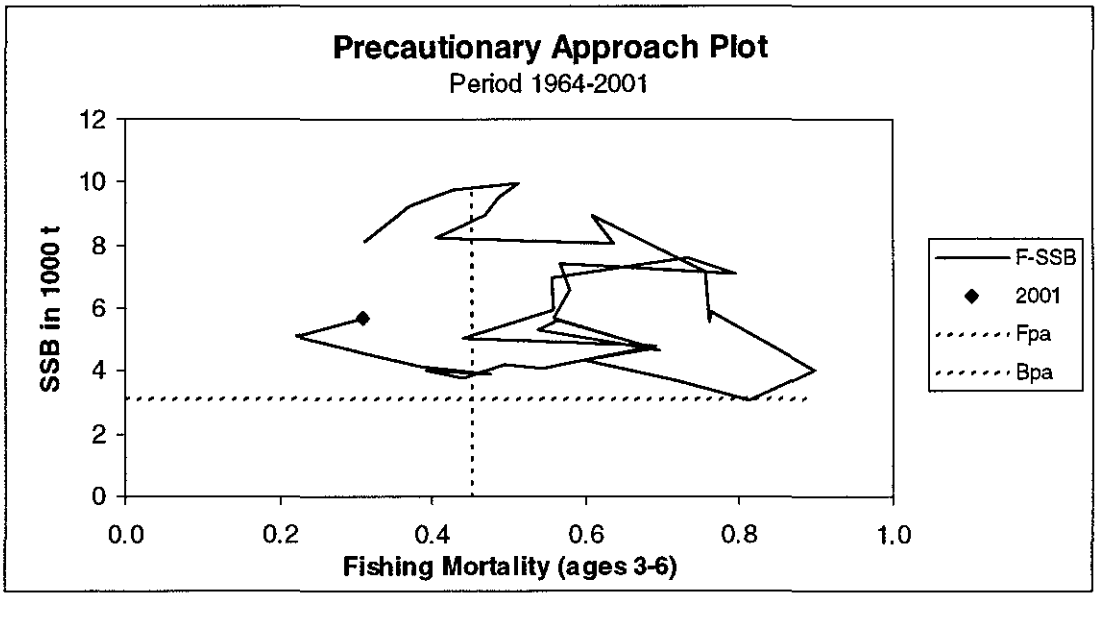

Precautionary Approach Plot
Period 1964-2001
SSB in 1000 t
Fishing Mortality (ages 3-6)
F-SSB
2001
Fpa
Bpa
12
10
8
6
4
2
0
0.0
0.2
0.4
0.6
0.8
1.0

Table 3.8.5.1 Nominal landings (t) of PLAICE in Division VIIa as officially reported to ICES.

Country	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000[1]
Belgium	403	243	265	301	138	321	128	332	327	344[3]	459	327	275	325
France	87	58	11	105	20	42	19	13	10	11	8	8[1]	5	22
Ireland	2,132	2,009	1,406	1,350	900	1,355	654	547	557	538	543	730	541	n/a
Netherlands	-	-	-	-	-	-	-	-	-	69	110	27	30	47
UK (Eng.&Wales)[2]	2,366	1,630	2,409	1,959	1,584	1,381	1,119	1,082	1,050	878	798	679	687	610
UK (Isle of Man)	9	12	18	27	51	24	13	14	20	16	11	14	5	n/a
UK (N. Ireland)	332	286	...	...	...	...	...	...	...	...	...	...	...	...
UK (Scotland)	243	127	76	219	104	70	72	63	60	18	25	18	23	21
UK (Total)														
Total	5,572	4,365	4,185	3,961	2,797	3,193	2,005	2,051	2,024	1,874	1,954	1,803	1,566	1,025
Discards[4]	270	220	-	-	-	-	-	-	-	-	-	-	-	-
Unallocated	378	420	187	-686	-243	74	-9	15	-150	-167	-83	-38	21	363
Total figures used by the Working Group for stock assessment	6,220	5,005	4,372	3,275	2,554	3,267	1,996	2,066	1,874	1,707	1,871	1,765	1,587	1,388

[1]Provisional.
[2]1989–1999 Northern Ireland included with England and Wales.
[3]Final Statlant 27a data.
{UK (Total) excludes Isle of Man data}.
[4] A '-' indicates no information on discards.
n/a = not available.

Table 3.8.5.2 Plaice in Division VIIa (Irish Sea).

Year	Recruitment Age 1 thousands	SSB tonnes	Landings tonnes	Mean F Ages 3-6
1964	32801	8128	2879	0.312
1965	16941	9246	3664	0.371
1966	15435	9758	4268	0.429
1967	12377	9950	5059	0.512
1968	14252	9492	4695	0.486
1969	21154	8962	4394	0.468
1970	19663	8255	3583	0.404
1971	13481	8064	4232	0.636
1972	9987	8921	5119	0.607
1973	13336	7128	5060	0.755
1974	13140	5529	3715	0.760
1975	11004	5862	4063	0.764
1976	17113	4006	3473	0.898
1977	19008	3094	2904	0.813
1978	22931	3689	3231	0.720
1979	20678	4326	3428	0.599
1980	15425	4745	3903	0.689
1981	8429	5592	3906	0.565
1982	21385	5271	3237	0.538
1983	21396	4649	3639	0.696
1984	22857	5664	4241	0.560
1985	16293	6561	5075	0.579
1986	19954	7413	4806	0.568
1987	21851	7083	6220	0.793
1988	13032	7574	5005	0.732
1989	7505	6946	4372	0.557
1990	11731	5952	3275	0.558
1991	10118	5071	2554	0.442
1992	11325	4767	3267	0.691
1993	9746	4095	1996	0.544
1994	8303	4195	2066	0.495
1995	8126	3773	1874	0.441
1996	11314	4038	1707	0.393
1997	11520	3887	1871	0.478
1998	10060	4138	1765	0.385
1999	8055	4514	1587	0.316
2000	9862	5089	1388	0.222
2001	9862	5654		0.310
Average	14775	6081	3555	0.555

[1)] Short term geometric mean (1989-1998).

3.8.6 Sole in Division VIIa (Irish Sea)

State of stock/exploitation: The stock is within safe biological limits. The fishing mortality in 2000 is at $\mathbf{F}_{pa}$ (0.3). SSB has recently increased from the historic low in 1997 and in 2001 is above $\mathbf{B}_{pa}$.

Management objectives: No explicit management objectives are set for this stock.

Precautionary Approach reference points (established in 1998):

ICES considers that:	ICES proposes that:
$\mathbf{B}_{lim}$ is 2 800 t. The lowest observed spawning stock in an earlier assessment.	$\mathbf{B}_{pa}$ be set at be set at 3 800 t, which is considered to be the minimum SSB required to ensure a high probability of maintaining SSB above its lowest observed value, taking into account the uncertainty of assessments.
$\mathbf{F}_{lim}$ is 0.4. Although poorly defined, there is evidence that fishing mortality in excess of 0.4 has led to a general stock decline and is only sustainable during periods of above average recruitment.	$\mathbf{F}_{pa}$ be set at 0.30. This F is considered to have a high probability of avoiding $\mathbf{F}_{lim}$.

Technical basis:

$\mathbf{B}_{lim}$ = $\mathbf{B}_{loss}$	$\mathbf{B}_{pa}$ ~ $\mathbf{B}_{lim}$ * 1.4
$\mathbf{F}_{lim}$ = $\mathbf{F}_{loss}$ poorly defined; based on historical considerations	$\mathbf{F}_{pa}$ = see above

Advice on management: ICES recommends that fishing mortality in 2002 remains below the proposed $\mathbf{F}_{pa}$, corresponding to landings of less than 1 100 t in 2002.

Relevant factors to be considered in management: Discarding of sole increased in 1998 and 1999 with the bulk of the discards coming from the 1996 year class, and to a lesser extent from the 1997 year class. No data are available for discarding in 2000.

Comparison with previous assessment and advice: The estimates of fishing mortality in 1999 is 17% lower and SSB in 2000 7% higher in this years assessment compared to last years assessment. The basis for a single stock fishery advice is the same as last year.

Catch forecast for 2002:

Basis: F(2001) = F(98-00);, $\mathbf{F}_{sq}$ = 0.30; Landings(2001) = 1.13; SSB(2002) = 4.58.

F(2002) onwards	Basis	Landings (2002)	SSB (2003)	Medium term (10 year) probability (%) of SSB < $\mathbf{B}_{pa}$
0.24	0.8 F(98-00)	0.90	4.84	<25
0.27	0.9 F(98-00)	1.00	4.74	<25
0.30	1.0 F(98-00) = $\mathbf{F}_{pa}$	1.10	4.65	<25
0.33	1.1 F(98-00)	1.19	4.55	25
0.36	1.2 F(98-00)	1.29	4.46	25

Weights in '000 t.

Shaded scenarios considered inconsistent with the precautionary approach.

Medium- and long-term projections: There is a low probability of SSB falling below $\mathbf{B}_{pa}$ at the current fishing mortality of $\mathbf{F}_{pa}$.

Elaboration and special comment: Sole are taken mainly in a beam trawl fishery and are also taken as a by-catch in otter trawl fisheries. In recent years, catch rates of sole have been low in the Irish Sea, and part of the beam trawl fleet has moved to sole fishing grounds in other areas. The analytical assessment is based on a tuned catch at age analysis with CPUE data from two commercial beam trawl fleets and two surveys.

Source of information: Report of the Working Group on the Assessment of Northern Shelf Demersal Stocks, August 2001 (ICES CM 2002/ACFM:02).

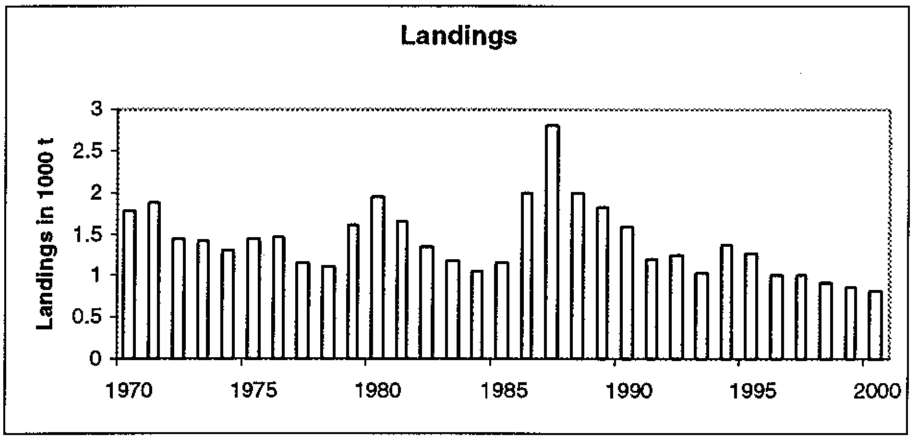
Yield and spawning biomass per Recruit F-reference points:

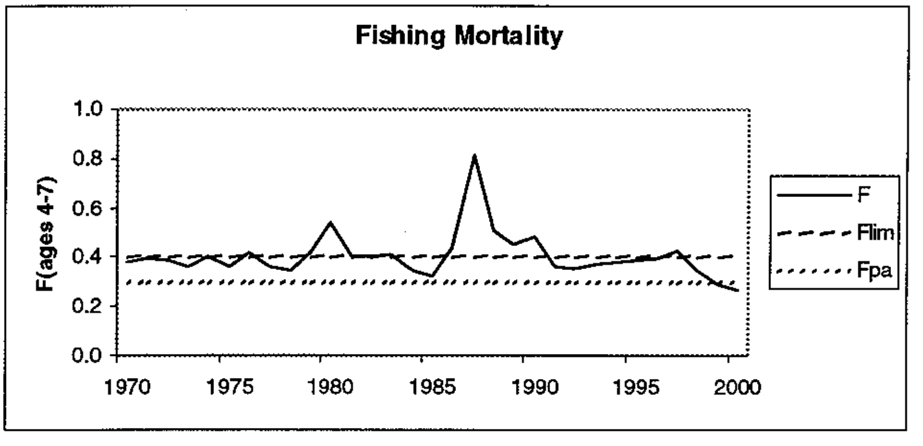
	Fish Mort Ages 4-7	Yield/R	SSB/R
Average Current	0.298	0.180	0.785
$\mathbf{F}_{max}$	0.520	0.185	0.475
$\mathbf{F}_{0.1}$	0.186	0.164	1.175
$\mathbf{F}_{med}$	0.315	0.181	0.746

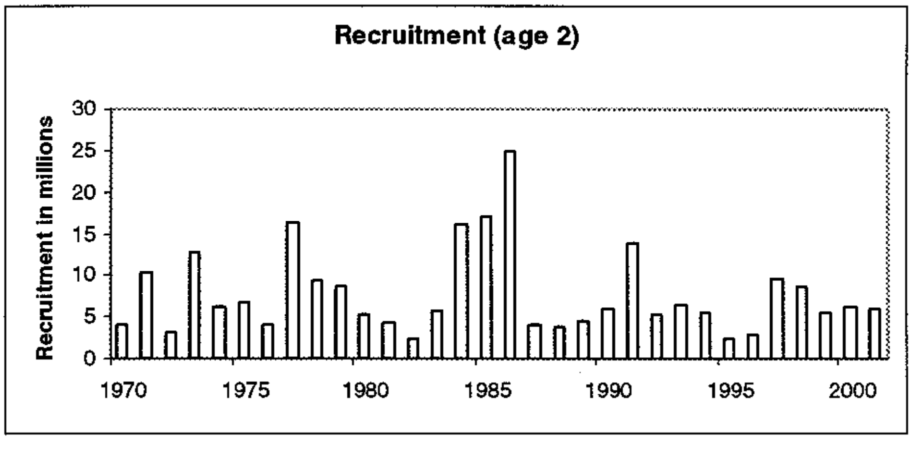
Catch data (Tables 3.8.6.1–2):

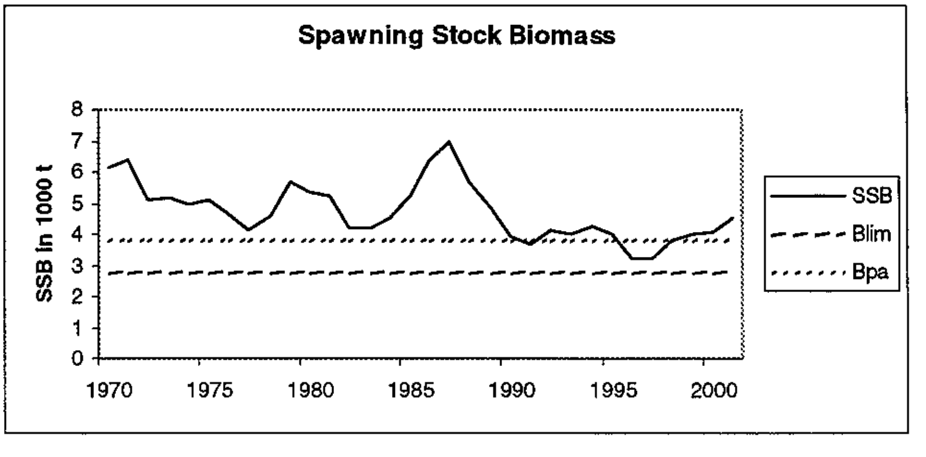
Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC	Official landings	ACFM landings[2]
1987	No increase in F	1.9	2.1	2.0	2.8
1988	80% of F(86); TAC	1.6	1.75	1.9	2.0
1989	80% of F(87); TAC	< 1.48	1.48	1.8	1.8
1990	Interim advice	1.05[3]	1.5	1.6	1.6
1991	90% of F(89); TAC	1.3	1.5	1.2	1.2
1992	No long-term gains in increased F	1.2[1]	1.35	1.2	1.3
1993	F = F(91) ~ 920 t	0.92	1.0	1.0	1.0
1994	No long-term gains in increased F	1.51[1]	1.5	1.4	1.4
1995	20% reduction in F	0.8	1.3	1.3	1.3
1996	20% reduction in F	0.8	1.0	1.0	1.0
1997	20% reduction in F	0.8	1.0	1.0	1.0
1998	20% reduction in F	0.85	0.9	0.9	0.9
1999	Reduce F below $\mathbf{F}_{pa}$	0.83	0.9	0.8	0.9
2000	Reduce F below $\mathbf{F}_{pa}$	< 1.08	1.08	0.7[4]	0.8
2001	Reduce F below $\mathbf{F}_{pa}$	< 0.93	1.1		
2002	Keep F below $\mathbf{F}_{pa}$	<1.1			

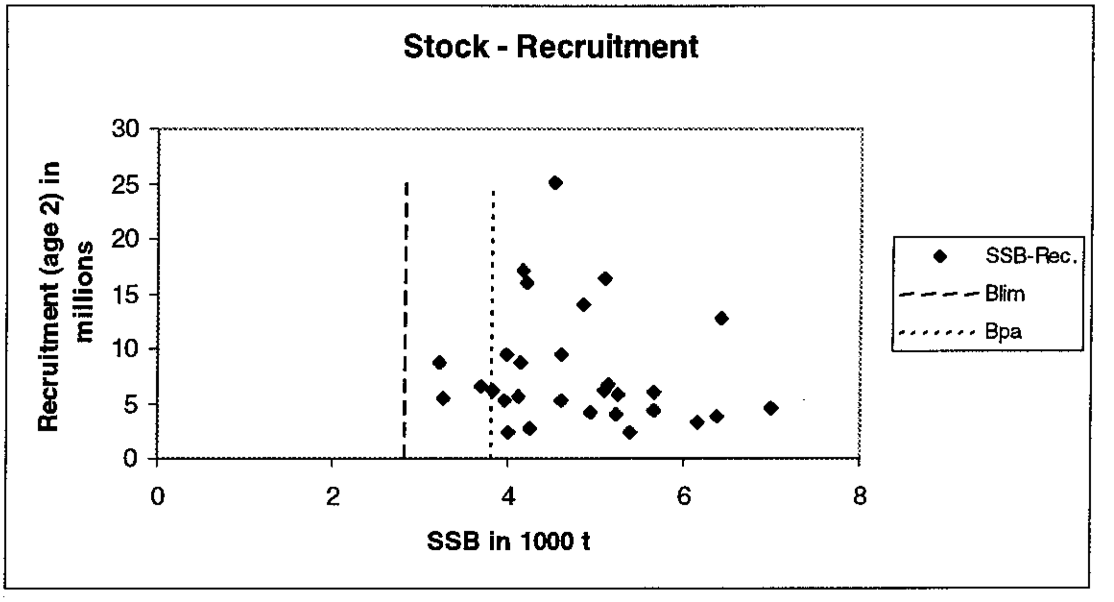
[1]Catch at *Status quo* F. [2] Not including misreporting. [3]Revised in 1990 to 1.5. [4]Incomplete statistics. Weights in '000 t.

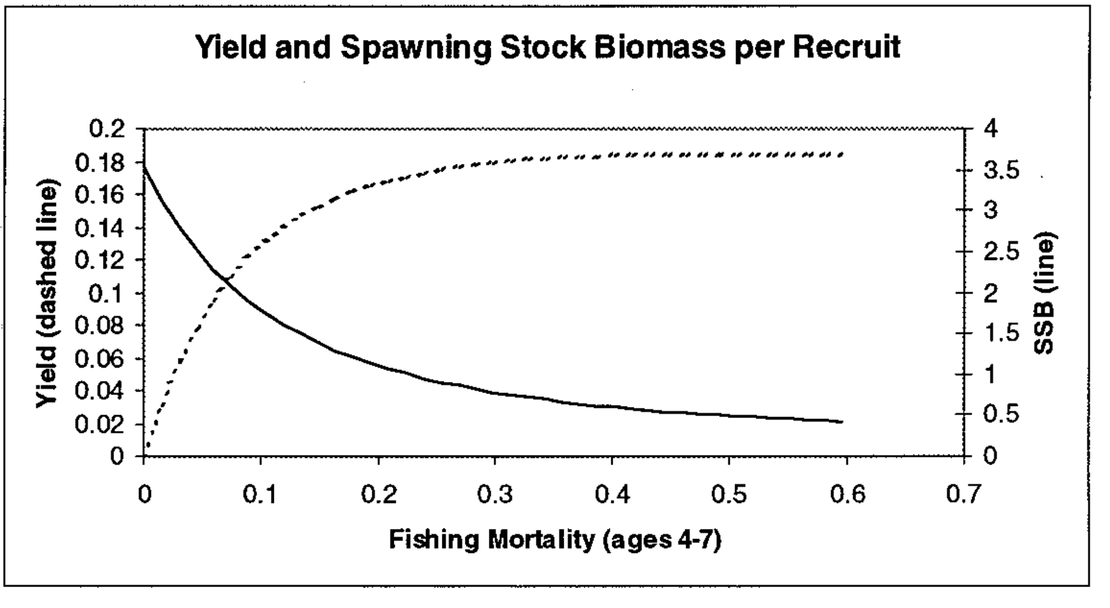

Landings
Landings in 1000 t
3
2.5
2
1.5
1
0.5
0
1970
1975
1980
1985
1990
1995
2000


Fishing Mortality
F(ages 4-7)
1.0
0.8
0.6
0.4
0.2
0.0
1970
1975
1980
1985
1990
1995
2000
F
Flim
Fpa


Recruitment (age 2)
Recruitment in millions
30
25
20
15
10
5
0
1970
1975
1980
1985
1990
1995
2000


Spawning Stock Biomass
SSB in 1000 t
8
7
6
5
4
3
2
1
0
1970
1975
1980
1985
1990
1995
2000
SSB
Blim
Bpa


Stock - Recruitment
Recruitment (age 2) in millions
SSB in 1000 t
SSB-Rec.
Blim
Bpa
0
5
10
15
20
25
30
0
2
4
6
8


Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
SSB (line)
Fishing Mortality (ages 4-7)
0
0.02
0.04
0.06
0.08
0.1
0.12
0.14
0.16
0.18
0.2
0.5
1
1.5
2
2.5
3
3.5
4
0.1
0.2
0.3
0.4
0.5
0.6
0.7

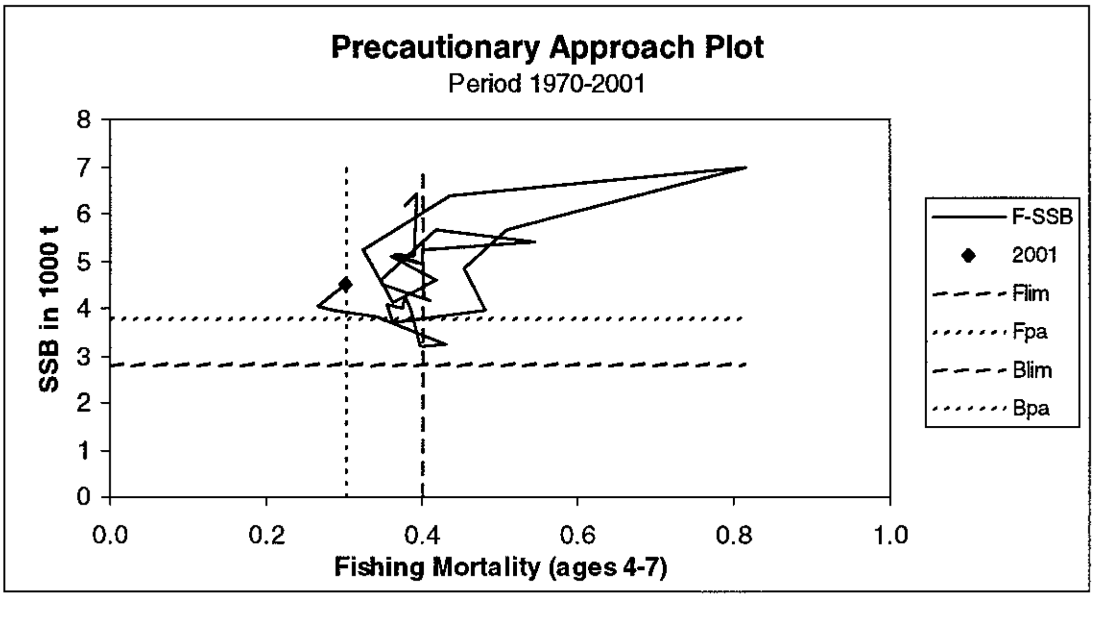

Precautionary Approach Plot
Period 1970-2001
SSB in 1000 t
Fishing Mortality (ages 4-7)
F-SSB
2001
Flim
Fpa
Blim
Bpa
0
1
2
3
4
5
6
7
8
0.0
0.2
0.4
0.6
0.8
1.0

Table 3.8.6.1 Irish Sea SOLE. Divisions VIIa. Nominal landings (t), as officially reported to ICES.

Country	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000*
Belgium	987	915	1,010	786	371	531	495	706	675	533	570	525	469	493
France	5	11	5	2	3	11	8	7	5	5	3	5*	1*	2*
Ireland	312	366	155	170	198	164	98	226	176	133	130	134	120	n/a
Netherlands	-	-	-	-	-	-	-	-	-	149	123	60	46	60
UK (Engl.& Wales)[1]	599	507	613	569	581	477	338	409	424	194	189	161	165	133
UK (Isle of Man)	3	1	2	10	44	14	4	5	12	4	5	3	1	n/a
UK (N. Ireland)[1]	72	47	...	...	...	...	...	...	...	...	...	...	...	...
UK (Scotland)	63	38	38	39	26	37	28	14	8	5	7	9	8	8
Total	2,041	1,885	1,823	1,576	1,223	1,234	971	1,367	1,300	1,023	1,027	897	810	696
Unallocated	767	114	10	7	-9	25	52	2	-34	-23	-24	14	53	122
Total used by Working Group in Assessment	2,808	1,999	1,833	1,583	1,214	1,259	1,023	1,369	1,266	1,002	1,003	911	863	818

* Preliminary.
[1] 1989–1999 N.Ireland included with England & Wales.
n/a Not available.

Table 3.8.6.2 Sole in Division VIIa (Irish Sea).

Year	Recruitment Age 2 thousands	SSB tonnes	Landings tonnes	Mean F Ages 4-7
1970	4045	6157	1785	0.378
1971	10291	6416	1882	0.393
1972	3218	5103	1450	0.390
1973	12768	5137	1428	0.364
1974	6189	4937	1307	0.401
1975	6786	5111	1441	0.359
1976	4169	4615	1463	0.418
1977	16328	4125	1147	0.362
1978	9461	4600	1106	0.346
1979	8673	5674	1614	0.417
1980	5293	5387	1941	0.544
1981	4423	5252	1667	0.401
1982	2355	4205	1338	0.402
1983	5822	4166	1169	0.409
1984	16001	4525	1058	0.350
1985	17086	5232	1146	0.323
1986	25070	6379	1995	0.436
1987	4083	6994	2808	0.816
1988	3903	5663	1999	0.508
1989	4535	4864	1833	0.453
1990	6090	3966	1583	0.481
1991	13940	3681	1212	0.362
1992	5313	4106	1259	0.354
1993	6573	4010	1023	0.375
1994	5620	4240	1374	0.377
1995	2350	3985	1266	0.386
1996	2809	3207	1002	0.397
1997	9498	3254	1003	0.431
1998	8710	3824	911	0.343
1999	5479	3973	863	0.287
2000	6161	4061	818	0.265
2001	5943	4530		0.300
Average	7781	4731	1416	0.401

3.8.7 Irish Sea herring (Division VIIa)

State of the stock/exploitation: The state of the stock is uncertain. SSB declined through the 1980s, and may have been stable in the 1990s but cannot be estimated in relation to precautionary reference points. $\mathbf{F_{pa}}$ has not been proposed, but the fishing mortality in 2000 is likely to be below any candidate value for $\mathbf{F_{pa}}$.

Management objectives: There are no explicit management objectives for this stock. However, for any management objective to meet precautionary criteria, spawning stock biomass should be greater than the proposed $\mathbf{B_{pa}}$.

Precautionary Approach reference points (established in 2000):

ICES considers that:	ICES proposes that:
$\mathbf{B_{lim}}$ is 6,000t	$\mathbf{B_{pa}}$ = 9,500t
$\mathbf{F_{lim}}$ is not defined	$\mathbf{F_{pa}}$ under review, proposed as 0.36 in 1999, not adopted

Technical basis:

$\mathbf{B_{lim}}$: lowest observed SSB	$\mathbf{B_{pa}}$: $\mathbf{B_{lim}}$ *1.58; still under consideration
$\mathbf{F_{lim}}$: not defined	$\mathbf{F_{pa}}$: $\mathbf{F_{med}}$

Advice on management: ICES advises that landings should not exceed the average catch of the last 5 years, corresponding to 4,800t.

Relevant factors to be considered in management: Areas closed to herring fishing around the east coast of Ireland and west coast of Britain were put in place to protect juveniles when an industrial fishery operated. A closed area exists to the east of the Isle of Man to protect the spawning aggregations.

These closed areas should be maintained. The catch in 1998 to 2000 is uncertain.

Comparison with previous assessment and advice: The update of the assessment gave 20% lower estimates of SSB for the last 15 years. Until this change in the perception of the stock size is explained it will not be possible to use the assessment for a quantitative catch advice.

Catch forecast for 2002: The assessment is not certain enough to be used as basis for a catch forecast.

Elaboration and special comment: Fishing mortality was high during the 1970s due to a transfer of effort from other closed herring fisheries and the operation of an industrial fleet. Since 1981 the size of the exploiting fleets in this area has declined and the industrial fishery has closed.

Survey indices have been revised and the new assessments are based on the same catches with additional survey data series providing more information on recruitment and the age structure of the stock. Further exploratory analyses are required before the current assessment can be regarded as stable.

In 2000, the catch was lower because some quota holders did not participate in the fishery.

Many aspects of the biology and fisheries data changed rapidly in the mid-1980s, affecting assessment results. These changes require further investigations and depending on the causes of the changes, reference points may be affected. If the changes are a result of stock components being exploited by the fishery, any similar changes in the future could cause serious problems for producing reliable assessments.

Source of information: Report of the Herring Assessment Working Group for the Area South of 62°N, March 2001 (ICES CM 2001/ACFM:12).

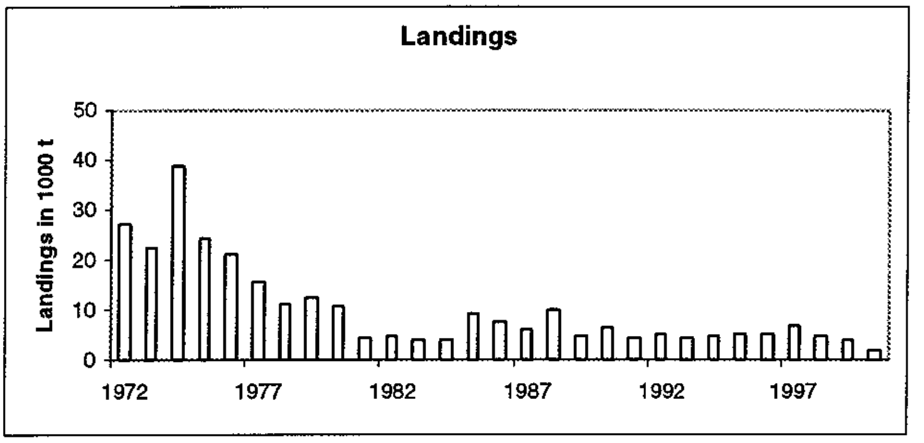
Yield and spawning biomass per Recruit F-reference points:

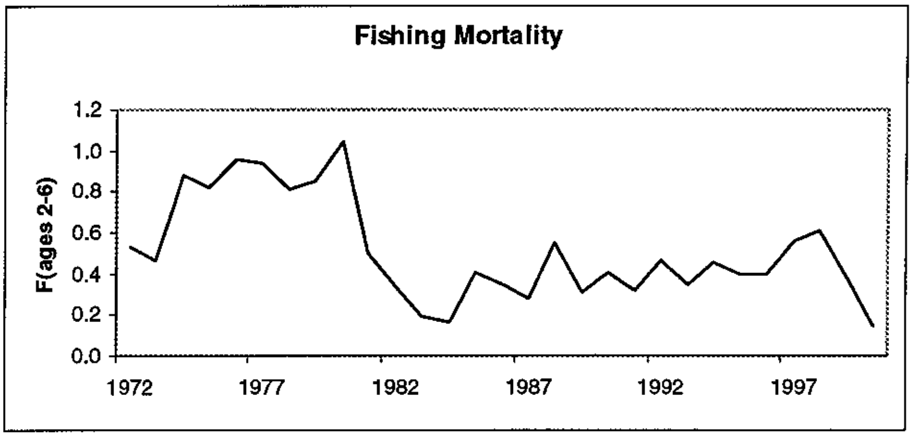
	Fish Mort Ages 2-6	Yield/R	SSB/R
Average Current	0.147	0.029	0.173
$\mathbf{F_{max}}$	N/A		
$\mathbf{F_{0.1}}$	0.166	0.030	0.157
$\mathbf{F_{med}}$	0.410	0.036	0.065

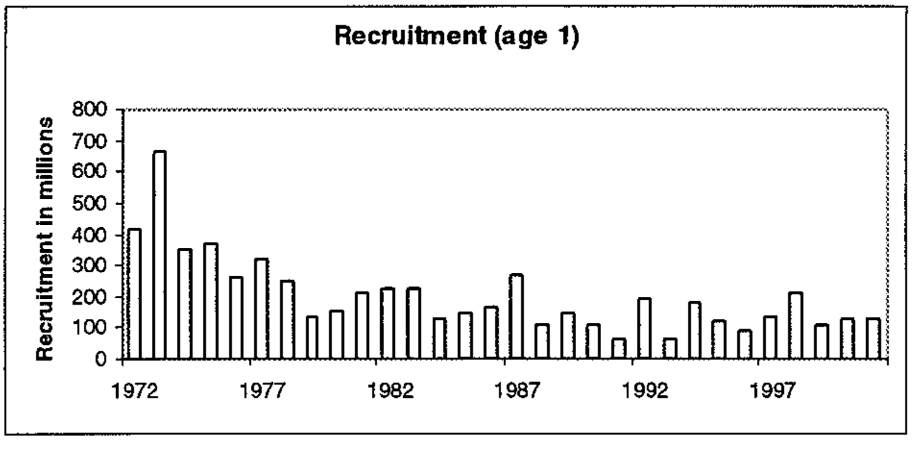
Catch data (Tables 3.8.7.1–2):

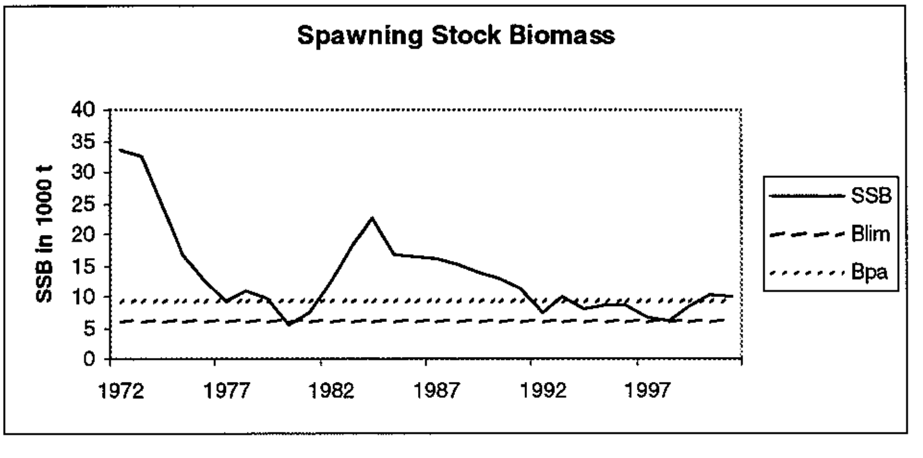
Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC	ACFM Catch
1987	TAC	4.3	4.5	5.8
1988	TAC (Revised advice in 1988)	10.5 (5.6)	10.5	10.2
1989	TAC	5.5	6.0	5.0
1990	Precautionary TAC	5.7	7.0	6.3
1991	TAC	5.6	6.0	4.4
1992	TAC	6.6	7.0	5.3
1993	TAC	4.9-7.4	7.0	4.4
1994	Precautionary TAC	5.3	7.0	4.8
1995	Precautionary TAC	5.1	7.0	5.1
1996	If required, precautionary TAC	5.0	7.0	5.3
1997	No advice given	-	9.0	6.6
1998	*Status quo* F	6.5	9.0	4.9
1999	F=Proposed $\mathbf{F}_{pa}$=0.36	4.9	6.6	4.1
2000	F=90% F(98)=0.31	3.9	5.4	2
2001	*Status quo* F= 0.26	5.1	6.9	
2002	Average catch of 1996-2000	4.8		

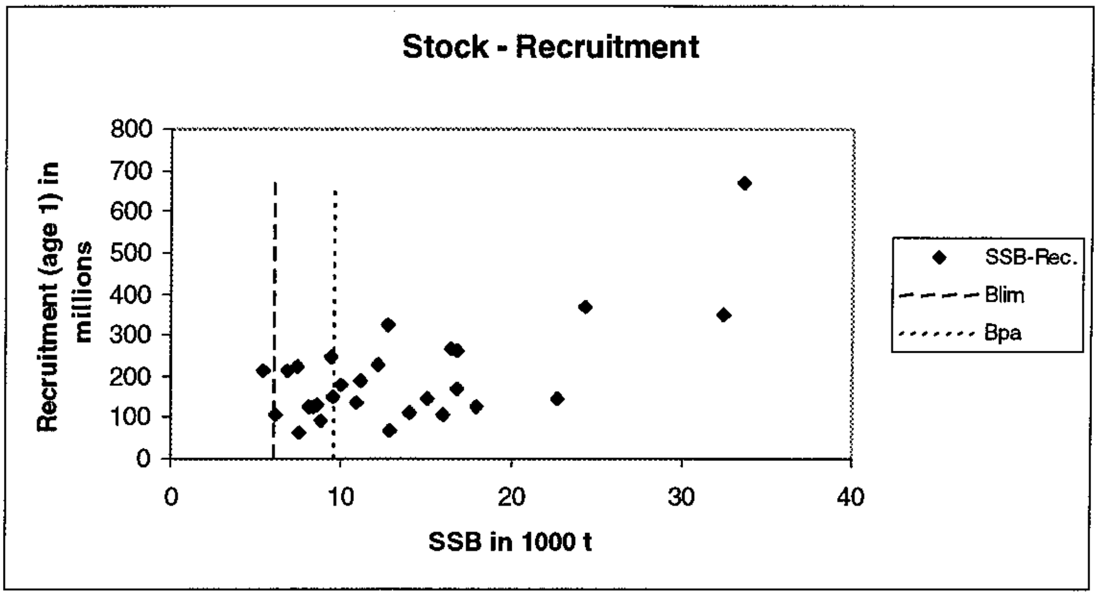
Weights in '000 t.

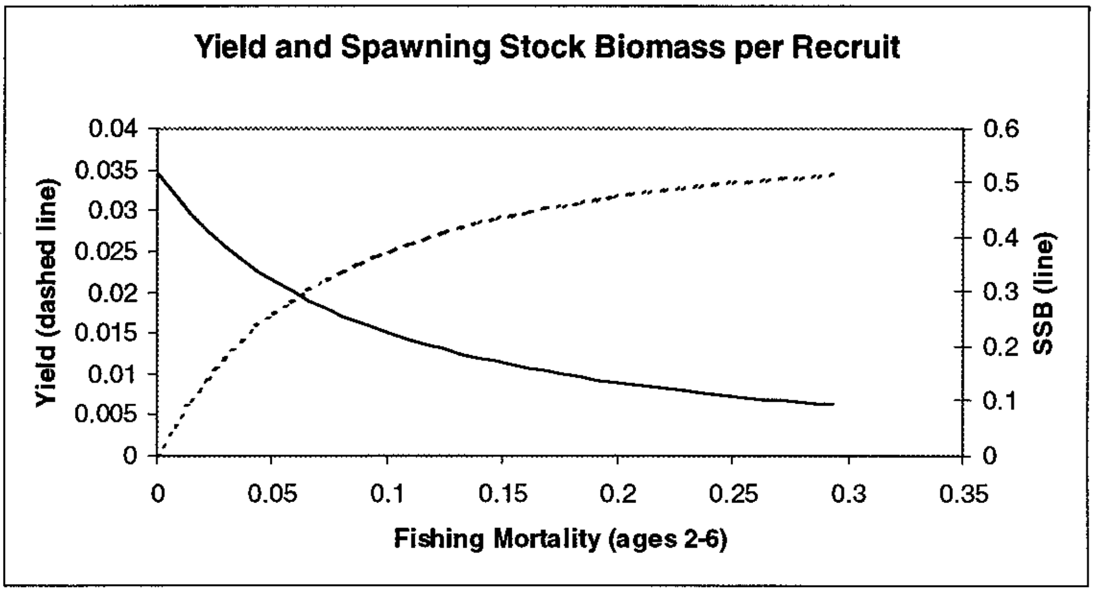

Landings
Landings in 1000 t
50
40
30
20
10
0
1972
1977
1982
1987
1992
1997


Fishing Mortality
F(ages 2-6)
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1972
1977
1982
1987
1992
1997


Recruitment (age 1)
Recruitment in millions
800
700
600
500
400
300
200
100
0
1972
1977
1982
1987
1992
1997


Spawning Stock Biomass
SSB in 1000 t
40
35
30
25
20
15
10
5
0
1972
1977
1982
1987
1992
1997
SSB
Blim
Bpa


Stock - Recruitment
Recruitment (age 1) in millions
800
700
600
500
400
300
200
100
0
0
10
20
30
40
SSB in 1000 t
SSB-Rec.
Blim
Bpa


Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
SSB (line)
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
Fishing Mortality (ages 2-6)

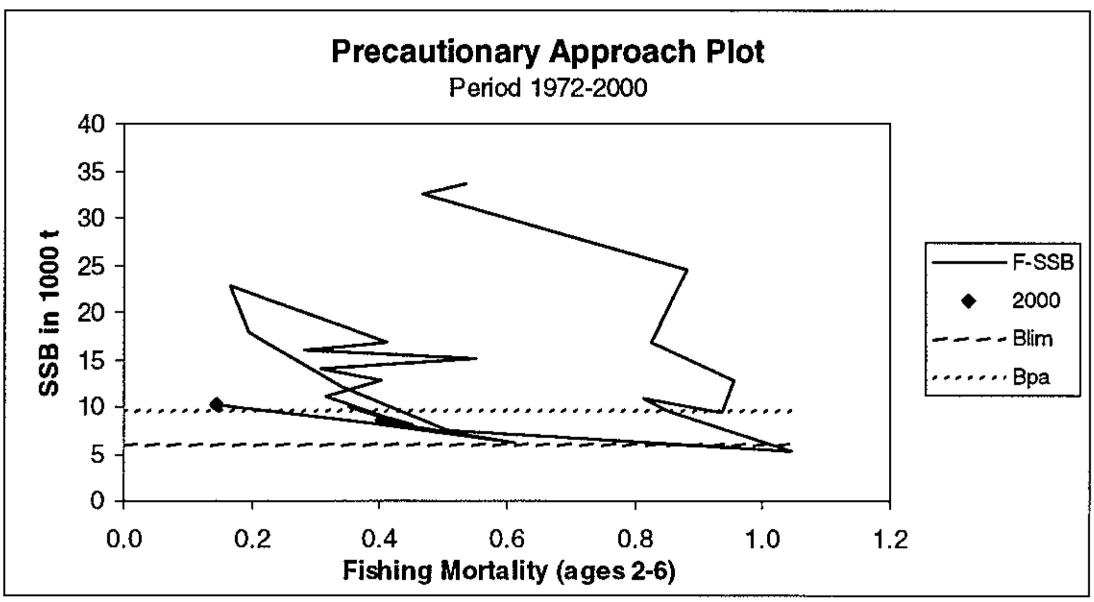

Precautionary Approach Plot
Period 1972-2000
SSB in 1000 t
40
35
30
25
20
15
10
5
0
0.0
0.2
0.4
0.6
0.8
1.0
1.2
Fishing Mortality (ages 2-6)
F-SSB
2000
Blim
Bpa

Table 3.8.7.1 Irish Sea HERRING (Division VIIa(N)). Catch in tonnes by country, 1985-2000. These figures do not in all cases correspond to the official statistics and cannot be used for management purposes.

Country	1985	1986	1987	1988	1989	1990	1991	1992	1993
Ireland	1,000	1,640	1,200	2,579	1,430	1,699	80	406	0
UK	4,077	4,376	3,290	7,593	3,532	4,613	4,318	4,864	4,408
Unallocated	4,110	1,424	1,333	-	-	-	-	-	-
Total	9,187	7,440	5,823	10,172	4,962	6,312	4,398	5,270	4,408

Country	1994	1995	1996	1997	1998	1999	2000
Ireland	0	0	100	0	0	0	0
UK	4,828	5,076	5,180	6,651	4,905	4,127	2002
Unallocated	-	-	22	-	-	-	-
Total	4,828	5,076	5,302	6,651	4,905*	4,127*	2002*

* Reliability uncertain.

Table 3.8.7.2 Irish Sea herring (Division VIIa).

Year	Recruitment Age 1 thousands	SSB tonnes	Landings tonnes	Mean F Ages 2-6
1972	414040	33644	27350	0.5341
1973	667440	32467	22600	0.4658
1974	349020	24405	38640	0.8805
1975	368570	16838	24500	0.8252
1976	262690	12730	21250	0.9570
1977	322880	9398	15410	0.9361
1978	246680	10868	11080	0.8129
1979	137130	9542	12338	0.8497
1980	152200	5418	10613	1.0468
1981	213430	7371	4377	0.5076
1982	224560	12211	4855	0.3387
1983	226050	17929	3933	0.1934
1984	128070	22715	4066	0.1673
1985	145470	16803	9187	0.4109
1986	167920	16436	7440	0.3505
1987	265710	16038	5823	0.2829
1988	108490	15060	10172	0.5516
1989	145120	14027	4949	0.3057
1990	111460	12835	6312	0.4022
1991	65920	11135	4398	0.3158
1992	190130	7556	5270	0.4612
1993	62940	9949	4409	0.3500
1994	180980	8083	4828	0.4512
1995	123730	8822	5076	0.3963
1996	92420	8563	5301	0.3925
1997	132750	6861	6651	0.5568
1998	214250	6152	4905	0.6139
1999	107210	8350	4127	0.3799
2000	125790	10296	2002	0.1469
2001	130569	10095		
Average	202787	13420	10064	0.5132

3.9 Stocks in the Celtic Sea (Divisions VIIf-k), Western Channel (Division VIIe) and northern parts of the Bay of Biscay (Divisions VIIIa,b–d, and e)

3.9.1 Overview

Fleets and fisheries

Most of the demersal fisheries in this area have a mixed catch. Although it is possible to associate specific target species with particular fleets, various quantities of cod, whiting, hake, anglerfish, megrim, sole, plaice and *Nephrops* are taken together, depending on gear type.

In the Celtic Sea and Western Channel, fisheries for demersal species, mainly cod, whiting, sole and plaice, are conducted by Belgium, France, Ireland and the UK. The principal gears used are otter trawls and beam trawls. The targeting of sole and plaice using beam trawls became prevalent during the mid-1970s, leading to an increase in the landings of these two species. The gradual replacement of otter trawls by beam trawls has occurred in the Belgian and UK fleets. In the Bay of Biscay there has been a substantial replacement of inshore trawling by gill-net fisheries targeting sole.

A trawl fishery for anglerfish by Spanish and French vessels developed in the Celtic Sea and Bay of Biscay in the 1970s and expanded until 1990. In addition, a gill net fishery has developed in the Celtic Sea in the 1990s. Selectivity is known to be poor for these species.

Nephrops are an important component of the fisheries in this area. These fisheries developed in the 1970s and 1980s. Fishing effort has decreased continuously since the early 1990s. However, gear efficiency has increased in recent years and this may have helped maintaining LPUE at relatively high levels. In the Bay of Biscay, since 1st January 2000, the mesh size used when fishing for *Nephrops* has increased and is now similar to the one used for other demersal fish (70mm). Management of these fisheries needs to be sensitive to by-catches of stocks requiring protection such as Celtic Sea cod and Northern hake.

There are separate trawl fisheries targeting herring in the Celtic Sea and mackerel and horse mackerel in the whole area. The herring fishery is principally a "roe" fishery and discard rates have at times reached very high levels, but not in the most recent two years. There is also a small directed fishery for sprat in the Channel.

Management measures

The assessment units used for many of the demersal stocks in this area are small and catches deriving from them are generally in the region of 10 000 t or less. However, the TACs set for the stocks often cover many assessment units. In addition, for some units, there are still insufficient data for adequate assessments. This means that TACs comprise a summation across units of analytical forecasts and average catches which may offer no effective management control of the exploitation rate. Since a number of stocks affected by this problem are close to or outside safe biological limits, there is a need to reconsider the areas on which TACs are set if management is to improve.

A notable feature of the demersal fisheries in this area is their mixed nature. The effectiveness of single species TACs is likely to be diminished unless this is taken into account. Use of measures to reduce fishing mortality directly, such as effort reductions in fleets, is likely to avoid a number of the disadvantages of catch controls in regulating the exploitation rate.

The fisheries in the Celtic Sea are very similar to the fisheries in the Bay of Biscay and some of the same fleets operate in both areas. However, the technical measures in the two areas differ. Despite the revision by the European Commission Technical Conservation Regulation of existing technical measures in 1st January 2000, the minimum mesh sizes in the Celtic Sea are still often different from those in the Bay of Biscay. These differences make enforcement more difficult.

The catch includes a large amount of juveniles of some late-maturing species (anglerfish, hake). While improving selectivity to prevent any catch of hake less than 55 cm (length of maturity for females) seems to be difficult, some selective devices such as rigid grids should be promoted to protect juveniles of the incoming strong year-classes of white anglerfish.

State of the stocks

The majority of fish stocks which are assessed in this area are harvested outside safe biological limits. They are characterised by low spawning stock biomass and recent high fishing mortality rates. Of particular concern are Celtic Sea (VIIf,g) and Western Channel (VIIe) sole and plaice, Celtic Sea (VIIe-k) cod and Bay of Biscay (VIIIabd) sole. These stocks exhibit high F, low SSB and low recruitments in most recent years.

The Celtic Sea whiting stock has been fluctuating within safe biological limits, following period of low and high recruitment.

The assessment of Celtic Sea haddock was considered preliminary due to the short time series. Recruitment seems to be highly variable influencing the variation in the stock size. This is also reflected in the landings.

Anglerfish and megrim are close to safe biological limits Recent recruitment of L. *piscatorius* (1998-1999 year classes) are well above average.

The Northern hake stock is discussed fully in Section 3.12.2. It is important to note that this species is taken by most of the demersal fleets in this area. This hake stock is outside safe biological limits, and a rebuilding plan is needed in order to rebuild the SSB.

There are no major concerns about the *Nephrops* stock in the Celtic Sea.

The *Nephrops* stock in the Bay of Biscay has been declined since the early 1990s. A strong reduction in the fishing mortality and an improvement of the selection pattern is required. The recent increase (from 55mm to 70mm) which occurred in 2000 is unlikely to have improved selectivity significantly.

The abundance of anchovy varies considerably according to fluctuations in recruitment which is likely to be strongly dependent on environmental factors. In 2001, the stock is inside safe biological limit.

The mackerel caught in the area belong to the Southern and Western spawning components. The Western horse mackerel has declined rapidly since the mid 1980s and is estimated to continue to decline.

3.9.2 Cod in Divisions VIIe-k

State of stock/exploitation: The stock is outside safe biological limits. SSB has decreased since 1996, is currently below $\mathbf{B_{pa}}$, at $\mathbf{B_{lim}}$, and close to a historical low estimate. Recruitment is highly variable. The 1997 and 1998 year classes are well below average and the 1999 year class is estimated to be above. Fishing mortality shows a generally increasing trend since the early 1980s and has fluctuated well above $\mathbf{F_{pa}}$ since 1989. Fishing mortality has been above $\mathbf{F_{lim}}$ since 1998.

Management objectives: There are no explicit management objectives for this stock.

Precautionary Approach reference points (established in 1999):

ICES considers that:	ICES proposes that:
$\mathbf{B_{lim}}$ is 5 400 t, the lowest observed spawning stock biomass.	$\mathbf{B_{pa}}$ be set at 10 000 t. Biomass above this affords a high probability of maintaining SSB above $\mathbf{B_{lim}}$, taking into account the uncertainty in assessments.
$\mathbf{F_{lim}}$ is 0.90, the fishing mortality estimated to lead to potential collapse.	$\mathbf{F_{pa}}$ be set at 0.68. This F is considered to have a high probability of avoiding $\mathbf{F_{lim}}$ and maintaining SSB above $\mathbf{B_{pa}}$ in the medium term, taking into account the uncertainty assessments.

Technical basis:

$\mathbf{B_{lim}} = \mathbf{B_{loss}}$	$\mathbf{B_{pa}}$ = historical development of the stock
$\mathbf{F_{lim}}$ = based on historical response of the stock	$\mathbf{F_{pa}} = 5^{th}$ percentile of $\mathbf{F_{loss}}$

Advice on management: ICES recommends that fishing mortality should be reduced to less than 0.55 which is below $\mathbf{F_{pa}}$, corresponding to landings of less than 5 300 t in 2002. This represents a reduction in F of 45% and this would allow SSB to reach $\mathbf{B_{pa}}$ in the short-term.

Comparison with previous assessment and advice: The current assessment estimates are very similar to those obtained last year. This year's advice is stronger than the one provided last year because of the further decline in the stock size, the uncertainty in the strength of the 1999 year class and high contribution of assumed 2000-2001 year classes to SSB in 2003. Mean weights at age have been revised for years prior to 1980.

Relevant factors to be considered in management: Even though advised reduction in fishing mortality is higher than last year, the catch corresponding to present advice is higher than the catch advised last year due to recruitment of the strong 1999 year class. This year class contributes about 50% to the catch in 2002.

The assessment area was expanded in 1997 to cover Divisions VIIe-k. The TAC for cod is set for all of Sub-area VII (excluding Division VIIa) and Division VIII. In order to protect cod in Divisions VIIe-k, the TAC should be allocated on a stock basis. If setting an overall TAC for Sub-areas VII(excl. Division VIIa) and VIII, the state of cod in Division VIId that is assessed as part of the North Sea stock should be considered.

The yield-per-recruit model suggests that a reduction in F to $\mathbf{F_{max}}$ (=0.29) will increase the long-term yield.

Catch forecast for 2002:

Basis: F(2001) = F(98–00) = 1.00; Landings(2001) = 8.1; SSB(2002) = 7.9.

F(2002) onwards	Basis	Catch(2002)	Landings (2002)	SSB (2003)
0.4	0.4 F_{98-00}		4.1	11.4
0.5	0.5 F_{98-00}		5.0	10.4
0.55	0.55 F_{98-00}		5.3	10.0
0.6	0.6 F_{98-00}		5.7	9.5
0.68	F_{pa}		6.2	8.9
1.0	1.0 F_{98-00}		8.0	6.6

Weights in '000 t.

Shaded scenarios considered inconsistent with the precautionary approach.

Catch and SSB are sensitive to the strength of the 1999 year-class, which still needs to be confirmed. Also about 60% of SSB in 2003 (ages 2-3) is based on long-term geometric mean recruitment.

Medium- and long-term projections: Assuming the current selection pattern, fishing at $\mathbf{F}_{max}$ would require a 71% reduction in F.

Elaboration and special comment: Cod in Divisions VIIe-k are taken as a component of catches in mixed trawl fisheries. Landings are made mainly by French gadoid trawlers, which prior to 1980 were mainly fishing for hake in the Celtic Sea. Landings of cod by French *Nephrops* trawlers have fluctuated between 10% and 20% of the total French cod landings from this stock in recent years. UK (England and Wales) accounts for about 10% and Ireland for 15%, while Belgian vessels take about 5%. Landings are made throughout the year, but mainly in the winter months during November to April.

Analysis of landings trip by trip for the French gadoid trawlers for the period 1996-1999 showed that on a trip basis, cod and whiting were mixed. Information from the fishery indicates that on a haul basis, these two species are rather well separated. This means that fishermen seem to be able, for each trawl operation, to target cod and whiting separately. In Ireland in recent years, cod has increasingly been the target, using gillnet rather than trawl.

Most cod spawning in the Celtic Sea occurs off northern Cornwall in mid to late March. There is also some spawning off south-east Ireland and a little in the Western Channel. Tagging studies have given no evidence of cod movement out of Division VIIe, where there appears to be a simple inshore-offshore migration between deep-water wrecks and reefs in the summer and inshore spawning areas in the winter. Recent tagging work in the Irish Sea suggest that only a small component of cod landings from the Celtic Sea are fish which spawn in the Irish Sea. Furthermore, no cod tagged in the Celtic Sea were recaptured in the Irish Sea.

The analytical assessment was based on landing data and CPUE data for four commercial fleets and one survey. Landing data prior to 1988 are not available for Divisions VIIe,j and k and have been estimated assuming the same relative area distribution of landings as observed in the period 1988-1998. Landings for France in 1999 and 2000 are based on official landings for the TAC area and log book data.

Source of information: Report of the Working Group on the Assessment of Southern Shelf Demersal Stocks, September 2001 (ICES CM 2002/ACFM:05).

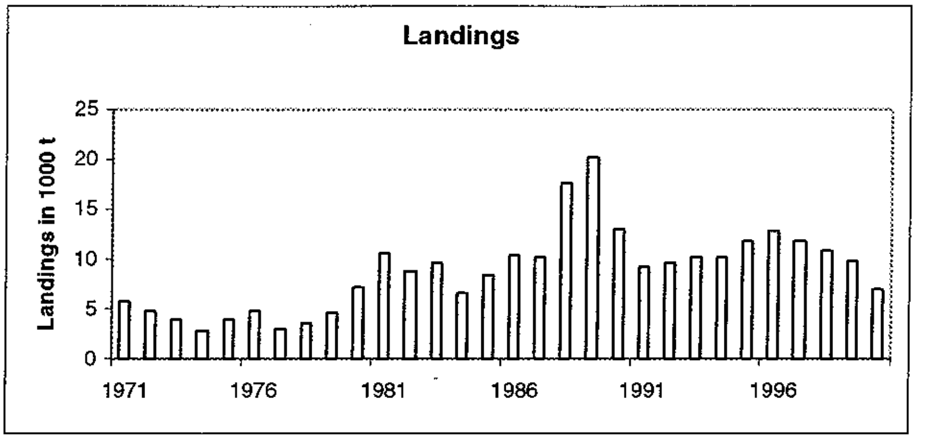
Yield and spawning biomass per Recruit F-reference points:

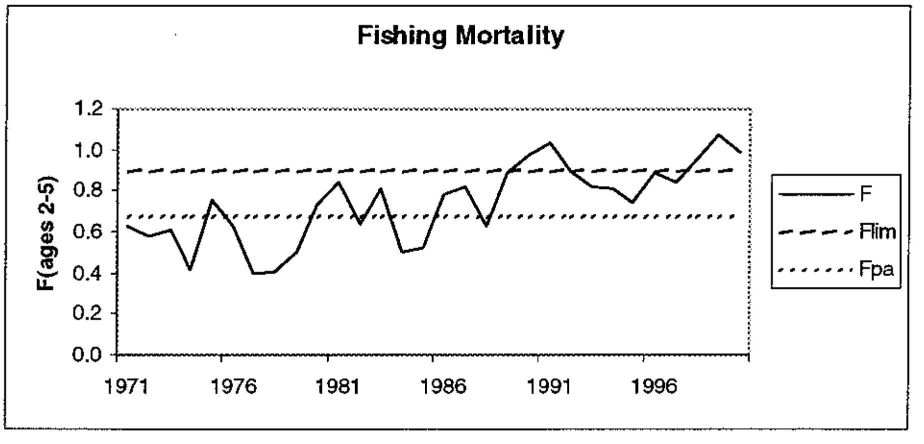
	Fish Mort Ages 2-5	Yield/R	SSB/R
Average Current	1.003	1.877	1.698
$\mathbf{F}_{max}$	0.288	2.567	9.065
$\mathbf{F}_{0.1}$	0.172	2.403	14.360
$\mathbf{F}_{med}$	0.723	2.133	2.808

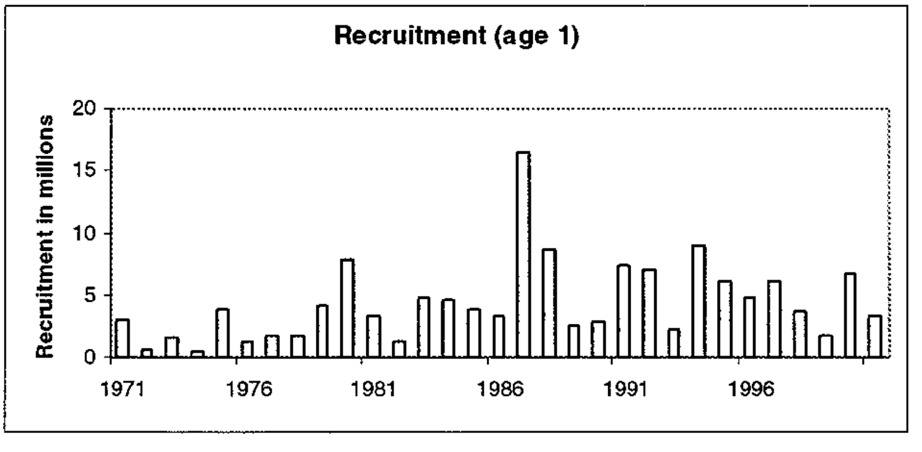
Catch data (Tables 3.9.2.1-2):

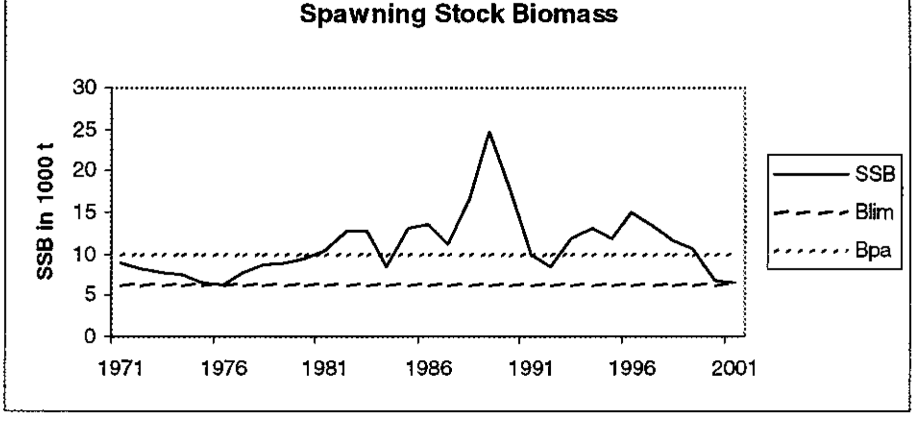
Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC[1]	ACFM Landings
1987	Reduce F	< 6.4[2]		-
1988	No increase in F; TAC	7.0[2]		17.7
1989	No increase in F; TAC	8.6[2]		20.3
1990	No increase in F; TAC	9.2[2]		12.9
1991	TAC; SSB = mean	4.5[2]		9.3
1992	Appropriate to reduce F	-		9.6
1993	20% reduction in F	6.5[2]	19.0	10.2
1994	20% reduction in F	5.6[2]	17.0	10.3
1995	20% reduction in F	4.7[3]	17.0	11.7
1996	20% reduction in F	4.7[3]	20.0	12.8
1997	20% reduction in F	7.4[4]	20.0	11.8
1998	10% reduction in F	8.8[4]	20.0	10.7
1999	Reduce F below $\mathbf{F}_{pa}$	9.2[4]	19.0	9.8
2000	Reduce F below $\mathbf{F}_{pa}$	< 7.6[5]	16.0	7.0
2001	40% reduction in F	< 4.3[5]	10.5	
2002	45% reduction in F	< 5.3[5]		

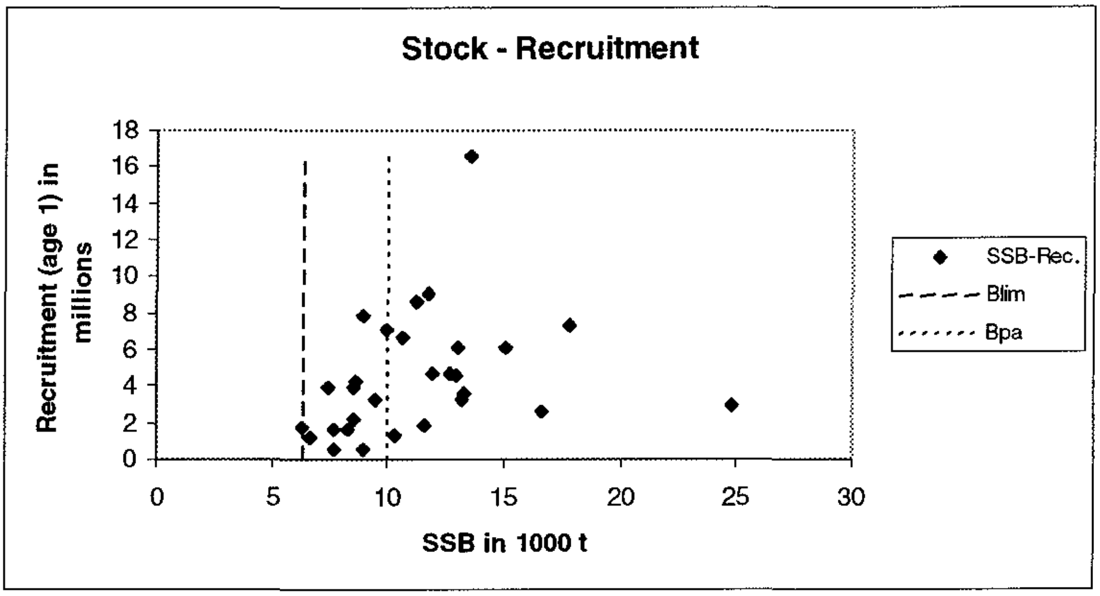
[1]TAC covers Sub-areas VII (except Division VIIa) and VIII. [2] For the VIIf+g stock component. [3] For the VIIf-h stock component. [4] For the VIIe-h stock component. [5] For VIIe-k stock component. Weights in '000 t.

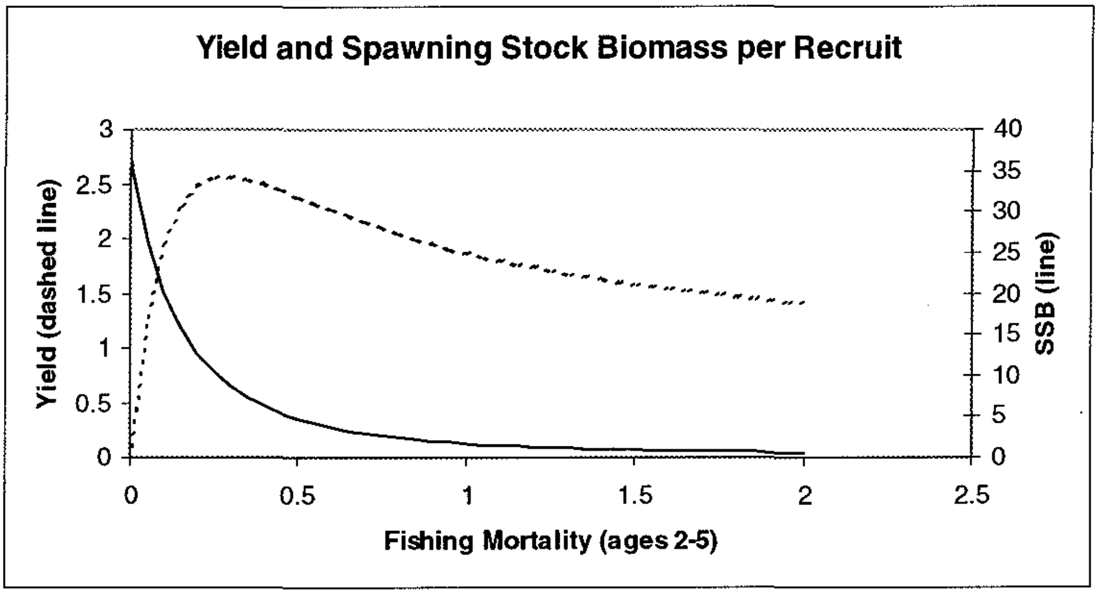

Landings
Landings in 1000 t
25
20
15
10
5
0
1971
1976
1981
1986
1991
1996


Fishing Mortality
F(ages 2-5)
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1971
1976
1981
1986
1991
1996
F
Flim
Fpa


Recruitment (age 1)
Recruitment in millions
20
15
10
5
0
1971
1976
1981
1986
1991
1996


Spawning Stock Biomass
SSB in 1000 t
30
25
20
15
10
5
0
1971
1976
1981
1986
1991
1996
2001
SSB
Blim
Bpa


Stock - Recruitment
Recruitment (age 1) in millions
18
16
14
12
10
8
6
4
2
0
0
5
10
15
20
25
30
SSB in 1000 t
SSB-Rec.
Blim
Bpa


Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
3
2.5
2
1.5
1
0.5
0
40
35
30
25
20
15
10
5
0
SSB (line)
0
0.5
1
1.5
2
2.5
Fishing Mortality (ages 2-5)

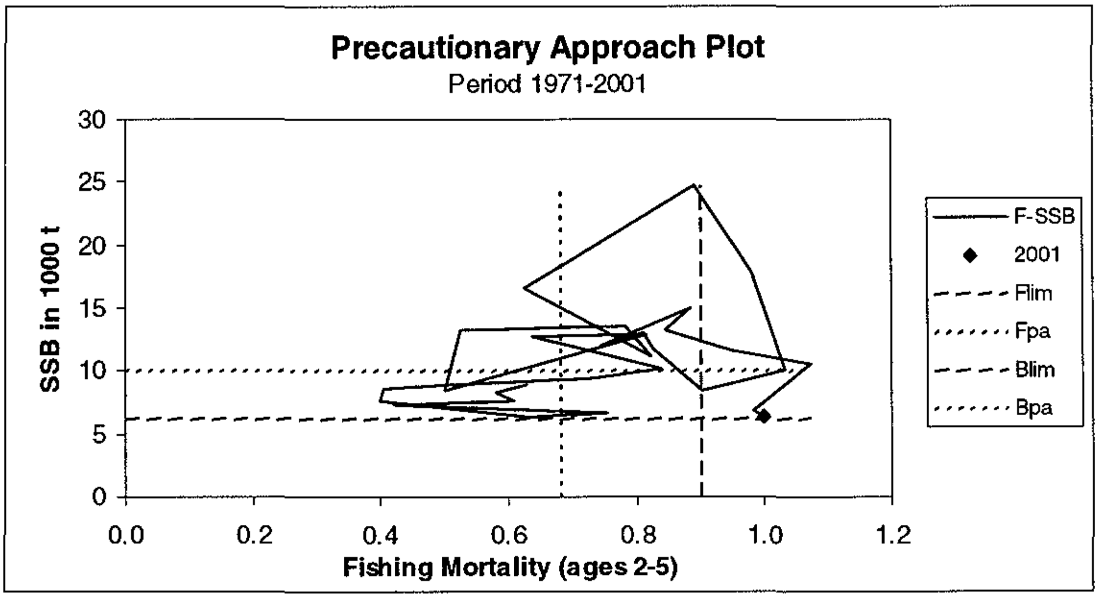

Precautionary Approach Plot
Period 1971-2001
SSB in 1000 t
30
25
20
15
10
5
0
0.0
0.2
0.4
0.6
0.8
1.0
1.2
Fishing Mortality (ages 2-5)
F-SSB
2001
Flim
Fpa
Blim
Bpa

Table 3.9.2.1 Nominal landings of Cod in Divisions VIIf–h, VIIe, VIIe–h, VIIj–k, VIIe–k as used by the Working Group in 2001.

Divisions VIIf,g,h

Year	Belgium	France	Ireland	UK (E + W)	Others	Total
1971						4647
1972						3807
1973	524	2413	64	196	30	3227
1974	197	1954	24	154		2329
1975	377	2657	15	130	30	3209
1976	226	3535	13	97	1	3872
1977	107	2272	17	62		2458
1978	88	2744	30	69		2931
1979	110	3469	72	86		3737
1980	172	5187	246	209	7	5821
1981	285	7806	108	317		8516
1982	174	6391	142	338		7045
1983	262	7013	274	199		7748
1984	240	4569	204	316		5329
1985	456	5632	198	398		6684
1986	374	7473	226	345		8418
1987	216	7187	380	437		8220
1988	542	12065	612	400		13619
1989	891	14298	1003	482		16674
1990	615	8612	177	689		10093
1991	297	5750	246	590		6883
1992	193	6417	340	655		7605
1993	386	7650	331	604		8971
1994	397	6947	966	480		8790
1995	388	7571	820	539		9317
1996	550	8324	949	597		10420
1997	687	7665	397	556		9305
1998	519	6325	659	515		8018
1999*	326	5788**	1219	444		7777
2000*	207	4011**	985	407		5610

Division VIIe

Year	Belgium	France	Ireland	UK	Others	Total
1988	12	1899		839		2750
1989	19	1453		727	2	2201
1990	6	654		610	9	1279
1991	6	341		408		755
1992	2	331		365		698
1993	5	307		274	2	587
1994	1	308		309	2	620
1995	12	554		348		914
1996	2	497		415		914
1997	1	627		441		1069
1998	5	955		456		1416
1999*	0	831**		431		1262
2000*	0	606**		324		930

Continued ...

Table 3.9.2.1 Continued

Divisions VIIe,f,g,h

Year	Belgium	France	Ireland	UK	Others	Total
1988	554	13964	612	1239	0	16369
1989	910	15751	1003	1209	2	18875
1990	621	9266	177	1299	9	11372
1991	303	6091	246	998	0	7638
1992	195	6748	340	1020	0	8303
1993	391	7957	331	878	2	9558
1994	398	7255	966	789	2	9410
1995	399	8124	820	888	0	10231
1996	552	8821	949	1012	0	11334
1997	688	8292	397	997	0	10374
1998	525	7280	659	970	0	9434
1999*	326	6619**	1220	874	0	9039
2000*	208	4616**	985	731	0	6540

Divisions VIIj,k

Year	Belgium	France	Ireland	UK	Others	Total
1988		407	868	53	2	1330
1989		508	857	14	13	1392
1990		276	1064	47	149	1536
1991		115	1413	96	20	1644
1992		202	872	187	13	1274
1993		143	435	67	4	649
1994		117	650	117	6	890
1995		193	1126	147	8	1474
1996		233	1033	154	0	1420
1997	6	153	1116	169	0	1444
1998	4	102	1059	118	0	1283
1999*	0	109**	664	22	0	795
2000*	0	79**	351	20	0	450

Continued ...

Table 3.9.2.1 Continued

Divisions VIIe,f,g,h,j,k

Year	Belgium	France	Ireland	UK	Others	Total
1971	-	-	-	-	-	5782
1972	-	-	-	-	-	4737
1973	-	-	-	-	-	4015
1974	-	-	-	-	-	2898
1975	-	-	-	-	-	3993
1976	-	-	-	-	-	4818
1977	-	-	-	-	-	3058
1978	-	-	-	-	-	3647
1979	-	-	-	-	-	4650
1980	-	-	-	-	-	7243
1981	-	-	-	-	-	10596
1982	-	-	-	-	-	8766
1983	-	-	-	-	-	9641
1984	-	-	-	-	-	6631
1985	-	-	-	-	-	8317
1986	-	-	-	-	-	10475
1987	-	-	-	-	-	10228
1988	554	14371	1480	1292	2	17699
1989	910	16259	1860	1223	15	20267
1990	621	9542	1241	1346	158	12908
1991	303	6206	1659	1094	20	9282
1992	195	6950	1212	1207	13	9577
1993	391	8100	766	945	6	10207
1994	398	7372	1616	906	8	10300
1995	399	8317	1946	1035	8	11705
1996	552	9055	1982	1166	0	12754
1997	693	8445	1513	1166	0	11818
1998	528	7383	1718	1089	0	10718
1999*	326	6729**	1883	896	0	9834
2000*	208	4695**	1336	751	0	6990

* Provisional.
** Estimated landings derived from official landings in TAC area and computed log-books.

Table 3.9.2.2 Cod in Divisions VIIe-k.

Year	Recruitment Age 1 thousands	SSB tonnes	Landings tonnes	Mean F Ages 2-5
1971	3075	8928	5782	0.6284
1972	565	8225	4737	0.5822
1973	1665	7669	4015	0.6096
1974	500	7412	2898	0.4194
1975	3889	6630	3993	0.7549
1976	1202	6304	4818	0.6317
1977	1716	7692	3059	0.3994
1978	1690	8626	3647	0.4050
1979	4221	8951	4650	0.5067
1980	7821	9453	7243	0.7340
1981	3318	10286	10597	0.8388
1982	1349	12741	8766	0.6380
1983	4727	12922	9641	0.8137
1984	4602	8503	6631	0.5008
1985	3918	13178	8317	0.5247
1986	3288	13525	10475	0.7832
1987	16554	11221	10228	0.8222
1988	8572	16600	17699	0.6250
1989	2570	24791	20267	0.8894
1990	2940	17797	12908	0.9810
1991	7322	10013	9282	1.0317
1992	7071	8531	9577	0.9025
1993	2224	11786	10207	0.8253
1994	9010	13080	10300	0.8099
1995	6069	11951	11705	0.7414
1996	4739	15044	12754	0.8858
1997	6143	13265	11818	0.8452
1998	3637	11593	10717	0.9498
1999	1828	10611	9834	1.0746
2000	6677	6882	6990	0.9837
2001	3367*	6444		1.0000**
Average	4396	10989	8502	0.7464

* GM, ** $F_{98\text{-}00}$

3.9.3 Whiting in Divisions VIIe–k

State of stock/exploitation: The stock is within safe biological limits. SSB reached high levels in 1995 and 1996, and has decreased until 1999 though remaining well above $\mathbf{B}_{pa}$. In 2001 SSB reaches a record high mainly due to the outstanding 1999 year class. Fishing mortality was very high during the 1980s, decreased in the early 1990s and is currently estimated to be around 0.5.

Management objectives: There are no explicit management objectives for this stock.

Precautionary Approach reference points (established in 1998):

ICES considers that:	ICES proposes that:
$\mathbf{B}_{lim}$ is 15 000 t, the lowest observed spawning stock biomass.	$\mathbf{B}_{pa}$ be set at 21 000 t. Biomass above this affords a high probability of maintaining SSB above $\mathbf{B}_{lim}$, taking into account the uncertainty of the assessment.
$\mathbf{F}_{lim}$ is not defined.	$\mathbf{F}_{pa}$ not proposed.

Technical basis:

$\mathbf{B}_{lim} = \mathbf{B}_{loss}$	$\mathbf{B}_{pa} = \mathbf{B}_{lim} * 1.4$
$\mathbf{F}_{lim}$ not proposed.	$\mathbf{F}_{pa}$ not proposed.

Advice on management: There is no $\mathbf{F}_{pa}$ defined for this stock, but there is no long-term gain in increasing fishing mortality. Therefore, ICES recommends that fishing mortality should not increase, corresponding to landings of at most 27 700 t in 2002.

Comparison with previous assessment and advice: Last year there was not enough information to confirm the strength of the 1999 year class and ICES used a geometric mean of past recruitment for prediction purposes. This outstanding year class is now consistently estimated in two surveys and verified by one commercial fleet. There was a slight downward revision of F and an upward revision of SSB in the current assessment. Addition of new tuning fleets contributed further to the revision of SSB.

Relevant factors to be considered in management: The assessment area was expanded in 1997 to cover Divisions VIIe-k. The TAC for whiting is set for all of Sub-area VII (excluding Division VIIa). In order to protect whiting in Divisions VIIe-k, the TAC should be allocated to Divisions and catches in the other parts of Sub-area VII be accounted against such TACs. The state of whiting in Division VIId should be considered, if setting an overall TAC for Sub-area VII.

Catch forecast for 2002:

Basis: F(2001) = F(98–00) = 0.49; Landings(2001) = 23.4; SSB(2002) = 73.7.

F (2002 onwards)	Basis	Catch (2002)	Landings (2002)	SSB (2003)
0.29	0.6 F_{98-00}		18.2	71.0
0.39	0.8 F_{98-00}		23.2	66.0
0.49	1.0 F_{98-00}		27.7	61.4
0.59	1.2 F_{98-00}		31.8	57.3
0.68	1.4 F_{98-00}		35.6	53.5
0.79	1.6 F_{98-00}		39.0	50.1

Weights in '000 t.

Shaded scenarios considered inconsistent with the precautionary approach.

Medium- and long-term projections: $\mathbf{F}_{max}$ is not well estimated due to a flat-topped Y/R curve.

Elaboration and special comment: The landings in 2001 are predicted to be considerably higher than the advised TAC because of the contribution of the outstanding 1999 year class. In 2003 46% of SSB is predicted to consist of fish from this year class.

Celtic Sea whiting are taken in mixed species (cod, whiting, hake, *Nephrops*) fisheries. French trawlers account for about 60% of the total landings, Ireland 30% and the UK (England and Wales) 7%, while Belgian vessels take less than 1%. The French *Nephrops* trawlers have for several years adopted a larger mesh, following by-catch restrictions and market demand for larger *Nephrops*. Landings for France in

2000 are based on official landings for the TAC area and computed log books.

Analysis of landings trip by trip by the French gadoid trawlers for the period 1996-1998 showed that on a trip basis, cod and whiting were mixed. Information from the fishery indicates that on a haul basis, these two species are rather well separated. This means that fishermen seem to be able, for each trawl operation, to target cod and whiting separately.

The main Irish fleets in Divisions VIIf,g,h are inshore and offshore otter trawlers and seiners based in Dunmore East and Kilmore Quay. However, in recent years there has been an increase in the number of Irish beamers (+6 vessels) targeting anglerfish and megrim with whiting as by–catch, offshore in Division VIIg. Division VIIj–k whiting are taken in a mixed species fisheries (cod/whiting/anglerfish/megrim and *Nephrops*). The main gears used are otter trawl and seiners, and landings are taken by Ireland (90%) and France (7%).

The main Irish fleet in Divisions VIIj,k are otter trawlers that target mixed gadoids and account for 10% of landings of whiting in Divisions VIIe-k. The main UK fisheries in Divisions VIIe,f,g,h are inshore between Newlyn and Salcombe and off the north Cornish coast, the bulk of the landings (> 60%) being made in the winter months between November and March. UK landings in the 1950s were 4–5 times higher than at present, though landings overall have generally increased during the period since 1982, with peaks in 1989 (16 540 t) and in 1995 (22 680 t). The main gears used in the Western Channel are otter-trawls targeting a wide range of species, and beam-trawls targeting sole, anglerfish and plaice.

The main spawning areas of whiting in the Western Channel and Celtic Sea are off Start Point (VIIe), off Trevose Head (VIIf), and south-east of Ireland (VIIg). Returns of adult whiting tagged in the Western Channel indicated more movement into the Celtic Sea than between the Western and Eastern Channel. Whiting released in the Bristol Channel moved south and west towards the two spawning grounds off Trevose Head and south-east of Ireland. There was no evidence of emigration out of the Celtic Sea area. The results of returns of whiting tagged and released in the County Down spawning area show that a greater proportion of Irish Sea whiting move south into the Celtic Sea than north towards the west of Scotland.

Analytical assessment is based on landings, commercial CPUE, and surveys data. Some information on discards indicates that they may be substantial.

Source of information: Report of the Working Group on the Assessment of Southern Shelf Demersal Stocks, September 2001 (ICES CM 2002/ACFM:05).

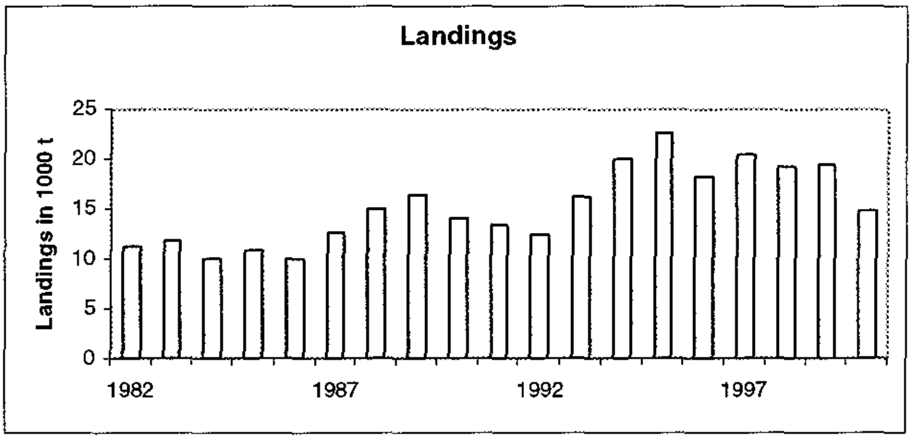
Yield and spawning biomass per Recruit F-reference points:

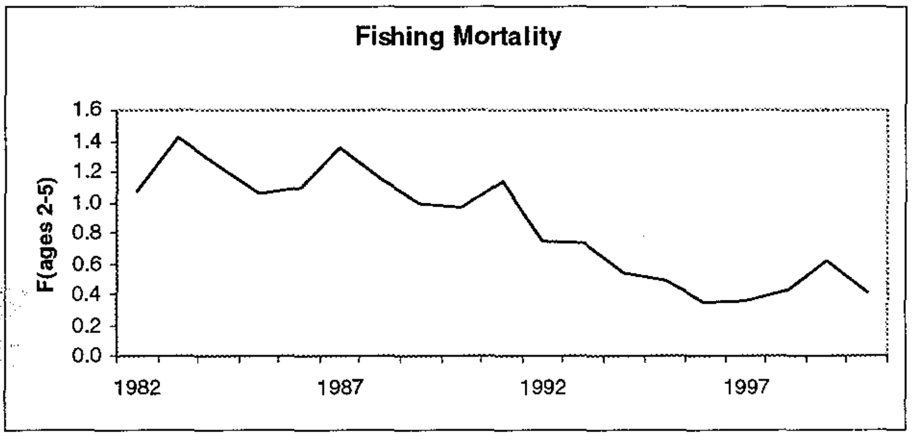
	Fish Mort Ages 2-5	Yield/R	SSB/R
Average Current	0.488	0.174	0.519
F_{max}	2.011	0.183	0.256
$F_{0.1}$	0.225	0.151	0.793
F_{med}	1.434	0.183	0.300

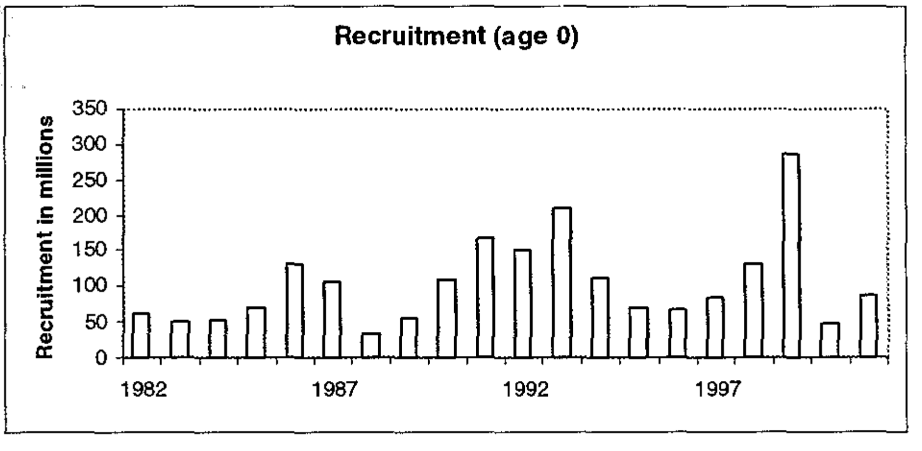
Catch data (Tables 3.9.3.1–2):

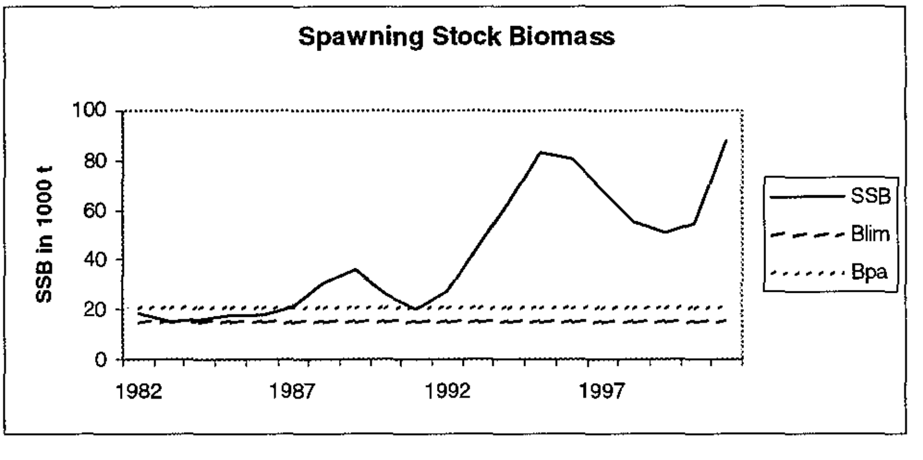
Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC[1]	ACFM Landings
1987	*Status quo* F; TAC	7.1[2]		12.7
1988	Precautionary TAC	7.0[2]		13.6
1989	Precautionary TAC	7.9[2]		16.5
1990	No increase in F; TAC	8.4[2]		14.1
1991	Precautionary TAC	8.0[2]		13.5
1992	If required, precautionary TAC	8.0[2]		12.4
1993	Within safe biological limits	6.6[2]	22.0	16.3
1994	Within safe biological limits	< 9.4[2]	22.0	20.0
1995	20% reduction in F	8.2[3]	25.0	22.7
1996	20% reduction in F	8.6[3]	26.0	18.3
1997	At least 20% reduction in F	< 7.3[4]	27.0	20.5
1998	At least 20% reduction in F	< 8.2[4]	27.0	19.2
1999	No increase in F	12.4[4]	25.0	19.4
2000	17% reduction in F	< 13.1[4]	22.2	14.8
2001	No increase in F	13.5[4]	21.0	
2002	No increase in F	27.7[4]		

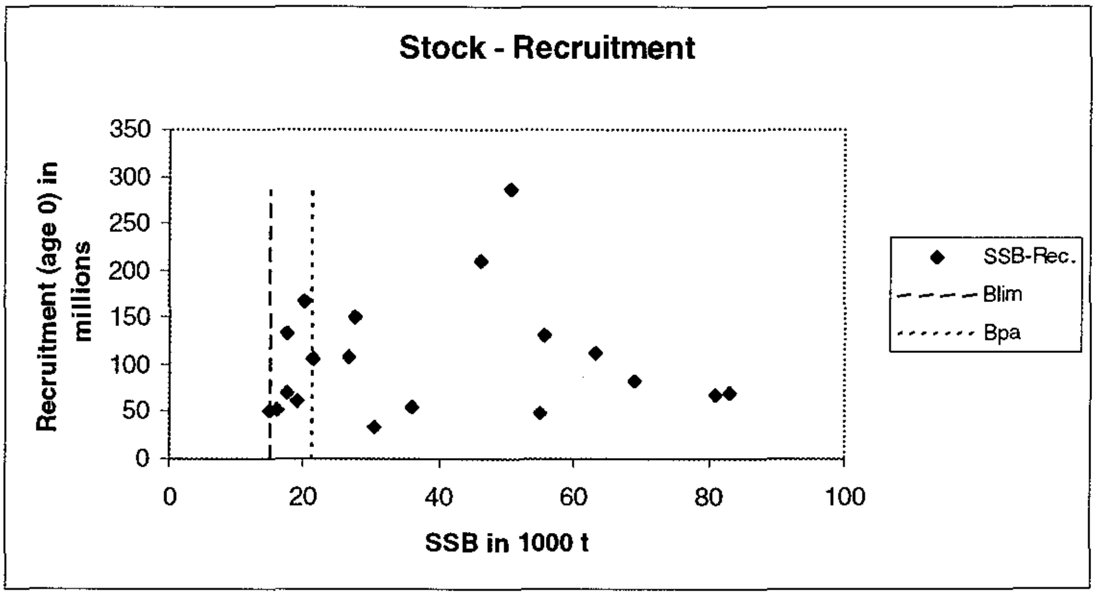
[1] TAC covers Sub-area VII (except Division VIIa). [2] For the VIIf+g stock component, [3] For the VIIf-h stock component, [4]For the VII e-k stock component. Weights in '000 t.

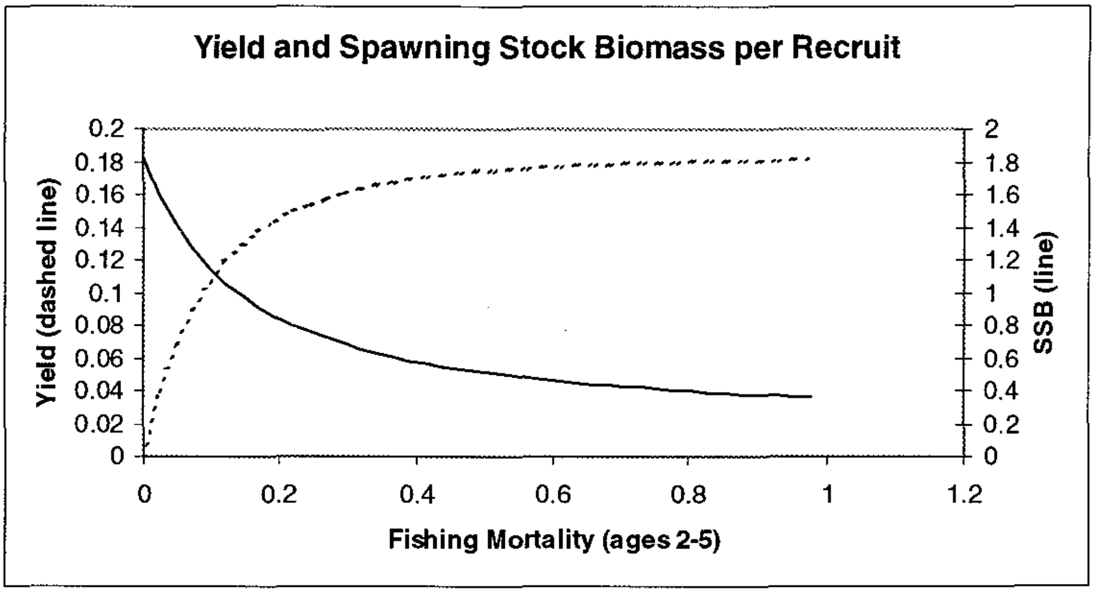

Landings
Landings in 1000 t
25
20
15
10
5
0
1982
1987
1992
1997


Fishing Mortality
F(ages 2-5)
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1982
1987
1992
1997


Recruitment (age 0)
Recruitment in millions
350
300
250
200
150
100
50
0
1982
1987
1992
1997


Spawning Stock Biomass
SSB in 1000 t
100
80
60
40
20
0
1982
1987
1992
1997
SSB
Blim
Bpa


Stock - Recruitment
Recruitment (age 0) in millions
350
300
250
200
150
100
50
0
0
20
40
60
80
100
SSB in 1000 t
SSB-Rec.
Blim
Bpa


Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
SSB (line)
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0
0.2
0.4
0.6
0.8
1
1.2
Fishing Mortality (ages 2-5)

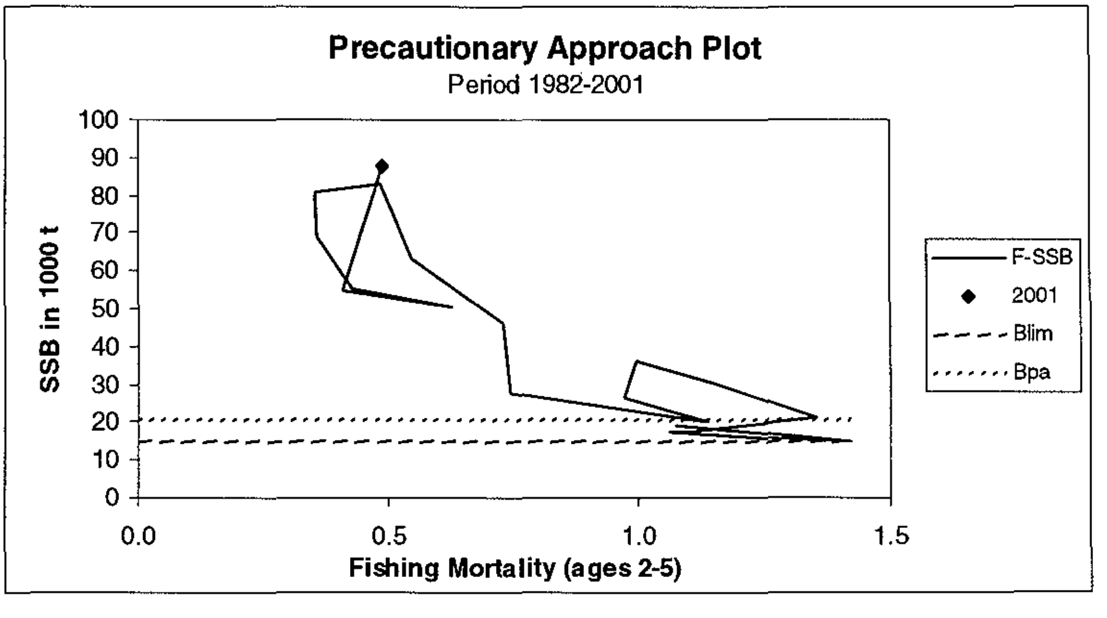

Precautionary Approach Plot
Period 1982-2001
SSB in 1000 t
100
90
80
70
60
50
40
30
20
10
0
0.0
0.5
1.0
1.5
Fishing Mortality (ages 2-5)
F-SSB
2001
Blim
Bpa

Table 3.9.3.1 Whiting in Divisions VIIe-k. Nominal Landings (t) used by the Working Group.

	1983	1984	1985	1986	1987	1988	1989	1990
Denmark								
France	8,982	7,171	7,820	7,647	10,054	11,410	12,171	10,464
Germany								
Ireland	1,487	1,301	2,241	1,309	1,452	398	2,817	1,478
Belgium	135	161	167	107	111	159	296	308
Netherlands	0	398	0	124	0	0	0	0
UK (E&W)	1,177	954	610	765	1,035	1,598	1,252	1,782
UK(Scotland)						1	5	74
Total	11,781	9,985	10,838	9,952	12,652	13,566	16,541	14,106

	1991	1992	1993	1994	1995	1996	1997	1998	1999[1]	2000[1]
Denmark			0	0	0	0	0	0	0	0
France	9,956	9,165	10,771	12,634	13,095	9,992	11,707	11,964	11,790	8,848
Germany		14	0	0	0	0	0	0	0	0
Ireland	1,258	1,691	3,631	5,618	7,609	6,392	6,695	5,189	5,807	4,526
Belgium	292	107	145	228	204	267	447	449	431	192
Netherlands	0	0	0	0	0	0	0	0	0	0
UK (E&W)	1,969	1,379	1,756	1,548	1,748	1,609	1,683	1,643	1,330	1,243
UK(Scotland)	33	8	17	6	22	0	0	0	1	0
Total	13,508	12,364	16,320	20,034	22,678	18,260	20,532	19,245	19,359	14,809

[1]Preliminary.

Table 3.9.3.2 Whiting in Divisions VIIe-k.

Year	Recruitment Age 0 thousands	SSB tonnes	Landings tonnes	Mean F Ages 2-5
1982	62000	18900	11200	1.074
1983	50000	15000	11800	1.420
1984	54000	16100	10000	1.233
1985	71000	17400	10800	1.063
1986	133000	17600	10000	1.098
1987	106000	21200	12700	1.356
1988	33000	30500	15100	1.153
1989	56000	36100	16500	0.995
1990	109000	26700	14100	0.974
1991	167000	20300	13500	1.137
1992	151000	27600	12400	0.746
1993	209000	46100	16300	0.730
1994	113000	63200	20000	0.548
1995	69000	83000	22700	0.486
1996	67000	81000	18300	0.354
1997	83000	68900	20500	0.357
1998	131000	55500	19200	0.430
1999	287000	50500	19400	0.625
2000	48000	55000	14800	0.411
2001	87000	88000		0.490
Average	104300	41930	15226	0.834

3.9.4 Celtic Sea plaice (Divisions VIIf and g)

State of stock/exploitation: The stock is outside safe biological limits. SSB decreased sharply from 1988 to 1997 when it fell below $\mathbf{B_{pa}}$. Since then SSB has continued to decline at a lower rate. Fishing mortality has fluctuated around the average. Most recent year classes have been below average.

Management objectives: There are no explicit management objectives for this stock.

Precautionary Approach reference points (established in 1998, modified in 2001):

ICES considers that:	ICES proposes that:
$\mathbf{B_{lim}}$ is 1 100 t, the lowest observed spawning stock biomass $\mathbf{B_{loss}}$.	$\mathbf{B_{pa}}$ be set at 1 800 t. Biomass above this affords a high probability of maintaining SSB above $\mathbf{B_{lim}}$, taking into account the uncertainty assessments.
$\mathbf{F_{lim}}$ not defined.	$\mathbf{F_{pa}}$ not defined

Technical basis:

$\mathbf{B_{lim}}$=$\mathbf{B_{loss}}$	$\mathbf{B_{pa}}$= $\mathbf{B_{lim}}$ * 1.64
$\mathbf{F_{lim}}$=Not defined	$\mathbf{F_{pa}}$ not defined

Advice on management: ICES recommends a reduction in F of at least 35% relative to $\mathbf{F_{sq}}$, corresponding to landings of less than 680 t in 2002. This is consistent with the reduction in F recommended for sole, which is the target species for the flatfish fishery in this area. This is expected to result in an increase in SSB to $\mathbf{B_{pa}}$ in the short-term.

Comparison with previous assessment and advice: Results of this assessment are very close to the previous one. As previously, advice has been based on Sole. Previously adopted $\mathbf{F_{pa}}$ ($\mathbf{F_{med}}$) is no more relevant. The fishing mortality has been fluctuating around the previously adopted $\mathbf{F_{pa}}$ during the assessment period, and this has not prevented the stock from declining below $\mathbf{B_{pa}}$. However, a new proposal for $\mathbf{F_{pa}}$ is postponed until a new basis is found.

Relevant factors to be considered in management: Given the apparent low recruitment since 1989, SSB is unlikely to increase at current fishing mortality.

Catch forecast for 2002:

Basis: TAC constraint; Landings (2001) = 0.76; F(2001) = 0.50; SSB(2002) = 1.57.

F(2002) onwards	Basis	Landings (2002)	SSB(2003)
0.37	0.6 $F_{98\text{-}00}$	0.63	1.84
0.40	0.65 $F_{98\text{-}00}$	0.68	1.80
0.43	0.7 $F_{98\text{-}00}$	0.72	1.76
0.49	0.8 $F_{98\text{-}00}$	0.80	1.68
0.61	1.0 $F_{98\text{-}00}$	0.95	1.54
0.73	1.2 $F_{98\text{-}00}$	1.09	1.41

Weights in '000 t.

Shaded scenarios considered inconsistent with the precautionary approach.

Medium- and long-term projections: Assuming the current selection pattern, $\mathbf{F_{max}}$ is estimated to be 0.36 $\mathbf{F_{sq}}$. Assuming status quo F in 2001, results of the medium-term analysis indicate that the probability of SSB falling below $\mathbf{B_{pa}}$ after 10 years is less than 5% when fishing mortality is reduced by 35% in 2002 onwards.

Elaboration and special comment: The fisheries that catch plaice in the Celtic Sea mainly involve vessels from France and Belgium: Total landings are split among France (39%), Belgium (30%), England and Wales (24%), and Ireland (the remaining 7%).

In the 1970s, the Divisions VIIf,g plaice fishery was mainly carried out by Belgian beam trawlers and Belgian and UK otter trawlers. Effort in the UK and Belgian beam-trawl fleets increased in the late 1980s, but has since declined. Recently, many otter trawlers have been replaced by beam trawlers, which target sole. Landings gradually increased until 1989, then declined rapidly in 1991. The main fishery occurs in the spawning area off the north Cornish coast, at depths greater than 40 m, about 20 to 25 miles offshore. Although plaice are taken throughout the year, the larger landings occur during

March after the peak of spawning, and again in September.

There is some evidence from tagging that plaice from the south and west coasts of Wales move southwards to join the adult population off the north Cornish coast during spawning.

Analytical age-based assessment using landings, survey, and commercial CPUE data.

Source of information: Report of the Working Group on the Assessment of Southern Shelf Demersal Stocks, September 2001 (ICES CM 2002/ACFM:05).

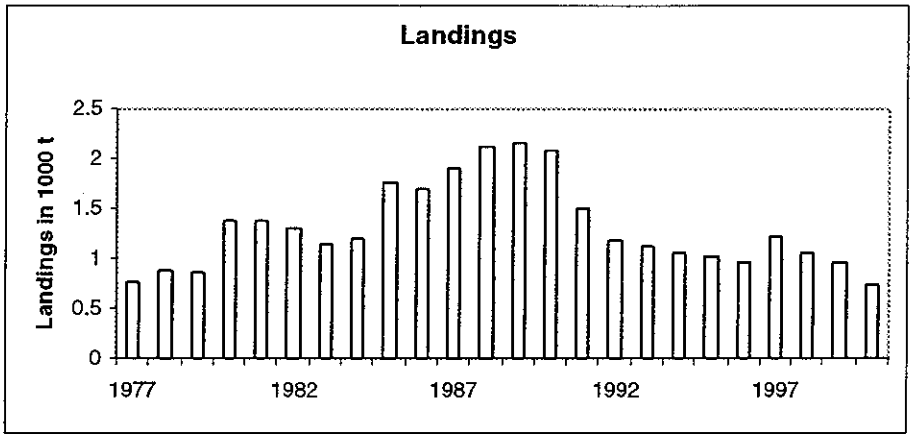
Yield and spawning biomass per Recruit F-reference points:

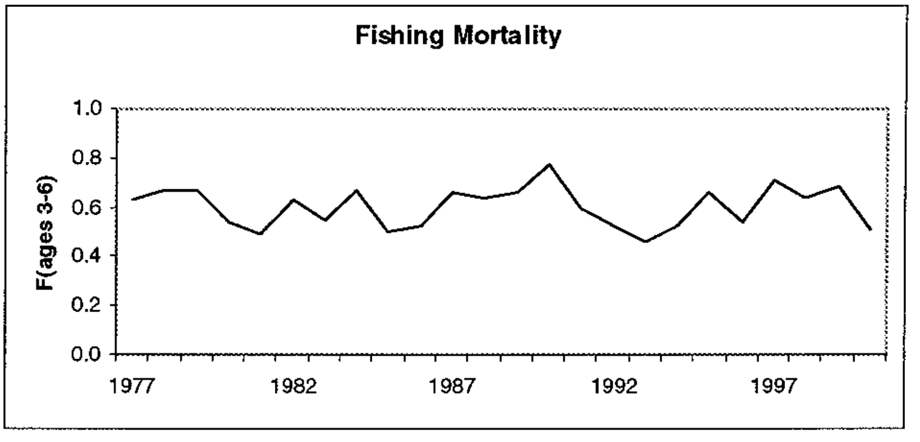
	Fish Mort Ages 3-6	Yield/R	SSB/R
Average Current	0.609	0.244	0.402
F_{max}	0.218	0.267	1.066
$F_{0.1}$	0.100	0.241	1.954
F_{med}	0.499	0.250	0.487

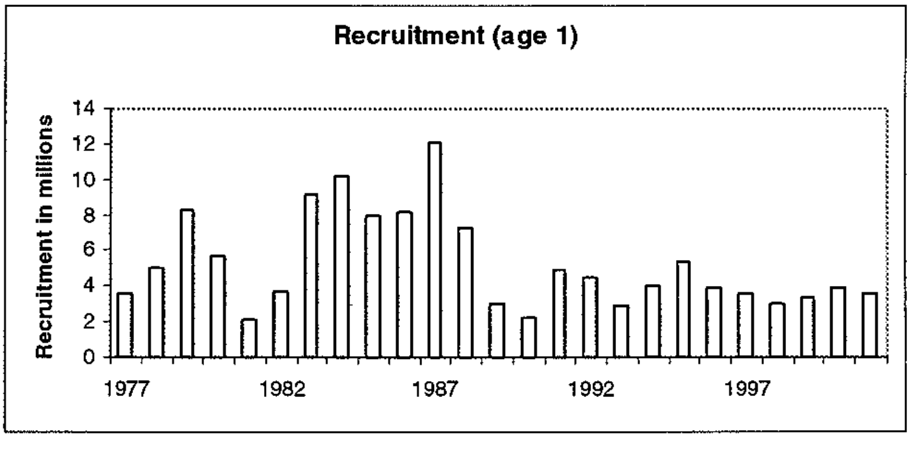
Catch data (Tables 3.9.4.1-2):

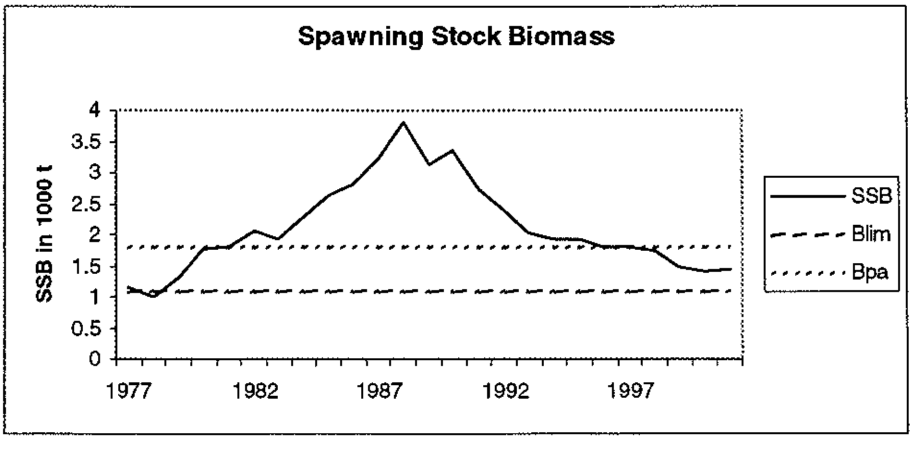
Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC	Official landings	ACFM Landings
1987	TAC not to be restrictive on other species	-	1.8	1.90	1.90
1988	TAC not to be restrictive on other species	-	2.5	2.12	2.12
1989	TAC not to be restrictive on other species	-	2.5	2.15	2.15
1990	F likely to be F(88)	~1.9	1.9	2.08	2.08
1991	F likely to be F(89)	~1.7	1.9	1.50	1.50
1992	No long-term gains in increasing F	-	1.5	1.19	1.19
1993	No long-term gains in increasing F	-	1.4	1.11	1.11
1994	No long-term gains in increasing F	-	1.4	1.07	1.07
1995	No increase in F	1.29	1.4	1.03	1.03
1996	20% reduction in F	0.93	1.1	0.95	0.95
1997	20% reduction in F	1.10	1.1	1.22	1.22
1998	20% reduction in F	1.00	1.1	1.07	1.07
1999	35% reduction in F	0.67	0.9	0.97	0.97
2000	30% reduction in F	0.70	0.80	0.74	0.74
2001	40% reduction in F	0.60	0.76		
2002	At least 35% reduction in F	0.68			

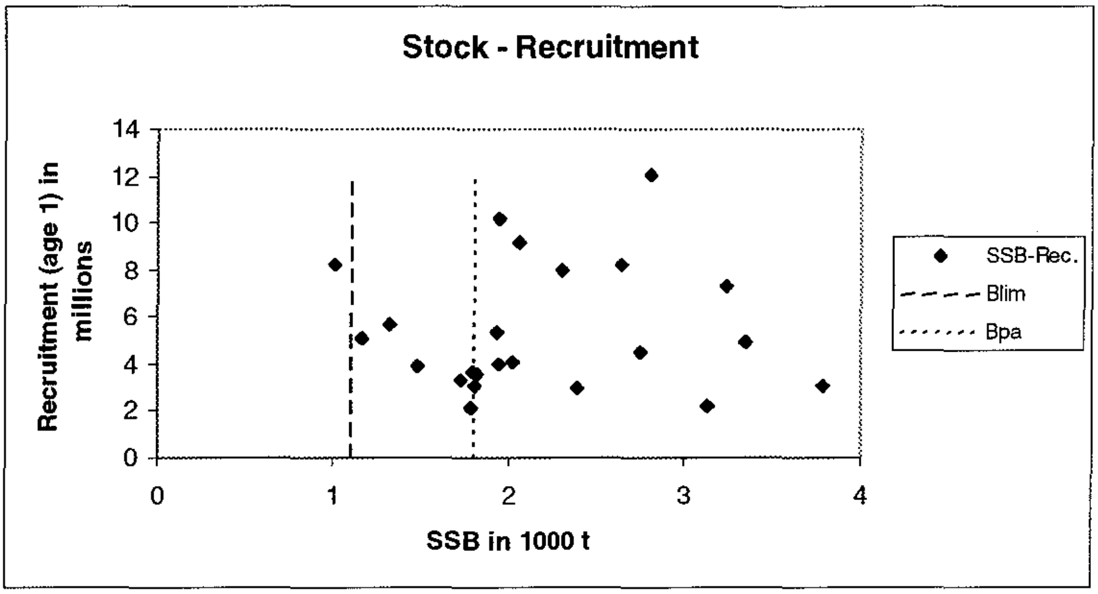
Weights in '000 t.

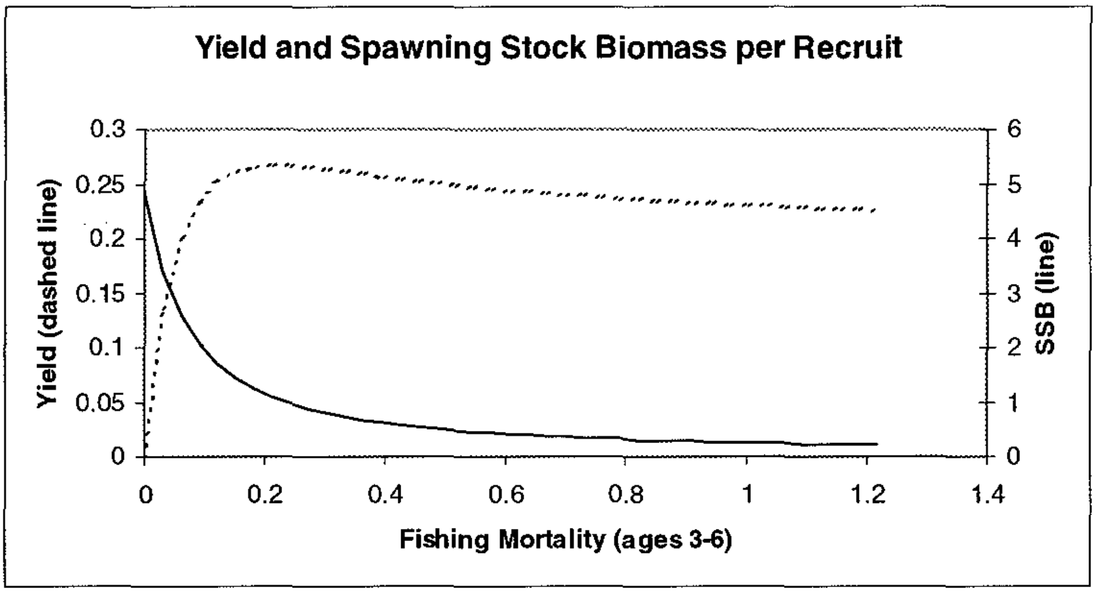

Landings
Landings in 1000 t
2.5
2
1.5
1
0.5
0
1977
1982
1987
1992
1997


Fishing Mortality
F(ages 3-6)
1.0
0.8
0.6
0.4
0.2
0.0
1977
1982
1987
1992
1997


Recruitment (age 1)
Recruitment in millions
14
12
10
8
6
4
2
0
1977
1982
1987
1992
1997


Spawning Stock Biomass
SSB in 1000 t
4
3.5
3
2.5
2
1.5
1
0.5
0
1977
1982
1987
1992
1997
SSB
Blim
Bpa


Stock - Recruitment
Recruitment (age 1) in millions
SSB in 1000 t
SSB-Rec.
Blim
Bpa
0
2
4
6
8
10
12
14
0
1
2
3
4


Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
SSB (line)
Fishing Mortality (ages 3-6)
0
0.05
0.1
0.15
0.2
0.25
0.3
0
1
2
3
4
5
6
0
0.2
0.4
0.6
0.8
1
1.2
1.4

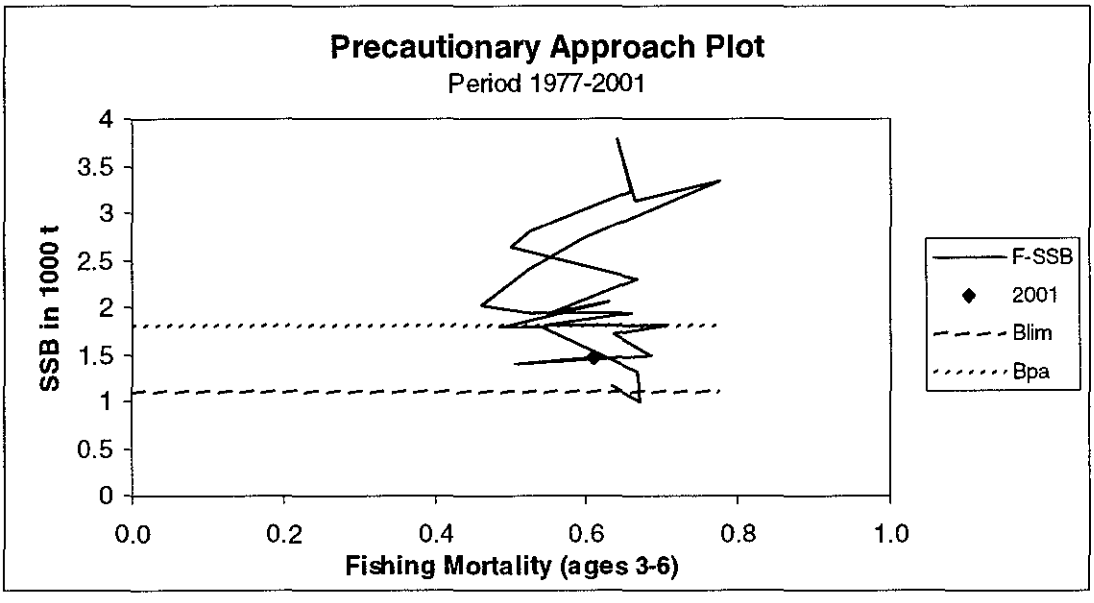

Precautionary Approach Plot
Period 1977-2001
SSB in 1000 t
Fishing Mortality (ages 3-6)
F-SSB
2001
Blim
Bpa
0
0.5
1
1.5
2
2.5
3
3.5
4
0.0
0.2
0.4
0.6
0.8
1.0

Table 3.9.4.1 Celtic Sea Plaice. Nominal landings (t) in Divisions VIIf+g, as used by Working Group.

Year	Belgium	France	Ireland	UK (Engl. & Wales)	Others	Total reported	Unallocated	Total as used by WG
1977	214	365	28	150	0	757	0	757
1978	196	527	0	152	0	875	0	875
1979	171	467	49	176	0	863	0	863
1980	372	706	61	227	7	1,373	0	1,373
1981	365	697	64	251	0	1,377	0	1,377
1982	341	568	198	196	0	1,303	0	1,303
1983	314	532	48	279	0	1,173	-27	1,146
1984	283	558	72	366	0	1,279	-69	1,210
1985	357	493	91	466	0	1,407	345	1,752
1986	544	598	59	324	21	1,546	145	1,691
1987	576	708	122	495	0	1,901	0	1,901
1988	635	687	164	630	0	2,116	0	2,116
1989	835	649	195	472	0	2,151	0	2,151
1990	777	642	167	496	0	2,082	0	2,082
1991	479	533	94	395	0	1,501	0	1,501
1992	326	455	106	301	0	1,188	0	1,188
1993	396	342	87	290	0	1,114	0	1,114
1994	357	281	182	250	0	1,070	0	1,070
1995	337	254	153	284	0	1,028	0	1,028
1996	359	239	116	238	0	952	0	952
1997	494	321	143	259	0	1,217	0	1,217
1998	458	298	135	176	0	1,067	0	1,067
1999	415	262	122	169	0	968	0	968
2000	233	302	70	134	0	739	0	739

N.B.: ICES receives statistics from some countries only for Divisions VIIg-k combined and not for each Division separately. The figures up to 1982 and 1987 onwards are provided by members of the Working Group; from 1983–1986, they are figures submitted to the EC by member states.

Table 3.9.4.2 Celtic Sea plaice (Divisions VIIf and g).

Year	Recruitment Age 1 thousands	SSB tonnes	Landings tonnes	Mean F Ages 3-6
1977	3633	1170	757	0.632
1978	5091	1010	875	0.673
1979	8264	1323	863	0.666
1980	5709	1789	1373	0.541
1981	2080	1793	1377	0.488
1982	3680	2055	1303	0.630
1983	9161	1942	1146	0.551
1984	10212	2299	1210	0.666
1985	7946	2636	1752	0.500
1986	8230	2810	1691	0.527
1987	12086	3238	1901	0.660
1988	7292	3792	2116	0.641
1989	3065	3135	2151	0.664
1990	2198	3347	2082	0.777
1991	4885	2751	1501	0.598
1992	4534	2398	1188	0.523
1993	2943	2025	1114	0.462
1994	4045	1928	1070	0.527
1995	5370	1944	1028	0.660
1996	3946	1817	952	0.544
1997	3578	1810	1217	0.706
1998	3062	1728	1067	0.635
1999	3335	1479	968	0.686
2000	3883	1405	739	0.505
2001	3614	1465		0.610
Average	5274	2124	1310	0.603

3.9.5 Sole in Divisions VIIf and g (Celtic Sea)

State of stock/exploitation: The stock is outside safe biological limits. Fishing mortality has increased since the late 1970s, exceeding $\mathbf{F_{pa}}$ since the early 1980s, and sometimes has even exceeded $\mathbf{F_{lim}}$. SSB has declined steadily since the early 1970s. SSB fell below $\mathbf{B_{pa}}$ in 1995 and has remained low since then. Recruitment has fluctuated with some peaks: the 1970, 1989 and 1998 year classes are the strongest.

Management objectives: There are no explicit management objectives for this stock.

Precautionary Approach reference points (established in 1998):

ICES considers that:	ICES proposes that:
$\mathbf{B_{lim}}$ is not defined	$\mathbf{B_{pa}}$ be set at 2 200 t. There is no evidence of reduced recruitment at the lowest biomass observed and $\mathbf{B_{pa}}$ can therefore be set equal to the lowest observed SSB.
$\mathbf{F_{lim}}$ is 0.52, the fishing mortality estimated to lead to potential stock collapse.	$\mathbf{F_{pa}}$ be set at 0.37. This F is considered to have a high probability of avoiding $\mathbf{F_{lim}}$ and maintaining SSB above $\mathbf{B_{pa}}$ in 10 years, taking into account the uncertainty of assessments.

Technical basis:

$\mathbf{B_{lim}}$:Not defined	$\mathbf{B_{pa}}$: $\mathbf{B_{loss}}$
$\mathbf{F_{lim}}$:$\mathbf{F_{loss}}$	$\mathbf{F_{pa}}$: $\mathbf{F_{lim}}$ x 0.72; *implies a less than 5% probability that* $(SSB_{MT} < B_{pa})$

Advice on management: ICES recommends that the fishing mortality should be reduced to below $\mathbf{F_{pa}}$, corresponding to landings of less than 1 000 t in 2002. This corresponds to a reduction of 35% from *status quo* F, and will promote an increase in SSB above $\mathbf{B_{pa}}$ in the short-term.

Comparison with previous assessment and advice: Results are very close to those of the previous assessment.

Relevant factors to be considered in management: The assessment indicates a large 1998 year class, and SSB is expected to increase in the short-term. However, outstanding year classes have only been produced at long intervals and the stock increase is therefore likely to be temporary. The 1998 year class contributes 36% to the landings in 2002. This year class will not be fully mature until 2003, and the high exploitation before 2003 will reduce the potential for this year class to contribute to the SSB.

Sole is taken mainly in a directed beam-trawl fishery with plaice as a by-catch, and to a lesser extent in otter trawl fisheries. Management should take account of the mix of Celtic Sea sole and plaice.

Catch forecast for 2002:

Basis: TAC constraint; Landings(2001) = 1.02; F(2001) = 0.43; SSB(2002) = 2.40.

F(2002)	Basis	Landings (2002)	SSB (2003)
0.34	0.6 $F_{98\text{-}00}$	0.94	2.71
0.37	0.65 $F_{98\text{-}00}$ = $\mathbf{F_{pa}}$	1.00	2.64
0.40	0.7 $F_{98\text{-}00}$	1.07	2.57
0.46	0.8 $F_{98\text{-}00}$	1.19	2.44
0.57	1.0 $F_{98\text{-}00}$	1.41	2.19

Weights in '000 t.

Shaded scenarios considered inconsistent with the precautionary approach.

Medium- and long-term projections: Assuming status quo F in 2001, results of the medium-term analysis indicate that the probability of SSB falling below $\mathbf{B_{pa}}$ after 5-10 years is less than 5% when fishing mortality is reduced below $\mathbf{F_{pa}}$ from 2002 onwards. Assuming the current selection pattern, $\mathbf{F_{max}}$ is 0.46* $\mathbf{F_{sq}}$.

Elaboration and special comment: The fisheries for sole in the Celtic Sea and Bristol Channel involve vessels from Belgium, taking 2/3, the UK 1/4, and France and Ireland taking minimal amounts of the total landings. The sole fishery is concentrated on the north Cornish coast off Trevose Head and around Lands End.

Sole are taken mainly in a beam trawl fishery that started in the early 1960s and, to a lesser extent, in the longer established otter-trawl fisheries. In the 1970s, the fishery was mainly carried out by Belgian beam trawlers and Belgian and UK otter trawlers. The use of beam trawls (to target sole and plaice) increased during the mid 1970s, and the Belgian otter trawlers have now been almost entirely replaced by beam trawlers. Effort in the Belgium beam-trawl fleet increased in the late 1980s as vessels normally operating in the North Sea were attracted to the west by improved fishing opportunities. Beam -trawling by UK vessels increased substantially from 1986, reaching a peak in 1990 and decreased thereafter. In the Celtic Sea, the beam and otter trawl fleets also take plaice, rays, brill, turbot and anglerfish.

The main spawning areas for sole in the Celtic Sea are in waters 40–75 m deep, off Trevose Head, and spawning usually takes place between February and April. Juvenile sole are found in relatively high abundance in depths up to 40 m, and adult sole (fish aged 3 plus) are generally found in deeper water. Spawning and nursery grounds are well defined.

The results of recent tagging experiments suggest that there is only limited movement of sole between the Bristol Channel and adjacent areas.

Age-based analytical assessment using catch-per-unit effort data from two commercial fleets and one survey.

Source of information: Report of the Working Group on the Assessment of Southern Shelf Demersal Stocks, September 2001 (ICES CM 2002/ACFM:05).

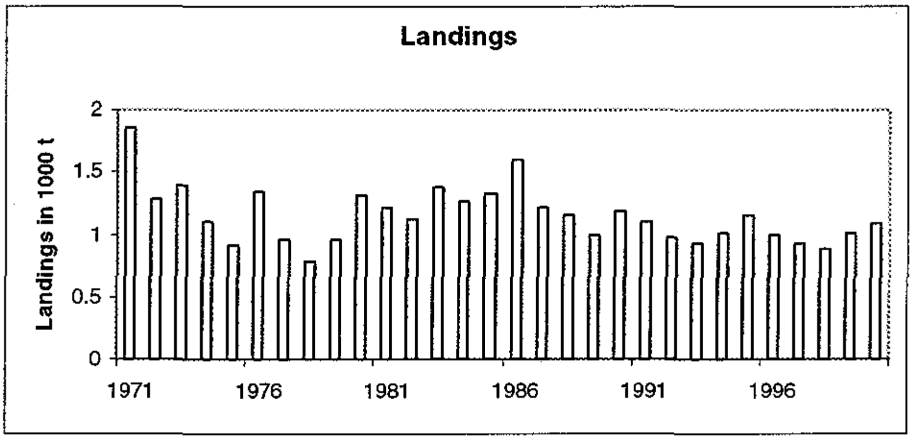
Yield and spawning biomass per Recruit F-reference points:

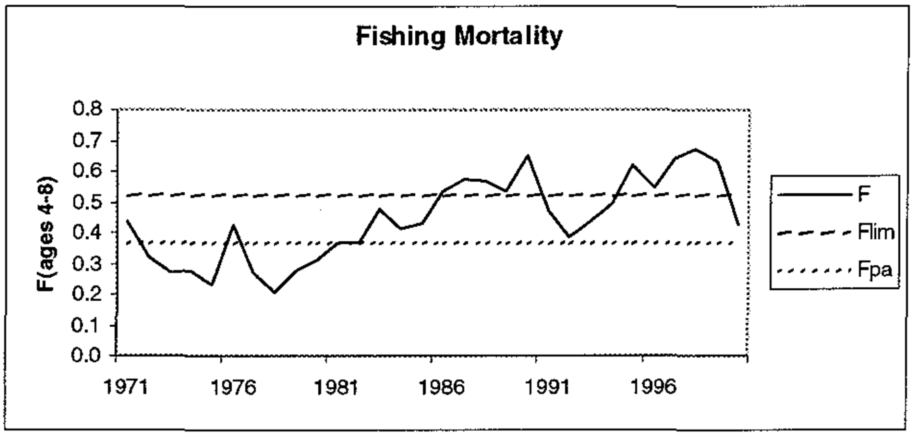
	Fish Mort Ages 4-8	Yield/R	SSB/R
Average Current	0.547	0.209	0.367
$\mathbf{F}_{max}$	0.266	0.223	0.899
$\mathbf{F}_{0.1}$	0.129	0.203	1.800
$\mathbf{F}_{med}$	0.341	0.221	0.673

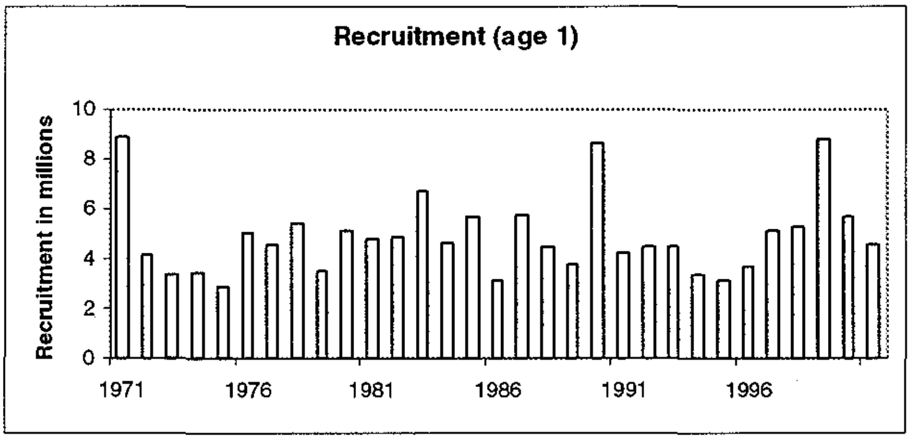
Catch data (Tables 3.9.5.1-2):

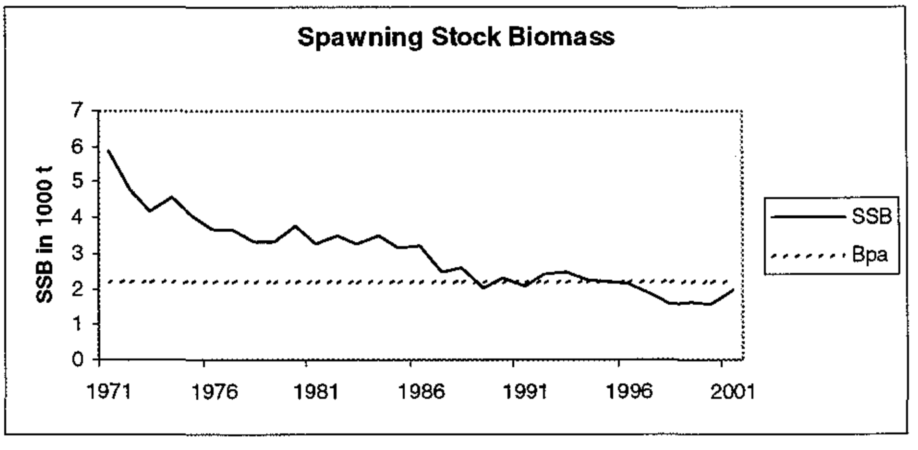
Year	ICES advice	Predicted catch corresp. to advice	Agreed TAC	ACFM Landings
1987	*Status quo* F; TAC	1.6	1.6	1.22
1988	F = F(pre-86); TAC	0.9	1.1	1.15
1989	F at F(81–85); TAC	1.0	1.0	0.99
1990	No increase in F	1.2	1.2	1.19
1991	No increase in F	1.1	1.2	1.11
1992	No long-term gains in increasing F	1.1	1.2	0.98
1993	No long-term gains in increasing F	-	1.1	0.93
1994	No long-term gains in increasing F	-	1.1	1.01
1995	No increase in F	1.0	1.1	1.16
1996	20% reduction in F	0.8	1.0	1.00
1997	20% reduction in F	0.8	0.9	0.93
1998	20% reduction in F	0.7	0.85	0.88
1999	Reduce F below $\mathbf{F}_{pa}$	0.81	0.96	1.01
2000	Reduce F below $\mathbf{F}_{pa}$	<1.16	1.16	1.09
2001	Reduce F below $\mathbf{F}_{pa}$	< 0.81	1.02	
2002	Reduce F below $\mathbf{F}_{pa}$	< 1.00		

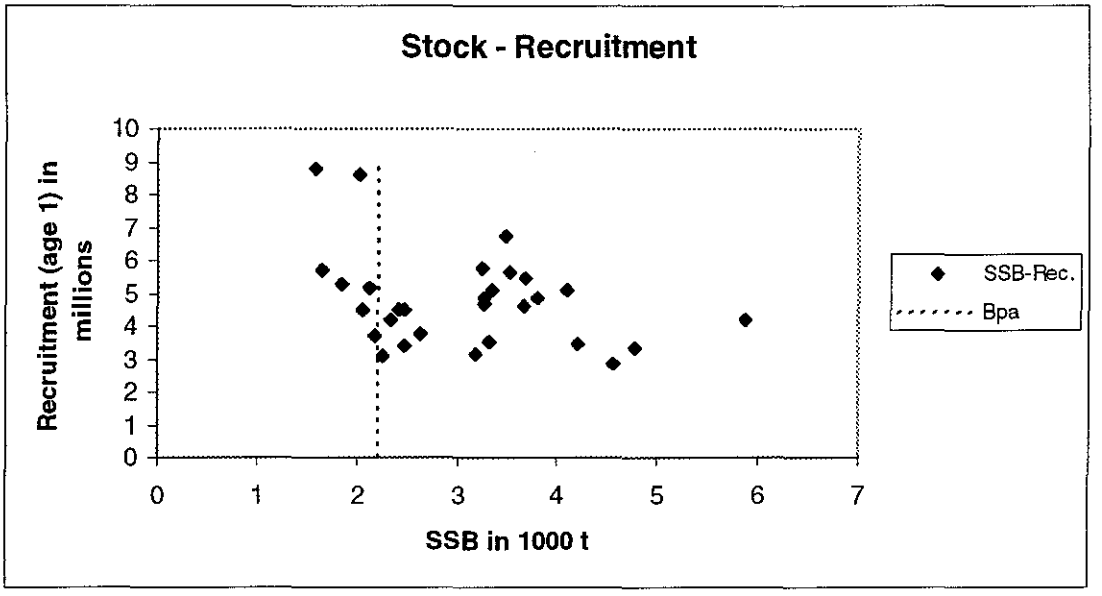
Weights in '000 t.

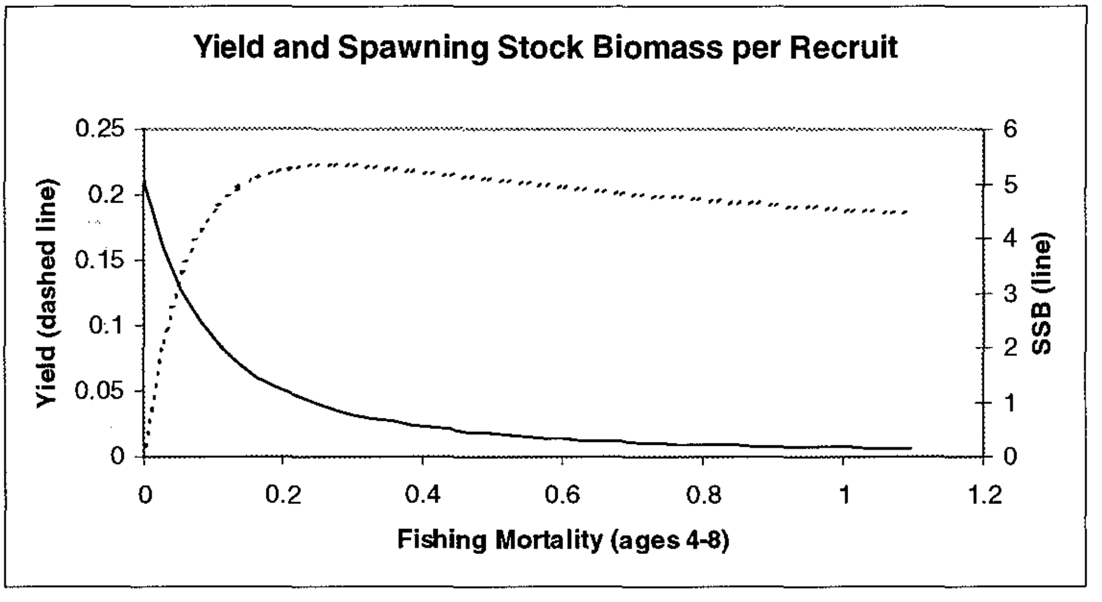

Landings
Landings in 1000 t
2
1.5
1
0.5
0
1971
1976
1981
1986
1991
1996


Fishing Mortality
F(ages 4-8)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1971
1976
1981
1986
1991
1996
F
Flim
Fpa


Recruitment (age 1)
Recruitment in millions
10
8
6
4
2
0
1971
1976
1981
1986
1991
1996


Spawning Stock Biomass
SSB in 1000 t
7
6
5
4
3
2
1
0
1971
1976
1981
1986
1991
1996
2001
SSB
Bpa


Stock - Recruitment
Recruitment (age 1) in millions
SSB in 1000 t
SSB-Rec.
Bpa
0
1
2
3
4
5
6
7
8
9
10
0
1
2
3
4
5
6
7


Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
SSB (line)
Fishing Mortality (ages 4-8)
0
0.05
0.1
0.15
0.2
0.25
0
1
2
3
4
5
6
0
0.2
0.4
0.6
0.8
1
1.2

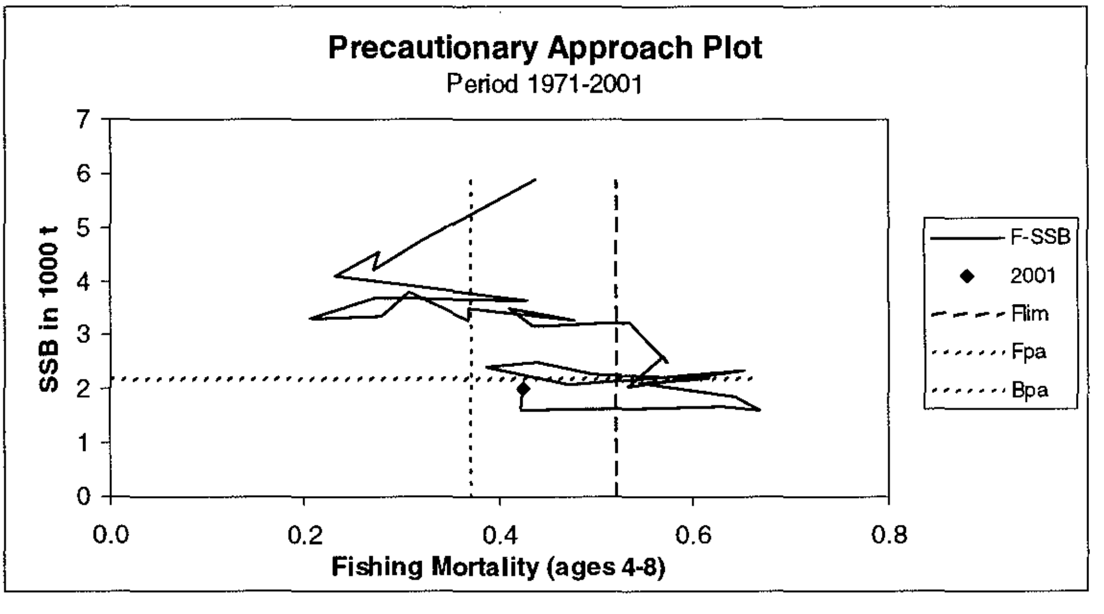

Precautionary Approach Plot
Period 1971-2001
SSB in 1000 t
Fishing Mortality (ages 4-8)
F-SSB
2001
Flim
Fpa
Bpa
0
1
2
3
4
5
6
7
0.0
0.2
0.4
0.6
0.8

Table 3.9.5.1 Celtic Sea SOLE. Divisions VIIf and VIIg. Nominal landings (t), 1986–1999. Data used by the Working Group.

Country	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000[1]
Belgium	1,092	704	725	660	689	839	516	512	612	728	610	562	568	669	694
France	92	72	89	97	100	80	136	103	86	89	97	79	72	61	74
Ireland	12	9	15	32	41	n/a	4	28	47	45	23	36	37	50	n/a
UK(E. & W.)	404	437	317	203	359	395	325	285	264	294	265	251	198	231	243
Others	-	-	-	-	-	10	-	-	-	-	-	-	-	-	-
Total	1,600	1,222	1,146	992	1,189	1,324	981	928	1,009	1,156	995	928	875	1,011	1,011
Unallocated	-	-	-	-	-	-217	-	-	-	1	-	-1	-	1	80
Total used in assessment	1,600	1,222	1,146	992	1,189	1,107	981	928	1,009	1,157	995	927	875	1,012	1,091

[1]Preliminary.

Table 3.9.5.2 Sole in Divisions VIIf and g (Celtic Sea).

Year	Recruitment Age 1 thousands	SSB tonnes	Landings tonnes	Mean F Ages 4-8
1971	8901	5884	1861	0.438
1972	4177	4776	1278	0.322
1973	3336	4203	1391	0.271
1974	3425	4556	1105	0.277
1975	2845	4088	919	0.232
1976	5074	3651	1350	0.429
1977	4581	3671	961	0.273
1978	5430	3318	780	0.208
1979	3532	3340	954	0.279
1980	5105	3796	1314	0.308
1981	4830	3270	1212	0.368
1982	4859	3483	1128	0.369
1983	6755	3262	1373	0.479
1984	4679	3516	1266	0.411
1985	5648	3183	1328	0.435
1986	3143	3236	1600	0.535
1987	5742	2479	1222	0.573
1988	4505	2625	1146	0.569
1989	3748	2035	992	0.532
1990	8633	2337	1189	0.653
1991	4204	2068	1107	0.471
1992	4465	2413	981	0.388
1993	4458	2486	928	0.440
1994	3392	2256	1009	0.498
1995	3114	2183	1157	0.617
1996	3672	2122	995	0.545
1997	5151	1858	927	0.644
1998	5271	1586	875	0.669
1999	8787	1659	1012	0.630
2000	5668	1605	1091	0.424
2001	4551	2001		0.426
Average	4893	2998	1148	0.442

3.9.6 Plaice in Division VIIe (Western Channel)

State of stock/exploitation: The stock is outside safe biological limits. SSB peaked in 1988–1990, following a series of good year classes in the mid-1980s, but has declined rapidly to well below $\mathbf{B}_{pa}$ until 1995 and has remained low since then. Fishing mortality increased in the 1980s and has fluctuated well above $\mathbf{F}_{pa}$ in the 1990s. In recent years recruitment has been mostly below average.

Management objectives: There are no explicit management objectives for this stock.

Precautionary Approach reference points (established in 1998):

ICES considers that:	ICES proposes that:
$\mathbf{B}_{lim}$ is 1 300 t, the lowest observed spawning stock biomass.	$\mathbf{B}_{pa}$ be set at 2 500 t. This is the previously proposed MBAL. Biomass above this affords a high probability of maintaining SSB above $\mathbf{B}_{lim}$, taking into account the uncertainty in assessments.
$\mathbf{F}_{lim}$ not defined	$\mathbf{F}_{pa}$ be set at 0.45. This F is considered to have a high probability of maintaining SSB above $\mathbf{B}_{pa}$ in the medium term, taking into account the uncertainty in assessments.

Technical basis:

$\mathbf{B}_{lim}$=$\mathbf{B}_{loss}$	$\mathbf{B}_{pa}$ = MBAL
$\mathbf{F}_{lim}$=Not defined	$\mathbf{F}_{pa}$ = low probability that (SSB$_{MT}$< $\mathbf{B}_{pa}$)

Advice on management: ICES recommends that fishing mortality should be reduced to below $\mathbf{F}_{pa}$, corresponding to catches of less than 890 t in 2002. This represents a reduction in F of around 25% and will allow SSB to reach $\mathbf{B}_{pa}$ in three years with 50% probability.

Comparison with previous assessment and advice: The current assessment estimates are very similar to those obtained last year.

Relevant factors to be considered in management: A reduction in F of at least 70%, corresponding to a catch of less than 400 t, would be required to promote SSB above $\mathbf{B}_{pa}$ in the short-term. If the advice for sole is followed, it will imply an approximate 40% reduction in F for plaice.

The TAC for plaice in the Channel is set for Divisions VIId,e combined, so the results from this assessment need to be considered along with those for the much larger Division VIId stock. Given that the Division VIId component dominates the TAC, a catch control does not guarantee that fishing mortality in Division VIIe is constrained. To achieve a decrease in fishing mortality, a direct reduction in fishing effort in Division VIIe, or a separate catch control, is necessary.

Plaice are taken in a mixed demersal species otter trawl fishery, and as a by-catch in the sole beam trawl fishery. Management measures should therefore be considered in conjunction with those for Division VIIe sole. There is anecdotal evidence of strategic mis-reporting of landings.

Catch forecast for 2002:

Basis: F(2001) = F(98–00) = 0.61; Landings (2001) = 1.09; SSB(2002) = 1.77.

F(2002)	Basis	Landings (2002)	SSB(2003)
0.18	0.3*$\mathbf{F}_{sq}$	0.40	2.50
0.25	$\mathbf{F}_{max}$	0.53	2.38
0.37	0.6*$\mathbf{F}_{sq}$	0.75	2.17
0.43	0.7*$\mathbf{F}_{sq}$	0.85	2.08
0.45	$\mathbf{F}_{pa}$	0.89	2.04
0.49	0.8*$\mathbf{F}_{sq}$	0.95	1.99
0.61	1.0*$\mathbf{F}_{sq}$	1.12	1.82

Weights in '000 t.

Shaded scenarios considered inconsistent with the precautionary approach.

Medium- and long-term projections: Assuming the current selection pattern, $\mathbf{F}_{max}$ is 41% of $\mathbf{F}_{sq}$.

Elaboration and special comment: The fisheries taking plaice in the Western Channel mainly involve vessels from the bordering countries: The total landings are split among UK vessels (75%), France (22%) and Belgium (the remaining 3%). Landings of plaice in the Western Channel were low and stable between 1950 and the mid-1970s, and increased rapidly during 1976 to 1988 as beam-trawls began to replace otter-trawls, although plaice are taken mainly as a by-catch in beam-trawling directed at sole and anglerfish. Reported landings have been declining throughout the 1990s. The main fishery is south and west of Start Point. Although plaice are taken throughout the year, the larger landings are made during February, March, October and November.

Most plaice tagged whilst spawning during December to March around Start Point in the western Channel migrated into the eastern Channel and the North Sea after spawning, whilst few plaice tagged there during April and May were recaptured outside the Channel. This suggests there is both a resident stock and one, which migrates to the North Sea after spawning in the Channel.

Analytical age-based assessment based on landings, survey, and commercial CPUE data. Mis-reporting of landings is known to occur.

Source of information: Report of the Working Group on the Assessment of Southern Shelf Demersal Stocks, September 2001 (ICES CM 2002/ACFM:05).

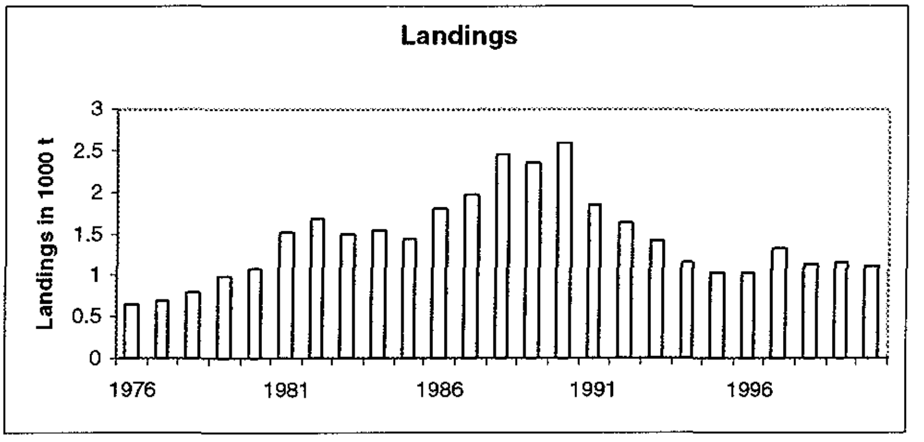
Yield and spawning biomass per Recruit F-reference points:

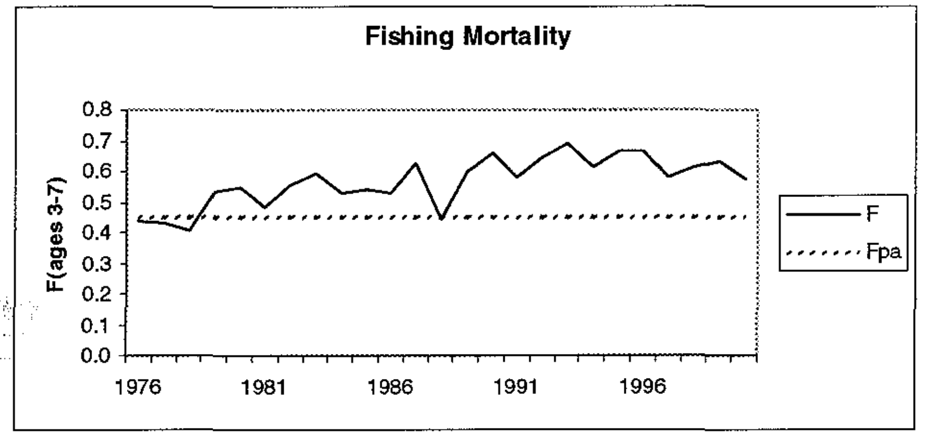
	Fish Mort Ages 3-7	Yield/R	SSB/R
Average Current	0.609	0.265	0.418
$\mathbf{F}_{max}$	0.247	0.286	1.106
$\mathbf{F}_{0.1}$	0.115	0.260	2.119
$\mathbf{F}_{med}$	0.569	0.267	0.450

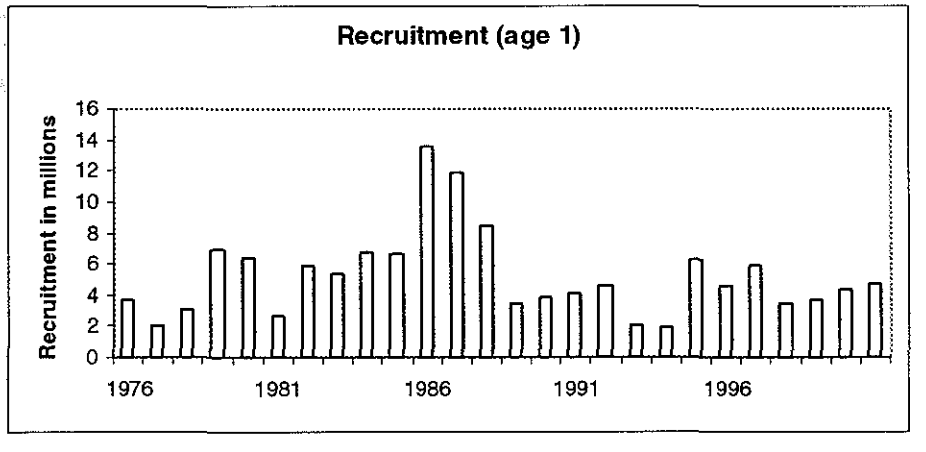
Catch data (Tables 3.9.6.1-2):

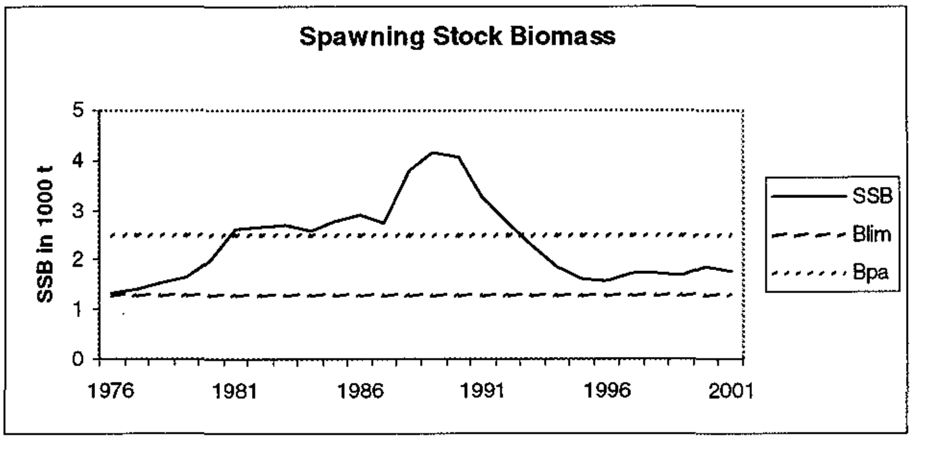
Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC[1]	Official Landings	ACFM Landings
1987	Precautionary TAC	6.8	8.3	1.92	1.96
1988	Precautionary TAC	6.9	9.96	2.33	2.46
1989	No increase in effort; TAC	11.7	11.7	2.25	2.36
1990	No increase in F; TAC	10.7	10.7	1.99	2.59
1991	50% reduction in F in VIIe	8.8	10.7	1.65	1.85
1992	Sq. F gives over mean SSB	2.0[2]	9.6	1.56	1.62
1993	Not outside safe biological limits	-	8.5	1.44	1.42
1994	Within safe biological limits	-	9.1	1.29	1.16
1995	No increase in F	1.4[2]	8.0	1.16	1.03
1996	60% reduction in F	0.6[2]	7.5	1.14	1.04
1997	60% reduction in F	0.51[2]	7.09	1.37	1.32
1998	60% reduction in F	0.5[2]	5.7	1.24	1.13
1999	Reduce F below $\mathbf{F}_{pa}$	1.1[2]	7.4	1.16	1.16
2000	Reduce F below $\mathbf{F}_{pa}$	< 1.08[2]	6.5	1.10	1.09
2001	Reduce F below $\mathbf{F}_{pa}$	< 0.93	6.0		
2002	Reduce F below $\mathbf{F}_{pa}$	< 0.89			

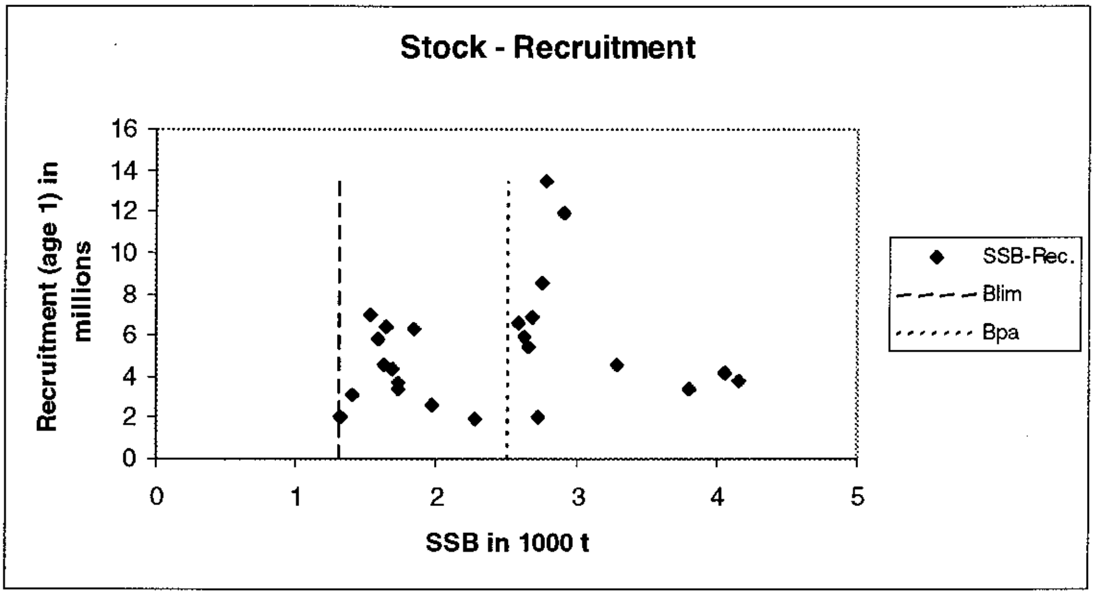
[1]TACs for Divisions VIId,e. [2]For Division VIIe only. Weights in '000 t.

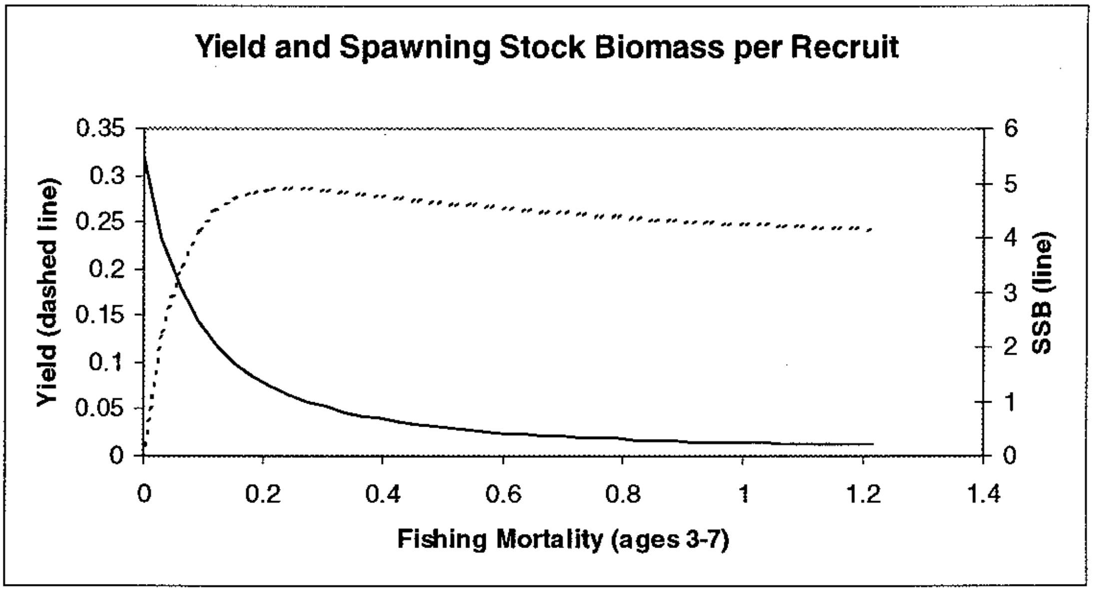

Landings
Landings in 1000 t
3
2.5
2
1.5
1
0.5
0
1976
1981
1986
1991
1996


Fishing Mortality
F(ages 3-7)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1976
1981
1986
1991
1996
F
Fpa


Recruitment (age 1)
Recruitment in millions
16
14
12
10
8
6
4
2
0
1976
1981
1986
1991
1996


Spawning Stock Biomass
SSB in 1000 t
5
4
3
2
1
0
1976
1981
1986
1991
1996
2001
SSB
Blim
Bpa


Stock - Recruitment
Recruitment (age 1) in millions
SSB in 1000 t
SSB-Rec.
Blim
Bpa
0
2
4
6
8
10
12
14
16
0
1
2
3
4
5


Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
SSB (line)
Fishing Mortality (ages 3-7)
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0
1
2
3
4
5
6
0
0.2
0.4
0.6
0.8
1
1.2
1.4

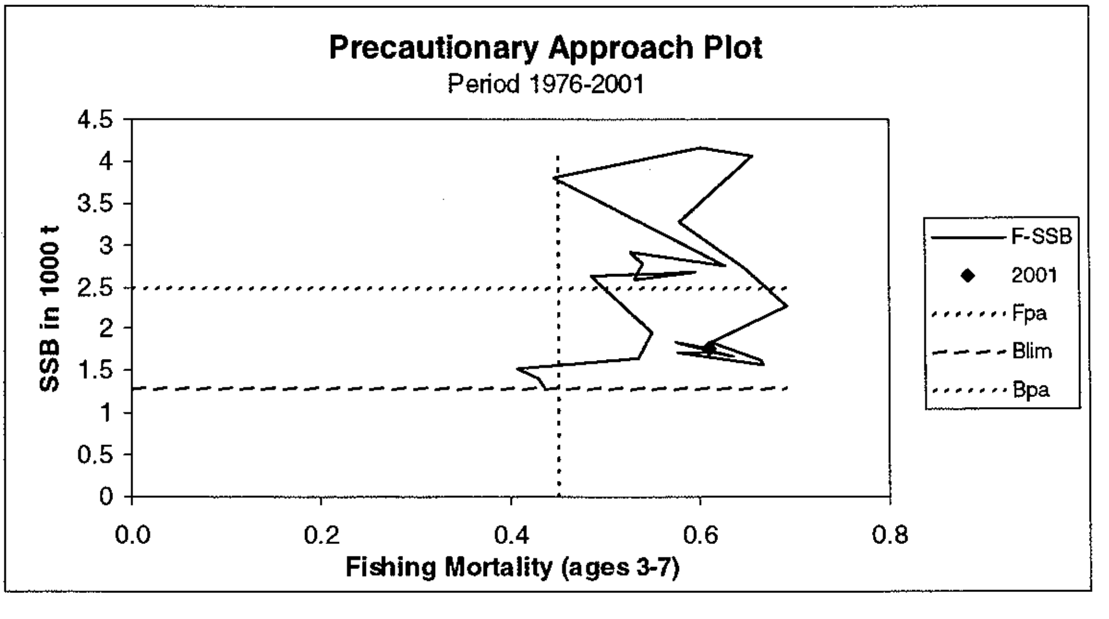

Precautionary Approach Plot
Period 1976-2001
SSB in 1000 t
Fishing Mortality (ages 3-7)
F-SSB
2001
Fpa
Blim
Bpa
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
0.0
0.2
0.4
0.6
0.8

Table 3.9.6.1 Western Channel Plaice. Nominal landings (t) in Division VIIe, as used by Working Group.

Year	Belgium	Denmark	France	UK (Engl. & Wales)	Others	Total reported	Unallocated[2]	Total
1976	5	-[1]	323	312	-	640	-	640
1977	3	-[1]	336	363	-	702	-	702
1978	3	-[1]	314	467	-	78	-	784
1979	2	-[1]	458	515	-	975	2	977
1980	23	-[1]	325	609	9	966	113	1,079
1981	27	-	537	953	-	1,517	-16	1,501
1982	81	-	363	1,109	-	1,553	135	1,688
1983	20	-	371	1,195	-	1,586	-91	1,495
1984	24	-	278	1,144	-	1,446	101	1,547
1985	39	-	197	1,122	-	1,358	83	1,441
1986	26	-	276	1,389	-[1]	1,691	119	1,810
1987	68	-	435	1,419	-	1,922	36	1,958
1988	90	-	584	1,654	-	2,328	130	2,458
1989	89	-	448[2]	1,708	2	2,247	111	2,358
1990	82	2	N/A[3]	1,885	18	1,987	606	2,593
1991	57	-	251[2]	1,323	16	1,647	201	1,848
1992	25	-	419	1,102	14	1,560	64	1,624
1993	56	-	284	1,080	24	1,444	-27	1,417
1994	10	-	277	998	3	1,288	-132	1,156
1995	13	-	288	857	-	1,158	-127	1,031
1996	4	-	279	855	-	1,138	-94	1,044
1997	6	-	329	1,032	1	1,368	-45	1,323
1998	22	-	327[2]	892	1	1,242	-111	1,131
1999	12	-	204[2]	947	-	1,163	-22	1,141
2000	4	-	170[2]	926	+	1,100	-6	1,094

[1]Included in Division VIId.
[2]Estimated by the Working Group.
[3]Divisions VIId,e = 4,739 t.

Table 3.9.6.2 Plaice in Division VIIe (Western Channel).

Year	Recruitment Age 1 thousands	SSB tonnes	Landings tonnes	Mean F Ages 3-7
1976	3764	1321	640	0.436
1977	2001	1410	702	0.430
1978	3101	1524	784	0.406
1979	6963	1640	977	0.535
1980	6418	1973	1079	0.550
1981	2629	2630	1501	0.486
1982	5909	2660	1688	0.555
1983	5415	2684	1495	0.596
1984	6839	2584	1547	0.532
1985	6642	2775	1441	0.540
1986	13525	2910	1810	0.527
1987	11929	2748	1958	0.627
1988	8502	3803	2458	0.445
1989	3405	4157	2358	0.602
1990	3813	4061	2593	0.656
1991	4145	3281	1848	0.580
1992	4604	2728	1624	0.648
1993	2068	2281	1417	0.692
1994	1955	1839	1156	0.612
1995	6280	1624	1031	0.664
1996	4577	1582	1044	0.666
1997	5857	1727	1323	0.578
1998	3432	1723	1131	0.616
1999	3704	1683	1141	0.635
2000	4367	1846	1094	0.576
2001	4720	1766		0.610
Average	5252	2345	1434	0.569

3.9.7 Sole in Division VIIe (Western Channel)

State of stock/exploitation: The stock is outside safe biological limits. SSB has declined since 1980 and has been estimated to be at its historic lowest level in 2001, well below $\mathbf{B_{pa}}$. Although fishing mortality in the 1990s has been lower than in the 1980s, it is still estimated to be well above $\mathbf{F_{pa}}$ and even above $\mathbf{F_{lim}}$. Since 1990 all year classes have been below average.

Management objectives: There are no explicit management objectives for this stock.

Precautionary Approach reference points (changed in 2001): The age range used in this year's assessment has been extended from 10 to 12 years old, because historically the old age groups have been a significant part of the stock. This has resulted in a general downward revision of fishing mortality and upward revision of SSB. Therefore, the PA reference points needed to be re-evaluated.

Precautionary Approach reference points (established in 1998):

ICES considers that:	ICES proposes that:
$\mathbf{B_{lim}}$ is 2 000 t, the lowest observed spawning stock biomass.	$\mathbf{B_{pa}}$ be set at 2 800 t.
$\mathbf{F_{lim}}$ is 0.28, the fishing mortality estimated to lead to potential stock collapse.	$\mathbf{F_{pa}}$ be set at 0.2.

Technical basis:

$\mathbf{B_{lim}} = \mathbf{B_{loss}}$	$\mathbf{B_{pa}}$: historical development: Biomass below this has increased risk of reduced recruitment.
$\mathbf{F_{lim}} = \mathbf{F_{loss}}$	$\mathbf{F_{pa}}$:$\mathbf{F_{lim}}$ x 0.72

Advice on management: ICES recommends that F should be reduced to below $\mathbf{F_{pa}}$, corresponding to catches of less than 450 t in 2002.

Comparison with previous assessment and advice: For most recent years the assessment is similar to last year's assessment. In general, the trends in biomass and fishing mortality are similar to the previous assessment.

Relevant factors to be considered in management: Fisheries for sole also take plaice as a by-catch. This needs to be taken into account in management.

The advice represents a reduction in F of around 40% and will allow SSB to rebuild above $\mathbf{B_{pa}}$ in 2004. In order to increase SSB above $\mathbf{B_{pa}}$ in 2003 a reduction in F of more than **95%** would be required. This corresponds to catches of less than 40 t.

Catch forecast in 2002:
Basis: F(2001) = F(98–00) = 0.32; Landings(2001) = 0.66; SSB(2002) = 2.10.

F(2002) onwards	Basis	Landings (2002)	SSB (2003)
0.02	0.05* $F_{98\text{-}00}$	0.04	2.80
0.13	$\mathbf{F_{0.1}}$	0.31	2.55
0.19	0.6* $F_{98\text{-}00}$	0.43	2.43
0.20	$\mathbf{F_{pa}}$	0.45	2.41
0.22	0.7* $F_{98\text{-}00}$	0.50	2.37
0.25	0.8* $F_{98\text{-}00}$	0.56	2.31
0.29	0.9* $F_{98\text{-}00}$	0.63	2.25
0.32	1* $F_{98\text{-}00}$	0.69	2.19

Weights in '000 t.
Shaded scenarios considered inconsistent with the precautionary approach.

Medium- and long-term projections: $\mathbf{F_{max}}$ is poorly determined (yield per recruit curve flat-topped).

Elaboration and special comment: In recent years, UK vessels have accounted for around 60% of the total landings, with France taking approximately a third and Belgian vessels the remainder. UK landings were low and stable between 1950 and the mid-1970s, but increased rapidly after 1978 due to the replacement of otter trawlers by beam trawlers. The principal gears used are otter-trawls and beam-trawls, and sole tends to be the target species of an offshore beam-trawl fleet, which is concentrated off the south Cornish coast, and also takes plaice and anglerfish and at times cuttlefish.

In the Western Channel the peak spawning period of sole is April and May. The main spawning areas are to the west of the Isle of Wight and in the vicinity of Hurd Deep. The nurseries are in estuaries, tidal inlets and shallow, sandy bays. Adult sole in the Western Channel may recruit from local nurseries and from those in the Eastern Channel, but there is no evidence of subsequent emigration from the Western Channel. Coupled with the localised spawning areas in the western Channel, this suggests that adult sole are largely isolated from those found in northern Biscay, the eastern Celtic Sea, and the Eastern Channel.

Analytical assessment based on landings, survey, and commercial CPUE data. There is anecdotal evidence of strategic mis-reporting of landings from this stock, which may compromise the assessment. Biological sampling data are good. Variations in effort and fleet catchability may occur as vessels move in and out of the fishery dependent on prevailing catch rates of sole.

Source of information: Report of the Working Group on the Assessment of Southern Shelf Demersal Stocks, September 2001 (ICES CM 2002/ACFM:05).

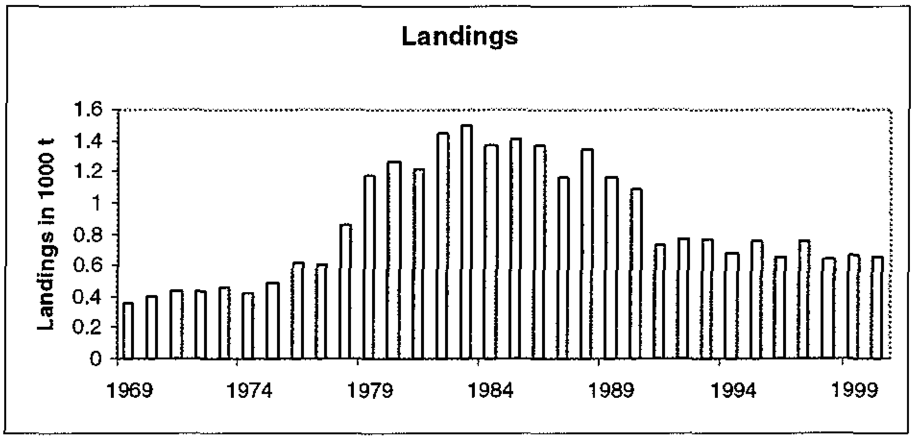
Yield and spawning biomass per Recruit F-reference points:

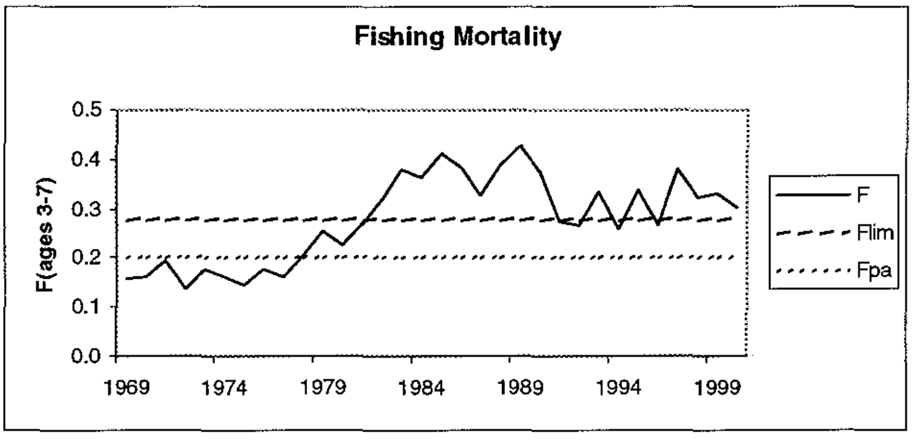
	Fish Mort Ages 3-7	Yield/R	SSB/R
Average Current	0.318	0.209	0.654
$\mathbf{F}_{max}$	0.382	0.209	0.544
$\mathbf{F}_{0.1}$	0.133	0.184	1.426
$\mathbf{F}_{med}$	0.273	0.207	0.761

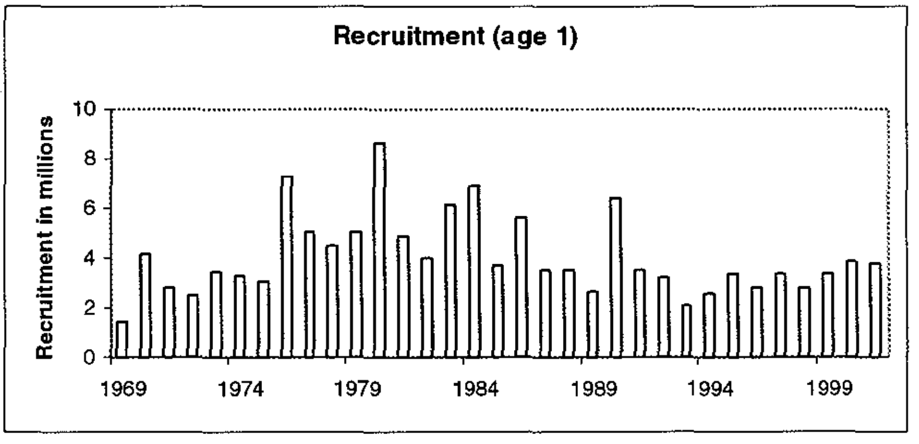
Catch data (Tables 3.9.7.1-2):

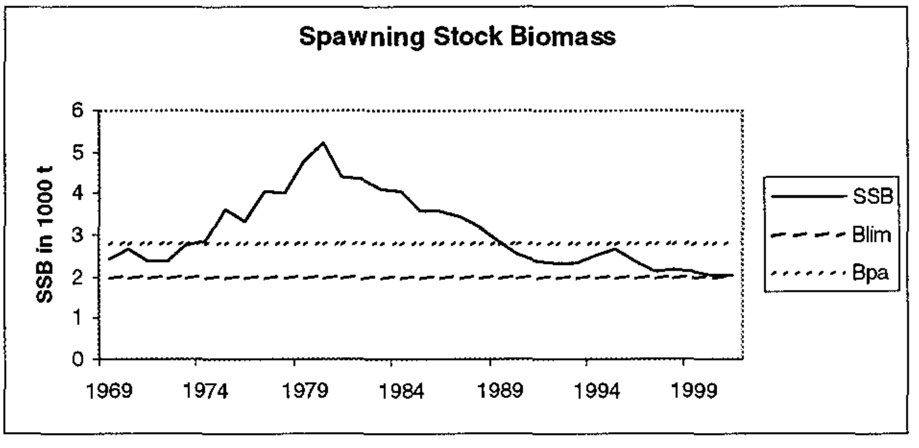
Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC	Official Landings	ACFM Landings
1987	No increase in F	1.15	1.15	1.11	1.16
1988	No decrease in SSB; TAC	1.3	1.3	0.95	1.35
1989	No decrease in SSB; TAC	1.0	1.0	0.8	1.16
1990	SSB = 3,000 t; TAC	0.9	0.9	0.75	1.08
1991	TAC	0.54	0.8	0.84	0.73
1992	70% of F(90)	0.77	0.8	0.77	0.77
1993	35% reduction in F	0.7	0.9	0.79	0.76
1994	No increase in F	1.0	1.0	0.84	0.68
1995	No increase in F	0.86	0.95	0.88	0.76
1996	$F_{96} < F_{94}$	0.68	0.70	0.74	0.65
1997	No increase in F	0.69	0.75	0.86	0.75
1998	No increase in F	0.67	0.67	0.77	0.65
1999	Reduce F below $\mathbf{F}_{pa}$	0.67	0.70	0.66	0.66
2000	Reduce F below $\mathbf{F}_{pa}$	< 0.64	0.64	0.65	0.65
2001	Reduce F below $\mathbf{F}_{pa}$	<0.58	0.60		
2002	Reduce F below $\mathbf{F}_{pa}$	<0.45			

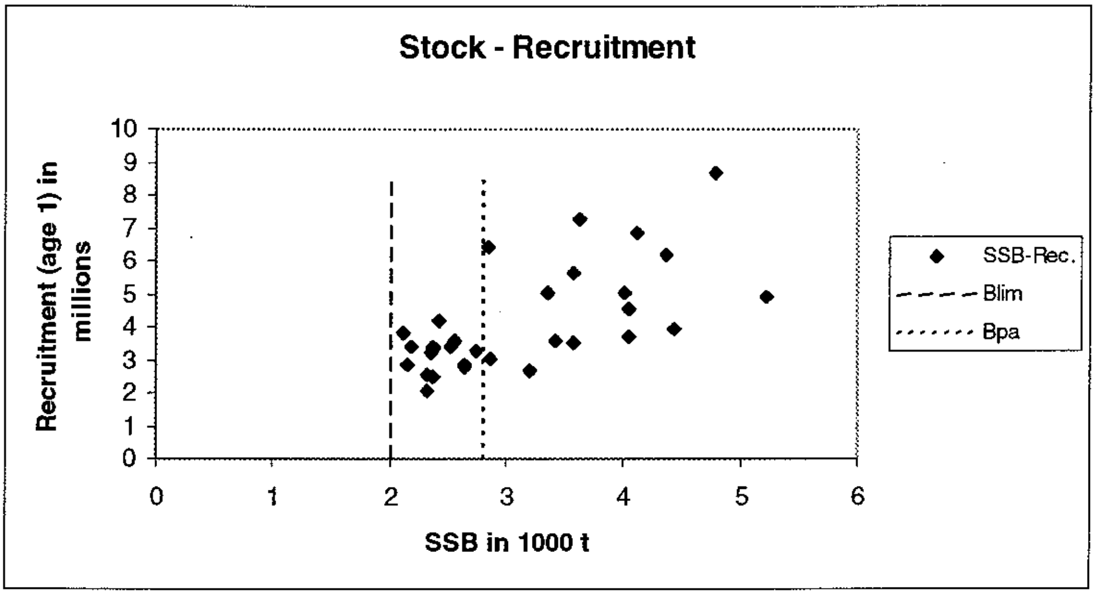
Weights in '000 t.

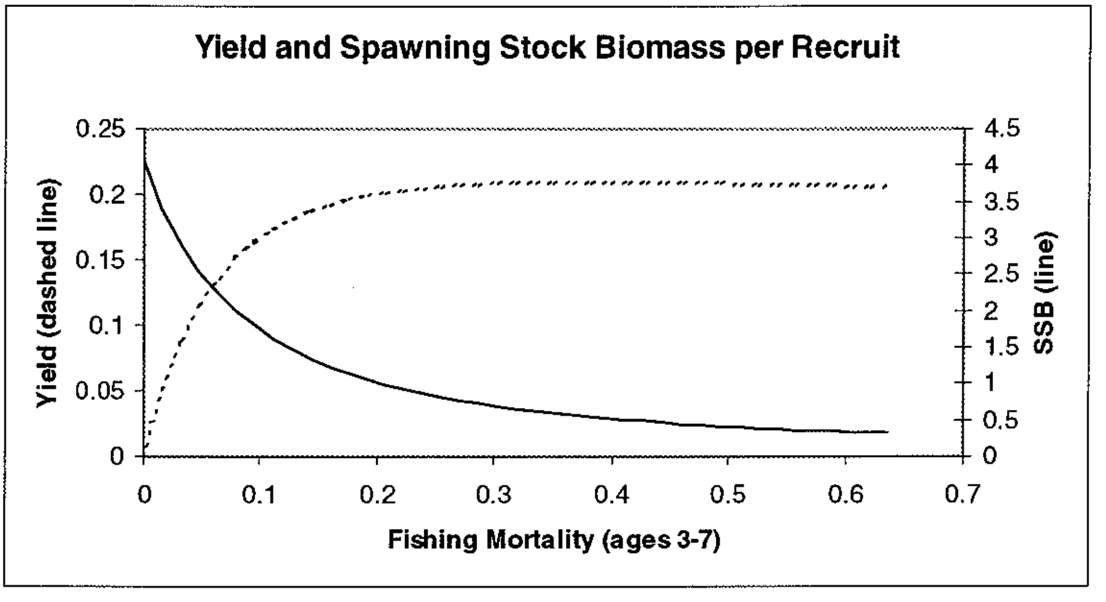

Landings
Landings in 1000 t
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1969
1974
1979
1984
1989
1994
1999


Fishing Mortality
F(ages 3-7)
0.5
0.4
0.3
0.2
0.1
0.0
1969
1974
1979
1984
1989
1994
1999
F
Flim
Fpa


Recruitment (age 1)
Recruitment in millions
10
8
6
4
2
0
1969
1974
1979
1984
1989
1994
1999


Spawning Stock Biomass
SSB in 1000 t
6
5
4
3
2
1
0
1969
1974
1979
1984
1989
1994
1999
SSB
Blim
Bpa


Stock - Recruitment
Recruitment (age 1) in millions
SSB in 1000 t
SSB-Rec.
Blim
Bpa


Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
SSB (line)
Fishing Mortality (ages 3-7)

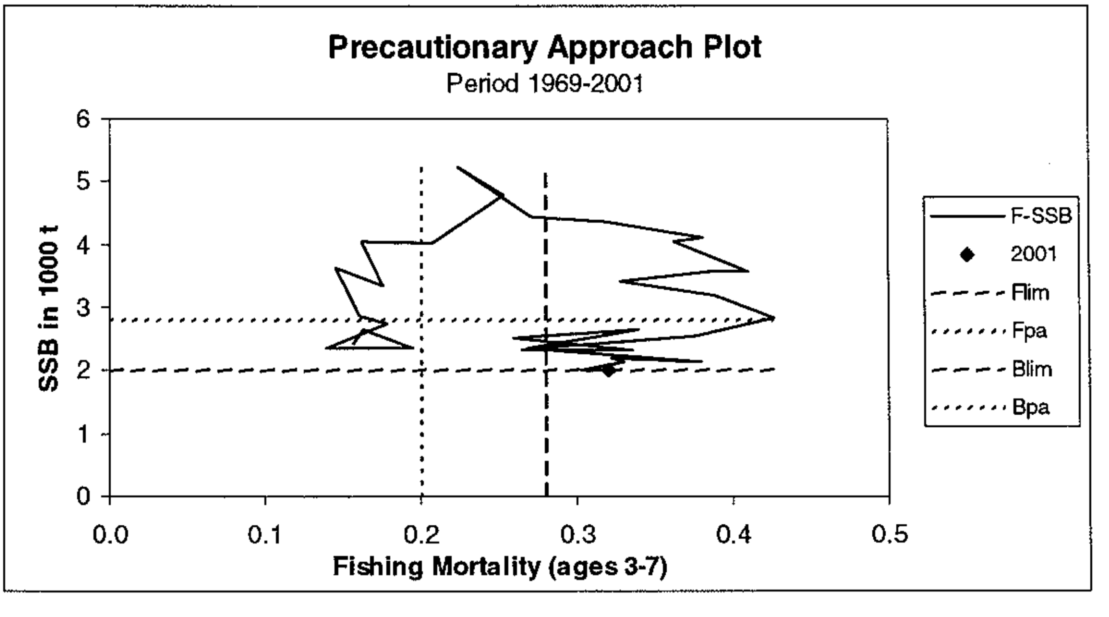

Precautionary Approach Plot
Period 1969-2001
SSB in 1000 t
Fishing Mortality (ages 3-7)
F-SSB
2001
Flim
Fpa
Blim
Bpa

Table 3.9.7.1 Division VIIe Sole. Nominal landings (t), 1972–2000 used by Working Group.

Year	Belgium	France	UK (Engl. & Wales)	Other	Total Reported	Unallocated [2]	Total
1972	6	230[1]	201	-	437	-	437
1973	2	263[1]	194	-	459	-	459
1974	6	237	181	-	424	3	427
1975	3	271	217	-	491	-	491
1976	4	352	260-	-	616	-	616
1977	3	331	271	-	606	-	606
1978	4	384	453	20	861	-	861
1979	1	515	665	-	1,181	-	1,181
1980	45	447	764	13	1,269	-	1,269
1981	16	415	788	1	1,220	-5	1,215
1982	98	321	1,028	-	1,447	-1	1,446
1983	47	405	1,043	3	1,498	-	1,498
1984	48	421	901	-	1,370	-	1,370
1985	58	130	911	-	1,099	310	1,409
1986	62	467	840	127	1,496	-128	1,368
1987	48	432	632	-	1,112	47	1,159
1988	67	98	784	-	949	401	1,350
1989	69	112[3]	610	6	797	364	1,161
1990	41	81[3]	632	-	754	328	1,082
1991	35	325[3]	477	-	837	-106	731
1992	41	267[3]	457	9	774	-5	769
1993	59	236[3]	480	18	793	-30	763
1994	33	257[3]	548	-	838	-158	680
1995	21	294	565	-	880	-123	757
1996	8	297	437	-	742	-95	647
1997	13	348	496	1	858	-104	754
1998	40	343	389	-	772	-127	645
1999[3]	13	254	396	-	663	1	664
2000[3]	4	237	413	-	654	-4	650

[1]Estimated from Division VIId,e total by the Working Group.
[2]Estimated by the Working Group.
[3]Provisional.

Table 3.9.7.2 Sole in Division VIIe (Western Channel).

Year	Recruitment Age 1 thousands	SSB tonnes	Landings tonnes	Mean F Ages 3-7
1969	1476	2426	353	0.157
1970	4186	2638	391	0.163
1971	2821	2375	432	0.195
1972	2479	2377	437	0.139
1973	3411	2753	459	0.179
1974	3247	2866	427	0.161
1975	3039	3627	491	0.145
1976	7293	3360	616	0.176
1977	5022	4041	606	0.162
1978	4517	4019	861	0.207
1979	5037	4792	1181	0.253
1980	8641	5220	1269	0.224
1981	4896	4425	1215	0.271
1982	3963	4371	1446	0.318
1983	6191	4104	1498	0.381
1984	6876	4045	1370	0.362
1985	3668	3578	1409	0.410
1986	5628	3565	1368	0.385
1987	3537	3426	1159	0.328
1988	3554	3199	1350	0.389
1989	2664	2840	1161	0.427
1990	6440	2558	1082	0.376
1991	3554	2353	731	0.274
1992	3195	2329	769	0.265
1993	2063	2323	763	0.336
1994	2575	2529	680	0.259
1995	3392	2640	757	0.339
1996	2817	2368	647	0.268
1997	3344	2152	754	0.380
1998	2829	2195	645	0.321
1999	3367	2130	664	0.331
2000	3839	2024	650	0.302
2001	3779	2020		0.320
Average	4041	3081	864	0.279

3.9.8 Sole in Divisions VIIIa,b (Bay of Biscay)

State of stock/exploitation: The stock is outside safe biological limits. Fishing mortality has been variable, but with an increasing trend since 1984 and in 2000 is 70% above $\mathbf{F_{pa}}$. SSB has remained relatively stable up to 1994, but has decreased sharply since then. Since 1994 recruitment has also decreased to the lowest on record.

Management objectives: There is no explicit management objective for this stock.

Precautionary Approach reference points (changed in 2001):
Revised assessment and new maturity ogive resulted in new estimates of reference points.

ICES considers that:	ICES proposes that:
$\mathbf{B_{lim}}$ not defined.	$\mathbf{B_{pa}}$ be set at 13 000 t. The probability of reduced recruitment increases when SSB is below 13 000 t.
$\mathbf{F_{lim}}$ = 0.5, the fishing mortality estimated to lead to potential stock collapse.	$\mathbf{F_{pa}}$ = 0.36

Technical basis:

$\mathbf{B_{lim}}$ = Not defined.	$\mathbf{B_{pa}}$ ~ historical development of the stock [lowest observed for the converged part of the VPA, i.e. the most recent years are not included]
$\mathbf{F_{lim}}$: based on historical response of the stock	$\mathbf{F_{pa}}$ = $\mathbf{F_{lim}}$ * 0.72

Advice on management: In the light of the sharp decrease in SSB and recruitment since 1995, ICES recommends a recovery plan that will ensure a safe and rapid recovery of SSB to a level in excess of 13 000 t. If a recovery plan is not implemented, ICES recommends that the fishing mortality should be reduced to the lowest possible level in 2002.

Rebuilding plan: Rebuilding of the sole stock can be obtained by reducing the fishing mortality, by improving the exploitation pattern, or by a combination of the two.

Setting the TAC at a low level may reduce fishing mortality, but past experience has shown that it is very difficult to control fishing mortality by TACs alone. ICES, therefore, recommends that in addition to a TAC, restrictions in effort of fleets exploiting sole should be implemented. Large closed areas and seasons may contribute to stock recovery, but only if accompanied by major reductions in effort.

The selection pattern improved in the late 1980s when the gill net fishery expended. More than half of the sole is caught by gill net, and strong regulation of this fishery (limitation of number and length of nets) should be implemented, since no or small further improvement of selectivity of these nets is expected. However, improvement of selection pattern for the trawl fishery would contribute to stock recovery in the medium-term. It has to be noted that the stock of sole may benefit from the effort measures taken for the rebuilding of the hake stock.

A fishing mortality of zero in 2002 would allow SSB to almost reach $\mathbf{B_{pa}}$ by 2003. However, a rebuilding plan could achieve this goal in 4-5 years. Fishing mortality less than 0.24 ($F_{98\text{-}00}$ reduced by 60%) in 2002, 2003 and 2004 is expected to rebuild it by 2004 with close to 50% probability (see text table below). The table also shows that a weaker reduction in F (50%) would require two years more to rebuild SSB above $\mathbf{B_{pa}}$ with the same probability. Given the state of the stock, and the risk of impaired recruitment, this is not in accordance with precautionary approach.

Medium-term projections: Presented below from 2002-2006. The stock-recruitment relationship is assumed to have a flat asymptote for large SSB, (a Beverton and Holt S-R) The basis for the simulations is: F(2001) = $\mathbf{F_{sq}}$ = $F_{(98\text{-}00)}$ = 0.59.

F(2002) onwards = 1.0 * $\mathbf{F_{sq}}$: Catches 2002 = 4.2.

		SSB	
	25%	Median	75%
2002	7.3	7.9	8.3
2003	7.6	8.2	8.8
2004	7.4	8.0	8.6
2005	6.5	7.1	7.7
2006	5.9	6.4	7.0

F(2002) onwards = 0.4 * $\mathbf{F_{sq}}$: Catches 2002 = 2.0

		SSB	
	25%	Median	75%
2002	7.3	7.9	8.3
2003	10.0	10.7	11.4
2004	12.0	**12.8**	13.7
2005	**13.1**	14.1	15.1
2006	14.4	15.5	16.7

F(2002) onwards = 0.5 * F_{sq} : Catches 2002 = 2.4

	SSB		
	25%	Median	75%
2002	7.3	7.9	8.3
2003	9.5	10.2	10.9
2004	11.0	11.8	12.6
2005	11.6	12.4	13.4
2006	12.2	**13.2**	14.3

Comparison with previous assessment and advice: The previous assessment was not considered reliable, because some landings and effort data were missing. This year's assessment gives a perception of a more rapid decline of the stock.

Relevant factors to be considered in management: Even though the exploitation pattern of this stock has improved in the past due to the development of the gillnet fishery (in the mid-1980s), fishing mortality is too high to allow a sustainable exploitation of this stock.

Catch forecast for 2002:

Basis: F(2001) = F(98–00) = 0.59; Landings(2001) = 4.05; SSB(2002) = 7.78.

F(2002)	Basis	Landings (2002)	SSB (2003)
0	0	0	12.75
0.09	$F_{0.1}$	0.78	11.84
0.18	F_{max}	1.46	11.05
0.24	0.4 F_{98-00}	1.89	10.54
0.30	0.5 F_{98-00}	2.30	10.07
0.36	F_{pa} = 0.61 F_{98-00}	2.71	9.59
0.42	0.7 F_{98-00}	3.06	9.19
0.47	0.8 F_{98-00}	3.40	8.79
0.59	1.0 F_{98-00}	4.04	8.06

Weights in '000 t.

Shaded scenarios considered inconsistent with the precautionary approach.

About 70% of the projected SSB in 2003 is based on recruitment of yearclasses the strength of which has not been verified neither by commercial fisheries nor by abundance surveys. The calculations are done assuming that these yearclasses have a strength equal to the geometric mean of past recruitment.

Elaboration and special comment: A succession of weak recruitments in recent years gives concern on the further development of the state of this stock if fishing mortality remains at this high level.

Catches have increased continuously until a maximum was reached in 1994 (7 400 t). They decreased to 6300 t in 1995 and remained for 4 years between 6 000 t and 6 300 t. They decreased again to 5 400 t in 1999 and 5 100 t in 2000. Since 1984, catches of sole by French small-mesh shrimp trawlers decreased markedly. The gill-net and trammel-net fisheries have expanded and account for more than half of the French landings in the last years.

Landings by Belgium beam trawlers increased rapidly in the late 1980s and, since 1991, have been relatively constant at 6-9% of the total landings. Since 1996, an increase in effort of this fleet is associated with a decrease of its CPUE.

Analytical assessment based on landings, available discards information, and CPUE data series from 1984 to 2000. No recruitment indices are available for this stock. Data prior to 1984 are not considered reliable. A maturity ogive based on females has been applied instead of knife-edge at age 3.

Unallocated landings may account for more than 25% of estimated landings.

Source of information: Report of the Working Group on the Assessment of Southern Shelf Demersal Stocks, September 2001 (ICES CM 2002/ACFM:05).

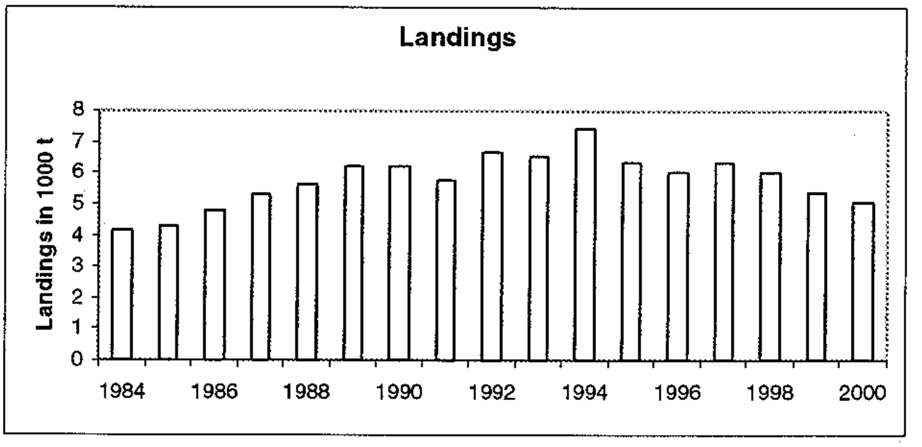
Yield and spawning biomass per Recruit F-reference points:

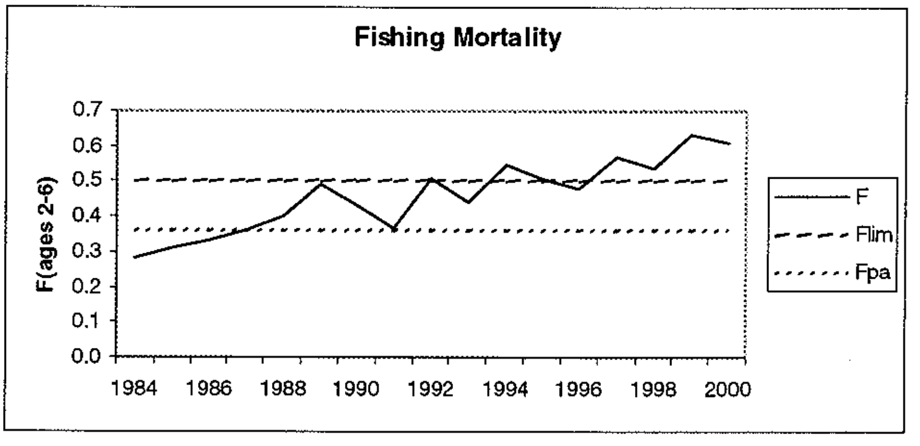
	Fish Mort Ages 2-6	Yield/R	SSB/R
Average Current	0.594	0.174	0.326
F_{max}	0.188	0.205	1.042
$F_{0.1}$	0.095	0.187	1.799
F_{med}	0.391	0.190	0.504

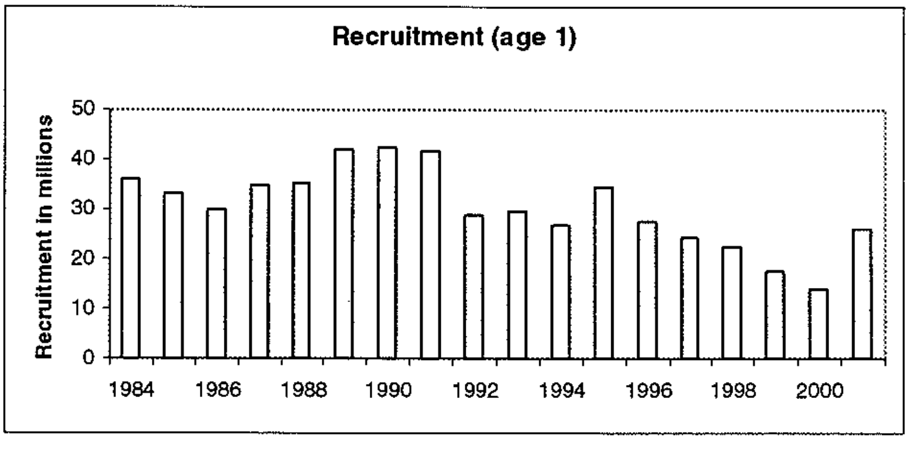
Catch data (Tables 3.9.8.1-2):

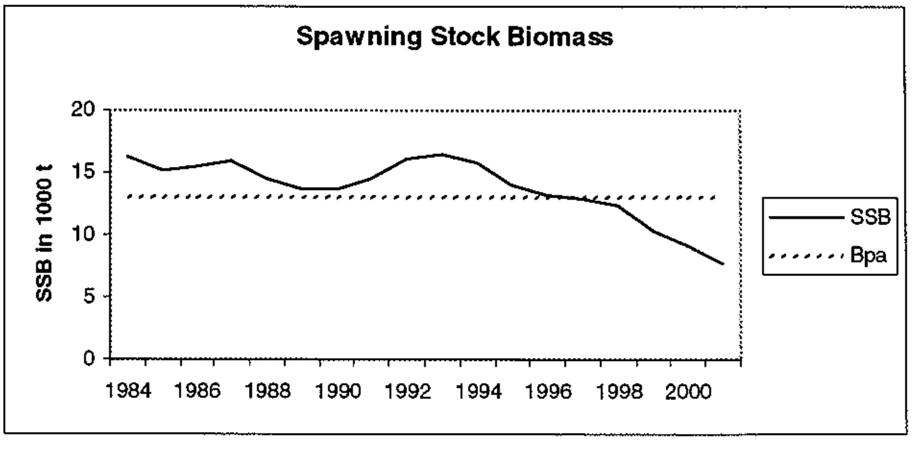
Year	ICES Advice	Catch corresp. to advice	Agreed TAC	Official Landings	ACFM Landings	Disc. slip.	ACFM Catch
1987	Not assessed	-	4.4	4.4	5.1	0.2[3]	5.3
1988	Precautionary TAC	3.7	4.0	4.4	5.4	0.3[3]	5.6
1989	No increase in effort; TAC	4.5	4.8	5.8[1]	5.8	0.4[3]	6.2
1990	No increase in F; TAC	5.1	5.2	5.5[1]	5.9	0.3[3]	6.2
1991	Precautionary TAC	4.7	5.3	4.7[1]	5.6	0.2[3]	5.8
1992	F = F(90)	5.0	5.3	6.4[1]	6.6	0.1[3]	6.7
1993	No long-term gain in increasing F	-	5.7	6.5	6.4	0.1[3]	6.5
1994	No long-term gain in increasing F	-	6.6	7.1	7.2	0.2[3]	7.4
1995	No long-term gain in increasing F	5.4[2]	6.6	5.9	6.2	0.1[3]	6.3
1996	No increase in F	5.0	6.6	4.7	5.9	0.1[3]	6.0
1997	40% reduction in F	3.1	5.4	5.0	6.2	0.1	6.3
1998	No increase in F	7.6	6.0	4.3[4]	5.9	0.1	6.0
1999	Reduce F below $\mathbf{F}_{pa}$	< 5.0	5.4	3.8[4]	5.2	0.2	5.4
2000	F at $\mathbf{F}_{pa}$	< 5.8	5.8	5.8[4]	5.0	0.1	5.1
2001	TAC 2001 at most TAC 2000	< 5.8	5.8				
2002	Establish rebuilding plan or no fishing	0					

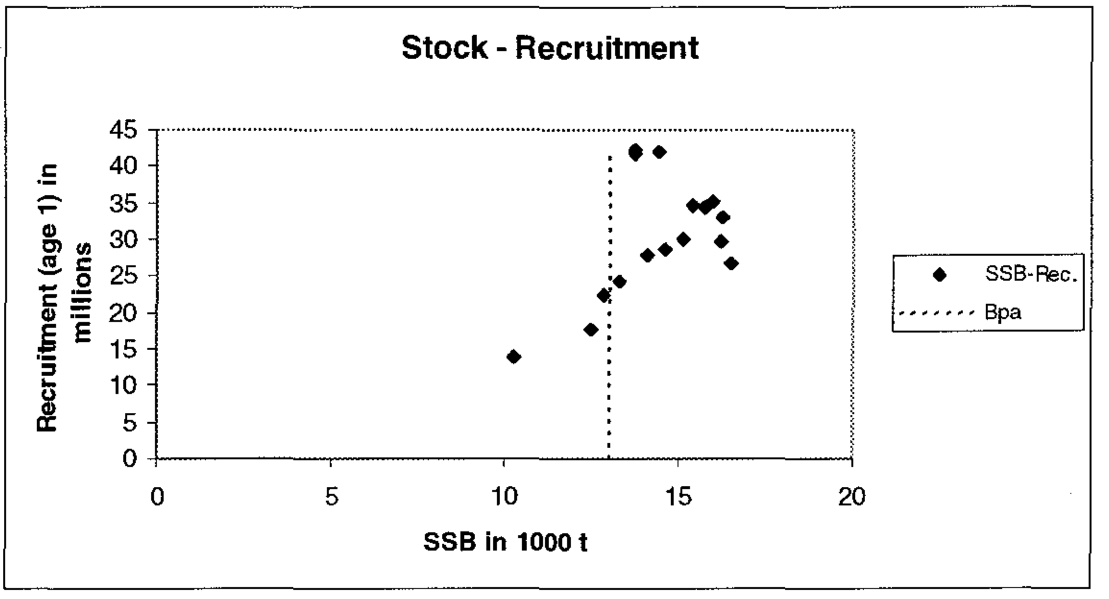
[1]Not reported for all countries. [2]Landings assuming current discarding practise. [3] Discards revised in 1998. [4] Preliminary. Weights in '000 t.

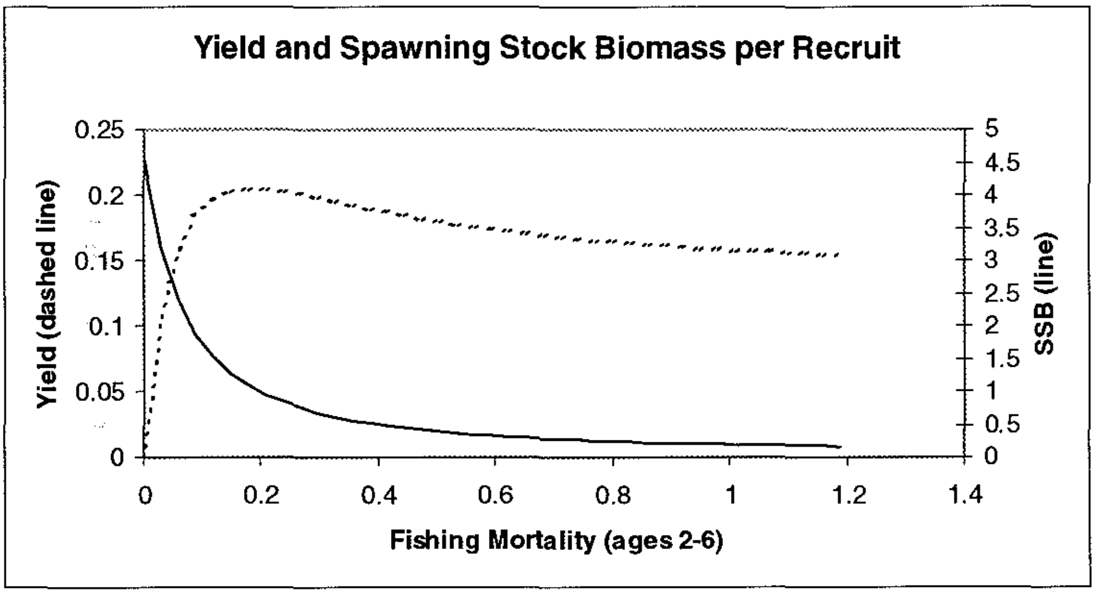

Landings
Landings in 1000 t
8
7
6
5
4
3
2
1
0
1984
1986
1988
1990
1992
1994
1996
1998
2000


Fishing Mortality
F(ages 2-6)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1984
1986
1988
1990
1992
1994
1996
1998
2000
F
Flim
Fpa


Recruitment (age 1)
Recruitment in millions
50
40
30
20
10
0
1984
1986
1988
1990
1992
1994
1996
1998
2000


Spawning Stock Biomass
SSB in 1000 t
20
15
10
5
0
1984
1986
1988
1990
1992
1994
1996
1998
2000
SSB
Bpa


Stock - Recruitment
Recruitment (age 1) in millions
SSB in 1000 t
SSB-Rec.
Bpa
0
5
10
15
20
25
30
35
40
45
0
5
10
15
20


Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
SSB (line)
Fishing Mortality (ages 2-6)
0
0.05
0.1
0.15
0.2
0.25
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
0
0.2
0.4
0.6
0.8
1
1.2
1.4

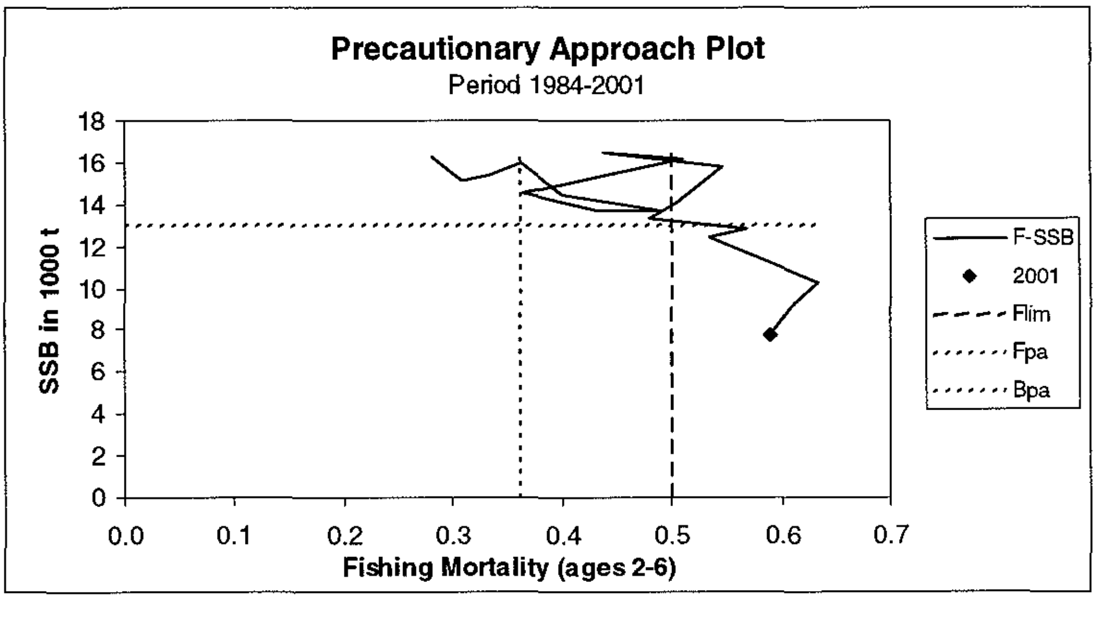

Precautionary Approach Plot
Period 1984-2001
SSB in 1000 t
Fishing Mortality (ages 2-6)
F-SSB
2001
Flim
Fpa
Bpa
0
2
4
6
8
10
12
14
16
18
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7

Table 3.9.8.1 Sole in Divisions VIIIa,b (Bay of Biscay). International landings and catches used by Working Group (in tonnes).

	Official Landings					Unallocated	WG	Discards	WG
Year	Belgium	France	Nether.	Spain	Total	Landings	Landings		Catches
1979	5*	2376		62*	2443	176	2619	-	-
1980	33*	2549		107*	2689	297	2986	-	-
1981	4*	2581*	13*	96*	2694	242	2936	-	-
1982	19*	1618*	52*	57*	1746	2067	3813	-	-
1983	9*	2590	32*	38*	2669	959	3628	-	-
1984		2968	175*	40*	3183	855	4038	99	4137
1985	25*	3423	169*	308*	3925	326	4251	64	4315
1986	52*	4227	213*	75*	4567	238	4805	27	4832
1987	124*	4009	145*	101*	4379	707	5086	198	5284
1988	135*	4308			4443	939	5382	254	5636
1989	311*	5471*			5782	63	5845	356	6201
1990	301*	5231			5532	384	5916	303	6219
1991	389*	4315		3	4707	862	5569	198	5767
1992	440*	5919			6359	191	6550	123	6673
1993	400*	6083		13	6496	-76	6420	104	6524
1994	466*	6620		17***	7103	123	7226	184	7410
1995	546*	5325		6***	5877	328	6205	130	6335
1996	460*	3843		13***	4316	1537	5853	142	5995
1997	435*	4526		23***	4984	1212	6196	117	6313
1998	469*	3821**	44	40***	4330	1542	5872	124	5996
1999	504*	3280**		41***	3825	1339	5164	192	5356
2000	451*	5303**			5754	-748	5006	66	5072
Mean					4446	617	5062	158	5974

*Reported in VIII.
**Preliminary.
*** Reported as *Solea* spp (*Solea lascaris* and *Solea solea*) in VIII.

Table 3.9.8.2 Sole in Divisions VIIIa,b (Bay of Biscay).

Year	Recruitment Age 1 thousands	SSB tonnes	Landings tonnes	Mean F Ages 2-6
1984	36161	16259	4137	0.282
1985	33097	15105	4315	0.309
1986	30082	15424	4832	0.333
1987	34744	15976	5284	0.363
1988	35171	14446	5636	0.401
1989	41882	13722	6201	0.490
1990	42297	13723	6219	0.433
1991	41657	14578	5767	0.365
1992	28620	16193	6673	0.510
1993	29724	16485	6524	0.439
1994	26817	15759	7410	0.547
1995	34244	14085	6335	0.506
1996	27789	13293	5995	0.480
1997	24405	12837	6313	0.568
1998	22304	12479	5996	0.534
1999	17705	10269	5356	0.634
2000	13997	9272	5072	0.612
2001	26006	7719		0.590
Average	30372	13757	5769	0.466

3.9.9 Celtic Sea and Division VIIj herring

State of the stock/exploitation: The stock status is unknown.

Management objectives: There are no explicit management objectives for this stock.

Precautionary Approach reference points (unchanged since 1999):

ICES considers that:	ICES proposes that:
B_{lim} is 26 000 t	B_{pa} be set at 44 000 t
F_{lim}: not defined	F_{pa}: not defined

Technical basis:

B_{lim}: The lowest stock observed	B_{pa}: Low probability of low recruitment
F_{lim}: not defined	F_{pa}: not defined

Advice on management: ICES recommends that catches be restricted to 6 000 t for the first half of 2002, which is about 2/3 of current landings during the 1st half year. Advice for the second half of 2002 will be given in June 2002.

Relevant factors to be considered in management: It is difficult to give appropriate management advice for 2002 because of the uncertainty about the current stock size. A scientific program aimed at collecting additional biological information (including the age composition and distribution of the adult stocks throughout the Celtic Sea and Division VIIj) was organized by the local management committee and was carried out by the Irish Marine Institute during the period June to October 2001. This programme also included two acoustic surveys. Preliminary information from this program was presented to ICES in October 2001. These data together with new data from the 2001/2002 fishery will be used by ICES in May 2002 to provide management advice for the second half of 2002.

Catches from this fishery in recent years have been taken almost exclusively by Ireland. The management of the Irish fishery is on a seasonal basis in which about 50% of the national quota is allocated to the January to February period, while the remainder is allocated to the mid-October to December period. A new management committee is currently monitoring the catches and if the fishery in the fourth quarter of 2001 is dominated by catches of small herring then the fishery will be closed immediately.

Source of information: Report of the Herring Assessment Working Group for the Area South of 62°N, March 2001 (ICES CM 2001/ACFM:12).

Catch data (Tables 3.9.9.1–2):

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC	Official Landings	Discards	ACFM Catch[1]
1987	Precautionary TAC	18	18	18	4.2	27.3
1988	TAC	13	18	17	2.4	19.2
1989	TAC	20	20	18	3.5	22.7
1990	TAC	15	17.5	17	2.5	20.2
1991	TAC (TAC excluding discards)	15 (12.5)	21	21	1.9	23.6
1992	TAC	27	21	19	2.1	23.0
1993	Precautionary TAC (including discards)	20–24	21	20	1.9	21.1
1994	Precautionary TAC (including discards)	20–24	21	19	1.7	19.1
1995	No specific advice	-	21	18	0.7	19.0
1996	TAC	9.8	16.5 - 21[2]	21	3.0	21.8
1997	If required, precautionary TAC	< 25	22	20.7	0.7	18.8
1998	Catches below 25	< 25	22	20.5	0.0	20.3
1999	F = 0.4	19	21	19.4	0.0	18.1
2000	F < 0.3	20	21	18.8	0.0	17.1
2001	F < 0.34	17.9	20			
2002	Precautionary TAC for 1st half of 2002	6.0				

[1]By calendar year. [2]Revised during 1996 after ACFM May meeting. Weights in '000 t.

Celtic Sea and Division VIIj herring

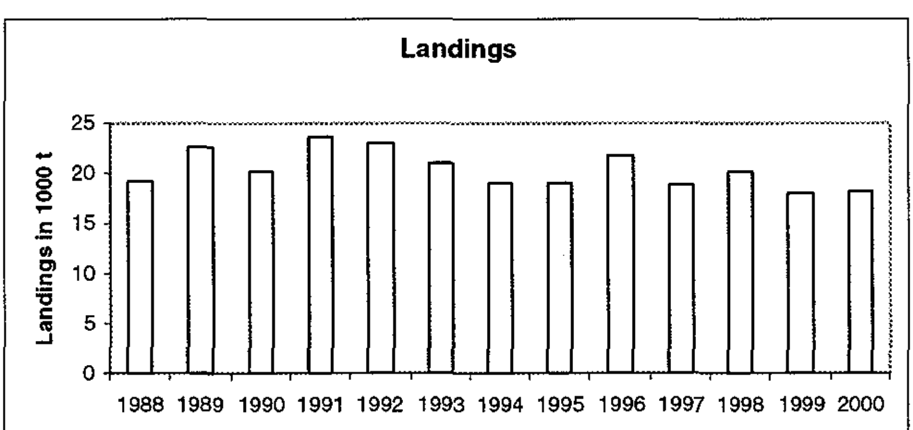


Table 3.9.9.1 Celtic Sea and Division VIIj herring landings by calendar year (t), 1988–2000. (Data provided by Working Group members.)

These figures may not in all cases correspond to the official statistics and cannot be used for management purposes.

Year	France	Germany	Ireland	Netherlands	U.K.	Unallocated	Discards	Total
1988	-	-	16,800	-	-	-	2,400	19,200
1989	+	-	16,000	1,900	-	1,300	3,500	22,700
1990	+	-	15,800	1,000	200	700	2,500	20,200
1991	+	100	19,400	1,600	-	600	1,900	23,600
1992	500	-	18,000	100	+	2,300	2,100	23,000
1993	-	-	19,000	1,300	+	-1,100	1,900	21,100
1994	+	200	17,400	1,300	+	-1,500	1,700	19,100
1995	200	200	18,000	100	+	-200	700	19,000
1996	1,000	0	18,600	1,000	-	-1,800	3,000	21,800
1997	1,300	0	18,000	1,400	-	-2,600	700	18,800
1998	+	-	19,300	1,200	-	-200	0	20,300
1999		200	17,900	1,300	+	-1300	0	18,100
2000[1)]	573	228	18,038	44	1	-617	0	18,267

[1] Preliminary.

Table 3.9.9.2 Celtic Sea and Division VIIj herring landings (t) by season (1 April–31 March) 1988/1989-1999/2000. (Data provided by Working Group members. 1998/99 figures are preliminary.).

These figures may not in all cases correspond to the official statistics and cannot be used for management purposes.

Year	France	Germany	Ireland	Netherlands	U.K.	Unallocated	Discards	Total
1988/1989	-	-	17,000	-	-	-	3,400	20,400
1989/1990	+	-	15,000	1,900	-	2,600	3,600	23,100
1990/1991	+	-	15,000	1,000	200	700	1,700	18,600
1991/1992	500	100	21,400	1,600	-	-100	2,100	25,600
1992/1993	-	-	18,000	1,300	-	-100	2,000	21,200
1993/1994	-	-	16,600	1,300	+	-1,100	1,800	18,600
1994/1995	+	200	17,400	1,300	+	-1,500	1,900	19,300
1995/1996	200	200	20,000	100	+	-200	3,000	23,300
1996/1997	1,000	-	17,900	1,000	-	-1,800	750	18,800
1997/1998	1,300	-	19,900	1,400	-	-2100	0	20,500
1998/1999	+	-	17,700	1,200	-	-700	-0	18,200
1999/2000		200	18,300	1,300	+	-1300	0	18,500
2000/2001[1)]	573	228	16,962	44	1	-617	0	17,191

[1)] Preliminary.

3.9.10 Sprat in Divisions VIId,e

State of stock/exploitation: The state of the stock is not known.

Management objectives: There are no specific management objectives for this stock.

Elaboration and special comment: Insufficient data are available to carry out an assessment. Sprat catches are very low and are mainly taken in the second half of the year by the Lyme Bay sprat fishery. The 2000 catch has decreased to 1710 t; the catch has thus been lower than average since 1984.

Source of information: Report of the Herring Assessment Working Group for the Area South of 62°N, March 2001 (ICES CM 2001/ACFM:12).

Catch data (Table 3.9.10.1):

Year	ICES Advice	Predicted catch corresp. to advice	Agreed RTAC TAC	ACFM Catch
1987	No advice	-	5	2.7
1988	No advice	-	5	5.5
1989	No advice	-	12	3.4
1990	No advice	-	12	2.1
1991	No advice	-	12	2.6
1992	No advice	-	12	1.8
1993	No advice	-	12	1.8
1994	No advice	-	12	3.2
1995	No advice	-	12	1.5
1996	No advice	-	12	1.8
1997	No advice	-	12	1.6
1998	No advice	-	12	2.0
1999	No advice	-	6.3	3.6
2000	No advice	-	12	1.7
2001	No advice	-	12	
2002	No advice			

[1]Weights in '000 t.

Sprat in Divisions VIId,e

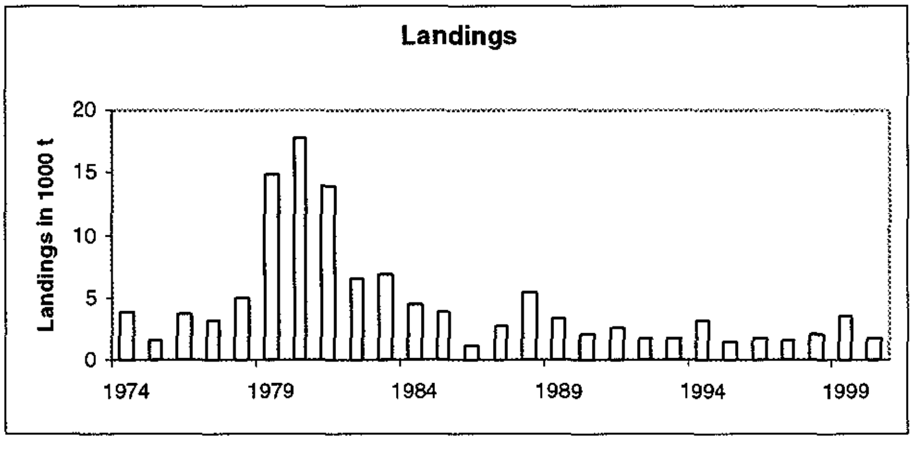


Table 3.9.10.1 Nominal catch of sprat (t) in Divisions VIId,e1985–2000.

Country	1985	1986	1987	1988	1989	1990	1991	1992
Denmark		15	250	2,529	2,092	608		
France	14		23	2	10			35
Germany								
Netherlands								
UK (Engl.&Wales)	3,771	1,163	2,441	2,944	1,319	1,508	2,567	1,790
Total	3,785	1,178	2,714	5,475	3,421	2,116	2,567	1,825

Country	1993	1994	1995	1996	1997	1998*	1999*	2000*
Denmark								
France	2	1	0					18
Germany								
Netherlands							1	1
UK (Engl.&Wales)	1,798	3,177	1,515	1,789	1,621	2,024	3,559	1,692
Total	1,800	3,178	1,515	1,789	1,621	2,024	3,560	1,711

* Preliminary.

3.9.11 Megrim (*L. whiffiagonis*) in Sub-area VII and Divisions VIIIa,b,d

State of stock/exploitation: The stock is harvested outside safe biological limits. SSB was high from 1984 to 1988, then declined until 1990 and has been above $\mathbf{B_{pa}}$ since then. The fishing mortality has declined from the 1991 peak until 1997 and has increased since then to above $\mathbf{F_{pa}}$. Recruitment at age 1 has been relatively stable with a peak in 1998. However, the strength of this 1997 year class needs to be confirmed.

Management objectives: There are no explicit management objectives for this stock.

Precautionary Approach reference points (established in 1998):

ICES considers that:	ICES proposes that:
$\mathbf{B_{lim}}$ is not defined	$\mathbf{B_{pa}}$ be set at 55 000 t. There is no evidence of reduced recruitment at the lowest biomass observed and $\mathbf{B_{pa}}$ was therefore set equal to the lowest observed SSB.
$\mathbf{F_{lim}}$ is 0.44, the fishing mortality above which stock dynamics are unknown	$\mathbf{F_{pa}}$ be set at 0.30, the estimated $\mathbf{F_{med}}$. This F is consistent with the proposed $\mathbf{B_{pa}}$ and it approximates $\mathbf{F_{MSY}}$.

Technical basis:

$\mathbf{B_{lim}}$ =	$\mathbf{B_{pa}} = \mathbf{B_{loss}}$
$\mathbf{F_{lim}} = \mathbf{F_{loss}}$	$\mathbf{F_{pa}} = \mathbf{F_{med}}$; implies a less than 5% probability that ($SSB_{MT} < \mathbf{B_{pa}}$)

Advice on management: ICES recommends that fishing mortality should be reduced to below $\mathbf{F_{pa}}$, corresponding to landings of less than 12 400 t in 2002. Including a 5% contribution of *L. boscii* in the landings, the equivalent TAC for the two species combined would be 13 000 t.

Comparison with previous assessment and advice: Historical trends in F and SSB are similar to those in the previous assessment, with a slight downward revision in F and upward revision in SSB. The estimated high 1997 year class was out of the scope of the previous (two years ago) assessment.

Relevant factors to be considered in management: Until 1999, the minimum landing size of *Lepidorhombus spp.* in this area was 25 cm length. From 1st January 2000 the minimum landing size for these species was reduced to 20 cm. Technical measures such as increases in mesh size to reduce the catches of small fish should be investigated for this stock.

Catch forecast for 2002:

Basis: F(2001) = F(98–00) scaled to F_{00} = 0.39; Landings(2001) = 16.4; Catch(2001) = 21.9; SSB(2002) = 62.6.

F(2002)	Basis	Catch(2002)	Landings (2002)	SSB(2003)
0.16	0.4 F_{00}	9.2	7.0	72.8
0.18	$\mathbf{F_{max}}$	10.6	8.1	71.0
0.24	0.6 F_{00}	13.2	10.1	67.8
0.30	$\mathbf{F_{pa}}$	16.3	12.4	64.2
0.31	0.8 F_{00}	17.0	13.0	63.3
0.39	1.0 F_{00}	20.4	15.6	59.2
0.47	1.2 F_{00}	23.7	18.0	55.3

Weights in '000 t.

Shaded scenarios considered inconsistent with the precautionary approach.

Projection of biomass and landings are sensitive to the strength of the 1997 year class. This 1997 year class contributes 33% to landings in 2002 and 20% to SSB in 2003.

Medium- and long-term projections: Assuming the current selection pattern, $\mathbf{F_{max}}$ is 0.47 $\mathbf{F_{sq}}$.

Elaboration and special comment: Estimates of recruitment are very dependant on discards information. Since discard data are available for some years only, derivations were carried out for years without information. In 1998, high discard estimates from France resulted in a large estimate of recruitment coming into the spawning stock biomass in 2000. No French discard data for 1999 were available, and the data available on Spanish discards in 1999 indicated a large change in the discard pattern. For 2001 no discard estimates from France and Spain are expected.

Megrim in the Celtic sea, west of Ireland and in the Bay of Biscay are caught predominantly by Spanish and French vessels, which together have reported more than 60% of the total landings, and by Irish and UK demersal trawlers. For most fleets, megrim is taken in mixed fisheries for hake, anglerfish, *Nephrops*, cod and whiting. Most UK landings of megrim are made by beam trawlers fishing in Divisions VIIe,f,g,h. Otter trawlers account for the majority of Spanish landings from Sub-area VII, the remainder being taken by gill netters prosecuting a mixed fishery for anglerfish, hake and megrim on the shelf edge around the 200 m contour to the south and west of Ireland. Irish megrim landings are largely made by multi-purpose vessels fishing in Divisions VIIb,c,g for gadoids as well as plaice, sole and anglerfish. Megrim landings have remained fairly stable over the period 1986–2000. Discards are estimated to be about 14% (27% in 1998) of the total catches by weight and comprise fish over a large range of sizes.

Megrim are widely distributed over the whole of Sub-areas VII and VIII and are most abundant in the deeper waters of the continental shelf. Spawning takes place between January and April along the edge of the continental shelf to the southwest and west of the British Isles, and research vessel trawling surveys indicate that 0-group megrim do not move far from the spawning grounds on the shelf edge during their first year.

Age-based analytical assessment using catch-per-unit effort from three commercial fleets and one survey. Discard estimates were used but were considered incomplete.

Source of information: Report of the Working Group on the Assessment of Southern Shelf Demersal Stocks, September 2001 (ICES CM 2002/ACFM:05).

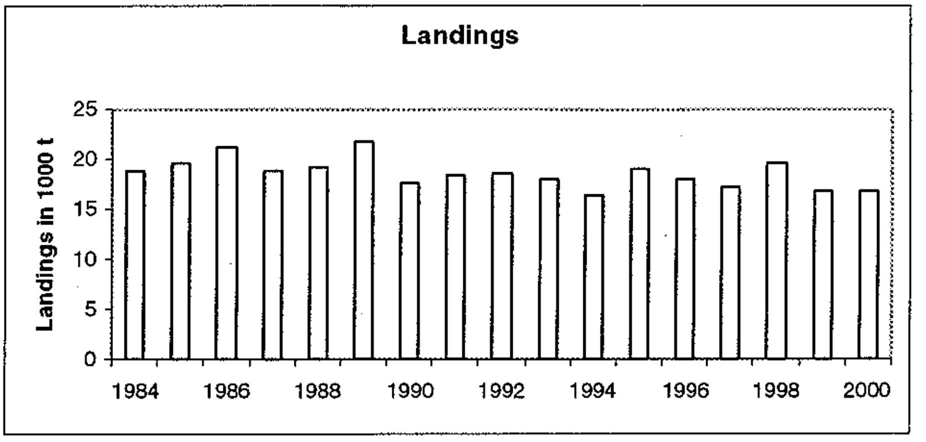
Yield and spawning biomass per Recruit
F-reference points:

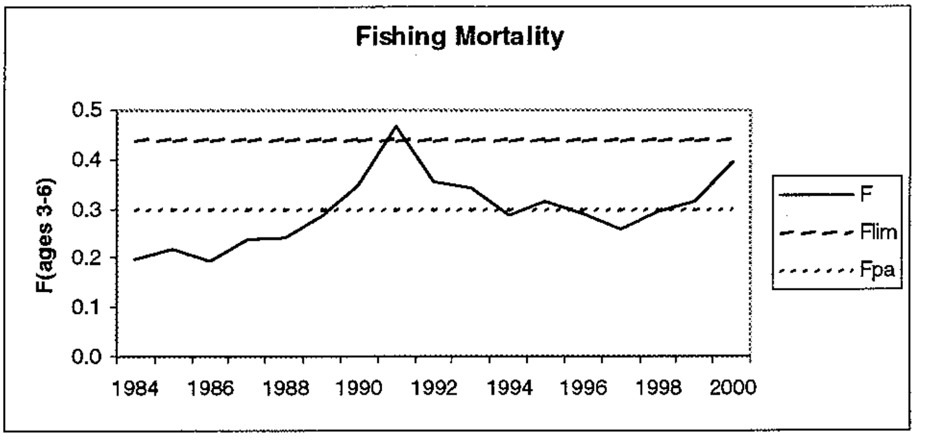
	Fish Mort Ages 3-6	Yield/R	SSB/R
Average Current	0.334	0.068	0.238
$\mathbf{F_{max}}$	0.233	0.070	0.339
$\mathbf{F_{0.1}}$	0.138	0.065	0.526
$\mathbf{F_{med}}$	0.290	0.069	0.274

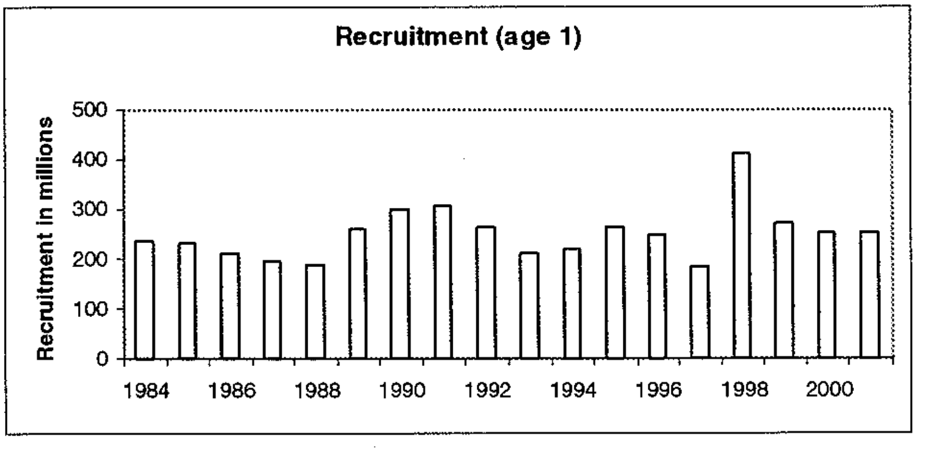
Catch data (Tables 3.9.11.1-2):

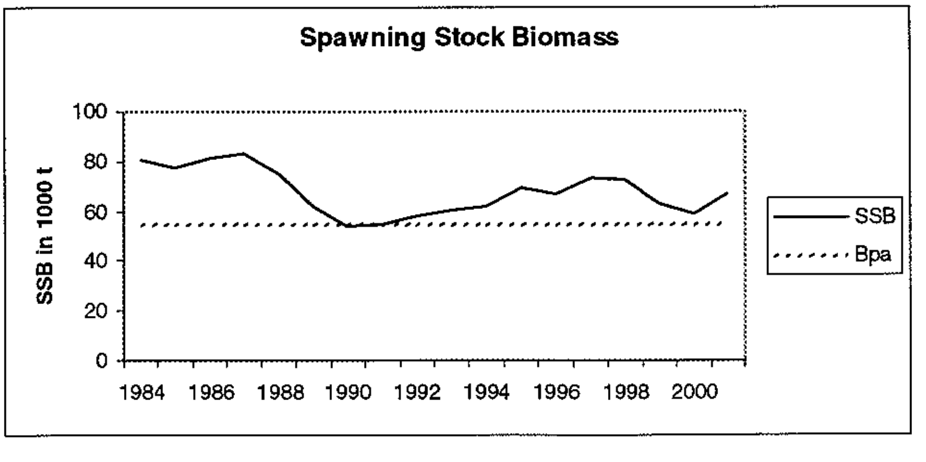
Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC[1]	ACFM Landings	Disc. slip	ACFM catch
1987	Not assessed	-	16.46	17.1	1.7	18.8
1988	Not assessed	-	18.1	17.6	1.7	19.3
1989	Not assessed	-	18.1	19.2	2.6	21.8
1990	Not assessed	-	18.1	14.4	3.3	17.7
1991	No advice	-	18.1	15.1	3.3	18.4
1992	No advice	-	18.1	15.6	3.0	18.6
1993	Within safe biological limits	-	21.46	14.9	3.1	18.0
1994	Within safe biological limits	-	20.33	13.7	2.7	16.4
1995	No particular concern	-	22.59	15.9	3.2	19.1
1996	No long-term gain in increased F	16.6[2]	21.20	15.1	3.0	18.1
1997	No advice	14.3[2]	25.0	14.3	3.1	17.3
1998	No increase in F	15.2[2]	25.0	14.3	5.4	19.7
1999	Reduce F below $\mathbf{F_{pa}}$	14.6[2,1]	25.0	13.7	3.1	16.9
2000	Reduce F below $\mathbf{F_{pa}}$	<14.2[2,1]	20.0	14.5	2.3	16.8
2001	Reduce F below $\mathbf{F_{pa}}$	< 14.1[2,1]	16.8			
2002	Reduce F below $\mathbf{F_{pa}}$	< 13.0[2,1]				

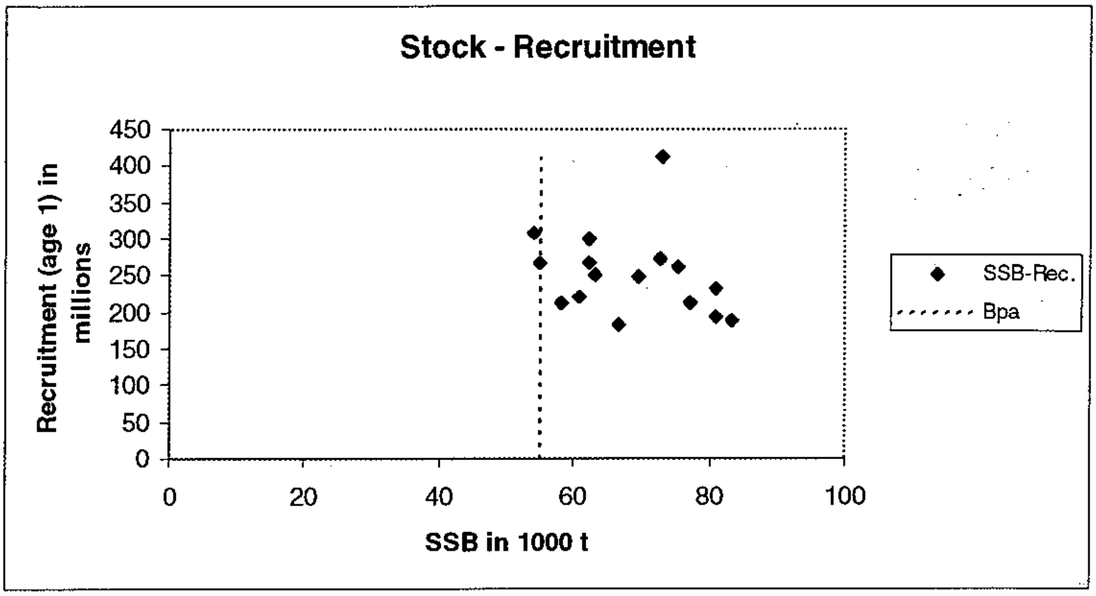
[1]Includes *L. boscii.* [2]Landings assuming current discarding practise. Weights in '000 t.

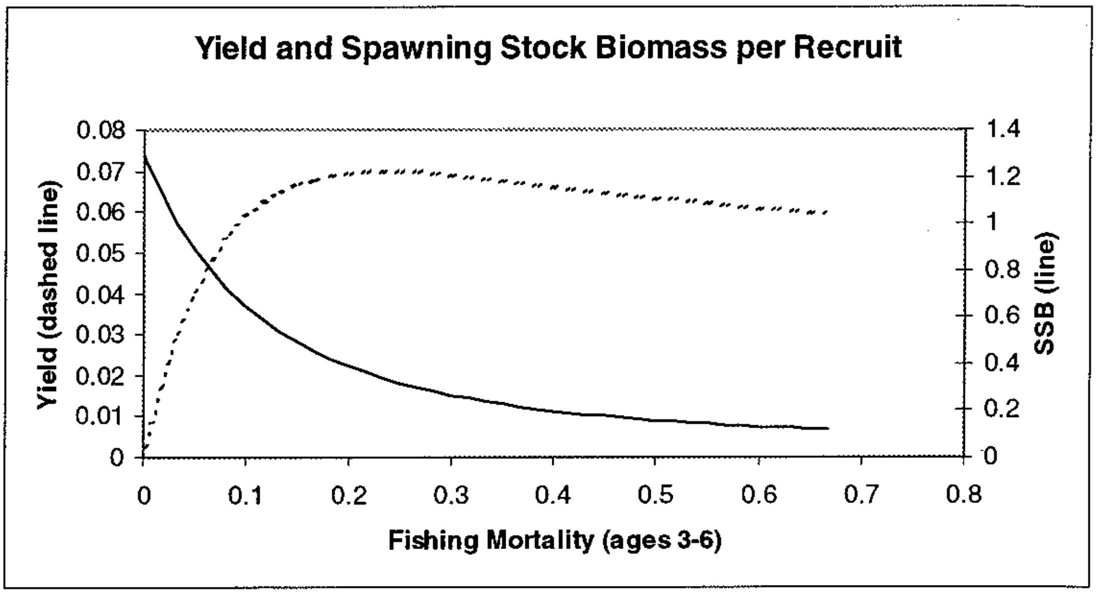

Landings
Landings in 1000 t
25
20
15
10
5
0
1984
1986
1988
1990
1992
1994
1996
1998
2000


Fishing Mortality
F(ages 3-6)
0.5
0.4
0.3
0.2
0.1
0.0
1984
1986
1988
1990
1992
1994
1996
1998
2000
F
Flim
Fpa


Recruitment (age 1)
Recruitment in millions
500
400
300
200
100
0
1984
1986
1988
1990
1992
1994
1996
1998
2000


Spawning Stock Biomass
SSB in 1000 t
100
80
60
40
20
0
1984
1986
1988
1990
1992
1994
1996
1998
2000
SSB
Bpa


Stock - Recruitment
Recruitment (age 1) in millions
450
400
350
300
250
200
150
100
50
0
0
20
40
60
80
100
SSB in 1000 t
SSB-Rec.
Bpa


Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
1.4
1.2
1
0.8
0.6
0.4
0.2
0
SSB (line)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
Fishing Mortality (ages 3-6)

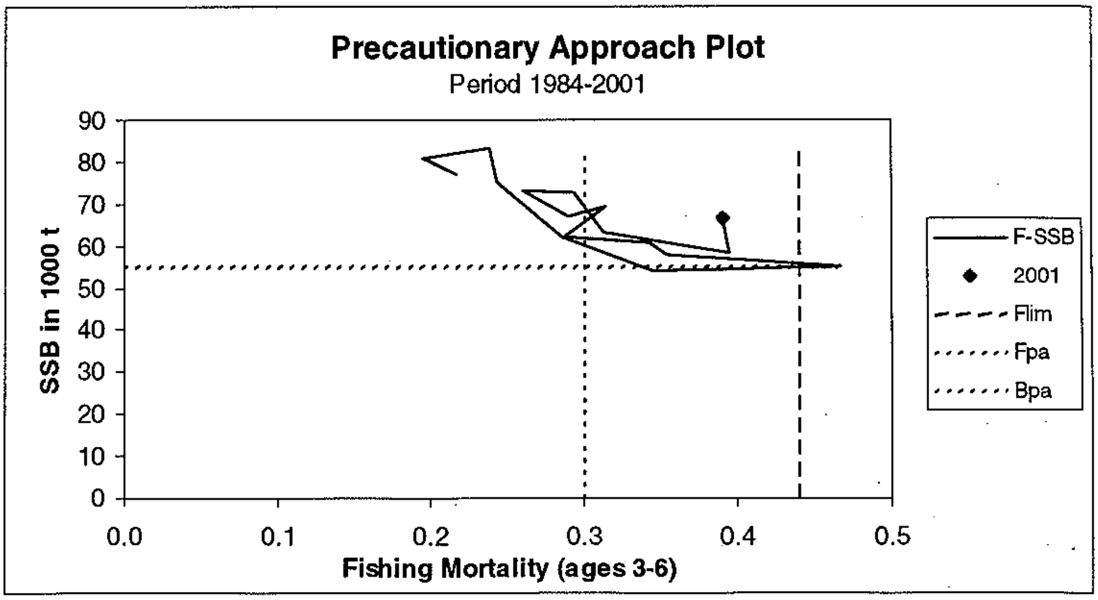

Precautionary Approach Plot
Period 1984-2001
SSB in 1000 t
90
80
70
60
50
40
30
20
10
0
0.0
0.1
0.2
0.3
0.4
0.5
Fishing Mortality (ages 3-6)
F-SSB
2001
Flim
Fpa
Bpa

Table 3.9.11.1 Megrim (*L. whiffiagonis*) in Divisions VIIb-c, e-k and VIIIa,b,d. Nominal landings and catches (t) provided by the Working Group.

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Total landings	17865	18927	17114	17577	19233	14371	15094	15600	14929	13685
Total discards	1732	2321	1705	1725	2582	3284	3282	2988	3108	2700
Total catches	19597	21248	18819	19302	21815	17655	18376	18588	18037	16385
Agreed TAC [1]			16460	18100	18100	18100	18100	18100	21460	20330

	1995	1996	1997	1998	1999	2000
Total landings	15862	15109	14254	14345	13714	14485
Total discards	3206	3026	3066	5371	3135	2265
Total catches	19068	18135	17320	19716	16850	16750
Agreed TAC [1]	22590	21200	25000	25000	25000	20000

[1] For both Megrim species and VIIa included.

Table 3.9.11.2 Megrim (*Whiffiagonis*) in Sub-area VII and Divisions VIIIa,b,d.

Year	Recruitment Age 1 thousands	SSB tonnes	Catches tonnes	Mean F Ages 3-6
1984	237000	80900	18800	0.196
1985	231000	77300	19600	0.217
1986	213000	81100	21200	0.195
1987	195000	83400	18800	0.239
1988	188000	75300	19300	0.243
1989	261000	62400	21800	0.286
1990	301000	54100	17700	0.345
1991	309000	54900	18400	0.467
1992	266000	58100	18600	0.354
1993	212000	60700	18000	0.343
1994	222000	62200	16400	0.287
1995	266000	69600	19100	0.315
1996	249000	66800	18100	0.290
1997	184000	73200	17300	0.260
1998	411000	72800	19700	0.294
1999	274000	63200	16900	0.313
2000	251000	58500	16800	0.394
2001	251000	66700		0.390
Average	251167	67844	18618	0.302

3.9.12 Anglerfish in Divisions VIIb–k and VIIIa,b (*L. piscatorius* and *L. budegassa*)

State of stocks/exploitation: The stock of *L. piscatorius* is outside safe biological limits, and the stock of *L. budegassa* is inside safe biological limit. The SSB of both stocks decreased from 1986 until 1993, then increased up to 1995-1996 and are presently decreasing. For both stocks, fishing mortality in most years has been above $\mathbf{F}_{pa}$. In 2000 fishing mortality is estimated to be about $\mathbf{F}_{pa}$. Recent recruitments of *L. piscatorius* (1998 and 1999 year classes) are well above average, while those of *L. budegassa* have decreased steadily in 1993-1998, and remained low in 1999-2000.

Management objectives: There are no explicit management objectives for this stock. However, for any management objectives to meet precautionary criteria, their aim should be to reduce or maintain F below $\mathbf{F}_{pa}$, and to increase or maintain spawning stock biomass above $\mathbf{B}_{pa}$.

Precautionary Approach reference points (changed in 2000):

L. piscatorius:

ICES considers that:	ICES proposes that:
$\mathbf{B}_{lim}$ is not defined	$\mathbf{B}_{pa}$ be set at 31 000 t. There is no evidence of reduced recruitment at the lowest biomass observed and $\mathbf{B}_{pa}$ can therefore be set equal to the lowest observed SSB.
$\mathbf{F}_{lim}$ is 0.33, the fishing mortality estimated to lead to potential stock collapse.	$\mathbf{F}_{pa}$ be set at 0.24. This F is considered to have a high probability of avoiding $\mathbf{F}_{lim}$, taking into account the uncertainty in assessments.

Technical basis:

$\mathbf{B}_{lim}$: Not defined	$\mathbf{B}_{pa}$: $\mathbf{B}_{loss}$
$\mathbf{F}_{lim}$:$\mathbf{F}_{loss}$	$\mathbf{F}_{pa}$: $\mathbf{F}_{lim}$ x 0.72

L. budegassa:

ICES considers that:	ICES proposes that:
$\mathbf{B}_{lim}$ is not defined.	$\mathbf{B}_{pa}$ be set at 16 600 t. There is no evidence of reduced recruitment at the lowest biomass observed and $\mathbf{B}_{pa}$ can therefore be set equal to the lowest observed SSB.
$\mathbf{F}_{lim}$ is not defined.	$\mathbf{F}_{pa}$ be set at $\mathbf{F}_{med}$ = 0.23. This F is consistent with the proposed $\mathbf{B}_{pa}$.

Technical basis:

$\mathbf{B}_{lim}$= Not defined	$\mathbf{B}_{pa}$= $\mathbf{B}_{loss}$
$\mathbf{F}_{lim}$= Not defined	$\mathbf{F}_{pa}$= see above.

Advice on management: ICES recommends that F should be kept below $\mathbf{F}_{pa}$. This corresponds to landings of less than 19 900 t in 2002 for both species combined (14 300 t *L. piscatorius*, and 5 600 t *L. budegassa*). For *L. piscatorius*, this will allow SSB to rebuild above $\mathbf{B}_{pa}$ in the short-term.

Comparison with previous assessment and advice: This assessment is quite different from the assessment performed in 2000 (using the 1999 data set). For *L. piscatorius* the inclusion of new survey and data from 1999-2000 resulted in a big upwards revision in F and downwards revision in SSB estimates for the most recent 5 years. In the case of assessment for *L. budegassa* no major changes have occurred. The recruitment estimates in the most recent years have changed substantially for both species. The status of *L. piscatorius* has been revised compared to last year.

Relevant factors to be considered in management: *L. piscatorius* and *L. budegassa* are both caught on the same grounds by the same fleets, and are usually not separated by species in landings; therefore, management measures for both species must be considered together and in conjunction with other species caught in these fisheries (sole, cod, rays, megrim, and hake). The management area for this stock also includes Division VIIa, where catches in recent years have been between 500 and 1 300 t.

The fishery may become heavily dependant on two strong year classes (*L. piscatorius* 1998-1999) entering in the fishery. In order to protect juveniles of these year-classes the use of selective devices, such as rigid grids, should be promoted.

Catch forecast for 2002:

Basis: *L. piscatorius*: F_{2001} = F(98-00) = 0.29; Landings(2001) = 16.3; SSB(2002) = 28.3.

Basis: *L. budegassa*: F_{2001} = F(98-00) = 0.24; Landings(2001) = 7.2; SSB(2002) = 20.1.

L. piscatorius				*L. budegassa*			
F(2002)	Basis	Landings(2002)	SSB(2003)	F(2002)	Basis	Landings(2002)	SSB(2003)
0.18	0.6$\mathbf{F}_{sq}$	11.1	33.9	0.15	0.6$\mathbf{F}_{sq}$	4.3	21.4
0.21	0.7$\mathbf{F}_{sq}$	12.7	32.6	0.17	0.7$\mathbf{F}_{sq}$	5.0	20.8
0.24	0.8$\mathbf{F}_{sq}$= $\mathbf{F}_{pa}$	14.3	31.3	0.19	0.8$\mathbf{F}_{sq}$	5.6	20.3
0.26	0.9$\mathbf{F}_{sq}$	15.8	30.1	0.22	0.9$\mathbf{F}_{sq}$	6.3	19.7
0.28	0.95$\mathbf{F}_{sq}$	16.5	29.5	0.23	0.95$\mathbf{F}_{sq}$ = $\mathbf{F}_{pa}$	6.6	19.4
0.29	$\mathbf{F}_{sq}$	17.2	28.9	0.24	$\mathbf{F}_{sq}$	6.9	19.2
0.32	1.1$\mathbf{F}_{sq}$	18.6	27.8	0.27	1.1$\mathbf{F}_{sq}$	7.5	18.7

Weights in '000 t.

Shaded scenarios considered inconsistent with the precautionary approach.

Medium- and long-term projections: Assuming the current selection pattern, $\mathbf{F}_{max}$ is 0.32 and 0.58 $\mathbf{F}_{sq}$ for *L. piscatorius* and *L. budegassa* respectively.

Elaboration and special comment: Anglerfish landings from the west of the British Isles and down to the northern Bay of Biscay comprise two species - *L. piscatorius* and *L. budegassa*. *L. piscatorius* has a wide distribution in waters from the south-western Barents Sea to the Atlantic coast of Spain, whereas *L. budegassa* has a more southerly distribution, ranging from the British Isles in the north to Senegal in the south. Large specimens of both species are found in deep waters. Juvenile anglerfish have been caught both in deep water and along the shoreline, and discrete nursery areas have not been identified.

Anglerfish are an important component of mixed fisheries taking hake, megrim, sole, cod, plaice, and *Nephrops*. A trawl fishery by Spanish and French vessels developed in the Celtic Sea and Bay of Biscay in the 1970s, and overall annual landings may have attained 35–40 000 t by the early 1980s. Even though fishing effort increased until 1990, landings decreased between 1986 and 1993, but returned to the original level 10 years ago, when France and Spain together reported more than 75% of the total landings of both species combined. The remainder is taken by the UK and Ireland (around 10% each) and Belgium (less than 5%). Otter-trawls (the main gear used by French, Spanish and Irish vessels) currently take about 80% of the total landings of *L. piscatorius*, while around 60% of UK landings are by beam trawlers and gill netters. Over 95% of total international landings of *L. budegassa* are taken by otter trawlers. There has been an expansion of the French gill net fishery in the last decade in the Celtic Sea and in the north of the Bay of Biscay, mainly by vessels based in Spain and fishing in medium to deep waters. Otter-trawling in medium and deep water in ICES Sub-area VII appears to have declined, even though the increasing use of twin trawls by French vessels may have increased significantly the overall efficiency of the French fleet. Fishing activity by UK gill netters and beam trawlers has remained relatively stable over the period 1986–1995. Belgium landings of anglerfish are exclusively by beam trawlers.

The analytical age-based assessment is based on landings, survey and commercial CPUE data. The catch-at-age matrix covers ages to 13+ for *L. piscatorius* and to 14+ for *L. budegassa*. Short-term predictions of landings and SSB are not sensitive to recent assumed recruitment.

Source of information: Report of the Working Group on the Assessment of Southern Shelf Demersal Stocks, September 2001 (ICES CM 2002/ACFM:05).

Anglerfish (*Piscatorius*)

Yield and spawning biomass per Recruit F-reference points:

	Fish Mort Ages 3-8	Yield/R	SSB/R
Average Current	0.295	1.034	2.060
$\mathbf{F}_{max}$	0.094	1.369	8.216
$\mathbf{F}_{0.1}$	0.055	1.276	12.420
$\mathbf{F}_{med}$	0.279	1.058	2.238

Anglerfish (*Budegassa*)

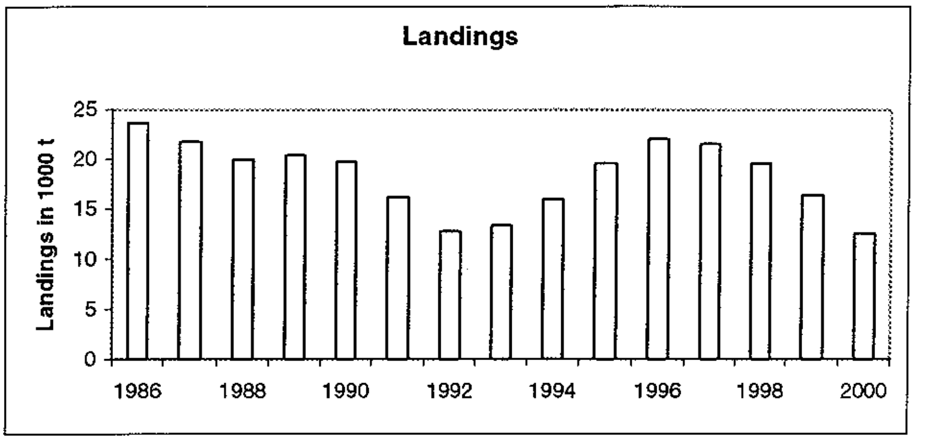
Yield and spawning biomass per Recruit F-reference points:

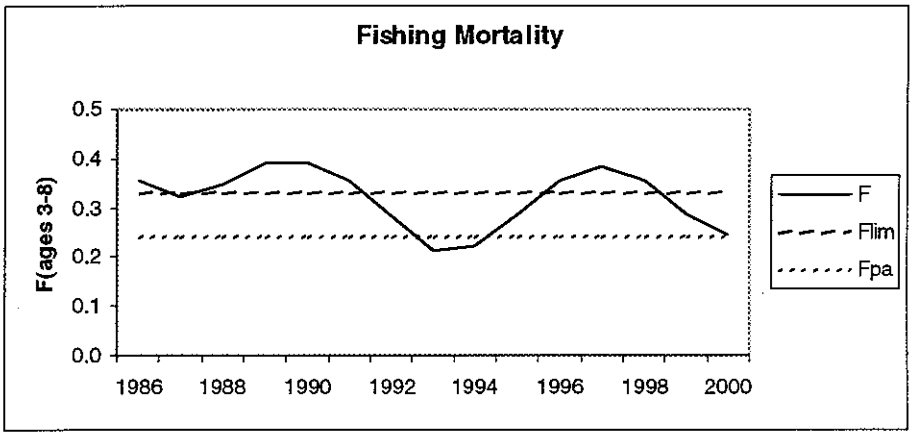
	Fish Mort Ages 6-10	Yield/R	SSB/R
Average Current	0.243	0.471	1.303
$\mathbf{F}_{max}$	0.140	0.507	2.569
$\mathbf{F}_{0.1}$	0.085	0.475	4.065
$\mathbf{F}_{med}$	0.223	0.480	1.461

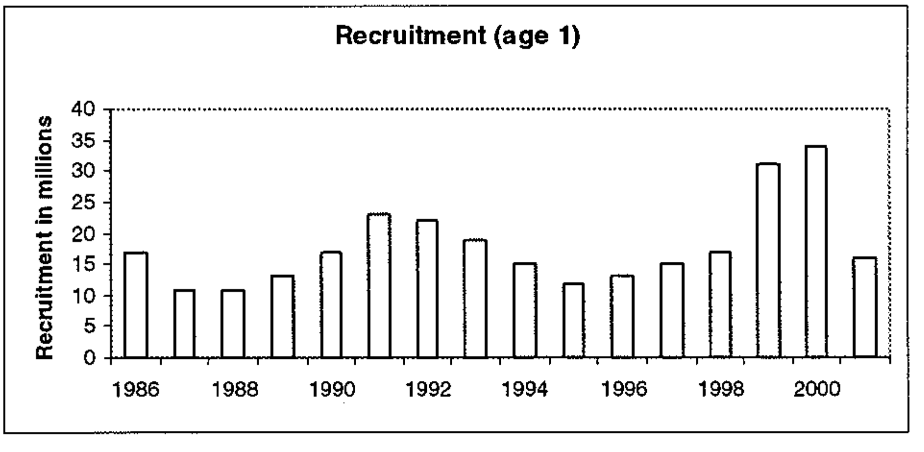
Catch data (Tables 3.9.12.1-5):

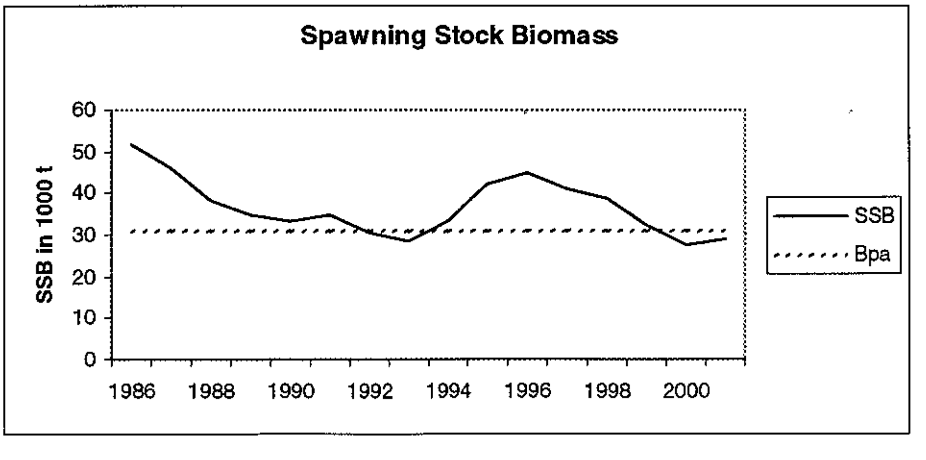
Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC[1]	ACFM Landings	Landings of *L. piscat.*	Landings of *L. budeg.*
1987	Not assessed	-	39.08	29.5	21.9	7.6
1988	Not assessed	-	42.99	28.5	20.1	8.4
1989	Not assessed	-	42.99	30.0	20.5	9.5
1990	Not assessed	-	42.99	29.4	19.8	9.6
1991	No advice	-	42.99	25.1	16.2	8.8
1992	No advice	-	42.99	21.1	12.8	8.3
1993	Concern about *L. pisc.* SSB decrease	-	25.1	20.1	13.5	6.7
1994	SSB decreasing, still inside safe biological limits	-	23.9	21.9	16.1	5.8
1995	No increase in F	20.0	23.2	26.8	19.7	7.1
1996	No increase in F	30.3	30.4	30.2	22.1	8.1
1997	No increase in F	34.3	34.3	29.8	21.7	8.1
1998	No increase in F	33.0	34.3	28.2	19.6	8.6
1999	No increase in F	32.9	34.3	24.8[3]	16.5[3]	8.3[3]
2000	At least 20% decrease in F	< 22.3	29.6	19.8	12.6	7.2
2001	Reduce F below $\mathbf{F}_{pa}$	< 27.6	27.6			
2002	Reduce F below $\mathbf{F}_{pa}$	< 19.9				

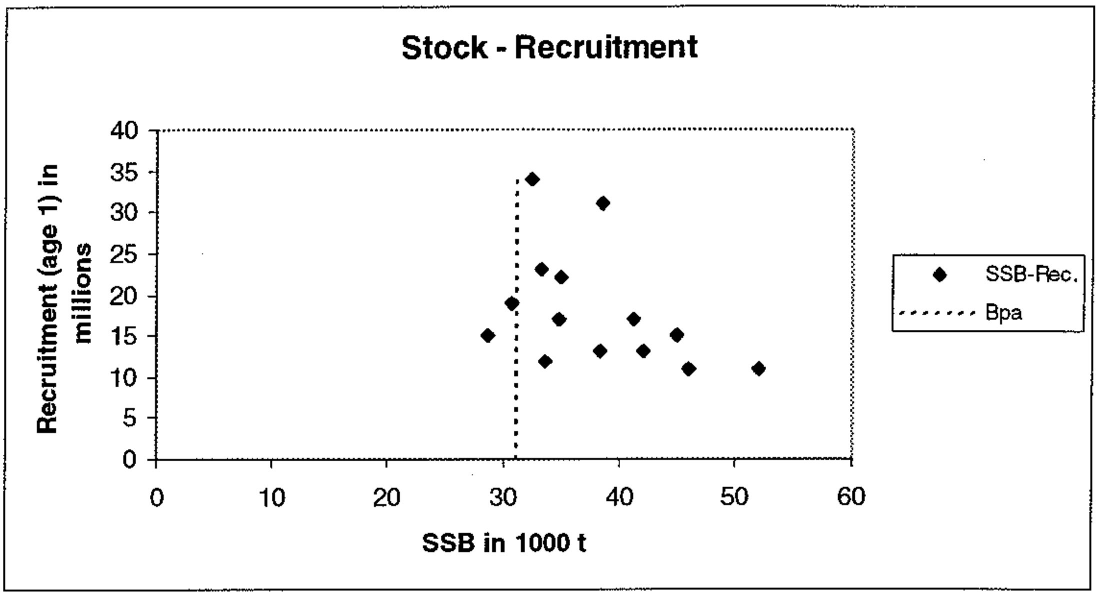
[1]Includes Division VIIa and Divisions VIIId,e; applies to both species. [3]Revised. Weights in '000 t.


Landings
Landings in 1000 t
25
20
15
10
5
0
1986
1988
1990
1992
1994
1996
1998
2000

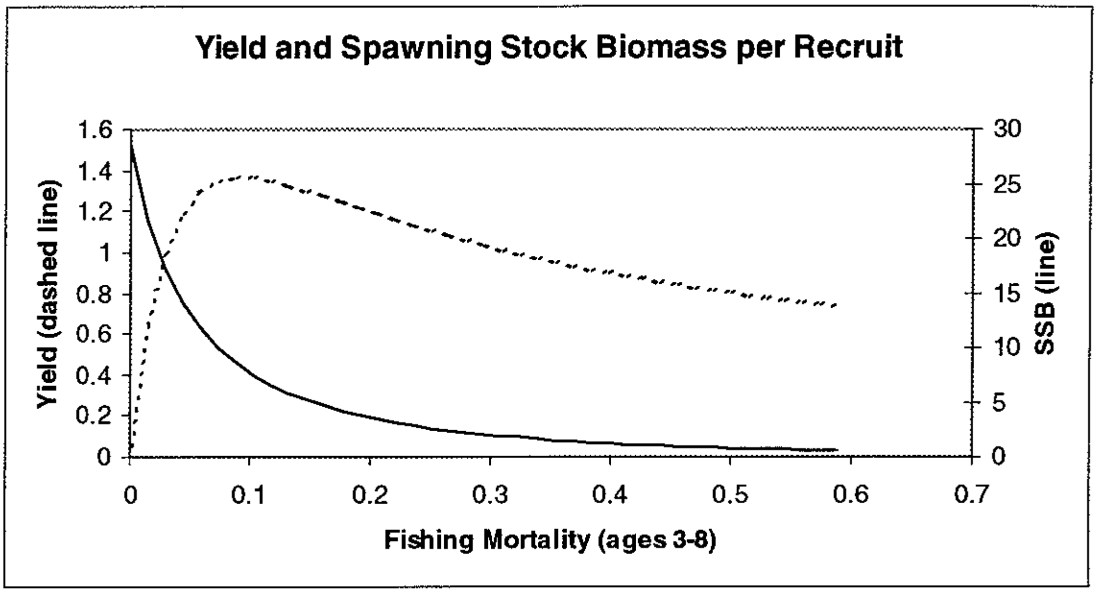

Fishing Mortality
F(ages 3-8)
0.5
0.4
0.3
0.2
0.1
0.0
1986
1988
1990
1992
1994
1996
1998
2000
F
Flim
Fpa


Recruitment (age 1)
Recruitment in millions
40
35
30
25
20
15
10
5
0
1986
1988
1990
1992
1994
1996
1998
2000

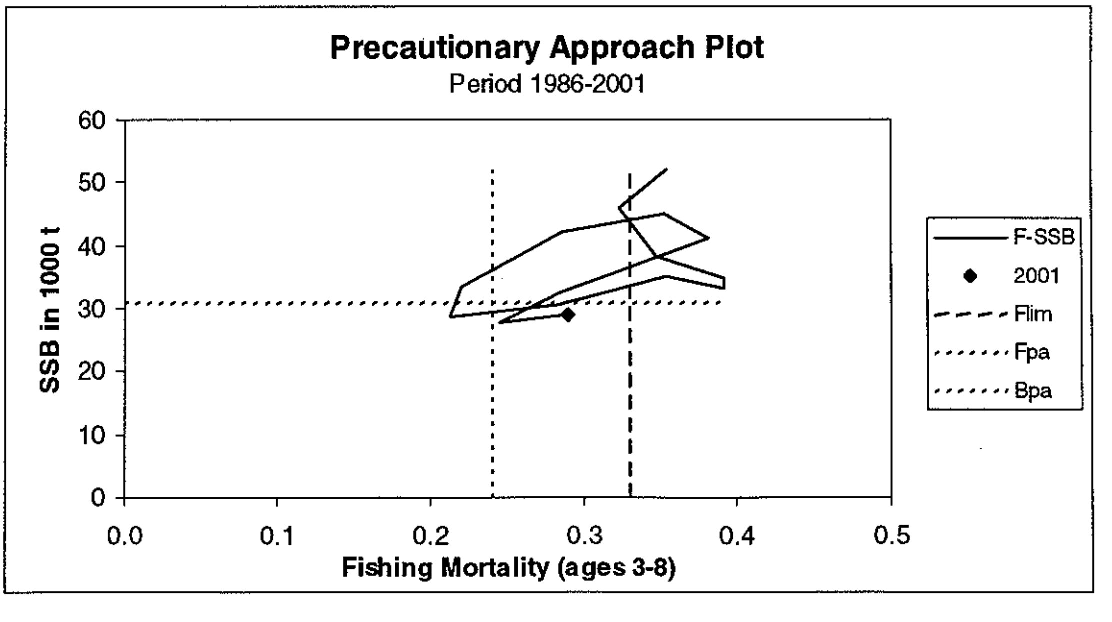

Spawning Stock Biomass
SSB in 1000 t
60
50
40
30
20
10
0
1986
1988
1990
1992
1994
1996
1998
2000
SSB
Bpa



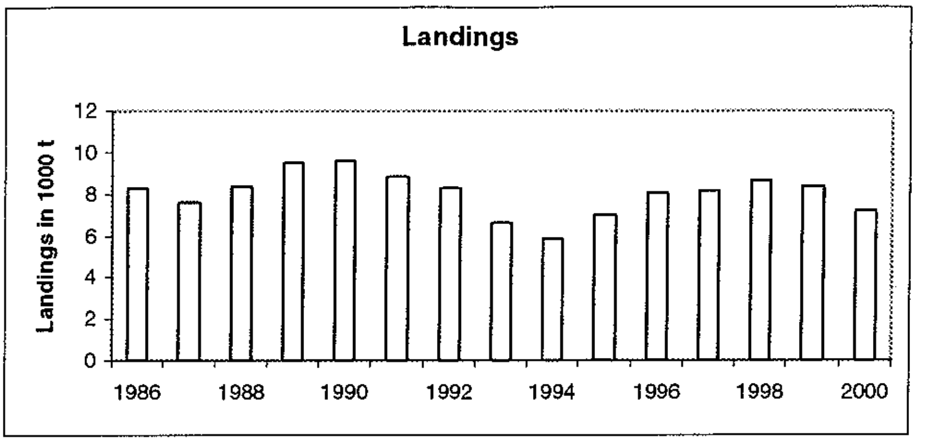
Stock - Recruitment
Recruitment (age 1) in millions
SSB in 1000 t
SSB-Rec.
Bpa

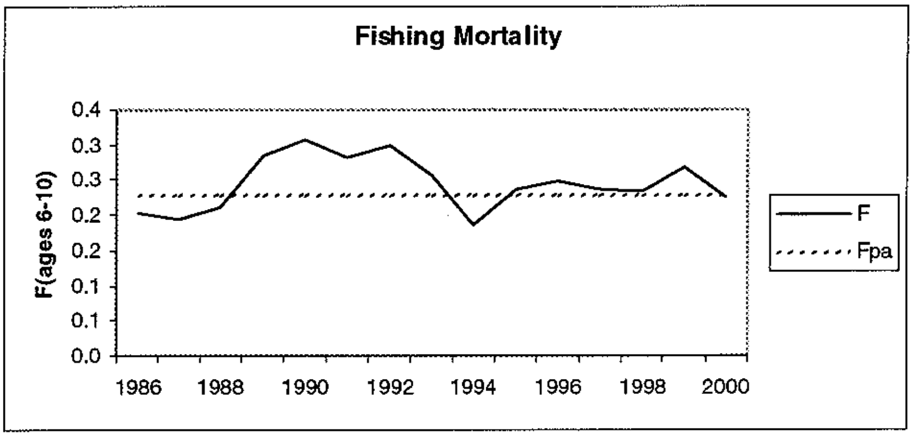


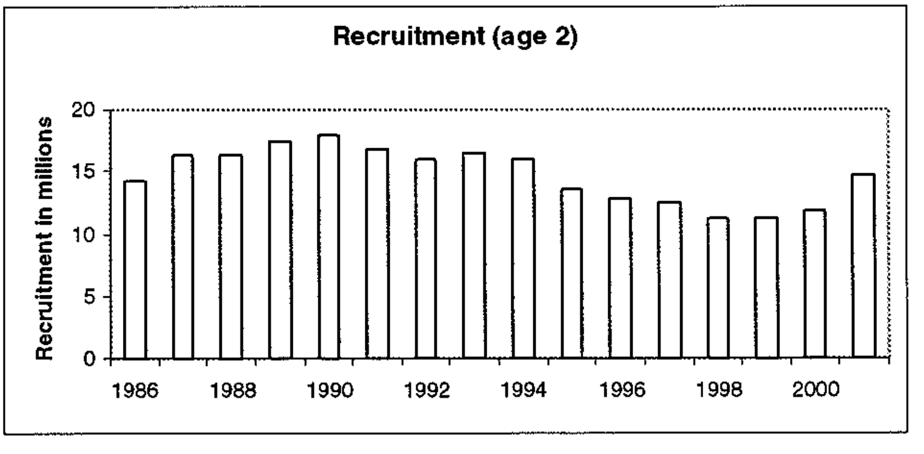
Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
SSB (line)
Fishing Mortality (ages 3-8)

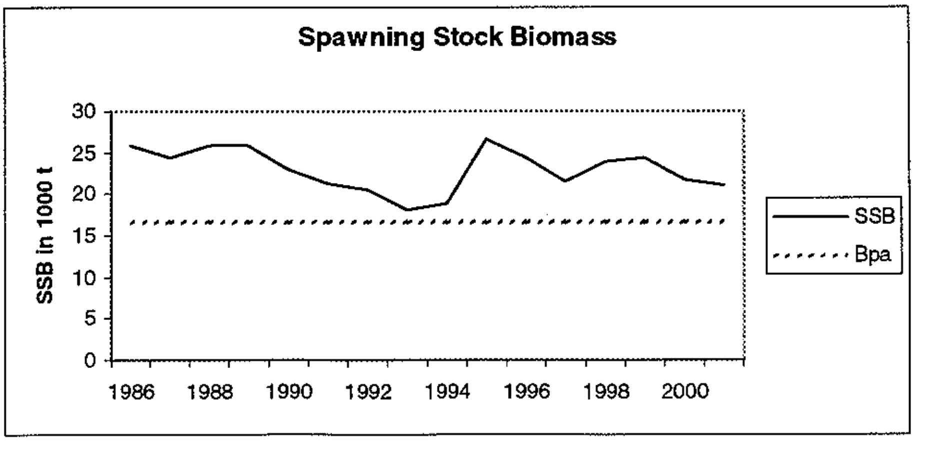


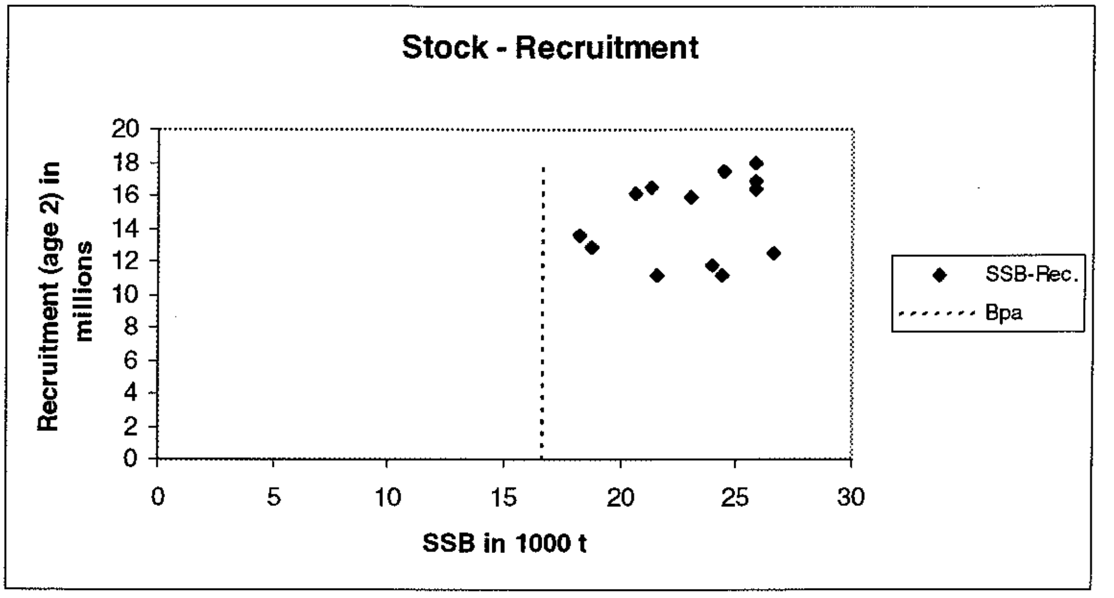
Precautionary Approach Plot
Period 1986-2001
SSB in 1000 t
Fishing Mortality (ages 3-8)
F-SSB
2001
Flim
Fpa
Bpa

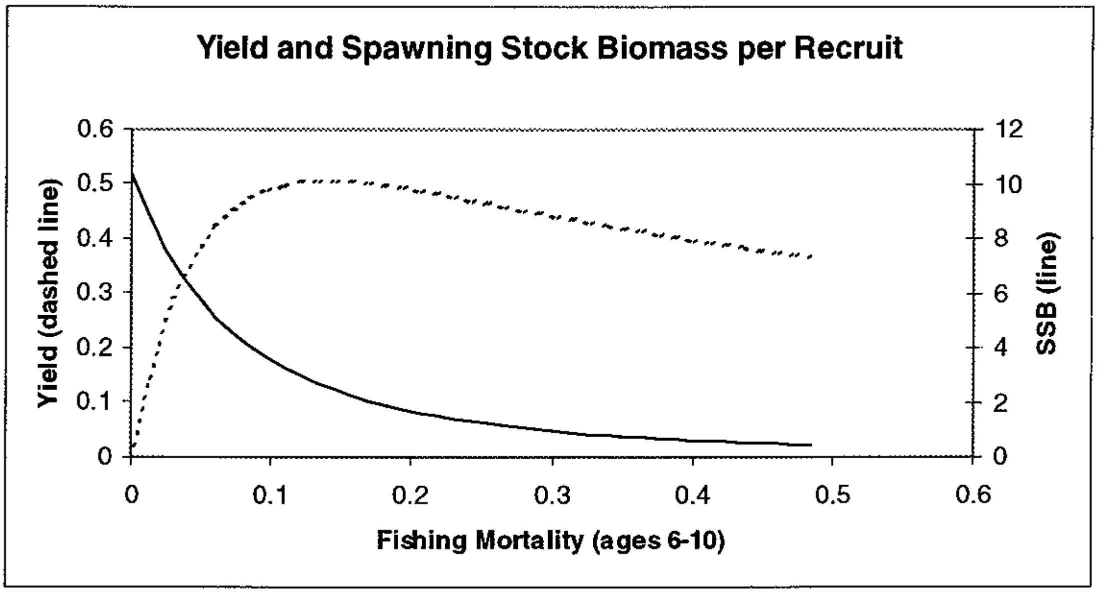

Landings
Landings in 1000 t
12
10
8
6
4
2
0
1986
1988
1990
1992
1994
1996
1998
2000


Fishing Mortality
F(ages 6-10)
0.4
0.3
0.3
0.2
0.2
0.1
0.1
0.0
1986
1988
1990
1992
1994
1996
1998
2000
F
Fpa


Recruitment (age 2)
Recruitment in millions
20
15
10
5
0
1986
1988
1990
1992
1994
1996
1998
2000


Spawning Stock Biomass
SSB in 1000 t
30
25
20
15
10
5
0
1986
1988
1990
1992
1994
1996
1998
2000
SSB
Bpa


Stock - Recruitment
Recruitment (age 2) in millions
SSB in 1000 t
SSB-Rec.
Bpa
0
2
4
6
8
10
12
14
16
18
20
0
5
10
15
20
25
30


Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
SSB (line)
Fishing Mortality (ages 6-10)
0
0.1
0.2
0.3
0.4
0.5
0.6
0
2
4
6
8
10
12

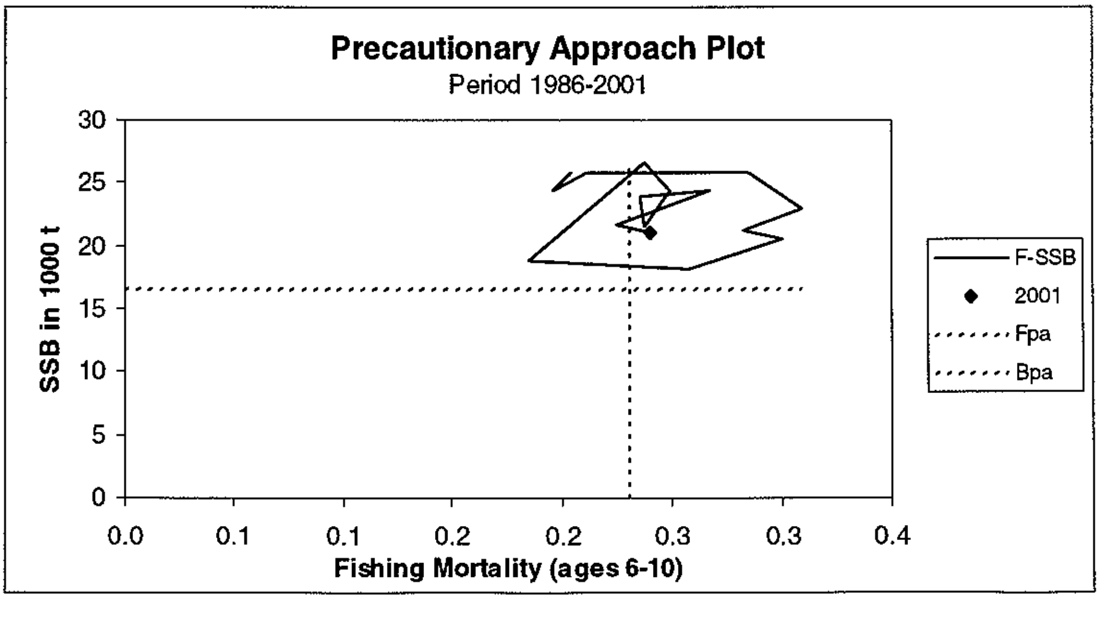

Precautionary Approach Plot
Period 1986-2001
SSB in 1000 t
Fishing Mortality (ages 6-10)
F-SSB
2001
Fpa
Bpa
0
5
10
15
20
25
30
0.0
0.1
0.1
0.2
0.2
0.3
0.3
0.4

Table 3.9.12.1 Landings (t) of both species of Anglerfish in Divisions VIIb-k and VIIIa,b,d. Working Group estimates.

Year	VIIb-k	VIIIa,b,d	Total
1977[1]			19895
1978[1]			23445
1979[1]			29738
1980[1]			38880
1981[1]			39450
1982[1]			35285
1983[1]			38280
1984[1]	28847	7909	36756
1985[1]	28491	7161	35652
1986	25987	5897	31883
1987	22295	7233	29528
1988	22494	5983	28477
1989	24731	5276	30007
1990	23434	5950	29384
1991	20385	4684	25069
1992	17554	3530	21084
1993	16633	3507	20140
1994	18093	3841	21934
1995	21922	4862	26784
1996	24132	6102	30233
1997	23928	5846	29774
1998	23295	4876	28171
1999*	20582	4266	24848
2000*	16217	3541	19758

*Preliminary.
[1] Revised.

Table 3.9.12.2 Landings (t) of *L. piscatorius* in Divisions VIIb-k and VIIIa,b,d. Working Group estimates.

Year	VIIb-k	VIIIa,b,d	Total
1984[1]	23056	5416	28472
1985[1]	23193	4568	27761
1986	19544	4122	23666
1987	17180	4729	21909
1988	16147	3948	20095
1989	17584	2889	20474
1990	16374	3379	19753
1991	14071	2158	16229
1992	11456	1362	12818
1993	11894	1587	13481
1994	14075	2045	16120
1995	16618	3113	19730
1996	18153	3988	22141
1997	17743	3917	21660
1998	16786	2787	19572
1999*	14552	1964	16516
2000*	11082	1476	12558

*Preliminary.
[1] Revised

Table 3.9.12.3 Landings (t) of *L. budegassa* in Divisions VIIb-k and VIIIa,b,d. Working group estimates.

Year	VIIb-k	VIIIa,b,d	Total
1984[1]	5791	2493	8284
1985[1]	5298	2593	7891
1986	6443	1775	8217
1987	5115	2504	7619
1988	6347	2035	8382
1989	7146	2387	9533
1990	7061	2571	9632
1991	6314	2526	8840
1992	6098	2168	8266
1993	4739	1919	6659
1994	4018	1796	5814
1995	5304	1749	7053
1996	5978	2114	8092
1997	6185	1929	8114
1998	6510	2089	8599
1999*	6030	2302	8332
2000*	5135	2065	7200

*Preliminary.
[1] Revised.

Table 3.9.12.4 Anglerfish (*Piscatorius*) in Divisions VIIb-k and VIIIa,b.

Year	Recruitment Age 1 thousands	SSB tonnes	Landings tonnes	Mean F Ages 3-8
1986	17000	52000	23700	0.354
1987	11000	46000	21900	0.323
1988	11000	38400	20100	0.348
1989	13000	34800	20500	0.392
1990	17000	33200	19800	0.392
1991	23000	35000	16200	0.354
1992	22000	30700	12800	0.283
1993	19000	28700	13500	0.213
1994	15000	33500	16100	0.220
1995	12000	42100	19700	0.286
1996	13000	45000	22100	0.353
1997	15000	41300	21700	0.382
1998	17000	38600	19600	0.353
1999	31000	32400	16500	0.285
2000	34000	27700	12600	0.245
2001	16000	29000		0.290
Average	17875	36775	18453	0.317

Table 3.9.12.5 Anglerfish (*Budegassa*) in Divisions VIIb-k and VIIIa,b.

Year	Recruitment Age 2 thousands	SSB tonnes	Landings tonnes	Mean F Ages 6-10
1986	14162	25822	8217	0.204
1987	16306	24478	7619	0.196
1988	16353	25795	8382	0.211
1989	17424	25800	9533	0.285
1990	17979	23021	9632	0.309
1991	16809	21283	8840	0.282
1992	15930	20611	8266	0.300
1993	16497	18250	6659	0.258
1994	16077	18790	5814	0.185
1995	13630	26596	7053	0.237
1996	12858	24366	8092	0.249
1997	12449	21597	8114	0.237
1998	11130	23913	8599	0.235
1999	11137	24374	8331	0.267
2000	11799	21669	7200	0.225
2001	14779	21028		0.240
Average	14707	22962	8023	0.245

3.10 Stocks in Divisions VIIb,c,h–k (West of Ireland)

3.10.1 Overview

Fleet and Fisheries

The fishery in Divisions VIIb,c is mainly a trawl fishery although some gill netting is carried out. The fishery in Divisions VIIh–k is also a trawl fishery but gill netting is increasing in importance in the area. These are mixed fisheries for cod, haddock, whiting, hake, monk, megrim, sole and plaice; and cod and whiting are taken as by-catch in the *Nephrops* fishery. In recent years, there has been an increase in the number of seiners operating in the Irish fleet in Division VIIg,j, targeting whiting and haddock .

Landing figures for these ICES Divisions are difficult to interpret as several countries differ in the manner in which they report their landings data for the various ICES Divisions.

Other species taken in the area are herring, mackerel and blue whiting (See Sections 3.9.9, 3.10.3, 3.12.3 and 3.12.5).

Management Measures

There are single cod and whiting TACs covering the whole of Divisions VIIb–k so that assessment areas do not correspond to management areas. In 1997, the assessment areas for Celtic Sea cod and whiting were extended to include Divisions VIIj,k. The assessment areas now cover Divisions VIIe-k. There are separate plaice and sole TAC's for Division VIIbc and for Division VIIjk.

State of the Stocks

Since stock monitoring programmes and annual groundfish and young fish surveys have been in place since 1993, assessments were carried out in 2001 for the stocks of sole and plaice in Division VIIbc and for Division VIIjk. Given the short time series, the preliminary assessments of the state of these stocks are considered only indicative of recent stock development.

SSB of Plaice in West of Ireland has declined steadily since 1994 and being below the average since 1998. SSB in 2000 is estimated at 164 t. Fishing mortality has fluctuated, thought with an increasing trend over the time series, although it decreased in 2000. Recruitment has steadily declined, with values below the average since 1997, with exception in 2000, where recruitment is estimated higher than average, and above 1996 level.

SSB of Plaice in Southwest of Ireland has declined steadily, following a series of declining recruitment, and being below the average since 1998. SSB in 2000 is estimated at 599 t. Fishing mortality has decreased until 1996 and again in 1999, being the lowest value in the time series, thought 2000 presented the second highest value. Recruitment has steadily declined, with values below the average since 1997.

SSB of Sole in West of Ireland has been constant in recent years, being above the average only in 1994 and 1996. SSB in 2000 is estimated at 248 t. Fishing mortality decreased until 1996, increased until 1999, bur decreased again in 2000. Recruitment has steadily increased, with the exception of 1995.

SSB of Sole in Southwest of Ireland has declined steadily, since 1996. SSB in 2000 is estimated at 609 t. Fishing mortality presents an increasing trend, thought in 2000 has a strong decrease. Recruitment has been variable, with a high value in 2000.

Fish in this area may only be components of larger stock complexes. It is still not clear if these stocks should be assessed with the stocks in the Celtic Sea or with the stocks off the West of Scotland.

There is a directed fishery for hake mainly in Divisions VIIh–k and an overview of hake is provided in Section 3.12.2.

Anglerfish and megrim are important species in this area, but are assessed for Sub-areas VII and VIII combined. An overview is provided in Sections 3.9.11 and 3.9.12.

Nephrops fisheries take place in Functional units 16–19 (see Section 3.10.4 in the 1999 ACFM report). Catch per unit of effort is fluctuating without trend. There is a TAC for all of Sub-area VII. An overview of *Nephrops* stocks is provided in Section 2.4 in the 2001 ACFM report.

3.10.2 Demersal Stocks

3.10.2.a Haddock in Divisions VIIb-k

State of stock/exploitation: The state of the stock is unknown. A preliminary assessment of the state of this stock is considered only indicative of recent stock development. Recruitment seems to be highly variable. This is also reflected in the landings. There are some indications from surveys of good 1999-2000 year classes.

Management objectives: none.

Precautionary Approach reference points: not defined.

Advice on management: ICES recommends not to increase landings above the average of the last four years of 8 000 t. ICES recommends that a management plan, including monitoring of the development of the stock and of the fishery should be developed and implemented.

Relevant factors to be considered in management: This stock is presently managed by means of a TAC set for the whole of Sub-areas VII, VIII, IX and X. The TAC currently includes an additional allocation for Division VIIa. The current TAC is not restrictive on catches from Divisions VIIb-k and creates the opportunity for mis-reporting from other areas.

Elaboration and special comment: Assessment of the state of this stock is difficult due to a short time series of assessment data. Catches of haddock are recorded along the entire western seaboard of the British Isles, with concentrations off the west coast of Scotland, off the NW coast of Ireland, in the Celtic Sea, and in the western Irish Sea. The extent of mixing between these areas is not presently known. However, recent patterns of recruitment and growth differ between areas.

Some information on discards indicates that they may be substantial.

Source of information: Report of the Working Group on the Assessment of Southern Shelf Demersal Stocks, September 2001 (ICES CM 2002/ACFM:05).

Catch data (Table 3.10.2.a.1):

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC[1]	Official Landings[2]	ACFM landings
1987	Not dealt with			3.0	2.6
1988	Not dealt with			4.0	3.6
1989	Not dealt with			4.2	3.2
1990	Not dealt with			2.9	2.0
1991	Not dealt with			2.6	2.3
1992	Not dealt with			2.9	2.7
1993	Not dealt with			3.4	3.3
1994	Not dealt with			4.1	4.1
1995	Not dealt with		6	4.5	4.5
1996	Not dealt with		7[3]	6.7	6.8
1997	Not dealt with		14	10.3	10.8
1998	Not dealt with		20	7.4	7.7
1999	Not dealt with		22[5]	5.9	5.1
2000	No expansion of catches		16.6[6]	3.7	7.8
2001	No expansion of catches		12[1]		
2002	No expansion of catches	8.0			

[1]Applies to Sub-areas VII, VIII, IX and X. [2]Possible underestimates due to misreporting. [3]Increased in-year to 14 000 t. [4]Incomplete official statistics. [5]Includes separate Division VIIa allocation of 4 990 t. [6]Includes separate Division VIIa allocation of 3 400 t. Weights in 000' tonnes.

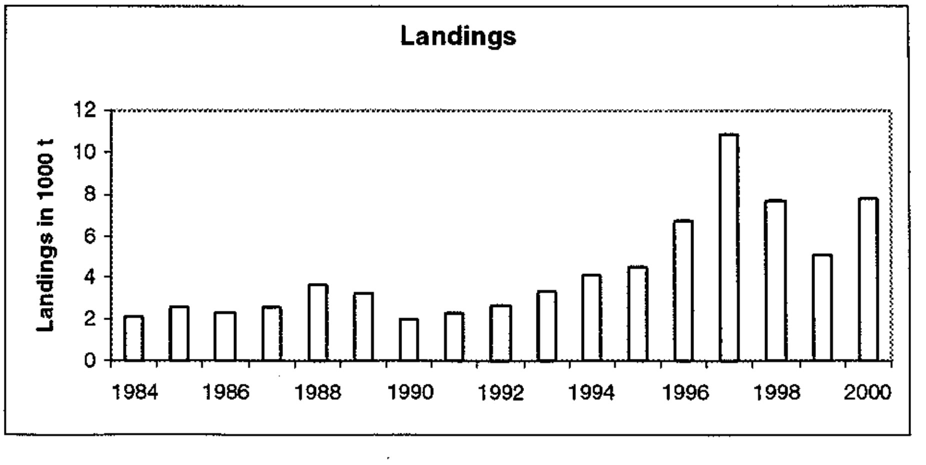
Table 3.10.2.a.1 Nominal landings (t) of Haddock in Divisions VIIb,c,e-k, 1984-2000, as officially reported to ICES.

Country	1984	1985	1986	1987	1988	1989	1990	1991
Belgium	-	4	6	12	64	117	22	18
France	3,328	2,438	2,279	2,380	3,275	3,412[a]	2,110[a]	1,247
Ireland	646	794	317	314	275	323	461	1,020
Norway	17	4	86	-	-	27	31	38
Spain	532	561	-	-	-	-	-	-
UK (Channel Islands)	-	-	-	-	-	-	-	-
UK (England & Wales)	340	168	188	194	405	278	123	137
UK (Scotland)	63	7	57	79	4	17	195	113
Total	4,926	3,976	2,933	2,979	4,023	4,174	2,942	2,573
Unallocated	-2,768	-1,383	-654	-405	-375	-940	-948	-231
Total figures used by Working Group	2,158	2,593	2,279	2,574	3,648	3,234	1,994	2,342

Country	1992	1993	1994	1995	1996	1997	1998	1999	2000
Belgium	21	51	123	189	133	246	142	51	90
France	1,461	1,839	2,788	2,964	4,527	6,581	3,674*	2,725[1]*	3,357[1]*
Ireland	1,073	1,262	908	966	1,468	2,789	2,788	2,034	n/a
Norway	26	-	17	64	38	31	49	71*	13*
Netherlands	-	-	-	-	-	-	3	-	-
Spain	-	-	-	19	48	54	260	88	n/a
UK (Channel Islands)	-	-	1	-	-	-	-	-	-
UK (England & Wales)	220	189	193	228	432	554	410	273	287
UK (Scotland)	86	67	47	38	7	15	35	5	2
Total	2,887	3,408	4,077	4,468	6,653	10,270	7,361	5,247	3,749
Unallocated	-183	-60	54	2	103	557	307	-197	4,005
Total figures used by Working Group	2,704	3,348	4,131	4,470	6,756	10,827	7,668	5,050	7,754

[*] Preliminary.
[a] Reported as total landings for Sub-areas VII & VIII.
[1] Includes the whole of area VII.
n/a = not available.

Haddock in Divisions VIIb-k



3.10.3 Herring in Divisions VIa (South) and VIIb,c

State of the stock/exploitation: The stock is considered to be outside safe biological limits. The SSB is likely to be below the proposed $\mathbf{B_{pa}}$. Fishing mortality has decreased from a very high level, but is still in excess of the $\mathbf{F_{pa}}$.

Management objectives: A local Irish management committee has been established for this stock. One of its aims is to rebuild the stock to above $\mathbf{B_{pa}}$ over a three-year period.

Precautionary Approach reference points (unchanged since 1999):

ICES considers that:	ICES proposes that:
$\mathbf{B_{lim}}$ is 81 000 t	$\mathbf{B_{pa}}$ be set at 110 000 t
$\mathbf{F_{lim}}$ is 0.33	$\mathbf{F_{pa}}$ be set at 0.22

Technical basis:

$\mathbf{B_{lim}}$: Lowest reliable estimated SSB	$\mathbf{B_{pa}}$: Approximately 1.4 $\mathbf{B_{lim}}$
$\mathbf{F_{lim}}$: $\mathbf{F_{loss}}$	$\mathbf{F_{pa}}$: = Fmed98

Advice on management: ICES recommends that the catches in 2002 should not exceed the 2001 TAC of 14 000 t.

Rebuilding plan: A management and rebuilding plan for this stock is currently in place. A continuation of this should ensure that catches do not exceed the TAC and that the stock is rebuilt to $\mathbf{B_{pa}}$ in the medium term.

Relevant factors to be considered in management: Recent changes to the management of the fisheries on this stock are likely to have greatly reduced the impact of misreporting and under-reporting of catches in this area. These changes to the reliability and composition of the catch data could have great impacts on the assessment, which is solely based on catch-at-age data. A few more years of consistent data under the current management regime will be necessary before it will be possible to produce reliable estimates of SSB and review the appropriateness of the reference points.

The management plan currently in place has led to a closure of this fishery in mid-February 2001, and it will not be re-opened until October 2001.

The high stock levels observed from 1984 to 1992 are the result of two high year classes in 1982 and 1986. No other year classes of this magnitude have been observed over the time series from 1970 to 2000.

Comparison with previous assessment and advice: Perception of the stock is more uncertain this year, particularly with respect to being below $\mathbf{B_{lim}}$. The provisional SSB was revised downwards and F revised upwards in this year's assessment.

Catch forecast for 2002: No forecast available.

Elaboration and special comments: In the absence of tuning data the assessment in recent years was carried out by assuming various terminal F values on the catch at age data. These assessments appear to have poorly estimated F and this year some exploratory work was carried out in an effort to objectively select a terminal F. Dramatic changes to the age composition of the catch since 1998 make it impossible to reliably estimate terminal F.

Total catches have decreased and are in 2001 in line with the TAC since 1998. An acoustic survey has been resumed on the stock and commercial vessels have been equipped with data loggers to obtain information on the distribution of the stocks.

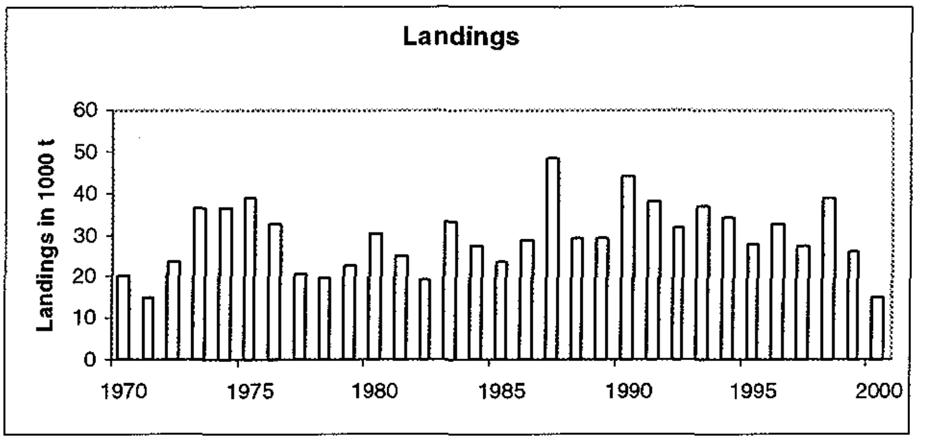
The fishery exploits a mixture of autumn- and winter/spring-spawning fish, which spawn from October to March. The winter/spring-spawning component is distributed in the northern part of the area. The main decline in the overall stock appears to have taken place on the autumn-spawning component, and this is particularly evident on the traditional spawning grounds in the southern part of the area.

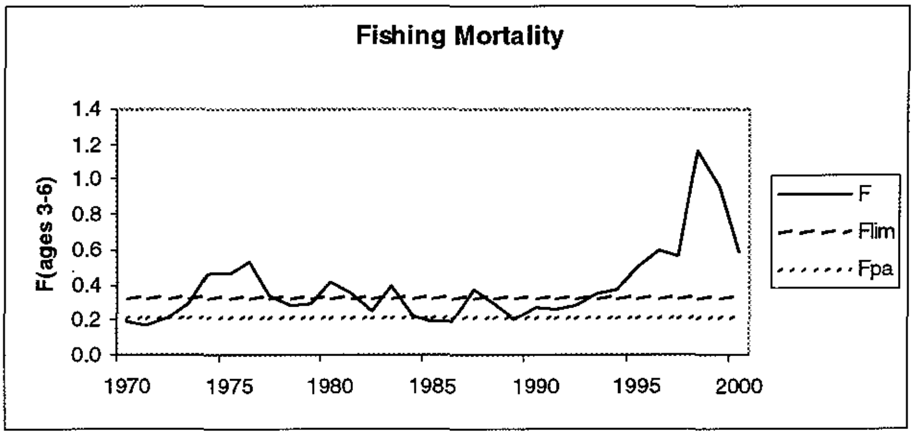
Source of information: ACFM Working Document and Report of the Herring Assessment Working Group for the Area South of 62°N, March 2001 (ICES CM 2001/ACFM:12).

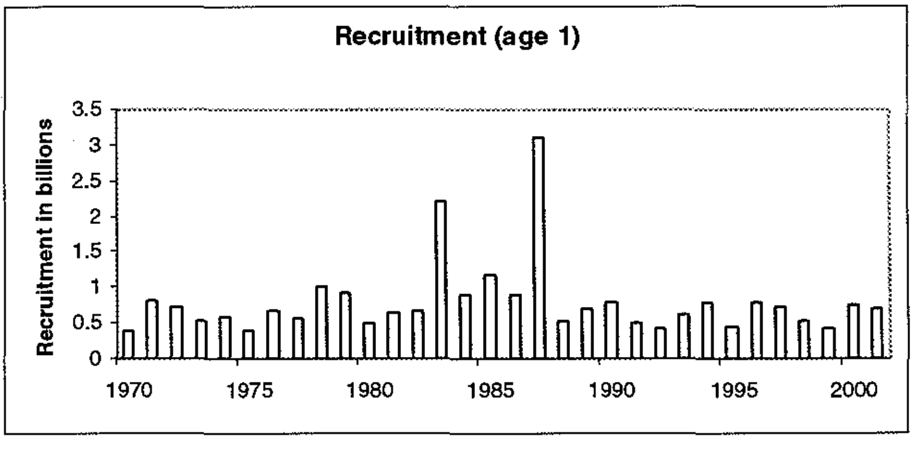
Catch data (Tables 3.10.3.1–2):

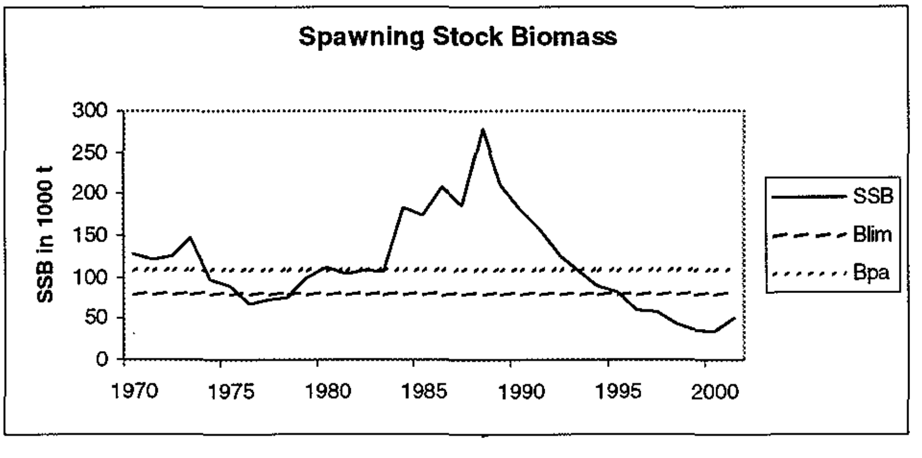
Year	ICES Advice	Predicted catch Corresp. to advice	Agreed TAC	Official Landing s	Disc slip.	ACFM Catch
1987	TAC	18	17	17	-	49
1988	TAC depending on whether 1987 TAC is taken	11–18	14	15	-	29
1989	TAC	15	20	21	1.0	29
1990	TAC depending on whether 1989 TAC is taken	25–27	27.5	28	2.5	44
1991	TAC	< 26	27.5	23	3.4	38
1992	TAC (including discards)	29	28	27	0.1	32
1993	Precautionary TAC (including discards)	29	28	30	0.3	37
1994	Precautionary TAC	28	28	27	0.7	34
1995	Precautionary TAC (including discards)	36	28	27	-	28
1996	If required, precautionary TAC	34	28	25	-	33
1997	Catches below 25	< 25	28	28	0.1	27
1998	Catches below 25	< 25	28	28	-	39
1999	F 70% of F(97)	19	21	18	-	26
2000	F 40% of F(98) =Proposed $\mathbf{F}_{pa}$	14	14	10	-	15
2001	F 40% of F(99) F = 0.2	14	14			
2002	No increase in catches	14				

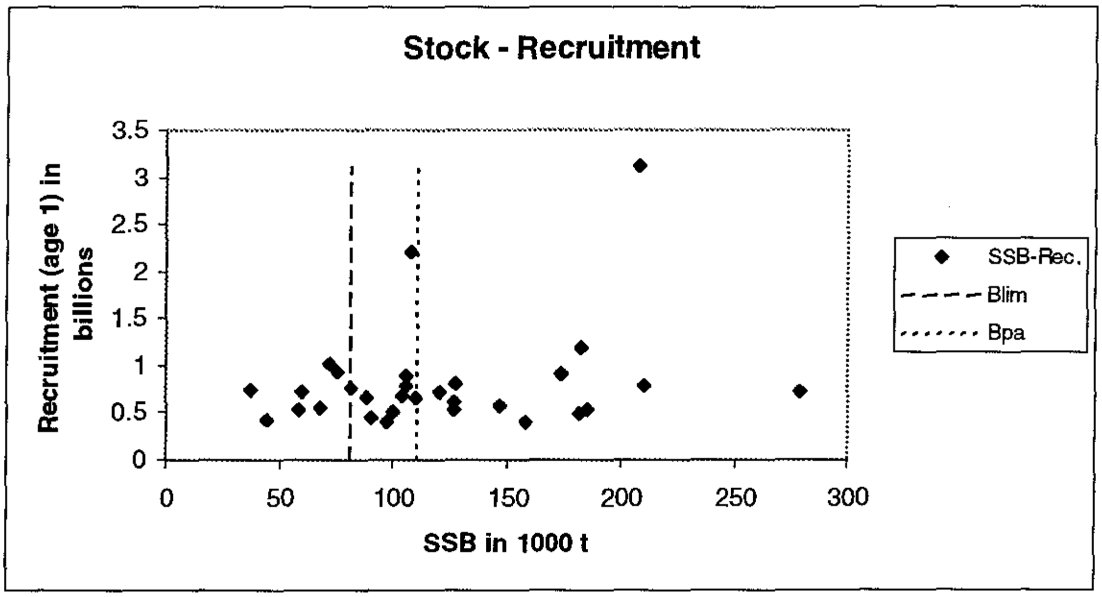
[1]Weights in '000 t.


Landings
Landings in 1000 t
60
50
40
30
20
10
0
1970
1975
1980
1985
1990
1995
2000


Fishing Mortality
F(ages 3-6)
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1970
1975
1980
1985
1990
1995
2000
F
Flim
Fpa


Recruitment (age 1)
Recruitment in billions
3.5
3
2.5
2
1.5
1
0.5
0
1970
1975
1980
1985
1990
1995
2000


Spawning Stock Biomass
SSB in 1000 t
300
250
200
150
100
50
0
1970
1975
1980
1985
1990
1995
2000
SSB
Blim
Bpa


Stock - Recruitment
Recruitment (age 1) in billions
3.5
3
2.5
2
1.5
1
0.5
0
0
50
100
150
200
250
300
SSB in 1000 t
SSB-Rec.
Blim
Bpa

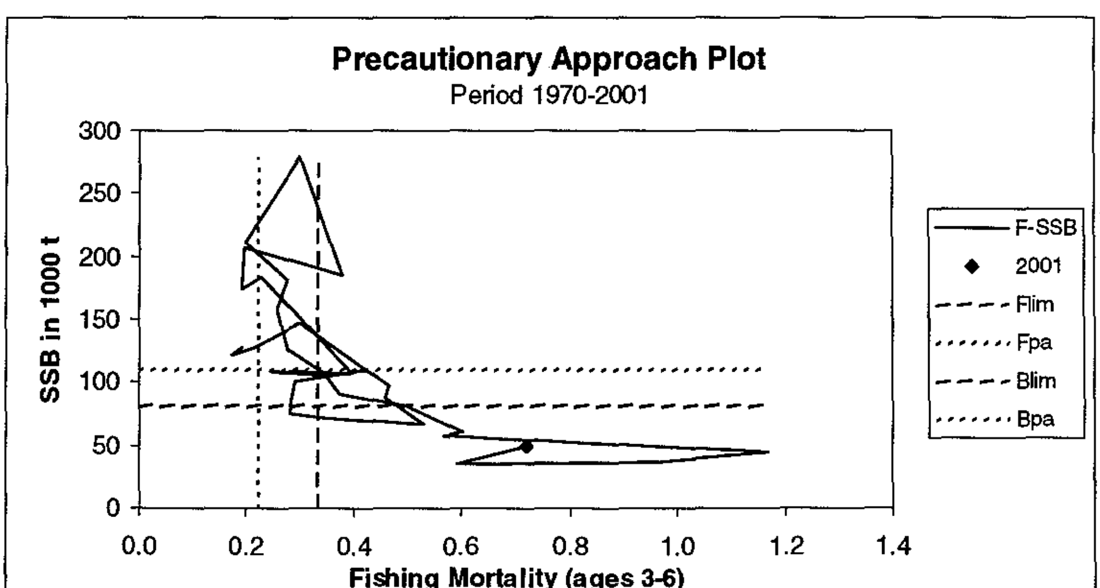

Precautionary Approach Plot
Period 1970-2001
SSB in 1000 t
300
250
200
150
100
50
0
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
Fishing Mortality (ages 3-6)
F-SSB
2001
Flim
Fpa
Blim
Bpa

Table 3.10.3.1 Estimated Herring catches in tonnes in Divisions VIa (South) and VIIb,c, 1988–2000. These figures do not in all cases correspond to the official statistics and cannot be used for management purposes.

Country	1988	1989	1990	1991	1992	1993
France	-	-	+	-	-	-
Germany, Fed.Rep.	-	-	-	-	250	-
Ireland	15,000	18,200	25,000	22,500	26,000	27,600
Netherlands	300	2,900	2,533	600	900	2,500
UK (N.Ireland)	-	-	80	-	-	-
UK (England + Wales)	-	-	-	-	-	-
UK Scotland	-	+	-	+	-	200
Unallocated	13,800	7,100	13,826	11,200	4,600	6,250
Total landings	29,100	28,200	41,439	34,300	31,750	36,550
Discards	-	1,000	2,530	3,400	100	250
Total catch	29,100	29,200	43,969	37,700	31,850	36,800

Country	1994	1995	1996	1997	1998	1999
France	-	-	-	-	-	-
Germany, Fed.Rep.	-	11	-		-	-
Ireland	24,400	25,450	23,800	24,400	25,200	16,325
Netherlands	2,500	1,207	1,800	3,400	2,500	1,868
UK (N.Ireland)	-	-	-		-	-
UK (England + Wales)	50	24	-		-	-
UK (Scotland)	-	-	-		-	-
Unallocated	6,250	1,100	6,900	-700	11,200	7,916
Total landings	33,200	27,792	32,500	27,100	38,900	26,109
Discards	700	-	-	50	-	-
Total catch	33,900	27,792	32,500	27,150	38,900	26,109

Country	2000[1]
France	
Germany	
Ireland	10,164
Netherlands	1,234
UK	
Unallocated	3,607
Total landings	15,005
Discards	-
Total catch	15,005

[1]Provisional according to text.

Table 3.10.3.2 Herring in Divisions VIa (South) and VIIb,c.

Year	Recruitment Age 1 thousands	SSB tonnes	Landings tonnes	Mean F Ages 3-6
1970	399215	128049	20306	0.1929
1971	805333	120496	15044	0.1721
1972	721419	127016	23474	0.2134
1973	521781	146713	36719	0.2980
1974	576266	97802	36589	0.4678
1975	397059	88537	38764	0.4580
1976	665481	67412	32767	0.5278
1977	560352	72360	20567	0.3408
1978	1014922	75772	19715	0.2805
1979	933319	100196	22608	0.2915
1980	503357	110812	30124	0.4225
1981	648016	104539	24922	0.3450
1982	669949	108235	19209	0.2473
1983	2201412	106130	32988	0.3971
1984	898240	182813	27450	0.2266
1985	1178334	174296	23343	0.1901
1986	907259	207867	28785	0.1945
1987	3110952	185502	48600	0.3768
1988	526637	279008	29100	0.2983
1989	711461	210460	29210	0.1988
1990	787985	181538	43969	0.2747
1991	497132	157940	37700	0.2557
1992	411423	126704	31856	0.2774
1993	611186	106487	36763	0.3470
1994	793038	90585	33908	0.3755
1995	436301	82052	27792	0.4951
1996	773668	59855	32534	0.6014
1997	723191	58093	27225	0.5641
1998	529963	44215	38895	1.1667
1999	420286	36990	26109	0.9610
2000	744772	34687	15005	0.5926
2001	712238	50032		0.7200
Average	793498	116350	29421	0.3991

3.11 Stocks in the Iberian Region (Division VIIIc and Sub-areas IX and X)

3.11.1 Overview

The fisheries

The Iberian Region along the eastern Atlantic shelf is considered an upwelling area with high productivity; this phenomenon takes place during late spring and summer. The region is characterized by a large number of commercial and non-commercial fish species.

The fisheries are of a typical mixed nature. Different kinds of Spanish and Portuguese fleets operate: one is the mixed trawl fleet (single, pair and crustacean trawlers) fishing for hake, blue whiting, horse mackerel, megrim, anglerfish, mackerel, *Nephrops*, bib and cephalopods as the main species. Other fisheries are longliners fishing for hake and hand-line fishing for mackerel, fixed nets used for hake, anglerfish and mackerel and purse seiners which mainly target sardine and anchovy, but also horse mackerel and mackerel.

Many bottom trawlers are fishing in the southern part of Division IXa (Gulf of Cadiz); these trawlers are smaller than those operating in the northern parts of the Iberian Region. The composition of their catches is also different. They are fishing for hake as well as crustaceans, molluscs and cephalopods (*Octopus* etc.).

The number of trawlers has decreased since the early 1980s, resulting in a decreasing trend in the overall effort in the Portuguese and Spanish fleets. The number ofo boats in fleets operating gillnets and long lines has also declined in recent years. Spanish boats using trawl, longline or fixed nets are currently subjected to a restricted entry system.

Two stocks of anchovy are considered in the Iberian Region, one in Sub-area VIII and one in Division IXa. The Spanish and French fleets fishing for anchovy in Sub-area VIII are well separated geographically and in time (the Spanish fleet operates mainly in Division VIIIc and VIIIb in spring and the French fleets in Division VIIIa in summer and autumn and in Division VIIIb in winter and summer). Changes in the catch-at-age composition between the 1984–1996 period and the earlier years could be related to a higher dependence of catches on recruitment in recent years and a change in the seasonality in this fishery. The number of Spanish purse seiners for anchovy has remained stable since 1990 and a slight increase in the number of French purse seiners has been observed in the last five years. A sharp increase in fishing effort for anchovy in the Bay of Biscay has occurred since 1987 mainly due to the increased effort in the French pelagic trawl fleet.

Traditionally the anchovy fishery in Division IXa is located in the Gulf of Cadiz (Sub-division IXa South). However, in 1995 the bulk of the fishery was located to the North of Portugal and to the West of Galicia (Sub-Division IXa North) and was very reduced in the Gulf of Cadiz, owing to exceptional availability of anchovy in the Northern part of the Division IXa. In recent years the bulk of the anchovy fishery in IXa is again located in the Gulf of Cadiz.

In Divisions VIIIc (East) and VIIIb the target species for the purse seine fleet change with the season - anchovy in spring and tuna in the summer. This fleet changes gear and uses trolling and bait boats to catch tuna.

The catches of horse mackerel in Divisions VIIIc and IXa have been relatively stable over the last ten years. The proportion of landings by different gears has changed, i.e., trawl catches are decreasing while the purse seine catches are increasing.

During the 1990s the purse seine fleets in Divisions VIIIc West usually directed to sardine redirected the effort to horse mackerel because of lower availability of sardine in VIIIc West than during the 1980s.

Mackerel is a target species for the hand line fleet during the spawning season in Division VIIIc, during which about one third of the total catches are taken. It is taken as by-catch by the trawl fleets in Division VIIIc and IXa. The highest catches (80%) from the Southern component are taken in the first half of the year-mainly from Division VIIIc and consist of adult fish. In the second half of the year, catches consist of juveniles and are mainly taken in Division IXa, as by-catches of the trawl fisheries. Catches from the southern component have been increasing in recent years and in 1998 and 1999 reached a maximum of 44 000 t each year.

Management measures

The fisheries in the Iberian Region are managed by a TAC system and technical measures. In 2000 a new EU regulation was established. Common mesh sizes for trawls are 55 mm, except for trawlers targeting blue whiting or horse mackerel (40 mm) and these can only operate in depths +- ≤2000 m. Other measures are minimum landing sizes and seasonal closures to protect juvenile hake.

At national level there are management measures enforced in the sardine fishery for restriction of days of absence from the ports, number of purse-seiners in activity, annual catch restrictions and seasonal closures. A minimum landing size is enforced at the international level.

A TAC for southern mackerel is in place, as a part of the Northeast Atlantic mackerel TAC.

In recent years data quality has improved including landing statistics and length composition, notably in the Gulf of Cadiz. Routine estimates of discards are only available for Northern Spanish waters in 1994, and 1999. For most of the stocks the sampling level of the landings is considered adequate for assessment purposes. The low level of samples of discards, particularly of undersized hake, is considered a problem.

The Iberian Region is an important nursery ground for hake, sardine, horse mackerel and blue whiting. Catches of fleets operating gears with low selectivity therefore contain significant quantities of juvenile fish.

State of stocks

The stock of hake is outside safe biological limits. SSB decreased very sharply between 1982 and 1986 and gradually decreased thereafter. Recruitment has declined steadily in 1984-1991. However, the 1996 year class is estimated to be above average and comparable to year classes produced consistently in early 1980s. Although there are indications that fishing effort has decreased since the early 1990s, the estimate of a sharp decrease in fishing mortality on hake last three years was considered unreliable.

The anglerfish stocks (*L. piscatorius* and *L. budegassa*) are outside safe biological limits. The biomass in recent years is estimated to be below B_{pa} for both species.

The megrim stocks (*L. boscii* and *L. whiffiagonis*) are outside safe biological limits. SSB of both species has decreased over most of the assessment period. Recruitment in both species appears to be falling. Fishing mortality has fluctuated with no clear trend.

Two stocks of *Nephrops* are considered in Division VIIIc and five in Division IXa. The landings are slightly decreasing in Division VIIIc while the catches fluctuate without a clear trend in Division IXa. The fishing mortality is low and stable for this area.

The southern horse mackerel (*Trachurus trachurus*) stock is harvested outside safe biological limits. Although the spawning stock is estimated to be above the proposed B_{pa}, fishing mortality in is still below F_{pa}.

The spatial distribution of Sardine in Divisions VIIIc and IXa changed as compared with the 1980s. The availability of sardine has decreased in the northern area, but remains constant in the southern area. It is not at present clear whether the observed change in distribution is due to a migration driven by climatic effects, a migration driven by a reduction in stock size, or due to a local depletion of independent population units. Whichever case pertains, a reduction in fishing mortality is advised to prevent further decline of spawning stock biomass and promote recovery.

The southern mackerel component is of the order of 25% of the *Northeast Atlantic mackerel. Egg surveys also indicate that SSB of this component has increased.*

3.11.2 Hake - Southern stock (Divisions VIIIc and IXa)

State of stock/exploitation: The stock is outside safe biological limits. SSB is currently estimated to be just below $\mathbf{B_{pa}}$. SSB decreased sharply between 1982 and 1986 and has since then remained low, although there has been an increase in the most recent years. Fishing mortality has been variable, but has generally declined since 1987. *Status quo* F is slightly above $\mathbf{F_{pa}}$. Mean recruitment in the 1990s has been well below the average of the previous period.

Management objectives: There are no explicit management objectives for this stock. However, for any management objectives to meet precautionary criteria, their aim should be to reduce or maintain F below $\mathbf{F_{pa}}$ and to increase or maintain spawning stock biomass above $\mathbf{B_{pa}}$.

Precautionary Approach reference points (established in 2000):

ICES considers that:	ICES proposes that:
$\mathbf{B_{lim}}$ is 20 500 t	$\mathbf{B_{pa}}$ be set at 33 600 t
$\mathbf{F_{lim}}$ is 0.45	$\mathbf{F_{pa}}$ be set at 0.27

Technical basis:

$\mathbf{B_{lim}} = \mathbf{B_{loss}}$ the lowest observed spawning stock biomass	$\mathbf{B_{pa}} \sim \mathbf{B_{lim}}$ x 1.64
$\mathbf{F_{lim}} = \mathbf{F_{loss}}$ the fishing mortality above which the stock dynamics are unknown	$\mathbf{F_{pa}}$~: $\mathbf{F_{lim}}$ x 0.61

Advice on management: ICES recommends that fishing mortality be reduced to below $\mathbf{F_{pa}}$, corresponding to a catch of less than 8 000 t in 2002. This allows SSB to increase above $\mathbf{B_{pa}}$ in the short-term.

Comparison with previous assessment and advice: The trends in recruitment, SSB and fishing mortality are similar to the previous assessment. Fishing mortality is slightly higher and SSB is slightly lower. There is still a systematic bias to under-estimate terminal fishing mortality, and to over-estimate SSB. The rationale for advice is the same as last year (based on $\mathbf{F_{pa}}$).

Relevant factors to be considered in management: The present assessment is considered to give an accurate picture of the historic development of this stock. However, biomass has been overestimated and fishing mortality underestimated in recent years. It is therefore possible that this assessment gives a too optimistic impression of the state of the stock, and future assessments may well revise the stock size downward.

In order to protect juveniles, fishing is prohibited in some areas during part of the year.

Hake is taken in a mixed species trawl fishery, and the management of other stocks such as horse mackerel, megrim and anglerfish needs to be taken into account when considering the requirements of the hake stock.

Catch forecast for 2002:

Basis: F(2001) = F(98-00) = 0.28; Landings(2001) = 8.6; SSB(2002) = 35.7.

F(2002) onwards	Basis	Landings (2002)	SSB (2003)
0.17	0.6 $F_{(98\text{-}00)}$	5.2	41.0
0.21	$\mathbf{F_{0.1}}$	6.4	39.7
0.22	0.8 $F_{(98\text{-}00)}$	6.8	39.3
0.27	$\mathbf{F_{pa}}$	8.0	38.0
0.28	$F_{(98\text{-}00)}$	8.3	37.7
0.31	1.1$F_{(98\text{-}00)}$	9.0	37.0
0.36	1.2$F_{(98\text{-}00)}$	9.7	36.2

Weights in '000 t.

Shaded scenarios considered inconsistent with the precautionary approach.

Medium- and long-term projections: Medium-term predictions not reliable. $\mathbf{F_{max}}$ is not well defined.

Elaboration and special comment: Spanish and Portuguese fleets exploit this stock in a mixed fishery using trawls, gillnets and long lines.

Fishing mortalities on the recruiting year classes are estimated to be very low as small fish (less than 27 cm) have been underreported in the landings since 1989. Low Fs (less than assumed natural mortality) on the older ages are also estimated by this assessment since 1995, possibly due to a change in target species. The assessment becomes unstable when F is very low - the stock dynamics are driven by the natural mortality, not by the fishing mortality - therefore, medium-term predictions are not reliable.

Analytical assessment using commercial CPUE and survey data. Information from surveys at age 0 is included in this year's assessment. The stock-recruitment relationship is driven by the high values of earlier years, since the recent values are clustered and do not show a clear relationship (recruitment in 2000 the lowest of the series). Combined age-length keys are used prior to 1993.

Source of information: Report of the Working Group on the Assessment of Southern Shelf Demersal Stocks, September 2001 (ICES CM 2002/ACFM:05).

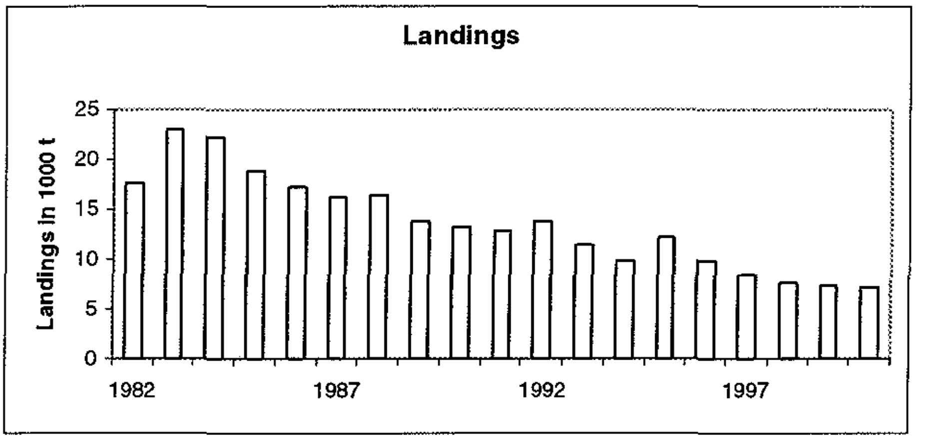
Yield and spawning biomass per Recruit F-reference points:

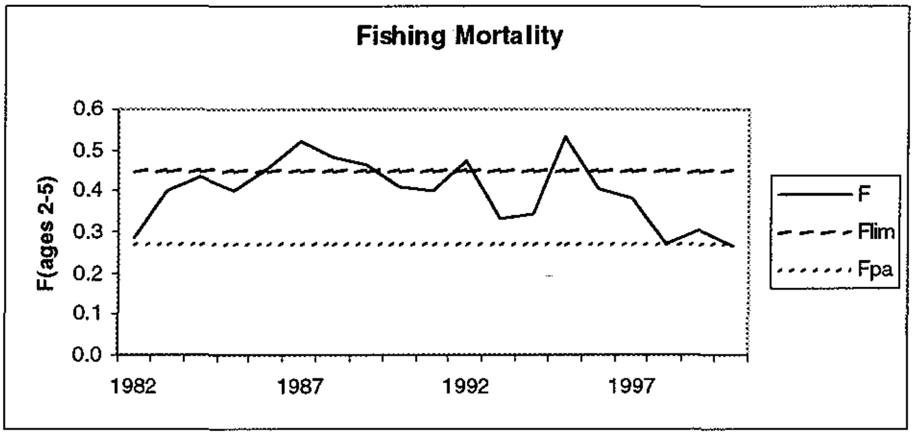
	Fish Mort Ages 2-5	Yield/R	SSB/R
Average Current	0.280	0.163	0.776
$\mathbf{F_{max}}$	0.327	0.164	0.631
$\mathbf{F_{0.1}}$	0.211	0.156	1.070
$\mathbf{F_{med}}$	0.461	0.159	0.367

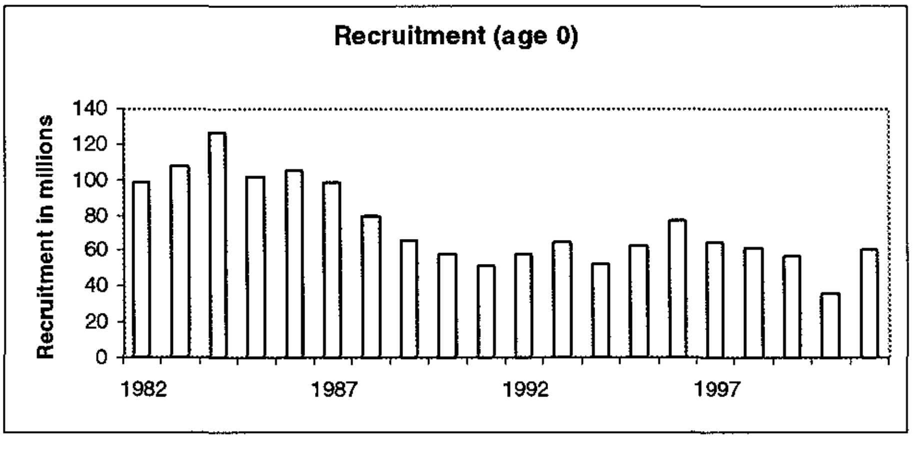
Catch data (Tables 3.11.2.1-2):

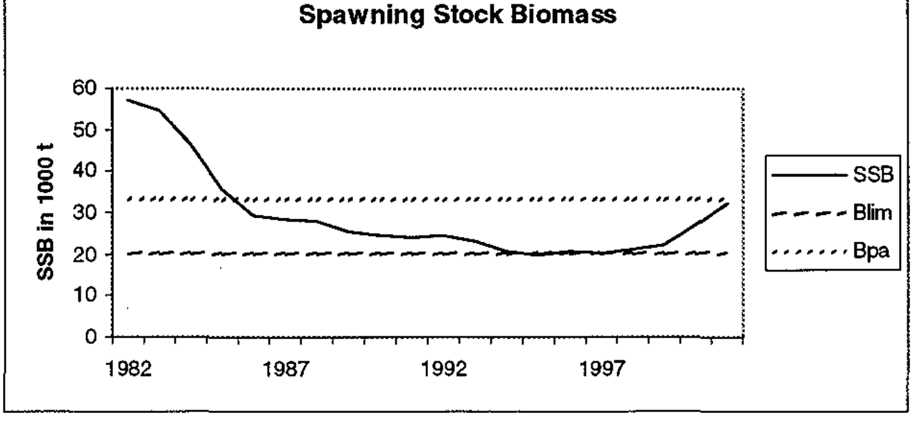
Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC	ACFM Landings
1987	Precautionary TAC; juvenile protection	15.0	25.0	16.2
1988	TAC; juvenile protection	15.0	25.0	16.4
1989	TAC; juvenile protection	15.0	20.0	13.8
1990	TAC; juvenile protection	15.0	20.0	13.2
1991	Precautionary TAC	10.0	18.0	12.8
1992	Precautionary TAC	10.3	16.0	13.8
1993	F = 10% of F 91	1.0	12.0	11.5
1994	F lowest possible at least reduced by 80%	2.0	11.5	9.9
1995	F lowest possible	-	8.5	12.2
1996	F lowest possible	-	9.0	9.9
1997	F lowest possible	-	9.0	8.5
1998	60% reduction in F	4.0	8.2	7.7
1999	Reduce F below $\mathbf{F_{pa}}$	9.5	9.0	7.5
2000	20% reduction from 1994-98 average landings	< 7.7	8.5	7.3
2001	Reduce F below $\mathbf{F_{pa}}$; no increase in landings	8.5	8.9	
2002	F below $\mathbf{F_{pa}}$	< 8.0		

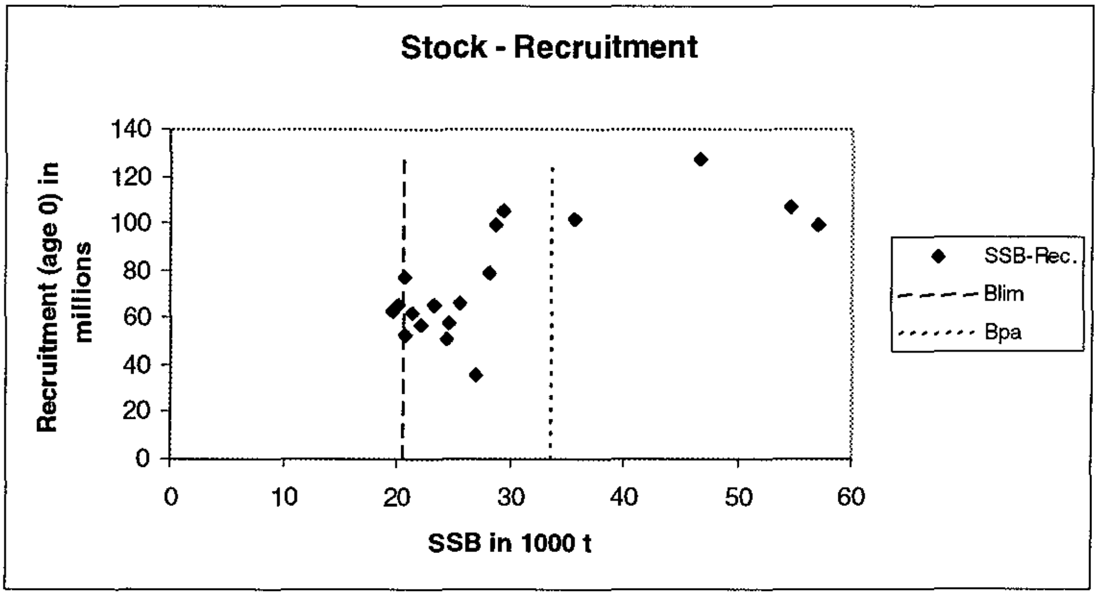
Weights in '000 t.

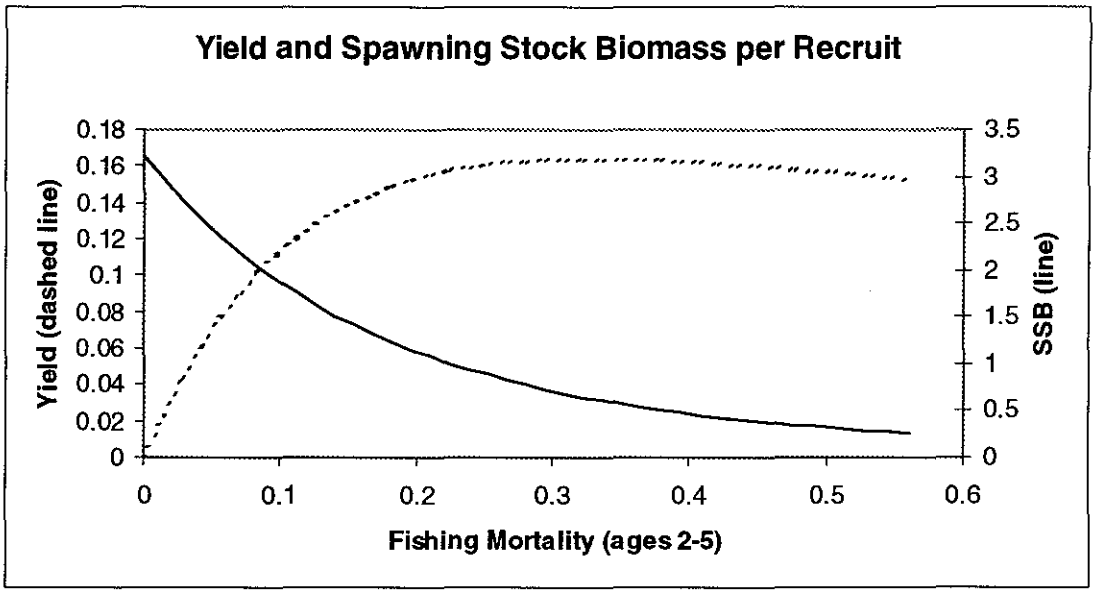

Landings
Landings in 1000 t
25
20
15
10
5
0
1982
1987
1992
1997


Fishing Mortality
F(ages 2-5)
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1982
1987
1992
1997
F
Flim
Fpa


Recruitment (age 0)
Recruitment in millions
140
120
100
80
60
40
20
0
1982
1987
1992
1997


Spawning Stock Biomass
SSB in 1000 t
60
50
40
30
20
10
0
1982
1987
1992
1997
SSB
Blim
Bpa


Stock - Recruitment
Recruitment (age 0) in millions
140
120
100
80
60
40
20
0
0
10
20
30
40
50
60
SSB in 1000 t
SSB-Rec.
Blim
Bpa


Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
3.5
3
2.5
2
1.5
1
0.5
0
SSB (line)
0
0.1
0.2
0.3
0.4
0.5
0.6
Fishing Mortality (ages 2-5)

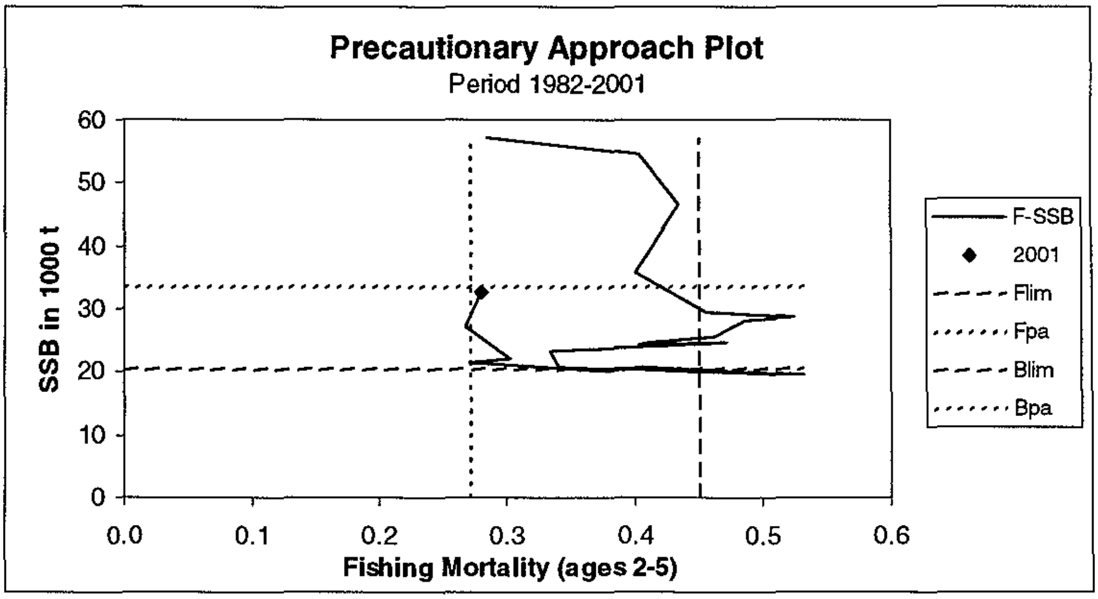

Precautionary Approach Plot
Period 1982-2001
SSB in 1000 t
60
50
40
30
20
10
0
0.0
0.1
0.2
0.3
0.4
0.5
0.6
Fishing Mortality (ages 2-5)
F-SSB
2001
Flim
Fpa
Blim
Bpa

Table 3.11.2.1 Landing estimates ('000 t) for the Southern Hake stock (Divisions VIIIc and IXa) by country and gear as determined by the Working Group, 1972–2000.

Year	Spain							Portugal			France	Total Stock
	Gillnet[1]	Small Gillnet	Longline	Artisanal Unal-located	Total Artisanal	Trawl[2]	Total	Artisanal	Trawl	Total		
1972	-	-	-	-	7.1	10.2	17.3	4.7	4.1	8.8	-	26.1
1973	-	-	-	-	8.5	12.3	20.8	6.5	7.3	13.8	0.2	34.8
1974	2.6	1.0	2.2	-	5.8	8.3	14.1	5.1	3.5	8.6	0.1	22.8
1975	3.5	1.3	3.0	-	7.8	11.2	19.0	6.1	4.3	10.4	0.1	29.5
1976	3.1	1.2	2.6	-	6.9	10.0	16.9	6.0	3.1	9.1	0.1	26.1
1977	1.5	0.6	1.3	-	3.4	5.8	9.2	4.5	1.6	6.1	0.2	15.5
1978	1.4	0.1	2.1	-	3.6	4.9	8.5	3.4	1.4	4.8	0.1	13.4
1979	1.7	0.2	2.1	-	4.0	7.2	11.2	3.9	1.9	5.8	-	17.0
1980	2.2	0.2	5.0	-	7.4	5.3	12.7	4.5	2.3	6.8	-	19.5
1981	1.5	0.3	4.6	-	6.4	4.1	10.5	4.1	1.9	6.0	-	16.5
1982	1.2	0.3	4.2	-	5.7	4.4	10.1	5.0	2.5	7.5	-	17.6
1983	2.1	0.4	6.6	-	9.0	5.9	14.9	5.2	2.9	8.0	-	23.0
1984	2.3	0.3	7.5	-	10.1	6.5	16.7	4.3	1.2	5.5	-	22.2
1985	1.8	0.8	4.4	-	7.0	6.1	13.1	3.8	2.1	5.8	-	18.9
1986	2.1	0.8	3.5	-	6.4	5.8	12.2	3.2	1.8	4.9	0.0	17.2
1987	2.0	0.5	4.4	-	6.9	4.5	11.4	3.5	1.3	4.8	0.0	16.2
1988	2.0	0.7	3.0	-	5.6	4.7	10.4	4.3	1.7	6.0	0.0	16.4
1989	1.9	0.6	2.0	-	4.4	4.8	9.2	2.7	1.8	4.6	0.0	13.8
1990	1.7	0.6	2.1	-	4.4	5.3	9.8	2.3	1.1	3.4	0.0	13.2
1991	1.4	0.4	2.2	-	4.0	4.8	8.9	2.7	1.2	4.0	0.0	12.8
1992	1.5	0.4	2.1	-	3.9	4.8	8.7	3.8	1.3	5.1	-	13.8
1993	1.3	0.4	2.8	-	4.4	3.2	7.6	3.0	0.9	3.9	-	11.5
1994	1.9	0.4	1.5	-	3.7	3.0	6.8	2.3	0.8	3.1	-	9.9
1995	1.6	0.4	1.0	-	2.9	5.7	8.7	2.6	1.0	3.6	-	12.2
1996	1.2	0.2	1.0	-	2.4	4.6	7.0	2.0	0.9	2.9	-	9.9
1997	1.1	0.3	0.8	-	2.2	4.0	6.1	1.5	0.9	2.4	-	8.5
1998	0.8	0.3	0.6	-	1.7	3.4	5.1	1.7	0.9	2.6	-	7.7
1999	0.6	0.2	0.3	0.2	1.3	3.0	4.3	2.1	1.1	3.2	-	7.5
2000	0.9	0.1	0.1	0.1	1.3	2.8	4.1	2.1	1.2	3.3	-	7.3

[1] Gulf of Cadiz landings included since 1993.
[2] Gulf of Cadiz landings included since 1982.

Table 3.11.2.2 Hake - Southern stock (Divisions VIIIc and IXa).

Year	Recruitment Age 0 thousands	SSB tonnes	Landings tonnes	Mean F Ages 2-5
1982	99000	57000	17600	0.284
1983	107000	54600	23000	0.404
1984	127000	46600	22200	0.435
1985	102000	35600	18900	0.400
1986	105000	29400	17200	0.456
1987	99000	28700	16200	0.524
1988	79000	28100	16400	0.486
1989	66000	25500	13800	0.463
1990	58000	24500	13200	0.412
1991	51000	24400	12800	0.404
1992	58000	24600	13800	0.472
1993	65000	23300	11500	0.334
1994	53000	20700	9900	0.342
1995	63000	19600	12200	0.532
1996	77000	20700	9900	0.405
1997	65000	20200	8500	0.380
1998	62000	21400	7700	0.270
1999	57000	22100	7500	0.303
2000	36000	27000	7300	0.267
2001	61000	32400		0.280
Average	74500	29320	13663	0.393

3.11.3 Megrim (*L. boscii* and *L. whiffiagonis*) in Divisions VIIIc and IXa

State of stocks/exploitation: The state of these stocks in relation to precautionary reference points is not known. SSB of both species has decreased over most of the assessment period, but an increase has been observed since 1995. Fishing mortality for both species has generally declined during the 1990s. For both species current SSB is estimated to be close to average and current fishing mortality is below average.

Management objectives: There are no explicit management objectives for these stocks.

Precautionary Approach reference points set in 2000: The time series is short and reference points were not defined.

Advice on management: In order to prevent a decline in SSB, ICES recommends that F should be kept below F_{sq} (0.21 and 0.20, respectively) for *both species*. This corresponds to landings in 2002 of less than 1 220 t for *L. boscii* and of less than 330 t for *L. whiffiagonis*.

Comparison with previous assessment and advice: The trends in SSB, F and R are similar to last year's assessment.

Relevant factors to be considered in management: The TAC covers both megrim species (*L. boscii* and *L. whiffiagonis*) and has been set well above actual catches in recent years.

Both megrim species are caught together in fisheries, which also take a large number of other commercial species, including southern hake.

Catch forecast for 2002:

L. boscii: Basis: F(2001) = F(98–00) = F_{sq} = 0.21; Landings (2001) = 1.27; SSB(2002) = 6.09.

F(2002) onwards	Basis	Landings (2002)	SSB (2003)
0.17	0.8 $F_{98\text{-}00}$	1.01	6.37
0.21	1.0 $F_{98\text{-}00}$	1.22	6.13
0.26	1.2 $F_{98\text{-}00}$	1.43	5.91

Weights in '000 t.

L. whiffiagonis: Basis: F (2001) = F (98–00) scaled to F00 = 0.20; Landings (2001) = 0.31; SSB(2002) = 1.63.

F(2002) onwards	Basis	Landings (2002)	SSB (2003)
0.16	0.8 $F_{98\text{-}00}$	0.27	1.74
0.20	1 $F_{98\text{-}00}$	0.33	1.67
0.24	1.2 $F_{98\text{-}00}$	0.38	1.61

Weights in '000 t. There are no Precautionary Reference points, and hence no shading was applied.

Elaboration and special comment: Megrim species are generally taken as a by-catch in mixed fisheries by Portuguese and Spanish trawlers, and also in small quantities by the Portuguese artisanal fleet. *L. boscii* accounts for about 70–90% of combined megrim landings. *L. boscii* is distributed equally in Divisions VIIIc and IXa, and *L. whiffiagonis* is distributed in both Divisions, with its highest abundance in Division VIIIc.

Total landings data for these stocks are not available before 1986. However, some Spanish ports have longer landing series for both species, and the Spanish survey provides abundance indices since 1983. These data sources indicate stable, but low, abundance up to 1986, increasing sharply to 1990, and decreasing again to the low level observed in the initial years. In Divisions VIIIc and IXa the peak spawning period of both megrim species is in March.

Age-based analytical assessment using commercial CPUE and survey data.

Source of information: Report of the Working Group on the Assessment of Southern Shelf Demersal Stocks, September 2001 (ICES CM 2002/ACFM:05).

Megrim (*Boscii*)
Yield and spawning biomass per Recruit F-reference points:

	Fish Mort Ages 2-4	Yield/R	SSB/R
Average Current	0.213	0.050	0.252
F_{max}	0.574	0.054	0.162
$F_{0.1}$	0.151	0.047	0.294
F_{med}	0.264	0.052	0.228

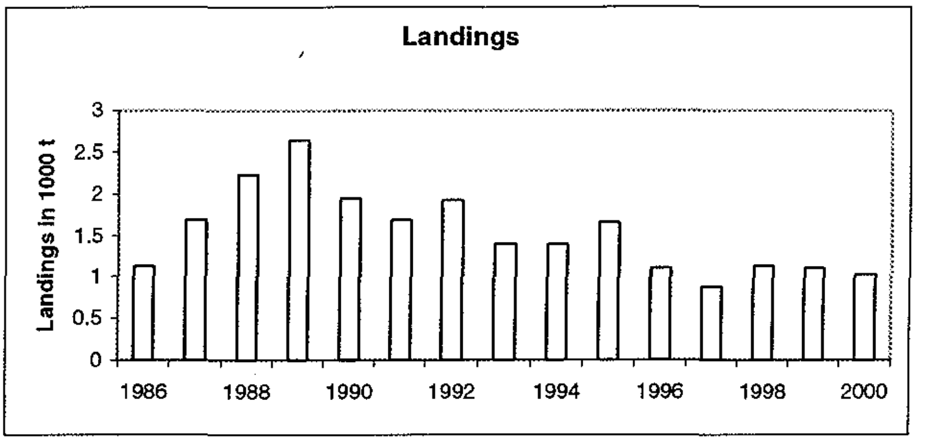
Megrim (*Whiffiagonis*)
Yield and spawning biomass per Recruit F-reference points:

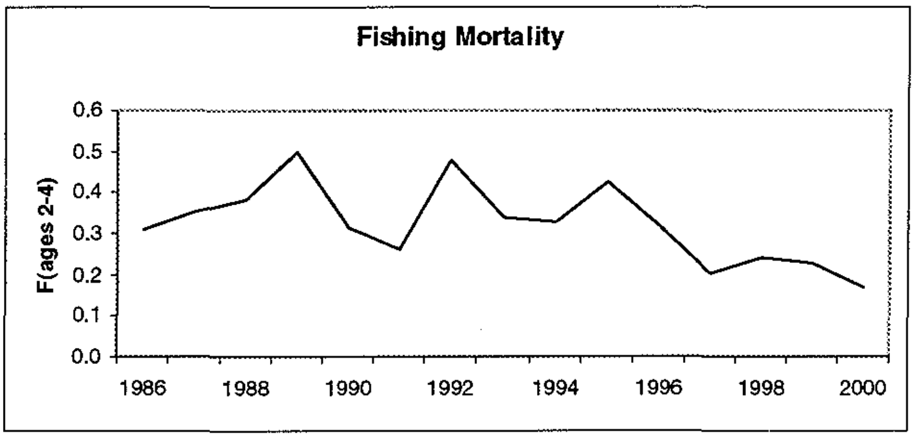
	Fish Mort Ages 2-4	Yield/R	SSB/R
Average Current	0.199	0.058	0.281
F_{max}	0.377	0.060	0.206
$F_{0.1}$	0.128	0.053	0.344
F_{med}	0.426	0.060	0.194

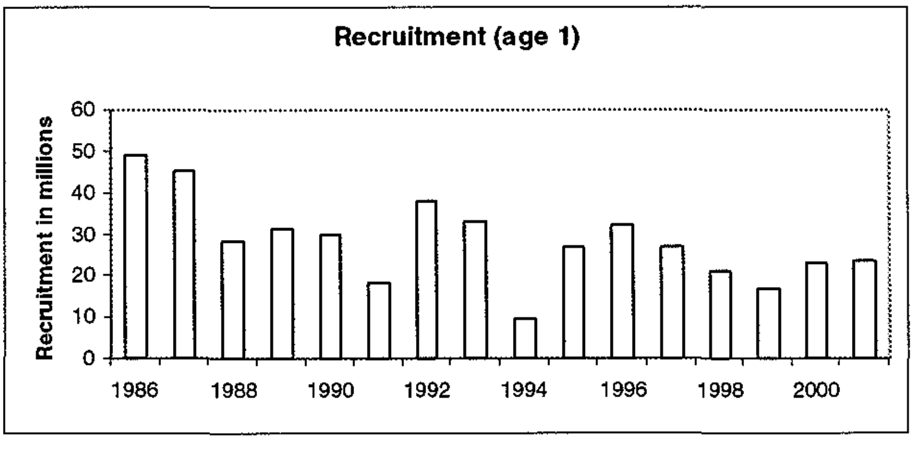
Catch data (Tables 3.11.3.1-4):

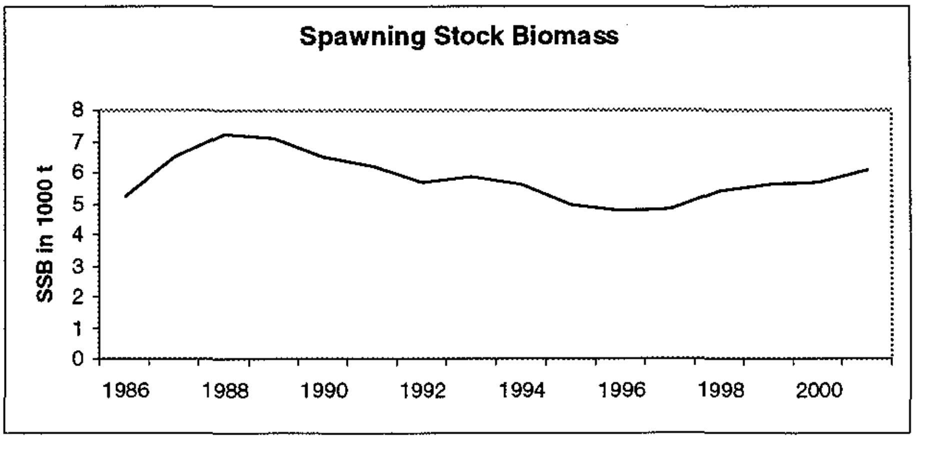
Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC[1]	ACFM landings[1]	Landings *L. boscii*	Landings *L. whiff*
1987	Not dealt with	-	13.0	2.19	1.69	0.50
1988	Not dealt with	-	13.0	3.04	2.22	0.82
1989	Not dealt with	-	13.0	3.34	2.63	0.71
1990	Not dealt with	-	13.0	2.93	1.95	0.98
1991	No advice	-	14.3	2.29	1.68	0.61
1992	No advice	-	14.3	2.44	1.92	0.52
1993	*L. boscii* no long-term gain in increasing F, *L. whiff* within safe biological limits	-	8.0	1.76	1.38	0.38
1994	No long-term gains in increasing F	-	6.0	1.88	1.40	0.48
1995	Concern about low SSB	-	6.0	1.87	1.65	0.22
1996	Mixed fishing aspects	-	6.0	1.43	1.10	0.33
1997	Reduce F by at least 50%	-	6.0	1.25	0.90	0.36
1998	Reduce F by at least 50%	0.9[1]	6.0	1.57	1.12	0.45
1999	Reduce F by at least 50%	1.0[1]	6.0	1.46	1.12	0.35
2000	Reduce F by at least 20%	< 1.5[1]	5.0	1.29	1.04	0.25
2001	No increase in F	1.6[1]	5.0			
2002	No increase in F	1.6[1]				

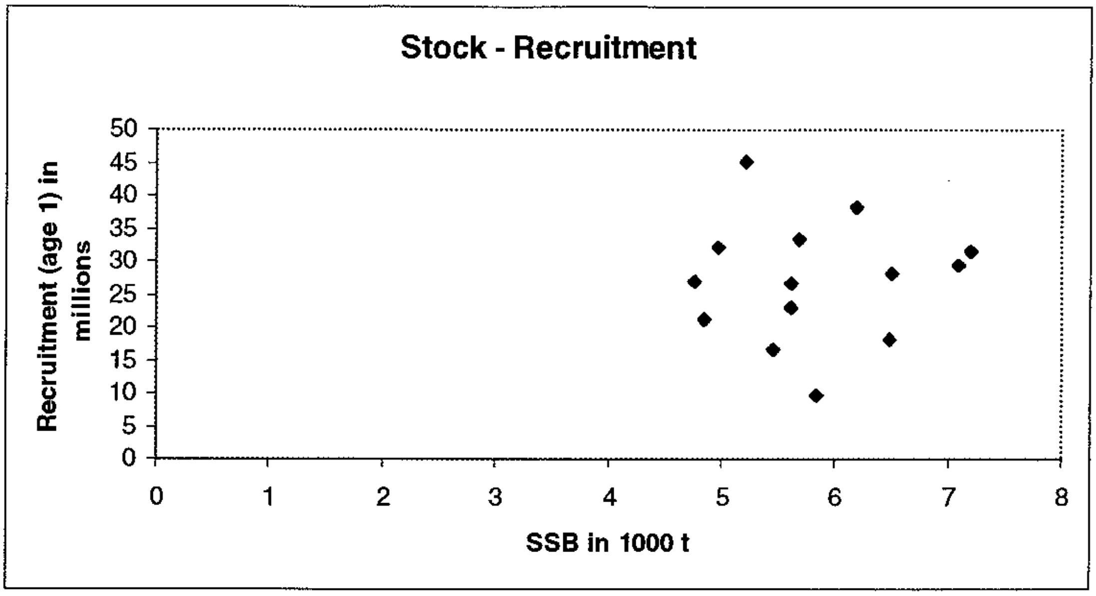
[1] Including *L. whiffiagonis*+ *L. boscii*. Weights in '000 t.

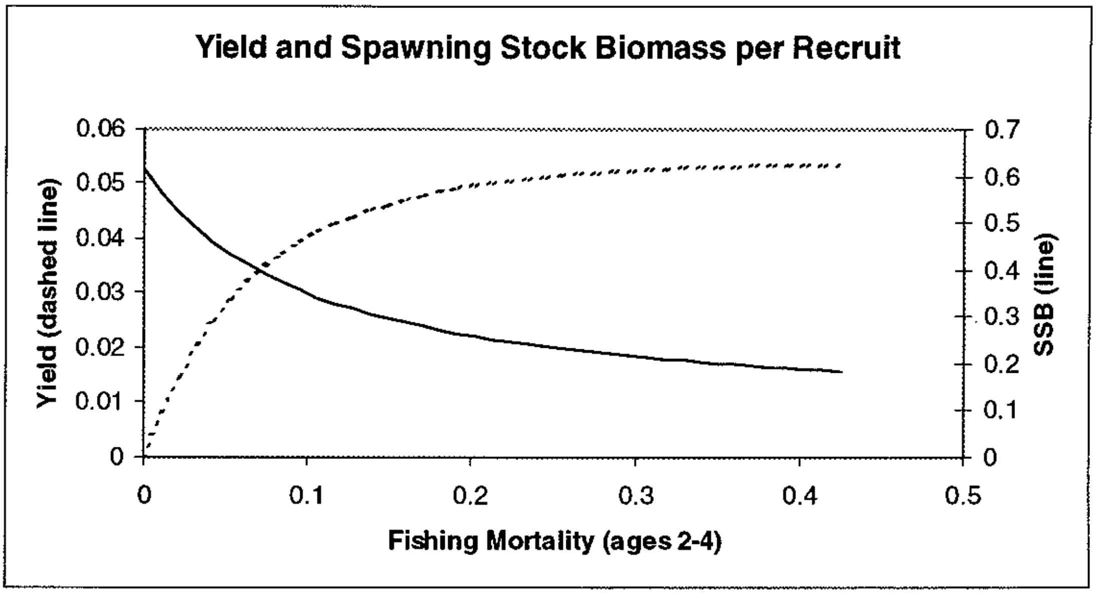

Landings
Landings in 1000 t
3
2.5
2
1.5
1
0.5
0
1986
1988
1990
1992
1994
1996
1998
2000

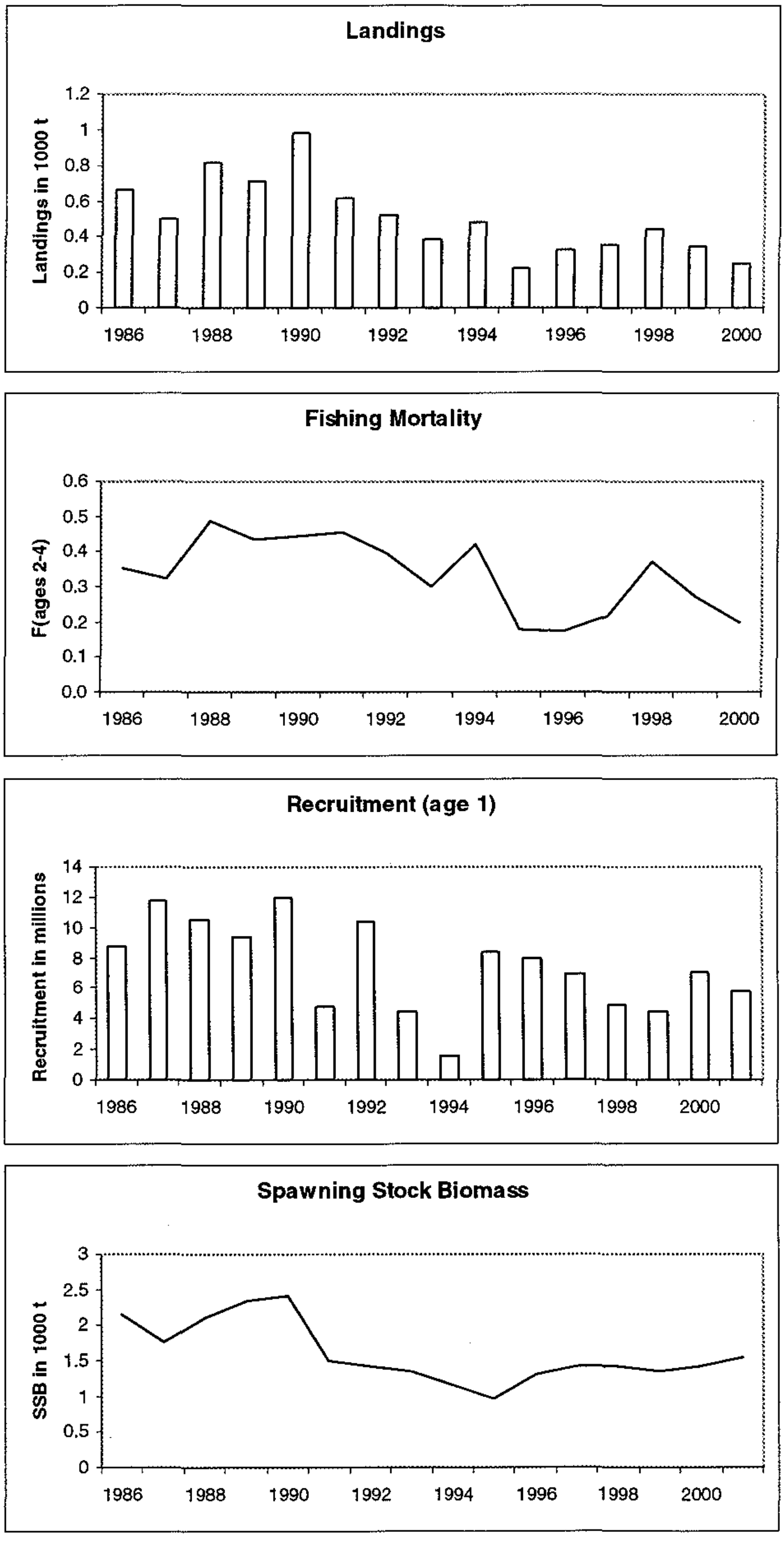

Fishing Mortality
F(ages 2-4)
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1986
1988
1990
1992
1994
1996
1998
2000


Recruitment (age 1)
Recruitment in millions
60
50
40
30
20
10
0
1986
1988
1990
1992
1994
1996
1998
2000

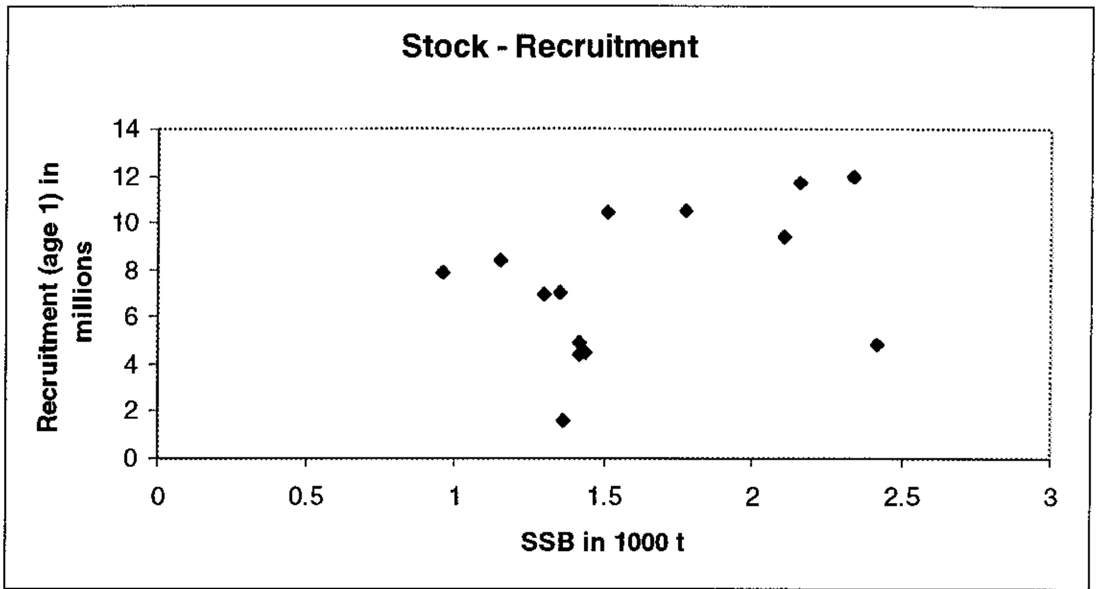

Spawning Stock Biomass
SSB in 1000 t
8
7
6
5
4
3
2
1
0
1986
1988
1990
1992
1994
1996
1998
2000


Stock - Recruitment
Recruitment (age 1) in millions
50
45
40
35
30
25
20
15
10
5
0
0
1
2
3
4
5
6
7
8
SSB in 1000 t


Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
0.06
0.05
0.04
0.03
0.02
0.01
0
SSB (line)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.1
0.2
0.3
0.4
0.5
Fishing Mortality (ages 2-4)



Landings
Landings in 1000 t
1.2
1
0.8
0.6
0.4
0.2
0
1986
1988
1990
1992
1994
1996
1998
2000
Fishing Mortality
F(ages 2-4)
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1986
1988
1990
1992
1994
1996
1998
2000
Recruitment (age 1)
Recruitment in millions
14
12
10
8
6
4
2
0
1986
1988
1990
1992
1994
1996
1998
2000
Spawning Stock Biomass
SSB in 1000 t
3
2.5
2
1.5
1
0.5
0
1986
1988
1990
1992
1994
1996
1998
2000


Stock - Recruitment
Recruitment (age 1) in millions
SSB in 1000 t
14
12
10
8
6
4
2
0
0
0.5
1
1.5
2
2.5
3

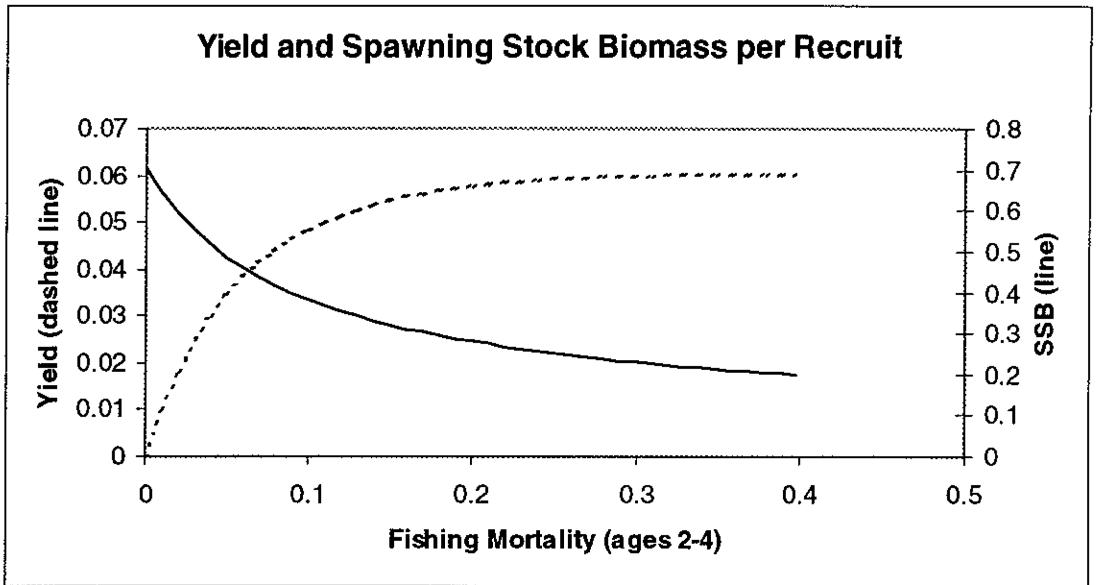

Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
SSB (line)
Fishing Mortality (ages 2-4)
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.1
0.2
0.3
0.4
0.5

Table 3.11.3.1 Four spot megrim (*L. boscii*) in Divisions VIIIc and IXa. Total landings (t).

	Spain			Portugal	Total
Year	VIIIc	IXa	Total	IXa	VIIIc, IXa
1986	799	197	996	128	1124
1987	995	586	1581	107	1688
1988	917	1099	2016	207	2223
1989	805	1548	2353	276	2629
1990	927	798	1725	220	1945
1991	841	634	1475	207	1682
1992	654	938	1592	324	1916
1993	744	419	1163	221	1384
1994	665	561	1227	176	1403
1995	685	826	1512	141	1652
1996	480	448	928	170	1098
1997	505	289	794	101	896
1998	725	284	1010	113	1123
1999	713	298	1011	104	1115
2000	674	225	899	141	1040

Table 3.11.3.2 Megrim (*L. whiffiagonis*) in Divisions VIIIc and IXa. Total landings (t).

	Spain			Portugal	Total
Year	VIIIc	IXa	Total	IXa	VIIIc, IXa
1986	508	98	606	53	659
1987	404	46	450	47	497
1988	657	59	716	101	817
1989	533	45	578	136	714
1990	841	25	866	111	977
1991	494	16	510	104	614
1992	474	5	479	37	516
1993	338	7	345	38	383
1994	440	8	448	31	479
1995	173	20	193	25	218
1996	283	21	305	24	329
1997	298	12	310	46	356
1998	372	8	380	66	446
1999	332	4	336	12	348
2000	238	5	243	11	254

Table 3.11.3.3 Megrim (*Boscii*) in Divisions VIIIc and IXa.

Year	Recruitment Age 1 thousands	SSB tonnes	Landings tonnes	Mean F Ages 2-4
1986	49062	5203	1124	0.3081
1987	45088	6506	1688	0.3546
1988	28135	7200	2223	0.3826
1989	31427	7091	2629	0.4974
1990	29540	6487	1945	0.3164
1991	18256	6190	1682	0.2632
1992	38158	5682	1916	0.4776
1993	33255	5845	1384	0.3388
1994	9808	5610	1403	0.3307
1995	26808	4975	1652	0.4250
1996	32168	4765	1098	0.3171
1997	27010	4841	896	0.2014
1998	21295	5447	1123	0.2428
1999	16669	5615	1115	0.2269
2000	22918	5666	1040	0.1684
2001	23682	6041		0.2100
Average	28330	5823	1528	0.3163

Table 3.11.3.4 Megrim (*Whiffiagonis*) in Divisions VIIIc and IXa.

Year	Recruitment Age 1 thousands	SSB tonnes	Landings tonnes	Mean F Ages 2-4
1986	8712	2162	659	0.355
1987	11707	1775	497	0.325
1988	10528	2103	817	0.487
1989	9439	2339	714	0.436
1990	11975	2415	977	0.445
1991	4799	1510	614	0.454
1992	10433	1434	516	0.397
1993	4474	1363	383	0.299
1994	1610	1154	479	0.419
1995	8367	958	218	0.180
1996	7908	1301	329	0.174
1997	6945	1418	356	0.217
1998	4960	1420	446	0.374
1999	4441	1354	348	0.272
2000	7048	1434	254	0.199
2001	5808	1546		0.200
Average	7447	1605	507	0.327

3.11.4 Anglerfish in Divisions VIIIc and IXa (*L. piscatorius* and *L. budegassa*)

State of stocks/exploitation: The combined stocks (*L. piscatorius* and *L.budegassa*) are outside safe biological limits. The biomass of both species combined is estimated to be around 33% of the $\mathbf{B}_{MSY}$ in 2001, and the fishing mortality has been above the estimated $\mathbf{F}_{MSY}$ since the beginning of the time series.

Management objectives: There are no explicit management objectives for these stocks.

Precautionary Approach reference points: The ASPIC model provides estimates of the biomass relative to $\mathbf{B}_{MSY}$, and of F relative to $\mathbf{F}_{MSY}$. The $\mathbf{B}_{MSY}$ and $\mathbf{F}_{MSY}$ points are used in the advice as a lower boundary for the biomass and an upper boundary for F.

Advice on management: ICES advises that F should be reduced by 30%, corresponding to landings in 2002 of 3 500 t for both species combined. This will allow F to be at or below $\mathbf{F}_{MSY}$ with high probability, and for biomass to increase to $\mathbf{B}_{MSY}$ in the medium-term (around 2005).

Comparison with previous assessment and advice: Trends in both F and B ratios are similar to those in last year's assessments. For the most recent years, however, the estimate of the F-ratio is higher and the B-ratio is lower than in the last year's assessment. This is consistent with the retrospective pattern. There are some changes to the model parameters and this has resulted in a more optimistic forecast.

Relevant factors to be considered in management: Given that these two species are not usually sorted in the landings and that the proportion of landings by species is based on samples taken from the various ports, an assessment with both species combined was carried out. Previous TACs have been well above the landings. A portion of the catch of *L. piscatorius* and *L. budegassa* is taken together with other species in mixed trawl fisheries.

The length-frequency distributions of *L. piscatorius* indicate that in recent years there is no evidence of strong recruiting year classes.

Catch forecast for 2002:
Both species combined (*L. piscatorius* and *L. budegassa*)
Basis: F(2001) = F(2000); F/$\mathbf{F}_{MSY}$ = 1.1; Landings(2001) = 3.5; B/$\mathbf{B}_{MSY}$(2002) = 0.44.

F/$\mathbf{F}_{MSY}$(2002)	Basis	Landings(2002)	B/$\mathbf{B}_{MSY}$ (2003)
0.7	0.7*F_{00}	3.5	0.66
1	0.9*F_{00}	4.2	0.58
1.1	$F_{01} = F_{00}$	4.5	0.55

Weights in '000 t.
Shaded scenarios considered inconsistent with the precautionary approach.

Elaboration and special comment: Both species are caught in mixed fisheries by Portuguese and Spanish fleets. In the early 1970s, commercial interest for these species increased and a directed artisanal fishery developed in Spain, originally targeting large fish.

A surplus production model incorporating covariates (ASPIC) was used as in previous assessments. The model provides estimates of stock biomass and fishing mortality relative to their respective MSY values.

ASPIC is used to provide guidance reference points, as well as a perspective of the evolution of total biomass and prediction of landings under different fishing mortalities.

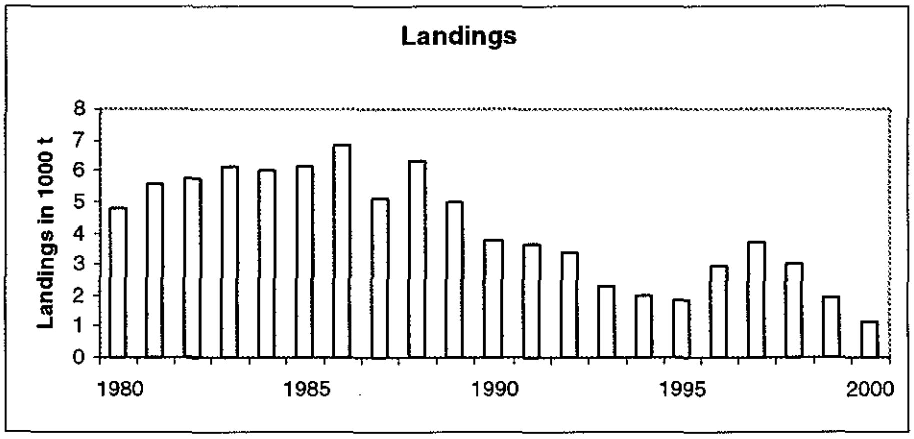
Source of information: Report of the Working Group on the Assessment of Southern Shelf Demersal Stocks, September 2001 (ICES CM 2002/ACFM:05).

Catch data (Tables 3.11.4.1–2):

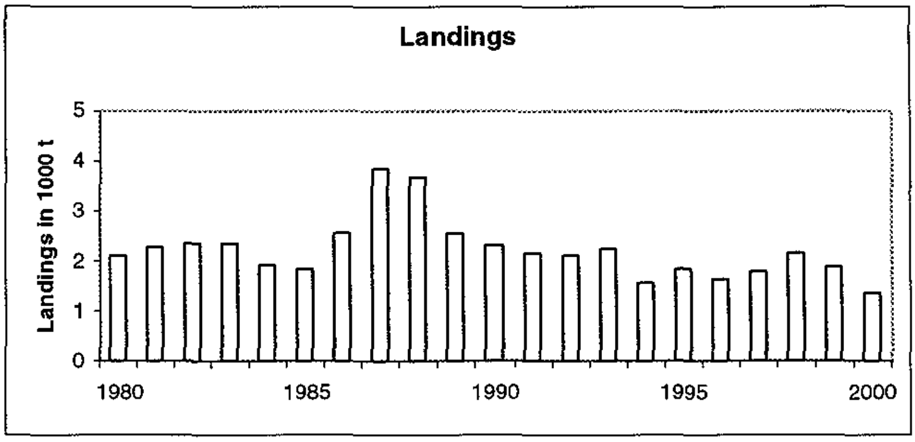
Year	ICES Advice	Predicted catch corresp.to advice	Agreed TAC[1]	ACFM Landings[1]	Landings of *L. piscat.*	Landings of *L. budeg.*
1987	Not dealt with	-	12.0	8.9	5.1	3.8
1988	Not dealt with	-	12.0	10.0	6.3	3.7
1989	Not dealt with	-	12.0	7.6	5.0	2.6
1990	Not dealt with	-	12.0	6.1	3.8	2.3
1991	No advice	-	12.0	5.8	3.6	2.2
1992	No advice	-	12.0	4.2	3.4	2.1
1993	No long-term gain in increasing F	-	13.0	4.5	2.3	2.2
1994	No advice	-	13.0	3.6	2.0	1.6
1995	If required a precautionary TAC	-	13.0	3.6	1.8	1.8
1996	If required a precautionary TAC	-	13.0	4.6	3.0	1.6
1997	If required a precautionary TAC	-	13.0	5.5	3.7	1.8
1998	Restrict catch to < 80% recent		10.0	5.1	3.0	2.1
1999	Reduce F to $\mathbf{F}_{pa}$	4.2[1]	8.5	3.8	1.9	1.9
2000	60% reduction in F	1.6[1]	6.8	2.5	1.2	1.4
2001	50% reduction in F	2.8[1]	6.0			
2002	30% reduction in F	3.5[1]				

[1]For both species combined. Weights in '000 t.

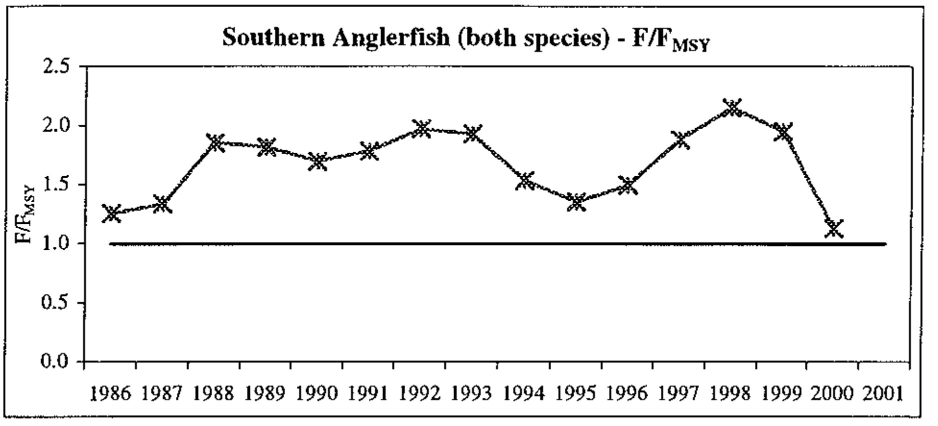
Anglerfish (*L. piscatorius*) in Divisions VIIIc and IXa



Anglerfish (*L. budegassa*) in Divisions VIIIc and IXa



ANGLERFISH (*L. piscatorius* and *L. budegassa*) Divisions VIIIc and IXa.
Development of relative Fishing mortality (a) and Biomass (b) during 1986-1999.



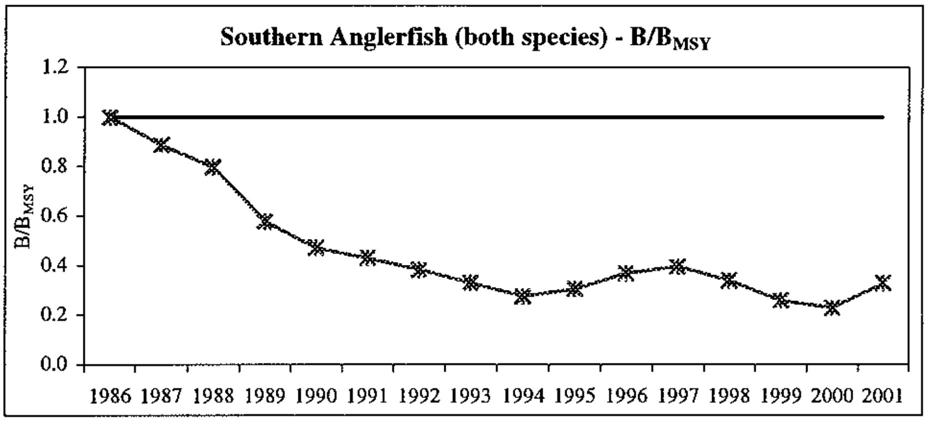


Table 3.11.4.1 Anglerfish (*L. piscatorius*) - Divisions VIIIc and IXa. Landings (t) by the main fishing fleets for 1978–2000 as determined by the Working Group.

	VIIIc			IXa				VIIIc & IXa
Year	Spain Trawl	Spain Gillnet	Total	Spain Trawl	Portugal Trawl	Portugal Artisanal	Total	Total
1978	n/a	n/a	n/a	258	0	115	373	
1979	n/a	n/a	n/a	319	0	225	544	
1980	2806	1270	4076	401	0	339	740	4816
1981	2750	1931	4681	535	0	352	887	5568
1982	1915	2682	4597	875	0	310	1185	5782
1983	3205	1723	4928	726	0	460	1186	6114
1984	3086	1690	4776	578	186	492	1256	6032
1985	2313	2372	4685	540	212	702	1454	6139
1986	2499	2624	5123	670	167	910	1747	6870
1987	2080	1683	3763	320	194	864	1378	5141
1988	2525	2253	4778	570	157	817	1543	6321
1989	1643	2147	3790	347	259	600	1206	4996
1990	1439	985	2424	435	326	606	1366	3790
1991	1490	778	2268	319	224	829	1372	3640
1992	1217	1011	2228	301	76	778	1154	3382
1993	844	666	1510	72	111	636	819	2329
1994	690	827	1517	154	70	266	490	2007
1995	830	572	1403	199	66	166	431	1834
1996	1306	745	2050	407	133	365	905	2955
1997	1449	1191	2640	315	110	650	1075	3714
1998	912	1359	2271	184	28	497	710	2981
1999	545	1013	1558	79	9	285	374	1932
2000	262	482	744	67	4	340	411	1155

n/a : not available.

Table 3.11.4.2 Anglerfish (*L. budegassa*) - Divisions VIIIc and IXa. Landings (t) by the main fishing fleets for 1978–2000 as determined by the Working Group.

	VIIIc			IXa				VIIIc & IXa
Year	Spain Trawl	Spain Gillnet	Total	Spain Trawl	Portugal Trawl	Portugal Artisanal	Total	Total
1978	n/a	n/a	n/a	248	0	107	355	
1979	n/a	n/a	n/a	306	0	210	516	
1980	1203	207	1409	385	0	315	700	2110
1981	1159	309	1468	505	0	327	832	2300
1982	827	413	1240	841	0	288	1129	2369
1983	1064	188	1252	699	0	428	1127	2379
1984	514	176	690	558	223	458	1239	1929
1985	366	123	489	437	254	653	1344	1833
1986	553	585	1138	379	200	847	1425	2563
1987	1094	888	1982	813	232	804	1849	3832
1988	1058	1010	2068	684	188	760	1632	3700
1989	648	351	999	764	272	542	1579	2578
1990	491	142	633	689	387	625	1701	2334
1991	503	76	579	559	309	716	1584	2163
1992	451	57	508	485	287	832	1603	2111
1993	516	292	809	627	196	596	1418	2227
1994	542	201	743	475	79	283	837	1580
1995	913	104	1017	615	68	131	814	1831
1996	840	105	945	342	133	210	684	1629
1997	800	198	998	524	81	210	815	1813
1998	774	153	926	704	181	332	1217	2144
1999	571	127	698	671	110	406	1187	1885
2000	434	63	497	392	142	336	870	1367

n/a : not available.

3.11.5 Mackerel in Divisions VIIIc and IXa (Southern component)

Evaluation of this component is given in Section 3.12.3, dealing with the combined mackerel assessment.

3.11.6 Southern horse mackerel (*Trachurus trachurus*) (Divisions VIIIc and IXa)

State of stock/exploitation: The stock is harvested outside safe biological limits, but the fishing mortality is only slightly above $\mathbf{F_{pa}}$. The spawning stock is estimated to be above $\mathbf{B_{pa}}$.

Management objectives: There are no explicit management objectives for this stock.

Precautionary Approach reference points (established in 1998):

ICES considers that:	ICES proposes that:
$\mathbf{B_{lim}}$ is 136 000 t, the lowest observed biomass.	$\mathbf{B_{pa}}$ be set at 205 000 t. This affords a high probability of maintaining SSB above $\mathbf{B_{lim}}$, taking into account the uncertainty of the assessment.
$\mathbf{F_{lim}}$ is 0.27, the fishing mortality rate above which recruitment and stock dynamics are unknown.	$\mathbf{F_{pa}}$ be established at 0.17. This F is considered to provide approximately 95% probability of avoiding $\mathbf{F_{lim}}$, taking into account the uncertainty of assessments.

Technical basis:

$\mathbf{B_{lim}} = \mathbf{B_{loss}}$	$\mathbf{B_{pa}} = \mathbf{B_{loss}} * 1.5$
$\mathbf{F_{lim}} = \mathbf{F_{loss}}$	$\mathbf{F_{pa}} = \mathbf{F_{lim}} * 0.63$

Advice on management: Fishing mortality should be below 0.113, corresponding to landings of less than 34 000 t in 2002. This will keep SSB above $\mathbf{B_{pa}}$ in 2003. ICES recommends, that the TAC for this stock should only apply to *Trachurus trachurus*.

Comparison with previous assessment and advice: This year's assessment shows close agreement with last year's assessment. The spawning stock biomass estimated from the 1995 egg surveys is in good agreement with the 1995 SSB estimated by VPA using CPUE-at-age series of two October surveys, the July survey, and of two commercial fleets. The SSB in 2000 is estimated to be lower than the forecast from last year's assessment. This may be due to poor recruitments in recent years.

Relevant factors to be considered in management: The TAC up to 1999 was 73 000 t, and 68 000 t for 2000 and 2001. The TAC includes all *Trachurus* species.

Catch forecast for 2002:

Basis: F(2001) = F(98–00) = $\mathbf{F_{sq}}$ = 0.19; Landings (2001) = 52; SSB (2001) = 221.

F(2002)	Basis	SSB (2002)	Landings (2002)	SSB (2003)
0.076	0.4 $\mathbf{F_{sq}}$	208	23	214
0.111	$\mathbf{F_{0.1}}$	207	33	206
0.113	0.6 $\mathbf{F_{sq}}$	206	34	205
0.151	0.8 $\mathbf{F_{sq}}$	205	44	197
0.170	$\mathbf{F_{pa}}$	204	49	193
0.188	$\mathbf{F_{max}}$	203	53	189
0.189	1.0 $\mathbf{F_{sq}}$	203	54	189
0.227	1.2 $\mathbf{F_{sq}}$	202	63	181

Weights in '000 t.

Shaded scenarios are considered inconsistent with the precautionary approach.

Medium- and long-term projections: No medium or long-term projections were made.

Elaboration and special comment: Trawl, purse seine, and artisanal fisheries exploit this stock. The increase of F in 1998 was due mainly to the higher catches obtained by the Spanish purse seiners and to a lesser extent by the Portuguese trawlers and purse seiners. The high Spanish purse seiner catches in 1997, 1998 and 1999 are a result of the decrease in abundance of species like sardine, which caused the fleet to switch target species to horse mackerel and other species.

Source of information: Report of the Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine and Anchovy, September 2001 (ICES CM 2002/ACFM:06).

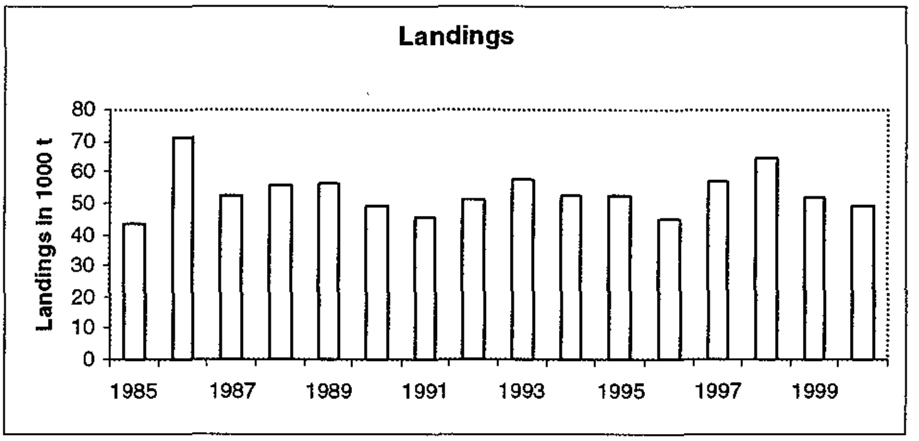
Yield and spawning biomass per Recruit F-reference points:

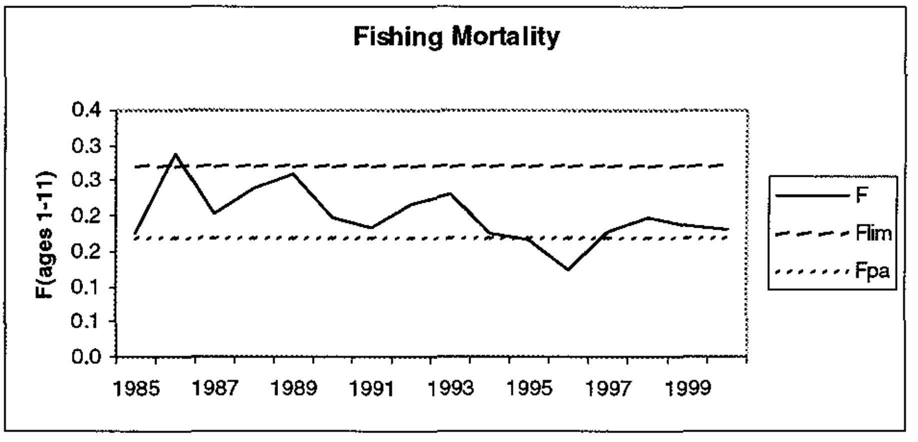
	Fish Mort Ages 1-11	Yield/R	SSB/R
Average Current	0.189	0.042	0.133
$\mathbf{F}_{max}$	0.188	0.042	0.134
$\mathbf{F}_{0.1}$	0.111	0.039	0.263
$\mathbf{F}_{med}$	0.162	0.041	0.167

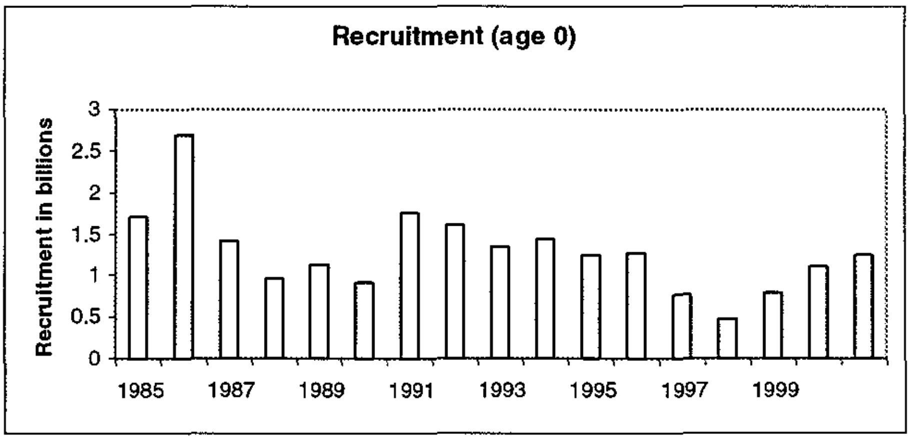
Catch data (Tables 3.5.11.1 and 3.11.6.1-3):

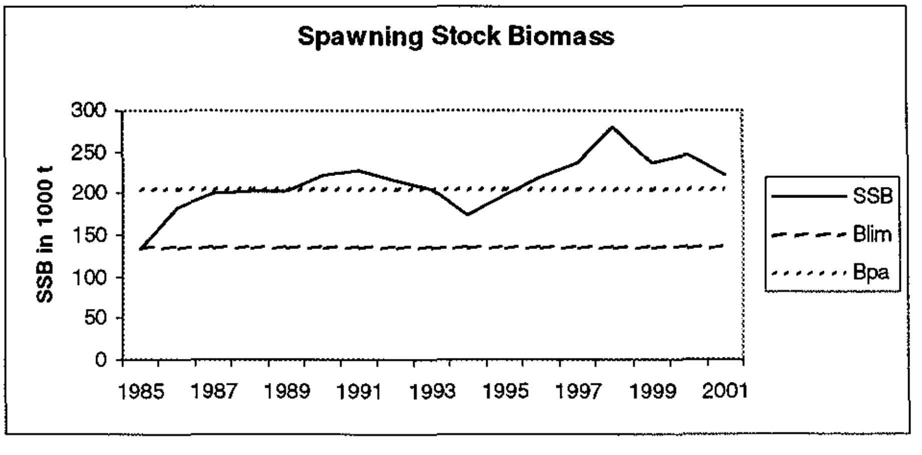
Year	ICES Advice	Predicted catch corresp. to advice[1]	Agreed TAC[1]	ACFM Landings[2]
1987	Not assessed	-	72.5[3]	55
1988	Mesh size increase	-	82.0[3]	56
1989	No increase in F; TAC	72.5	73.0[3]	56
1990	F at $\mathbf{F}_{0.1}$; TAC	38	55.0[4]	49
1991	Precautionary TAC	61	73.0[4]	46
1992	If required, precautionary TAC	61	73.0[4]	51
1993	No advice	-	73.0[4]	57
1994	*Status quo* prediction	55[5]	73.0[4]	53
1995	No long-term gains in increasing F	63[5]	73.0[4]	53
1996	No long-term gains in increasing F	60[5]	73.0[4]	45
1997	No advice	-	73.0[4]	57
1998	F should not exceed the F(94–96)	59	73.0[4]	64
1999	No increase in F	58	73.0[4]	52
2000	F $<\mathbf{F}_{pa}$	<59	68.0[4]	49
2001	F $<\mathbf{F}_{pa}$	<54	68.0[4]	
2002	F <0.113	<34		

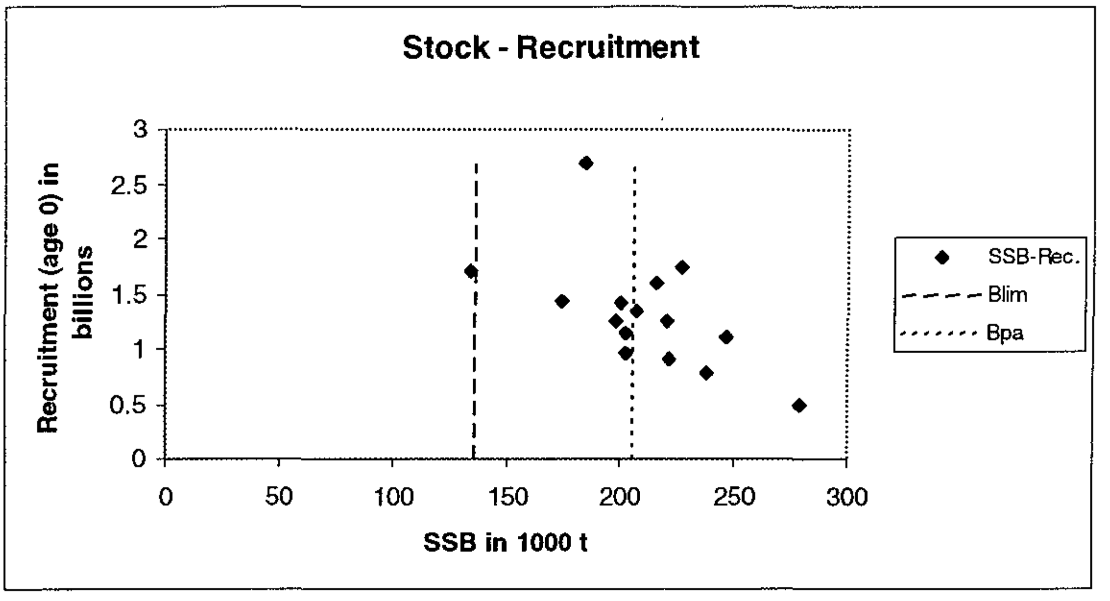
[1]Includes all *Trachurus* spp. [2]Includes only *Trachurus trachurus* L. [3]Division VIIIc, Sub-areas IX and X, and CECAF Division 34.1.1 (EC waters only). [4] Division VIIIc and Sub-area IX. [5]Catch at *status quo* F. Weights in '000 t.

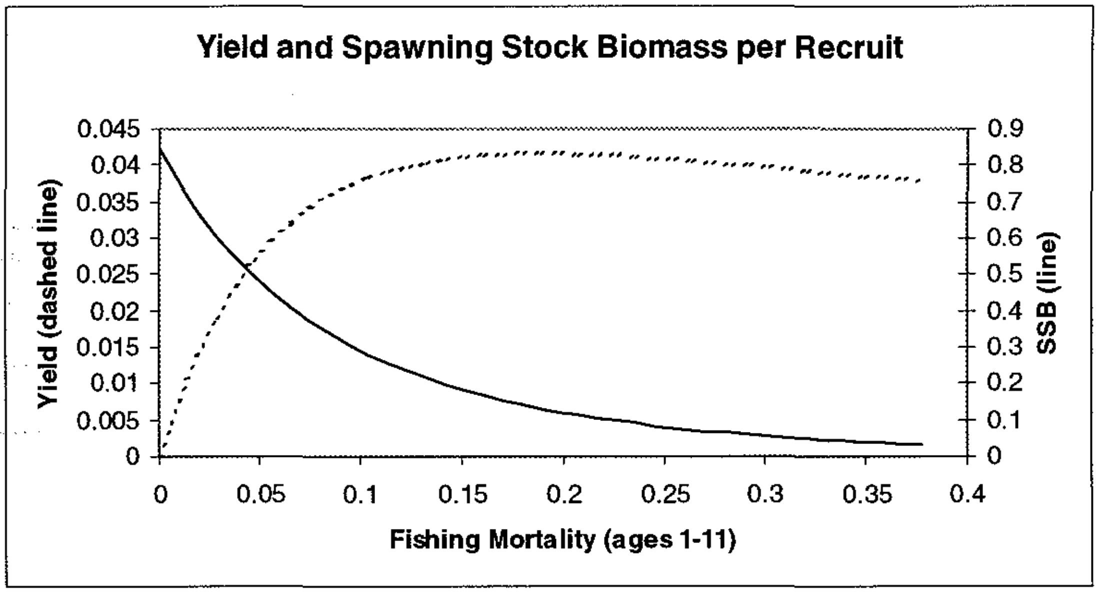

Landings
Landings in 1000 t
80
70
60
50
40
30
20
10
0
1985
1987
1989
1991
1993
1995
1997
1999


Fishing Mortality
F(ages 1-11)
0.4
0.3
0.3
0.2
0.2
0.1
0.1
0.0
1985
1987
1989
1991
1993
1995
1997
1999
F
Flim
Fpa


Recruitment (age 0)
Recruitment in billions
3
2.5
2
1.5
1
0.5
0
1985
1987
1989
1991
1993
1995
1997
1999


Spawning Stock Biomass
SSB in 1000 t
300
250
200
150
100
50
0
1985
1987
1989
1991
1993
1995
1997
1999
2001
SSB
Blim
Bpa


Stock - Recruitment
Recruitment (age 0) in billions
3
2.5
2
1.5
1
0.5
0
0
50
100
150
200
250
300
SSB in 1000 t
SSB-Rec.
Blim
Bpa


Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
0.045
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
SSB (line)
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
Fishing Mortality (ages 1-11)

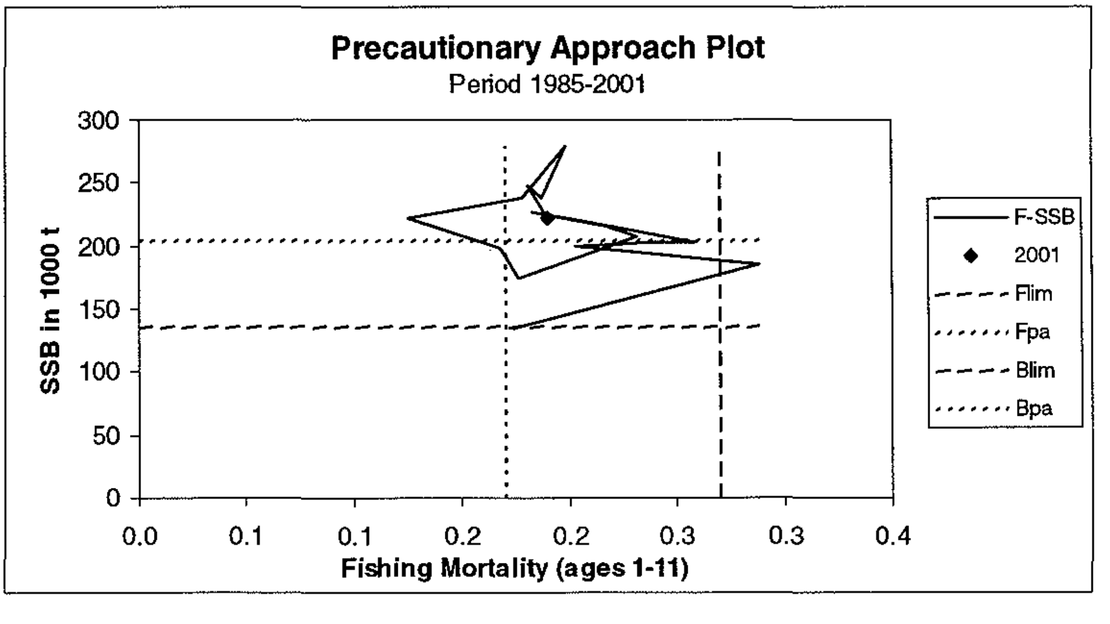

Precautionary Approach Plot
Period 1985-2001
SSB in 1000 t
300
250
200
150
100
50
0
0.0
0.1
0.1
0.2
0.2
0.3
0.3
0.4
Fishing Mortality (ages 1-11)
F-SSB
2001
Flim
Fpa
Blim
Bpa

Table 3.11.6.1 Annual catches (tonnes) of Southern Horse mackerel by countries by gear in Divisions VIIIc and IXa. Data from 1984–2000 are Working Group estimates.

Year	Portugal (Division IXa)				Spain (Divisions IXa + VIIIc)					Total VIIIc+IXa
	Trawl	Seine	Artisanal	Total	Trawl	Seine	Hook	Gillnet	Total	
1963	6,593	54,267	3,900	64,760	-	-	-	-	53,420	118,180
1964	8,983	55,693	4,100	68,776	-	-	-	-	57,365	126,141
1965	4,033	54,327	4,745	63,105	-	-	-	-	52,282	115,387
1966	5,582	44,725	7,118	57,425	-	-	-	-	47,000	104,425
1967	6,726	52,643	7,279	66,648	-	-	-	-	53,351	119,999
1968	11,427	61,985	7,252	80,664	-	-	-	-	62,326	142,990
1969	19,839	36,373	6,275	62,487	-	-	-	-	85,781	148,268
1970	32,475	29,392	7,079	59,946	-	-	-	-	98,418	158,364
1971	32,309	19,050	6,108	57,467	-	-	-	-	75,349	132,816
1972	45,452	28,515	7,066	81,033	-	-	-	-	82,247	163,280
1973	28,354	10,737	6,406	45,497	-	-	-	-	114,878	160,375
1974	29,916	14,962	3,227	48,105	-	-	-	-	78,105	126,210
1975	26,786	10,149	9,486	46,421	-	-	-	-	85,688	132,109
1976	26,850	16,833	7,805	51,488	89,197	26,291	376[1]	-	115,864	167,352
1977	26,441	16,847	7,790	51,078	74,469	31,431	376[1]	-	106,276	157,354
1978	23,411	4,561	4,071	32,043	80,121	14,945	376[1]	-	95,442	127,485
1979	19,331	2,906	4,680	26,917	48,518	7,428	376[1]	-	56,322	83,239
1980	14,646	4,575	6,003	25,224	36,489	8,948	376[1]	-	45,813	71,037
1981	11,917	5,194	6,642	23,733	28,776	19,330	376[1]	-	48,482	72,235
1982	12,676	9,906	8,304	30,886	-[2]	-[2]	-[2]	-	28,450	59,336
1983	16,768	6,442	7,741	30,951	8,511	34,054	797	-	43,362	74,313
1984	8,603	3,732	4,972	17,307	12,772	15,334	884	-	28,990	46,297
1985	3,579	2,143	3,698	9,420	16,612	16,555	949	-	34,109	43,529
1986	-[2]	-[2]	-[2]	28,526	9,464	32,878	481	143	42,967	71,493
1987	11,457	6,744	3,244	21,445	-[2]	-[2]	-[2]	-[2]	33,193	54,648
1988	11,621	9,067	4,941	25,629	-[2]	-[2]	-[2]	-[2]	30,763	56,392
1989	12,517	8,203	4,511	25,231	-[2]	-[2]	-[2]	-[2]	31,170	56,401
1990	10,060	5,985	3,913	19,958	10,876	17,951	262	158	29,247	49,205
1991	9,437	5,003	3,056	17,497	9,681	18,019	187	127	28,014	45,511
1992	12,189	7,027	3,438	22,654	11,146	16,972	81	103	28,302	50,956
1993	14,706	4,679	6,363	25,747	14,506	16,897	124	154	31,681	57,428
1994	10,494	5,366	3,201	19,061	10,864	22,382	145	136	33,527	52,588
1995	12,620	2,945	2,133	17,698	11,589	23,125	162	107	34,983	52,681
1996	7,583	2,085	4,385	14,053	10,360	19,917	214	146	30,637	44,690
1997	9,446	5,332	1,958	16,736	8,140	31,582	169	143	40,034	56,770
1998	13,221	5,906	2,217	21,334	13,150	29,805	63	118	43,136	64,480
1999	6,866	5,705	1,849	14,420	10,015	27,332	29	126	37,502	51,922
2000	7,971	4,209	2,168	15,348	10,144	23,373	59	214	33,790	49,138

[1] Estimated value.

[2] Not available by gear.

Table 3.11.6.2 Landings and discards of HORSE MACKEREL (t) by year and division, for the Southern horse mackerel. (Data submitted by Working Group members.)

Year	VIIIc	IXa	Total	Grand Total
1982	19,610	39,726	59,336	104,958
1983	25,580	48,733	74,313	147,195
1984	23,119	23,178	46,297	149,400
1985	23,292	20,237	43,529	150,830
1986	40,334	31,159	71,493	201,806
1987	30,098	24,540	54,638	223,512
1988	26,629	29,763	56,392	268,163
1989	27,170	29,231	56,401	358,533
1990	25,182	24,023	49,205	441,430
1991	23,733	21,778	45,511	391,066
1992	24,243	26,713	50,955	436,548
1993	25,483	31,945	57,428	504,190
1994	24,147	28,442	52,589	447,153
1995	27,534	25,147	52,681	580,034
1996	24,290	20,400	44,690	460,185
1997	29,129	27,642	56,771	518,882
1998	22,906	41,574	64,480	398,523
1999	24,188	27,733	51,921	363,033
2000	21,978	27,160	49,138	272,496

Table 3.11.6.3 Southern horse mackerel (Divisions VIIIc and IXa).

Year	Recruitment Age 0 thousands	SSB tonnes	Landings tonnes	Mean F Ages 1-11
1985	1702128	133674	43535	0.1737
1986	2690280	184334	71258	0.2887
1987	1418792	199877	52747	0.2029
1988	955838	202824	55888	0.2388
1989	1139949	202474	56396	0.2591
1990	902226	221905	49207	0.1980
1991	1746939	226600	45511	0.1825
1992	1601784	215283	50956	0.2173
1993	1344551	206786	57428	0.2311
1994	1437281	174170	52588	0.1761
1995	1255421	198507	52681	0.1679
1996	1261660	221262	44690	0.1248
1997	779452	238176	56770	0.1778
1998	491284	279463	64480	0.1981
1999	783824	238302	51922	0.1877
2000	1100975	246863	49138	0.1809
2001	1242705	221482		0.1900
Average	1285593	212470	53450	0.1997

3.11.7 Sardine

3.11.7.a Sardine in Divisions VIIIc and IXa

State of stock/exploitation: No precautionary approach reference points have been proposed for this stock. Fishing mortality has decreased since 1998 and spawning stock biomass has remained at a low level. The perception of the state of the stock depends on the relative contributions to the stock from the northern and southern areas. These relative contributions are presently unknown. Abundance is reduced in the northern part while abundance has been stable in the south. Acoustic surveys indicate a strong 2000 year class, but its size is still uncertain since previous indications of strong recruitment for this stock have later been shown to be overly optimistic. Since the early 1990s, there has been an overall decrease of the distribution area.

Management objectives: There are no explicit management objectives for this stock.

Advice on management: ICES recommends that fishing mortality be reduced to below F=0.25, corresponding to a catch of less than 95 000 t in 2002 in order to prevent short-term decline in stock size.

Comparison with previous assessment and advice: Trends in this year assessment agree well with the previous one. SSBs in the most recent years have been adjusted downward because the strength of the 1998 year class was re-evaluated.

Relevant factors to be considered in management: At present the spawning stock biomass is considered to be close to its lowest historical level. The 1998 year class, which initially was estimated to be a strong year class, now appears to be below the geometric mean of the time series. Acoustic surveys indicated a strong 2000 year class, which mainly occurred off north Portugal.

Fishing mortality increased from 1995 to 1998, when its highest value since 1980 was reached. Fishing mortality decreased since 1998. Spain and Portugal undertook management measures to reduce fishing effort (i.e. closed periods, limitation of fishing days) and the overall catches (daily and/or annual allowable catches per boat and/or per fisherman organisation), which may have contributed to the reduction in the fishing mortality.

Catch forecast for 2002:

Basis: F(2001) = $\mathbf{F}_{sq}$(2000) = 0.28; Landings (2001) = 99,582; SSB (2001)=339.

F (2002)	Basis	SSB (2002)	Catch IXa (2002)	Catch VIIIc (2002)	Total Catch (2002)	SSB (2003)
0.20	0.7*$\mathbf{F}_{sq}$	347	63	13	76	359
0.22	0.8*$\mathbf{F}_{sq}$	345	71	14	85	350
0.25	0.9*$\mathbf{F}_{sq}$	343	79	16	95	341
0.28	$\mathbf{F}_{sq}$	341	86	17	103	333

Weights in 000't.

Shaded scenarios likely to cause decrease in SSB.

The catches are allocated to areas according to the proportion of catch-at-age by area in recent years (1998-2000). This forecast is based on the assumption of no change in the spatial distribution of the population and stable fishing mortality levels. However, changes in the spatial distribution are being observed.

Elaboration and special comment: Since the 1940s there have been periods of high and low sardine landings (Figure 3.11.7.a.1). Because of spatial changes in fish distribution and the shift of the exploitation pattern towards older ages in the southern area it is difficult to obtain a meaningful comparison between the stock size and the fishing mortality in the mid-1980s and the late 1990s, and to provide accurate estimates of the state of the stock.

The current assessment model is shown to be robust (both in relation to goodness-of-fit and stock trajectory) to the addition of new input data, but uncertainties about accuracy of estimates, and therefore about absolute stock levels still remain. The fishing mortality decreased from 1990 to 1995, then increased until 1998 when it reached its highest value since 1980. There was a sharp decrease in 1999. Mean recruitment in the 1990s is estimated to be lower than the mean recruitment in the 1980s. The stock shows two periods of high productivity in the mid-1980s and mid-1990s. Periods of low productivity occurred at the beginning of the 1980s, the beginning of the 1990s, and at present.

The changes in stock abundance in different areas remain a matter of concern. The biological relationship between the different areas and the general stock definitions are still unclear. This may imply a vulnerability of the fishery at both a local and a global level. Therefore, close monitoring of this stock is still needed, as well as a better understanding of the stock structure and behaviour.

As absolute values of historic stock size cannot be calculated reliably and in view of uncertainty about the biology of the stock, ICES does not have a proper basis to propose precautionary reference points for management purposes.

The analytical assessment used was based on catches in numbers and by age, acoustic survey results, and egg surveys in 1988, 1997, and 1999.

Source of information: Report of the Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine and Anchovy, September 2001 (ICES CM 2002/ACFM:06).

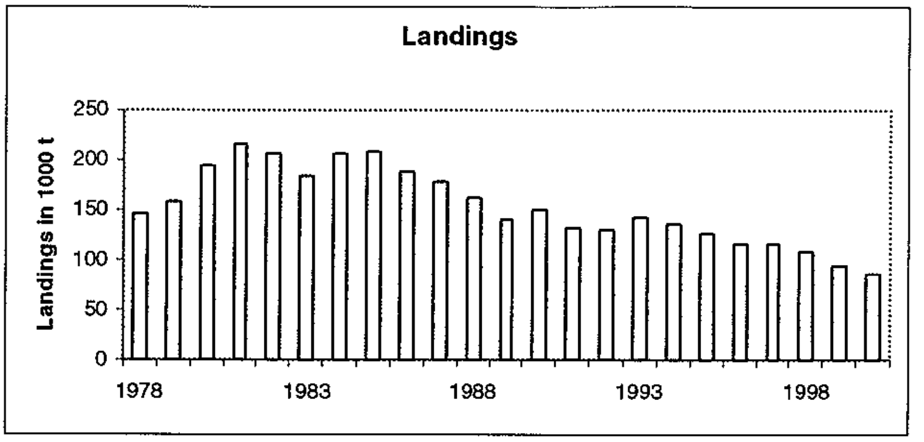
Yield and spawning biomass per Recruit F-reference points:

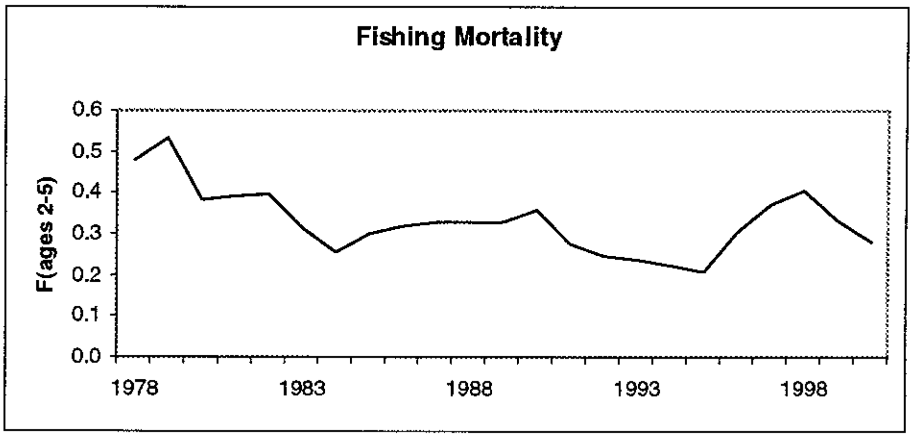
	Fish Mort Ages 2-5	Yield/R	SSB/R
Average Current	0.623	0.021	0.031
F_{max}	2.101	0.023	0.007
$F_{0.1}$	0.356	0.018	0.047
F_{med}	0.319	0.017	0.050

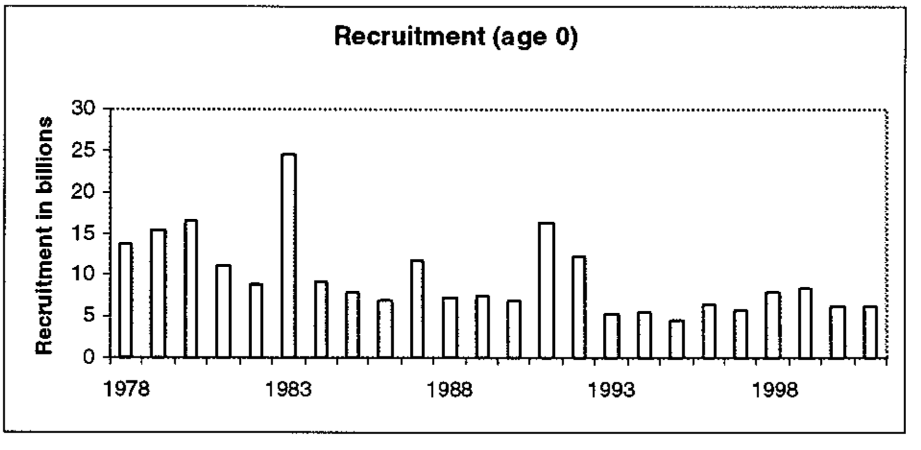
Catch data (Tables 3.11.7.a.1–2):

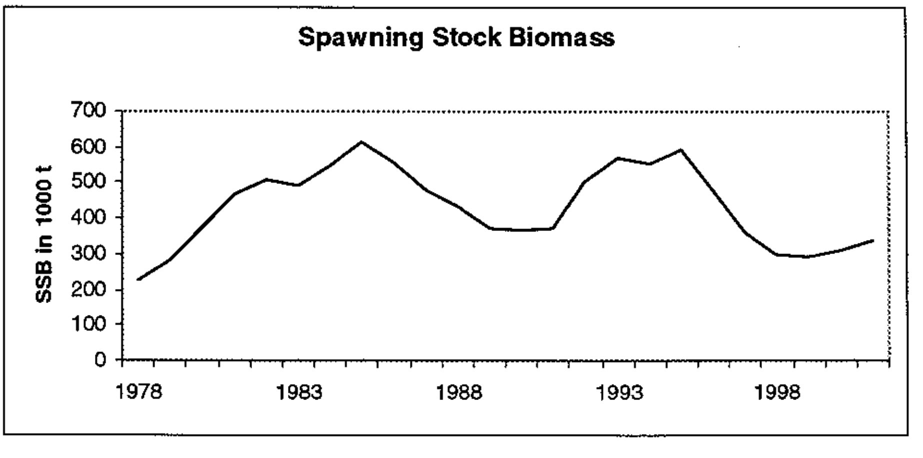
Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC	Official Landings VIII & IX	ACFM Landings[3]
1987	No increase in F; TAC	140	-		178
1988	No increase in F; TAC	150	-	167	162
1989	No increase in F; TAC	212	-	146	141
1990	Room for increased F	227[2]	-	150	149
1991	Precautionary TAC	176	-	135	133
1992	No advice	-	-	139	130
1993	Precautionary TAC	135	-	153	142
1994	No advice	118[1]	-	147	137
1995	No advice; apparently stable stock	-	-	137	125
1996	Lowest possible level	-	-	134	117
1997	Lowest possible level	-	-	n/a	116
1998	Significant reduction	-	-	n/a	109
1999	Reduce F to 0.2	38	-	n/a	94
2000	F below 0.2	<81	-	n/a	86
2001	F below 0.2	<88	-		
2002	F below 0.25	<95			

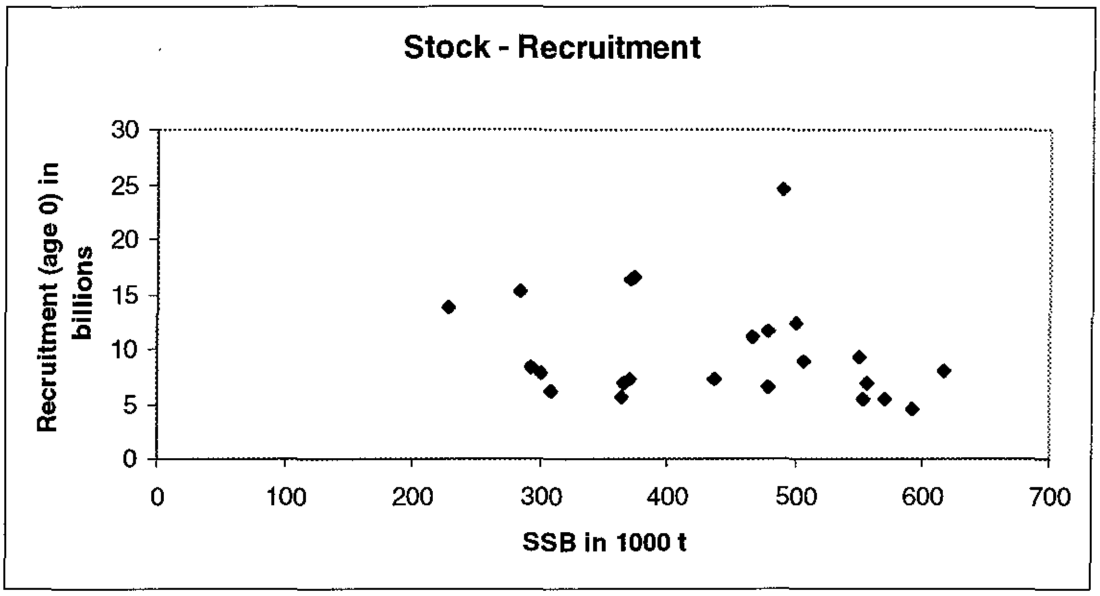
[1]Estimated catch at *Status quo* F. [2]Catch corresponding to 20% increase in F. [3] Includes only VIIIc and IXa. N/a=not available. Weights in '000 t.


Landings
Landings in 1000 t
250
200
150
100
50
0
1978
1983
1988
1993
1998


Fishing Mortality
F(ages 2-5)
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1978
1983
1988
1993
1998


Recruitment (age 0)
Recruitment in billions
30
25
20
15
10
5
0
1978
1983
1988
1993
1998


Spawning Stock Biomass
SSB in 1000 t
700
600
500
400
300
200
100
0
1978
1983
1988
1993
1998


Stock - Recruitment
Recruitment (age 0) in billions
30
25
20
15
10
5
0
0
100
200
300
400
500
600
700
SSB in 1000 t

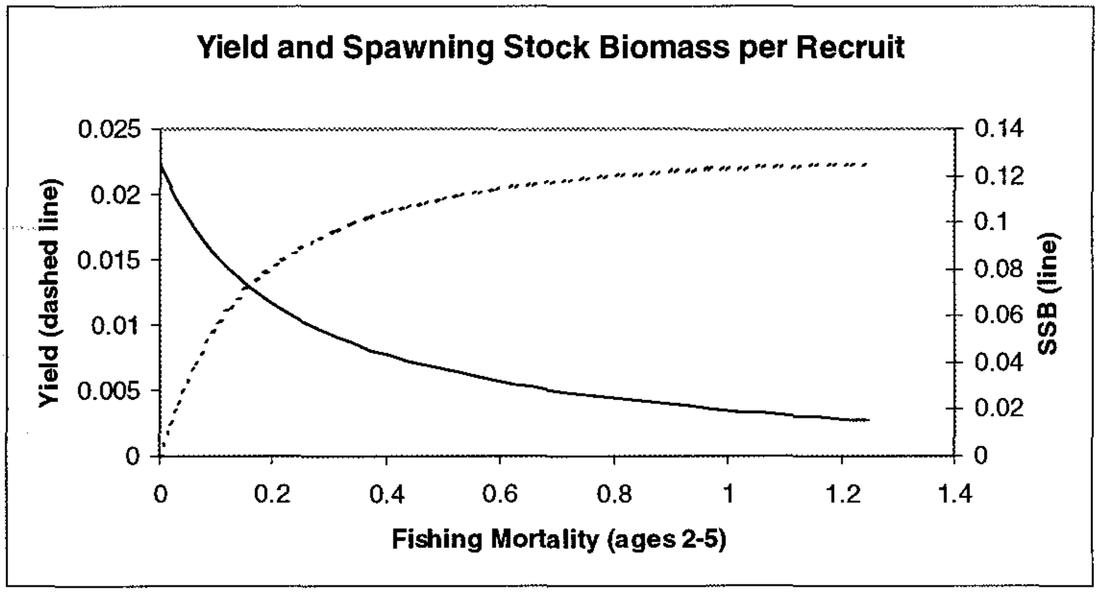

Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
0.025
0.02
0.015
0.01
0.005
0
SSB (line)
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
0
0.2
0.4
0.6
0.8
1
1.2
1.4
Fishing Mortality (ages 2-5)

Table 3.11.7.a.1 Annual landings (t) of SARDINE in Divisions VIIIc and IXa by country.

Country	1979	1980	1981	1982	1983	1984	1985
Portugal	91,294	106,302	113,253	100,859	85,922	95,110	111,709
Spain	62,147	85,380	100,880	103,645	95,217	107,576	92,398
Cadiz (IXa South, Spain)	3,800	3,120	2,384	2,442	2,688	3,319	4,333
Total*	153,441	191,682	214,133	204,504	181,139	202,686	204,107

Country	1986	1987	1988	1989	1990	1991	1992
Portugal	103,451	90,214	93,591	91,091	96,173	92,638[1]	83,315
Spain	77,155	78,611	64,949	46,035	46,753	35,118	42,739
Cadiz (IXa South, Spain)	6,757	8,870	2,990	3,835	6,503	4,834	4,196
Total*	180,606	168,825	158,540	137,126	142,926	127,756	126,054

Country	1993	1994	1995	1996	1997	1998	1999
Portugal	90,440	94,468	87,818	85,757	81,156	82,890	71,820
Spain	48,391	38,332	33,466	25,674	27,878	19,440	14,425
Cadiz (IXa South, Spain)	3,664	3,782	3,996	5,304	6,780	6,594	7,846
Total*	138,831	132,800	121,284	111,431	109,034	102,330	86,245

Country	2000
Portugal	66,141
Spain	14,563
Cadiz (IXa South, Spain)	5,081
Total*	

* not including Cadiz.
[1] Discards included.

Table 3.11.7.a.2 Sardine in Divisions VIIIc and IXa.

Year	Recruitment Age 0 thousands	SSB tonnes	Landings tonnes	Mean F Ages 2-5
1978	13748910	228162	145609	0.4803
1979	15354210	283937	157241	0.5323
1980	16603470	372471	194802	0.3844
1981	11140240	466477	216517	0.3933
1982	8892810	506191	206946	0.3980
1983	24496160	488610	183837	0.3155
1984	9186950	550170	206005	0.2550
1985	7938500	616981	208440	0.3018
1986	6850950	556537	187363	0.3207
1987	11641250	479231	177695	0.3307
1988	7281170	437094	161530	0.3292
1989	7359780	370538	140962	0.3311
1990	6973470	365941	149430	0.3573
1991	16412880	370031	132587	0.2766
1992	12324890	500935	130249	0.2454
1993	5375280	569446	142495	0.2379
1994	5491690	552506	136581	0.2215
1995	4507750	592137	125280	0.2097
1996	6518300	478631	116736	0.3070
1997	5679010	363595	115814	0.3718
1998	7812650	300651	108925	0.4080
1999	8343200	293197	94091	0.3358
2000	6252305	308469	85786	0.2799
2001	6252305	339424		0.2799
Average	9684922	432973	153257	0.3293

3.11.8 Anchovy

3.11.8.a Anchovy in Sub-area VIII (Bay of Biscay)

State of stock/exploitation: The stock is inside safe biological limits in 2001. SSB is above $\mathbf{B}_{pa}$, and the fishing mortality has remained well below $\mathbf{F}_{pa}$ in recent years.

Management objectives: There are no explicit management objectives for this stock. However, for any management objectives to meet precautionary criteria, their aim should be to keep SSB above $\mathbf{B}_{pa}$ and reduce or maintain F below $\mathbf{F}_{pa}$.

Precautionary Approach reference points (established in 1998):

ICES considers that:	ICES proposes that:
$\mathbf{B}_{lim}$ is 18 000 t, the lowest observed biomass.	$\mathbf{B}_{pa}$ = 36 000 t.
There is no biological basis for defining $\mathbf{F}_{lim}$.	$\mathbf{F}_{pa}$ be established between 1.0–1.2.

Technical basis:

$\mathbf{B}_{lim} = \mathbf{B}_{loss}$ = 18 000 t.	$\mathbf{B}_{pa}$= SSB that can withstand two successive years of poor recruitment.
	$\mathbf{F}_{pa}$= F for 50% spawning potential ratio, i.e., the F at which the SSB/R is half of what it would have been in the absence of fishing.

Advice on management: ICES recommends that a preliminary TAC for 2002 is set to 33 000 t. This is based on the conservative assumption that recruitment in 2001 and beyond is 8.5 billion (mean of the below mean year classes in the historical series), and that the fishing mortality is the average of that of recent years (F=0.65). This TAC should be revised in the middle of the year 2002, based on the results of the fishery and of acoustic and egg surveys in May-June.

Comparison with previous assessment and advice: The year class 2000 was in the previous assessment set to be of average strength. The estimate now available is almost five times that value. Also the survey indices have been revisited and this has resulted in an upward adjustment of SSB.

Relevant factors to be considered in management: Due to the short life span of the anchovy, the fishery depends largely on the abundance of the incoming year class, the abundance of which cannot be estimated before the next spring as one-year-olds. Advice for the full year related to biomass reference points will have to be conservative, and maybe more restrictive than necessary. Therefore, ICES proposes that if the fishery is regulated with a TAC based on an analytical approach, a two-stage management regime should be implemented. In such a two-stage regime, a preliminary TAC should be set at the beginning of the year based on an analytic assessment in the autumn, and revised according to measurements of the stock by acoustic and Daily Egg Production Method (DEPM) surveys in May-June. In order to be precautionary, the preliminary TAC set at the beginning of the year should aim at keeping the stock safely above $\mathbf{B}_{lim}$ even if the incoming year class is poor.

Catch forecast for 2002:

Basis: Landings (2001) = 33,000 t; F(2001) = 0.43; SSB (2001) = 95.

F(2002)	Basis	SSB (2002)	Catch (2002)
0.13	$0.2F_{(95\text{-}2000)}$	63	8
0.26	$0.4F_{(95\text{-}2000)}$	60	15
0.39	$0.6F_{(95\text{-}2000)}$	57	22
0.52	$0.8F_{(95\text{-}2000)}$	54	28
0.65	$F_{(95\text{-}2000)}$	51	33
0.78	$1.2F_{(95\text{-}2000)}$	49	38
0.91	$1.4F_{(95\text{-}2000)}$	46	42

Weights in '000 t.

Elaboration and special comments: The abundance of this short-lived species will vary considerably according to fluctuations in recruitment. The recruitment is likely to be strongly dependent on environmental factors. The low accuracy of the environmental indexes as recruitment predictors makes it impossible at present to estimate the population abundance one year in advance. ICES considers that a full operative model to evaluate alternative management regimes, including the one proposed by STECF, needs to be developed.

The stock is exploited by Spanish purse seiners, mostly in the first half of the year, and French trawlers mostly in the second half of the year. Most of the fish (around 85%) have spawned at least once before being caught, since the French fishery takes place outside the spawning season and the Spanish fishery is outside the spawning area.

Analytical assessment (ICA) is based on catch-at-age data from French and Spanish fisheries and stock biomass estimates from egg (1987–2001) and acoustic surveys (1989–2001).

Source of information: Report of the Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine and Anchovy, September 2001 (ICES CM 2002/ACFM:06).

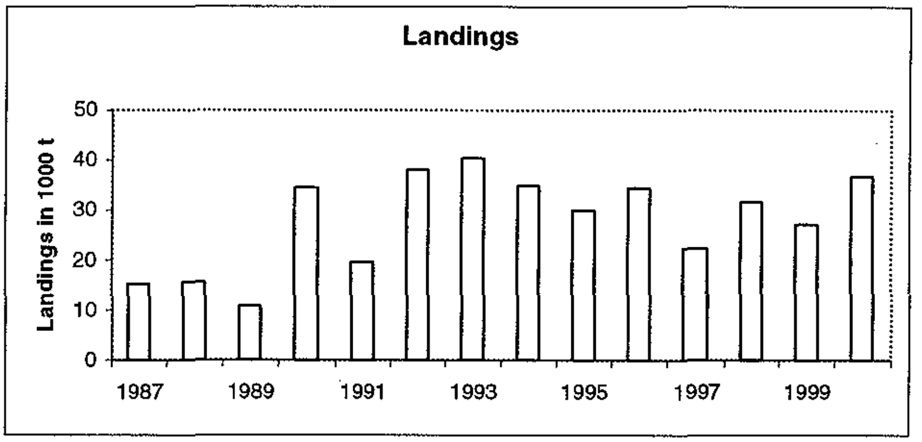
Yield and Spawning Biomass Per Recruit F-Reference Points:

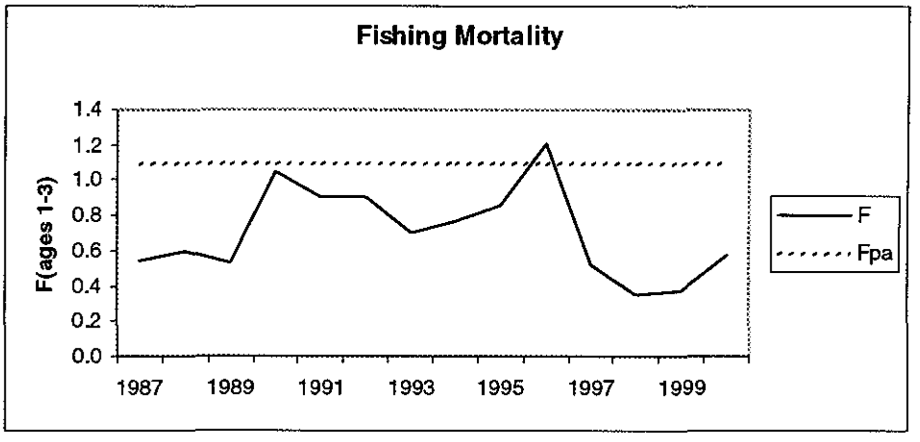
	Fish Mort Ages 1-3	Yield/R	SSB/R
Average Current	0.754	0.002	0.007
$\mathbf{F_{max}}$	N/A		
$\mathbf{F_{0.1}}$	2.874	0.004	0.005
$\mathbf{F_{med}}$	N/A		

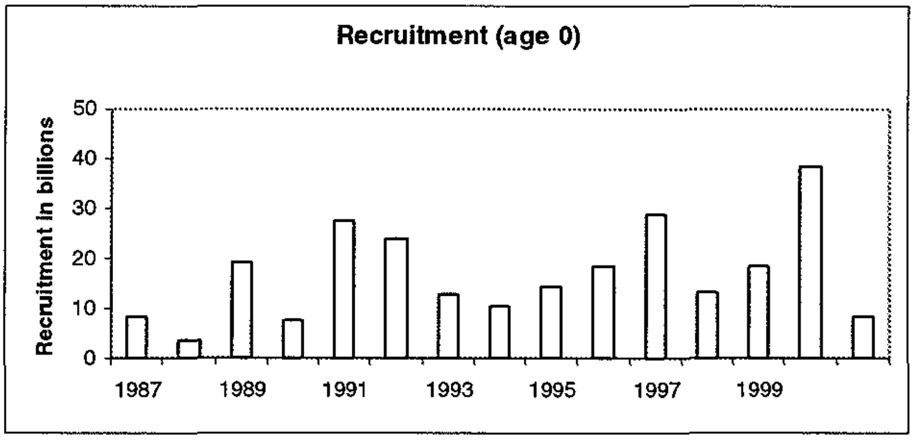
Catch data (Tables 3.11.8.a.1–2):

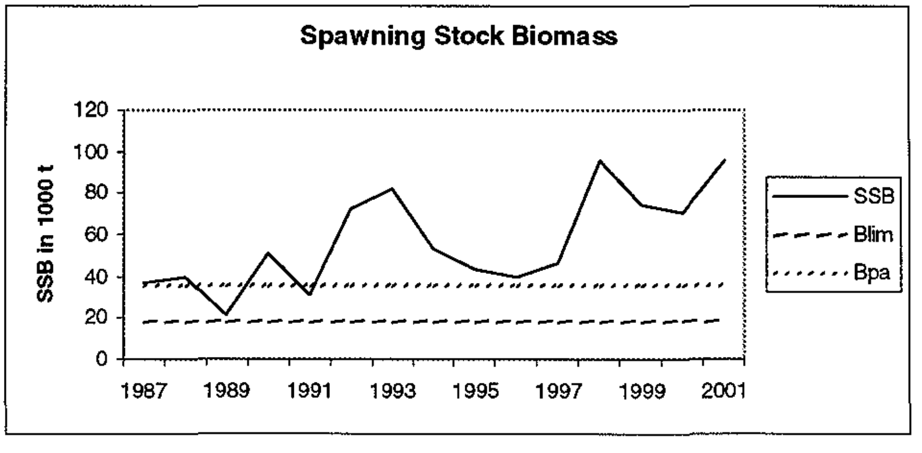
Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC	Official landings	ACFM landings
1987	Not assessed	-	32	14	15
1988	Not assessed	-	32	14	16
1989	Increase SSB; TAC	10.0[1]	32	n/a	11
1990	Precautionary TAC	12.3	30	n/a	34
1991	Precautionary TAC	14.0	30	n/a	20
1992	No advice	-	30	n/a	38
1993	Reduced F on juveniles; closed area	-	30	n/a	40
1994	Reduced F on juveniles; closed area	-	30	n/a	35
1995	Reduced F on juveniles; closed area	-	33	n/a	30
1996	Reduced F on juveniles; closed area	-	33	n/a	34
1997	Reduced F on juveniles; closed area	-	33	n/a	22
1998	Reduced F on juveniles; closed area		33	n/a	32
1999	Reduced F on juveniles, closed area		33	n/a	27
2000	Closure of the Fishery	0.0	33	n/a	37
2001	Preliminary TAC corresponding to recent exploitation	18	33	n/a	23[2]
2002	Preliminary TAC corresponding to recent exploitation	33			

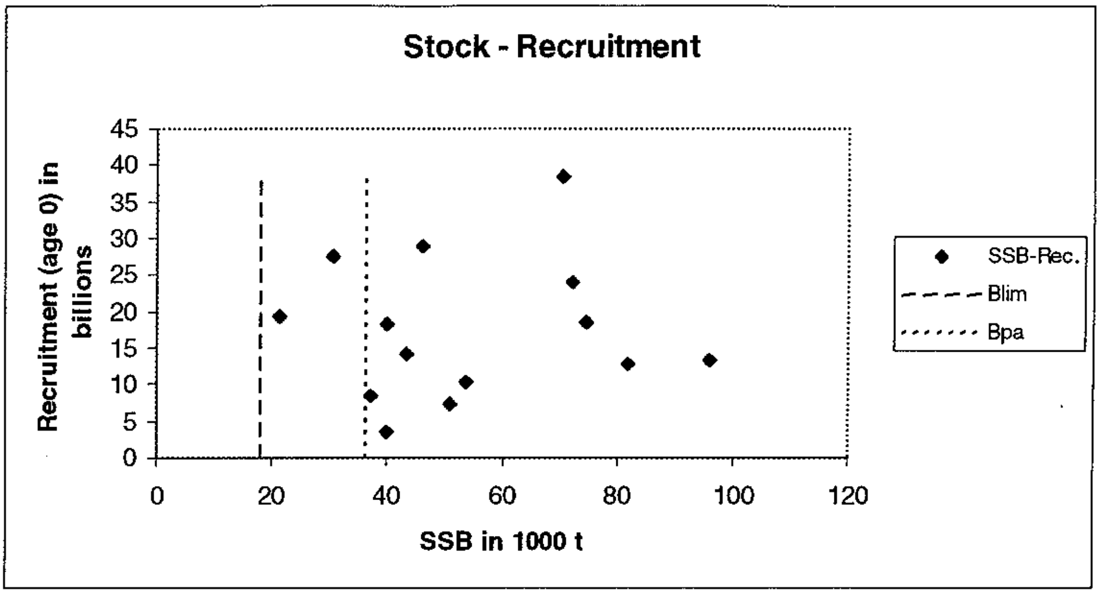
Weights in '000 t. [1]Mean catch of 1985–1987. [2]Preliminary for the first half of the year. n/a: not available.

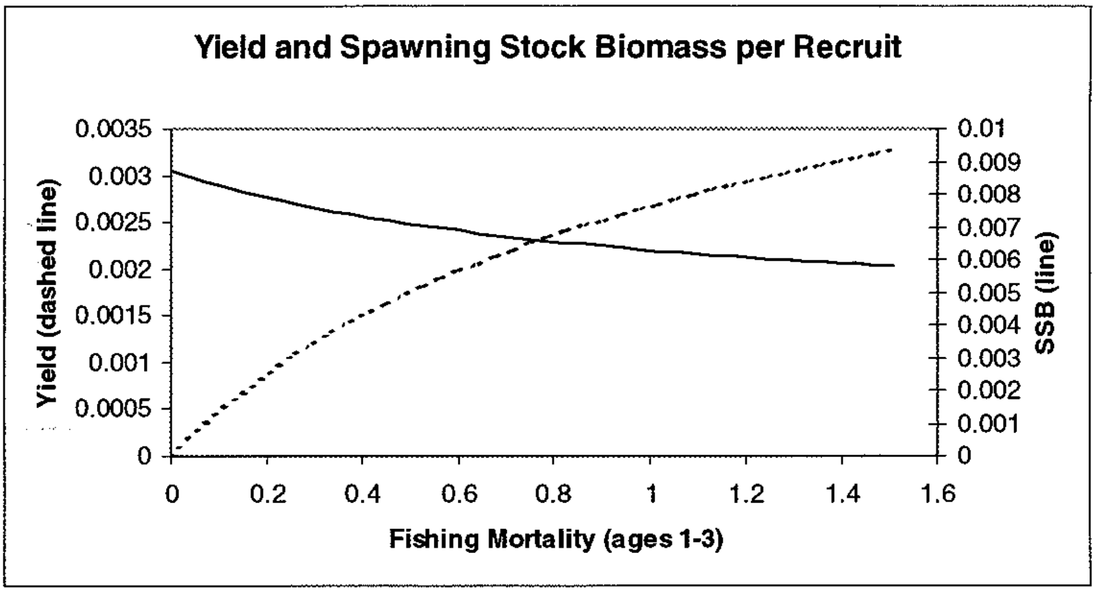

Landings
Landings in 1000 t
50
40
30
20
10
0
1987
1989
1991
1993
1995
1997
1999


Fishing Mortality
F(ages 1-3)
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1987
1989
1991
1993
1995
1997
1999
F
Fpa


Recruitment (age 0)
Recruitment in billions
50
40
30
20
10
0
1987
1989
1991
1993
1995
1997
1999


Spawning Stock Biomass
SSB in 1000 t
120
100
80
60
40
20
0
1987
1989
1991
1993
1995
1997
1999
2001
SSB
Blim
Bpa


Stock - Recruitment
Recruitment (age 0) in billions
45
40
35
30
25
20
15
10
5
0
0
20
40
60
80
100
120
SSB in 1000 t
SSB-Rec.
Blim
Bpa


Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
0.0035
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
SSB (line)
0.01
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
Fishing Mortality (ages 1-3)

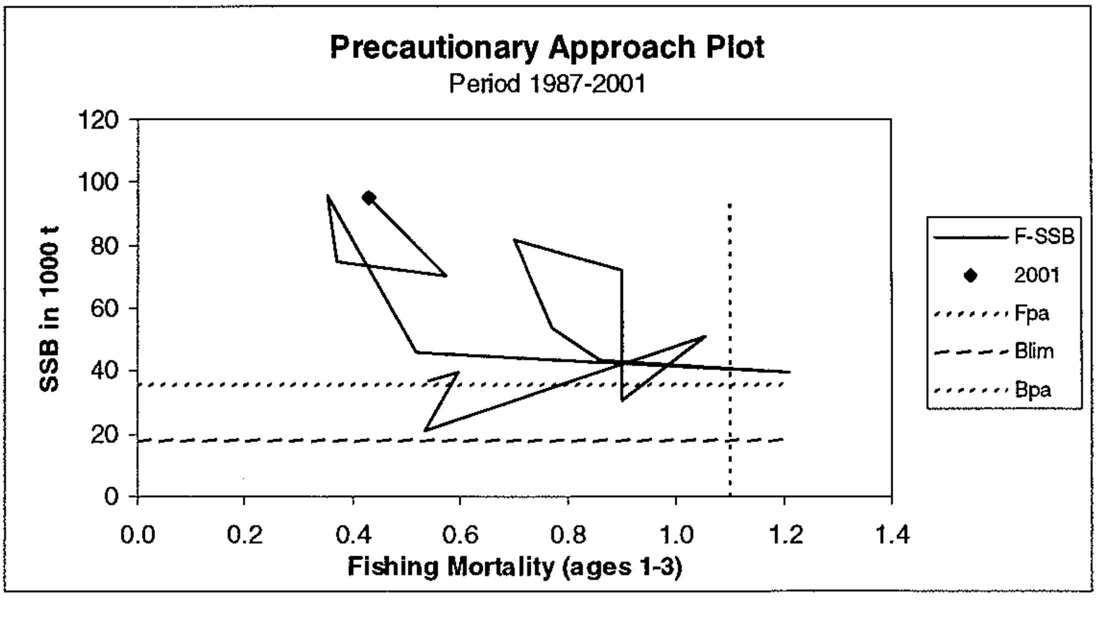

Precautionary Approach Plot
Period 1987-2001
SSB in 1000 t
120
100
80
60
40
20
0
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
Fishing Mortality (ages 1-3)
F-SSB
2001
Fpa
Blim
Bpa

Table 3.11.8.a.1 Annual catches (in tonnes) of Bay of Biscay Anchovy (Sub-area VIII). As estimated by the Working Group members.

Country	France	Spain	Spain	International
Year	VIIIa,b	VIIIb,c, Landings	Live Bait Catches	VIII
1960	1,085	57,000	n/a	58,085
1961	1,494	74,000	n/a	75,494
1962	1,123	58,000	n/a	59,123
1963	652	48,000	n/a	48,652
1964	1,973	75,000	n/a	76,973
1965	2,615	81,000	n/a	83,615
1966	839	47,519	n/a	48,358
1967	1,812	39,363	n/a	41,175
1968	1,190	38,429	n/a	39,619
1969	2,991	33,092	n/a	36,083
1970	3,665	19,820	n/a	23,485
1971	4,825	23,787	n/a	28,612
1972	6,150	26,917	n/a	33,067
1973	4,395	23,614	n/a	28,009
1974	3,835	27,282	n/a	31,117
1975	2,913	23,389	n/a	26,302
1976	1,095	36,166	n/a	37,261
1977	3,807	44,384	n/a	48,191
1978	3,683	41,536	n/a	45,219
1979	1,349	25,000	n/a	26,349
1980	1,564	20,538	n/a	22,102
1981	1,021	9,794	n/a	10,815
1982	381	4,610	n/a	4,991
1983	1,911	12,242	n/a	14,153
1984	1,711	33,468	n/a	35,179
1985	3,005	8,481	n/a	11,486
1986	2,311	5,612	n/a	7,923
1987	4,899	9,863	546	15,308
1988	6,822	8,266	493	15,581
1989	2,255	8,174	185	10,614
1990	10,598	23,258	416	34,272
1991	9,708	9,573	353	19,634
1992	15,217	22,468	200	37,885
1993	20,914	19,173	306	40,393
1994	16,934	17,554	143	34,631
1995	10,892	18,950	273	30,115
1996	15,238	18,937	198	34,373
1997	12,020	9,939	378	22,337
1998	22,987	8,455	176	31,617
1999	13,649	13,145	465	27,259
2000	17,765	19,230	n/a	36,994
2001	2,548	20,650		23,198
Average (1960–2000)	5,934	27,927	318	33,962

Provisional estimate for the first half of the year.
n/a=not available.

Table 3.11.8.a.2 Anchovy in Sub-area VIII (Bay of Biscay).

Year	Recruitment Age 0 thousands	SSB tonnes	Landings tonnes	Mean F Ages 1-3
1987	8507240	37187	15308	0.5392
1988	3460910	39812	15581	0.5962
1989	19287970	21265	10614	0.5325
1990	7456310	51031	34272	1.0528
1991	27443140	30641	19634	0.9015
1992	24011310	72241	37885	0.9017
1993	12716740	81905	40293	0.7024
1994	10405430	53638	34631	0.7723
1995	14254180	43310	30115	0.8592
1996	18262000	39816	34373	1.2096
1997	28812110	46136	22337	0.5169
1998	13386580	96063	31617	0.3528
1999	18419290	74552	27259	0.3700
2000	38393820	70323	36994	0.5741
2001	8543400	95344		0.4300
Average	16890695	56884	27922	0.6874

3.11.8.b Anchovy in Division IXa

State of stock/exploitation: No precautionary approach reference points have been proposed for this stock and the state of the stock in relation to safe biological limits is unknown.

Management objectives: There are no explicit management objectives for this stock.

Advice on management: ICES recommends that catches in 2002 be restricted to 4 900 t (mean catches from the period 1988-1999 (excluding 1995 and 1998)). This level should be kept until the response of the stock to the fishery is known. ICES recommends that a management plan, including monitoring of the development of the stock and of the fishery with corresponding regulations should be developed and implemented.

Relevant factors to be considered in management: It is recognised that the state of the resource can change quickly, and therefore in-year monitoring and management should be considered. At present, the scarcity of biological information for this stock hampers the provision of advice on more appropriate management measures.

Catch forecast for 2002: Not available.

Elaboration and special comments: In recent years there has been considerable progress in assembling data for assessing the stock.

There is a regular fishery for anchovy in Sub-division IXa South (Gulf of Cadiz). The fleets in the northern part of Division IXa occasionally target anchovy when its abundance is high, as occurred in 1995. Catch statistiscs are available from Portugal since 1943. Before 1988, Spanish data included catches from other areas. In 2000, catches decreased, probably caused by a large reduction in the fishing effort by the Barbate single-purpose purse-seine fleet. Most of these vessels accepted a tie-up scheme in 2000 and 2001 because the EU-Morocco Fishery Agreement was not renewed.

The differences found between areas (specially between Sub-division IXa South and the remaining ones) in trends in historical catches, size composition, growth rate, and maturity-length relationships, support the suggestion that the populations inhabiting these areas may have different biological characteristics and dynamics. Thus, the anchovy population in IXa South appears to be well established and relatively independent from other populations along the Division, which seem to be abundant only when suitable environmental conditions occur. Catches in IXa South consist largely of 0-1 year-old fish with a negligible proportion of older fish which could be attributed to either high mortality or emigration.

At present, there is not sufficient information to estimate appropriate reference points.

Source of information: Report of the Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine and Anchovy, September 2001 (ICES CM 2002/ACFM:06).

Catch data (Table 3.11.8.b.1):

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC[1]	ACFM landings
1987	Not assessed	-	4.6	n/a
1988	Not assessed	-	6	4.7
1989	Not assessed	-	6	6.0
1990	Not assessed	-	9	6.5
1991	Not assessed	-	9	5.9
1992	Not assessed	-	12	3.2
1993	If required, precautionary TAC	-	12	2.0
1994	If required, precautionary TAC	-	12	3.4
1995	If required, precautionary TAC	-	12	13.0
1996	If required, precautionary TAC	-	12	4.6
1997	If required, TAC at pre-95 catch level	-	12	5.3
1998	No advice		12	11.0
1999	If required, TAC at pre-95 catch level	4.6	13	7.4
2000	Fishery less than pre-95 level and develop and implement management plan	4.6	10	2.5
2001	Average catch excl. 95 and 98	4.9	10	
2002	Average catch excl. 95 and 98	4.9		

[1]TAC for Sub-areas IX and X and CECAF 34.1.1. n/a=not available. Weights in '000 t.

Anchovy in Division IXa

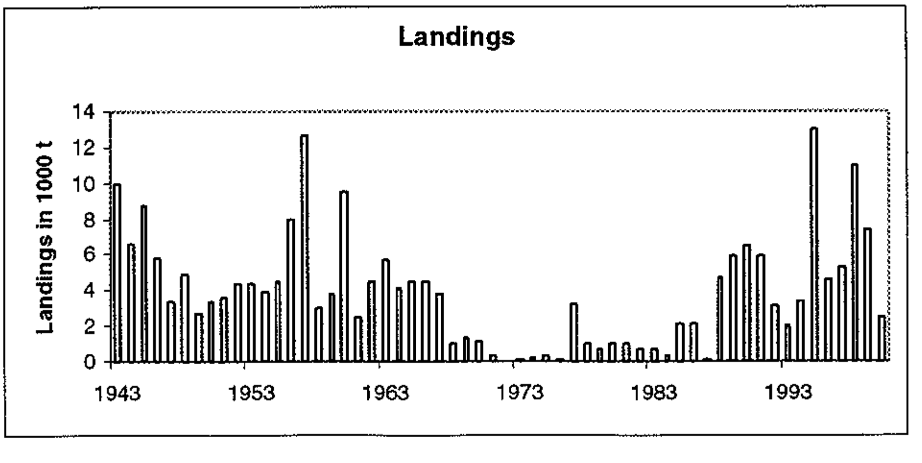


Table 3.11.8.b.1 Portuguese and Spanish annual landings (t) of Anchovy in Division IXa. (From Pestana, 1989 and 1996 and Working Group members).

	Portugal				Spain			
Year	IXa C-N	IXa C-S	IXa South	Total	IXa North	IXa South	Total	TOTAL
1943	7121	355	2499	9975	-	-	-	-
1944	1220	55	5376	6651	-	-	-	-
1945	781	15	7983	8779	-	-	-	-
1946	0	335	5515	5850	-	-	-	-
1947	0	79	3313	3392	-	-	-	-
1948	0	75	4863	4938	-	-	-	-
1949	0	34	2684	2718	-	-	-	-
1950	31	30	3316	3377	-	-	-	-
1951	21	6	3567	3594	-	-	-	-
1952	1537	1	2877	4415	-	-	-	-
1953	1627	15	2710	4352	-	-	-	-
1954	328	18	3573	3919	-	-	-	-
1955	83	53	4387	4523	-	-	-	-
1956	12	164	7722	7898	-	-	-	-
1957	96	13	12501	12610	-	-	-	-
1958	1858	63	1109	3030	-	-	-	-
1959	12	1	3775	3788	-	-	-	-
1960	990	129	8384	9503	-	-	-	-
1961	1351	81	1060	2492	-	-	-	-
1962	542	137	3767	4446	-	-	-	-
1963	140	9	5565	5714	-	-	-	-
1964	0	0	4118	4118	-	-	-	-
1965	7	0	4452	4460	-	-	-	-
1966	23	35	4402	4460	-	-	-	-
1967	153	34	3631	3818	-	-	-	-
1968	518	5	447	970	-	-	-	-
1969	782	10	582	1375	-	-	-	-
1970	323	0	839	1162	-	-	-	-
1971	257	2	67	326	-	-	-	-
1972	-	-	-	-	-	-	-	-
1973	6	0	120	126	-	-	-	-
1974	113	1	124	238	-	-	-	-
1975	8	24	340	372	-	-	-	-
1976	32	38	18	88	-	-	-	-
1977	3027	1	233	3261	-	-	-	-
1978	640	17	354	1011	-	-	-	-
1979	194	8	453	655	-	-	-	-
1980	21	24	935	980	-	-	-	-
1981	426	117	435	978	-	-	-	-
1982	48	96	512	656	-	-	-	-
1983	283	58	332	673	-	-	-	-
1984	214	94	84	392	-	-	-	-
1985	1893	146	83	2122	-	-	-	-
1986	1892	194	95	2181	-	-	-	-
1987	84	17	11	112	-	-	-	-
1988	338	77	43	458	-	4263	4263	4721
1989	389	85	22	496	118	5336	5454	5950
1990	424	93	24	541	220	5726	5946	6487
1991	187	3	20	210	15	5697	5712	5922
1992	92	46	0	138	33	2995	3028	3166
1993	20	3	0	23	1	1960	1961	1984
1994	231	5	0	236	117	3036	3153	3389
1995	6724	332	0	7056	5329	571	5900	12956
1996	2707	13	51	2771	44	1780	1824	4595
1997	610	8	13	632	63	4600	4664	5295
1998	894	153	566	1613	371	8977	9349	10962
1999	957	96	355	1408	413	5587	6000	7408
2000	71	61	178	310	10	2182	2191	2502

(-) Not available. (0) Less than 1 tonne.

3.12 Widely Distributed and Migratory Stocks

3.12.1 Overview

A number of stocks assessed by ICES are not confined to the individual areas considered in other sections of this report. They include species with stock units that are distributed over much wider areas such as hake and a number of deep-water species, and migratory species such as mackerel, horse mackerel and blue whiting.

The Northern Hake is fished throughout Sub-areas IV, VI, VII and VIII. The stock, which is estimated to be about 88,000 t in 2000, has been at a low level for a number of years and is considered to be outside safe biological limits. The landings, which are mainly taken by Spain and France, have decreased in recent years and the 1999 landings of 39,300 t were the second lowest recorded for over twenty years. Recruitment has been very poor in 1997 and 1998 and the stock is not expected to increase unless there is a substantial reduction in fishing mortality.

The North East Atlantic mackerel stock which is considered to consist of three spawning components (North Sea, Western and Southern) is fished over a very wide area extending throughout Sub-areas II, IV, VI, VII and VIII. Considerable mixing of the components occurs at various times throughout the year. The fishery is conducted by a number of countries, but Norway, United Kingdom, Russia, Ireland and the Netherlands take the main catches. The total catch in 1999 was estimated to be over 609,000 t. The spawning stock has increased in recent years and in 2000 was estimated to be over 3.9 million t. This high SSB is expected to be maintained in the future if fishing mortality is kept at or below $\mathbf{F}_{pa}$.

The Western horse mackerel fishery extends throughout Sub-areas IV, VI, VII and VIII. The stock is exploited by a number of countries, Netherlands and Ireland take the main catches. The catch in 1999 was estimated to be about 275,000 t, which was the lowest since 1990. The stock is inside safe biological limits. Following the outstanding 1982 year class, which for more than a decade contributed a significant part of the catches, recruitment of horse mackerel has been weak. SSB is bound to be low as this year class is fished out and the sustainable yield is unlikely to be higher than about 130 000 t per year.

The Northern Blue Whiting stock is fished in Sub-areas II, V, VI and VII and by a number of countries, mainly by Norway, Russia, Iceland, Denmark, Faroe Islands, United Kingdom and Ireland. The 1999 catches were over 1.3 million t and were the highest recorded from the fishery. Most of these catches were landed for industrial purposes. The spawning stock, that in 2000 was estimated to be 2.8 million t, has been boosted by the very good year classes in 1995 and 1996. However, it is expected that the stock will rapidly decline in the near future as recruitment seems to return to normal and will not be able to maintain the present high catches.

3.12.2 Hake – Northern stock (Division IIIa, Sub-areas IV, VI and VII, and Divisions VIIIa, b, d)

State of stock/exploitation: The stock is outside safe biological limits. Fishing mortality has been above $\mathbf{F_{pa}}$, for the entire period of the assessment, which is since 1978, and has even been above $\mathbf{F_{lim}}$ in most years since 1988. Current F is just above $\mathbf{F_{lim}}$. SSB has generally declined and has been below $\mathbf{B_{pa}}$ since 1987, and even below $\mathbf{B_{lim}}$ for most years since 1990. Recruitment estimates for 1997-2000 are the lowest recorded.

Management objectives: There are no explicit management objectives for this stock.

Precautionary Approach reference points (established in 1998):

ICES considers that:	ICES proposes that:
$\mathbf{B_{lim}}$ is 120 000 t, the lowest observed biomass in the 1998 assessment.	$\mathbf{B_{pa}}$ be set at 165 000 t. Biomass above this affords a high probability of maintaining SSB above $\mathbf{B_{lim}}$, taking into account the uncertainty in assessments.
$\mathbf{F_{lim}}$ is 0.28, the fishing mortality above which stock dynamics are unknown.	$\mathbf{F_{pa}}$ be set at 0.20. This F is considered to have a high probability of avoiding $\mathbf{F_{lim}}$ and a 50% probability of maintaining SSB above $\mathbf{B_{pa}}$ in the next 10 years, taking into account the uncertainty in assessments.

Technical basis:

$\mathbf{B_{lim}} = \mathbf{B_{loss}}$.	$\mathbf{B_{pa}} \sim \mathbf{B_{lim}}$ x 1.4.
$\mathbf{F_{lim}} = \mathbf{F_{loss}}$.	$\mathbf{F_{pa}} \sim \mathbf{F_{lim}}$ x 0.72, implies a less than 10% probability that $(\mathbf{SSB_{MT}} < \mathbf{B_{pa}})$.

Advice on management: In the light of the continued decrease in SSB and very poor recruitment since 1997, ICES recommends a recovery plan that will ensure a safe and rapid recovery of SSB to a level in excess of 165 000 t. If a recovery plan is not implemented ICES recommends that fishing mortality on hake should be reduced to the lowest possible level in 2002.

Setting the TAC at low level may reduce fishing mortality, but past experience has shown that it is very difficult to control fishing mortality by TACs alone. ICES therefore recommends that in addition to TAC constraints, restrictions in effort of fleets exploiting hake should be implemented. Large closed areas and seasons may contribute to stock recovery, but only if accompanied by major reductions in effort.

Rebuilding plan: Rebuilding of the hake stock can be obtained by reducing the fishing mortality, or by a reduction in F and an improvement of the selection pattern.

An emergency plan for Northern Hake has been implemented since 1st September 2001. This comprises a low TAC for 2001 and the use of mesh size of 100mm for trawlers targeting Hake in the Bay of Biscay and for trawlers operating in two non-*Nephrops* areas (one in the Bay of Biscay, one in the Celtic Sea). ICES has not been able to quantify the likely impact of these changes in mesh size, but they will not be sufficient to reduce exploitation to the level needed to rebuild the hake stock and additional reduction in mortality is needed.

A fishing mortality of zero in 2002 is not expected to rebuild SSB to $\mathbf{B_{pa}}$ by 2003, but fishing mortality less than 0.12 ($F_{98\text{-}00}$ reduced by 60%) in 2002, 2003 and 2004 is expected to rebuild it by 2005 (see Table 3.12.2.3). This table also shows that with a smaller reduction in F (50%), it would require one year more to rebuild SSB above $\mathbf{B_{pa}}$. Given the state of the stock, and the risk of impaired recruitment, the fastest possible rebuilding to $\mathbf{B_{pa}}$ is strongly advised.

Since hake is a late maturing fish [23 % age 3 are mature, 60% age 4, 90% age 5 and 100% at age 6 and above], any improvement in the selection pattern preventing from catching younger fish (ages 0-2, ~ less than 30 cm) will allow SSB to increase in the medium term only. An improvement in the selection pattern alone is unlikely to be effective enough to rebuild SSB. At status quo F and with no catch at age 0-2 the SSB is expected to be 10% higher in 2006 than with the current selection pattern. SSB will be 30% higher in 2010, but still below $\mathbf{B_{pa}}$.

However, improving the selection pattern would increase the probability that a reduction in F will allow a rebuilding in SSB. Furthermore, this improvement is a prerequisite of any future sustainable exploitation of this stock.

Comparison with previous assessment and advice: The trends in F, SSB and R are similar to those estimated in previous assessment. However, there has been a revision of the database since 1995 (Danish landings and length distribution, revision of French landings for 1999, French tuning information available for 1998 and 1999, minor revision of catch at age for A

Coruna fleet since 1995), and there have also been changes in the tuning process (new fleets, taper and full year range). This has led to an upward revision of F (between 1986 and 1996) and downward revision of SSB prior to 1997. Recent F and SSB have been revised downward and upward respectively. The decline in SSB is estimated this year less sharp than last year. Recruitments in recent years are estimated higher in this year's assessment. However, they are still the lowest of the time series.

Relevant factors to be considered in management: SSB cannot be rebuilt above $\mathbf{B_{pa}}$ in the short-term, even with an F of 0 in 2002.

Information from the fishery indicates a decrease in the amount of small hake caught in recent years (64% of fish less than 30cm in 1997 compared to around 30% in 1998-2000). This might be explained by an improvement in the selection pattern, changes in fishing strategy, because the small fish became inaccessible to sampling, or simply a consequence of weak year classes in recent years.

Hake is caught in nearly all fisheries in Sub-areas VII and VIII. LPUEs series show different trends in different areas and between different fleets. In recent years for some fleets there has been an increase in LPUE in Sub-area VII and a generally decreasing LPUE trend in Sub-area VIII. The assessment of the stock seems to be driven more by Divisions VIIIa,b indices than by those from Sub-area VII, although the Sub-area VII indices are included in the assessment. However, even though there are some conflicting signals in LPUE between areas in recent years, the matter of concern is the overall declining trend in the stock size since the beginning of the assessment period (1978). This declining trend is evenly indicated when separate mean indices from Sub-areas VII and VIII are used in the assessment, even though the decrease is slightly lower when using indices from Sub-area VII.

Catch forecast for 2002: Forecasts with both a TAC constraint for 2001 and an $\mathbf{F_{sq}}$ for 2001 are presented below. In 2000, the minimum mesh size increased which may improve the exploitation pattern and the Spanish fishery was closed in November. This suggests that $\mathbf{F_{sq}}$ may not provide the more accurate prediction of the catch in 2001. No restriction on fleets has been reported yet and if the TAC is overshot the forecasts using an $\mathbf{F_{sq}}$ for 2001 would be the more realistic.

Basis: F(2001) = $\mathbf{F_{sq}}$ = F_{00} scaled to mean $F_{(98\text{-}00)}$ = 0.29; Landings(2001) = 37.4; Catch(2001) = 38.0; SSB(2002) = 98.

F(2002) onwards	Basis	Catch (2002)	Landings (2002)	SSB (2003)
0	0	0	0	135.1
0.06	0.2 $\mathbf{F_{sq}}$	8.5	8.4	125.8
0.12	0.4 $\mathbf{F_{sq}}$	16.4	16.2	117.2
0.17	0.6 $\mathbf{F_{sq}}$	23.9	23.4	109.2
0.20	$\mathbf{F_{pa}}$	27.4	26.9	105.4
0.23	0.8 $\mathbf{F_{sq}}$	30.8	30.2	101.7
0.29	1.0 $\mathbf{F_{sq}}$	37.2	36.5	94.8

Weights in '000 t.

Shaded scenarios are considered inconsistent with the precautionary approach.

Basis: TAC constraint; Landings(2001) = 22.6, Catch(2001) = 23.0, F(2001) = 0.16, $\mathbf{F_{sq}}$ = F_{00} scaled to mean $F_{(98\text{-}00)}$ = 0.29, SSB(2002) = 115.5.

F(2002) onwards	Basis	Catch (2002)	Landings (2002)	SSB (2003)
0	0	0	0	155.2
0.06	0.2 $\mathbf{F_{sq}}$	9.8	9.6	144.5
0.10	$\mathbf{F_{0.1}}$	16.7	16.5	136.9
0.12	0.4 $\mathbf{F_{sq}}$	18.9	18.6	134.5
0.14	0.5 $\mathbf{F_{sq}}$	23.3	22.9	129.8
0.16	$\mathbf{F_{max}}$	25.6	25.2	127.3
0.17	0.6 $\mathbf{F_{sq}}$	27.4	27.0	125.3
0.20	$\mathbf{F_{pa}}$	31.1	30.6	121.2
0.23	0.8 $\mathbf{F_{sq}}$	35.4	34.8	116.7
0.29	1.0 $\mathbf{F_{sq}}$	42.8	42.1	108.7

Weights in '000 t.

Shaded scenarios are considered inconsistent with the precautionary approach.

Medium-term projections: Medium-term results using both a TAC constraint for 2001 and using status quo F in 2001 are presented.

Elaboration and special comment: Since the 1930s, hake has been the main species supporting trawl fleets on the Atlantic coasts of France and Spain. In 1999, Spain took 60% of the landings, France 20%, UK about 8% and Ireland 5%. Hake are caught throughout the year, the peak landings being made in the spring-summer months. The three main gear types used by vessels fishing for hake as a target species are lines (E & W, Spain), fixed-nets, and otter trawls (all countries). By-catches of mainly juvenile hake are taken in the *Nephrops* fisheries in the Northern Bay of Biscay. These fisheries have a high proportion (80%) of small hake (less than 30 cm) in their catches, but account for less than 20% in the total international catch of these small hakes.

Hake spawn from February through July along the shelf edge, the main areas extending from north of the Bay of Biscay to the south and west of Ireland. 0-groups descend to the seabed (at depths in excess of 200 m), moving to shallower water with a muddy seabed (75–120 m) by September. There are two major nursery areas: in the Bay of Biscay and off southern Ireland. Three years old hake begin to move into the shallower regions of the Bay of Biscay and Celtic Sea, but as they approach maturity they disperse to offshore regions.

Hake movements are indicated by the seasonal distribution of catches. From the beginning of the year until March/April hake are present in the North of the Bay of Biscay. They appear on the shelf edge in the Celtic Sea in June and July. Between August and December the hake fishery is centred to the west and south-west of Ireland, with a decline in catch rates in shallower waters.

Length composition data by fishery unit are available annually for 1978–1989 and quarterly for 1990–2000. Prior to 1992, these were converted to age compositions by numerical methods. For 1992–2000, age readings were used. Some discards data are used in the assessment. However more of the available discards data should be included.

In September 2001 a Spanish survey took place in the Porcupine bank (Division VIIb-k), providing an index of abundance of hake. This survey should be continued in order to provide information, independent on the fishery, on the abundance (mainly of old fish) on this area, which could be used in the assessment.

Source of information: Report of the Working Group on the Assessment of Southern Shelf Demersal Stocks, September 2001 (ICES CM 2002/ACFM:05).

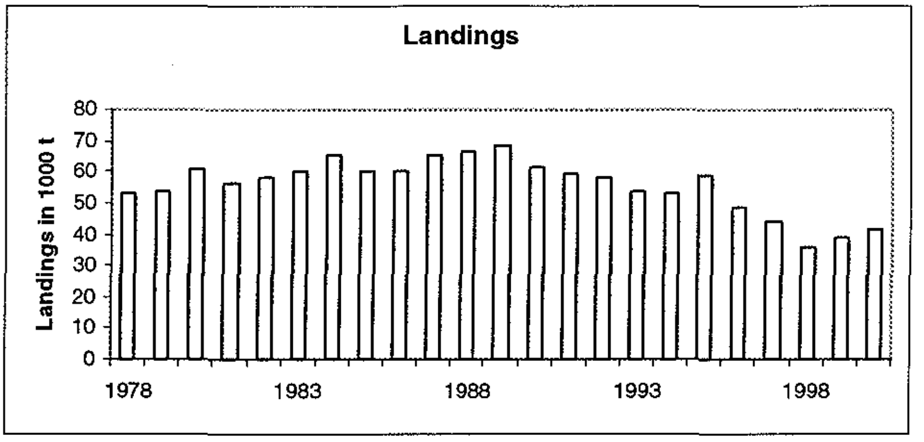
Yield and spawning biomass per Recruit F-reference points:

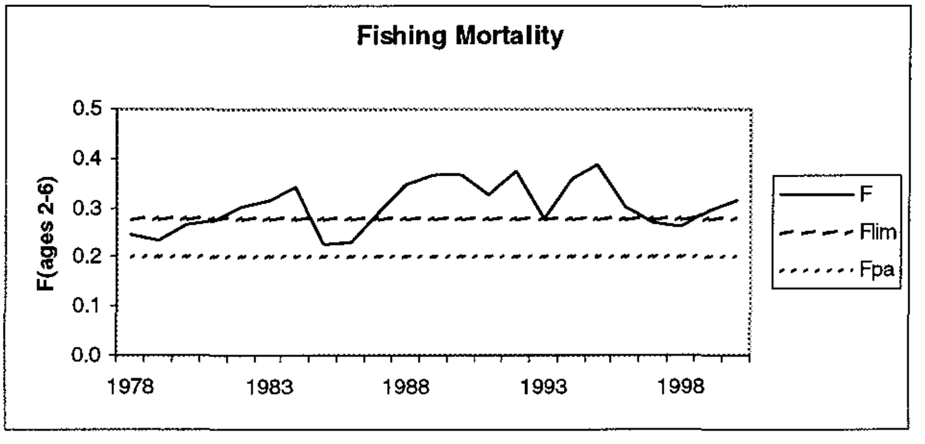
	Fish Mort Ages 2-6	Yield/R	SSB/R
Average Current	0.289	0.229	0.594
$\mathbf{F}_{max}$	0.163	0.251	1.155
$\mathbf{F}_{0.1}$	0.102	0.236	1.724
$\mathbf{F}_{med}$	0.284	0.231	0.607

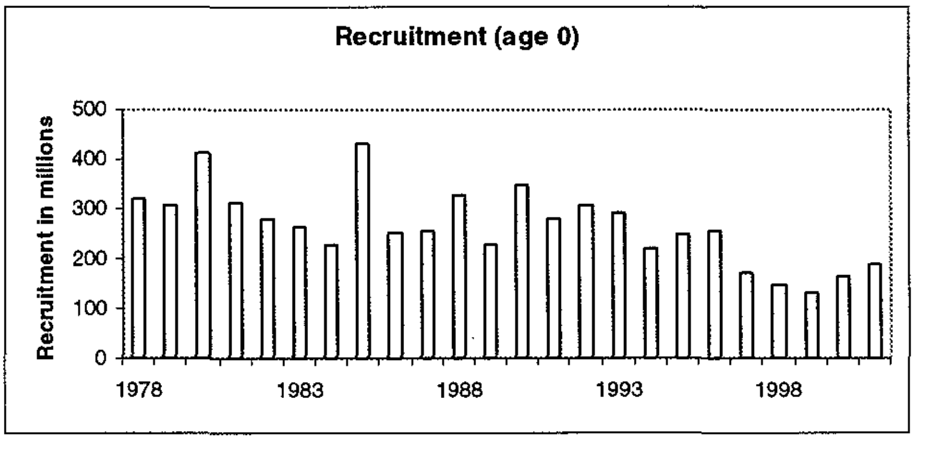
Catch data (Tables 3.12.2.1–2):

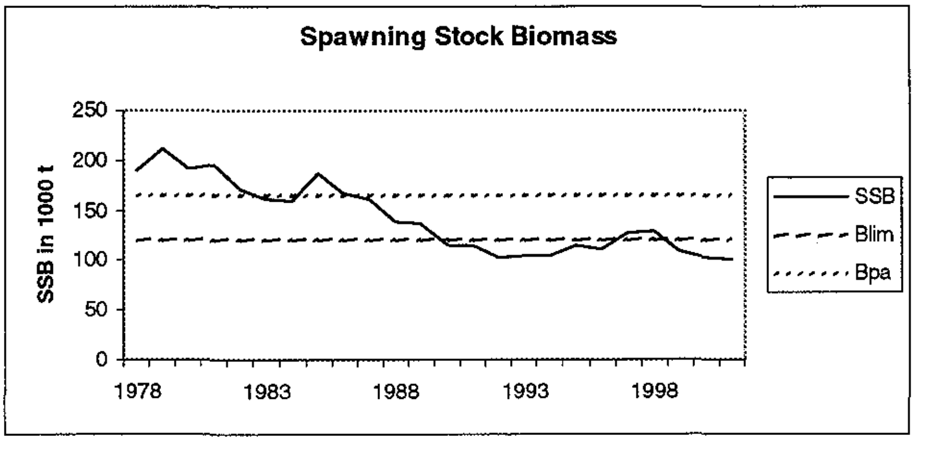
Year	ICES Advice	Predicted catch corresp to advice	Agreed TAC[1]	ACFM landings	Disc. slip.	ACFM catch
1987	Precautionary TAC; juvenile protection	-	63.5	63.4	2.0	65.3
1988	Precautionary TAC; juvenile protection	54	66.2	64.8	2.0	66.8
1989	Precautionary TAC; juvenile protection	54	59.7	66.5	2.3	68.8
1990	Precautionary TAC; juvenile protection	59	65.1	59.9	1.5	61.4
1991	Precautionary TAC; juvenile protection	59	67.0	57.6	1.7	59.3
1992	If required, precautionary TAC	61.5	69.0	56.6	1.7	58.3
1993	Enforce juvenile protection legislation	-	71.5	52.1	1.5	53.6
1994	F significantly reduced	<46	60.0	51.3	1.9	53.1
1995	30% reduction in F	31	55.1	57.6	1.2	58.9
1996	30% reduction in F	39	51.1	47.2	1.5	48.8
1997	20% reduction in F	54	60.1	42.6	1.8	44.4
1998	20% reduction in F	45[2]	59.1	35.0	0.8	35.8
1999	Reduce F below $\mathbf{F}_{pa}$	<36[2]	55.1	38.5	0.8	39.2
2000	50% reduction in F	<20[2]	44.2	40.9	0.5	41.4
2001	Lowest possible catch, rebuilding plan	0	22.6			
2002	Lowest possible catch / rebuilding plan	0				

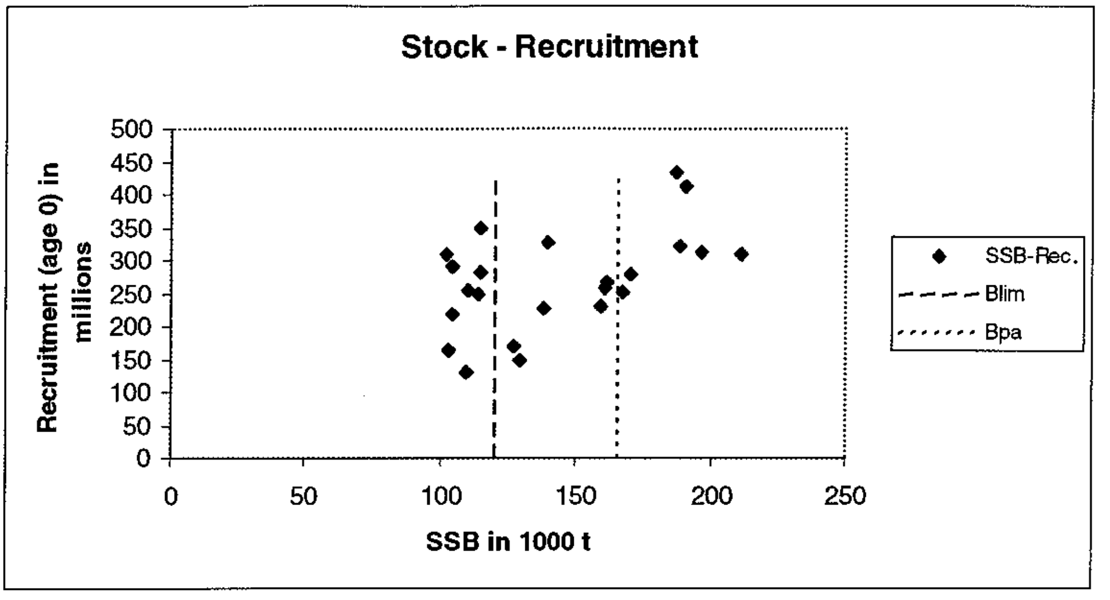
[1]Sum of area TACs corresponding to Northern stock plus Division IIa (EC zone only). [2]Landings. Weights in '000 t.

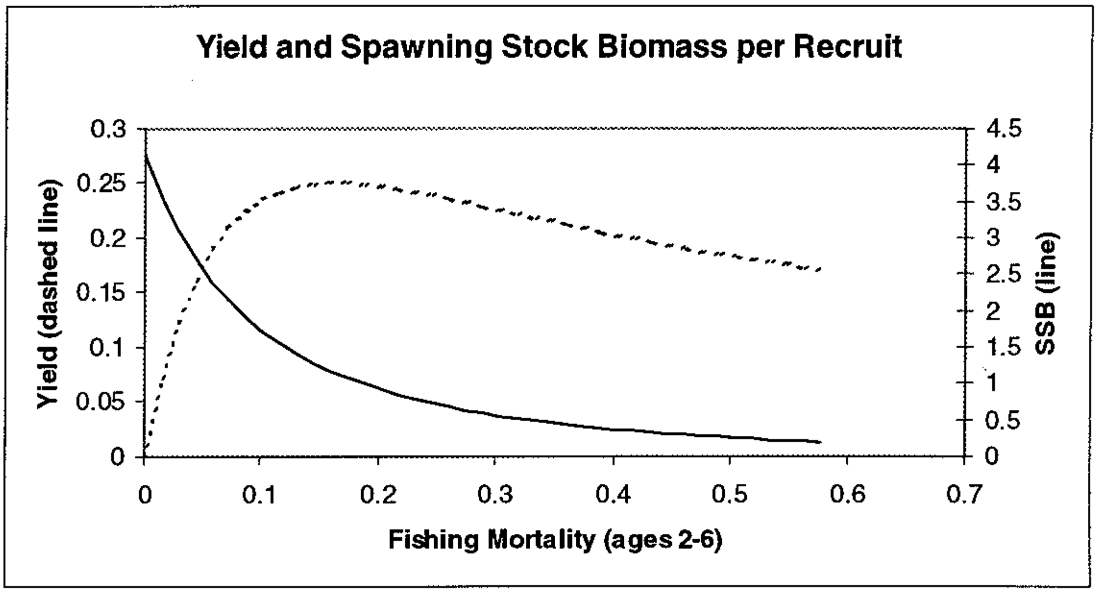

Landings
Landings in 1000 t
80
70
60
50
40
30
20
10
0
1978
1983
1988
1993
1998


Fishing Mortality
F(ages 2-6)
0.5
0.4
0.3
0.2
0.1
0.0
1978
1983
1988
1993
1998
F
Flim
Fpa


Recruitment (age 0)
Recruitment in millions
500
400
300
200
100
0
1978
1983
1988
1993
1998


Spawning Stock Biomass
SSB in 1000 t
250
200
150
100
50
0
1978
1983
1988
1993
1998
SSB
Blim
Bpa


Stock - Recruitment
Recruitment (age 0) in millions
SSB in 1000 t
500
450
400
350
300
250
200
150
100
50
0
0
50
100
150
200
250
SSB-Rec.
Blim
Bpa


Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
SSB (line)
Fishing Mortality (ages 2-6)
0.3
0.25
0.2
0.15
0.1
0.05
0
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7

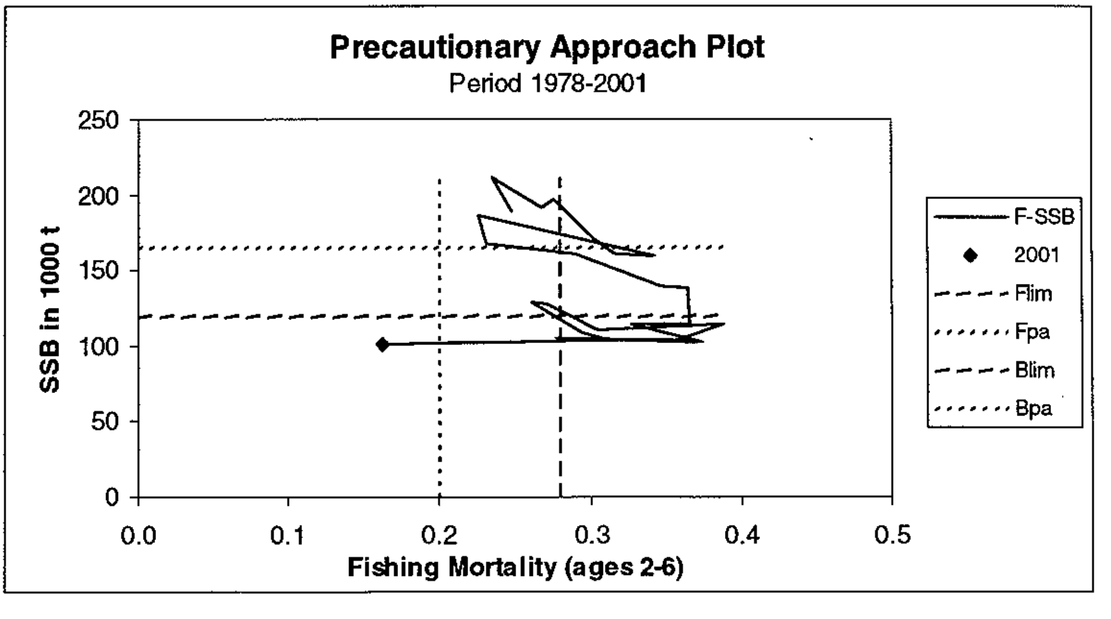

Precautionary Approach Plot
Period 1978-2001
SSB in 1000 t
Fishing Mortality (ages 2-6)
250
200
150
100
50
0
0.0
0.1
0.2
0.3
0.4
0.5
F-SSB
2001
Flim
Fpa
Blim
Bpa

Table 3.12.2.1 Estimates of catches ('000 t) for the Northern Hake by area for 1961–2000.

	Landings [1]					Discards [2]	Catches [3]
Year	IIIa+IVa+VI	VII	VIIIa,b	Unallocated	Total	VIIIa,b	Total
1961	-	-	-	95.6	95.6	-	95.6
1962	-	-	-	86.3	86.3	-	86.3
1963	-	-	-	86.2	86.2	-	86.2
1964	-	-	-	76.8	76.8	-	76.8
1965	-	-	-	64.7	64.7	-	64.7
1966	-	-	-	60.9	60.9	-	60.9
1967	-	-	-	62.1	62.1	-	62.1
1968	-	-	-	62.0	62.0	-	62.0
1969	-	-	-	54.9	54.9	-	54.9
1970	-	-	-	64.9	64.9	-	64.9
1971	8.5	19.4	23.4	0	51.3	-	51.3
1972	9.4	14.9	41.2	0	65.5	-	65.5
1973	9.5	31.2	37.6	0	78.3	-	78.3
1974	9.7	28.9	34.5	0	73.1	-	73.1
1975	11.0	29.2	32.5	0	72.7	-	72.7
1976	12.9	26.7	28.5	0	68.1	-	68.1
1977	8.5	21.0	24.7	0	54.2	-	54.2
1978	8.0	20.3	24.5	-2.2	50.6	2.4	52.9
1979	8.7	17.6	27.2	-2.4	51.1	2.7	53.8
1980	9.7	22.0	28.4	-2.8	57.3	3.2	60.5
1981	8.8	25.6	22.3	-2.8	53.9	2.3	56.3
1982	5.9	25.2	26.2	-2.3	55.0	3.1	58.1
1983	6.2	26.3	27.1	-2.1	57.5	2.6	60.1
1984	9.5	33.0	22.9	-2.1	63.3	1.9	65.1
1985	9.2	27.5	21.0	-1.6	56.1	3.8	59.9
1986	7.3	27.4	23.9	-1.5	57.1	3.0	60.1
1987	7.8	32.9	24.7	-2.0	63.4	2.0	65.3
1988	8.8	30.9	26.6	-1.5	64.8	2.0	66.8
1989	7.4	26.9	32.0	0.2	66.5	2.3	68.8
1990	6.7	23.0	34.4	-4.2	59.9	1.5	61.4
1991	8.3	21.5	31.6	-3.9	57.6	1.7	59.3
1992	8.6	22.5	23.5	2.1	56.6	1.7	58.3
1993	8.5	20.5	19.8	3.3	52.1	1.5	53.6
1994	5.4	21.1	24.7	0	51.3	1.9	53.1
1995	5.4	24.1	28.1	0	57.6	1.2	58.9
1996	4.4	24.7	18.1	0	47.2	1.5	48.8
1997	3.3	18.9	20.3	0	42.6	1.8	44.4
1998	3.2	18.7	13.1	0	35.0	0.8	35.8
1999	3.6	22.7	12.3	0	38.5	0.7	39.2
2000	4.0	25.4	11.5	0	40.9	0.5	41.4

[1] Spanish data for 1961-1972 not revised, data for Sub-area VIII for 1973-1978 include data for Divisions VIIIa,b only. Data for 1979-1981 are revised based on French surveillance data. Includes Divisions IIIa, IVb,c from 1976.
There are some unallocated landings (moreover for the period 1961-1970).

[2] Discards have been estimated from 1978 and only for Divisions VIIIa,b.

[3] From 1978 total catches used for the Working Group.

Table 3.12.2.2 Hake - Northern stock (IIIa, IV, VI, VII, VIIIa,b).

Year	Recruitment Age 0 thousands	SSB tonnes	Landings tonnes	Mean F Ages 2-6
1978	320545	188560	52900	0.2479
1979	308935	211029	53800	0.2345
1980	412843	190956	60500	0.2673
1981	311002	196352	56300	0.2751
1982	278806	170563	58100	0.3034
1983	265870	161361	60100	0.3157
1984	229743	159169	65100	0.3422
1985	432966	186782	59900	0.2256
1986	252835	167186	60100	0.2311
1987	257781	160715	65300	0.2904
1988	326059	139277	66800	0.3467
1989	227306	137965	68800	0.3654
1990	348064	114935	61400	0.3664
1991	281857	114561	59300	0.3267
1992	308579	102411	58300	0.3734
1993	291241	104828	53600	0.2767
1994	218355	104342	53100	0.3571
1995	247194	114214	58900	0.3885
1996	254179	110536	48800	0.3042
1997	170051	127192	44400	0.2721
1998	149923	129045	35800	0.2609
1999	131359	109303	39200	0.2934
2000	164227	103394	41400	0.3129
2001	189000	101369		0.1622
Average	265780	141919	55735	0.2975

Table 3.12.2.3. Hake - Northern stock (IIIa, IV, VI, VII, VIIIa,b) – **Rebuilding plan.** Medium-term projections carried out from 2002 onwards. Development of SSB and its 50% confidence intervals.

Basis: F(2001) = **TAC constraint** = F = 0.16, $\mathbf{F_{sq}}$ = F_{00} scaled to mean $F_{(98-00)}$ = 0.29:

F(2002) onwards = 1.0 * $\mathbf{F_{sq}}$: Catches 2002 = 42.8

		SSB	
	25%	Median	75%
2002	112.5	115.3	118.4
2003	106.5	108.7	111.2
2004	102.2	104.7	107.4
2005	100.8	104.1	108.0
2006	102.3	107.5	112.8
2010	118.1	127.6	137.6

F(2002) onwards = 0.5 * $\mathbf{F_{sq}}$: Catches 2002 = 23.3

		SSB	
	25%	Median	75%
2002	112.5	115.3	18.4
2003	127.1	129.7	132.8
2004	142.7	145.9	149.7
2005	159.4	164.0	169.7
2006	178.7	**186.1**	193.9
2010	282.4	299.4	321.2

F(2002) onwards = 0.4 * $\mathbf{F_{sq}}$: Catches 2002 = 18.9

		SSB	
	25%	Median	75%
2002	112.5	115.3	118.4
2003	131.7	134.5	137.7
2004	152.6	156.0	160.1
2005	175.1	**180.0**	186.3
2006	200.6	208.0	217.7
2010	341.9	365.2	389.6

Continued……

Table 3.12.2.3 Continued

Rebuilding plan including improvement of the selection pattern:

F(2002) onwards = 1.0 * F_{sq} and No catch at ages 0-2 : Catches 2002 = 40.2

		SSB	
	25%	Median	75%
2002	112.5	115.3	118.4
2003	107.2	109.4	111.9
2004	105.3	108.0	110.7
2005	107.8	111.8	116.3
2006	114.7	120.6	127.4
2010	123.5	162.1	174.8

F(2002) onwards = 0.5 * F_{sq} and No catch at ages 0-2 : Catches 2002 = 21.9

		SSB	
	25%	Median	75%
2002	112.5	115.3	118.4
2003	127.5	130.1	133.2
2004	144.3	147.7	151.2
2005	164.1	**168.9**	174.6
2006	187.7	195.2	204.0
2010	314.4	333.3	357.2

Continued......

Table 3.12.2.3 **Continued**

Basis: F(2001) = **status quo F**, $\mathbf{F_{sq}}$ = F_{00} scaled to mean $F_{(98-00)}$ = 0.29

F(2002) onwards = 1.0 * $\mathbf{F_{sq}}$: Catches 2002 = 37.3

		SSB	
	25%	Median	75%
2002	96.5	98.9	101.6
2003	93.2	95.1	97.2
2004	91.8	94.1	96.5
2005	93.2	96.4	100.2
2006	96.7	101.6	107.0
2010	111.5	120.8	130.0

F(2002) onwards = 0.5 * $\mathbf{F_{sq}}$: Catches 2002 = 20.3

		SSB	
	25%	Median	75%
2002	96.5	98.9	101.6
2003	111.1	113.3	116.0
2004	127.6	130.5	134.0
2005	146.3	150.8	155.9
2006	167.4	**174.4**	182.1
2010	268.7	199.5	306.0

F(2002) onwards = 0.4 * $\mathbf{F_{sq}}$: Catches 2002 = 16.5

		SSB	
	25%	Median	75%
2002	96.5	98.9	101.6
2003	115.1	117.4	120.2
2004	136.4	139.5	143.2
2005	160.5	**165.2**	171.0
2006	187.5	195.1	203.7
2010	325.0	348.1	370.5

3.12.3 Mackerel

3.12.3.a Mackerel (combined Southern, Western and North Sea spawning components)

State of stock/exploitation: The combined stock is harvested outside safe biological limits. The spawning stock biomass in 2001 is estimated to be well above $\mathbf{B}_{pa}$, and the fishing mortality in 2000 is just above $\mathbf{F}_{pa}$. The North Sea component remains severely depleted.

Management objectives: The agreed record of negotiations between Norway, Faeroe Islands and EU in 1999, states:

"For 2000 and subsequent years, the Parties agreed to restrict their fishing on the basis of a TAC consistent with a fishing mortality in the range of 0.15 - 0.20 for appropriate age groups as defined by ICES, unless future scientific advice requires modification of the fishing mortality rate."

"Should the SSB fall below a reference point of 2 300 000 tonnes ($\mathbf{B}_{pa}$), the fishing mortality rate, referred to under paragraph 1, shall be adapted in the light of scientific estimates of the conditions prevailing. Such adaptation shall ensure a safe and rapid recovery of the SSB to a level in excess of 2 300 000 tonnes."

"The Parties shall, as appropriate, review and revise these management measures and strategies on the basis of any new advice provided by ICES."

Agreements for international waters have to be included here as well, but were not available at the meeting.

The rationale for ICES proposing $\mathbf{F}_{pa} = 0.17$ is to have a high probability of avoiding exploiting the stock above $\mathbf{F}_{lim}$. In addition, projections indicate that F =0.17 will optimise long-term yield and at the same time result in a low risk for the stock to decrease below $\mathbf{B}_{pa}$. If F on average is kept below 0.17, ICES regards the management plan to meet precautionary criteria.

Precautionary Approach reference points (established in 1998):

ICES considers that:	ICES proposes that:
There is no biological basis for defining $\mathbf{B}_{lim}$	$\mathbf{B}_{pa}$ be set at 2.3 million t
$\mathbf{F}_{lim}$ is 0.26, the fishing mortality estimated to lead to potential stock collapse.	$\mathbf{F}_{pa}$ be set at 0.17. This F is considered to provide approximately 95% probability of avoiding $\mathbf{F}_{lim}$, taking into account the uncertainty in the assessments.

Technical basis:

	$\mathbf{B}_{pa} = \mathbf{B}_{loss}$ in Western stock raised by 15%: = 2.3 million t.
$\mathbf{F}_{lim} = \mathbf{F}_{loss} = 0.26$	$\mathbf{F}_{pa} = \mathbf{F}_{lim}$ x 0.65. $\mathbf{F}_{0.1} = 0.17$

Advice on management: ICES advises a fishing mortality in 2002 of no more than $\mathbf{F}_{pa}$ (0.17), corresponding to landings in 2002 of less than 694 000 t. Preliminary information from an egg survey in 2001 suggests that this projection is too optimistic. ICES advises that any agreed TAC should cover all areas where North-East Atlantic mackerel are fished.

The North Sea spawning component still needs the maximum possible protection.

- **There should be no fishing for mackerel in Divisions IIIa and IVb,c at any time of the year.**
- **There should be no fishing for mackerel in Division IVa during the period 1 February–31 July.**
- **The 30 cm minimum landing size at present in force in Sub-area IV should be maintained.**

Comparison with previous assessment and advice: The assessment method was unchanged from last year, and the results are well in accordance with last year's assessment.

Relevant factors to be considered in management: Egg surveys were carried out in the western and southern spawning areas during February-July 2001. Preliminary egg production estimates show a decline in both the Western and the Southern area. The results of the fecundity studies are not yet available and until these results are included in the assessment, it is difficult to be confident about the accuracy of the assessment. Tag recapture data indicate an increasing trend in total mortality since 1995-1996. Both the egg surveys and the tag recaptures indicate that the projection could be too optimistic.

Little is known about discards in the mackerel fishery; however, sampling for discards has improved. ICES recommends that observers should be placed on vessels in order to estimate discards in those fisheries where discarding of mackerel is perceived to be a problem.

The closure of the mackerel fishery in Divisions IVb,c and IIIa throughout the whole year is designed to protect the North Sea component in this area and also the juvenile Western mackerel which are numerous, particularly in Division IVb,c during the second half of the year. This closure has unfortunately resulted in increased discards of mackerel in the non-directed fisheries (especially horse mackerel fisheries) in these areas as vessels at present are permitted to take only 10% of their catch as mackerel by-catch. No data on the actual size of mackerel by-catch are available, but the reported landings of mackerel in Divisions IIIa and IVb,c for 1997 might seriously under-estimate catches due to discarded by-catch.

Closure of Division IVa for fishing during the first half of the year was recommended for several years. This was based on the perception that the western mackerel entered the North Sea in July/August, and stayed there until December before migrating back to their spawning areas. Updated observations taken in the late 1990s suggested that this return migration actually started in mid- to late February. This was believed to result in large-scale misreporting from the Northern part of the North Sea (Division IVa) to Division VIa. It was recommended that the closure date for IVa be extended to the 1st February. This was adopted for the 1999/2000 fishing season. There is some indication that this has achieved its objective. However, it should be noted that in the first quarter of 2000, the timing of migration from the North Sea was much earlier than in previous years, probably starting in December 1999. Detailed information from the fishery are still not ready for November 2000-March 2001, but a first impression is that the mackerel might have left the North Sea a little later than last year. This indicates that the migration pattern of mackerel is not fixed and can show rapid and substantial changes.

Catch forecast for 2002:

Basis: F(2001) = F(98-00, unscaled)=$\mathbf{F_{sq}}$ = 0.1835; Landings (2001) = 726; SSB(2001) = 4023.

F (2002)	Basis	SSB (2002)	Landings (2002)	Landings (2002) **N**	Landings (2002) **S**	SSB (2003)
0.15	Lowest level agreements	4111	617	580	37	4145
0.17	$\mathbf{F_{pa}}$	4083	694	652	42	4057
0.1835	$\mathbf{F_{sq} = F_{0.1}}$	4064	745	700	45	3999
0.20	highest level agreements	4042	806	757	49	3930

Weights in '000 t.

N: Northern area comprising the Western areas, North Sea, Skagerrak and Norwegian Sea (I, IIa, IIIa, IVa, Vb, VI, VII, VIIIa,b,d); catches in the international zone in IIa are included.

S: Southern area (VIIIc, IXa).

Shaded scenarios considered inconsistent with the precautionary approach.

The catches are allocated to areas according to the proportion of catch-at-age by area in recent years (1998-2000). This forecast is based on the assumption of no change in the spatial distribution of the population and stable fishing mortality levels.

The mid-year prediction for 2001 is based on $\mathbf{F_{sq}}$. For the first time the TAC for 2001 covers also the international waters, but it is uncertain if this TAC will be fully effective.

Medium- and long-term projections: No medium- or long-term projections were carried out.

Elaboration and special comment: This year's assessment indicates that the stock is slightly lower than predicted in the previous years. According to this estimate, the stock is now well above $\mathbf{B_{pa}}$, and the largest in the time-series. The spawning stock is well above $\mathbf{B_{pa}}$ and is harvested just above $\mathbf{F_{pa}}$. The upward trend in the present stock estimate is uncertain, and the perception of a substantial increase in stock size depends on a limited number of observations of SSB. In particular, there is little information to support the abundance estimates of the youngest year classes, and the predictions are sensitive to these. For the first time, small catches were reported from the Barents Sea.

Stock components: ICES currently uses the term **"North East Atlantic Mackerel"** to define the mackerel present in the area extending from ICES Division IXa in the south to Division IIa in the north, including mackerel in the North Sea and Division IIIa. The spawning areas of mackerel are widely spread, and only the area in the North Sea is sufficiently distinct to be clearly identified as a separate spawning component. Tagging experiments have demonstrated that after spawning, fish from Southern and Western areas migrate to feed in the Norwegian Sea and the North Sea during the second half of the year. In the North Sea they mix with the North Sea component. Since it is at present impossible to allocate catches to the stocks previously considered by ICES, they are at present, for practical reasons, considered as one stock: the **North East Atlantic Mackerel Stock.** Catches cannot be allocated specifically to spawning area components on biological grounds, but by convention the catches from the Southern and Western components are separated according to the area where they are taken.

In order to be able to keep track of the development of the spawning biomasses in the different spawning areas, the North East Atlantic mackerel stock is divided into three area components termed the **Western Spawning Component**, the **North Sea Spawning Component**, and the **Southern Spawning Component**:

North-East Atlantic Mackerel			
Distributed and fished in ICES Sub-areas and Divisions IIa, IIIa, IV, Vb, VI, VII, VIII and IXa			
Spawning component	**Western**	**Southern**	**North Sea**
Spawning Areas	VI, VII, VIIIa,b,d,e.	VIIIc, IXa.	IV, IIIa.

The Western Component is defined as mackerel spawning in the western area (ICES Divisions and Sub-Areas VI, VII, VIII a,b,d,e). This component comprises 71-86% of the entire North East Atlantic Stock. Similarly, the Southern Component is defined as mackerel spawning in the southern area (ICES Divisions VIIIc and IXa). Although the North Sea component has been at an extremely low level since the early 1970s, ACFM regards the North Sea Component as still existing. This component spawns in the North Sea and Skagerrak (ICES Sub-Area IV and Division IIIa). Current knowledge of the state of the spawning components is summarised below:

Western Component: The catches of this component were low in the 1960s, but increased to more than 800 000 t in 1993. The main catches are taken in directed fisheries by purse seiners and mid-water trawlers. Large catches of the western component are taken in the northern North Sea and in the Norwegian Sea. The 1996 catch showed a large reduction of about 200 000 t, compared with 1995, because of the reduced TACs. The 1999 catch decreased by nearly 60 000 t compared to that of 1998. The SSB of the Western Component declined in the 1970s from above 3.0 million t to 2.2 million t in 1994, but was estimated to have increased to 2.7 million t in 1999 and decreased to 2.6 million t in 2000. A separate assessment for this stock component is made in order to maintain a longer time-series of stock-recruitment data.

North Sea Component: Very large catches were taken in the 1960s in the purse seine fishery, reaching a maximum of about 1 million t in 1967. The component subsequently collapsed and catches declined to less than 100 000 t in the late 1970s. Catches during the last five years have been assumed to be about 10 000 t. The size of the North Sea Component was last estimated at 68 000 t by egg surveys in 1999. This component is considered to be severely depleted and outside safe biological limits. An exceptionally large number of juvenile mackerel (1996 year class) was observed throughout the North Sea and adjacent areas during 1997, but did not appear in the IBTS survey in 1998, and did not produce an increase in the spawning population in 1999. These fish are therefore likely to have been of Western origin.

Southern Component: Mackerel is a target species for the hand line fleet during the spawning season in Division VIIIc, during which about one third of the total catches are taken. It is taken as a by-catch in other fleets. The highest catches (87%) from the Southern Component are taken in the first half of the year, mainly from Division VIIIc, and consist of adult fish. In the second half of the year catches consist of juveniles and are mainly taken in Division IXa. Catches from the Southern Component increased from about 20 000 t in 1993 to 44 000 t in 1999, and decreased to 36 000 t in 2000. Egg surveys indicate that the size of the Southern Component increased from 1995 to 1998 and may have been in the order of 25% of the total stock in 1998, while it was considered to have been about 15% in previous years.

Combined Assessment: Analytic assessment is based on catch numbers at age for the period 1984 - 2000 and egg survey estimates of SSB from 1992, 1995 and 1998.

Source of information: Report of the Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine and Anchovy, September 2001 (ICES CM 2002/ACFM:06).

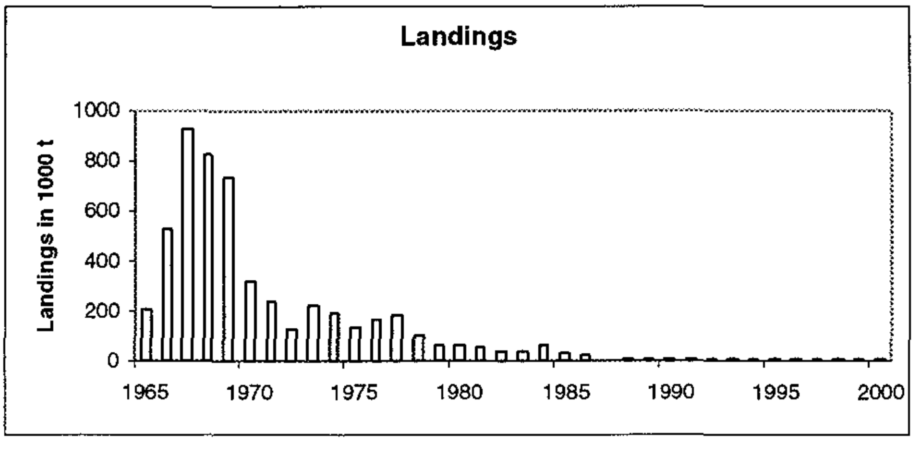
Mackerel Combined
Yield and spawning biomass per Recruit
F-reference points:

	Fish Mort Ages 4-8	Yield/R	SSB/R
Average Current	0.184		
F_{max}	0.712	0.170	0.370
$F_{0.1}$	0.186	0.144	0.865
F_{med}	0.346	0.163	0.600

Mackerel West
Yield and spawning biomass per Recruit
F-reference points:

	Fish Mort Ages 4-8	Yield/R	SSB/R
Average Current	0.211		
F_{max}	0.259	0.146	0.435
$F_{0.1}$	0.081	0.123	0.964
F_{med}	0.144	0.140	0.695

Mackerel in the North Sea Area (Fishing Areas IIa, IV and IIIa)



Catch data for combined area (Tables 3.12.3.a.1-6):

Year	ICES Advice	Predicted catch corresp. to advice	Total Agreed TAC[4]	Official landings	Disc.[1] slip	ACFM landings[2]
1987	Given by stock component		442	589	11	655
1988	Given by stock component		610	621	36	676
1989	Given by stock component		532	507	7	586
1990	Given by stock component		562	574	16	626
1991	Given by stock component		612	599	31	668
1992	Given by stock component		707	723	25	760
1993	Given by stock component		767	778	18	825
1994	Given by stock component		837	792	5	823
1995	Given by stock component		645	660	8	756
1996	Significant reduction in F	-	452	493	11	564
1997	Significant reduction in F	-	470	434	19	570
1998	F between 0.15 and 0.2	498	549	647	8	667
1999	F of 0.15 consistent with PA	437	562	595	n/a	609
2000	F=0.17: $\mathbf{F}_{pa}$	642	612	579	2	667
2001	F=0.17: $\mathbf{F}_{pa}$	665	670			
2002	F=0.17: $\mathbf{F}_{pa}$	694				

[1]Data on discards and slipping from only two fleets. [2]Landings and discards from IIa, IIIa, IV, Vb, VI, VII, VIII and IXa. [4]All areas except some catches in international waters in II. n/a=not available. Weights in '000 t.

Catch data for western component (Tables 3.12.3.a.4 and 7):

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC[1]	Disc. slip	ACFM landings[2]
1987	SSB = 1.5 mill. t; TAC	380	405	11	615
1988	F = $\mathbf{F}_{0.1}$; TAC; closed area; landing size	430	573[1]	36	628
1989	Halt SSB decline; TAC	355	495[1]	7	567
1990	TAC; F = $\mathbf{F}_{0.1}$	480	525[1]	16	606
1991	TAC; F = $\mathbf{F}_{0.1}$	500	575[1]	31	646
1992	TAC for both 1992 and 1993	670	670[1]	25	742
1993	TAC for both 1992 and 1993	670	730[1]	18	805
1994	No long-term gains in increased F	831[3]	800[1]	5	798
1995	20% reduction in F	530	608[1]	8	729
1996	No separate advice	-	422[1]	11	529
1997	No separate advice	-	416[1]	19	529
1998	No separate advice	-	514[1]	8	623
1999	No separate advice	-	520[1]	0	565
2000	No separate advice	-	573[1]	2	631
2001	No separate advice	-	630[1]		
2002	No separate advice				

[1]TAC for mackerel taken in all areas VI, VII, VIIIa,b,d, Vb, IIa, IIIa, IV. [2]Landings and discards of Western component; includes catches of North Sea component. [3]Catch at *Status quo* F. Weights in '000 t.

Catch data for North Sea component (Tables 3.12.3.a.3 and 8):

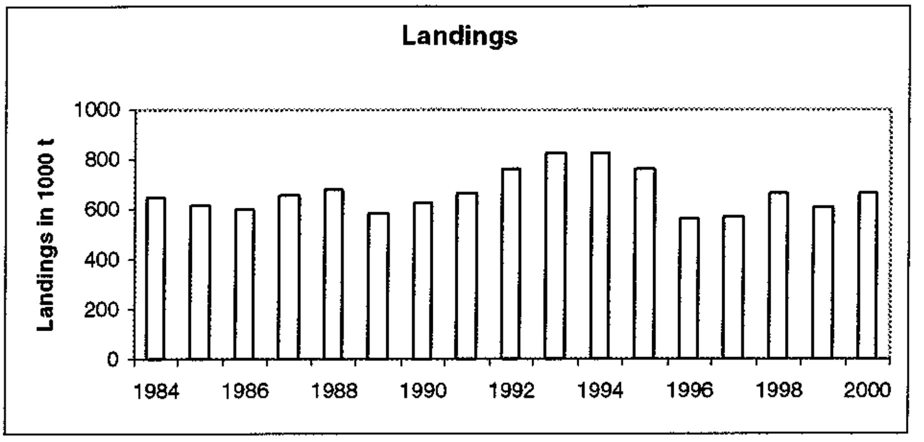
Year	ICES Advice	Predicted catch corresp. to advice[1]	Agreed TAC[2]	ACFM landings[3]
1987	Lowest practical level	LPL	55	3
1988	Closed areas and seasons; min. landing size; by-catch regulations	LPL	55	6
1989	Closed areas and seasons; min. landing size; by-catch regulations	LPL	49.2	7
1990	Closed areas and seasons; min. landing size; by-catch regulations	LPL	45.2	10
1991	Closed areas and seasons; min. landing size; by-catch regulations	LPL	65.5	-[4]
1992	Closed areas and seasons; min. landing size; by-catch regulations	LPL	76.3	[4]
1993	Maximum protection; closed areas and seasons; min landing size	LPL	83.1	-[4]
1994	Maximum protection; closed areas and seasons; min landing size	LPL	95.7	-[4]
1995	Maximum protection; closed areas and seasons; min landing size	LPL	76.3	-[4]
1996	Maximum protection; closed areas and seasons; min landing size	LPL	52.8	-[4]
1997	Maximum protection; closed areas and seasons; min landing size	LPL	52.8	-[4]
1998	Maximum protection; closed areas and seasons; min landing size	LPL	62.5	-[4]
1999	Maximum protection; closed areas and seasons; min landing size	LPL	62.5	-[4]
2000	Maximum protection; closed areas and seasons; min landing size	LPL	69.7	-[4]
2001	Maximum protection; closed areas and seasons; min landing size	LPL	71.4	-[4]
2002	Maximum protection; closed areas and seasons; min landing size			

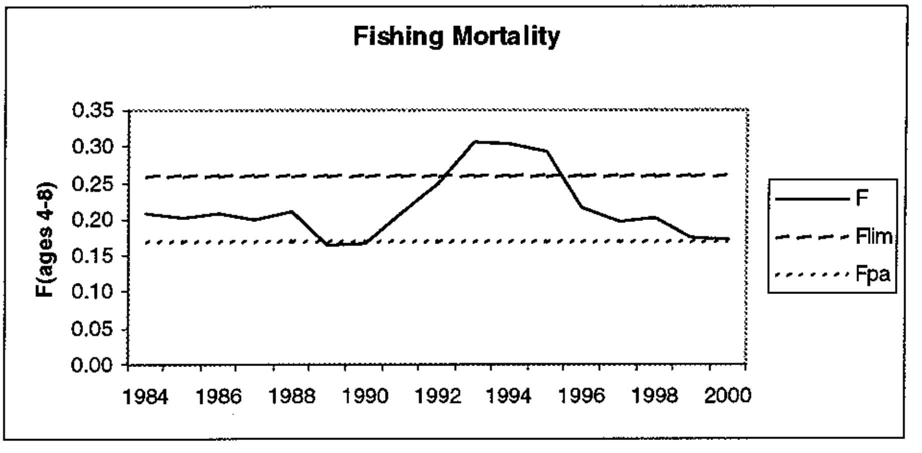
[1]Sub-area IV and Division IIIa. [2]TAC for Sub-area IV, Divisions IIIa, IIIb,c,d (EU zone) and Division IIa (EU zone). [3]Estimated landings of North Sea component. [4]No information. Weights in '000 t.

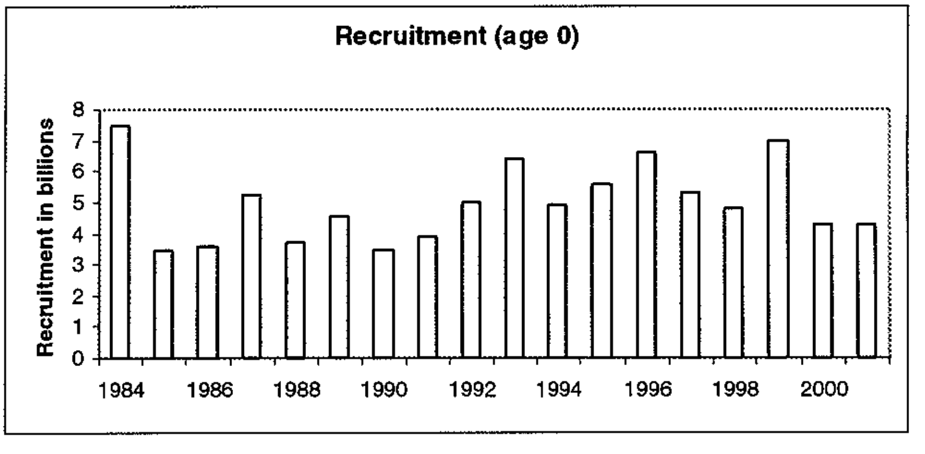
Catch data for southern component (Table 3.12.3.a.5):

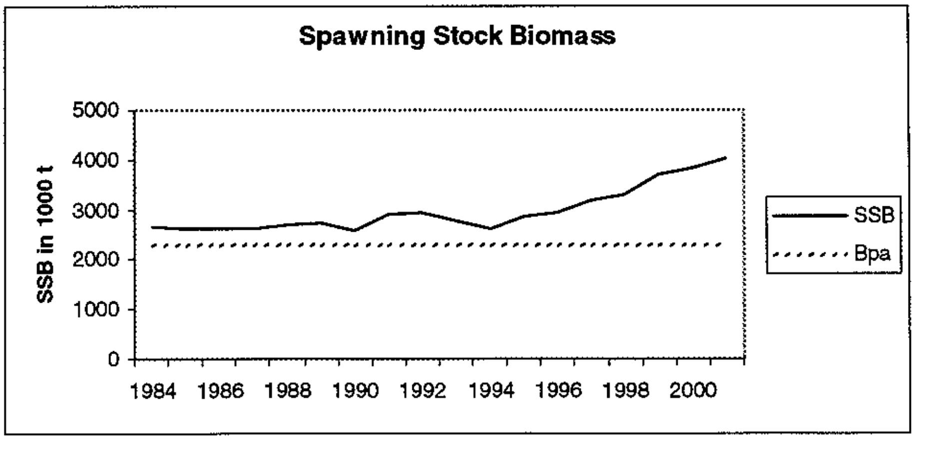
Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC[1]	ACFM landings
1987	Reduce juvenile exploitation	-	36.57	22
1988	Reduce juvenile exploitation	-	36.57	25
1989	No advice	-	36.57	18
1990	Reduce juvenile exploitation	-	36.57	21
1991	Reduce juvenile exploitation	-	36.57	21
1992	No advice	-	36.57	18
1993	No advice	-	36.57	20
1994	No advice	-	36.57	25
1995	No advice	-	36.57	28
1996	No separate advice	-	30.00	34
1997	No separate advice	-	30.00	41
1998	No separate advice	-	35.00	44
1999	No separate advice	-	35.00	44
2000	No separate advice	-	39.20	36
2001	No separate advice	-	40.18	
2002	No separate advice			

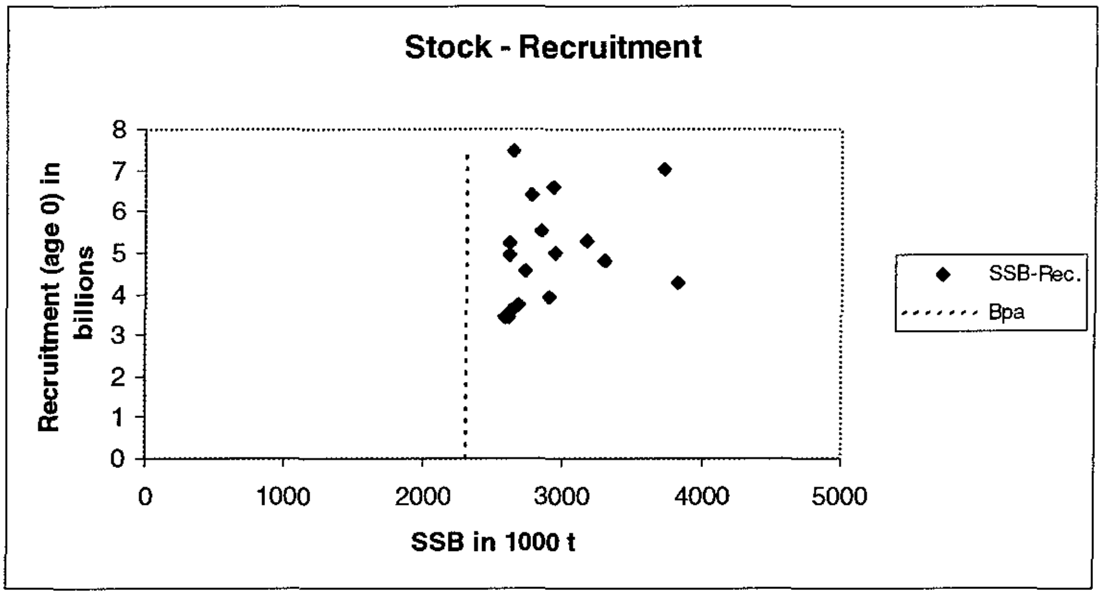
[1]Division VIIIc, Sub-Areas IX and X, and CECAF Division 34.1.1 (EU waters only). Weights in '000 t.

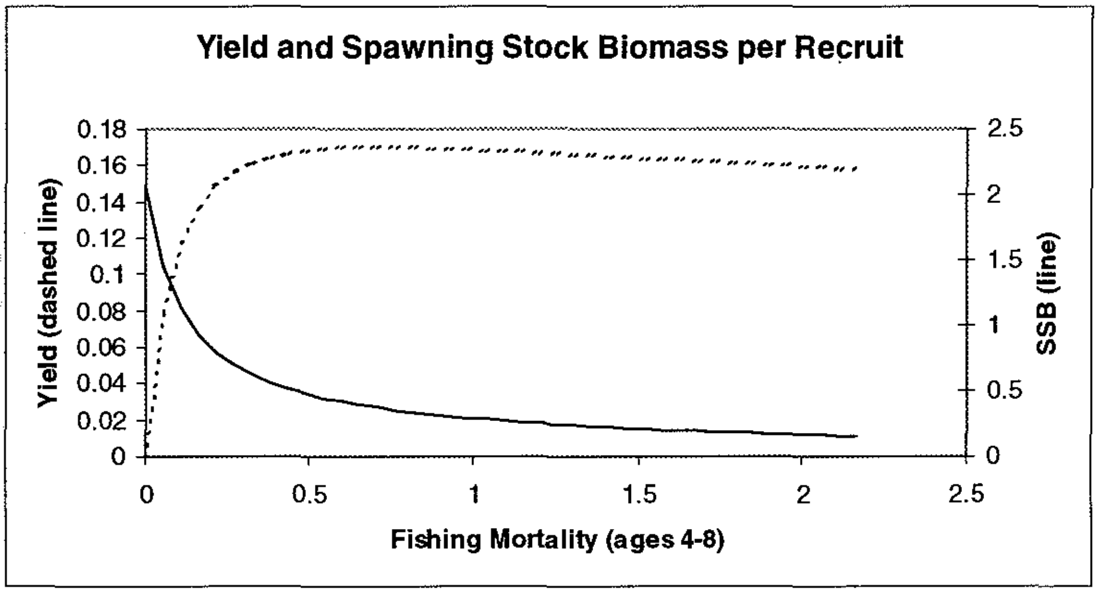

Landings
Landings in 1000 t
1000
800
600
400
200
0
1984
1986
1988
1990
1992
1994
1996
1998
2000

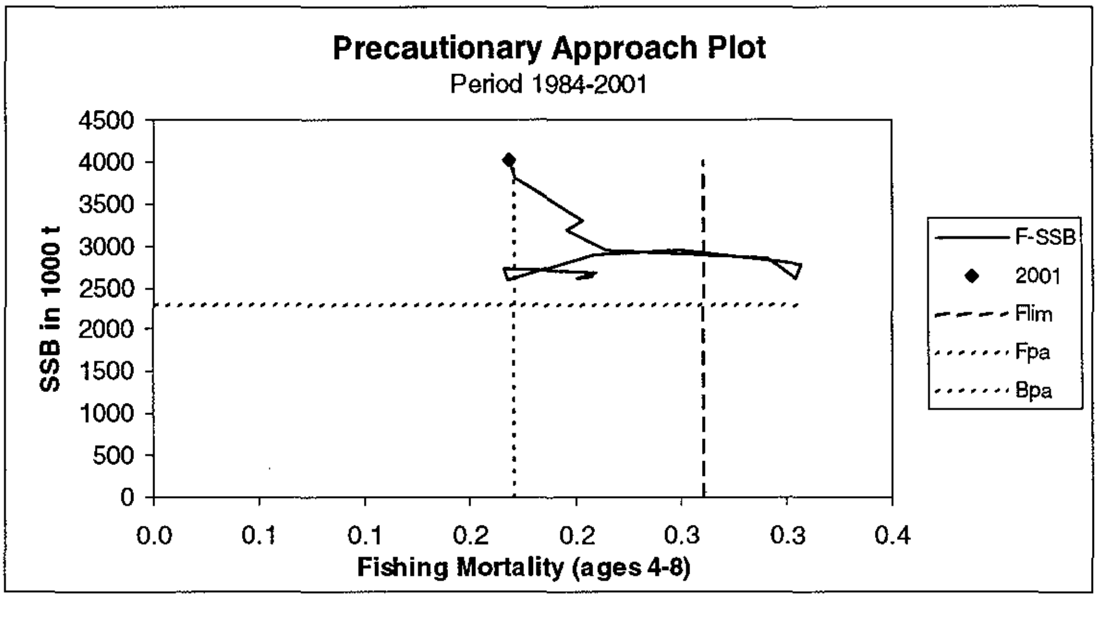

Fishing Mortality
F(ages 4-8)
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
1984
1986
1988
1990
1992
1994
1996
1998
2000
F
Flim
Fpa

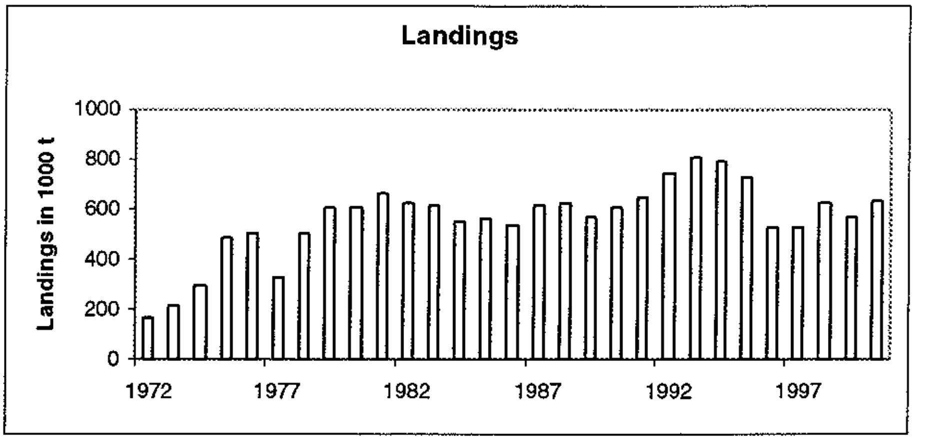

Recruitment (age 0)
Recruitment in billions
8
7
6
5
4
3
2
1
0
1984
1986
1988
1990
1992
1994
1996
1998
2000

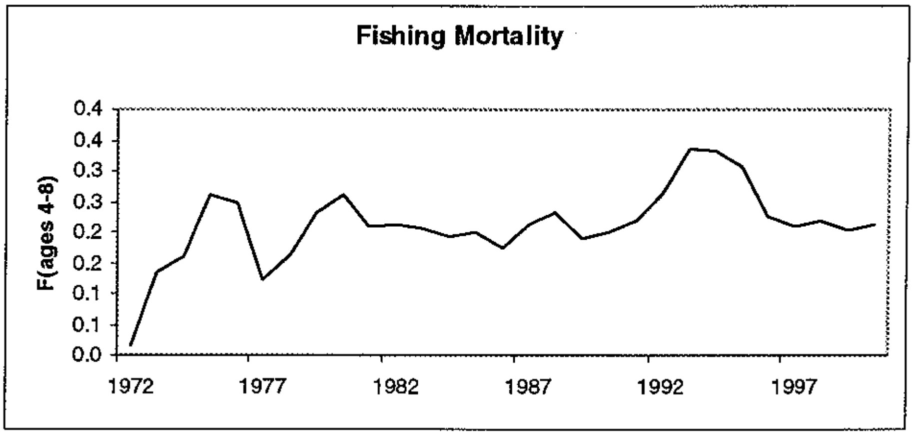

Spawning Stock Biomass
SSB in 1000 t
5000
4000
3000
2000
1000
0
1984
1986
1988
1990
1992
1994
1996
1998
2000
SSB
Bpa

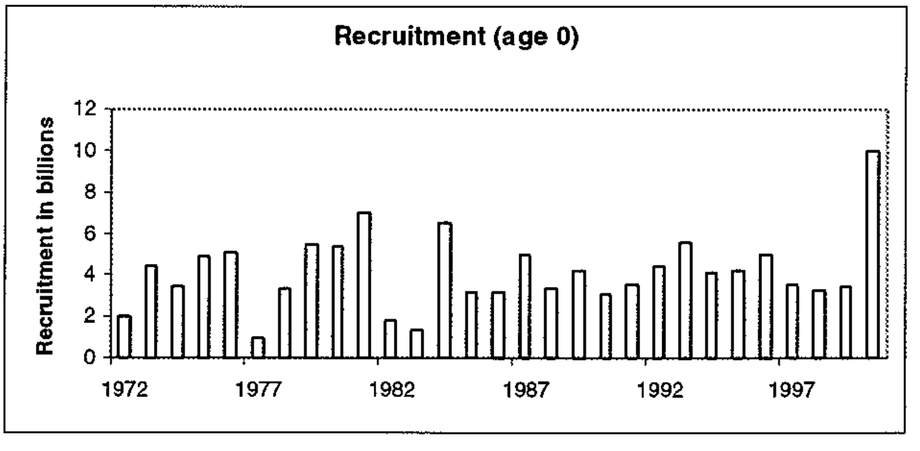

Stock - Recruitment
Recruitment (age 0) in billions
0
1
2
3
4
5
6
7
8
0
1000
2000
3000
4000
5000
SSB in 1000 t
SSB-Rec.
Bpa

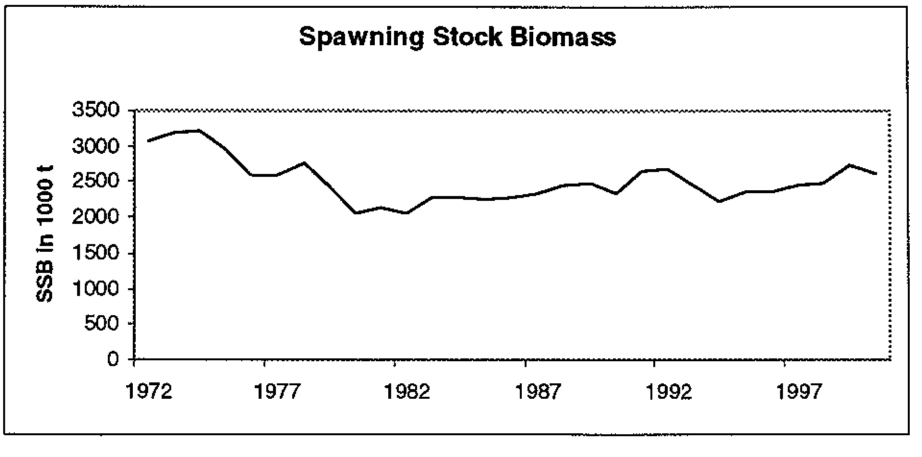

Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
0
0.02
0.04
0.06
0.08
0.1
0.12
0.14
0.16
0.18
SSB (line)
0
0.5
1
1.5
2
2.5
0
0.5
1
1.5
2
2.5
Fishing Mortality (ages 4-8)

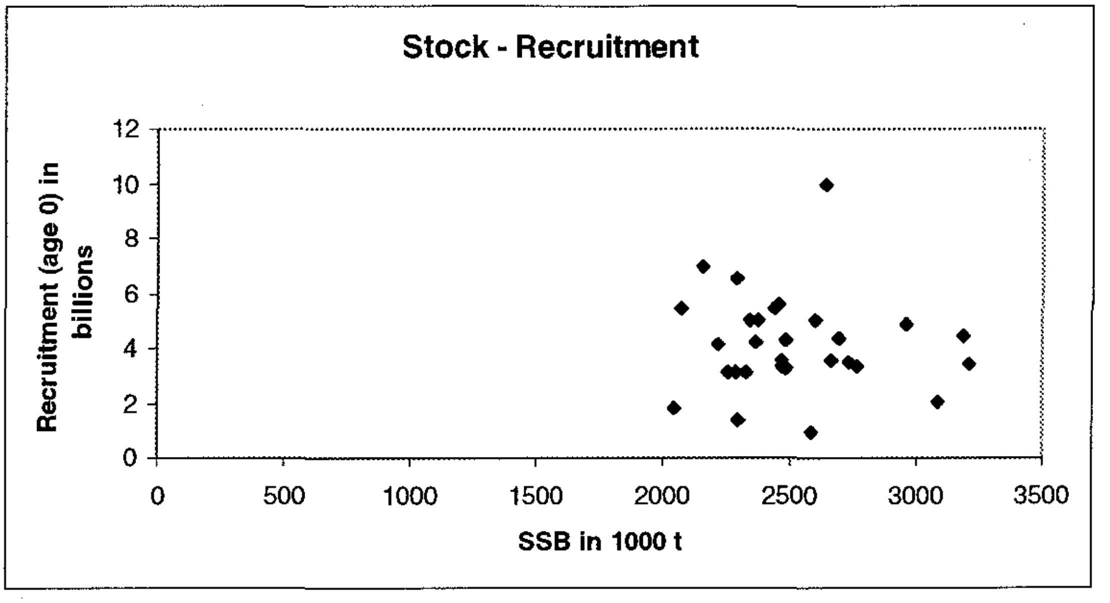

Precautionary Approach Plot
Period 1984-2001
SSB in 1000 t
0
500
1000
1500
2000
2500
3000
3500
4000
4500
0.0
0.1
0.1
0.2
0.2
0.3
0.3
0.4
Fishing Mortality (ages 4-8)
F-SSB
2001
Flim
Fpa
Bpa


Landings
Landings in 1000 t
1000
800
600
400
200
0
1972
1977
1982
1987
1992
1997


Fishing Mortality
F(ages 4-8)
0.4
0.4
0.3
0.3
0.2
0.2
0.1
0.1
0.0
1972
1977
1982
1987
1992
1997


Recruitment (age 0)
Recruitment in billions
12
10
8
6
4
2
0
1972
1977
1982
1987
1992
1997


Spawning Stock Biomass
SSB in 1000 t
3500
3000
2500
2000
1500
1000
500
0
1972
1977
1982
1987
1992
1997


Stock - Recruitment
Recruitment (age 0) in billions
12
10
8
6
4
2
0
0
500
1000
1500
2000
2500
3000
3500
SSB in 1000 t

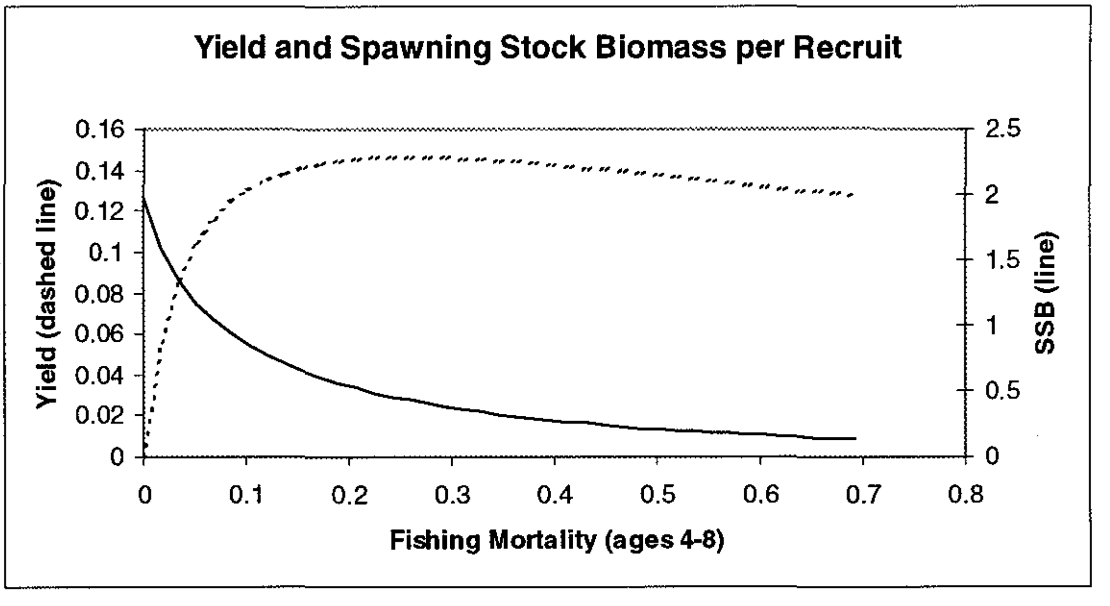

Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
2.5
2
1.5
1
0.5
0
SSB (line)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
Fishing Mortality (ages 4-8)

Table 3.12.3.a.1 Catches (t) of Mackerel by area. Discards not estimated prior to 1978. (Data submitted by Working Group members.)

Year	Sub-area VI			Sub-area VII and Divisions VIIIa,b,d,e			Sub-area IV and Division III[3]			Sub-area I,II &Div. Vb[1]	Divs. VIIIc, IXa	Total		
	Landings	Discards[2]	Catch	Landings	Discards[2]	Catch	Landings	Discards[2]	Catch	Landings	Landings	Landings	Discards[2]	Catch
1969	4,800		4,800	66,300		66,300	739,182		739,182			810,282		810,282
1970	3,900		3,900	100,300		100,300	322,451		322,451	163		426,814		426,814
1971	10,200		10,200	122,600		122,600	243,673		243,673	358		376,831		376,831
1972	10,000		10,000	157,800		157,800	188,599		188,599	88		356,487		356,487
1973	52,200		52,200	167,300		167,300	326,519		326,519	21,600		567,619		567,619
1974	64,100		64,100	234,100		234,100	298,391		298,391	6,800		603,391		603,391
1975	64,800		64,800	416,500		416,500	263,062		263,062	34,700		779,062		779,062
1976	67,800		67,800	439,400		439,400	303,842		303,842	10,500		821,542		821,542
1977	74,800		74,800	259,100		259,100	258,131		258,131	1,400	27,417	620,848		620,848
1978	151,700	15,100	166,900	355,500	35,500	391,000	148,817		148,817	4,200	26,508	686,725	50,700	737,425
1979	203,300	20,300	223,600	398,000	39,800	437,800	152,323	500	152,823	7,000	22,475	783,098	60,600	843,698
1980	218,700	6,000	224,700	386,100	15,600	401,700	87,391		87,391	8,300	15,964	716,455	21,600	738,055
1981	335,100	2,500	337,600	274,300	39,800	314,100	64,172	3,216	67,388	18,700	18,053	710,325	45,516	755,841
1982	340,400	4,100	344,500	257,800	20,800	278,600	35,033	450	35,483	37,600	21,076	691,909	25,350	717,259
1983	315,100	22,300	337,400	245,400	9,000	254,400	40,889	96	40,985	49,000	14,853	665,242	31,396	696,638
1984	306,100	1,600	307,700	176,100	10,500	186,600	39,374	202	39,576	93,900	20,308	635,782	12,302	648,084
1985	388,140	2,735	390,875	75,043	1,800	76,843	46,790	3,656	50,446	78,000	18,111	606,084	8,191	614,275
1986	104,100		104,100	128,499		128,499	236,309	7,431	243,740	101,000	24,789	594,697	7,431	602,128
1987	183,700		183,700	100,300		100,300	290,829	10,789	301,618	47,000	22,187	644,016	10,789	654,805
1988	115,600	3,100	118,700	75,600	2,700	78,300	308,550	29,766	338,316	116,200	24,772	640,722	35,566	676,288
1989	121,300	2,600	123,900	72,900	2,300	75,200	279,410	2,190	281,600	86,900	18,321	578,831	7,090	585,921
1990	114,800	5,800	120,600	56,300	5,500	61,800	300,800	4,300	305,100	116,800	21,311	610,011	15,600	625,611
1991	109,500	10,700	120,200	50,500	12,800	63,300	358,700	7,200	365,900	97,800	20,683	637,183	30,700	667,883
1992	141,906	9,620	151,526	72,153	12,400	84,553	364,184	2,980	367,164	139,062	18,046	735,351	25,000	760,351
1993	133,497	2,670	136,167	99,828	12,790	112,618	387,838	2,720	390,558	165,973	19,720	806,856	18,180	825,036
1994	134,338	1,390	135,728	113,088	2,830	115,918	474,830	1,150	475,980	69,900	25,043	817,198	5,370	822,568
1995	145,626	74	145,700	117,883	6,917	124,800	322,670	730	323,400	134,100	27,600	747,879	7,721	755,600
1996	129,895	255	130,150	73,351	9,773	83,124	211,451	1,387	212,838	103,376	34,123	552,196	11,415	563,611
1997	65,044	2,240	67,284	114,719	13,817	128,536	224,759	2,807	227,566	105,449	40,708	550,679	18,864	569,543
1998	110,141	71	110,212	105,181	3,206	108,387	264,947	4,735	269,700	134,219	44,164	658,652	8,030	666,682
1999*	98,666		98,666	93,821		93,821	299,798		299,798	72,848	43,796	608,929		608,929
2000	150,927	1	150,928	113,520	1,918	115,438	271,997	165	272,162	92,557	36,074	665,075	2,084	667,159

*Discards reported as part of unallocated catches.

[1] For 1976–1985 only Division IIa. Sub-area I and Division IIb included in 2000 onlt.

[2] Discards estimated only for one fleet in recent years.

[3] Divisions IIIb, d included in 2000 only.

NB: Landings from 1969–1978 were taken from the 1978 Working Group report (Tables 2.1, 2.2 and 2.5).

Table 3.12.3.a.2 Catches (t) of Mackerel in the Norwegian Sea (Division IIa) and off the Faroes (Division Vb). (Data submitted by Working Group members.)

Country	1984	1985	1986	1987	1988	1989
Denmark	11,787	7,610	1,653	3,133	4,265	6,433
Faroe Islands	137	-	-	-	22	1,247
France	-	16	-	-	-	11
Germany, Fed. Rep.	-	-	99	-	380	-
German Dem. Rep.	-	-	16	292	-	2,409
Norway	82,005	61,065	85,400	25,000	86,400	68,300
United Kingdom	-	-	2,131	157	1,413	-
USSR	4,293	9,405	11,813	18,604	27,924	12,088
Total	98,222	78,096	101,112	47,186	120,404	90,488

Country	1990	1991	1992	1993	1994	1995	1996	1997	1998
Denmark	6,800	1,098	251	-	-	4,746	3,198	37	2,090
Estonia	-	-	216	-	3,302	1,925	3,741	4,422	7,356
Faroe Islands	3,100	5,793	3,347	1,167	6,258	9,032	2,965	5,777[2]	2,716
France	-	23	6	6	5	5	0	270	-
Germany	-	-	-	-	-	-	1	-	-
Iceland	-	-	-	-	-	-	92	925	357
Latvia	-	-	100	4,700	1,508	389	233	-	-
Netherlands	-	-	-	-	-	-	561	-	-
Norway	77,200	76,760	91,900	110,500	141,114	93,315	47,992	41,000	54,477
Poland	-	-	-	-	-	--	-	22	-
Russia	-	-	42,440	49,600	28,041	44,537	44,545	50,207	67,201
United Kingdom	400	514	802	-	1,706	194	48	938	199
USSR	28,900	13,631[1]	-	-	-	-	-	-	-
Misreported (IVa)	-	-	-	-	-109,625	-18,647	-	-	-177
Discards	2,300	-	-	-	-	-	-	-	-
Total	118,700	97,819	139,062	165,973	72,309	135,496	103,376	103,598	134,219

Country	1999	2000
Denmark	106	1,375
Estonia	3,595	2,673
Faroe Islands	3,011	5,546
France	-	-
Germany	-	-
Iceland	-	-
Ireland	100	-
Latvia	-	-
Lithuania	-	2,085
Netherlands	661	-
Norway	53,821	31,778
Poland	-	-
Russia	51,003	49,100*
United Kingdom	662	-
Misreported (IVa)	-40,011	
Misreported (VIa)	-100	
Discards	-	
Total	72,848	92,557

[1]Russia.

[2] Faroese catch revised from previously reported 7,628.

* Includes small by-catches in Sub-area I and Division IIb.

Table 3.12.3.a.3 Catch (t) of Mackerel in the North Sea, Skagerrak, and Kattegat (Sub-area IV and Division IIIa). (Data submitted by Working Group members).

Country	1986	1987	1988	1989	1990	1991	1992
Belgium	49	14	20	37	-	125	102
Denmark	23,368	28,217	32,588	26,831	29,000	38,834	41,719
Estonia	-	-	-	-	-	-	400
Faroe Islands	-	-	-	2,685	5,900	5,338	-
France	1,200	2,146	1,806	2,200	1,600	2,362	956
Germany, Fed. Rep.	1,853	474	177	6,312	3,500	4,173	4,610
Iceland	-	-	-	-	-	-	-
Ireland	-	-	-	8,880	12,800	13,000	13,136
Latvia	-	-	-	-	-	-	211
Netherlands	1,949	2,761	2,564	7,343	13,700	4,591	6,547
Norway	50,600	108,250	59,750	81,400	74,500	102,350	115,700
Sweden	1,300	3,162	1,003	6,601	6,400	4,227	5,100
United Kingdom	559	19857	1,002	38,660	30,800	36,917	35,137
USSR (Russia from 1990)	-	-	-	-	-	-	-
Romania	-	-	-	-	-	-	-
Misreported (IIa)	-	-	-	-	-	-	-
Misreported (VIa)	148,000	117,000	180,000	92,000	126,000	130,000	127,000
Unallocated	7,391	8,948	29,630	6,461	-3,400	16,758	13,566
Discards	7,431	10,789	29,776	2,190	4,300	7,200	2,980
Total	243,700	301,618	338,316	281,600	305,100	365,875	367,164

Country	1993	1994	1995	1996	1997	1998	1999	2000[1]
Belgium	191	351	106	62	114	125	177	146
Denmark	42,502	47,852	30,891	24,057	21,934	25,326	29,353	27,720
Estonia	-	-	-	-	-	-	-	-
Faroe Islands	11,408	11,027	17,883	13,886	3,288[2]	4,832	4,370	10,614
France	1,480	1,570	1,599	1,316	1,532	1,908	2,056	1,588
Germany, Fed. Rep.	4,940	1,479	712	542	213	423	473	78
Iceland	-	-	-	-	-	-	357	-
Ireland	13,206	9,032	5,607	5,280	280	145	11,293	9,956
Latvia	-	-	-	-	-	-	-	-
Netherlands	7,770	3,637	1,275	1,996	951	1,373	2,819	2,262
Norway	112,700	114,428	108,890	88,444	96,300	103,700	106,917	142,320
Sweden	5,934	7,099	6,285	5,307	4,714	5,146	5,233	4,994
Romania	-	2,903	-	-	-	-	-	-
Russia	-	-	-	-	3,525	635	345	1,672
United Kingdom	41,010	27,479	21,609	18,545	19,204	19,755	31,578	57,110
Misreported (IIa)	-	109,625	18,647	-	-	-	40,000	-
Misreported (VIa)	146,697	134,765	106,987	51,781	73,523	98,432	59,882	8,591
Unallocated	-	-	983	236	1,102	3,147	4,946	3,197
Discards	2,720	1,150	730	1,387	2,807	4,753	-	1,912
Total	390,558	472,397	322,204	212,839	231,484	269,700	299,799	272,160

[1] Includes small catches in Divisions IIIb,d.

[2] Faroese catches revised from previously reported 1,367.

Table 3.12.3.a.4 Catch (t) of Mackerel in the Western area (Sub-areas VI and VII and Divisions VIIIa,b,d,e). (Data submitted by Working Group members).

Country	1984	1985	1986	1987	1988	1989	1990	1991
Denmark	200	400	300	100	-	1,000	-	1,573
Estonia	-	-	-	-	-	-	-	-
Faroe Islands	9,200	9,900	1,400	7,100	2,600	1,100	1,000	4,095
France	12,500	7,400	11,200	11,100	8,900	12,700	17,400	10,364
Germany	11,200	11,800	7,700	13,300	15,900	16,200	18,100	17,138
Ireland	84,100	91,400	74,500	89,500	85,800	61,100	61,500	64,827
Netherlands	99,000	37,000	58,900	31,700	26,100	24,000	24,500	29,156
Norway	34,700	24,300	21,000	21,600	17,300	700	-	-
Spain	100	-	-	-	1,500	1,400	400	4,020
United Kingdom	198,300	205,900	156,300	200,700	208,400	149,100	162,700	162,588
USSR	200	-	-	-	-	-	-	-
Unallocated	18,000	75,100	49,299	26,000	4,700	18,900	11,500	-3,802
Misreported (IVa)	-	-	-148,000	-117,000	-180,000	-92,000	-126,000	-130,000
Discards	12,100	4,500	-	-	5,800	4,900	11,300	23,550
Grand Total	479,600	467,700	232,599	284,100	197,000	199,100	182,400	183,509

Country	1992	1993	1994	1995	1996	1997	1998	1999
Denmark	194	-	2,239	1,443	1,271	-	-	552
Estonia	-	-	-	361	-	-	-	-
Faroe Islands	-	2,350	4,283	4,248	-	2,448[1]	3,681	4,239
France	9,109	8,296	9,998	10,178	14,347	19,114	15,927	14,311
Germany	21,952	23,776	25,011	23,703	15,685	15,161	20,989	19,476
Ireland	76,313	81,773	79,996	72,927	49,033	52,849	66,505	48,282
Netherlands	32,365	44,600	40,698	34,514	34,203	22,749	28,790	25,141
Norway	-	600	2,552	-	-	-	-	-
Spain	2,764	3,162	4,126	4,509	2,271	7,842	3,340	4,120
United Kingdom	196,890	215,265	208,656	190,344	127,612	128,836	165,994	127,094
Unallocated	1,472	0	4,632	28,245	10,603	4,577	8,351	9,254
Misreported (IVa)	-127,000	-146,697	-134,765	-106,987	-51,781	-73,523	-98,255	-59,982
Discards	22,020	15,660	4,220	6,991	10,028	16,057	3,277	-
Grand Total	236,079	248,785	251,646	270,476	213,272	196,110	218,599	192,486

Country	2000
Denmark	82
Estonia	-
Faroe Islands	4,863
France	17,857
Germany	22,901
Ireland	61,277
Netherlands	30,123
Norway	-
Spain	4,500
United Kingdom	126,620
Unallocated	0
Misreported (IVa)	-3,775
Discards	1,920
Grand Total	266,367

[1] Faroese catches revised from 2,158.

Table 3.12.3.a.5 Landings (tonnes) of Mackerel in Divisions VIIIc and IXa, 1980–1999. Data submitted by Working Group members.

Country	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Spain[1]	11,316	12,834	15,621	10,390	13,852	11,810	16,533	15,982	16,844	13,446
Portugal[2]	1,929	3,108	3,018	2,239	2,250	4,178	6,419	5,714	4,388	3,112
Spain[2]	2,719	2,111	2,437	2,224	4,206	2,123	1,837	491	3,540	1,763
Total[2]	4,648	5,219	5,455	4,463	6,456	6,301	8,256	6,205	7,928	4,875
TOTAL	15,964	18,053	21,076	14,853	20,308	18,111	24,789	22,187	24,772	18,321

[1]Division VIIIc.
[2]Division IXa.

Country	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Spain[1]	16,086	16,940	12,043	16,675	21,146	23,631	28,386	35,015	36,174	37,631
Portugal[2]	3,819	2,789	3,576	2,015	2,158	2,893	3,023	2,080	2,897	2,002
Spain[2]	1,406	1,051	2,427	1,027	1,741	1,025	2,714	3,613	5,093	4,164
Total[2]	5,225	3,840	6,003	3,042	3,899	3,918	6,737	5,693	7,990	6,165
TOTAL	21,311	20,780	18,046	19,719	25,045	27,549	34,123	40,708	44,164	43,796

[1]Division VIIIc.
[2]Division IXa.

Country	2000
Spain[1]	30,061
Portugal[2]	2,253
Spain[2]	3,760
Total[2]	6,013
TOTAL	36,074

[1]Division VIIIc.
[2]Division IXa.

Table 3.12.3.a.6 Mackerel (combined Southern, Western & North Sea spawning component).

Year	Recruitment Age 0 thousands	SSB tonnes	Landings tonnes	Mean F Ages 4-8
1984	7478720	2645828	648084	0.2068
1985	3465860	2616406	614275	0.2013
1986	3575910	2632340	602128	0.2074
1987	5239640	2611702	654805	0.1999
1988	3731310	2687998	676288	0.2099
1989	4539060	2724120	585921	0.1653
1990	3437690	2580921	625611	0.1678
1991	3929230	2902582	667883	0.2084
1992	4985450	2938102	760351	0.2487
1993	6387130	2766249	825036	0.3066
1994	4946240	2611792	823477	0.3039
1995	5550350	2846404	756291	0.2915
1996	6590670	2932761	563585	0.2147
1997	5283160	3173685	569543	0.1960
1998	4787740	3300059	666678	0.2034
1999	7007220	3722444	608928	0.1756
2000	4280500	3814606	667158	0.1716
2001	4280500	4023000		0.1682
Average	4972021	2973944	665650	0.2137

Table 3.12.3.a.7 Mackerel in the Western Area (Fishing Areas VI, VII and VIII).

Year	Recruitment Age 0 thousands	SSB tonnes	Landings tonnes	Mean F Ages 4-8
1972	2003630	3083399	170775	0.015
1973	4405000	3184063	219445	0.134
1974	3422830	3209338	298054	0.163
1975	4880290	2957247	491380	0.262
1976	5041170	2601410	507178	0.250
1977	953230	2584456	325974	0.123
1978	3322110	2765640	503913	0.166
1979	5462830	2433768	605744	0.233
1980	5421080	2069979	604761	0.261
1981	6983040	2157655	661762	0.211
1982	1838920	2048495	623819	0.212
1983	1358320	2293194	614287	0.205
1984	6520310	2290224	550929	0.194
1985	3124730	2261718	561292	0.201
1986	3151200	2288027	537615	0.173
1987	5025620	2340589	615380	0.214
1988	3340550	2466094	628000	0.233
1989	4270450	2484621	567400	0.192
1990	3105900	2331479	605937	0.201
1991	3592310	2664193	646169	0.220
1992	4379610	2694716	742305	0.262
1993	5579610	2453634	805039	0.336
1994	4156700	2217616	795723	0.332
1995	4188340	2369967	728742	0.306
1996	5023340	2374528	529464	0.226
1997	3546720	2465106	528835	0.208
1998	3240390	2484048	623411	0.219
1999	3503010	2733068	565132	0.202
2000	9953410	2636952	631085	0.212
Average	4165333	2515353	561709	0.213

Table 3.12.3.a.8 Mackerel, North Sea Spawning Component (Weight in '000 t).

Year	Spawning Stock Biomass	Landings
1965	2850[1]	208
1966	2700[1]	530[2]
1967	1900[1]	930[2]
1968	1500[1]	822[2]
1969	1113[3]	739[2]
1970	550[3]	323[2]
1971	580[3]	243[2]
1972	1249[3]	125[4]
1973	1097[3]	226[4]
1974	1036[3]	190[4]
1975	826[4]	138[4]
1976	700[4]	165[4]
1977	583[4]	188[4]
1978	436[4]	103[4]
1979	336[4]	66[4]
1980	258[4]	61[4]
1981	189[4]	60[4]
1982	162[4]	40[4]
1983	168[4]	43[4]
1984	111[5]	67[4]
1985		35[4]
1986	43[5]	25[4]
1987		3[4]
1988	36[5]	6
1989		7
1990	76[5]	10
1991		-[6]
1992		-[6]
1993		-[6]
1994		-[6]
1995		-[6]
1996	110[5]	-[6]
1997		-[6]
1998		-[6]
1999	68[5]	-[6]
2000		-[6]

[1]Hamre, J. 1980 Rapp.P.-v. Reun.Cons.Int.Explor.Mer. 177:212–242.
[2]Report of the Mackerel Working Group 1975. ICES CM 1975/H:3.
[3]Report of the Mackerel Working Group 1981. ICES CM 1981/H:7.
[4]Report of the Mackerel Working Group 1989. ICES CM 1989/Assess:11.
[5]Estimations based on Mackerel Egg Surveys. ICES CM 2000/G:01 Page 5.
[6]Since 1990 assumed by the Working Group to be 10,000 t.

3.12.4 Western horse mackerel (*Trachurus trachurus*) (Divisions IIa, IVa, Vb, VIa, VIIa–c,e–k, VIIIa,b,d,e)

State of stock/exploitation: The stock status is undefined. The current fishing mortality is above $\mathbf{F}_{0.1}$. Spawning stock biomass has decreased compared with the mid-1980s and is estimated to continue to decline at all levels of fishing mortality. Fishing mortality on the youngest ages is increasing.

Management objectives: There are no explicit management objectives for this stock.

Precautionary Approach reference points: ICES withdraws the $\mathbf{B}_{pa}$ reference point. The reference point $\mathbf{B}_{pa}$ (=500 000 t) was established in 1998 and was based on the egg survey estimate of the SSB that produced the exceptionally strong 1982 year class. This year class has dominated the stock development since then and recruitment has not been at a comparable level. The reference point needs to be revised in view of the recruitment experience over the last 20 years.

Advice on management: ICES advises that catches in 2002 be effectively limited to less than 98 000 t, corresponding to F = 0.15 which in 2000 was estimated to be $\mathbf{F}_{0.1}$. ICES also recommends that the TAC for this stock should apply to all areas in which Western horse mackerel are fished, i.e. Divisions IIa, IIIa (western part), VI, Vb, IVa, VIIa–c, VIIe–k, and VIIIa,b,d,e. ICES also advises that in Divisions VIIe,f directed horse mackerel fisheries in which juveniles are abundant, and industrial fisheries in which horse mackerel is taken as a by-catch, should be prohibited.

Comparison with previous assessment and advice: The assessment was done with the same method as last year. The new assessment estimates much lower values of recruitment than the previous assessment. The SSB has been adjusted considerably downwards and the fishing mortality correspondingly upwards compared to last year's assessment. The assessment is unstable.

Relevant factors to be considered in management: The extraordinarily strong 1982 year class was nearly 20 times larger than the average of subsequent year classes and 8 times larger than the second largest, the 1993 year class, in the documented history of the fishery 1982–2000. The 1982 year class reached its maximum biomass in 1987 and has decreased since then.

In the absence of outstanding year classes, sustainable yield is unlikely to be higher than about 130 000 t, dependent on the exploitation pattern. It is therefore clear that catches will have to be reduced unless another outstanding year class is produced. It is not known how abundant the more recent year classes are, but the assessment indicates that they may be well below average since 1996.

Recently fisheries in Divisions VIIe,f have taken large catches of mainly juvenile horse mackerel from the western stock. There has been a clear change in the age-structure of the catches from older to younger fish since 1996. Therefore, ICES expresses concern about this high exploitation of juvenile fish at a time when the recruitment is at a low level.

If the current increase in targeted juvenile mortality continues, landings will have to be reduced at a faster rate than that for an adult fishery. ICES recommends that a management strategy similar to that for North Sea Herring, in which both adult and juvenile mortality are independently restricted, be explored for this stock.

If the fishing mortality in 2001 is the same as in 2000 the catch in 2001 will decrease below the 175 000 t recorded for 2000. Continued fishing at the level estimated for 2000 will result in a further reduction of catch in 2001. The decline in SSB is estimated to continue throughout 2002 and 2003.

The TAC has been overshot considerably since 1988, except for 2000. However, the TAC has only been given for parts of the distribution and fishing areas (EU waters). ICES advises that if a TAC is set for this stock, it should apply to all areas where western horse mackerel are caught, i.e. Divisions IIa, IIIa (western part), IVa, Vb, VIa, VIIa–c, VIIe–k and VIIIa,b,d,e.

Catch forecast for 2002:

Basis: F(2001) = F(2000) = $\mathbf{F}_{sq(4-10)}$ = 0.23; Landings (2001) = 155; SSB (2001) = 612.

F(2002)	Basis	SSB (2002)	Catch (2002)	Landings (2002)	SSB (2003)
0.10		500	67	67	457
0.15	$\mathbf{F}_{0.1}$(2000), Basis for last years advice	490	98	98	429
0.18		486	113	113	416
0.20		481	128	128	403
0.23	F(2000)	475	145	145	388
0.25		472	156	156	378

Weights in '000 t.

Shaded scenario considered inconsistent with the precautionary approach.

Elaboration and special comment: There have been changes in the distribution of this stock, which has resulted in additional fleets outside the TAC area exploiting the stock. In 2000, the catches in the North Sea were reduced drastically.

The recent history of this stock reflects the development of a single large year class within the period of 17 years for which data are available. The frequency of the occurrence of such large year classes cannot be evaluated on the basis of the short time-series.

As in previous years some countries with major catches did not carry out biological sampling programmes. Although this has improved since 1998, the lack of biological data severely hampers the assessment. The maturity ogive is not well estimated, and there is uncertainty about natural mortality (0.15).

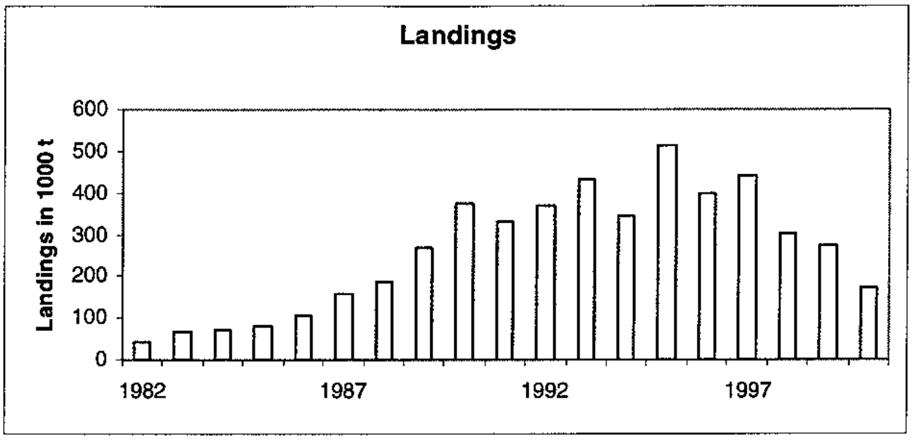
The assessment carried out uses the results of the international horse mackerel egg surveys. An egg survey on this stock, carried out in 1998 estimated the spawning stock biomass to be 1.4 million t. A new egg survey was carried out in 2001. Preliminary results suggest a considerable reduction in egg production.

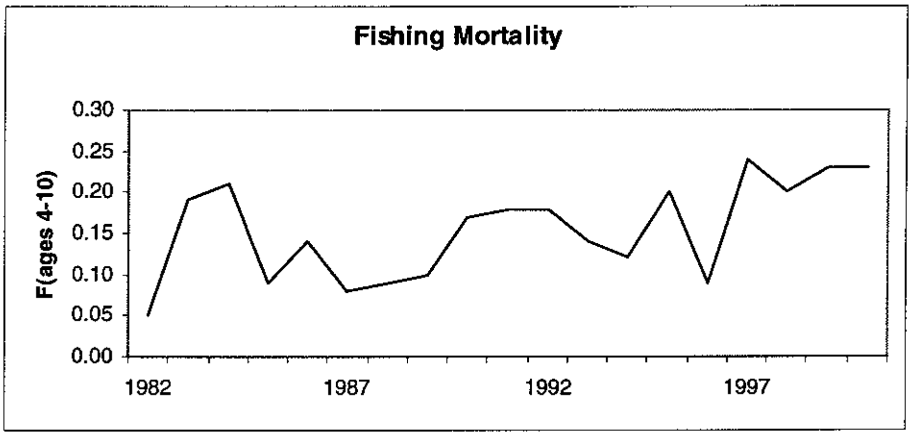
Source of information: Report of the Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine and Anchovy, September 2001 (ICES CM 2002/ACFM:06).

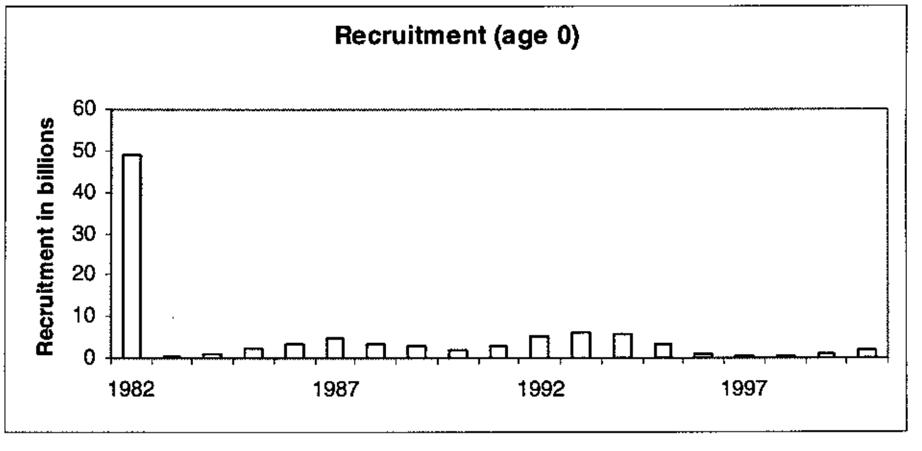
Catch data (Tables 3.5.11.1 and 3.12.4.1–6):

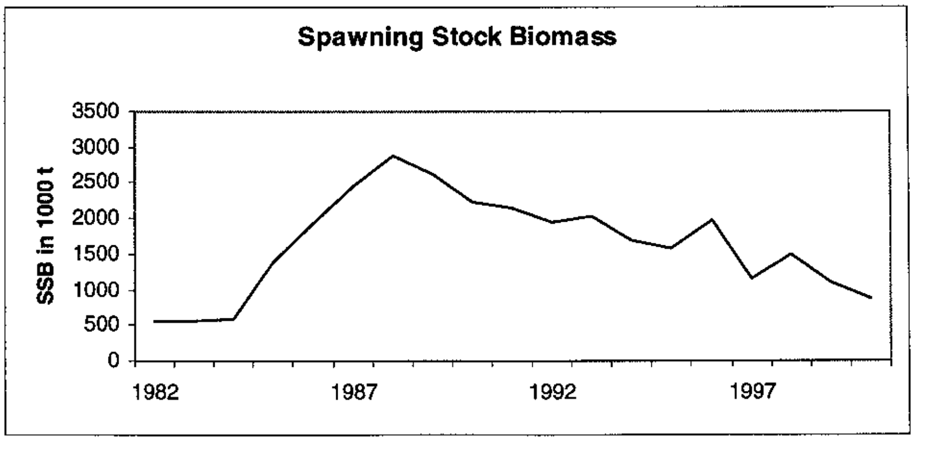
Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC[1]	ACFM landings	Disc. slip	ACFM catch
1987	Not assessed	-	155	157	-	157
1988	No increase in catches	102	169	184	4	188
1989	If sustained catches required; TAC	100	153	267	1	269
1990	TAC	~200	203	363	10	373
1991	Within safe biological limits	-	230	328	5	334
1992	Within safe biological limits	-	250	369	2	371
1993	Within safe biological limits	-	250	424	9	433
1994	Prudent not to increase F	-	300	385	4	389
1995	Reduction in catch	-	300	509	2	511
1996	Reduction in catch	-	300	379	17	397
1997	Reduction in F	173	300	440	3	443
1998	Reduction in F to 0.15	150	320	296	1	304
1999	Effectively limit catches to 200 000t	200	265	274	-	274
2000	Effectively limit catches to 200 000t	200	240	175	-	175
2001	Effectively limit catches to <224 000t	<224	233			
2002	Effectively limit catches to 98 000t effectively limited to less than 98 000 t	<98				

[1]Division Vb (EU waters only), Sub-areas VI and VII, Divisions VIIIa,b,d,e. Weights in '000 t.


Landings
Landings in 1000 t
600
500
400
300
200
100
0
1982
1987
1992
1997


Fishing Mortality
F(ages 4-10)
0.30
0.25
0.20
0.15
0.10
0.05
0.00
1982
1987
1992
1997


Recruitment (age 0)
Recruitment in billions
60
50
40
30
20
10
0
1982
1987
1992
1997


Spawning Stock Biomass
SSB in 1000 t
3500
3000
2500
2000
1500
1000
500
0
1982
1987
1992
1997

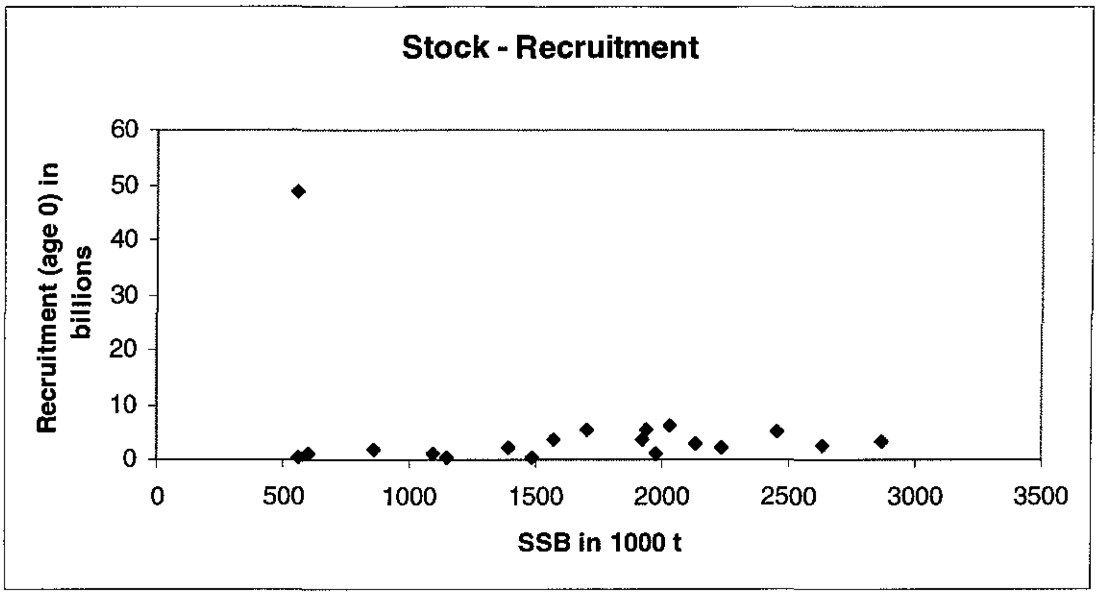

Stock - Recruitment
Recruitment (age 0) in billions
60
50
40
30
20
10
0
0
500
1000
1500
2000
2500
3000
3500
SSB in 1000 t

Table 3.12.4.1 Landings (t) of Horse mackerel in Sub-area II. (Data as submitted by Working Group members.)

Country	1980	1981	1982	1983	1984	1985	1986	1987
Denmark	-	-	-	-	-	-	-	39
France	-	-	-	-	1	1	-[2]	-[2]
Germany, Fed.Rep	-	+	-	-	-	-	-	-
Norway	-	-	-	412	22	78	214	3,272
USSR	-	-	-	-	-	-	-	-
Total	-	+	-	412	23	79	214	3,311

Country	1988	1989	1990	1991	1992	1993	1994	1995
Denmark	-	-	-	-	-	-	-	200
Faroe Islands	-	-	964[3]	1,115	9,157[3]	1,068	-	950
France	-[2]	-	-	-	-	-	55	-
Germany, Fed. Rep.	64	12	+	-	-	-	-	-
Norway	6,285	4,770	9,135	3,200	4,300	2,100	4	11,300
USSR/Russia (1992 -)	469	27	1,298	172	-	-	700	1,633
UK (England & Wales)	-	-	17		-	-	-	-
Total	6,818	4,809	11,414	4,487	13,457	3,168	759	14,083

Country	1996	1997	1998	1999	2000[1]
Denmark	-	-	1,755[3]	-	-
Estonia	-	-	22	-	-
Faroe Islands	1,598	799[3]	188[3]	132[3]	250[3]
France	-	-	-	-	-
Germany	-	-	-	-	-
Norway	887	1,170	234	2,304	841
Russia	881	648	345	121	84[3]
UK (England & Wales)	-	-	-	-	-
Total	3,366	2,617	2,544	2,557	1,175

[1]Preliminary.
[2]Included in Sub-area IV.
[3]Includes catches in Division Vb.

Table 3.12.4.2 Landings (t) of Horse mackerel in Sub-area IV and Division IIIa by country. (Data submitted by Working Group members).

Country	1980	1981	1982	1983	1984	1985	1986	1987	1988
Belgium	8	34	7	55	20	13	13	9	10
Denmark	199	3,576	1,612	1,590	23,730	22,495	18,652	7,290	20,323
Faroe Islands	260	-	-	-	-	-	-	-	-
France	292	421	567	366	827	298	231[2]	189[2]	784[2]
Germany, Fed.Rep.	+	139	30	52	+	+	-	3	153
Ireland	1,161	412	-	-	-	-	-	-	-
Netherlands	101	355	559	2,029[3]	824	160[3]	600[3]	850[4]	1,060[3]
Norway[2]	119	2,292	7	322	[3]	203	776	11,728[4]	34,425[4]
Poland	-	-	-	2	94	-	-	-	-
Sweden	-	-	-	-	-	-	2	-	-
UK (Engl. & Wales)	11	15	6	4	-	71	3	339	373
UK (Scotland)	-	-	-	-	3	998	531	487	5,749
USSR	-	-	-	-	489	-	-	-	-
Total	2,151	7,253	2,788	4,420	25,987	24,238	20,808	20,895	62,877

Country	1989	1990	1991	1992	1993	1994	1995	1996	1997
Belgium	10	13	-	+	74	57	51	28	-
Denmark	23,329	20,605	6,982	7,755	6,120	3,921	2,432	1,433	648
Estonia	-	-	-	293	-		17	-	-
Faroe Islands	-	942	340	-	360	275	-	-	296
France	248	220	174	162	302		-	-	-
Germany, Fed.Rep.	506	2,469[4]	5,995	2,801	1,570	1,014	1,600	7	7,603
Ireland	-	687	2,657	2,600	4,086	415	220	1,100	8,152
Netherlands	14,172	1,970	3,852	3,000	2,470	1,329	5,285	6,205	37,778
Norway	84,161	117,903	50,000	96,000	126,800	94,000	84,747	14,639	45,314
Poland	-	-	-	-	-	-	-	-	-
Sweden	-	102	953	800	697	2,087	-	95	232
UK (Engl. & Wales)	10	10	132	4	115	389	478	40	242
UK (N. Ireland)	-	-	350	-	-		-	-	-
UK (Scotland)	2,093	458	7,309	996	1,059	7,582	3,650	2,442	10,511
USSR/Russia (1992 -)	-	-	-						
Unallocated + discards	12,482[4]	-317[4]	-750[4]	-278[6]	-3,270	1,511	-28	136	-31,615
Total	112,047	145,062	77,904	114,133	140,383	112,580	98,452	26,125	79,161

Country	1998	1999	2000[1]
Belgium	19	21	19
Denmark	2,048	8,006	4,409
Estonia	22	-	-
Faroe Islands	28	908	24
France	379	60	49
Germany	4,620	4,071	3,115
Ireland	-	404	103
Netherlands	3,811	3,610	3,382
Norway	13,129	44,344	1,246
Poland	-	-	-
Russia	-	-	2
Sweden	3,411	1,957	1,141
UK (Engl. & Wales)	2	11	15
UK (N. Ireland)	-	-	-
UK (Scotland)	3,041	1,658	3,465
Unallocated + discards	737	-325	14,613
Total	31,247	64,725	31,583

[1] Preliminary. [2] Includes Division IIa. [3] Estimated from biological sampling.
[4] Assumed to be misreported. [5] Includes 13 t from the German Democratic Republic.
[6] Includes a negative unallocated catch of -4,000 t.

Table 3.12.4.3 Landings (t) of Horse mackerel in Sub-area VI by country. (Data submitted by Working Group members).

Country	1980	1981	1982	1983	1984	1985	1986	1987	1988
Denmark	734	341	2,785	7	-	-	-	769	1,655
Faroe Islands	-	-	1,248	-	-	4,014	1,992	4,450[3]	4,000[3]
France	45	454	4	10	14	13	12	20	10
Germany, Fed. Rep.	5,550	10,212	2,113	4,146	130	191	354	174	615
Ireland	-	-	-	15,086	13,858	27,102	28,125	29,743	27,872
Netherlands	2,385	100	50	94	17,500	18,450	3,450	5,750	3,340
Norway	-	5	-	-	-		83	75	41
Spain	-	-	-	-	-		-[2]	-[2]	-[2]
UK (Engl. &Wales)	9	5	+	38	+	996	198	404	475
UK (N. Ireland)						-	-	-	-
UK (Scotland)	1	17	83	-	214	1,427	138	1,027	7,834
USSR	-	-	-		-	-	-	-	-
Unallocated + disc.						-19,168	-13,897	-7,255	-
Total	8,724	11,134	6,283	19,381	31,716	33,025	20,455	35,157	45,842

Country	1989	1990	1991	1992	1993	1994	1995	1996	1997[1]
Denmark	973	615	-	42	-	294	106	114	780
Faroe Islands	3,059	628	255	-	820	80	-	-	-
France	2	17	4	3	+	-	-	-	52
Germany, Fed. Rep.	1,162	2,474	2,500	6,281	10,023	1,430	1,368	943	229
Ireland	19,493	15,911	24,766	32,994	44,802	65,564	120,124	87,872	22,474
Netherlands	1,907	660	3,369	2,150	590	341	2,326	572	498
Norway	-	-	-	-	-	-	-	-	-
Spain	-[2]	-[2]	1	3	-	-	-	-	-
UK (Engl. & Wales)	44	145	1,229	577	144	109	208	612	56
UK (N.Ireland)	-	-	1,970	273	-	-	-	-	767
UK (Scotland)	1,737	267	1,640	86	4,523	1,760	789	2,669	14,452
USSR/Russia (1992 -)	-	44	-	-	-	-	-	-	-
Unallocated + disc.	6,493	143	-1,278	-1,940	-6,960[4]	-51	-41,326	-11,523	837
Total	34,870	20,904	34,456	40,469	53,942	69,527	83,595	81,259	40,145

Country	1998	1999	2000[1]
Denmark	-	-	-
Faroe Islands	-	-	-
France	221	25,007	-
Germany	414	1,031	209
Ireland	21,608	31,736	15,843
Netherlands	885	1,139	687
Norway	-	-	-
Russia	-	-	-
Spain	-	-	-
UK (Engl. & Wales)	10	344	41
UK (N.Ireland)	1,132	-	-
UK (Scotland)	10,447	4,544	1,839
Unallocated +disc.	98	1,507	2,038
Total	34,815	65,308	20,657

[1]Preliminary.
[2]Included in Sub-area VII.
[3]Includes Divisions IIIa, IVa,b and VIb.
[4]Includes a negative unallocated catch of -7,000 t.

Table 3.12.4.4 Landings (t) of Horse mackerel in Sub-area VII by country. (Data submitted by the Working Group members).

Country	1980	1981	1982	1983	1984	1985	1986	1987	1988
Belgium	-	1	1	-	-	+	+	2	-
Denmark	5,045	3,099	877	993	732	1,477[2]	30,408[2]	27,368	33,202
France	1,983	2,800	2,314	1,834	2,387	1,881	3,801	2,197	1,523
Germany, Fed.Rep.	2,289	1,079	12	1,977	228	-	5	374	4,705
Ireland	-	16	-	-	65	100	703	15	481
Netherlands	23,002	25,000	27,500[2]	34,350	38,700	33,550	40,750	69,400	43,560
Norway	394	-	-	-	-	-	-	-	-
Spain	50	234	104	142	560	275	137	148	150
UK (Engl. & Wales)	12,933	2,520	2,670	1,230	279	1,630	1,824	1,228	3,759
UK (Scotland)	1	-	-	-	1	1	+	2	2,873
USSR	-	-	-	-	-	120	-	-	-
Total	45,697	34,749	33,478	40,526	42,952	39,034	77,628	100,734	90,253

Country	1989	1990	1991	1992	1993	1994	1995	1996	1997
Belgium	-	+	-	-	-	1	-	-	18
Denmark	34,474	30,594	28,888	18,984	16,978	41,605	28,300	43,330	60,412
Faroe Islands	-	28	-	-	-	-	-	-	-
France	4,576	2,538	1,230	1,198	1,001	-	-	-	27,201
Germany, Fed.Rep.	7,743	8,109	12,919	12,951	15,684	14,828	17,436	15,949	28,549
Ireland	12,645	17,887	19,074	15,568	16,363	15,281	58,011	38,455	43,624
Netherlands	43,582	111,900	104,107	109,197	157,110	92,903	116,126	114,692	81,464
Norway	-	-	-	-	-	-	-	-	-
Spain	14	16	113	106	54	29	25	33	-
UK (Engl. & Wales)	4,488	13,371	6,436	7,870	6,090	12,418	31,641	28,605	17,464
UK (N.Ireland)	-	-	2,026	1,690	587	119	-	-	1,093
UK (Scotland)	+	139	1,992	5,008	3,123	9,015	10,522	11,241	7,931
USSR/Russia (1992-)	-	-	-	-	-	-	-	-	-
Unallocated + discards	28,368	7,614	24,541	15,563	4,0103	14,057	68,644	26,795	58,718
Total	135,890	192,196	201,326	188,135	221,000	200,256	330,705	279,100	326,474

Country	1998	1999	2000[1]
Belgium	18	-	-
Denmark	25,492	19,223	13,946
Faroe Islands	-	-	550
France	24,223	-	20,401
Germany	25,414	15,247	9,692
Ireland	51,720	25,843	32,999
Netherlands	91,946	56,223	50,120
Norway	-	-	-
Russia	-	-	-
Spain	-	-	50
UK (Engl. & Wales)	12,832	8,885	2,972
UK (N.Ireland)	-	-	-
UK (Scotland)	5,095	4,994	5,152
Unallocated + discards	12,706	31,239	1,884
Total	249,446	161,654	137,766

[1]Provisional.

[2]Includes Sub-area VI.

Table 3.12.4.5 Landings (t) of Horse mackerel in Sub-area VIII by country. (Data submitted by Working Group members).

Country	1980	1981	1982	1983	1984	1985	1986	1987	1988
Denmark	-	-	-	-	-	-	446	3,283	2,793
France	3,361	3,711	3.073	2,643	2,489	4,305	3,534	3,983	4,502
Netherlands	-	-	-	-	-[2]	-[2]	-[2]	-[2]	-
Spain	34,134	36,362	19,610	25,580	23,119	23,292	40,334	30,098	26,629
UK (Engl. & Wales)	-	+	1	-	1	143	392	339	253
USSR	-	-	-	-	20	-	656	-	-
Total	37,495	40,073	22,684	28,223	25,629	27,740	45,362	37,703	34,177

Country	1989	1990	1991	1992	1993	1994	1995	1996	1997
Denmark	6,729	5,726	1,349	5,778	1,955	-	340	140	729
France	4,719	5,082	6,164	6,220	4,010	28	-	7	8,690
Germany, Fed. Rep.	-	-	80	62	-		-	-	-
Netherlands	-	6,000	12,437	9,339	19,000	7,272	-	14,187	2,944
Spain	27,170	25,182	23,733	27,688	27,921	25,409	28,349	29,428	31,081
UK (Engl. & Wales)	68	6	70	88	123	753	20	924	430
USSR/Russia (1992 -)	-	-	-	-	-	-	-	-	-
Unallocated + discards	-	1,500	2,563	5,011	700	2,038	-	3,583	-2,944
Total	38,686	43,496	46,396	54,186	53,709	35,500	28,709	48,269	40,930

Country	1998	1999	2000[1]
Denmark	1,728	4,818	2,584
France	1,844	74	7
Germany	3,268	3,197	3,760
Ireland	-	-	6,485
Netherlands	6,604	22,479	11,768
Russia	-	-	-
Spain	23,599	24,190	24,154
UK (Engl. & Wales)	9	29	112
UK (Scotland)	-	-	249
Unallocated + discards	1,884	-8658	5,093
Total	38,936	46,129	54,121

[1]Preliminary.
[2]Included in Sub-area VII.

Table 3.12.4.6 Western horse mackerel (IIa,IVa,Vb,VIa,VIIa-c,e-k,VIIIabde).

Year	Recruitment Age 0 thousands	SSB tonnes	Landings tonnes	Mean F Ages 4-10
1982	48822143	558571	41588	0.05
1983	370110	564279	64862	0.19
1984	1078406	599751	73625	0.21
1985	2230104	1390655	80521	0.09
1986	3552464	1922743	105665	0.14
1987	5025940	2451866	156247	0.08
1988	3404399	2868682	188100	0.09
1989	2676167	2630778	268867	0.10
1990	2023982	2235474	373463	0.17
1991	3017831	2135225	333600	0.18
1992	5321818	1934526	368200	0.18
1993	6014130	2031935	432000	0.14
1994	5635975	1705023	347842	0.12
1995	3506518	1567332	512995	0.20
1996	1094974	1977956	396448	0.09
1997	513813	1145086	442571	0.24
1998	368437	1485965	303543	0.20
1999	912290	1092142	273888	0.23
2000	1994428	862540	174927	0.23
Average	5134944	1640028	259945	0.15

3.12.5 Blue whiting combined stock (Sub-areas I–IX, XII and XIV)

State of stock/exploitation: The stock is considered to be outside safe biological limits. In recent years the stock has rapidly declined. SSB is estimated to have been at $\mathbf{B}_{pa}$ in 2000 and will be close to $\mathbf{B}_{lim}$ in 2001. Fishing mortality has increased from around the proposed $\mathbf{F}_{pa}$ in 1997, to well above $\mathbf{F}_{pa}$ in 1998 and 1999, and well above $\mathbf{F}_{lim}$ in 2000. Total landings in 2000 were 1.4 million t, far above the ICES recommended catch of 800 000 t. Landings in 2000 mainly consisted of the strong 1996 and 1997 year classes. The strength of incoming year classes is unknown.

Management objectives: At present there are no agreed management objectives for this stock and there is no agreed TAC for the combined area. It has been suggested by NEAFC, based on previous ICES advice, that the fishery should be managed with a constant catch of 650 000 t.

Precautionary Approach reference points (proposed in 2000):

The reference points are provisional as there is doubt about the present productivity of the stock.

ICES considers that:	ICES proposes that:
$\mathbf{B}_{lim}$ is 1.5 mill t	$\mathbf{B}_{pa}$ be set at 2.25 million t
$\mathbf{F}_{lim}$ is 0.51	$\mathbf{F}_{pa}$ be set at 0.32

Technical basis

$\mathbf{B}_{lim}$: $\mathbf{B}_{loss}$	$\mathbf{B}_{pa}$= $\mathbf{B}_{lim}$ exp(1.645*σ) σ=0.25
$\mathbf{F}_{lim}$: $\mathbf{F}_{loss}$ (0.51)	$\mathbf{F}_{pa}$: $\mathbf{F}_{med}$ (1998)

Advice on management: ICES recommends that the fishery in 2002 for blue whiting in all areas be closed until a rebuilding plan has been implemented including provisions described below.

Rebuilding plan: A rebuilding plan should be established in which the fishing mortality is reduced to a low level until SSB has increased to above $\mathbf{B}_{pa}$. An inherent part of this plan must ensure that the entire catch taken by the fisheries is controlled and regulated. At present 86 % of the catches is not subject to TACs. The rebuilding plan must ensure that the TAC applies to all areas in which blue whiting are distributed. In addition, measures must be taken to eliminate catches of juvenile blue whiting that are taken as by-catch in the mixed industrial fisheries. A reduction in F in 2001 would accelerate the rebuilding process.

Relevant factors to be considered in management: The fishery is largely unregulated and the exploitation rate is not sustainable. The spawning stock biomass reached a peak in 1999 due to the strong year classes 1995, 1996 and 1997, and is expected to decline rapidly at the present level of fishing mortality, to below $\mathbf{B}_{lim}$ in 2002.

Current exploitation rate and pattern mean that very few year classes support the fishery. The year classes dominating in the fishery are harvested heavily before they can reproduce or reach full growth potential. The estimate of year class strength for such young age groups is uncertain. There has been a shift towards dominance of the younger ages in the stock in recent years, in accordance with the increased fishing mortality.

Blue whiting is widely distributed in the eastern North Atlantic. Its distribution extends from the Strait of Gibraltar to the Barents Sea. It consists of several populations with genetic "leakage" between them, but it is treated as one stock as it so far has not been possible to define an unambiguous border between populations.

Comparison with previous assessment and advice: The present assessment is in accordance with the assessments made in 1999 and 2000.

Catch forecast for 2002:

Basis: $F_{(2001)} = F_{(2000)} = 0.86$; $\text{Landings}_{(2001)} = 1.159$; SSB in 2001 = 1.514.

F(2002) onwards	Basis	Catch (2002)	Landings (2002)	SSB in year 2002	SSB in year 2003
0.00	No fishing	0	0	1430	1925
0.09	0.1 *F(2000)	119	119	1406	1786
0.17	0.2 *F(2000)	231	231	1382	1659
0.26	0.3 *F(2000)	335	335	1359	1543
0.35	0.4 *F(2000)	433	433	1336	1437
0.43	0.5 *F(2000)	525	525	1314	1340
0.86	F(2000)	909	909	1208	963

Weights in '000 t, Mean F, ages 3–7.

Shaded scenarios considered inconsistent with the precautionary approach. SSB is not likely to rebuild to $\mathbf{B}_{pa}$ in the short term, even with no fishery.

Medium- and long-term projections: Medium term projections were made using two assumptions on fishing mortality for 2001, one assumption sets F at status quo and the other uses a lower F of 0.4. These projections suggest that the stock will reach $\mathbf{B}_{pa}$ with a high probability in 5-10 years at an F of 0.15 or lower from 2002 onwards.

Elaboration and special comment: Most of the catches are taken in the directed pelagic trawl fishery in the spawning and post-spawning areas (Divisions Vb, VIa,b and VIIb,c), but juveniles are also caught in a mixed industrial fishery in Sub-area IV and Division IIIa and in the pelagic trawl fishery in the northern areas (Sub-area I and II, Divisions Va, XIVa,b). These fisheries in the northern areas have taken 340 000 – 1 390 000 t per year in the last decade while catches in the southern areas (Sub-area VIII, IX, Divisions VIId,e and g-k) have been stable in the range of 25 000–34 000 t. The Portuguese and Spanish fleets do not target blue whiting in Division IXa, only a small pair trawl fleet takes blue whiting as a target species fishing in Spanish waters (Divisions VIIIc and IXa). The catch taken by this fleet is only a very low percentage of the total catch. In Division IXa blue whiting is taken as by-catch in mixed trawl fisheries. There are significant discards in this division.

Most countries that have substantial catches from this fishery sample the catches adequately. Sampling from the mixed industrial fishery in the North Sea is not satisfactory at present.

Estimates of spawning biomass by acoustic surveys are well above the level indicated by the assessment. Although the acoustic surveys may be indicative for the trends in biomass, the absolute values are considered not fully representative.

The analytical assessment is based on catch data, acoustic surveys and commercial CPUE data.

Source of information: Report of the Northern Pelagic and Blue Whiting Fisheries Working Group, April 2001 (ICES CM 2001/ACFM:17).

Yield and spawning biomass per Recruit F-reference points:

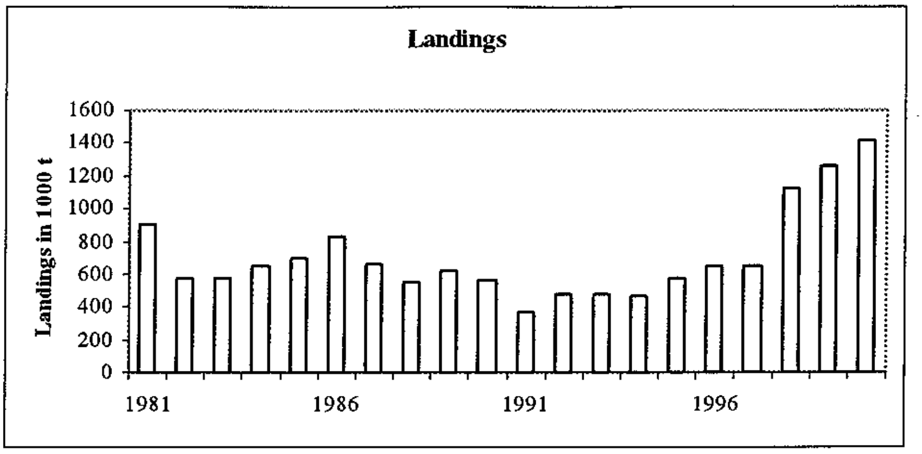
	Fish Mort Ages 3-7	Yield/R	SSB/R
Average Current	0.864	0.045	0.058
$\mathbf{F}_{max}$	0.790	0.045	0.063
$\mathbf{F}_{0.1}$	0.203	0.038	0.183
$\mathbf{F}_{med}$	0.299	0.042	0.141

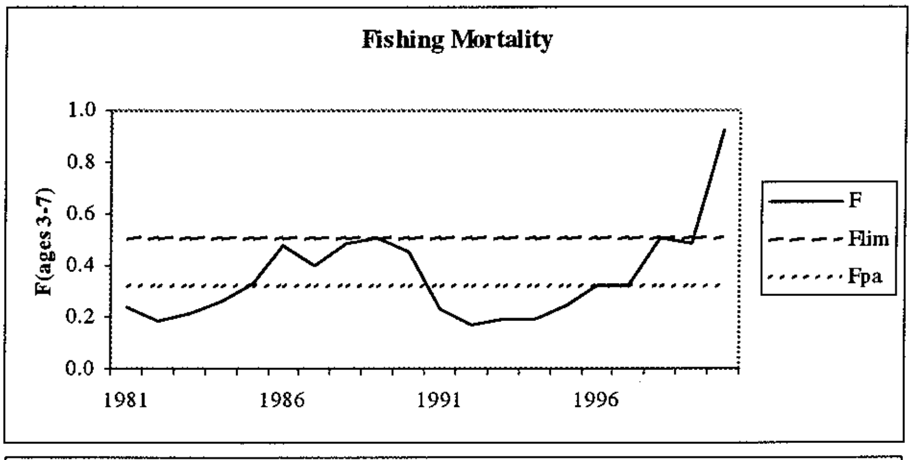
Catch data (Tables 3.12.5.1–6):

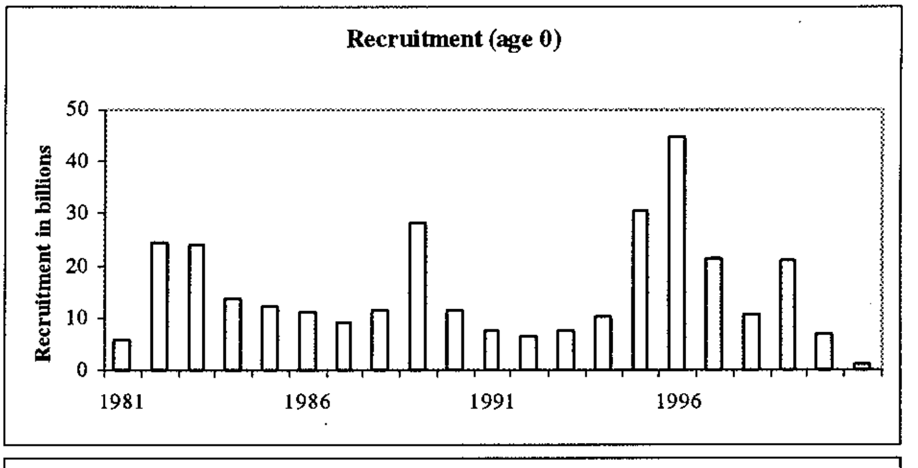
Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC	ACFM catch
1987	TAC for northern areas; no advice for southern areas	950	-	665
1988	TAC for northern areas; no advice for southern areas	832	-	558
1989	TAC for northern areas; no advice for southern areas	630	-	627
1990	TAC for northern areas; no advice for southern areas	600	-	562
1991	TAC for northern areas; no advice for southern areas	670	-	370
1992	No advice	-	-	475
1993	Catch at *status quo* F (northern areas); no assessment for southern areas	490	-	481
1994	Precautionary TAC (northern areas); no assessment for southern areas	485	650[1]	459
1995	Precautionary TAC for combined stock	518	650[1]	579
1996	Precautionary TAC for combined stock	500	650[1]	646
1997	Precautionary TAC for combined stock	540		672
1998	Precautionary TAC for combined stock	650		1125
1999	Catches above 650 000 t may not be sustainable in the long run.	650		1256
2000	F should not exceed the proposed $\mathbf{F}_{pa}$	800		1412
2001	F should not exceed the proposed $\mathbf{F}_{pa}$	628		
2002	Rebuilding plan			

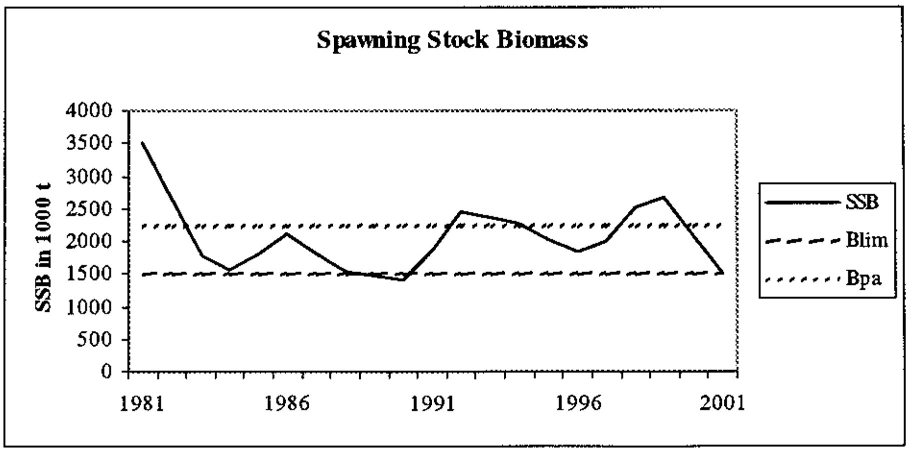
[1]NEAFC proposal for NEAFC regions 1 and 2. Weights in '000 t.

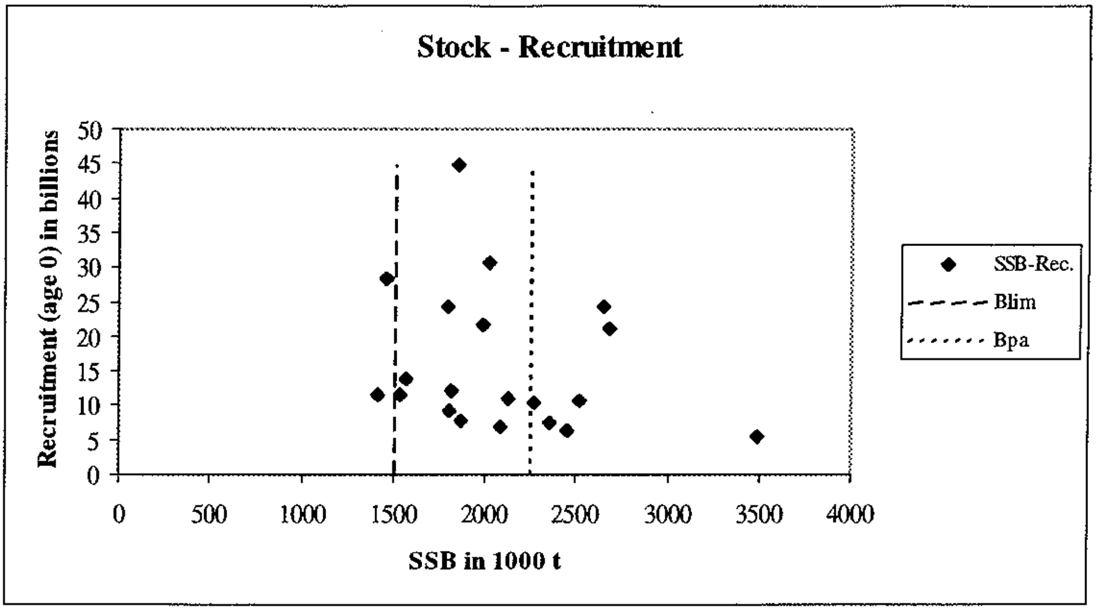
Blue whiting combined stock (Sub-areas I-IX, XII & XIV)

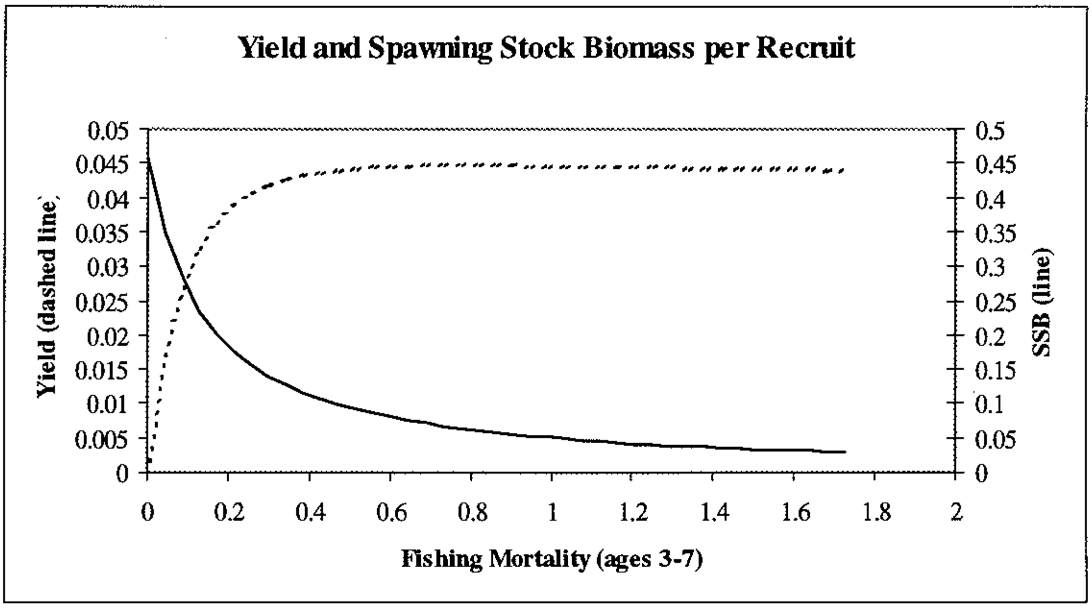









Stock - Recruitment
Recruitment (age 0) in billions
SSB in 1000 t
0
500
1000
1500
2000
2500
3000
3500
4000
50
45
40
35
30
25
20
15
10
5
0
SSB-Rec.
Blim
Bpa


Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
SSB (line)
Fishing Mortality (ages 3-7)
0.05
0.045
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2

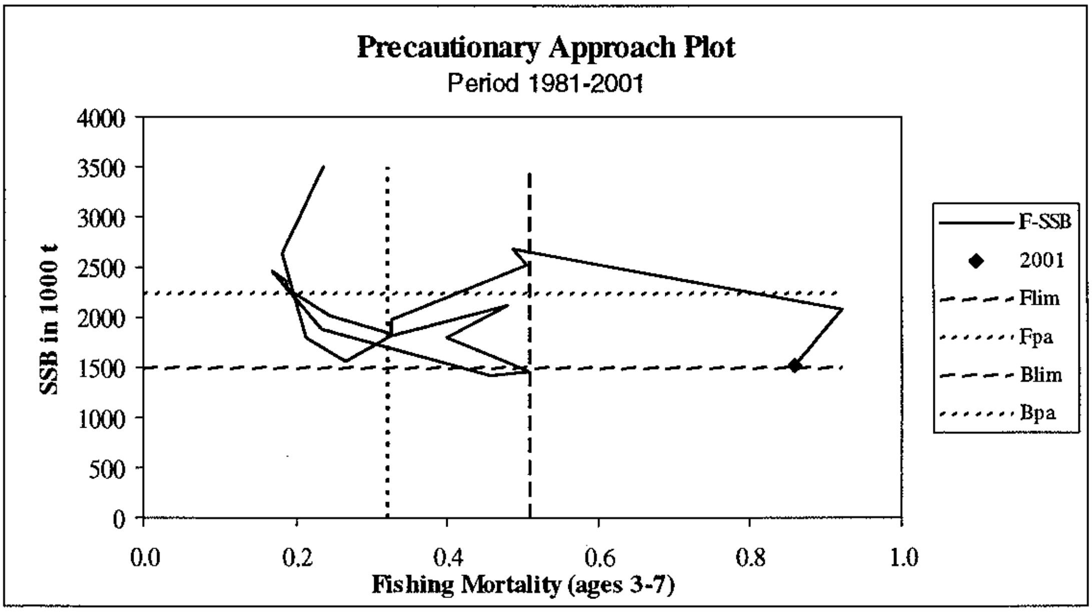

Precautionary Approach Plot
Period 1981-2001
SSB in 1000 t
Fishing Mortality (ages 3-7)
4000
3500
3000
2500
2000
1500
1000
500
0
0.0
0.2
0.4
0.6
0.8
1.0
F-SSB
2001
Flim
Fpa
Blim
Bpa

Table 3.12.5.1 Landings (tons) of BLUE WHITING from the main fisheries, 1987–2000, as estimated by the Working Group.

Area	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Norwegian Sea Fishery (Subareas I+II and Divisions Va,XIVa-b)	123,042	55,829	42,615	2,106	78,703	62,312	43,240	22,674	23,733	23,447	62,570	173,676	182,436	276,545
Fishery in the spawning area (Divisions Vb, VIa, VIb and VIIb-c)	446,287	426,037	475,179	463,495	218,946	318,081	347,101	378,704	423,504	478,077	514,654	827,194	940,881	996,577
Industrial mixed Fishery (Divisions Iva-c, Vb and IIIa)	62,689	45,143	75,958	63,192	39,872	65,974	58,082	28,563	104,004	119,359	65,091	94,881	106,609	114,477
Subtotal northern Fishery	632,018	527,009	593,752	528,793	337,521	446,367	448,423	429,941	551,241	620,883	642,315	1,095,751	1,229,926	1,387,599
Southern fishery (Subareas VIII+IX, Divisions VIId,e,g-k)	32,819	30,838	33,695	32,817	32,003	28,722	32,256	29,473	27,664	25,099	30,122	29,400	26,402	24,654
Grand total	664,837	557,847	627,447	561,610	369,524	475,089	480,679	459,414	578,905	645,982	672,437	1,125,151	1,256,328	1,412,253

Table 3.12.5.2 Landings (tons) of BLUE WHITING from the directed fisheries (Sub-areas I and II, Division Va, XIVa and XIVb) 1987–2000, as estimated by the Working Group.

Country	1987	1988	1989 [3])	1990	1991	1992	1993	1994 [2])	1995 [3])	1996	1997	1998	1999	2000
Faroes	9,290	-	1,047	-	-	-	-	-	-	345	-	44,594	11,507	17,980
Germany	1,010	3	1,341	-	-	-	-	2	3	32	-	78	-	-
Greenland	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Iceland	-	-	4,977	-	-	-	-	-	369	302	10,464	64,863[4]	99,092	146,903
Netherlands	-	-	-	-	-	-	-	-	72	25	-	63	435	-
Norway	-	-	-	566	100	912	240	-	-	58	1,386	12,132	5,455	-
Poland	56	10	-	-	-	-	-	-	-	-	-	-	-	-
UK (Eng.&Wales)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
USSR/Russia [1])	112,686	55,816	35,250	1,540	78,603	61,400	43,000	22,250	23,289	22,308	50,559	51,042	65,932	103,941
Estonia	-	-	-	-	-	-	-	-	-	377	161	904	-	-
Latvia	-	-	-	-	-	-	-	422	-	-	-	-	-	-
Denmark													15	7,721
Total	123,042	55,829	42,615	2,106	78,703	62,312	43,240	22,674	23,733	23,447	62,570	173,676	182,436	276,545

[1]) From 1992 only Russia

[2]) Includes Vb for Russia.

[3]) Icelandic mixed fishery in Va.

[4]) include mixed in Va and directed in Vb.

Table 3.12.5.3 Landings (tons) of BLUE WHITING from directed fisheries (Division Vb,VIa,b, VIIb,c. VIIg-k and Sub-area XII) 1987–2000, as estimated by the Working Group.

Country	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998[1]	1999	2000
Denmark	2,655	797	25	-	-	3,167	-	770	-	269	-	5051	19,625	11,856
Faroes	70,625	79,339	70,711	43,405	10,208	12,731	14,984	22,548	26,009	18,258	22,480	26,328	93,234	129,969
France	-	-	2,190	-	-	-	1,195	-	720	6,442	12,446	7,984	6,662	13,481
Germany	3,850	5,263	4,073	1,699	349	1,307	91	-	6,310	6,844	4,724	17,891	3,170	12,655
Iceland	-	-	-	-	-	-	-	-	-	-	-	-	61,438	113,280
Ireland	3,706	4,646	2,014	-	-	781	-	3	222	1,709	25,785	45635	35,240	25,200
Netherlands[2])	5,627	800	2,078	7,280	17,359	11,034	18,436	21,076	26,703	17,644	23,676	27,884	35,408	46,128
Norway	191,012	208,416	258,386	281,036	114,866	148,733	198,916	226,235	261,272	337,434	318,531	519,622	475,004	460,274
UK (Scotland)	3,315	5,071	8,020	6,006	3,541	6,849	2,032	4,465	10,583	14,325	33,398	92,383	98,853	42,478
USSR/Russia[3])	165,497	121,705	127,682	124,069	72,623	115,600	96,000	94,531	83,931	64,547	68,097	79,000	112,247	141,257
Japan	-	-	-	-	-	918	1,742	2,574	-	-	-	-	-	-
Estonia	-	-	-	-	-	6,156	1,033	4,342	7754	10,605	5,517	5,416	-	-
Latvia	-	-	-	-	-	10,742	10,626	2,160	-	-	-	-	-	-
Lithauen	-	-	-	-	-	-	2,046	-	-	-	-	-	-	-
Total	446,287	426,037	475,179	463,495	218,946	318,081	347,101	378,704	423,504	478,077	514,654	827,194	940,881	996,577

[1]) Including some directed fishery also in Division IVa.

[2]) Revised for the years 1987, 1988, 1989, 1992, 1995,1996,1997

[3]) From 1992 only Russia

Table 3.12.5.4 Landings (tons) of BLUE WHITING from the mixed industrial fisheries and caught as by-catch in ordinary fisheries in Divisions IIIa, IVa 1987–2000, as estimated by the WG.

Country	1987	1988	1989	1990	1991	1992	1993[3])	1994	1995	1996	1997	1998[2]	1999	2000
Denmark	28,541	18,144	26,605	27,052	15,538	31,189	41,053	19,686	12,439	51,832	26,270	56,472	45,013	38,109
Faroes	7,051	492	3,325	5,281	355	705	1,522	1,794	-	6,068	6,066	296	265	42
Germany[1])	115	280	3	-	-	25	9	-	-	-	-			-
Netherlands	-	-	-	20	-	2	46	-	-	-	793			-
Norway	24,969	24,898	42,956	29,336	22,644	31,977	12,333	3,408	78,565	57,458	27,394	28,814	48,338	73,006
Sweden	2,013	1,229	3,062	1,503	1,000	2,058	2,867	3,675	13,000	4,000	4,568	9,299	12,993	3,319
UK	-	100	7	-	335	18	252	-	-	1	-			-
Total	62,689	45,143	75,958	63,192	39,872	65,974	58,082	28,563	104,004	119,359	65,091	94,881	106,609	114,477

[1]) Including directed fishery also in Division IVa.

[2]) Including mixed industrial fishery in the Norwegian Sea

[3]) Imprecise estimates for Sweden: reported catch of 34265 t in 1993 is replaced by the mean of 1992 and 1994, i.e. 2,867 t, and used in the assessment.

Table 3.12.5.5 Landings (tons) of BLUE WHITING from the Southern areas (Sub-areas VIII and IX and Divisions VIIg-k and VIId,e) 1987–2000, as estimated by the Working Group.

Country	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Netherlands	-	-	-	450	10	-	-	-	-	-	-	10[1]	-	-
Norway	4	-	-	-	-	-	-	-	-	-	-			-
Portugal	9,148	5,979	3,557	2,864	2,813	4,928	1,236	1,350	2,285	3,561	2,439	1,900	2,625	2,032
Spain	23,644	24,847	30,108	29,490	29,180	23,794	31,020	28,118	25,379	21,538	27,683	27,490	23,777	22,622
UK	23	12	29	13	-	-	-	5	-	-	-	-	-	-
France	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Total	32,819	30,838	33,695	32,817	32,003	28,722	32,256	29,473	27,664	25,099	30,122	29,400	26,402	24,654

[1]) Directed fisheries in VIIIa

Table 3.12.5.6 Results of stock assessment Blue Whiting, Output from final AMCI run.

Year	Recruitment Age 0 thousands	SSB tonnes	Landings tonnes	Mean F Ages 3-7
1981	5550240	3496846	909556	0.238
1982	24356160	2648940	576419	0.184
1983	24189990	1791259	570072	0.215
1984	13774480	1562920	641776	0.265
1985	12128640	1819209	695596	0.327
1986	11071540	2125704	826986	0.480
1987	9179300	1803309	664431	0.399
1988	11597640	1532708	553446	0.487
1989	28310490	1463991	625433	0.510
1990	11547080	1415128	561610	0.458
1991	7717350	1872460	369524	0.234
1992	6331630	2456247	474245	0.169
1993	7522430	2358046	480679	0.189
1994	10344360	2271753	459414	0.191
1995	30675990	2017171	578683	0.245
1996	44687970	1847190	644273	0.327
1997	21564440	1987498	646652	0.326
1998	10602820	2515858	1125151	0.506
1999	21181860	2682051	1256328	0.488
2000	6802300	2085705	1413145	0.921
2001	1232100	1514000		0.860
Average	15255658	2060381	703671	0.382

Table 3.12.5.7 Blue Whiting. Medium term projections.

Blue whiting: Medium term predictions

	Probabilities (%) B<Blim 2002	B<Blim 2010	B>Bpa 2002	B>Bpa 2010	Year when risk B<Blim is below 10%	Year when prob. B>Bpa is above 90%	Catch in 2001 25%	50%	75%	Catch in 2002 25%	50%	75%
Fixed F in all years from 2002 onwards; F2001 = 0.4												
F-value from 2002												
0.00	1	0	53	100	2002	2003	723	784	853	0	0	0
0.10	1	0	48	100	2002	2003				202	222	278
0.15	1	0	45	97	2002	2003				297	325	358
0.20	1	0	43	85	2002	2003				388	425	468
0.25	1	0	41	62	2002	2004				475	520	573
0.32	1	9	37	30	2002	-				591	647	714
Fixed F in all years from 2002 onwards; F2001 = 0.86 (F 2000)												
F-value from 2002												
0.00	19	0	11	100	2003	2004	1321	1434	1561	0	0	0
0.10	23	0	2	100	2003	2006				149	164	182
0.15	25	0	2	96	2003	2007				220	242	267
0.20	27	0	2	83	2003	-				287	316	350
0.25	29	1	1	60	2004	-				352	388	429
0.32	32	12	1	27	-	-				439	483	536
F at F2000 in all years												
0.864	61	100	0	0	-	-	1321	1434	1561	972	1077	1197

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3.12.6 Deep-water Fisheries Resources south of 63°N

These resources are assessed on a bi-annual basis and Coop. Res. Rep. 242 (2000) includes an overview of these resources and their status. The advice given in 2000 is clarified below in an answer to NEAFC and Norwegian requests for further information.

3.12.6.a Answer to Special Request on the Management of Deep-water Species

NEAFC requested ICES to consider the following with regards to deep-sea species:

a) Characterize and classify the most important deep-sea species (listed in Annex 2 in the request) according to their life history strategies and rank them by vulnerability to exploitation together with more well known deep-sea species, e.g., redfish and Greenland halibut;
b) Clarify advice statements for stocks where little biological information is available in order to generate consistency in advice (as outlined in Annex I pt 1-3 of the request);
c) Give established reference points used as basis for statements on stock status (as outlined in Annex I pt 5 in the request); and
d) Provide advice on how to improve data-collecting systems and advice on appropriate improvement for monitoring deep-sea resources (as outlined in Annex I pt 6 of the request).

Norway requested ICES:

> To evaluate the present assessment approach of treating different species of deep-water sea fish resources as one unit.

This is essentially the same request as a) above. Answers to the two requests are therefore combined in this section of the ICES advice on fishery management.

Answer to point a) of the NEAFC request and to Norway

ICES considers that evaluation of stock status on each species should be done based on the population dynamics of that specific species and that all deep-water species should not be treated as having the same population dynamics. ICES has in its advice assessed the stocks individually based on available data. The ranking requested by NEAFC further enlightens the differences in population dynamics among deep-water species.

Use of life history parameter as a basis for management

As noted above management should be based on population dynamic information. However, for deep-water species such data are largely lacking and much of the scientific basis for management must therefore be taken from the general biology of the species. There is a well-developed theoretical framework on life history dynamics as a basis for scientific advice on exploitation.

ICES has used life history parameters to rank the species according to productivity which, according to the theoretical framework should be informative guides on vulnerability to exploitation:

- For a given fishing mortality, stocks of lower productivity will decrease faster than more productive stocks.

- Once depleted, the more productive species will be able to rebuild more quickly.

Vulnerability includes many factors in addition to species life history. Some factors are biological, e.g. aspects of species biology like shoaling, migrations, habitat preferences, whereas others reflect the fisheries, e.g., markets for the species and fleet capacity. Many deep-water species are widely distributed, and features of their life history may not be constant across their range or may change in response to exploitation. For these reasons life history parameters are useful, but not perfect guides to sustainable management. However, because the most and best information is available on life histories they are the primary guide at this time.

Below, deep-water species are ranked by their life history parameters, which are indicators of productivity. As noted above this means that those stocks ranked as more vulnerable will be those stocks for which detrimental impacts of fishing will be more difficult to reverse.

Ranking the deep-water species according to life history parameters

Annex II of the NEAFC lists the following species:

Common Name	*Scientific Name*
Blue ling	*Molva dypterygia*
Ling	*Molva molva*
Tusk	*Brosme brosme*
Roundnose grenadier	*Coryphaenoides rupestris*
Black scabbardfish	*Aphanopus carbo*
Greater silver smelt	*Argentina silus*
Orange roughy	*Hoplostethus atlanticus*
Red sea bream	*Pagellus bogaraveo*
Greater forkbeard	*Phycis blennoides*
Alfonsinos	*Beryx* spp.

Available information on life history characteristics was compiled, and the deep-water species were ranked together with three reference species; redfish (*Sebastes marinus* and *S. mentella*) and Greenland halibut (*Reinhardtius hippoglossoides*). The three reference species have been exploited for an extensive period within the ICES area, and more data on their biology and population dynamics are available than for other deep-water species. The ranking was made on the basis of several biological parameters: longevity, growth, natural mortality, fecundity, and length or age at first maturity (Tables 3.12.6.a.2-6). Rank 1 is assigned to the species for which the sustainable catch level should be the lowest fraction of the virgin biomass. Less vulnerable species were assigned higher ranks. Where the biological parameters were considered to be quite similar between two or more species the same rank was assigned. The available data did not allow ranking of all species (or species groups) according to all parameters. The species with no data are listed at the top of the tables and given no rank (as indicated by "?"). Some parameters may be highly correlated. For example, longevity, growth rate and natural mortality are most often derived from the same data, or they may rely upon the same, unverified, assumptions. It is then to be expected that these different parameters provide the same species ranking.

The estimated life history parameters used to rank the species are taken from the literature. Numbers given may have been estimated by different methodologies, have wide confidence intervals, or apply to local areas or environments. Where data are available from the ICES areas they were preferred. When no information was available information was extrapolated from other areas. Parameter estimates from the Mediterranean, where at least growth is clearly different, were not included in the analyses.

In order to summarise the detailed information, a simple rank average was produced and the species (or species groups) were ordered (Table 3.12.6.a.1). This analysis is of course crude. It should be emphasised that the underlying data are of variable quality and that new information is needed for several species in order to achieve a more reliable ranking. Nonetheless, the main pattern as indicated is believed to be robust.

Table 3.12.6.a.1 Summary of ranking of the deep-water species and the reference species redfish and Greenland halibut. A low rank means high vulnerability. Cases where no rank could be assigned due to lack of information are indicated by "?". The overall rank in the rightmost column is an average of the available ranks in each row.

	Life history parameter					Rank average
Species	**Longevity**	**Growth rate**	**Natural Mortality**	**Fecundity**	**Length and age at first maturity**	**(? ignored)**
Greater Forkbeard	4	?	?	?	?	?
Deep water squalid sharks: Centroscymnus coelolepis Centrophorus squamosus	2	?	1	1	2	1.5
Orange roughy	1	1	1	4	1	1.6
Roundnose grenadier	2	3	2	3	2	2.4
Sebastes	3	2	2	4	2	2.6
Greenland halibut	4	3	3	3	3	3.2
Greater silver smelt	3	5	?	2	3	3.3
Tusk	4	?	2	6	3	3.8
Black scabbardfish	4	6	3	?	3	4.0
Blue ling	3	?	?	5	4	4.0
Ling	4	?	3	5	4	4.0
Red (Blackspot) Seabream	4	4	?	4	5	4.3
Beryx decadactylus	5	4	?	?	5	4.7
Beryx splendens	5	5	?	?	5	5.0

Longevity

Estimates of longevity are based upon maximum age observed from otolith readings (Table 3.12.6.a.2). For several species age is difficult to determine and age readings may not be validated. Although some validations have been attempted, satisfactory validations in the sense of Beamish and McFarlane (1983) are only available for few deep-water species. For orange roughy and roundnose grenadier, age validation has been carried out, but results apply only to juveniles (Gordon and Swan, 1996; Mace *et al.*, 1990). For orange roughy and *Sebastes*, radiometric dating of otolith cores has been carried out, and the results suggest longevity in accordance with otolith growth zone readings (Fenton *et al.*, 1991; Francis 1995; Kastelle *et al.*, 2000; Smith *et al.*, 1995).

Orange roughy, roundnose grenadier, and the deep-water squalids have the longest life-spans. Most of the other species have intermediate longevity (15-30 yrs), but the *Beryx* species are relatively short-lived.

Table 3.12.6.a.2 Deep-water species ranked according to longevity.

Rank	Species	Longevity (years)	Authors
1	Orange roughy	125	Annala and Sullivan, 1996; Tracey and Horn, 1999
2	Roundnose grenadier	>60	Allain and Lorance, 2000; Bergstad, 1990; Kelly *et al.*, 1997
2	Deep water squalid sharks *Centroscymnus coelolepis* *Centrophorus squamosus*	 - 60-70	 Clarke, in press, and WD
3	Sebastes	45-50	Nedreaas, 1990
3	Blue ling	~30	Bergstad and Hareide 1996; Magnusson *et al.* 1997
3	Greater silver smelt	~35	Bergstad, 1993
4	Greenland halibut	15-20	ICES Arctic Fisheries WG
4	Ling	~20	Bergstad and Hareide 1996; Magnusson *et al.* 1997
4	Tusk	~20 (?)	Bergstad and Hareide 1997; Magnusson *et al.* 1997
4	Black scabbardfish	8 12 from whole otoliths ~25 from sections	Morales-Nin *et al.*, 1996 FAIR 1999; BASBLACK 2000
4	Red (Blackspot) Seabream	16	Menezes *et al.*, 2001
4	Greater Forkbeard	15 ?	FAIR 1999, Sub-t. 5.12, Doc.55
5	*Beryx decadactylus*	13	Krug *et al.*,1998
5	*Beryx Splendens*	11	Krug *et al.*,1998

Growth rate

The k parameter of the von Bertalanffy growth equation is used here as an expression of growth rate and species with the lowest ranks have the lowest growth parameter (Table 3.12.6.a.3). This coefficient represents the rate at which the individuals of a species reach their asymptotic length, while L_∞ is a measure of asymptotic size (Francis, 1996). However, these two parameters are highly correlated and strongly different. L_∞,k pairs may fit properly the same set of length-at-age data, especially when the full age range of the population is not represented in the sample. This may for example be a great problem for black scabbardfish for which both juveniles and adults are lacking in samples from the west of the British Isles and off Portugal (only sub-adults (a "sub-adult" is a juvenile, but a rather large juvenile approaching maturity) are caught). Ripe specimens have only been found near Madeira and the Azores.

Table 3.12.6.a.3 Deep-water species ranked according to growth rate.

Rank	Species		Growth rate, k (y^{-1})	Authors/comments
?	Ling			Probably Rank 3
?	Blue ling			Probably Rank 3
?	Tusk			Probably Rank 2
?	Greater Fork beard			
?	*Centroscymnus coelolepis* *Centrophorus squamosus*			
1	Orange roughy		0.06-0.07	Annala and Sullivan, 1996; Tracey and Horn, 1999
2	Sebastes		0.06-0.11	Nedreaas, 1990
3	Roundnose grenadier			
		♂	0.105	Bergstad, 1990
		♀	0.100	
		♂	0.128	Kelly *et al.*, 1997
		♀	0.101	Allain and Lorance, 2000
		♂	0.06	
		♀	0.06	
3	Greenland halibut		0.02-0.03 (probably underestimated)	Bowering and Nedreaas 2001 (growth curves linear)
4	Red (Blackspot) Seabream			Menezes *et al.*, 2001
		♂	0.17	
		♀	0.102	
4	*Beryx decadactylus*			Menezes *et al.*, 2001
		♂	0.11	
		♀	0.165	
5	Greater silver smelt			Bergstad, 1993
		♂	0.20	
		♀	0.17	
5	*Beryx splendens*			Menezes *et al.*, 2001
		♂	0.134	
		♀	0.141	
6	Black scabbard fish		0.251	Morales-Nin *et al.*, 1996

Based on the growth data, orange roughy is again the species with the lowest rank. Black scabbardfish appears to be much faster growing. The estimated k is based upon the age reading from Morales-Nin and Sena-Carvalho (1996), however, the ages estimated from sectioned otoliths, e.g., as used by Connolly and Kelly (FAIR 1999), would provide a much lower k parameter. The results from the recently finished BASBLACK project suggest that growth rate is rather high (see WD by Figueiredo *et al.* 2001).

Natural mortality

Estimates of the natural mortality of deep-water species were derived either from catch curves of unexploited stocks (roundnose grenadier, tusk) or from crude estimates according to the maximum age observed in the populations (Annala and Sullivan, 1996; Anon. 2000a). Such data were only available for a few species (Table 3.12.6.a.4).

Table 3.12.6.a.4 Deep-water species ranked according to natural mortality rate.

Rank	Species	Natural mortality, M (y^{-1})	Authors/comments
?	Blue ling		
?	Greater silver smelt		
?	Red (Blackspot) Seabream		
?	Greater forkbeard		
?	*Centroscymnus coelolepis* *Centrophorus squamosus*		
?	Alfonsino (*Beryx* spp.)		
1	Orange roughy	0.04 – 0.045	Annala and Sullivan, 1996; Tracey and Horn, 1999
2	Sebastes	0.1	ICES Arctic Fisheries WG
2	Roundnose grenadier	0.1	Lorance *et al.*, in press
2	Tusk	0.1-0.2	Anon. 2000a
3	Greenland halibut	0.15	Value used by ICES WGs
3	Black scabbard fish	0.17	Martins *et al.*, 1989
3	Ling	0.2-0.3	Derived from Z estimates compiled by SGDEEP 2000.

Fecundity and reproductive processes

Deep-water species are adapted to an environment where disturbance may be weaker or more rare than in the more shallow water ecosystems. Life history theory predicts several features of their reproductive biology. Deep-water species may have developed a reduced fecundity balanced by a much higher survival of adult fish. For the long-lived species, the total egg production of an adult may be spread over a long period and this may be necessary to ensure sufficient recruitment. Reduction of the adult biomass by fishing may thus have a stronger negative effect on the deep-living fishes than for species living on the shelf. Data on fecundity are still limited (Table 3.12.6.a.5), as is exact information on reproductive strategies in general. There may also be geographical variations. E. g. the roundnose grenadier to the west of Britain appears to spawn at least 2 batches per year (Allain, 1998, 1999, *in press*) and the spawning period may be protracted. However, in the Skagerrak, the same species appears to have a single well-defined late autumn spawning period (Bergstad and Gordon, 1994).

The estimate of fecundity may have a very different meaning in terms of resilience to exploitation and/or capacity of recovery, depending on the early life history and dispersion processes of larvae. Early life history processes are generally poorly known for deep-water species. There is probably a potential for compensation to exploitation, but the actual potential may be very limited. The fecundity of orange roughy may increase as the stock reduces (Koslow, *et al.*, 1995), however this may not be the case for all stocks (Clark, *et al.*, 2000). The scope for compensation would seem very limited for the deep-water squalids.

Within teleosts, there should be a major difference between species that have a short spawning period, such as the orange roughy, and species that spawn all year round or during most of the year (e.g. roundnose grenadier west of Britain, greater argentine in the Skagerrak). The survival rate of eggs, larvae and early juveniles would be expected to be different for species for which a short spawning period is finely tuned to some expectedly "optimal" survival conditions for the spawned eggs, and for species whose progeny is dispersed more widely in space and time. This leads to a "success of reproduction" parameter. This is very poorly known for deep-water species. However, for the orange roughy, the recruitment seems to be episodic (Clark, 1998; Clark, *et al.*, 2000; Koslow, *et al.*, 2000). It could be argued that the recruitment of species that spawn all year round should be less variable as it is more likely that a more constant proportion of the progeny encounters favourable conditions, while for the orange roughy the conditions are either good or bad for all of a given year class of one population.

Table 3.12.6.a.5 Deep-water species ranked according to fecundity.

Rank	Species	Fecundity		Authors
		Total ($N..y^{-1}$)	relative($N.\ kg^{-1}.y^{-1}$)	
?	Black scabbard fish			
?	Greater forkbeard			
?	Alfonsino			
1	Deep water squalid sharks *Centroscymnus coelolepis*	7 – 11 (3) 13	1 or 2 (5)	Girard and Du Buit, 1999; Girard, 2000) Clarke, WD
	Centrophorus squamosus	8 – 19 (4) 8	1 or 2 (5)	Girard and Du Buit, 1999; Girard, 2000 Clarke, WD
2	Greater silver smelt	Few thousand		
3	Greenland halibut	20 000-70 000		Gundersen *et al.* 1999
3	Roundnose grenadier (2)	23 000 (2 500 – 70 000)	25 000	Allain, 1998, 1999, *in press*
4	Red (Blackspot) Sea Bream	290000-1125000		Krug, 1998
4	Orange roughy (1)	28 000 – 385 000	38 000 (11 000 – 136 000)	Berrehar, DuBuit, Lorance, unpublished
4	Sebastes mentella	30 000 – 40 000	40 000	Shibanov V. per. Comm. (Irminger Sea)
5	Ling	Millions		
5	Blue ling	Millions		
6	Tusk	Millions		

(1) Data for the North-east Atlantic; values from the southern hemisphere are lower due to the smaller size of the fish.

(2) per batch.

(3) Ovarian fecundity: number of simultaneous ovules in the ovaries.

(4) Uterine fecundity: number of simultaneous embryos in the uterus.

(5) Hypothetical mean number of pup/year/female estimated from the ovarian or uterine fecundity, and duration of the reproductive cycle derived from indirect method.

Length and age at first maturity

Length at first maturity is known for many species (Table 3.12.6.a.6). Age at first maturity is less often determined, and the estimates frequently depend on assumed rather than validated age data. It is difficult to rank the species according to these criteria. The parameter of interest is not the length or age *per se*, rather at what stage in their life they start to reproduce. A better basis for the ranking would have been age/length at first maturity as a proportion of an estimate of maximum age/length. A precise proportion could not be derived for all species, but an approximate measure was used whenever possible as basis for the final ranking given in Table 3.12.6.a.6.

Data from Australia and New Zealand suggest that orange roughy matures at a very high age (25-30 yrs), but this is not really late in life for a species with a life span of 100 years or more. Others may spawn for the first time at an age corresponding to a half or a third of their maximum life-span.The lings and tusk grow to about half their maximum size before maturing, but others such as roundnose grenadier and greater silver smelt are comparatively big when spawning for the first time.

Table 3.12.6.a.6 Deep-water species ranked according to length and age at first maturity.

Rank	Species	Length at first maturity (cm)	Age at first maturity (years)	Authors
?	Greater Forkbeard			
1	Orange roughy (1)			Berrehar, Du Buit, Lorance, unpublished
	♂	48		
	♀	52		
2	Sebastes		12-15	ICES Arctic Fisheries WG
2	Roundnose grenadier (2)			Bergstad, 1990
	♂		8	
	♀		10	
	♂	13.3 (PAFL)		Allain, 1998, 1999, *in press*; FAIR, 1999, Iceland
	♀	14.2 (PAFL)		
2	*Centroscymnus coelolepis*			
	♂	86		Girard and Du Buit, 1999; Girard, 2000;
	♀	102		
	Centrophorus squamosus			Clarke WD
	♂	98-101		Girard and Du Buit, 1999; Girard, 2000;
	♀	124-128		Clarke WD
3	Greenland halibut			
	♂	40	4	Høines, pers. comm.
	♀	60	8	
3	Tusk	40-45	8-10	Magnusson *et al.* 1997
3	Greater silver smelt			Magnusson 1988; Bergstad 1993; FAIR, 1999
	♂	36.2	6-9	
	♀	37.2	6-9	
3	Black scabbard fish			
	♂	84-88		FAIR 1999, Iceland
	♀	92-97		Sena-Carvalho, Reis, Morales-Nin, in prep, in Anon., 2000a
	♂	73.7		
	♀	102.7		
4	Ling	60-75	5-7	Magnusson *et al.* 1997
4	Blue ling			
	♂	73.9		FAIR 1999, Iceland
	♀	89.0		
5	Red (Blackspot) Seabream	30-35 cm		Spain,WD by Gil and Sobrino, 2001
	♂	26.2	3	Azores, Mendonca *et al.*, 1998
	♀	29.2	4	
5	*Beryx splendens*			
	♂	22.9	2	Azores, Mendonca *et al.*, 1998
	♀	23	2	
5	*Beryx decadactylus*			
	♂	30.3	4	Azores, Mendonca *et al.*, 1998
	♀	32.5	4	

(1)Data for the Northeast Atlantic, fish in the southern hemisphere mature younger at a lower size (Horn *et al.*, 1998; Tracey and Horn, 1999).

Answer to point b) of the NEAFC request

Annex I of the NEAFC request reads as follows:

Request for clarification of advice for deep-sea species

The following points are issues where review and clarification of advice on deep-sea species presented in the June 2000 ACFM report are requested:

1. Two statements are made that are generally applicable to deep-sea fisheries where there is little biological information:

   "ICES recommends immediate reduction in these fisheries unless they can be shown to be sustainable"

   and

   "Consistent with a precautionary approach, fishing should not be allowed to expand faster than the acquisition of information necessary to provide a basis for sustainable exploitation."

   Both statements appear on p. 186 of the ACFM June 2000 report, where a general recommendation is made for many stocks. The second statement is also repeated in respect of argentine, orange roughy, red seabream, greater forkbeard, and alfonsinos.

   The statements are contradictory. The former states that catches should be reduced (but gives no indication by how much). The latter statement implies catches can be maintained at current levels. This ambiguity in the advice should be resolved.

2. Comparing different stocks, there does not seem to be consistency between the estimated level of stock depletion and the level of the proposed reductions. Specifically,

   - Orange roughy is estimated as being outside safe biological limits and biomass is estimated as being about half B_{msy} in Sub-area VI. This is a similar situation to that estimated for black scabbardfish, tusk and roundnose grenadier, but whereas in those cases an effort reduction of 30 to 50% is advised, for the orange roughy the advice only implies that catches should not increase. The advice seems to be on a different level of risk acceptance than ICES has accepted for many other species.

   - Roundnose grenadier is estimated to be depleted to 30% of unexploited stock size, and a 50% effort reduction is envisaged. In comparison, tusk is estimated to be more depleted (to 20% of unexploited stock size), yet the advice is to reduce effort by only 30%.

3. For ling, total mortality in the stock is estimated to be 0.7 to 0.8 (implying an F of around 0.5 to 0.7) and advice is to reduce fishing effort by 30%. This implies that acceptable fishing mortality levels are in the range about 0.4 to 0.5. This is the same sort of range as proposed for more productive species on the continental shelf, and for which close monitoring of the stocks allows reduction of risk by taking appropriate remedial actions in the case of stock declines. Such options are not available in the case of deep-sea species. Additionally, the stock is reported to be "outside safe biological limits in some parts of its range" by ACFM. Given that, as advised on p. 265, "the species and stocks are *a priori* not able to cope with high or even moderate exploitation rates", the implied levels of risk for this stock seem much higher than those normally considered acceptable.

4. ICES is asked to clarify, for black scabbardfish, to which zones the advice is intended to be applied.

5. For several stocks, reference is made that the stock is "outside safe biological limits". However, the precautionary reference points and the basis for their definition is not given in the ACFM report, although mention is made of these in the corresponding Study Group report. As for the other stocks, ICES is asked to state explicitly its precautionary reference points as the basis for defining safe biological limits, and to describe the risks incurred on violating such limits.

6. ACFM recommends that "a comprehensive data collection system is urgently required, and research on all stocks should be increased to provide the data necessary for assessment". It would be helpful if ACFM would review the existing and proposed data-collection systems and advise on extensions or modifications that may be required to make them appropriate for monitoring deep-sea resources. Specifically, STECF in 2000 has recommended minimum standards of data collection for many stocks, including deep-sea species; and NEAFC has had a log-book reporting scheme in existence for some years (see EU regulation 2807/83).

Answer to the NEAFC request point b)

Clarification of advice statements, Annex I, Pts. 1-4.

Pt. 1 Apparent contradictory statements

The sentence "Consistent with a precautionary approach, fishing should not be allowed to expand faster than the acquisition of information necessary to provide a basis for sustainable exploitation" only applies to deep water fisheries that may develop on virgin stocks (stocks that have not previously been exploited) or on stocks where exploitation clearly has only been on a marginal or limited part of the entire population. New fisheries, expansion into unexploited areas, or significant changes in the fisheries (i.e. introduction of new gears or fleets) should be permitted only when these fisheries expand very slowly, and are accompanied by programmes to collect data which allow evaluation of stock status. Species for which this type of advice is applicable is listed under *Category 1* in Table 3.12.6.a.7.

Most exploited deep-water species are at present considered to be harvested outside safe biological limits. ICES recommends immediate reduction in these fisheries unless they can be shown to be sustainable. When these fisheries have been reduced, consistent with a precautionary approach, fishing should not be allowed to expand faster than the acquisition of information necessary to provide a basis for sustainable exploitation. Species/stocks for which this type of advice applies is listed under *Category 2* in Table 3.12.6.a.7.

Table 3.12.6.a.7 Species/stock grouped according to which advice statement applies. Category 1 comprises stocks for which new fisheries may develop, but only if the state of the stock is closely monitored. Category 2 comprises stocks that are fully exploited or overexploited and for which immediate reduction in the fishery is recommended. * indicates that all known stocks of the species falls in that category. Mainly based on ICES Coop. Res. Rep. No. 242, including some new evaluations of expanding fisheries.

Species/Stock	**Category 1** Developing new fisheries	**Category 2** Fully or overexploited	**Comment**
General recommendation	**Advice 2000:** Fisheries on such species be permitted only when they expand very slowly, and are accompanied by programs to collect data which allow evaluation of stock status	**Advice 2000:** Immediate reduction unless fisheries can be shown to be sustainable	
Blue ling		All Populations **Advice 2000:** there should be no directed fisheries for this stock and measures should be implemented to reduce/minimise catches of this stock in mixed fisheries.	
Ling		All Populations **Advice 2000:** overall fishing effort should be reduced by 30%.	
Tusk	Hatton Bank fishery (Part of Sub-area VI and XII)	All areas except Hatton Bank **Advice 2000:** overall fishing effort should be reduced by 30%.	Mainly by-catch in ling fishery.
Roundnose grenadier	Stocks outside Sub-areas VI, VII, Vb	Sub-areas VI, VII and Vb combined **Advice 2000:** reduction in fishing effort by 50% for Sub-areas VI and VII and Division Vb combined.	Status of fishery and stock in the Skagerrak (IIIa) unclear but landings are high compared with size of area.
Black scabbardfish	Stock in Sub-area X	Stock in Sub-areas V, VI, VII, and XII Stock in Sub-area IX is probably Category 2. **Advice 2000:** Reduction in fishing effort by 50%.	Stock structure remains unclear.
Greater silver smelt or argentine	All Populations		Applies primarily to areas where target fishery is expanding, e.g. V, VI, VII
Orange roughy	Stocks in all areas except VI	Sub-area VI **Advice (see pt 2 below):** a significant reduction of effort to around 50%.	Stock structure and status unclear except in Sub-area VI
Red (=blackspot) seabream		All Populations	
Greater forkbeard	All Populations		State of stocks unknown
Alfonsinos (*Beryx* spp.)	All Populations		State of stocks unknown
Deep-water squalid sharks	All Populations		State of stocks unknown

Pt. 2 Inconsistencies in advice. Comparisons between stocks.

The analysis presented in the answer to the NEAFC request a) suggests that the three species mentioned in the NEAFC request, i.e. Orange roughy (average rank 1.6), Tusk (average rank 3.8) and Roundnose grenadier (average rank 2.4), differ in their vulnerability to fishing.

Orange roughy is vulnerable to fishing both because of its life history (see answer to request a)) and because it is an aggregating species. Catch per unit of effort data may be a poor indicator of impact of harvesting because the index may stay high despite sequential depletion of local aggregations. The vulnerability of orange roughy was not fully reflected in last year's advice. An assessment of the orange roughy in Sub-area VI is available, while the stock status in other Sub-areas cannot be assessed due to insufficient data. No new evaluation of the orange roughy in Sub-area VI is available this year, but on the basis of the 2000 assessment showing a very depleted stock, a significant reduction of effort to around 50% is proposed. The fishery in Sub-area VI is more intensive than in other Sub-areas. The reduction of effort proposed is similar to that proposed for the somewhat less vulnerable but heavily exploited roundnose grenadier.

The advice on tusk was not based on an estimate of the overall biomass to be below 20% of the virgin stock biomass. Tusk is estimated to below U_{lim} (20% of virgin biomass) in Division Vb only. Elsewhere CPUE has been declining, but data since 1996 are not available for some of the most important fisheries. There is not sufficient reliable data to evaluate stock status in these areas, but the fisheries have continued in the same manner and may even have expanded since 1996. ICES therefore judged that an overall significant reduction in effort is required and proposed a 30% reduction.

Compared with data available for tusk, data for roundnose grenadiers cover a much wider area (Division Vb and Sub-areas VI and VII). The assessment is therefore considered more reliable than that of tusk, but the grenadier is more vulnerable to fishing than the tusk. The biomass estimate for roundnose grenadier is close to U_{lim}. Compared with tusk, and despite the stronger confidence in the grenadier assessment, a stronger reduction in effort is advisable for grenadier, mainly because of the differences in vulnerability between the two species. This was the basis for the advice on a 50% reduction in effort.

Pt. 3 Ling - Acceptable mortality level

Ling has a wide geographical and bathymetrical range also comprising shelf and coastal waters. Ling has life history characteristics and ecology that makes it less vulnerable to exploitation than the more long-lived deep-sea species such as orange roughy, *Sebastes* a.o. The available biological parameters suggest that exploitation limits might be comparable to, e.g., Northeast Arctic cod. Such stocks seem by experience to be able to sustain fishing mortalities around 0.4. This is the background for the 2000 advice" that the overall fishing effort be reduced by 30%."

Pt. 4 Black Scabbardfish - Zones to which the ICES advice applies

The data available cover the black scabbardfish in Sub-areas V, VI, VII and XII. However, there is also a fishery on black scabbardfish in Sub-area IX. ICES will include this component in the overall advice for management of the black scabbardfish until evidence that Sub-area IX supports a single stock separate from that in other areas becomes available. Therefore the advice for a reduction in fishing effort by 50% applies to the Sub-areas V, VI, VII, XII and IX.

A new fishery for black scabbardfish in Sub-area X is developing. The catch rates obtained are very high compared with other longline fisheries for this species. This suggests that abundance in this Sub-area is much higher than in other sub-areas. There is insufficient data available for a proper analysis of the stock situation. It is proposed that the fishery is allowed to develop following the principle specified for a new deep-water fishery as discussed under the answer to point 1) above. The fishery in Sub-area X is developing under close monitoring by observers collecting relevant data following this advice.

Answer to NEAFC request point c): Give established reference points used as basis for statements on stock status (as outlined in Annex 1 of the request pt 5).

The Precautionary Approach gives two strong justifications for advice on and management of deep-water species being more conservative than for the shelf stocks, which have been the historic focus of fisheries. Specifically, the Precautionary Approach requires that decisions be risk averse when there is risk of harm that is serious or difficult to reverse, and that management should be more cautious when uncertainty is greater. The discussion below addresses these justifications in the general case for deep-water species. Deep-water (and shelf species) show diverse life histories, so there may be occasional exceptions to each argument, and advice and management should always be based on the best information available.

First, any specific negative change in stock status will be more serious for deep-water species than for shelf stocks, and more difficult to reverse. As described in the answer to the NEAFC request pt 1, see above, the life histories of deep-water species mean that they are less productive than shelf stocks. Being less productive, they can sustain only lower exploitation rates, and they can only increase more slowly in response to management actions intended to improve stock status.

Second, for several reasons uncertainty will be higher for deep-water stocks. Data are sparse for deep-water species in the ICES area, and even with expanded research and monitoring efforts, will remain less complete than data for shelf stocks for many years to come. Moreover, the types of information available for these species are rarely the time-series of age-structured catch and survey data, which form the basis for assessments of shelf stocks. Therefore advice and management will have to be based on indicators of stock status other than B and F, and the performance of these indicators as guides to advice and management is poorly known. Also, because of the differences in life histories between deep-water and shelf species, knowledge of perturbations of population status (reductions in abundance, changes in age composition, etc.) from which shelf species can recover cannot be transferred with confidence to deep-water species.

Reference points for deep-water species must be set in context of both of those factors. Because any harm will be more serious and more difficult to reverse for deep-water stocks than for shelf stocks, limit reference point of deep-water species must be set to ensure that stocks are in better condition than the stock status associated with limit reference points for shelf stocks. Because uncertainty is greater for deep-water stocks, precautionary reference points will have to be further from limit reference points than is the case for shelf stocks, to achieve the same degree of risk avoidance by management.

ICES used biological reference points for deep-water species for the first time in 1998 and suggested using the following limit and PA reference points:

$F_{lim} = F_{35\%SPR}$
$F_{pa} = M$

$B_{lim} = 0.2*B_{max}$ (maximum observed biomass, may be a smoothed (over time) estimate)

$B_{pa} = 0.5*B_{max}$

For many stocks there is no absolute biomass estimate available and instead ICES uses indicators, e.g. a CPUE index from a research vessel survey (preferably) or from logbook data for commercial fishing. These indices are notated U so that U_{lim} is an index for B_{lim}, etc. Using such indices posed for data poor situations the references points become:

$U_{lim} = 0.2*U_{max}$ (maximum observed biomass indicator, may be a smoothed (over time) index)

$U_{pa} = 0.5*U_{max}$

For most deep-water stocks the only information available on fishing mortality rates is from catch-curves (if an estimate of M is available) and, given that the assessment methods used (Production and modified DeLury models) generate estimates of current and virgin exploitable biomass, these biomass reference points were used for all stocks.

ICES advice on deep-water species in 2000 did not refer explicitly to reference points for the individual stocks. However, $U_{lim} = 0.2*U_{max}$ and $U_{pa} = 0.5*U_{max}$, were adopted for all the deep-water species for which advice was provided, although further work is needed to determine if deep-sea species can recover readily from depletion to 20% of the unexploited condition. As knowledge accumulates on deep-water species and fisheries, ICES will continue to bring forward and refine reference points for these stocks. ICES will assess the status of the deep-water species again in 2002.

Answer to NEAFC Request point d). Provide advice on how to improve data-collecting systems and advice on appropriate improvement for monitoring deep-sea resources.

Assessments of deep-water species depend on retrospective time-series of catch and effort. Currently used time-series are referenced to ICES Sub-areas and Divisions or aggregates of these. Because of the patchy distribution of deep-water fish interpretation of such time-series depends on knowledge of the fishing grounds where these catches were taken. Therefore, detailed spatial information on catch and effort is important. Landings and effort data on more relevant reporting areas, such as rectangles would be of special importance for fisheries statistics for Sub-area XII.

ICES finds that the existing data could be improved by:

- Providing more detail on spatial information on where the fishing took place. Many deep-sea species extend their occurrence over very wide areas, but with very uneven distribution within these areas. Information on a fine scale would be of great value to the assessments.

- Including the depth of the fishing ground in the logbook.

- Expanding the species list to include request for information on sharks and rays.

NEAFC issued in 1998 "Recommendation on a scheme of control and enforcement in respect of fishing vessels fishing in areas beyond the limits of national fisheries jurisdiction in the convention area ("The scheme"). This scheme was entered into force on 1 July 1999. The EU has implemented corresponding reporting practices for their own and non-EU vessels fishing within its EEZ.

Articles 7 and 8 of the NEAFC scheme concerning logbooks and reporting of catch and effort are those most relevant to the ICES work on deep-sea resources. ICES has attempted to identify desired changes with the view to facilitate the improvement of basic information and data flow to the assessment process.

Spatial Information

In accordance with Article 7b (and Annex IV), logbooks shall contain species-specific catch and effort information on the spatial scale of 'small statistical rectangle or fishing location'.

The fishery for deep-water species are under VMS satellite tracking, a system that provides very detailed information on the position of the vessel. Such detailed data will be subject to confidentiality considerations, but it may be an efficient solution to the statistics problem to link the logbook databases with the VMS databases with a time lack. From a stock assessment point of view such a time lag of between 3 and 6 months would be acceptable.

However, such detailed statistics have not consistently been available. Usually data only allow an aggregate catch and effort estimate on the scale of ICES Sub-area or Division, and this system of areas is not suitable for deep-sea fish stocks. It would therefore be of great value to the assessments if data on the requested finer-scale data were made available. This would enable aggregation of catches by more natural sub-areas. It is therefore suggested that catch and effort data by statistical rectangle be provided to ICES.

ICES should cooperate with NEAFC and together explore the possibility of compiling a database from which time-series of data by statistical rectangles can be constructed.

Depth on Fishing Ground

Logbooks used in deep-water fisheries do not include information on depth of fishing, although fishing operations may extend over wide depth ranges within short time-periods. The lack of provision for the recording of depth is a shortcoming in the scheme. Even within a statistical rectangle the depth may vary considerably, and it is known from several previous studies that target species and communities change markedly with depth. Inclusion of depth information, even coarse data such as an average depth of tows or longline sets, would therefore facilitate more detailed data analysis.

If VMS data were linked to the logbook databases it would be possible to infer the fishing depth using fishing charts and an entry in the logbook would not be necessary.

Species List

Attachment II related to Article 8 lists the species included in the scheme. For most species this list is adequate, but a problem is the lack of species-specific information for sharks and rays. Deep-sea sharks have life histories that make them particularly vulnerable to enhanced mortality rates, and life history patterns vary among species. ICES has obtained some species-specific landings and effort data through national sampling schemes, but the data sets are limited and do not cover a sufficient proportion of the catch. Provision of species-specific data on sharks and rays would constitute a considerable improvement.

Sharks and rays are notorious difficult to identify and therefore either an educational scheme among the fishermen or an observer programme is required for a breakdown to species.

Discards

The recording of discards is optional (Annex IV). ICES has compiled discard information, mainly based on observers reports, but again the scale of such observations is limited both geographically and temporally. The assessments would benefit from a change of the scheme whereby the recording of discards (by species) becomes mandatory. Experience suggests that reliable discard data can only be obtained through an observer scheme.

Working Papers

Clarke, M. 2001. A Working Document for ICES Working Group on the Biology and Assessment of Deep Sea Fisheries Resources. 8p.

Durán Muñoz, P., 2001a. Results of a spring deep-sea exploratory fishing in North Atlantic in 2000. 10 p.

Durán Muñoz, P. 2001b. Preliminary available information on the Spanish deep-water bottom trawl fishery on the Hatton Bank in 2000. 5 p.

Figueiredo, I., Machado, P.B. and Moura, O. 2001. Portugal mainland contribution to the 2001 report of the ICES study group on the biology and assessment of deep-sea fisheries resources. 8 p.

Gil, J. and Sobrino, I. 2001. New biological information about the red seabream (*Pagellus bogaraveo*) of the Strait of Gibraltar (ICES IXa).

Sigurdsson, T. 2001. Information on the deep sea species in Icelandic waters.

Vinnichenko, V. I. and Khlivnoy, V. N. 2001. Russian deep-sea investigations and fisheries in the Northeast Atlantic in 2000. 19p.

REFERENCES

Allain V., 1998. Reproduction and fecundity of 3 species of deep-sea fish from the North-east Atlantic Ocean. ICES C.M. 1998/O:4.

Allain V., 1999. Ecologie, biologie et exploitation des populations de poissons profonds de l'Atlantique du nord-est., Océanologie Biologique, Université de Bretagne Occidentale, Brest, 376.

Allain V., Lorance P., 2000. Age estimation and growth of some deep-sea fish from the Northeast Atlantic ocean. *Cybium*, 24 ((3) suppl.), 7-16.

Allain V., *in press*. Reproductive strategies of 3 deep-water benthopelagic fishes from the north-east Atlantic Ocean. *Fisheries Research*,

Annala J. H., Sullivan K. J., 1996. Report from the Fishery assessment plenary, April-May 1996: stock assessments and yield estimates. NIWA, Wellington,, 308 pp.

Beamish R. J., McFarlane G. A., 1983. The forgotten requirement for age validation in fisheries biology. *Transaction of the american fisheries society*, 112 (6), 735-743.

Bergstad O. A., 1990. Distribution, population structure, growth and reproduction of the roundnose grenadier *Coryphaenoides rupestris* (Pisces: Macrouridae) in the deep waters of the Skagerrak. *Marine Biology*, 107, 25-39.

Bergstad, O. A. 1993. Distribution, population structure, growth, and reproduction of the greater silver smelt, *Argentina silus* (Pisces, Argentinidae), of the Skagerrak and the north-eastern North Sea. ICES Journal of Marine Science, 50:129-143.

Bergstad, O.A. and Gordon, J.D. M. 1994. Deep-water ichthyoplankton of the Skagerrak with special reference to *Coryphanoides rupestris* (Gunnerus, 1765 (Pisces, Macrouridae)) and *Argentina silus. Sarsia,* 79: 33-43.

Bergstad, O.A. and Hareide, N.-R. 1996. Ling, blue ling and tusk of the North-east Atlantic. *Fisken og Havet* 15, 1996. 126 p.

Bowering, W.R. and Nedreaas, K. H. 2001. Age validation and growth of Greenland halibut (*Reinhardtius hippoglossoides* (Walbaum)): a comparison of populations in the Northwest and Northeast Atlantic. *Sarsia* 86: 53-68.

Clark M., 1998. Are deepwater fisheries sustainable? The example of orange roughy in New Zealand. *ICES Science Conference*, 15.

Clark M. R., Anderson O. F., Francis R. I. C. C., Tracey D. M., 2000. The effects of commercial exploitation on orange roughy (*Hoplosthetus atlanticus*) from the continental slope of the Chatham Rise, New Zealand, from 1979 to 1997. *Fisheries Research*, 45, 217-238.

Duran Muñoz, P. and E. Román. 2000. Spanish experimental fishings: a cooperative research initiative between scientists and the local fishing industry. *ICES CM 2000/ W:03.*

Duran Muñoz, P., E. Román and F.González. 2000. Results of a deep-water experimental fishing in the North Atlantic: An example of a Cooperative research initiative with the fishing industry. *ICES CM 2000/W: 04.*

Fenton G. E., Short S. A., Ritz D. A., 1991. Age determination of orange roughy, *Hoplostethus atlanticus* (Pisces: Trachichthyidae) using ^{210}Pb:^{226}Ra disequilibria. *Marine Biology*, 109, 197-202.

Francis R. I. C. C., 1995. The problem of specifying otolith-mass growth parameters in the radiometric estimation of fish age using whole otoliths. *Marine Biology*, 124, 169-176.

Francis R. I. C. C., 1996. Do herring grow faster than orange roughy? *Fishery Bulletin*, 94 (4), 783-786.

Girard M., Du Buit M.-H., 1999. Reproductive biology of two deep-water sharks from the British Isles, Centroscymnus coelolepis and Centrophorus squamosus. *Journal of the Marine Biological Association of the United Kingdom*, 79, 923-931.

Girard M., 2000. Distribution et reproduction de deux espèces de requins de grands fonds, les "sikis", Centrophorus squamosus et Centroscymnus coelolepis exploités dans l'Atlantique Nord-Est., ENSAR, Rennes, 214.

Gordon J. D. M., Swan S. C., 1996. Validation of age readings from otoliths of juvenile roundnose grenadier, *Coryphaenoides rupestris*, a deep-water macrourid fish. *Journal of Fish Biology*, 49 (Supplement A), 289-297.

Gundersen, A., Kjesbu, O.S., Stene, A. and Nedreaas, K. 1999. Fecundity of the Northeast Arctic Greeenland halibut, *Reinharthius hippoglossus. Northwest Atlantic Fishery Science* 25: 29-36.

Horn P. L., Tracey D. M., Clark M. R., 1998. Between-area differences in age and length at first maturity of the orange roughy *Hoplostehus atlanticus. Marine Biology*, 132, 187-194.

Hunter J. & Lo N.C.-H., 1993. Icthyoplankton methods for estimating fish biomass. Introduction and Terminology. *Bulletin of Marine Science*, 53(2): 723-727.

Kastelle C. R., Kimura D. K., Jay S. R., 2000. Using Pb-210/Ra-226 disequilibrium to validate conventional ages in Scorpaenids (genera Sebastes and Sebastolobus). *Fisheries Research*, 46 (1-3), 299-312.

Kelly C. J., Connolly P. L., Bracken J. J., 1997. Age estimation, growth, maturity and distribution of the roundnose grenadier from the Rockall Trough. *Journal of Fish Biology*, 50, 1-17.

Koslow J. A., Bell J., Virtue P., Smith D. C., 1995. Fecundity and its variability in orange roughy: Effects of population density, condition, egg size, and senescence. *Journal of Fish Biology*, 47 (6), 1063-1080.

Koslow J. A., Boehlert G., Gordon J. D. M., Haedrich R. L., Lorance P., Parin N., 2000. Continental slope and deep-sea fisheries: implications for a fragile ecosystem. *ICES Journal of Marine Science*, 57 (3), 548-557.

Krug, H. M. 1998. variation in reproductive cycle of the blackspot seabream, *Pagellus bogaraveo* (Brunnich, 1768) in the Azores. *Arquipélago. Life and Marine Sciences* 16A:37-47.

Krug, H., Rosa, D., Menezes, G. M , Pinho, M. R. 1998. Age and growth of some demersal species of the Azores. ICES CM.1998/O:84 Poster

Lorance, P., Dupouy H., Allain V., sous presse. Assessment of the roundnose grenadier (*Coryphaenoides rupestris*) stock in the Rockall Trough and neighbouring areas (ICES Sub-areas V, VI and VII). *Fisheries Research*,

Mace, P. M., Fenaughty J. M., Coburn R. P., Doonan I. J., 1990. Growth and productivity of orange roughy (*Hoplostethus atlanticus*) on the north Chatham Rise. *New Zealand Journal of Marine and Freshwater Research*, 24, 105-119.

Magnusson, J. V. 1988. On silver smelt (*Argentina silus* Asc.) in Icelandic waters. ICES C.M. 1988/G:39, 12 p.

Magnusson, J.V., Bergstad, O.A., Hareide, N.-R., Magnusson, J. and Reinert, J. 1997. Ling, blue ling and tusk of the northeast Atlantic. TemaNord 1997:535, 58 p.

Martins M. R., Martins M. M., Cardador F., 1989. Portuguese fishery of black scabbard fish (Aphanopus carbo Lowe, 1839) off Sesimbra waters. ICES science conference, ICES. C.M./G:38, 29 pp.

Mendonça, A., Estácio, S., Krug, H. Menezes, G. M., Branco, J., Pinho, M. R. 1998. Reproduction aspects of some demersal fishes captured in azores Archipelago. ICES CM. 1998/O:83

Menezes, G. M.; H. M. Silva, H. Krug, E. Balguerias, J. Delgado, J. G. Pérez, Ignacio L. Soldevilla, J. L. Nespereira, D. Carvalho, J. S. Morales, 1998. Design Optimization and Implementation of Demersal Cruise Surveys in the Macaronesian Archipelagos. Final Report. Arquivos do DOP, Série Estudos, N°3/98, 162pp.

Menezes, G. M., J. Delgado, H. Krug, M. R. Pinho, H. M. Silva, D. Carvalho,1999. Design Optimization and Implementation of Demersal Cruise Surveys in the Macaronesian Archipelagos - II. Final Report. Commission of the European Communities – DG XIV/C/1 – Study contract 95/095. Arquivos do DOP, Série Estudos, N°1/99, 160pp.

Menezes G., Rogers A., Krug H., Mendonça A., Stockley B. M., Isidro E., Pinho M. R., Fernandes A., 2001. Seasonal changes in biological and ecological traits of demersal and deep-water fish species in the Azores. Final report, draft, DG XIV/C/1- study contract 97-081. Universidade dos Açores, University of Southampton, Horta, The Azores,, 164 p + appendix pp.

Morales-Nin B., Massuti E., Stefanescu C., 1996. Distribution and biology of *Alepocephalus rostratus* from the Mediterranean Sea. *Journal of Fish Biology*, 48, 1097-1112.

Nedreaas, K.H. 1990. Age determination of northeast Atlantic *Sebastes* species. *J. Cons. Explor. Mer*, 47: 208-230.

Parker K., 1980. A direct method for estimating northern anchovy, *Engraulis mordax*, spawning biomass. *Fishery Bulletin*, 78: 541-544.

Parker K., 1985. Biomass model for the egg production method. pp 5-6. In Lasker R. Ed. An egg production method for estimating spawning biomass of pelagic fish: Application to the northern anchovy *Engraulis mordax*, U.S. Department of Commerce. NOAA Technical Report NMFS 36.

Paz, X., E. Román & P. Duran Muñoz. 2000. Results from the 2000 Spanish Bottom Trawl Survey in the NAFO Regulatory Area for Divisions 3NO. *NAFO SCR Doc.00/46, Serial No N4277.*

Sigler, M. F., J. T. Fujioka, 1988. Evaluation of variability in Sablefish, *Anaploma fimbria*, Abundance indices in the Gulf of Alaska using the bootstrap method. *Fishery Bulletin U.S.* 86 (3): 445-452.

Smith D. C., Fenton G. E., Robertson S. G., Short S. A., 1995. Age determination and growth of orange roughy (Hoplostethus atlanticus): a comparison of annulus counts with radiometric ageing. *Can J Fish Aquat Sci*, 52, 391-401.

Tracey D. M., Horn P. L., 1999. Background and review of ageing orange roughy (Hoplostethus atlanticus, Trachichthyidae) from New Zealand and elsewhere. *New Zealand Journal of Marine and Freshwater Research*, 33,67-86.

3.13 Stocks in the Baltic

3.13.1 Overview

The main fisheries for cod in the Baltic use demersal trawls, high opening trawls (operating both pelagically and demersally), and gillnets. There has been an increase in gillnet fisheries in the 1990s and the share of the total catch of cod taken by gillnets has in recent years been about 50%. The Baltic herring is exploited mainly by pelagic trawls and demersal trawls and, during the spawning season, by trap-nets/pound-nets in coastal areas. The herring trawl fishery is largely a mixed herring and sprat fishery where share of herring varies significantly by sub-divisions and seasons. The main body of the sprat catch is taken by pelagic pair trawling and used for industrial purposes. There has been an increase in catches of sprat in the most recent years and 1997 catches were at a record high of 529 000 t in the whole Baltic. The sprat catches have since decreased continuously to 389 000 t in 2000. Baltic salmon is exploited by drift net, trap net and longline fisheries.

An overview of catches of fish in the Baltic until 1999 as officially reported to ICES, is given in Section 3.13.2.

For Baltic **cod** there is one management unit covering all Sub-divisions 22–32. ICES considers the stocks in Sub-divisions 22–24 and Sub-divisions 25–32 as separate stocks, however, and advice is provided on them separately.

ICES reiterates its advice that the cod stocks should be managed separately in order to better adapt the exploitation to the present development in the two stocks.

IBSFC has in September 1999 adopted a **Long-Term Management Strategy for the Cod Stocks in the Baltic Sea**

The IBSFC agreed to implement a long-term management plan for the two cod stocks, Eastern and Western stocks, as defined by ICES, which is consistent with a precautionary approach and designed to ensure a rational exploitation pattern and provide for stable and high yield. The plan shall consist of the following elements:

1. *Every effort shall be made to maintain a minimum level of Spawning Stock Biomass (SSB) greater than 160 000 tonnes for the Eastern stock and 9 000 tonnes for the Western stock*
2. *A long-term management plan shall be implemented, by which annual quotas shall be set for the fishery on the Eastern stock, reflecting a fishing mortality rate of 0.6, and for the Western stock 1.0, both for appropriate age groups as defined by ICES.*
3. *Should the SSB fall below a reference point of 240 000 tonnes for the Eastern stock and 23 000 tonnes for the Western stock, the fishing mortality rates referred to under paragraph 2 will be adapted in the light of scientific estimates of the conditions then prevailing, to ensure safe and rapid recovery of spawning stock biomasses to levels in excess of 240 000 tonnes and 23 000 tonnes, respectively, for the Eastern and Western stocks.*
4. *For allocation purposes, a combined TAC will be established; The Contracting Parties agree to further collaborate, inter alia, through bilateral agreements to ensure an efficient management of the cod stocks.*
5. *The exploitation pattern in the fisheries for cod and in particular, the selectivity shall be improved in the light of new scientific advice from ICES with the objective to enhance the spawning biomass of cod and reduce discards.*
6. *Additional technical measures including, inter alia, further limitation on effort, restrictions on fishing days, closing of areas and/or seasons, obligation to change fishing ground in case of high abundance of juveniles, special reporting requirements, and other appropriate control measures should be considered.*
7. *The IBSFC shall, as appropriate, adjust management measures and elements of the plan on the basis of any new advice provided by ICES.*

A review of this arrangement shall take place no later than year 2003.

For **cod**, unusually strong year classes in 1976, 1979 and 1980 formed the basis for an increase in the stock in the eastern Baltic and an expansion in the fisheries. Catch levels more than doubled and the fishery attracted vessels from other Baltic fisheries and from fleets normally operating outside the Baltic Sea. In almost all years landings have been far above the levels recommended by ICES. The decline in stock size and landings started around 1985 and continued up to 1992. Fleet capacity and fishing effort have now been reduced to some extent, but fishing mortality increased as the stocks declined. Improved recruitment in the early 1990s has resulted in spawning stock biomasses increasing above the 1992 minimum, and this increase has been seen especially in the western Baltic cod stock. After a slight increase in 1994–1995, the SSB of the eastern Baltic cod stock has decreased again in 1996–1999 to a historically low level.

The success of cod reproduction is, among other things, dependent on certain minimum levels of salinity and oxygen concentration for the fertilisation and survival of the eggs and larvae. The unusually long period with low influx of North Sea water from the late 1970s to the early 1990s was in general a period of low recruitment. The influx in 1993 resulted in improved environmental conditions, which allowed the possibility of improved recruitment but did not secure it. Since 1993 there have not been major influxes. The effect of an intrusion of North Sea water into the Baltic Sea is usually sufficient to support better environmental conditions for two spawning seasons (about 1.5 years) at the most, because after that period the salinity and oxygen levels in the deep water layers decrease below the level at which cod eggs can survive.

The recent improvement in recruitment and the reversal of the downward trend in spawning stock biomass has been seen in both the Western (Sub-divisions 22 and 24) in 1994–1997 and Eastern (Sub-divisions 25–32) cod stocks in 1994–1995. However, fishing mortalities are still estimated to be high in the Western stock and increased from a lower level in the Eastern stock. In the Western stock the increase in spawning stock biomass in recent years was caused mainly by the 1994 year class, and it is expected that the spawning stock biomass will increase with the present exploitation pattern, due to the 1997 year class, which is estimated to be above average. The Eastern stock has been below the long-term average since 1986, and thus a recovery of the stock can hardly be expected with the present exploitation pattern and tendency for fishing mortality to increase. It is therefore considered that a precautionary approach, including reductions in fishing effort is needed if these stocks are to recover on a more permanent basis.

The landings of **sprat** for industrial purposes have increased markedly during the last decade. **Herring** and sprat are used mainly for human consumption when landed in the countries on the eastern Baltic coasts, but for production of fishmeal and oil in the countries on the west coast.

Herring in the Baltic is assessed as five stocks. This is to be regarded as a compromise between using the larger number of stocks/populations that have been identified for biological reasons and the practical constraints, e.g. in what units are catch figures available, and what are the possibilities for correctly allocating individual fish to particular stocks.

Sprat is assessed as one unit for the entire Baltic.

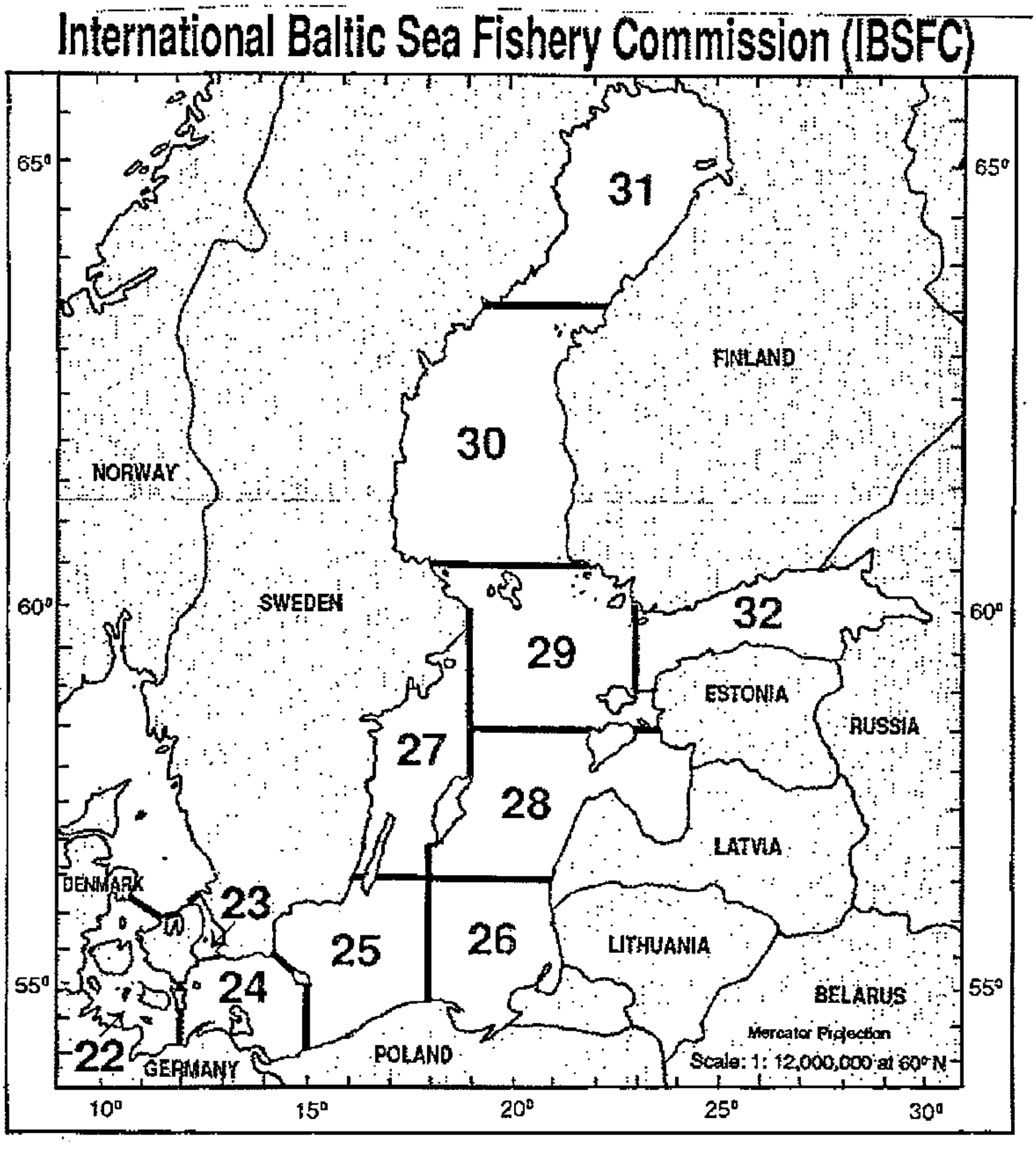
The exploitation rate of pelagic stocks in the Baltic has increased since the mid-1990s. Due to the low abundance of cod the natural mortality of Baltic herring and sprat is low at present. The Baltic sprat is considered to be harvested inside safe biological limits. A sharp decrease in mean weight at age of sprat has been observed since 1993. A continuous decreasing trend in mean weight at age has been observed in most herring stocks in the Baltic since the mid-1980s. This decline in mean weight at age partly explains the declining trend in biomass of the herring stock in Sub-divisions 25–29, 32 (including Gulf of Riga). At the present the mean weight of herring remains at a very low level. Still, there have been some indications in the last few years that the decreasing trend of the mean weight is slowing down. Due to the decreasing SSB and increasing trend in fishing mortality the Central Baltic herring is assumed to be outside of biological limits.

It has, for several reasons, been difficult to estimate the absolute stock size for the pelagic stocks, although the development of stock size in relative terms is better described. Inconsistencies between years in the results from acoustic surveys and low precision in the estimates of species composition in the mixed fisheries have contributed to the variation in stock estimates given during the latest years. However, a fourfold increase in sprat catches between 1991 and 1997 has been observed and the development of this fishery, and consequently the rate of fishing mortality, should be closely monitored.

The multispecies interactions may periodically have a strong influence on the state of fish stocks in the Baltic, depending on the abundance of cod as the main predator in the Baltic Sea ecosystem. To take into account the multispecies effects, the data from multispecies assessment methods are used in the assessment of pelagic stocks. However, interactions with other potential top predators, such as salmon and seal that are potentially very important in the northern Baltic Sea, are not yet quantified and are therefore not directly included in the present ICES advice.

The spring-spawning of herring stock in Sub-divisions 22–24 and Division IIIa migrates after the spawning season into the Kattegat, Skagerrak and eastern parts of the North Sea, where it mixes with the North Sea autumn-spawning herring stock during the feeding period. Difficulties in allocating catches to the Baltic spring-spawning stock and to the considerably larger North Sea stock, uncertain catch statistics, and conflicting trends in survey indices have resulted in unreliable assessments for the spring-spawning stock of herring in Sub-divisions 22–24 and Division IIIa.

For **Baltic salmon and sea trout** see overview in Section 3.13.15.



International Baltic Sea Fishery Commission (IBSFC)
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3.13.2 Nominal catches in the Baltic Area

Officially reported catches in the Baltic until 1999 are given in Tables 3.13.2.1–5. These are the catches officially reported to ICES by national statistical offices for publication in the *ICES Fishery Statistics.*

In the assessments, the working groups try to estimate discards and slipped fish, landings which are not officially reported, and the composition of by-catches. These amounts are included in the estimates of total catch for each stock and are used in the assessments; thus, they appear in the tables and figures produced by working groups. These estimates vary considerably between different stocks and fisheries, being negligible in some cases and constituting important parts of the total removals from other stocks. Further, the catches used by the working groups are broken down into sub-divisions, whereas the officially reported catches by some countries are reported by the larger Divisions IIIb, c, and d. The trends in Tables 3.13.2.1–5 may not, therefore, correspond to those on which assessments have been based, and are presented for information only, without any comment from ACFM.

The 1990 catches listed under the Federal Republic of Germany and the German Democratic Republic refer to catches by vessels from the respective former territories during the whole of 1990, before and after political union. Thus, catches taken by vessels registered in the former German Democratic Republic in the months after unification are included in the German Democratic Republic figures.

The catch data used in the assessments are given in other tables.

Table 3.13.2.1 Nominal fish catches in the Baltic from 1973-1999 (in '000 t). Anadromous species, except salmon, not included. (Data as officially reported to ICES.)

Year	Species							Total
	Cod	Herring	Sprat	Flatfish	Salmon	Freshwater species	Others	
1973	189	404	213	18	2.7	23	55	905
1974	189	407	242	21	2.9	21	54	937
1975	234	415	201	24	2.9	20	60	957
1976	255	393	195	19	3.1	21	46	932
1977	213	413	211	22	2.4	22	42	925
1978	196	420	132	23	2.0	22	44	839
1979	273	459	78	24	2.3	20	47	903
1980	388	453	57	18	2.4	14	29	961
1981	380	419	47	16	2.4	13	31	908
1982	361	442	45	17	2.2	13	30	910
1983	376	459	31	16	2.4	13	20	917
1984	442	426	52	15	3.7	13	17	969
1985	344	431	69	17	4.0	11	16	892
1986	271	401	75	18	3.5	12	19	800
1987	238	373	91	16	3.8	13	24	759
1988	225	407	86	14	3.2	13	31	779
1989	192	414	89	14	4.2	14	18	745
1990	167	360	92	12	5.6	11	18	666
1991[1]	139	295	111	14	4.6	17	19	600
1992[1]	72	339	146	12	4.7	8	13	595
1993[1]	41	352	194	12	3.4	10	7	619
1994[1]	75	353	301	18	2.9	9	8	767
1995[1]	117	343	326	22	2.7	9	17	837
1996[1]	164	326	464	22	2.6	9	6	994
1997[1]	134	370	520	20	2.6	12	9	1,068
1998[1]	103	383	446	18	2.1	11	5	968
1999[1]	117	343	408	18	1.7	11	6	905

[1]Preliminary.

Table 3.13.2.2 Nominal catch (tonnes) of HERRING in Divisions IIIb,c,d 1963-1999. (Data as officially reported to ICES.)

Year	Denmark	Finland	German Dem.Rep.	Germany, Fed.Rep.	Poland	Sweden	USSR	Total
1963	14,991	48,632	10,900	16,588	28,370	27,691	78,580[1]	225,752
1964	29,329	34,904	7,600	16,355	19,160	31,297	84,956	223,601
1965	20,058	44,916	11,300	14,971	20,724	31,082[2]	83,265	226,216
1966	22,950	41,141	18,600	18,252	27,743	30,511	92,112	251,309
1967	23,550	42,931	42,900	23,546	32,143	36,900	108,154	310,124
1968	21,516	58,700	39,300	16,367	41,186	53,256	124,627	354,952
1969	18,508	56,252	19,100	15,116	37,085	30,167	118,974	295,202
1970	16,682	51,205	38,000	18,392	46,018	31,757	110,040	312,094
1971	23,087	57,188	41,800	16,509	43,022	32,351	120,728	334,685
1972	16,081	53,758	58,100	10,793	45,343	41,721	118,860	344,656
1973	24,834	67,071	65,605	8,779	51,213	59,546	127,124	404,172
1974	19,509	73,066	70,855	9,446	55,957	60,352	117,896	407,081
1975	18,295	69,581	71,726	10,147	68,533	62,791	113,684	414,757
1976	23,087	75,581	58,077	6,573	63,850	41,841	124,479	393,488
1977	25,467	78,051	62,450	7,660	60,212	52,871	126,000	412,711
1978	26,620	89,792	46,261	7,808	63,850	54,629	130,642	419,602
1979	33,761	83,130	50,241	7,786	79,168	86,078	118,655	458,819
1980	29,350	74,852	59,187	9,873	68,614	92,923	118,074	452,873
1981	28,424	65,389	56,643	9,124	64,005	84,500	110,782	418,867
1982	40,289	73,501	50,868	8,928	76,329	92,675	99,175	441,765
1983	32,657	83,679	51,991	9,273	82,329	86,561	112,370	458,860
1984	32,272	86,545	50,073	8,166	78,326	65,519	105,577	426,478
1985	27,847	88,702	51,607	9,079	85,865	57,554	110,783	431,437
1986	21,598	83,800	53,061	9,382	77,109	39,909	115,665	400,524
1987	23,283	82,522[3]	50,037	6,199	60,616	36,446	113,844	372,947
1988	29,950	92,824[3]	53,539	5,699	60,624	41,828	122,849	407,313
1989	26,654	81,122[3]	54,828	5,777	58,328	65,032	121,784	413,525
1990	16,237	66,078[3]	40,187	5,152	60,919	55,174	116,478	360,225

Year	Denmark	Estonia	Finland	Germany	Latvia	Lithuania	Poland	Sweden	Russia	Total
1991	23,995	27,034[4]	51,546[3]	16,022	33,270	6,468[5]	45,991	59,176	31,755	295,257[6]
1992	33,855	29,556	72,171[3]	17,746	25,965	3,237[6]	52,864	75,907	27,979	339,280[6]
1993	34,945	32,982	77,353[3]	20,143	21,949	3,912[6]	50,833	86,497	23,545	352,159[6]
1994	45,190	34,493	97,674[3]	12,367	22,676	4,988[6]	49,111	70,886	15,904	353,411[6,7]
1995	37,762	43,482	94,613[3]	7,898	24,972	3,706[6]	45,676	68,019	16,970	343,099[6]
1996	34,340	45,296	93,337[3]	7,737	27,523	4,257[6]	31,246	67,116	14,780	325,632[6]
1997	30,876	52,436	90,334[3]	12,755	29,330	3,321[6]	28,939	110,463	11,801	370,255[6]
1998	38,800	42,721	85,545[3]	9,514	24,417	2,368[6]	21,873	147,706	10,544	383,488[6]
1999	37,974	44,039	82,237[3]	10,115	27,162	1,312[6]	19,229	108,316	12,756	343,141[6]

[1]Including Division IIIa.
[2]Large quantity of herring used for industrial purposes is included with "Unsorted and Unidentified Fish".
[3]Includes some by-catch of sprat.
[4]As reported by Estonian authorities; 32,683 t reported by Russian authorities.
[5]As reported by Lithuanian authorities; 6,456 t reported by Russian authorities.
[6]Preliminary.
[7]Includes catches from the Faroe Islands of 122 t.

Table 3.13.2.3 Nominal catch (tonnes) of SPRAT in Divisions IIIb,c,d 1963–1999. (Data as officially reported to ICES.)

Year	Denmark	Finland	German Dem.Rep.	Germany, Fed.Rep.	Poland	Sweden	USSR	Total
1963	2,525	1,399	8,000	507	10,693	101	45,820[1]	69,045
1964	3,890	2,111	14,700	1,575	17,431	58	55,753	95,518
1965	1,805	1,637	11,200	518	16,863	46	52,829	84,898
1966	1,816	2,048	21,200	66	13,579	38	52,407	91,454
1967	3,614	1,896	11,100	2,930	12,410	55	40,582	72,587
1968	3,108	1,291	10,200	1,054	14,741	112	55,050	85,556
1969	1,917	1,118	7,500	377	17,308	134	90,525	118,879
1970	2,948	1,265	8,000	161	20,171	31	120,478	153,054
1971	1,833	994	16,100	113	31,855	69	133,850	184,814
1972	1,602	972	14,000	297	38,861	102	151,460	207,294
1973	4,128	1,854	13,001	1,150	49,835	6,310	136,510	212,788
1974	10,246	1,035	12,506	864	61,969	5,497	149,535	241,652
1975	9,076	2,854	11,840	580	62,445	31	114,608	201,434
1976	13,046	3,778	7,493	449	56,079	713	113,217	194,775
1977	16,933	3,213	17,241	713	50,502	433	121,700	210,735
1978	10,797	2,373	13,710	570	28,574	807	75,529	132,360
1979	8,897	3,125	4,019	489	13,868	2,240	45,727	78,365
1980	4,714	2,137	151	706	16,033	2,388	31,359	57,488
1981	8,415	1,895	78	505	11,205	1,510	23,881	47,489
1982	6,663	1,468	1,086	581	14,188	1,890	18,866	44,742
1983	2,861	828	2,693	550	8,492	1,747	13,725	30,896
1984	3,450	374	2,762	642	10,954	7,807	25,891	51,880
1985	2,417	364	1,950	638	22,156	7,111	34,003	68,639
1986	5,693	705	2,514	392	26,967	2,573	36,484	75,328
1987	8,617	287[2]	1,308	392	34,887	870	44,888	91,249
1988	6,869	495[2]	1,234	254	25,359	7,307	44,181	85,699
1989	9,235	222[2]	1,166	576	20,597	3,453	53,995	89,244
1990	8,858	162[2]	518	905	14,299	7,485	59,737	91,964

Year	Denmark	Estonia	Finland	Germany	Latvia	Lithuania	Poland	Sweden	Russia	Total
1991	21,781	14,124[3]	99[2]	736	17,996[4]	3,569	23,200	8,328	20,736	110,569[5]
1992	28,210	4,140	893[2]	608	17,388	1,697[5]	30,126	53,558	9,851	146,471[5]
1993	27,435	5,763	206[2]	8,267	12,553	2,798[5]	33,701	92,416	10,745	193,884[5]
1994	69,644	9,079	497[2]	374	20,132	2,789[5]	44,556	135,779	16,719	300,535[5,6]
1995	76,420	13,052	4,103[2]	230	24,383	4,799[5]	37,280	150,435	14,934	325,636[5]
1996	123,549	22,493	14,351[2]	161	34,211	10,165[5]	77,472	163,087	18,287	463,776[5]
1997	153,765	39,692	19,852[2]	428	49,314	6,000[5]	105,298	123,207	22,194	519,750[5]
1998	111,003	32,165	27,014	4,551	44,858	5,132[5]	59,091	141,209	21,078	446,122[5,7]
1999	97,686	36,407	18,886[2]	182	42,834	3,117[5]	71,705	106,000	31,627	408,444[5]

[1]Including Division IIIa.
[2]Some by-catch of sprat included in herring.
[3]As reported by Estonian authorities; 17,893 t reported by Russian authorities.
[4]As reported by Latvian authorities; 17,672 t reported by Russian authorities.
[5]Preliminary.
[6]Includes catches from the Faroe Islands of 966 t.
[7] Includes catches from the Faroe Islands of 21 t.

Table 3.13.2.4 Nominal catch (tonnes) of COD in Divisions IIIb,c,d 1963–1999. (Data as officially reported to ICES.)

Year	Denmark	Faroe Islands	Finland	German Dem.Rep.	Germany Fed.Rep.	Poland	Sweden	USSR	Total
1963	35,851		12	7,800	10,077	47,514	22,827	30,550[1]	154,631
1964	34,539		16	5,100	13,105	39,735	16,222	24,494	133,211
1965	35,990		23	5,300	12,682	41,498	15,736	22,420	133,649
1966	37,693		26	6,000	10,534	56,007	16,182	38,269	164,711
1967	39,844		27	12,800	11,173	56,003	17,784	42,975	180,606
1968	45,024		70	18,700	13,573	63,245	18,508	43,611	202,731
1969	45,164		58	21,500	14,849	60,749	16,656	41,582	200,558
1970	43,443		70	17,000	17,621	68,440	13,664	32,248	192,486
1971	47,563		3	9,800	14,333	54,151	12,945	20,906	159,701
1972	60,331		8	11,500	13,814	56,746	13,762	30,140	186,301
1973	66,846		95	11,268	25,081	49,790	16,134	20,083	189,297
1974	58,659		160	9,013	20,101	48,650	14,184	38,131	188,898
1975	63,860		298	14,740	21,483	69,318	15,168	49,289	234,156
1976	77,570		278	8,548	24,096	70,466	22,802	51,516	255,276
1977	74,495		310	10,967	31,560	47,703	18,327	29,680	213,042
1978	50,907		1,446	9,345	16,918	64,113	15,996	37,200	195,925
1979	60,071		2,938	8,997	18,083	79,697	24,003	78,730	272,519
1980	76,015	1,250	2,317	7,406	16,363	123,486	34,089	124,359	388,186[2]
1981	93,155	2,765	3,249	12,938	15,082	120,942	44,300	87,746	380,177
1982	98,230	4,300	3,904	11,368	19,247	92,541	44,807	86,906	361,303
1983	108,862	6,065	4,677	10,521	22,051	76,474	54,876	92,248	375,774
1984	121,297	6,354	5,257	9,886	39,632	93,429	65,788	100,761	442,404
1985	107,614	5,890	3,793	6,593	24,199	63,260	54,723	78,127	344,199
1986	98,081	4,596	2,917	3,179	18,243	43,237	48,804	52,148	271,205
1987	85,544	5,567	2,309	5,114	17,127	32,667	50,186	39,203	237,717
1988	75,019	6,915	2,903	4,634	16,388	33,351	58,027	28,137	225,374
1989	66,235	4,499	1,913	2,147	14,637	31,855	55,919	14,722	191,927
1990	56,702	3,558	1,667	1,630	7,225	28,730	54,473	13,461	167,446

Year	Denmark	Estonia	Faroe Islands	Finland	Germany	Latvia	Lithuania	Poland	Sweden	Russia	Total
1991	50,640	1,805[3]	2,992	1,662	8,637	2,627	1,849	25,748	39,552	3,196	138,708[4]
1992	30,418	1,369	593	460	6,668	1,250	874[4]	13,314	16,244	404	71,594[4]
1993	10,919	70	558	203	5,127	1,333	904[4]	8,909	12,201	483	40,707[4]
1994	19,822	905	779	520	7,088	2,379	1,886[4]	14,426	25,685	1,114	74,604[4]
1995	34,612	1,049	777	1,851	14,681	6,471	3,629[4]	25,001	27,289	1,612	117,265[4,5]
1996	48,505	1,392	714	3,132	20,607	8,741	5,521[4]	34,856	36,932	3,304	163,993[4,5]
1997	42,581	1,173	33	1,537	14,483	6,187	4,497[4]	31,659	29,329	2,803	134,282[4]
1998	29,476	1,070	-	1,033	10,989	7,778	4,187[4]	25,778	17,665	4,599	102,575[4]
1999	38,169	1,060	-	1,570	15,439	6,914	4,370[4]	26,581	17,476	5,211	116,790[4]

[1]Including Division IIIa.
[2]Includes catches from United Kingdom (England & Wales) of 2,901 t.
[3]As reported by Estonian authorities; 1,812 t reported by Russian authorities.
[4]Preliminary.
[5]Includes preliminary catches from Norway of 293 t for 1995 and 289 t for 1996.

Table 3.13.2.5 Nominal catch (tonnes) of FLATFISH in Divisions IIIb,c,d 1963-1999. (Data as officially reported to ICES.)

Year	Denmark	Finland	German Dem.Rep.	Germany, Fed.Rep.	Poland	Sweden	USSR	Total
1963	9,888	-	3,390	794	2,794	1,026	1,460[1]	19,862
1964	9,592	-	4,600	905	1,582	1,147	4,420	22,246
1965	8,877	-	2,300	899	2,418	1,140	5,471	21,105
1966	7,590	-	2,900	647	3,817	1,113	5,328	21,395
1967	8,773	-	3,400	786	2,675	1,077	4,259	20,970
1968	9,047	-	3,600	769	4,048	1,047	4,653	23,164
1969	8,693	-	2,800	681	3,545	953	4,167	20,839
1970	7,937	-	2,200	606	3,962	464	3,731	18,900
1971	7,212	-	2,500	553	4,093	415	4,088	18,861
1972	6,817	-	3,200	542	4,940	412	3,950	19,861
1973	6,181	-	3,419	655	4,278	724	2,550	17,807
1974	9,686	55[2]	2,390	628	4,668	653	2,515	20,595
1975	8,257	100	2,172	937	5,139	658	6,455	23,718
1976	7,572	194	2,801	836	4,394	582	3,018	19,397
1977	7,239	203	3,378	960	4,879	484	4,754	21,897
1978	9,184	390	4,034	1,106	5,418	396	2,500	23,028
1979	10,376	399	4,396	665	5,137	450	2,670	24,093
1980	8,276	52	3,286	460	3,429	427	2,305	18,235
1981	6,674	78	3,031	704	2,958	434	2,323	16,202
1982	5,818	50	3,608	543	4,214	250	2,596	17,079
1983	6,000	39	3,957	751	2,809	217	2,371	16,144
1984	5,165	43	3,173	662	3,865	176	1,859	14,943
1985	6,506	37	4,290	542	3,533	170	1,528	16,606
1986	6,808	52	3,480	494	5,044	250	1,438	17,566
1987	5,734	58	2,457	757	4,468	273	2,194	15,941
1988	5,092	69	3,227	759	3,030	281	1,605	14,063
1989	4,597	70	3,822	644	2,946	245	1,723	14,047
1990	5,682	59	1,722	820	2,253	257	1,427	12,220

Year	Denmark	Estonia	Finland	Germany	Latvia	Lithuania	Poland	Sweden	Russia	Total
1991	5,583	248[3]	76	3,055	445[4]	n/a	4,009	224	317[5]	13,957[6]
1992	4,579	164	64	2,287	624	399[6]	3,906	337	75	12,435[6]
1993	3,275	165	85	2,156	475	155[6]	5,101	271	159	11,842[6]
1994	5,094	162	79	6,634	337	270[6]	4,900	314	173	17,963[6]
1995	6,556	102	89	5,146	411	209[6]	8,964	661	268	22,406[6]
1996	6,387	297	98	3,134	336	401[6]	8,836	1,597	774	21,860[6]
1997	6,357	334	85	3,311	413	696[6]	6,168	1,374	1,131	19,869[6]
1998	5,862	355	81	2,955	400	811[6]	5,835	677	1,188	18,164[6]
1999	5,579	416	82	3,239	563	571[6]	5,787	439	1,013	17,689[6]

[1]Including Division IIIa.
[2]Excluding subsistence fisheries.
[3]As reported by Estonian authorities; 236 t reported by Russian authorities.
[4]As reported by Latvian authorities; 466 t reported by Russian authorities.
[5]Includes 141 t reported by Russian authorities for Lithuania.
[6]Preliminary.

3.13.3 Herring in Sub-divisions 22–24 and Division IIIa (spring spawners) (see Section 3.4.7)

3.13.4 Herring in Sub-divisions 25–29 (including Gulf of Riga) and 32

Answer to request for information on herring stock components: ICES has compiled information on herring stock components in the central Baltic. This information is insufficient to justify a new assessment structure with several subunits and further documentation is required before such stock units could be reliably re-defined. Until this work is completed, ICES will present an assessment for the stock components combined in Sub-divisions 25-29+32 (incl. Gulf of Riga) and a separate assessment for the Gulf of Riga herring.

State of stock/exploitation: Although the exact stock size is uncertain, there is high confidence that the spawning biomass has continued to decrease and is close to the historic low. The fishing mortality increased throughout the late 1990s and the stock is currently harvested outside safe biological limits. Current fishing mortality is above $\mathbf{F_{pa}}$ and even above $\mathbf{F_{lim}}$.

Management objectives: There are no explicit management objectives for this stock. However, for any management objective to meet the precautionary criteria, F should be less than the proposed $\mathbf{F_{pa}}$ and spawning stock biomass should be maintained above $\mathbf{B_{pa}}$ once an appropriate value is identified.

Precautionary Approach reference points (unchanged since 2000):

ICES considers that:	ICES proposes that:
$\mathbf{B_{lim}}$ not defined	$\mathbf{B_{pa}}$ not defined
$\mathbf{F_{lim}}$ is 0.33	$\mathbf{F_{pa}}$ be set at 0.17

Technical basis:

$\mathbf{B_{lim}}$ not defined	$\mathbf{B_{pa}}$ not defined
$\mathbf{F_{lim}}$: $\mathbf{F_{loss}}$	$\mathbf{F_{pa}}$: $\mathbf{F_{med}}$

There is no biological basis at present for determining biomass reference points. Past proposed biomass reference points were based on lowest observed biomass. However, it is uncertain how relevant past spawning biomass sizes are as a guide to precautionary reference points for this stock in the present regime of low productivity and low weights at age.

Advice on management: ICES recommends that fishing mortality in 2002 should be reduced below the $\mathbf{F_{pa} = 0.17}$ to allow the SSB to increase. The TAC for herring in Sub-divisions 25–29, 32 should be set so that the catch of this stock in 2002 is less than 73 000 t. To allow the SSB to rebuild to historic sizes associated with good recruitment, a rebuilding plan should be developed.

Rebuilding plan: Two examples of medium-term scenarios that could be implemented for rebuilding are discussed below.

Relevant factors to be considered in management: The TAC for herring has been kept far above the reported landings since 1989. Herring and sprat are mostly caught in mixed fisheries, but directed fisheries exist in some countries.

The implication of a substantially reduced harvest of the herring stock as advised should be considered when implementing the management plan for sprat fisheries.

The species composition in these mixed pelagic fisheries has changed profoundly during the 1990s. Sprat now constitutes about 60% of reported landings compared to less than 10% in earlier years. The mismatch of species proportions in quotas and in landings has created incentives for misreporting by species. Such misreporting seriously affects rebuilding of the herring stock. The misreporting also affects the quality of the assessments of both sprat and herring. To ensure that mixed fisheries operate in compliance with quotas for both herring and sprat, measures must be taken to ensure that reporting is accurate. Reporting of catches by species must be based on appropriate sampling. The respective TACs must reflect species abundances in the sea.

Large variability in mean weight at age has been observed during the last decade. A general decrease in growth, caused by environmentally changed feeding conditions has been coupled with changes in relative abundance of stock components. Increased proportions of slow-growing herring, especially in Sub-divisions 25 and 26 have decreased the weight at age even further in these areas. Migrations of stock components with different growth rates between spawning areas and feeding areas contribute to the large seasonal and area variability in mean weights. Also any changes in the area distributions of reported landings contribute to the variability. These factors increase the uncertainty in the prognoses and make it more difficult for management to set TACS that meet the desired objectives.

Much of the estimated decline in SSB has been attributed to the overall decrease in mean weights at age, as the numbers of mature herring (spawning stock in numbers) have remained stable during 1982–1996

(Figure 3.13.4.1). The decrease in SSB since 1997 has, however, been associated with a marked decline in numbers.

Comparison with previous assessment and advice: The present assessment gives about 22% higher estimates of SSB and 32% lower fishing mortality than last year's assessment. These changes are principally due to revised data for natural mortalities and coverage corrections of the acoustic survey data, together with a shorter age span for the assessment data. This latter point created the major effect on the assessment. The trends in spawning stock and fishing mortality have, however, not changed.

Catch forecast for 2002:

Basis: F(2001) =$\mathbf{F_{sq}}$= F(1998–2000) =0.47; Landings(2001) = 191; SSB(2001) = 442.

F(2002)	Basis	SSB(2002)	Landings (2002)	SSB (2003)
0.00	0.0	467	0	598
0.05	0.1 * $\mathbf{F_{sq}}$	460	21	570
0.09	0.2 * $\mathbf{F_{sq}}$	454	41	544
0.14	0.3 * $\mathbf{F_{sq}}$	448	61	518
0.17	$\mathbf{F_{pa}}$	444	73	503
0.24	0.5 * $\mathbf{F_{sq}}$	435	98	472
0.27	$\mathbf{F_{0.1}}$	431	113	454
0.33	0.7 * $\mathbf{F_{sq}}$	424	132	430
0.47	$\mathbf{F_{sq}}$	406	179	375

Weights in '000 t.

Shaded scenario considered inconsistent with the precautionary approach.

Medium- and long-term projections: Two medium-term predictions are given in Figures 3.13.4.2 and 3.13.4.3, both based on the assumption of a 15% reduction in F for year 2001 and using mean weights at age for 1998–2000. In Figure 3.13.4.2, F is reduced to 80% of the $\mathbf{F_{pa}}$ level for the whole period 2002–2010, whereas in Figure 3.13.4.3, F is kept at $\mathbf{F_{pa}}$. Fishing at 0.8*$\mathbf{F_{pa}}$ would result in average annual catches from 75 000 t to 135 000 t between 2002 and 2010. SSB is projected to reach 750 000 t (the previously proposed $\mathbf{B_{lim}}$ for the stock). Fishing at $\mathbf{F_{pa}}$ would result in catches of about 130 000 t, with SSB remaining around 600 000 t. The $\mathbf{B_{pa}}$ formerly proposed is inserted in the figures for illustration purposes. Continuation of the present exploitation is expected to lead to a continued reduction of SSB.

Elaboration and special comment: The assessment is uncertain, due to the complexity of the stock structure and the uncertain split between herring and sprat in most pelagic fisheries in the area.

The following stock components were also considered separately: Sub-divisions 25–27, Sub-divisions 28 (Gulf of Riga excluded), 29 & 32, and Gulf of Riga (see below). IBSFC proposed to use Sub-divisions 29S+32, Open Sea herring in Sub-divisions 25–28, and Coastal herring in Sub-divisions 25 and 26. However, taking data availability into account those components for which assessment and advice were presented, were considered to be the best compromise.

For herring in Sub-divisions 25–27, SSB has steadily decreased since the mid-1980s. In the last three years the SSB has been at the lowest observed level (about 2 times lower than the average value in 1980–2000). Fishing mortality was high in the 1980s and has increased steadily thereafter. Recruitment has been at or below the long-term average since the mid-1980s. Landings have declined from around 160 000 t in the 1980s to around 80 000 t in the 1990s, Table 3.13.4.1.

For the Gulf of Riga herring, SSB and recruitment have been high since 1990 with the exception of the 1996 year class. Fishing mortality was below $\mathbf{F_{pa}}$ during the 1990s, except for 1996–1998. Landings have increased since 1992 and reached 39 800 t in 1997 (see section below on Gulf of Riga herring).

For herring in Sub-divisions 28,29 and 32 (excl. Gulf of Riga herring), SSB has steadily decreased since the end of 1980s and is at present at the lowest observed level. Recruitment in the 1990s has been close to or below the long-term average. Fishing mortality has increased considerably since the mid-1990s. Landings decreased from 140 000–120 000 t during most of the 1980s to a rather stable level in the 1990s fluctuating around 90 000 t, Table 3.13.4.2.

In order to illustrate the degree of consistency in the way that the separate assessments have been performed comparisons were made between the result from the whole area (Sub-divisions 25-29, 32) and the sum of the results from Sub-divisions 25–27, Sub-divisions 28 (Gulf of Riga excluded), 29 and 32, and Gulf of Riga (Figure 3.13.4.4). The agreement between the sum of the parts and the whole is generally good for total stock biomass, average weight in the stock, spawning stock biomass, yield/SSB and fishing mortality. However, differences are apparent in the numbers of recruits estimated in the earlier assessment years where the sum is smaller than the result from the whole area. The trends in stock development are similar for the two larger stock units where there is a declining trend; whilst the Gulf of Riga exhibits an increasing trend. Fishing mortalities in the earlier years of the assessment are higher in the Gulf of Riga than for the whole area; whilst for the most recent years the fishing mortalities in Sub-divisions 28 (Gulf of Riga excluded), 29 and 32 are higher than for the whole area.

Source of information: Report of the Baltic Fisheries Assessment Working Group, April 2001 (ICES CM 2001/ACFM:18).

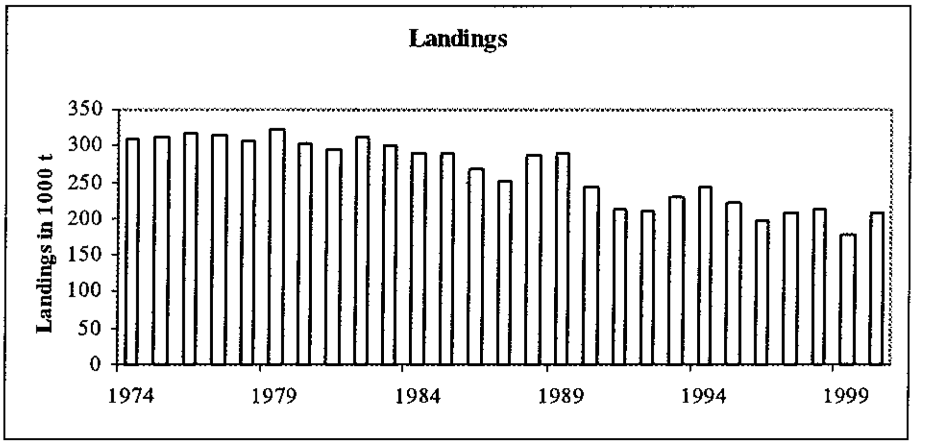
Yield and spawning biomass per Recruit F-reference points:

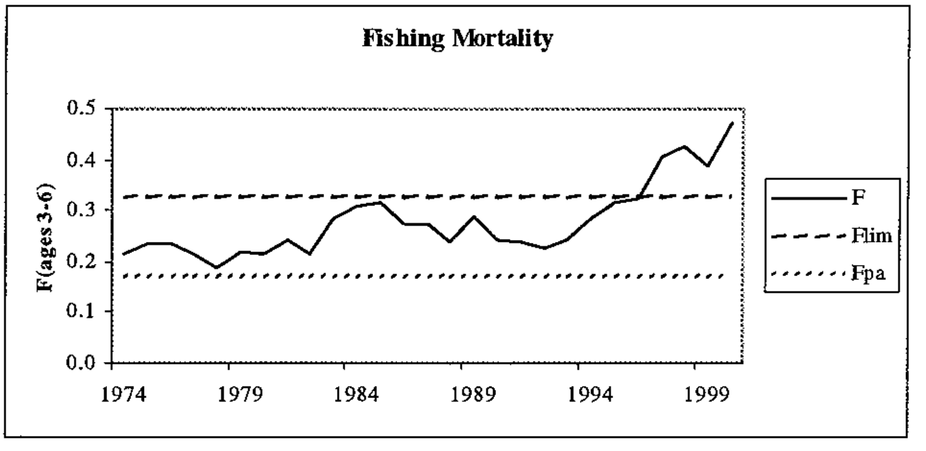
	Fish Mort Ages 3-6	Yield/R	SSB/R
Average Current	0.473	0.011	0.024
$\mathbf{F}_{max}$	1.522	0.011	0.007
$\mathbf{F}_{0.1}$	0.277	0.009	0.036
$\mathbf{F}_{med}$	0.203	0.009	0.044

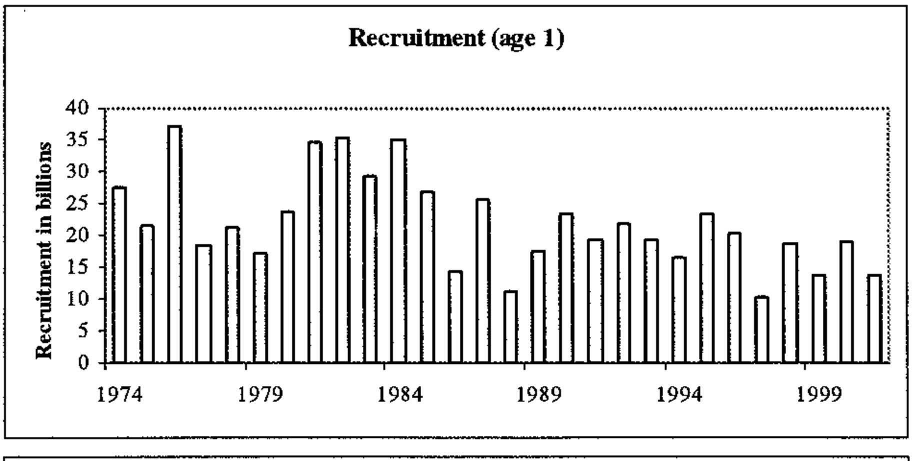
Catch data (Tables 3.13.4.1-4):

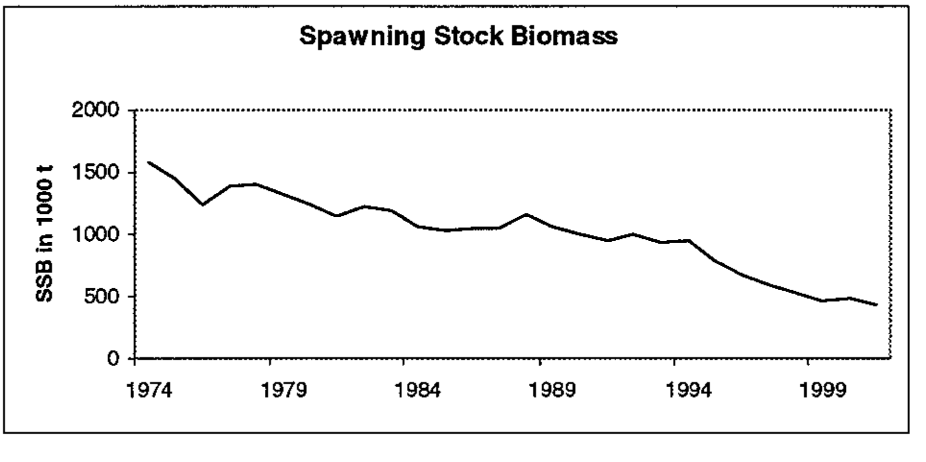
Year	ICES Advice	Predicted catch Corresp. to advice	Agreed TAC[1]	ACFM Catch 22–24	ACFM Catch 25–29+32	ACFM Catch Total
1987		200	399	102	252	354
1988		204	399	99	286	385
1989		176	399	95	290	385
1990		112	399	78	244	322
1991	TAC for entire area	293	402	70	213	283
1992	F near present level	343	402	85	210	295
1993	Increase in yield at higher F	371	560	81	231	312
1994	Increase in yield at higher F	317–463	560	66	242	308
1995	TAC	394	560	74	221	295
1996	TAC	394	560	58	195	253
1997	No advice	-	560	68	208	276
1998	No advice	-	560	51	214	265
1999	Proposed $\mathbf{F}_{pa} = (0.17)$	117	476	50	177	227
2000	Proposed $\mathbf{F}_{pa} = (0.17)$	95	405	35	208	242
2001	Proposed $\mathbf{F}_{pa} = (0.17)$	60	300			
2002	$< \mathbf{F}_{pa}$	73				

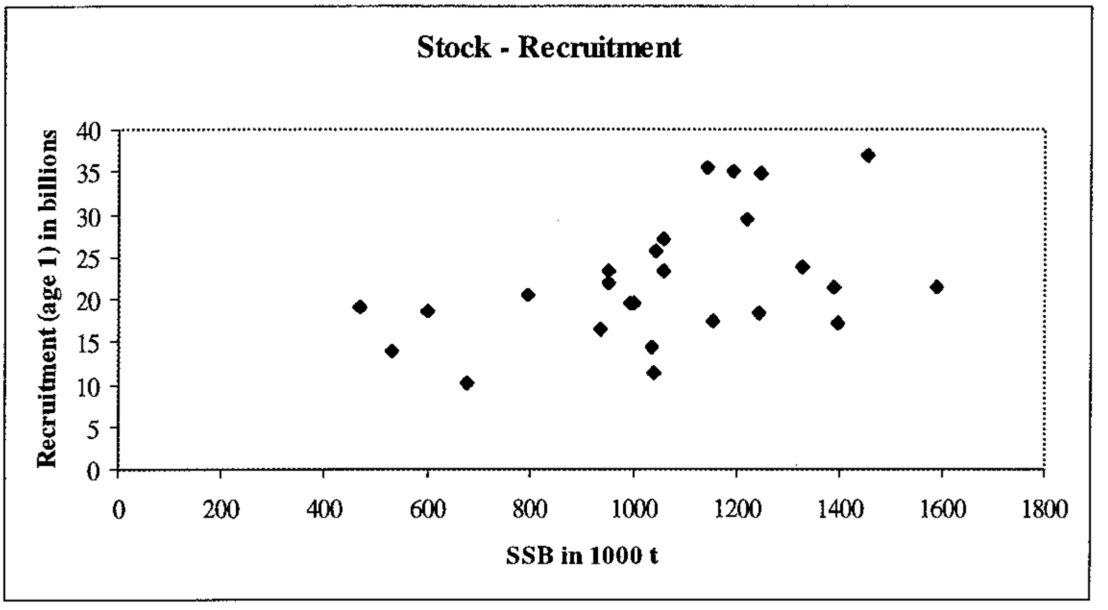
[1] TAC is for Sub-divisions 22–29, 32. Weights in '000 t.

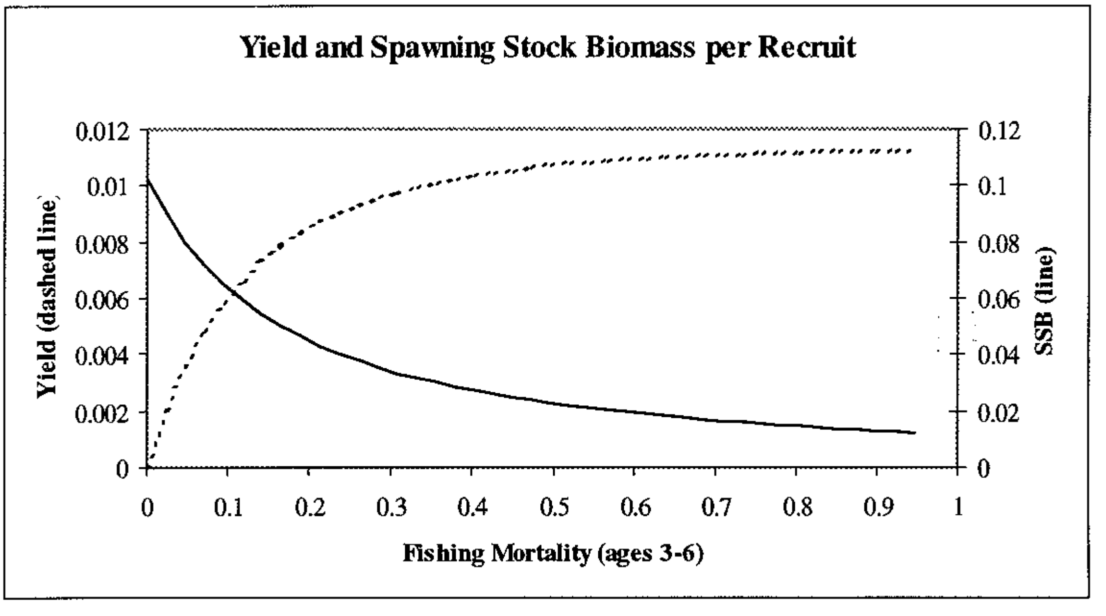

Landings
Landings in 1000 t
350
300
250
200
150
100
50
0
1974
1979
1984
1989
1994
1999


Fishing Mortality
F(ages 3-6)
0.5
0.4
0.3
0.2
0.1
0.0
1974
1979
1984
1989
1994
1999
F
Flim
Fpa


Recruitment (age 1)
Recruitment in billions
40
35
30
25
20
15
10
5
0
1974
1979
1984
1989
1994
1999


Spawning Stock Biomass
SSB in 1000 t
2000
1500
1000
500
0
1974
1979
1984
1989
1994
1999


Stock - Recruitment
Recruitment (age 1) in billions
0
5
10
15
20
25
30
35
40
0
200
400
600
800
1000
1200
1400
1600
1800
SSB in 1000 t


Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
0
0.002
0.004
0.006
0.008
0.01
0.012
SSB (line)
0
0.02
0.04
0.06
0.08
0.1
0.12
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Fishing Mortality (ages 3-6)

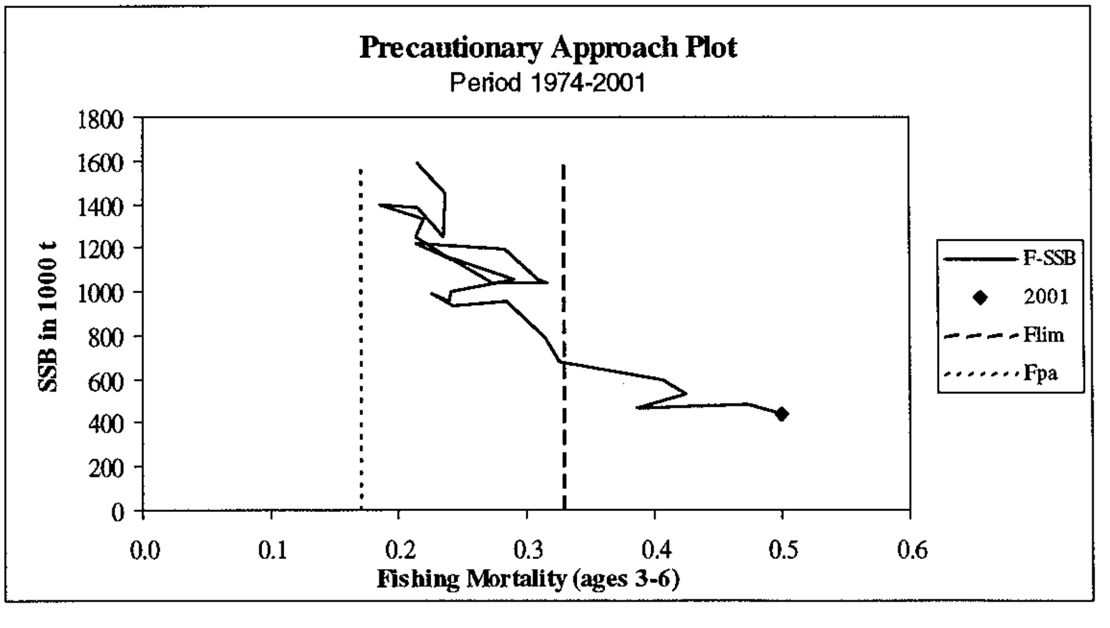

Precautionary Approach Plot
Period 1974-2001
SSB in 1000 t
0
200
400
600
800
1000
1200
1400
1600
1800
0.0
0.1
0.2
0.3
0.4
0.5
0.6
Fishing Mortality (ages 3-6)
F-SSB
2001
Flim
Fpa

Table 3.13.4.1 Herring catches in Sub-divisions 25-29, 32 (thousand tonnes).

Year	Denmark	Estonia	Finland	Germany	Latvia	Lithuania	Poland	Russia**	Sweden	Total
1977	11.9		33.7	0.0			57.2	137.0	48.7	313.7
1978	13.9		38.3	0.1			61.3	130.6	55.4	305.2
1979	19.4		40.4	0.0			70.4	118.1	71.3	323.1
1980	10.6		44.0	0.0			58.3	118.0	72.5	304.4
1981	14.1		42.5	1.0			51.2	110.2	72.9	294.0
1982	15.3		47.5	1.3			63.0	99.2	83.8	311.1
1983	10.5		59.1	1.0			67.1	84.6	78.6	302.0
1984	6.5		54.1	0.0			65.8	105.6	56.9	289.9
1985	7.6		54.2	0.0			72.8	110.8	42.5	289.5
1986	3.9		49.4	0.0			67.8	115.7	29.7	268.3
1987	4.2		50.4	0.0			55.5	113.8	25.4	251.9
1988	10.8		58.1	0.0			57.2	122.8	33.4	286.3
1989	7.3		50.0	0.0			51.8	121.8	55.4	289.9
1990	4.6		26.9	0.0			52.3	116.2	44.2	244.2
1991	6.8	32.7	18.1	0.0	33.3	6.5	47.1	31.9	36.5	212.8
1992	8.1	29.7	30.0	0.0	25.8	4.6	39.2	29.5	43.0	209.9
1993	8.9	32.7	32.3	0.0	25.4	3.0	41.1	21.6	66.4	231.4
1994	11.3	33.7	38.2	3.7	26.2	4.9	46.1	16.7	61.6	242.4
1995	11.4	42.9	31.4	0.0	28.4	3.6	38.7	17.0	47.2	220.6
1996	12.1	44.9	31.5	0.0	31.0	4.2	30.7	14.6	25.9	195.1
1997	9.4	54.7	23.7	0.0	33.8	3.3	26.2	12.5	44.1	207.8
1998	13.9	42.9	24.8	0.0	27.6	2.4	19.3	10.5	71.0	212.4
1999	6.2	43.1	17.9	0.0	30.2	1.3	18.1	12.7	48.9	178.3
2000*	15.8	39.7	23.2	0.0	30.0	1.1	23.1	14.8	60.2	207.8

* preliminary, ** in 1977-1990 sum of catches by Estonia, Latvia, Lithuania and Russia.

Table 3.13.4.2 Herring in Sub-divisions 25, 26 and 27.

Year	Recruitment Age 1	Spawning Stock Biomass	Landings	Fishing mortality Ages 3-6
1980	7542	729.76	168.29	0.202
1981	13740	692.50	158.73	0.213
1982	11781	709.69	179.00	0.196
1983	11464	712.98	173.84	0.263
1984	10637	615.84	155.02	0.268
1985	9721	568.27	154.71	0.329
1986	6063	579.07	138.49	0.294
1987	5810	542.07	118.73	0.239
1988	4983	584.68	143.66	0.223
1989	6974	509.22	163.06	0.277
1990	7157	502.90	127.20	0.275
1991	6186	514.17	107.24	0.259
1992	5831	529.46	102.72	0.233
1993	5181	422.19	126.17	0.325
1994	5006	418.17	126.00	0.383
1995	7881	349.48	97.70	0.333
1996	5880	327.42	76.50	0.304
1997	2871	320.85	75.61	0.342
1998	5539	248.47	93.48	0.419
1999	4957	239.15	67.41	0.325
2000	6026	254.84	87.49	0.398
2001	-	238.32	78.68	-

Table 3.13.4.3 Herring in Sub-divisions 28, 29 and 32 (excluding Gulf of Riga).

Year	Recruitment Age 1	Spawning Stock Biomass	Landings	Fishing mortality Age 3-7
1983	7,045	441	143.92	0.245
1984	11,951	409	128.63	0.282
1985	9,120	404	125.59	0.284
1986	3,499	413	114.33	0.248
1987	12,298	444	119.08	0.259
1988	3,884	460	127.45	0.279
1989	7,031	403	122.83	0.296
1990	10,624	353	100.05	0.281
1991	7,238	345	92.78	0.281
1992	9,931	333	88.12	0.223
1993	8,790	336	95.20	0.227
1994	6,424	374	91.26	0.243
1995	8,809	294	90.89	0.303
1996	7,540	251	88.30	0.372
1997	4,840	191	92.40	0.513
1998	8,649	171	90.70	0.542
1999	4,815	145	79.85	0.624
2000	8,683	141	86.50	0.748
2001	7,809	132	*	*
Average	7,842	318	104.33	0.350
Unit	Millions	1000 tons	1000 tons	

Table 3.13.4.4 Herring in Sub-divisions 25-29+32 (Combined Stock)

Year	Recruitment Age 1 thousands	SSB tonnes	Landings tonnes	Mean F Ages 3-6
1974	27426636	1587743	310000	0.2147
1975	21418582	1455292	313000	0.2361
1976	37034468	1245207	318000	0.2353
1977	18454936	1387988	314000	0.2155
1978	21390052	1395698	305000	0.1857
1979	17140020	1329567	323000	0.2198
1980	23720376	1246469	304000	0.2137
1981	34706152	1145440	294000	0.2418
1982	35433356	1220460	311000	0.2137
1983	29316646	1193251	302000	0.2837
1984	34967380	1057392	290000	0.3092
1985	27005554	1035366	290000	0.3172
1986	14274608	1042104	268000	0.2719
1987	25667976	1041110	252000	0.2742
1988	11369604	1155025	286000	0.2399
1989	17485506	1060271	290000	0.2906
1990	23308218	1003535	244000	0.2411
1991	19422728	952657	213000	0.2392
1992	21916274	992325	210000	0.2251
1993	19470280	935510	231000	0.2429
1994	16432264	953683	244000	0.2853
1995	23298670	792724	221000	0.3155
1996	20408400	676032	196113	0.3258
1997	10234773	600190	207770	0.4063
1998	18609258	530693	214560	0.4255
1999	13768655	469600	178302	0.3863
2000	18985948	490862	207819	0.4729
2001	13790063	441955		0.5000
Average	22016335	1015648	264354	0.2867

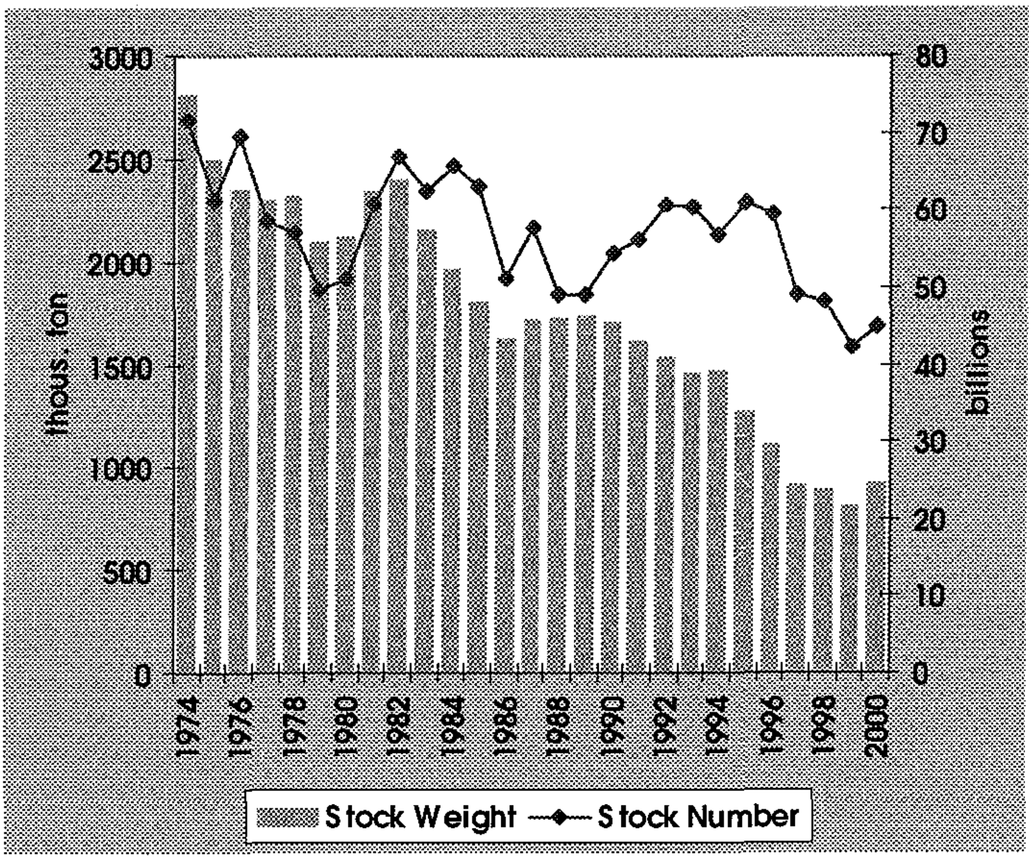


Figure 3.13.4.1 Herring in SD 25–29+32 (incl. Gulf of Riga).

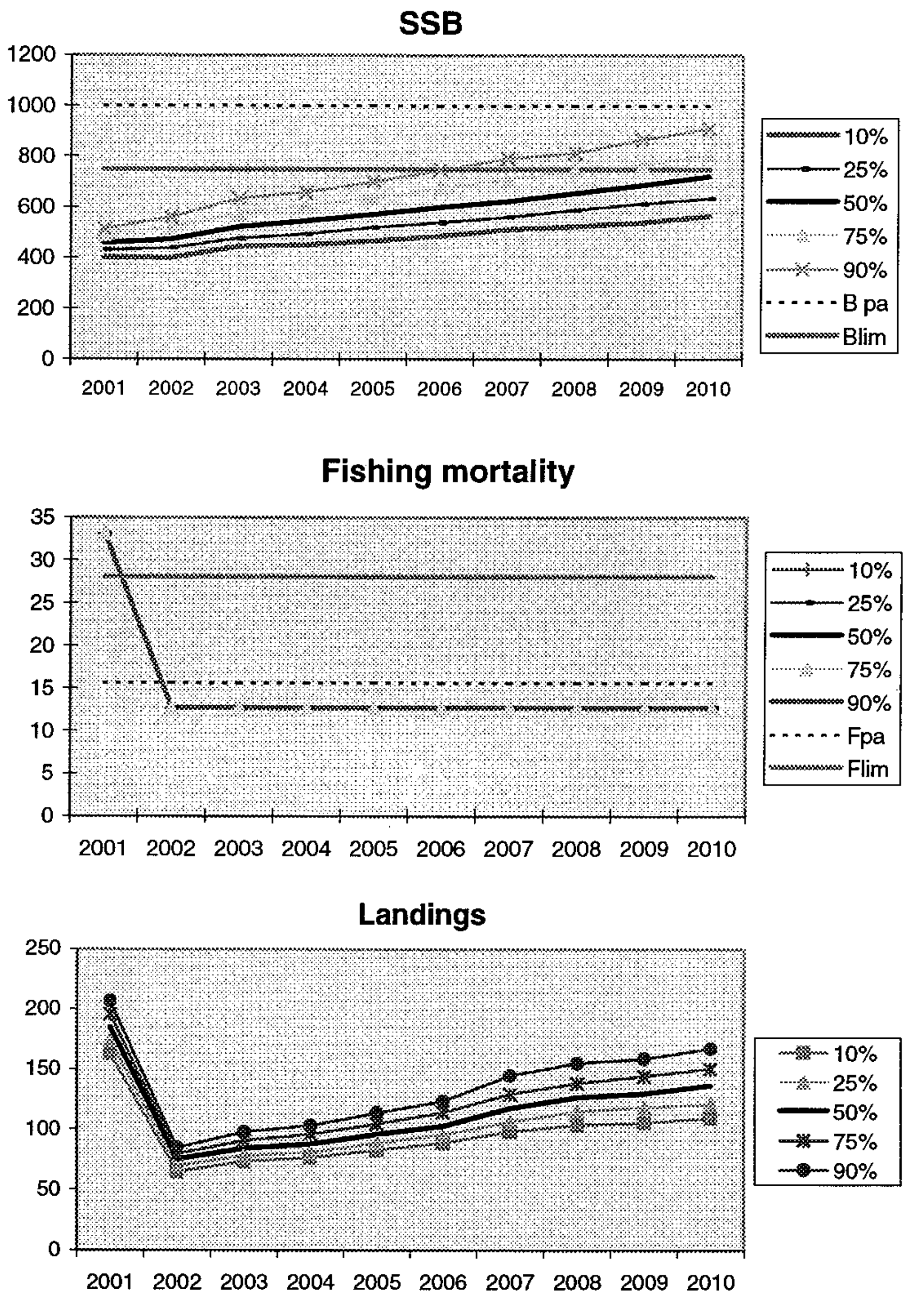


Figure 3.13.4.2 Herring in SD 25–29+32 (incl. Gulf of Riga). Medium-term projection. F(2001)=0.85*F(2000), F(2002-2010)=0.80*F_{pa}.

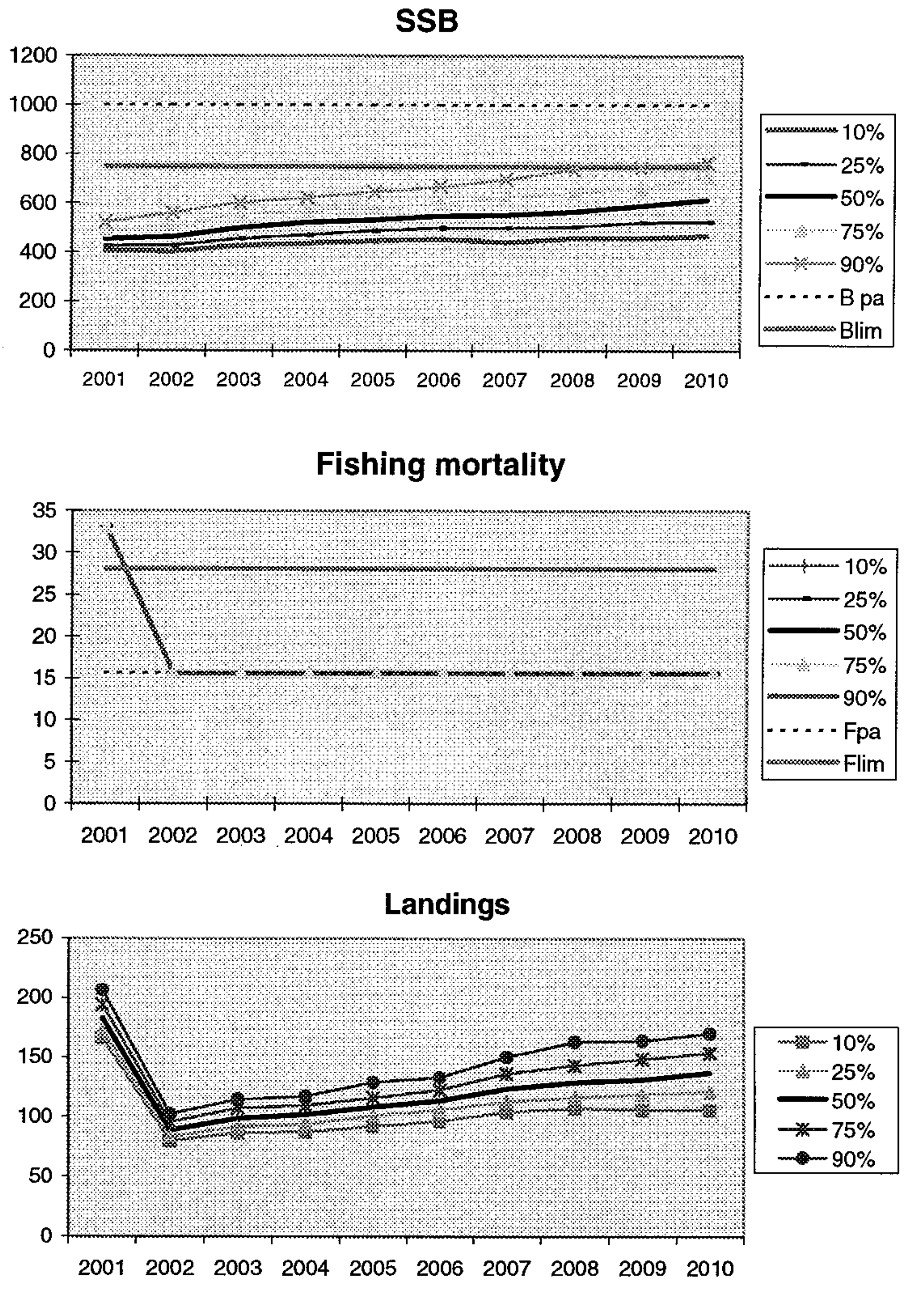


Figure 3.13.4.3 Herring in SD 25–29+32 (incl. Gulf of Riga). Medium-term projection. F(2001)=0.85*F(2000), F(2002-2010)=F_{pa}.

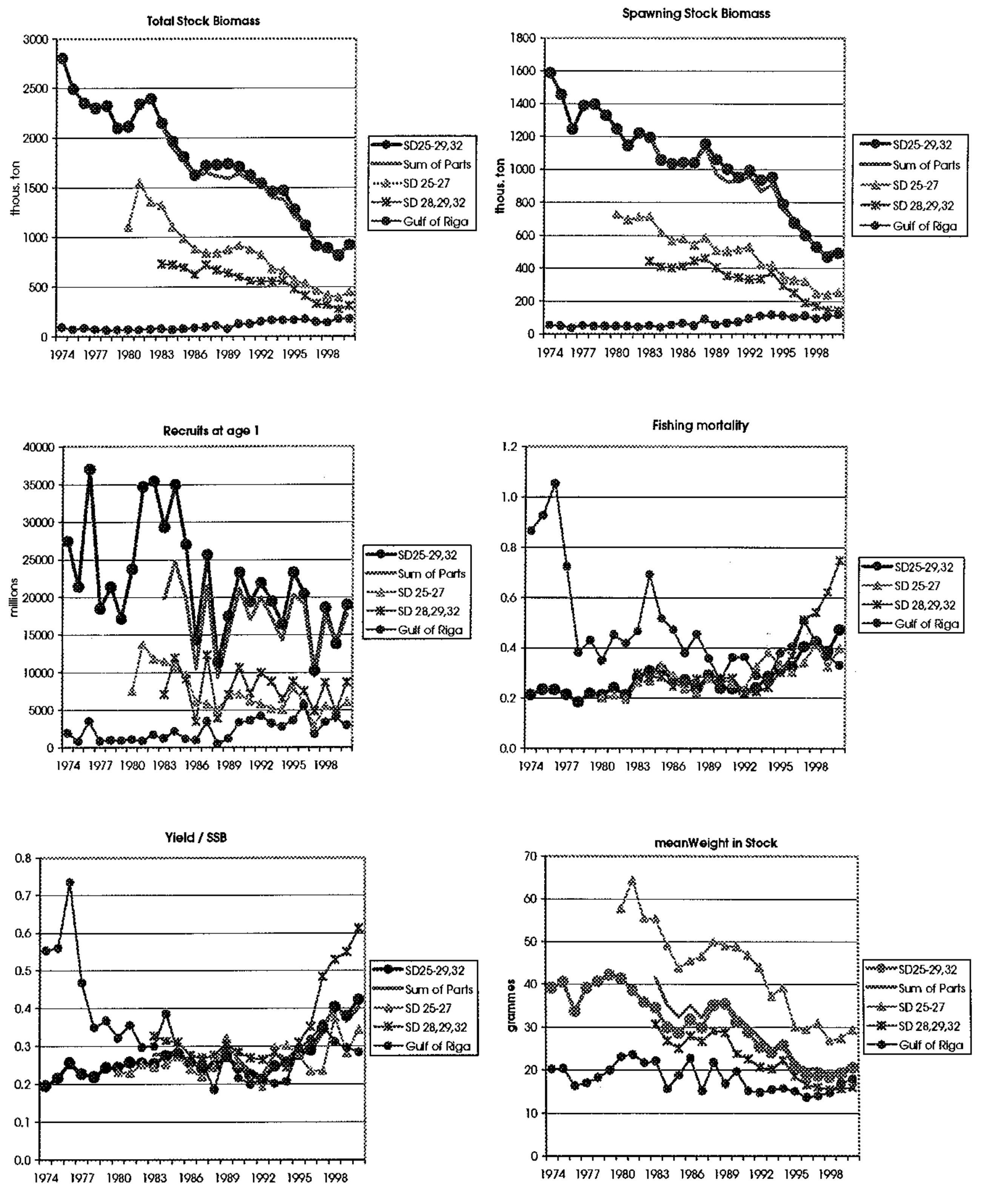


Figure 3.1.3.4.4 Herring in SD 25-29+32 (incl. Gulf of Riga). Comparisons between estimates from different assessments

3.13.4.a Herring in the Gulf of Riga

State of stock/exploitation: The stock component is at present considered to be within safe biological limits. SSB and recruitment have been high since 1990, with the exception of the 1996 year class. Fishing mortality was below $\mathbf{F_{pa}}$ during the 1990s, except for 1996–1998.

Management objectives: There are no explicit management objectives for this stock component. However, for any management objective to meet the precautionary criteria, F should be less than the $\mathbf{F_{pa}}$ and spawning stock biomass should be maintained above the $\mathbf{B_{pa}}$.

Precautionary Approach reference points (proposed in 1999):

ICES considers that:	ICES proposes that:
$\mathbf{B_{lim}}$ is 36 500 t	$\mathbf{B_{pa}}$ be set at 50 000 t
$\mathbf{F_{lim}}$ not defined	$\mathbf{F_{pa}}$ be set at 0.4

Technical basis:

$\mathbf{B_{lim}}$: $\mathbf{B_{pa}}$/exp (1.65*0.2)	$\mathbf{B_{pa}}$: = MBAL=50 000 t
$\mathbf{F_{lim}}$: not defined	$\mathbf{F_{pa}}$: from medium-term projections

Advice on management: At the current exploitation rate the stock component is forecasted to remain within safe biological limits. The expected landings in 2002 corresponding to this rate are 33 200 t.

Comparison with previous assessment and advice: The present assessment gives 14% lower estimates of SSB than last years assessment and F is increased by 43%.

Catch forecast for 2001:

Basis: F(2001)=$\mathbf{F_{sq}}$=F(1998-20000)=0.33; Landings(2001) =33.5; SSB(2001)=123.

F (2002)	Basis	SSB (2002)	Catch (2002)	SSB (2003)	Medium-term effect of fishing at given level
0.27	0.8*$\mathbf{F_{sq}}$ (=$\mathbf{F_{0.1}}$)	128	27	121	Increase of SSB
0.33	$\mathbf{F_{sq}}$	126	33.2	114	Slow increase of SSB
0.40	1.2*$\mathbf{F_{sq}}$ ($\mathbf{F_{pa}}$)	125	39	108	Stable SSB
0.47	1.4*$\mathbf{F_{sq}}$	123	44	102	Decrease in SSB

Weights in '000 t.

Shaded scenarios considered inconsistent with the precautionary approach

Elaboration and special comment: Herring catches in the Gulf of Riga include both Gulf herring and open-sea herring, which enter the Gulf of Riga from April to June for spawning. The herring in the Gulf of Riga is fished by Estonia and Latvia. The landings, which were about 30 000 t in the early 1970s, decreased to 12 000–15 000 t in the 1980s. Since 1992 the catches have increased, reaching 39 800 t in 1997 (the figure includes unallocated catches and some catches of Gulf herring outside the Gulf of Riga). The structure of the fishery has remained unchanged in recent decades: approximately 70% of the catches are taken by the trawl fishery and 30% by the trapnet fishery on the spawning grounds.

Analytical assessment is based on catch data and CPUE series. Gulf of Riga herring is used as a component of the herring in Sub-divisions 25–29 and 32, separated in the landings by means of otolith structure.

A stock-recruitment relation with stochastic variation is used for generating possible future recruitment figures. During the projection period (10 years) the spawning stock is projected to increase.

Source of information: Report of the Baltic Fisheries Assessment Working Group, April 2001 (ICES CM 2001/ACFM:18).

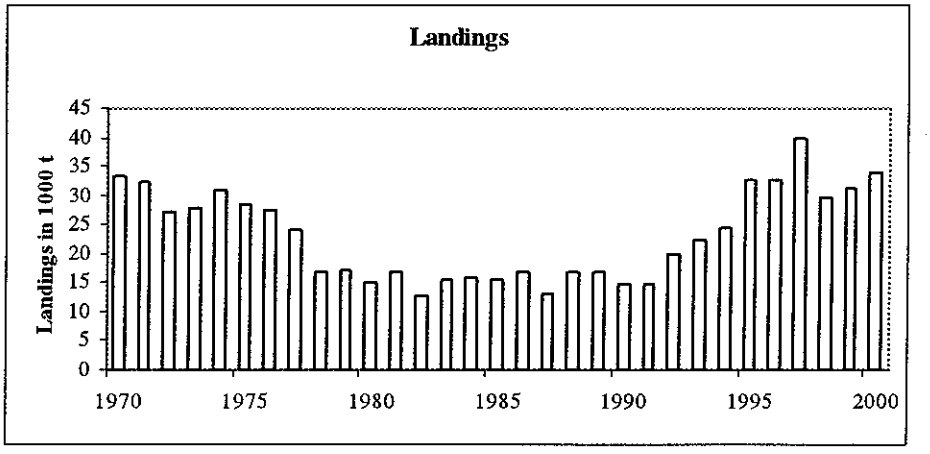
Yield and spawning biomass per Recruit F-reference points:

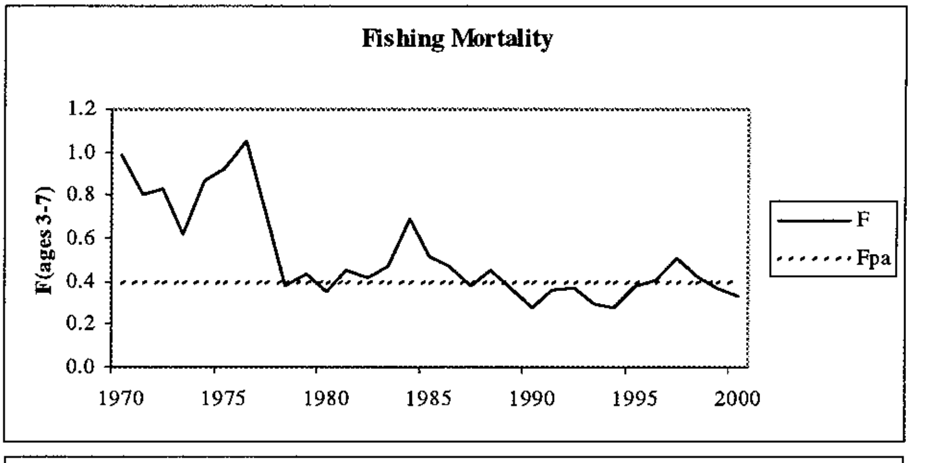
	Fish Mort Ages 3-7	Yield/R	SSB/R
Average Current	0.333	0.010	0.036
$\mathbf{F_{max}}$	N/A		
$\mathbf{F_{0.1}}$	0.269	0.009	0.040
$\mathbf{F_{med}}$	0.368	0.010	0.033

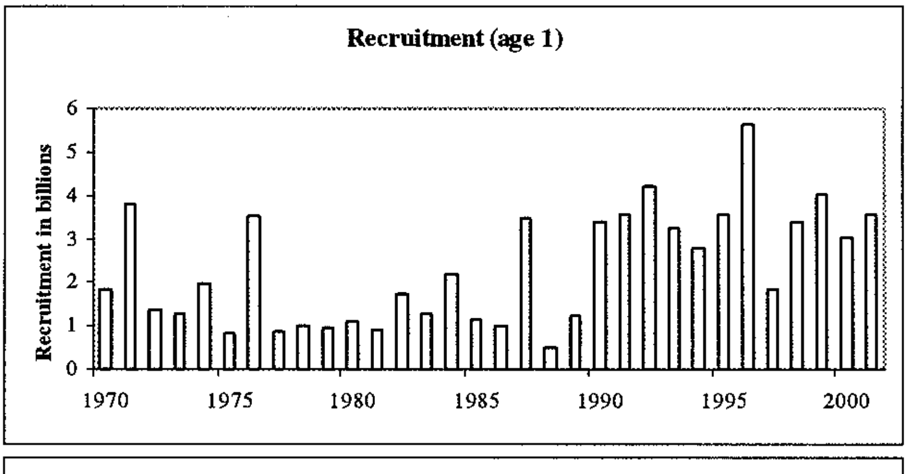
Catch data (Table 3.13.4.a.1-2):

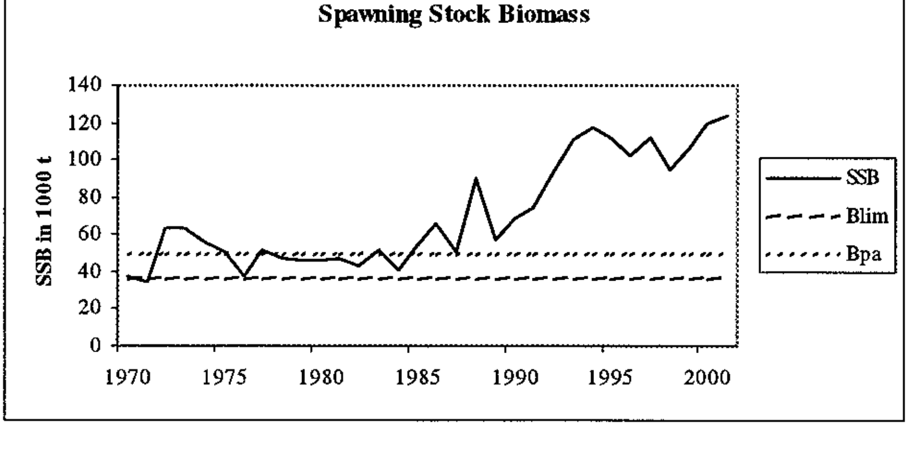
Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC	ACFM Catch
1987	Reduce F towards $\mathbf{F}_{0.1}$	8	-	13
1988	Reduce F towards $\mathbf{F}_{0.1}$	6	-	17
1989	F should not exceed present level	20	-	17
1990	F should not exceed present level	20	-	15
1991	No separate advice for this stock component	-	-	15
1992	No separate advice for this stock component	-	-	20
1993	No separate advice for this stock component	-	-	22
1994	No separate advice for this stock component	-	-	24
1995	No separate advice for this stock component	-	-	33
1996	No separate advice for this stock component	-	-	33
1997	Current exploitation rate within safe biological limits	35	-	40
1998	Current exploitation rate within safe biological limits	35	-	29
1999	Current exploitation rate within safe biological limits	34	-	31
2000	Current exploitation rate within safe biological limits	37	-	34
2001	Current exploitation rate within safe biological limits	34.1	-	
2002	Current exploitation rate within safe biological limits	33.2	-	

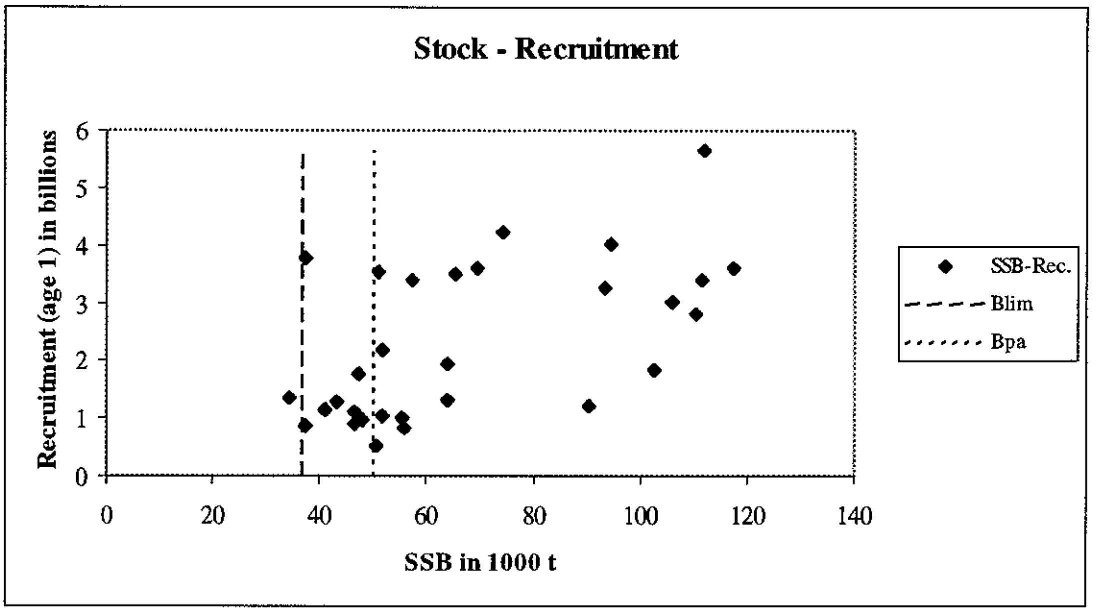
Weights in '000 t.

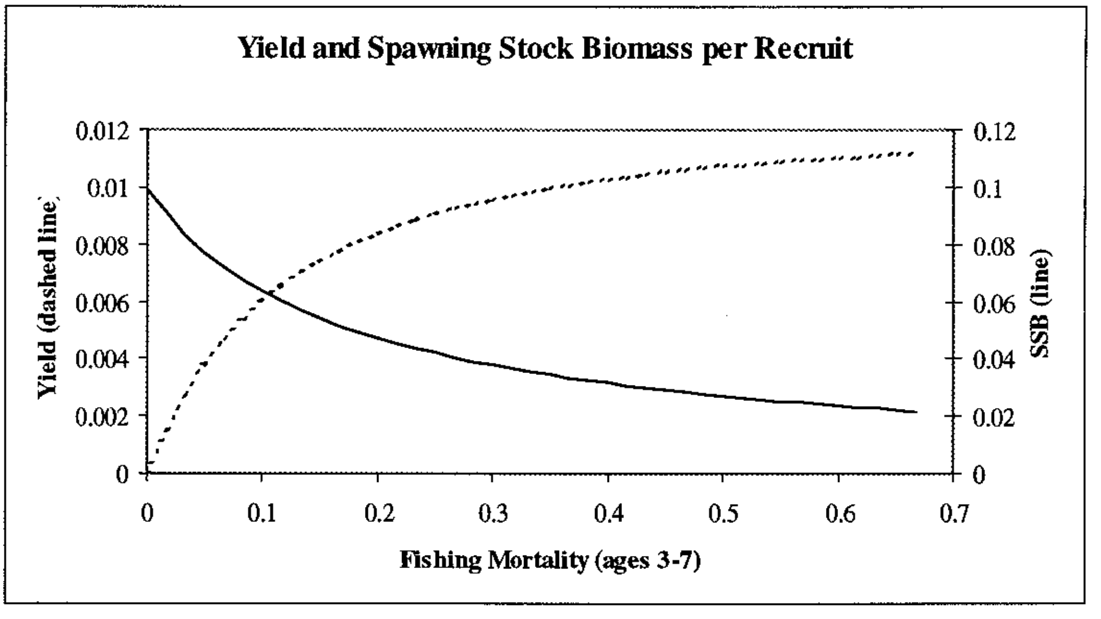

Landings
Landings in 1000 t
45
40
35
30
25
20
15
10
5
0
1970
1975
1980
1985
1990
1995
2000


Fishing Mortality
F(ages 3-7)
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1970
1975
1980
1985
1990
1995
2000
F
Fpa


Recruitment (age 1)
Recruitment in billions
6
5
4
3
2
1
0
1970
1975
1980
1985
1990
1995
2000


Spawning Stock Biomass
SSB in 1000 t
140
120
100
80
60
40
20
0
1970
1975
1980
1985
1990
1995
2000
SSB
Blim
Bpa


Stock - Recruitment
Recruitment (age 1) in billions
SSB in 1000 t
SSB-Rec.
Blim
Bpa
0
1
2
3
4
5
6
0
20
40
60
80
100
120
140


Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
SSB (line)
Fishing Mortality (ages 3-7)
0
0.002
0.004
0.006
0.008
0.01
0.012
0.02
0.04
0.06
0.08
0.1
0.12
0.1
0.2
0.3
0.4
0.5
0.6
0.7

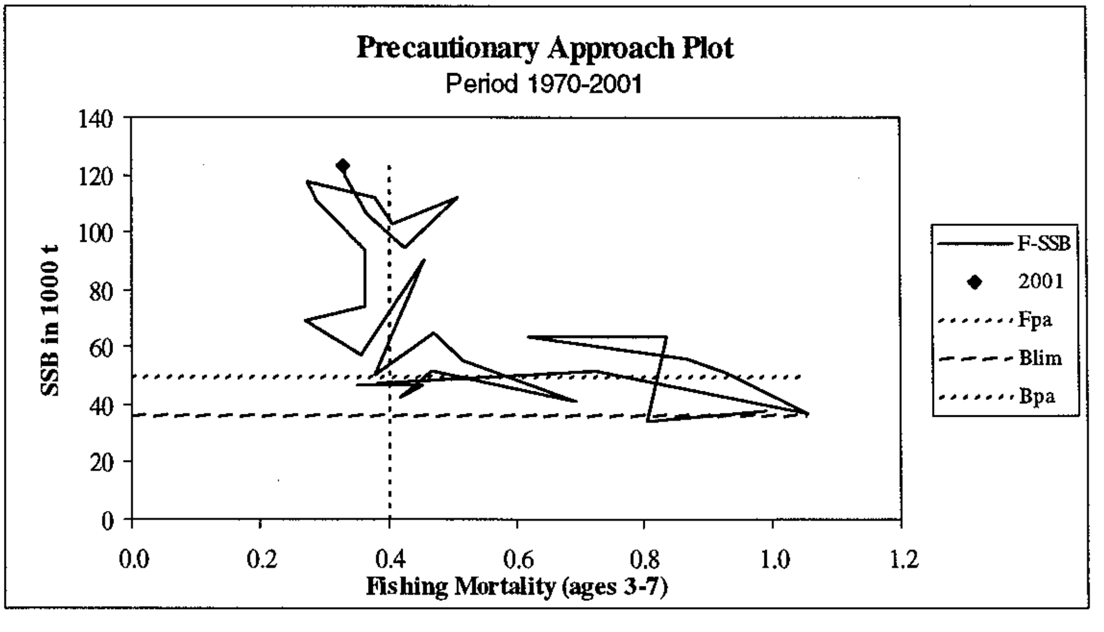

Precautionary Approach Plot
Period 1970-2001
SSB in 1000 t
Fishing Mortality (ages 3-7)
F-SSB
2001
Fpa
Blim
Bpa
0
20
40
60
80
100
120
140
0.0
0.2
0.4
0.6
0.8
1.0
1.2

Table 3.13.4.a.1 Herring catches in the Gulf of Riga

Category	Catch in '000 t							
	1976	1977	1978	1979	1980	1981	1982	1983
Total catch	31.9	26.6	23.0	21.8	20.7	22.7	17.5	20.3
Gulf of Riga herring	27.4	24.2	16.7	17.1	15.0	16.8	12.8	15.5
Open sea herring	4.5	2.4	6.3	4.7	5.7	5.9	4.7	4.8

Category	Catch in '000 t							
	1984	1985	1986	1987	1988	1989	1990	1991
Total catch	19.6	20.2	18.2	17.7	19.8	22.7	20.8	20.8
Gulf of Riga herring	15.8	15.6	16.9	12.9	16.8	16.8	14.8	14.7
Open sea herring	3.8	4.6	1.3	4.8	3.0	5.9	6.0	6.1

Category	Catch in '000 t								
	1992	1993	1994	1995	1996	1997	1998	1999	2000
Total catch	23.9	26.5	29.3	38.8	37.0	44.1	33.5	35.7	38.6
Gulf of Riga herring	20.4	22.2	24.3	32.7	32.6	39.8	29.4	31.4	34.1
Open sea herring	3.5	4.3	5.0	6.1	4.4	4.3	4.1	4.3	4.5

Table 3.13.4.a.2 Herring in the Gulf of Riga.

Year	Recruitment Age 1 thousands	SSB tonnes	Landings tonnes	Mean F Ages 3-7
1970	1822601	37472	33196	0.9899
1971	3795689	34356	32178	0.8041
1972	1361391	63737	27145	0.8348
1973	1303494	63928	27895	0.6187
1974	1948933	55766	30850	0.8662
1975	829199	50914	28523	0.9275
1976	3537533	37328	27422	1.0559
1977	858237	51695	24186	0.7238
1978	1027032	47919	16728	0.3830
1979	980141	46701	17142	0.4314
1980	1110901	46716	14998	0.3502
1981	916251	47241	16769	0.4529
1982	1753779	43042	12777	0.4200
1983	1273856	51758	15541	0.4680
1984	2200669	41050	15843	0.6930
1985	1160012	55347	15575	0.5173
1986	1001550	65241	16927	0.4735
1987	3500208	50683	12884	0.3805
1988	513448	90573	16791	0.4558
1989	1230428	57232	16783	0.3588
1990	3396569	69274	14931	0.2730
1991	3593372	74258	14791	0.3630
1992	4222849	93628	20000	0.3649
1993	3246128	110435	22200	0.2912
1994	2793690	117345	24300	0.2744
1995	3594807	111779	32656	0.3797
1996	5644919	102611	32584	0.4059
1997	1841142	111711	39843	0.5078
1998	3393803	94720	29443	0.4246
1999	4009500	106186	31403	0.3668
2000	3002056	119946	34069	0.3333
2001	3564792	123443		0.3300
Average	2325906	71064	23109	0.5162

3.13.5 Herring in Sub-division 30, Bothnian Sea

State of stock/exploitation: Although the exact stock status is uncertain, the stock is considered to be harvested outside safe biological limits. The spawning stock biomass has been high in the early 1990s, but has decreased since 1994 and is presently close to the $\mathbf{B}_{pa}$. The fishing mortality has increased since 1993, being above $\mathbf{F}_{pa}$ since 1997 and at $\mathbf{F}_{lim}$ in 2000. Landings have been at the high level of around 60 000 t since 1994. The 1997 and 1999 year classes have been well above the long-term average.

Management objectives: There are no explicit management objectives for this stock. However, for any management objective to meet the precautionary criteria, F should be less than $\mathbf{F}_{pa}$ and the spawning stock biomass should be maintained above $\mathbf{B}_{pa}$.

Precautionary Approach reference points (proposed in 2000):

ICES considers that:	ICES proposes that:
$\mathbf{B}_{lim}$ is 145 000 t	$\mathbf{B}_{pa}$ be set at 200 000 t
$\mathbf{F}_{lim}$ is 0.30	$\mathbf{F}_{pa}$ be set at 0.21

Technical basis:

$\mathbf{B}_{lim}$: spawning stock biomass, where probability of lower recruitment increases	$\mathbf{B}_{pa}$: $\mathbf{B}_{lim*}$ exp(1.645*0.2)
$\mathbf{F}_{lim}$: $\mathbf{F}_{loss}$	$\mathbf{F}_{pa}$: $\mathbf{F}_{med}$

Advice on management: ICES recommends to reduce the fishing mortality to no more than $\mathbf{F}_{pa,}$ corresponding to landings of less than 39 500 t in 2002.

Relevant factors to be considered in management: This stock is part of the IBSFC management unit 3. The exploitation of the stock has increased in the 1990s, and according to medium-term projections (Figures 3.13.5.1–2) the present fishing mortality is not sustainable. A reduction in fishing mortality to below $\mathbf{F}_{pa}$ has a high probability of keeping the spawning stock biomass above $\mathbf{B}_{pa}$ in the longterm.

Comparison with previous assessment and advice: This years assessment gives about 25% higher estimates of spawning stock biomass than last years assessment and a corresponding decrease in fishing mortality.

Catch forecast for 2002:

Basis: F(2001) = $\mathbf{F}_{sq}$ = F(1998–2000) = 0.30; Landings(2001) = 60; SSB(2001) = 203.

F(2002)	Basis	SSB(2002)	Landings (2002)	SSB (2003)
0.00	No fishing	201	0	251
0.21	$\mathbf{F}_{pa}$ =0.7*$\mathbf{F}_{sq}$	195	39	206
0.24	0.8*$\mathbf{F}_{sq}$	194	44	200
0.27	0.9*$\mathbf{F}_{sq}$	194	49	194
0.30	$\mathbf{F}_{lim}$ =$\mathbf{F}_{sq}$	193	54	189

Weights in '000 t.

Shaded scenario considered inconsistent with the precautionary approach.

Medium- and long-term projections: Medium-term projections were calculated for a 10-year period based on Monte Carlo simulations.

Medium-term projections for 10 years, starting from the most recent estimate of the survivors, are presented for different fishing mortality levels in Figures 3.13.5.1–2.

The medium-term projection using the average fishing mortality from 1998–2000 (F_{bar}=0.30) reveals a decreasing trend over a 10-year period and there is a high probability of the spawning stock biomass being close to the $\mathbf{B}_{lim}$ of 145 000 t.

Elaboration and special comment: About 90% of the total catch is taken by trawl fishery. Trapnet fishery is of minor importance. In the trawl fishery more effective and larger trawls have been introduced in the 1990s. Fishing effort is to a large extent market-driven.

Source of information: Report of the Baltic Fisheries Assessment Working Group, April 2001 (ICES CM 2001/ACFM:18).

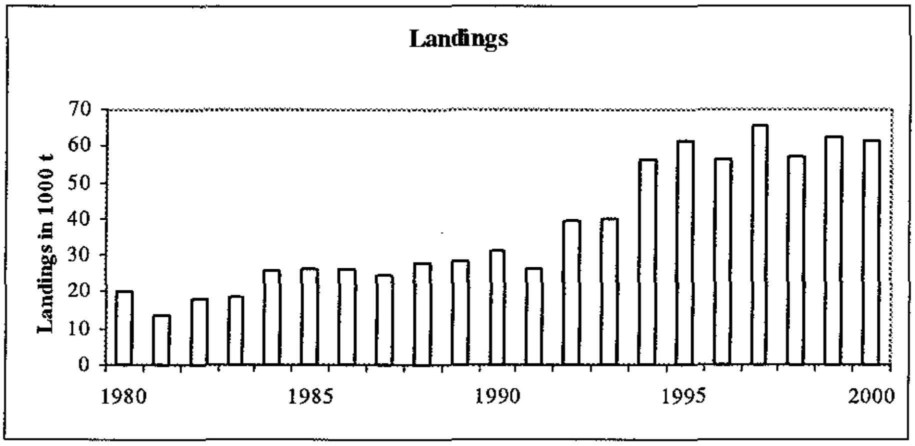
Yield and spawning biomass per Recruit F-reference points:

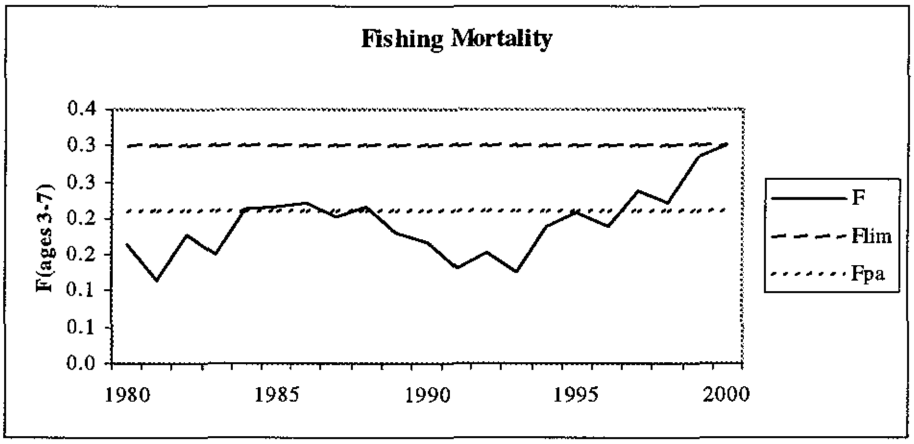
	Fish Mort Ages 3-7	Yield/R	SSB/R
Average Current	0.302	0.013	0.047
$\mathbf{F_{max}}$	0.487	0.013	0.032
$\mathbf{F_{0.1}}$	0.166	0.012	0.068
$\mathbf{F_{med}}$	0.265	0.013	0.051

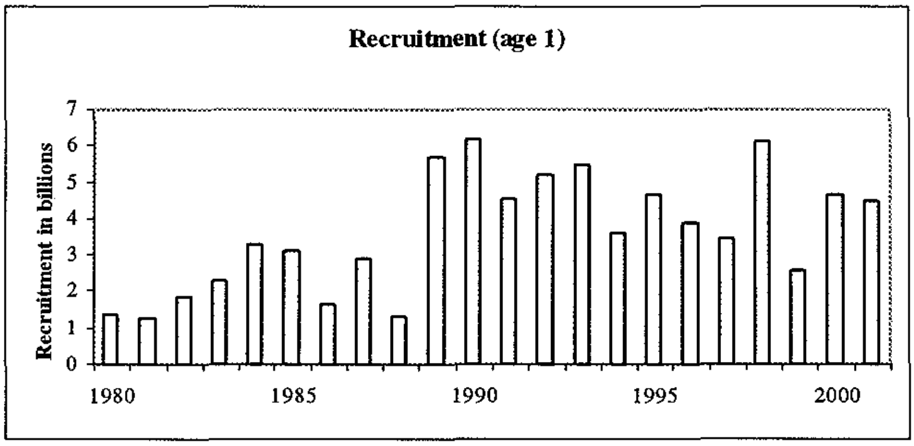
Catch data (Tables 3.13.5.1–2):

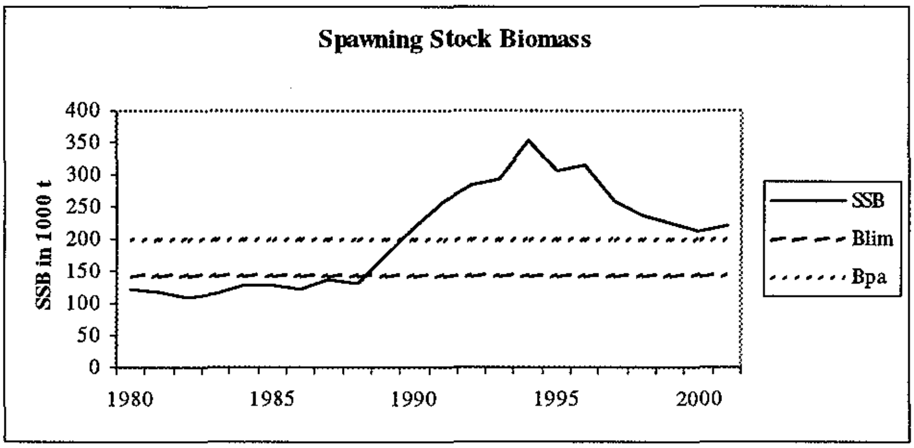
Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC[2]	ACFM Catch
1987				25
1988				28
1989				29
1990				31
1991	TAC for eastern part of SD, allowance for western part	32+	84	26
1992	*Status quo* F	39	84	39
1993	*Status quo* F	39	90	40
1994	No specific advice	41[1]	90	56
1995	TAC	73	110	61
1996	TAC	73	110	56
1997	F(97) = 1.4 * F(95)	78	110	61
1998	*Status quo* F	50	110	57
1999	Reduce catches	-	94	62
2000	Reduce catches	-	85	61
2001	$\mathbf{F_{pa}} = 0.21$	36	72	
2002	F below $\mathbf{F_{pa}}$	40		

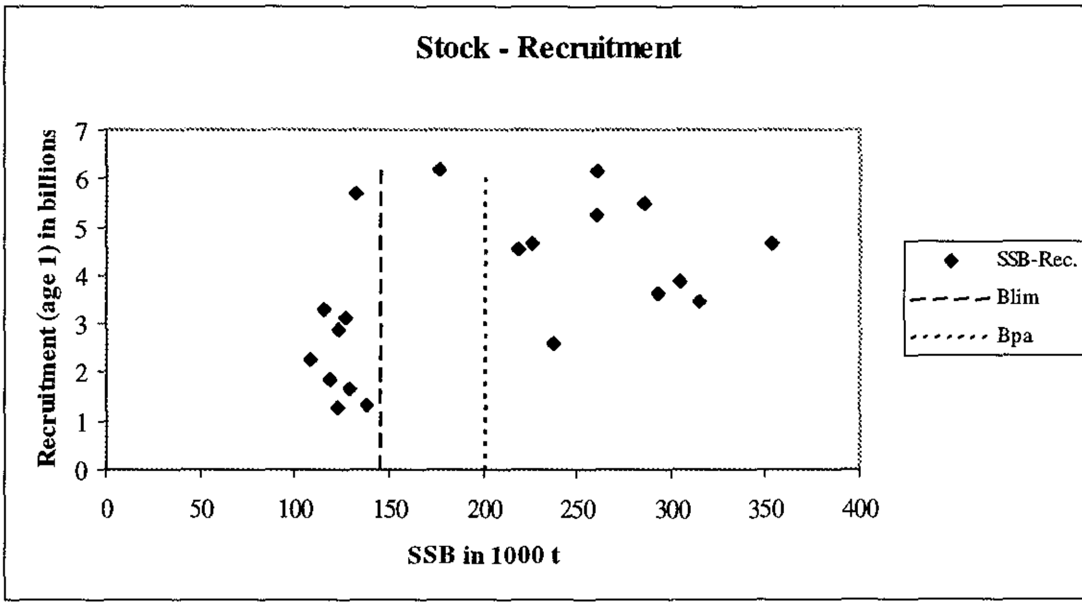
[1]Catch at F_{01}. [2]TAC for the area 29N, 30, 31, Management Unit 3. Weights in '000 t

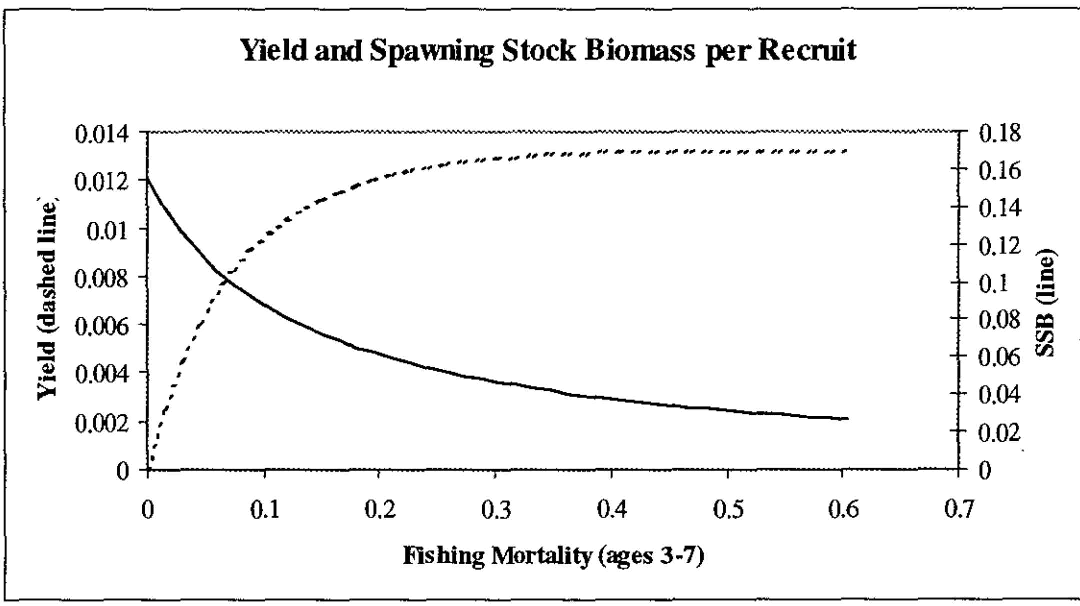

Landings
Landings in 1000 t
70
60
50
40
30
20
10
0
1980
1985
1990
1995
2000


Fishing Mortality
F(ages 3-7)
0.4
0.3
0.3
0.2
0.2
0.1
0.1
0.0
1980
1985
1990
1995
2000
F
Flim
Fpa


Recruitment (age 1)
Recruitment in billions
7
6
5
4
3
2
1
0
1980
1985
1990
1995
2000


Spawning Stock Biomass
SSB in 1000 t
400
350
300
250
200
150
100
50
0
1980
1985
1990
1995
2000
SSB
Blim
Bpa


Stock - Recruitment
Recruitment (age 1) in billions
SSB in 1000 t
0
50
100
150
200
250
300
350
400
SSB-Rec.
Blim
Bpa


Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
SSB (line)
Fishing Mortality (ages 3-7)

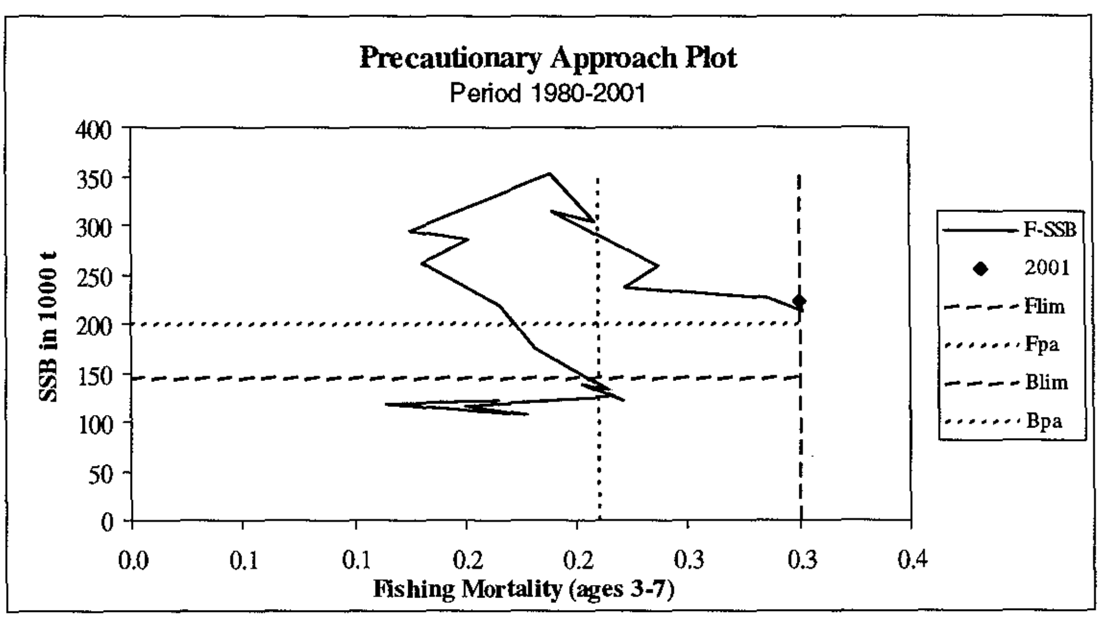

Precautionary Approach Plot
Period 1980-2001
SSB in 1000 t
Fishing Mortality (ages 3-7)
F-SSB
2001
Flim
Fpa
Blim
Bpa

Table 3.13.5.1 Herring catches in Sub-division 30 (tonnes).

Year	Finland	Sweden	Total
1971	24284	5100	29384
1972	24027	5700	29727
1973	20027	6944	26971
1974	17597	6321	23918
1975	13567	6000	19567
1976	19315	4455	23770
1977	22694	3610	26304
1978	22215	2890	25105
1979	17459	1590	19049
1980	18758	1392	20150
1981	12410	1290	13700
1982	16117	1730	17847
1983	16104	2397	18501
1984	23228	2401	25629
1985	24235	1885	26120
1986	23988	2501	26489
1987	22615	1905	24520
1988	24478	3172	27650
1989	25416	3205	28621
1990	29875	2467	32342
1991	26105	3000	29105
1992	35536	3700	39236
1993	36489	3579	40068
1994	53716	2520	56236
1995	58662	2280	60942
1996	55078	1737	56815
1997	61317	1995	63312
1998	54115	2777	56892
1999	60483	1862	62345
2000*	59948	1374	61322

* Preliminary.

Table 3.1.3.5.2 Herring in Subdivision 30 (Bothnian Sea).

Year	Recruitment Age 1 thousands	SSB tonnes	Landings tonnes	Mean F Ages 3-7
1980	1344657	123149	20150	0.1652
1981	1274718	119028	13700	0.1143
1982	1840638	108628	17847	0.1773
1983	2271223	115511	18501	0.1500
1984	3294617	127490	25629	0.2146
1985	3140164	129321	26120	0.2152
1986	1642383	122834	26489	0.2209
1987	2879467	138611	24520	0.2027
1988	1333578	132767	27650	0.2153
1989	5667686	176178	28658	0.1811
1990	6183653	218547	31282	0.1663
1991	4536967	260441	26219	0.1305
1992	5218656	285554	39310	0.1520
1993	5476167	293376	40179	0.1251
1994	3630441	352640	56380	0.1881
1995	4671458	304843	61086	0.2089
1996	3884651	314545	56109	0.1891
1997	3446769	259891	65527	0.2373
1998	6123975	237161	56892	0.2219
1999	2579859	226144	62345	0.2857
2000	4664747	212735	61322	0.3021
2001	4460000	222785		0.3000
Average	3616658	203735	37425	0.1983

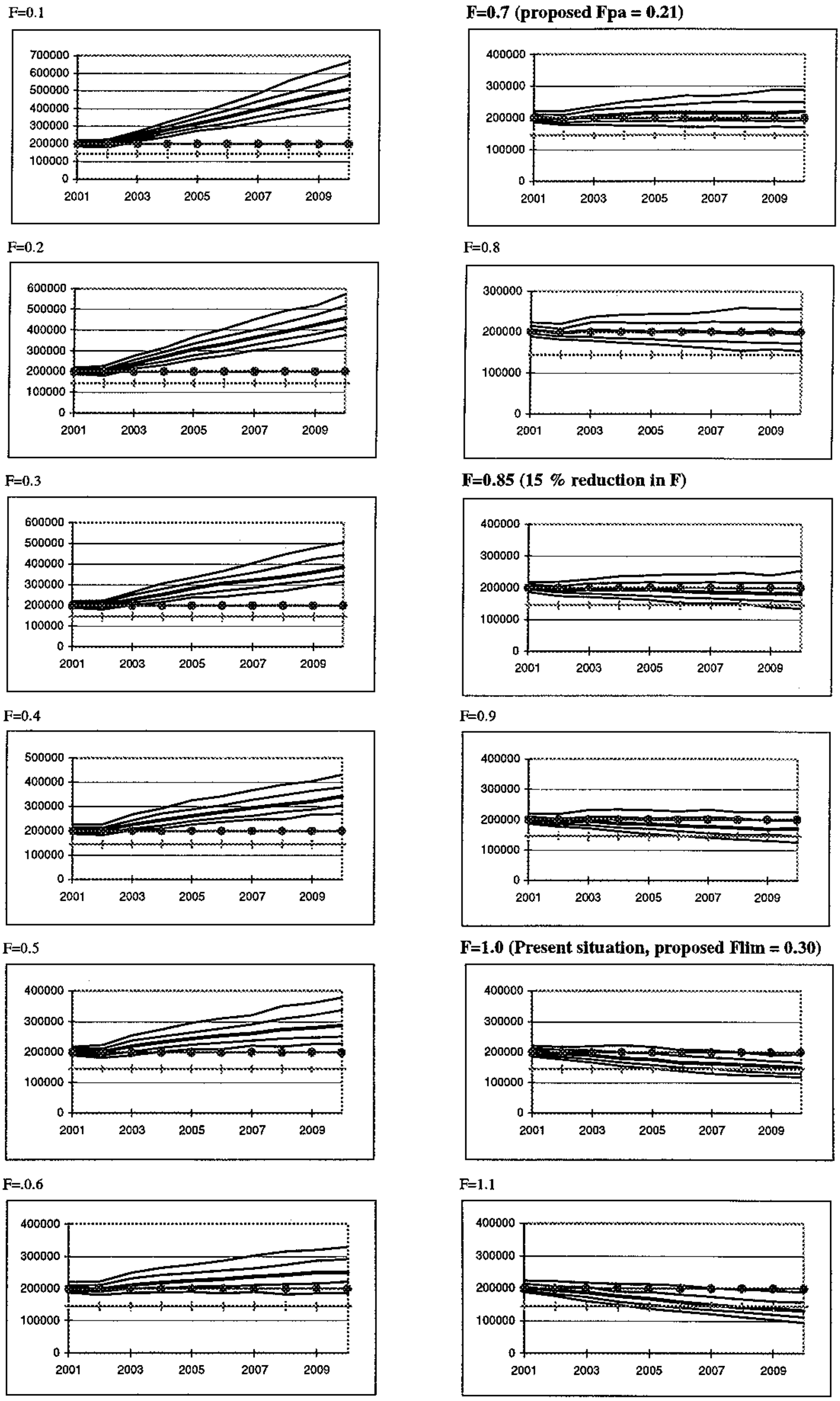


Figure 3.13.5.1 Medium-term projections of SSB. F=1.0 refers to *status quo* fishing mortality in 2000 (=0.30). Fishing pattern: 1998–2000 mean. Lines present 10, 25, 50, 75 and 90 percentile of biomass distribution. **Herring in SD 30.**

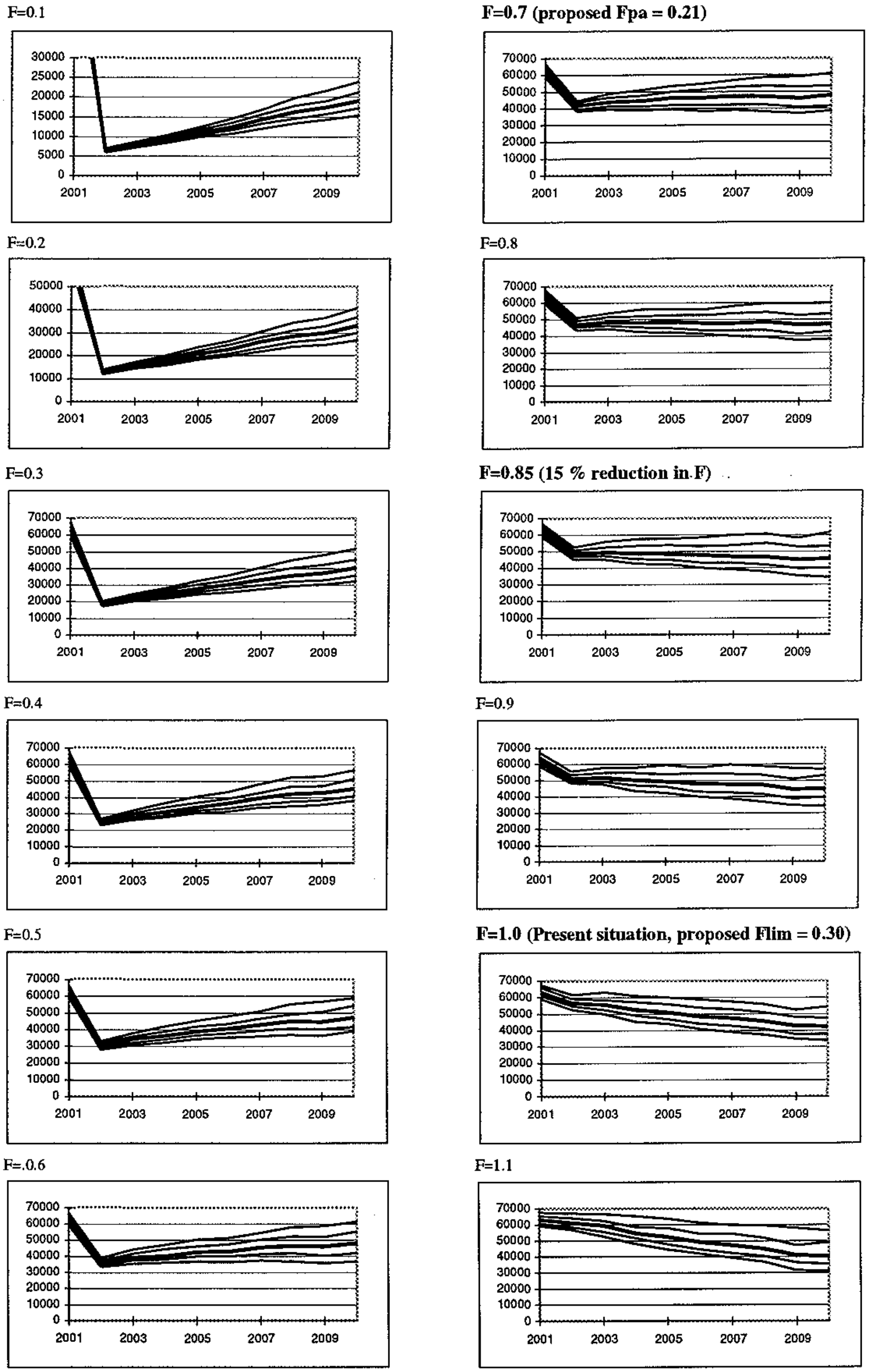


Figure 3.13.5.2. Medium-term projections of Yield (t). F=1.0 refers to *status quo* fishing mortality in 2000 (=0.30). Fishing pattern: 1998–2000 mean. Lines present 10, 25, 50, 75 and 90 percentile of yield distribution. **Herring in SD 30.**

3.13.6 Herring in Sub-division 31, Bothnian Bay

State of stock/exploitation: The status of the stock is unknown, but the current assessment, although uncertain indicates that spawning stock biomass was high in the 1980s and has declined considerably since the mid-1990s to a very low level. The fishing mortality was high in the 1990s. Landings have been decreasing and they were at a record low in 2000 (3 000 t). The 1994, 1995 and 1999 year classes were above the long-term average, and preliminary information indicates that this also applies for the year class in 2000.

Management objectives: There are no explicit management objectives for this stock.

Precautionary Approach reference points: There are no Precautionary Reference points proposed for this stock.

Advice on management: ICES advises that exploitation rates should be decreased from their recent high levels.

Relevant factors to be considered in management: This stock is part of the IBSFC management unit 3. The exploitation of the stock has increased in the 1990s. Recruitment is influenced not only by the size of the spawning stock, but to a large extent by the environmental conditions. The herring TAC is set for IBSFC management unit 3, which includes Sub-divisions 29N, 30 and 31. The management of this stock should take account of the recommendations of management actions in other parts of management unit 3.

Comparison with previous assessment and advice: This years assessment gives about 14% lower estimates of spawning stock biomass than last years assessment, together with a 40% higher fishing mortality. Previous estimates of the stock productivity have been overoptimistic.

Elaboration and special comment: The main body of the total catch is taken by trawl fishery. Total fishing effort in the trawl fishery is to a large extent market-driven, and the fluctuation in total trawl catches and the length of fishing seasons depend upon the onset of winter and ice cover in the autumn. Normally the trawl fishing season starts in late April and stops for the spawning season in late May to July. Trawl fishery starts again in August/September. The ice cover usually appears in early November.

Source of information: Report of the Baltic Fisheries Assessment Working Group, April 2001 (ICES CM 2001/ACFM:18).

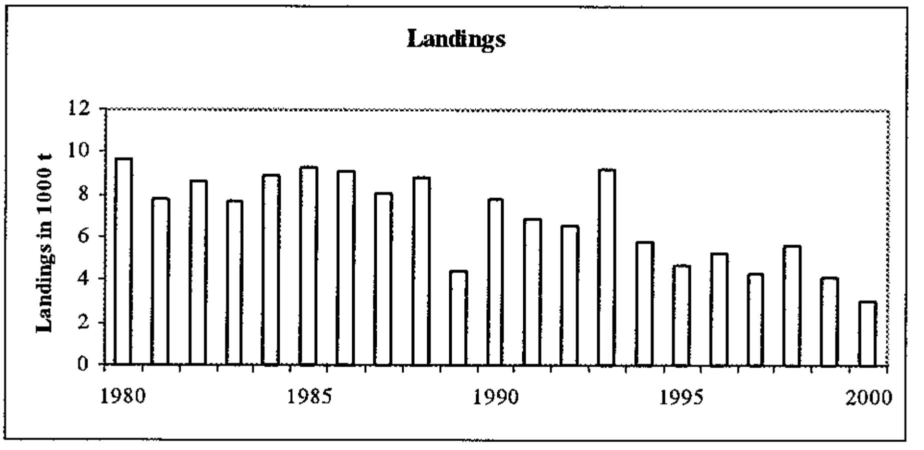
Yield and spawning biomass per Recruit
F-reference points:

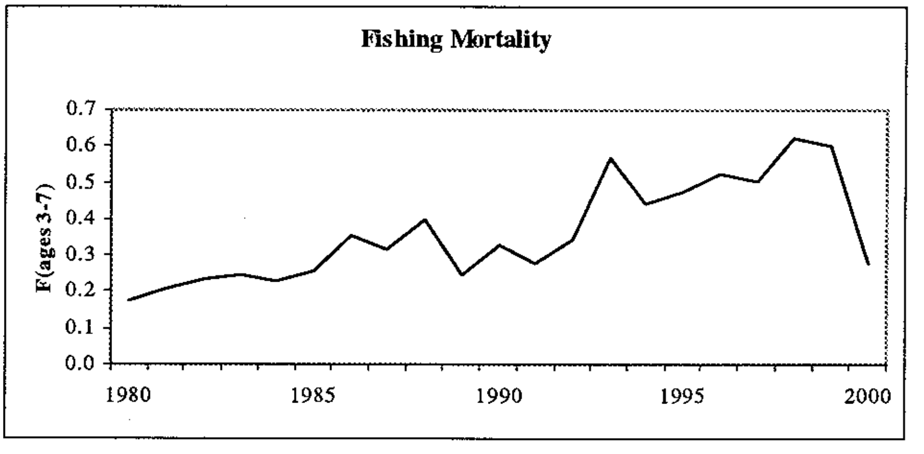
	Fish Mort Ages 3-7	Yield/R	SSB/R
Average Current	0.502	0.017	0.045
F_{max}	0.356	0.017	0.056
$F_{0.1}$	0.104	0.014	0.109
F_{med}	0.202	0.016	0.079

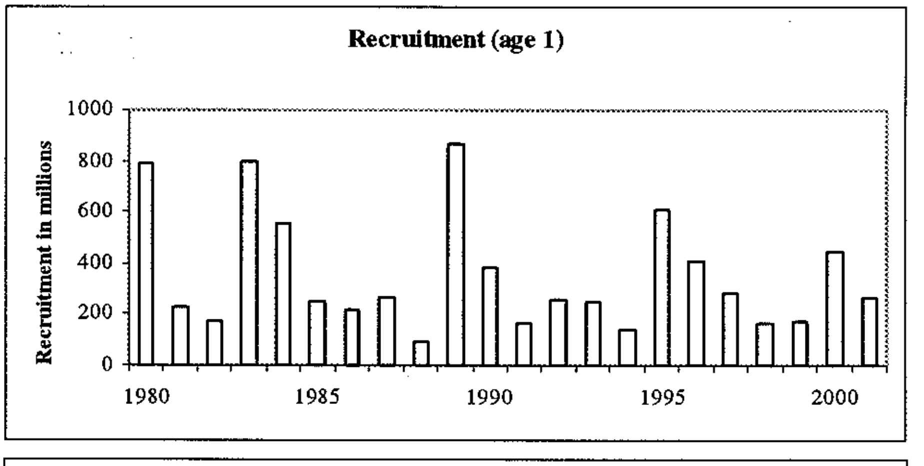
Catch data (Tables 3.13.6.1–2):

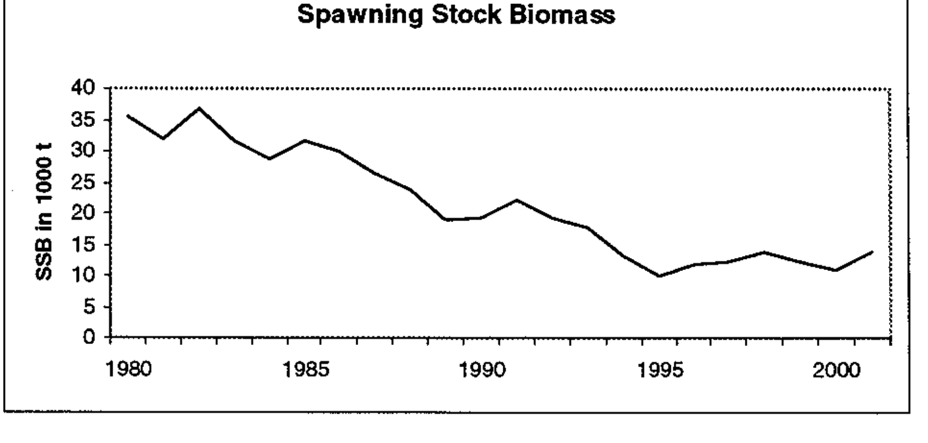
Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC[1]	ACFM Catch
1987			9	8.1
1988			13	8.8
1989			7	4.4
1990			9	7.8
1991	TAC for eastern part of SD, allowance for western part		9+	6.8
1992	*Status quo* F		8	6.5
1993	Increase in yield by increasing F		-	9.2
1994	Increase in yield by increasing F		-	5.8
1995	Increase in yield by increasing F		18.4	4.7
1996	Increase in yield by increasing F		18.4	5.2
1997	Increase in yield by increasing F		-	4.3
1998	Increase in yield by increasing F		-	5.6
1999	Increase in yield by increasing F		-	4.2
2000	Increase in yield by increasing F		-	3.0
2001	Exploitation rate should not be increased.		-	
2002	Exploitation rate should be decreased		-	

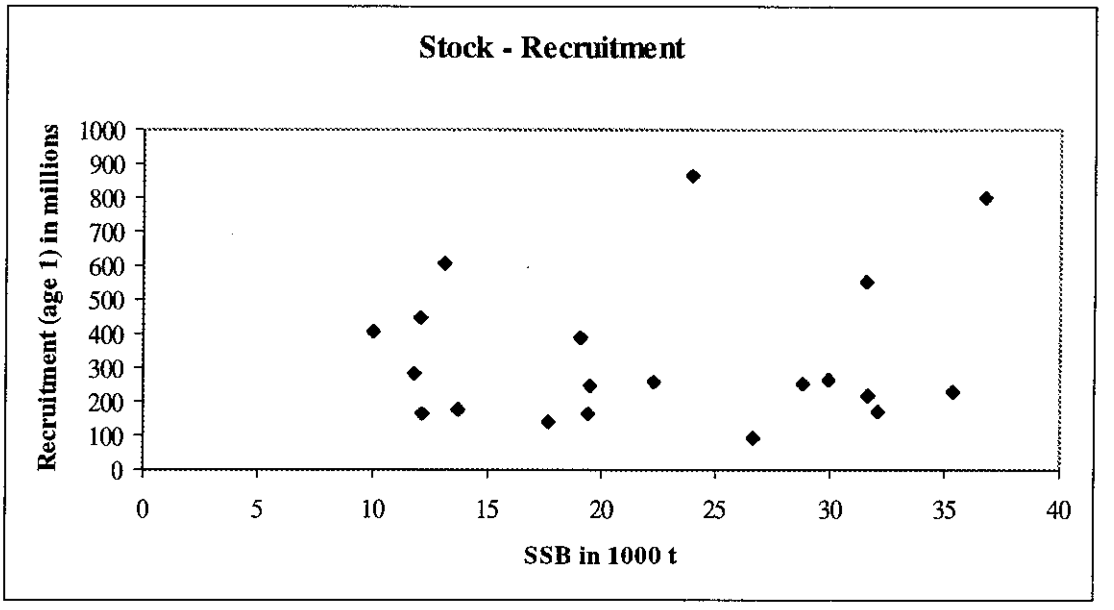
[1]TAC for the area 29N, 30, 31, Management Unit 3. Weights in '000 t.


Landings
Landings in 1000 t
12
10
8
6
4
2
0
1980
1985
1990
1995
2000


Fishing Mortality
F(ages 3-7)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1980
1985
1990
1995
2000


Recruitment (age 1)
Recruitment in millions
1000
800
600
400
200
0
1980
1985
1990
1995
2000


Spawning Stock Biomass
SSB in 1000 t
40
35
30
25
20
15
10
5
0
1980
1985
1990
1995
2000


Stock - Recruitment
Recruitment (age 1) in millions
0
100
200
300
400
500
600
700
800
900
1000
0
5
10
15
20
25
30
35
40
SSB in 1000 t

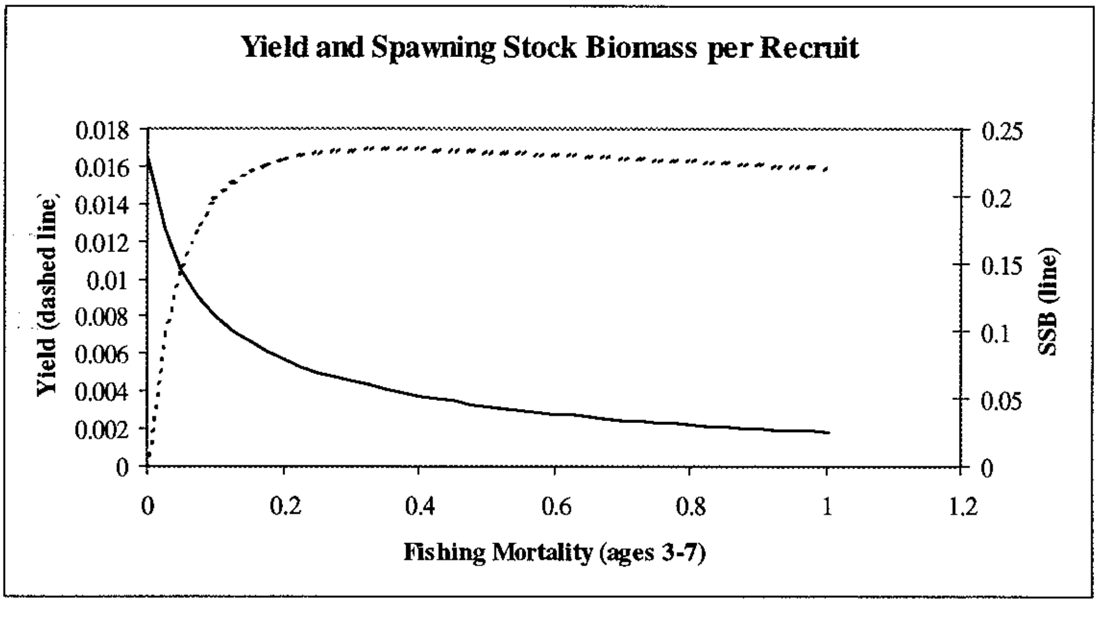

Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
0
0.002
0.004
0.006
0.008
0.01
0.012
0.014
0.016
0.018
SSB (line)
0
0.05
0.1
0.15
0.2
0.25
0
0.2
0.4
0.6
0.8
1
1.2
Fishing Mortality (ages 3-7)

Table 3.13.6.1 Herring catches in Sub-division 31 (tonnes).

Year	Finland	Sweden	Total
1971	6143	820	6963
1972	3550	770	4320
1973	3152	727	3976
1974	5737	665	6482
1975	4802	800	5547
1976	7763	750	8508
1977	6580	750	7330
1978	9068	700	9768
1979	6275	785	7060
1980	8899	760	9659
1981	7206	620	7826
1982	7982	670	8652
1983	7011	696	7707
1984	8322	594	8916
1985	8595	717	9312
1986	8754	336	9090
1987	7788	320	8108
1988	8501	267	8768
1989	4005	423	4437
1990	7603	295	7818
1991	6800	400	6800
1992	6900	400	6540
1993	8752	383	9167
1994	5195	411	5825
1995	3898	563	4681
1996	5080	114	5249
1997	4195	86	4281
1998	5358	224	5582
1999	3905	248	4153
2000*	2870	113	2983

* Preliminary.

Table 3.13.6.2 Herring in Sub-division 31, Bothnian Bay.

Year	Recruitment Age 1 thousands	SSB tonnes	Landings tonnes	Mean F Ages 3-7
1980	789288	35327	9659	0.1740
1981	229603	32093	7826	0.2078
1982	169801	36715	8652	0.2331
1983	797517	31521	7707	0.2470
1984	553853	28772	8916	0.2311
1985	250956	31654	9312	0.2561
1986	216954	29927	9090	0.3562
1987	266629	26608	8108	0.3152
1988	91657	23894	8768	0.4004
1989	865771	19105	4437	0.2479
1990	386138	19420	7818	0.3267
1991	166171	22258	6800	0.2799
1992	255892	19495	6540	0.3426
1993	246792	17676	9167	0.5672
1994	142233	13153	5825	0.4436
1995	607411	10059	4681	0.4766
1996	403651	11845	5249	0.5248
1997	282973	12140	4281	0.5038
1998	165763	13741	5582	0.6235
1999	174941	12108	4153	0.6039
2000	447468	11013	2983	0.2783
2001	262724	14025		0.2800
Average	353372	21480	6931	0.3600

3.13.7 Sprat in Sub-divisions 22–32

State of stock/exploitation: The stock is considered to be within safe biological limits. SSB has increased in recent years and attained its historical maximum of 1.6–1.7 million tonnes in 1996–1997. Since then the SSB has decreased to 1 million t in 2001, which remains well above the long-term average. In the most recent years the estimates of fishing mortality have almost doubled the values of the early 1990s and have come close to F_{pa}. The 1998 year class is estimated to be very weak, whereas the 1999 year class is estimated to be strong. The 2000 year class is predicted to be below average.

Management objectives: In Resolution XIII, September 2000, the IBSFC agreed to implement a long-term management plan for sprat in the Baltic:

"The IBSFC agreed to implement a long-term management plan for the sprat stock which is consistent with a precautionary approach and designed to ensure a rational exploitation pattern and provide for stable and high yields. This plan shall consist of the following elements:

1. *Every effort shall be made to maintain a level of spawning stock biomass (SSB) greater than 200 000 t.*
2. *A long-term management plan, by which annual quotas shall be set for the fishery, reflecting a fishing mortality rate of 0.4 for relevant age groups as defined by ICES shall be implemented.*
3. *Should the SSB fall below a reference point of 275 000 t, the fishing mortality rate referred to under paragraph 2 will be adapted in the light of scientific estimates of the conditions then prevailing, to ensure safe and rapid recovery of the spawning stock biomass to levels in excess of 275 000 t.*
4. *The IBSFC shall, as appropriate, adjust management measures and elements of the plan on the basis of any new advice provided by ICES.*

A review of this arrangement shall take place not later than in the year 2003."

ICES considers that the agreed management plan is consistent with the precautionary approach, provided the reference points are used as upper bounds on F and lower bounds on SSB, and not as targets.

Precautionary Approach reference points (unchanged since 2000):

ICES considers that:	ICES proposes that:
$\mathbf{B_{lim}}$ is 200 000 t	$\mathbf{B_{pa}}$ be set at 275 000 t
$\mathbf{F_{lim}}$ is not yet defined	$\mathbf{F_{pa}}$ be set at 0.40

Technical basis:

$\mathbf{B_{lim}}$: MBAL	$\mathbf{B_{pa}}$: $\mathbf{B_{lim}}$*1.38; some sources of uncertainty in assessment taken into account
$\mathbf{F_{lim}}$: –	$\mathbf{F_{pa}}$:~ average $\mathbf{F_{med}}$ in recent years, allowing for variable natural mortality

Advice on management: ICES recommends that the fishing mortality should remain below F_{pa}, corresponding to catches less than 369 000 t.

Relevant factors to be considered in management: Sprat and herring are taken mostly in mixed pelagic fisheries. Management of sprat fisheries should take account of the recommendation to greatly reduce fishing mortality and catches of herring in Sub-divisions 25–29 and 32.

The strong 1997 and 1999 year classes will constitute over 50% of catches in 2002. The future of the fishery will depend greatly on the strength of future recruiting year classes. The fishing mortality this stock can sustain is dependent on natural mortality, which is linked to the abundance of cod. Strong recruitment and low predation in recent years contributed to the high SSB in the mid-1990s. However, the SSB is predicted to decrease markedly in the medium-term under the present fishing intensity. If the cod stock is to recover a much lower exploitation rate on sprat is necessary.

Comparison with previous assessment and advice: This years assessment gives about 10% higher estimates of spawning stock biomass for recent years than last years assessment did, mostly as a result of applying updated estimates of predation mortality on sprat. The trend in stock development is similar in both assessments.

Catch forecast for 2002:

Basis: TAC; Landings(2001) = 355; F(2001) =F(2000)= 0.35.

F (2002)	Basis	Landings (2002)	SSB (2002)	SSB (2003)	Medium-term effect of fishing at given level
0.21	0.6*F(2001)	205	987	1020	High probability for SSB remaining above $\mathbf{B}_{pa}$
0.28	0.8*F(2001)	267	963	950	High probability for SSB remaining above $\mathbf{B}_{pa}$
0.35	1.0*F(2001)	325	940	885	High probability for SSB remaining above $\mathbf{B}_{pa}$
0.40	IBSFC agreement	369	922	838	High probability for SSB remaining above $\mathbf{B}_{pa}$
0.41	1.2*F(2001)	380	918	826	High probability for SSB remaining above $\mathbf{B}_{pa}$

Weights in '000 t.

Shaded scenarios are considered to be inconsistent with the precautionary approach.

Medium- and long-term projections: The medians of spawning stock biomass under *status quo* fishing mortality tend to result in an equilibrium of about 770 000 t SSB (Figure 3.13.7.1–2). Fisheries in 2004 and onwards will depend very heavily on the strengths of future recruitment.

Elaboration and special comment: The assessment is based on catch data and acoustic surveys. Better sampling of industrial fisheries has improved the quality of the data input to the assessment.

Natural mortality is expected to vary over time as abundance of predators varies. Hence annual estimates of $\mathbf{F}_{med}$ are expected to continue to be comparably variable, and multispecies interactions should be considered in setting precautionary reference points.

Landings increased from 1983, reaching a record high in 1997, and decreased thereafter. The increase in landings since 1992 is due to the development of an industrial pelagic fishery. The catches in this fishery consist mainly of sprat (about 65%) and herring. With the current advice to reduce F on herring by more than 50%, the proportion of herring in the industrial pelagic catches will either have to decrease, or the herring catch alone will limit this fishery.

Sprat is fished with pelagic trawls during the first half and in the last few months of the year. Most catches used for human consumption are taken in mixed fisheries for herring and sprat.

Source of information: Report of the Working Group on Baltic Fisheries Assessment, April 2001 (ICES CM 2001/ACFM:18).

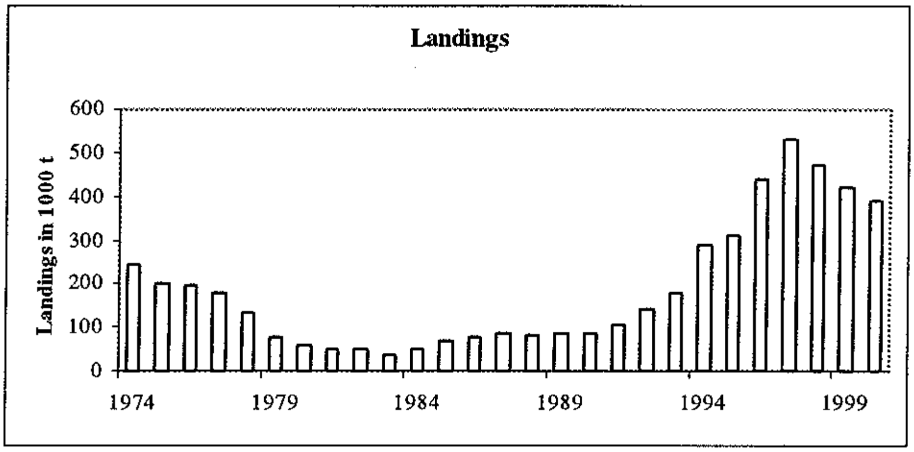
Yield and spawning biomass per Recruit
F-reference points:

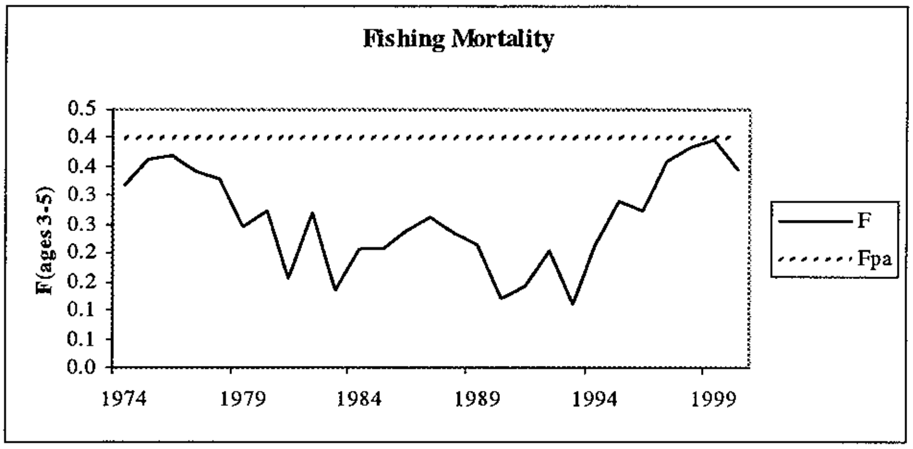
	Fish Mort Ages 3-5	Yield/R	SSB/R
Average Current	0.345	0.003	0.010
$\mathbf{F}_{max}$	2.468	0.005	0.001
$\mathbf{F}_{0.1}$	0.488	0.004	0.008
$\mathbf{F}_{med}$	0.373	0.004	0.009

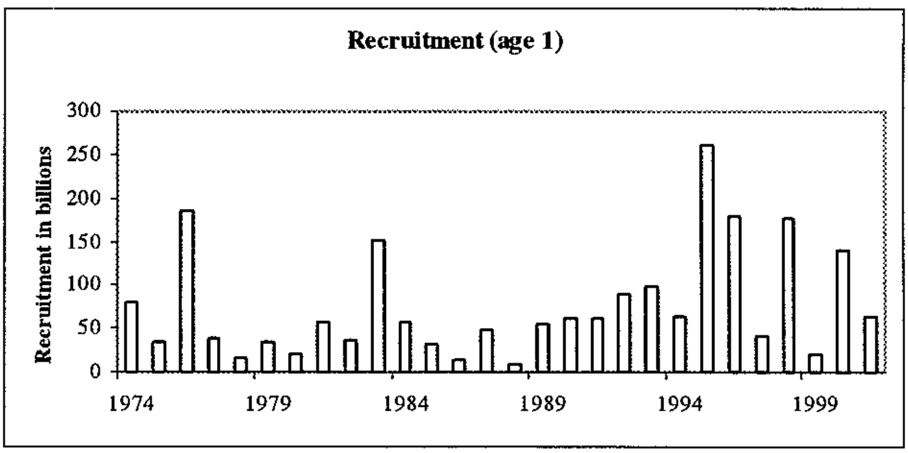
Catch data (Tables 3.13.7.1–3):

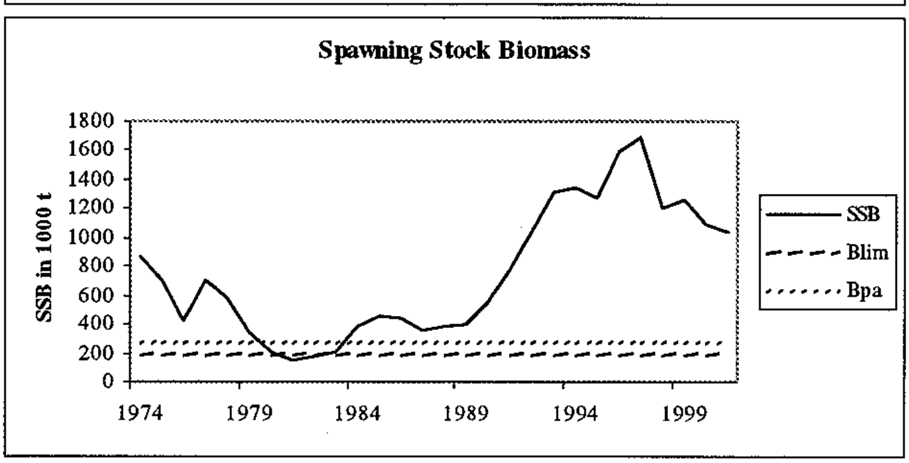
Year	ICES Advice	Predicted catch Corresp. to advice	Agreed TAC	ACFM catch
1987			117.2	88
1988	Catch could be increased in SD 22–25	-	117.2	80
1989		72	142	86
1990		72	150	86
1991	TAC	150	163	103
1992	*Status quo* F	143	290	142
1993	Increase in yield by increasing F	-	415	178
1994	Increase in yield by increasing F	-	700	289
1995	TAC	205	500	313
1996	Little gain in long-term yield at higher F	279	550	441
1997	No advice	-	550	529
1998	*Status quo* F	343	550	471
1999	Proposed $\mathbf{F}_{pa}$	304	467.5	421
2000	Proposed $\mathbf{F}_{pa}$	192	400	389
2001	Proposed $\mathbf{F}_{pa}$	314	355	
2002	Proposed $\mathbf{F}_{pa}$	369		

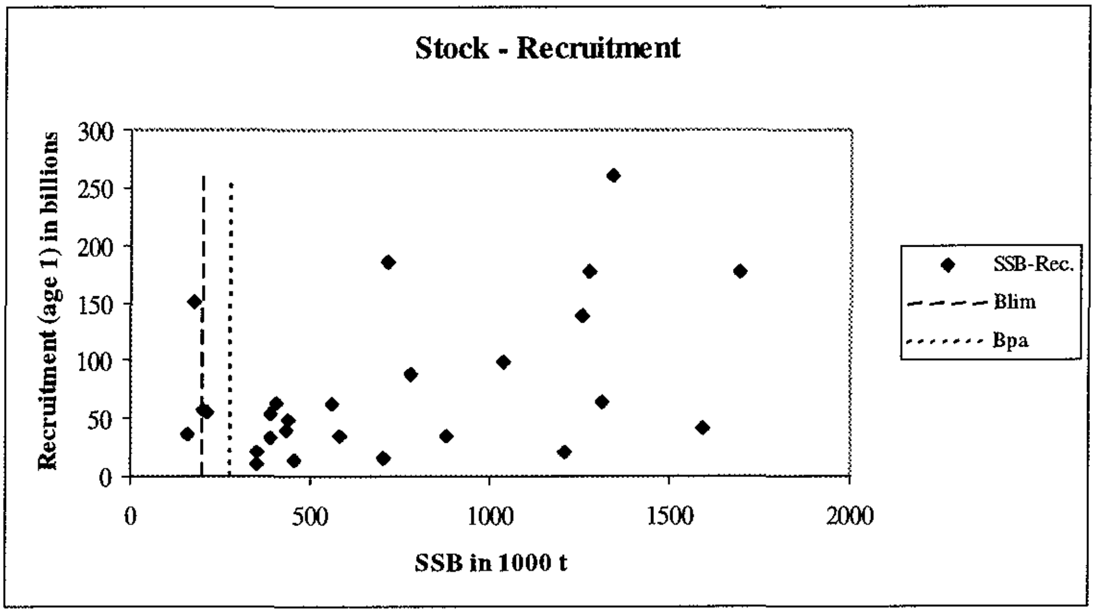
Weights in '000 t.

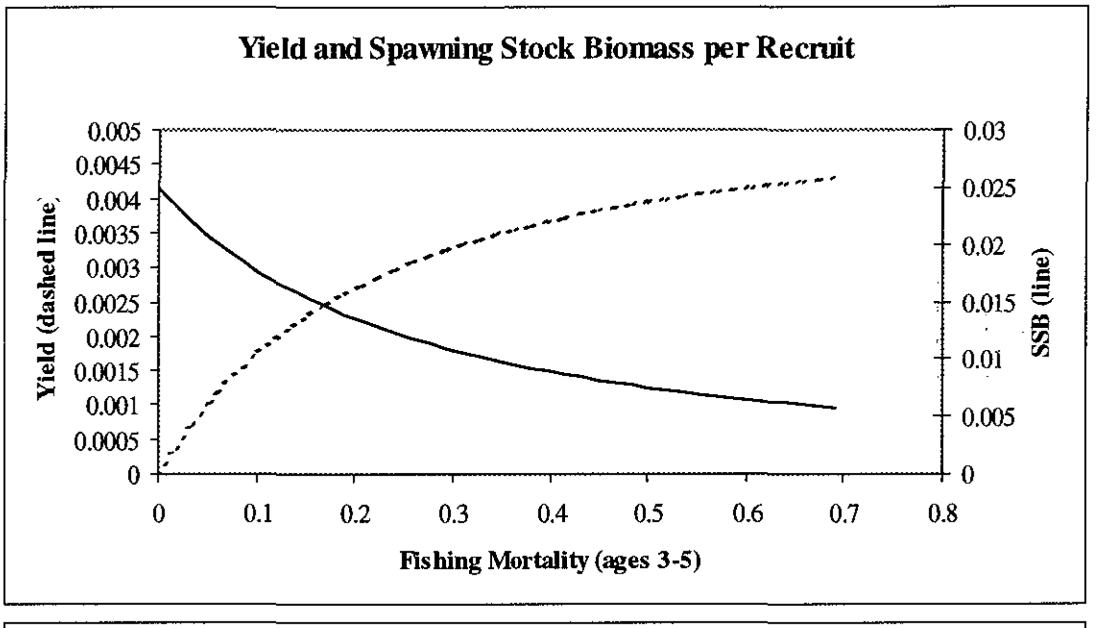

Landings
Landings in 1000 t
600
500
400
300
200
100
0
1974
1979
1984
1989
1994
1999


Fishing Mortality
F(ages 3-5)
0.5
0.4
0.4
0.3
0.3
0.2
0.2
0.1
0.1
0.0
1974
1979
1984
1989
1994
1999
F
Fpa


Recruitment (age 1)
Recruitment in billions
300
250
200
150
100
50
0
1974
1979
1984
1989
1994
1999


Spawning Stock Biomass
SSB in 1000 t
1800
1600
1400
1200
1000
800
600
400
200
0
1974
1979
1984
1989
1994
1999
SSB
Blim
Bpa


Stock - Recruitment
Recruitment (age 1) in billions
300
250
200
150
100
50
0
0
500
1000
1500
2000
SSB in 1000 t
SSB-Rec.
Blim
Bpa


Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
0.005
0.0045
0.004
0.0035
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
0.03
0.025
0.02
0.015
0.01
0.005
0
SSB (line)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
Fishing Mortality (ages 3-5)

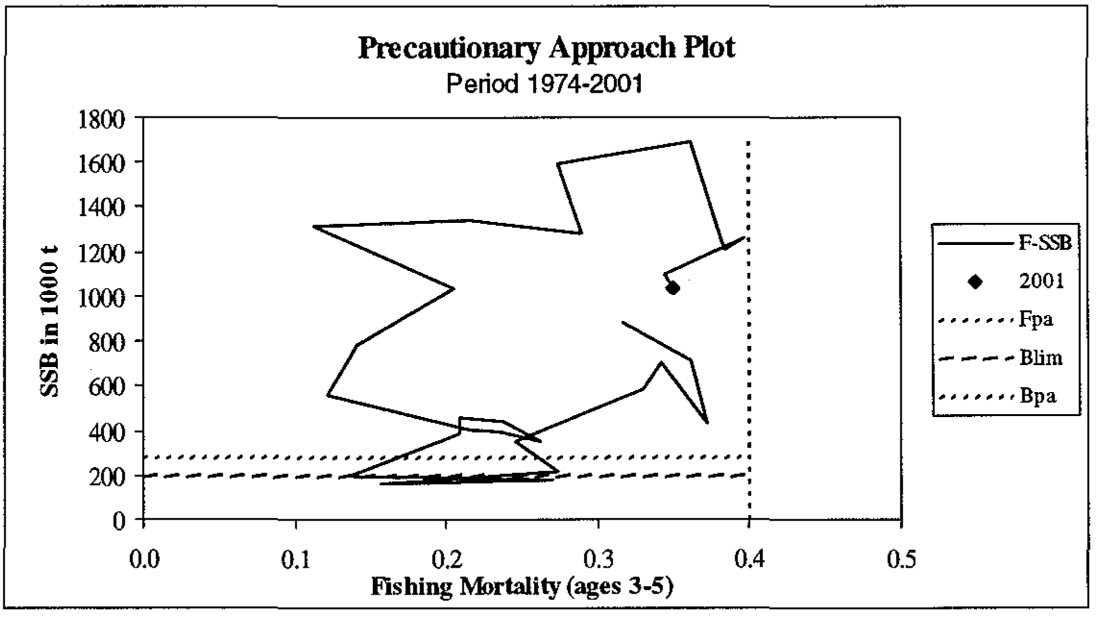

Precautionary Approach Plot
Period 1974-2001
SSB in 1000 t
1800
1600
1400
1200
1000
800
600
400
200
0
0.0
0.1
0.2
0.3
0.4
0.5
Fishing Mortality (ages 3-5)
F-SSB
2001
Fpa
Blim
Bpa

Table 3.13.7.1 Sprat catches in Sub-divisions 22–32 (thousand tonnes).

Year	Denmark	Finland	German Dem. Rep.	German Fed. Rep.	Poland	Sweden	USSR	Total
1977	7.2	6.7	17.2	0.8	38.8	0.4	109.7	180.8
1978	10.8	6.1	13.7	0.8	24.7	0.8	75.5	132.4
1979	5.5	7.1	4.0	0.7	12.4	2.2	45.1	77.1
1980	4.7	6.2	0.1	0.5	12.7	2.8	31.4	58.1
1981	8.4	6.0	0.1	0.6	8.9	1.6	23.9	49.3
1982	6.7	4.5	1.0	0.6	14.2	2.8	18.9	48.7
1983	6.2	3.4	2.7	0.6	7.1	3.6	13.7	37.3
1984	3.2	2.4	2.8	0.7	9.3	8.4	25.9	52.5
1985	4.1	3.0	2.0	0.9	18.5	7.1	34.0	69.5
1986	6.0	3.2	2.5	0.5	23.7	3.5	36.5	75.8
1987	2.6	2.8	1.3	1.1	32.0	3.5	44.9	88.2
1988	2.0	3.0	1.2	0.3	22.2	7.3	44.2	80.3
1989	5.2	2.8	1.2	0.6	18.6	3.5	54.0	85.8
1990	0.8	2.7	0.5	0.8	13.3	7.5	60.0	85.6
1991	10.0	1.6		0.7	22.5	8.7	59.7*	103.2

Year	Denmark	Estonia	Finland	Germany	Latvia	Lithuania	Poland	Russia	Sweden	Total
1992	24.3	4.1	1.8	0.6	17.4	3.3	28.3	8.1	54.2	142.2
1993	18.4	5.8	1.7	0.6	12.6	3.3	31.8	11.2	92.7	178.1
1994	60.6	9.6	1.9	0.3	20.1	2.3	41.2	17.6	135.2	288.8
1995	64.1	13.1	5.2	0.2	24.4	2.9	44.2	14.8	143.7	312.6
1996	109.1	21.1	17.4	0.2	34.2	10.2	72.4	18.2	158.2	441.1
1997	137.4	38.9	24.4	0.4	49.3	4.8	99.9	22.4	151.9	529.4
1998	91.8	32.3	25.7	4.6	44.9	4.5	55.1	20.9	191.1	470.8
1999	90.2	33.2	18,9	0.2	42.8	2.3	66.3	31.5	137.3	422.6
2000	51,5	39,4	20,2	0,0	46,2	1,7	79,2	30,4	120,6	389,1

* Sum of catches by Estonia, Latvia, Lithuania and Russia.

Table 3.13.7.2 Sprat catches in the Baltic Sea by country and Sub-division ('000 t).

Year 1997

Country	Total catch	22	24	25	26	27	28	29	30	31	32
Denmark	137.42	8.06	0.78	128.59	-	-	-	-	-	-	-
Estonia	38.95	-	-	-	-	-	3.32	17.73	-	-	17.90
Finland	24.38	-	0.50	3.80	2.00	0.10	0.80	10.33	2.35	0.00	4.50
Germany	0.43	0.40	0.03	-	-	-	-	-	-	-	-
Latvia	49.31	-	-	-	3.63	-	45.68	-	-	-	-
Lithuania	4.79	-	-	-	4.79	-	-	-	-	-	-
Poland	99.86	-	1.11	33.25	65.50	-	-	-	-	-	-
Russia	22.37	-	-	-	22.37	-	-	-	-	-	-
Sweden	151.86	-	2.59	38.03	26.86	45.15	30.50	8.73	-	-	-
Total	529.37	8.46	5.01	203.66	125.16	45.25	80.30	36.79	2.35	0.00	22.40

Year 1998

Country	Total catch	22	24	25	26	27	28	29	30	31	32
Denmark	91.8	2.45	0.92	88.48	-	-	-	-	-	-	-
Estonia	32.3	-	-	-	-	-	4.36	12.52	-	-	15.40
Finland	27.0	-	0.69	3.50	0.15	0.88	1.54	10.51	2.43	0.04	7.24
Germany	4.6	0.03	0.51	3.84	0.18	-	-	-	-	-	-
Latvia	44.9	-	-	-	12.32	-	32.54	-	-	-	-
Lithuania	4.5	-	-	4.46	-	-	-	-	-	-	-
Poland	55.1	-	0.29	25.96	28.83	-	-	-	-	-	-
Russia	20.9	-	-	-	20.95	-	-	-	-	-	-
Sweden	191.1	-	3.82	51.75	24.46	88.90	14.78	7.38	-	-	-
Total	472.1	2.5	6.2	178.0	86.9	89.8	53.2	30.4	2.4	0.0	22.6

Year 1999

Country	Total catch	22	24	25	26	27	28	29	30	31	32
Denmark	90.2	8,70	0,70	80.80	-	-	-	-	-	-	-
Estonia	33.2	-	-	-	-	-	2.92	12.40	-	-	17.85
Finland	18.9	-	0.49	0.40	0.07	0.20	0.06	3.01	3.75	0.00	10.90
Germany	0.2	0.03	0.15	-	-	-	-	-	-	-	-
Lithuania	2.3	-	-	-	2.30	-	-	-	-	-	-
Latvia	42.8	-	-	4.00	7.03	-	31.81	-	-	-	-
Poland	66.3	-	0.42	32.29	33.57	-	-	-	-	-	-
Russia	31.5	-	-	-	31.49	-	-	-	-	-	-
Sweden	137.3	-	2.02	31.68	4.61	57.00	16.15	25.80	-	-	-
Total	422.6	8.7	3.8	149.2	79.1	57.2	50.9	41.2	3.7	0.0	28.8

Year 2000

Country	Total catch	22	24	25	26	27	28	29	30	31	32
Denmark	51,5	9,43	0,84	41,19	-	-	-	-	-	-	-
Estonia	39,4	-	-	-	-	-	6,08	13,88	-	-	19,45
Finland	20,2	-	-	-	-	-	-	3,55	4,78	0,00	11,91
Germany	0,0	0,02	-	-	-	-	-	-	-	-	-
Lithuania	1,7	-	-	-	1,68	-	-	-	-	-	-
Latvia	46,2	-	-	2,57	7,32	-	36,30	-	-	-	-
Poland	79,2	-	0,76	40,53	37,89	-	-	-	-	-	-
Russia	30,4	-	-	-	28,34	-	2,03	-	-	-	-
Sweden	120,6	-	2,13	31,74	13,18	31,50	23,93	18,10	-	-	-
Total	389,1	9,5	3,7	116,0	88,4	31,5	68,3	35,5	4,8	0,0	31,4

Table 3.13.7.3 Sprat in Sub-divisions 22 to 32.

Year	Recruitment Age 1 thousands	SSB tonnes	Landings tonnes	Mean F Ages 3-5
1974	80974872	877930	241700	0.317
1975	35012980	713025	201434	0.362
1976	184852928	435472	194775	0.372
1977	39349568	702837	180800	0.342
1978	14967399	583469	132360	0.330
1979	35171704	349387	77100	0.245
1980	21110056	214279	58100	0.275
1981	56321352	158303	49300	0.157
1982	36184100	176834	48700	0.270
1983	150315856	202274	37320	0.136
1984	57875716	391180	52560	0.209
1985	32738194	457949	69497	0.209
1986	13643529	437935	75800	0.238
1987	47915640	353839	88276	0.262
1988	10054936	392510	80300	0.235
1989	54460608	405011	85817	0.216
1990	62644532	557707	85578	0.121
1991	62922060	780903	103200	0.140
1992	88893312	1035753	142195	0.206
1993	98387032	1315381	178100	0.112
1994	63386148	1339215	288700	0.215
1995	260938368	1277155	313000	0.290
1996	177545376	1591604	441100	0.275
1997	42138476	1690384	529400	0.361
1998	176148960	1209511	470770	0.384
1999	20057268	1256974	421397	0.397
2000	139367216	1095917	389140	0.345
2001	65152000	1036000		0.350
Average	76018935	751384	186534	0.263

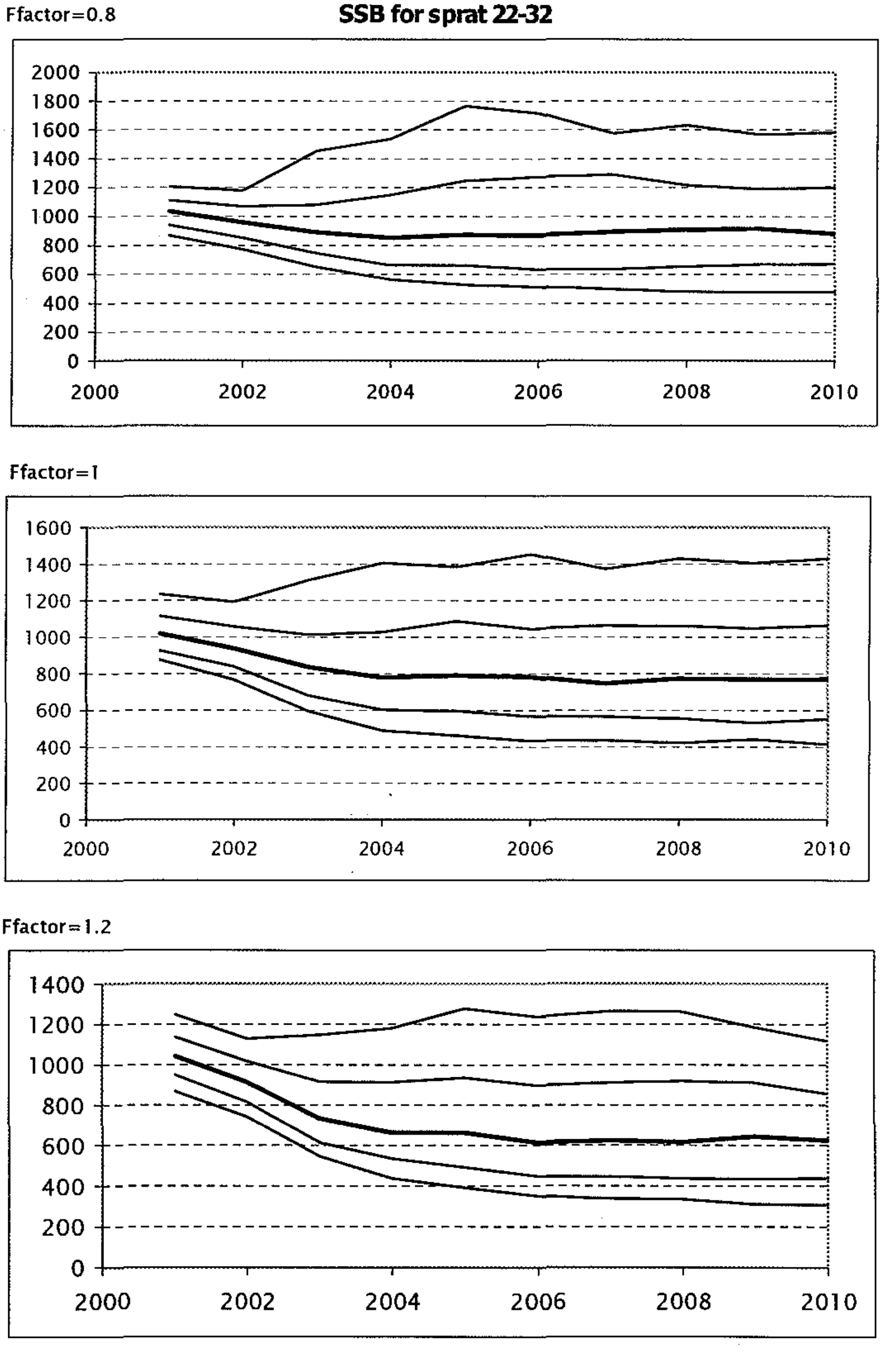


Figure 3.13.7.1 Medium-term projections of biomass for sprat 22–32 (10, 25, 50, 75, and 90 percentiles of SSB distribution are presented), B_{pa}=275 000 tonnes

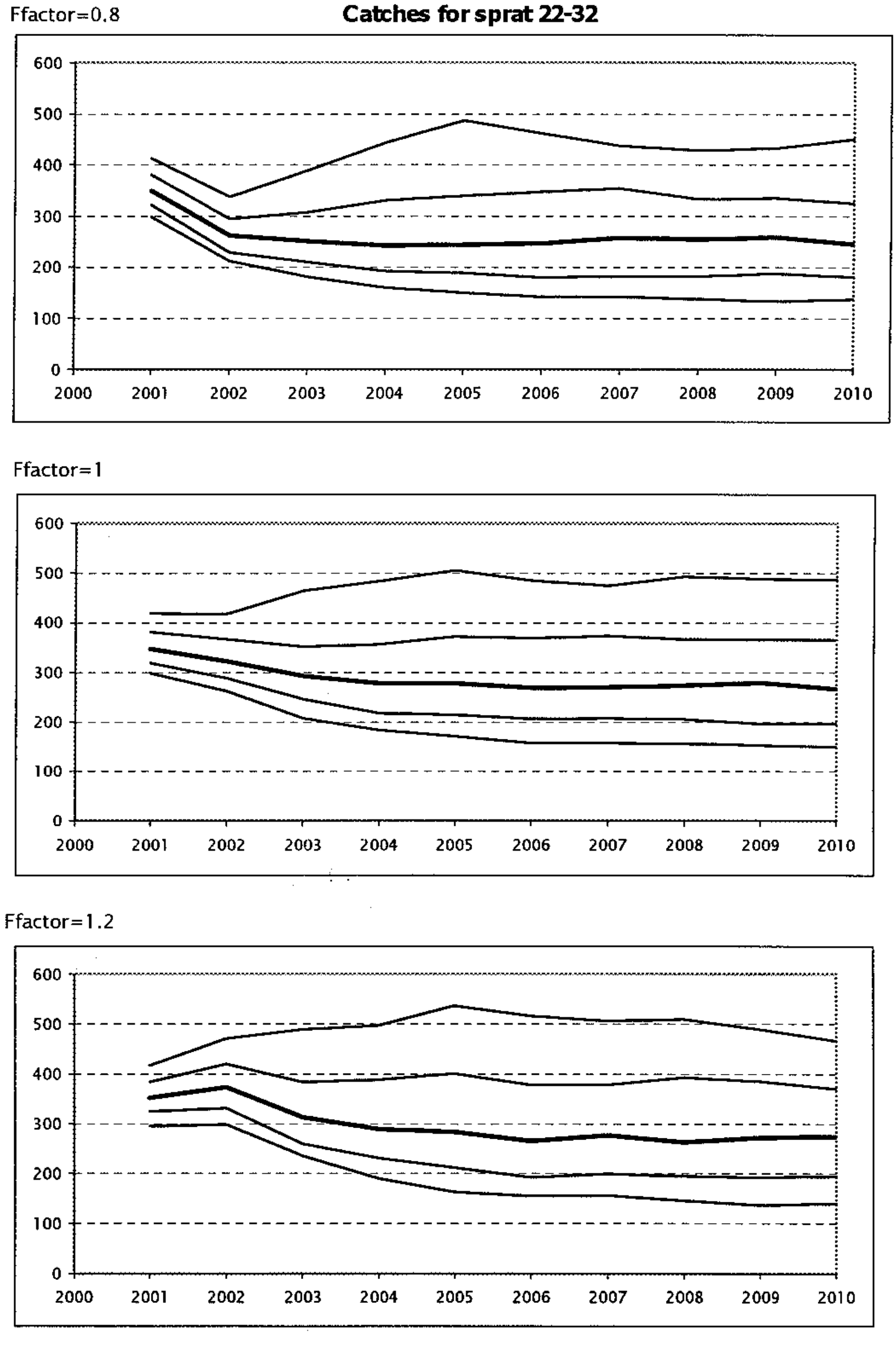


Figure 3.13.7.2 Medium-term projections of catches for sprat 22–32 (10, 25, 50, 75, and 90 percentiles of catch distribution are presented)

3.13.8 Cod in Sub-divisions 22–24 (including Sub-division 23)

State of the stock/exploitation: The present fishing mortality is 1.11, above the F of 1.0 agreed by IBSFC. SSB is estimated to be 29 900 t in 2001, above the $\mathbf{B}_{pa}$ (23 000 t). Recruitment has been below average since 1998.

Management objectives: IBSFC have adopted a long-term management strategy for cod in the Baltic (section 3.13.1). ICES considers that the agreed management plan is consistent with the precautionary approach, provided the reference points are used as upper bounds on F and lower bounds on SSB, and not as targets.

Reference points: There is doubt about whether these cod form a closed population, as there may be substantial exchange with adjacent cod stocks. Such exchange could inflate R/SSB reference points, which are very high for this stock, e.g. $\mathbf{F}_{med}$ = 1.08, and the high fishing mortality estimates may not accurately represent the exploitation rate for the unit stock. Further consideration of the magnitude and consequences of exchange is needed before establishing an appropriate $\mathbf{F}_{lim}$.

Precautionary Approach reference points (Unchanged since 1999):

ICES considers that:	ICES proposes that:
$\mathbf{B}_{lim}$ is not yet defined	$\mathbf{B}_{pa}$ be set at 23 000 t
$\mathbf{F}_{lim}$ is not yet defined	$\mathbf{F}_{pa}$ is not yet defined

Technical basis:

-	Previous MBAL
-	-

Advice on management: ICES recommends that the fishing mortality in 2002 should be reduced by at least 10% to below the F of 1.0 agreed by IBSFC, corresponding to a catch below 36 300 t.

Relevant factors to be considered in management: The catch forecast is sensitive to the estimated size of the 1998 and 1999 year classes which account for about 70% of the yield in 2002. Following year classes also appear to be below average, and catches are expected to decline further if fishing is kept at $\mathbf{F}_{pa}$.

The fishery is largely based on recruiting year classes, and discarding is substantial. An increase in the minimum trawl mesh size, as agreed by IBSFC to be implemented by January 2002, may significantly reduce the amount of discards.

The stock has been rebuilt from the low SSBs of the early 1990s as a result of strong recruitment, especially from the 1994, 1996 and 1997 year classes. The patterns of recruitment to this stock over time and relative to spawning biomass suggest that there may be recruitment dispersal and/or migration between this stock and adjacent cod stocks in the Baltic and/or Kattegat.

Comparison with previous assessment and advice: The current assessment has revised the estimate of the SSB in 1999 downwards; mainly due to changes in the mean weight at age in the stock. This has not changed the state of the stock with respect to safe biological limits, and the advice is consistent with last years.

Catch forecast for 2002:

Basis: F(2001) = $\mathbf{F}_{sq}$ = 1.11; Landings(2001) = 40 500; SSB(2002) = 27,400.

F (2002)	Basis	Landings (2002)	SSB (2003)
0	0	0	61,700
0.22	0.2*$\mathbf{F}_{sq}$	10,600	52,000
0.44	0.4*$\mathbf{F}_{sq}$	19,500	43,000
0.66	0.6*$\mathbf{F}_{sq}$	27,100	37,300
0.89	0.8*$\mathbf{F}_{sq}$	33,500	31,800
1.00	0.9*$\mathbf{F}_{sq}$ (IBSFC agreed)	36,300	29,400
1.1	$\mathbf{F}_{sq}$	39,000	27,200
1.33	1.2*$\mathbf{F}_{sq}$	43,700	23,300

Weights in t.

Shaded scenarios considered inconsistent with the precautionary approach.

Medium- and long-term projections: Medium-term projections were simulated over 10 years, using the IBSFC agreed F of 1.0. The outcome shows less than 10% probability that the SSB will fall below the $\mathbf{B}_{pa}$ of 23 000 t. The long-term projection reference points are estimated as $\mathbf{F}_{0.1}$=0.17 and $\mathbf{F}_{max}$=0.28. The input and results from the yield per recruit analysis estimates S/R reference points at $\mathbf{F}_{med}$= 1.08, $\mathbf{F}_{high}$=1.74 and $\mathbf{F}_{low}$=0.43.

Elaboration and special comment: As a result of the high fishing mortality, SSBs and yield are dependent on ages 2–4. The contribution of ages 2 and 3 in the yield has for recent years been around 70% of the landings. The estimates of the size of the year classes attaining these ages in the forecast are uncertain, being based on partly recruited fish or solely on research survey information. For the period 1992–1994 landings are uncertain due to incomplete reporting; however, the data quality has improved significantly since then.

Source of information: Report of the Baltic Fisheries Assessment Working Group, April 2001 (ICES CM 2000/ACFM:18), Technical Minutes of ACFM, May 2001.

Yield and spawning biomass per Recruit F-reference points:

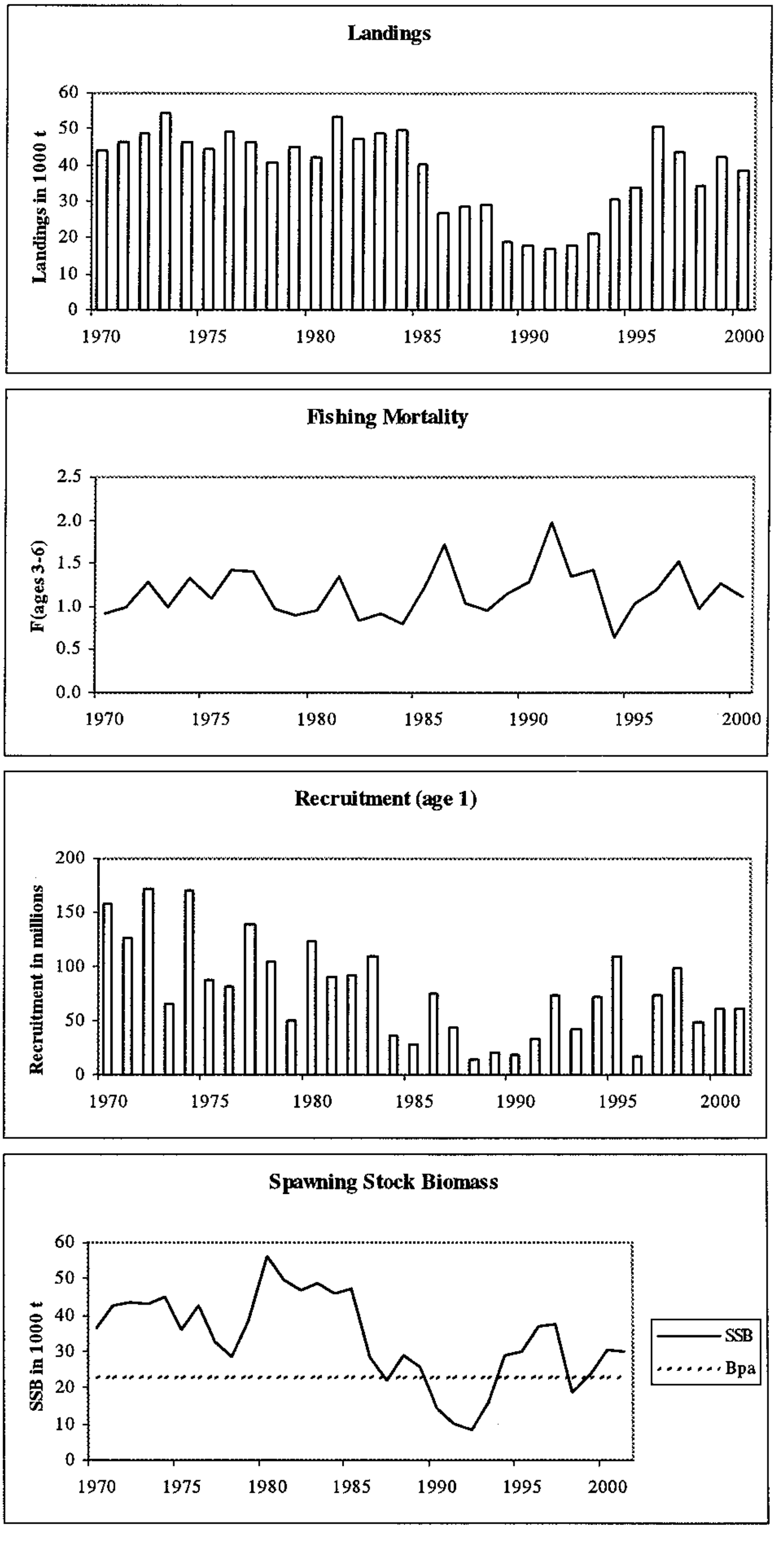
	Fish Mort Ages 3-6	Yield/R	SSB/R
Average Current	1.107	0.640	0.448
$\mathbf{F_{max}}$	0.279	0.850	2.647
$\mathbf{F_{0.1}}$	0.167	0.797	4.162
$\mathbf{F_{med}}$	1.109	0.640	0.446

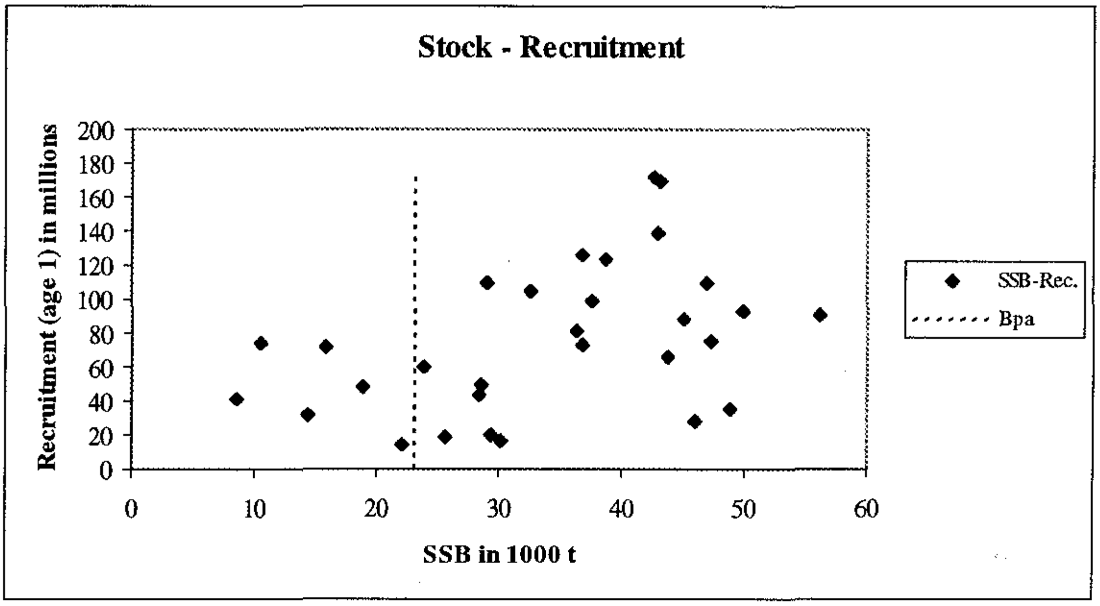
Catch data (Tables 3.13.8.1–2):

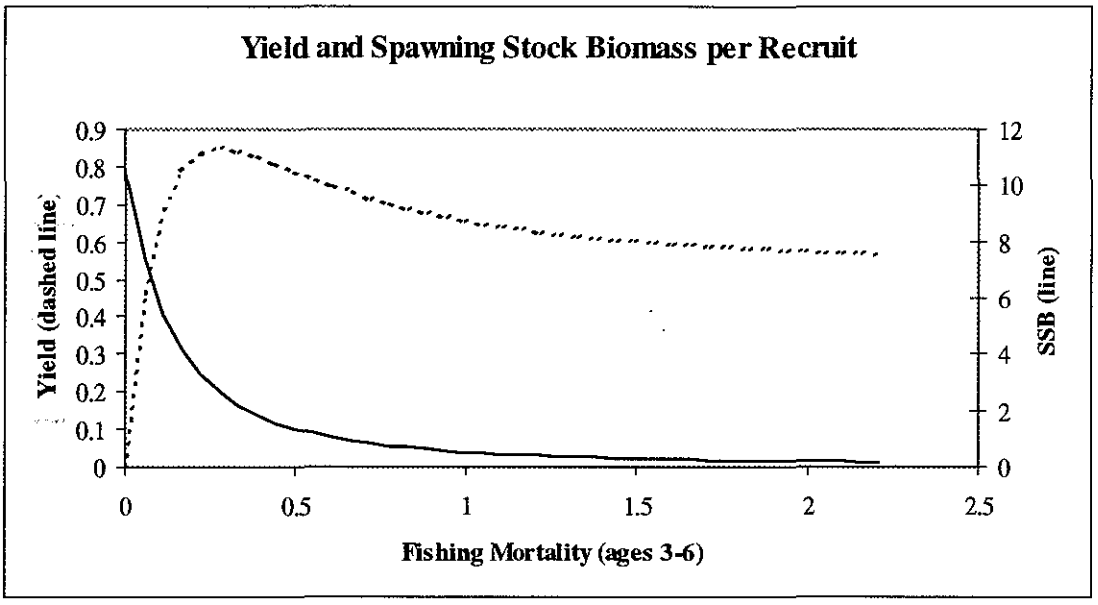
Year	ICES Advice	Predicted catch Corresp. to advice	Agreed TAC[1]	ACFM Catch (22–24)	ACFM Catch (22–32)
1987	TAC	9		29	236
1988	TAC	16		29	223
1989	TAC	14	220	19	198
1990	TAC	8	210	18	171
1991	TAC	11	171	17	140
1992	Substantial reduction in F	-	100	18	73[2]
1993	F at lowest possible level	-	40	21	66[2]
1994	TAC	22	60	31	124[2]
1995	30% reduction in fishing effort from 1994 level	-	120	34	142[2]
1996	30 % reduction in fishing effort from 1994 level	-	165	51	173
1997	Fishing effort should not be allowed to increase above level in recent years	-	180	44	132
1998	20% reduction in F from 1996	35	160	34	102
1999	At or below F_{sq} with 50% probability	38	126	42	115
2000	Reduce F by 20%	44.6	105	38	104
2001	Reduce F by 20%	48.6	105		
2002	Reduce F to below 1.0	36.3			

[1] Included in TAC for total Baltic. [2] The reported landings in 1992–1995 are known to be incorrect due to incomplete reporting. Weights in '000 t.

Cod in Sub-divisions 22 to 24




Stock - Recruitment
Recruitment (age 1) in millions
200
180
160
140
120
100
80
60
40
20
0
0
10
20
30
40
50
60
SSB in 1000 t
SSB-Rec.
Bpa


Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
12
10
8
6
4
2
0
SSB (line)
0
0.5
1
1.5
2
2.5
Fishing Mortality (ages 3-6)

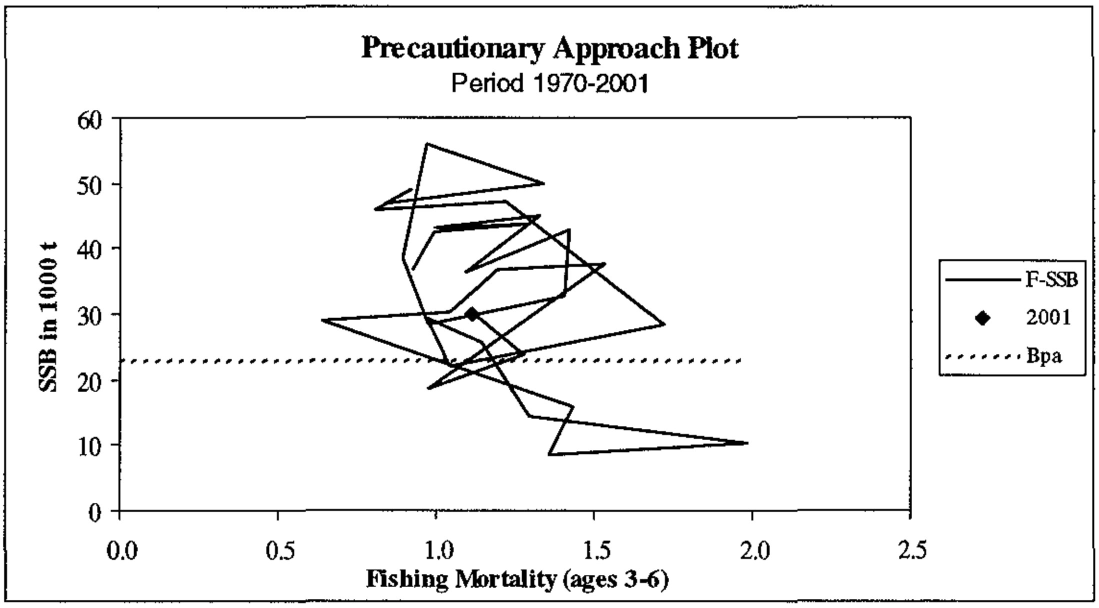

Precautionary Approach Plot
Period 1970-2001
SSB in 1000 t
60
50
40
30
20
10
0
0.0
0.5
1.0
1.5
2.0
2.5
Fishing Mortality (ages 3-6)
F-SSB
2001
Bpa

Table 3.13.8.1 Total landings of cod in Sub-divisions 22, 23 and 24 (t).

Year	Denmark		Finland	German Dem.Rep.[2]	Germany. Fed. Rep.	Estonia	Latvia	Poland	Sweden	
	23	22+24	24	22+24	22+24	24	24	24	23	24
1965		19,457		9,705	13,350					2,182
1966		20,500		8,393	11,448					2,110
1967		19,181		10,007	12,884					1,996
1968		22,593		12,360	14,815					2,113
1969		20,602		7,519	12,717					1,413
1970		20,085		7,996	14,589					1,289
1971		23,715		8,007	13,482					1,419
1972		25,645		9,665	12,313					1,277
1973		30,595		8,374	13,733					1,655
1974		25,782		8,459	10,393					1,937
1975		23,481		6,042	12,912					1,932
1976	712	29,446		4,582	12,893					1,800
1977	1,166	27,939		3,448	11,686				550	1,516
1978	1,177	19,168		7,085	10,852				600	1,730
1979	2,029	23,325		7,594	9,598				700	1,800
1980	2,425	23,400		5,580	6,657				1,300	2,610
1981	1,473	22,654		11,659	11,260				900	5,700
1982	1,638	19,138		10,615	8,060				140	7,933
1983	1,257	21,961		9,097	9,260				120	6,910
1984	1,703	21,909		8,093	11,548				228	6,014
1985	1,076	23,024		5,378	5,523				263	4,895
1986	748	16,195		2,998	2,902				227	3,622
1987	1,503	13,460		4,896	4,256				137	4,314
1988	1,121	13,185		4,632	4,217				155	5,849
1989	636	8,059		2,144	2,498				192	4,987
1990	722	8,584		1,629	3,054				120	3,671
1991	1,431	9,383			2,879				232	2,768
1992	2,449	9,946			3,656				290	1,655
1993	1,001	8,666			4,084				274	1,675
1994	1,073	13,831			4,023				555	3,711
1995	2,547	18,762	132		9,196		15		611	2,632
1996	2,999	27,946	50		12,018	50	32		1,032	4,418
1997	1,886	28,887	11		9,269	6		263	777	2,525
1998	2,467	19,192	13		9,722	8	13	623	607	1,571
1999	2,839	23,074	116		13,224	10	25	660	682	1,525
2000 [1]	2,451	19,876	169		11,572	5	84	926	698	2,564

[1]) Provisional data.

Continued...

Table 3.13.8.1 Continued.

Year	Total						
	22	23	24	Unalloc.	22+24	22+24 + Unalloc.	22-24+ Unalloc.
1965	27,867		17,007		44,874	44,874	44,874
1966	27,864		14,587		42,451	42,451	42,451
1967	28,875		15,193		44,068	44,068	44,068
1968	32,911		18,970		51,881	51,881	51,881
1969	29,082		13,169		42,251	42,251	42,251
1970	31,363		12,596		43,959	43,959	43,959
1971	32,119		14,504		46,623	46,623	46,623
1972	32,808		16,092		48,900	48,900	48,900
1973	38,237		16,120		54,357	54,357	54,357
1974	31,326		15,245		46,571	46,571	46,571
1975	31,867		12,500		44,367	44,367	44,367
1976	33,368	712	15,353		48,721	48,721	49,433
1977	29,510	1,716	15,079		44,589	44,589	46,305
1978	24,232	1,777	14,603		38,835	38,835	40,612
1979	26,027	2,729	16,290		42,317	42,317	45,046
1980	22,881	3,725	15,366		38,247	38,247	41,972
1981	26,340	2,373	24,933		51,273	51,273	53,646
1982	20,971	1,778	24,775		45,746	45,746	47,524
1983	24,478	1,377	22,750		47,228	47,228	48,605
1984	27,058	1,931	20,506		47,564	47,564	49,495
1985	22,063	1,339	16,757		38,820	38,820	40,159
1986	11,975	975	13,742		25,717	25,717	26,692
1987	12,105	1,640	14,821		26,926	26,926	28,566
1988	9,680	1,276	18,203		27,883	27,883	29,159
1989	5,738	828	11,950		17,688	17,688	18,516
1990	5,361	842	11,577		16,938	16,938	17,780
1991	7,184	1,663	7,846		15,030	15,030	16,693
1992	9,887	2,739	5,370		15,257	15,257	17,996
1993	7,296	1,275	7,129	5,528	14,425	19,953	21,228
1994	8,229	1,628	13,336	7,502	21,565	29,067	30,695
1995	16,936	3,158	13,801		30,737	30,737	33,895
1996	21,417	4,031	23,097	2,300	44,514	46,814	50,845
1997	21,966	2,663	18,995		40,961	40,961	43,624
1998	15,093	3,074	16,049		31,142	31,142	34,216
1999	20,409	3,521	18,225		38,634	38,634	42,155
2000 [1]	18,934	3,149	16,262		35,196	35,196	38,345

[1)] Provisional data.

Table 3.13.8.2 Cod in Sub-divisions 22–24.

Year	Recruitment Age 1 thousands	SSB tonnes	Landings tonnes	Mean F Ages 3-6
1970	157127	36748	43959	0.9266
1971	125916	42545	46623	0.9960
1972	172095	43702	48900	1.2948
1973	66253	43138	54357	0.9921
1974	169799	44950	46571	1.3257
1975	87785	36281	44367	1.0962
1976	81450	42845	49433	1.4190
1977	139281	32633	46305	1.4050
1978	104511	28604	40612	0.9733
1979	49961	38667	45046	0.8922
1980	124040	56101	41972	0.9658
1981	90185	49800	53646	1.3404
1982	92464	46930	47524	0.8398
1983	109579	48921	48605	0.9168
1984	35634	46040	49495	0.8058
1985	28149	47279	40159	1.2157
1986	75617	28465	26692	1.7185
1987	43337	22119	28566	1.0443
1988	13727	29289	29159	0.9657
1989	20391	25707	18516	1.1441
1990	18384	14429	17780	1.2925
1991	32246	10423	16693	1.9786
1992	73911	8527	17996	1.3563
1993	41445	15846	21228	1.4303
1994	71372	29000	30695	0.6366
1995	109315	30228	33895	1.0407
1996	16959	36828	50845	1.1921
1997	73524	37528	43621	1.5288
1998	98297	18795	34208	0.9725
1999	48284	23853	42149	1.2762
2000	60485	30637	38357	1.1066
2001	60673	29898		1.1100
Average	77881	33649	38644	1.1625

3.13.9 Cod in Sub-divisions 25–32

State of stock/exploitation: The stock is outside safe biological limits. Although the actual status of the stock cannot be estimated precisely the available information indicates that the SSB in 2001 is well below $\mathbf{B_{pa}}$. The fishing mortality is poorly estimated, but is well above $\mathbf{F_{pa}}$. In the most recent years the stock has been below $\mathbf{B_{lim}}$ and the fishing mortality has been fluctuating around $\mathbf{F_{lim}}$.. Recruitment since the late 1980s has been below average.

Management objectives: IBSFC have adopted a long-term management strategy for cod in the Baltic (section 3.13.1). ICES considers that the agreed management plan is consistent with the precautionary approach, provided the reference points are used as upper bounds on F and lower bounds on SSB, and not as targets.

Precautionary Approach reference points (unchanged since 1999):

ICES considers that:	ICES proposes that:
$\mathbf{B_{lim}}$ is 160 000 t	$\mathbf{B_{pa}}$ be set at 240 000 t
$\mathbf{F_{lim}}$ is 0.96	$\mathbf{F_{pa}}$ be set at 0.6

Technical basis:

$\mathbf{B_{lim}}$: SSB below which recruitment is impaired	$\mathbf{B_{pa}}$: MBAL
$\mathbf{F_{lim}}$: Fmed98	$\mathbf{F_{pa}}$: 5 percentile of $\mathbf{F_{med}}$

Advice on management: ICES recommends that no fishery for cod be permitted in the eastern Baltic in 2002. Concerning TAC for 2001, see Section 3.13.16.

Rebuilding plan: A rebuilding plan should be developed as soon as possible, including criteria for reopening the fishery. The current area and seasonal closures are not considered to be sufficiently effective to achieve rapid and safe rebuilding. Large closed areas and seasons may contribute to stock recovery, but only if accompanied by major reductions in effort or catch. Increases in minimum mesh size in trawls to be introduced on the 1st January 2002 may help improve the exploitation pattern and reduce discards.

Relevant factors to be considered in management: Cod in the Baltic have traditionally been taken in a directed fishery with very few cod occurring as by-catch in other fisheries. It should therefore be possible for managers to effectively reduce fishing mortality on cod without disrupting fisheries on other species.

There are no indications of substantial movements of fish from this stock to areas outside of Sub-divisions 25–32, so management measures do not need to consider migration effects in relation to this stock. However, management measures should consider the possible displacement of effort onto the western Baltic cod stock where ICES advice is also for a reduction of F in 2002.

Recruitment is influenced not only by the size of the spawning stock, but to a large extent by the environmental conditions (e.g., volume of water with high salinity and high oxygen content). Since the early 1980s fewer and smaller influxes of saline North Sea water were observed than in earlier years. This is reflected in the recruitment pattern, with most recent year classes below the long-term average. It is not possible to predict if and when the present regime of saltwater movements will change. Even though it is not possible to predict these environmental changes precisely, they need to be taken into account in both short-term management and medium-term recovery plans, to ensure that SSB does not become further depleted during the current period of low recruitment, and that rebuilding schedules are realistic. There have been no recent inFlows of saline water to the eastern Baltic. Environmental data for early 2001 indicate very poor conditions in the main spawning areas, so cod reproduction in the eastern Baltic in 2001 is unlikely to be successful.

Comparison with previous assessment and advice: Fishing mortality has consistently been under-estimated and stock size over-estimated in the previous assessments. In addition, weights at age in 1999 have been lower than previously assumed.

Catch forecast for 2002:

Basis: F(2001) = F_{sq} = F(1998-2000) =1.12; Landings (2001) = 79.6; SSB(2002)= 92.5.

F (2002)	Basis	Landings (2002)	SSB (2003)
0	0	0	175
0.22	0.2 * F_{sq}	20.8	150
0.45	0.4 * F_{sq}	38.4	130
0.56	0.5 * F_{sq}	46.1	121
0.67	0.6 * F_{sq}	53.2	113
0.89	0.8 * F_{sq}	65.9	100
1.12	F_{sq}	76.8	88

Weights in '000t.

Shaded scenarios considered inconsistent with the precautionary approach.

Medium- and long-term projections: Medium-term projections are not reported because the point estimates and probabilities from the assessment were not considered reliable.

Elaboration and special comment: Analysis has indicated that age-reading problems have resulted in considerable uncertainty about the absolute level of SSB and F, but that annual trends are robust to these effects.

Misreporting caused severe problems in the quality of the data in the early 1990s and is still thought to occur.

The earlier surveys were not adequately coordinated. Recent work on standardizing surveys has implied that surveys today are coordinated and use similar gears.

Calibrations of the historical time series information to the new gear standards were impossible to finalise this year. This adds uncertainty to their use as tuning indices.

The landings increased from about 150 000 t in the mid-1970s to around 360 000 t in the early 1980s, but decreased thereafter. The fisheries developed during the 1970s with more fleets entering in the early 1980s, and the intensity of the fishery increased further with the introduction of a gillnet fishery at the end of the 1980s and the beginning of the 1990s. The size of the gill-net fleet has decreased in recent years, and the majority of catches are now taken by mobile gears.

Source of information: Report of the Baltic Fisheries Assessment Working Group, April 2001 (ICES CM 2001/ACFM:18).

Yield and spawning biomass per Recruit F-reference points:

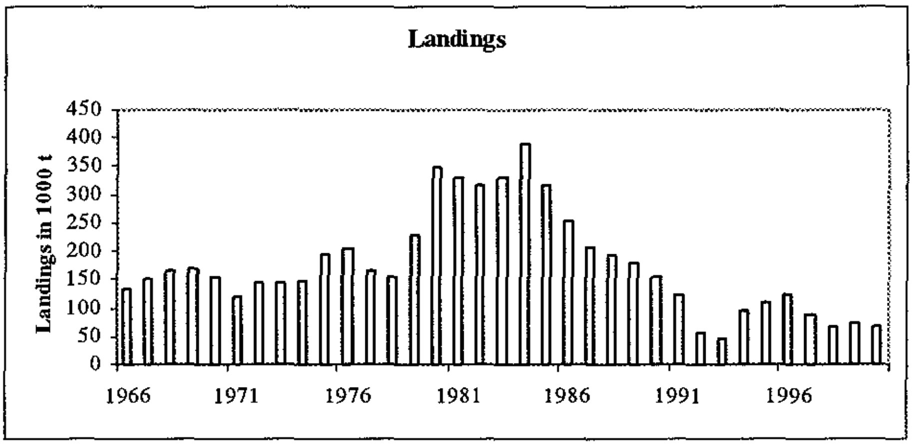
	Fish Mort Ages 4-7	Yield/R	SSB/R
Average Current	1.117	0.632	0.753
F_{max}	0.262	0.841	3.632
$F_{0.1}$	0.158	0.789	5.471
F_{med}	0.856	0.669	1.000

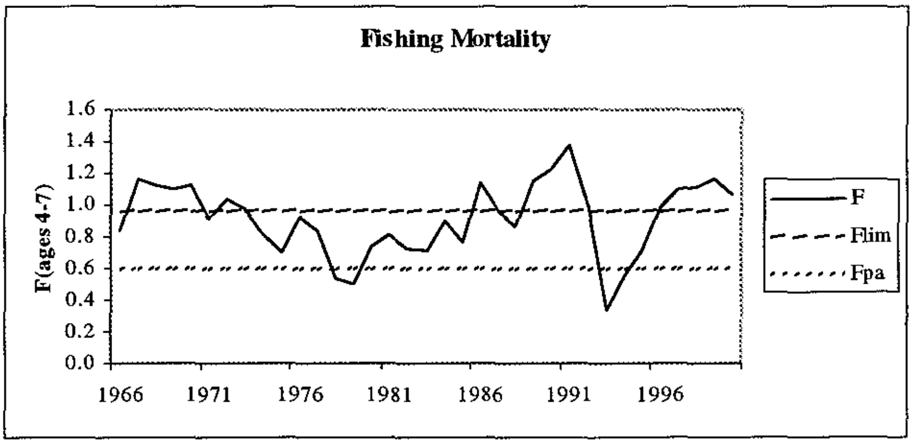
Catch data (Tables 3.13.9.1-2):

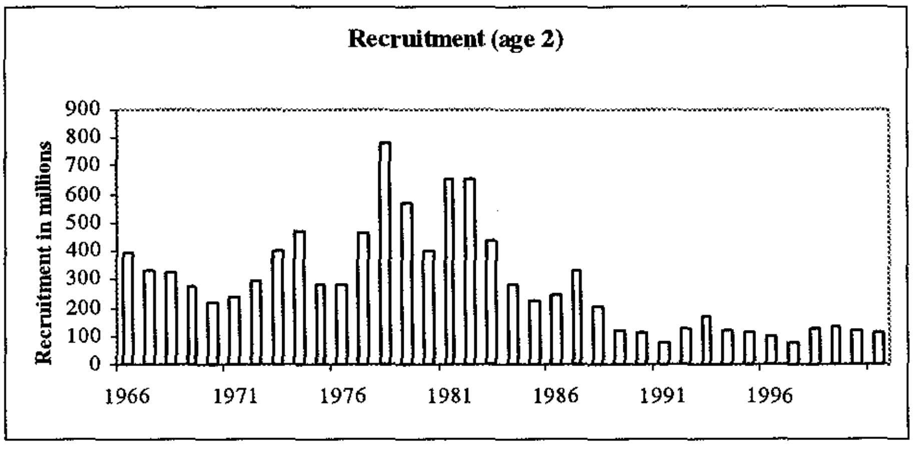
Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC[1]	ACFM Catch (25–32)	ACFM Catch (22–32)
1987	Reduce towards F_{max}	245		207	236
1988	TAC	150		194	223
1989	TAC	179	220	179	198
1990	TAC	129	210	153	171
1991	TAC	122	171	123	140
1992	Lowest possible level	-	100	55[2]	73[2]
1993	No fishing	0	40	45[2]	66[2]
1994	TAC	25	60	93[2]	124[2]
1995	30% reduction in fishing effort from 1994 level	-	120	108[2]	142[2]
1996	30% reduction in fishing effort from 1994 level	-	165	122	173
1997	20% reduction in fishing mortality from 1995	130	180	89	132
1998	40% reduction in fishing mortality from 1996	60	140	67	102
1999	Proposed F_{pa} (= 0.6)	88	126	72	115
2000	40% reduction in F from 96–98 level	60	105	66	104
2001	Fishing mortality of 0.30	39	105		
2002	No fishing	0			

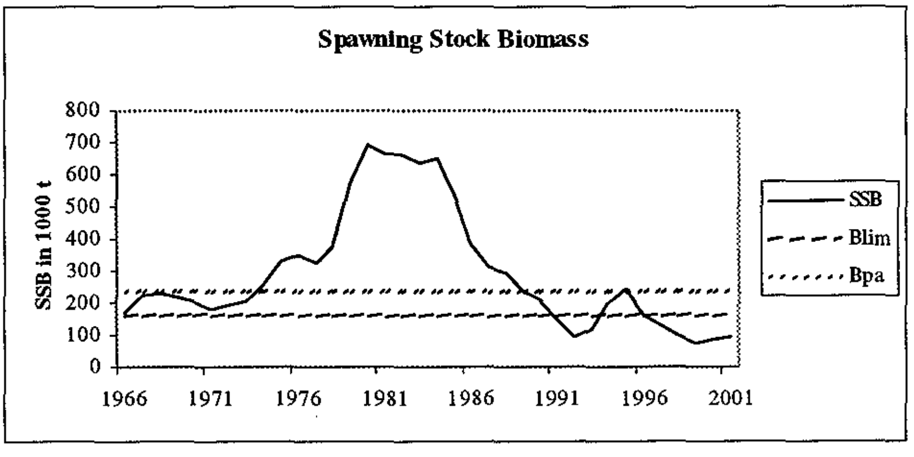
[1]For total Baltic. [2] The reported landings in 1992–1995 are known to be incorrect due to incomplete reporting. Weights in '000 t.

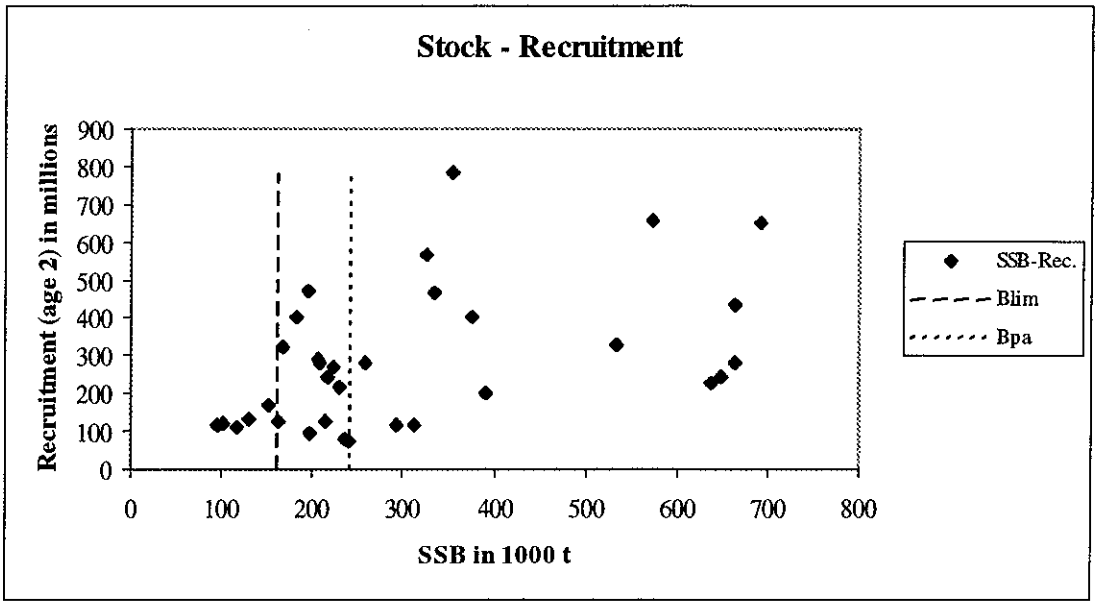
Cod in Sub-divisions 25 to 32

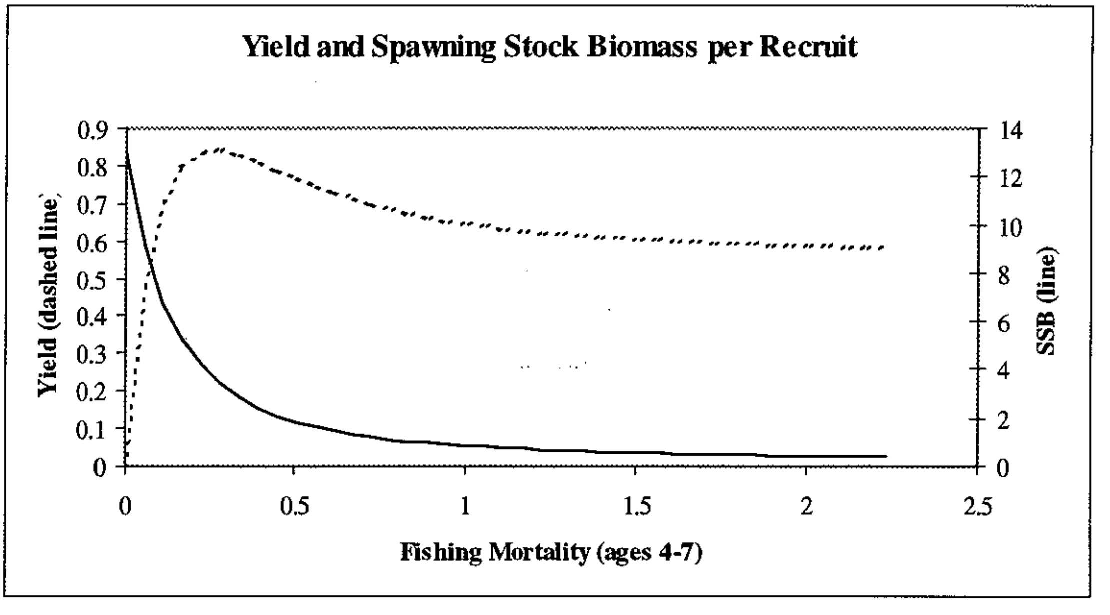









Stock - Recruitment
Recruitment (age 2) in millions
900
800
700
600
500
400
300
200
100
0
0
100
200
300
400
500
600
700
800
SSB in 1000 t
SSB-Rec.
Blim
Bpa


Yield and Spawning Stock Biomass per Recruit
Yield (dashed line)
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.5
1
1.5
2
2.5
Fishing Mortality (ages 4-7)
14
12
10
8
6
4
2
0
SSB (line)

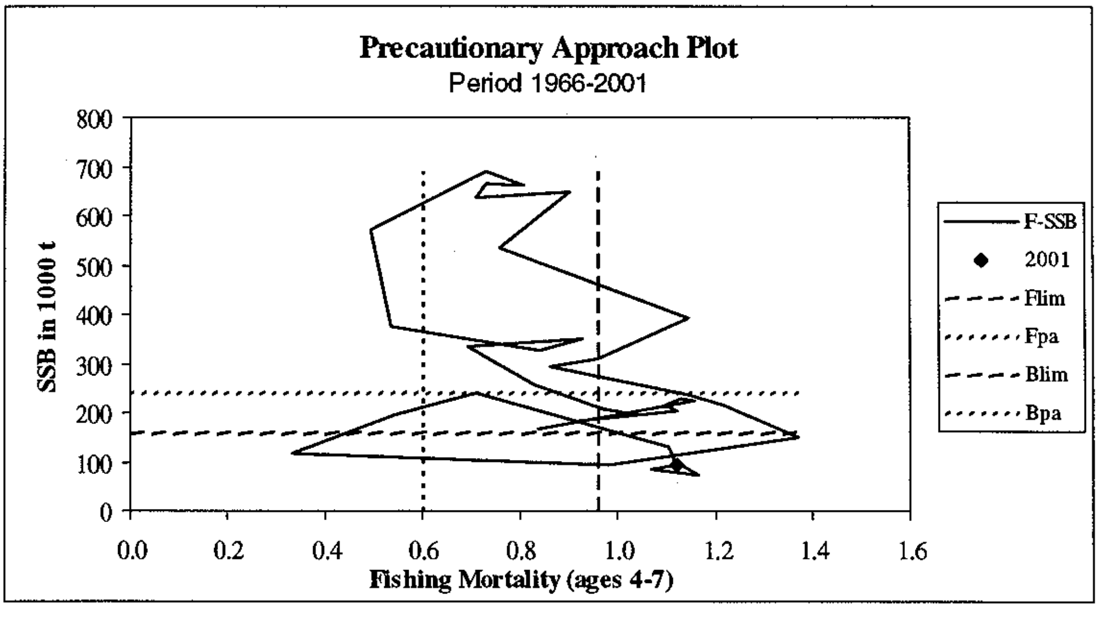

Precautionary Approach Plot
Period 1966-2001
SSB in 1000 t
800
700
600
500
400
300
200
100
0
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
Fishing Mortality (ages 4-7)
F-SSB
2001
Flim
Fpa
Blim
Bpa

Table 3.13.9.1 Total landings (t) of COD in Sub-divisions 25–32 by country.

Year	Denmark	Estonia	Finland	German Dem.Rep.[2]	Germany, Fed. Rep.	Latvia	Lithuania	Poland	Russia	Sweden	USSR	Faroe Islands[4]	Norway	Unallo-cated[3]	Total
1965	15856		23	975	2183			41498		19523	22420				102478
1966	16570		26	2196	1383			56007		20415	38270				134867
1967	19924		27	11020	1057			56003		21367	42980				152378
1968	21516		70	12118	2018			63245		21895	43610				164472
1969	23459		58	18460	4715			60749		20888	41580				169909
1970	22307		70	10103	4855			68440		16467	32250				154492
1971	23116		53	2970	2766			54151		14251	20910				118217
1972	34072		76	4055	3203			57093		15194	30140				143833
1973	35455		95	6034	14973			49790		16734	20083				143164
1974	32028		160	2517	11831			48650		14498	38131				147815
1975	39043		298	8700	11968			69318		16033	49289				194649
1976	47412		287	3970	13733			70466		18388	49047				203303
1977	44400		310	7519	19120			47702		16061	29680				164792
1978	30266		1437	2260	4270			64113		14463	37200				154009
1979	34350		2938	1403	9777			79754		20593	75034	3850			227699
1980	49704		5962	1826	11750			123486		29291	124350	1250			347619
1981	68521		5681	1277	7021			120001		37730	87746	2765			330742
1982	71151		8126	753	13800			92541		38475	86906	4300			316052
1983	84406		8927	1424	15894			76474		46710	92248	6065			332148
1984	90089		9358	1793	30483			93429		59685	100761	6354			391952
1985	83527		7224	1215	26275			63260		49565	78127	5890			315083
1986	81521		5633	181	19520			43236		45723	52148	4596			252558
1987	68881		3007	218	14560			32667		42978	39203	5567			207081
1988	60436		2904	2	14078			33351		48964	28137	6915			194787
1989	57240		2254	3	12844			36855		50740	14722	4520			179178
1990	47394		1731		4691			32028		50683	13461	3558			153546
1991	39792	1810	1711		6564	2627	1865	25748	3299	36490		2611			122517
1992	18025	1368	485		2793	1250	1266	13314	1793	13995		593			54882
1993	8000	70	225		1042	1333	605	8909	892	10099		558		13450	45183
1994	9901	952	594		3056	2831	1887	14335	1257	21264		779		36498	93354
1995	16895	1049	1729		5496	6638	4513	25000	1612	24723		777	293	18993	107718
1996	17549	1338	3089		7340	8709	5524	34855	3306	30669		706	289	8515	121889
1997	9776	1414	1536		5215	6187	4601	31396	2803	25072		600			88600
1998	7818	1188	1026		1270	7765	4176	25155	4599	14431					67428
1999	12170	1052	1456		2215	6889	4371	25920	5202	13720					72995
2000 [1]	9715	604	1528		1508	6196	5165	21194	4231	15910					66051

[1] Provisional data. [2] Includes landings from Oct.-Dec. 1990 of Fed.Rep.Germany.
[3] Working group estimates. No information available for years prior to 1993. [4] For 1997 landings not officially reported, estimated by the WG.

Table 3.13.9.2 Cod in Sub-divisions 25–32.

Year	Recruitment Age 2 thousands	SSB tonnes	Landings tonnes	Mean F Ages 4-7
1966	392574	167655	134867	0.8358
1967	332904	222639	152378	1.1574
1968	320464	228855	164472	1.1289
1969	272325	217804	169909	1.0948
1970	217939	205062	154492	1.1227
1971	242104	181671	118217	0.9119
1972	292775	195548	143833	1.0419
1973	400793	208707	143164	0.9717
1974	471922	258456	147815	0.8296
1975	280934	333523	194649	0.6943
1976	281565	352450	203303	0.9245
1977	463519	324738	164792	0.8423
1978	782719	375359	154009	0.5344
1979	567880	572912	227699	0.4942
1980	403688	691303	347619	0.7325
1981	654965	662716	330742	0.8070
1982	651642	663916	316052	0.7290
1983	433384	637241	332148	0.7126
1984	279824	647878	391952	0.9020
1985	228161	533459	315083	0.7581
1986	244217	390503	252558	1.1434
1987	330164	311839	207081	0.9595
1988	203194	292636	194787	0.8597
1989	116954	237350	179178	1.1457
1990	114837	215200	153546	1.2191
1991	77598	151374	122517	1.3723
1992	128763	95848	54882	0.9812
1993	170266	117618	45183	0.3343
1994	117628	197187	93354	0.5452
1995	113210	241705	107718	0.7109
1996	97919	162319	121889	0.9868
1997	76658	130434	88600	1.1038
1998	124514	102332	67429	1.1181
1999	130390	74628	72989	1.1655
2000	122180	87082	66051	1.0679
2001	111786	94977		1.1200
Average	284788	294026	175284	0.9183

3.13.10 Flounder

State of stock/exploitation: The total landings of flounder were quite stable from the early 1970s until 1994, when reported landing increased markedly. Reported catches in 1995 and 1996 were well above the previous average, but have decreased thereafter.

Results from a tentative assessment of the stock in Sub-divisions 24 and 25 suggest a relatively stable spawning stock of around 25 000 t since the late 1970s (Table 3.13.10.2).

Comparison with previous assessment and advice: The tentative assessment is consistent with that of last year.

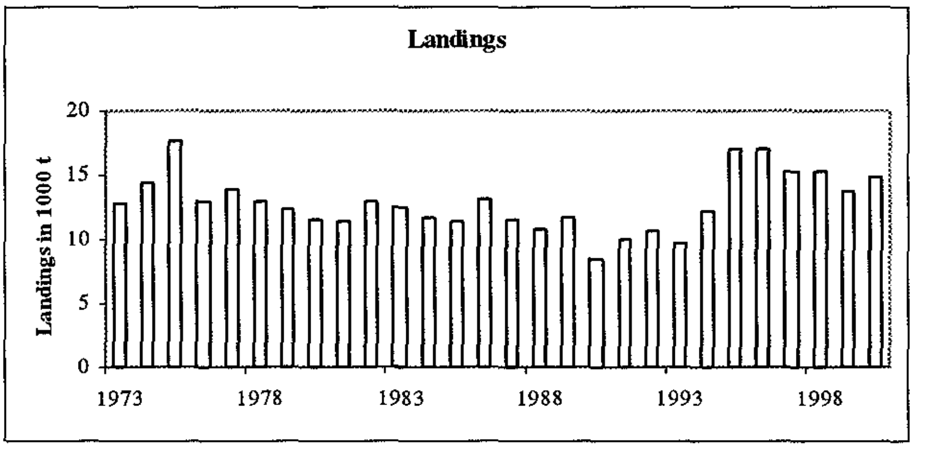
Elaboration and special comment: Flounder is taken as a by-catch in the cod trawl and gillnet as well as in coastal fisheries. There are also directed trawl fisheries for this species in Sub-divisions 24 and 25. For 1994–1998 high total landings of flounder were recorded, likely due to misreporting of other fish species as flounder (Table 3.13.10.1).

The majority of the landings are caught in Sub-divisions 24, 25 and 26. The amount of discarded flounder is not known, but it is assumed to be high because landings depend on market price and minimum marketable size.

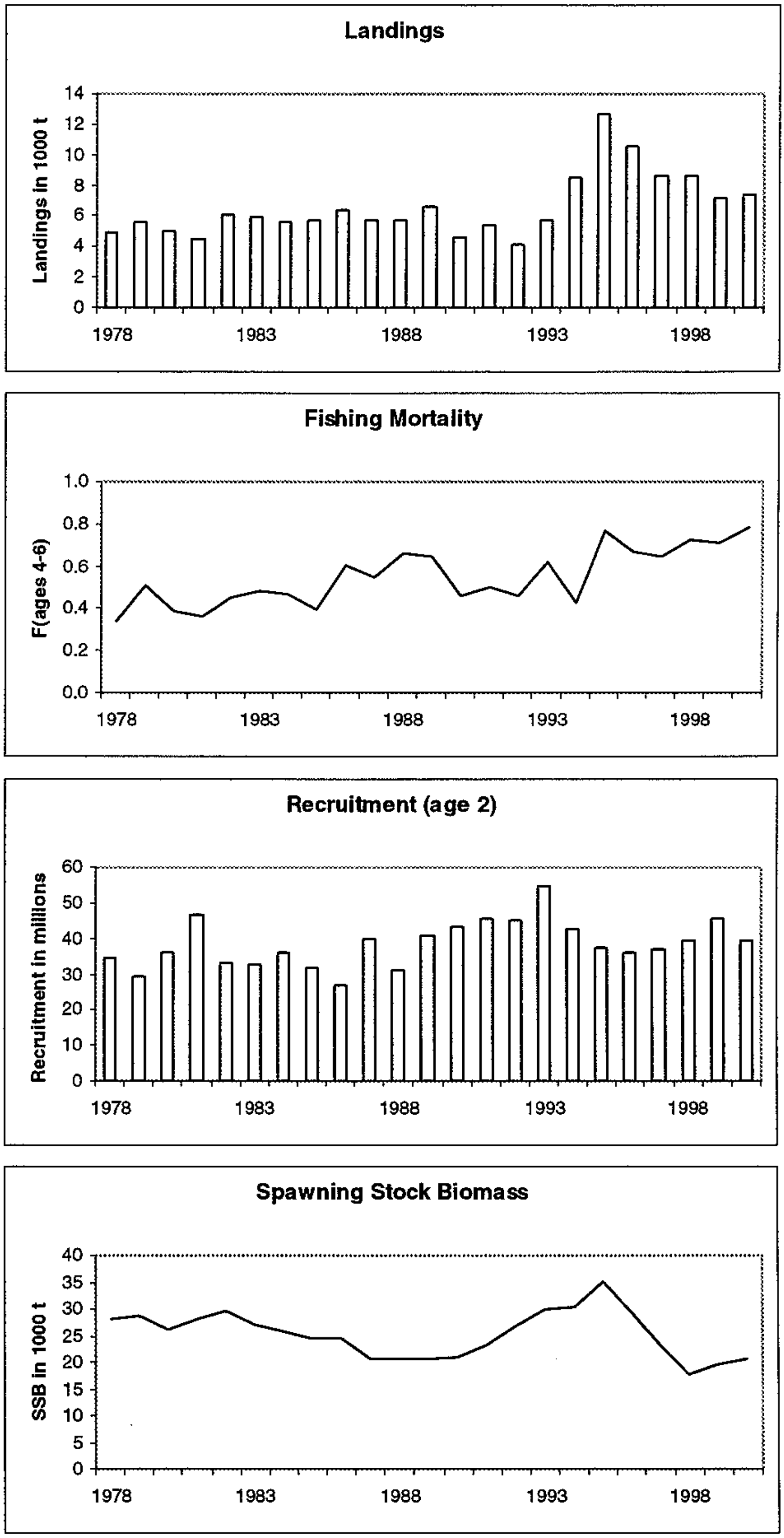
For most of the flounder stocks the data available are insufficient to make an analytical assessment and catch forecasts. An assessment could be made only for the flounder stock in Sub-divisions 24–25.

Source of information: Report of the Baltic Fisheries Assessment Working Group, April 2001 (ICES CM 2001/ACFM:18).

Flounder in Sub-divisions 22 to 32



Flounder in Sub-divisions 24 and 25



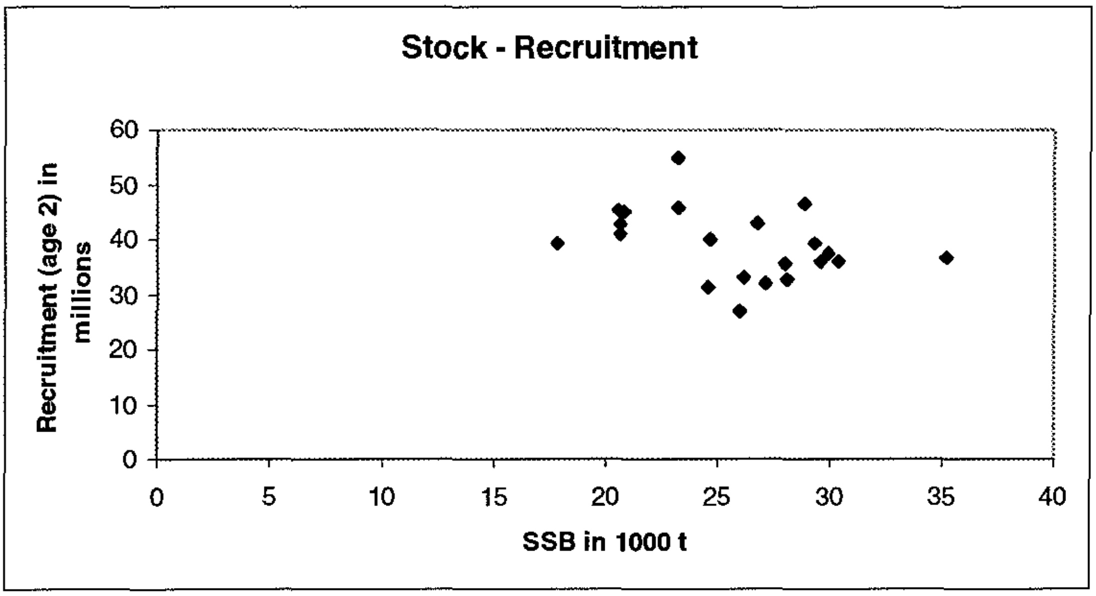

Stock - Recruitment
Recruitment (age 2) in millions
60
50
40
30
20
10
0
0
5
10
15
20
25
30
35
40
SSB in 1000 t

Table 3.13.10.1 Total landings (tonnes) of Flounder in the Baltic by sub-division and country. (There are some gaps in the information, therefore "Total" is preliminary.

Year	Denmark[1]					Finland					German Dem. Rep.[2]			Germany, Fed. Rep.				Poland		Sweden[3]							
	22	23	24.25	26	28(29)	24	25	29[6]	30	32	22	24	25(+26)	22	24(+25)	26	28	25(+24)	26	22	23	24	25	26	27	28	29
1973	1,983		386								181	1,624	1,516	349	4			1,580	2,070				502				
1974	2,097		2,578								165	1,482	654	304	3			1,635	2,473				470				
1975	1,992		1,678					113	22	47	163	1,469	406	469	1			1,871	2,585				400				
1976	2,038		482					118	23	59	174	1,556	901	392	2			1,549	2,289				400				
1977	1,974		389					115	32	56	555	2,708	1,096	393	4			2,071	2,089				416				
1978	2,965		415					174	61	155	348	2,572		477	1			996	2,106				346				
1979	2,451		405					192	54	153	189	2,509		259	3			1,230	1,860				315				
1980	2,185		286					194	69	165	138	2,775		212	1			1,613	1,380			16	46		20	181	32
1981	1,964		548					227	56	135	271	2,595		351	1			1,151	1,541			21	30		21	194	34
1982	1,563	104	257					219	58	144	263	3,202		248	1			2,484	1,623			22	33		65	16	3
1983	1,714	115	450					181	67	120	280	3,572		418	1			1,828	905			72	108		212	52	9
1984	1,733	85	306					174	108	135	349	2,719		371	1			2,471	1,288			18	27		53	13	2
1985	1,561	130	649					157	97	137	236	3,253		199	4			2,063	1,302			16	24		47	12	2
1986	1,525	65	1,558					199	128	181	127	2,838		125	10			3,030	1,784			20	31		60	15	3
1987	1,208	122	1,007					159	106	143	71	2,096		114	11			2,530	1,745			17	26		51	13	2
1988	1,162	125	990					177	118	159	92	2,981		133	5			1,728	1,292			23	35		68	17	3
1989	1,321	83	1,062					175	122	163	126	3,616		122	2			1,896	1,089			22	34		66	16	3
1990	941		1,389					219	81	161	52	1,622		183	10			1,617	599				120				
1991	925		1,497					236	81	167				246	1,814			2,008	1,905			24	31		88	20	
1992	713	185	975					405	40	627				227	1,972			1,877	1,869			41	88	3	86	11	3
1993	649	194	635					438	57	683				235	1,230			3,276	1,229		26	27	63	1	83	10	
1994	882	181	1,016					445	33	87				44	4,262	2	3	3,177	1,266		84	20	18	37	33	55	10
1995	859	231	2,110					398	28	131				286	2,825	4	40	7,437	1,482		58	28	186	7	81	18	
1996	1,041	227	2,306				1	365	78	271				189	1,322	10	9	6,069	2,556	2	58	101	718	48	114	31	
1997	1,356		2,421	31	10		1	283	69	299				655	1,982	12	4	3,877	1,730		42	62	308	31	105	370	
1998	1,372		2,393				4	284	59	297				411	1,729	2		4,215	1,370		61	49	187	18	70	117	
1999	1,473		1,206				1	286	57	276				510	1,825			4,015	1,435		37	24	87	47	15		
2000[5]	1,896		1,757			5	2	230	26	271				660	2,089			3,423	1,668		41	49	122		73	28	

continued

Table 3.13.10.1 continued

Year	USSR				Estonia					Latvia			Lithuania[8]		Russia		Total										Total
	26	28	29	32	25	26	28	29	32	25	26	28	25	26	26	28	22	23[1]	24	25[4]	26	27	28	29	30	32	22-32
1973		2610															2,513		2,014	3,598	2,070		2,610				12,805
1974		2510															2,566		4,063	2,759	2,473		2,510				14,371
1975		6455															2,624		3,148	2,677	2,585		6,455	113	22	47	17,671
1976	471	1779	409	359													2,604		2,040	2,850	2,760		1,779	527	23	418	13,001
1977	210	1081	321	414													2,922		3,101	3,583	2,299		1,081	436	32	470	13,924
1978	288	1290	334	395													3,790		2,988	1,342	2,394		1,290	508	61	550	12,923
1979	158	1170	330	1012													2,899		2,917	1,545	2,018		1,170	522	54	1,165	12,290
1980	93	798	334	1080													2,535		3,078	1,659	1,473	20	979	560	69	1,245	11,618
1981	58	742	445	1078													2,586		3,165	1,181	1,599	21	936	706	56	1,213	11,463
1982	195	665	615	1121													2,074	104	3,482	2,517	1,818	65	681	837	58	1,265	12,901
1983	209	551	497	1114													2,412	115	4,095	1,936	1,114	212	603	687	67	1,234	12,475
1984	145	202	286	1226													2,453	85	3,044	2,498	1,433	53	215	462	108	1,361	11,712
1985	268	189	265	806													1,996	130	3,922	2,087	1,570	47	201	424	97	943	11,417
1986	442	159	281	556													1,777	65	4,426	3,061	2,226	60	174	483	128	737	13,137
1987	1315	203	279	397													1,393	122	3,131	2,556	3,060	51	216	440	106	540	11,615
1988	578	439	257	331													1,387	125	3,999	1,763	1,870	68	456	437	118	490	10,713
1989	783	512	214	214													1,569	83	4,702	1,930	1,872	66	528	392	122	377	11,641
1990	752	390	144	141													1,176		3,021	1,737	1,351		390	363	81	302	8,421
1991						49	1	135	51		123	323		125	216	10	1,171		3,335	2,039	2,418	88	354	371	81	218	10,075
1992							47	47	46		26	664		483	146		940	185	2,988	1,965	2,527	86	722	455	40	673	10,581
1993							52	86	55		99	389			225		884	220	1,892	3,339	1,554	83	451	524	57	738	9,742
1994								3	4		31	276			167		926	265	5,298	3,195	1,503	33	334	458	33	91	12,136
1995					8		16	52	35		39	322	8	53	271		1,145	289	4,963	7,639	1,856	81	396	450	28	166	17,013
1996							44	99	145		74	215		231	740		1,232	285	3,729	6,788	3,659	114	299	464	78	416	17,064
1997					15		101	96	125		78	284			1,001		2,011	42	4,465	4,201	2,883	105	769	379	69	424	15,348
1998					10		146	79	87	2	88	274		737	1,188		1,783	61	4,171	4,418	3,403	70	537	363	59	384	15,249
1999					8		92	150	164		140	365		547	964		1,983	37	3,055	4,111	3,133	15	457	436	57	440	13,724
2000 [5]					2	1	65	150	126	3	113	302		575	1236		2,556	41	3,900	3,552	3,593	73	395	380	26	397	14,913

[1] For the years 1973-1981 the catches of Sub-division 23 are included in Sub-division 22.
[2] From October-December 1990 landings of Germany, Fed. Rep. are included.
[3] For the years 1973-1979 and 1990 the catches of Sub-divisions 24-29 are included in Sub-division 25.
[4] For the years 1973-1979 and 1990 the Swedish catches of Sub-divisions 24-29 are included in Sub-division 25.
[5] Provisional.
[6] Landings of Sub-division 27 are included
[7] Landings of Sub-division 31 are included
[8] Lithuania, for 1993, 1994, 1997 and 1998 no data reported

Table 3.13.10.2 Flounder in Sub-divisions 24 and 25.

Year	Recruitment Age 2 thousands	SSB tonnes	Landings tonnes	Mean F Ages 4-6
1978	34476	27960	4960	0.3371
1979	29171	28817	5593	0.5081
1980	35769	26113	5058	0.3844
1981	46387	28003	4532	0.3652
1982	33245	29523	6002	0.4493
1983	32792	27116	5926	0.4823
1984	35985	25909	5554	0.4695
1985	31836	24639	5664	0.3965
1986	26849	24548	6404	0.6079
1987	39862	20659	5687	0.5514
1988	31254	20643	5762	0.6650
1989	40982	20596	6632	0.6461
1990	43040	20836	4607	0.4576
1991	45597	23247	5374	0.5003
1992	45160	26743	4121	0.4599
1993	54844	29917	5745	0.6198
1994	42846	30304	8493	0.4235
1995	37314	35130	12603	0.7664
1996	36118	29239	10516	0.6699
1997	36887	23219	8667	0.6481
1998	39442	17847	8589	0.7220
1999	45822	19562	7166	0.7105
2000	39380	20648	7441	0.7841
Average	38481	25270	6569	0.5489

3.13.11 Plaice

State of stock/exploitation: The available data do not permit the current stock size and exploitation to be assessed.

Elaboration and special comment: Sub-divisions 22 and 24 are the most important areas for plaice fishery in the Baltic. The total landings of plaice (Table 3.13.11.1) were high in the 1970s, but have decreased since the 1980s to the lowest on record in 1993 (269 t). Since then the landings have increased to 2 700 t, mainly due to increased landings from Sub-division 22.

Source of information: Report of the Baltic Fisheries Assessment Working Group, April 2001 (ICES CM 2001/ACFM:18).

Plaice in Sub-divisions 22 to 32

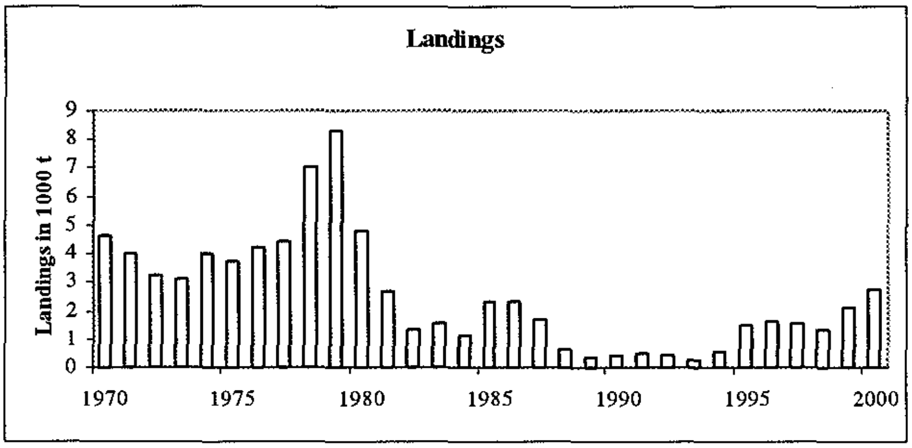


Table 3.13.11.1 Total landings (tones) of Plaice in the Baltic by sub-division and country. (There are some gaps in the information, therefore "Total" is preliminary.

Year	Denmark			Germ.Dem. R.[1]		Germany, Fed. Rep.				Poland		Sweden[2]							
	22	23	24(25)	22	24	22	24(+25)	26	28	25(+24)	26	22	23	24	25	26	27	28	29
1970	3,757		494			202	16							149					
1971	3,435		314			160	2							107					
1972	2,726		290			154	2							78					
1973	2,399		203	2	44	163	1			174	30			75					
1974	3,440		126	36	10	166	2			114	86			60					
1975	2,814		184	11	67	302	1			158	142			45					
1976	3,328		178	11	82	302	3			164	76			44					
1977	3,452		221	5	36	348	2			265	26			41					
1978	3,848		681	33	1,198	346	3			633	290			32					
1979	3,554		2,027	10	1,604	195	7			555	224			113					
1980	2,216		1,652	5	303	84	5			383	53			113					
1981	1,193		937	6	52	74	31			239	27			118					
1982	716		393	6	25	39	6			43	64			40	6		7	1	
1983	901		297	5	12	37	14			64	12			133	20		24	2	
1984	803		166	7	2	23	8			106				23	3		4	1	
1985	648		771	68	593	26	40			119	49			25	4		5	1	
1986	570		1,019	34	372	25	7			171	59			48	7		9	1	
1987	414		794	4	142	14	16			188	5			68	10		12	1	
1988	234		323	3	16	7	1			9	1			49	7		9	1	
1989	167		149		5	7				10				34	5		6	1	
1990	236		100		1	9	1			6				50					
1991	328		112			15	9			2	1			5	2		2		
1992	316		74			11	4			6				3	1		1		
1993	171		66			16	6			4			2	4					
1994	355		159			1				43	4		6	4	7				
1995	601	64	343			75	91		1	233	2		12	13	10	1			
1996	859	81	263			43	77			183	5	1	13	28	23	10	1		
1997	902		201			51	56			308	3		13	7	8		1		
1998	642		278			213	41			101	14		13	6	17		1		
1999	1,456		183			244	46			145	1	1	13	5	10				
2000 [4]	1932		161			140	37			408	3		26	9	12				

continued

Table 3.13.11.1 Continued

Year	Total								Total
	22	23	24[3]	25	26	27	28	29	22-29
1970	3,959		659						4,618
1971	3,595		423						4,018
1972	2,880		370						3,250
1973	2,564		323	174	30				3,091
1974	3,642		198	114	86				4,040
1975	3,127		297	158	142				3,724
1976	3,641		307	164	76				4,188
1977	3,805		300	265	26				4,396
1978	4,227		1,914	633	290				7,064
1979	3,759		3,751	555	224				8,289
1980	2,305		2,073	383	53				4,814
1981	1,273		1,138	239	27				2,677
1982	761		464	49	64	7	1		1,346
1983	943		456	84	12	24	2		1,521
1984	833		199	109		4	1		1,146
1985	742		1,429	123	49	5	1		2,349
1986	629		1,446	178	59	9	1		2,322
1987	432		1,020	198	5	12	1		1,668
1988	244		389	16	1	9	1		660
1989	174		188	15		6	1		384
1990	245		152	6					403
1991	343		126	4	1	2			476
1992	327		81	7		1			416
1993	187	2	76	4					269
1994	356	6	163	50	4				579
1995	676	76	447	243	3		1		1,446
1996	903	94	368	206	15	1			1,587
1997	953	13	264	316	3	1			1,550
1998	855	13	325	118	14	1			1,326
1999	1,701	13	234	155	1				2,104
2000[4]	2,072	26	207	420	3				2,728

[1] From October-December 1990 landings of Germany, Fed. Rep. are included.
[2] For the years 1970-1981 and 1990 the catches of Sub-divisions 25-28 are included in Sub-division 24.
[3] For the years 1970-1981 and 1990 the Swedish catches of Sub-divisions 25-28 are included in Sub-division 24.
[4] Provisional.

3.13.12 Dab

State of stock/exploitation: The available data do not permit the current stock size and exploitation to be assessed.

Elaboration and special comment: The total landings of dab (Table 3.13.12.1) were stable at around 2 000 t per year in the 1980s and the early 1990s. The reported catches in 1994 and 1995 increased to 3 000 t, but in 1996 they returned to the previous level. From 1997 onwards the landings decreased to under 1 500 t, landings characteristic to the beginning of the 1970s.

The temporary increase in landings reported for 1994 and 1995 is influenced by misreporting of other species as dab.

Most catches were taken from Sub-division 22, followed by Sub-division 24 with only up to 12% of the total landings.

Source of information: Report of the Baltic Fisheries Assessment Working Group, April 2001 (ICES CM 2001/ACFM:18).

Dab in Sub-divisions 22 to 32

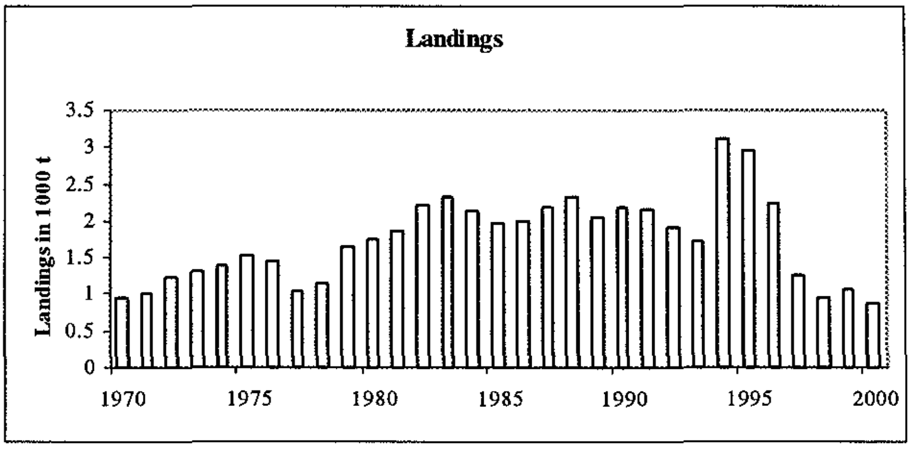


Table 3.13.12.1 Total landings (tonnes) of Dab in the Baltic by Sub-division and country. (There are some gaps in the information, therefore "Total" is preliminary.

Year	Denmark				G. Dem. Rep.[1]		Germany, Fed. Rep.				Sweden[2]								Total									Total
	22	23	24(+25)	25-28	22	24	22	24	25	26	22	23	24	25	27	28	29	30	22	23	24[3]	25[5]	26	27	28	29	30	22-30
1970	845		20		11		74												930		20							950
1971	911		26		10		64												985		26							1,011
1972	1110		30		9		63						23						1,182		53							1,235
1973	1087		58		18		118						30						1,223		88							1,311
1974	1178		51		18		118						34						1,314		85							1,399
1975	1273		74		20		131						32						1,424		106							1,530
1976	1238		60		17		114						27						1,369		87							1,456
1977	889		32		13		89						25						991		57							1,048
1978	928		51		19	14	128	4											1,075		69							1,144
1979	1413		50		18	25	123	1					9						1,554		85							1,639
1980	1593		21		15	25	101						3						1,709		49							1,758
1981	1601		32		24	39	164						5						1,789		76							1,865
1982	1863		50		46	38	182	4					6	5	8	6		1	2,091		98	5		8	6		1	2,209
1983	1920		42		46	28	198						24	20	32	22		2	2,164		94	20		32	22		2	2,334
1984	1796		65		30	47	175	2					4	3	5	4		1	2,001		118	3		5	4		1	2,132
1985	1593		58		52	51	187	2					3	3	5	3		1	1,832		114	3		5	3		1	1,958
1986	1655		85		36	35	185	1					1	1	1	1			1,876		122	1		1	1			2,001
1987	1706		93		14	87	276	4					1	1	1	1			1,996		185	1		1	1			2,184
1988	1846		75		22	91	281	1					1	1	1	1			2,149		168	1		1	1			2,320
1989	1722		48		26	19	218	1					1	1	2	1			1,966		69	1		2	1			2,039
1990	1743		146		14	11	252	1					8						2,009		166							2,175
1991	1731		95				340	5					1						2,071		101							2,172
1992	1406		81				409	6						1	1		4		1,815		87	1		1		4		1,908
1993	996		155				556	10				7	1	1			1		1,552	7	166	1				1		1,727
1994	1621		163				1190	80	45			5	1	1					2,811	5	244	46						3,106
1995	1510	47	127	10			1185	49	3			5	1	5		1			2,695	52	177	18			1			2,943
1996	913	37	128				991	134	13	2	3		3	4	1				1,907	37	265	17	2	1				2,229
1997	728		60				413	21	2			5	5	10	3	1			1,141	5	86	12		3	1			1,248
1998	569		89				280	6	2			7	3	3	1				849	7	98	5		1				960
1999	664		59				339	4				3	1	1					1,003	3	64	1						1,071
2000[1]	612		46				212	3				2		1					824	2	49	1						876

[1] From October-December 1990 landings of Germany, Fed. Rep. are included.

[2] For the years 1970-1981 and 1990 the catches of Sub-divisions 25-28 are included in Sub-division 24.

[3] For the years 1970-1981 and 1990 the Swedish catches of Sub-divisions 25-28 are included in Sub-division 24.

[4] Provisional.

[5] In 1995 Danish landings of Sub-divisions 25-28 are included.

3.13.13 Turbot

State of stock/exploitation: The available data do not permit the current stock size and exploitation to be assessed.

Elaboration and special comment: The landings of turbot in the Baltic increased from less than a 100 t in the 1960s and 1970s to nearly 500 t in the early 1990s, and again to above 1 000 t in the mid-1990s. Catches declined after 1996, and are now about 500 t (Table 3.13.13.1).

The main turbot fishery takes place in Sub-divisions 22, 24, 25, 26 and 28. Due to the high market demand a directed turbot gillnet fishery developed in the 1990s.

At present the IBSFC regulations of the turbot fishery are a temporary closure of fishing during the spawning season, and a minimum landing size. There are also additional national regulations, for example, a minimum mesh size for some fisheries.

The landings are uncertain due to incomplete reporting, especially for the early years.

Although there are ongoing study programs in several countries focusing on the status of turbot stocks in the Baltic, the data available are insufficient to allow evaluation of the appropriateness of the present management measures in respect to the precautionary approach.

Source of information: Report of the Baltic Fisheries Assessment Working Group, April 2001 (ICES CM 2001/ACFM:18).

Turbot in Sub-divisions 22 to 32

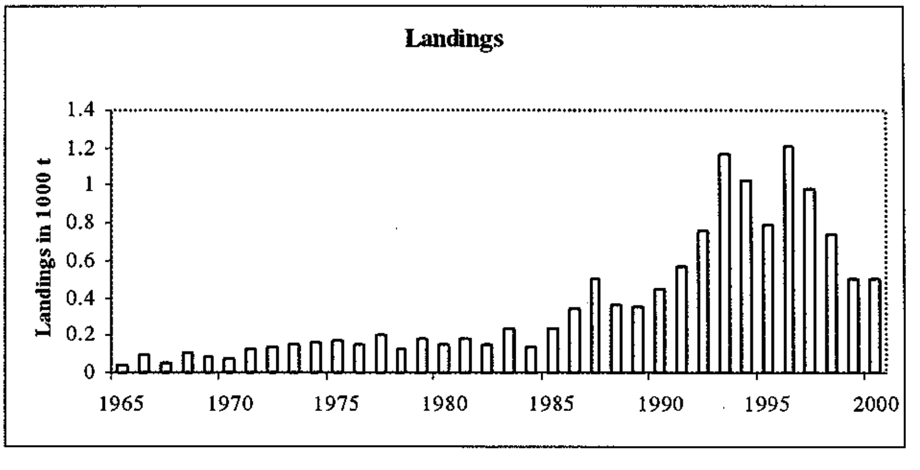


Table 3.13.13.1 Total landings (tonnes) of Turbot in the Baltic by sub-division and country. (There are some gaps in the information, therefore "Total is preliminary).

Year	Denmark			Germ. Dem.R.[1]		Germany, Fed. Rep.						Poland		Sweden[2]							Latvia		Lithuania[5]	Russia
	22	23	24(25)	22	24	22	24	25	26	27	28	25(+24)	26	22	23	24	25	26	27	28(+29)	26	28	26	26
1966	16		21	5	53																			
1967	14		20	7	10																			
1968	14		18	3	67																			
1969	13		13	4	57																			
1970	11		13	5	40											2								
1971	11		26	4	86											2								
1972	10		26	3	100											3								
1973	11		30	3	33							58	13			5								
1974	14		40	2	23							34	36			6								
1975	27		48	3	38	15						23	6			7								
1976	29		24		52	11						14	12			7								
1977	32		37		55	9						12	55			8								
1978	33		37	2	27	9						7	3			10								
1979	23		38	3	39	6						29	34			12								
1980	28		38		30	9						12	20			15								
1981	28		62	1	46	8						10	19			7								
1982	31		51	1	27	7						2	17			3	4		4	3				
1983	33		40	3	9	8						5	4			31	41		35	24				
1984	41		45	4	8	12						13	2			3	4		3	2				
1985	56		34	5	22	15						67	15			4	5		4	3				
1986	99		81	6	32	25						32	37			6	8		7	5				
1987	134		93	4	34	30						155	21			8	11		9	6				
1988	117		117	3	28	34						7	10			12	16		14	9				
1989	135		109	7	22	20							11			11	15		13	9				
1990	178		181	4	2	26						24	25			14								
1991	228		137			44	39					73	20			2	12		16					
1992	267		127			55	68					80	55			12	12		21	36				30
1993	159	29	152			74	56					520	72		2	4	14		13	38				34
1994	211	18	166			52	57	10				380	30		2	3	18	1	17	44				15
1995	257	11	94			65	53	4				30	15		2	3	54	9	31	83	34	27		20
1996	207	12	95			36	47	4		1		288	92	1	3	15	100	5	54	104	42	3	76	25
1997	151		68			60	52	3				290	70		2	6	70	1	53	86	33	14		25
1998	138		80			44	55	1				66	68		2	4	58	1	18	69	12	24		96
1999	106		59			23	48					18	15		2	4	41	3	17	60	20	34		48
2000[4]	97		58			23	54					90	12		2	3	39		16	39	7	9		53

continued

Table 3.13.13.1 Continued

Year	Total							Total
	22	23	24[3]	25	26	27	28(+29)	22-28(+29)
1965	3		39					42
1966	21		74					95
1967	21		30					51
1968	17		85					102
1969	17		70					87
1970	16		55					71
1971	15		114					129
1972	13		129					142
1973	14		68	58	13			153
1974	16		69	34	36			155
1975	45		93	23	6			167
1976	40		83	14	12			149
1977	41		100	12	55			208
1978	44		74	7	3			128
1979	32		89	29	34			184
1980	37		83	12	20			152
1981	37		115	10	19			181
1982	39		81	6	17	4	3	150
1983	44		80	46	4	35	24	233
1984	57		56	17	2	3	2	137
1985	76		60	72	15	4	3	230
1986	130		119	40	37	7	5	338
1987	168		135	166	21	9	6	505
1988	154		157	23	10	14	9	367
1989	162		142	15	11	13	9	352
1990	208		197	24	25			454
1991	272		178	85	20	16		571
1992	322		207	92	85	21	36	763
1993	233	31	212	534	106	13	38	1,167
1994	263	20	226	408	46	17	44	1,024
1995	322	13	150	88	78	31	110	792
1996	244	15	157	392	240	55	107	1,210
1997	211	2	126	363	129	53	100	984
1998	182	2	139	125	177	18	93	736
1999	129	2	111	59	86	17	94	498
2000[4]	120	2	115	129	72	16	48	502

[1] From October-December 1990 landings of Germany, Fed. Rep. are included

[2] For the years 1970-1981 and 1990 the catches of Sub-divisions 25-28 are included in Sub-division 24

[3] For the years 1970-1981 and 1990 the Swedish catches of Sub-divisions 25-28 are included in Sub-division 24

[4] Provisional.

[5]Lithuania, for 1995,1997,1998,1999 and 2000 no data reported

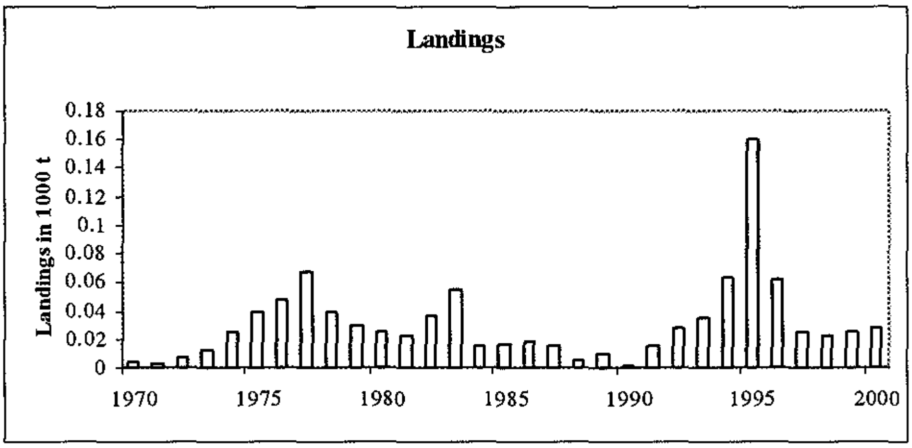
3.13.14 Brill

State of stock/exploitation: The available data do not permit the current stock size and exploitation to be assessed.

Elaboration and special comment: The landings of brill in the Baltic are low and are typically less than 50 t (Table 3.13.14.1) and are mainly taken in Sub-division 22.

Source of information: Report of the Baltic Fisheries Assessment Working Group, April 2001 (ICES CM 2001/ACFM:18).

Brill in Sub-divisions 22 to 32



million in 2000. The wild smolt production, which may be about 0.5 million, constitutes about 15% of the total smolt production. Most of the stocks remain in the coastal area within about 150 km of the point of release, but a high proportion of those from Poland and some from southern Sweden migrate further into offshore areas. Coastal populations are mainly taken in gillnets or trap nets. In the Gulf of Bothnia, they are caught as a by-catch in fisheries for whitefish. The stocks entering the offshore area are exploited by salmon drift netting and long lines. Sea trout are important for the recreational fishery in coastal areas and rivers. The catches of sea trout have been quite variable in recent years, but it seems likely that misreporting of salmon as sea trout in some years has influenced the statistics.

IBSFC has not established any management objectives for sea trout.

The populations in the Gulf of Bothnia (Sweden and Finland), particularly those in Sub-division 31, are in a poor state. Several of these populations are overexploited to the extent that they now exist mainly as non-migratory brown trout populations. The state of the populations in the remainder of the Baltic Sea is variable, but in general better than in the Gulf of Bothnia.

Sea trout are affected by M74 to a much lesser degree than salmon are. Populations in some rivers in the Gulf of Finland and the southern part of Gulf of Bothnia and northernmost part of the Main Basin have exhibited a limited incidence of M74. The situation in the Main Basin is less well known.

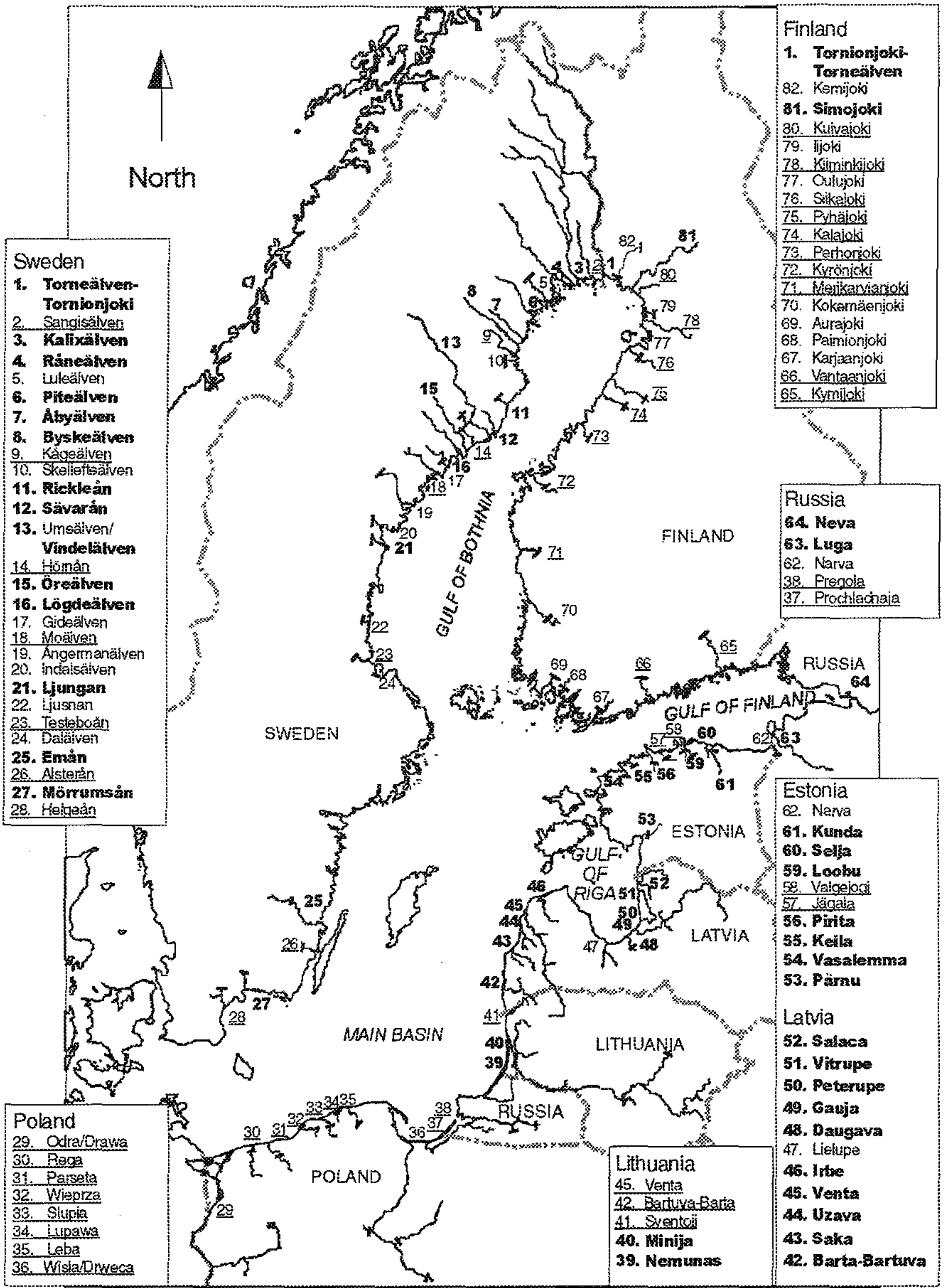


Figure 3.13.15.a.1 Baltic salmon rivers divided into three categories (see above figure). Only lower parts of rivers with current salmon production or potential for production of wild salmon are shown. The presence of dams, which prevents access to areas, is indicated by lines across rivers. *Notation:* **river name in bold** = *river with wild smolt production*; river name underlined = *river with potential for establishment of wild salmon*; normal font = *river with releases, no natural reproduction.*

3.13.15.b Salmon in the Main Basin and the Gulf of Bothnia (Sub-divisions 22–31)

State of stocks/fishery: Parr densities in most rivers being monitored in the Gulf of Bothnia are improving and smolt production should exceed the 50% target for most monitored rivers by 2002. Wild smolt production in the Main Basin is more uncertain due to poorer monitoring, but is thought to be as good or better than in rivers Flowing into the Gulf of Bothnia. The survival rate of smolt to adult has not been determined for these larger smolt year classes. Therefore the status of the wild stock as a whole, although unquestionable improved, remains uncertain. Catches of salmon are given in Tables 3.13.15.b.1 and 3.13.15.b.2.

Salmon smolt production in the Gulf of Bothnia and Baltic Main Basin are shown below (in millions):

Year	Wild[1]	Reared	Total
1987	0.43	5.55	5.98
1988	0.42	5.67	6.09
1989	0.43	5.23	5.66
1990	0.42	4.39	4.81
1991	0.43	4.09	4.52
1992	0.47	4.70	5.17
1993	0.51	5.37	5.88
1994	0.60	3.95	4.55
1995	0.30	4.49	4.79
1996	0.31	4.74	5.05
1997	0.35	5.20	5.55
1998	0.46	5.61	6.07
1999	0.56	5.45	6.01
2000	1.16	5.83	7.02
2001[2]	1.42	5.61	7.03

[1]Data on wild smolt production since the 1990s is to a large extent based on annual surveys. Smolt production estimates based on counts only for rivers Tornionjoki and Simojoki (20–30% of total production). [2]Preliminary data.

Wild stocks: There are wild salmon populations in 13 rivers discharging into the Gulf of Bothnia. In the early 1990s, most populations in this area were depleted, producing 5-20% of their potential. The management measures taken, including the reduction in TAC and the national regulatory measures, coincided with the occurrence of a strong brood-year class in 1990 and increased parr densities in almost all of these rivers in 1996–2000. Improved parr densities are expected to give high smolt runs in 2001–2002 (3–4 year old smolts) and good spawning runs in 2002–2005 (Table 3.13.15.b.3). In a small number of rivers entering into the Gulf of Bothnia populations are improving only slowly, often from returning numbers so low that the stocks were at risk of extinction. The spawning run in 2000, originating from the small year classes 1994–1995, was low and estimated egg deposition was about the same as in year 1999. The spawning runs of multi-sea-winter wild salmon are expected to be low also for the year 2001, mainly because the population in the sea consists at present mainly of 1995–1996 year classes which suffered high M74 mortality (Table 3.13.15.b.4). However, the spawning run of one sea-winter salmon is expected to increase in 2001.

In the Main Basin area the status of populations is somewhat better in terms of parr densities and number of spawners than in the Gulf of Bothnia. In general, smolt production in rivers in the area are higher in relation to production capacity than in the Gulf of Bothnia. However, the status of individual rivers is generally uncertain due to incomplete monitoring. Recent parr surveys in Latvian rivers suggest that these stocks are not affected by M74.

Reared stocks: Most of the salmon smolt recruitment originates from the releases. Tagging results suggest that survival of reared smolts has declined since the early 1990s, and no indication of increase has been observed (Figure 3.13.15.b.1).

Management objectives: The IBSFC objective is to increase the natural production of wild Baltic salmon to at least 50% of the natural production capacity of each river by 2010, while retaining the catch level as high as possible.

Advice on management: ICES advises that a continuation of the national and international measures in place in 1997-2000, with the TAC for 2002 of 410 000 salmon, is consistent with the Salmon Action Plan.

ICES further advises that the exploitation in rivers should be closely monitored and kept sufficiently low to allow the number of spawning fish to increase. Some rivers have reached what is considered to be full production and many more rivers may achieve this status shortly. As rivers reach full production density-dependent interaction may become a concern and there may be implications for the best way to distribute harvest among rivers. For these reasons IBSFC should consider setting spawning stock targets for individual rivers, which are at or near full production.

Relevant factors to be considered in management: Many indices show that many populations are benefiting from current management measures, thereby increasing the probability of achieving the management objective. However, there is less or no improvement in parr densities in some rivers, particularly those with very low escapements at the beginning of the current management initiative. Therefore, the exploitation rate must be kept very low on the Baltic salmon while the stocks are exploited in mixed fisheries. Otherwise the small stocks, which are recovering much more slowly, could suffer over-exploitation. From a biological perspective all wild stocks should be rebuilt as quickly as possible.

ICES is aware that current harvest advice would result in a certain amount of reared fish returning to their release site, and thus not being harvested with current management measures. If river-specific measures could be developed to harvest such surplus reared fish without by-catch of wild salmon, such harvesting could proceed, and be incremental to the TAC without causing a conservation concern. Some relevant experience on strategies for harvesting surplus reared salmon without increasing exploitation on wild stocks has been acquired in other jurisdictions, and could guide development of national programs to harvest surplus reared salmon. However, any such programs should be reviewed by ICES prior to implementation, to ensure that they provide protection to wild stocks.

TAC is an effective tool to safeguard salmon in the Main Basin to allow them to begin their spawning run. However, to restrict fishing mortality in coastal fisheries directed at homing wild salmon, complementary technical measures are essential. In the Gulf of Bothnia the date of opening coastal fisheries has been delayed to restrict the harvest of the early run when the proportion of multi-sea-winter wild salmon is the largest. As the spawning migration covers a short time period and is progressing quickly, a change in opening date would cause large differences in exploitation and have a corresponding effect on spawning stock size.

There is evidence from tagging that survival rate from smolt to adult may be declining. Such declines could offset the improvements in smolt production and justify caution in harvesting. Increasing catches, before the survival rate of these larger smolt runs is known, could jeopardise the progress achieved to date with the salmon recovery plan. In addition, the lowered relative abundance of the reared component in the standing stock leads to a higher exploitation of the wild component in the TAC management regime.

The factors influencing the development of M74 are poorly understood. The M74 mortality has varied over the years (Table 3.13.15.b.4) and sudden unpredictable changes in the incidence of the disease may occur. This is an additional justification for a cautious harvesting.

The salmon fishery in the Baltic Sea is based mainly on reared fish. In recent years reared fish should have constituted about 90% of the catch, based on the ratio of smolt production of reared and wild fish. Nevertheless, data on coastal tagging and sampling of spawners indicate that the proportion of wild salmon in the catch is higher than previously considered, which implies a higher survivorship for wild smolts compared to reared.

Yield from salmon smolt releases has been decreasing since 1994. Lower catches have been explained by reduced TAC and strong regulations in coastal fisheries. Decreases are also considered to result from reduced survival of salmon in post-smolt phase. According to tagging data the return rate for year classes since 1996 is lower than average rates in the long term. Return rates fluctuate in the same tempo in Sweden and Finland, which indicates that long-term variation may be caused by temporary changes in the Baltic Sea ecosystem (Figure 3.13.15.b.1). A ca. 20% survival rate has traditionally been assumed for reared salmon; however, it seems likely that the post-smolt survival is considerably below this value at present.

Management measures taken have decreased the offshore and coastal exploitation since the early 1990s. This has resulted in an increase in the proportion of reared fish returning to the rivers (Figure 3.13.15.b.2). Similarly there seems to be a trend of increasing catch in rivers with large compensatory releases. However, the differences in development in rivers is so pronounced that it is impossible to draw general conclusions regarding the size of the increase over the entire Main Basin and Gulf of Bothnia (Figure 3.13.15.b.3).

Some reviews assume that present management measures result in a large amount of non-exploited surplus of reared salmon in the rivers. The limited information available does not support the idea of a large non-exploited amount of salmon in the Main Basin. Instead in the Gulf of Bothnia there may be some non-harvested surplus of reared salmon, but there are considerable differences among rivers. Based on the limited data available, there seems to be a difference among Finnish and Swedish rivers. There is probably a larger number of non-exploited fish in Swedish rivers, because the coastal fishery outside rivers and river fisheries are less intense than in Finland. ICES recognises that present data on abundance of reared salmon spawners in rivers are based mainly on small scale mark-recapture estimates, made 3–5 years ago. ICES therefore recommends that larger studies should be carried out to estimate the exploitation and abundance of spawners in several rivers. These studies should be carried out before any management plan is implemented to utilise an assumed large number of non-exploited reared salmon in the rivers.

Non-reported catches and discards are estimated to be about 20% of the reported landings (in numbers), each being about the same magnitude. About 70% of discards are caused by seal damages. Catch losses have continued to increase and the most serious damage occurs in the Sub-divisions 29–31. These losses are not included in the TAC, so as catch losses by seals continue to increase, the total number of salmon killed in the fishing gear will increase even with a *status quo* TAC, affecting achievement of rebuilding objectives. Moreover, it is pointed out that the effect of seals has consequences on fishery at different levels:

- the direct catch loss due to damaged or escaped fish;
- capital losses due to gear damages;
- indirect effects through changes of fishing strategy;
- effects of fishery through competition for the salmon resource.

Forecast for 2001:

Wild stocks: From surveys of juvenile salmon in the rivers it was estimated that the wild smolt run in 2000 was 1.16 million. This was about 72% of the potential production as presently estimated. The number of spawners in 1996-1998 and densities of parr in 1997-1999 in Finnish and Swedish rivers suggest that the smolt production in these rivers will peak in 2001 and come down a little again in 2002 (Table 3.13.15.b.3).

Reared stocks: The production of reared smolts in 2000 was 5.86 million, and is expected to be 5.61 million in 2001.

Elaboration and special comment: In some rivers parr densities in recent years have been far above the range of historically reliable data. Although earlier studies have found no density dependency from parr to smolt or smolt to adult survivorship, that situation may not apply at the higher densities now observed. Until survivorship rates at current parr densities can be assessed, the forecasts of smolt production and adult returns in the next few years will be uncertain.

At present the assessment is based on a complex of stocks from rivers having wild salmon populations. There is an indication that the populations in the larger rivers have increased, while the status of populations in smaller, more vulnerable rivers is improving much more slowly (Table 3.13.15.b.3 and Figure 3.13.15.b.4).

Because of the depleted state of many wild populations it is necessary to monitor the status of as many populations as possible. However, better analysis of the status of salmon populations will require an intensified long-term monitoring, which for practical reasons will have to concentrate on a few selected rivers (index rivers). A number of index rivers have been established as a part of the IBSFC Salmon Action Plan. According to the IBSFC the status of wild salmon populations in these rivers will be considered the basis for monitoring the fulfilment of the Salmon Action Plan. It is only in the Gulf of Bothnia, however, where both smolt trapping and counting of spawners are planned to take place in the same river. ICES stresses that both elements must occur in index rivers in the Main Basin and the Gulf of Finland as well as in the Gulf of Bothnia. Otherwise it will be not be possible to evaluate reliably the future development of populations in these areas.

Estimates of wild smolt production are available for each region, but estimates in the Main Basin are based on limited surveys.

Because the management objective is to achieve 50% of the potential production level, the potential production level should be well defined. Ideally target production sizes should include consideration of both the production capacity of habitats and stock-recruitment curves. However, Baltic salmon populations have been depleted for more than 30 years and there is no empirical basis for estimating parameters of such models. Estimates of potential production in the Baltic Sea rivers are normally based on measurements of the reproductive area in combination with an estimated smolt production per unit area. These estimates may need to be revised when more data accumulate at higher production levels. In addition, the potential production estimates should be considered as average potential values, which suggest that even after rebuilding is completed they may be substantially exceeded in some years, and may also occasionally experience shortfalls.

ICES considers that the following guidelines are appropriate for use in the development of more reliable values of potential production:

1) An inventory of the size and quality of the parr rearing habitat areas for each river according to an agreed protocol. This should preferably be combined with electrofishing surveys stratified by quality of areas;
2) Measurement of the parr and smolt production in regional index rivers for a number of years. Because of the large variation it is necessary to measure for a number of years at high production levels before estimating the potential production in a river;
3) The values for the index river are transferred to other rivers in the region via measurement of the habitat area and the quality gradation of them.

The stock estimates are based on electrofishing surveys, smolt trapping, age-disaggregated catch and tagging data.

Source of information: Report of the Baltic Salmon and Trout Assessment Working Group, April 2001 (ICES CM 2001/ACFM:14).

Catch data (Tables 3.13.15.b.1–2):

TACs

Year	ICES Advice	Catch corresp. to advice '000 t	Rec. TAC '000 fish	Agreed TAC[1] '000 t	Agreed TAC[1] '000 fish
1987	No increase in effort	-	-		
1988	Reduce effort	<3.00			
1989	TAC	2.90	850		
1990	TAC	1.68			
1991	Lower TAC	-[2]	-[2]	3.35	
1992	TAC		688	3.35	
1993	TAC		500[3]		650
1994	TAC		500[3]		600
1995	Catch as low as possible in offshore and coastal fisheries	-	-		500
1996	Catch as low as possible in offshore and coastal fisheries	-	-		450
1997	Catch as low as possible in offshore and coastal fisheries	-	-		410
1998	Offshore and coastal fisheries should be closed	-	-		410
1999	Same TAC and other management measures as in 1998		410		410
2000	Same TAC and other management measures as in 1999		410		450
2001	Same TAC and other management measures as in 2000		410		450
2002	Same TAC and other management measures as in 2001		410		

Landings

Year	Rivers		Coast		Offshore		Coast and Offshore[4]		Total	
	'000 t	'000 fish	'000 t	'000 fish	'000 t	'000 fish	'000 t	'000 fish[5]	'000 t	'000 fish[5]
1987	0.05		0.39		3.21		3.59	891	3.64	897
1988	0.06		0.41		2.43		2.85	784	2.90	791
1989	0.08		0.65		3.27		3.92	1035	4.00	1049
1990	0.13		1.31		3.65		4.96	1113	5.08	1131
1991	0.12		1.03		3.00		4.03	757	4.15	776
1992	0.12		1.24		2.66		3.90	710	4.02	727
1993	0.11		0.83		2.57		3.40	679	3.52	657
1994	0.10		0.58		2.25		2.83	584	2.93	595
1995	0.12		0.67		1.98		2.65	553	2.77	571
1996	0.21	36	0.73	168	1.77	366	2.50	534	2.65	570
1997	0.28	45	0.78	149	1.53	282	2.31	431	2.59	476
1998	0.19	30	0.55	104	1.56	314	2.11	418	2.30	449
1999	0.17	30	0.57	104	1.25	256	1.82	360	1.99	390
2000[6]	0.17	29	0.52	97	1.42	303	1.94	400	2.11	429

[1]TAC does not include river catch. [2]TAC much below present levels. [3]Equivalent to 2.25–2.70 thousand t.
[4]For comparison with TAC. [5]Catch in numbers before 1993 based on estimates. [6]Preliminary.

Table 3.13.15.b.1 Nominal catches of Baltic Salmon in tonnes round fresh weight, from sea, coast and river by country and region in 1972 – 2000. (2000 provisional figures). S=sea, C=Coast, R=river.

Year	Main Basin (Sub-divisions 22-29)										
	Denmark	Finland	Germany	Poland	Sweden		USSR		Total		
	S	S+C	S	S	S	R	S	C+R	S	C+R	GT
1972	1034	122	117	13	277	0	0	107	1563	107	1670
1973	1107	190	107	17	407	3	0	122	1828	125	1953
1974	1224	282	52	20	403	3	21	155	2002	158	2160
1975	1112	211	67	10	352	3	43	194	1795	197	1992
1976	1372	181	58	7	332	2	84	123	2034	125	2159
1977	951	134	77	6	317	3	68	96	1553	99	1652
1978	810	191	22	4	252	2	90	48	1369	50	1419
1979	854	199	31	4	264	1	167	29	1519	30	1549
1980	886	305	40	22	325	1	303	16	1881	17	1898

Year	Main Basin (Sub-divisions 22-29)																						
	Denmark		Estonia		Finland			Germany	Latvia		Lithuania		Poland			Russia	Sweden			Total			
	S	C	S	C	S	C	R	S	S	C	S	C	S	C	R	S	S	C	R	S	C	R	GT
1981	844	*	23	0	310	18	0	43	167	17	36	na	45	na	na	56	401	0	1	1925	35	1	1961
1982	604	*	45	0	184	16	0	20	143	31	30	na	38	na	na	57	376	0	1	1497	47	1	1545
1983	697	*	55	0	134	18	0	25	181	105	33	na	76	na	na	93	370	0	2	1664	123	2	1789
1984	1145	*	92	0	208	29	0	32	275	89	43	na	72	na	na	81	549	0	4	2497	118	4	2619
1985	1345	*	87	0	280	26	0	30	234	90	41	na	162	na	na	64	842	0	5	3085	116	5	3206
1986	848	*	52	0	306	38	0	41	279	130	57	na	137	na	na	46	764	0	4	2530	168	4	2702
1987	955	*	82	0	446	40	0	26	327	68	62	na	267	na	na	81	887	0	4	3133	108	4	3245
1988	778	*	60	0	305	30	0	41	250	96	48	na	93	na	na	74	710	0	6	2359	126	6	2491
1989	850	*	67	0	365	35	0	52	392	131	70	na	80	na	na	104	1053	0	4	3033	166	4	3203
1990	729	*	68	0	467	46	1	36	419	188	66	na	195	na	na	109	949	0	9	3038	234	10	3282
1991	625	*	64	0	478	35	1	28	361	120	62	na	77	na	na	86	641	0	14	2422	155	15	2592
1992	645	*	19	4	354	25	1	27	204	74	20	na	170	na	na	37	694	0	7	2170	103	8	2281
1993	575	*	23	4	425	76	1	31	204	52	15	na	191	na	na	49	754	7	5	2283	139	6	2428
1994	737	*	2	4	372	80	1	10	97	33	5	na	184	na	na	29	574	11	8	2010	128	9	2147
1995	556	*	4	3	613	86	1	19	100	39	2	na	121	12	na	36	464	13	6	1915	153	7	2075
1996	525	*	2	4	306	53	1	12	97	53	14	na	124	1	na	35	551	8	5	1666	119	6	1791
1997	489	*	1	5	359	44	0	38	106	64	1	4	110	0	0	23	354	9	7	1481	126	7	1614
1998	485	10	0	4	324	14	0	42	65	60	1	4	105	9	4	33	442	3	7	1497	104	11	1612
1999	385	10	0	4	234	108	0	29	107	59	1	5	122	9	4	22	334	2	7	1234	197	11	1442
2000	411	10	1	7	254	98	0	44	91	58	na	na	125	13	6	23	461	2	8	1410	188	14	1612
Mean 95-99	488	10	1	4	367	61	0	28	95	55	4	4	116	6	3	30	429	7	6	1559	140	8	1707

Continued

Table 3.13.15.b.1 Continued

Year	Gulf of Bothnia (Sub-divisions 30-31) Denmark	Finland			Sweden			Total				Main Basin+Gulf of Bothnia (Sub-divs. 22-31) Total		
	S	S	S+C	C	S	C	R	S	C	R	GT	S	C+R	GT
1972	11	0	143	0	9	126	65	163	126	65	354	1726	298	2024
1973	12	0	191	0	13	166	134	216	166	134	516	2044	425	2469
1974	0	0	310	0	15	180	155	325	180	155	660	2327	493	2820
1975	98	0	412	0	33	272	127	543	272	127	942	2338	596	2934
1976	38	271	0	155	22	229	80	331	384	80	795	2365	589	2954
1977	60	348	0	142	49	240	60	457	382	60	899	2010	541	2551
1978	0	127	0	145	18	212	40	145	357	40	542	1514	447	1961
1979	0	172	0	121	20	171	35	192	292	35	519	1711	357	2068
1980	0	162	0	148	23	172	35	185	320	35	540	2066	372	2438

Year	Gulf of Bothnia (Sub-divisions 30-31) Finland			Sweden			Total				Main Basin + Gulf of Bothnia (Sub-divisions 22-31) Total			
	S	C	R	S	C	R	S	C	R	GT	S	C	R	GT
1981	125	157	6	26	242	35	151	399	41	591	2076	434	42	2552
1982	131	111	3	0	135	30	131	246	33	410	1628	293	34	1955
1983	176	118	4	0	140	32	176	258	36	470	1840	381	38	2259
1984	401	178	5	0	140	52	401	318	57	776	2898	436	61	3395
1985	247	151	4	0	114	38	247	265	42	554	3332	381	47	3760
1986	124	176	5	11	146	41	135	322	46	503	2665	490	50	3205
1987	66	173	6	8	106	38	74	279	44	397	3207	387	48	3642
1988	74	146	6	1	141	48	75	287	54	416	2434	413	60	2907
1989	225	207	6	10	281	68	235	488	74	797	3268	654	78	4000
1990	597	680	14	12	395	103	609	1075	117	1801	3647	1309	127	5083
1991	580	523	14	1	350	90	581	873	104	1558	3003	1028	119	4150
1992	487	746	14	7	386	95	494	1132	109	1735	2664	1235	117	4016
1993	279	426	16	10	267	91	289	693	107	1089	2572	832	113	3517
1994	238	269	14	0	185	73	238	454	87	779	2248	582	96	2926
1995	66	302	20	0	214	97	66	516	117	699	1981	669	124	2774
1996	96	350	93	5	261	110	101	611	203	915	1767	730	209	2706
1997	44	360	110	1	295	158	45	655	268	968	1526	781	275	2582
1998	57	225	43	2	224	137	59	449	180	688	1556	553	191	2300
1999	17	175	23	1	195	133	18	370	156	544	1252	567	167	1986
2000	11	161	27	0	167	133	11	328	160	499	1421	516	174	2111
Mean 95-99	56	282	58	2	238	127	58	520	185	763	1616	660	193	2470

Continued

Table 3.13.15.b.1 Continued

Year	Gulf of Finland (Sub-division 32)					Sub-division 22-32		
	Finland			USSR		Total		
	S	S+C	C	S	C+R	S	C+R	GT
1972	0	138	0	0	0	1864	298	2162
1973	0	135	0	0	0	2179	425	2604
1974	0	111	0	0	0	2438	493	2931
1975	0	74	0	0	0	2412	596	3008
1976	81	0	0	0	14	2446	603	3049
1977	75	0	0	0	13	2085	554	2639
1978	68	0	1	0	6	1582	454	2036
1979	63	0	3	0	4	1774	364	2138
1980	51	0	2	0	7	2117	381	2498

Year	Gulf of Finland (Sub-division 32)												Sub-division 22-32			
	Estonia			Finland			Russia		Total				Total			
	S	C	R	S	C	R	S	R	S	C	R	GT	S	C	R	GT
1981	0	2	0	46	1	0	5	0	51	3	0	54	2127	437	42	2606
1982	0	5	0	91	7	0	0	0	91	12	0	103	1719	305	34	2058
1983	0	3	0	163	32	0	0	0	163	35	0	198	2003	416	38	2457
1984	0	5	0	210	42	0	7	0	217	47	0	264	3115	483	61	3659
1985	0	4	0	219	34	2	20	0	239	38	2	279	3571	419	49	4039
1986	24	0	0	270	79	2	28	0	322	79	2	403	2987	569	52	3608
1987	10	0	0	257	61	2	23	0	290	61	2	353	3497	448	50	3995
1988	19	0	0	122	112	2	15	0	156	112	2	270	2590	525	62	3177
1989	36	0	0	181	145	2	37	0	254	145	2	401	3522	799	80	4401
1990	25	0	0	118	369	2	35	4	178	369	6	553	3825	1678	133	5636
1991	22	0	0	140	398	2	88	3	250	398	5	653	3253	1426	124	4803
1992	6	3	0	77	415	2	28	1	111	418	3	532	2775	1653	120	4548
1993 1)	3	1	1	91	309	3	39	2	133	310	6	449	2705	1142	119	3966
1994	3	1	0	88	141	6	15	1	106	142	7	255	2354	724	103	3181
1995	1	1	0	32	200	5	25	2	58	201	7	266	2039	870	131	3040
1996	0	3	0	83	324	10	10	2	93	327	12	432	1860	1057	221	3138
1997	0	4	0	89	341	10	4	0	93	345	10	448	1619	1126	285	3030
1998	0	4	0	21	156	10	0	3	21	160	13	194	1577	713	204	2494
1999	0	10	0	29	127	7	0	3	29	137	10	176	1281	704	177	2162
2000	0	14	1	30	104	11	0	4	30	118	16	164	1451	634	190	2275
Mean 95-99	0	4	0	51	230	8	8	2	59	234	10	303	1675	894	204	2773

* No fishery occurred.
All data from 1972-1994, includes sub-divisions 24-32, while it is more uncertain in which years sub-divisions 22-23 are included. The catches in sub-divisions 22-32 are normally less than one tonnes. From 1995 data includes
Catches from the recreational fishery are included as follows: Finland from 1980, Sweden from 1988, Denmark from 1998.
Other countries have no, or very low recreational catches.
Danish, Finnish, German, Polish and Swedish catches are converted from gutted to round fresh weight w by multiplying by 1.1.
Estonian, Latvian, Lithuanian and Russian catches before 1981 are summarized as USSR catches.
Estonian, Latvian, Lithuanian and Russian catches are reported as hole fresh weight.
Sea trout are included in the sea catches in the order of 3 % for Denmark (before 1983), 3% for Estonia, Germany, Latvia, Lithuania, Russia, and about 5% for Poland (before 1997).
Estonian sea catches in Sub-division 32 in 1986-1991 include a small quantity of coastal catches.
Estimated non-reported coastal catches in Sub-division 25 has from 1993 been included in the Swedish statistics.
Danish coast catches are non-profesional trolling catches.
1) In 1993 fishermen from the Faroe Islands caught 16 tonnes, which are included in total Danish catches.

Table 3.12.15.b.2 Nominal catches of Baltic Salmon in numbers, from sea, coast and river by country and region in 1996-2000 (2000 provisional figures). S=sea, C=coast, R=river.

Year	Main Basin (Sub-divisions 22-29)																					
	Denmark		Estonia		Finland			Germany	Latvia		Lithuania		Poland			Russia	Sweden			Total			
	S	C	S	C	S	C	R	S	S	C	S	C	S	C	R	S	S	C	R	SEA	COAST	RIVER	GT
1996	105934	0	263	528	58844	8337	200	2400	19400	10577	1485	1059	27479	222	0	5199	121631	1322	633	342635	22045	833	365513
1997	87746	0	205	1023	61469	7018	0	6840	20033	12095	214	665	24436	0	65	4098	68551	1415	810	273592	22216	875	296683
1998	90687	2000	0	770	60248	2368	0	8379	13605	8098	288	781	23305	1927	890	6522	99407	573	940	302441	16517	1830	320788
1999	73956	2000	28	741	45652	15007	0	5805	24309	9059	166	1132	24435	1835	860	4330	74192	408	876	252873	30182	1736	263008
2000	82938	2000	129	1190	46803	13241	0	8810	24735	9106	na	na	25051	2679	1195	4648	107719	400	1005	300833	28616	2200	314291

Year	Gulf of Bothnia (Sub-divisions 30-31)										Main Basin + Gulf of Bothnia (Sub-divisions 22-31) Total			
	Finland			Sweden			Total							
	S	C	R	S	C	R	S	C	R	GT	SEA	COAST	RIVER	GT
1996	22196	84940	14000	1181	61239	20571	23377	146179	34571	204127	366012	168224	35404	569640
1997	8205	76683	17000	251	49724	27159	8456	126407	44159	179022	282048	148623	45034	475705
1998	11105	46269	5100	329	41487	23438	11434	87756	28538	127728	313875	104273	30368	448516
1999	3529	35348	3100	89	38447	25546	3618	73795	28646	106059	256491	103977	30382	390850
2000	2144	35560	3650	13	32588	23291	2157	68148	26941	97246	302990	96764	29141	428895

Year	Gulf of Finland (Sub-division 32)												Sub-divisions 22-32 Total			
	Estonia			Finland			Russia		Total							
	S	C	R	S	C	R	C 1)	R	S	C	R	GT	SEA	COAST	RIVER	GT
1996	0	396	0	20664	55840	1500	1485	296	20664	57721	1796	80181	386676	225945	37200	649821
1997	0	819	0	19577	54493	1500	1023	0	19577	56335	1500	77412	301625	204958	46534	553117
1998	22	761	76	4210	23876	1500	65	650	4232	24702	2226	31160	318107	128975	32594	479676
1999	12	1904	132	6234	19306	1100	95	915	6246	21305	2147	29698	262737	125282	32529	420548
2000	79	2833	254	6029	15607	1900	79	835	6108	18519	2989	27616	309098	115283	32130	456511

Data from the recreational fishery are included in Swedish and Finnish data. Recreational fishery are included in Danish data from 1998. Other countries have no, or very low recreational catches.
In 1996 sea trout are included in the Polish catches in the order of 5%.
1) Russian coastal catches have in earlier reports been recorded as sea catches.

Table 3.13.15.b.3 Salmon smolt production in Baltic rivers with natural reproduction of salmon in the 1980s and 1990s. Estimated number of smolts from natural reproduction and releases of reared fish.

Region, Sub-div. country and river	Category	Reprod. area ha	Poten-tial	Natural 1980s	1993	1994	1995	1996	1997	1998	1999	2000	Pred 2001	Pred 2002	Method of estimate Pot.prod.	Pres.prod	Reared 2000
Gulf of Bothnia, Sub-div. 31																	
Finland																	
Kiiminkijoki	potential	90	30	+	+	+	+	+	+	+	1	+	+	+	3	2	70
Pyhäjoki	potential	100	40	+	+	+	+	+	+	+	+	+	+	+	3	4	59
Simojoki	wild	255	75	10	10	12	1.4	1.3	2.5	9.4	9	57.4	66	79	3	2	76.4
Finland/Sweden																	
Tornionjoki;Torne älv	wild	5000	500	75	123	199	75	71	50	144	175	400	675	603	3	2	97.4
Sweden																	
Kalix älv	wild	2500	250	50	88	130	42	48	61	55	83.7	236	287	223	3	4	0
Råne älv	wild	390	20	+	+	3.2	2.1	2.2	0.5	1	2	8.1	8.8	7.1	3	4	0
Pite älv	wild	435	33	+	+	+	3	3	5	5.6	4.2	5.1	18	11.6	3	5	7.2
Åby älv	wild	80	16	+	+	5.8	1.9	2.3	3	6	6.5	9.9	16.3	18.5	3	4	0
Byske älv	wild	530	80	15	23	35	11	12	40	33	49	140	106	118	3	4	0
Sävarån	wild	20	4	+	+	+	+	+	0.1	0.7	0.7	1.1	1.5	2	3	4	4.2
Rickleån	wild	15	5	+	+	+	+	+	0.3	0.3	0.4	0.2	0.9	1	3	1 and 3	3.5
Ume/Vindelälven	wild	1000	200	25	23	39	15	14	13	24	52	116	75	36.5	3	4	0
Öre älv	wild	100	20	+	+	1.4	1.4	1.4	0.1	0.7	0.4	0.5	0.9	0.9	3	4	0.8
Lögde älv	wild	95	19	+	+	3.8	1.4	1.7	1.1	3.5	4.6	0.6	4.1	5.9	3	4	0
Sum of +				5	20	4	4	4									
Total Sub-div. 31		**10610**	**1292**	**180**	**287**	**433**	**158**	**161**	**177**	**283**	**389**	**975**	**1260**	**1107**			**319**
Gulf of Bothnia, Sub-div. 30																	
Ljungan	mixed	20	20	10	15	4	4	4	5	10	10	10	10	10	3	4	25.2
Total Gulf of B., Sub-divs.30-31			**1312**	**190**	**302**	**437**	**162**	**165**	**182**	**293**	**399**	**985**	**1270**	**1117**			**344**
Main Basin, Sub-divs. 22-29																	
Sweden																	
Emån	wild	21.7	15		5	4.5	3	2.5	4	3.5	4	5	3		3	4	0
Mörrumsån	wild	44	100		90	60	30	35	60	60	76	98	70		3	4	0
Total Sweden			115		95	64.5	33	37.5	64	63.5	80	103	73		6	8	0
Estonia																	
Pärnu	wild	3	3.5						3	2	1	0.1	0.02	0.03	4	3 and 4	
Latvia (1)																	
Salaca	wild		30		22	15	15	20	20	29	27	19	20	20	3	2	119.3
Vitrupe	wild				5	5	5	5	5	4	4	4	4	4	6	5	
Peterupe	wild				5	5	5	5	5	4	4	4	4	4	6	2 and 5	
Gauja	mixed				17	13	13	14	14	13	13	13	13	13	6	2 and 5	165.3
Daugava	mixed				5	5	5	5	5	5	5	5	5	5	6	5 and 7	642.9
Irbe	wild				10	10	8	7	7	7	7	7	7	7	6	5	
Venta	mixed				15	15	15	15	12	12	12	12	12	12	6	2 and 5	42.2
Saka	wild				10	10	10	10	8	7	7	7	7	7	6	5	
Uzava	wild				2	2	2	2	2	1	2	2	2	2	6	5	
Barta	wild				2	2	2	2	2	1	1	1	1	1	6	5	
Total Latvia			30		93	82	80	85	80	83	82	74	75	75			969.7
Lithuania																	
Nemunas river basin	wild		150		20	20	20	20	20	20	20	n/a	n/a	n/a	7	10	
Total Main B., Sub-divs. 22-29			**299**	**0**	**208**	**167**	**133**	**143**	**167**	**169**	**183**	**177.1**	**148**	**75.03**			**970**
Gulf of B.+Main B., Sub-divs. 22-31			**1611**		**510**	**604**	**295**	**307**	**349**	**462**	**582**	**1162**	**1418**	**1192**			**1313**

Continued

Table 3.13.15.b.3 Continued

Region, Sub-div. country and river	Category	Reprod. area ha	Poten-tial	Natural											Method of estimate		Reared
				1980s	1993	1994	1995	1996	1997	1998	1999	2000	Pred 2001	Pred 2002	Pot.prod.	Pres.prod	2000
Gulf of Finland, Sub-div. 32																	
Finland																	
Kymijoki	mixed	50	100				3	3	4	4	4	4	4	4	3	4	489.4
Total Finland		60	120				3	3	4	4	4	4	4	4	3	4	489.4
Russia																	
Neva	mixed	20	20				7	7	7	7	7	7	7	7	7	6 and 8	104
Luga	mixed	40	80				4	4	4	4	4	5	5	5	7	6 and 8	80
Total Russia		60	100				11	11	11	11	11	12	12	12			184
Estonia																	
Kunda	wild	1.5	2.1	+	+	+	+	+	+	+	+	1.8	0.8	0.4	3	3 and 4	0
Selja	mixed	9	10	+	+	+	+	+	+	0	0	1.4	0.2	0.13	3	3 and 4	31
Loobu	wild	6	6	+	+	+	+	+	+	+	0	0.3	0.3	0.4	3	3 and 4	0
Pirita	mixed	10	10	+	+	+	+	+	+	0	0	0	0.6	0	3	3 and 4	16
Vasalemma	wild	1	1	+	+	+	+	+	+	+	+	0	0.1	0.04	3	3 and 4	0
Keila	wild	3.5	4	+	+	+	+	+	+	+	+	0.3	1.5	0.16	3	3 and 4	0
Valgejögi	mixed	1.5	1.7	0	0	0	0	0	0	0	0	0	0.1	0.007	3	3 and 4	27
Jägala	mixed	0.3	1.5	0	0	0	0	0	0	0	0	0	0	0	3	3 and 4	5
Vääna	mixed	3.5	2.5	0	0	0	0	0	0	0	0	0	0	0.004	3	3 and 4	9
Total Estonia		36.3	38.8	15	15	15	7	7	8	6	2	3.8	3.6	1.148			88
Total Gulf of F., Sub-div. 32		**156**	**259**	**15**	**15**	**15**	**21**	**21**	**23**	**21**	**17**	**20**	**20**	**17**			**762**
Total Baltic, Sub-divs. 22-32 (1)			**1869**	**15**	**525**	**619**	**316**	**328**	**372**	**483**	**599**	**1182**	**1437**	**1209**			**2075**

+ = Low and uncertain production. (1) Estimate of potential production in Latvia is missing. n/a No data available.

Methods of estimating production

Potential production

1. Stock-recruitment curve.
2. Estimate of reproduction area, quality gradation of them and estimate of peak production per area from other source.
3. Estimate of reproduction area and peak production per area from other sources.
4. Accessible linear stream length and peak production per area from other sources.
5. Salmon catch series, exploitation and survival estimates.
6. No data.
7. Not known.

Present production

1. Complete count of smolts.
2. Sampling of smolts and estimate of total smolt run size.
3. Estimate of smolt run from parr production by relation developed in the same river.
4. Estimate of smolt run from parr production by relation developed in another river.
5. Inference of smolt production from data derived from similar rivers in the region.
6. Count of spawners.
7. Estimate inferred from stocking of reared fish in the river.
8. Salmon catch, exploitation and survival estimate.
9. No data.
10. Not known.

Table 3.13.15.b.4 M74-mortality (in %) of searun female spawners belonging to reared populations of Baltic salmon in hatching years 1985-2000 with projections for year 2001. All data originate from hatcheries.

River	Sub-div	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Simojoki (2)	31		6	2	6	3	*12*	0	53	74	*53*	92	*86*	91	31	59	38	
Torne älv (2)	31				5	6	1	29	70	76	89	76			25	61	32	50
Lule älv	31								58	66	62	50	52	38	6	34	21	25
Skellefteälven	31								40	49	69	49	77	16	5	42	12	
Ume/Vindelälven	30	40	20	25	19	16	31	45	77	88	90	69	78	37	16	53	45	
Ångermanälven	30								50	77	66	46	63	21	4	28	21	
Indalsälven	30	4	7	8	7	3	8	7	45	72	68	41	64	22	1	20	22	
Ljungan	30								64	*96*	*50*	56	28	*29*	10	25	10	
Ljusnan	30							17	33	75	64	56	72	22	9	41	25	
Dalälven	30	28	8	9	20	11	9	21	79	85	56	55	57	38	17	33	20	30
Mörrumsån	25	47	49	65	46	58	72	65	55	90	*80*	63	*56*	23				
Neva/Åland	29									70	50							
Neva/Kymi	32								45	60-70		57	*40*	*79*	42	20	28	
Mean River Lule, Indalsälven, Dalälven		16.0	7.5	8.5	13.5	7.0	8.5	14.0	60.7	74.3	62.0	48.7	57.7	32.7	8.0	29.0	21.0	27.5
Mean total		29.8	18.0	21.8	17.2	16.2	22.2	26.3	55.8	76.5	66.4	59.2	61.2	37.8	15.1	37.8	24.9	35.0

1.) River Lule älv missing before 1992 and River Indalsälven in year 2000.
All estimates known to be based on material from less than 20 females in italics.
2.)The estimates in the rivers Simojoki and Tornionjoki/Torne älv are if possible given as the percentage of females affected of M74 and secondly, percentage of yolk-sac-fry mortality.

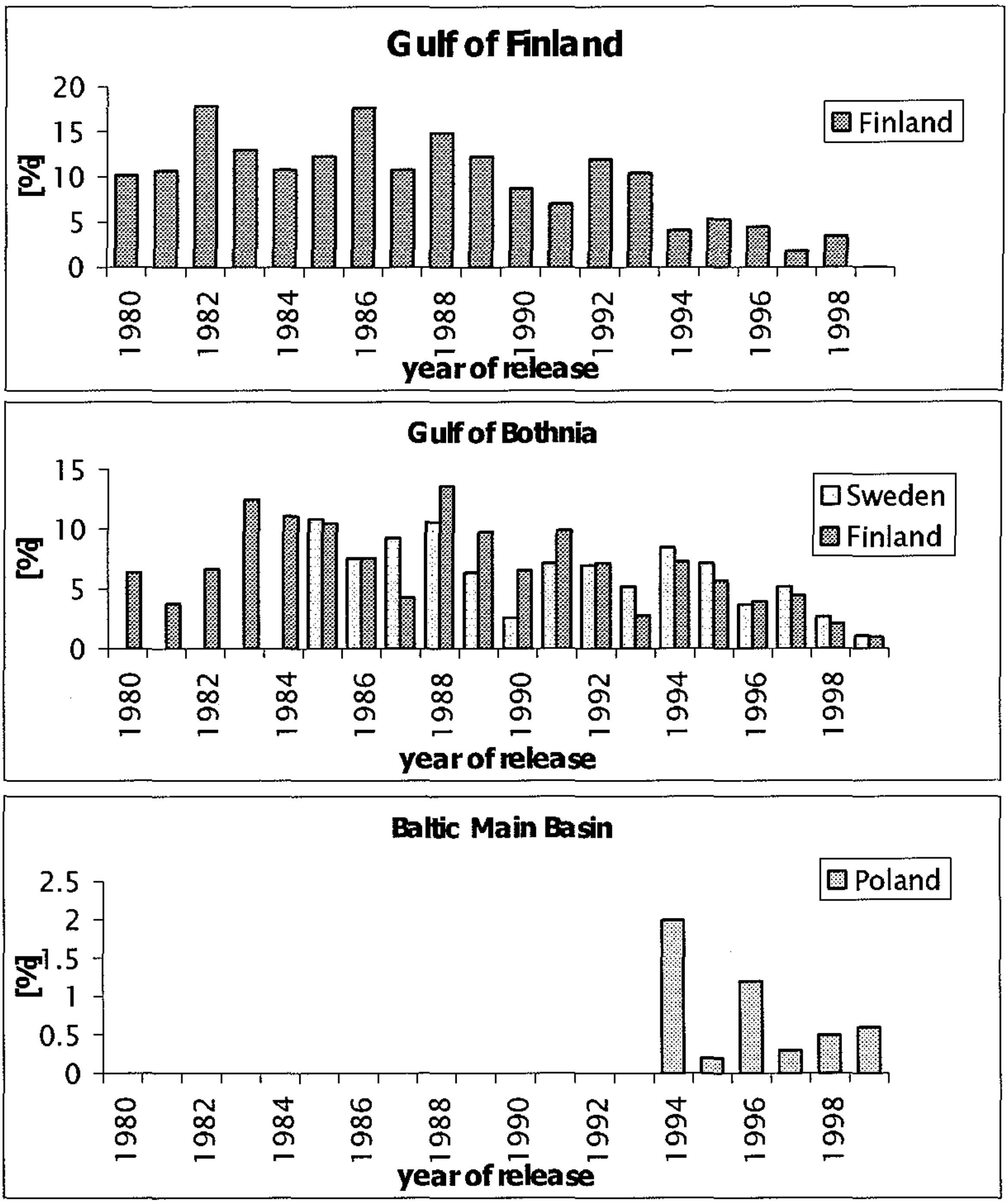


Figure 3.13.15.b.1 Recapture rate (in percent) of the tagged salmon released to Gulf of Finland, Gulf of Bothnia and Baltic Main Basin.

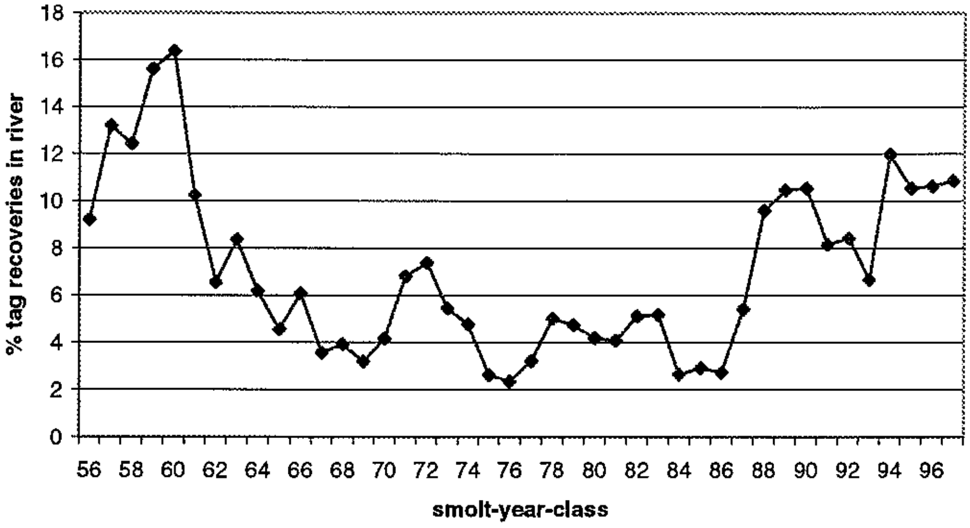


Figure 3.13.15.b.2 Percent of total tag recoveries in rivers from Swedish smolt releases in Gulf of Bothnia by year of release in years 1956-97.

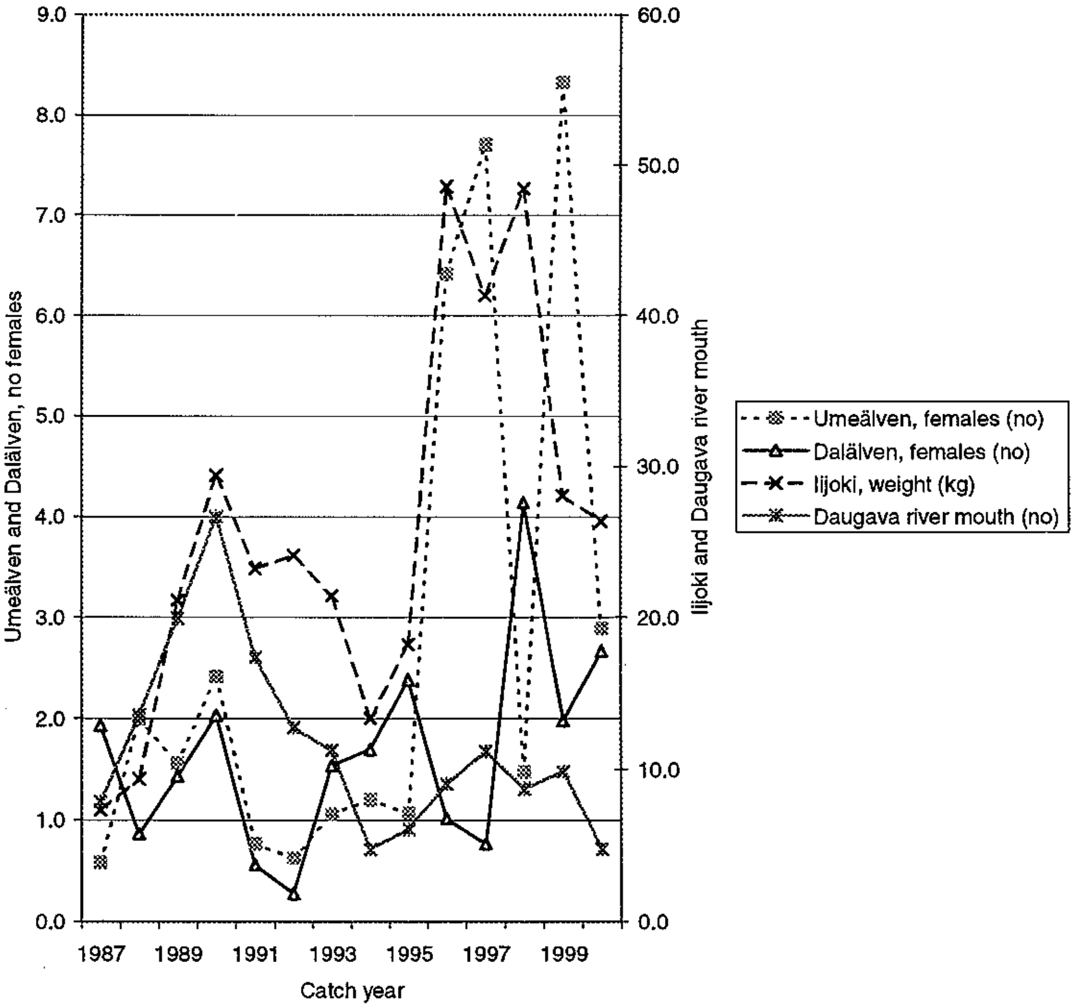


Figure 3.13.15.b.3 Catch of reared salmon in four rivers where gear have operated with constant effort in years 1987-2000. The figures are given per 1000 smolts released.

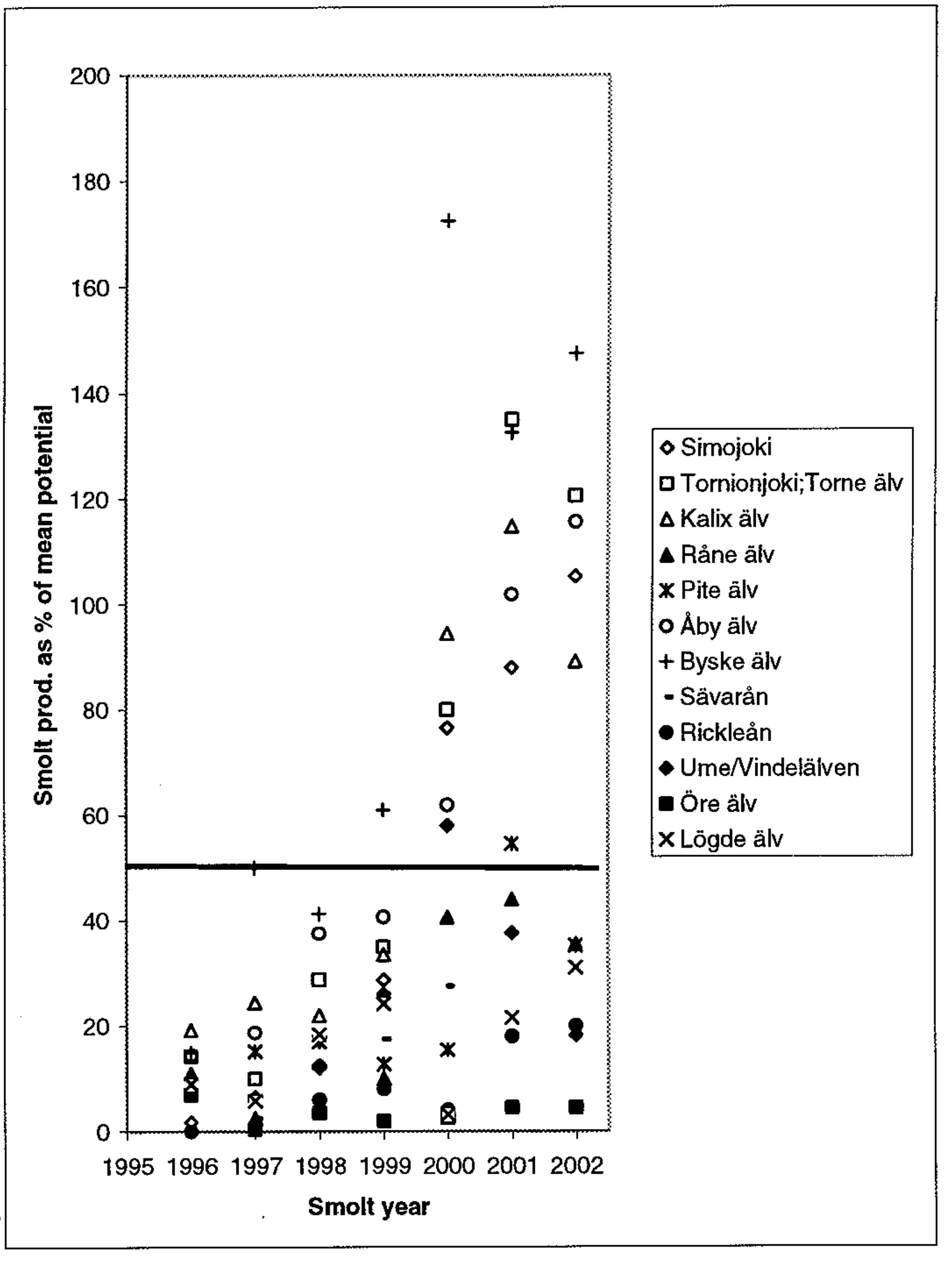


Figure 3.13.15.b.4 Estimated smolt production by river in % of the average potential for wild salmon rivers in The Gulf of Bothnia including predictions for 2001-2002. The line showing 50% of the (uncertain), potential production is indicated.

3.13.15.c Salmon in the Gulf of Finland (Sub-division 32)

State of stocks/fishery: ICES considers that the wild stocks are outside safe biological limits. Parr densities increased in most monitored rivers in 1999, but decreased again in 2000 (Table 3.13.15.c.1).

Salmon smolt production in the Gulf of Finland is shown below (in thousands):

Year	Wild[1]	Reared	Total
1987	15	593	608
1988	15	569	584
1989	15	432	447
1990	15	573	588
1991	15	501	516
1992	15	415	430
1993	15	558	573
1994	15	633	648
1995	10[3]	710	720
1996	10[3]	661	671
1997	12[3]	690	702
1998	10[3]	722	732
1999	6[3]	891	897
2000	8[3]	826	834
2001[2]	8[3]	791	799

[1]Data on wild smolt production assumed until 1994. 1995 figures based on surveys. [2]Preliminary data. [3]Data on wild production in Russia reported for 1995–2000: 11 000 smolts annually. Not included in table.

Wild stocks: Based on earlier evidence there are wild salmon populations in 9 Estonian rivers in the Gulf of Finland. Surveys indicate that parr densities vary strongly in these rivers, and densities are much lower than in rivers of similar type at these latitudes in average (Table 3.13.15.c.1). Five of these populations have been supported by smolt releases in the last few years.

Minor natural reproduction occurs as a consequence of large long-term releases in one Finnish river in the area. Surveys also indicate that some natural reproduction occurs in one or two Russian rivers. Also these two populations are supported by long-term releases (Table 3.13.15.b.3). However, there are no national plans to attain self-sustainable populations in these rivers.

Reared stocks: Most of the salmon catch in the Gulf of Finland originates from smolt releases. Despite increases in releases, the catches have decreased considerably in the last few years, which indicate a lowered initial smolt survival of released salmon (Figure 3.13.15.c.1). Also tagging results give evidence for decreased survival of reared smolts (Figure 3.13.15.b.1).

Management objectives: The IBSFC objective is to increase the natural production of wild Baltic salmon to at least 50% of the natural production capacity of each river by 2010, while retaining the catch as high as possible.

Advice on management: ICES recommends that, in light of the precarious state of wild stocks in the Gulf of Finland and the very low wild smolt production in 2000, fisheries should only be permitted at sites where there is virtually no chance of taking wild salmon along with reared salmon. It is particularly urgent that national conservation programmes to protect wild salmon be enforced around the Gulf of Finland.

Relevant factors to be considered in management: At present wild salmon populations occur in nine Estonian rivers and many of these populations are at risk of extinction. The potential smolt production is very small compared to all other wild salmon populations in the Baltic Sea. It is uncertain whether a much reduced TAC would affect the status of these stocks. The TAC has been reduced 4 times since 1996, but in 2000 it was still more then 3 times the catch, and not restrictive on harvests. Coastal fisheries at sites likely to be on migration paths of wild salmon from Estonian rivers present a particular threat to biological viability of these wild stocks. Coastal and river fisheries intercepting these populations should be prohibited. All possible means should be used to prevent all fishing in rivers and river mouths supporting these wild stocks. Additionally enhancement releases should be continued and expanded to avoid possible extinction of these stocks.

M74 caused high mortality among offspring of sea-run females in Finnish hatcheries in 1992–1997, but the M74-related mortality has lowered since 1998. No estimates are available for the mortality in 2001 (Table 3.13.15.b.4). Hatchery experiments suggest that M74-related mortality is low in Estonian salmon populations.

Tagged reared Latvian salmon recovered in the Gulf of Finland suggest that wild and reared Latvian salmon to some extent are also exploited in this area.

Forecast for 2001: A *status quo* projection for Sub-division 32 gives a catch prediction for 2001 and 2002 of 18 000 and 26 000 fish, respectively, to be compared to the catch in 2000 of 28 000 fish. The TAC for 2001 of 70 000 salmon is therefore not restrictive to the fishery.

Wild stocks: In Estonian rivers the wild production is less than in preceding years. Densities of 0+ parr in 2000 decreased from 1999 in most of the rivers, and production of smolts is expected to remain low in the coming years. Using the most recent estimate of wild production of 3 800 smolts, they represent less than 1% of the total smolt production (wild plus reared smolts). This is a much lower figure than in the Main Basin and the Gulf of Bothnia.

Reared stocks: The smolt production is expected to be about 800 000 smolts in 2001.

Elaboration and special comment: Considering that at present released smolts are estimated to outnumber wild smolts by approximately 50:1 in this area, the current management measures may be insufficient to ensure preservation of these stocks. Under these circumstances it would be appropriate to adopt additional measures specifically intended to prevent the biological extinction of wild salmon in the Gulf of Finland.

Small reproduction areas and unpredictable variation in the size of year-classes is characteristic of Estonian wild salmon rivers. Electrofishing surveys since the 1970s indicate that there has been no spawning in some years. In spite of improvement in the water quality in the 1990s, the natural reproduction has not increased in these rivers.

Fishing effort in the Estonian coast increased significantly in the 1990s. This partly illegal fishery developed quickly because the coastal fish stocks, salmonids included, had been under-exploited and catches were relatively good. The decline of agriculture and other industries in the region that resulted in decreased pollution of the streams should have had a positive effect on the salmon stocks. However, the decrease in the offshore fishery and improvement of water quality did not compensate for the effect of the increased coastal fishery, which exploits salmon and sea trout populations as by-catch.

The Finnish offshore and especially coastal fishery catch the major part of the total landings in the Gulf of Finland. However, the total effort has decreased in the last few years, because of the low catch per unit of effort combined with low price and particularly due to increased seal damages. Damage caused by seals is most severe at fishing sites furthest away from the coast, which has caused the trap net fishing to move closer to the shoreline.

There was no Russian commercial salmon fishery in the Gulf of Finland in year 2000, but the catch consisted of by-catch from other fisheries.

The assessment shows a very low initial survival for released smolts in the last four years compared to the early 1990s.

The analytical assessment is based on catch at age estimated from tag recoveries and catch samples. Estimates of wild production are based on limited surveys and do not include all rivers. Lack of data on the productivity in the freshwater phase prevents calculation of the appropriate TAC strategy to meet any target based on smolt production.

Source of information: Report of the Baltic Salmon and Trout Assessment Working Group, April 2001 (ICES CM 2001/ACFM:14).

Catch data (Table 3.13.15.c.1):

TACs

Year	ICES Advice	Catch corresp. to advice '000 fish	Agreed TAC '000 t	Agreed TAC '000 fish
1987	No advice	-		
1988	No advice	-		
1989	No advice			
1990	No advice			
1991	No advice		0.43	
1992	No advice		0.43	
1993	TAC for reared stock	109[1]		109
1994	TAC for reared stock	65[2]		120
1995	Catch as low as possible in offshore and coastal fisheries	-		120
1996	Catch as low as possible in offshore and coastal fisheries	-		120
1997	Offshore and coastal fisheries should be closed	-		110
1998	Offshore and coastal fisheries should be closed	-		110
1999	Offshore and coastal fisheries should be closed	-		100
2000	Only fishery on released salmon should be permitted	-		90
2001	Only fishery on released salmon should be permitted	-		70
2002	Only fishery on released salmon should be permitted	-		

[1]Equivalent of 600 t. [2]Equivalent of 400 t.

Landings

Year	River t	Coast t	Offshore t	Coastal and offshore[2] t	Coastal and offshore[2] '000 fish	Total t	Total '000 fish
1987	2	61	290	351		353	
1988	2	112	156	268		270	
1989	2	145	254	399		401	
1990	6	369	178	347		553	
1991	5	398	250	648		653	
1992	3	418	111	529		532	
1993	6	310	133	443		449	111
1994	7	142	106	248		255	57
1995	7	201	58	259	38	266	39
1996	12	327	93	420	78	432	80
1997	10	345	93	438	76	448	77
1998	13	160	21	181	29	194	31
1999	10	137	29	166	28	176	30
2000[1]	16	118	30	148	25	164	28

[1]Preliminary. Table revised because of additional data.
[2]For comparison with TAC.

Table 3.13.15.c.1 Densities of wild salmon parr in electrofishing surveys at permanent stations in rivers discharging into the Gulf of Finland, Sub-division 32.

River	Year	Number of parr/100m^2		Number of parr
		0+	1+ and older	
Kunda				
	1992	7.4	12.9	118
	1993	0	4.5	26
	1994	2.4	0	7
	1995	15.4	3.1	60
	1996	22.6	13.7	98
	1997	1.2	21.5	78
	1998	13.8	0.90	68
	1999	6.4	18.1	103
	2000	20.8	7.6	75
Selja				
	1995	1.3	6.5	18
	1996	0	0.4	1
	1997	0	0	0
	1998	0	0	0
	1999	0.1	2.3	26
	2000	1.2	0.4	32
Loobu				
	1994	1.2	2.8	23
	1995	0.2	0.2	2
	1996	0	0.4	2
	1997	0	0.3	3
	1998	0.2	0	1
	1999	10.5	0.8	70
	2000	0.6	0.8	17
Valgejõgi				
	1998	0	0	0
	1999	2.4	0	26
	2000	0.4	1	14
Jägala				
	1998	0	0	0
	1999	0.5	0	2
	2000	0	0	0
Pirita				
	1992	1.9	0.7	11
	1993**)			
	1994	0	0	0
	1995	0	0	0
	1996	0	+	1
	1997*)			
	1998	0	0	0
	1999	6.5	0	55
	2000	0	0.9	13
Vääna				
	1998	0	0.1	1
	1999	0	0	0
	2000	0.1	0	1
Keila				
	1994	1.1	1.1	12
	1995	6.9	0.3	105
	1996	11.7	1.1	115
	1997	0	5.2	47
	1998	0	1.1	10
	1999**)	95	1.3	154
	2000	3.8	6.6	52
Vasalemma				
	1992	3.4	2.6	23
	1993*)			
	1994	1.9	0	7
	1995	18.7	0.4	99
	1996	4.8	5	51
	1997	0	1.5	8
	1998	0	0.2	2
	1999	13.5	0	80
	2000	3.5	1.7	27

*) = no electrofishing
**)= Flow was extremely small and fish were concentrated on little area
+ = minor production.

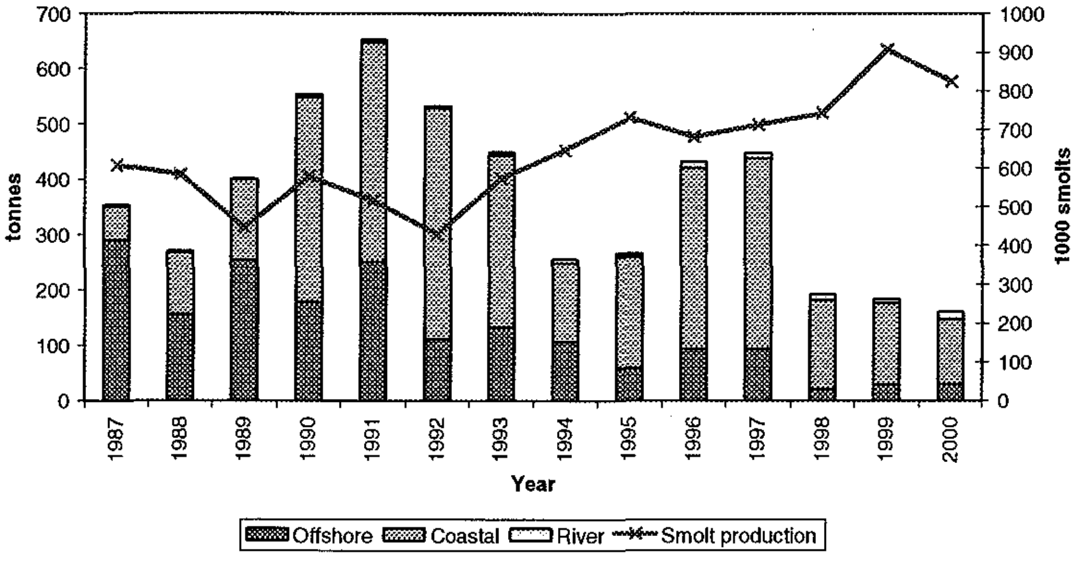


Figure 3.13.15.c.1 Salmon catches and smolt production in the Gulf of Finland in 1987-2000.

3.13.15.d Sea trout

State of stocks/fishery:

Wild stocks: Currently approximately 400 rivers in the Baltic Sea support wild populations of sea trout. There are no estimates of the original number of sea trout populations or quantitative estimates of the total natural smolt production. Stocks in several rivers in the Main Basin are considered to be in good or satisfactory condition with nursery areas well utilised. However, populations in numerous small Danish brooks are assessed to be in poor condition. In the Gulf of Bothnia the status of most stocks particularly in Sub-division 31 is poor or unknown (Table 3.13.15.d.1). Several of these populations are probably overexploited to the extent that they now mainly exist as non-migratory brown trout.

Reared stocks: Sea trout smolt production is shown below (in thousands):

Year	Baltic Main Basin	Gulf of Bothnia	Gulf of Finland	Total
1987	994	1081	358	2433
1988	1312	1083	226	2621
1989	1537	906	198	2641
1990	1237	1035	237	2509
1991	665	1186	259	2110
1992	1023	1247	314	2584
1993	1576	1171	251	2998
1994	1485	985	285	2755
1995	1967	1243	378	3588
1996	1509	1416	139	3064
1997	2726	970	220	3916
1998	2545	943	378	3866
1999	2506	971	355	3832
2000	1825	987	353	3164

Hatchery production in the Main Basin has increased in recent years, while the smolt production in the Gulf of Bothnia has been rather stable.

Forecast for 2001: Not available.

Elaboration and special comment: The production of sea trout in the Baltic Sea is dominated by reared production to a similar extent as production of salmon is.

Sea trout stocks in the Baltic Sea exhibit two types of migration pattern. Most of the stocks migrate in the coastal area within about 150 km of the point of release, but particularly those from Poland and some from southern Sweden migrate further into offshore areas. The fish that migrate only short distances are mainly exploited in coastal and river fisheries, and they are also affected by the coastal salmon fisheries. Fish that migrate offshore are to a large extent taken as a by-catch in the offshore salmon fishery. The stocks remaining in coastal waters are only exploited in local fisheries and may therefore be managed on a national or local basis, but the stocks migrating into offshore areas would benefit from international management measures. It is not known to what extent stocks in southern Sweden migrate to offshore areas. The management of many of these populations would benefit from knowledge of their migration pattern.

The exploitation pattern is rather variable in different areas. In the Gulf of Bothnia and Gulf of Finland sea trout are to a large extent caught in gill nets for whitefish, and to a minor extent in a recreational net fishery or in trap nets. National management agencies around the Gulf of Bothnia and Gulf of Finland should consider changes in local fishery regulations as well as implementation of restoration programs to improve the status of these sea trout populations, which are in a poor state.

Source of information: Report of the Baltic Salmon and Trout Assessment Working Group. April 2001 (ICES CM 2001/ACFM:14).

Catch data[2] (Table 3.13.15.d.2):

Year	Baltic Main Basin t	Gulf of Bothnia t	Gulf of Finland t	Total t
1987	319	150	184	653
1988	331	282	290	903
1989	460	331	298	1089
1990	794	432	337	1563
1991	613	463	297	1373
1992	611	469	322	1402
1993	901	250	718	1869
1994	769	190	648	1607
1995	647	227	119	993
1996	511	238	95	844
1997	474	238	93	805
1998	741	252	159	1152
1999	898	319	104	1321
2000[1]	1046	325	93	1464

[1]Preliminary data. [2]No catch advice is given for sea trout. Catch figures do include recreational fisheries only for some countries.

Table 3.13.15.d.1 Status of monitored wild and mixed sea trout population in 2000.

	Poor	Satisfactory	Good	Not known	Total number
Gulf of Bothnia					
Sub-div 31					
Finland	1	1			2
Finland/Sweden		1			1
Sweden	10	2			12
Sub-div 30					
Sweden	13	9	1	15	38
Finland		1			1
Main Basin					
Sweden	25	23	11	15	74
Estonia	2	5	1	13	21
Latvia	2	5	8		15
Lithuania					
Poland	10	8	5	1	24
Danmark (Sub-div 22-25)	82	52	16		150
Russia				5	5
Gulf of Finland					
Finland	5				5
Russia				15	15
Estonia	6	5	3	23	37
Total	**156**	**112**	**45**	**87**	**400**

Table 3.13.15.d.2 Nominal catches (tonnes) of sea trout in the Baltic Sea, S=Sea, C=Coast and R=River.

Year	Baltic Main Basin													Gulf of Bothnia					Gulf of Finland			Total
	Denmark[1,4]	Estonia	Finland[2]	Germany[4]	Latvia	Lithuania		Poland			Sweden[4]			Finland[2]		Sweden			Estonia	Finland[2]		
	S + C	C	S + C	C	C	S	C	S[9]	S + C	R	S[6]	C[6]	R	C	R	S[6]	C[6]	R	C	C	R	
1979	3	na	10	na	na	na	na	na	81[3]	24	na	na	3	6	na	na	na	na	na	73	0	200
1980	3	na	11	na	na	na	na	na	48[3]	26	na	na	3	87	na	na	na	na	na	75	0	253
1981	6	na	51	na	5	na	na	na	45[3]	21	na	na	3	131	na	na	na	na	2	128	0	392
1982	17	na	52	1	13	na	na	na	80	31	na	na	3	134	na	na	na	na	4	140	0	475
1983	19	na	50	na	14	na	na	na	108	25	na	na	3	134	na	na	na	na	3	148	0	504
1984	29	na	66	na	9	na	na	na	155	30	na	na	5	110	na	na	na	na	2	211	0	617
1985	40	na	62	na	9	na	na	na	140	26	na	na	13	103	na	na	na	na	3	203	0	599
1986	18	na	53	na	8	na	na	na	91	49	7	9	8	118	na	1	24	na	2	178	0	566
1987	31	na	66	na	2	na	na	na	163	37	6	9	5	123	na	1	26	na	na	184	0	653
1988	28	na	99	na	8	na	na	na	137	33	7	12	7	196	na	na	44	42	3	287	0	903
1989	39	na	156	18	10	na	na	na	149	35	30	17	6	215	na	1	78	37	3	295	0	1,089
1990	48[3]	na	189	21	7	na	na	na	388	100	15	15	10	318	na	na	71	43	4	334	0	1,563
1991	48[3]	1	185	7	6	na	na	na	272	37	26	24	7	349	na	na	60	54	2	295	0	1,373
1992	27[3]	1	173	na	6	na	na	na	221	60	103	26	1	350	na	na	71	48	8	314	0	1,402
1993	59[3]	1	386	14	17	na	na	na	202	70	125	21	2	160	na	na	47	43	14	704[7]	0	1,869
1994	33[8,3]	2	384	15[8]	18	+	+	na	152	70	76	16	3	124	na	na	24	42	6	642	0	1,607
1995	69[8,3]	1	226	13	13	+	3	na	187	75	44	5	11	162	na	na	33	32	5	114	0	993
1996	71[8,3]	2	76	6	10	+	2	na	150	90	93	2	9	151	25	na	20	42	14	78	3	844
1997	53[8,3]	2	44	+	7	na	2	na	200	80	72	7	7	156	12	na	16	54	8	82	3	805
1998	60	2	103	4	7	na	na	208	184	76	88	3	6	192	12	0	9	39	6	150	3	1,152
1999	110[8,3]	2	84	9	10	0	1	384	126	116	51	2	3	248	12	0	18	41	8	93	3	1,321
2000[5]	58	4	99	9	14	0	1	474	268	70	42	4	3	256	12	0	18	39	10	80	3	1,464

[1] Additional sea trout catches are included in the salmon statistics for Denmark until 1982 (table 3.1.2).

[2] Finnish catches include about 70 % non-commercial catches in 1979 - 1995, 50 % in 1996-1997.

[3] Rainbow trout included.

[4] Sea trout are also caught in the Western Baltic in Sub-divisions 22 and 23 by Denmark, Germany and Sweden.

[5] Preliminary data.

[6] Catches reported by licensed fishermen and from 1985 also catches in trapnets used by nonlicensed fishermen.

[7] Finnish catches include about 85 % non-commercial catches in 1993.

[8] ICES Sub-div. 22 and 24.

+ Catch less than 1 tonne.

[9] Catches in 1979-1997 included sea and coastal catches,since 1998 costal (C) and sea (S) catches are registered separately

na=Data not available

3.13.16 In-year revision of Baltic cod TAC

IBSFC has requested ICES to:

"Update the advised [cod] TAC for 2001, taking into account the most recent survey and catch information."

Because of new information about the state of the stock, ICES advises that there be no fishing for eastern Baltic cod in 2002 (see Section 3.13.9) and that fishing cease on the eastern stock as soon as possible, i.e. for the remainder of 2001.

IBSFC established a cod TAC for 2001 of 105 000 t. The assessment of both the western and the eastern stocks in 2001 are lower than was estimated in 2000. A 2001 TAC set at a particular fishing mortality is therefore lower than was estimated in 2000. The 2001 assessment presents a further year of data and is therefore more precise than the 2001 forecast presented last year. Also, because the assessment is subject to noise it cannot be expected that the assessment in 2001 will be exactly identical to the assessment presented in 2000.

Because the splitting of TAC between the two cod stocks is not specified, no precise estimate of a 2001 catch corresponding to particular fishing mortalities can be given. As an illustration, the advice for the western stock was for a reduction in F of 20%, while the advice for the eastern stock was for a reduction in F to 0.3* F_{sq}. The predicted catch for 2001 for this option was in the advice provided last year 87 600 t, while the assessment now available indicates a catch from the two stocks combined for this option of 67 500 t.

3.13.17 Cod catches in pelagic fisheries

ICES used the International Baltic Sea Sampling Program database (IBSSP II) to assess cod by-catches in the pelagic fisheries and to evaluate the consequences of lowering the present 10% by-catch rule of cod in the herring and sprat fisheries (IBSFC fishing rule 8.3).

The distributions of samples by Sub-division and share of trips with observed by-catch of cod are presented in Figure 3.13.17.1. In general, the cod by-catches in sampled pelagic fisheries were generally low (near zero), but the highest share of trips with by-catch was in Sub-divisions 24–26.

Tables 3.13.17.1–2 present the total amount of cod by-catch and discards in the pelagic fishery raised from the combined herring and sprat landings by year/quarter/Sub-division/country strata for the years 1998–2000. The highest by-catch of cod in the pelagic fishery was in the first and second quarter of the three years. Discards occurred in all quarters of 2000, with more than 85% (by weight) in the third quarter, but only in the first quarter of 1999, and none were recorded in 1998.

The total share of cod by-catch in the combined total landings of sprat and herring fisheries was within the range of 1.3% to 2.0% in the years 1998–2000. Whilst it is not possible to evaluate how much of the cod by-catch is recorded in official catch statistics, a lowering of the present 10% by-catch fishing rule will not significantly improve the state of the cod stock.

Table 3.13.17.1 The total cod by-catch and discard in pelagic fisheries by Sub-division and year (t).

Subdivision	By-catch			Discard		
	2000	1999	1998	2000	1999	1998
22	0.0	0.0	268.2	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0	0.0	0.0
24	28.8	47.8	4.9	11.1	30.0	0.0
25	1397.6	1476.0	795.4	44.8	110.6	0.0
26	662.7	0.0	271.4	149.0	0.0	0.0
27	0.0	0.0	0.0	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0	0.0	0.0
29	0.0	0.0	0.0	0.0	0.0	0.0
30	1.4	0.0	0.0	0.0	0.0	0.0
31	0.0	0.0	0.0	0.0	0.0	0.0
32	0.7	0.2	0.4	0.0	0.0	0.0
Total	2091.3	1523.9	1340.3	204.9	140.6	0.0

Table 3.13.17.2 The total cod by-catch and discard in pelagic fisheries by quarter and year (t).

Year	By-catch					Discard				
	Quarter					Quarter				
	1	2	3	4	Total	1	2	3	4	Total
2000	402.4	1326.3	182.6	179.9	**2091.3**	13.4	15.1	174.5	1.9	**204.9**
1999	1315.5	0.0	0.0	208.4	**1523.9**	140.6	0.0	0.0	0.0	**140.6**
1998	329.3	474.8	268.6	267.6	**1340.3**	0.0	0.0	0.0	0.0	**0.0**

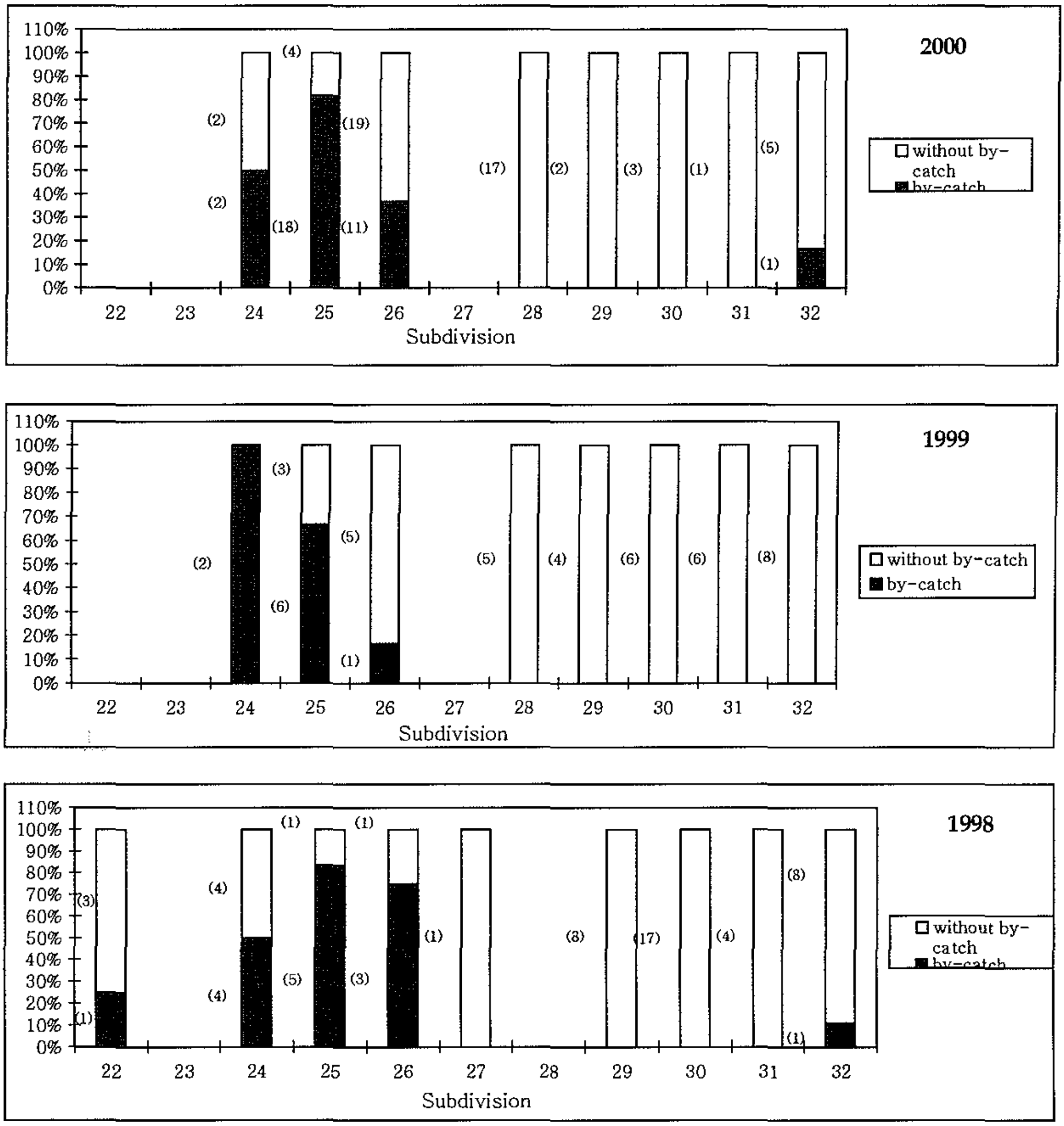


Figure 3.13.17.1 The share of journeys with occurring cod by-catch in pelagic fisheries by Sub-division and (the numbers in brackets indicate the number of journeys).

3.13.18 Reference points for herring and sprat – Maturity ogive

ICES investigated the effect on biological reference points of changes in the maturity ogives of Baltic herring and sprat. For each of the two stocks three maturity ogive options were used to estimate biological reference points. The results of the calculations are presented in Tables 3.13.18.1 and 3.13.18.2.

The estimates for $\mathbf{F}_{pa}$ and $\mathbf{F}_{lim}$ for herring remain unchanged from those reported last year; whilst the estimate of $\mathbf{F}_{pa}$ for sprat remains unchanged from that reported last year.

No new maturity ogives were used for the assessments of the herring and sprat stocks in the Baltic, but mean maturity ogives covering the years 1997–2000 were calculated (Tables 3.13.18.3 and 3.13.18.4).

Table 3.13.18.1 The impact of different maturity at age on the estimated reference points foro herring in Sub-divisions 25-29+32.

Herring 25-29+32, Maturity at age

Age	Presently used	New estim. 1997-99	Average
1	0.00	0.01	0.00
2	0.70	0.60	0.65
3	0.90	0.83	0.87
4	1.00	0.91	0.95
5	1.00	0.93	0.97
6	1.00	0.93	0.97
7	1.00	0.93	0.97
8	1.00	0.93	0.97
9	1.00	0.93	0.97
mean(1-3)	0.533	0.479	0.506

The estimates of F reference points

Ref. point	Maturity		
	Presently used	New estim. 1997-99	Average
F0.1	0.24	0.24	0.24
Flow	0.05	0.04	0.04
Fmed	0.21	0.18	0.19
Fhigh	0.29	0.26	0.28
F35%SPR	0.26	0.26	0.26
Floss	0.32	0.28	0.30

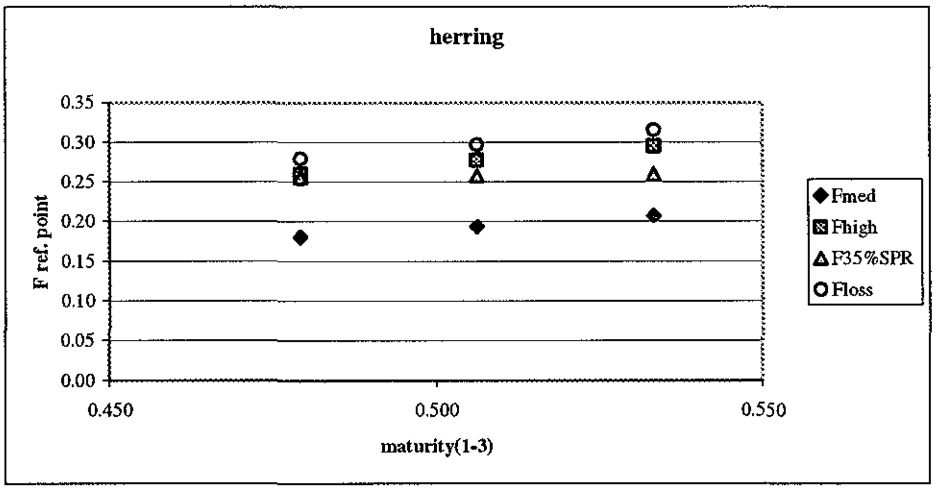


Table 3.13.18.2 The impact of different maturity at age on the estimated reference points for sprat in Sub-divisions 22-32.

Sprat 22-32, Maturity at age

Age	Presently used	New estim. 1997-99	Average
1	0.00	0.32	0.16
2	0.70	0.91	0.80
3	1.00	0.97	0.98
4	1.00	0.97	0.99
5	1.00	0.98	0.99
6	1.00	0.99	0.99
7	1.00	0.98	0.99
8	0.23	0.97	0.98
Mean(1-3)	0.567	0.731	0.649

The estimates of F reference points

Ref. point	Maturity		
	Presently used	New estim. 1997-99	Average
F0.1	0.42	0.42	0.42
Flow	0.00	0.00	0.00
Fmed	0.43	0.59	0.50
Fhigh	1.28	2.21	1.67
F35%SPR	0.37	0.46	0.41
Floss	1.25	2.15	1.63

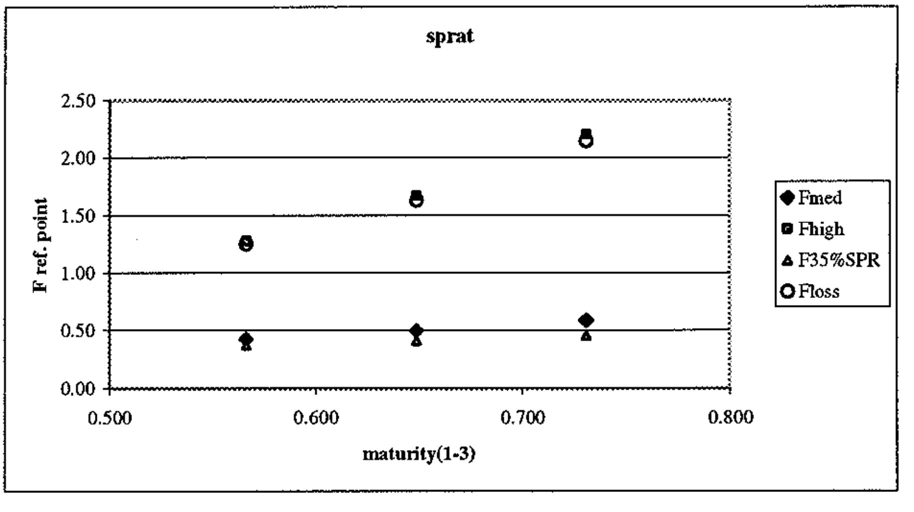


Table 3.13.18.3 Proportion mature at age for the herring stock in Sub-divisions 25-29+32 by Sub-division and source. 1996-2000 (for Sub-divisions25. 26 and 27 the same ogive was assumed.

Year	Sub-division	Prop. of the stock[1]	Age group 1	2	3	4	5+	Source
1996	25	25	0.000	0.223	0.471	0.661	0.778	GFR
	26	14						
	27	9						
	28 (open-sea h.)	10	0.000	0.380	0.680	0.840	1.000	LAT
	28 (Gulf of Riga)	10	0.000	0.728	0.921	0.974	0.990	LAT
	29	17	0.000	0.942	1.000	1.000	0.996	EST
	32(Gulf herring)	15	0.000	0.683	0.943	0.987	0.995	EST
	Weighted mean		0.000	0.480	0.698	0.817	0.891	
1997	25	25	0.000	0.815	1.000	1.000	1.000	POL
	26	14	0.000	0.797	0.996	0.989	1.000	POL,rev.
	27	9						
	28 (open-sea h.)	10	0.000	0.670	0.880	1.000	1.000	LAT
	28 (Gulf of Riga)	10	0.000	0.710	0.975	0.973	1.000	LAT
	29	17	0.000	0.787	0.984	0.991	1.000	EST
	32(Gulf herring)	15	0.099	0.511	0.922	0.959	0.975	EST
	Weighted mean		0.015	0.731	0.969	0.984	0.996	
1998	25	25	0.000	0.690	0.948	0.980	1.000	POL
	26	14	0.000	0.715	0.986	1.000	1.000	POL
	27	9						
	28 (open-sea h.)	10	0.000	0.610	0.830	0.860	1.000	LAT
	28 (Gulf of Riga)	10	0.000	0.645	0.933	0.983	0.951	LAT
	29	17	0.000	0.779	0.970	0.988	0.988	EST
	32(Gulf herring)	15	0.056	0.496	0.921	0.978	0.995	EST
	Weighted mean		0.008	0.667	0.940	0.972	0.992	
1999	25	25	0.000	0.763	1.000	1.000	1.000	POL
	26	14	0.000	0.900	1.000	1.000	1.000	POL
	27	9						
	28 (open-sea h.)	10	0.000	0.580	0.930	0.930	0.980	LAT
	28 (Gulf of Riga)	10	0.000	0.822	0.935	0.971	0.986	LAT
	29	17						
	32(Gulf herring)	15						
	Weighted mean							
2000	25	25	0.017	0.845	1.000	1.000	1.000	POL
	26	14	0.017	0.798	1.000	1.000	1.000	POL
	27	9						
	28 (open-sea h.)	10	0.000	0.870	0.960	0.920	0.960	LAT
	28 (Gulf of Riga)	10	0.000	0.843	0.964	1.000	1.000	LAT
	29	17	0.180	0.910	0.930	0.920	1.000	FIN
	32(Gulf herring)	15	0.000	0.460	0.960	0.970	1.000	FIN
	Weighted mean		0.039	0.801	0.975	0.974	0.996	
	Mean 96-98,2000		0.016	0.479	0.852	0.937	0.963	
	WG data		0.000	0.700	0.900	1.000	1.000	

SD 29 = coastal sping spawners

SD 28 (Gulf of Riga) = Gulf of Riga herring. Proportions mature at age are probably underestimated.

SD 28 (open-sea h.): proportions mature at age are probably underestimated.

SD 32 = Gulf herring

[1] mean of the catch proportions (%) from 1986-1998

Table 3.13.18.4 Proportion mature at age for the sprat stock in Sub-divisions 22-32 by Sub-division and source, 1997-2000 (preliminary means, for Sub-division 28 partly the maturity ogive from Russia (Sub-division 26, 2nd quarter) is taken, stock component III is neglected, for Sub-division 26 in 2000 only Polish data were taken).

Year	Sub-division	Prop. of the stock[1]	Age group 1	2	3	4	5	6	7	8	9	Source	
	22+24	6 (I)											
	25	25 (I)	0.366	0.922	0.937	0.933	0.954	0.879	0.933	1.000	1.000	POL (24)+25 Q1	rev.2001
	26	31 (II)	0.000	0.624	0.890	0.819	0.908	0.951	0.968	1.000	1.000	POL Q1	rev.2001
			0.168	0.944	1.000	1.000	1.000	1.000				RUS Q2	
1997			0.084	0.784	0.945	0.910	0.954	0.976	1.000	1.000	1.000	Mean	
	27	6 (III)											
	28	21 (II)	0.168	0.944	1.000	1.000	1.000	1.000	1.000	1.000	1.000	RUS 26 Q2	
	29	6 (III)											
	32	5 (III)											
	Weighted mean		0.211	0.876	0.956	0.941	0.966	0.946	0.975	1.000	1.000		
	22+24	6 (I)											
	25	25 (I)	0.373	1.000	1.000	1.000	0.984	1.000	1.000	1.000	1.000	POL (24)+25 Q1	rev.2001
	26	31 (II)	0.132	0.955	0.996	1.000	1.000	1.000	0.863	1.000		POL Q1	rev.2001
			0.139	0.933	1.000	1.000	1.000	1.000	1.000			RUS Q2	
1998			0.136	0.944	0.998	1.000	1.000	1.000	0.932			Mean	
	27	6 (III)											
	28	21 (II)	0.063	1.000	1.000	1.000	1.000	1.000	1.000			LAT	
	29	6 (III)											
	32	5 (III)											
	Weighted mean		0.206	0.979	0.999	1.000	0.994	1.000	0.974	1.000	1.000		
	22+24	6 (I)											
	25	25 (I)	0.749	0.998	1.000	1.000	1.000	1.000	1.000	1.000	1.000	POL (24)+25 Q1	rev.2001
	26	31 (II)	0.305	0.996	1.000	1.000	1.000	1.000	1.000	1.000	1.000	POL Q1	rev.2001
			0.136	0.735	0.849	0.918	0.947	1.000	0.913	0.667		RUS Q2	
1999			0.221	0.866	0.925	0.959	0.974	1.000	0.957	0.834		**Mean**	
	27	6 (III)											
	28	21 (II)	0.136	0.735	0.849	0.918	0.947	1.000	0.913	0.667		RUS 26 Q2	
	29	6 (III)											
	32	5 (III)											
	Weighted mean		0.397	0.882	0.934	0.964	0.977	1.000	0.962	0.896	1.000		
2000	22+24	6 (I)											
	25	25 (I)	0.642	1.000	0.996	1.000	1.000	1.000	1.000	1.000	1.000	POL 24+25 Q1	
	26	31 (II)	0.472	1.000	1.000	1.000	1.000	1.000		1.000		POL Q1	
	27	6 (III)											
	28	21 (II)	0.195	1.000	1.000	1.000	1.000	1.000	1.000	1.000		LAT	
	29	6 (III)											
	32	5 (III)											
	Weighted mean		0.465	1.000	0.625	0.627	0.627	0.627	0.627	0.373	1.000		
1997-2000	**Mean**		0.320	0.801	0.972	0.883	0.891	0.893	0.884	0.881	0.843		
	WG data		0.000	0.700	1.000	1.000	1.000	1.000	1.000	1.000			

[1] mean of the catch proportions (%) from 1987-1998. In brackets the stock component.

3.13.19 Answer to special request from IBSFC on the selection properties of trawls with double netting

IBSFC has requested ICES to:

"evaluate the selection properties for Baltic cod trawls using double-nettings made of twine exceeding ca. 4 mm in diameter."

Cod-end selectivity is affected by many factors. A key determinant is the mesh size in the cod-end, but also netting twine diameter and properties such as twine stiffness affect cod-end selectivity (e.g. Polet & Redant, 1994, and Ferro & O'Neill, 1994). A systematic examination of the magnitude of these effects was carried out within the EU-project VARSEL (Study of factors affecting the variability of cod-end selectivity) (Anon., 1997; Lowry, 1995; Lowry & Robertson, 1994, 1996). Identifying individual contributions to selectivity from each factor proved difficult as the results were affected by a combination of other factors (e.g. catch size, variable operational conditions during the experiments, etc.). In 1999–2001 a joint German-Polish experiment has been conducted in which the effect of twine size and number of twines on cod-end selectivity was investigated for cod in the Baltic. Three single-twine cod-ends with netting with twine diameters ranging from 4 to 8 mm and two double-twine cod-ends with netting of 4 and 6 mm were tested. The trials were carried out on the same research vessel, under similar operational conditions, at the same time of the year, same fishing ground and with identical trawls. Any differences observed, therefore, are likely to be caused predominantly by changed twine diameters/netting twine configuration. The results are summarised in the table below:

L50 for cod as a function of nominal twine size and numbers of twine.

	Twine				
	Single 4 mm	Single 6 mm	Single 8 mm	Double 4 mm	Double 6 mm
L50 of cod (cm)	37.7	31.7	26.8	33.0	24.9

There is a clear negative correlation between nominal twine diameter and cod-end selectivity for Baltic cod. An increase in twine diameter by one millimeter is expected to result in a reduction of L50 with single twine of 2.7 cm, and with double twine of ca 4 cm.

Although the results originate from a research trawler and therefore cannot directly be transferred to commercial ships, the results indicate that increasing the number of twines is one of the most effective ways to reduce the selection of Baltic cod at a given legal mesh size.

At present there are no suitable means to measure twine diameter at sea, particularly if the twine consists of a hollow-core braid. Dahm (1983) suggested a photographic and Ferro (1989) an electronic measuring method. Both gave reproducible results in inter-calibration tests, but only under laboratory conditions. Ferro's measuring principle has recently been taken up in the development of a precise twine diameter measuring instrument, but designed for laboratory use only.

Sources of Information:

Anon., 1997: Study of factors affecting the variability of codend selectivity. EC-Contract No. AIR2- CT94-1544, Final report.

Dahm, E., 1983: Untersuchungen zum Problem der Durchmesserbestimmung bei Netzgarnen. Infn Fischw. 30,1,43-46.

Ferro, R.S.T., 1989: Objective measurement of the thickness of netting twine used in the fishing industry. Fisheries Research, 8, 103–112.

Ferro, R.S.T.; O'Neill, F.G., 1994: An overview of the characteristics of twines and netting that may change codend selectivity. ICES C.M. 1994/B:35.

Lowry, N.; Robertson, J.H.B, 1994.: The effect of twine thickness on codend selectivity of trawls for haddock in the North Sea. ICES C.M. 1994.

Lowry, N., 1995: The effect of twine size on bottom trawl codend selectivity. ICES C.M. 1995/B:6 (Poster).

Lowry, N.; Robertson, J.H.B., 1996: The effect of twine thickness on codend selectivity of trawls for haddock in the North Sea. Fish.Res. 26, 353-363.

Polet, H. and Redant F., 1994: Selectivity experiments in the Belgian Norway lobster (*Nephrops norvegicus*) fishery.

3.13.20 Discards of cod in the Baltic

The amounts of cod not retained and landed by the fishermen were estimated based on data collected under the EU Study Programme (98/024): **International Baltic Sea Sampling program (IBSSP II)**, and two previous projects having the same objectives. Observers on board commercial fishing vessels collect data and all relevant biological information and details concerning the catch. Discard data are only available from 1996 onwards. At present, almost 10 000 hauls/set have been sampled for the period from the 3rd quarter in 1995 to the end of 2000. The sampling is ongoing and includes all countries around the Baltic Sea, except Lithuania.

The discard results obtained by sampling are aggregated by year, country, Sub-division, quarter and metier (fishery). For each stratum, the age distribution in numbers of the discard was compiled.

The discard by age group was raised by the ratio:

> Total commercial landings of cod by stratum/total landings in samples by stratum.

National landing statistics were available dis-aggregated into landings for a number of metiers, defined with respect to discard patterns and covering all fisheries where significant discards are present. The metiers were defined independently in each country. After raising to the total national level, the data were aggregated to the fleets comparable to the assessment input; namely, trawl and gillnet.

The extrapolations of missing strata are made taking into account the following priorities:

1. Same quarter, another country.

2. Same country, same quarter, adjacent Sub-division.

3. Another country, same quarter, adjacent Sub-division.

Before discard data can be integrated into the stock assessments, more than 5 consecutive years are needed for the time series. In order to investigate the extrapolation of the time series backwards in time, the discard percentages for each stratum were listed for each year of discard data (Table 3.13.20.1). No obvious pattern of variability was observed, although a more comprehensive analysis is necessary to determine what patterns, if any, are present in the data.

Because of the short time series available, the discard estimates were neither integrated into the stock assessment of the western nor the eastern stock of cod. An additional problem is that due to annual variability, extrapolation of discards back in time requires a more complete overview of the discard pattern.

Western Cod Stock (Sub-divisions 22–24)

The total discards in numbers by metier and year is given in Table 3.13.20.2. The overall mean discards per year in numbers is 48 000 for gillnet and 18 million for trawl. Most years have around 15 million in total except 1996 and 1998, which have more discards. This is consistent with the two high recruitments of age group 1 cod in 1995 and 1998.

Table 3.13.20.3 gives the discard and the landings by age group. Age group 1 is the most dominating age group in the discard in all years except 1999 – a year when the strong 1997 year class dominated discards as age group 2.

Eastern Cod Stock (Sub-divisions 25–32)

The total discard in numbers and years is given in Table 3.13.20.4. The overall mean discard in numbers is 6.5 millions per year in gillnet and 12 million for trawl.

Table 3.13.20.5 gives the discard and the landings by age group. Age groups 1, 2 and 3 are all very abundant in the discards. Age group 3 and older are mostly discarded from the gillnet fishery.

Table 3.13.20.1 Discard percentage (of total catch) by age group in the period 1996-2000.

	Sub-division 22-24					Sub-division 25-32				
	1996	1997	1998	1999	2000	1996	1997	1998	1999	2000
Age0	100.0	100.0	100.0	100.0	100.0	100.0	1000.0	100.0	100.0	100.0
Age1	98.2	81.6	80.4	75.7	71.6	94.3	99.2	97.9	99.6	93.0
Age2	15.3	2.5	15.0	25.6	29.5	22.0	22.8	39.4	13.6	70.2
Age3	1.5	0.1	3.5	2.1	8.2	2.6	24.7	9.8	10.4	4.9
Age4	0.0	0.0	0.0	0.0	0.0	0.9	0.2	0.8	0.2	0.1
Age5	0.0	0.0	0.0	0.0	0.0	0.6	0.5	0.2	0.2	0.1

Table 3.13.20.2 Discard in numbers (*10-3) by metier and year.

Stock	22-24

	Year					
Metier	1996	1997	1998	1999	2000	Total
Gillnet	592	691	189	220	349	2041
Trawl	25919	15723	20476	14252	14750	91119
Grand Total	26511	16414	20665	14472	15098	93160

Table 3.13.20.3 Landing and discard in numbers (*10-3) by age group in the period 1996-2000.

Stock	22-24

	Year									
	1996		1997		1998		1999		2000	
	Landing	Discard	Landing	Discard	Landing	Discard	Landing	Discard	Landing	Discard
Age0		15		39		85		250		325
Age1	395	21025	3658	16264	3968	16309	1387	4317	3096	7798
Age2	28610	5162	3762	97	23553	4154	27903	9606	12439	5201
Age3	20584	308	28004	15	3238	116	14002	299	19897	1774
Age4	3647	1	5174	0	4634	0	1832	0	3942	0
Age5	2217	0	1030	0	701	0	1146	0	306	0

Table 3.13.20.4 Discard in numbers (*10-3) by metier and year.

Stock	25-32

	Year					
Metier	1996	1997	1998	1999	2000	Total
Gillnet	2037	2255	12772	865	14471	32400
Trawl	5318	15325	9565	21314	8822	60344
Grand Total	7355	17580	22337	22179	23293	92744

Table 3.13.20.5 Landing and discard in numbers (*10-3) by age group in the period 1996-2000.

Stock	25-32

	Year									
	1996		1997		1998		1999		2000	
	Landing	Discard	Landing	Discard	Landing	Discard	Landing	Discard	Landing	Discard
Age0		427		0		1		1		10
Age1	163	2719	72	8401	324	15410	67	17128	314	4176
Age2	10676	3016	2641	782	7619	4963	8353	1312	7478	17574
Age3	30543	824	25209	8289	16483	1794	31660	3681	29041	1503
Age4	26250	237	22022	50	17527	146	18495	36	25353	20
Age5	21553	132	12396	58	10067	22	8945	21	7568	10

3.14 *Nephrops* Stocks

3.14.1 Overview of *Nephrops* Stocks

Functional Units and Management Areas

Functional Units are defined by groupings of statistical rectangles according to the present knowledge on the distribution of *Nephrops* stocks. Management Areas are defined using as far as possible, existing ICES Sub-area and Division boundaries. ICES provides catch advice by Functional units. However, under the existing quota system, a TAC is often set for an area that is larger than the management area that is considered appropriate. Therefore the present TAC areas do not allow management of the stocks in individual Functional Units taking differences in exploitation into account. While for some management areas it may be advised to reduce exploitation, it may be possible to increase catches in others management areas within the same TAC area. If the sum of the recommended catches for the separate areas is taken as the basis for setting the TAC for the whole area, this could lead to an undesirable and an unsustainable increase in exploitation for some management areas within the TAC area.

The problem is particularly relevant in Sub-areas IV and VII. ICES reiterates its advice given in previous years that management of *Nephrops* stocks should be at the Management Area level as defined in Figures 3.14.1.1-3.14.1.3 and Table 3.14.1.1 As an alternative, specific management tools could be developed aimed to control fishing effort on a much smaller geographical scale than is the case in the existing system.

In an attempt to partly resolve this problem (at least with respect to Sub-area VII), ICES suggests that a separate *Nephrops* TAC for Division VIIa be considered, as is common practice already for several finfish stocks (such as cod, whiting, plaice and sole).

Recommended and Agreed TACs

ICES notes that the agreed TACs are nearly always above those recommended by ICES.

Assessment Methods Employed

The assessment of the stocks was based on a variety of methods:

- Analysis of long-term trends in fishery data (landings, effort, CPUE, LPUE, etc.);
- Length-based assessments (LCA) (for a very small number of stocks only - see below);
- Age-based analytical assessments (VPA);
- Y/R analyses based on the output of the VPA; and
- Fishery independent surveys (mostly underwater TV surveys).

For those stocks that show severe signs of overexploitation, short-term catch predictions were made, based on the outcome of a VPA.

Examination of trends in fishery data remains an important element of *Nephrops* assessments, especially for stocks with few biological or sampling data. For most stocks, the available information now extends over many years.

Previously, Length Cohort Analysis (LCA) has been widely used as an assessment tool for *Nephrops* stocks. This method is no longer applied in cases where the steady-state assumptions inherent in the LCA method are not met or where an age-based assessment is possible. A weakness of LCA is that it gives no information on recruitment overfishing. Where this occurs, the LCA method can give severely misleading conclusions about stock status with respect to growth overfishing.

Age-based VPA for *Nephrops*, on the other hand, suffers from:

- uncertainties in the slicing of length into 'age' distributions (despite the application of an improved slicing technique, which now gives 'real' instead of 'nominal' age groups);
- the year-to-year variations in emergence of *Nephrops* (which may result in unrealistic estimates of stock biomass, particularly for the females); and
- in a number of cases, the lack of discard data (which results in levelling off the estimates of the recruits and in a false impression of stability in recruitment).

Fishery independent surveys have become an increasingly useful tool in the assessment of *Nephrops* stocks. Firstly, as a means to obtain fishery independent estimates of stock size and biomass and secondly, as a means to validate the trends in total stock biomass shown by the analytical assessments. For some stocks, where landing statistics were believed to be unreliable, or where sampling levels were inadequate for a 'traditional' analytical approach, they have even become the only means for assessing the state of exploitation of the stock and for making predictions on its fisheries potential.

Male vs. Female Exploitation

Female *Nephrops* are less available for exploitation than males. Females are mainly caught in the summer months, but when berried (usually between early autumn and spring of the next year) they stay in the burrows and cannot be caught by trawls. In most stocks, this is reflected by much lower fishing mortality rates and much more optimistic Y/R predictions for females than for males. However, in summer fisheries, fishing mortality can be as high on females as on males. Stocks exploited in fisheries where the dominating part of the effort is exerted in summer are more vulnerable to spawning stock depletion, and there is a greater risk that such stocks will become depleted and outside safe biological limits.

Males are the most vulnerable component of the stock (while at the same time accounting for the majority of the landings). Therefore, overall evaluation of exploitation of the stocks, and hence the management advice, is largely based on considerations of the male stock.

The difference in exploitation pattern between males and females, and uncertainty about the reliability of the nominal VPA estimates of female stock biomass and recruitment (the trends in these however, are believed to be reliable), are the main reasons why stock biomass and recruitment are given for males and females separately, and not for the sexes combined.

Advice for 2002 and 2003

ICES provides advice in this report for 2002 and 2003.

For many stocks there was no basis this year to revise the advice given previously (1999). However, there are concerns about the state of some stocks, and additional management recommendations are made where appropriate.

For most *Nephrops* stocks occurring north of the Bay of Biscay, there is little or no change in the assessed state of the stocks, and hence the advice on management options largely remained unchanged. Where relevant and necessary, the corresponding TAC proposals were adjusted, to match recent trends in the fishery and/or stock.

In Skagerrak and Kattegat (IIIa) there is a mis-match between the current minimum landing size (40 mm carapace length) and the selectivity of the diamond mesh codends used, resulting in large quantities of *Nephrops* being discarded. The introduction of more selective trawls should be encouraged, to reduce discards.

For the Norwegian Deep (IVa) and Off Horn Reef (IVb,c) stocks, there is evidence of a rapidly expanding fishery, with increasing landings and, particularly in the Off Horn Reef stock, increasing LPUEs.

For nearly all southern stocks (Bay of Biscay, FUs 23+24; and Iberian Peninsula, FUs 25, 26+27, 28+29, 30 and 31) however, there are serious reasons for concern. There is evidence of declining trends in LPUE/CPUE and/or biomass and recruitment, and ICES proposes that drastic management action should be taken. In view of the alarming state of these stocks, advice is given for the year 2002 only, and ICES recommends that these stocks be reassessed in 2002.

Table 3.14.1.1 Description of Management Areas together with their *Nephrops* Working Group labels and the Functional Units contained within them.

WG label	ICES description	Functional Units (FUs) or groupings thereof when treated as one in assessments	
A	Va	1	Iceland
B	Vb (non EC)	2	Faeroe Islands
C	VIa	11	North Minch
		12	South Minch
		13	Clyde
D	Vb (EC) + VIb		None
E	IIIa	3	Skagerrak
		4	Kattegat
F	IVa, rect. 44-48 E6-E7 + 44E8	9	Moray Firth
		10	Noup
G	IVa, West of 2° E excl. MA F	7	Fladen
H	IVb,c, East of 1° E excl. rect. 43F5-F7	5	Botney Gut
		33	Off Horn Reef
I	IVb,c, West of 1° E	6	Farn Deeps
		8	Firth of Forth
J	VIIa, North of 53° N	14	Irish Sea East
		15	Irish Sea West
K	VIId,e		None
L	VIIb,c,j,k	16	Porcupine Bank
		17	Aran Grounds
		18	Ireland NW coast
		19	Ireland SW and SE coast
M	VIIf,g,h, excl. rect. 31E1 32E1-E2 + VIIa, South of 53° N	20+21+22	Celtic Sea
N	VIIIa,b	23+24	Bay of Biscay
O	VIIIc	25	North Galicia
		31	Cantabrian Sea
P	VIIId,e		None
Q	IXa	26	West Galicia
		27	North Portugal
		28+29	South-West and South Portugal
		30	Gulf of Cadiz
R	IXb + X		None
S	IVa, East of 2° E + rect. 43F5-F7	32	Norwegian Deep

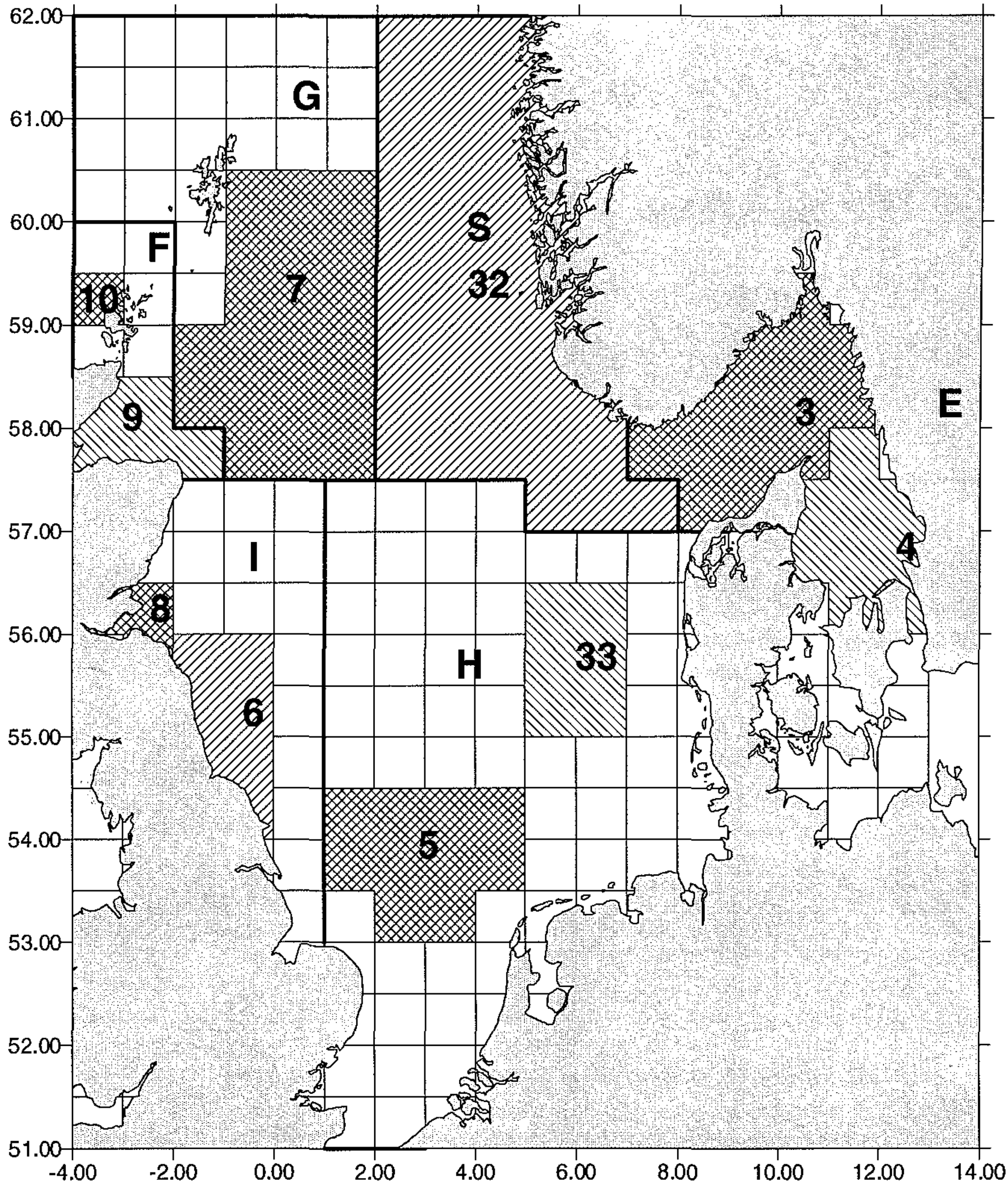


Figure 3.14.1.1 *Nephrops* Functional Units and Management Areas in Division IIIa and Sub-area IV (Letters and figures refer to Management Areas and Functional Units given in Table 3.14.1.1).

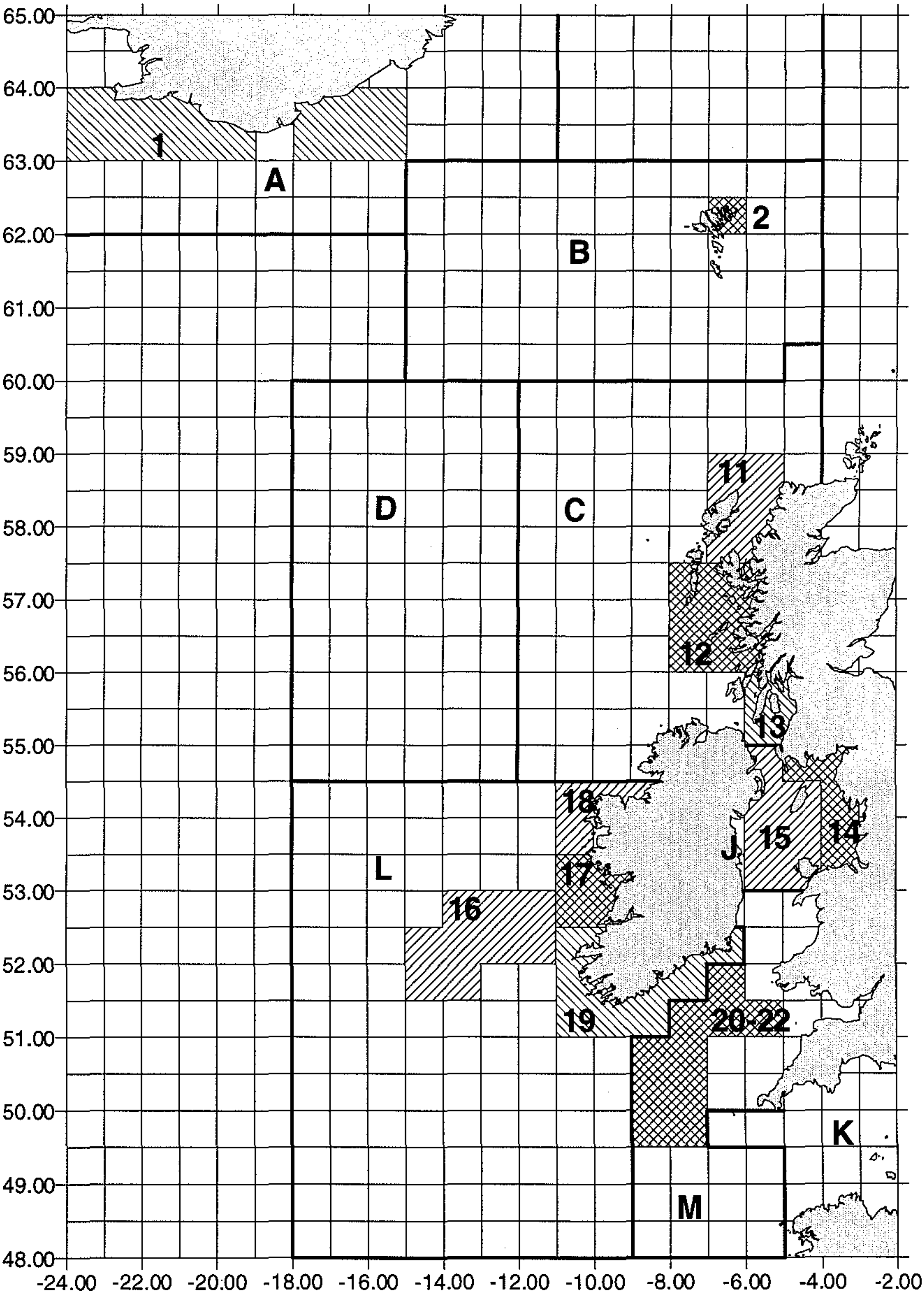


Figure 3.14.1.2 *Nephrops* Functional Units and Management Areas in Sub-areas V, VI and VII (Letters and figures refer to Management Areas and Functional Units given in Table 3.14.1.1).

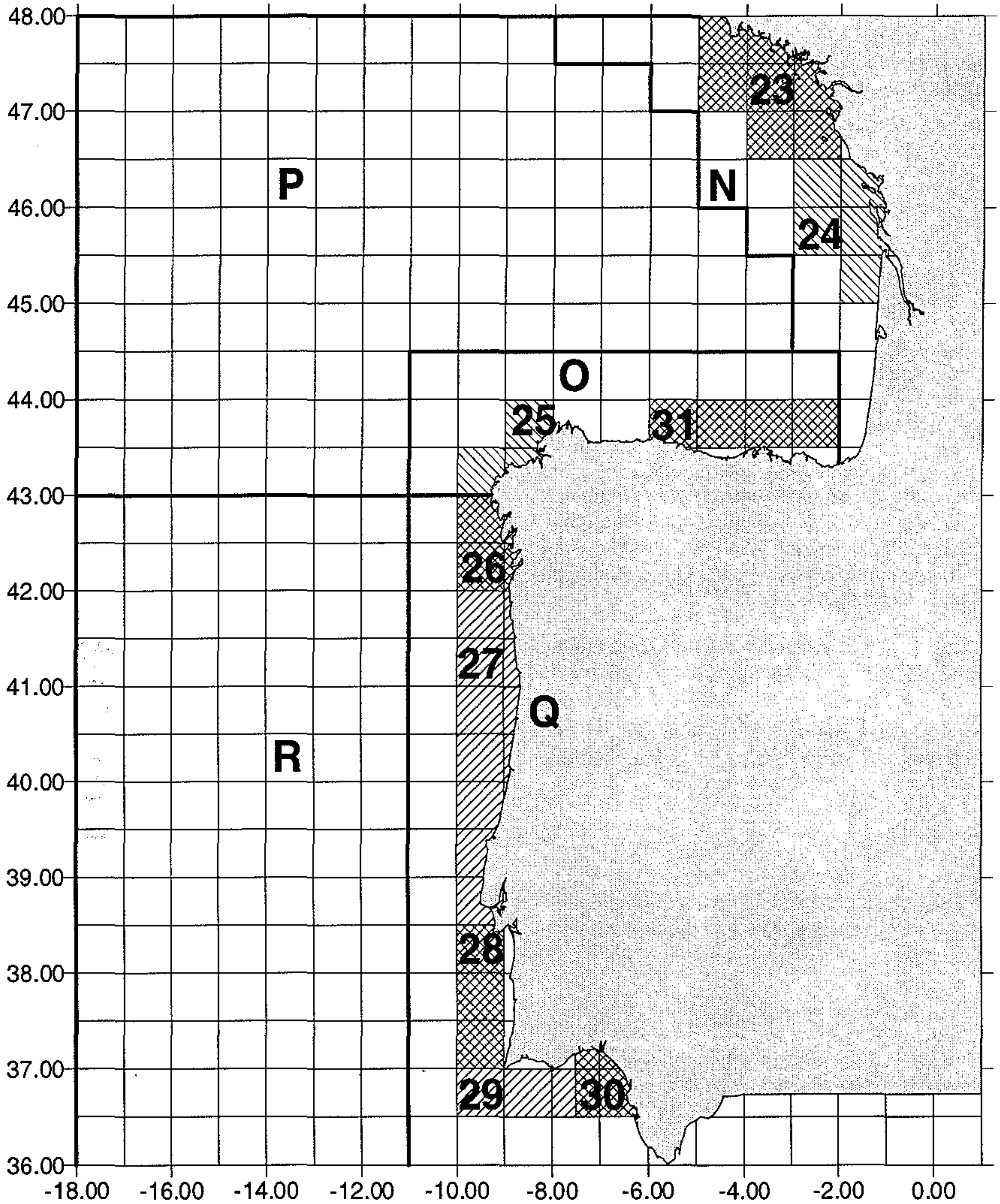


Figure 3.14.1.3 *Nephrops* Functional Units and Management Areas in Sub-areas VIII, IX and X (Letters and figures refer to Management Areas and Functional Units given in Table 3.14.1.1).

3.14.2.a *Nephrops* in Division IIIa (Management Area E)

There are two Functional Units in this Management Area: a) Skagerrak (FU 3) and b) Kattegat (FU 4).

State of stock/exploitation: The stocks in this Management Area appear to be exploited at sustainable levels.

a+b) Skagerrak and Kattegat combined: Age-based assessment for FUs 3 and 4 combined, suggests that male and female stock biomass are generally increasing. Female recruitment seems to have been stable, while male recruitment seems to have increased in the most recent years. There is some doubt about the reliability of the VPA estimates of recruitment. Strong male recruitment however, is evident from discard monitoring data, which show a considerable increase in the male discards (< 40 mm CL), particularly in 2000. F_{bar} for males has recently increased, but is still below long-term average. Y/R analysis based on outputs of VPA shows that current F is close to $\mathbf{F_{max}}$ for males, and well below $\mathbf{F_{max}}$ for females.

Management objectives: There are no management objectives set for this fishery.

Advice on management: ICES expects that biomass will remain stable or slightly increase in these stocks, and that yield will increase in the next coming years, following the very high numbers of undersized (male) *Nephrops* (< 40 mm CL) in the catches, particularly in 2000. ICES recommends that the total landings from Division IIIa be maintained at the 2000 level. This corresponds to a TAC for both 2002 and 2003 of not more than 4 700 t.

Relevant factors to be considered in management: The mismatch between minimum landing size (40 mm CL in Division IIIa) and the selectivity of the 70 mm diamond mesh cod-ends results in large quantities of *Nephrops* being discarded. Square meshed 70 mm cod-ends have successfully been introduced in Sweden, and their use should be encouraged to reduce discards.

ICES also notes that the use of two different minimum landing sizes for *Nephrops* in Divisions IIIa and IV is likely to cause an enforcement and policing problem in countries where *Nephrops* from the two areas are being landed.

Since most of the trawl fisheries for *Nephrops* in Division IIIa are mixed fisheries, increased effort in this fishery will affect by-catch levels of other commercial species caught unless the species and size selectivity properties of the *Nephrops* trawls is improved.

Comparison with previous assessment and advice: Previous age-based assessments on these FUs (carried out in 1999) were not considered to be sufficiently reliable for management purposes. Proposed TAC of 4700 t represents a net increase of 900 t over the current TAC. This is justified by strong recruitment in the most recent years (as shown by the discard data), and the close relationship between recruitment levels and LPUEs 4 years later.

Elaboration and special comments: The majority of landings are made by Denmark and Sweden, with Norway contributing small landings from the Skagerrak. During the last 10 years, landings from the Skagerrak varied between 1900 and 3250 t, while landings from the Kattegat varied between 900 and 1800 t (with the lowest landings recorded in 1992-1995).

LPUE and mean size data are available for both FUs. Length compositions are available from 1991 onwards.

Source of information: Report of the Working Group on *Nephrops* Stocks, April 2001 (ICES CM 2001/ACFM:16).

Catch data (Tables 3.14.2.a.1- 3.14.2.a.2):

Year	ICES advice	Recommended TAC	Agreed TAC	ACFM landings
1987				4.0
1988				3.7
1989				3.9
1990				4.3
1991				4.2
1992		~4.0	3.5	2.9
1993		~4.3	3.5	3.2
1994		2.9	3.5	2.9
1995		2.9	4.8	3.4
1996	*Status quo* TAC	2.9	4.8	4.0
1997	*Status quo* TAC	2.9	4.8	4.2
1998		4.0	4.8	5.0
1999		4.0	4.8	4.9
2000		3.8	5.0	4.7
2001		3.8	4.5	
2002	*Catches to be maintained at the 2000 level*	4.7		
2003	*Catches to be maintained at the 2000 level*	4.7		

(Weights in '000 t)

Table 3.14.2.a.1 *Nephrops* landings (tonnes) by Functional Unit plus Other rectangles in Management Area E (IIIa).

Year	FU 3	FU 4	Other	Total
1991	2934	1304	0	***4238***
1992	1900	1012	0	***2912***
1993	2285	924	0	***3209***
1994	1981	893	0	***2874***
1995	2429	998	0	***3427***
1996	2694	1285	0	***3979***
1997	2612	1594	0	***4206***
1998	3248	1796	0	***5044***
1999	3194	1749	0	***4943***
2000 *	2894	1809	0	***4703***
* provisional na = not available				

Table 3.14.2.a.2 *Nephrops* landings (tonnes) by country in Management Area E (IIIa).

Year	Denmark	Norway	Sweden	Total
1991	2824	195	1219	***4238***
1992	2052	111	749	***2912***
1993	2250	100	859	***3209***
1994	2049	62	763	***2874***
1995	2419	90	918	***3427***
1996	2844	101	1034	***3979***
1997	2959	117	1130	***4206***
1998	3541	184	1319	***5044***
1999	3486	214	1243	***4943***
2000 *	3325	181	1197	***4703***
* provisional na = not available				

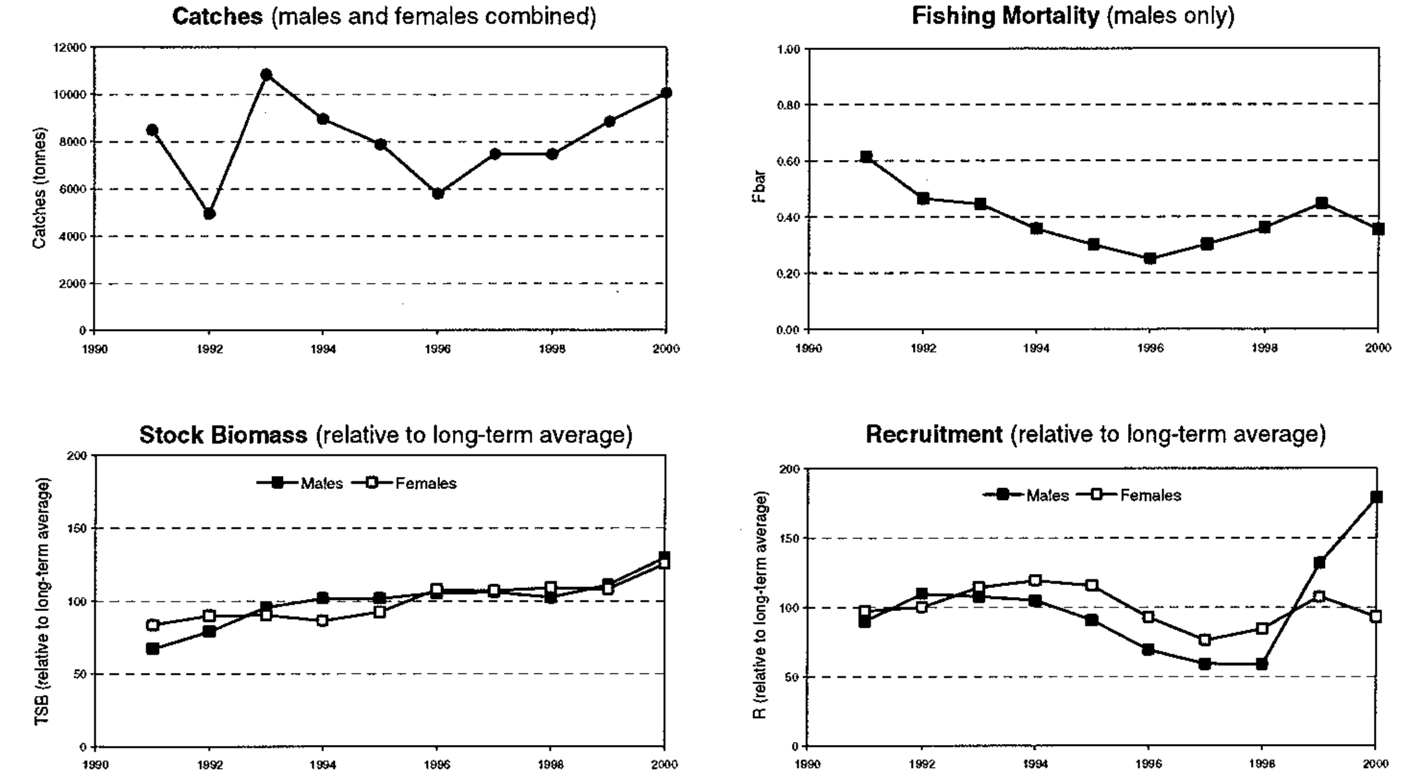


Figure 3.14.2.a.1 Skagerrak and Kattegat (FUs 3-4): Output VPA: Trends in Catches, Fbar, Stock Biomass and Recruitment

3.14.2.b *Nephrops* in Division IVa, rectangles 44-48 E6-E7+44 E8 (Management Area F)

There are two Functional Units in this Management Area: a) Moray Firth (FU 9) and b) Noup (FU 10).

State of stock/exploitation:

All stocks in this Management Area appear to be exploited at sustainable levels.

a) Moray Firth: Age based assessment shows that stock biomass and recruitment in both males and females have been generally stable in the 1990s, although at a lower level than in the mid- and late 1980s. Annual LPUEs show large fluctuations (without obvious trend), but were generally higher in the early and mid-1980s than in the 1990s. Abundance trends from the TV camera surveys (1993-2000) are in broad agreement with the VPA, showing slight increase in stock biomass in the most recent years. F_{bar} fluctuates for both males and females, without obvious long-term trend. Y/R analysis based on outputs of VPA shows that current F is close to $\mathbf{F_{max}}$ for males, and well below $\mathbf{F_{max}}$ for females.

b) Noup: Increasing trends in LPUE, and landings per area and effort per area indices, suggest that current levels of fishing effort are acceptable for this stock.

Management objectives: There are no management objectives set for this fishery.

Advice on management: For the Moray Firth stock, there is no reason to take restrictive action, and ICES recommends to set the TAC for this FU corresponding to the current landings, i.e. at 1500 t. The Noup stock also is not giving cause for concern, so that the 1999 suggestion of 400 t continues to apply. Landings from statistical rectangles outside these FUs but within the Management Area are comparable to those observed in the early 1990s, and the previous allowance made for these rectangles (100 t) should be applied again. Taken together, the TAC advice for Management Area F amounts to 2000 t for both 2002 and 2003.

Relevant factors to be considered in management: In the North Sea TAC area (which comprises eight *Nephrops* stocks, with quite different states of exploitation), the present aggregated management approach runs the risk of unbalanced effort distribution. Adoption of management initiatives to ensure that effort can be appropriately controlled in smaller areas within the overall TAC area is recommended.

Comparison with previous assessment and advice: The proposed Management Area TAC of 2000 t represents a net increase of 150 t over the current advice. This is justified in view of the less pessimistic assessment for the Moray Firth stock, which makes up almost three-quarters of the landings from this Management Area.

Elaboration and special comments: Only UK vessels fish for *Nephrops* in this Management Area. *Nephrops* directed trawlers account for 75-85 % and 50-75 % of the total landings from the Moray Firth and the Noup respectively. The use of 70 mm multi-rig trawls has declined in both fisheries following the UK national ban, but effort using multi-rig trawls with larger mesh sizes has increased in the most recent years. Moray Firth landings fell to about 1000 t in 1998 and 1999, but have increased again by almost 50 % in 2000. Landings from the Noup have fluctuated along the same overall pattern as effort, and have remained generally stable since 1995.

LPUE, landings/area and effort/area data are available for both FUs, but mean size data are available for the Moray Firth only. TV camera surveys were carried out in Moray Firth in 1993-2000 (except 1995) and were compared with the VPA estimates of biomass and recruitment. Length composition data is available for the Moray Firth since 1981.

Source of information: Report of the Working Group on *Nephrops* Stocks, April 2001 (ICES CM 2001/ACFM:16).

Catch data (Table 3.14.2.b.1):

Year	ICES advice	Recommended TAC	Agreed TAC[1]	ACFM landings
1987				2.1
1988				2.1
1989				2.7
1990				2.3
1991				1.8
1992		~2.4	12.0	1.8
1993		2.4	12.0	2.3
1994		2.4	13.0	2.2
1995		2.4	15.2	1.7
1996		2.4	15.2	1.9
1997		2.4	15.2	1.9
1998		2.4	15.2	1.4
1999		2.4	15.2	1.4
2000		1.85	17.2	1.8
2001		1.85	15.48	
2002		2.0		
2003		2.0		

(Weights in '000 t) [1)] EU zone of IIa and IV

Table 3.14.2.b.1 *Nephrops* landings (tonnes) by Functional Unit plus Other rectangles in Management Area F (IVa, rectangles 44-48 E6-E7 + 44 E8). All catches taken by UK.

Year	FU 9	FU 10	Other	Total
1991	1519	196	65	***1780***
1992	1591	188	43	***1822***
1993	1808	376	69	***2253***
1994	1538	495	138	***2171***
1995	1297	280	77	***1654***
1996	1451	344	101	***1896***
1997	1446	316	94	***1856***
1998	1032	254	74	***1360***
1999	1008	279	74	***1361***
2000 *	1490	235	58	***1783***
* provisional na = not available				

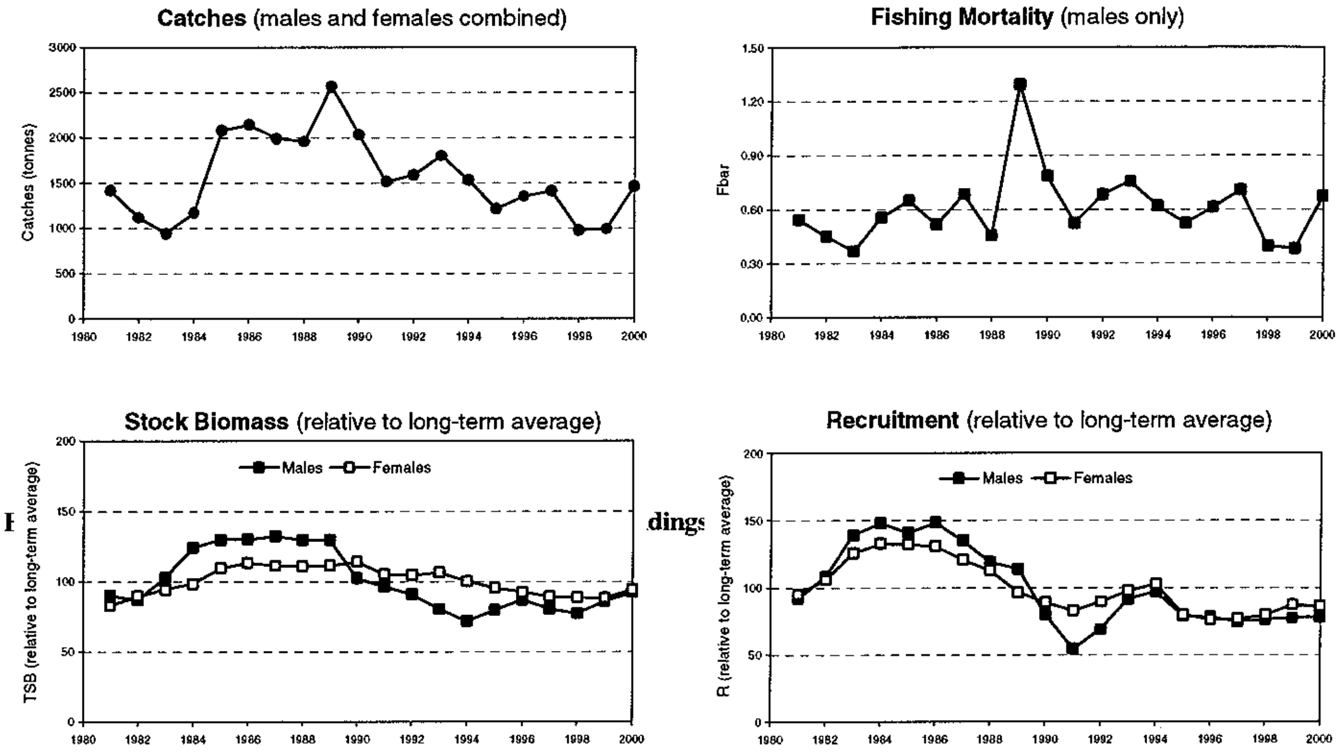


Figure 3.14.2.b.1 Moray Firth (FU 9): Output VPA: Trends in Catches, Fbar, Stock Biomass and Recruitment.

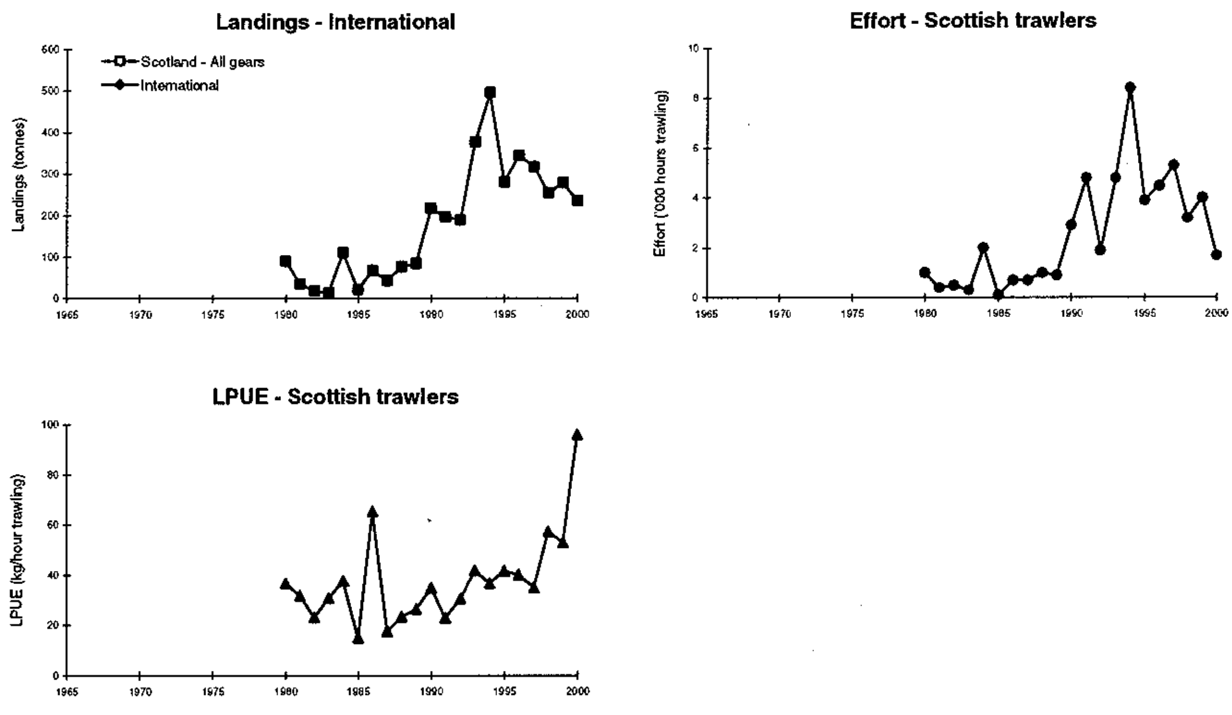


Figure 3.14.2.b.2 Noup (FU 10): long-term trends in landings, effort and CPUEs of *Nephrops* in catches and/or landings.

3.14.2.c *Nephrops* in Division IVa, West of 2° E, excluding Management Area F (Management Area G)

There is only one Functional Unit in this Management Area: Fladen Ground (FU 7).

State of stock/exploitation: The state of exploitation of the stock shows spatial variation, with the most heavily fished parts considered to be exploited at sustainable levels.

Fladen Ground: The relatively high LPUEs, the evidence from the TV surveys, the low values of the fishing pressure indices (compared to other stocks), and the results of the length-based assessment all suggest that this FU remains in a healthy state. Parts of this stock are exploited at considerably lower levels than others. Annualised LPUEs and mean sizes in landings are generally stable. TV camera surveys (1992-2000, except 1996) suggest that total stock biomass exceeds 100 000 t.

Management objectives: There are no management objectives set for this fishery.

Advice on management: ICES recommends a *status quo* TAC for Management Area F of 9000 t for both 2002 and 2003.

Relevant factors to be considered in management: There is concern over the quality of the landings data.

The risks of an overall North Sea TAC leading to unbalanced effort distribution over the North Sea *Nephrops* FUs, or of a rapid quota uptake in the Fladen leading to difficulties in the rest of the North Sea remains. Therefore, the adoption of management initiatives to ensure that effort can be properly controlled at a FU level is recommended.

The 9000 t proposed represents 7.5 % of the estimated stock biomass. This harvest ratio is at the lower end of the harvest ratios observed in other stocks.

Comparison with previous assessment and advice: All analyses confirm the earlier statements on the state of exploitation of this stock. Therefore, ICES sees no reason to change its previous advice.

Elaboration and special comments: Most landings from this Management Area are reported by UK-Scotland (over 90 % of the total international landings), together with much smaller quantities by Belgium, Denmark, Norway and UK-England. The Fladen Ground is exempt from the UK legislation banning 70 mm mesh multi-rig trawls, but the proportion of effort by multi-rig *Nephrops* vessels has strongly declined in the early 1990s. The overall trend in landings from the Fladen Ground is upward, with the highest figures recorded in 1995, 1997 and 1999. Throughout the 1990s, reported landings repeatedly exceeded the recommended TAC. Effort shows a long-term increase in the Scottish fleet, but has declined in the Danish fleet (owing to a shift in effort to other grounds).

LPUEs, mean sizes, and landings/area and effort/area indices are available for this stock. Stock abundance and biomass estimates from TV surveys are available for 1992-2000, and are considered to be reliable. Length composition data are available since the beginning of the 1990s, but the data sets for the earlier years are not sufficiently extensive for assessment purposes.

Source of information: Report of the Working Group on *Nephrops* Stocks, April 2001 (ICES CM 2001/ACFM:16).

Catch data (Tables 3.14.2.c.1-3.14.2.c.2):

Year	ICES advice	Recommended TAC	Agreed TAC [1]	ACFM landings
1987				1.7
1988				1.6
1989				2.3
1990				2.6
1991				4.3
1992		~2.7	12.0	3.4
1993		2.7	12.0	3.5
1994		5.0	13.0	4.7
1995		5.0	15.2	6.6
1996		5.0	15.2	5.4
1997		5.0	15.2	6.3
1998		7.0	15.2	5.2
1999		7.0	15.2	6.7
2000		9.0	17.2	5.4
2001		9.0	15.48	
2002		9.0		
2003		9.0		

(Weights in '000 t) [1)] EU zone of IIa and IV

Table 3.14.2.c.1 *Nephrops* landings (tonnes) by Functional Unit plus Other rectangles in Management Area G (IVa, West of 2° E, excluding Management Area F).

Year	FU 7	Other	Total
1991	4221	52	***4273***
1992	3363	39	***3402***
1993	3493	39	***3532***
1994	4569	117	***4686***
1995	6421	184	***6605***
1996	5210	150	***5360***
1997	6171	95	***6266***
1998	5136	94	***5230***
1999	6519	175	***6694***
2000*	5346	79	***5424***
* provisional na = not available			

Table 3.14.2.c.2 *Nephrops* landings (tonnes) by country in Management Area G (IVa, West of 2° E, excluding Management Area F).

Year	Belgium	Denmark	Norway	UK	Total
1991	0	427	4	3842	***4273***
1992	3	364	28	3007	***3402***
1993	0	228	3	3301	***3532***
1994	0	395	6	4285	***4686***
1995	0	441	1	6163	***6605***
1996	0	287	1	5072	***5360***
1997	0	235	0	6031	***6266***
1998	0	173	0	5057	***5230***
1999	16	96	0	6582	***6694***
2000*	6	105	0	5313	***5424***
* provisional na = not available					

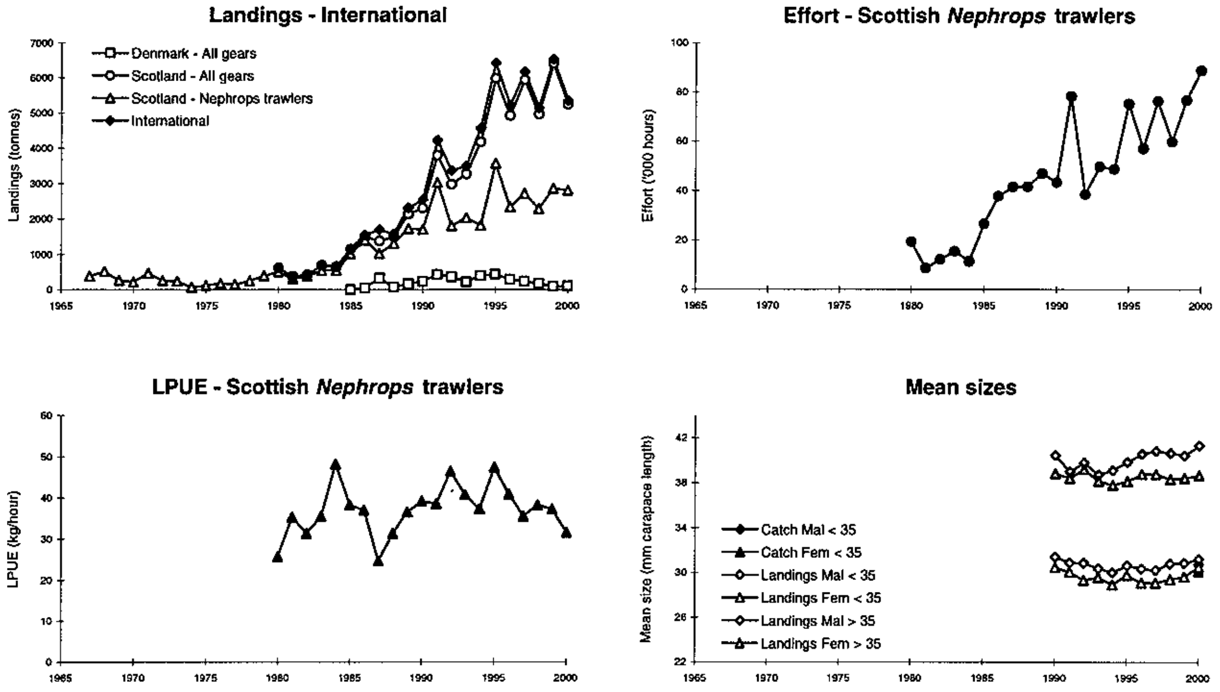


Figure 3.14.2.c.1 Fladen (FU 7) : Long-term trends in landings, effort, CPUEs/LPUEs and mean sizes of *Nephrops* in catches and landings.

3.14.2.d *Nephrops* in Division IVa, East of 2° E + rectangles 43 F5-F7 (Management Area S)

There is only one Functional Unit in this Management Area: Norwegian Deep (FU 32).

State of stock/exploitation: Despite recent increases in landings, abundance seems to have been stable since 1994. The stock does not appear to be fully exploited, and there may be scope for further cautious increases in landings and in effort.

Management objectives: There are no management objectives set for this fishery.

Advice on management: Pending further information on the state of exploitation of this stock, ICES advises that effort be allowed to increase only slowly from the present level, corresponding to an increase in catches of about 10% to 1 200 t.

Relevant factors to be considered in management: The Danish LPUE figures for this FU seem to have levelled off in the most recent years, but this trend is valid only for the areas that are presently exploited, and which constitute only part of the stock. Sediment maps for this Management Area indicate that there are possibilities to let the fishery expand into new grounds, which have scarcely been fished to date.

Comparison with previous assessment and advice: Results of 2001 data analyses confirm the overall picture of a stock that is not fully exploited.

Elaboration and special comments: The majority of the landings from this FU are made by Denmark and Norway. During the last five years, landings have fluctuated between 750 t and 1150 t, with the highest figures recorded in 1999 (approx. 1130 t) and 2000 (approx. 1050 t - provisional). The LPUEs of Danish vessels has increased from 50-75 kg/day in the early 1990s to over 200 kg/day in the late 1990s. Mean sizes in both research vessel catches and commercial landings are high compared to neighbouring areas (Skagerrak and Kattegat).

LPUE and mean size data are available since 1989 and 1997 respectively. Length-frequency data for this fishery were insufficient to allow analytical assessments.

Source of information: Report of the Working Group on *Nephrops* Stocks, April 2001 (ICES CM 2001/ACFM:16).

Catch data (Tables 3.14.2.d.1-3.14.2.d.2):

Year	ICES advice	Recommended TAC	Agreed TAC[1]	ACFM landings
1987				< 0.1
1988				< 0.1
1989				< 0.1
1990				0.2
1991				0.2
1992			12.0	0.2
1993			12.0	0.3
1994			13.0	0.8
1995			15.2	0.5
1996			15.2	1.0
1997			15.2	0.8
1998			15.2	0.8
1999			15.2	1.1
2000			17.2	1.1
2001			15.48	
2002		1.2		
2003		1.2		

(Weights in '000 t) [1)] EU zone of IIa and IV

Table 3.14.2.d.1 *Nephrops* landings (tonnes) by Functional Unit plus Other rectangles in Management Area S (IVa, East of 2° E + rectangles 43 F5-F7).

Year	FU 32	Other	Total
1991	178	0	***178***
1992	160	0	***160***
1993	338	0	***338***
1994	759	0	***759***
1995	494	0	***494***
1996	960	0	***960***
1997	760	0	***760***
1998	838	0	***838***
1999	1129	0	***1129***
2000*	1051	0	***1051***
* provisional na = not available			

Table 3.14.2.d.2 *Nephrops* landings (tonnes) by country in Management Area S (IVa, East of 2° E + rectangles43 F5-F7).

Year	Denmark	Norway	UK	Total
1991	70	102	6	***178***
1992	66	83	11	***160***
1993	220	102	16	***338***
1994	584	165	10	***759***
1995	418	74	2	***494***
1996	868	82	10	***960***
1997	689	64	7	***760***
1998	743	91	4	***838***
1999	972	144	13	***1129***
2000*	871	147	33	***1051***
* provisional na = not available				

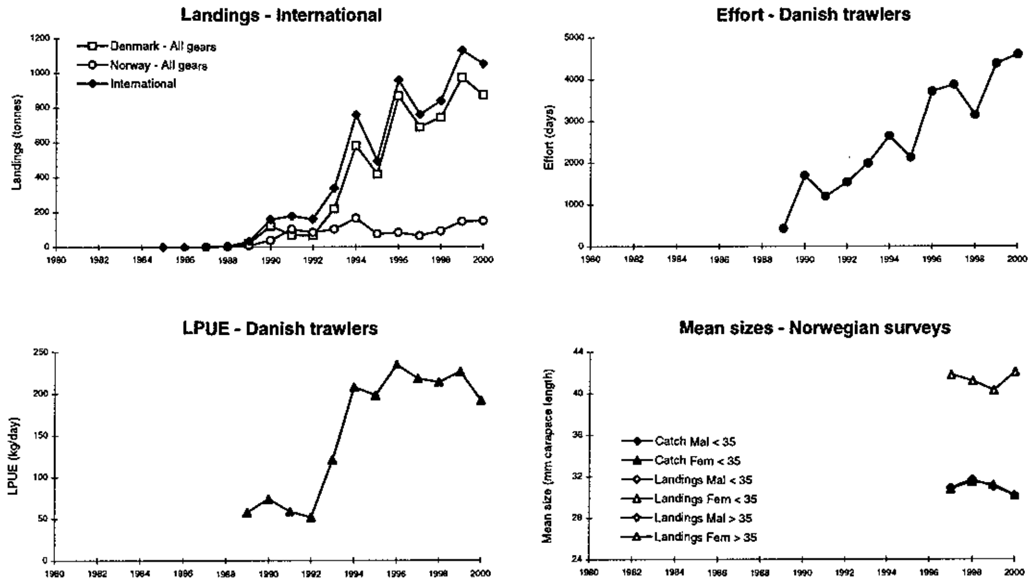


Figure 3.1.4.2.d.1 Norwegian Deep (FU 32): Long-term trends in landings, effort, LPUEs and mean sizes of *Nephrops* in catches and landings.

3.14.2.e *Nephrops* in Divisions IVb,c, West of 1° E (Management Area I)

There are two Functional Units in this Management Area: a) Farn Deeps (FU 6) and b) Firth of Forth (FU 8).

State of stock/exploitation: All stocks in this Management Area appear to be exploited at sustainable levels.

a) Farn Deeps: LPUEs fluctuating around a generally upward trend up to 1993, stable from then onwards. CPUEs decreased in the late 1980s, but generally are stable since then. Age-based assessment shows that both male and female stock biomass are fairly stable. Recruitment in both males and females are variable, with above-average values in the most recent years. F_{bar} for both males and females fluctuating without obvious trend, but values for the most recent years are below the long-term average. Y/R analysis based on outputs of VPA shows that current F is slightly above $\mathbf{F}_{max}$ for males, but well below $\mathbf{F}_{max}$ for females.

b) Firth of Forth: LPUEs fluctuating without obvious long-term trend, but with generally higher values in the early 1970s, the mid-1980s and the late 1990s. Age-based assessment suggests that stock biomass is stable in both males and females. Overall, recruitment seems to have increased since the early 1990s. Results of TV surveys broadly confirm the trends in the VPA estimates of stock biomass. F_{bar} for both males and females fluctuating without obvious trend. Y/R analysis based on outputs of VPA shows that current F is above $\mathbf{F}_{max}$ for males, but well below $\mathbf{F}_{max}$ for females.

Management objectives: There are no management objectives set for this fishery.

Advice on management: The basis for the advice is unchanged and therefore ICES reiterates its previous advice and recommends a Management Area TAC of 4170 t for both 2002 and 2003.

Relevant factors to be considered in management: Since 1993, landings from this Management Area have exceeded the TAC recommended by ICES. Up to the early 1990s, effort has increased much faster in the Farn Deeps than in the Firth of Forth. While effort has recently decreased in both FUs, there is still the potential for an imbalance in the exploitation rates. With the current large North Sea TAC area (which comprises eight *Nephrops* FUs), there is no mechanism for controlling effort locally. Management should therefore be carried out at the FU level recommended by ICES.

Comparison with previous assessment and advice: Results of this year's analytical assessments generally confirm those of the assessments carried out in 1997 and 1999.

Elaboration and special comments: Landings from this Management Area are almost solely by UK-England (FU 6) and UK-Scotland (FU 8) *Nephrops* directed vessels. Farn Deeps effort increased by about four times since the early 1970s to a peak in 1994. Landings have fluctuated considerably (between 1460 and 3700 t) in the last 10 years, also reaching a peak in 1994. Since 1994, both effort and landings have decreased again. Firth of Forth effort and landings have generally increased since the late 1960s. Effort decreased in the most recent years, while landings seem to have stabilised around 2000 t. Landings increased in 1997-99, without a corresponding increase in effort.

LPUE and mean size data, and landings/area and effort/area indices are available for both units. CPUE data available for the Farn Deeps since 1985. Length composition data available since 1985 for the Farn Deeps and since 1981 for the Firth of Forth. TV surveys carried out in both FUs (1996-2000 for the Farn Deeps, and 1993-2000, except 1995 and 1997 for the Firth of Forth).

Source of information: Report of the Working Group on *Nephrops* Stocks, April 2001 (ICES CM 2001/ACFM:16).

Catch data (Tables 3.14.2.e.1 –3.14.2.e.2)

Year	ICES advice	Recommended TAC	Agreed TAC[1]	ACFM landings
1987				4.0
1988				5.3
1989				5.1
1990				4.6
1991				3.8
1992		~4.6	12.0	3.5
1993		4.17	12.0	5.7
1994		4.17	13.0	6.0
1995		4.17	15.2	4.7
1996		4.17	15.2	4.6
1997		4.17	15.2	4.7
1998		4.17	15.2	4.6
1999		4.17	15.2	5.0
2000		4.17	17.2	4.3
2001		4.17	15.48	
2002		4.17		
2003		4.17		

(Weights in '000 t) [1]) EU zone of IIa and IV

Table 3.14.2.e.1 *Nephrops* landings (tonnes) by Functional Unit plus other rectangles in Management Area I (IVb,c, West of 1° E).

Year	FU 6	FU 8	Other	Total
1991	2064	1404	355	***3823***
1992	1463	1757	270	***3491***
1993	3030	2369	261	***5661***
1994	3697	1850	407	***5953***
1995	2569	1763	373	***4705***
1996	2482	1688	387	***4557***
1997	2189	2194	338	***4721***
1998	2175	2145	278	***4598***
1999	2401	2205	401	***5006***
2000 *	2155	1743	387	***4285***
* provisional na = not available				

Table 3.14.2.e.2 *Nephrops* landings (tonnes) by country in Management Area I (IVb,c, West of 1° E).

Year	Belgium	Denmark	UK	Total
1991	4	1	3818	***3823***
1992	1	7	3483	***3491***
1993	1	6	5654	***5661***
1994	0	1	5952	***5953***
1995	0	2	4703	***4705***
1996	0	3	4554	***4557***
1997	0	1	4720	***4721***
1998	0	2	4596	***4598***
1999	0	0	5006	***5006***
2000 *	1	0	4284	***4285***
* provisional na = not available				

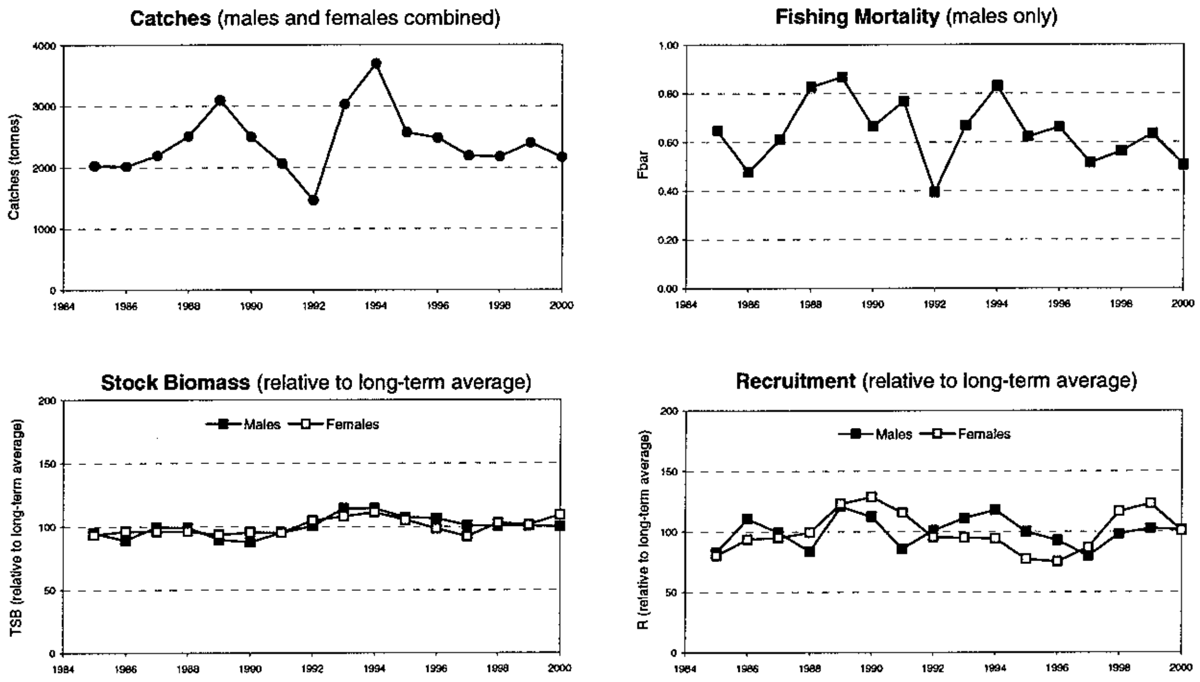


Figure 3.14.2.e.1 Farn Deeps (FU 6): Output VPA: Trends in Catches, Fbar, Stock Biomass and Recruitment.

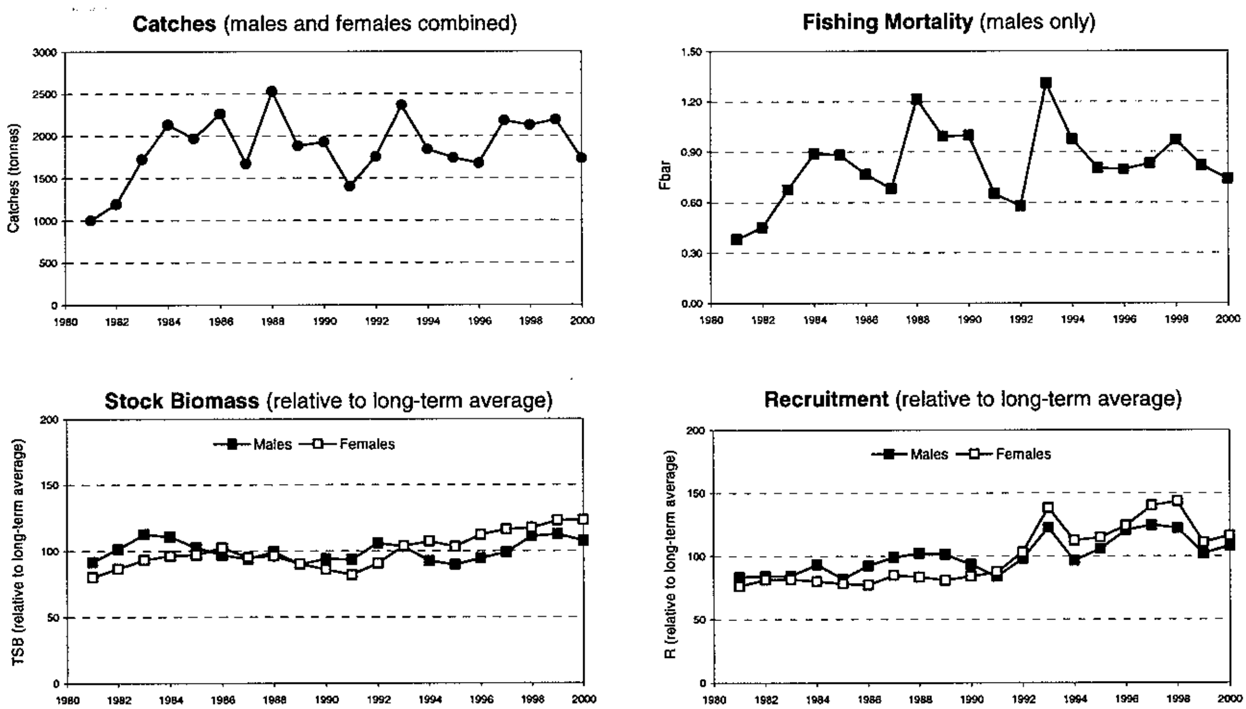


Figure 3.14.2.e.2 Firth of Forth (FU 8): Output VPA: Trends in Catches, Fbar, Stock Biomass and Recruitment.

3.14.2.f *Nephrops* in Divisions IVb,c, East of 1° E, excluding rectangles 43 F5-F7 (Management Area H)

There are two Functional Units in this Management Area: a) Botney Gut - Silver Pit (FU 5) and b) Off Horn Reef (FU 33).

State of stock/exploitation: The Botney Gut - Silver Pit stock appears to be exploited at sustainable levels, and the Off Horn Reef stock is not fully exploited.

a) Botney Gut - Silver Pit: Annual LPUEs show considerable variation and values for different vessel and gear types show different trends. Age-based assessment suggests that stock biomass is fairly stable in both males and females, albeit with a slight downward trend in male biomass in most recent years. Estimates of recruitment are stable, but are considered questionable (owing to the lack of discard length frequency data). F_{bar} has recently increased, particularly in males. Y/R analysis based on outputs of VPA shows that current F is close to $\mathbf{F_{max}}$ for males, and below $\mathbf{F_{max}}$ for females.

b) Off Horn Reef: Upward trends in landings and LPUE indicate that the stock is not fully exploited, and might yield some further increases in landings.

Management objectives: There are no management objectives set for this fishery.

Advice on management: The stocks in FU 5 and 33 appear to be able to sustain catches of the order of recent years and therefore ICES advises an overall Management Area TAC of 2 100 t for both 2002 and 2003.

Relevant factors to be considered in management: In the North Sea TAC area, the present aggregated management approach runs the risk of unbalanced effort distribution between this and the other *Nephrops* Management Areas. Adoption of management at the level of the Management Areas is recommended.

Comparison with previous assessment and advice: Results of this year's assessments generally confirm the conclusions that could be drawn from the 1997 and 1999 assessments.

Elaboration and special comments: Belgium (mostly FU 5), Denmark (mostly FU 33), the Netherlands (mostly FU 5) and the UK (mostly FU 5) are involved in these fisheries. International landings from FU 5 have generally increased, from less than 200 t per year in the mid-1960s to 1050-1200 t in the late 1990s. Belgian *Nephrops* directed effort has considerably decreased, particularly in the early 1990s, owing to the decommissioning of mostly older and less profitable vessels. A *Nephrops* directed fishery, using light beam trawls, has developed in the Netherlands in recent years. An almost exclusively Danish *Nephrops* directed fishery is expanding in FU 33, resulting in an almost tenfold increase of the landings, from about 75 t in 1991 and 1992, to 720 t in 1999.

LPUE and mean size data are available for FU 5, LPUE data only for FU 33. Length-frequency data on landings are available for FU 5 and for the Belgian fleet only. There is no discard sampling in these fisheries, and this makes the VPA estimates of recruitment questionable.

Source of information: Report of the Working Group on *Nephrops* Stocks, April 2001 (ICES CM 2001/ACFM:16).

Catch data (Tables 3.14.2.f.1-3.14.2.f.2):

Year	ICES advice	Recommended TAC	Agreed TAC [1]	ACFM landings
1987				0.5
1988				0.7
1989				0.8
1990				0.9
1991				1.0
1992		0.87	12.0	0.7
1993		0.87	12.0	0.9
1994		0.87	13.0	0.7
1995		0.87	15.2	1.2
1996		0.87	15.2	0.9
1997		0.87	15.2	1.6
1998		1.0	15.2	1.6
1999		1.0	15.2	2.2
2000		1.6	17.2	2.0
2001		1.6	15.48	
2002		2.1		
2003		2.1		

(Weights in '000 t) [1)] EU zone of IIa and IV

Table 3.14.2.f.1 *Nephrops* landings (tonnes) by Functional Unit plus Other rectangles in Management Area H (IVb,c, East of 1° E, excluding rectangles 43 F5-F7).

Year	FU 5	FU 33	Other	Total
1991	860	74	87	***1020***
1992	605	76	44	***725***
1993	719	160	62	***941***
1994	503	137	41	***682***
1995	869	164	207	***1240***
1996	678	77	168	***923***
1997	1150	276	131	***1557***
1998	1071	350	222	***1642***
1999	1185	724	295	***2204***
2000 *	1069	597	309	***1975***
* provisional na = not available				

Table 3.14.2.f.2 *Nephrops* landings (tonnes) by country in Management Area H (IVb,c, East of 1° E, excluding rectangles 43 F5-F7).

Year	Belgium	Denmark	Netherl.	UK	Total
1991	704	305	na	12	***1020***
1992	589	114	na	21	***725***
1993	706	228	na	8	***941***
1994	515	147	na	20	***682***
1995	657	318	253	12	***1240***
1996	290	152	422	59	***923***
1997	491	377	627	62	***1557***
1998	380	519	691	52	***1642***
1999	475	893	660	176	***2204***
2000 *	391	767	577	240	***1975***
* provisional na = not available					

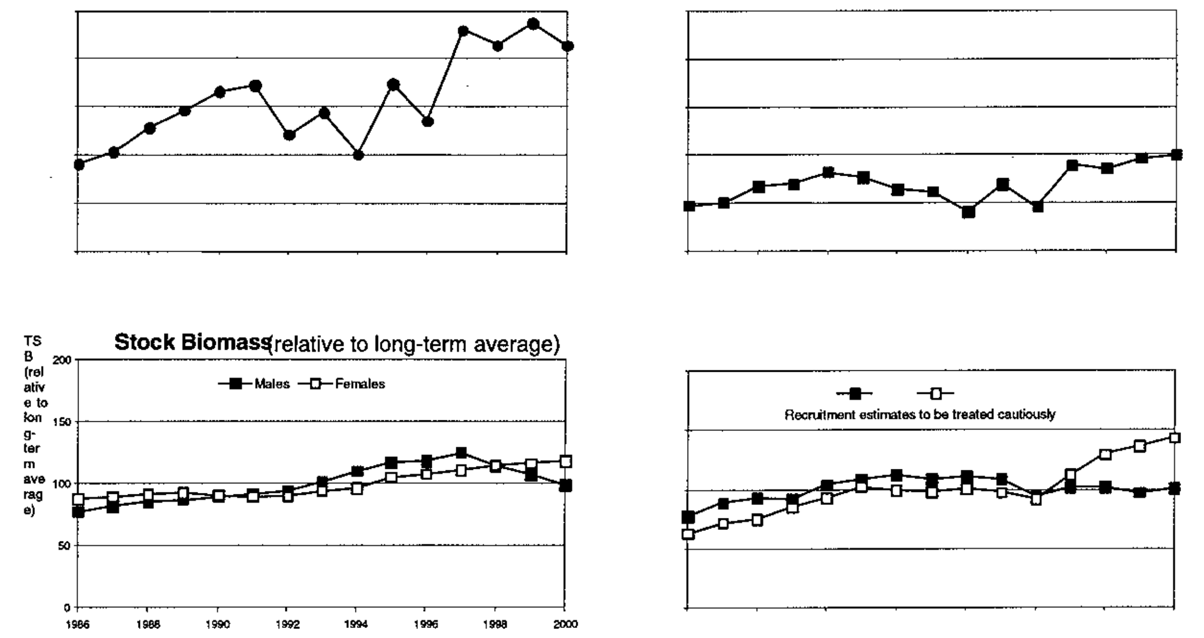


Figure 3.14.2.f.1 Botney Gut – Silver Pit (FU 5): Output VPA: Trends in Catches, Fbar, Stock Biomass and Recruitment.

3.14.2.g *Nephrops* in Divisions VIId,e (Management Area K)

Advice on management: There are no reported landings of *Nephrops* from this area. It is suggested that a zero TAC be set to prevent mis-reporting.

Source of information: Report of the Working Group on *Nephrops* Stocks, April 2001 (ICES CM 2001/ ACFM:16).

3.14.2.h *Nephrops* in Division VIa (Management Area C)

There are three Functional Units in this Management Area: a) North Minch (FU 11), b) South Minch (FU 12) and c) Clyde (FU 13).

State of stock/exploitation:

All stocks in this Management Area appear to be exploited at sustainable levels.

a) North Minch: Annual LPUEs have fluctuated without trend, despite a twofold increase in effort over the past 25 years. VPA estimates of stock biomass and recruitment fluctuating, but there is no evidence of long-term trends. Relatively stable biomass levels are also evident from the results of the TV camera surveys. F_{bar} of both males and females fluctuating, without long-term trend. Y/R analysis based on outputs of VPA shows that current F is close to $\mathbf{F_{max}}$ for males, and below $\mathbf{F_{max}}$ for females.

b) South Minch: Annual LPUEs fluctuating without trend. Male stock biomass has been stable till 1994, but has slightly declined since then. Female stock biomass has generally increased till the mid-1990s, then stabilised. Recruitment shows little variation, but currently is slightly below the long-term average, particularly in males. TV camera surveys suggest that abundance is fluctuating but stable. F_{bar} of both males and females fluctuating without trend. Y/R analysis based on outputs of VPA indicates that current F is at $\mathbf{F_{max}}$ for males, and below $\mathbf{F_{max}}$ for females.

c) Clyde: LPUEs were at a low level in the early 1990s, but markedly increased since then. Overall, annual LPUEs have been fluctuating along a slightly upward long-term trend. Age-based assessment suggests stable stock biomass for males, and increasing biomass for females. Recruitment in the last eight years has been above the long-term average. TV camera surveys suggest continued increase in abundance from 1995 to 1998, lower abundance levels in 1999, and higher levels again in 2000. F_{bar} shows a feeble upward trend for males, except for the last three years, and is fairly stable for females. Y/R analysis shows that current F is well above $\mathbf{F_{max}}$ for males, and below $\mathbf{F_{max}}$ for females.

Management objectives: There are no management objectives set for this fishery.

Advice on management: There is no basis to revise the advice given previously, and therefore ICES reiterates its advice of a Management Area TAC of 11 300 t for both 2002 and 2003.

Relevant factors to be considered in management: Catch composition data indicate that the creel fisheries in these FUs are taking higher proportions of berried females than the trawl fisheries. This could result in higher losses to the female spawning stock than in other FUs, where berried females are less accessible to exploitation.

In 1999, attention was drawn to the shift in effort between the FUs in this Management Area and the change in balance in the landings which this entailed. Since then, the landings from the Clyde have declined, returning the balance to that observed during the early 1990s.

Comparison with previous assessment and advice: The results of the analytical assessments confirm the conclusions that could be drawn from the 1997 and 1999 assessments.

Elaboration and special comments: Only UK vessels are involved in these fisheries. In FUs 11 and 12, *Nephrops* directed trawlers and creelers account for 75-85 % and 10-15 % of the landings respectively. In FU 13, over 95 % of the landings are taken by *Nephrops* directed trawlers. The use of 70 mm mesh size multi-rig gear has been eliminated following the UK national ban. Landings and effort in all three FUs have increased since the 1960s. In the North Minch and South Minch, landings have declined in recent years, corresponding to a decrease in *Nephrops* directed effort. Landings from the Clyde were very high in the mid-1980s, lower in the early 1990s, and higher again in the late 1990s.

LPUEs and mean size data, and landings/area and effort/area indices are available for all FUs. Length-frequency data are available since 1981.

Source of information: Report of the Working Group on *Nephrops* Stocks, April 2001 (ICES CM 2001/ACFM:16).

Catch data (Tables 3.14.2.h.1-3.14.2.h.2):

Year	ICES advice	Recommended TAC	Agreed TAC	ACFM landings
1987				11.2
1988				12.7
1989				11.0
1990				10.0
1991				10.5
1992		~11.4	12.0	10.8
1993		~11.3	12.0	11.3
1994		11.3	12.6	11.1
1995		11.3	12.6	12.8
1996		11.3	12.6	11.2
1997		11.3	12.6	11.2
1998		11.3	12.6	11.2
1999		11.3	12.6	11.5
2000		11.3	12.6	10.2
2001		11.3	11.34	
2002		11.3		
2003		11.3		

(Weights in '000 t).

Table 3.14.2.h.1 *Nephrops* landings (tonnes) by Functional Unit plus Other rectangles in Management Area C (VIa).

Year	FU 11	FU 12	FU 13	Other	Total
1991	2792	4442	3018	250	***10502***
1992	3560	4236	2788	244	***10828***
1993	3192	4455	3342	344	***11332***
1994	3616	4415	2629	438	***11098***
1995	3656	4680	3989	460	***12785***
1996	2871	3995	4060	239	***11165***
1997	3046	4345	3618	219	***11228***
1998	2441	3730	4843	143	***11157***
1999	3257	4051	3753	437	***11497***
2000*	2890	3693	3259	384	***10227***
* provisional na = not available					

Table 3.14.2.h.2 *Nephrops* landings (tonnes) by country in Management Area C (VIa).

Year	Rep. of Ireland	Spain	UK	Total
1991	33	0	10469	***10502***
1992	10	0	10818	***10828***
1993	7	0	11325	***11332***
1994	3	0	11095	***11098***
1995	13	1	12770	***12785***
1996	8	1	11156	***11165***
1997	8	4	11216	***11228***
1998	23	11	11122	***11157***
1999	141	31	11325	***11497***
2000*	109	53	10065	***10227***
* provisional na = not available				

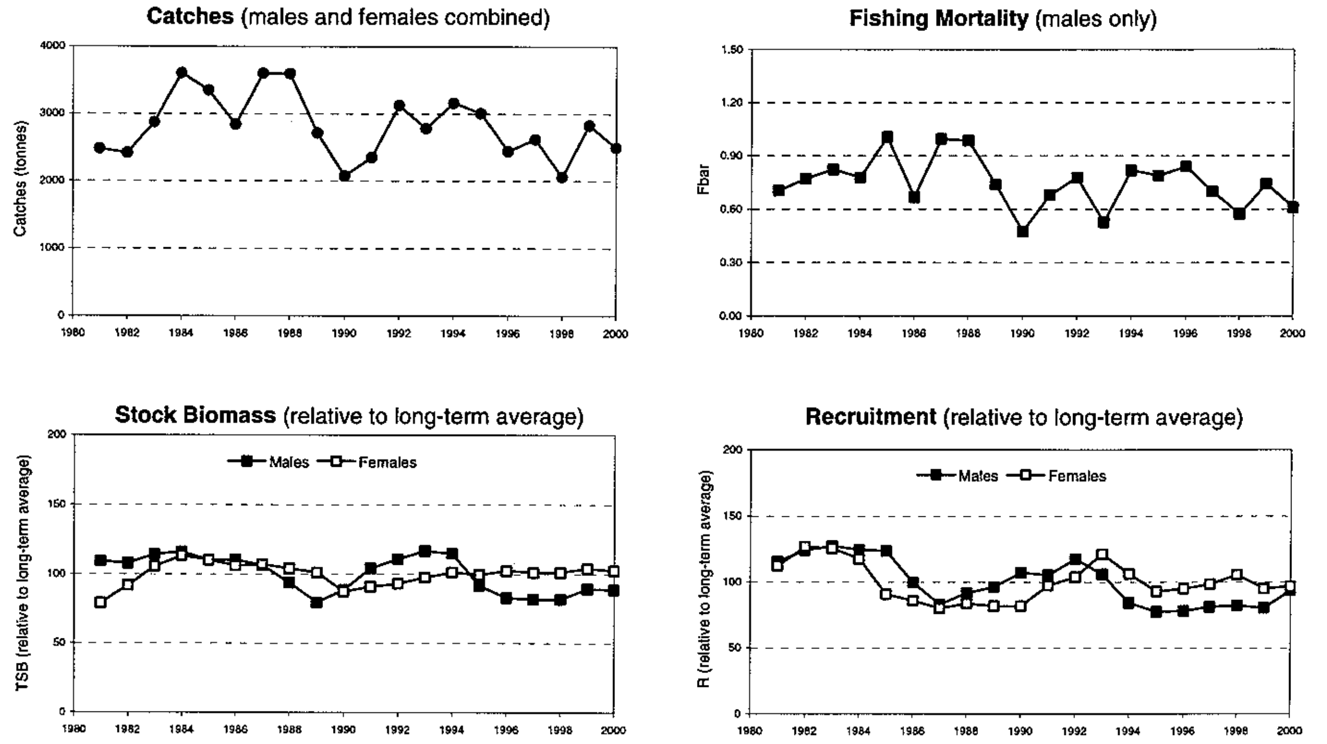


Figure 3.14.2.h.1 North Minch (FU 11): Output VPA: Trends in Catches, Fbar, Stock Biomass and Recruitment.

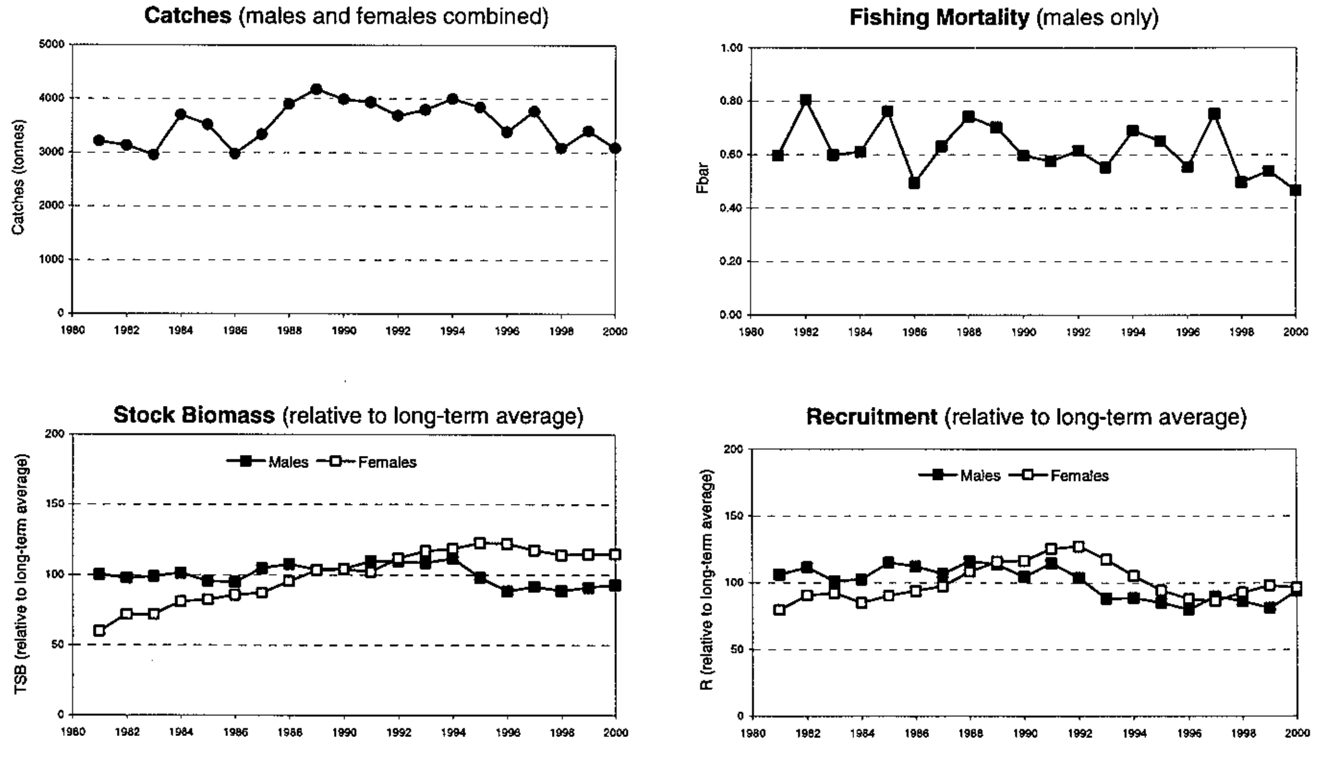


Figure 3.14.2.h.2 South Minch (FU 12): Output VPA: Trends in Catches, Fbar, Stock Biomass and Recruitment.

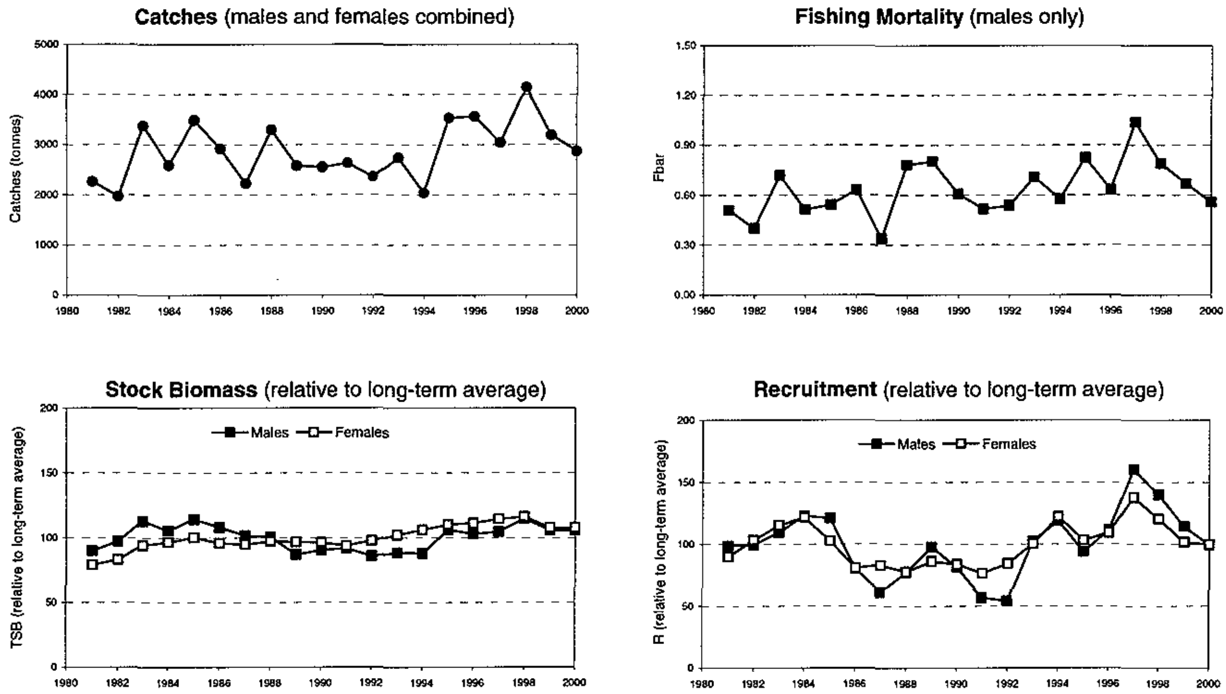


Figure 3.14.2.h.3 Clyde (FU 13): Output VPA: Trends in Catches, Fbar, Stock Biomass and Recruitment.

3.14.2.i *Nephrops* in Divisions Vb (EU zone) and VIb (Management Area D)

Advice on management: There are no reported landings of *Nephrops* from this area. It is suggested that a zero TAC be set to prevent mis-reporting.

Source of information: Report of the Working Group on *Nephrops* Stocks, April 2001 (ICES CM 2001/ACFM:16).

3.14.2.j *Nephrops* in Division VIIa, north of 53° N (Management Area J)

There are two Functional Units in this Management Area: a) Irish Sea East (FU 14) and b) Irish Sea West (FU 15).

State of the stock/exploitation: The stocks in this Management Area appear to be exploited at sustainable levels.

a) Irish Sea East: Annual LPUEs fluctuating, but generally lower in the 1990s than in the late 1970s and early 1980s. Landings fairly stable since the mid-1980s. Length-based Y/R analysis suggests that current F is at or above $\mathbf{F}_{max}$ for males (depending on procedure used to estimate length composition of the discards), and at or below $\mathbf{F}_{max}$ for females. No age-based assessment carried out.

b) Irish Sea West: CPUEs and LPUEs have recovered from the low values in the early 1990s. Age-based assessment indicates an increase in male biomass, and relative stability in female biomass and in both male and female recruitment. F_{bar} of males is currently stable and lower than 10 years ago. F_{bar} of females fluctuating without obvious trend, but higher than in most other *Nephrops* stocks. Y/R analysis based on outputs of VPA shows that current F is slightly above $\mathbf{F}_{max}$ for males, and at $\mathbf{F}_{max}$ for females.

Management objectives: There are no management objectives set for this fishery.

Advice on management: There is no basis to revise the advice given previously, and therefore ICES recommends that the landings from this Management Area in 2002 and 2003 be kept at a level corresponding to the average for 1995-1999, i.e. at 9550 t.

ICES also notes that this Management Area is within a much larger TAC area (Sub-area VII), and that a single TAC set for the whole Sub-area will not result in balanced exploitation. In an attempt to resolve this problem, ICES suggests a separate *Nephrops* TAC for Division VIIa, as is done for several finfish stocks (such as cod, whiting, plaice and sole).

Relevant factors to be considered in management: Although exploited throughout the year, increased effort generally occurs during the summer months, when females are available for capture after hatching their eggs. This results in higher annual fishing mortality rates on females than in most other northern FUs. The high F values on both sexes in the Irish Sea West suggest that the situation should be very carefully monitored.

Comparison with previous assessment and advice: The results of this year's assessments broadly confirm the conclusions that could be drawn from the 1997 and 1999 assessments. The proposed Management Area TAC of 9550 t represents a net increase of 150 t over the current advice, which is entirely due to an update of the reference period used to calculate the 5 years' average of the landings (viz. 1995-1999 as opposed to 1987-1991. This formed the basis for the advice given previously).

Elaboration and special comments: Most of the landings from this Management Area are taken by the UK and Ireland. Irish Sea East landings and effort increased to a peak in the late 1970s and early 1980s, and have now stabilised at about 60 % of that level. In the Irish Sea West, both landings and effort have been reasonably stable over the past 12 years.

LPUE and mean size data are available for both units, CPUE data for the Irish Sea West only. Length composition data are collected on a regular basis for both FUs. The lack of discard samples from the Irish Sea East in the most recent years prevented the use of an age-based assessment for this stock.

Source of information: Report of the Working Group on *Nephrops* Stocks, April 2001 (ICES CM 2001/ACFM:16)

Catch data (Tables 3.14.2.j.1-3.14.2.j.2):

Year	ICES advice	Recommended TAC	Agreed TAC [1]	ACFM Landings
1987				9.9
1988				9.1
1989				8.5
1990				8.9
1991				10.3
1992		8.9	20.0	8.0
1993		9.4	20.0	8.7
1994		9.4	20.0	8.1
1995		9.4	20.0	8.4
1996		9.4	23.0	7.8
1997		9.4	23.0	10.6
1998		9.4	23.0	9.5
1999		9.4	23.0	11.4
2000		9.4	21.0	8.9
2001		9.4	18.9	
2002		9.55		
2003		9.55		

(Weights in '000 t) [1)] Sub-area VII.

Table 3.14.2.j.1 *Nephrops* landings (tonnes) by Functional Unit plus Other rectangles in Management Area J (VIIa, North of 53° N).

Year	FU 14	FU 15	Other	Total
1991	772	9566	0	**10339**
1992	432	7547	0	**7979**
1993	586	8110	1	**8697**
1994	515	7623	0	**8139**
1995	638	7790	14	**8442**
1996	512	7235	23	**7770**
1997	599	9914	107	**10619**
1998	389	9131	15	**9534**
1999	625	10729	58	**11412**
2000 *	566	8273	61	**8900**
* provisional na = not available				

Table 3.14.2.j.2 *Nephrops* landings (tonnes) by country in Management Area J (VIIa, North of 53° N).

Year	Belgium	France	Rep. of Ireland	Isle of Man	UK	Total
1991	0	12	3390	62	6875	**10339**
1992	0	6	2381	14	5578	**7979**
1993	0	8	2750	32	5907	**8697**
1994	0	17	1797	16	6309	**8139**
1995	2	7	2413	23	5996	**8442**
1996	1	2	1641	10	6115	**7770**
1997	2	0	3406	7	7205	**10619**
1998	1	0	3127	17	6389	**9534**
1999	0	0	4735	6	6670	**11412**
2000 *	2	0	3511	0	5387	**8900**
* provisional						

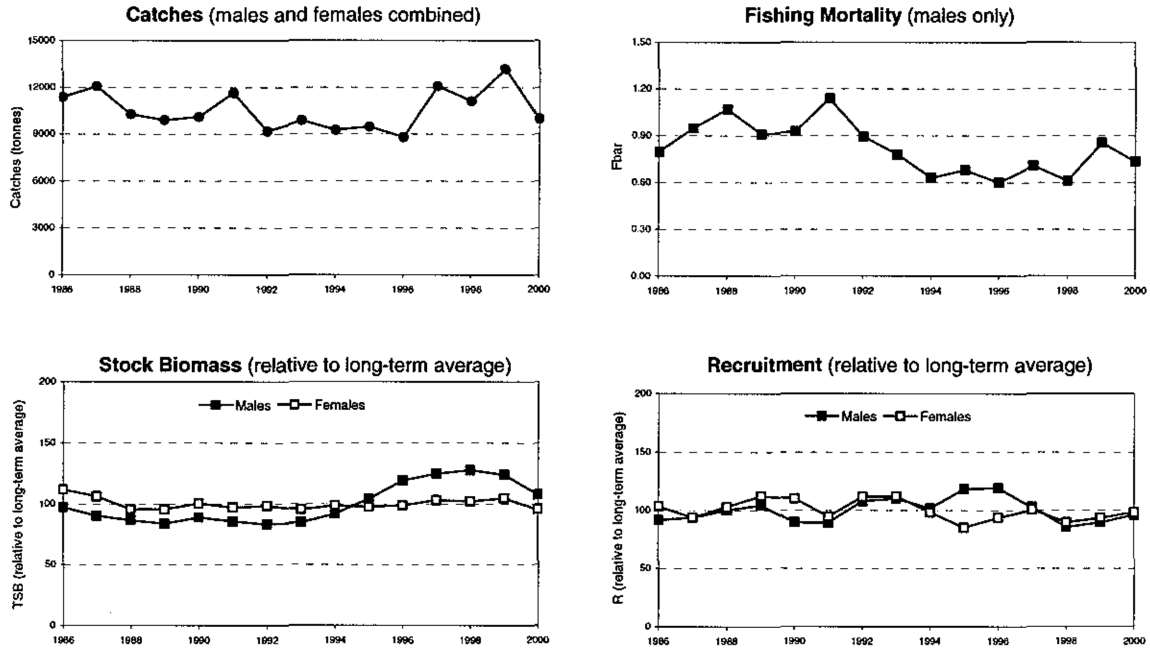


Figure 3.14.2.j.1 Irish Sea West (FU 15): Output VPA: Trends in Catches, Fbar, Stock Biomass and Recruitment.

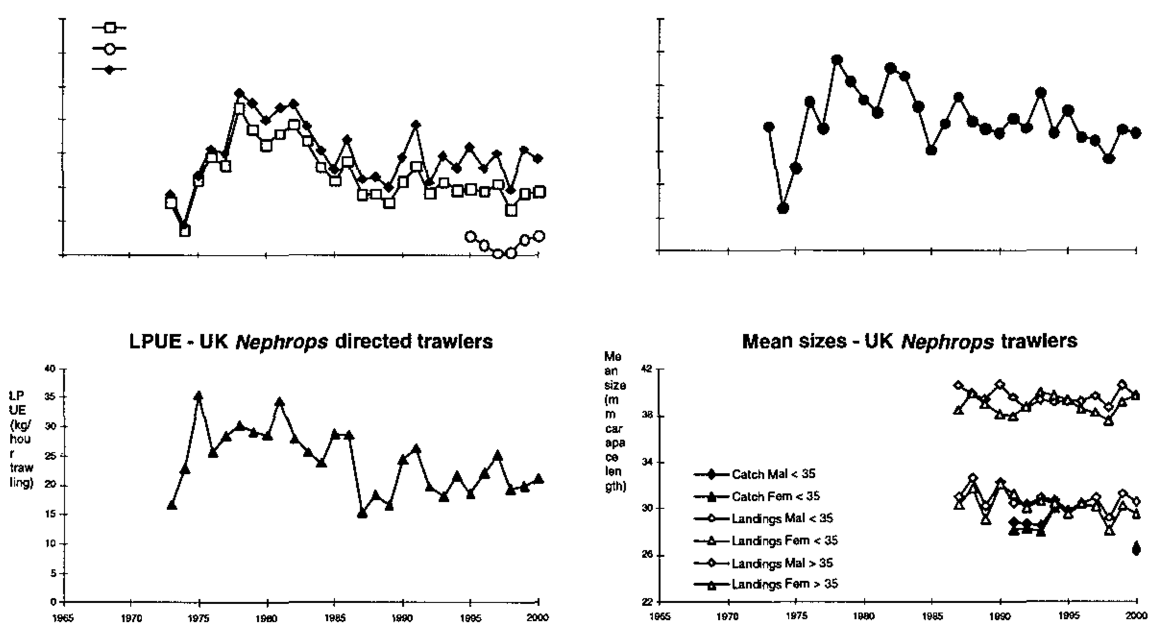


Figure 3.14.2.j.2 Irish Sea East (FU 14): Long-term trends in landings, effort, LPUEs and mean size *Nephrops* in catches and landings.

3.14.2.k *Nephrops* in Divisions VIIb,c,j,k (Management Area L)

There are four Functional Units in this Management Area: a) Porcupine Bank (FU 16), b) Aran Grounds (FU 17), c) Ireland NW coast (FU 18) and d) Ireland SW and SE coast (FU 19).

State of stock/exploitation: All stocks in this Management Area are considered to be exploited at sustainable levels.

a) Porcupine Bank: Annual LPUEs of the Spanish *Nephrops* fleet steeply declined in the mid- and late 1980s, but relatively stable since then. LPUEs of the French and Irish fleets have been fluctuating, but show little evidence of a decrease. Mean sizes in landings generally stable. No length- or age-based assessments carried out.

b) Aran Grounds: There are only LPUE and limited effort data on this stock. Landings and effort varied considerably over the past 6 years, following the same pattern, with low values in 1996 and peak values in 1998. No age-based assessment carried out.

c+d) Ireland coastal stocks: There are only LPUE and limited effort data on these stocks. Landings are strongly fluctuating (with a marked dip in 1994) along an overall downward trend. LPUE data show a dip in 1999 and 2000, but the data series is too short to draw definite conclusions. Data are insufficient to allow for length- or age-based assessments.

Management objectives: There are no management objectives set for this fishery.

Advice on management: ICES recommends that the landings be kept at a level corresponding to the average for 1995-1999, i.e an overall Management Area TAC of 4440 t for both 2002 and 2003.

Relevant factors to be considered in management: It should be noted that this Management Area includes four FUs and that a TAC set for the entire area will not necessarily result in a balance of exploitation between the units. At present, this Management Area is within a much larger TAC area (Sub-area VII), where the problem referred to is even greater.

Comparison with previous assessment and advice: The proposed Management Area TAC represents a net increase of 440 t over the current advice, which is entirely due to an update of the reference period used to calculate the 5 years' average of the landings (viz. 1995-1999 as opposed to 1987-1991, which formed the basis for the advice given previously).

Elaboration and special comments: Landings from the Porcupine Bank are mainly by France, Ireland, Spain and the UK. Landings from the other FUs are mostly by Ireland. Spanish landings from FU 16 continued to decrease over the past 5 years, while French and Irish landings remained relatively stable. Total landings from the Porcupine Bank peaked in the early 1980s, but have decreased since. Landings from FU 17 have generally increased, while those from FU 19 decreased. Total international landings from the Management Area as a whole have increased between the mid-1980s and the late 1990s, exceeding the recommended TAC in almost all years since 1994.

CPUE, LPUE and mean size data are available for most FUs, but the extent of the data series is often limited.

Landings from 'Other rectangles' (i.e. rectangles that are not part of a FU) from this Management Area are sometimes considerable, and may even exceed those taken from the FUs. It does not seem logical that analytical assessments are being performed on FUs, which yield scarcely 100 t of *Nephrops* landings per year (or even less), while areas that yield several hundreds of tonnes remain unassessed. Therefore, ICES suggests that the available data on the distribution of these deep-water stocks be critically reviewed, and – if deemed necessary – that a revision of the FUs within this Management Area be considered.

Source of information: Report of the Working Group on *Nephrops* Stocks, April 2001 (ICES CM 2001/ACFM:16).

Catch data (Tables 3.14.2.k.1-3.14.2.k.2):

Year	ICES advice	Recommended TAC	Agreed TAC[1]	ACFM landings
1987				4.5
1988				3.9
1989				4.0
1990				3.1
1991				3.4
1992		3.8	20.0	3.7
1993		~4.0	20.0	3.6
1994		~4.0	20.0	4.3
1995		~4.0	20.0	4.9
1996		4.0	23.0	4.1
1997		4.0	23.0	4.0
1998		4.0	23.0	5.0
1999		4.0	23.0	4.2
2000		4.0	21.0	2.7
2001		4.0	18.9	
2002		4.44		
2003		4.44		

(Weights in '000 t) [1)] Sub-area VII.

Table 3.14.2.k.1 *Nephrops* landings (tonnes) by Functional Unit plus other rectangles in Management Area L (VIIb,c,j,k).

Year	FU 16	FU 17	FU 18	FU 19	Other	Total
1991	1613	519	0	1077	196	***3405***
1992	1969	412	1	888	454	***3724***
1993	1826	372	10	905	487	***3599***
1994	2482	729	126	389	599	***4326***
1995	2668	866	24	699	610	***4867***
1996	2129	527	45	806	651	***4158***
1997	2026	735	10	690	551	***4013***
1998	1806	1392	75	740	938	***4951***
1999	1865	1117	16	505	650	***4152***
2000 *	764	877	9	632	382	***2665***
* provisional na = not available						

Table 3.14.2.k.2 *Nephrops* landings (tonnes) by country in Management Area L (VIIb,c,j,k).

Year	France	Rep. of Ireland	Spain	UK	Total
1991	590	1519	1152	144	***3405***
1992	909	1351	1139	325	***3724***
1993	1039	1310	1075	175	***3599***
1994	1322	1716	1069	219	***4326***
1995	1500	2325	767	275	***4867***
1996	1216	1751	875	316	***4158***
1997	1123	2001	554	335	***4013***
1998	980	3039	571	361	***4951***
1999	904	2516	536	196	***4152***
2000 *	425	1784	320	136	***2665***
* provisional na = not available					

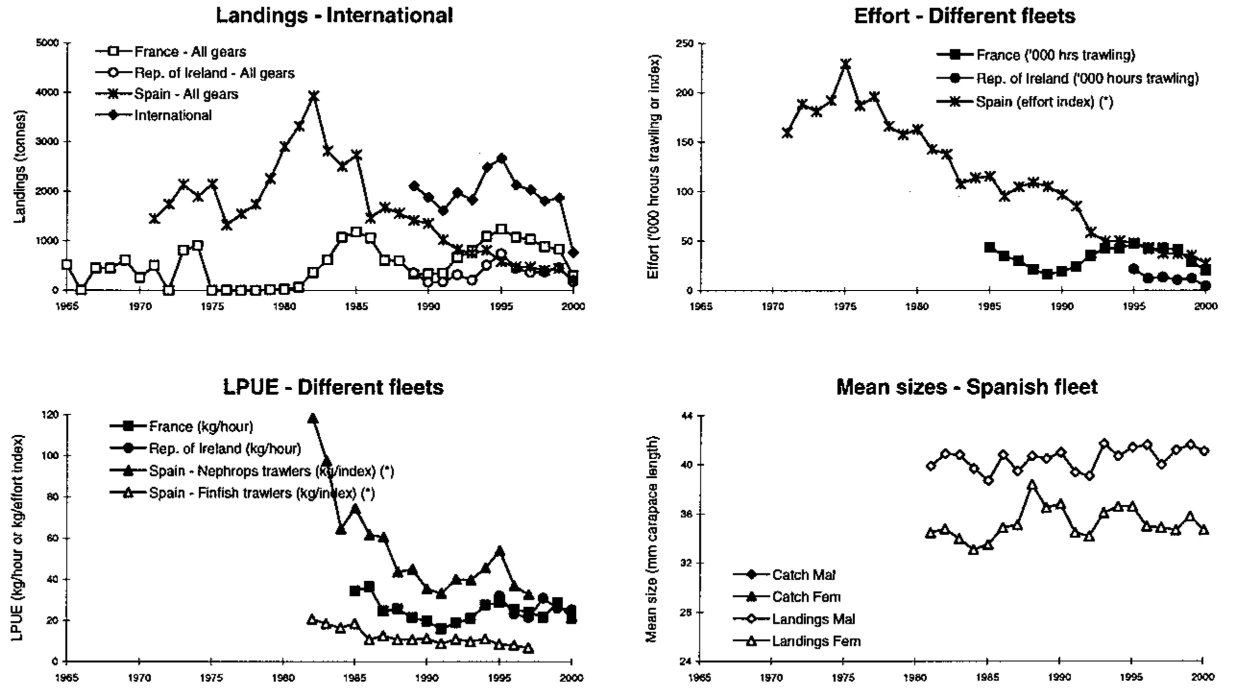


Figure 3.14.2.k.1 Porcupine Bank (FU 16): Long term trends in landings, effort, LPUEs and mean sizes of *Nephrops in catches and landings.* (*) The Spanish effort index and LPUE data are based on hours at sea and average engine power.

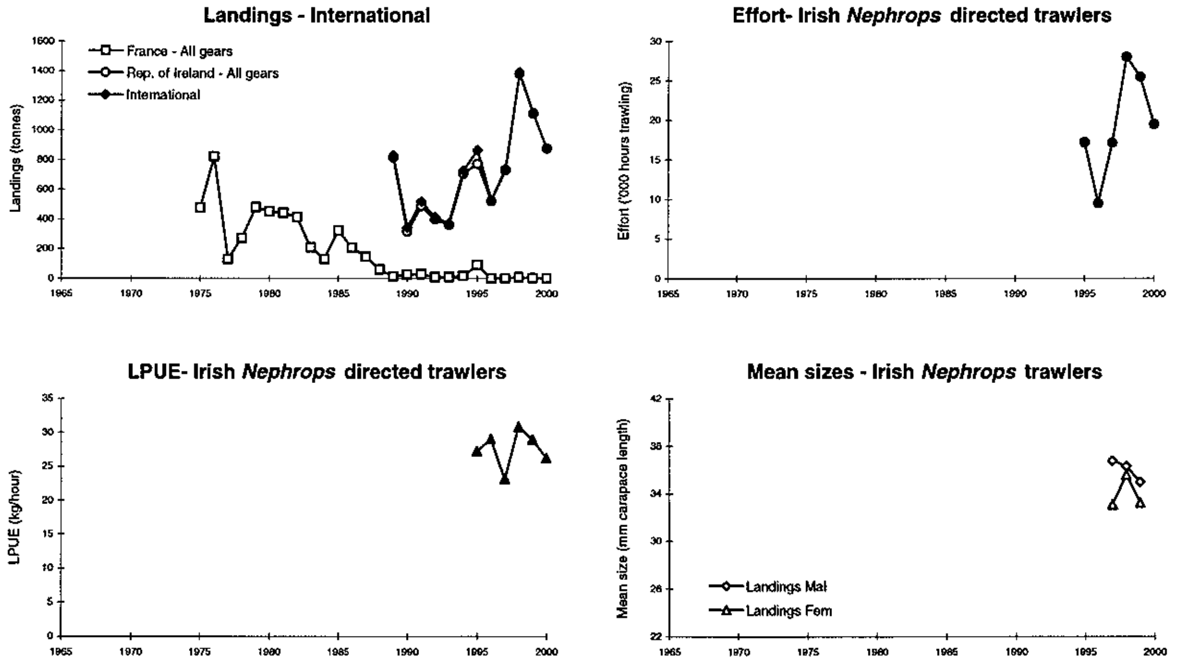


Figure 3.14.2.k.2 Aran Grounds (FU 17): Long-term trends in landings, effort, LPUEs and mean sizes of *Nephrops* in catches and landings.

3.14.2.1 *Nephrops* in Divisions VIIf,g,h, excluding rectangles 31 E1 and 32 E1-E2 + VIIa, south of 53° N (Management Area M)

There are three Functional Units in this Management Area: FUs 20, 21 and 22, together called Celtic Sea.

State of stock/exploitation: The stock in this Management Area appears to be exploited at sustainable levels.

a) Celtic Sea (FUs 20, 21 and 22 combined): Annual LPUEs of French *Nephrops* trawlers fell in 1989-91, slightly increased till 1995, then decreased again. Mean sizes in catches and landings show an overall increasing trend. Age-based assessment (on males only) shows relative stability in stock biomass, and temporary decline in recruitment in 1997-1998. Estimates of recruitment should be considered cautiously, owing to the lack of a regular discard sampling programme. F_{bar} for males is fluctuating, with the values for the most recent years at the lower end of the range. Y/R analysis (males only) based on outputs of VPA suggests that current F is close to $\mathbf{F_{max}}$.

Management objectives: There are no management objectives set for this fishery.

Advice on management: There is no basis to revise the advice given previously, and therefore ICES recommends a TAC for Management Area M of 3800 t for both 2002 and 2003.

Relevant factors to be considered in management: It is expected that the mesh size increase that was implemented in the beginning of 2000, will have a long-term beneficial effect on the exploitation pattern of this stock. Comparison of the length-frequencies of the landings for 1998, 1999 and 2000, shows a net decrease in the proportion of smaller *Nephrops* in the 2000 landings.

Comparison with previous assessment and advice: Results of this year's assessment (using an improved method for the calculation of the discard removals) give a less pessimistic appreciation of the state of exploitation, with much more stable values for (male) stock biomass, and a less dramatic decline in recruitment. Females were not assessed, for reasons of their overall scarcity in the landings. This makes the estimates of their removals too dependent on the estimates of the discards, for which regular sampling data are not available.

Elaboration and special comments: Landings from this stock are reported by France, Ireland and the UK. Until 1993, the French landings represented at least 80 % of the total, since then their share has dropped to 55-65 %. There has been a considerable increase in Irish landings, from 650-750 t in early 1990s to over 1500 t in the late 1990s. International landings reached a peak in 1995, and have generally decreased since, except in 2000, when they increased again to approx. 4250 t.

LPUE, mean size data and length compositions of the French landings are available for this stock. Discard data available for some years only.

A serious delay in the processing of the French fishery statistics prevented inclusion of the effort data for the years 1999 in the XSA tuning. For 2000, an estimate of overall effort was derived from logbook data. However, this estimate was not corrected for target species of the effort. Establishment of an Irish sampling programme, and more frequent discard samplings of the French fleet would greatly improve the quality of the length-frequency data, the more so since (a) the minimum landing sizes applied by the two fleets are different (25 mm CL in Ireland vs. 35 mm CL in France), and (b) discarding by the French fleet is substantial (owing to the large commercial minimum landing size).

Source of information: Report of he Working Group on *Nephrops* Stocks, April 2001 (ICES CM 2001/ACFM:16).

Catch data (Tables 3.14.2.1.1-3.14.2.1.2):

Year	ICES advice	Recommended TAC	Agreed TAC [1]	ACFM landings
1987				3.4
1988				3.1
1989				3.9
1990				4.4
1991				3.3
1992		~3.8	20.0	4.3
1993		3.8	20.0	4.7
1994		3.8	20.0	5.2
1995		3.8	20.0	5.6
1996		3.8	23.0	4.8
1997		3.8	23.0	4.3
1998		3.8	23.0	3.9
1999		3.8	23.0	2.9
2000		3.8	21.0	4.3
2001		3.8	18.9	
2002		3.8		
2003		3.8		

(Weight in '000 t) [1)] Sub-area VII.

Table 3.14.2.1.1 *Nephrops* landings (tonnes) by Functional Unit plus Other rectangles in Management Area M (VIIf,g,h, excluding rectangles 31 E1 and 32 E1-E2 + VIIa, South of 53° N).

Year	FUs 20-22	Other	Total
1991	3100	178	***3278***
1992	4013	236	***4249***
1993	4403	275	***4679***
1994	4900	285	***5185***
1995	5260	334	***5594***
1996	4536	265	***4801***
1997	4037	259	***4295***
1998	3737	148	***3885***
1999	2502	352	***2854***
2000 *	4238	52	***4290***
* provisional na = not available			

Table 3.14.2.1.2 *Nephrops* landings (tonnes) by country in Management Area M (VIIf,g,h, excluding rectangles 31 E1 and 32 E1-E2 + VIIa, South of 53° N).

Year	Belgium	France	Ireland	UK	Total
1991	3	2617	644	15	***3278***
1992	0	3413	750	86	***4249***
1993	0	3846	770	63	***4679***
1994	2	3692	1426	65	***5185***
1995	2	3891	1576	125	***5594***
1996	2	3328	1388	82	***4801***
1997	4	2614	1590	87	***4295***
1998	1	2158	1668	58	***3885***
1999	0	1926	890	38	***2854***
2000 *	1	2441	1805	44	***4290***
* provisional na = not available					

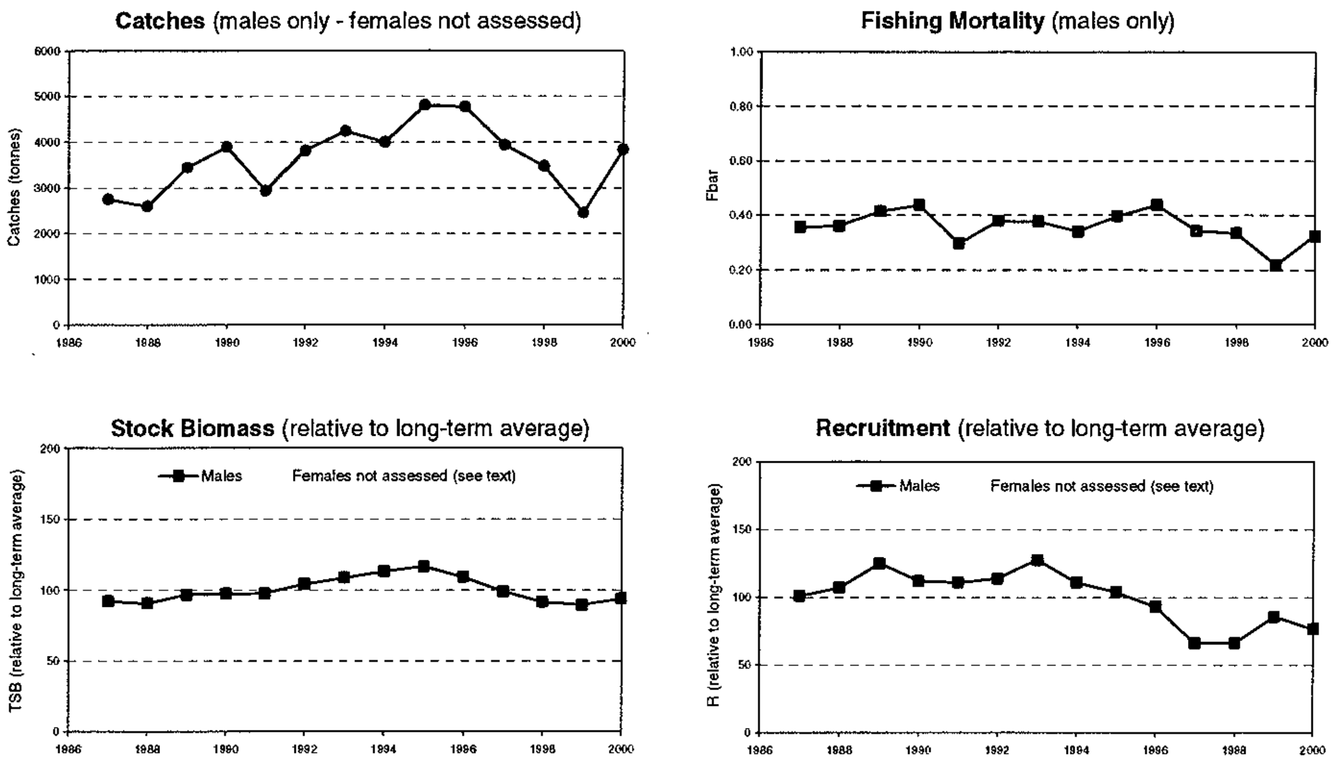


Figure 3.14.2.1.1 Celtic Sea (FUs 20-22): Output VPA: Trends in Catches, Fbar, Stock Biomass and Recruitment.

3.14.2.m *Nephrops* in Divisions VIIIa, b (Management Area N)

There are two Functional Units in this Management Area: a) Bay of Biscay North (FU 23) and b) Bay of Biscay South (FU 24), together called Bay of Biscay.

State of stock/exploitation: The stock in this Management Area is showing signs of severe over-exploitation.

a+b) Bay of Biscay North and South combined: Annual LPUEs fluctuating, with the values for 1995-1998 (the most recent data available) at the upper end of the range. Gear efficiency in the area has increased in the most recent years (following the use of twin-trawls and rock hoppers, which made trawling possible in areas that were previously inaccessible), and this may have helped maintaining the LPUEs at relatively high levels. Age-based assessment suggests that biomass for males are seriously declining. F_{bar} on males has fluctuated along a general upward trend. Female biomass seems also to be declining and F_{bar} has fluctuated without evidence of a long-term trend, but these results were considered less reliable than for males. Y/R analysis based on outputs of VPA shows that current F is well above $\mathbf{F_{max}}$ for both males and females.

The assessment is accepted to be indicative of stock trends and shows a declining trend since the early 1990s. This is attributed to the exploitation rate being too high.

Management objectives: There are no management objectives set for this fishery.

Advice on management: In order to halt the decline of the stock ICES advises a 40% reduction in the exploitation rate. This corresponds to a catch of 2000 t for 2002.

Relevant factors to be considered in management: The mesh size increase that was implemented in the year 2000, did not improve size selectivity, owing to the use of much more rigid twines, which actually reduce the size selective properties of the meshes.

Comparison with previous assessment and advice: The results of this year's assessment confirm the assessments performed in 1999 and indicate that the Bay of Biscay *Nephrops* stock is showing serious signs of depletion.

Elaboration and special comment: Nearly all landings from FUs 23 and 24 are taken by French trawlers. Landings have been generally high, though fluctuating (typically between 4500 and 7000 t), until the early 1990s, but have decreased to a much lower level since then. Number of fishing days has decreased since 1994, owing to changes in fishing practices and decommissioning of vessels.

LPUE, mean sizes and length compositions of the landings are available for the two FUs combined. Discard data available for some years only.

As for the Celtic Sea, there was a serious delay in the processing of French fishery statistics for this area. The lack of effort data for the years 1999 and 2000 prevented the use of the XSA in the age-based assessment. Instead, a simple user-defined VPA was performed. The VPA estimates of recruitment should be treated cautiously, owing to the lack of adequate discard data for most years in the time series.

Source of information: Report of the Working Group on *Nephrops* Stocks, April 2001 (ICES CM 2001/ACFM:16).

Catch data (Tables 3.14.2.m.1-3.14.2.m.2)

Year	ICES advice	Recommended TAC	Agreed TAC	ACFM Landings
1987				5.7
1988				6.8
1989				5.4
1990				5.1
1991				4.8
1992		~6.8	6.8	5.7
1993		6.8	6.8	5.0
1994		6.8	6.8	4.1
1995		6.8	6.8	4.5
1996		6.8	6.8	4.3
1997		6.8	6.8	3.6
1998		4.2	5.5	3.3
1999		4.2	5.5	3.3
2000		4.2	4.44	3.3
2001		4.2	4.0	
2002	*40 % reduction of current exploitation rate*	2.0		
2003		2.0		

(Weights in '000 t).

Table 3.14.2.m.1 *Nephrops* Landings (tonnes) by Functional Unit plus other rectangles in Management Area N (VIIIa,b).

Year	FU 23	FU 24	FUs 23-24 **	Other	Total
1991	4352	401	1	55	***4809***
1992	5123	558	0	47	***5728***
1993	4404	512	0	49	***4965***
1994	3687	368	0	27	***4082***
1995	4060	379	0	14	***4453***
1996	4205	88	0	15	***4308***
1997	3451	147	2	43	***3643***
1998	2899	244	2	121	***3266***
1999	2873	275	2	127	***3277***
2000 *	2919	198	0	172	***3289***

* provisional na = not available

** Countries reporting aggregated landings figures only for FUs 23+24

Table 3.14.2.m.2 *Nephrops* landings (tonnes) by country in Management Area N (VIIIa,b).

Year	Belgium	France	Spain	Total
1991	1	4753	55	***4809***
1992	0	5681	47	***5728***
1993	0	4916	49	***4965***
1994	0	4055	27	***4082***
1995	0	4439	14	***4453***
1996	0	4293	15	***4308***
1997	2	3600	41	***3643***
1998	2	3224	40	***3266***
1999	2	3249	26	***3277***
2000 *	0	3253	36	***3289***

* provisional na = not available

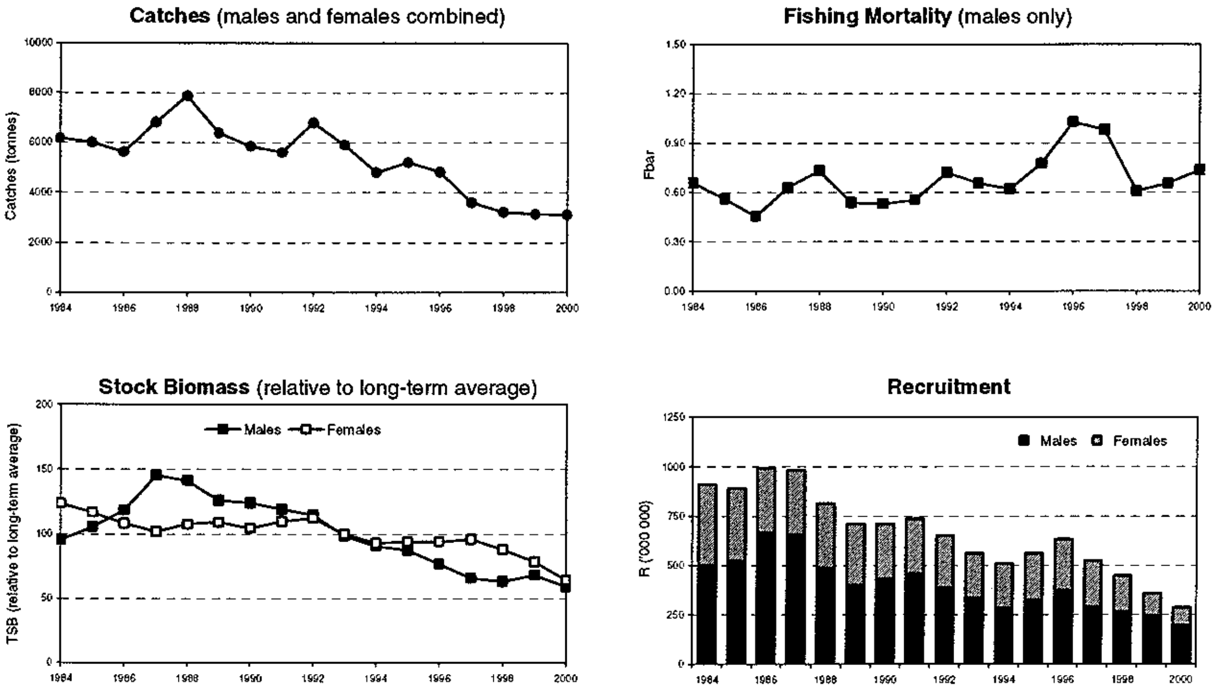


Figure 3.14.2.m.1 Bay of Biscay (FUs 23-24): Output VPA: Trends in Catches, Fbar, Stock Biomass and Recruitment.

3.14.2.n *Nephrops* in Division VIIIc (Management Area O)

There are two Functional Units in this Management Area: a) North Galicia (FU 25) and b) Cantabrian Sea (FU 31).

State of stock/exploitation: All stocks in this Management Area are seriously over-exploited.

a) North Galicia: Annual LPUEs fluctuating along a marked downward trend. Age-based assessment (carried out for the first time on this FU) gives evidence of sharp declines in stock biomass and recruitment for both males and females. F_{bar} values for males and females fluctuating, without obvious long-term trend. F values for females are considerably lower than for males. Y/R analysis based on outputs of VPA shows that current F is well above $\mathbf{F_{max}}$ for males, but below $\mathbf{F_{max}}$ for females. Bottom trawl survey indices of abundance confirm overall picture of declining stock.

b) Cantabrian Sea: LPUEs strongly fluctuating, with high values in 1988-90 and 1997-98, and much lower values in the other years. LPUEs in 1999 and 2000 are the lowest on record. Mean sizes of both males and females sharply increasing. Bottom trawl survey indices of abundance suggest decline in stock. Insufficient data to perform length- or age-based assessments.

Management objectives: There are no management objectives set for this fishery.

Advice on management: ICES advises that fishing mortality on these stocks should be reduced to zero. If the by-catch of *Nephrops* in fisheries targeting other species makes this impossible, ICES recommends that suitable technical measures (closed areas, closed seasons, etc.) be investigated for implementation at the earliest possible opportunity in order to rebuild the stocks.

Catch options: Catch options for FU 25 (North Galicia), males and females combined. $F_{2001} = F_{1998\text{-}2000}$ scaled to F_{2000}. Recruitment = GM for the years 1996-1999. Last column gives % change in TSB_{2003} vs. TSB_{2001}.

2000				2002			2003	%
F factor	**Ref F**	**TSB**	**Landings**	**F factor**	**TSB**	**Landings**	**TSB**	**change**
		311	81	0.0	247	0	279	4
				0.2	247	12	266	-1
2001				0.4	247	22	255	-5
F factor	**Ref F**	**TSB**	**Landings**	0.5	247	27	249	-7
1		269	65	0.6	247	31	244	-9
				0.8	247	40	234	-13
				1.0	247	48	224	-17
				1.2	247	45	216	-20

Relevant factors to be considered in management: The mixed nature of the demersal fisheries in this Management Area has meant that historically the management measures for the target *fish* species have defined the levels of exploitation of *Nephrops*. This has prevented directed management of the *Nephrops* stocks in the area. However, to prevent further declines of the *Nephrops* stocks in Division VIIIc, fishing pressure on *Nephrops* must be substantially reduced. It is worth noticing that the agreed *Nephrops* TAC for VIIIc (1000 t until 1999, and 800 t for 2000) has never been restrictive.

Comparison with previous assessment and advice: Previous assessments of the North Galicia stock were length-based and gave an over-optimistic impression of the state of the stock. As pointed out in Section 3.14.1 Overview on *Nephrops* Stocks, LCA gives no information on recruitment overfishing and this can lead to severely misleading conclusions about stock status.

Elaboration and special comments: All catches from these FUs are taken by Spain. Landings and effort in both FUs have declined, and are now record low.

LPUE and mean size data are available for both FUs. Length-frequency data available for FU 25 since 1986. Discarding in these fisheries is marginal. Abundance indices are available for both FUs, derived from bottom trawl surveys to estimate hake recruitment and to collect information on the relative abundance of demersal species in general.

Source of information: Report of the Working Group on *Nephrops* Stocks, April 2001 (ICES CM 2001/ACFM:16).

Catch data (Tables 3.14.2.n.1–3.14.2.n.2):

Year	ICES advice	Recommended TAC	Agreed TAC	ACFM Landings
1987				0.53
1988				0.60
1989				0.52
1990				0.46
1991				0.56
1992		0.51	0.8	0.52
1993		0.51	1.0	0.37
1994		0.51	1.0	0.39
1995		0.51	1.0	0.37
1996		0.51	1.0	0.34
1997		0.51	1.0	0.32
1998		0.51	1.0	0.18
1999		0.51	1.0	0.17
2000		0.51	0.8	0.12
2001		0.51	0.72	
2002		0		
2003				

Weights in '000 t.

Table 3.14.2.n.1 *Nephrops* landings (tonnes) by Functional Unit plus Other rectangles in Management Area O (VIIIc).

Year	FU 25	FU 31	Other	Total
1991	453	109	0	***562***
1992	428	94	0	***522***
1993	274	91	0	***365***
1994	245	148	0	***393***
1995	273	94	0	***367***
1996	209	129	0	***338***
1997	219	98	0	***317***
1998	103	72	0	***175***
1999	124	48	0	***172***
2000 *	81	34	0	***115***
* provisional na = not available				

Table 3.14.2.n.2 *Nephrops* landings (tonnes) by country in Management Area O (VIIIc).

Year	Spain	Total
1991	562	***562***
1992	522	***522***
1993	365	***365***
1994	393	***393***
1995	367	***367***
1996	338	***338***
1997	317	***317***
1998	175	***175***
1999	172	***172***
2000 *	115	***115***
* provisional na = not available		

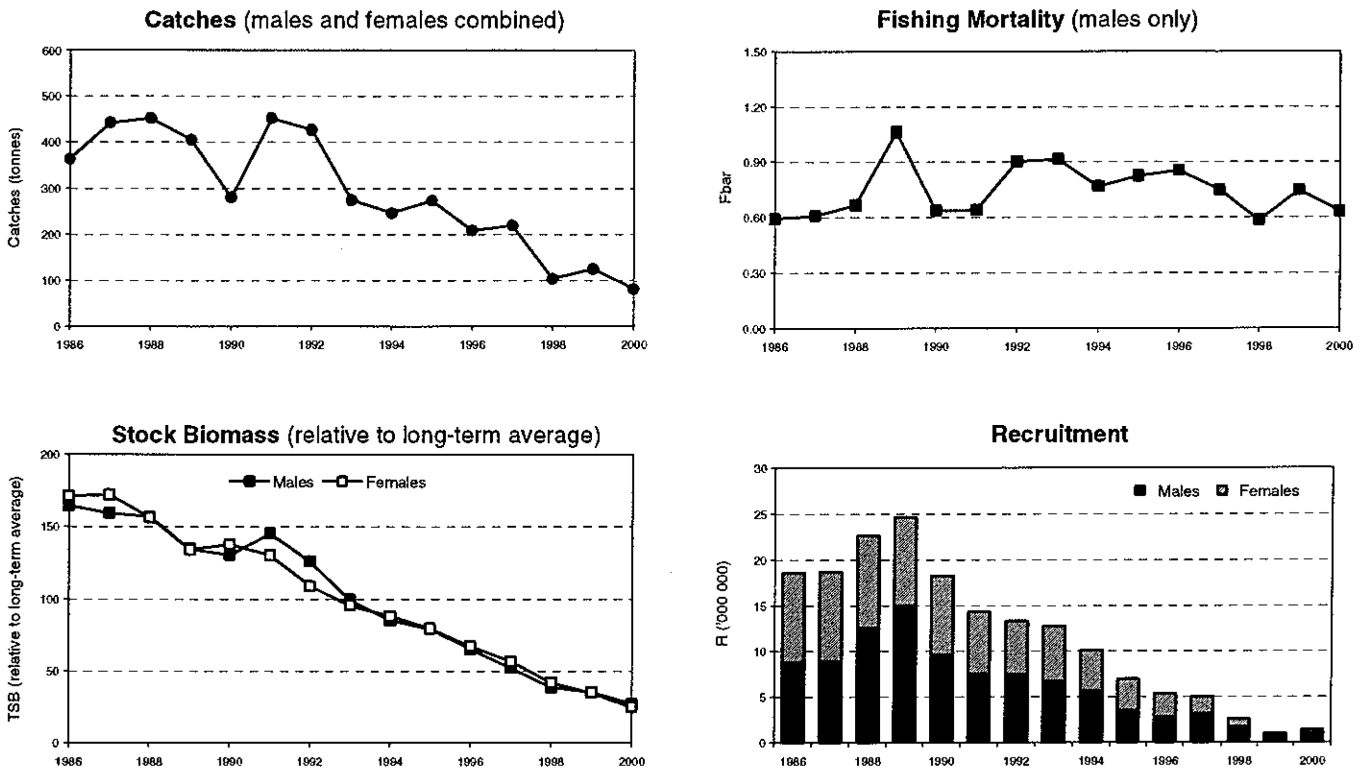


Figure 3.14.2.n.1 North Galicia (FU 25): Output VPA: Trends in Catches, Fbar, Stock Biomass and Recruitment.

3.14.2.o *Nephrops* in Divisions VIIId, e (Management Area P)

Advice on management: There are no reported landings of *Nephrops* from this area, so it is suggested that a zero TAC be set to prevent misreporting.

Source of information: Report of the Working Group on *Nephrops* Stocks, April 2001 (ICES CM 2001/ACFM:16).

3.14.2.p *Nephrops* in Division IXa (Management Area Q)

There are five Functional Units in this Management Area: a) West Galicia (FU 26), b) North Portugal (FU 27), c) Southwest Portugal (FU 28), d) South Portugal (FU 29) and e) Gulf of Cadiz (FU 30).

State of stocks/exploitation:

All stocks in this Management Area are seriously over-exploited.

a+b) West Galicia and North Portugal: LPUEs for FU 26 relatively high and declining for two ports, or low and fluctuating without trend for two other ports. Mean sizes of both males and females increasing in most recent years. Age-based assessment for the two FUs combined (performed for the first time) gives evidence of sharply declining stock biomass and recruitment in both males and females. $\mathbf{F_{bar}}$ for males strongly fluctuating, and currently at the lower end of the range. $\mathbf{F_{bar}}$ for females low and generally stable. Y/R analysis based on outputs of VPA shows that current F is far above $\mathbf{F_{max}}$ for males, and at $\mathbf{F_{max}}$ for females. Bottom trawl survey indices of abundance confirm picture of declining stock.

c+d) SW and S Portugal: Annualised CPUEs sharply declined in 1989-96, relatively stable since then. Mean sizes of both males and females in landings and in trawl survey catches increasing. Age-based assessment indicates that stock biomass and recruitment of both males and females have sharply declined in the early 1990s, remaining at a very low level since 1994-95. $\mathbf{F_{bar}}$ for males was highest in the early 1990s, then decreased till 1997, but increased again in the most recent years. $\mathbf{F_{bar}}$ for females fluctuating, without evidence of a long-term trend. Both length- and age-based Y/R analysis show that current F is at $\mathbf{F_{max}}$ for males, and slightly below $\mathbf{F_{max}}$ for females. The results of crustacean directed trawl surveys, usually carried out in June-August, support perception of a declining stock.

e) Gulf of Cadiz: There is very limited data only for this FU. Landings have generally decreased since the beginning of the 1990s and are currently less than half of the peak figures in the mid-1980s. Insufficient data to allow length- or age-based assessments.

Management objectives: There are no management objectives set for this fishery.

Advice on management: For FUs 26+27, ICES advises a zero TAC in order to stop the further decline of stock biomass and to allow the stock to rebuild. This however, may not be possible, because of the mixed nature of the fishery. Therefore, ICES recommends that suitable technical measures (closed areas, closed seasons, etc.) be investigated for implementation at the earliest possible opportunity in order to rebuild the stocks.

For FUs 28+29, ICES advises a reduction in F of 40 % in order to halt the deterioration of the stock and to facilitate rebuilding of stock biomass. This would correspond to a TAC of 120 t for the year 2002.

For FU 30, ICES recommends that effort be constrained to a level corresponding to the lowest landings in the most recent years, i.e. 50 t.

Taken together, this gives an overall Management Area TAC of 170 t for the year 2002.

Catch options:

1. Catch option for FUs 26+27 (West Galicia and North Portugal), males and females combined. $F_{2001} = F_{1998\text{-}2000}$ scaled to F_{2000}. Recruitment = GM for the years 1997-99. Last column gives % change in TSB vs. TSB_{2001}.

2000				2002			2003	%
F factor	Ref F	TSB	Landings	F factor	TSB	Landings	TSB	change
		965	155	0.0	552	0	652	4
				0.2	552	31	625	0
2001				0.4	552	58	600	-4
F factor	Ref F	TSB	Landings	0.5	552	72	587	-6
1		625	151	0.6	552	85	576	-8
				0.8	552	109	555	-11
				1.0	552	132	534	-15
				1.1	552	143	525	-16

2. Catch option for FUs 28+29 (SW and S Portugal), males and females combined. $F_{2001} = F_{1998\text{-}2000}$ scaled to F_{2000}. Recruitment = GM for the years 1993-2000. Last column gives % change in TSB vs. TSB_{2001}.

2000				2002			2003	%
F factor	Ref F	TSB	Landings	F factor	TSB	Landings	TSB	change
		897	201	0.0	851	0	1059	21
				0.2	851	44	1009	15
2001				0.4	851	84	961	10
F factor	Ref F	TSB	Landings	0.5	851	103	939	7
1		874	198	0.6	851	122	917	5
				0.8	851	157	876	0
				1.0	851	189	839	-4
				1.1	851	205	820	-6

Relevant factors to be considered in management: ICES notes that the advice given in 1997 and 1999 was not followed, despite the strong signs that the further depletion of the stocks in this area can only be stopped by severe reductions in fishing mortality.

Comparison with previous assessment and advice: Previous assessments of the West Galicia and North Portugal stocks (FUs 26+27) were length-based, and gave an over-optimistic impression of the state of exploitation of these stocks. As pointed out in the 1999 Report of the Working Group on *Nephrops* Stocks (ICES, 1999), LCA gives no information on recruitment over-fishing, and this can give rise to severely misleading conclusions about stock status. The results of the SW and S Portugal (FUs 28+29) age-based assessment confirm the overall picture of a severely declining stock.

Elaboration and special comments: The fishery in FUs 26, 27 and 30 is mainly conducted by Spain, and that in FUs 28 and 29 by Portugal, on deep-water grounds (200-750 m). The Portuguese fleet comprises two components: demersal fish trawlers and crustacean trawlers. Landings from all FUs within this Management Area have declined significantly in recent years. Effort in FUs 26 and 27 in general is declining. In FUs 28 and 29, effort fell in the late 1980s, and has since remained at that level.

CPUEs and/or LPUEs, effort data and mean size data are available for most FUs, except FU 30 (Gulf of Cadiz). Length-composition data are available for FUs 26+27 combined and for FUs 28+29 combined. Discarding is marginal in these fisheries. Research trawl survey data are available for FU 26 and for FUs 28+29.

Source of information: Report of the Working Group on *Nephrops* Stocks, April 2001 (ICES CM 2001/ACFM:16).

Catch data (Tables 3.14.2.p.1–3.14.2.p.2):

Year	ICES advice	Recommended TAC	Agreed TAC	ACFM Landings
1987				1.55
1988				1.29
1989				1.35
1990				1.19
1991				1.31
1992		1.3	2.5	1.35
1993		1.3	2.5	1.06
1994		1.3	2.5	0.79
1995		1.3	2.5	0.92
1996		1.3	2.5	0.51
1997		1.3	2.5	0.67
1998		0.5	2.5	0.60
1999		0.5	2.0	0.58
2000		0.5	1.5	0.45
2001		0.5	1.2	
2002		0.17		
2003	*Stocks to be re-assessed in 2002*			

Weights in '000 t.

Table 3.14.2.p.1 *Nephrops* landings (tonnes) by Functional Unit plus Other rectangles in Management Area Q (IXa).

Year	FU 26 **	FU 27 **	FU 26-27 **	FU 28-29	FU 30	Other	Total
1991	180	54	369	478	226	0	***1307***
1992	199	52	385	470	243	0	***1349***
1993	162	50	310	377	160	0	***1059***
1994	120	22	306	237	107	0	***792***
1995	117	10	384	273	132	0	***916***
1996	264	67		132	49	0	***512***
1997	359	74		136	99	0	***668***
1998	295	50		161	89	0	***595***
1999	194	54		211	123	0	***581***
2000 *	125	30		201	92	0	***448***

* provisional na = not available

** Disaggregated data by FU not available for all countries and for all years

Table 3.14.2.p.2 *Nephrops* landings (tonnes) by country in Management Area Q (IXa).

Year	Portugal	Spain	Total
1991	532	775	***1307***
1992	522	827	***1349***
1993	427	632	***1059***
1994	259	533	***792***
1995	283	633	***916***
1996	149	363	***512***
1997	142	526	***668***
1998	169	426	***595***
1999	216	365	***581***
2000 *	210	238	***448***

* provisional na = not available

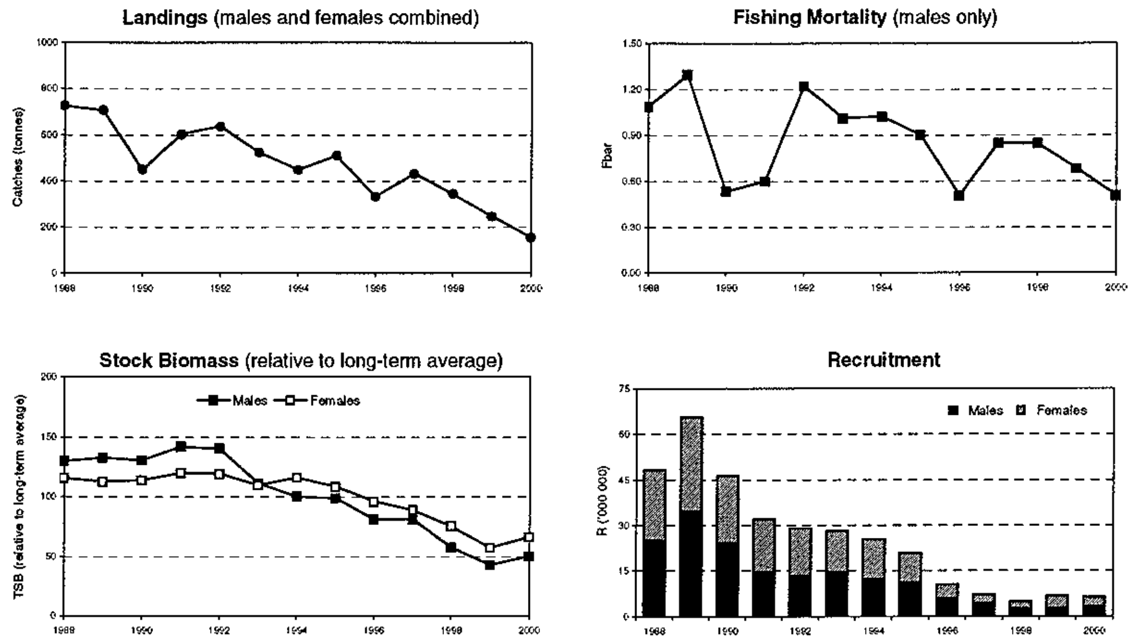


Figure 3.14.2.p.1 West Galicia and North Portugal (FUs 26-27): Output VPA: Trends in Catches, Fbar, Stock Biomass and Recruitment.

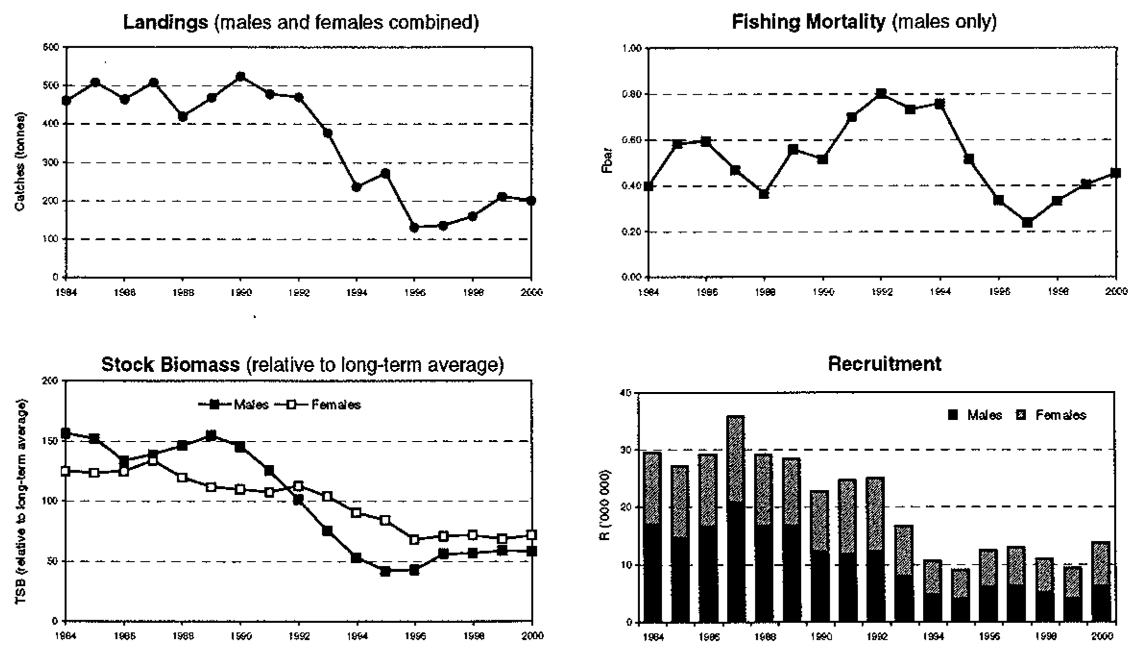


Figure 3.14.2.p.2 SW and S Portugal (FUs 28-29): Output VPA: Trends in Catches, Fbar, Stock Biomass and Recruitment.

3.14.2.q *Nephrops* in Division IXb and Sub-area X (Management Area R)

Advice on management: There are no reported landings of *Nephrops* from this area, so it is suggested that a zero TAC be set to prevent mis-reporting.

Source of information: Report of the Working Group on *Nephrops* Stocks, April 2001 (ICES CM 2001/ACFM:16).

3.15 Preliminary Answer to EC on Request for Information on Sea Bass

EC has requested information on:

1) The stock identity of bass (*Dicentrarchus labrax*) in Community waters and, if necessary, adjacent waters in the Northeast Atlantic (not the Mediterranean);

2) The historical and current state of these stocks of bass;

3) Current problems in the exploitation of bass and advice on possibilities for overcoming these problems.

The answer given below is preliminary and in particular does not provide assessments of stock status. ICES will continue in 2001 to compile a database of assessment-related data and to carry out preliminary assessments, where possible, and will report on further progress in answering EC in June 2002.

Sea bass is not on the continuous ICES assessment programme and, therefore, work to provide the Commission with the needed data and information was split into several phases. The first task, which was completed during the first half of 2001, was to assemble an overview of the information on sea bass available in European fisheries laboratories.

ICES has prepared a description of the European fisheries in which sea bass are taken. This overview is found in the report of the Study Group on Sea Bass (CM 2001/ACFM:25) available through the ICES Secretariat. The species is an important seasonal component of inshore commercial and recreational fisheries, extending from the southern North Sea and Irish Sea southwards to the Iberian Peninsula. A directed mid-water trawl fishery takes spawning bass in VIIe, VIIf,g and VIIIa,b in the first quarter of the year.

The Study Group report also includes an inventory of the available data and information pertinent for the assessment of sea bass stocks, with an indication of their quality, but there has not been sufficient time to compile these data. Information on stock identity of sea bass has been compiled, from which the results of tagging studies and the seasonal distribution of the fisheries taking bass suggest, provisionally, four management/assessment units: a stock which moves between the English Channel and the southern North Sea; a stock which migrates along the west coast of Britain and into Cornish waters; a stock which remains largely within Irish waters; and a stock which moves between Biscay and the western English Channel. The level of interchange between these stocks may inhibit genetic differentiation, but the seasonal fisheries taking each of the stocks are quite discrete. Nothing is known about the stock structure of bass around the coasts of Spain or Portugal.

It has not yet been possible to carry out an evaluation of the status of sea bass stocks in European waters, though it appears that there may be sufficient biological data for ICES divisions VIIa,d,e,f,g and h over the period 1985–2000 to assess stock status. Catch data probably do not reflect the trends and level of exploitation given the character of the fisheries taking bass, in particular the large artisanal and recreational components. It is known, however, that directed effort on the spawning populations in VIIe,f,g has increased since the late 1980s. In this period, the appearance of several good year classes is associated with a northwards extension of the population range of bass, most noticeable in the North Sea.

A summary of existing conservation measures aimed at protecting bass fisheries is presented. These have been implemented at a national level in order to achieve the following management objectives:

1. To protect juvenile bass from heavy exploitation in nursery areas, where they remain for up to 5 years and may be particularly vulnerable. The UK introduced a minimum landing size (36 cm) and a ban on mesh sizes of 70 – 89 mm in enmeshing nets (both later adopted in EC regulations), plus a ban on fishing for bass in 37 nursery areas in England and Wales. This has been shown to reduce growth overfishing (increase Y/R) and boost recruitment to the spawning stock.

2. To preserve markets, France has implemented a weekly landing limit of 5 t per vessel (since 1996), which was adopted by the UK in 2000. This is the only quantitative control on the offshore fishery for spawning bass. This fishery is easily identified, and could be controlled by effort restrictions, if necessary.

3. To identify and protect recreational fisheries for bass, daily catch limits for non-commercial fishermen (Ireland and Spain, proposed in the UK), and a ban on commercial exploitation of bass (Ireland), have been introduced. These fisheries have a high economic value in several countries, but can also operate to the detriment of artisanal commercial fisheries by supplying low cost fish (illegally) to the market.

3.16 European eel

The EC in 1998 requested ICES to advise on the management of European eel:

"There is an increasing concern about the situation for the European eel stock and its future development. ICES is therefore requested, to provide information about the status of eel stock(s) and on any possible management actions, and to identify gaps in knowledge about eel in order to secure a sustainable development of the eel fisheries within the European Union."

Introduction: The European eel (*Anguilla anguilla* (L.)) is found and exploited in fresh, brackish and coastal waters in almost all of Europe, in northern Africa and in Mediterranean Asia (Figure 3.16.1). Reproduction takes place in the open Atlantic Ocean, presumably in the Sargasso Sea. Larvae drift to the continent, transform into glass eel and migrate into continental waters, where the growing phase is known as yellow eel (Figure 3.16.2). Maturation starts after 2-20 years (males) or 5-50 years (females) depending on the climate and latitude. This stage, known as silver eel, migrates back to the Ocean. Spawning has never been observed in the wild and artificial reproduction is not yet successful. Genetic evidence suggests there is only one, genetically almost uniform, spawning stock.

Fisheries for eel are found throughout the distribution area. The target of the fisheries varies from glass eel (south-western Europe, north-western Africa), through yellow eel (throughout the distribution area) to silver eel (predominantly northern Europe). Fisheries are generally organised on a very small scale and apply a wide range of gears, including trawls, traps, fykenets, hooks, spears etc.

Aquaculture is exclusively based on wild caught glass eel. It takes place in several European countries, but is fully outnumbered by Asian aquaculture of European eel. European aquaculture production is less than the yield of fisheries, but increasing. The rising demand for glass eel has raised the price to extreme levels (300 €/kg in Europe, 3000 €/kg in Asia).

Glass eel catch is used for direct consumption (20 %), for aquaculture (10 % in Europe, 60 % in Asia) and for re-stocking in (northern) outdoor waters (10 %). Natural immigration is estimated to be about 10 % of the total glass eel recruitment.

3.16.1 State of stock and advice

State of stock exploitation: All information indicates that the stock is at a historic minimum. The current fishery is not sustainable. Fishing mortality is high both on juvenile (glass eel) and older eel (yellow and silver eel) in many water systems. Recruitment has declined since 1980 and recent information indicates that the decline continues and recruitment reached a new historic minimum in 2001.

Management objective: There is no stock-wide objective for this stock. Some countries have formulated national policies that include both biological and economic considerations, but in most countries no management objective has been set.

Advice on management: **ICES recommends that an international rebuilding plan is developed for the whole stock. Such a rebuilding plan should include measures to reduce exploitation of all life stages and restore habitats. Until such a plan is agreed upon and implemented, ICES recommends that exploitation be reduced to the lowest possible level.**

Relevant factors to be considered in management: Actions that would lead to a recovery of the stock are urgently required. Conservation of the spawning stock can only be achieved by internationally co-ordinated management actions in continental waters. Management of eel fisheries is only possible at a water basin level, often spanning multiple jurisdictions. Uncoordinated management actions in isolated areas are not likely to lead to a recovery of the stock. Because of the length of the life cycle, it will take 5-20 years before positive effects of management actions can be expected.

3.16.2 Possible measures to rebuild the stock

In order to rebuild the oceanic spawning stock, measures should aim for increased escapement of spawners from continental waters. This might be achieved through a reduction of exploitation, restocking of recruits, or restoration of habitats.

3.16.2.1 Protecting the stock by limiting exploitation

Measures to limit exploitation by fisheries will generally be site/area and circumstance specific and will have to consider exploitation in all life stages.

Prohibition of fishing

Prohibition of fishing can be life-stage specific or area specific. In addition to restrictions on existing fisheries, it is prudent to prohibit introduction of new fisheries and locally to prohibit fishing for currently unexploited life stages.

Total allowable catches/quotas

With the diverse nature of eel fisheries, it is difficult to envisage how one TAC on a shared stock would be allocated and subsequently managed/enforced in the scattered inland fisheries over the vast distribution area. TAC approaches are therefore probably not appropriate.

Gear controls

Regulations on number, size, mesh-size, usage, and location of gear are already implemented in several eel fisheries. These measures should be strengthened, or introduced where they do not exist.

Landing size limits

Minimum landing size restrictions reduce excessive exploitation of yellow and silver eel. Limits on maximum landing size would promote escapement of larger (female) spawners, but could also result in increases in fishing effort, which might deplete the stock of smaller sizes.

Closed seasons

The timing of closed seasons must be related to local characteristics of eel and fisheries, and has primarily to consider closure during periods of vulnerability. Only banning of fishing over relatively long time periods (months) would be fully effective, e.g. if extending well into the periods of local glass eel immigration or silver eel emigration runs.

Closed areas

Closed areas could be used to designate 'reserve' or 'refuge' areas where no exploitation would be permitted. These could also be locally effective in preventing extension of fisheries into new areas or for protection of vulnerable glass eel or silver eel runs.

Licensing of fishermen

Licensing specific to eel fishermen and their gear offers opportunities for controlling and monitoring fishing effort and, ultimately, fishing mortality.

3.16.2.2 Enhancing the stock by re-stocking of recruits

Whether re-stocking contributes to spawner escapement is questionable. Restocking might, however, contribute to the fisheries and might be considered a compensatory measure for the decline in the catches. Re-stockings from nearby estuaries (in contrast to transports from southern to northern Europe) minimises the risks of transfer of diseases and parasites.

3.16.2.3 Protecting and recovering the stock by habitat restoration

The loss of habitat has strongly affected the capacity to produce eel. Destruction of habitat, loss of upstream accessibility, hazardous escapement through turbines and deteriorated water quality all have a negative impact, almost throughout the distribution area. Migration barriers can be overcome with eel ladders and by-passes.

3.16.2.4 Elaboration and Special comments

Current scientific knowledge is inadequate to derive management targets specific for eel. Estimates of the total spawning stock and total recruitment for the eel in all of its distribution area are not available and are very unlikely to be feasible at all. Consequently, stock-wide management targets will have to be translated into derived targets for local management units. The number of water bodies for which adequate information is available to warrant local management on the basis of fully documented assessments is extremely limited. In the absence of such data, it might be feasible to derive proximate criteria. Length-frequency data are easily obtained and might offer simple reference points related to the average size of emigrating spawners. This approach has not yet been pursued in Europe. Provisional targets might have to be chosen on a rather arbitrary basis.

Eels are exploited in all life stages present in continental waters. Total yield has declined to about half since the mid-1960s. Other anthropogenic factors (habitat loss, contamination, and transfer of diseases) have had additional negative effects on the stock. Several hypotheses on the causes of the decline have been raised (including climate change), but no conclusive evidence is available.

Current monitoring is based on national programmes only. Several of the long-lasting time-series have come under pressure, because of decreased turnover of local eel fisheries and the impossibility of addressing the stock decline at the local level. However, in light of the poor state of the stock and the high anthropogenic impacts, it is of utmost importance that existing time-series of monitoring recruitment, effort, and yield should be continued and preferably be supplemented.

Improvement of the advice depends crucially on agreement to, and implementation of, an international management process with appropriate feedback to scientific advisory bodies. Current national research scheduling for eel does not adequately react to international management needs. The formation of an institution directing and requesting particular monitoring and research on eel in both individual countries and on a coordinated basis is recommended.

Individual countries should develop or strengthen the legislative framework to enable management measures to be implemented.

Source of information: Report of the ICES/EIFAC Working Group on Eels, August 2001 (ICES CM 2002/ACFM:03).

Table 3.16.1 Recruitment data series. In this table, recruitment data series are listed in arbitrary units. Part 1: Scandinavia and British Isles.

Country	N	S	S	S	S	Dk	D	N.Irl	Irl	Irl	UK
Site	Imsa	Viskan	Upsala	Motala	Göta Älv	Vidaa	Ems	Bann	Erne	Shannon	Severn
1950				305	2947		875				
1951			210	2713	1744		719				
1952			324	1544	3662		1516				
1953			242	2698	5071		3275				
1954			509	1030	1031		5369				
1955			550	1871	2732		4795		0.2		
1956			215	429	1622		4194				
1957			162	826	1915		1829				
1958			337	172	1675		2263				
1959			613	1837	1745		4654		0.2		
1960			289	799	1605		6215	7409	1.2		
1961			303	706	269		2995	4939	0.6		
1962			289	870	873		4430	6740	2.5		
1963			445	581	1469		5746	9077	0.4		
1964			158	182	622		5054	3137	0.2		
1965			276	500	746		1363	3801	0.9		
1966			158	1423	1232		1840	6183	1.4		
1967			332	283	493		1071	1899	0.3		
1968			266	184	849		2760	2525	1.5		
1969			34	135	1595		1687	422	0.6		
1970			150	2	1046		683	3992	0.1		
1971		12	242	1	842	787	1684	4157	0.5		
1972		88	88	51	810	780	3894	2905			
1973		177	160	46	1179	641	289	2524			
1974		13	50	59	631	464	4129	5859	0.8		
1975		99	149	224	1230	888	1031	4637	0.4		
1976		500	44	24	798	828	4205	2920	0.4		
1977		850	176	353	256	91	2172	6443	0.1	1.0	
1978		533	34	266	873	335	2024	5034	0.3	1.4	
1979		505	34	112	190	220	2774	2089	0.5	6.7	40
1980		72	71	7	906	220	3195	2486	1.4	4.5	33
1981		513	7	31	40	226	962	3023	2.3	2.1	32
1982		380	1	22	882	490	674	3854	4.4	3.2	30
1983	7	308	56	12	113	662	92	242	0.7	6.3	6
1984	3	21	34	48	325	123	352	1534	1.1	5.1	29
1985		200	70	15	77	13	260	557	0.4	1.1	19
1986		151	28	26	143	123	89	1848	0.7	0.9	16
1987	2	146	74	201	168	341	8	1683	2.3	1.6	18
1988	7	92	69	170	475	141	67	2647	3.0	0.1	23
1989	4	32		35	598	9	13	1568	1.7	0.1	14
1990	13	42		21	149	5	99	2293	2.2	0.5	16
1991	3	1		2	264		52	677	0.5	0.1	8
1992	2	70	8	108	404		6	978	1.4	0.1	18
1993	3.4	43	6	89	64		20	1525	1.8	0.1	21
1994	0.2	76	72	650	377		52	1249	3.5	0.3	22
1995	0.8	6	8	32			40	1403	2.4	0.4	36
1996	0.4	1	18	14	277		20	2667	1.0	0.5	24
1997		8		8	180		5	2533	1.0	2.0	17
1998		5		6			4	1283	0.8	0.1	20
1999		2		85			3	1345	1.1	0.1	18
2000		14		270			4	563	0.9		8
2001		2					0	250	0.7		

Table 3.16.2 Recruitment data series; continued. Part 2: Mainland Europe.

Country	NL	B	F	F	F	F	F	E	P/E	It
Site	Den Oever	Yser	Loire	Vilaine	Gironde (CPUE)	Gironde (Yield)	Adour	Nalon	Minho	Tiber
1950	7		86							
1951	13		166							
1952	84		121							
1953	12		91							
1954	18		86							
1955	25		181					14		
1956	7		187					17		
1957	15		168					15		
1958	48		230					14		
1959	27		174					13		
1960	21		411					19		
1961	36		334					13		
1962	80		185					18		
1963	115		116					11		
1964	36	4	142					16		
1965	75	115	134					20		
1966	18	385	253					12		
1967	28	575	258					13		
1968	19	554	712					22		
1969	16	445	225					16		
1970	36	795	453					198		
1971	17	399	330					18		
1972	29	557	311	39				11		
1973	22	356	292	78				11		
1974	25	946	563	107				25	2	
1975	32	264	495	44				32	11	11.0
1976	26	618	770	106				55	20	6.7
1977	57	450	654	52				37	37	5.9
1978	37	388	523	105				650	24	3.6
1979	50	675	608	209	20	286		77	28	8.4
1980	26	358	502	95	26	405		42	21	8.2
1981	22	74	284	57	20	332		35	54	4.0
1982	14	138	266	98	15	123		27	16	4.0
1983	9	10	276	69	14	80		22	30	4.0
1984	12	6	168	36	19	82		23	31	1.8
1985	14	13	159	32	10	65		12	21	2.5
1986	14	26	137	48	11	45	8	14	13	0.2
1987	6	33	93	32	14	82	10	24	8	7.4
1988	4	48	138	39	11	33	12	15	8	10.5
1989	3	30	61	30	7	80	9	14	9	5.5
1990	3	218	76	31	6	48	3	9	6	4.4
1991	1	13	30	15	8	64	2	7	9	0.8
1992	3	19	32	30	4	42	8	11	10	0.6
1993	3	12	80	32	8		4	10	8	0.5
1994	4	18	95	24	9		3	10	5	0.5
1995	7	2	68	30	8		8			0.3
1996	7	5	32	22	5		4			0.1
1997	12	10	90	23	7		5			0.1
1998	2	8		18	4		2			0.1
1999	3	76		15			4			0.1
2000	2			14			9			
2001	0.5			8						

Table 3.16.3 Statistics of eel landings, reported in the FAO data base of fishing yields. These data include landings of 'river eels' in Atlantic waters, the Mediterranean and Inland waters. Data for Denmark, Netherlands and Italy have been corrected for incorrectly included aquaculture yield.

Country Year	Norway	Sweden	Denmark	Germany	Ireland	UK	Netherlands	France	Spain	Portugal	Italy	Rest of Europe	N. Africa
1950	300	2200	4500	400			4200	500	100		1000		
1951	300	1900	4400	400			3700	500	100		1000		
1952	200	1600	3900	400			4000	700	100		1000		
1953	400	2400	4300	500		400	3100	600	100		1000	900	
1954	300	2100	3800	300		500	2100	500	900		1000	800	
1955	500	2600	4800	500		700	1700	500	600		1000	1000	
1956	300	1500	3700	400		600	1800	500	800		2000	900	
1957	400	2200	3600	400		600	2500	500	500		2000	800	
1958	400	1800	3300	400	100	600	2700	500	500		2100	1200	
1959	400	2800	4000	500	100	500	3400	900	500		3000	700	
1960	400	1500	4723	400	0	800	3000	1300	500		2700	1000	
1961	500	2100	3875	500	100	800	2660	1300	400		2600	900	300
1962	400	1900	3907	400	100	700	1543	1300	800		3100	1000	300
1963	500	1900	3928	2100	100	700	1818	1400	1100		3500	1000	300
1964	400	2368	3282	1900	100	600	2368	1400	1700		3500	1100	400
1965	500	1868	3197	1500	200	800	2509	1700	1300		3200	900	500
1966	500	2070	3690	1700	100	1000	2739	1300	1300		3100	1000	400
1967	500	1667	3436	1900	100	600	2884	2000	1400		3100	1100	400
1968	600	1872	4218	1800	100	600	2622	2700	1300		3200	1100	400
1969	500	1773	3624	1600	100	600	2741	1900	1400		3400	1100	400
1970	400	1270	3309	1600	200	800	1512	4200	1100		3300	1400	100
1971	400	1469	3195	1300	100	800	1153	4900	1100		3400	1500	100
1972	400	1274	3229	1300	100	700	1057	2600	1000		2900	1138	100
1973	400	1277	3455	1300	100	800	1023	3900	700		2900	1150	800
1974	383	1106	2814	1285	67	817	994	2493	1300	42	2697	1528	352
1975	411	1492	3225	1398	79	833	1173	1590	570	44	2973	1400	85
1976	386	1023	2876	1322	150	694	1306	2959	675	38	2677	1254	47
1977	352	1084	2323	1317	108	742	929	1538	666	52	2462	1384	159
1978	347	1162	2335	1162	76	877	862	2455	655	44	2237	1357	112
1979	374	1043	1826	1164	110	879	687	3144	394	25	2422	1518	134
1980	387	1205	2141	1051	75	1053	828	4503	300	32	2264	1242	448
1981	369	976	2087	1033	94	858	876	1425	250	33	2340	1192	497
1982	385	1250	2378	1027	144	1032	1097	1469	200	14	2087	1419	455
1983	324	1304	2003	1029	117	1113	1230	1856	150	11	2076	1782	575
1984	309	1176	1745	911	88	957	681	2336	150	80	2361	2445	477
1985	352	1261	1519	866	87	781	666	2288	200	76	1907	2123	258
1986	271	981	1552	887	87	997	729	2924	200	633	1928	1867	356
1987	282	896	1189	731	221	939	512	2378	259	566	2076	2479	306
1988	513	1198	1759	746	215	715	590	2879	205	501	2165	2790	256
1989	312	1141	1582	678	400	1075	645	2482	83	6	1301	2365	368
1990	336	1120	1568	976	256	1039	657	2484	75	295	1199	2209	560
1991	323	1244	1366	1010	245	822	707	2260	65	314	1106	2337	358
1992	373	1375	1342	1026	234	782	621	1964	60	674	1662	2749	358
1993	340	1336	1023	1027	260	752	320	1674	55	505	1307	2509	613
1994	472	1480	1140	585	300	873	369	1417	50	979	986	2797	732
1995	454	1257	840	585	400	808	279	500	106	10	886	2572	1176
1996	352	1226	717	696	550	895	336	563	97	21	883	2676	984
1997	497	1288	757	746	550	807	315	1942	113	16	1010	2034	1327
1998	353	877	557	717	670	741	346	491	160	13	682	2159	1069
1999	475	987	686	747	675	697	372	189	166	3		1532	1257
2000							368						

Table 3.16.4 Re-stocking of glass eel and yellow eel smaller than minimum legal size (bootlace eel). Numbers of eels (in millions) re-stocked in (eastern) Germany (D east), the Netherlands (NL), Sweden (S), Poland (PO) and Northern Ireland (N.Irl.).

	Glass eel						Bootlace eel				
Year	D east	NL	S	PO	N.Irl.	SUM	D east	NL	S	DK	SUM
1945					17.0	17.0					0.0
1946		7.3			21.0	28.3					0.0
1947		7.6				7.6		1.6			1.6
1948		1.9				1.9		2.0			2.0
1949		10.5				10.5		1.4	0.0		1.4
1950	0.0	5.1				5.1	0.9	1.6	0.0		2.5
1951	0.0	10.2	0.0			10.2	0.9	1.3	0.0		2.2
1952	0.0	16.9	0.1	17.6		34.5	0.6	1.2	0.0		1.8
1953	2.2	21.9	0.0	25.5		49.6	1.5	0.8	0.0		2.3
1954	0.0	10.5		26.6		37.1	1.1	0.7	0.0		1.8
1955	10.2	16.5		30.8	0.5	58.0	1.2	0.9	0.0		2.2
1956	4.8	23.1		21.0		48.9	1.3	0.7	0.0		2.0
1957	1.1	19.0		24.7		44.8	1.3	0.8	0.0		2.1
1958	5.7	16.9		35.0		57.6	1.9	0.8	0.0		2.8
1959	10.7	20.1		52.5	0.7	83.9	1.9	0.7	0.0		2.6
1960	13.7	21.1		64.4	25.9	125.1	0.8	0.4	0.0		1.2
1961	7.6	21.0		65.1	16.7	110.4	1.8	0.6	0.0		2.4
1962	14.1	19.8		61.6	27.6	123.1	0.8	0.4	0.0		1.2
1963	20.4	23.2		41.7	28.5	113.8	0.7	0.1	0.0		0.9
1964	11.7	20.0	0.0	39.2	10.0	80.9	0.8	0.3	0.1		1.3
1965	27.8	22.5		39.8	14.2	104.4	1.0	0.5	0.1		1.6
1966	21.9	8.9		69.0	22.7	122.6	1.3	1.1	0.1		2.5
1967	22.8	6.9		74.2	6.7	110.7	0.9	1.2	0.1		2.2
1968	25.2	17.0			12.1	54.3	1.4	1.0	0.1		2.5
1969	19.2	2.7			3.1	25.0	1.4	0.0	0.0		1.4
1970	27.5	19.0			12.2	58.6	0.7	0.2	0.0		1.0
1971	24.3	17.0			14.1	55.4	0.6	0.3	0.0		1.0
1972	31.5	16.1			8.7	56.3	1.9	0.4	0.1		2.4
1973	19.1	13.6			7.6	40.2	2.7	0.5	0.1		3.3
1974	23.7	24.4			20.0	68.1	2.4	0.5	0.1		3.0
1975	18.6	14.4			15.1	48.1	2.9	0.5	0.1		3.6
1976	31.5	18.0			9.9	59.5	2.4	0.5	0.1		2.9
1977	38.4	25.8			19.7	83.9	2.7	0.6	0.0		3.3
1978	39.0	27.7			16.1	82.8	3.3	0.8	0.1		4.2
1979	39.0	30.6	0.1		7.7	77.5	1.5	0.8	0.1		2.4
1980	39.7	24.8	0.1		11.5	76.1	1.0	1.0	0.1		2.1
1981	26.1	22.3			16.1	64.5	2.7	0.7	0.1		3.6
1982	30.6	17.2			24.7	72.5	2.3	0.7	0.4		3.4
1983	25.2	14.1			2.9	42.2	2.3	0.7	1.0		4.0
1984	31.5	16.6			12.0	60.1	1.7	0.7	0.8		3.2
1985	6.0	11.8	0.8		13.8	32.3	1.1	0.8	0.9		2.8
1986	23.8	10.5	0.1		25.4	59.8	0.0	0.7	0.5		1.2
1987	26.3	7.9	0.0		25.8	59.9	0.0	0.4	1.0	1.6	3.0
1988	26.6	8.4	0.2		23.4	58.6	0.0	0.3	1.3	0.8	2.4
1989	14.3	6.8	0.0		9.9	31.0	0.0	0.1	1.0	0.4	1.5
1990	10.5	6.1	0.7		13.3	30.6	0.1	0.1	1.6	3.5	5.3
1991	1.9	1.9	0.3		3.5	7.6	0.2	0.1	1.8	3.1	5.1
1992	6.2	3.5	0.3		9.4	19.4	0.2	0.0	2.2	3.9	6.3
1993	7.6	3.8	0.6		9.9	21.9	0.3	0.0	2.0	4.0	6.3
1994	7.4	6.2	1.7		16.4	31.8	0.4	0.1	2.0	7.4	9.9
1995	6.2	4.8	1.5		13.5	26.0	0.4	0.1	1.8	8.4	10.7
1996	0.5	1.8	2.3		11.1	15.7	0.9	0.0	2.5	4.6	8.1
1997	0.4	2.3	2.4		10.9	16.1	2.3	0.1	2.5	2.5	7.4
1998	0.0	2.5	2.1		6.2	10.9	1.8	0.1	2.4	3.0	7.3
1999	0.0	2.9	2.2		12.0	17.1	1.1	0.1	2.4	4.1	7.7
2000		2.8	1.2		5.4	9.4		0.0	1.5	3.8	5.3
2001		0.9			2.8	3.7				1.7	1.7

Table 3.16.5 Production of European eel in aquaculture in Europe and Asia. Compilation of production estimates (tonnes) derived from reports of previous meetings, FAO, FEAP and others.

Country	Year	1984	1985	1986	1987	1988	1989	1990	1991	1992
Norway										
Sweden		15	47	59	193	233	190	160	195	179
Denmark		16	30	120	160	300	620	900	900	706
Germany										
Ireland										
UK					20	30	0	0		
Netherlands			20	100	200	200	350	550	520	500
Belgium/Lux.						30	30	125	125	30
Spain		15	20	25	37	32	57	98	105	130
Portugal		60	60	590	566	501	6	270	622	267
Marocco								35	41	60
Algeria						72	53	22	1	46
Tunisia								150	151	144
Italy		2600	2800	4200	4600	4250	4500	3700	4185	3265
Greece				6	4	10	54	94	132	81
Turkey										
Macedonia										
Yugoslavia		44	52	48	49	19	10	5	1	8
Croatia									7	
Hungary						90	39	73	33	98
Czech.rep.										
SUM EU		1950	2229	3448	4729	5517	5159	6667	6098	6349
Asia			3000							

Country	Year	1993	1994	1995	1996	1997	1998	1999	2000
Norway			120	200	200	200	200		
Sweden		192	182	158	184	215	250	250	250
Denmark		900	1000	1200	1200	1700	2468	2700	2675
Germany			100	100	100	150	150	150	150
Ireland									
UK			25		25				
Netherlands		1250	1487	1535	2800	2443	3250	3800	4000
Belgium/Lux.		125	125	150	140	150	150	40	20
Spain		175	134	214	249	266	270	300	425
Portugal		505	979	200	110	200	200	200	200
Marocco		68	85	55	55	56			
Algeria		0	22	20	17	17			
Tunisia		250	260	108	158	147	108		
Italy		3000	2800	3000	3000	3100	3100	3100	2800
Greece		337	341	659	550	312	500	500	300
Turkey									
Macedonia		1	0	70	83	60			
Yugoslavia		8	2	9	5	5			
Croatia		5	5	7	6	7			
Hungary			50		50			19	19
Czech.rep.		2	4	4	3	3			
SUM EU		6818	7721	7689	8935	9031	10646	11059	10839
Asia									10000

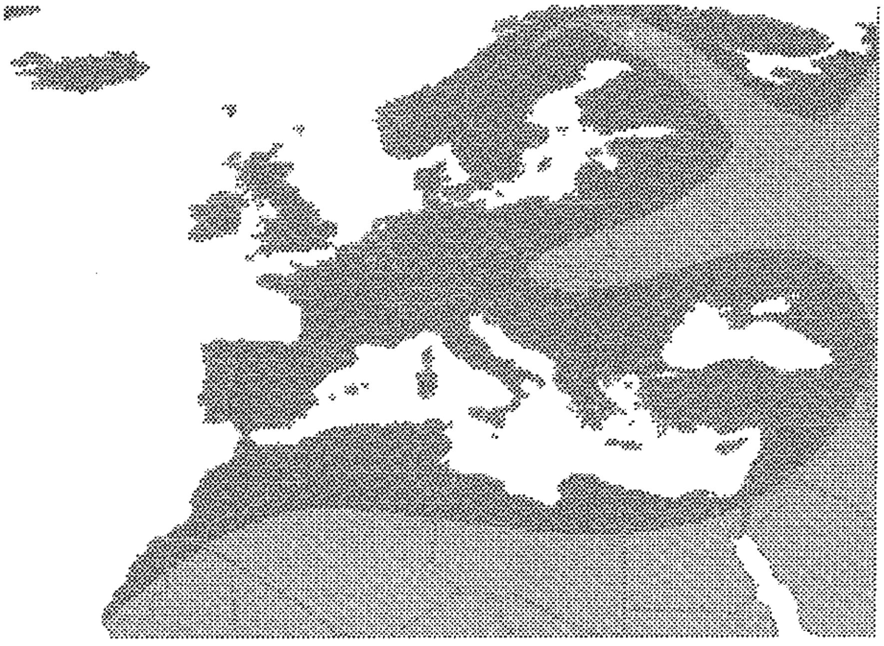


Figure 3.16.1 Distribution area of the eel.

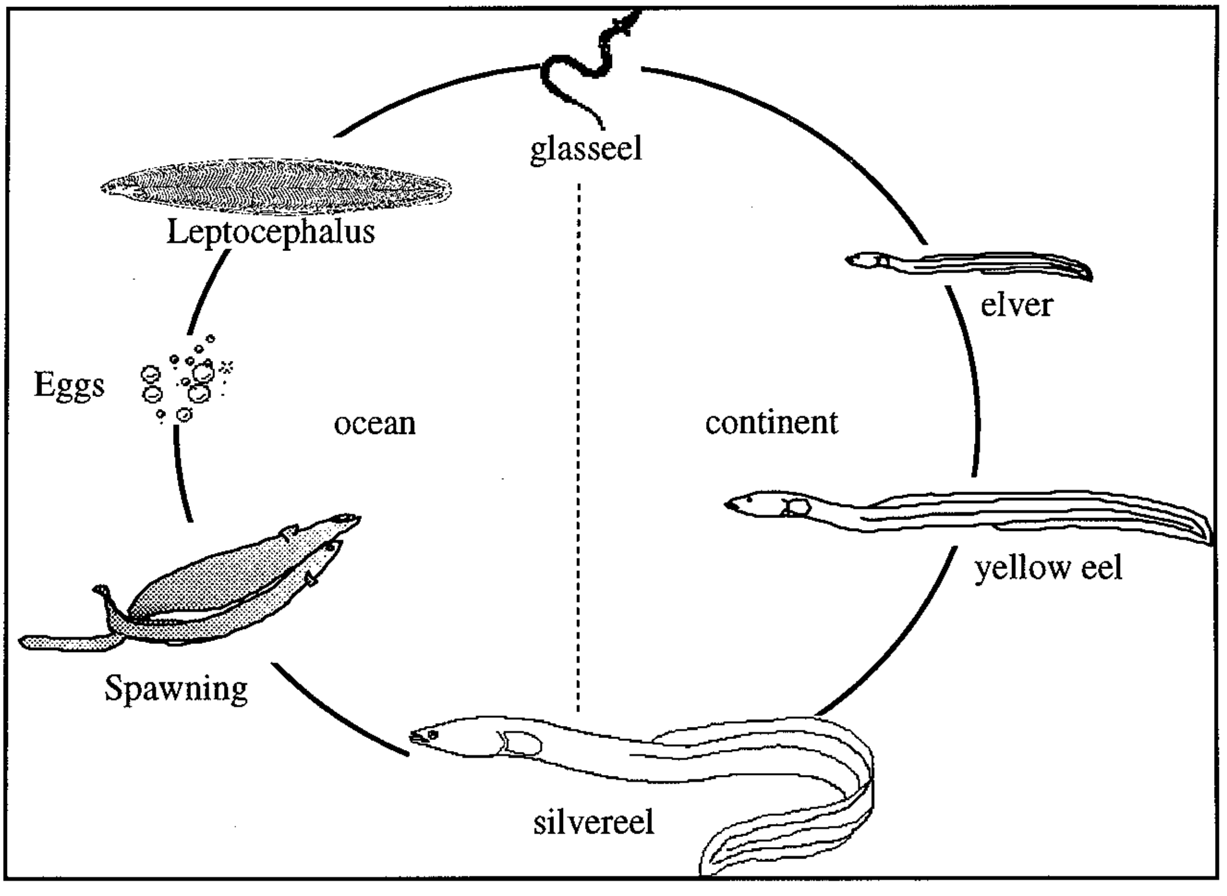


Figure 3.16.2 Life cycle of the eel. The names of the major life stages have been indicated. Spawning and eggs have never been observed in the wild and are therefore only tentatively included.

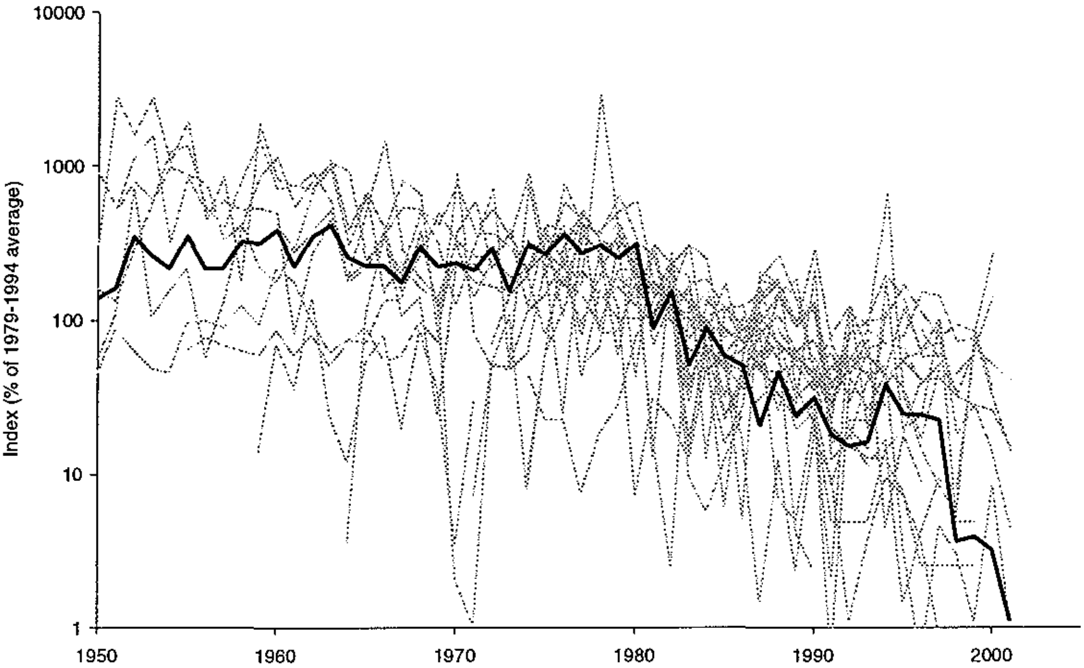


Figure 3.16.3 Time-series of glass eel monitoring in Europe. Each series has been scaled to the 1979-1994 average. The heavy line indicates the geometric mean of the series from Loire (F), Ems (D), Göta Älv (S) and Den Oever (NL), which are the longest and most consistent time series.

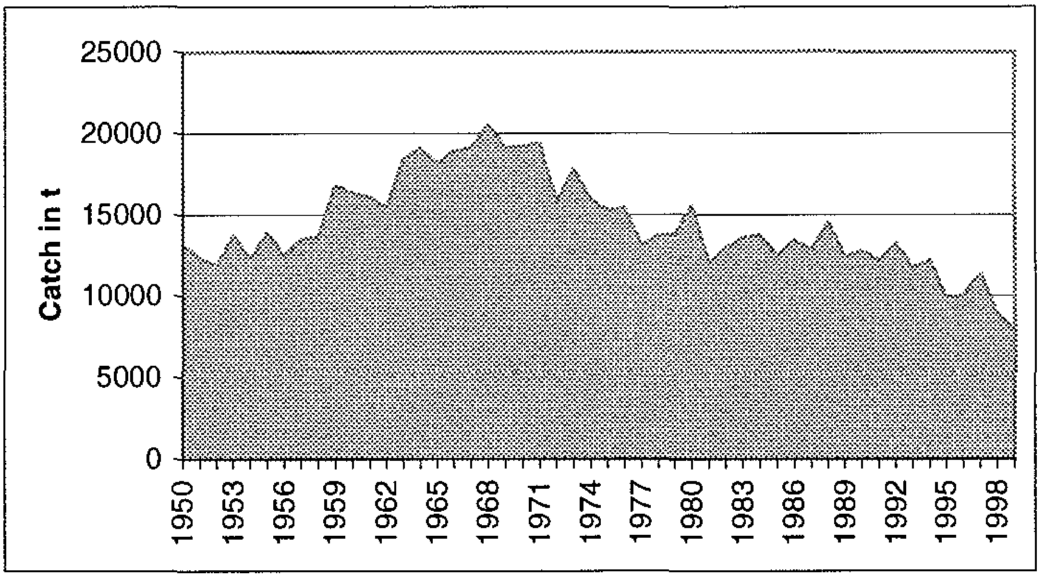


Figure 3.16.4 Landing statistics of the eel in the past 50 years, as reported by FAO database, with minor corrections. The catches in the first part of the time-series are under-represented as some countries did not report their catches until the mid- or late-1950s and one country not until 1974.

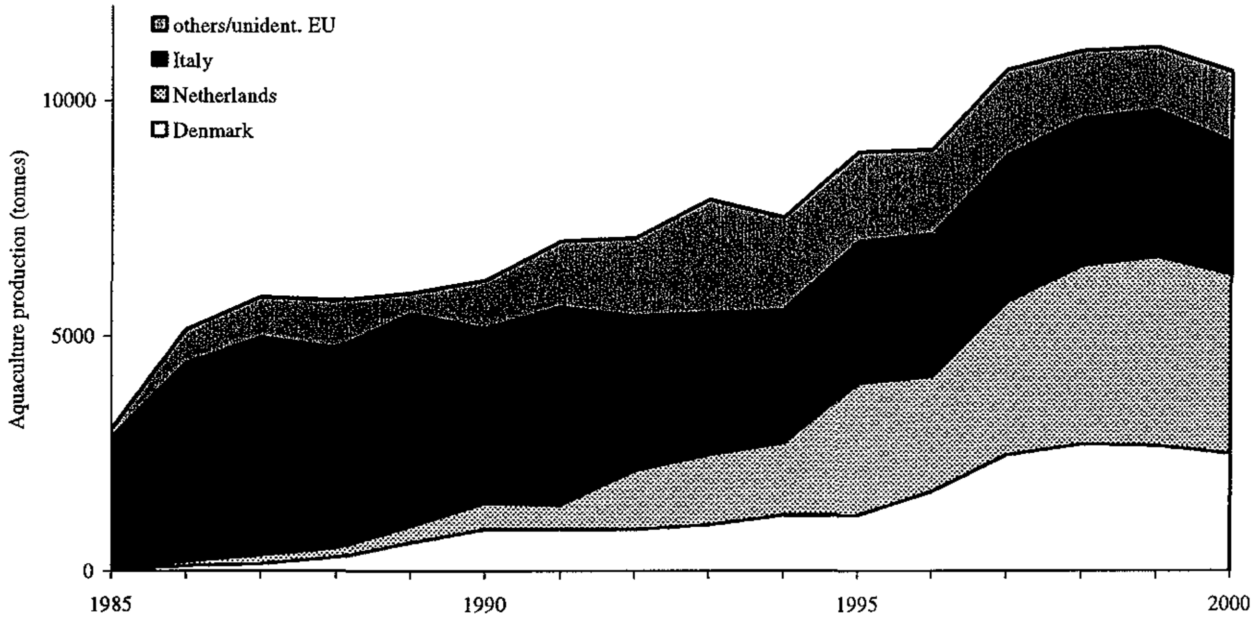


Figure 3.16.5 Trends in aquaculture production of the European eel.

4 ATLANTIC SALMON IN THE NORTH ATLANTIC AREA

4.1 Catches of North Atlantic Salmon

4.1.1 Nominal catches of salmon

Nominal catches of salmon reported by country in the North Atlantic (including ranched salmon in Iceland) for 1960-2000 are given in Table 4.1.1.1. Reported catches (in t), in four North Atlantic regions are illustrated in Figure 4.1.1.1, and those for NASCO Commission Areas, 1994-1998 are shown below.

Area	1995	1996	1997	1998	1999	2000
NEAC	3283	2754	2076	2229	2075	2643
NAC	260	292	229	157	152	150
WGC	85	92	59	11	19	21
Total	3628	3138	2364	2397	2246	2814

The catch data for 2000 (Table 4.1.1.1) are provisional, but the total nominal catch of 2 814 t is amongst the lowest on record. Catches in most countries remain below the averages of the most recent 5- and 10-years period. Some of the reduction in catches in recent years may be accounted for by management plans, which have reduced fishing effort in several countries.

Where data were available, the nominal catch (in t) of wild fish in 2000 was partitioned according to whether the catch was taken by coastal, estuarine or riverine fisheries. These are shown below for the NEAC and NAC Commission Areas. The proportions accounted for by each fishery varied considerably between countries. In total, however, coastal fisheries accounted for 53% of catches in North East Atlantic countries compared to 9% in North America, whereas in-river fisheries took 41% of catches in North East Atlantic countries compared to 77% in North America. The breakdown by country is shown in Table 4.1.1.2.

Area	Coast		Estuary		River		Total
	Weight	%	Weight	%	Weight	%	Weight
NEAC	1407	53	161	6	1086	41	2654
NAC	13	9	22	14	117	77	152

4.1.2 Catch and release

Catch and release data for the 1990s have been provided by 6 countries. In 1999, the proportion of the total rod catch that was released ranged from 100% in USA to 10% in Iceland. In 2000, there was no fishing allowed in USA. Catch and release rates for other countries were 74% 53%, 42% and 34% for Russia, Canada, UK (England & Wales) and UK (Scotland), respectively. In most of these countries, rates in 2000 are among the highest in each time series and indicate an increasing trend in recent years

4.1.3 Unreported catches of salmon

The total estimate of unreported catch within the NASCO Commission Areas in 2000 was 1 269 t (Table 4.1.1.1), or 31% of the total of reported and unreported catch. The estimate for 2000 is an increase of 23% compared with 1999 (1 032 t) and an increase of 21% compared to the 1995–1999 mean of 1 051 t. After 1994 there are no data available on salmon catches in international waters. Limited surveillance flights, which were the basis of past estimates of catches in international waters, have not reported any salmon fishing where these have occurred in recent years. Estimates (in tonnes) of unreported catches for the Commission Areas are given below:

Area	1994	1995	1996	1997	1998	1999	2000
NEAC	1157	942	947	732	1108	887	1135
NAC	107	98	156	90	91	133	124
WGC	<12	<20	<20	5	11	12	10
International waters	25-100	n/a	n/a	n/a	n/a	n/a	n/a

Where available, data are presented by country for 2000 (Table 4.1.1.3). The individual inputs to the total North Atlantic catch range from 0% to 16%. While this broadly indicates the level of non-reporting by each country relative to the total catch in the North Atlantic, it should be noted that the method of estimation varies both within and among countries. The non-reporting rates range from 0% to 67% of the total national catch in each country.

4.1.4 Production of farmed and ranched salmon

The production of farmed Atlantic salmon in the North Atlantic area in 2000 was 658 735 t. This was the highest production recorded so far (Figure 4.1.1.2) and represented a 3% increase compared to 1999 (636 783 t) and a 30% increase on the 1995-1999 average (504 809 t). Partial data on the worldwide production of farmed Atlantic salmon were available for 2000 (704 134 t). This figure excludes a significant production in Chile. However, worldwide production of farmed Atlantic salmon in 2000 was over 200 times the reported nominal catch of Atlantic salmon in the North Atlantic in the same year. This availability of farmed salmon has probably contributed to the decline in commercial fishing effort in many countries.

The total production of ranched Atlantic salmon in the North Atlantic was 11 t in 2000, 22 t less than in 1999 and the lowest value since 1984. Production in Iceland declined dramatically because no smolts were released for ocean ranching in 1999, thus only 2SW fish were harvested in 2000. Production of ranched fish was less than 5% in each of the other three countries reporting (Ireland, UK(N. Ireland) and Norway).

4.2 Use of Case Studies to Illustrate Options for Taking Account of Risk in the Provision of Catch Advice

Salmon advice in the standard ICES framework for fisheries advice

ICES considered this question, together with the supplementary request that "ICES provide information that will assist with the implementation and evaluation by NASCO and its Contracting parties of the decision structure (Annex 4 of document CNL(00)18, provisionally adopted by the Council).

Management of Atlantic salmon in the North American and Greenland Commission areas is based on a fixed escapement strategy. The fixed escapement is biologically-based, as the product of a research-derived estimate of the maximum productivity achievable for a unit of spawning habitat, i.e. 2.4 eggs m^{-2} in most of North America except Quebec where egg depositions are derived from specific SR relationships. These egg depositions are subsequently referenced to survey derived estimates of the amount of suitable habitat potentially available to salmon. All potential returning salmon in excess of the fixed escapement are considered to be available for harvest.

Since 1998, ICES has provided advice to clients within a framework of *limit* and *precautionary* reference points set by technical experts, and *target* reference points set by managers, and has used a probabilistic framework suitable for risk-based management. This fixed escapement for North American salmon has some properties of both limit and target reference points, as the terms are used by ICES. The resemblance to a limit reference point is due to expected recruitment declining below the fixed escapement. Declining recruitment is a conservation concern, and hence, spawning escapement to North America below the fixed escapement is an undesirable event to be avoided with high probability. The similarity to a target reference point arises because the fixed escapement is also the escapement thought to produce maximum productivity for North American salmon, and hence is a desirable state that managers have agreed they wish to achieve with high probability.

The dual nature of the fixed escapement presents some special challenges when providing scientific advice in a risk management framework. According to current thinking and conclusions of diverse technical discussions, limit reference points should be avoided with high probability, and uncertainty should be considered fully in advice on proximity to limits. To achieve this, in its management advice ICES has used precautionary reference points which are more precautionary than the limit reference points (ex. higher spawning biomasses, lower exploitation rates), to account for some sources of uncertainty. Then ICES generally advises harvest options which have a 95% probability of being in compliance with the limit reference points, and at least a 50% probability of complying with the precautionary reference point, given the assessment's estimate of current stock status. The combination of the precautionary reference points and strong risk aversion with regard to limit reference points ensures management based on the scientific advice has a very low risk of allowing the occurrence of conservation threats to the stock.

Applying this approach when using the salmon fixed escapement as a *limit* reference point means that advice would be framed to deliver escapements higher than the fixed escapement. A precautionary escapement would be set higher than the actual fixed escapement, and advised harvests would ensure escapements would have a high probability of being at or above the precautionary reference escapement. Thus the expected escapement if the advice were implemented would be higher than the biological fixed escapement to account for the magnitude of uncertainty in both the true best escapement and the true state of the resource. This directly contradicts the intention that all potential returning salmon in excess of the fixed escapement are considered to be available for harvest, and delivers escapements exceeding those at which the stock is maximally productive due to density dependent effects in freshwater.

If the fixed escapement is used as *target* reference point, advice should try to continually deliver escapements as near the target as possible; on average being risk neutral with regard to the target. This meets the objective of allowing all potential returning salmon in excess of the fixed escapement to be available for harvest, but half the time escapements below the target will be expected. When uncertainty is large, there is risk of advising harvests which result in escapements well below the biological fixed escapement in some years.

To successfully advise on and manage salmon in a risk-based framework, ICES and NASCO must work together to resolve several issues. The current functional contradiction of the fixed escapement being partly a limit and partly a target must be resolved. Technical experts must clarify a) the degree to which falling below the fixed escapement constitutes a serious conservation problem, b) the major sources of uncertainty, and c) to the extent possible, their magnitudes. The uncertainties may include, for example, uncertainties in harvests and in the forecasts, and intrinsic inter-annual variance in the true best escapement. They must also specify how the various sources of uncertainty are addressed in the assessment and the advice. Managers must specify what their risk tolerances are, both with regard to reduction in productivity below the highest possible, and the danger of harm to the stocks that is serious or difficult to reverse. Once the uncertainties, risk tolerances, conservation-related reference points and management target reference points are known the determination of the annual quota is a direct step. The quota is the harvest which gives a 50% probability of the escapement being at the *target* reference point, *as long as the probability of forecast escapement falling below the precautionary reference point is within the risk tolerance of the managers.* However if at that harvest the risk of escapement being below the precautionary reference point exceeds the manager's risk tolerance of harm to the stock, the quota must be reduced until the risk profile produces a tolerable probability of escapement being above the precautionary reference point. High uncertainty makes the risk profile very flat (see e.g. Figure 4.2.1.3), so managing risk within the tolerances means harvests will often have to be lower than the difference between the estimate of current returns and the management target, even when the target escapement already may be substantially higher than the precautionary conservation reference point. Similarly, in a risk framework, target and precautionary reference points that are very close together will also require lower quotas than the difference between estimated returns and the target escapement, even when uncertainty is fairly low.

The current management approach used for the West Greenland fishery may not meet the ICES standards for risk management in a precautionary framework. The advised catch options correspond to a 50% probability of achieving the fixed escapement. If the fixed escapement is only a management target based on achieving maximum productivity, risk is not being managed relative to conservation-based limit and precautionary reference points. If the fixed escapement is a conservation reference point, a risk neutral rather than risk averse approach is being followed, and there is a 50% chance of an undesirable event occurring.

Because many salmon fisheries exploit mixed stocks, the true situation can be even more complex. The conceptual conservation objective becomes ensuring that the fixed escapements are met for all stock components simultaneously. There are more sources of uncertainty in the assessments, and risks are higher because harvests of individual stock components cannot be matched to the status of the components relative to their individual targets and limits. Moreover the stock at highest risk relative to its precautionary reference point determines the tolerable harvest or exploitation rate for all the stocks harvested together, even if risk to the other stock components is very low.

In order to formulate the current salmon catch advice, ICES will continue to use the fixed escapement strategy in the same way as used in recent years by ICES and NASCO. Throughout the following text, the advice consistently refers to the "management target" in NASCO terminology as "fixed escapements" to avoid judging whether these escapements in ICES terminology are conservation limits or management targets.

4.2.1 Case studies for calculating risk for the provision of catch advice.

ICES considered case studies to illustrate two approaches for taking account of risk in the provision of catch advice. Both are partial steps towards moving salmon management advice into a more complete risk management framework. The first considers incorporating the uncertainties in a risk analysis to provide a probability profile of meeting the fixed escapement. The second approach addresses the possible role of management targets, in managing the risk of not meeting the fixed escapement.

The case studies below consider a) a mixed stock fishery example for two levels of abundance and b) a single stock example for a homewater fishery.

a) Mixed stock fishery – West Greenland fishery

The deterministic calculation of catch options for the West Greenland fishery uses the point estimates of the input parameters. When the input parameters have uncertainty (for example the PFA value), the value at the risk neutral (50%) probability level is used. The procedure is described in Appendix 2 and summarized for two stock levels (low and moderate, Figure 4.2.1.1). For the low abundance period, the catch option at the point estimates and for a 40% allocation of surplus to West Greenland was 19 t. For the period of moderate abundance, the deterministic catch option was 561 t.

The deterministic calculation does not provide any analysis of the risk of not achieving the fixed escapement in North America at the calculated catch level. The data inputs are uncertain and a risk analysis for the objective of achieving the fixed escapement must incorporate these uncertainties appropriately. The uncertainties included in these case studies are:

- Fixed escapement uncertainty for six stock areas
- Uncertainty in the forecast PFA value
- Uncertainty in the biological characteristics of the salmon in the fishery

Management error (for example, not catching the exact quota) has not been incorporated but it could be included if an estimate was made from historic data.

<u>**Fixed escapement uncertainty**</u>

The 2SW spawner requirement for North America used by ICES is the sum of point estimates of individual river or fishing area spawner requirements. It has been shown that the sum of individual river or area requirements provides a probability level of less than 50% of simultaneously meeting the fixed escapement in individual rivers or areas (ICES 1996/Assess:11). This excludes the uncertainty in the individual river fixed escapements which have not been quantified for the majority of rivers of North America (except for Quebec rivers). The sum of the 2SW spawner requirements for North America is 152 548 fish and adjusted for natural mortality to the point prior to the fishery (spawner reserve) is 170 286 fish. To ensure that there is a 50% probability of spawner escapement at least 100% of fixed escapements for six stock areas simultaneously, 169 000 2SW are required to return to North America equivalent to 188 650 2SW fish released from the fishery (Figure 4.2.1.2). The uncertainty increases as the number of stock areas defined by managers increases. Additionally, the analysis assumes that the stock areas are all producing at the same rate relative to their fixed escapements.

Probability of achieving fixed escapements simultaneously in six stock areas

Probability Level	In North America	Prior to fishery (adjusted by M for 11 months)
Point estimate	152 548	170 286
50%	169 000	188 650
75%	173 000	193 100
90%	177 000	197 600

PFA Forecast Uncertainty

Forecasts of abundance in the year to come are dependent upon stochastic functional relationships. Generally, the forecasts have large uncertainty. The PFA forecasts for the low abundance and moderate abundance periods are shown in Figure 4.2.1.3. The PFA forecast value at a 50% level for the moderate abundance period was 437 000 fish compared to 183 000 fish in the low abundance period.

	Forecast values	
Probability level	Moderate abundance	Low abundance
10%	236 782	120 000
30%	342 213	155 000
50%	436 770	183 000
70%	553 223	215 000
90%	801 849	280 000

Biological characteristics of the fish

Biological characteristics of the fish in the fishery of the coming year are also unknown. These are estimated based on characteristics of previous years taking account of any temporal trends in characteristics if they occur. In the deterministic approach, the point estimates (such as the average weight of previous years, the average fecundity of females in recent years) are used. In the risk analysis, the uncertainty in 4 characteristics is considered: proportion North American origin 1SW salmon, mean weight of 1SW salmon of North America, the mean weight of 1SW salmon of European origin, and the age correction factor for older age groups in the fishery. The variability in the number of 1SW salmon at a given catch option is illustrated in Figure 4.2.1.4. For a catch of 50 tons, the expected catch of 1SW salmon of North American origin can vary between 11 700 fish and 15 450 fish (10th to 90th percentiles).

Completing the Risk Analysis

Incorporating all these uncertainties results in a measure of the reliability of the stock assessment for making management decisions. The reliability of the assessment has profound consequences on the catch options. In the theoretical example shown in Figure 4.2.1.5, two assessments provide the same point estimate (50% probability value) but the precisions are very different. Under a risk-prone management approach, the allowed catch would be greater for the imprecise assessment: at a 70% risk level, the advised catch under the precise assessment would be 500 t but the uncertain assessment would provide for a catch of 800 t. The risk-averse management approach would advise for lower catch options for the imprecise assessment: at a 20% risk level, the precise assessment would provide a catch option of about 400 t but for the imprecise assessment, no catch is advised.

The risk analysis probability profiles for the two years of contrasting stock abundance are shown in Figure 4.2.1.6. In the moderate abundance year, a catch option of about 1 250 t produces a 50% probability level of achieving the fixed escapement. This contrasts with the low abundance year when a catch option of just over 100 tons provides a 50% probability of meeting the fixed escapement. To adopt a more risk-averse approach, managers must select a lower probability (or lower risk) of stocks failing to meeting their fixed escapements. At a 65% probability level, there would not be any available harvest in the low abundance scenario and a quota of about 900 t in the higher abundance scenario.

The risk analysis described above has not incorporated management uncertainty. When management is imperfect, as is generally the case, the effect on the risk analysis is to increase the uncertainty in the probability of complying with any conservation reference points.

The analysis has also excluded any differences in status among the stock areas. In the case where stock status differs, the probability of meeting a fixed escapement for a given year will be overestimated because the spawning escapement to the areas will be different from those assumed in the model, for stochastic reasons, if nothing else. That is, if the fixed escapement is exactly being met *on average* for all stocks that year, escapements to approximately half of them will be below their respective stock specific fixed escapements and half above. An evaluation of performance of previous years' fisheries would provide valuable insight into the appropriateness of the data inputs and the assumptions of the risk analysis.

b) Single River Example – Miramichi River

The Miramichi River, at a maximum axial length of 250 km and draining an area of about 14 000 km^2, has the largest Atlantic salmon run of eastern North America. There are two major branches: the Northwest Branch covers about 3 900 km^2 and the Southwest Branch about 7 700 km^2 of drainage area. The two branches drain into a common estuary and subsequently drain into the Gulf of St. Lawrence at latitude 47°N. Separate branch assessments were introduced in 1992 to account for the differences in exploitation between the Northwest and Southwest branches. Native Peoples fisheries were historically conducted almost exclusively in the Northwest Miramichi (exploitation also occurs in the estuarial waters of the Miramichi River, downstream of the confluence of the two branches) and recreational fisheries exploitation also differs between the Northwest and Southwest branches.

Temporal stock distinctiveness has also been highlighted as an important component of the Atlantic salmon resource of the Miramichi. Early runs and late runs have different composition in terms of small and large salmon proportions and sex ratios. The early runs in both branches are also exploited more heavily than the late runs.

Atlantic salmon are presently exploited in Native Peoples and recreational fisheries. No large salmon (>= 63 cm fork length) can be retained in the recreational fishery (mandatory catch and release) and Native Peoples fisheries for small and large salmon are under gear, season and quota controls.

The spawning goal for the Miramichi River and each branch separately is based on an egg requirement of 2.4 eggs/m^2 of spawning and rearing habitat area. The objective is to obtain all the egg depositions from large salmon although compliance relative to the achievement of the fixed escapement is determined relative to egg depositions from both small and large salmon.

Forecast of returns in 2001

The association between small salmon (almost exclusively 1SW salmon) and large salmon returns the subsequent year was examined over the time series, 1985 to 2000 (Figure 4.2.1.7). The ratio of small salmon to large salmon for this time period varied between 1.4 and 7.1 with the most recent year ratio (1999 small, 2000 large salmon) at 1.41. The median ratio model for the recent five-year period (1995 to 1999) would predict returns of large salmon (including previous spawners) of 16 400 fish (ranging between 14 700 and 25 200).

Risk analysis of the fishery

The probability of meeting fixed escapements in 2001 was estimated from the predicted return of large salmon in 2001 based on the small:large salmon ratio of 1996 to 2000 and assuming that small salmon returns in 2001 would be similar to the previous five-year average. The model to assess the risk relative to the fixed escapement if fisheries were to occur in year 2001 can account for seasonal differences in harvest levels, catch-and-release mortality, and biological characteristics of the adults (Figure 4.2.1.8).

Risk is quantified in terms of the probability of meeting the fixed escapement and the egg loss resulting from the fisheries harvests as a percentage of total eggs in the returns of adult salmon to the river. Figure 4.2.1.9 shows the probability profiles for different combinations of losses of large and small salmon due to fisheries. For example, if losses of large salmon were 1000 fish and losses of small salmon were 10 000 fish, egg loss as a percentage of total eggs in the returns would be slightly less than 10% and the probability of meeting the fixed escapement would be 35%. For the Miramichi River overall, there is a 54% probability of meeting the fixed escapement in year 2001, in the absence of fisheries.

4.2.2 Case studies for use of management targets as a means of minimizing risk

NASCO (1998) proposed that "stocks be maintained above conservation limits [here called "fixed escapement" – pending resolution of the relationships among target, precautionary, and limit reference points and fixed escapement called both management target and conservation limit by NASCO] by means of management targets". The purpose of the management target would be to satisfy the management objective of ensuring a high probability that the fixed escapement will be exceeded. As discussed above, this usage differs from ICES' use of management *targets*. Within the ICES usage, management targets for biological characterstics of stocks are traits (escapements, stock sizes, etc) needed to deliver the social and economic objectives managers and users may have. (As described above, these targets must be high enough to avoid conservation problems with very high likelihood as well.) As NASCO uses "management targets" in the Draft Descision Structure it adopted, these "targets" appear to correspond most closely to precautionary reference points, including considerations of setting reference points higher than the biologically based limit reference points to reflect uncertainties, and managing risk tolerances relative to the precautionary reference points.

Within the case study examples provided in the draft decision structure adopted by NASCO, the use of "management targets" at some value proportionally higher than the fixed escapement was used. The challenge is to assess whether a "management target" [precautionary reference point] can be defined which would provide a high probability of avoiding the conservation-related limit reference point [possibly the fixed escapement]. The derivation of a "management target" *sensu* NASCO can be based upon an assessment of the same uncertainties as shown previously, namely uncertainty in fixed escapements for six stock areas, uncertainty in the forecast PFA value, and uncertainty in the biological characteristics of the salmon in the fishery.

The use of a "management target" assumes that managers may choose to harvest all the surplus relative to the "management target", and its associated risk tolerance, and the risks are therefore assessed on the assumption that this will be done. The analysis provided in Section 4.2.1 illustrates how a "management target" could be set with a risk tolerance of 0.5 (i.e. risk neutral with regard to the "target") which would increase the probability of achieving the fixed escapement (i.e. complying with the limit reference point) by a fixed amount. For the higher abundance year, to achieve a probability of meeting the fixed escapement of 60% a "management target" of 128% of the fixed escapement would be required and this target would result in a harvest reduced by 250 t (from 1 250 t at 50% to 1 000 t at 60%) (Figure 4.2.1.6). For the low abundance year, a probability of achieving the fixed escapement of 60% would result from a "management target" set at 116% of the fixed escapement, and would result in a harvest reduced by 100 t. The problem with this approach is that a "management target" defined as a fixed proportion above the fixed escapement, will not reduce risk by the same amount in different years, with difference in abundances and uncertainties. Although an average value could be employed, it could result in significant over-exploitation (or foregone harvest) in different years.

Summary and relative merits of the approaches

Our analysis shows that there is no single "management target" as a percentage of the fixed escapement which will provide the same level of protecton against failing to meet the fixed escapement over variations in abundance and assessment uncertainty. ICES therefore favours the approach of providing an annual risk analysis which considers the variations in abundance, and in the uncertainty of the assessment. When risk tolerances are specfied, the quota level consistent with the risk analysis and acceptable risk can be read directly off the risk analysis probability profile plot (such as in Figure 4.2.1.6). ICES recognizes that managers may consider that risk tolerances might differ for different fisheries and risk management of mixed stock fisheries is especially complex. ICES also stresses that within the precautionary approach, risk tolerances should be set in advance of the risk analysis, to ensure conservation is not compromised to deliver harvest opportunities.

4.2.3 Review of draft decision structure (NASCO CNL(00)18)

ICES tabled the Report of the Standing Committee on the Precautionary Approach (CNL(00)18 *Application of a Precautionary Approach to Management of Salmon Fisheries*) for discussion and comment.

ICES considered that the draft decision structure provided a very useful first step in developing mechanisms for guiding managers towards appropriate actions for fisheries, compatible with the underlying goal that conservation requirements (both abundance and diversity) of contributing stocks are achieved. ICES endorsed the emphasis given in the draft decision structure to systematically monitoring the effect of management measures and taking results into account in future management decisions. It was also felt that the various elements of the decision structure, if widely applied to fisheries and stocks, would provide a useful audit trail, showing the data available for stocks and the basis of the management decisions taken for the fisheries where those stocks are represented. This would also provide clear indications of data deficiencies and highlight where lack of data was impeding sound management.

The presentation would be improved by adopting a flow diagram type of approach, similar to that provided in ICES report (ICES CM 2000/ACFM:13). This should make the review and evaluation of measures taken more explicit (by means of feedback loops) and should indicate where risk should be considered.

The step in the single stock framework that refers to stocks threatened by external factors is unclear, as it is not obvious what happens if the stock is threatened but is not yet below the conservation limit (for example recently introduced disease into a still productive stock). It may be better to incorporate this into the general assessment of status, such that if status is threatened by external factors, the reasons could be identified and appropriate pre-agreed management actions taken.

ICES noted the clear distinction between action under conditions of unsatisfactory stock status (i.e. identify reasons and implement corrective action) and actions under conditions of surplus (implement pre-agreed management actions to harvest the surplus). However, ICES felt it was likely that many stocks with an exploitable surplus are also subject to impacts that may cause them to fall below surplus at some future time, if measures to mitigate impacts (for example, habitat rehabilitation) are not implemented. Therefore, it was insufficient to recommend implementation of measures only when status had become fully unsatisfactory.

ICES noted that in the pre-agreed decision structure, the decision should take account of all sources of uncertainty, with management targets being suggested where appropriate, however the draft decision framework did not fully address the incorporation of risk into the decision process. In this respect, the use of further case studies specifically to illustrate this would be valuable (see Section 4.2.1).

It was noted that no pre-agreed management actions were specified, though it is accepted that a generic structure may not be able to cover all specific cases. Moreover, the decision structure repeatedly refers to "pre-agreed management actions" with no indication of the source of such agreements. ICES notes that the process for gaining pre-agreement on specific actions to be taken under specific conditions is rarely simple and agreement on a decision structure without unambiguous specification of the "pre-agreed management actions" and their triggers is only a small step towards improved conservation.

In summary, ICES recommends some modifications and reference to similar salmon management structures being developed by contracting parties for use in homewater fisheries.

4.3 Differences in the occurrence of escaped farmed salmon in fisheries and stocks in different areas

In 2000, about 627 000 t of farmed salmon were produced in the Atlantic area, with Norway and Scotland accounting for the majority of production (see Section 4.1.4). In comparison, the total nominal landings of salmon in commercial fisheries in the north Atlantic in 2000 were about 2 800 t.

Farmed salmon are abundant in large numbers in Norwegian coastal commercial salmon fisheries. The proportion is known to be lower in fjord and freshwater catches, but increases in spawning populations. Tagging experiments have shown that farmed salmon from Norway are caught in the Faroes fisheries, and it has been shown that the incidence of escaped farmed salmon in this fishery can be high. Estimates from the commercial fishery at West Greenland in 1991 and 1992 showed that the incidence of farmed fish was less than 1.5%. Results from monitoring salmon fisheries and stocks in Scotland, Ireland and Northern Ireland have suggested a much lower proportion of farmed salmon. Fish farm escapees also occur in rivers in Canada and USA, particularly in areas with high density of farms.

Analyses carried out in Norway have shown that the occurence of farmed salmon is highest in rivers close to areas with high density of fish farms. In Ireland there have been 13 reported incidents between 1986 and 2000 involving 189 000 adults and 120 000 smolts escaping primarily from sites in the West, but also from sites in the North West, South West and North. There is a significant relationship between the number of escapees in the declared catches and the reported salmon farm escapes although these numbers are very low.

Wild salmon leave their home rivers as smolts in the spring and move quickly into oceanic areas. In the north east Atlantic areas, results from smolt tagging experiments and post-smolt surveys have strongly indicated that ocean currents are the vectors that force the fish northwards. Hatchery-reared salmon released as smolts in freshwater are thought to have a similar migratory pattern as wild salmon. Hatchery smolts released on the coast tend to return to the same area from where they were released, but apparently enter any river in that area to spawn.

In Norway, it has been observed that when released tagged hatchery-reared salmon post-smolts were kept in saltwater and sequentially over one year, there was annual variation in both survival and homing precision, with poor survival of the groups released in late summer and autumn, and poor homing precision of fish released in winter. Large salmon escaping early in the summer, a few months before spawning, tended to move northwards with the current, and when they were ready to spawn, they entered freshwater in that area. They did not appear to have a homing instinct .

Based on the current knowledge from the literature, the results from the tagging experiments, direction and speed of ocean currents, and from available information of the apparent low proportion of fish farm escapees in Ireland and Scotland relative to the production of farmed salmon, it is hypothetised that fish farm escapees from Faroes, Ireland and Scotland are transported with the currents, and fish that become sexually mature when they are relatively close to the coast enter Norwegian and Russian fisheries and salmon rivers. Under the same hypothesis some fish farm escapees from Ireland may enter fisheries and salmon rivers in N. Ireland and Scotland, some Irish and Scottish fish farm escapees may even turn up in Denmark and Sweden, and some Norwegian fish farm escapees may enter fisheries and rivers in Sweden, Denmark and Russia. It may be that a continuous supply of fish farm escapees in the coastal current leads to a high proportion in Norwegian coastal salmon fisheries, although their survival are still low.

4.4 Recent Research Developments

4.4.1 Infectious salmon anaemia: implications for wild salmon management

Information was presented to ICES about infectious salmon anaemia (ISA) in North America. Aggressive control measures taken in Canada resulted in only one site reporting the disease to date from the spring 2000 smolt class. No ISA was detected in wild and escaped-farmed fish entering the Magaguadavic River, where positive tests for both groups were obtained for the first time in 1999. Positive tests for ISA were recorded for the first time in 2000 from the Margaree River Nova Scotia, the Morell River in Prince Edward Island, and the Saint John River New Brunswick, however, the initial results are problematic because they could not be confirmed. The first confirmed case of ISA from the East Coast USA salmon farming industry was announced on 16 March 2001. The US industry is now implementing measures similar to those used in Norway, Scotland and Canada to manage the problem. Genomics research found that European ISA isolates (Scotland and Norway) were 98 – 100% similar, whereas the Canadian isolate was only about 84-88% similar to the European group. The strains may have diverged from each other about 1900, which corresponds to a period of transfers of salmonids from North America to Europe (Rainbow trout) and from Europe to North America (sea run brown trout). Both species are asymptomatic hosts of the virus. It is not known where the virus originated. Independent testing of a widely used vaccine confirmed a significantly increased survival rate for fish that had been vaccinated.

4.4.2 Causes of fish farm escapes

The causes of escapes of farmed salmon from sea cages in British Columbia and East Coast North America were reviewed. In British Columbia, the reported number of escaped-farmed fish has stabilized at about 1% of the annual total salmon production. On average, there were 5.2 escape incidents per year in 1996 – 2000. Escapes resulted from net failures (42% of the total; caused by predator attacks (6 of 11 net failures) and other factors), mechanical problems with cage systems or boats (4%), handling errors (39%), and boat collisions with cages (15%).

The reporting of escapes in East Coast North America has been imperfect. Six incidents could be documented between December 1999 and December 2000. The smallest escape of salmon was 3000, and the largest > 100 000. One event released 25 000 rainbow trout. Three of these six releases were storm related, one involved a boat collision, one was due to vandalism, and the cause for one is uncertain. Escapes in these areas resulted predominantly from human error and storms. Severe storms predictably occur in autumn and winter. By contrast, it is difficult to predict when human error will occur. Thus the entry of farmed-salmon to fisheries and stocks will retain a large degree of unpredictability. Different salmon farming regions are also characterized by different climates and operating conditions. Releases of farmed fish to the wild, and their occurrence in fisheries and rivers, will vary in both magnitude and frequency among these regions depending upon the severity of the conditions.

4.4.3 Causes of post-smolt mortality in the marine phase

Possibility of by-catch of post-smolts in pelagic fisheries

Between 10 – 20 June 2000, special fishing experiments for post-smolts carried out in the Norwegian Sea yielded 268 post-smolts and 6 salmon in 14 tows during three consecutive days west and southwest of the Voeringplateau (68° 30'N – 63°N and 1° W - 5° E). Most of these fish were taken in three tows (170, 60, and 34 respectively). The CPUE at this particular cruise was 9 post-smolts per trawl hour, which is one of the highest recorded since 1990. Microtagged and Carlin-tagged fish occurred for the first time in the same hauls. In Norway no microtagging was carried out in 2000, indicating a south European origin of these fish, which supports the hypothesis that south Norwegian fish and European fish are mixed on the feeding areas in the Norwegian Sea also at the post-smolt stage. These large catch numbers are of concern with respect to the potential impact of the mackerel fishery in the Norwegian Sea in June – August. There is overlap between the mackerel fishing areas and the anticipated northward migration routes for the post-smolts of south and central Europe and southern Norway (ICES CM 2000/ACFM:13). The surface trawl method used by the Norwegian Research vessels resembles the commercial fishing method which also operates with a flotation on the trawl wings. However, the commercially used trawls are considerably deeper and longer, they are towed at higher speed, i.e. ~5 – 6 knots vs. 3-3.5 for the research ships, and the tows also last longer. The commercial trawlers thereby sweep much larger areas, and hence are likely to catch more post-smolts. So far it has not been possible to obtain detailed information on the methods used by the commercial ships, but the Norwegian Coastguards report a fleet of 25 –30 Russian and East European trawlers operating annually in the mackerel fishery in international area. Due to the assumed surface-near location of the post-smolts during migration and on their oceanic feeding grounds. ICES previously recommended that ICES/NASCO should look into the possibility for encouraging these commercial trawlers to lower the head rope of their gear to minimum 5 m below the sea surface (ICES CM 1999/ACFM:14). ICES recommends that the by-catch issue be further investigated to assess the possible impact on post-smolt survival.

Salmon lice observations in selected Norwegian fjords and the Norwegian Sea

The status of salmon lice (*Lepheoptheirus salmonis* Krøyer) on seaward migrating post-smolts has been monitored by surface trawling in two southwest Norwegian fjords since 1998. The two southern fjords (Sognefjord and the Nordfjord) had been selected because they are different both hydrographically and in densities of fish farms, with the northern-most of these two fjords (Nordfjord) containing the largest number of net-pens. Sampling in more northerly fjords was also carried out as these represent areas with low (Altafjord) or no fish farms at all and large numbers of wild post-smolts.

Overall infestation rates have varied greatly between the years, especially in the Sognefjord, where the mean number of lice per fish has been over 30 the two last years. These particular outmigrating cohorts may therefore have been subjected to infestation rates surpassing even conservative estimates of lethal limits. In the Nordfjord the average number of lice per fish was relatively high in 1998-1999, while it was zero in the samples of 2000. This may be due to a combination of earlier entry of the post-smolts into the sea, and a thick layer of fresh water extending to the outlet of this fjord which may have protected the fish from infestation, thus underlining the possible importance of hydrography for survival at the time of smolt passage through the fjords.

Post-smolt samples from more northern fjords were infested with, on average, only 0.4 salmon lice per fish. None of the samples analysed from the Norwegian Sea, carried more than 10 chalimus or older stages of lice per fish. This may indicate that fish with high infestation rates either die, or lag behind the main cohorts of sea migrating post-smolts. At present there are insufficient data available to enable correlation of the influence of the observed lice infestation rates on subsequent return rates of 1 SW or MSW salmon to the particular fjords. However, the high observed infestation rates are a matter of concern, which should be investigated in more detail.

4.4.4 Marine growth checks as evidence for sub-catchment population structuring

The occurrence of summer checks on the scales of salmon returning to Scottish home waters in the years 1997-1999 was shown to be significantly greater than levels derived from the previous 35-year period. There was no evidence that the incidence of checks varied between sexes. There was also no association between the presence of checks with either size at return or marine survival indices. The majority of checks tended to occur within a relatively narrow band within the third quarter of the marine zone. The proportion of salmon whose scales exhibited summer checks was highly variable both among years and sea age categories, but, in general, salmon showed a higher incidence of growth checks in their first year at sea than during their second year.

The incidence of summer checks was also strongly related to the subsequent run-timing (the calendar month when fish returned to freshwater) of the adult fish. The cause of the summer checks is unknown and the direct effects difficult to detect. Their relatively high incidence in recent years, however, may allow speculation on the mechanisms responsible for the observed patterns of association between groups of salmon in the ocean. Patterns of variation are relatively consistent among years suggesting that either different "run-timing groups" of salmon are differentially predisposed to the causal event or, salmon are not randomly mixed in the ocean and different groups follow, to some extent, different migration routes.

These observations may assist our understanding of recent trends in marine survival. The structured variation in the incidence of summer checks between "run-timing groups" reported here provides an association through which differential trends in marine survival may occur as it demonstrates that these groups may encounter similar conditions in a patchy marine environment.

4.4.5 Estimates of M at sea for Atlantic salmon

In the run-reconstruction models of the pre-fishery abundance (PFA) for the North American and Northeast Atlantic stock complexes, it is assumed that the natural mortality rate is 1% per month after the first year at sea. The assumed rate is from an analysis of weight and age data from the River Bush (U.K.). This rate of natural mortality is used to calculate the number of fish immediately after the first winter, prior to the high seas fisheries, and between the high seas fisheries and returns to homewaters. When high seas fisheries remove a large proportion of the stock several months before the animals are destined to return to the rivers, the estimate of the PFA is less sensitive to the assumed natural mortality rate than when fisheries are of low intensity. In the time series of catches and returns used to estimate the PFA, there have been reductions in the level of sea fisheries such that presumably a smaller proportion of the estimated PFA consists of actual observed/harvested animals than was the case a decade ago. The concern is that the perception of reduced / declining abundance is in part an artifact of the model assumption about natural mortality during the second year at sea in terms of its assumed level and assumed constant rate over time. Two methods for estimating mortality at sea were examined , the inverse-weight method and the maturity schedule method.

Method 1 - Inverse Weight Method

This is based on the assumption that M decreases with increased size because marine natural mortality is assumed to be primarily the result of predation. Following on that approach, the inverse weight hypothesis is used to estimate natural survival during the second year at sea based on catches, size-at-age, and return rates to the river. Based on this the natural mortality rate between Greenland and home waters (approx. 12 months) is between 3% and 12%, i.e. about 1% per month. M has been modelled for juvenile and adult fish as a power function of weight and using empirical observations of 113 species/stocks, derived parameter estimates for M relative to weight. Based on these parameter values and using estimates of weight at age for a known stock (in this case the River Bush salmon), the monthly mortality rate of Atlantic salmon in the second year of ocean life is about 3% per month.

Method 2 - Maturity Schedule Method

It is possible to estimate the sea survival rates of 1SW and 2SW salmon during the first and second years at sea by modeling the dynamics in the ocean using a simple life history model. Assuming that survival rates at age for males and females are similar, the model provides equations relating the survival rates and maturation profiles for 1SW and 2SW salmon.

The model was applied to data from three rivers:

1. Saint John River hatchery returns of age-1 smolts stocked at Mactaquac
2. LaHave River at Morgans Falls, wild smolts
3. Rivière de la Trinité (Québec) wild smolts

Sex ratios for the wild smolts were derived from sampling. Sex ratio for the age-1 smolts from Mactaquac were obtained from one year's sampling and assumed constant for the years analysed.

The model results support the widely held view that the major source of mortality in the ocean occurs during the first year. They also provide evidence against the constant mortality rate assumptions used in the run-reconstruction model and for at least one wild stock of eastern Canada, monthly instantaneous mortality rates of 5% (ranging between 2% and 15%) would seem more appropriate.

Although there appears to be increasing evidence of M being greater than 1% per month in the second year at sea and that M varies annually, the Working Group cautioned that only three rivers were evaluated and the data series on only one was longer than ten years. For this reason the revised values from preceding analysis have not been used in the forecast model for 2002. While an analysis of more rivers would be required to assess the among stock variability in the estimated survival rates and the representative level for the North American stock complex, it will be necessary to incorporate revised values for the forecast model in future as they become available. The Working Group recommended that further evaluation of the maturity schedule method be undertaken particularly as it relates to the sensitivities of the survival estimates to the sex ratio values of the smolts and the assumption of equal survival of male and female salmon.

4.4.6 Potential impact of climate change on juvenile salmon

Climate change has been identified as an important source of aquatic disturbance on a global scale and may alter species composition and dominance in aquatic ecosystems. Cold water ecosystems are particularly at risk and predictions from the climate change models for North America include: increase in mean surface air temperatures, increase in winter air temperatures, increased frequency and duration of summer hot spells, increased water temperatures in the range of 2 – 5° C with maximum changes occurring in spring and fall, advanced timing of snowmelt and spring runoff.

ICES reviewed an analysis of the hydrological conditions and river temperatures in the Miramichi River over a 50 year time period and the associated variability in juvenile salmon size-at-age during 1971 to 1999. The results of the analyses suggest that growth of juveniles in the Miramichi River is likely to be adversely affected by climate change, particularly during the spring months. Increases in air and water temperatures are expected to contribute to reduced size-at-age of juveniles with the potential effect of altering survival, age at smoltification, and ultimately sea survival.

4.4.7 Compilation of Tag Releases and Finclip Data by ICES Member Countries in 2000

Data on releases of tagged, fin-clipped, and marked salmon in 2000 were provided by ICES and are compiled as a separate report. A summary of Atlantic salmon marked in 2000 is given in Table 4.4.7.1. About 3.36 million salmon were marked in 2000, a decrease from the 4.43 million fish marked in 1999. The decrease was due largely to the reduced number of adipose fin clips. Primary marks are summarized in three classes: microtag (i.e., coded wire tag), external tag/mark, and adipose clips (without other external marks or fin clips. Secondary marks (primarily adipose clips on fish with coded wire tags) are also presented in the Annex. The adipose clip was the most used primary mark (2.35 million), with microtags (0.65 million) the next most used primary mark. Most marks were applied to hatchery-origin juveniles (3.30 million), while 45 115 wild juveniles and 16 150 adults were marked.

5 ATLANTIC SALMON IN THE NORTH-EAST ATLANTIC COMMISSION AREA

5.1 Events of the 2000 Fisheries and Status of Stocks

5.1.1 Fishing in the Faroese area 1999/2000 commercial fishery

In the period 1991-1998 inclusive the Faroese salmon quota was bought out. However, the Faroese Government continued sampling inside the 200 mile EEZ during most years (ICES CM 2000/ACFM:13). No buyout was arranged for 1999 and 2000. No fishing took place in 1999 and the commercial fishery resumed in 2000. In the 1999/2000 season approximately 8 t were caught by M/S "Túgvusteinur" during 2 commercial fishing trips between late January and early April 2000 (ICES CM 2000/ACFM:13).

Description of the 2000/2001 commercial fishery : No fishery for salmon was undertaken by Faroese fishermen during the 2000/2001 fishing season and, consequently, no biological information was available for this season.

5.1.2 Homewater fisheries in the NEAC area

In the NEAC area there has been a general reduction in catches since the 1980s. This reflects a decline in fishing effort, both as a consequence of management measures and the reduced value of commercially caught salmon, as well as a reduction in the size of stocks.

Gear and effort: While there have been no changes in the types of commercial fishing gear used, the number of licensed gear units has, in most cases, continued to fall. Most fisheries for which data are available record a reduction of over 40% in gear units operated over the last 10 years. There are no such consistent trends for the rod fishing effort in NEAC countries over this period. Further initiatives to reduce fishing effort were introduced in several countries.

Catches: The overall nominal catch in the NEAC area in 2000 (2 643 t) was substantially higher than that in 1999 (2075t). Catches in some northern European countries were particularly high and well above the recent five and ten-year averages; catches in most other NEAC countries were close to or below the long-term averages.

CPUE: CPUE data for the net and rod fisheries show differences between countries but no large scale geographic patterns emerge. ICES noted that reduction in the number of fisheries operating can benefit those fisheries still in operation and that the lack of consistent trends in CPUE may reflect the imprecise nature of these indices.

Composition of catches: No common trends were noted in the sea age composition of the 2000 catches in the NEAC areas. Differences in the age composition between countries in Northern and Southern Europe noted in 1999 were less apparent in 2000.

In general, the incidence of farmed salmon in NEAC homewater fisheries remained at low levels (<2%) and similar to recent years, despite the continued increase in the salmon farming industry. The proportion of farmed salmon (20%) in the nominal catch for Norway did not increase, but this was a result of the significantly increased catch of wild fish. The number of farmed fish in the Norwegian catch was the highest recorded in the time series.

Origin of catch: From 1996 to 1999 a total of 409 762 smolts, mainly hatchery reared were tagged and released in Norway. A total of 3 811 adult recoveries were reported from Norway and 19 from other countries (0.5% of the total number of salmon recovered). This is consistent with previous observations that very few Norwegian salmon are intercepted in other countries.

Exploitation rates: Exploitation rates showed no trends relative to long-term averages for 1SW stock components in the NEAC area, although significant downward trends were detected for the 2SW component of some fisheries. There appeared to be no uniform pattern across NEAC countries.

5.1.3 Status of stocks in the NEAC area

There are over 1 500 rivers supporting salmon in the NEAC area, but for most of these there is no information on the status of stocks. In this Section, stock status is described for around 40 monitored rivers of which many are of small size and contribute a proportionately small quantity of the salmon production in the NEAC area. In summary, the monitored rivers analysed in this section would suggest that the status of salmon stocks in the NEAC area is, in general poor (Figure 5.1.3.1). This broadly agrees with the results of the PFA-lagged spawner analysis which is based on national catch statistics and presented in Section 4.3.

Attainment of conservation requirements: Analysis of attainment of conservation limits (CL) in 2000 showed that the proportion of rivers with an egg deposition above their CL was higher than in 1999 but less than in 1998. However, a majority of rivers showed a decline in their level of attainment in 2000 compared to the previous year and in most cases the decline was substantial (30-80%). This indicates that the recovery of salmon stocks observed in 1998, from a period of low attainment (1994-1997), has not appeared to continue. Although some areas were not represented in the data (e.g. Norway) , the Working Group had no reason to assume that the indices were not representative of stocks in general and noted the analysis broadly corresponded to the results of the PFA analysis in Section 4.4.6.

Adult returns to rivers: Measures of adult returns back to the rivers showed that of the rivers examined in 2000, more than half showed increased counts. Both southern and northern rivers showed a significant decline over the last 10 years, whereas no clear trend was detected for the last 5-year period.

Marine survival indices: For most rivers where information is available, marine survival indices were below both the previous 5-and 10-year means. Route regression analysis showed a significant downward trend in marine survival for 1SW fish for the last 5- and 10-year period, while no trend was detected for 2SW fish. A similar analysis showed a downward trend in marine survival for 1SW and 2SW hatchery fish over the last 10 years but no decline over the past 5 year period. These results are consistent with the information on adult salmon counts and suggest that returns are strongly influenced by factors in the marine environment.

5.2 Evaluation of the Effects on Stocks and Homewater Fisheries of Significant Management Measures introduced since 1991

5.2.1 Evaluation of the effects of management measures introduced in Faroes since 1991

Between 1991 and 1998 the Faroese fishermen agreed to suspend commercial fishing for the salmon quota set by NASCO, in exchange for compensation payments. The number of fish spared as a result of this period of suspension is the catch that would have been taken if the fishery had operated, minus the catch in the research fishery which operated in most years. No buyout was arranged for 1999 or 2000. Although no fishing took place in 1999, a single vessel carried out commercial fishing in 2000, catching approximately 8t. As for last year, analysis was based on the assumption that full quota would have been taken, had full scale commercial fishing taken place. Thus, the maximum catch that would have been taken in 1999/2000 would have been 300 t (see below). For the 1999/2000 analysis therefore the fish spared totalled 292t (300t-8t).

Year	Quota (t)	Estimated increased returns to home waters in Europe			
		1SW	%	MSW	%
1992	550	2 842	0	70 809	6
1993	550	11 429	1	106 307	10
1994	550	21 078	1	134 159	11
1995	550	12 949	1	138 533	13
1996	470	10 573	1	122 196	12
1997	425	9 578	0	105 368	14
1998	380	19 699	1	103 169	13
1999	330	17 261	1	99 130	12
2000	300	15 332	1	87 726	10

The calculated additional returns represent between 6% and 14% of MSW fish and up to 1% of 1SW fish returning to homewaters between 1992 and 2000. However, about 65% of MSW salmon caught in the Faroes fishery would return to Scandinavian countries, Finland and Russia. If this were the case, they might have represented from 10% to 19% of MSW returns and up to 2% of 1SW returns to northern European homewaters in those years. These returns were estimated from PFA analysis, (Section 4.3). If stocks and fisheries had remained stable, total catches would have been expected to increase by approximately the same proportions in respective areas. However, examination of trends in catches in NEAC countries suggests that any expected increase may have been masked by other factors such as changes in marine survival and/or management measures in homewaters.

Evaluation of the effects of management measures introduced in homewaters since 1991 ICES noted significant reductions in the number of gear units deployed in most countries in the NEAC area. Additional measures have been taken in some countries.

In Ireland new management and conservation legislation was brought into force in 1997 which was aimed at reducing effort and exploitation in the fishery and to facilitate enforcement. In order to show whether there has been a change in the catch subsequent to the introduction of measures in 1997, the data were analysed using a Non-Parametric Random Ratio (NPR) test (ICES CM 2000/ACFM:13). The results of this test indicate that drift net catches in the most recent 4 years were significantly lower than the preceding 7 years ($p < 0.01$) in all regions. Similarly, draft net catches (excluding the North Western Region where the Moy River draft net was suspended in 1994) were also significantly lower in the most recent 4 years ($p<0.01$) in all regions. A similar analysis showed that the exploitation rates in the period from 1997 to 2000 were also significantly reduced compared to the previous 10 year period ($p <0.01$). It is concluded therefore that the measures introduced in 1997 contributed to a reduction in both the overall catch and the exploitation rate on Irish stocks.

In UK (England and Wales), the North East coast fishery is the largest net fishery and has taken 68%, on average, of the national declared net catch over the period 1970-1992. A phase out of this fishery was introduced in 1993 and the number of licences issued has subsequently fallen by 50%, from 142 in 1992 to 71 in 2000. The exploitation rate in 1992 was estimated to be in the region of 50%. Assuming the remaining fishermen are representative and that there have been no major changes in the fishery, the average exploitation rate (1996-2000) would have fallen to around 32% (i.e. a 36% reduction). This is in close agreement with the reduction in the average drift net catch (1996-2000), which has fallen by 32% compared with the 5 years (1988-92) prior to the start of the phase out. A number of other smaller coastal mixed stock fisheries have also been phased out since 1991.

National measures introduced in UK (England and Wales) in 1999 to protect spring salmon are estimated to have saved around 3 700 salmon from capture by net fisheries in 2000 before 1 June (based on the catch and the average proportion of fish taken in this period in the 5 years prior to the measures being introduced) and 1 400 by rod fisheries (based on a similar proportion, but adjusted for catch and release).

ICES noted that a large number of other measures had been introduced. For example, in UK (England and Wales) the total number of licences issued has been reduced by 46% since 1991, but the introduction of additional controls (e.g. increased close periods) has reduced the total allowable fishing effort by 60%. In UK (Scotland), a voluntary cessation of net effort for the first six weeks of the fishing season was agreed by the majority of fishermen and was introduced in 2000. In the rod fishery, there has been an increase in the practice of catch and release since 1994 as previously reported. These recent initiatives, and the continuing decline in overall net effort, are likely to reduce the impact on NEAC stocks. ICES expected these changes to reduce homewater exploitation rates.

5.3 Expected Abundance of Salmon in the North East Atlantic

NEAC - PFA model: No changes were made to the structure of the model used in 1999 to estimate pre-fishery abundance of salmon in the NEAC area. However, data inputs were reviewed and updated and for several countries the data sets were split into two or more regions to allow more precise input parameter values to be provided. No new information was provided to modify the way that stocks are grouped. The pre-fishery abundance estimates are therefore divided into Northern Europe (all Nordic countries plus Russia and Iceland) and Southern Europe (Ireland, UK and France) groups.

Trends in PFA for NEAC stocks: The PFA of maturing and non-maturing 1SW salmon and the numbers of 1SW and MSW spawners for the whole NEAC area and the Northern and Southern European groups are shown in Figures 5.3.1 to 5.3.6.

Figure 5.3.3 shows that recruitment of maturing 1SW salmon (potential grilse) in Northern Europe was generally high (around one million) in the 1970s and 1980s, although the numbers have fluctuated quite widely, but there was a steady decline in these stocks from the mid 1980s to the mid 1990s. In the past four years there has been an upturn in the recruitment, with stocks in 2000 returning to the levels observed in the early 1990s. The number of 1SW spawners was low in the 1970s, increased through the 1980s but declined again in the 1990s (Figure 5.3.4). However, escapement in 2000 appears to have been good.

Numbers of non-maturing 1SW recruits (potential MSW returns) for Northern Europe are also estimated to have fluctuated around one million between 1970 and 1985, but subsequently fell to about half this level in the late 1990s; there has been a slight upturn in the past three years. The numbers of MSW spawners, however, show no trend over the time series although numbers appear to have been good in 2000 (Figure 5.3.3). It therefore, appears that the decline in recruitment has been balanced by the reductions in exploitation both in homewater fisheries and at Faroes. These trends in recruitment for the Northern European stocks are broadly consistent with the limited data available on the marine survival of monitored stocks in Norway and Iceland.

In the Southern European stock complex (Figure 5.3.5), the numbers of maturing 1SW recruits are estimated to have fallen substantially since the 1970s. Recruitment was at its lowest during the 1990s and there was a further drop in the estimated recruitment in 1999 with value in 1999 and 2000 being the lowest in the time series. This pattern is consistent with the data obtained from a number of monitored stocks. Survival of wild smolts to return as 1SW fish fell to very low levels on the four monitored rivers in the Southern European area. This suggests that the marked reduction in 1SW returns in 1999 is likely to have been due in large part to a widespread decline in marine survival. Reductions have also been observed in freshwater production and marine survival could be affected by factors operating in freshwater.

The PFA estimates suggest that the number of non-maturing 1SW recruits in Southern Europe has declined fairly steadily over the past 30 years (Figure 5.3.5); these stocks have also reached their lowest levels in the time series in 1999 and 2000. This is broadly consistent with the general pattern of decline in marine survival of 2SW returns in most monitored stocks in the area. In more recent years, reductions in exploitation do not appear to have kept pace with the stock declines and the spawning escapement has thus also fallen over the period (Figure 5.3.6).

Forecasting PFA for NEAC stocks: In order to use the PFA estimates to provide quantitative catch advice, a forecast will be required of PFA recruits in the year of the fisheries. This means that it will be necessary to forecast the PFA two years forward from the latest estimate. The model used to forecast PFA for North American stocks is based upon both environmental (thermal habitat in the North-West Atlantic) and biological (lagged spawners) parameters. ICES has considered similar approaches for the NEAC area, but there is as yet insufficient information to develop such a model and no new data were supplied in 2001. There is still limited information on the factors affecting the distribution and survival of salmon during the marine phase of the life-cycle. ICES considers that inclusion of environmental parameters in a model must be based upon justifiable hypotheses concerning the impacts on freshwater and/or marine survival.

Evaluation of effects of farmed salmon on the catch advice: NASCO has asked ICES to evaluate the potential biases in the catch advice resulting from the inclusion of farmed escapees in the assessment models. The NEAC PFA model has previously only taken account of the presence of farm escapees in the Faroese catches and has not taken any account of farm escapees in other areas. The incidence of farmed fish in catches at West Greenland and in most homewater fisheries has been estimated to be less than 1.5%. These fish will therefore have a minimal effect on the PFA and National Conservation Limit assessments.

However, substantial numbers of farm escapees occur in coastal, fjord and river fisheries in Norway. These fish have previously been included in the run-reconstruction model and therefore contributed to the back-calculated estimate of recruitment (PFA). The farm escapees have also been incorporated into the estimates of the numbers of spawners and thus contribute to the estimated egg-deposition. However, farm fish probably don't spawn as successfully as wild fish and their offspring may not be as viable as wild offspring; their contribution to the egg deposition was therefore reduced by a weighting factor in the model.

ICES therefore, modified the assessment models to take account of potential effect of farmed fish on the assessment. Over the past 10 years the average proportions of farmed fish in catches of 1SW and MSW salmon have been 8% and 14% respectively. Removing these fish from the PFA assessment results in the estimated recruitment of 1SW and MSW salmon being reduced by an average of 10% and 18% over this period. The average proportion of farmed fish on the spawning grounds has been 11% and 15% for 1SW and MSW salmon respectively. Taking account of these fish in the assessment, and assuming an arbitrary weighting factor (W) of 0.5, the effective spawning numbers (and hence egg deposition) for 1SW and MSW salmon were reduced by 2% and 4% respectively. The conservation limit estimated by the national lagged-egg deposition model in this scenario was also reduced by about 4%. There is considerable uncertainty about the spawning success of farmed escapees and this evaluation took no account of the possibility of farmed fish having an adverse effect on the spawning success of wild fish.

For the 2001 assessment, the Norwegian input data for the PFA model have been split into three regions. However, it was not possible to provide data on farm escapees for these regions and this potential error will need to be taken into account when considering the catch advice.

5.4 Development of Age-Specific Conservation limits

Conservation limits have been set for all salmon rivers in France and UK (England & Wales) although some of these are still provisional; progress has also been reported in developing conservation limits in other NEAC countries. In order to provide preliminary conservation limits for other countries, ICES has previously developed a lagged egg deposition model. This approach generates pseudo-stock-recruitment relationships, i.e. plots of lagged eggs (stock) against 1SW adults in the sea (recruits) for national stocks. ICES used a new, more objective method to determine the point where recruitment begins to decline (i.e the conservation limit) on these plots and these values have been summed for the appropriate stock groups. These conservation limits have then increased to take account of the natural mortality between recruitment and the time of return in order to provide Spawning Escapement Reserves (SERs) for maturing and non-maturing 1SW salmon from the Northern and Southern Europe. The SERs are shown as horizontal lines in Figures 5.3.3 and 5.3.5 The SERs are not shown on the total NEAC data (Figure 5.3.1) because evaluation of stocks against conservation limits is thought to be inappropriate at that level.

5.5 Catch Options or Alternative Management Advice

ICES has been asked to provide catch options or alternative management advice with an assessment of risks relative to the objective of exceeding stock conservation limits in the NEAC area. ICES reiterated its concerns about harvesting salmon in mixed stock fisheries, particularly for fisheries exploiting individual river stocks and sub-river populations that are at unsatisfactorily low levels. Annual adjustments in quotas or effort regulations based on changes in the mean status of the stocks is unlikely to provide adequate protection to the individual river stocks that are most heavily exploited by the fishery or are in the weakest condition.

ICES also emphasises that the national stock conservation limits discussed above are not appropriate for the management of homewater fisheries, particularly where these exploit separate river stocks. This is because of the relative imprecision of the national conservation limits and because this approach will not take account of differences in the status of different river stocks or sub-river populations. Nevertheless, ICES agreed that the combined conservation limits for the main stock groups (national stocks) exploited by the distant water fisheries could be used to provide general management advice for these fisheries.

In view of the uncertainties expressed about the most appropriate stock groupings and the preliminary nature of the conservation limit estimates, ICES is unable to provide quantitative catch options at this stage. In the absence of a predictive estimate of PFA and more reliable estimates of conservation limits, it is unlikely that quantitative catch advice will be developed in the near future. However, ICES feels that the following qualitative catch advice is appropriate based upon the PFA data and estimated SERs shown in Figures 5.3.3 and 5.3.5.

The Southern European stock complex is believed to include the main European stocks that have contributed fish to the West Greenland fishery; evidence from tagging studies suggests that the Nordic countries contribute relatively few fish to this fishery. It is therefore, appropriate that the European input to the advice on the West Greenland fishery should be based principally on the status of non-maturing 1SW from the Southern area.

Provision of catch advice for the Faroes fishery is more complex. Recent tagging studies at Faroes (1991/1992 – 1994/1995), suggest that the main country contributing to the MSW salmon to the fishery is Norway, with significant contributions also from Scotland and Russia. The 1SW salmon caught in the fishery come mainly from the Southern European countries. This therefore, means that the catch advice for both Northern and Southern European stocks must be taken into account when considering management actions for the Faroes fishery.

For all fisheries, ICES considers that management of single stock fisheries should be based upon local assessments of the status of stocks. Conservation would be best achieved by fisheries in estuaries and rivers targeting stocks which have been shown to be above biologically-based escapement requirements.

[NB In the evaluation of the status of stocks, PFA or recruitment values should be assessed against the spawner escapement reserve values while the spawner numbers should be compared with the conservation limits.]

Northern European 1SW stocks: The spawning escapement of 1SW salmon from the Northern European stock complex has been within but close to safe biological limits in recent years, although there is evidence of an upturn in the past few years. It should be noted that the inclusion of farmed fish in the Norwegian data will result in the exploitable surplus being overestimated. **ICES considers that overall exploitation of the stock complex at the current rate is acceptable, although the status of individual stocks varies considerably. Since very few of these salmon have been caught outside homewater fisheries in Europe, even when fisheries were operating in the Norwegian Sea, management of maturing 1SW salmon should be based upon local assessments of the status of river or sub-river stocks.**

Northern European MSW stocks: The PFA of non-maturing 1SW salmon from Northern Europe has been declining since the mid 1980s and the exploitable surplus has fallen from around 1 million recruits in the 1970s to about half this level in recent years. ICES considers the Northern European MSW stock complex to be within safe biological limits, although it is recognised that the status of individual stocks will vary considerably. In addition, the inclusion of farmed fish in the Norwegian data will result in the exploitable surplus being overestimated. **ICES therefore, considers that great caution should be exercised in the management of these stocks particularly in mixed stock fisheries and exploitation should not be permitted to increase.**

Southern European 1SW stocks: The spawning escapement for the whole stock complex has fallen below the conservation limit throughout the past 10 years. Moreover, recruitment of maturing 1SW salmon in the Southern European stock complex has been below any previously observed value throughout this period. In both 1999 and 2000 recruitment before exploitation was below the spawning escapement reserve. **ICES considers that reductions in exploitation rates are required for as many stocks as possible and that mixed stock fisheries present particular threats to conservation.**

Southern European MSW stocks: The PFA of non-maturing 1SW salmon from Southern Europe has been declining steadily since the 1970s and the spawning escapement for the whole stock complex has been close to or outside safe biological limits throughout much of this period. The upper 95 % confidence limit for PFA of spawners has been below the spawner escapement reserve for the past four years. Qualitative projection of these estimates suggests that the PFA is likely to remain below this reserve in 2001. **ICES considers that further reductions in exploitation rates are urgently required for as many stocks as possible and that mixed stock fisheries present particular threats to conservation.**

5.6 Data deficiencies and research needs in the NEAC Area

More research into the biology of salmon in the marine phase is required. This includes the need to monitor trends in marine mortality for a wider range of stocks than at present, and identify causes for mortality. It should also include the examination of relationships between postsmolt growth and marine mortality. The use of data storage tags will significantly improve the information on the marine life history of salmon.

Research on post-smolts in the early marine phase should be continued and expanded. This should include studies of interactions with parasites and assessments of the impact of sea lice on post-smolts.

A Study Group is required to quantitatively assess the level of bycatches of post-smolts in pelagic fisheries. It is recommended that such a group should comprise both those with information relating to postsmolt distribution and those who can provide information on the activity and distribution of pelagic fisheries.

A coordinated programme of tagging and release of farmed salmon should be undertaken to improve knowledge on the marine survival and migratory behaviour of these fish

If the commercial fishery at Faroes recommences, it is recommended that biological samples from the salmon caught should be collected. Historical samples from this fishery which have not yet been worked up should continue to be analysed.

6 ATLANTIC SALMON IN THE NORTH AMERICAN COMMISSION AREA

6.1 Events of the 2000 fisheries and status of stocks

6.1.1 Fisheries in the NAC area

Gear and effort: Salmon are managed collaboratively by the Department of Fisheries and Oceans in 23 Salmon Fishing Areas (SFA) and by the province of Québec in 11 fishing zones (Q1 to Q11) (Figure 6.1.1.1). Three user groups exploited salmon in 2000: Native peoples, residents fishing for food in Labrador, and recreational fishers. Effectively in 2000, there were no commercial fisheries for Atlantic salmon in eastern Canada. Restrictions on commercial fisheries introduced in Canada in 1992 and subsequently in 1998 remained in force. These included the closure of commercial fisheries in Newfoundland and Labrador and most of Québec. In addition, the commercial fisheries in zone Q9 were closed and licenses bought back in 2000. Commercial quotas normally fished by Native peoples in Ungava Bay (Zone Q11) remained closed. In the recreational fishery, large portions of New Brunswick and Nova Scotia were closed to salmon fishing and hook-and-release regulations for small salmon were extended to some rivers in Québec and Newfoundland. The retention of large salmon was permitted only in selected rivers of Québec and rivers of northern Labrador (SFA 1 and 2). Following river-specific in season reviews, retention of large salmon was prohibited on seven rivers in Québec. In USA there is no commercial fishery for salmon and angling (catch-and-release only) for sea-run salmon in 1999 was permitted only in the State of Maine. Commercial and recreational fishing using gillnets continued in Saint-Pierre et Miquelon (France) in 1999 and effort was similar to the average of the previous four years.

Catch: The provisional landings for Canada in 2000 were 150 t, similar to the 1999 harvest of 152 t (Table 4.1.1.1; Figure 6.1.1.2). The landings of small salmon in numbers (50 108) and large salmon (11 458) were similar to those in 1999. Recreational fisheries exploited the greatest number of small salmon in each province, accounting for 79% of the total small salmon harvests in eastern Canada. Food fisheries including the Native peoples and the Labrador resident fishery took the highest share of large salmon (60% by number). There was no commercial fishery in eastern Canada in 2000. Unreported catch for the NAC area was estimated at 124 t, down 7% from 1999.

In 2000, about 49 700 salmon (20 700 large and 29 000 small) were caught and released. This was similar to the number released in 1999. Most of the fish released were in New Brunswick (44%), followed by Newfoundland (43%), Québec (9%), Nova Scotia (3%), and Prince Edward Island (< 1%). Expressed as a proportion of the fish caught, that is, the sum of the retained and released fish, the highest percentage (84%) was released in Nova Scotia, followed by New Brunswick (57%), Newfoundland (56%), Prince Edward Island (49%), and Québec (31%).

In December of 1999, the State of Maine instituted a regulation closing all Maine rivers to Atlantic salmon fishing until further notice.

In Saint-Pierre et Miquelon (France) the harvest was 2.3 t, the same as in 1998 and 1999 and split equally among professional and recreational fishers.

Composition and origin of catch: No external tagged fish of USA origin were reported from Canadian fisheries in 2000. In Canada, returns to the majority of rivers in Québec, Newfoundland and Labrador are comprised exclusively of wild salmon. Hatchery-origin fish were most abundant in returns to rivers in the outer Bay of Fundy and along the Atlantic coast of Nova Scotia. Aquaculture escapees in 2000 were sampled in one New Brunswick River (Magaguadavic, SFA 23), one international boundary river (St. Croix) and two coast of Maine rivers.

Exploitation rates: Exploitation rates in the recreational fishery of Newfoundland for rivers with retention of small salmon ranged between 6% and 28% in 2000. Exploitation rates in two Labrador rivers were 2% to 9%. In the recreational fishery of Québec, exploitation rates were 18% for small salmon and 10% for large salmon.

6.1.2 Status of stocks in the NAC area

Returns, recruits and spawners: Estimated (mid-point) 1SW and 2SW returns, spawners, and spawner requirements are shown for five of six regions in North America in Figures 6.1.2.1 and 6.1.2.2. Labrador returns and thus total North American returns have been unavailable since 1998. Returns of 2SW fish in 2000 were similar to or lower than the values in 1999 and remain among the lowest of the series in most areas except Newfoundland. 1SW returns increased slightly over those of 1999 but declined in Newfoundland and USA. The rank of the estimated returns in 2000 within the 1971–2000 time series and the estimated total spawning escapement of 2SW salmon in each region expressed as a percentage of the spawning requirement for each region (except Labrador) follows. The closer the rank of 2000 returns is to 1, the better the relative performance of the stock.

	Rank of 2000 returns in 1971–2000 time series (1=highest)		Mid-point estimate of 2SW spawners as proportion of escapement requirement
Region	1SW	2SW	(%)
Newfoundland	12	2	224
Québec	13	28	67
Gulf (Mainland)	22	27	65
Scotia-Fundy	24	30	14
USA	19	30	2

No estimate for Labrador is provided because there were no data available to carry out the analysis.

In all regions except Newfoundland the returns of 2SW fish are near the bottom of the 30-year time series. However, Newfoundland comprises only a small proportion of total salmon production. Returns of 1SW salmon were at the midpoint of the time series in Newfoundland and Québec and below the mid-point an in the lower third to quarter for the other areas.

The North American run-reconstruction model was used to update the estimates of pre-fishery abundance of non-maturing and maturing 1SW salmon from 1971–2000. The projected numbers of potential 2SW spawners that could have returned to North America in the absence of fisheries can be computed from estimates of the pre-fishery abundance taking into consideration the 11 months of natural mortality at 1% per month. These values, termed "potential 2SW recruits", along with total North American 2SW returns and spawners (1971–1999) and requirements are shown in Figure 6.1.2.3, and indicate that the overall North American spawner requirement could not have been met since 1992 even in the absence of all fisheries.

The changes made to the calculations that determine pre-fishery abundance of non-maturing 1SW salmon for 1997 were continued for the determination of pre-fishery abundance in 1999 and 2000. They included the addition of a new parameter to define the fraction of the Lake Melville catches that are immature and, in the absence of a commercial fishery in Labrador, the development of a raising factor to estimate 2SW returns to Labrador from a series of Labrador recruit estimates and pre-fishery abundance data from 1971-1996. A raising factor was also developed to include Labrador returns in the maturing component of pre-fishery abundance by dividing pre-fishery abundance without Labrador into pre-fishery abundance with Labrador based on the time series of Labrador recruit estimates and pre-fishery abundance data from 1971–1997.

In 2000, a revised method for estimating returns and spawners to Newfoundland was presented. The 90% confidence interval ranges of unweighted exploitation rates in the recreational fishery and ratios of small:large salmon were generated from the assessment rivers with retention angling fisheries for the years 1995 to 1998. The large rivers were excluded from the analysis since they were treated separately. Population estimates from rivers with counting facilities were taken from the assessment information and their angling catches were excluded. Returns to rivers of the Bay St. George area (SFA 13) were treated separately. The dramatic changes to estimates of 1SW and 2SW salmon in 1995 and 1996 were due to the use of weighted versus unweighted averages for the large rivers where exploitation rates are lower than in smaller rivers. In 2000, the large rivers were treated separately and the river-specific exploitation rates or assessments were used.

The estimate of pre-fishery abundance of 94, 118 non-maturing 1SW salmon for 1999 is just 2% higher than in 1998 and the second lowest on record (Figure 6.1.2.4). The recent three years year are shown with hollow symbols to denote the use of a raising factor for Labrador. The results indicate a slight levelling off of the general decline from 807 000 fish in 1975. For maturing 1SW salmon, the estimate for 2000 of 404 724 fish was a 5% increase from 1999 but 5% less than in 1998 and the fourth lowest in the 30-year time series. The total Northwest Atlantic population of 1SW recruits (maturing and non-maturing) originating in North America in the Northwest Atlantic has varied but generally trended downwards since the 1970s, and the abundance recorded 1993–2000 was the lowest in the time series (Figure 6.1.2.5). During 1993 to 2000, the total population was varying at around one-half million fish, 45% of the average abundance 1972 to 1990. The decline has been common to both maturing and non-maturing portions of the cohort but non-maturing 1SW salmon have declined further.

The estimated 2SW returns (533) to USA rivers in 2000 represent less than 2% of the spawner requirements for all rivers. This was 54% below the 1999 estimate and the lowest in the time series.

Egg depositions: Egg depositions in 2000 exceeded or equalled the river specific conservation requirements in 37 of the 67 assessed rivers (55%) and were less than 50% of conservation requirements in 15 other rivers (Figure 6.1.2.6). Large deficiencies in egg depositions were noted in the Bay of Fundy and Atlantic coast of Nova Scotia where nine of the 12 rivers assessed had egg depositions which were less than 50% of conservation requirements. Proportionally fewer rivers in Gulf (7%) and Québec (0%) had egg depositions less than 50% of conservation. Only 66% of the Gulf rivers and 72% of the Québec rivers had egg depositions which equalled or exceeded conservation. In Newfoundland, 64% of the rivers assessed met or exceeded the conservation egg requirements and almost all the others (23%) had egg depositions which were less than 50% of requirement. The deficits occurred in the southwest rivers of Newfoundland (SFA 13) and in Labrador.

Smolt production: It is not possible to estimate how many smolts in total leave the rivers of Atlantic Canada for any given year. However, juvenile abundance indices were considered as surrogates of smolt production from eastern Canada. To allow for the combined analysis of smolt counts and juvenile abundance surveys from all the rivers, the individual river surveys were divided by the average within river abundance for the period 1995 to 1998.

The index of smolts from North America was obtained by weighting the annual river indices by the relative proportion of the conservation egg requirements of the SFA or Zone to the total conservation egg requirements of the zones under consideration. An alternative weighting incorporated the relative contribution to the 2SW spawner requirements of the six main areas within North America. This allows indices of smolt production from all areas of North America to be used but attributes weights to the area indices according to the expected contribution to 2SW abundance. The number of rivers with available data has increased from two in 1971 to 25 or more rivers since 1995. The proportion of the indexed areas represented by the index rivers has increased from 11% in 1971 to more than 25% since 1993.

The relative index weighted by the area-index proportions suggests relative smolt production at two levels, the first in the 1970s with smolt production being less than 1/3 of the production in the 1990s, through the 1980s smolt production was highly variable, but increased steadily to the levels observed in the 1990s.

The relative index for 2SW recruitment (excludes the Newfoundland areas which do not produce 2SW salmon or weights all areas according to the 2SW spawner requirements by area) suggests an overall similar trend. The index corresponds to the documented status of many other rivers. Smolt production from Newfoundland rivers has approximately doubled over the 1971 to 2000 time period. The Gulf smolt index is at its highest in the 1990s. The Québec smolt index has declined between 1983 and 2000. The relative index for Scotia-Fundy has essentially remained unchanged.

Marine Survival: Survival rates to 1SW and 2SW fish have been variable in recent years. In 1998-2000 there has generally been an increase in survival rates from the low values observed throughout eastern Canada in 1997. Return rates to most rivers of Newfoundland generally recovered in 1998-2000 above conservation limits although survival rates generally remain low. Considering that the historical survival rates (prior to 1992) represent survival to the river after commercial fisheries, for the rest of eastern Canada the recent survival rates and in particular the low rates in 1997 are dismal. Despite major reductions in marine exploitation, marine survival rates are still low and sea survival of the salmon populations has not increased as expected.

For USA, induced freshwater habitat constraints are substantial in some areas and productive capacity has been reduced. Causes include physical, chemical and biological induced constraints. Documented losses include hydropower development, acidification, and siltation. Suspected losses include interactions caused by the introduction of competitive or predator species, chemicals that disrupt endocrine development and localised effects associated with aquaculture. Mitigation of these losses has, for the most part, been insufficient. Stock rebuilding programmes have generally been unsuccessful, USA salmon stocks exhibit the same downward trend that has been shown for many Canadian salmon stocks, especially those located in the Bay of Fundy and along the Atlantic coast of Nova Scotia.

6.2 Effects on US and Canadian stocks and fisheries of the quota management and closure after 1991 in Canadian commercial salmon fisheries, with special emphasis on the Newfoundland stocks

ICES previously considered the impact of the closure of the Newfoundland commercial fishery in 1992 on the Newfoundland stocks. Within Newfoundland, the commercial fishery closure has resulted in increased escapements of both small and large salmon to many rivers, higher catches of large salmon (which were subsequently released) in the recreational fishery, and increased spawning escapements of both size groups. These increased spawning escapements have not, however, always resulted in increased smolt production. Some areas of Newfoundland, particularly the south coast, did not see increases in escapement as was expected from the closure of the commercial fishery. The expected benefits to the spawning escapements were not realised. However, in the absence of the fishery closures and other management measures the spawning escapement would have been even lower at current low marine survival.

6.3 Age-specific stock conservation requirements

There are no changes recommended in the 2SW spawner requirements from those presented in 2000. Spawner requirements for 2SW salmon for Canada now total 123, 349 and for the USA, 29 199 for a combined total of 152 548.

6.4 Catch options or alternative management advice with an assessment of risks

It is possible to provide catch advice for the North American Commission area for two years. The first is a revised estimate for 2001 for 2SW maturing fish based on revised estimates of the 2000 pre-fishery abundance and accounting for fish which were already removed from the cohort by fisheries in Greenland and Labrador in 2000. The second is an estimate for 2002 based on the pre-fishery abundance forecast for 2001. A consequence of these annual revisions is that the catch options for 2SW equivalents in North America may change compared to the options developed the year before.

6.4.1 Catch option for 2001 fisheries on 2SW maturing salmon

A revised forecast of the pre-fishery abundance for 2000 is provided in Table 6.4.1.1. This value of 225 708 is higher than the value forecast last year at this time of 179 897. A pre-fishery abundance of 225 708 in 2000 can be expressed as 2SW equivalents by considering natural mortality of 1% per month for 10 months resulting in 204 229 2SW salmon equivalents. There have already been harvests of this cohort as 1SW non-maturing salmon in 2000 for both the Labrador (421) and Greenland (5 041) fisheries (Tables 6.4.1.2 and 6.4.1.3) for a total of 5 462 2SW salmon equivalents already harvested, when the mortality factor is considered.

Table 6.4.1.1 uses the probability density projections for the revised pre-fishery abundance estimate of 225 708 (at 50% probability) and subtracts the spawning reserve (170 286) and the harvests in Greenland and Labrador of 1SW non-maturing fish in 2000, and converts the remainder to 2SW salmon equivalents. Catch options values = [PFA_i - spawning reserve - harvest in Greenland and Labrador in 2000 of 1SW non-maturing fish] * exp[-(0.01 *10 months)] where PFA_i = values from 25–75% and spawning reserve = 170 286.

Results indicate that there are harvest possibilities at forecasted levels which would be considered risk-neutral or risk-averse, that is, at probability levels of 50% and below. It should be clear from the above that the numbers provided for catch options refer to the composite North American fisheries. As the biological objective is to have all rivers reaching their conservation requirements, it is obvious that river-by-river management is necessary. On individual rivers, where spawning escapement requirements are being achieved, river catches corresponding to surplus escapement can proceed.

Regional assessments in some areas of eastern North America provide a more detailed consideration of expectations for 2001, taking into consideration the contribution of all sea ages of salmon to the spawning population and relationships between 1SW and 2SW retruns of the smolt cohort. Data for 20 rivers in Québec, six rivers of the Gulf, and three rivers of the Scotia-Fundy geographic area for the period 1991-1992 to 1999-2000, during which most commercial salmon fisheries were closed, indicate that there are no expectations for significant increases in large salmon in 2001. The evidence for each of the three geographic areas suggests that the PFA forecast of approximately 225 000 non-maturing fish in Greenland in 2000, i.e., triple the PFA value for the previous year and double the average PFA values of the previous 5 years, is highly unlikely.

Additionally, by area, expectations for 2001 are. By area, these are:

<u>Labrador:</u> salmon returns in the year 2001 will be from a higher number of spawners than in recent years but the lack of long-term monitoring facilities makes it difficult to describe stock status or provide current expectations.

<u>Newfoundland:</u> number of spawners has been relatively high in recent years, however, smolt output from most monitored rivers has declined in each of the past three years. In the absence of any improvement in marine survival rates, returns of small salmon in 2001 could be lower.

<u>Québec:</u> Returns of large salmon are expected to be adequate for the attainment of conservation requirements in 43 of the 44 salmon rivers in northern part of Québec; one river will remain closed. On the 74 salmon rivers in southern part of Québec, nine rivers remained closed to fishing and returns of large salmon are expected to be insufficient for attainment of conservation requirement on 34 rivers. Consequently, only the retention of small salmon will be permitted on those rivers.

<u>Gulf:</u> In SFA 15, returns in 2001 should approximate conservation requirements as they have in the last 5 years. Current levels of harvest have not been limiting the attainment of stock conservation. In SFA 16, neither large salmon nor eggs from small and large fish are expected to meet the conservation requirements in most rivers. In SFA 18, expectations are mixed with over half the rivers expected to meet conservation.

<u>Scotia-Fundy:</u> In SFAs 19-23, salmon returns (both large and small) in 2000 are not expected, with few

exceptions, to be sufficient to meet conservation requirements, including those receiving hatchery stocking.

USA: Salmon returns (both large and small) in 2000 are not expected to be sufficient to meet conservation requirements in any river, including those receiving hatchery stocking.

6.4.2 Catch option for 2002 fisheries on 2SW maturing salmon

Most catches (93%) in North America now take place in rivers or in estuaries. The commercial fisheries are now closed and the remaining coastal food fisheries in Labrador are mainly located close to river mouths and likely harvest few salmon from other than local rivers. Fisheries are principally managed on a river-by-river basis and in areas where retention of large salmon is allowed, it is closely controlled.

Catch options which could be derived from the pre-fishery abundance forecast for 2001 (295 678 at the 50% probability level) would apply principally to North American fisheries in 2002 and hence the level of fisheries in 2001 need to be accounted for before providing these catch options. Assuming probability values between 25 and 75%, accounting for mortality and the spawning requirement and considering an allocation of 60% of the surplus to North America, would yield catch options in 2SW salmon equivalents of 77 000 to 138 000 fish. The numbers provided for catch options refer to the composite North American fisheries. As the biological objective is to have all rivers reaching their conservation requirements, river-by-river management will be necessary. On individual rivers, where spawning requirements are being achieved, there are no biological reasons to restrict the harvest.

6.4.3 Data deficiencies, monitoring needs and research requirements

Some progress was made on research needs identified last year. The Working Group reiterates many of last year's recommendations and suggests some further ones.

Estimates of total returns to Labrador no longer exist. There is a critical need to develop alternate methods to derive estimates of salmon returns and develop habitat-based spawner requirements in Labrador, and to monitor salmon returns in the Ungava regions of Québec.

There is a need to investigate changes in the biological characteristics (mean weight, sex ratio, sea-age composition) of returns to rivers, spawning stocks of Canadian and US rivers, and the harvest in food fisheries in Labrador. These data and new information on measures of habitat and stock recruitment are necessary to re-evaluate existing estimates of spawner requirements in Canada and USA and for use in the run reconstruction model.

There is a requirement for additional smolt-to-adult survival rates for wild salmon. As well, sea survival rates of wild salmon from rivers stocked with hatchery smolts should be examined to determine if hatchery return rates can be used as an index of sea survival of wild salmon elsewhere.

Further basic research is needed on the spatial and temporal distribution of salmon and their predators at sea to assist in explaining variability in survival rates.

Return estimates for the few rivers (Annapolis, Cornwallis and Gaspareau) in SFA 22 that do contribute to distant fisheries should be developed and, when these are available, the SFA 22 spawning requirements for these rivers (476 fish) be included in the total.

A consistent approach to estimating returns is needed, to incorporate broodstock, if offspring from such broodstock are stocked back into the management area from which their parents originated.

Accounting for escaped-farmed salmon from North America indicates a high but undocumented mortality. Scale analysis of salmon captured at West Greenland indicated an infrequent appearance of escaped-farmed salmon. In order to substantiate this conclusion farmed-salmon need to be included in background genetic analysis and the data re-examined for the presence of escaped-farmed salmon of North American origin.

7 ATLANTIC SALMON IN THE WEST GREENLAND COMMISSION AREA

7.1 Events in the 2000 fisheries and status of stocks

7.1.1 Fishery in the WGC area

Catch: In 1999, the West Greenland Commission of NASCO agreed on a multi-year approach for conservation of the salmon stocks occurring in Greenland, and therefore for 1999 and 2000 the catch at West Greenland in each of the years should be restricted to that amount used for subsistence in Greenland, which in the past has been estimated at 20 t. The Greenland authorities subsequently set the TAC for 2000 at 20 t. The fishery began on August 14 and was closed August 18 as the reported catch rapidly approached the allowed amount. The nominal catch totalled 20.5 t. In 2000, a private company was given permission to purchase salmon from the fishermen for distribution in Greenland. Most of the landings were sold through this arrangement, and only very few salmon were landed to the open markets. Despite the very short season and a considerably increased efficiency of the control system a relatively large part of the total fishery is still considered to remain unreported. The unreported catch in 2000 is estimated to be approximately 10 t.

Gear and effort: No new information was available on fishing gear and effort. However, only 45 licensed fishermen (out of 179 issued licences) reported having fished in 2000. In total, 46 licensed and non-licensed fishermen (food fishermen) reported catches.

Origin of catches: North American salmon stocks have been found to be distinct from European stocks using mitochondrial and nuclear DNA (microsatellites), and analytical methods are provided to distinguish continent of origin with 100 % accuracy. Based on this method samples obtained from catches in NAFO Division 1D (250 samples) and NAFO Division 1F (240 samples) could be classified to continent of origin. Applying the results of the above analysis to the reported catch indicated that 12.6 t (5 100 salmon) of North American origin and 7.6 t (2 700 salmon) of European origin were landed in West Greenland in 2000.

The numbers of North American salmon landed annually at West Greenland were greatly reduced during the period 1996-1999, but remained unchanged from 1999 to 2000. The number of landed salmon of European origin was similarly reduced from 1995 to 1999, but increased again in 2000 due to a high proportion of European salmon in the southern division.

Biological characteristics of the catch: Biological samples (scales, length, weight) were collected from the salmon landed in NAFO Divisions 1D and 1F (250 and 241 samples, respectively).

Analysis of the samples showed no significant changes in the very high proportion of one-sea-winter fish of North American and European origins during recent years. In 2000, the two components comprised 97.4 % and 100.0 %, respectively, of the catch samples, and they were among the highest proportions of a 14-year data set. No two-sea-winter maiden fish were observed in the samples, but in the North American component 2.6 % were previous spawners.

The downward trend in mean length of both North American and European 1SW fish since 1969 changed in 1996, as mean lengths increased. Mean lengths for both components showed an increasing trend during 1996-1999, whereas in 2000 the mean lengths decreased again and were among the lowest observed in the time series. Mean weights of both components decreased correspondingly from 1999 to 2000. The low values for both mean lengths and mean weights observed in 2000 could be related to the relatively early fishing season, in which period the weight increase is known to be 2-3 % per week.

Percentage river ages among fish sampled at West Greenland in 2000 were:

River age	1	2	3	4	5	6+
N American	3.2	26.6	38.6	23.4	7.6	0.0
European	36.4	46.7	13.1	2.9	0.7	0.0

The proportion of river age 2 salmon of North American origin was in 1999 and 2000 somewhat lower than in 1998, which was close to the overall mean value of 34.8%. The proportion of river age 1 salmon of European origin reached the highest values on record in the three most recent years (28.6, 27.7 and 36.5%, respectively). A high proportion of this group is reflecting a high contribution from the more southern European stocks.

7.1.2 Status of stocks in the WGC area

Salmon caught in the West Greenland fishery are non-maturing 1SW salmon or older, nearly all of which would return to homewaters in Europe or North America as MSW fish if they survived. In most years non-maturing 1SW salmon make up more than 90% of the catch there are also 2SW salmon and repeat spawners. The most abundant European stocks in West Greenland are thought to originate from the UK and Ireland although low numbers may originate from northern European rivers. For North American MSW salmon, the most abundant stocks in West Greenland are thought to originate in the southern area of the range.

Stocks originating in the Northeast Atlantic: Run-reconstruction estimates of pre-fishery abundance of non-maturing 1SW salmon from southern areas (Figure 5.3.5b) have been volatile over the period 1971–1999, but in steady decline over the past 14 years. In 1996-1999, it was estimated that even in the absence of all fisheries, the numbers of non-maturing recruits from the southern area were below the proposed spawning equivalent reserve. Non-maturing 1SW salmon from northern stocks (Figure 5.3.3b) have declined since 1985, particularly in 1986-1987. The recovery of the stocks that was suggested in 1998 did not seem to continue in 1999 and 2000.

In most cases, adult salmon counts in index rivers within the NEAC area increased from 1997 to 2000. However, over the last ten years, adult returns have been declining or showed no trend. Analysis of attainment of conservation limits (CL) indicated variable status of salmon stocks in different rivers of the NEAC area. Although homewater management measures have gone some way to reducing homewater exploitation rates, some rivers have never or seldom reached their CL over the last 10 years, whereas others have been consistently above their CL. Many rivers that have reached their CL in most years show a decreasing trend in escapement, however, and no tendency to recover was observed for rivers with low escapement values.

Stocks originating in North America: The run-reconstruction estimate of pre-fishery abundance of non-maturing 1SW salmon for 1999 was 94 118 fish, 2 % higher than that of 1998, this estimate being the second lowest in the 30-year time series (Figure 6.1.2.4).

Total returns of 2SW fish to Labrador and thus Canada could not be estimated since 1998. However, with the exception of insular Newfoundland where 2SW salmon are only a small proportion of the total salmon production, returns to the important Gulf, Québec and Scotia-Fundy production areas were either the lowest or second lowest of the 30-year time series, 1971–2000 (Figure 6.1.2.3). The estimated 2SW returns and spawners to USA rivers were in 2000 66 % and 73 % below the previous 5-and 10-year averages, respectively. Returns to most USA rivers are hatchery-dependent. Spawning escapements remained low compared to conservation requirements.

Egg depositions exceeded or equalled the specific conservation requirements in only 23 of the 54 rivers (43 %) that were assessed in Canada and were less than 50% of requirements in 18 other rivers (33%). Large deficiencies in egg depositions were noted in the Bay of Fundy and Atlantic coast of Nova Scotia where 10 of the 11 rivers assessed had egg depositions that were less than 50% of requirements (Figure 6.1.2.6).

North American salmon stocks remain low relative to the 1970s. The steady decline over the last twelve years is alarming (Figure 6.1.2.4). The 1SW non-maturing component continues to be depressed with river returns and total production amongst the lowest recorded. In addition, returns in 2000 of maturing 1SW salmon (grilse) to North American rivers were very low. This being the case, improvement in 2SW salmon returns and spawners is unlikely in 2001.

Thus, despite some improvements in 2SW returns to some rivers in European and North American areas, the overall status of stocks contributing to the West Greenland fishery is low compared to earlier.

7.1.3 Changes in the continent of origin of salmon captured at West Greenland including changes in migration patterns

The Working Group noted the considerable increase in proportion of North American origin salmon in the fishery at West Greenland in recent years. The proportion of North American origin salmon has changed dramatically over the period of observation, 1969-1999, from below 40 % to a record high level of 90 % in 1999. The proportion of North American origin salmon declined in 2000 fishery samples; however, this may have been due to the early opening and short duration of the fishery. Thus, the catch samples while being descriptive of the fishery may not be a good representation of the salmon population at Greenland. The biological explanation(s) for these changes in North American and European salmon will continue to elude us due to incomplete knowledge of migration of the various components contributing to the West Greenland fishery and more importantly the relative contributions of various stock groupings. Previous tagging studies including tagging at West Greenland had shown that the southern European stock group contributed more heavily to Greenland than did the northern group. Within North America, it has been shown that stocks in the Gulf of St. Lawrence contributed more heavily than others to Greenland. The DNA analysis in 2000 showed that annual variations in proportional contributions do occur. Exploratory work into more detailed discrimination of origin of salmon captured at West Greenland will lead to a greater understanding of the mixed stock fishery.

To learn more about the reasons behind the increasing North American proportion in Greenland a new variable was created by summing the pre-fishery abundances of North American and European non-maturing Atlantic salmon. Examination of the trends in North American proportion at Greenland and in the total pre-fishery abundance of North American plus southern European salmon indicates that the latter is actually declining ($r=-0.69$, $P<0.0001$) at the same time that the North American proportion at Greenland is increasing ($r=0.87$, $P<0.0001$) (Figure 7.1.3.1). This can only occur if the proportion of southern European salmon migrating to Greenland is declining or if the proportion of North American salmon migrating to Greenland is increasing ($r=-0.52$, $P<0.004$). However, given current trends the former is more likely the case.

7.2 Effects on European and North American stocks of the West Greenland management measures since 1993

There have been three significant changes in the management regime at West Greenland since 1993. First, NASCO adopted a new quota allocation model to derive TACs based upon ICES assessment of the PFA of non-maturing 1SW North American salmon and the spawner requirements for these stocks. This resulted in a substantial reduction in the TAC in 1993 from that of 1992, and further reductions in subsequent years. The second change in management was the suspension of fishing in 1993 and 1994 for compensation payments. The third change in management was a multi-year agreement in 1999 restricting the allowable catches to 20 tons, solely for local consumption in Greenland.

The estimated numbers of salmon returning to home waters in the absence of a fishery, 1993–1994, or had the fishery in 1995–1999, not taken place are:

Year	Quota T	Grnl TAC	Catch t	EU Fish	NA Fish
1993	89	89	0	12402	15052
1994	137	137	0	19091	23171
1995	77	77	83	8459	20177
1996	174	0	92	7239	20262
1997	57	0	58	3702	15598
1998	20	0	11	729	2740
1999	20	0	19	549	4847
2000	20	0	21	1844	4263

Estimation of TACs for 1993 and 1994 was based on the NASCO model, biological parameters (mean weights, proportions of NA fish, and age correction factors etc.) were assumed to be the mean of the 1992 and 1995 values. For the remaining years, estimates of fish that would have returned to home waters had there not been a fishery were based on same year biological characteristics and a natural mortality between Greenland and home waters of 0.10. The mean number of potential returns per ton caught at Greenland is 208 and 106 North American and European salmon, respectively.

In the years 1972–1992, exploitation rates in Greenland of the North American component of the salmon stock averaged about 30% but varied between 10 and 45%. The management measures in force in 1995-1997 resulted in an average exploitation rate of 13%, while the arrangements since 1998 reduced the exploitation rate to about 5 %.

ICES notes that these calculations assume that natural mortality of salmon at sea has remained unchanged. As highlighted in several places in this document, marine survival has declined markedly, particularly for salmon of North American origin. Methods are being explored for including a downward trend in survivorship in this and various other calculations.

7.3 Age-specific stock conservation limits for all stocks occurring in the WGC area

Sampling of the fishery at West Greenland since 1985 has shown that both European and North American stocks harvested there are primarily (greater than 90%) 1SW non-maturing salmon that would mature as either 2 or 3 SW salmon, if surviving to spawn. Usually less than 1% of the harvest are salmon which have previously spawned and a few percent are 2SW salmon which would mature as 3SW or older salmon, if surviving to spawn. For example, in 1999, 96.8 of the sampled catch of North American origin and 100% of the sampled catch of European origin were 1SW salmon. For this reason, conservation limits defined previously for North American stocks have been limited to this cohort (2SW salmon on their return to homewaters) that may have been at Greenland as 1SW non-maturing fish. The total requirement is 152 548 fish, with 123 349 and 29 199 prescribed for Canadian and USA rivers, respectively; the reserve spawner requirement (includes 10 months of mortality at 1%) is 170 286 fish.

In 2000, revised estimates of provisional conservation limits for MSW salmon in Europe were presented based on the methods developed in 1999. The conservation limits were split into 1SW and MSW components on the basis of the average age composition of catches in the past ten years. The stocks have also been partitioned into northern and southern groups, and tagging information and biological sampling indicates that the majority of the European salmon caught at West Greenland originate from the southern group. The provisional conservation limit for southern European MSW stocks is approximately 595 000 fish. There is still considerable uncertainty in the conservation limits for European stocks. The above value has been increased from 530 000 in the 2000 report. To date, the conservation limits for MSW salmon in Europe have not been incorporated into the modeling of catch options for West Greenland.

7.4 Catch options or alternative management advice with an assessment of risks

7.4.1 Overview of provision of catch advice

Concerns of the implications of applying TACs to mixed stock fisheries are relevant to the formulation of catch advice. In principle, adjustments in catches in mixed-stock fisheries provided by means of an annually adjusted TAC would reduce mean mortality on the contributing populations. However, there is no assurance that reductions in exploitation will affect those stocks that are not meeting conservation requirements, and benefits that might result for individual stocks would be difficult to demonstrate.

The procedures to develop catch advice, an evaluation of the models, and vulnerabilities in the existing procedures were presented in the 1997 and 1999 assessments. The processes remain unchanged in 2000 although some of the input data were modified to reflect new information (Section 7.5). Models based on thermal habitat in the northwest Atlantic and spawning stock indices are used to forecast pre-fishery abundance and provide catch advice for the West Greenland fishery. While the approach has been consistent since 1993, the models themselves have varied slightly over the years. The changes have been made to these models in attempts to improve the prediction and add more biological reality. In particular, the models since 1996 have used a spawning stock surrogate variable (lagged spawners) in an attempt to describe the variations in parental stock size of the non-maturing 1SW component (PFA).

North American run-reconstruction model: The model is used to estimate pre-fishery abundance of 1SW non-maturing and maturing 2SW fish adjusted by natural mortality to the time prior to the West Greenland fishery. Region-specific estimates of 2SW returns are shown in Figure 6.1.2.2. Estimates of 2SW returns prior to 1998 in Labrador are derived from estimated 2SW catches in the fishery using a range of assumptions regarding exploitation rates and origin of the catch. With the closure of the Labrador fishery, returns for Labrador were unknown in 1998 to 2000 and values for Labrador were estimated from a raising factor developed by dividing pre-fishery abundance without Labrador into pre-fishery abundance with Labrador based on the time series of Labrador recruit estimates and pre-fishery abundance data from 1971–1996.

Update of thermal habitat: A thermal habitat index has been updated to include data from year 2000 and January and February 2001 year data. Two periods of decline in the index are evident (1980 to 1984 and 1988 to 1995) (Table 7.4.1.1 and Figure 7.4.1.1). The habitat index for February increased slightly (3%) in 2001 from 1 634 to 1 685. Both values are close to the long-term mean of 1 653.

Update of lagged spawners: The lagged spawner variable used in the model is an estimate of the 2SW parental stock of the PFA. Previous analyses indicated that the sum of lagged spawner components from Labrador, Newfoundland, Québec, and Scotia-Fundy and excluding Gulf and U.S. was the strongest explanatory variable for the model. Inclusion of the Gulf spawning component reduced the explanatory power of the variable. The estimation procedure remained unchanged in 2000. Spawning escapement estimates for Labrador are not available for the years 1998-2000. The previously formulated lagged spawner variable will therefore not be available beyond 2002.

7.4.2 Forecast model for pre-fishery abundance of North American 2SW salmon

The model used to forecast pre-fishery abundance for 2001 was revised (Section 7.5) and results presented in Section 7.4.3 are based on this revised model. The basis for the revised model is the same two predictor variables as were used from 1999 to 2000: thermal habitat for February (term H2) and lagged spawners (sum of lagged spawners from Labrador, Newfoundland, Scotia-Fundy and Quebec, term SLNQ). The 2001 forecast of pre-fishery abundance was based on an alternative modelling approach that takes into consideration that habitat acts on PFA through survival rather than on absolute abundance. The reasons for adopting this model are given in Section 7.5.

There was a significant linear relationship between the PFA values and predicted values (log transformed model; $r^2 = 0.88$). The model continues to be influenced primarily by the spawning stock level in the predictive relationship for pre-fishery abundance. The habitat index accounted for about 10% of the total variance and SLNQ accounted for about 80%. The predicted values fit the observed data quite well except in the late 1980s and 1990s when abundance was low (Figure 7.4.2.1).

The forecasted estimate simulated by the PFA model of pre-fishery abundance for 2001 using the February thermal habitat and lagged spawner model is about 295 700 at the 50% probability level (Table 7.4.1.1). The lagged spawner variable (SLNQ) improved in the year 2001 primarily because of increases in Labrador since the mid-1990s and this is contributing substantially to the predicted increase in pre-fishery abundance.

Due to the time lag between forecasted and estimated pre-fishery abundance, the model predicts abundance two years in advance. Consequently, any developing trend in high positive or negative residuals indicating a poor fit to recent data will be hard to detect until after the fishery.

Using this model to estimate the 2000 pre-fishery abundance yields a value of 225 700, which is about 25% higher than the previously reported value of 179 900. Note that the previously reported value was based on the additive model without errors in the lagged spawners (Section 4.5). The inclusion of errors in the lagged spawners has been shown to increase the median value and to widen the distribution of the forecast. The relationship between the available 2SW to 1SW data from several rivers in Eastern Canada previously shown, indicated that the 2000 forecast of pre-fishery abundances, i.e., returns of 2SW salmon to North America in 2001, is unlikely to be achieved. Consequently, there is considerable uncertainty regarding the projected reversal of the declining trend in pre-fishery abundance forecasted by the model.

7.4.3 Development of catch options for 2001

The spawning requirement for all North American rivers is currently set at 152 548 2SW-fish which is the equivalent of 170 286 pre-fishery recruits (spawning reserve) prior to natural mortality between Greenland and home waters. The procedure for estimating the quota for West Greenland is summarised in Appendix 2.

Quota computation for the 2001 fishery requires an estimate of pre-fishery abundance, stock composition by continent [PropNA], mean weights of North American and European 1SW salmon [WT1SWNA and WT1SWE, respectively], and a correction factor for the expected sea-age composition of the total landings [ACF]. Exponentially smoothed values utilising data collected during the 1995-1999 fisheries are summarised below.

Parameter	Value
PropNA	0.779
WT1SWNA	2.954
WT1SWE	2.990
ACF	1.049

Greenland quota options are presented for the 25% and 75% cumulative probability levels of PFA (Table 7.4.3.1). Between the 25% and 75% probability level and at the f_{NA} (proportion of the harvest allocated to Greenland) of 0.4 quota options range from 28 to 467 t with a median value of 200 t.

Growth of salmon through the fishing season can significantly affect the total number of fish harvested under a fixed quota. A sensitivity analysis was conducted to evaluate the effect of salmon growth in August and September on the total number of fish harvested under a theoretical 200 t quota (Figure 7.4.3.1). This analysis shows that the number of fish harvested under a fixed quota declines significantly as the median date of the fishery is delayed through August and September.

7.4.4 Risk assessment of catch options

The provision of catch advice in a risk framework involves the incorporation of the uncertainty in all the factors used to develop the catch options. The method is described in more detail in Section 4.2. Annual variations in uncertainty result in differing assessments and differing levels of precision. The risk analysis plots are calculated for consideration of the 2001 fishery in West Greenland.

The pre-fishery abundance of salmon in 2001 is predicted to be moderate relative to historic levels (Table 7.4.1.1). The risk analysis results suggest a moderate risk that the returns of 2SW salmon to North America in 2002 will be below the conservation requirement, even in the absence of any fisheries on this age group in Greenland in 2001 (Figure 7.4.4.1).

The risk analysis performed considers the most optimistic scenario of equal production rates in all six stock areas of North America. The reality is that the stock status differs greatly within North America and that the expected returns of salmon to the USA and Scotia Fundy areas will be severely below their respective conservation requirements. In the USA, the escapement for the entire area has never been above 3000 spawners since 1992, no better than 10% of the requirement. Similarly, the Scotia-Fundy area lagged spawners have been less than 10 000 fish over the last ten years. If all stocks were at their spawner requirements, the U.S.A. stocks would be expected to produce almost 20% of the 2SW production from North America while the Scotia-Fundy stock is expected to produce just over 16% of the total. Under the current levels of spawning escapement, recruitment to USA rivers is not expected to be more than 2% of the total PFA, and Scotia-Fundy no better than 10% of the present PFA (Figure 7.4.4.2). The majority of the non-maturing 1SW salmon in the Northwest Atlantic in 2001 are expected to return principally to the other areas, Quebec, Gulf, Labrador and Newfoundland. With this consideration, the risk analysis applies more appropriately to these four areas while the probability of the Scotia-Fundy area meeting its conservation requirement is very near zero and is zero for the USA stocks.

There is little information available to confirm the possibility of an improvement in pre-fishery abundance in 2000 and 2001 as forecasted through modelling. Two sea winter adult returns in 2001 will provide initial indications regarding the overall abundance of non-maturing 1SW salmon in 2000. Associations between 1SW returns in year i and 2SW returns in year i+1 observed in several rivers in eastern Canada suggest that abundance of 2SW salmon in 2001 in eastern Canada will be similar to or less than recent years. Smolt production in 1999 and 2000 in monitored rivers of eastern Canada were similar to or below the average of the last five years. The adoption of risk neutral quota options on the basis of predicted sharp increases in pre-fishery abundance in 2000 and 2001 provides the potential for significant overexploitation if increases in pre-fishery abundance are not realized. Extreme caution is urged regarding harvest decisions for 2001, and adoption of conservative harvest levels is warranted until projected increases can be confirmed. The increasing advantage associated with each additional spawner in under-seeded river systems makes a strong case for a conservative management strategy.

The North American stock complex of non-maturing salmon remains in tenuous condition. Increased spawning escapements to rivers of some areas of eastern North America resulted in improved abundance of the juvenile life stages, and perhaps now at adult life stages. Despite the closure of Canadian and West Greenland commercial fisheries, sea survival of adults returning to rivers has not improved and in some areas has declined further. The abundance of maturing 1SW salmon has also declined in many areas of eastern North America. Until sea survivals improve, the abundance of non-maturing 1SW salmon in the Northwest Atlantic is not expected to improve above the levels of the last five years.

7.5 Changes to the model used to provide catch advice

The models used to predict pre-fishery abundance of the North American non-maturing stock complex and subsequent quota levels for West Greenland were revised based on exploratory work conducted by the Working Group and reported in the 1999 and 2000 reports. For the past several years, models used to predict the PFA were additive and hypothesized a linear effect of SLNQ and habitat on salmon abundance. An alternative approach, adopted in the 2001 assessment takes into consideration that habitat acts on PFA by mediating survival rather than on absolute abundance. The basis for these multiplicative models is the same two predictor variables (H2 and SLNQ) used in previous assessments. In addition, the uncertainty in the lagged spawner and PFA variables were incorporated in the model simulations. The distribution of the multiplicative models is skewed to the origin and long tailed towards large values. The predicted abundance is always greater than 0, contrary to what is given by the additive model. There is a greater cumulative probability for lower PFA levels (Figure 7.5.1) with the multiplicative model but the distribution suggests that there is insufficient information in the data to fix an upper bound on the PFA. Adoption of the multiplicative model resolves issues related to the biological logic of the model and the prediction of unreasonable PFA values, less than 0, generated by the additive model in previous assessments. The primary changes in performance of the multiplicative model adopted for 2001 relate to changes in pre-fishery abundance forecasts and characterization of uncertainty about these forecasts.

7.6 Catch advice

Although a large proportion of the examined North American stocks meet conservation targets (Figure 6.1.2.6) many are failing to meet targets or are only barely doing so. Despite complete closures of mixed and single stock fisheries the very small surplus over spawning requirements and the uncertainty in the estimates make a strong case for even more conservative management measures.

ICES considers this stock complex to be outside safe biological limits and recommends that there should be no exploitation of the 2000 smolt cohort as non-maturing 1SW fish in North America or at Greenland in 2001, and also recommends that the cohort should not be exploited as mature 2SW fish in North America in 2002. Exceptions are in-river harvests from stocks, which can be shown to be above biologically-based spawning escapement requirements. Further, exploitation rate on this cohort should be minimised in the North American Commission and in the West Greenland Commission Areas by controlling by-catch in other fisheries. It should also be noted that the assessment of stocks in Southern Europe which are also exploited at West Greenland has shown that these stocks are also below their conservation limits and this further supports the advice for no fishery at West Greenland.

Data deficiencies, monitoring needs and research requirements in the WGC area

1. Continued efforts should be made to improve the estimates of the annual catches of salmon taken for local consumption in Greenland.
2. The mean weights, sea and freshwater ages and continent of origin are essential parameters to provide catch advice for the West Greenland fishery. As these parameters are known to vary over time, the Working Group recommends that the sampling programme be continued and closely coordinated with fishery harvest plan to be executed annually in West Greenland.
3. The catch options for the West Greenland fishery are based almost entirely upon data taken from North American stocks (with the current exclusion of Labrador, see Section 7.6). In view of the evidence of a long-term decline in the European stock components contributing to this fishery (southern European non-maturing 1SW recruits) the Working Group emphasised the need for information from these stocks to be incorporated into the assessments as soon as possible.
4. Alternative models should be explored (for example different predictive variables, model formulations, univariate time series, non-parametric change-of-state analyses) to provide some index of plausibility of the quantitative forecasts.
5. Further basic research is needed on the spatial/temporal distribution and migration patterns of salmon and their predators at sea to assist in explaining variability in survival rates.
6. Samples should be obtained for DNA analysis from rivers in North America and Europe.

The status of the six stock areas should be incorporated into the analysis of risk of catch options.

APPENDIX 1

CNL (00)60

REQUEST FOR SCIENTIFIC ADVICE FROM NASCO TO ICES (JULY 2000)

1 with respect to Atlantic salmon in the North Atlantic area:

1.1 provide an overview of salmon catches and landings, including unreported catches by country and catch and release, and worldwide production of farmed and ranched salmon in 2000,

1.2 report on significant developments which might assist NASCO with the management of salmon stocks,

1.3 use case studies to illustrate options for taking account of risk in the provision of catch advice and comment on the relative merits of each option,

1.4 assess the possible reasons for the differences in the occurrence of escaped farmed fish in fisheries and stocks in different areas,

1.5 advise on the potential biases in the catch advice model resulting from the inclusion of fish farm escapes in the assessment models,

1.6 provide a compilation of tag releases by country in 2000.

2 with respect to Atlantic salmon in the North-East Atlantic Commission area:

2.1 describe the events of the 2000 fisheries and the status of the stocks,

2.2 update the evaluation of the effects on stocks and homewater fisheries of significant management measures introduced since 1991,

2.3 further develop the age-specific stock conservation limits where possible based upon individual river stocks,

2.4 provide catch options or alternative management advice with an assessment of risks relative to the objective of exceeding stock conservation limits,

2.5 update the information on by-catch of salmon post-smolts in pelagic fisheries,

2.6 identify relevant data deficiencies, monitoring needs and research requirements.

3 with respect to Atlantic salmon in the North American Commission area

3.1 describe the events of the 2000 fisheries and the status of the stocks,

3.2 update the evaluation of the effects on US and Canadian stocks and fisheries of management measures implemented after 1991 in the Canadian commercial salmon fisheries,

3.3 update age-specific stock conservation limits based on new information as available,

3.4 provide catch options or alternative management advice with an assessment of risks relative to the objective of exceeding stock conservation limits,

3.5 identify relevant data deficiencies, monitoring needs and research requirements.

4 with respect to Atlantic salmon in the West Greenland Commission area:

4.1 describe the events of the 2000 fisheries and the status of the stocks,

4.2 update the evaluation of the effects on European and North American stocks of the Greenlandic quota management measures and compensation arrangements since 1993,

4.3 provide a detailed explanation and critical examination of any changes to the model used to provide catch advice and of the impacts of any changes to the model on the calculated quota,

4.4 provide catch options or alternative management advice with an assessment of risks relative to the objective of exceeding stock conservation limits,

4.5 evaluate potential causes for the changes in the Continent of origin of salmon captured in the West Greenland fishery including potential changes in marine migration patterns,

4.6 identify relevant data deficiencies, monitoring needs and research requirements.

NOTES:

1 With regard to question 1.3. ICES is requested to provide information that will assist with the implementation of and the evaluation by NASCO and its Contracting Parties of the decision structure (Annex 4 of document CNL(00)18) provisionally adopted by the Council.

2 In response to questions 2.1, 3.1 and 4.1 ICES is asked to provide details of catch, gear, effort, composition and origin of the catch and rates of exploitation. For homewater fisheries the information provided should indicate the location of the catch in the following categories : in-river, estuarine and coastal. Any new information on non-catch fishing mortality of the salmon gear used and on by-catch of other species in salmon gear and of salmon in any new fisheries for other species is also requested.

3 In response to question 4.1, ICES is requested to provide a brief summary of the status of the North American and North-East Atlantic salmon stocks. The detailed information on the status of these stocks should be provided in response to questions 2.1 and 3.1.

4 With regard to question 4.3 "change to the model " would include the development of any new model.

APPENDIX 2

Computation of Catch Advice for West Greenland

The North American Spawning Reserve (SpT) for 2SW salmon of 152 548 fish remains the same as in 2000.

This number must be divided by the survival rate for the fish from the time of the West Greenland fishery to their return of the fish to home waters (11 months) to give the Spawning Target Reserve (SpR). Thus:

Eq. 1. $SpR = SpT * (exp(11*M)$ (where $M = 0.01$)

The Maximum Allowable Harvest (MAH) may be defined as the number of non-maturing 1SW fish that are available for harvest. This number is calculated by subtracting the Spawning Target Reserve from the pre-fishery abundance (PFA).

Eq. 2. $MAH = PFA - SpR$

To provide catch advice for West Greenland it is then necessary to decide on the proportion of the MAH to be allocated to Greenland (f_{NA}). The allowable harvest of North American non-maturing 1SW salmon at West Greenland NA1SW) may then be defined as

Eq. 3. $NA1SW = f_{NA} * MAH$

The estimated number of European salmon that will be caught at West Greenland (E1SW) will depend upon the harvest of North American fish and the proportion of the fish in the West Greenland fishery that originate from North America [PropNA] [1]. Thus:

Eq. 4. $E1SW = (NA1SW / PropNA) - NA1SW$

To convert the numbers of North American and European 1SW salmon into total catch at West Greenland in metric t, it is necessary to incorporate the mean weights (kg) of salmon for North America [WT1SWNA][1] and Europe [WT1SWE][1] and age correction factor for multi-sea winter salmon at Greenland based on the total weight of salmon caught divided by the weight of 1SW salmon [ACF][1]. The quota (in t) at Greenland is then estimated as

Eq. 5. $Quota = (NA1SW * WT1SWNA + E1SW * WT1SWE) * ACF/1000$

[1] Sampling data from the 1995-1999 fishery at West Greenland were used to update the forecast values by exponential smoothing of the proportion of North American salmon in the catch (PropNA), weights by continent [WT1SWNA, WT1SWE] and the age correction factor [ACF].

Table 4.1.1.1 Nominal catch of Salmon by country (in tonnes round fresh weight), 1960-2000. (2000 figures include provisional data).

Year	Canada (1)	Den.	Faroes (2)	Finland	France	East Grld.	West Grld. (3)	Iceland Wild	Iceland Ranch	Ireland (4,5)	Norway (6)	Russia (7)	Spain (8)	St. P. & M.	Sweden (West)	UK (E & W) (12)	UK N.Ireland (6,9)	UK (Scotland)	USA	Other (10)	Total Reported Catch	Unreported catches NASCO Areas	Unreported catches International waters (11)
1960	1636	-	-	-	-	-	60	100	-	743	1659	1100	33	-	40	283	139	1443	1	-	7237	-	-
1961	1583	-	-	-	-	-	127	127	-	707	1533	790	20	-	27	232	132	1185	1	-	6464	-	-
1962	1719	-	-	-	-	-	244	125	-	1459	1935	710	23	-	45	318	356	1738	1	-	8673	-	-
1963	1861	-	-	-	-	-	466	145	-	1458	1786	480	28	-	23	325	306	1725	1	-	8604	-	-
1964	2069	-	-	-	-	-	1539	135	-	1617	2147	590	34	-	36	307	377	1907	1	-	10759	-	-
1965	2116	-	-	-	-	-	861	133	-	1457	2000	590	42	-	40	320	281	1593	1	-	9434	-	-
1966	2369	-	-	-	-	-	1370	104	2	1238	1791	570	42	-	36	387	287	1595	1	-	9792	-	-
1967	2863	-	-	-	-	-	1601	144	2	1463	1980	883	43	-	25	420	449	2117	1	-	11991	-	-
1968	2111	-	5	-	-	-	1127	161	1	1413	1514	827	38	-	20	282	312	1578	1	403	9793	-	-
1969	2202	-	7	-	-	-	2210	131	2	1730	1383	360	54	-	22	377	267	1955	1	893	11594	-	-
1970	2323	-	12	-	-	-	2146	182	13	1787	1171	448	45	-	20	527	297	1392	1	922	11286	-	-
1971	1992	-	-	-	-	-	2689	196	8	1639	1207	417	16	-	18	426	234	1421	1	471	10735	-	-
1972	1759	-	9	32	34	-	2113	245	5	1804	1578	462	40	-	18	442	210	1727	1	486	10965	-	-
1973	2434	-	28	50	12	-	2341	148	8	1930	1726	772	24	-	23	450	182	2006	2.7	533	12670	-	-
1974	2539	-	20	76	13	-	1917	215	10	2128	1633	709	16	-	32	383	184	1628	0.9	373	11877	-	-
1975	2485	-	28	76	25	-	2030	145	21	2216	1537	811	27	-	26	447	164	1621	1.7	475	12136	-	-
1976	2506	-	40	66	9	<1	1175	216	9	1561	1530	542	21	2.5	20	208	113	1019	0.8	289	9327	-	-
1977	2545	-	40	59	19	6	1420	123	7	1372	1488	497	19	-	10	345	110	1160	2.4	192	9414	-	-
1978	1545	-	37	37	20	8	984	285	6	1230	1050	476	32	-	10	349	148	1323	4.1	138	7682	-	-
1979	1287	-	119	26	10	<0.5	1395	219	6	1097	1831	455	29	-	12	261	99	1076	2.5	193	8118	-	-
1980	2680	-	536	34	30	<0.5	1194	241	8	947	1830	664	47	-	17	360	122	1134	5.5	277	10127	-	-
1981	2437	-	1025	44	20	<0.5	1264	147	16	685	1656	463	25	-	26	493	101	1233	6	313	9954	-	-
1982	1798	-	606	54	20	<0.5	1077	130	17	993	1348	364	10	-	25	286	132	1092	6.4	437	8395	-	-
1983	1424	-	678	58	16	<0.5	310	166	32	1656	1550	507	23	3	28	429	187	1221	1.3	466	8755	-	-
1984	1112	-	628	46	25	<0.5	297	139	20	829	1623	593	18	3	40	345	78	1013	2.2	101	6912	-	-
1985	1133	-	566	49	22	7	864	162	55	1595	1561	659	13	3	45	361	98	913	2.1	-	8108	-	-
1986	1559	-	530	37	28	19	960	232	59	1730	1598	608	27	2.5	54	430	109	1271	1.9	-	9255	315	-
1987	1784	-	576	49	27	<0.5	966	181	40	1239	1385	564	18	2	47	302	56	922	1.2	-	8159	2788	-
1988	1310	-	243	36	32	4	893	217	180	1874	1076	420	18	2	40	395	114	882	0.9	-	7737	3248	-
1989	1139	-	364	52	14	-	337	140	136	1079	905	364	7	2	29	296	142	895	1.7	-	5903	2277	-
1990	911	13	315	60	15	-	274	146	280	567	930	313	7	1.9	33	338	94	624	2.4	-	4924	1890	180-350
1991	711	3.3	95	70	13	4	472	130	345	404	876	215	11	1.2	38	200	55	462	0.8	-	4106	1682	25-100
1992	522	10	23	77	20	5	237	175	460	630	867	167	11	2.3	49	171	91	600	0.7	-	4118	1962	25-100
1993	373	9	23	70	16	-	-	160	496	541	923	139	8	2.9	56	248	83	547	0.6	-	3696	1644	25-100
1994	355	6	6	49	18	-	-	140	308	804	996	141	10	3.4	44	324	91	649	-	-	3944	1276	25-100
1995	260	3.1	5	48	9	2	83	150	298	790	839	128	9	0.8	37	295	83	588	-	-	3628	1060	n/a
1996	292	1.7	-	44	14	0.5	92	122	239	687	787	131	7	1.6	33	183	77	427	-	-	3139	1123	n/a
1997	229	1.3	-	45	8	1	58	106	50	570	630	111	3	1.5	19	142	93	296	-	-	2364	827	n/a
1998	157	1.3	6	48	9	-	11	130	34	624	740	131	4	2.3	15	123	78	283	-	-	2397	1210	n/a
1999	152	0.5	-	63	11	0.5	19	119	26	515	811	103	6	2.3	16	150	53	199	-	-	2246	1032	n/a
2000	150	4.6	8	95	11	0	21	82	2	621	1176	124	-	2.3	33	214	78	192	-	-	2814	1269	n/a
Means																							
1995-1999	218	2	6	50	10	1	53	125	129	637	761	121	6	2	24	179	77	359	-	-	2755	1050	-
1990-1999	396	5	68	57	13	2	156	138	254	613	840	158	8	2	34	217	80	468	1	-	3456	1371	-

1. Includes estimates of some local sales, and, prior to 1984, by-catch.
2. Between 1991 & 1999, there was only a research fishery at Faroes. In 1997 & 1999 no fishery took place, the commercial fishery resumed in 2000
3. Includes catches made in the West Greenland area by Norway, Faroes, Sweden and Denmark in 1965-1975.
4. From 1994, includes increased rate of reporting of rod catches.
5. Catch on River Foyle allocated 50% Ireland and 50% N. Ireland.
6. Before 1966, sea trout and sea charr included (5% of total).
7. Figures from 1991 onwards do not include catches taken in the recently developed recreational (rod) fishery.
8. Weights prior to 1990 are estimated from 1994 mean weight. Weights from 1990 based on mean wt. from R. Asturias.
9. Not including angling catch (mainly 1SW).
10. Includes catches in Norwegian Sea by vessels from Denmark, Sweden, Germany, Norway and Finland.
11. Estimates refer to season ending in given year.
12. Data for 1993-98 altered from previous reports to take account of catch & release

Table 4.1.1.2 The weight (tonnes round fresh weight) and proportion (%) of the nominal catch by country taken in coastal, estuarine and riverine fisheries.

		Catch						
		Coast		Estuary		River		Total
Country	Year	Weight	%	Weight	%	Weight	%	Weight
Canada	1999	7	5	38	25	105	70	150
	2000	11	7	22	15	117	78	150
Finland	1995	0	0	0	0	48	100	48
	1996	0	0	0	0	44	100	44
	1997	0	0	0	0	45	100	45
	1998	0	0	0	0	48	100	48
	1999	0	0	0	0	63	100	63
	2000	0	0	0	0	95	100	95
France[1]	1995	-	-	2	20	8	80	10
	1996	-	-	4	31	9	69	13
	1997	-	-	3	38	5	63	8
	1998	1	13	2	25	5	63	8
	1999	0	0	4	35	7	65	11
	2000	0	4	4	35	7	61	11
Iceland	1995	20	13	0	0	130	87	150
	1996	11	9	0	0	111	91	122
	1997	0	0	0	0	106	100	106
	1998	0	0	0	0	130	100	130
	1999	0	0	0	0	119	100	119
	2000	0	0	0	0	82	100	82
Ireland	1995	566	72	140	18	84	11	790
	1996	440	64	134	20	110	16	684
	1997	380	67	100	18	91	16	571
	1998	433	69	92	15	99	16	624
	1999	335	65	83	16	97	19	515
	2000	440	71	79	13	102	16	621
Norway	1995	515	61	0	0	325	39	840
	1996	520	66	0	0	267	34	787
	1997	394	63	0	0	235	37	629
	1998	410	55	0	0	331	45	741
	1999	483	60	0	0	327	40	810
	2000	619	53	0	0	557	47	1176
Russia	1995	43	33	9	7	77	60	128
	1996	64	49	21	16	46	35	131
	1997	63	57	17	15	32	28	111
	1998	55	42	2	2	74	56	131
	1999	48	47	2	2	52	51	102
	2000	64	52	15	12	45	36	124

Table 4.1.1.2 **Continued**

		Catch						
		Coast		Estuary		River		Total
Country	Year	Weight	%	Weight	%	Weight	%	Weight
Spain	1995	0	0	0	0	9	100	9
	1996	0	0	0	0	7	100	7
	1997	0	0	0	0	4	100	4
	1998	0	0	0	0	4	100	4
	1999	0	0	0	0	6	100	6
	2000	n/a	-	n/a	-	n/a	-	n/a
Sweden	1995	24	65	0	0	13	35	37
	1996	19	58	0	0	14	42	33
	1997	10	56	0	0	8	44	18
	1998	5	33	0	0	10	67	15
	1999	5	31	0	0	11	69	16
	2000	10	30	0	0	23	70	33
UK	1995	200	68	45	15	49	17	294
England &	1996	83	45	42	23	58	32	183
Wales	1997	81	57	27	19	35	24	143
	1998	65	53	19	16	38	31	122
	1999	101	67	23	15	26	17	150
	2000	152	71	25	12	36	17	213
UK (N. Ireland) [2]	1999	44	83	9	17	0	0	53
	2000	63	82	14	18	0	0	77
UK	1995	201	34	105	18	282	48	588
Scotland	1996	129	30	80	19	218	51	427
	1997	79	27	33	11	184	62	296
	1998	60	21	28	10	195	69	283
	1999	35	18	23	12	141	71	199
	2000	30	16	24	12	139	72	193
Totals								
North East Atlantic [3]	2000	1386	53	161	6	1086	41	2633
North America [4]	2000	13	9	22	14	117	77	152

[1] An illegal net fishery operated from 1995 to 1998, catch unknown in the first 3 years but thought to be increasing.Fishery ceased in 1999

[2] no nominal catch data is collected for river fisheries in UK (NI)

[3] data not available from Denmark & Spain

[4] includes Canada & St Pierre et Miquelon

Table 4.1.1.3 Estimates of unreported catches by various methods in tonnes by country within national EEZs in the North-east Atlantic, North America and West Greenland Commissions of NASCO, 2000. (NA = not available

2000 Commission Area	Country	Unreported Catch t	Unreported as % of Total North Atlantic Catch (Unreported + Reported)	Unreported as % of Total National Catch (Unreported + Reported)
NEAC	Faroes	< 1	-	-
NEAC	Finland	25	0.6	21
NEAC	Iceland	2	0.0	2
NEAC	Ireland	132	3.2	18
NEAC	Norway	633	15.5	35
NEAC	Russia	250	6.1	67
NEAC	Sweden	4	0.1	11
NEAC	UK (E & W)	38	0.9	15
NEAC	UK (N.Ireland)	8	0.2	9
NEAC	UK (Scotland)	44	1.1	19
NAC	Canada	124	3.0	45
NAC	USA	0	0.0	0
WGC	West Greenland	10	0.2	32
	Total Unreported Catch	1269	31.1	
	Total Reported Catch of North Atlantic salmon	2814		

Table 4.4.7.1 Summary of Atlantic salmon tagged and marked in 2000. "Hatchery" and "Wild" refer to smolts or parr, "Adults" refers to wild and hatchery fish. Data from Belgium and France were not available. No fish were tagged in Finland.

		Primary Tag or Mark			
Country	Origin	Microtag	External mark	Adipose clip	Total
Canada	Hatchery	0	45,009	1,738,916	1,783,925
	Wild	0	9,083	329	9,412
	Adult	0	6,046	0	6,046
	Total	0	60,138	1,739,245	1,799,383
Denmark	Hatchery	72,900	0	0	72,900
	Wild	0	0	0	0
	Adult	0	0	0	0
	Total	72,900	0	0	72,900
Iceland	Hatchery	127,162	0	0	127,162
	Wild	2,516	0	0	2,516
	Adult	0	563	0	563
	Total	129,678	563	0	130,241
Ireland	Hatchery	289,029	0	0	289,029
	Wild	939	0	0	939
	Adult	0	0	0	0
	Total	289,968	0	0	289,968
Norway	Hatchery	0	85,692	0	85,692
	Wild	0	5,436	0	5,436
	Adult	0	631	0	631
	Total	0	91,759	0	91,759
Russia	Hatchery	0	3,000	417,750	420,750
	Wild	0	40	190	230
	Adult	0	1,809	0	1,809
	Total	0	4,849	417,940	422,789
Spain	Hatchery	83,225	10,000	133,778	227,003
	Wild	0	0	0	0
	Adult	0	0	0	0
	Total	83,225	10,000	133,778	227,003
Sweden	Hatchery	0	4,928	39,517	44,445
	Wild	0	0	0	0
	Adult	0	0	0	0
	Total	0	4,928	39,517	44,445
UK (England &	Hatchery	100,537	5,061	65,858	171,456
Wales)	Wild	4,139	0	973	5,112
	Adult	0	937	0	937
	Total	104,676	5,998	66,831	177,505
UK (N. Ireland)	Hatchery	34,487	0	35,536	70,023
	Wild	1,483	0	0	1,483
	Adult	0	0	183	183
	Total	35,970	0	35,719	71,689
UK (Scotland)	Hatchery	12,355	2,000	0	14,355
	Wild	6,948	6,462	4,750	18,160
	Adult	0	899	0	899
	Total	19,303	9,361	4,750	33,414
USA	Hatchery	0	172,842	47,857	220,699
	Wild	0	1,800	0	1,800
	Adult	0	5,052	30	5,082
	Total	0	179,694	47,887	227,581
All Countries	Hatchery	636,470	318,532	2,345,434	3,300,436
	Wild	16,025	22,821	6,242	45,088
	Adult	0	15,937	213	16,150
	Total	652,495	357,290	2,351,889	3,361,674

Table 6.4.1.1 Catch options for 2001 North American Fisheries

Catch Options for 2001 North American Fisheries (Probability levels refer to probability density function estimates of pre-fishery abundance)		
Probability Level	Pre-fishery Abundance Forecast	Catch Options in 2SW Salmon Equivalents (no.)
25	145 125	0
30	160 214	0
35	175 591	0
40	191 502	14 255
45	208 016	29 127
50	225 708	45 206
55	244 830	62 508
60	265 996	81 660
65	289 541	102 964
70	316 274	127 153
75	347 994	155 855

Table 6.4.1.2 Fishing mortalities of 2SW salmon equivalents by North American fisheries, 1972-2000. Only mid-points of the estimated values have been used.

Year	CANADA – MIXED STOCK: NF-LAB Comm 1SW (Yr i-1) (b)	% 1SW of total 2SW equivalents	NF-LAB Comm 2SW (Yr i) (b)	NF-Lab comm total	CANADA – TERMINAL FISHERIES IN YEAR i: Labrador rivers (a)	Nfld rivers (a)	Quebec Region	Gulf Region	Scotia - Fundy Region	Canadian total	USA Year i	Total	Terminal Fisheries as a % of Total
1972	27,874	11	156,881	184,755	314	633	27,417	22,389	6,801	242,310	346	242,656	24
1973	24,016	8	223,603	247,619	719	895	32,751	17,915	6,680	306,580	327	306,907	19
1974	32,828	9	240,676	273,504	593	542	47,631	21,429	12,734	356,434	247	356,681	23
1975	32,316	9	242,398	274,714	241	528	41,097	15,675	12,375	344,629	389	345,018	20
1976	47,846	13	261,770	309,616	618	412	42,139	18,088	11,111	381,985	191	382,176	19
1977	36,777	10	246,090	282,867	954	946	42,301	33,433	15,562	376,062	1,355	377,418	25
1978	37,200	14	160,477	197,677	580	559	37,421	23,803	10,781	270,821	894	271,714	27
1979	18,825	13	93,917	112,742	469	144	25,234	6,299	4,506	149,395	433	149,828	25
1980	27,923	8	221,597	249,520	646	699	53,567	29,828	18,411	352,670	1,533	354,202	30
1981	46,088	14	205,403	251,492	384	485	44,375	16,326	13,988	327,050	1,267	328,317	23
1982	45,894	18	137,132	183,026	473	433	35,204	25,707	12,353	257,195	1,413	258,608	29
1983	34,348	15	113,815	148,163	313	445	34,472	27,094	13,515	224,002	386	224,388	34
1984	25,969	18	84,480	110,448	379	215	24,408	6,041	3,971	145,464	675	146,138	24
1985	19,578	14	80,351	99,929	219	15	27,483	2,745	4,930	135,322	645	135,967	27
1986	26,504	15	107,009	133,514	340	39	33,846	4,582	2,824	175,145	606	175,750	24
1987	33,629	16	134,879	168,508	457	20	33,807	3,795	1,370	207,956	300	208,256	19
1988	42,874	26	82,769	125,642	514	29	34,262	3,922	1,373	165,743	248	165,990	24
1989	29,664	20	82,998	112,662	337	9	28,901	3,513	265	145,686	397	146,083	23
1990	26,164	22	58,518	84,682	261	24	27,986	2,847	593	116,394	696	117,089	28
1991	16,101	18	41,250	57,352	66	16	29,277	1,942	1,331	89,984	231	90,215	36
1992	13,336	18	25,615	38,952	581	67	30,016	4,303	1,114	75,033	167	75,201	48
1993	4,315	9	13,541	17,856	273	63	23,153	3,010	1,110	45,466	166	45,632	61
1994	2,859	7	12,179	15,038	365	80	24,052	2,368	756	42,659	1	42,660	65
1995	1,660	5	8,852	10,511	420	92	23,331	2,041	330	36,725	0	36,725	71
1996	1,437	4	5,760	7,197	320	108	22,413	2,586	766	33,389	0	33,389	78
1997	1,296	5	5,499	6,795	175	136	18,574	2,196	581	28,456	0	28,456	76
1998	1,544	9	1,909	3,453	268	129	11,256	2,224	322	17,651	0	17,651	80
1999	239	2	912	1,151	268	111	9,032	1,504	450	12,515	0	12,515	91
2000	203	1	1,300	1,503	268	291	9,903	2,203	193	14,361	0	14,361	90
2001	421	-	-	-	-	-	-	-		-	-	-	-

NF-Lab comm as 1SW = NC1(mid-pt) * 0.904837

NF-Lab comm as 2SW = NC2 (mid-pt) * 0.99005

Terminal fisheries = 2SW returns (mid-pt) - 2SW spawners (mid-pt)

a - starting in 1993, includes estimated mortality of 10% on hook and released fish

b - starting in 1998, there was no commercial fishery in Labrador; numbers reflect size of aboriginal fish harvest in 1998-2000 and resident food fishery harvest in 2000

Table 6.4.1.3 History of fishing-related mortalities of North American salmon as 2SW equivalents, 1972-2000.

Year	Canadian total	USA total	North America Grand Total	% USA of Total North American	Greenland total	NW Atlantic Total	Harvest in homewaters as % of total NW Atlantic
1972	242,310	346	242,656	0.14	260,296	502,952	48
1973	306,580	327	306,907	0.11	181,677	488,584	63
1974	356,434	247	356,681	0.07	218,512	575,193	62
1975	344,629	389	345,018	0.11	199,593	544,611	63
1976	381,985	191	382,176	0.05	252,304	634,479	60
1977	376,062	1,355	377,418	0.36	141,060	518,478	73
1978	270,821	894	271,714	0.33	171,656	443,370	61
1979	149,395	433	149,828	0.29	107,543	257,370	58
1980	352,670	1,533	354,202	0.43	181,023	535,225	66
1981	327,050	1,267	328,317	0.39	170,108	498,425	66
1982	257,195	1,413	258,608	0.55	206,056	464,664	56
1983	224,002	386	224,388	0.17	176,185	400,574	56
1984	145,464	675	146,138	0.46	30,077	176,215	83
1985	135,322	645	135,967	0.47	35,213	171,179	79
1986	175,145	606	175,750	0.34	125,983	301,734	58
1987	207,956	300	208,256	0.14	155,401	363,658	57
1988	165,743	248	165,990	0.15	157,158	323,149	51
1989	145,686	397	146,083	0.27	105,655	251,738	58
1990	116,394	696	117,089	0.59	54,917	172,007	68
1991	89,984	231	90,215	0.26	66,152	156,366	58
1992	75,033	167	75,201	0.22	100,147	175,348	43
1993	45,466	166	45,632	0.36	37,872	83,504	55
1994	42,659	1	42,660	0.00	0	42,660	100
1995	36,725	0	36,725	0.00	0	36,725	100
1996	33,389	0	33,389	0.00	19,310	52,699	63
1997	28,456	0	28,456	0.00	19,856	48,312	59
1998	17,651	0	17,651	0.00	15,214	32,865	54
1999	12,515	0	12,515	0.00	2,738	15,253	82
2000	14,361	0	14,361	0.00	4,863	19,223	75
2001	-	-	-	-	5,041	-	-

Greenland harvest of 2SW equivalents = NG1 * 0.904837

Table 7.4.1.1 Pre-fishery abundance estimates, thermal habitat index for February based on sea surface temperature (H2), lagged spawer index for North America excluding Gulf and US spawners (SLNQ), results of a jackknife cross-validation of the multiplicative forecast model, and simulated forecasts.

Year	Pre-fishery abundance			Thermal Habitat	Lagged spawners (SLNQ)			Jacknife Cross-validation	
	Low	High	Mid-point	February (H2)	Low	High	Mid-point	Prediction	Residuals
1971	578,974	726,622	652,798	2,011	.	.	.	.	.
1972	557,790	732,940	645,365	1,990	.	.	.	.	.
1973	672,631	867,684	770,157	1,708	.	.	.	.	.
1974	623,907	800,542	712,224	1,862	.	.	.	.	.
1975	710,252	904,626	807,439	1,827	.	.	.	.	.
1976	610,799	826,787	718,793	1,676	.	.	.	.	.
1977	506,919	667,787	587,353	1,915	.	.	.	.	.
1978	288,792	371,342	330,067	1,951	35,453	81,767	58,610	389,220	-59,153
1979	630,091	831,411	730,751	2,058	42,626	94,677	68,652	664,772	65,978
1980	550,336	734,489	642,412	1,823	43,173	97,017	70,095	590,190	52,222
1981	527,318	684,352	605,835	1,912	43,268	97,575	70,421	658,224	-52,389
1982	439,982	567,499	503,741	1,703	43,381	98,372	70,876	563,713	-59,972
1983	236,377	337,388	286,882	1,416	40,413	91,967	66,190	364,762	-77,880
1984	245,424	347,471	296,448	1,257	37,647	84,066	60,856	233,165	63,283
1985	399,028	539,102	469,065	1,410	39,344	83,435	61,389	248,799	220,266
1986	435,090	575,673	505,381	1,688	40,567	91,757	66,162	442,148	63,233
1987	398,168	527,764	462,966	1,627	36,636	88,818	62,727	353,451	109,515
1988	317,609	423,746	370,678	1,698	37,131	83,891	60,511	339,966	30,712
1989	241,044	345,930	293,487	1,642	41,955	86,459	64,207	400,432	-106,945
1990	218,191	296,332	257,262	1,503	40,948	81,667	61,307	304,340	-47,078
1991	249,798	349,917	299,857	1,357	37,582	72,966	55,274	178,975	120,882
1992	143,925	216,262	180,094	1,381	35,596	71,384	53,490	179,100	994
1993	95,352	179,428	137,390	1,252	38,387	79,232	58,810	244,899	-107,509
1994	110,985	219,159	165,072	1,329	38,395	75,762	57,079	215,540	-50,467
1995	120,523	202,958	161,740	1,311	36,740	69,943	53,342	168,198	-6,458
1996	104,675	163,182	133,928	1,470	33,492	61,600	47,546	134,001	-72
1997	69,083	123,311	96,197	1,594	29,876	55,241	42,558	107,109	-10,912
1998	58,751	126,207	92,479	1,849	25,629	50,461	38,045	91,858	621
1999	57,800	130,436	94,118	1,741	25,658	52,637	39,147	91,254	2,864
2000	.	.	.	1,634	32,960	68,185	50,572	*225,708* [1]	
2001	.	.	.	1,685	37,414	81,709	59,561	*295,678* [1]	

[1] Simulated forecast values.

Table 7.4.3.1 Quota options (t) for 2001 at West Greenland based on H2-SLNQ multiplicative forecasts of pre-fishery abundance. Proportion at West Greenland refers to the fraction of harvestable surplus allocated to the West Greenland fishery. The probability level refers to the pre-fishery abundance levels derived from the probabiltiy density function.

Prob.	Proportion at West Greenland (Fna)										
level	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
25	0	7	14	21	28	35	42	49	56	63	69
30	0	15	30	45	60	75	90	105	120	135	150
35	0	23	46	69	92	116	139	162	185	208	231
40	0	32	63	95	126	158	190	221	253	284	316
45	0	41	81	122	162	203	243	284	324	365	405
50	0	50	100	150	200	250	300	350	400	450	500
55	0	60	121	181	241	302	362	423	483	543	604
60	0	72	144	215	287	359	431	503	574	646	718
65	0	85	169	254	338	423	508	592	677	761	846
70	0	99	198	298	397	496	595	695	794	893	992
75	0	117	233	350	467	584	700	817	934	1,051	1,167

Sp. res =	170,286
Prop NA =	0.779
WT1SWNA =	2.954
WT1SWE =	2.990
ACF =	1.049

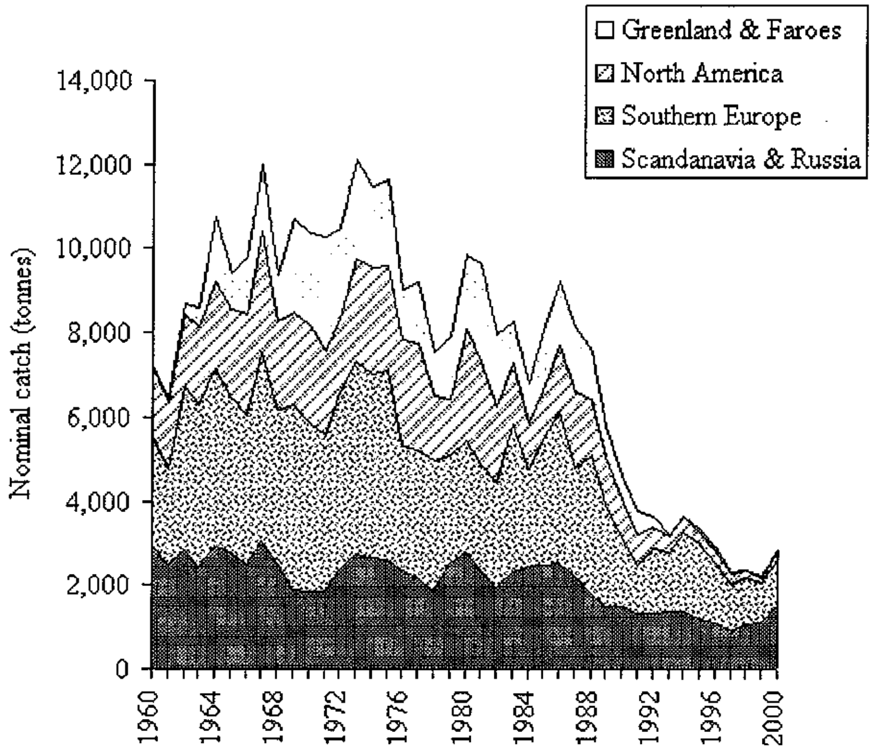


Figure 4.1.1.1 Nominal catches of salmon in four North Atlantic regions 1960-2000.

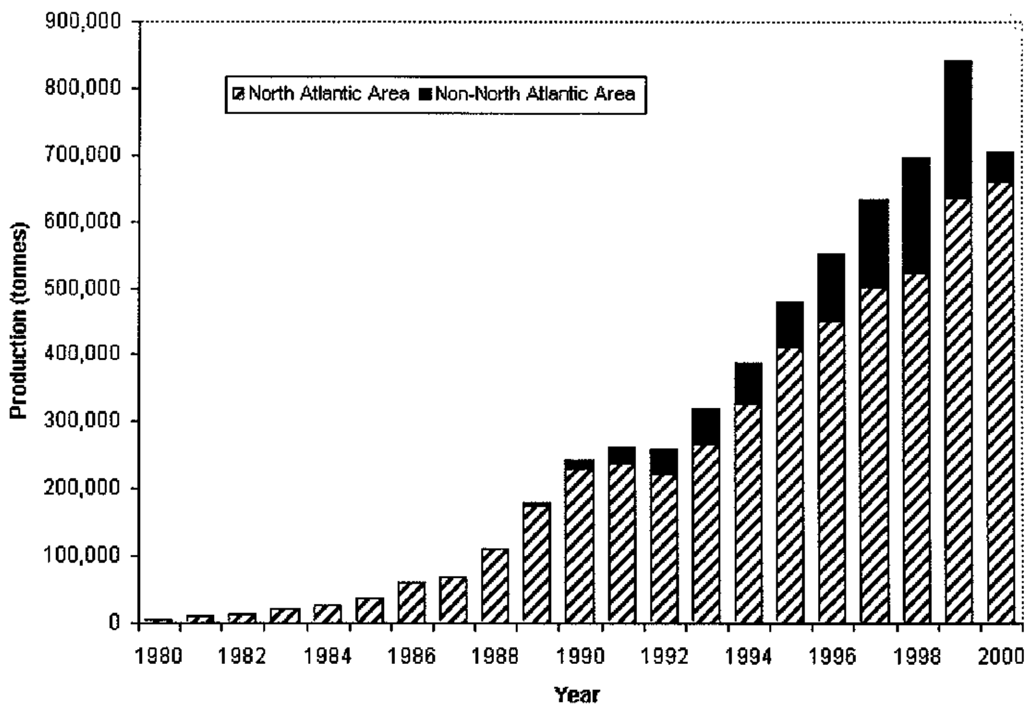


Figure 4.1.1.2 Worldwide production of farmed Atlantic salmon, 1980 – 2000. Data for non-North Atlantic area do not include Chile and other countries with notable production in 2000.

Deterministic calculation of quota for a low abundance period

Step 1	SpR = SpT * (exp(11*M))		
	SpT =	**152 548**	SpT = 2SW Conservation requirement for North America
	SpR =	170 286	SpR = Spawning Reserve for North America adjusted for 11 months of natural mortality between West Greenland and North America
Step 2	MAH = PFA – SpR		
	PFA =	**183 000**	PFA value at 50% probability
	MAH =	12 714	MAH = Maximum Allowable Harvest = Number of surplus North American origin fish
Step 3	NA1SW = fNA * MAH		
	FNA =	0.4	FNA = fraction of NA surplus allocated to Greenland
	NA1SW =	5 086	NA1SW = Number of North American surplus fish available for Greenland
Step 4	E1SW = (NA1SW / PropNA) – NA1SW		
	PropNA =	**0.779**	PropNA = proportion NA salmon in the fishery
	E1SW =	1 443	E1SW = number of European origin 1SW salmon expected in the fishery
Step 5	Quota (t) = (NA1SW * WT1SWNA + E1SW * WT1SWE) * ACF / 1000		
	WT1SWNA =	**2.666 kg**	WT1SWNA = weight (kg) of 1SW NA origin salmon in the fishery
	WT1SWE =	**2.832 kg**	WT1SWE = weight (kg) of 1SW European origin salmon in the fishery
	ACF =	**1.068**	ACF = age correction factor (>=1) to account for fish other than 1SW of age
	Quota (t) =	**19**	Quota = Allowable harvest (t) at West Greenland taking into account all the factors in steps 1 to 4

Deterministic calculation of quota for a moderate abundance period

Step 1	SpR = SpT * (exp(11*M))		
	SpT =	**152 548**	SpT = 2SW Conservation requirement for North America
	SpR =	170 286	SpR = Spawning Reserve for North America adjusted for 11 months of natural mortality between West Greenland and North America
Step 2	MAH = PFA – SpR		
	PFA =	**436 770**	PFA value at 50% probability
	MAH =	266 484	MAH = Maximum Allowable Harvest = Number of surplus North American origin fish
Step 3	NA1SW = fNA * MAH		
	FNA =	0.4	FNA = fraction of NA surplus allocated to Greenland
	NA1SW =	106 594	NA1SW = Number of North American surplus fish available for Greenland
Step 4	E1SW = (NA1SW / PropNA) – NA1SW		
	PropNA =	**0.59**	PropNA = proportion NA salmon in the fishery
	E1SW =	74 074	E1SW = number of European origin 1SW salmon expected in the fishery
Step 5	Quota (t) = (NA1SW * WT1SWNA + E1SW * WT1SWE) * ACF / 1000		
	WT1SWNA =	**2.75 kg**	WT1SWNA = weight (kg) of 1SW NA origin salmon in the fishery
	WT1SWE =	**3.13 kg**	WT1SWE = weight (kg) of 1SW European origin salmon in the fishery
	ACF =	**1.068**	ACF = age correction factor (>=1) to account for fish other than 1SW of age
	Quota (t) =	561	Quota = Allowable harvest (t) at West Greenland taking into account all the factors in steps 1 to 4

Figure 4.2.1.1 Deterministic calculations of catch options for the fishery at West Greenland for low abundance and moderate abundance periods. Values in bold and in box are parameters with uncertainty.

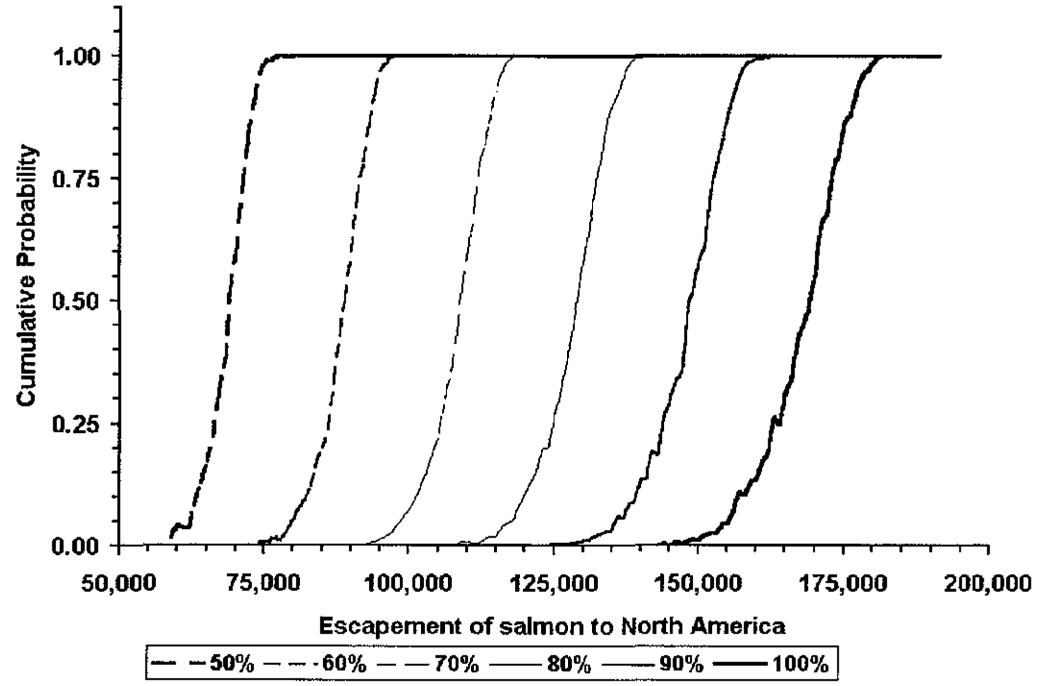


Figure 4.2.1.2 Probability profiles for simultaneously achieving a given level of escapement relative to conservation in six stock areas of North America.

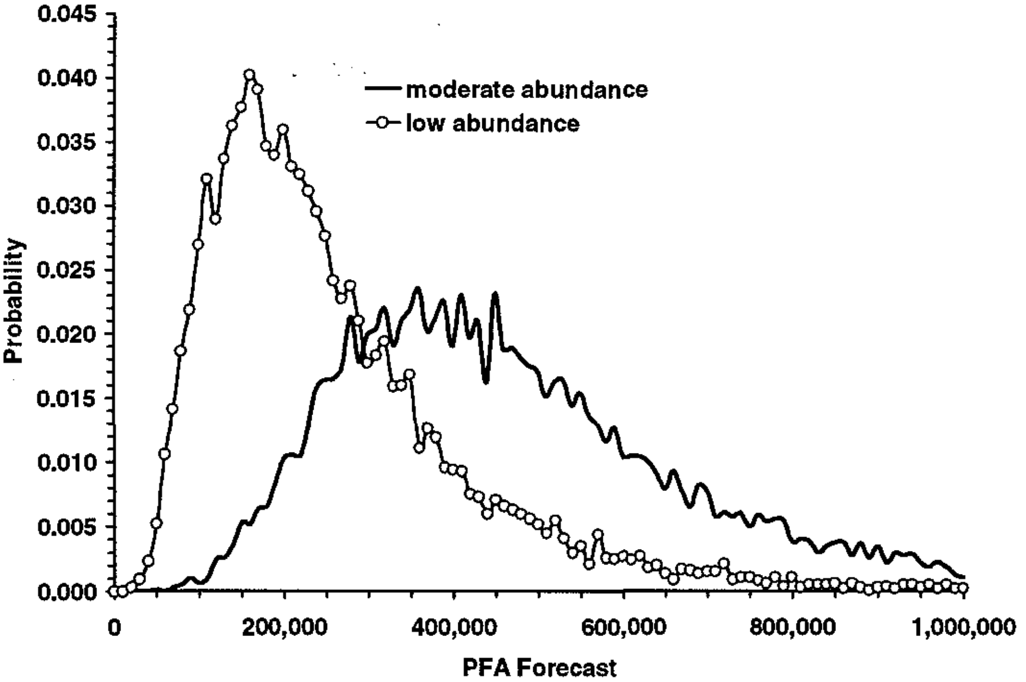


Figure 4.2.1.3 Probability profiles for the PFA forecast values for low abundance and moderate abundance periods.

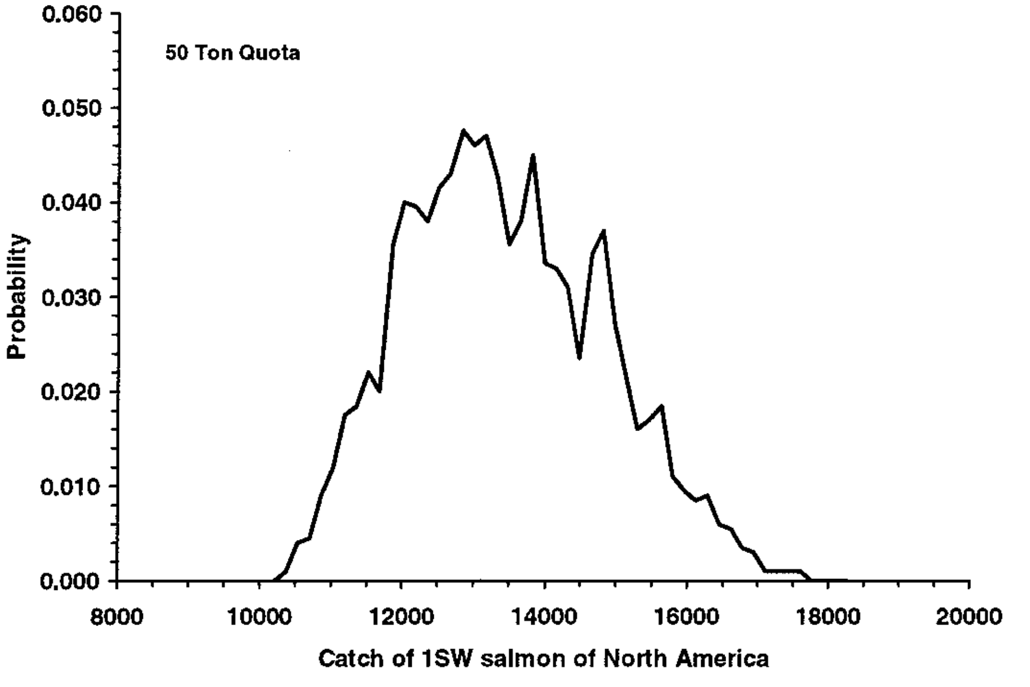


Figure 1.2.1.4 Expected catch of 1SW salmon of North American origin at a catch option of 50 tons at West Greenland. The uncertainty in catch is quantified by incorporating the observed temporal variation in proportion of fish of North American origin, mean weights of 1SW salmon of North American and European origin, and the age correction factor for older age groups.

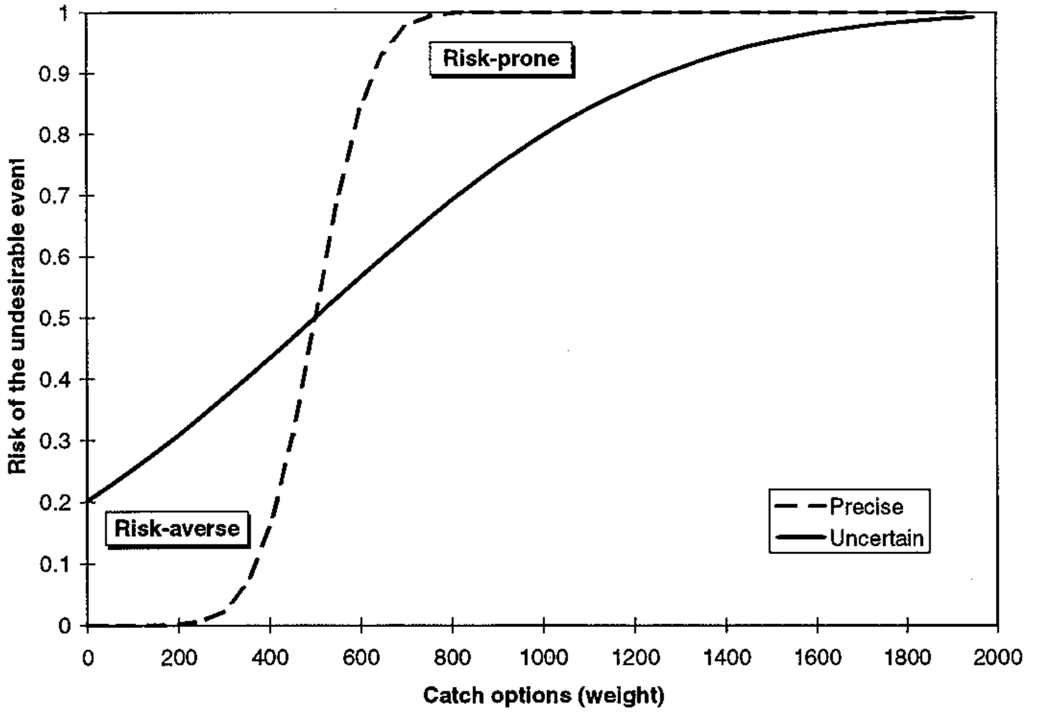


Figure 4.2.1.5 Theoretical risk analysis plots showing the risk-prone and risk-averse zones relative to the uncertainty of the stock assessment.

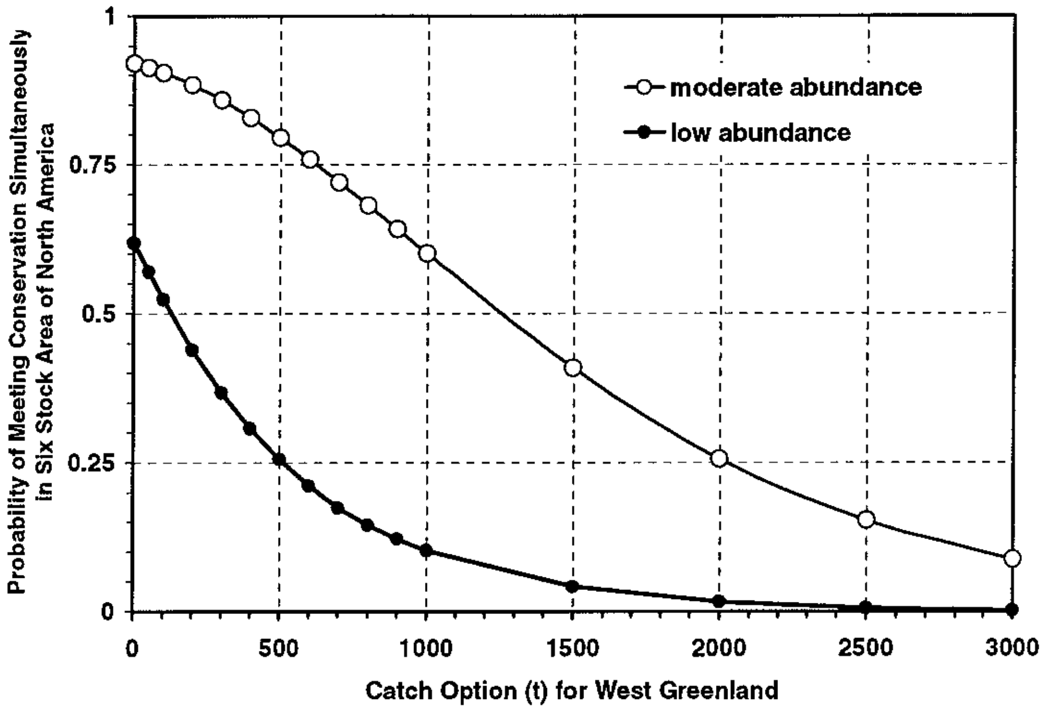


Figure 4.2.1.6 Examples of risk analysis profiles of catch options in West Greenland for low abundance and moderate abundance periods.

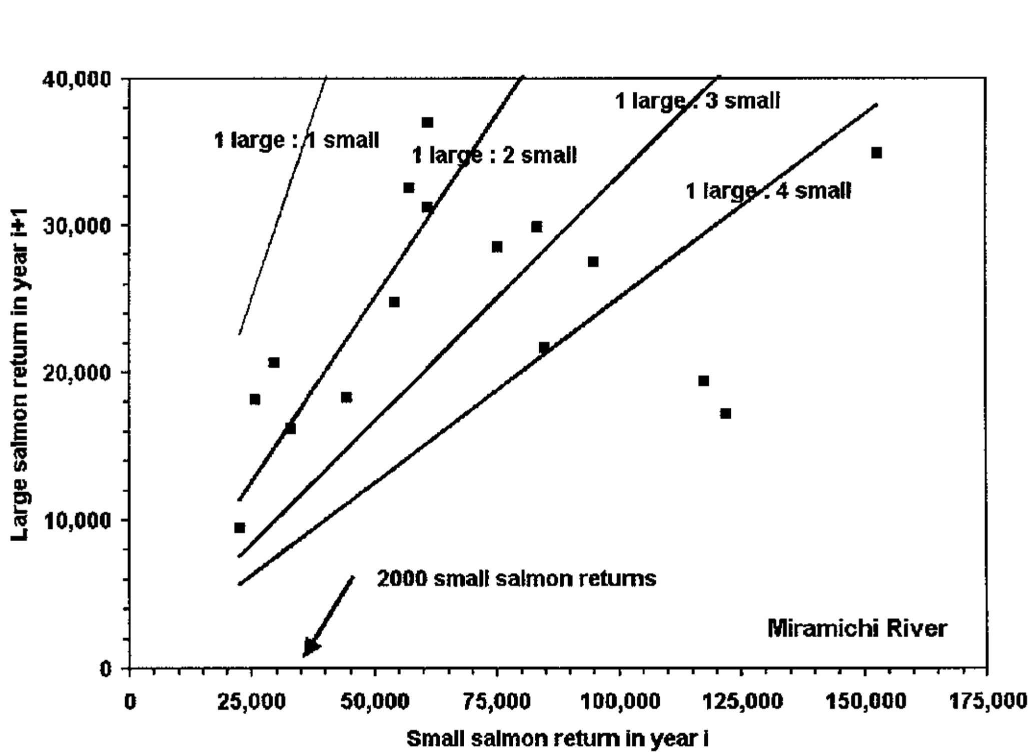
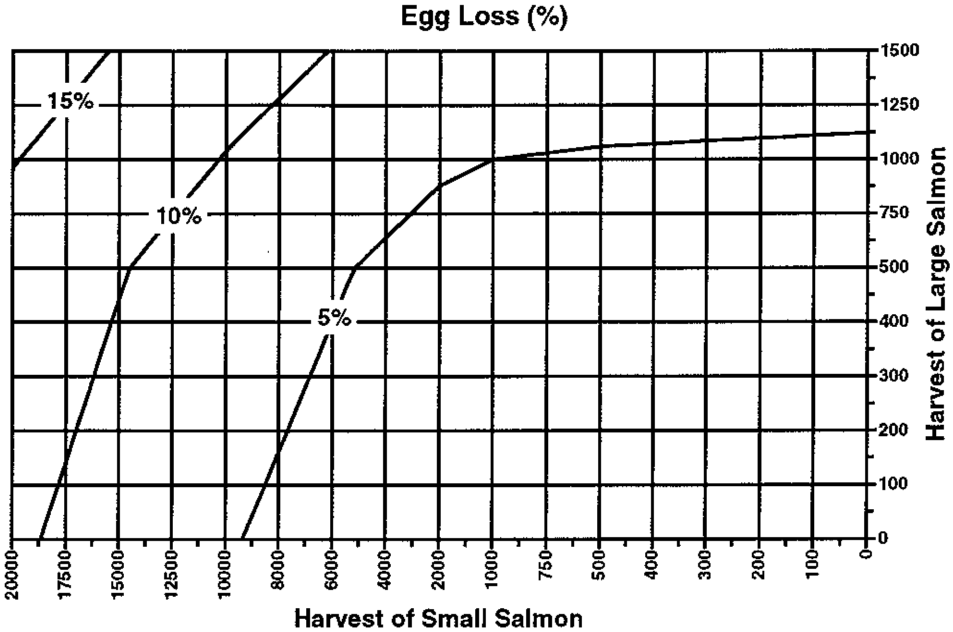


Figure 4.2.1.7 Relationship between small salmon (mostly 1SW salmon) in year i and large salmon (2SW salmon with an important component of multiple spawners) in year i+1, for 1985 to 2000.

Assumptions of the fisheries risk analysis model			
		Miramichi River	
		Salmon	Grilse
Assumed exploitation rates in angling fishery		30.0%	30.0%
Hook and release mortality estimates			
By season	Early	5.0%	5.0%
	Late	1.0%	1.0%
Integrated value used in assessments		3.0%	3.0%
Fecundity of fish by season (average 1996 to 2000)			
	Integrated	5429	669
First Nations Harvests (maximum harvests achieved 1994 to 1998)			
	Early	358	3595
	Late	190	792
Ratios (small / large) (1996 to 2000) for forecasting			
	Min.	1.39	
	Max.	2.42	
	Median	2.18	
Small salmon returns (1996 to 2000)			
	Mean		32,000
	Std. Dev.		8,676

Figure 4.2.1.8 Fishery, biological characteristics, and forecast data inputs to the risk analysis of the 2001 Miramichi homewater fishery.



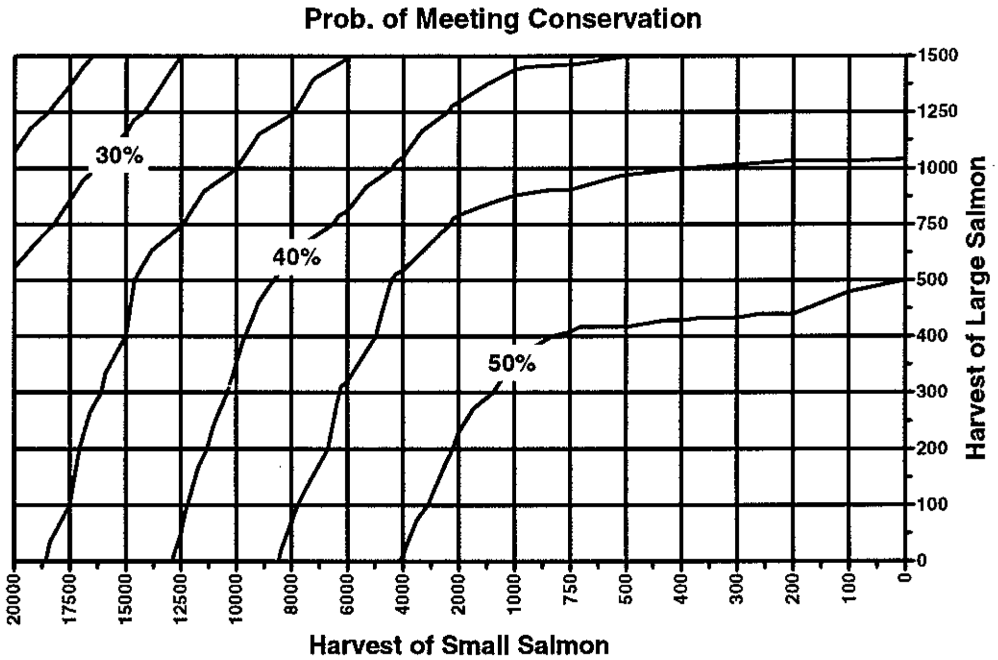


Figure 4.2.1.9 Risk analysis profiles for the 2001 homewater fisheries in the Miramichi River. The upper panel describes the egg loss from the harvest levels as a percentage of the total eggs in the predicted returns. The lower panel describes the risk to achieving the conservation requirements for different harvest levels.

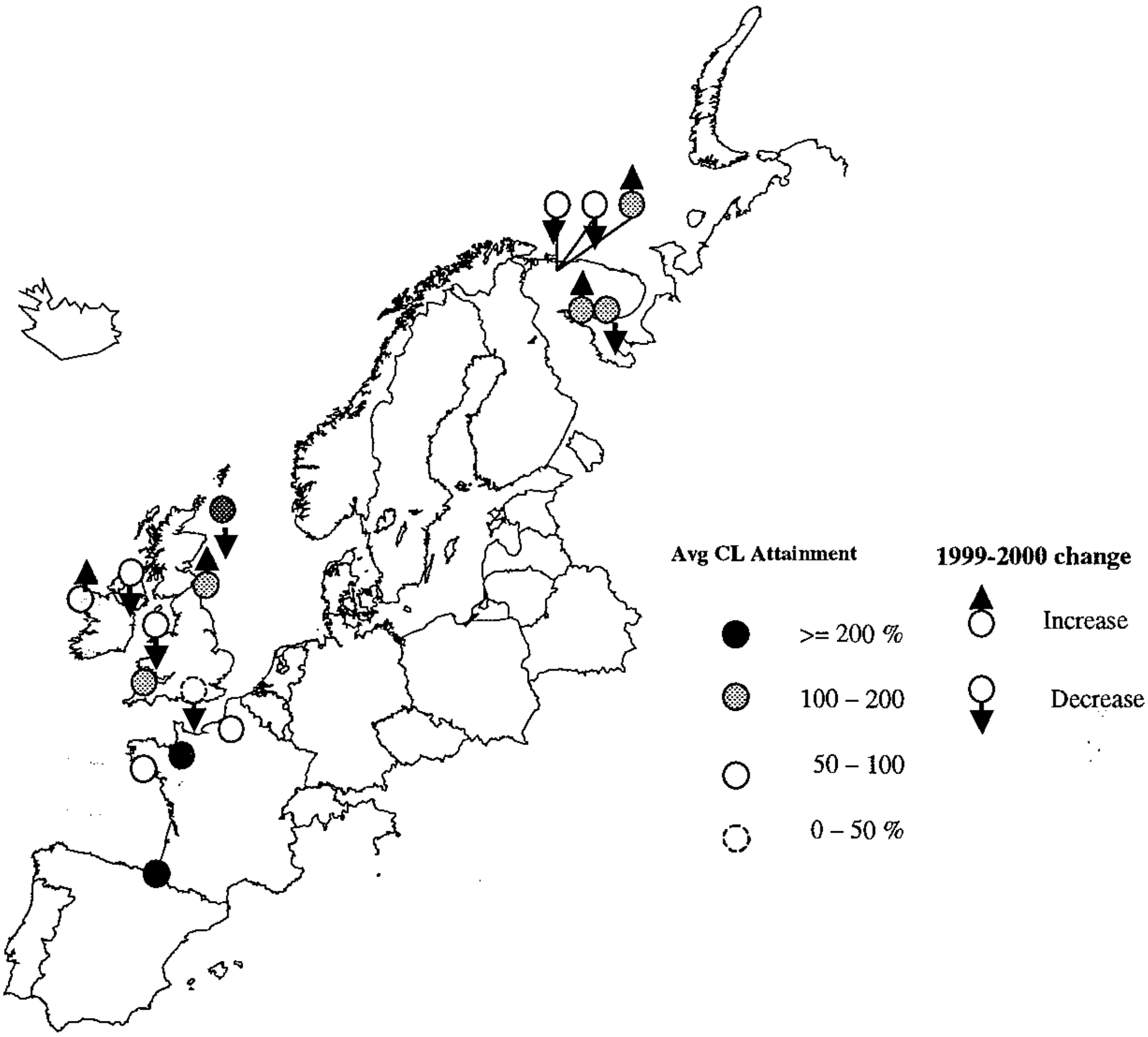


Figure 5.1.3.1 Rate of attainment of conservation limits: mean value over the last 10 years and 1999-2000 change.

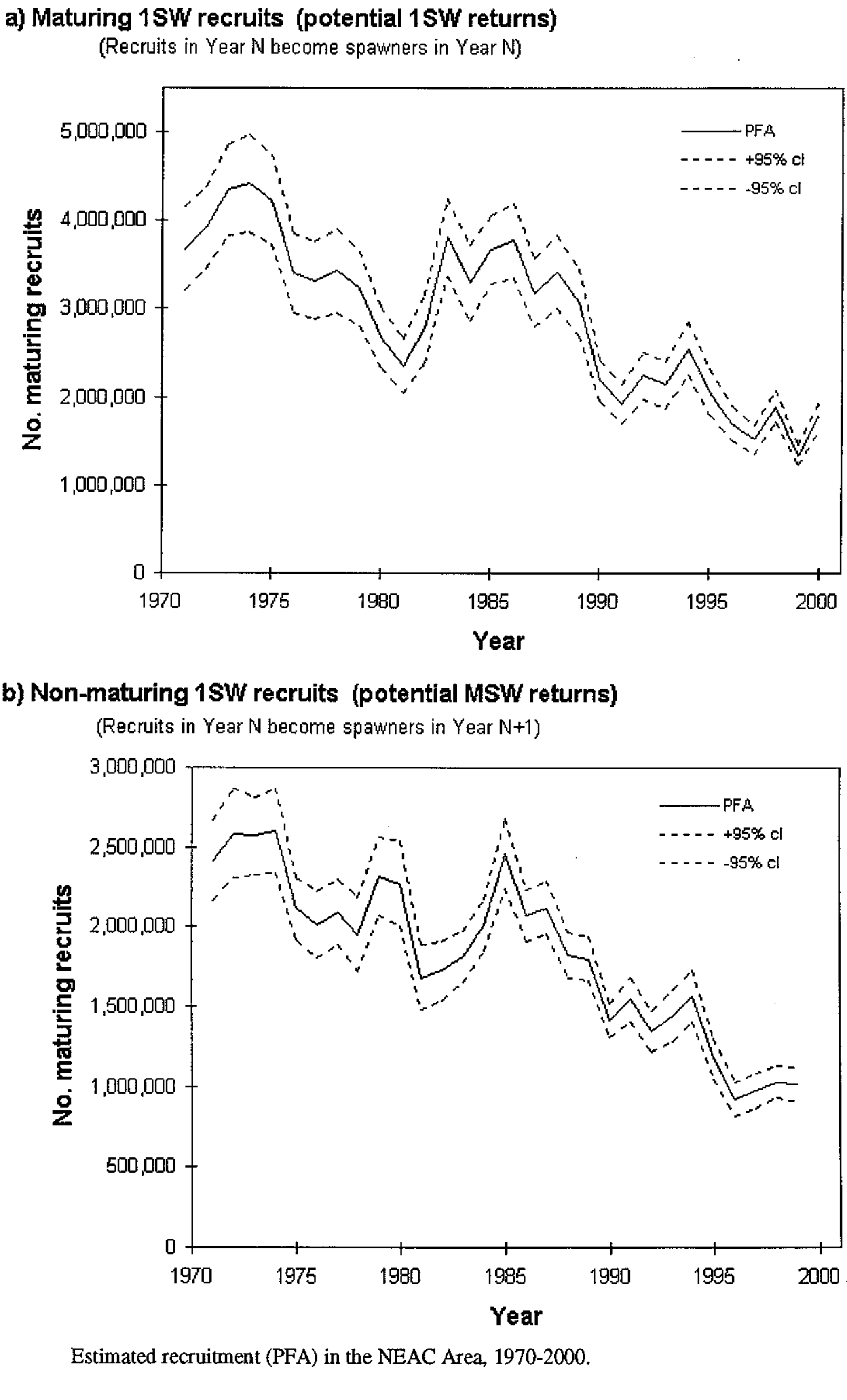
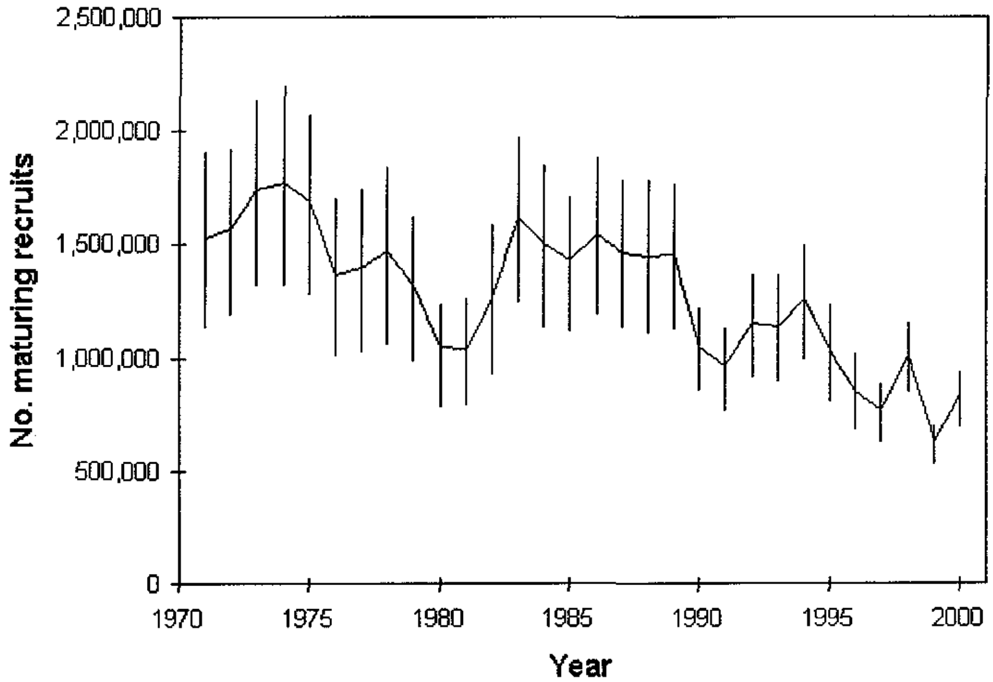


Figure 5.3.1 Estimated recruitment (PFA) in the NEAC Area, 1970-2000.

a) 1SW spawners (and 95% confidence limits)



b) MSW spawners (and 95% confidence limits)

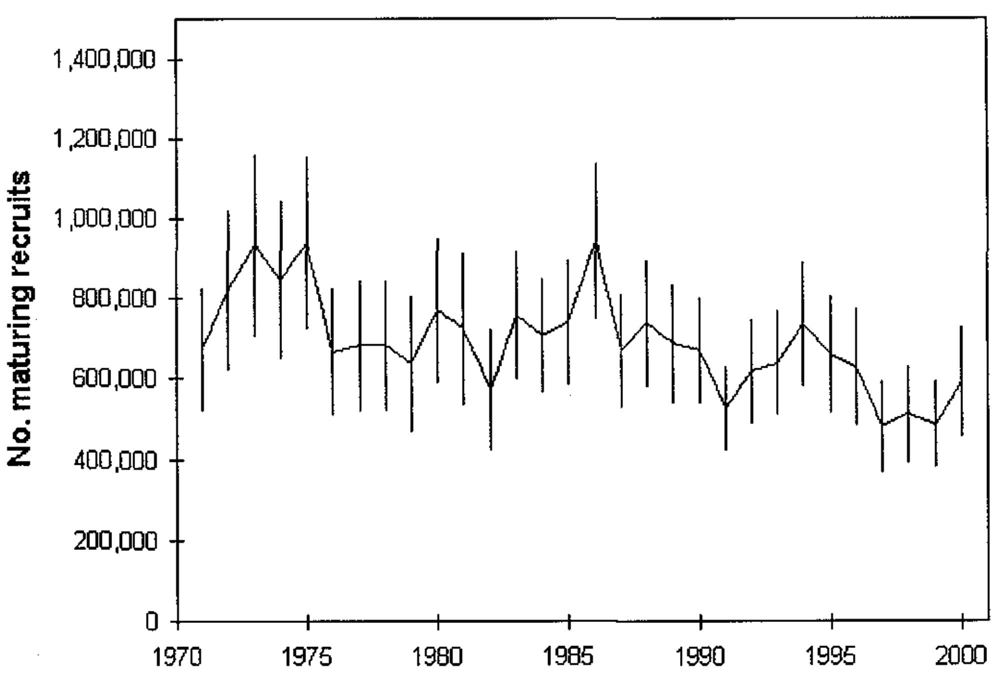
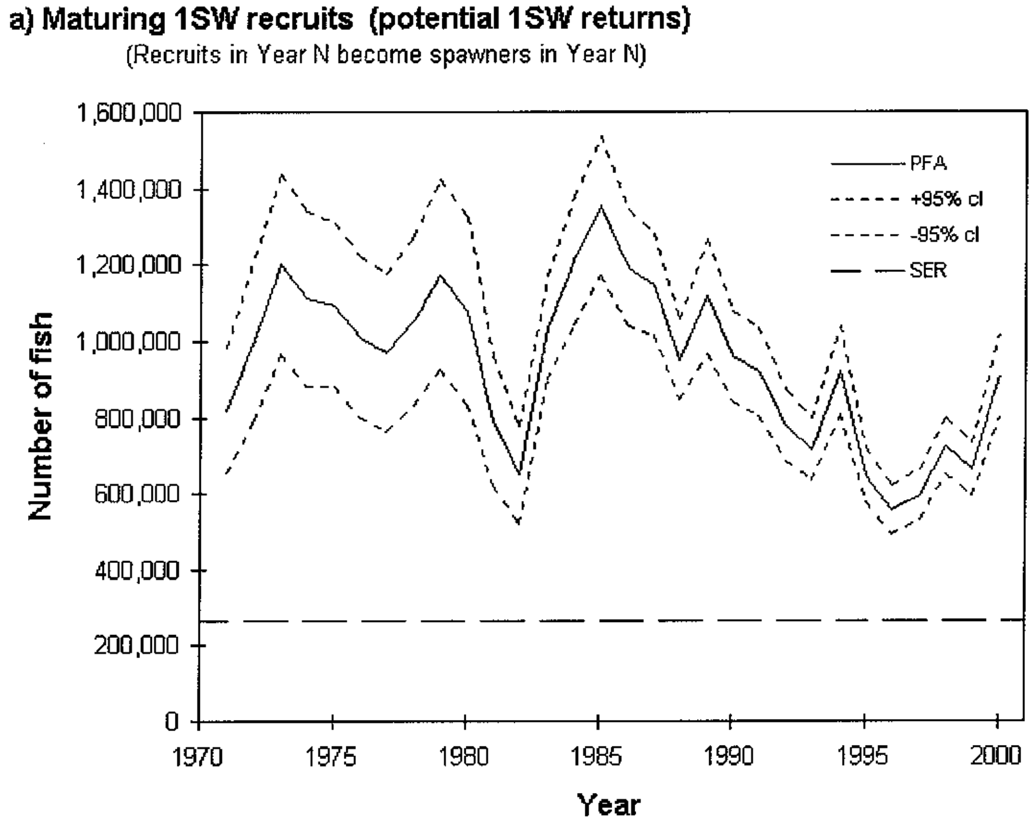


Figure 5.3.2 Estimated spawning escapement in the NEAC Area, 1970-2000.



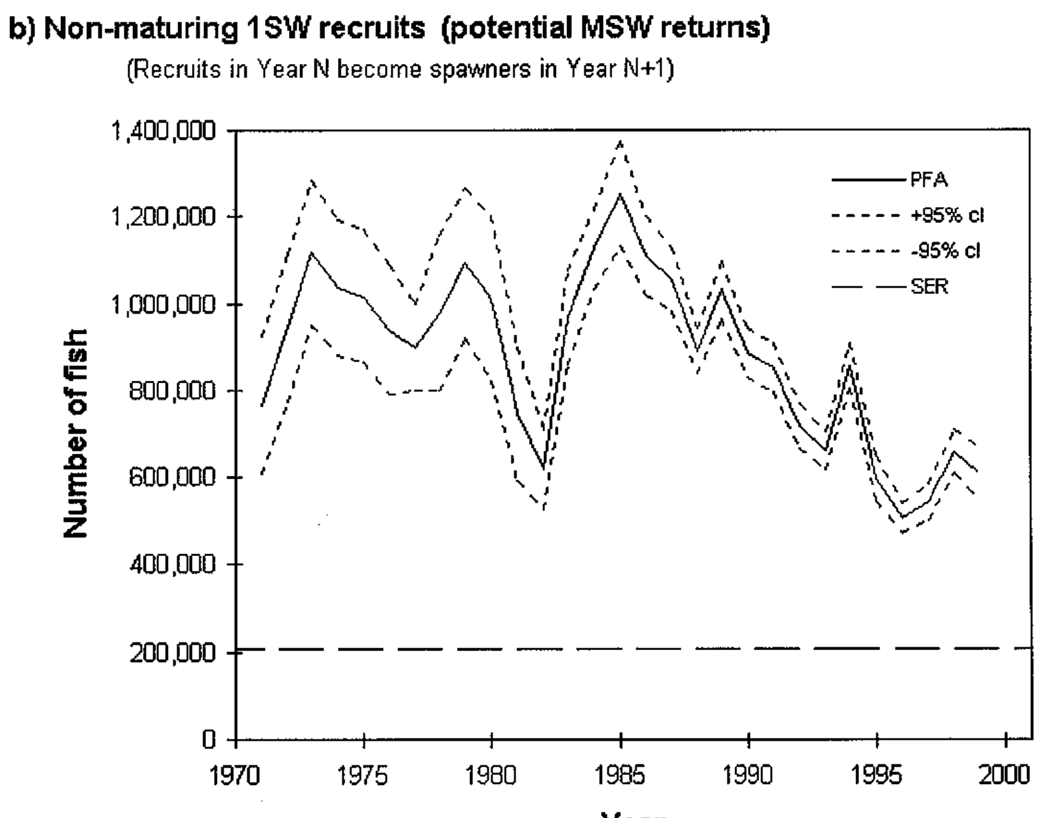
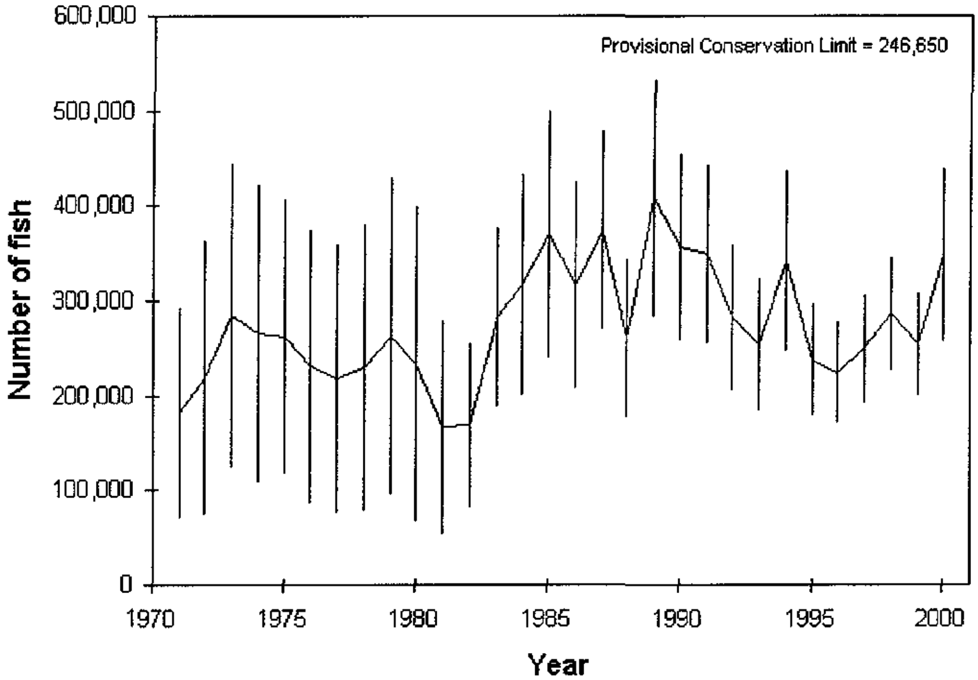


Figure 5.3.3 Estimated recruitment (PFA) and Spawning Escapement Reserve (SER) for maturing and non-maturing salmon in Northern Europe, 1971-2000.

a) 1SW spawners (and 95% confidence limits)



b) MSW spawners (and 95% confidence limits)

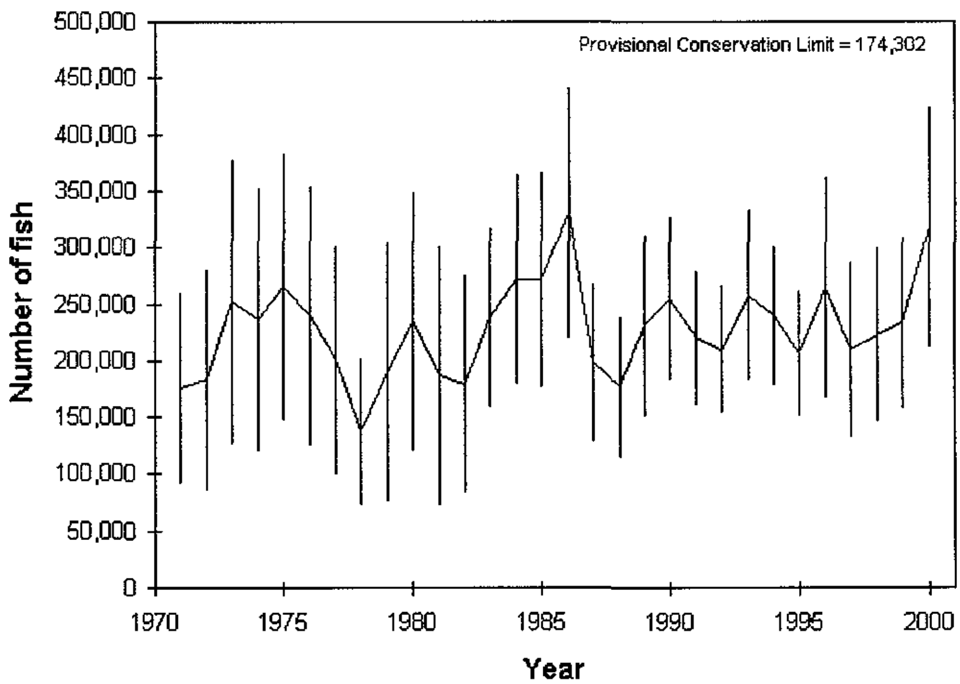


Figure 5.3.4 Estimated spawning escapement of maturing and non-maturing salmon in Northern Europe, 1971-2000.

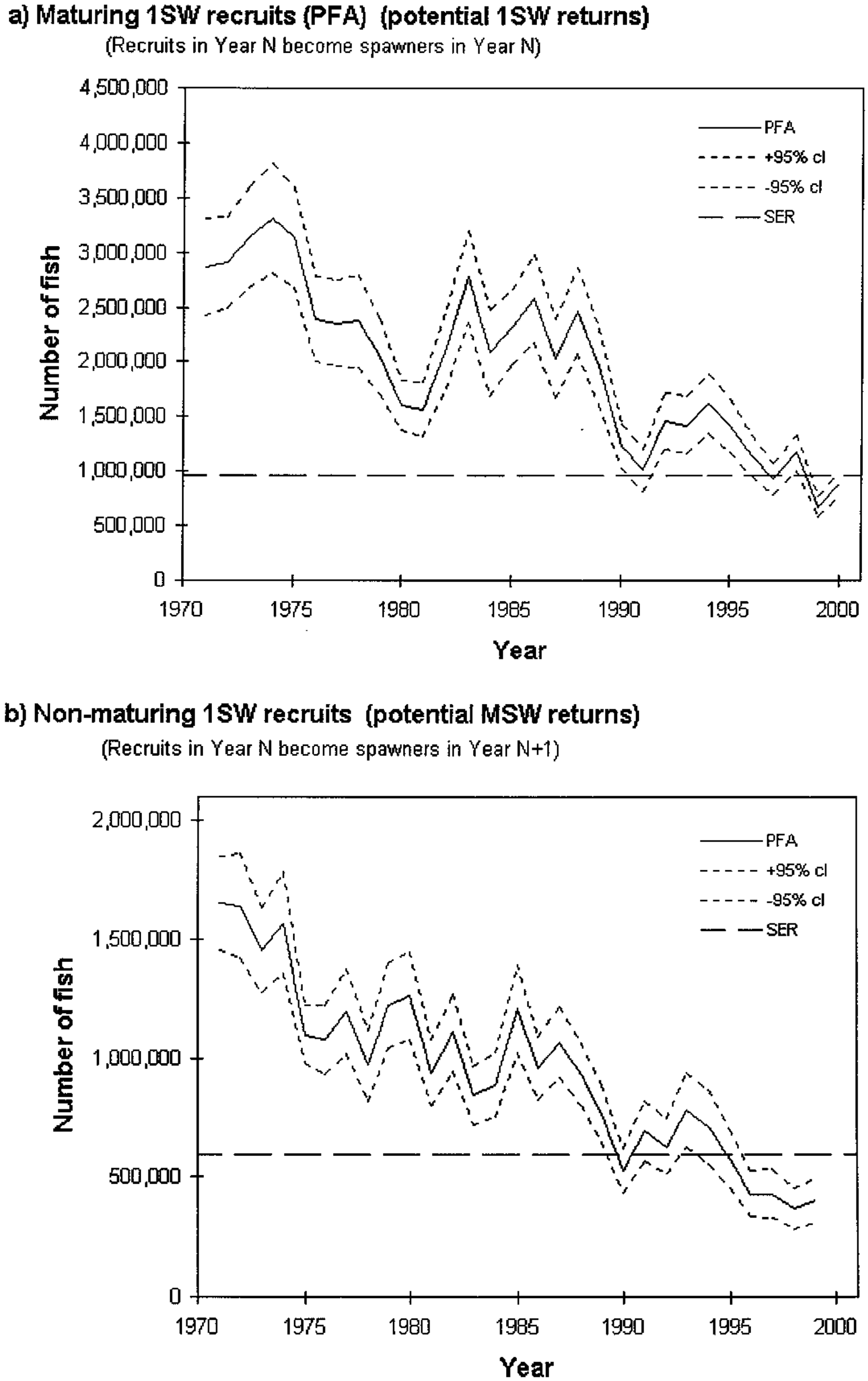
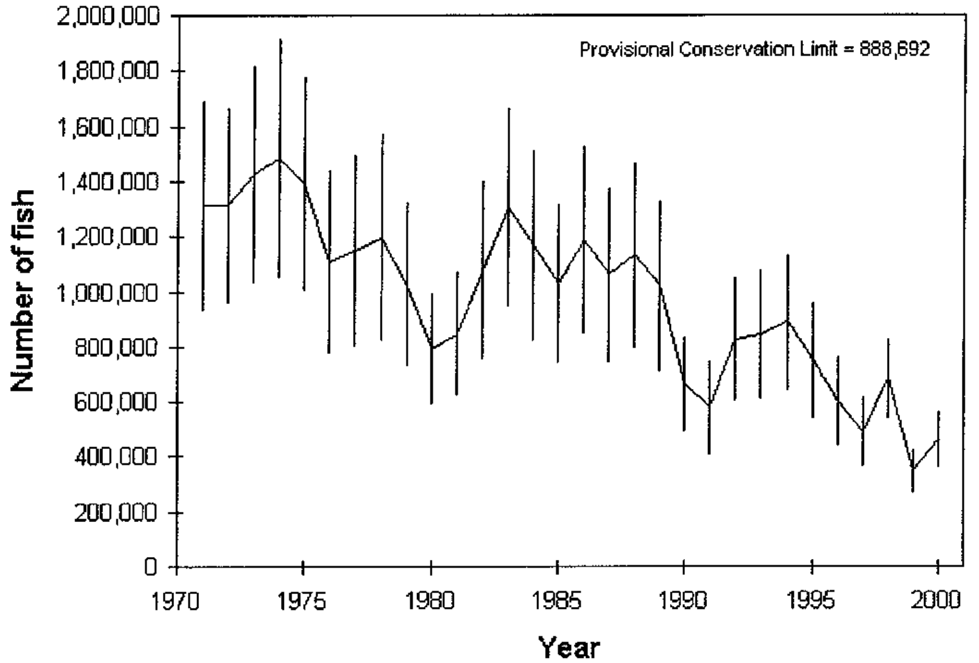


Figure 5.3.5 Estimated recruitment (PFA) and Spawning Escapement Reserve (SER) for maturing and non-maturing salmon in Southern Europe, 1971-2000.

a) 1SW spawners (and 95% confidence limits)



b) MSW spawners (and 95% confidence limits)

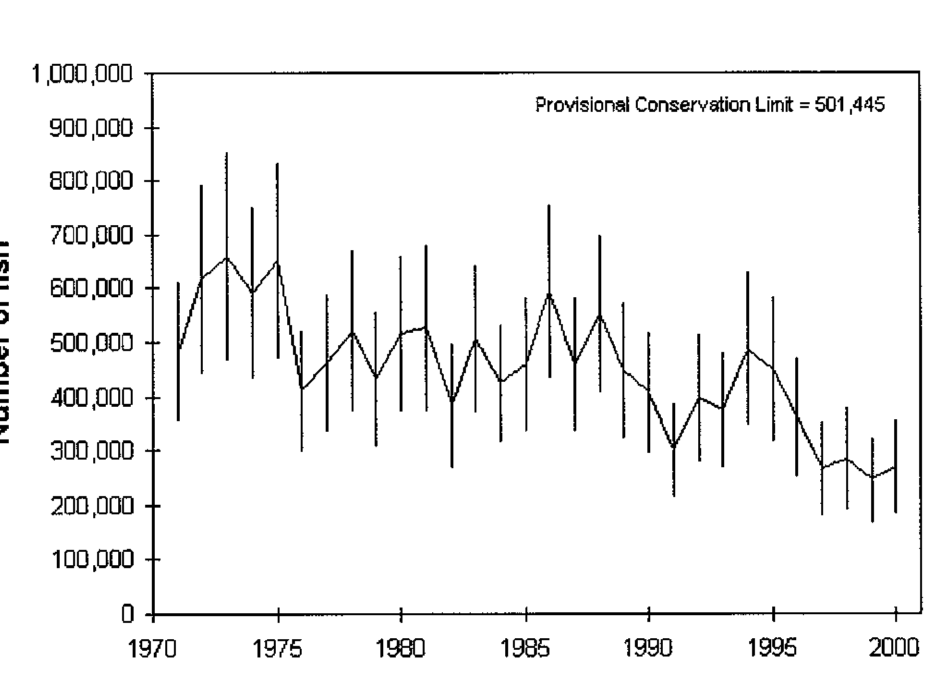


Figure 5.3.6 Estimated spawning escapement of maturing and non-maturing salmon in Southern Europe, 1971-2000.

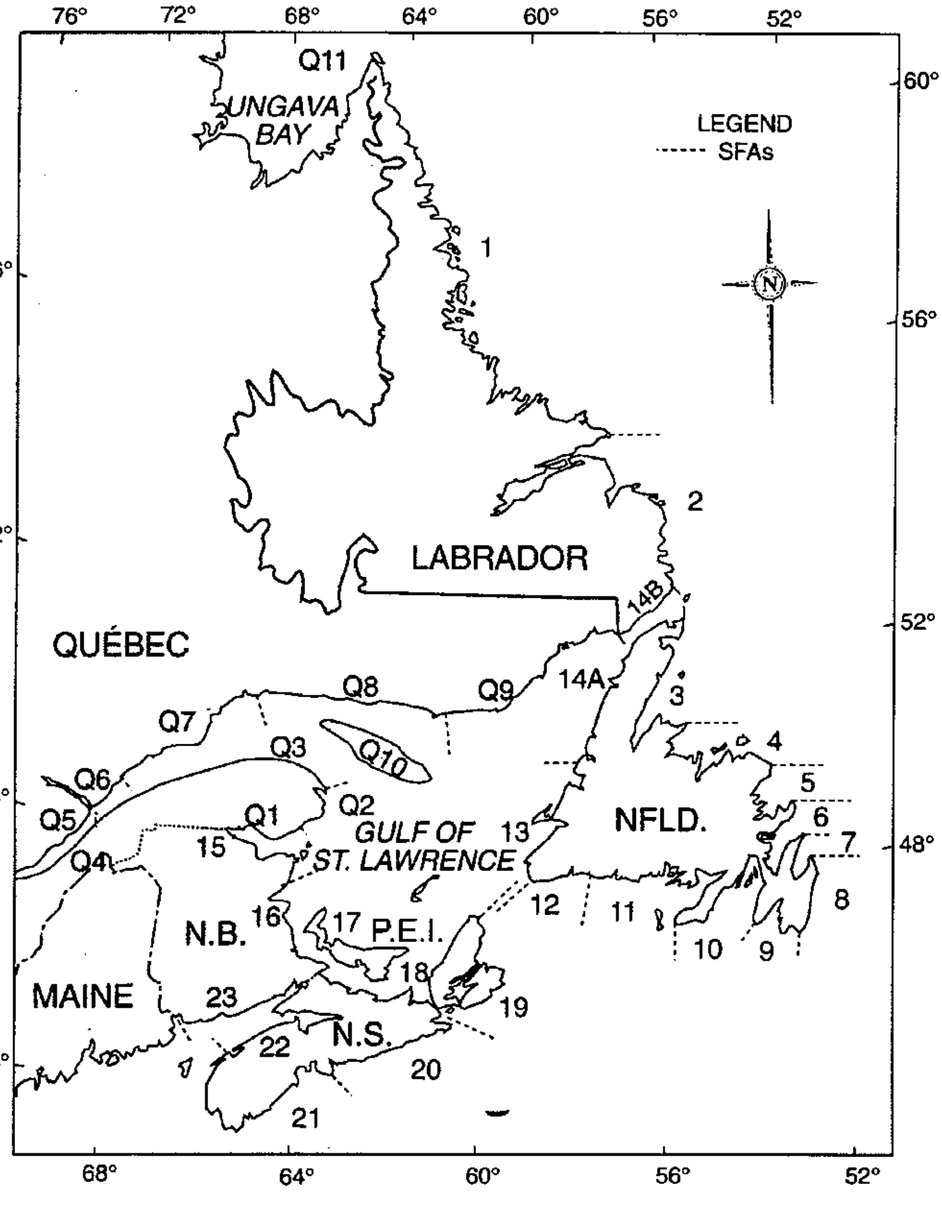


Figure 6.1.1.1 Map of Salmon Fishing Areas (SFAs) and Quebec Management Zones (Qs) in Canada.

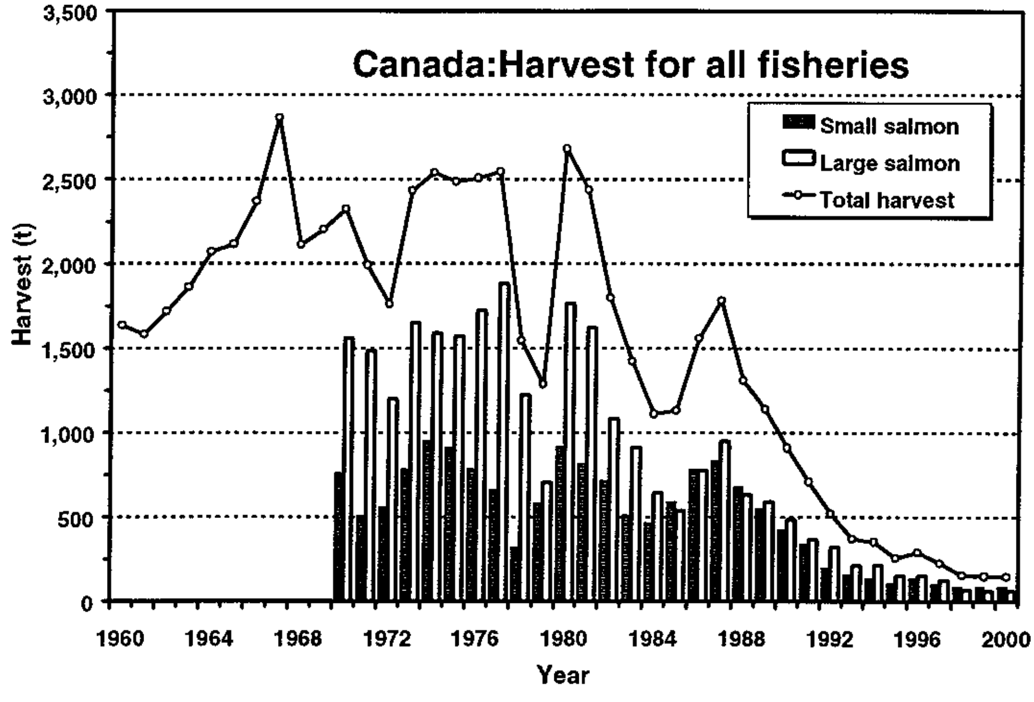


Figure 6.1.1.2 Harvest (t) of small salmon, large salmon, and combined in Canada, 1960-2000 by all users.

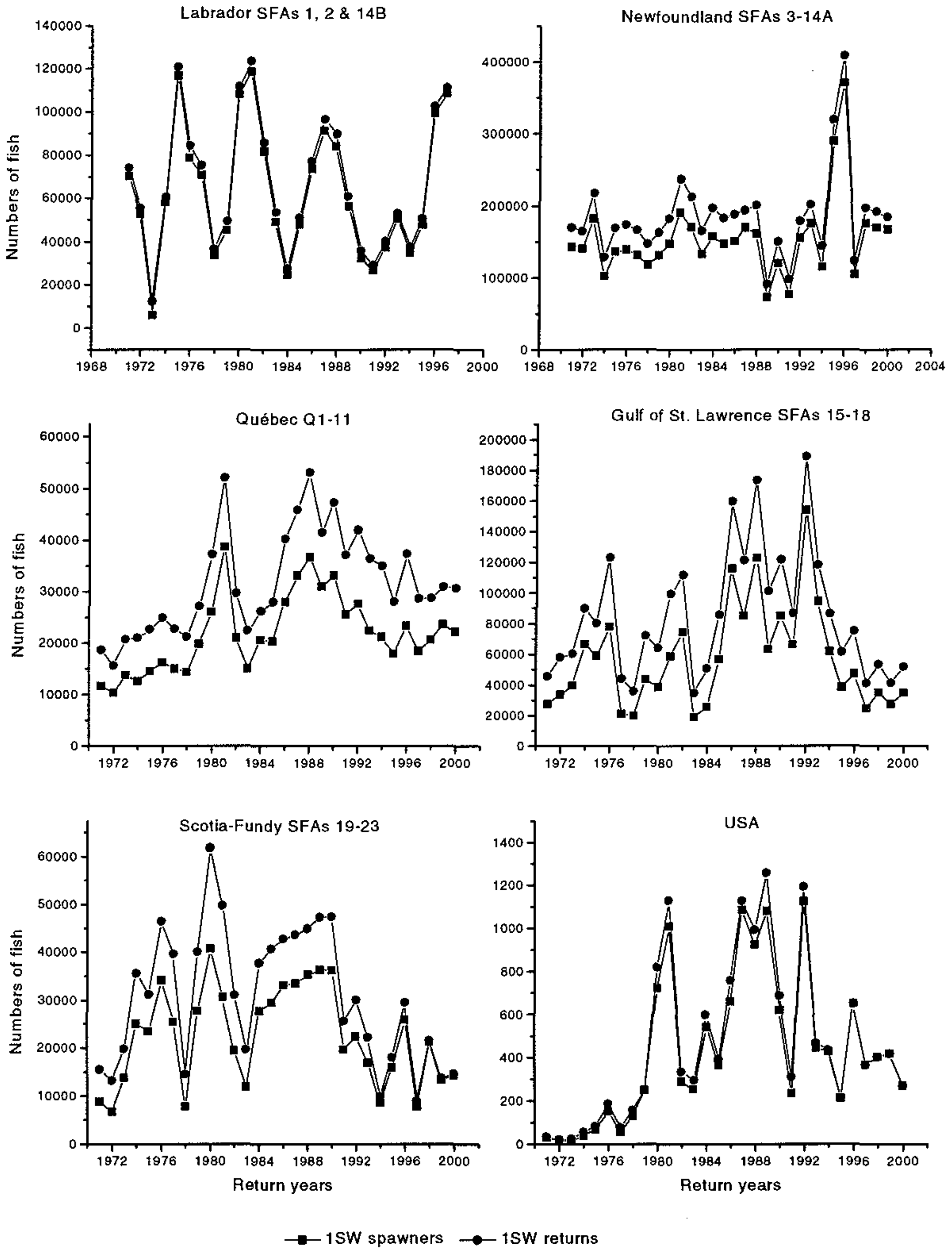


Figure 6.1.2.1 Comparison of estimated mid-points of 1SW returns to and 1SW spawners in rivers of six geographic areas in North America. Returns and spawners for Scotia-Fundy do not include those from SFA 22 and a portion of SFA 23.

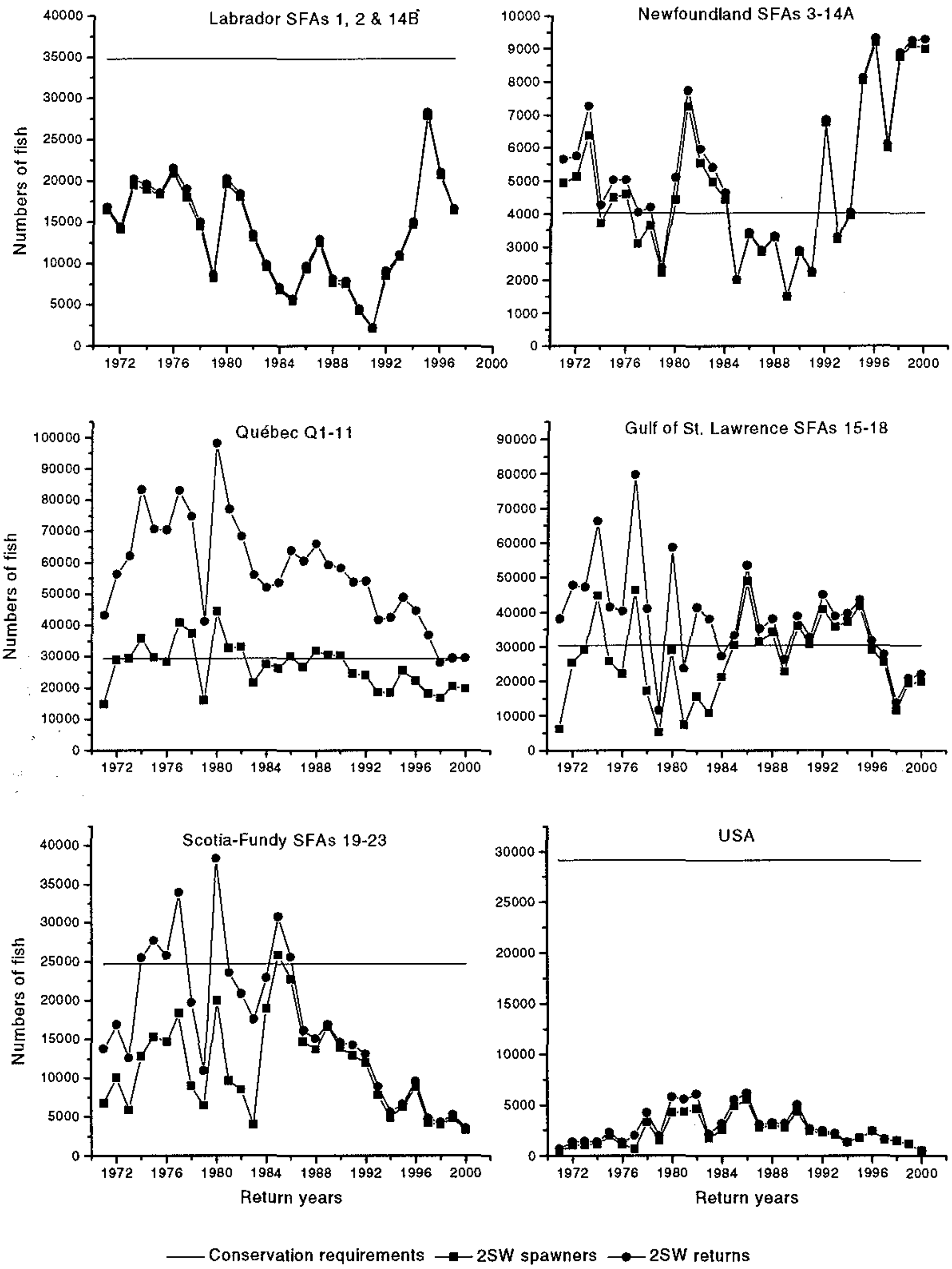


Figure 6.1.2.2 Comparison of estimated mid-points of 2SW returns, 2SW spawners, and 2SW conservation requirements for six geographic areas in North America. Returns and spawners for Scotia-Fundy do not include those from SFA 22 and a portion of SFA 23.

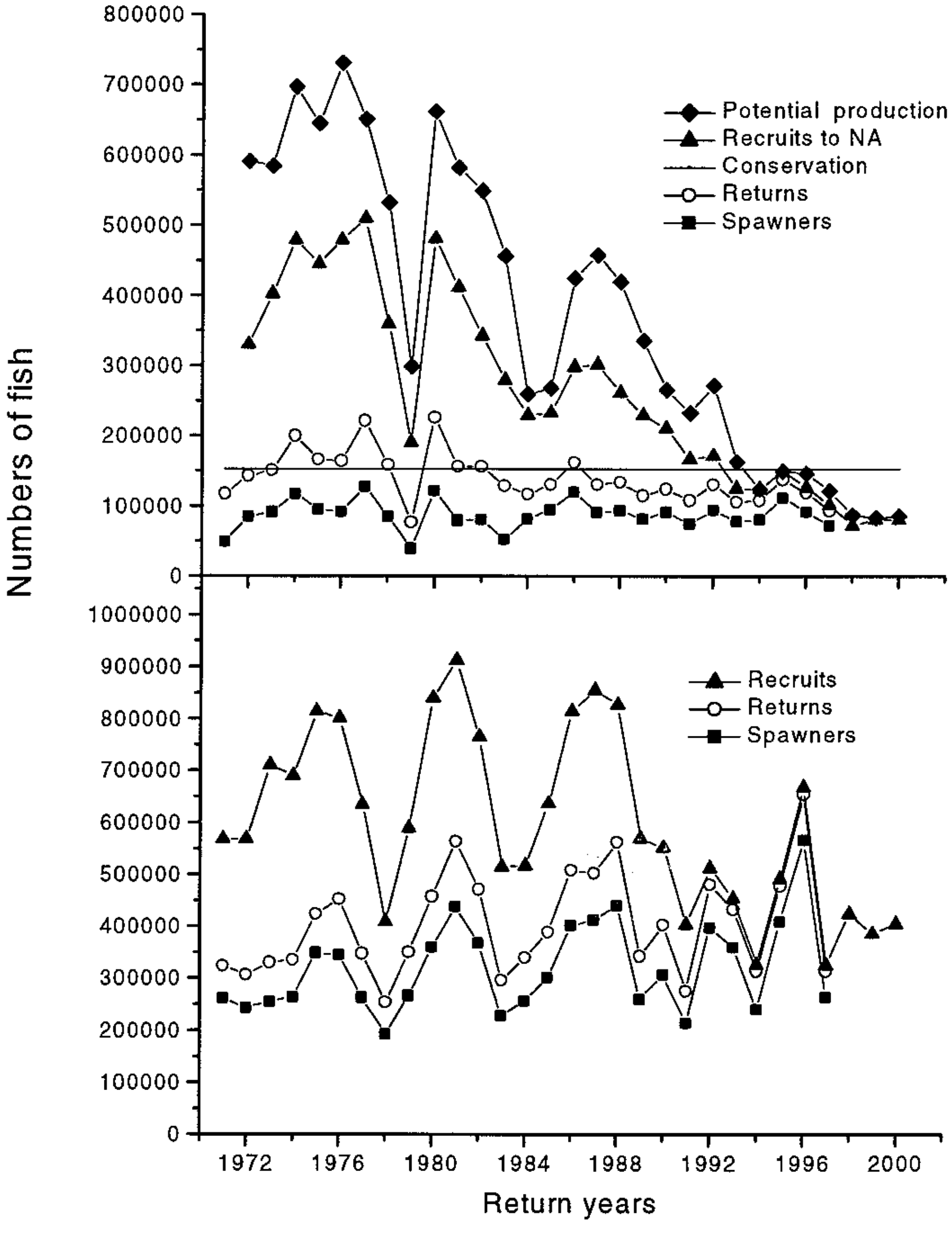


Figure 6.1.2.3 Top panel: comparison of estimated potential 2SW production prior to all fisheries, 2SW recruits available to North America, 1971-2000 and 2SW returns and spawners for 1971-1997, as 1998-2000 data for Labrador are unavailable. The horizontal line indicates the2SW spawner requirements. Bottom panel: comparison of potential maturing 1SW recruits, 1971-2000 and returns and 1SW spawners for 1971-97 return years as Labrador data for 1998-2000 are unavailable.

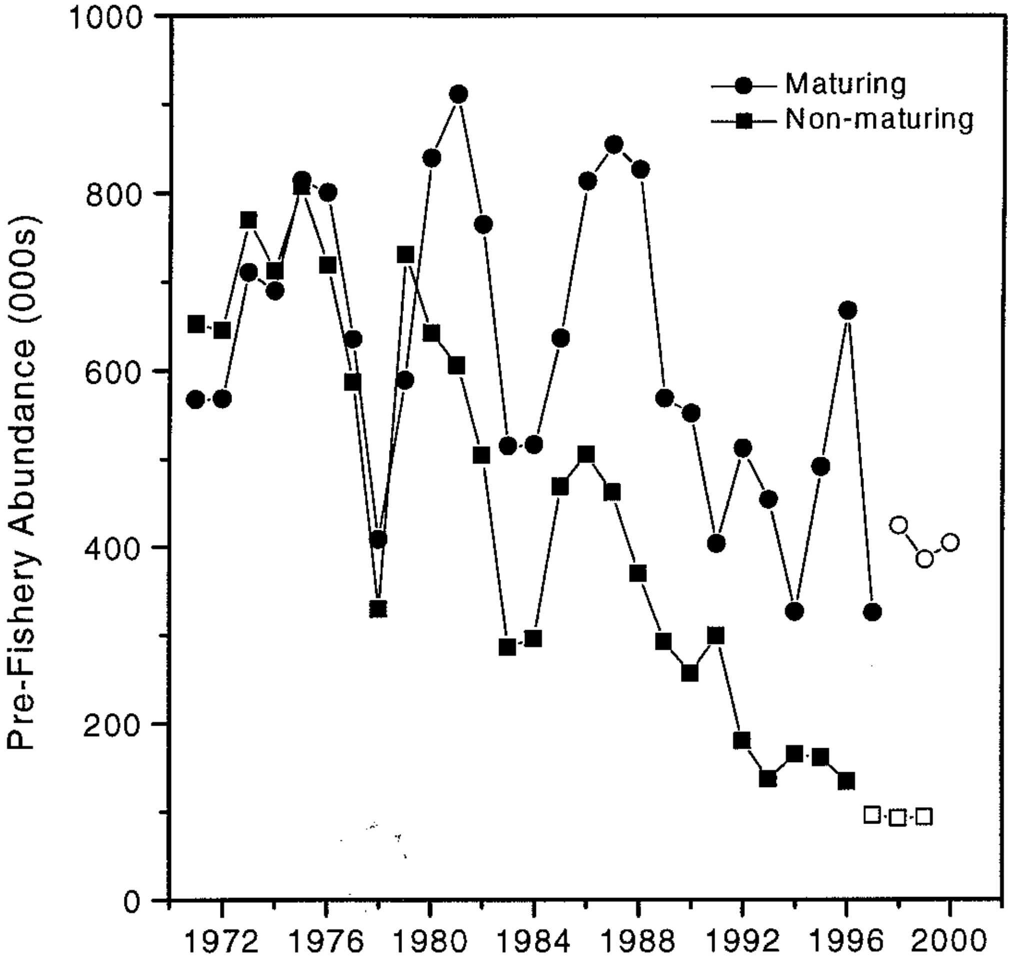


Figure 6.1.2.4 Pre-fishery abundance estimate of maturing and non-maturing salmon in North America. Open circles are for the years that returns to Labrador were assumed as a proportion of returns to other areas in North America.

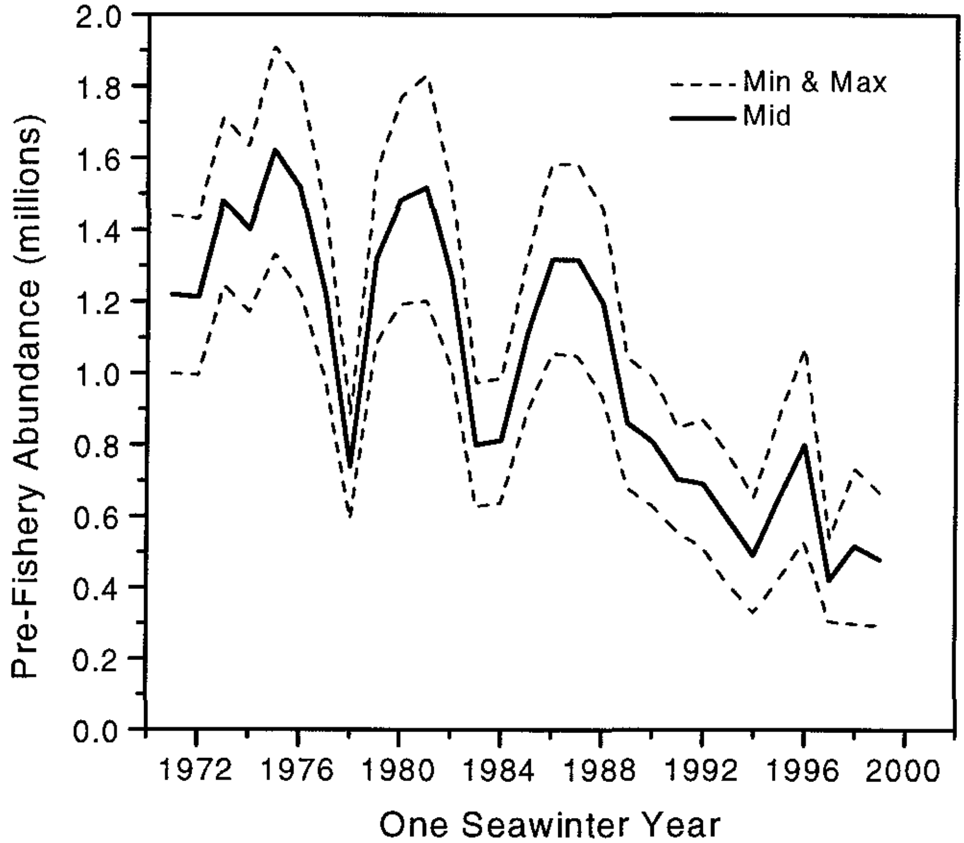
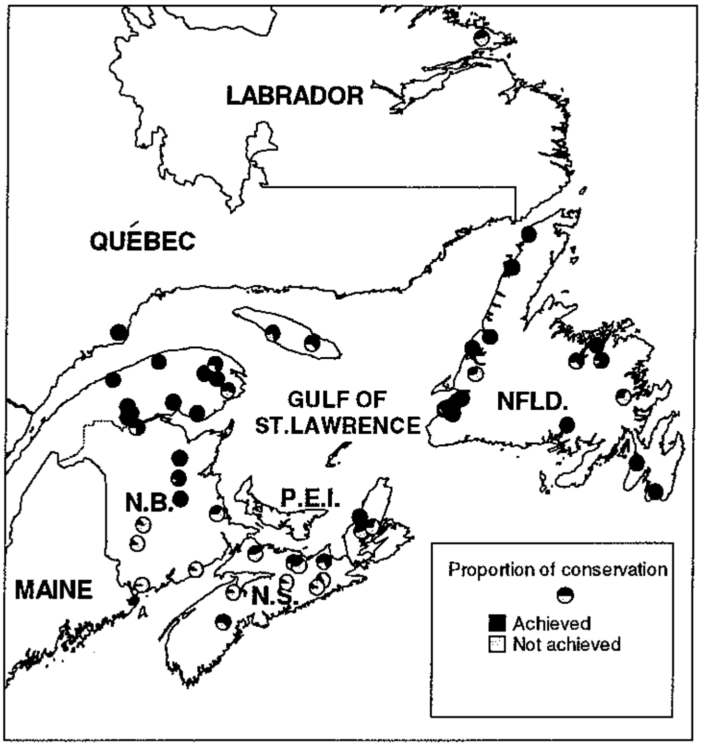


Figure 6.1.2.5 Total 1SW recruits (non-maturing and maturing) originating in North America.



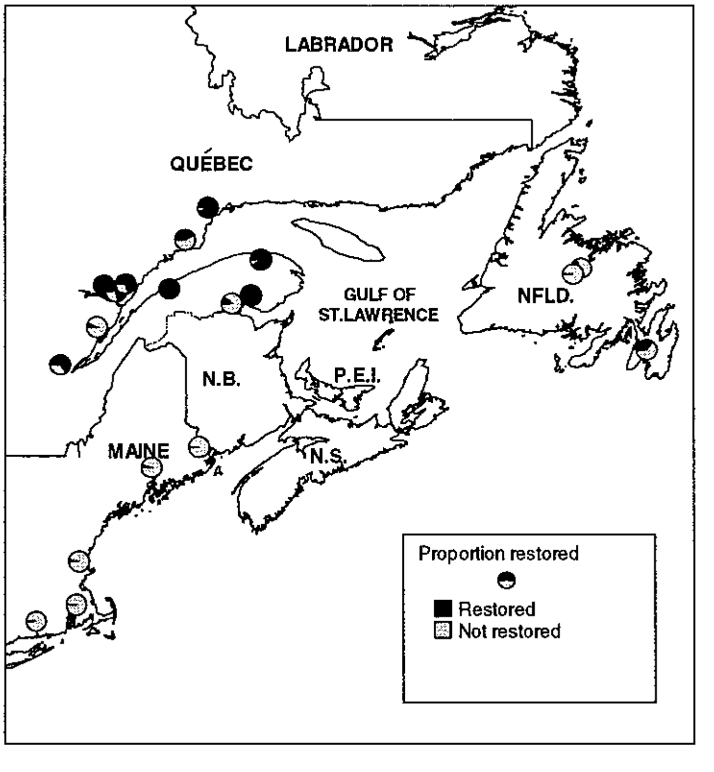


Figure 6.1.2.6 Egg depositions in 2000 relative to conservation requirements in 54 rivers (upper panel) and for 19 rivers of eastern Canada and five rivers of U.S. under colonization or rehabilitation (left panel). The black slice represents the proportion of the conservation requirement achieved in 2000. A solid black circle indicates the egg deposition requirement was attained or exceeded.

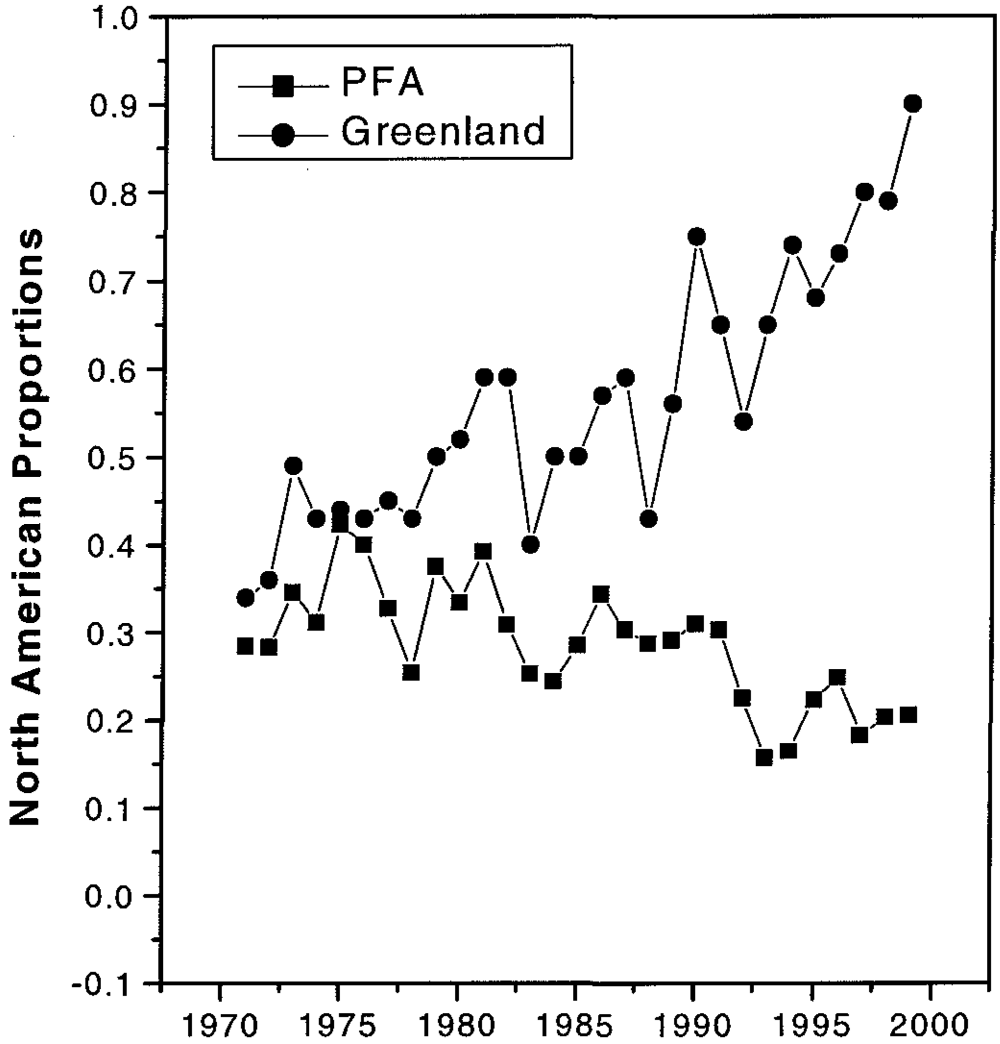


Figure 7.1.3.1 The proportions of North American salmon in samples at West Greenland and in the total pre-fishery abundance of North American and southern European 1SW non-maturing salmon, 1971-1999.

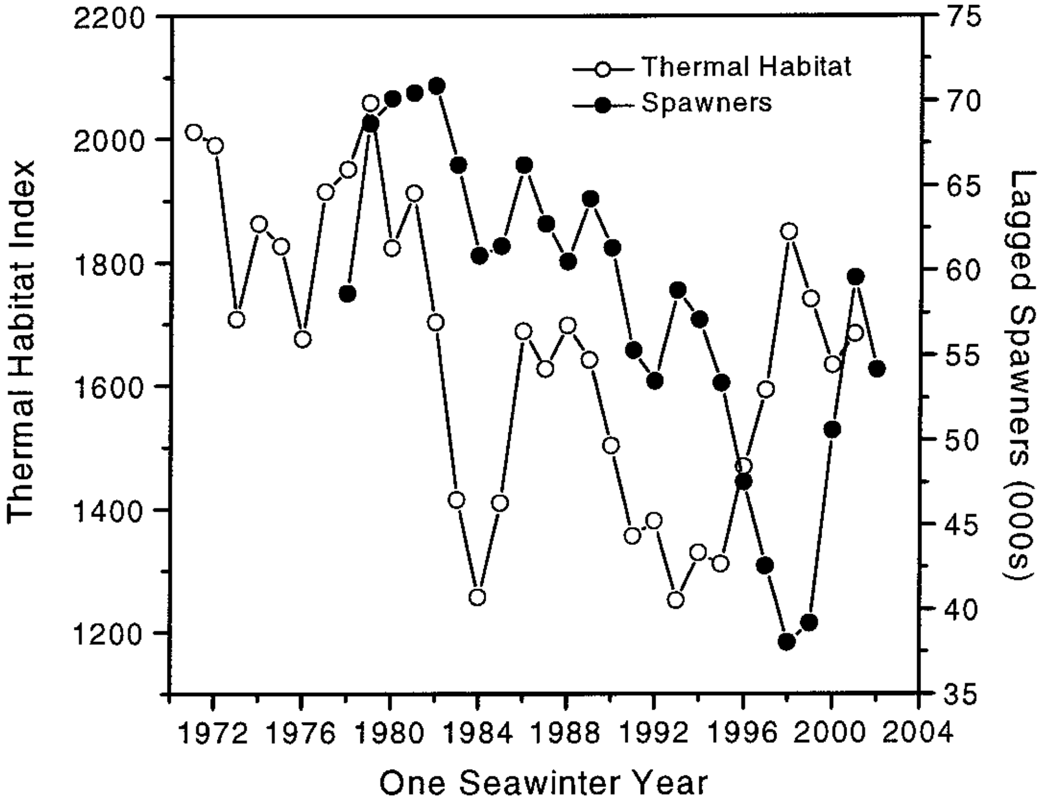


Figure 7.4.1.1 Thermal habitat index for Frebruary (H2) and lagged spawners (SLNQ).

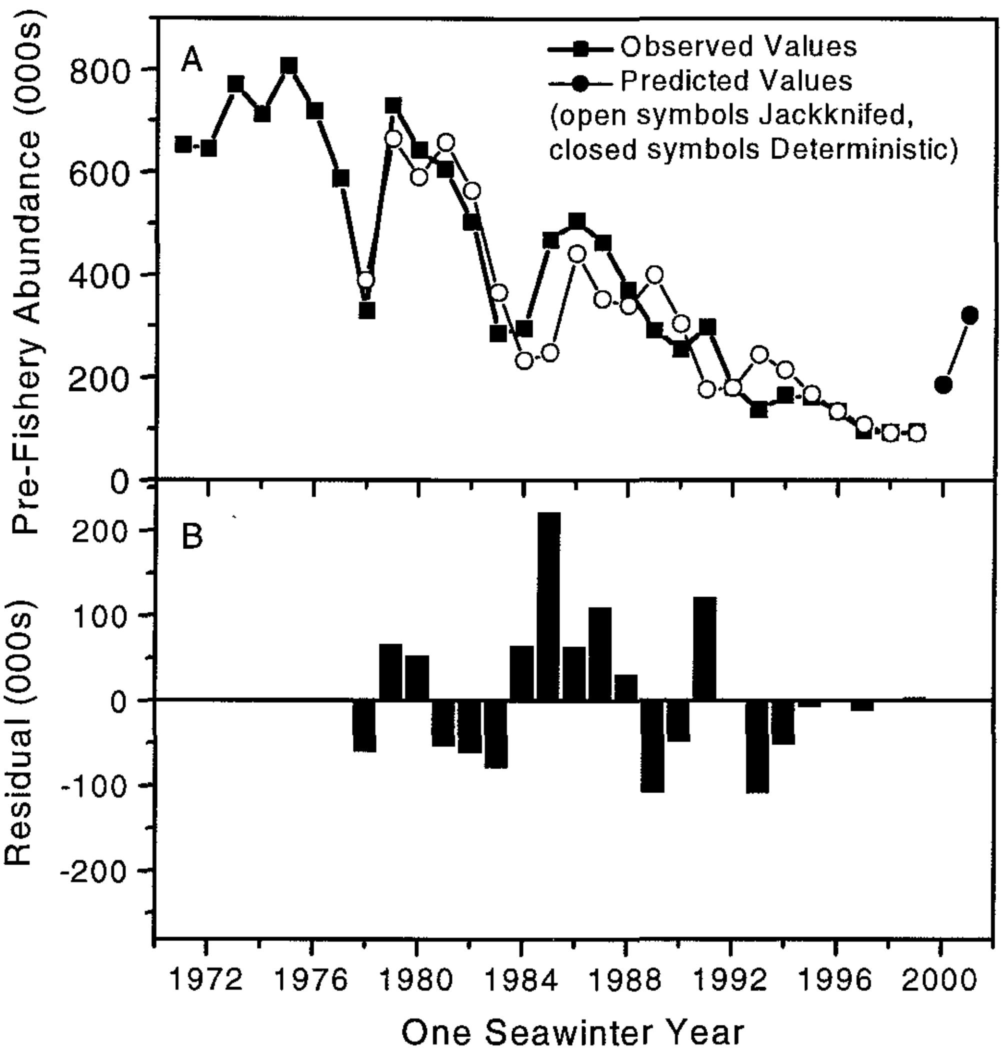


Figure 7.4.2.1 Observed estimates, jackknifed historical predictions, and deterministic forecasts (upper Panel A) of pre-fishery abundance from the multiplicative model. The residual pattern from the jackknifed predictions is shown in the lower panel (Panel B).

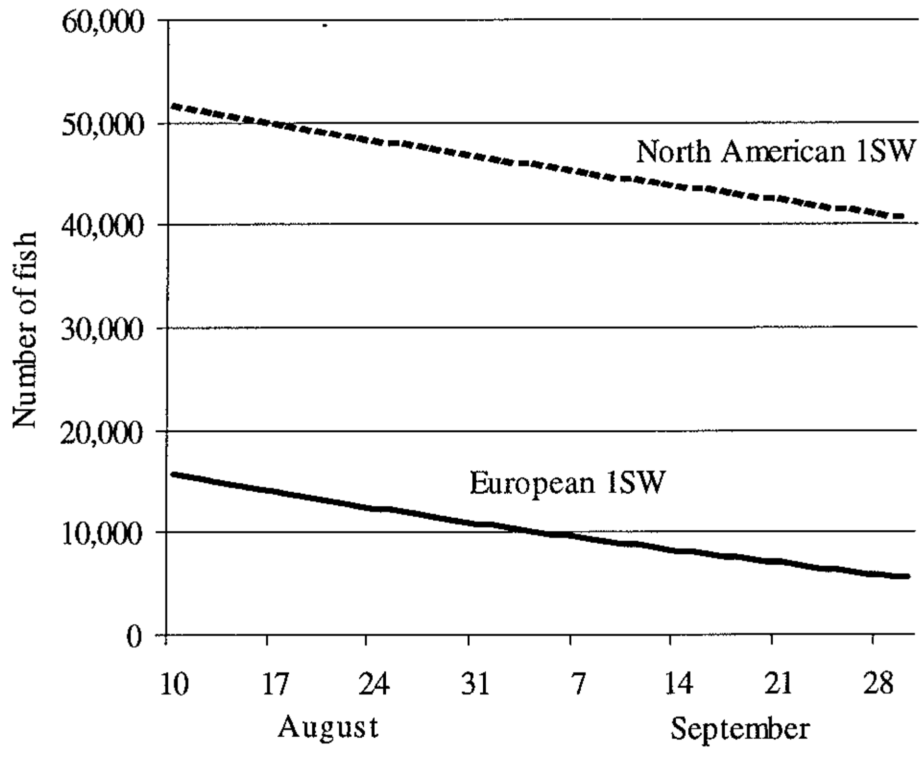


Figure 7.4.3.1 Number of fish yielding a 200 t quota, relative to changes in the median date of the fishery and associated changes in mean weight of fish harvested.

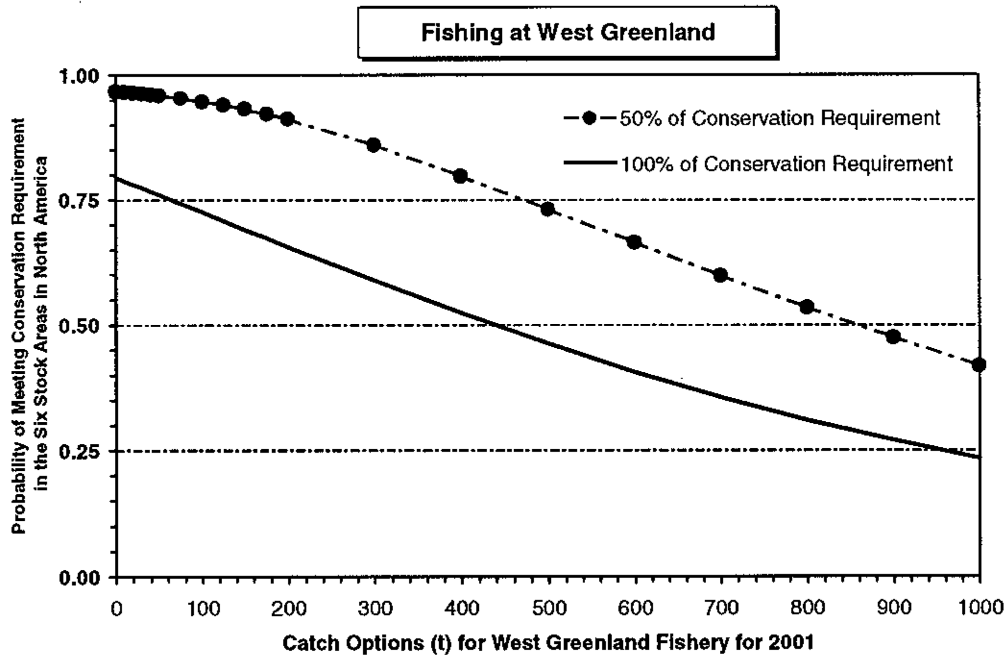


Figure 7.4.4.1 Risk analysis (probability of meeting the conservation requirement simultaneously in the six stock areas in North America) of catch options on the pre-fishery 1SW non-maturing salmon component in 2001.

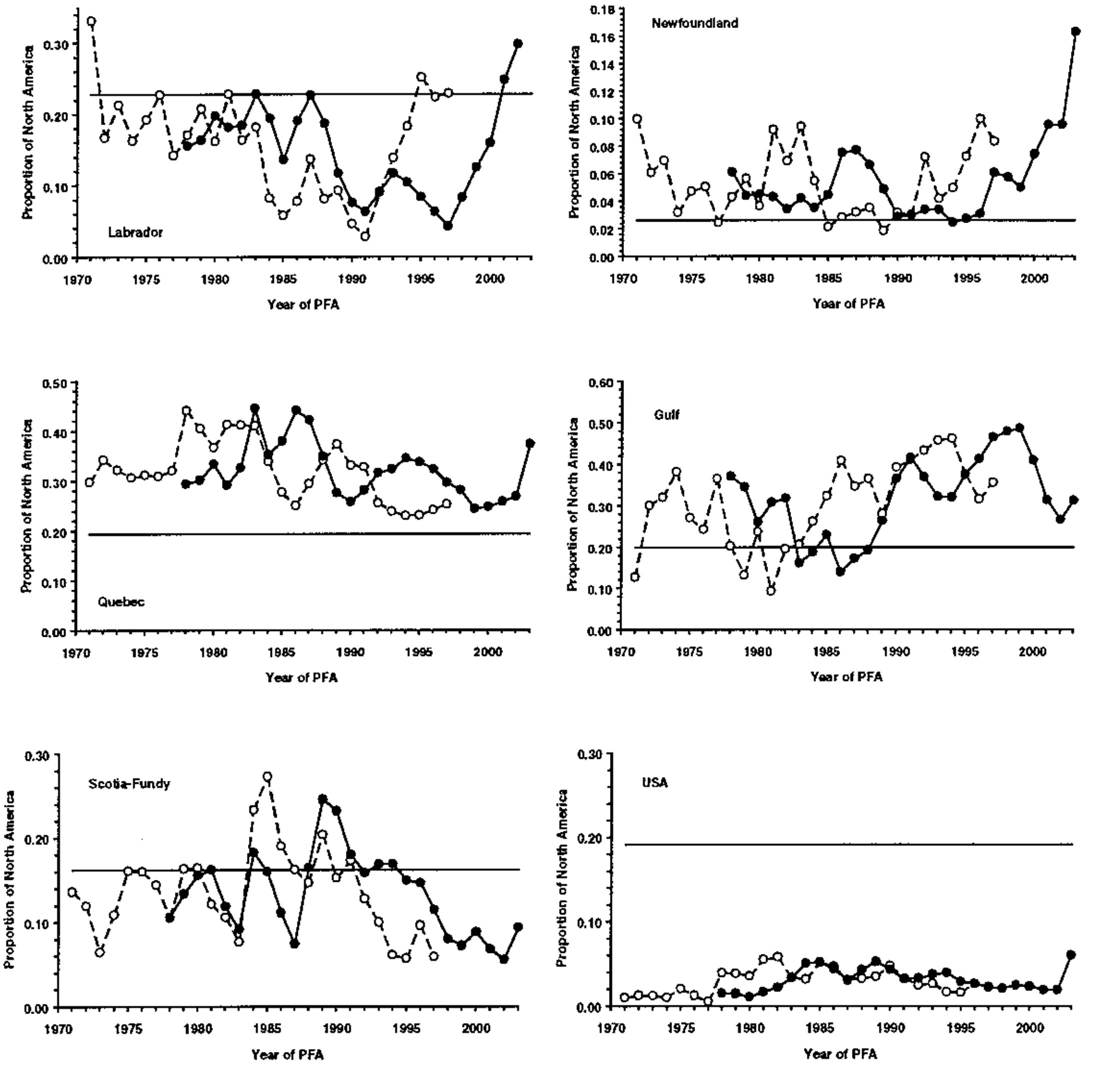


Figure 7.4.4.2 Proportion of spawners (mid-points) lagged to year of PFA (solid circles) and as returns to rivers (open circles) in six geographic areas of North America relative to the total lagged spawner or annual spawning escapement to North America. The horizontal line represents the theoretical spawner proportions for each area based on the 2SW spawner requirement for North America.

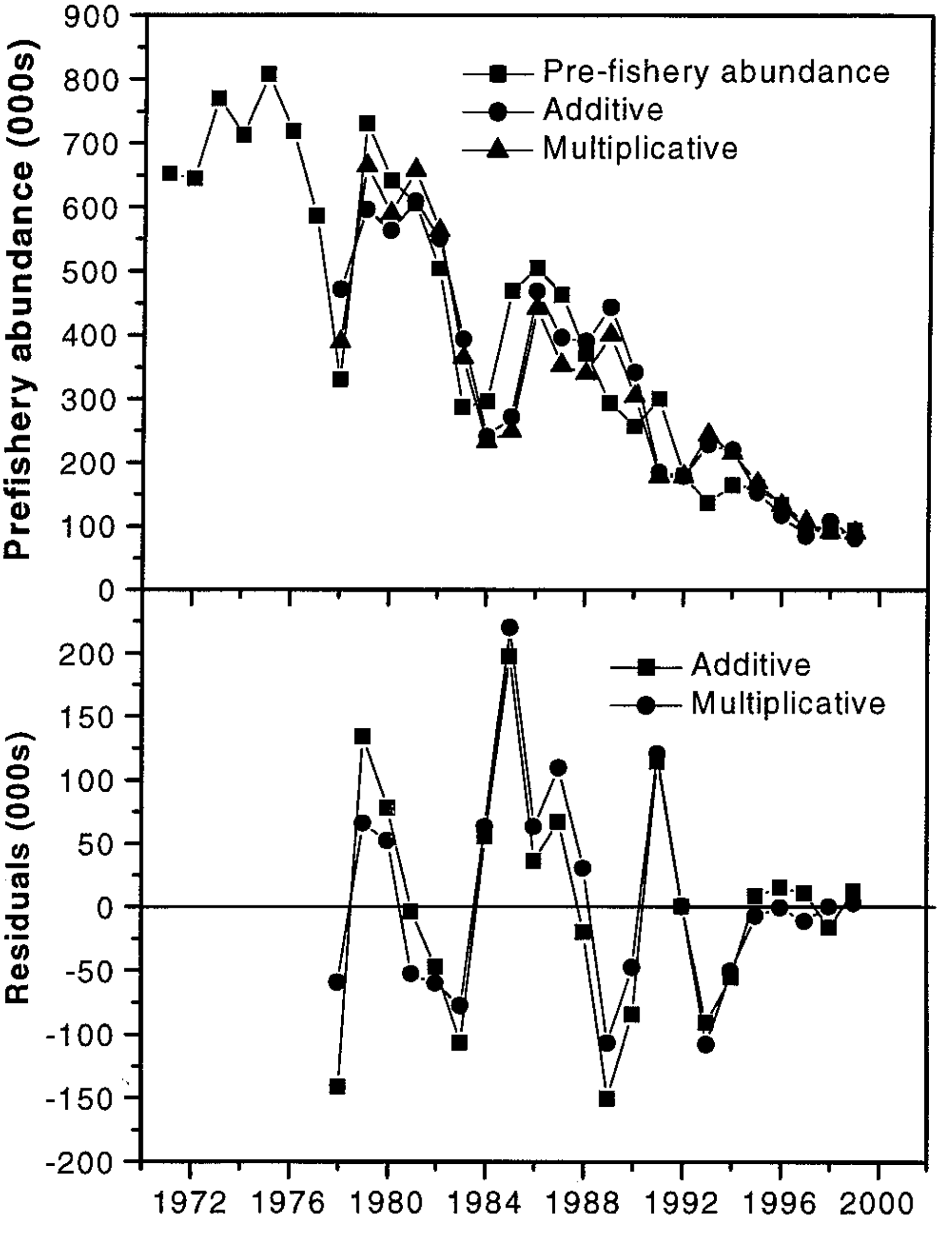


Figure 7.5.1 Observed estimates, jacknifed historical predictions (upper panel) of pre-fishery abundance. The residual pattern for the additive and multiplicative forecast models is shown in the lower panel.