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TABLE OF CONTENTS

PART 2

Section		Page

Section	Page

ACFM REPORT 1998 – PART 2

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 80 mm and 80 mm 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 12.2 m 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 Belgium 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 70 mm nets and 75 mm square-mesh panels. The larger vessels, including some which normally target roundfish, may use twin trawls with 80 mm 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

This year, ICES introduced a new definition of safe biological limits, with reference to precautionary biomass and fishing mortality reference points.

The stock of cod is considered to be outside safe biological limits: The spawning biomass is below the proposed $\mathbf{B}_{pa}$ and fishing mortality exceeds $\mathbf{F}_{pa}$. Fishing mortality on cod increased progressively throughout the 1980s. During the early 1990s, the spawning stock declined rapidly and is presently dominated by only a few age classes. 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. A combination of reduced fishing effort in the England/Wales fleet, targeting of haddock and a switch to twin trawling for *Nephrops* by some pelagic trawlers appears responsible for a substantial decline in fishing mortality on cod in 1995 and 1996.

The stock of whiting is also considered to be outside safe biological limits, both in terms of biomass and of fishing mortality. 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. It fell to a record low in 1997 despite the very strong 1991 year class.

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.

The stock of plaice is considered to be within safe biological limits. The landings declined in the 1990s, and in 1997 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 has been below average throughout the decade. If fishing mortality remains below $\mathbf{F}_{pa}$ as at present, 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 considered to be outside safe biological limits. It has benefited several times since 1970 from very strong year classes, and as a onsequence has sustained fishing mortalities that are considered high for a sole stock. The frequency of such year classes has decreased since the mid-1980s, leading to a decline in spawning stock to a historical low in 1997.

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/fishery: This stock is considered to be outside safe biological limits. F has decreased in recent years, but still exceeds the proposed $\mathbf{F_{pa}}$.

High fishing mortality rates from the mid 1980s resulted in SSB declining sharply until 1995. SSB has increased slightly since then, but is still below the proposed $\mathbf{B_{pa}}$. The probability of good recruitment appears to have been reduced at the SSBs observed in the 1990s.

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 $\mathbf{B_{pa}}$.

Advice on management: ICES recommends that fishing mortality on cod should be reduced below the proposed $\mathbf{F_{pa}}$ (0.72) corresponding to landings in 1999 of less than 4 900 t in order to rebuild SSB above $\mathbf{B_{pa}}$ (10 000 t). This is unlikely to be achieved in the short term.

Reference points:

ICES considers that:	ICES proposes that:
$\mathbf{B_{lim}}$ is 6 000 t, the lowest observed spawning stock.	$\mathbf{B_{pa}}$ 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 declines.

Technical basis:

$\mathbf{B_{lim} = B_{loss}}$	$\mathbf{B_{pa}}$ = Previous MBAL and signs of reduced recruitment
$\mathbf{F_{lim} = F_{med}}$	$\mathbf{F_{pa} = F_{med}}$ x 0.72

Relevant factors to be considered in management: Quota restrictions during the 1990s have resulted in misreporting of landings and deterioration of the quality of commercial catch data available for assessments.

A progressive reduction in overall fishing effort in the Irish Sea, together with low cod quotas, high demand for *Nephrops* and increased availability of haddock, appears responsible for the apparent decline in fishing mortality on cod in 1995 through to 1997. The fishing mortalities observed in the early 1990s have a very high risk of causing stock collapse and must be avoided. The spawning stock is still dominated by only a few age classes and remains susceptible to below-average recruitment. Recruitment following the weak 1992 year class are all below average, and early indications are that the 1998 year class may be very low. This implies that even if F is reduced as recommended by ICES, the SSB in 2000 may be less than the SSB in 1999.

Catch forecast for 1999:

Basis: F(98) = F(95–97) = 0.84, Landings (98) = 6.3, SSB(99) = 9.1.

F (99) onwards	Basis	Catch (99)	Landings(99)	SSB (2000)	Medium-term effect of fishing at given level
0.33	0.4F(95–97)		2.7	11.1	Very low probability of SSB< $\mathbf{B_{pa}}$; F above $F_{0.1}$
0.50	0.6F(95–97)		3.8	9.7	Very low probability of SSB< $\mathbf{B_{pa}}$;F close to F_{max}
0.67	0.8F(95–97)		4.7	8.5	Very low probability of SSB< $\mathbf{B_{pa}}$
0.72	$\mathbf{F_{pa}}$		4.9	8.2	Low probability of SSB< $\mathbf{B_{pa}}$
0.84	1.0F(95–97)		5.5	7.5	Probability of SSB< $\mathbf{B_{pa}}$ around 5%
1.00	1.2F(95–97		6.2	6.6	High probability of SSB < $\mathbf{B_{pa}}$

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

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.

A reduction in fishing mortality from 1995 to 1997 to around 70% of the extremely high fishing mortalities in the early 1990s, is thought to be caused by an overall decline in trawl effort in the Irish Sea and increased targeting of *Nephrops* and haddock.

The F is calculated over a younger age range (2–4) in this assessment than in previous assessments (ages 2–5) which rescales the entire series of F. The present assessment confirms a decline in F in 1995–97, but indicates a smaller decline than the previous assessment. The decline is consistent with the observed reduction in fishing effort on cod. The independent sets of data from commercial fleets and research surveys provide a consistent interpretation of the state of the stock. Recent recruitment appear reasonably well estimated by the five independent survey series.

Analytical assessment based on landings-at-age, commercial CPUE and recruitment indices from surveys in Division VIIa. Estimates of misreported landings included from 1991 onwards.

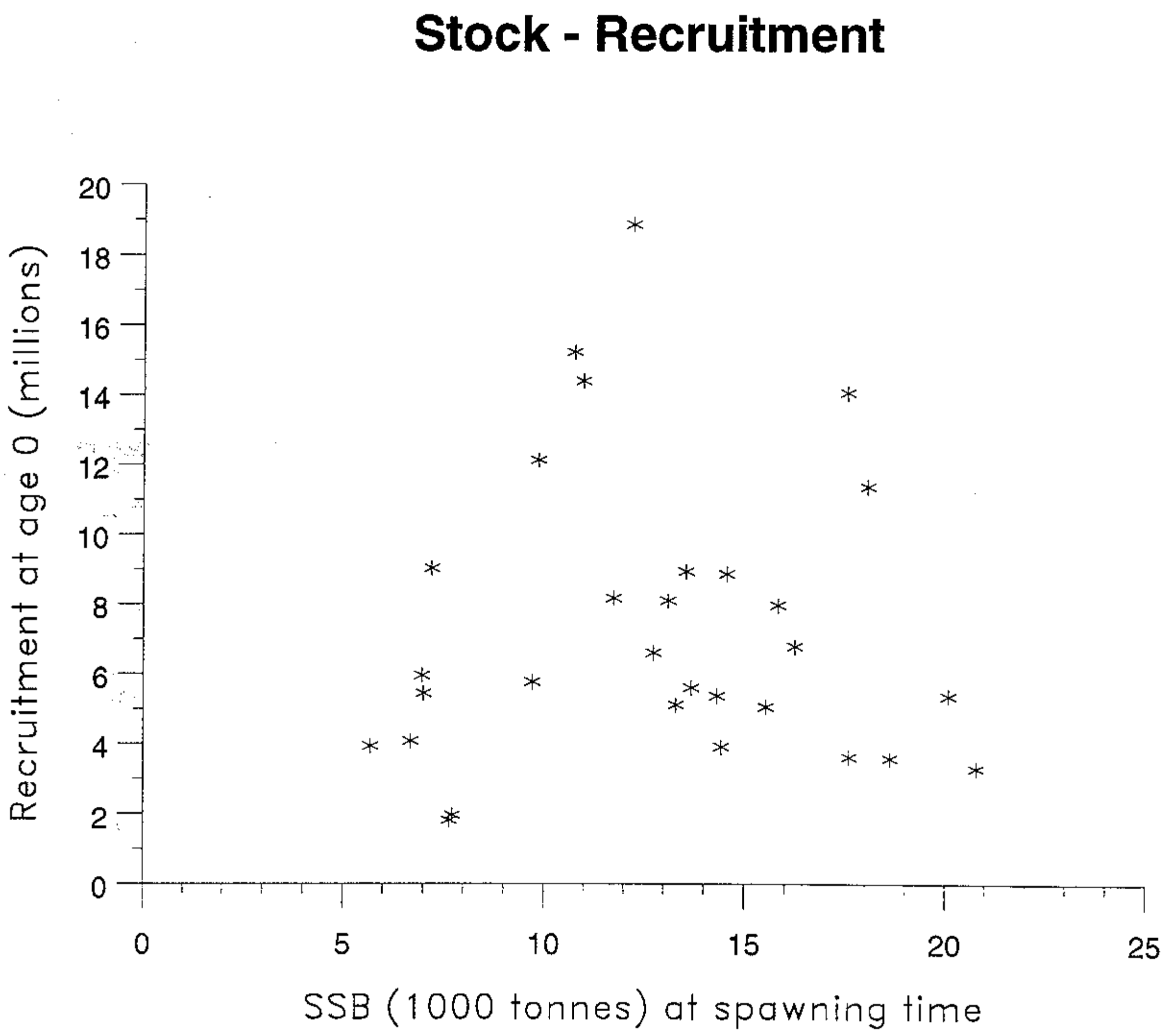
Source of information: Report of the Working Group on the Assessment of Northern Shelf Demersal Stocks, June 1998 (ICES CM 1999/ACFM:1).

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[1]	7.7[2]
1993	$\mathbf{F}_{med}$ ~ 10 200 t	10.2	11.0	5.8[1]	7.6[2]
1994	60% reduction in F	3.7	6.2	4.4[1]	5.4[2]
1995	50% reduction in F	3.9	5.8	4.5[1]	4.6[2]
1996	30% reduction in F	5.4	6.2	5.1[1]	4.8[2]
1997	30% reduction in F	5.9	6.2	2.8[3]	5.7[2]
1998	No increase in F	6.2	7.1		
1999	Reduce F below $\mathbf{F}_{pa}$	4.9			

[1]Preliminary. [2]Including estimates of misreporting. Weights in '000 t. [3]Incomplete data.

Cod in the Irish Sea (Fishing Area VIIa)



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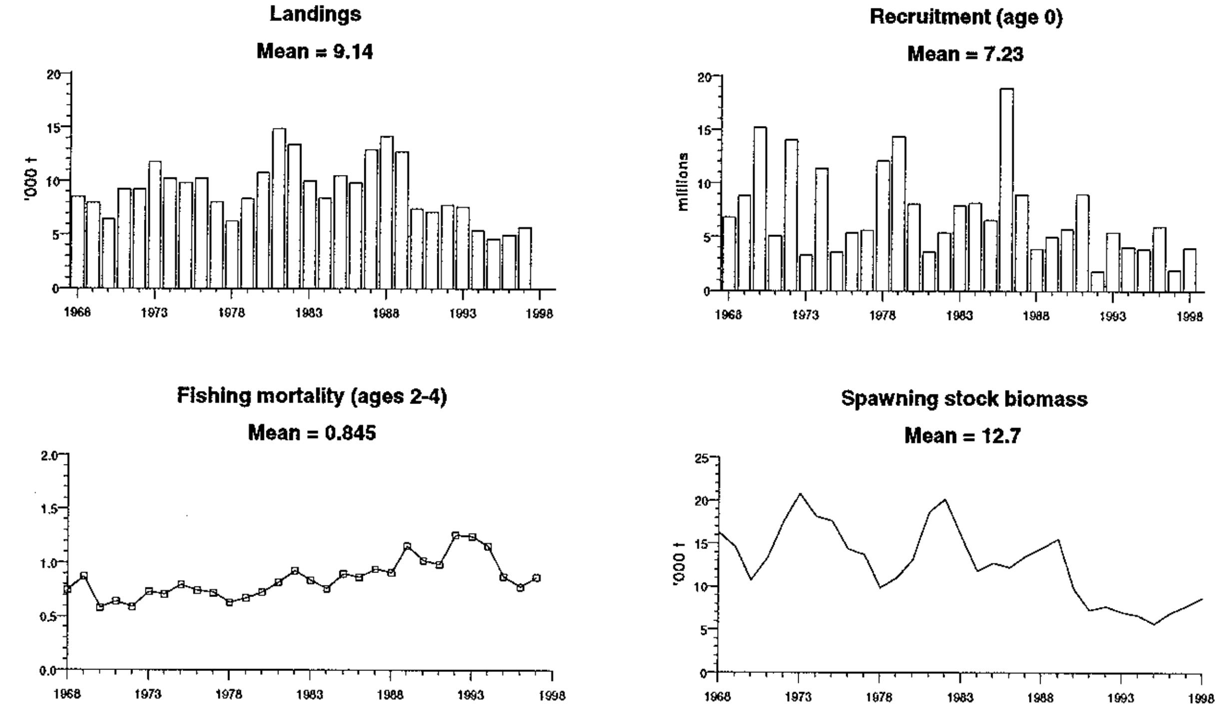
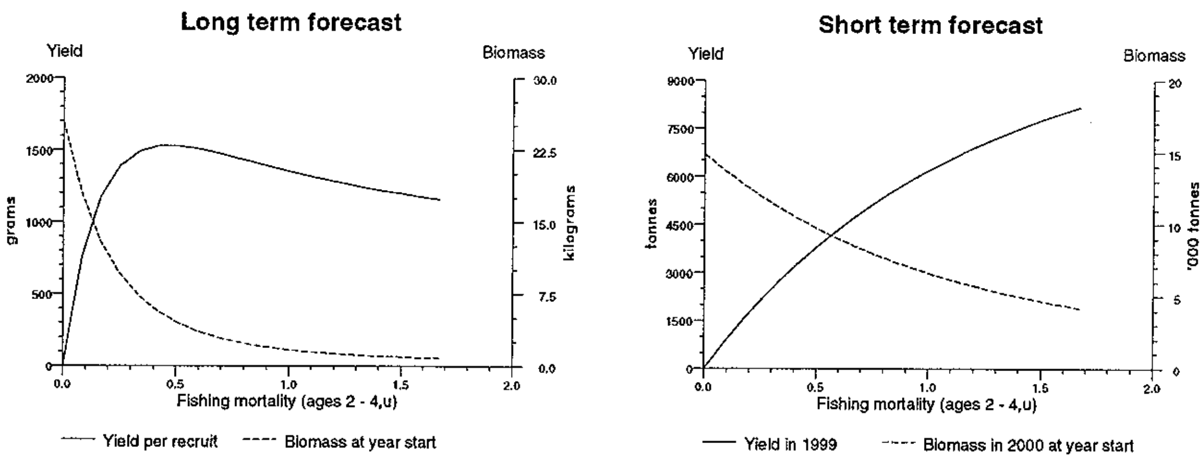


Cod in the Irish Sea (Fishing Area VIIa)

Yield and Spawning Stock Biomass



Precautionary Approach Plot

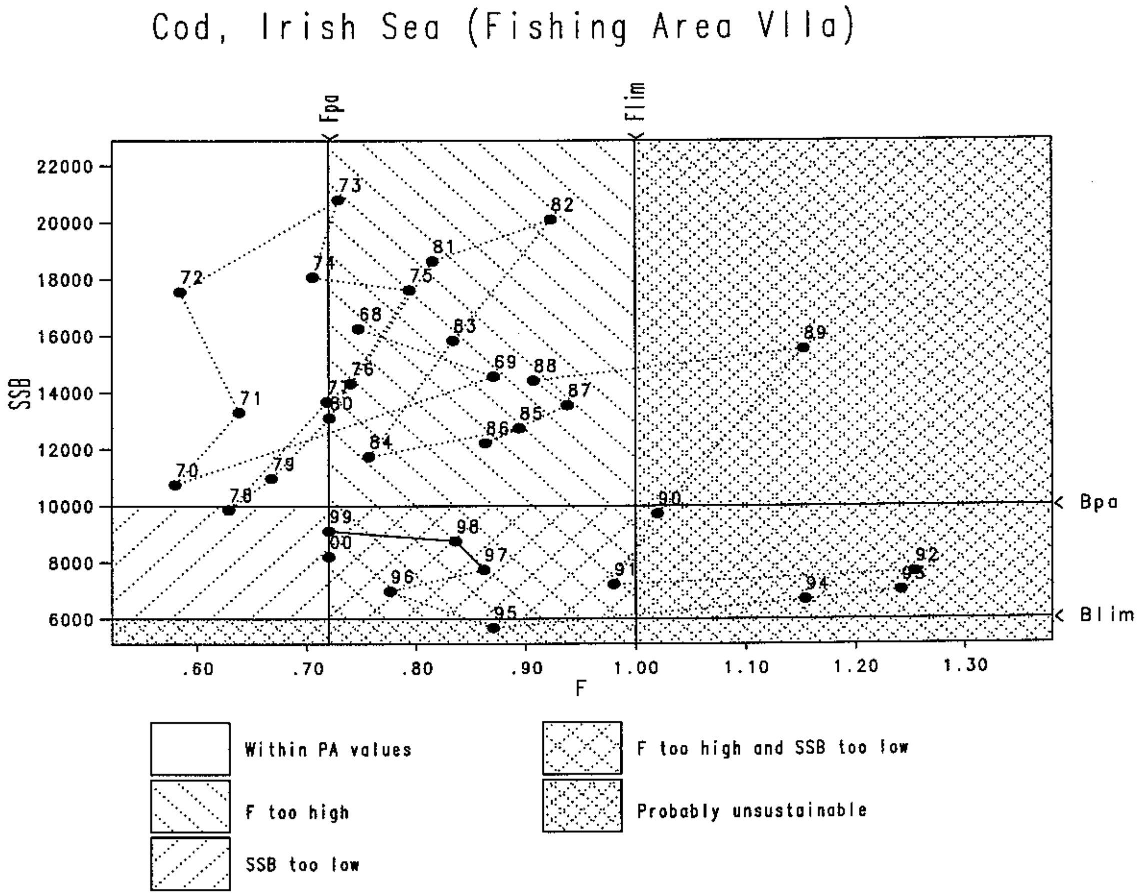


Table 3.8.2.1 Nominal catch (tonnes) of COD in Division VIIa as officially reported to ICES, and Working Group estimates of annual landings.

Country	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997[1]
Belgium	135	185	222	344	269	467	310	78	174	169	121	187	142[4]	173
France	912	1,782	1,480	1,717	2,406	352[1]	201[1]	320[1]	927[1]	505[1]	188[1]	111[1]	153	156
Ireland	2,885	4,121	3,991	5,017	5,821	3,656	2,800	2,364	2,260	1,328	1,506	1,414	2,476	n/a
Netherlands	38	104	-	-	-	-	-	-	-	-	-	-	25	31
UK (Engl.& Wales)[3]	1,253	1,200	847	1,922	2,667	6,320	4,752	3,562	3,529	3,244	2,274	2,330	...	...
UK (Isle of Man)	98	119	80	44	118	39	48	175	129	57	26	22	27	
UK (N. Ireland)	2,658	2,541	2,992	3,565	4,080								...	...
UK (Scotland)	669	1,038	446	574	472	465	1,767	515	393	453	326	414	126	...
UK													2,395	2,445
Total	8,648	11,090	10,058	13,183	15,833	11,299	9,878	7,014	7,412	5,756	4,441	4,478	5,344	2,805
Unallocated	-265	-607	-206	-289	-1,665	1,452	-2,499	81	323	1,799	961	109	-380	2,872
Total figures used by WG for stock assessment	8,383	10,483	9,852	12,894	14,168	12,751	7,379	7,095[2]	7,735[2]	7,555[2]	5,402[2]	4,587	4,964	5,677

[1]Preliminary.
[2]Revised.
[3]1989–1995 N. Ireland included with England and Wales.
[4]Final Statlant 27a data.

Table 3.8.2.2 Cod in the Irish Sea (Fishing Area VIIa).

Year	Recruitment Age 0	Spawning Stock Biomass	Landings	Fishing Mortality Age 2-4
1968	6.78	16.26	8.54	0.747
1969	8.85	14.56	7.99	0.871
1970	15.20	10.75	6.43	0.580
1971	5.10	13.31	9.25	0.638
1972	14.04	17.56	9.23	0.584
1973	3.29	20.80	11.82	0.729
1974	11.36	18.08	10.25	0.705
1975	3.61	17.61	9.86	0.794
1976	5.36	14.32	10.25	0.740
1977	5.60	13.68	8.05	0.718
1978	12.11	9.86	6.27	0.629
1979	14.37	10.97	8.37	0.667
1980	8.08	13.11	10.78	0.721
1981	3.58	18.63	14.91	0.815
1982	5.37	20.10	13.38	0.923
1983	7.95	15.84	10.02	0.834
1984	8.16	11.74	8.38	0.757
1985	6.60	12.74	10.48	0.894
1986	18.85	12.22	9.85	0.863
1987	8.92	13.55	12.89	0.938
1988	3.90	14.42	14.17	0.907
1989	5.05	15.53	12.75	1.152
1990	5.76	9.72	7.38	1.020
1991	9.01	7.21	7.10	0.980
1992	1.81	7.66	7.74	1.254
1993	5.43	7.01	7.56	1.242
1994	4.06	6.69	5.40	1.154
1995	3.92	5.68	4.59	0.870
1996	5.95	6.97	4.96	0.776
1997	1.95	7.74	5.68	0.862
1998	4.00	8.75	.	.
Average	7.23	12.68	9.14	0.845
Unit	Millions	1000 tonnes	1000 tonnes	-

3.8.3 Haddock in Division VIIa (Irish Sea)

State of stock/fishery: Occasional pulses of strong recruitment have resulted in opportunistic fisheries lasting only for comparatively short periods. A population outburst has occurred in the 1990s, with strong year classes in 1994 and 1996 causing a large increase in spawning biomass and catches. Current fishing mortality is poorly estimated, but is likely to be high.

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 $\mathbf{B_{pa}}$.

Advice on management: ICES recommends that fishing mortality should not be allowed to increase from the recent mean and that a separate catch limit be set for haddock taken in the Irish Sea. *Status quo* F catches in 1999 would be about 7 000 t.

Reference points:

ICES considers that:	ICES proposes that
There is currently no biological basis for defining appropriate reference points, in view of the rapid expansion of the stock size over a short period.	$\mathbf{F_{pa}}$ be set at 0.5 by analogy with other haddock stocks.

Relevant factors to be considered in management: This stock is presently managed by means of a TAC set for the whole of areas VII, VIII, IX and X. The present high availability of haddock has resulted in substantial misreporting and/or discarding due to large by-catches of haddock taken by fleets with restrictive allocations available to them.

There are no known reasons why haddock production could not be sustained in the Irish Sea and ICES recommends that recent strong year-classes should be allowed to grow, mature and reproduce.

The haddock stock is mainly confined to the western Irish Sea where important mixed-species fisheries for *Nephrops*, whiting and cod take place. Large by-catches of haddock are unavoidable during periods of high abundance, when targeting of the stock also takes place. Switching of effort from cod to haddock in 1995–97 appears to have been partly responsible for the reduction in fishing mortality on cod in those years.

Elaboration and special comment: Haddock production in the Irish Sea has been irregular in the 20th century, with one productive period in the late 1950s, two in the early 1970s, and a recent one in the latter half of the 1990s which exceeds the previous documented ones. Previous productive periods are believed to have coincided with strong year classes in Sub-Area VI, but not the recent one.

Data from surveys estimates of catches at age have provided a consistent analysis of the relative strength of incoming year classes. The landings in 1999 will be heavily dependent on the strength of the 1996 year class which is the strongest produced during the period for which data are available. The next strongest year class, produced in 1994, resulted in an increase in landings in 1996 and 1997 to over 3 000 t.

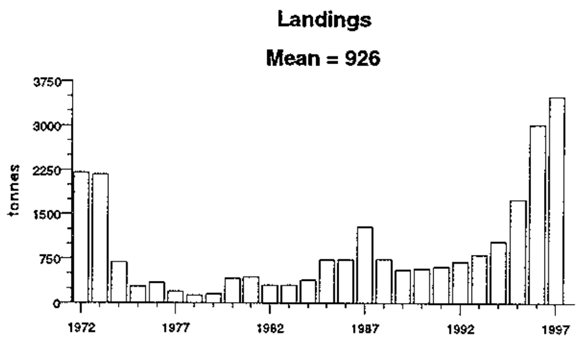
Assessment based on analysis of survey catch-rates of haddock and separable analysis of commercial catches at age.

Source of information: Report of the Working Group on the Assessment of Northern Shelf Demersal Stocks, June 1998 (ICES CM 1999/ACFM:1).

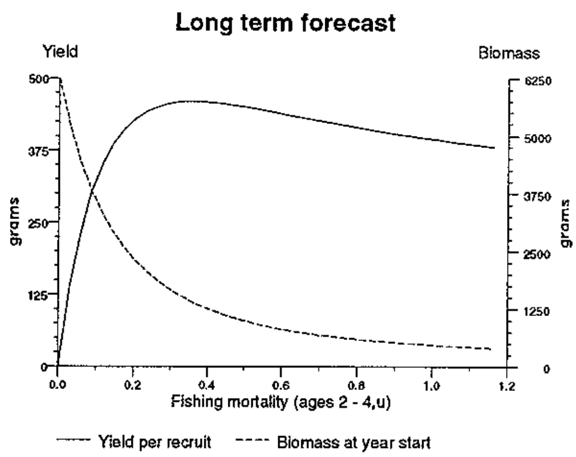
Catch data (Tables 3.8.3.1–2):

Year	ICES advice	Predicted catch corresp. to advice	Agreed TAC[1]	Official Landings[2]	ACFM landings
1987	Not dealt with			1287	1287
1988	Not dealt with			747	747
1989	Not dealt with			560	560
1990	Not dealt with			582	582
1991	Not dealt with			616	616
1992	Not dealt with			703	703
1993	Not dealt with			730	813
1994	Not dealt with			681	1043
1995	Not dealt with		6000	783	1753
1996	No advice		7000[3]	1348	3023
1997	Means of setting catch limits required		14000	863[4]	3497
1998	Catch limit for VIIa	3000	20000		
1999	No increase in F	7000			

[1] Applies to Sub-areas VII, VIII, IX and X. [2]Possible underestimates due to misreporting. [3] Increased in-year to 14000 t. [4] Incomplete official statistics. Weights in tonnes.



Yield and Spawning Stock Biomass



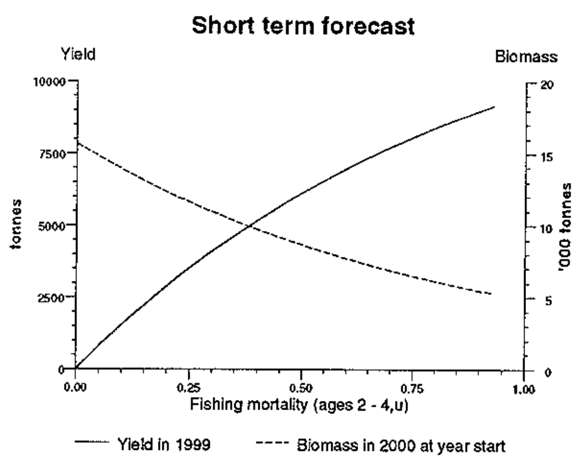


Table 3.8.3.1 Nominal landings of HADDOCK in Division VIIa, 1984–1997, as officially reported to ICES.

Country	1984	1985	1986	1987	1988	1989	1990
Belgium	3	4	5	10	12	4	4
France	38	31	39	50	47	n/a	n/a
Ireland	199	341	275	797	363	215	80
UK (England & Wales)[1]	29	28	22	41	74	252	177
UK (Isle of Man)	2	5	4	3	3	3	5
UK (N. Ireland)	38	215	358	230	196		
UK (Scotland)	78	104	23	156	52	86	316
Total	387	728	726	1,287	747	560	582
Unallocated	0	0	0	0	0	0	0
Total figures used by Working Group	387	728	726	1,287	747	560	582

Country	1991	1992	1993	1994	1995	1996	1997*
Belgium	1	8	18	22	32	34[2]	56
France	n/a	73*	41*	22*	n/a	105*	n/a
Ireland	254	251	252	246	320	798	n/a
Netherlands	-	-	-	-	-	1	15
UK (England & Wales)[1]	204	244	260	301	294	463	...
UK (Isle of Man)	14	13	19	24	27	38	...
UK (N. Ireland)							
UK (Scotland)	143	114	140	66	110	14	...
United Kingdom							792
Total	616	703	730	681	783	1,348	863
Unallocated	0	0	83	362	970	1,675	2,634
Total figures used by Working Group	616	703	813	1,043	1,753	3,023	3,497

*Preliminary.
[1]1989–1996 Northern Ireland included with England and Wales.
[2]Final Statlant 27a data.

n/a = not available.

Table 3.8.3.2 Haddock in the Irish Sea (Fishing Area VIIa).

Year	Landings
1972	2,204
1973	2,169
1974	683
1975	276
1976	345
1977	188
1978	131
1979	146
1980	418
1981	445
1982	303
1983	299
1984	387
1985	728
1986	726
1987	1,287
1988	747
1989	560
1990	582
1991	616
1992	703
1993	813
1994	1,043
1995	1,753
1996	3,023
1997	3,497
Average	926
Unit	tonnes

3.8.4 Whiting in Division VIIa (Irish Sea)

State of stock/fishery: This stock is considered to be outside safe biological limits. Fishing mortality is above the proposed $\mathbf{F_{pa}}$. SSB is above the proposed $\mathbf{B_{pa}}$. Catches and SSB have declined continuously since the early 1980's. Fishing mortality remains high.

High SSB was recorded in the early 1980s but since 1983 has declined to a historic low in 1997. The very large 1991 year class and reduced F in recent years have not arrested this decline.

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 $\mathbf{B_{pa}}$.

Advice on Management: ICES recommends that fishing mortality in 1999 be reduced below the proposed $\mathbf{F_{pa} = 0.65}$, corresponding to landings in 1999 less than 3 500 t. Measures to reduce discards in the fishery for *Nephrops* should be implemented and would contribute to the recommended reduction in fishing mortality

Reference points:

ICES considers that:	ICES proposes that
$\mathbf{B_{lim}}$ is 5 000 t, the lowest observed spawning stock biomass. 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 1.1. 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:

$\mathbf{B_{lim} = B_{loss}}$	$\mathbf{B_{pa} = B_{loss}}$ x 1.4
$\mathbf{F_{lim} = F_{loss}}$	$\mathbf{F_{pa}}$ = 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.

Relevant factors to be considered in management: Approximately 45% of the total estimated catch of whiting is discarded in the *Nephrops* directed fishery which operates on the main whiting nursery areas in the Irish Sea. Discarding by whitefish fleets is presently being studied, but estimates are not yet available. 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.

Catch forecast for 1999:

Basis: F(98) = F(95–97) =0.82, Catch(98) = 8.2, Landings(98) = 4.8, SSB(99) = 8.5.

F(99)	Basis[1]	Catch(99)	Landings(99)	SSB (2000)	Medium-term effect of fishing at given level
0.57	0.4F(95–97)	5.9	2.5	10.2	High probability of SSB > $\mathbf{B_{pa}}$
0.65	0.6F(95–97)	6.8	3.5	9.4	High probability of SSB > $\mathbf{B_{pa}}$ F = $\mathbf{F_{pa}}$
0.74	0.8F(95–97)	7.6	4.4	8.8	10% probability of SSB < B_{pa}
0.82	1.0F(95–97)	8.3	5.1	8.2	20% probability of SSB < B_{pa}
0.91	1.2F(95–97)	9.0	5.8	7.7	50% probability of SSB < B_{pa}

Weights in '000 t. [1] F multipliers applied to human consumption fishery only.
Shaded scenarios 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. Fishing effort in the *Nephrops* and pelagic fisheries increased steadily up to 1992, but subsequently declined.

Analytical assessment 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 misreported landings have been included since 1991. Last year, ICES considered the stock to be inside safe biological limits. The present assessments, however indicates a consistently declining trend in SSB over the whole time period and estimated SSBs in the period 1993–1997 are between 27 and 57% lower than those estimated last year.

The age range used to calculate average F has been changed from 2–4 to 1–3. This re-scales the fishing *mortality time-series.*

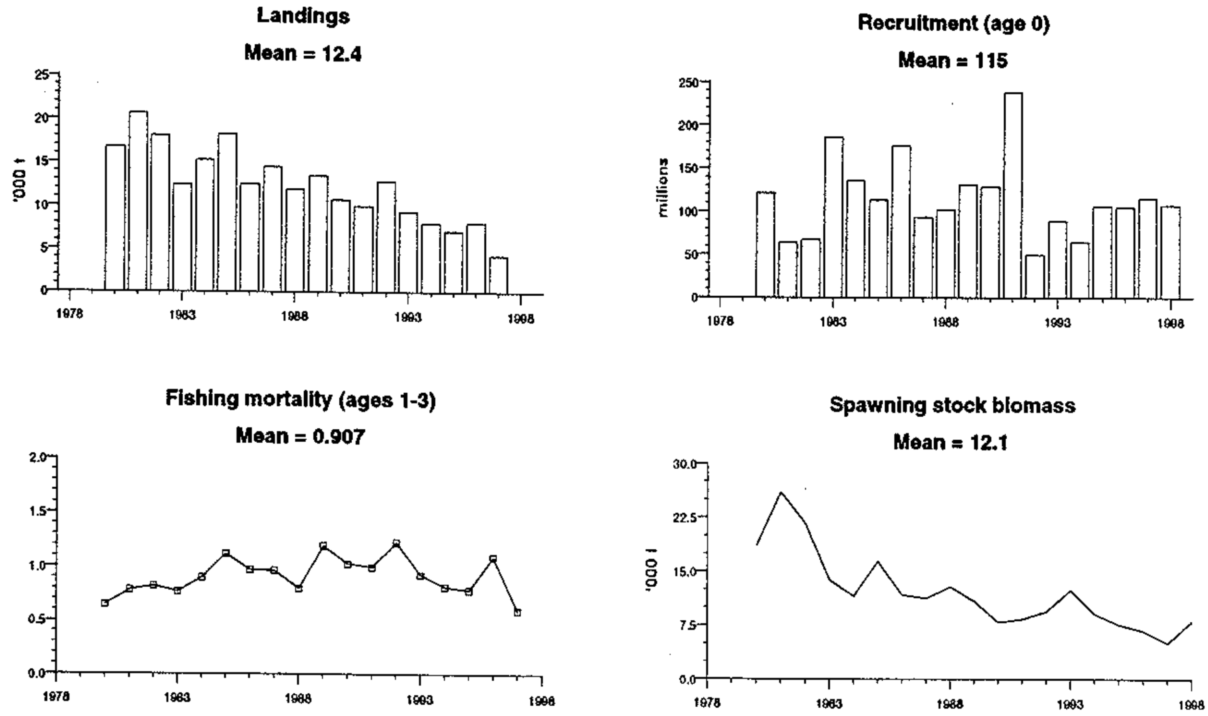
Source of information: Report of the Working Group on the Assessment of Northern Shelf Demersal Stocks, June 1998 (ICES CM 1999/ACFM:1).

Catch data (Tables 3.8.4.1–2):

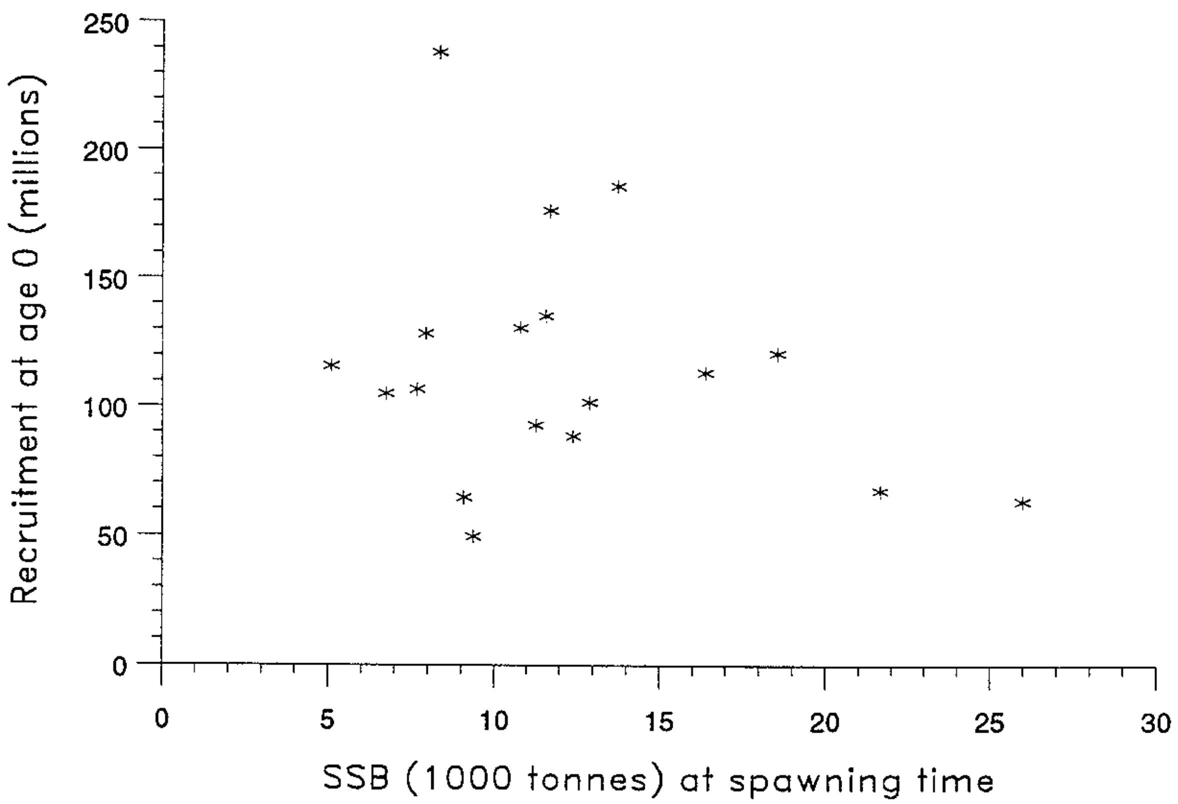
Year	ICES Advice	Predicted catches corresp. to advice	Agreed TAC	Official landings	Disc.[2]	ACFM catch
1987	Reduce F	16.0	18.2	11.7	3.8	14.4
1988	No increase in F; enforce mesh regulations	12.0	18.2	11.5	1.9	11.9
1989	$F = F_{high}$; enforce mesh regulation	11.0	18.2	11.3	2.0	13.4
1990	No increase in 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	4.2	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	5.8	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	3.5 [4]	1.9	4.2
1998	20% reduction in F	3.8[5]	5.0			
1999	Reduce F below $\mathbf{F}_{pa}$	3.5[5]				

[1]Not including discards from the *Nephrops* fishery. [2]From *Nephrops* fishery. [3]Including estimates of misreporting.
[4] Incomplete Statistics Weights in '000 t. 5 landings only, no discards included.

Landings in the graph below include discards



Stock - Recruitment



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Precautionary Approach Plot

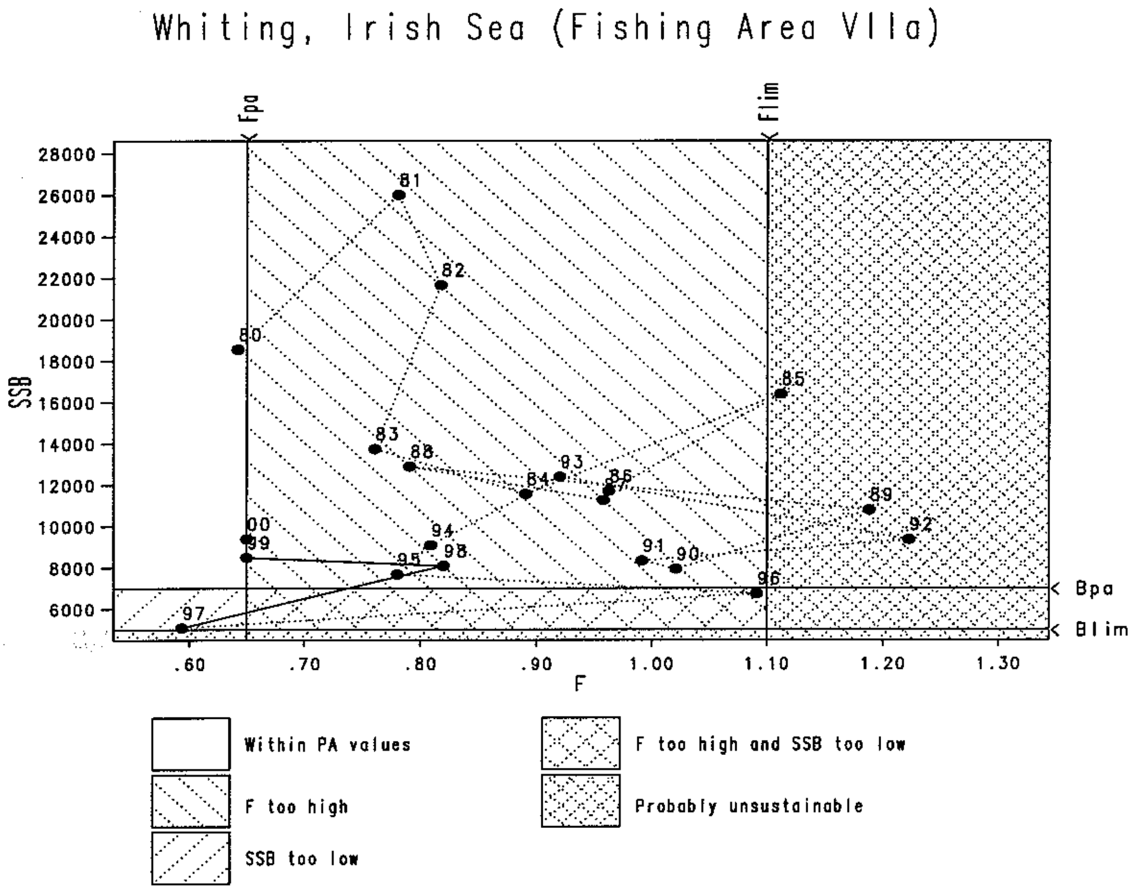


Table 3.8.4.1 Nominal catch (tonnes) of WHITING in Division VIIa, 1984–1997, as officially reported to ICES and Working Group estimates of human consumption and discards.

Country	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996[1]	1997[1]
Belgium	99	100	70	109	90	92	142	53	78	50	80	92	80[4]	42
France	930	956	770	826	1,063	533[1]	528[1]	611[1]	512[1]	255[1]	367[1]	169[1]	118	259
Ireland	4,276	5,521	3,101	4,067	4,394	3,871	2,000	2,200	2,100	1,440	1,418	1,840	1,773	n/a
Netherlands	5	30	-	-	-	-	-	-	-	-	-	-	17	14
UK (Engl.& Wales)[3]	1,224	1,379	1,004	1,529	1,202	6,652	5,202	4,250	4,089	3,859	3,724	3,125	...	...
UK (Isle of Man)	68	57	25	14	15	26	75	74	53	55	44	41	28	24
UK (N. Ireland)	5,660	8,382	4,940	4,858	4,621								...	...
UK (Scotland)	275	368	129	281	107	154	236	223	274	318	206	198	48	...
UK													3,557	3,178
Total human consumption	12,537	16,793	10,039	11,684	11,492	11,328	8,183	7,411	7,106	5,977	5,839	5,465	5,621	3,517
Unallocated human consumption	-891	-786	+16	-1,020	-1,537	-65	-211	-129	+1,435	+551	+917	-574	-1,149	-1,238
Estimated discards from *Nephrops* fishery[2]	3,589	2,229	2,360	3,754	1,901	2,015	2,684	2,664	4,250	2,702	1,180	2,153	3,494	1,926
Total figures used by the Working Group for stock assessment	15,235	18,236	12,415	14,418	11,856	13,408	10,656	9,946	12,791	9,230	7,936	7,044	7,966	4,205

[1]Preliminary.
[2]Based on UK (N. Ireland) and Ireland data.
[3]1989–1995 Northern Ireland included with England and Wales.
[4]Final Statlant 27a data.
n/a = Not Available

Table 3.8.4.2 Whiting in the Irish Sea (Fishing Area VIIa).

Year	Recruitment Age 0	Spawning Stock Biomass	Catch	Fishing Mortality Age 1-3
1980	121.10	18.56	16.79	0.642
1981	63.56	26.00	20.61	0.781
1982	67.61	21.66	18.11	0.818
1983	186.27	13.76	12.35	0.761
1984	135.45	11.58	15.24	0.891
1985	113.56	16.40	18.24	1.112
1986	176.69	11.71	12.42	0.963
1987	92.95	11.28	14.42	0.958
1988	101.84	12.91	11.86	0.791
1989	130.81	10.80	13.41	1.188
1990	128.51	7.94	10.66	1.021
1991	238.42	8.34	9.95	0.992
1992	49.55	9.37	12.79	1.222
1993	88.61	12.41	9.23	0.920
1994	64.64	9.09	7.94	0.809
1995	106.79	7.68	7.04	0.780
1996	105.06	6.75	7.97	1.091
1997	115.80	5.09	4.21	0.593
1998	107.17	8.09	.	.
Average	115.49	12.07	12.40	0.907
Unit	Millions	1000 tonnes	1000 tonnes	-

3.8.5 Plaice in Division VIIa (Irish Sea)

State of stock/fishery: The stock is considered to be within safe biological limits. Consistent with an overall decline in fishing effort in the Irish Sea the exploitation rate on this stock has declined in recent years.

SSB was relatively high in the mid-1980s following a series of good year classes, it subsequently declined due to low recruitment since 1988, and it has increased recently due to a reduction in fishing mortality. There is no evidence of reduced recruitment at observed low spawning biomass.

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 $\mathbf{B}_{pa}$.

Advice on Management: ICES recommends that fishing mortality on plaice should be maintained below the proposed $\mathbf{F}_{pa}$, in order to have a high probability of SSB remaining above lowest observed SSB. This can be achieved by maintaining *status quo* fishing mortality, corresponding to a landings of 2 400 t in 1999.

Reference points:

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 F 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.	$\mathbf{B}_{pa} = \mathbf{B}_{loss}$
	$\mathbf{F}_{pa} = \mathbf{F}_{med}$ and long term considerations

Relevant factors to be considered in management: 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. Significant discarding of under-sized plaice occurs in some fisheries, and measures to reduce discards will benefit the stock.

Catch forecast for 1999:

Basis: F(98) = F(95-97) = 0.38; Landings(98)= 2.3, SSB(99)= 5.8.

F(99) onwards	Basis	Catch(99)	Landings(99)	SSB (2000)	Medium term effect of fishing at given level
0.30	0.8F(95-97)	2.0	2.0	6.5	High probability for SSB above lowest observed
0.38	1.0F(95-97)	2.4	2.4	6.1	High probability for SSB above lowest observed
0.42	1.1F(95-97)	2.6	2.6	5.9	High probability for SSB above lowest observed

Weights in '000 t.

Shaded scenarios considered inconsistent with the precautionary approach.

Elaboration and special comment: Effort in the UK and Belgian beam trawl fleets increased in the late 1980s, but declined in the early 1990s. Beam trawl fleets direct for sole and target those areas where sole catch-rates are best. Catch rates of sole have been low in the Irish Sea in recent years, and part of the beam trawl fleet has moved to other sole fishing grounds.

Assessment calibrated with data from two commercial fleets and two surveys. Estimates of discards are only available for a few years and are not included in the assessment. $\mathbf{B}_{pa}$ to be reviewed following further analysis by the Working Group.

Egg-production based assessments gave estimates of stock sizes significantly greater than in the VPA assessments. The present assessment is considered to be the most reliable basis for advice and the sources of the discrepancies are being investigated; to date no single factor has been identified as the cause of the discrepancy.

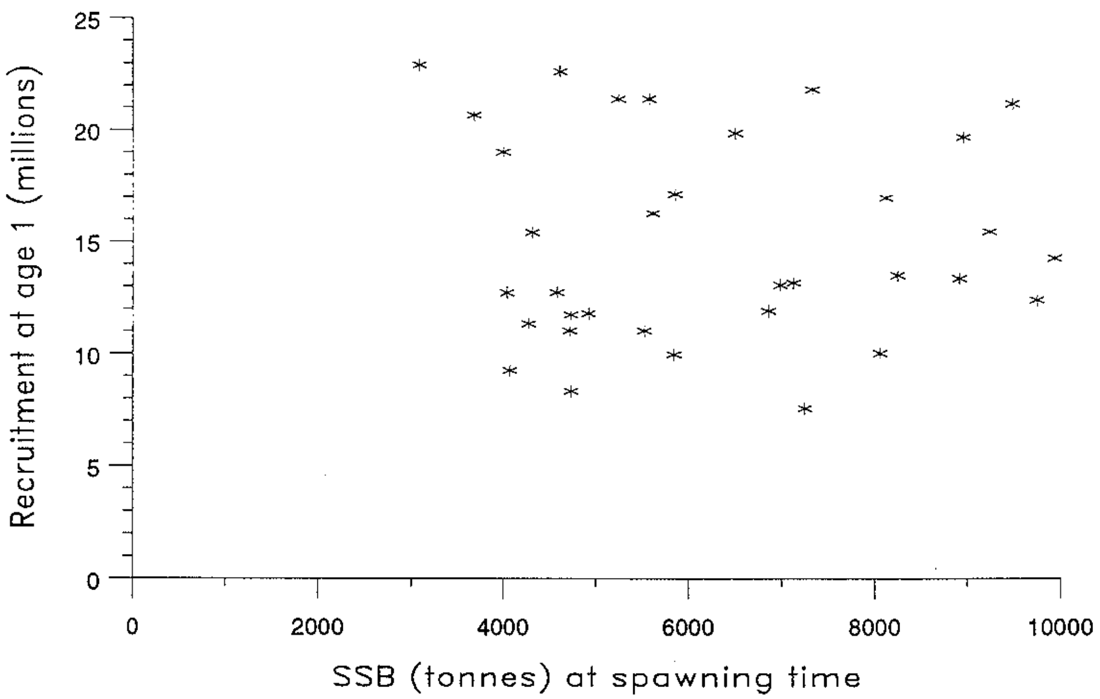
Source of information: Report of the Working Group on the Assessment of Northern Shelf Demersal Stocks, June 1998 (ICES CM 1999/ACFM:1).

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	2.0	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	1.4[2]	1.9
1998	No increase in F	2.4	2.4		
1999	Keep F below $\mathbf{F_{pa}}$	2.4			

Weights in '000 t. [1] Catch at *status quo* F [2] Incomplete data.

Stock - Recruitment



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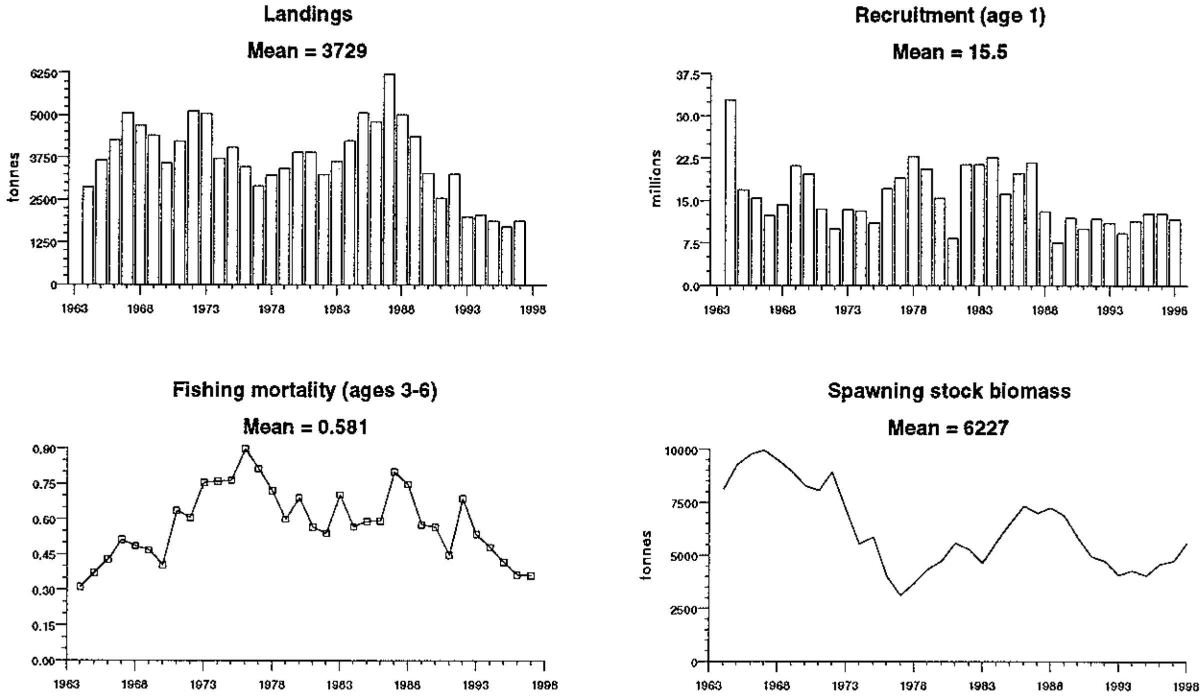
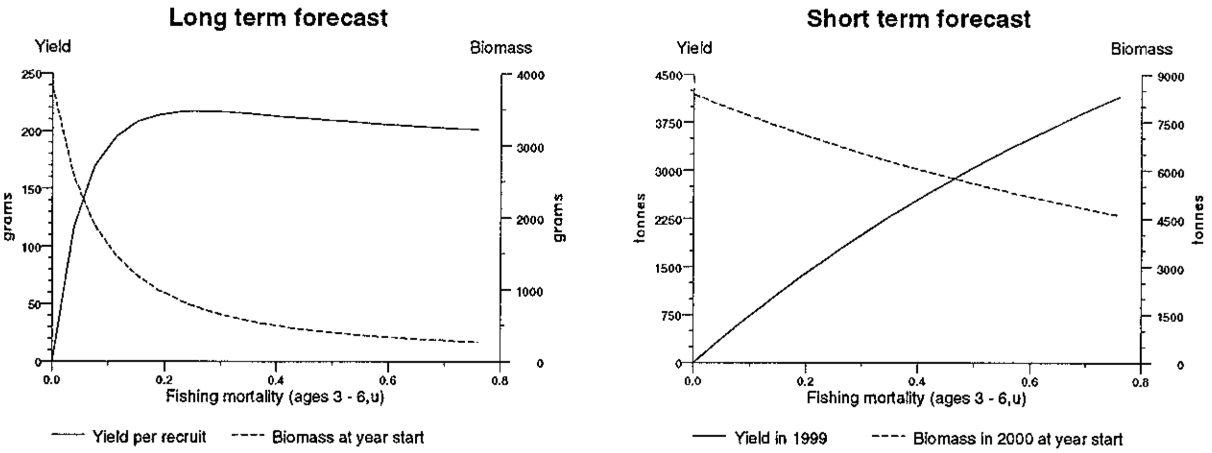


Plaice in the Irish Sea (Fishing Area VIIa)

Yield and Spawning Stock Biomass



Precautionary Approach Plot

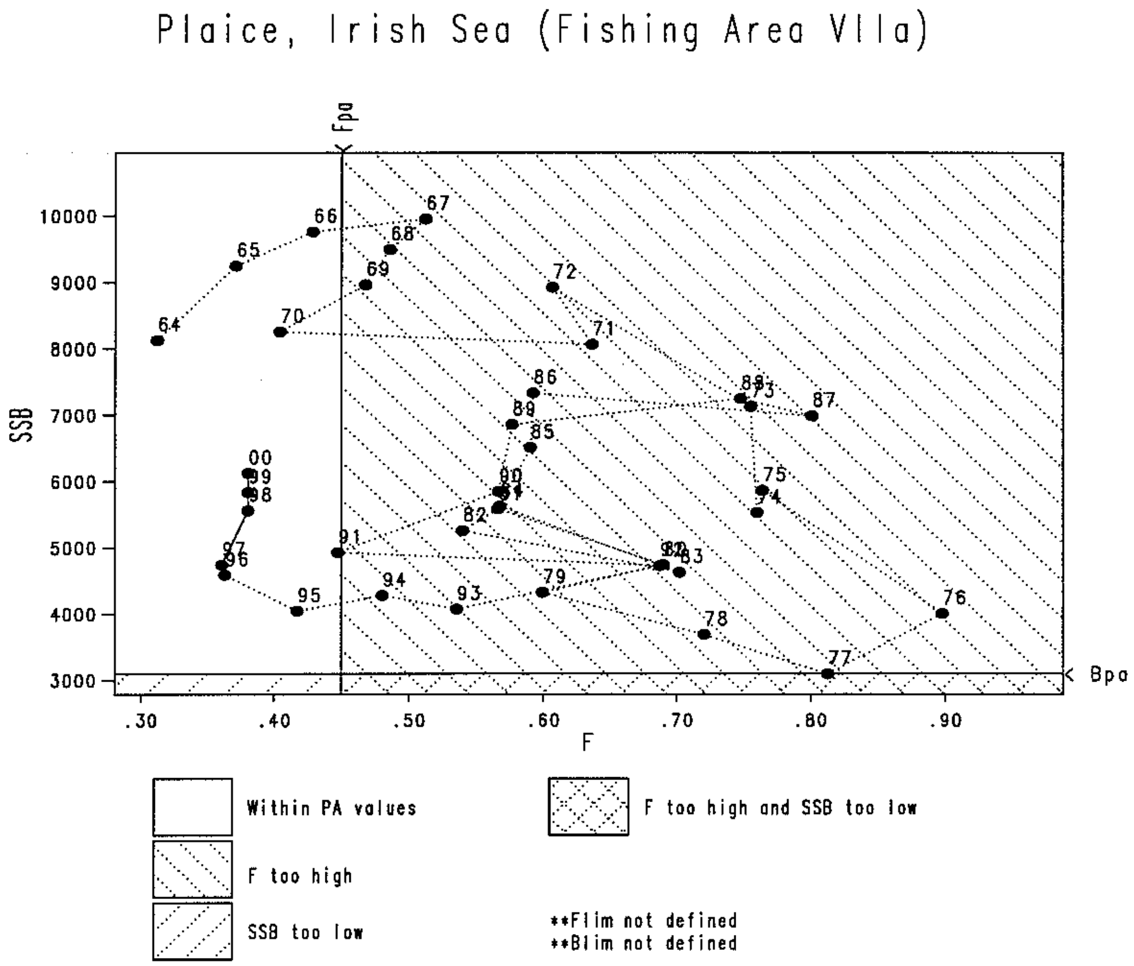


Table 3.8.5.1 Nominal landings (t) of PLAICE in Division VIIa as officially reported to ICES.

Country	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997[1]
Belgium	118	285	384	403	243	265	301	138	321	128	332	327	344[3]	418
France	38	110	165	87	58	11[1]	105[1]	20[1]	42[1]	19[1]	11[1]	10[1]	12[1]	7
Ireland	1,420	2,000	1,858	2,132	2,009	1,406	1,350	900	1,355	654	547	557	538	n/a
Netherlands	30	1,091	-	-	-	-	-	-	-	-	-	-	69	116
UK (Eng. & Wales)[2]	2,301	2,295	1,774	2,366	1,630	2,409	1,959	1,584	1,381	1,119	1,082	1,050	878	...
UK (Isle of Man)	11	26	12	9	12	18	27	51	24	13	14	20	16	n/a
UK (N. Ireland)	203	198	272	332	286									...
UK (Scotland)	86	118	119	243	127	76	219	104	70	72	63	60	18	...
UK (Total)														820
Total	4,207	6,123	4,584	5,572	4,365	4,185	3,961	2,797	3,193	2,005	2,049	2,024	1,875	1,361
Discards	-	-	250	270	220	0	0	0	0	0	0	0	0	0
Unallocated	34	-1,048	-28	378	420	187	-686	-243	74	-9	17	-150	-168	506
Total figures used by the Working Group for stock assessment	4,241	5,075	4,806	6,220	5,005	4,372	3,275	2,554	3,267	1,996	2,066	1,874	1,707	1,867

[1]Provisional
[2]1989–1996 N. Ireland included with England and Wales
[3]Final Statlant 27a data
{UK (Total) excludes Isle of Man data}
n/a = not available

Table 3.8.5.2 Plaice in the Irish Sea (Fishing Area VIIa).

Year	Recruitment Age 1	Spawning Stock Biomass	Landings	Fishing Mortality Age 3-6
1964	32.80	8.13	2.88	0.312
1965	16.94	9.25	3.66	0.371
1966	15.43	9.76	4.27	0.429
1967	12.38	9.95	5.06	0.512
1968	14.25	9.49	4.70	0.486
1969	21.15	8.96	4.39	0.468
1970	19.66	8.26	3.58	0.404
1971	13.48	8.06	4.23	0.636
1972	9.99	8.92	5.12	0.607
1973	13.34	7.13	5.06	0.755
1974	13.14	5.53	3.72	0.760
1975	11.00	5.86	4.06	0.764
1976	17.11	4.01	3.47	0.898
1977	19.00	3.09	2.90	0.813
1978	22.91	3.69	3.23	0.721
1979	20.66	4.32	3.43	0.599
1980	15.40	4.74	3.90	0.690
1981	8.32	5.58	3.91	0.566
1982	21.39	5.26	3.24	0.540
1983	21.39	4.63	3.64	0.702
1984	22.62	5.62	4.24	0.567
1985	16.27	6.51	5.08	0.590
1986	19.84	7.33	4.81	0.592
1987	21.79	6.99	6.22	0.801
1988	13.05	7.25	5.01	0.748
1989	7.54	6.86	4.37	0.576
1990	11.89	5.85	3.28	0.567
1991	9.94	4.93	2.55	0.448
1992	11.78	4.73	3.27	0.687
1993	11.01	4.07	2.00	0.535
1994	9.24	4.28	2.07	0.480
1995	11.32	4.04	1.87	0.417
1996	12.71	4.59	1.71	0.363
1997	12.72	4.74	1.87	0.361
1998	11.72	5.56	.	.
Average	15.52	6.23	3.73	0.581
Unit	Millions	1000 tonnes	1000 tonnes	-

3.8.6 Sole in Division VIIa (Irish Sea)

State of stock/fishery: This stock is considered to be outside safe biological limits. SSB in 1997 was estimated to be below the proposed $\mathbf{B}_{pa}$ and the lowest for the series (2 800 t). Fishing mortality remains substantially above the proposed $\mathbf{F}_{pa}$.

During the period 1970 to 1986, fishing mortality was so high that SSB could only be sustained by sporadic strong year classes. An increase in stock size in the mid 1980s followed a succession of three strong year classes, and the improved opportunities for sole fishing attracted beam-trawlers into the Irish Sea from other sole fisheries, leading to increased fishing mortality. This, coupled with a reduced incidence of strong year classes, has accelerated the decline in SSB which reached an historical low in 1996–97. F in 1997 was estimated to be around 20% higher than in recent years, although this may be an overestimate.

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 $\mathbf{B}_{pa}$.

Advice on management: ICES recommends that fishing mortality should be reduced below the proposed $\mathbf{F}_{pa}$ corresponding to landings less than 830 t in 1999. This will provide a greater than 50% probability of SSB exceeding the proposed $\mathbf{B}_{pa}$ in the year 2000 and a less than 10% probability that SSB will be below $\mathbf{B}_{pa}$, in the medium term.

Reference points:

ICES considers that:	ICES proposes that:
$\mathbf{B}_{lim}$ is 2 800 t. The lowest observed spawning stock.	$\mathbf{B}_{pa}$ 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 have 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:

$\mathbf{B}_{lim} = \mathbf{B}_{loss}$	$\mathbf{B}_{pa} \sim \mathbf{B}_{lim} * 1.4$
$\mathbf{F}_{lim} = \mathbf{F}_{loss}$ poorly defined; based on historical considerations	$\mathbf{F}_{pa}$ = see above

Relevant factors to be considered in management: Although sole are predominantly taken in the directed beam trawl fishery, they are also taken in a mixed demersal fishery and management of the other species needs to take account of the state of the sole stock.

As a result of two above average year-classes entering the fishery, the reduction in F advised for this stock leads to a predicted catch in line with recent ICES advice.

Catch forecast for 1999:

Basis: F(98) = F(95–97) = 0.50, Landings(98) = 1.1, SSB(99) = 3.3.

F(99) onwards	Basis	Landings(99)	SSB (2000)	Medium term effect of fishing at given level
0.20	0.4F(95–97)	0.58	3.98	Less than 5% probability of SSB< $\mathbf{B}_{pa}$
0.30	$\mathbf{F}_{pa}$	0.83	3.73	5% probability of SSB< $\mathbf{B}_{pa}$
0.35	0.7F(95–97)	0.95	3.61	20% probability of SSB< $\mathbf{B}_{pa}$
0.40	0.8F(95–97)	1.06	3.50	Prob. between 20 and 50% of SSB< $\mathbf{B}_{pa}$
0.50	1.0F(95–97)	1.28	3.28	Prob. > 50% of SSB< $\mathbf{B}_{pa}$
0.54	1.1F(95–97	1.38	3.18	High probability of SSB< $\mathbf{B}_{pa}$

Weights in '000 t.

Shaded scenarios considered inconsistent with the precautionary approach.

Elaboration and special comment: Sole are taken mainly in a beam trawl fishery that commenced in the 1960s and are also taken as a by-catch in the longer established otter trawl fisheries. Effort in the Belgian beam trawl fleet increased in the late 1980s as vessels normally operating in the North Sea were attracted into the Irish Sea by better fishing opportunities. In recent years, however, catch rates of sole have been low in the Irish Sea, and part of the beam trawl fleet has moved to other sole fishing grounds.

Assessment was tuned with data from two commercial fleets and two surveys.

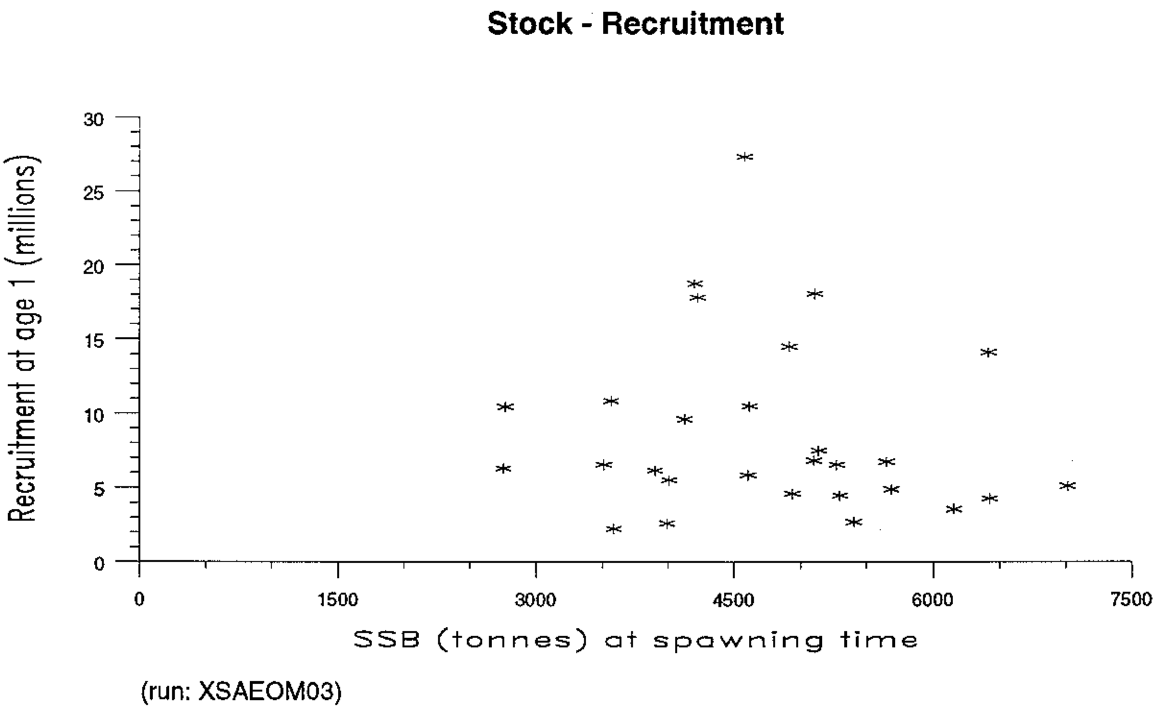
Egg-production based assessments gave estimates of stock sizes significantly greater than in the VPA assessments. The present assessment is considered to be the most reliable basis for advice and the sources of the discrepancies are being investigated.

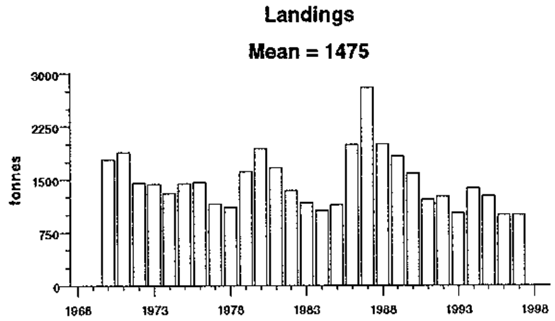
Source of information: Report of the Working Group on the Assessment of Northern Shelf Demersal Stocks, June 1998 (ICES CM 1999/ACFM:1).

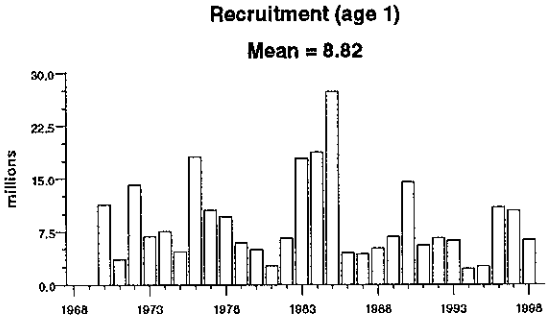
Catch data (Tables 3.8.6.1–2):

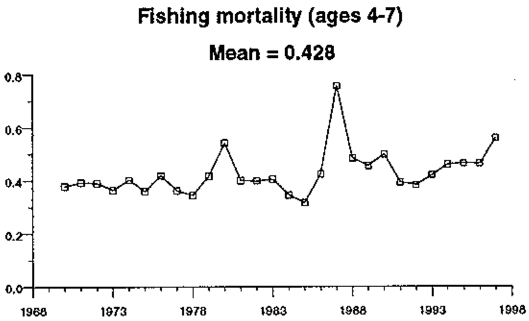
Year	ICES advice	Predicted catch. corresp. to advice	Agreed TAC	Official landings	ACFM landings[2]
1987	No increase in F	1.9	2.1	2.0	2.8
1988	80% of F(86); TAC	1.6	1.75	1.9	2.0
1989	80% of F(87); TAC	< 1.48	1.48	1.8	1.8
1990	Interim advice	1.05[3]	1.5	1.6	1.6
1991	90% of F(89); TAC	1.3	1.5	1.2	1.2
1992	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	0.9	1.0
1997	20% reduction in F	0.8	1.0	0.9	1.0
1998	20% reduction in F	0.85	0.9		
1999	Reduce F below F_{pa}	0.83			

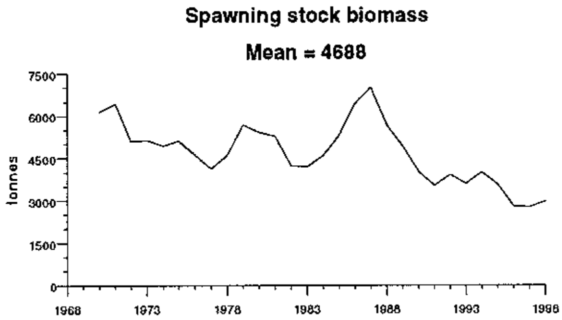
[1]Catch at *Status quo* F. [2] Not including misreporting. [3]Revised in 1990 to 1.5. Weights in '000 t.





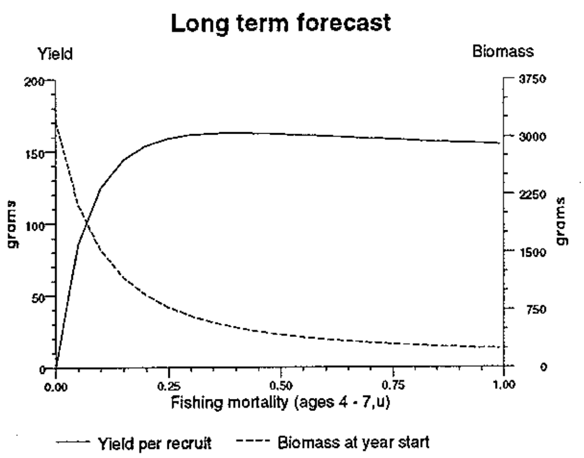


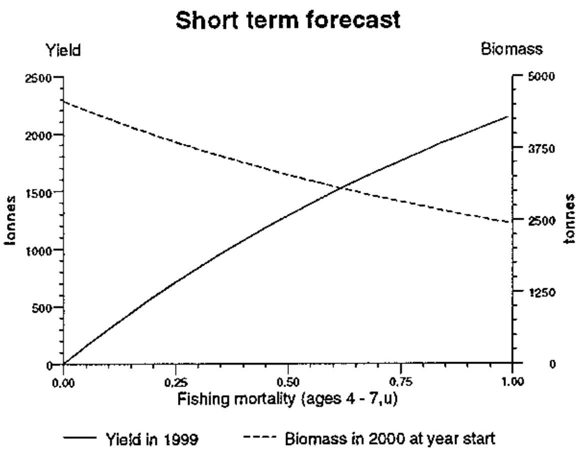




Sole in the Irish Sea (Fishing Area VIIa)

Yield and Spawning Stock Biomass





Precautionary Approach Plot

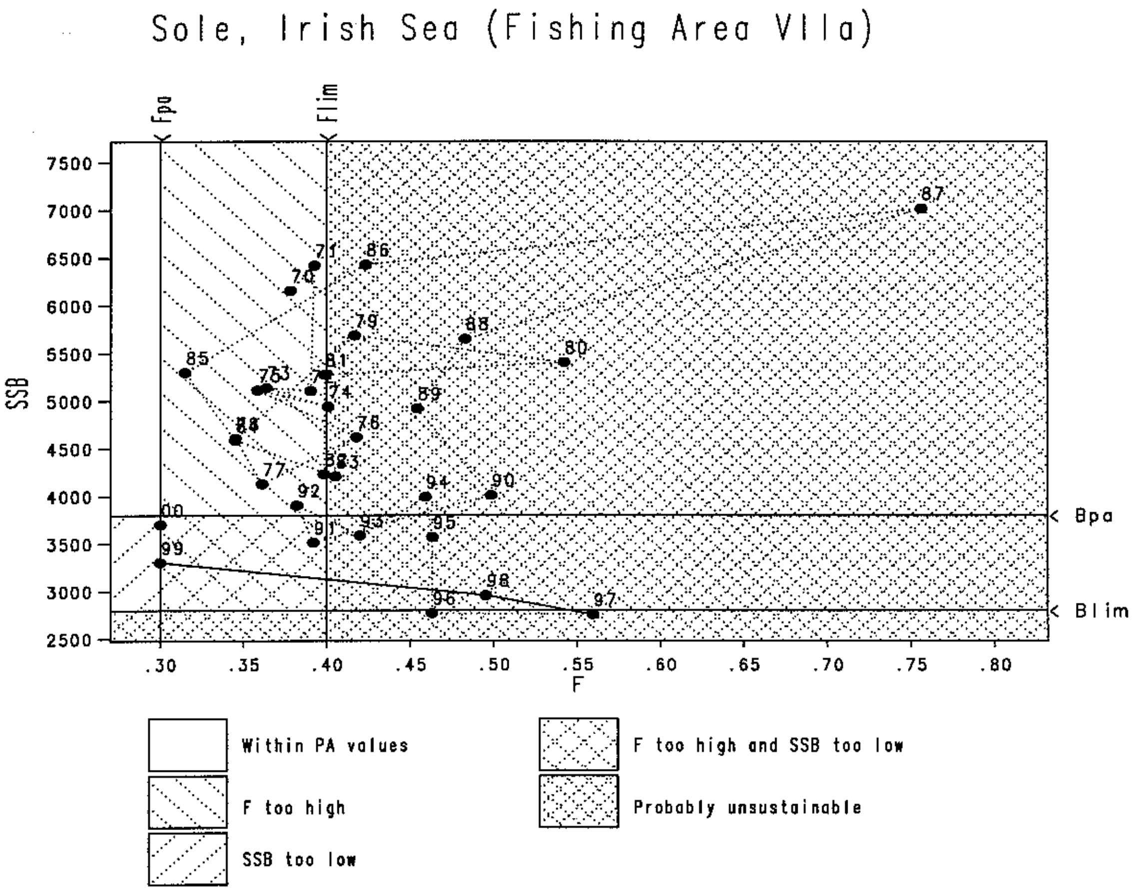


Table 3.8.6.1 Irish Sea SOLE. Divisions VIIa. Nominal landings (tonnes), as officially reported to ICES.

Country	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997*
Belgium	589	930	987	915	1010	786	371	531	495	706	675	533	553
France	9	17	5	11*	5*	2*	3*	11*	8*	8*	5*	7*	2
Ireland	180	235	312	366	155	170	198	164	98	226	176	133	n/a
Netherlands	546	-	-	-	-	-	-	-	-	-	-	149	123
UK (Engl.& Wales)[1]	269	637	599	507	613	569	581	477	338	409	424	194	...
UK (Isle of Man)	12	1	3	1	2	10	44	14	4	5	12	4	n/a
UK (N. Ireland)[1]	36	50	72	47									
UK (Scotland)[1]	28	46	63	38	38	39	26	37	28	14	8	5	...
United Kingdom													195
Total	1,669	1,916	2,041	1,885	1,823	1,576	1,223	1,234	971	1,368	1,300	1,025	873
Unallocated	-523	79	767	114	10	7	-9	25	52	1	-34	-23	128
Total used by Working Group in Assessment	1,146	1,995	2,808	1,999	1,833	1,583	1,214	1,259	1,023	1,369	1,266	1,002	1,001

* Preliminary

[1] 1989–1996 N. Ireland included with England & Wales

n/a Not available

Table 3.8.6.2 Sole in the Irish Sea (Fishing area VIIa).

Year	Recruitment Age 1	Spawning Stock Biomass	Landings	Fishing Mortality Age 4-7
1970	11.37	6.16	1.79	0.378
1971	3.56	6.42	1.88	0.393
1972	14.12	5.10	1.45	0.390
1973	6.84	5.14	1.43	0.364
1974	7.50	4.94	1.31	0.401
1975	4.61	5.11	1.44	0.359
1976	18.07	4.62	1.46	0.418
1977	10.49	4.13	1.15	0.361
1978	9.61	4.61	1.11	0.345
1979	5.87	5.68	1.61	0.417
1980	4.89	5.40	1.94	0.542
1981	2.69	5.27	1.67	0.399
1982	6.56	4.23	1.34	0.399
1983	17.82	4.21	1.17	0.405
1984	18.75	4.59	1.06	0.345
1985	27.34	5.30	1.15	0.315
1986	4.47	6.43	2.00	0.423
1987	4.25	7.02	2.81	0.756
1988	5.11	5.65	2.00	0.483
1989	6.75	4.92	1.83	0.454
1990	14.51	4.01	1.58	0.498
1991	5.52	3.51	1.21	0.392
1992	6.55	3.90	1.26	0.382
1993	6.18	3.59	1.02	0.420
1994	2.22	3.99	1.37	0.459
1995	2.59	3.57	1.27	0.463
1996	10.85	2.77	1.00	0.463
1997	10.43	2.75	1.00	0.559
1998	6.29	2.96	.	.
Average	8.82	4.69	1.47	0.428
Unit	Millions	1000 tonnes	1000 tonnes	-

3.8.7 Irish Sea herring (Division VIIa)

State of the stock/fishery: The stock is at present considered to be harvested outside safe biological limits as defined by the proposed reference points. Fishing mortality for the most recent year is uncertain but is likely to be above the proposed F_{pa}. Spawning stock biomass has been relatively stable for the last 6 years at a value below the proposed B_{pa}. Recent recruitment has typically been below the long-term average.

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

Advice on management: ICES recommends that F in 1999 should be reduced to F_{pa} =0.36 to ensure that the SSB is maintained within the precautionary region. This corresponds to a catch of 4 900 t.

Proposed reference points: An analysis of stock-recruitment data suggests that fishing mortalities in the region of 0.6 are associated with a high probability of serious stock decline. The value of F_{med} is 0.36 and is associated with a low probability of the SSB falling below the lowest observed values of about 6 000 t. It is suggested that F_{med} be used as F_{pa}.

Although there is some evidence that the expected recruitment is reduced as SSB declines, there is no particular value where the probability of poor recruitment increases. The lowest observed SSB is about 6 000 t. In order to have a high probability of avoiding this low value, management action to reduce fishing mortality below F_{pa} would be required at measured SSBs of 9 500 t. It is suggested that B_{pa} be set at 9 500 t.

Sustained fishing at F_{med} would be expected to result in an SSB fluctuating around an equilibrium value of about 13 000 t. The proposed F_{pa} is also close to F_{MSY}.

Relevant factors to be considered in management: Areas closed to herring fishing around the eastern Irish coast and west coast of Britain were put in place to protect juveniles when an industrial fishery operated. Although this fishery has ceased, these closed area should be maintained.

Catch forecast for 1999: Basis F(98)=F(97), Landings(98)= 5 800 t, SSB (98)=10 300 t.

Basis	F(99)	SSB(99)	Landings(99)	SSB(2000)	Long-term effect of fishing at given level
0.4F(97)	0.16	12500	2400	14700	Expected equilibrium SSB=42 000 t
0.6F(97)	0.24	11700	3500	12900	Expected equilibrium SSB=18 000
0.8F(97)	0.32	10800	4500	11300	Expected equilibrium SSB=14 000 t
F_{pa}	0.36	10500	4900	10600	Expected equilibrium SSB=13 000 t
1.0F(97)	0.40	10100	5400	10000	Expected equilibrium SSB=8 500 t

Weights in t.

Shaded scenario considered inconsistent with the precautionary approach.

Elaboration and special comment: There are two spawning stocks of herring in the Irish Sea (Manx and Mourne). At present these are treated as one stock for assessment and management purposes. The Mourne component is no longer a significant part of the stock. Fishing mortality increased substantially in the 1970s due to a transfer of effort from other closed herring fisheries and the operation of an industrial fleet. Since this period, the size of the exploiting fleets in this area has declined and the industrial fishery has closed. In recent years the Irish fleet has withdrawn from the fishery resulting in a reduction in effort.

Unlike last year, the assessment this year included tuning data but recent Fs were constrained to have a zero trend. These Fs are substantially higher than estimated by ACFM last year and are considered to be of low precision.

Source of information: Report of the Herring Assessment Working Group for the Area South of 62°N, March 1998 (ICES CM 1998/ACFM:14).

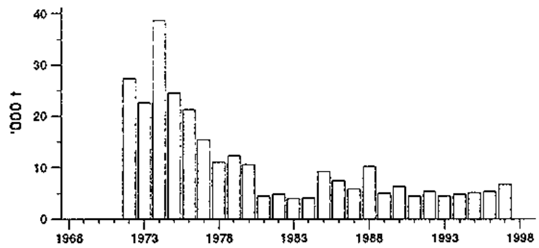
Catch data (Tables 3.8.7.1–2):

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	
1999	$F=F_{pa}=0.36$	4.9		

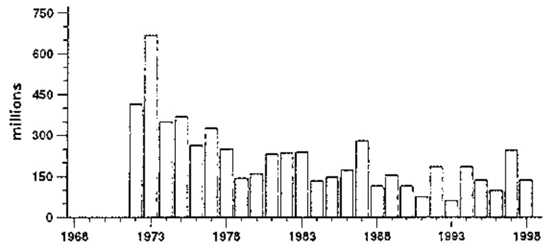
Weights in '000 t

Irish Sea herring (Division VIIa)

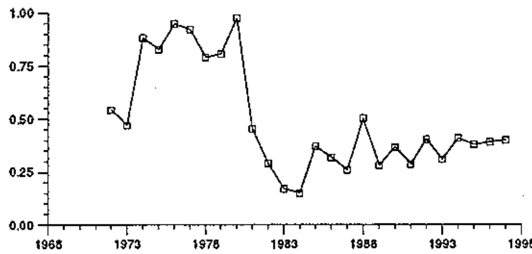
Landings
Mean = 10.8



Recruitment (age 1)
Mean = 217



Fishing mortality (ages 2-6)
Mean = 0.497



Spawning stock biomass
Mean = 14.9

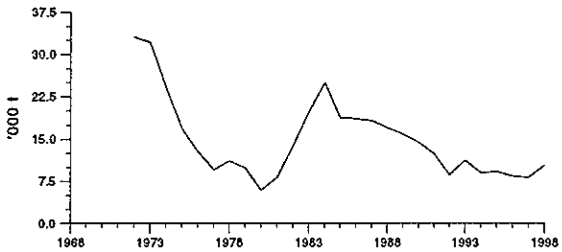


Table 3.8.7.1 Irish Sea HERRING (Division VIIa(N)). Catch in tonnes by country, 1984-1997. These figures do not in all cases correspond to the official statistics and cannot be used for management purposes.

Country	1984	1985	1986	1987	1988	1989	1990
Ireland	1,084	1,000	1,640	1,200	2,579	1,430	1,699
UK	2,982	4,077	4,376	3,290	7,593	3,532	4,613
Unallocated	-	4,110	1,424	1,333	-	-	-
Total	4,066	9,187	7,440	5,823	10,172	4,962	6,312

Country	1991	1992	1993	1994	1995	1996	1997
Ireland	80	406	0	0	0	100	0
UK	4,318	4,864	4,408	4,828	5,076	5,180	6,651
Unallocated	-	-	-	-	-	22	-
Total	4,398	5,270	4,408	4,828	5,076	5,302	6,651

Table 3.8.7.2 Herring in the North Irish Sea (Manx plus Mourne VIIa North).

Year	Recruitment Age 1	Spawning Stock Biomass	Landings	Fishing Mortality Age 2-6
1972	414.56	33.03	27.35	0.543
1973	667.63	32.14	22.60	0.470
1974	349.69	24.24	38.64	0.882
1975	369.70	16.85	24.50	0.827
1976	263.39	12.78	21.25	0.948
1977	326.21	9.56	15.41	0.920
1978	249.17	11.16	11.08	0.792
1979	140.25	9.92	12.34	0.805
1980	157.24	5.94	10.61	0.974
1981	231.74	8.12	4.38	0.453
1982	234.67	13.66	4.86	0.292
1983	237.03	19.81	3.93	0.171
1984	132.19	24.99	4.07	0.150
1985	147.72	18.84	9.19	0.372
1986	171.30	18.53	7.44	0.319
1987	279.32	18.24	5.82	0.261
1988	113.11	17.01	10.17	0.504
1989	154.11	15.83	4.95	0.281
1990	112.98	14.35	6.31	0.368
1991	73.76	12.40	4.40	0.287
1992	184.85	8.69	5.27	0.406
1993	60.42	11.18	4.41	0.311
1994	183.47	8.97	4.83	0.411
1995	134.26	9.18	5.08	0.380
1996	97.49	8.35	5.30	0.393
1997	245.12	8.19	6.65	0.403
1998	134.86	10.31	.	.
Average	217.27	14.90	10.80	0.497
Unit	Millions	1000 tonnes	1000 tonnes	-

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 a coastal gill-net fishery 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. The fishery's catch includes a large component of juvenile fish, for which there is no minimum landing size. In addition, a gill net fishery has developed in the Celtic Sea in the last decade.

Nephrops are an important component of the fisheries in this area. These fisheries developed in the 1970s and 1980s and effort increased continuously until recent years. Landings increased initially as effort increased but these have tended to stabilise or decline at continuing high effort levels. The mesh size when fishing for *Nephrops* can lead to a significant by-catch of juvenile fish, notably 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. 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 thousand t or less. However, the TACs set for the stocks often cover many assessment units. In addition, for a number of units, there are insufficient data for adequate assessments. This means that TACs which cover a number of heavily exploited stocks 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 regarded as being 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. The minimum mesh sizes in the Celtic Sea are often different from those in the Bay of Biscay. This difference makes enforcement more difficult since vessels can carry multiple mesh sizes and may fish in the Celtic Sea using the lower mesh sizes without being detected. It is noted, however, that the European Commission Technical Conservation Regulation revising the existing technical measures on 1st Jan. 2000 will largely eliminate this problem.

State of the stocks

The majority of fish stocks which are assessed in this area are considered to be outside or close to being 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. These stocks exhibit high F, low SSB level and low recruitments in most recent years.

The Northern hake stock is discussed fully in Section 3.12.2. It is important to note that species is taken by most of the demersal fleets in this area. This hake stock is regarded as being outside safe biological limits, which means that any management of the fisheries in the area needs to consider its protection.

There are no major concerns about the *Nephrops* stocks in this area though most stock units are fully exploited or over-exploited in terms of yield per recruit. Management of these fisheries, however, needs to be sensitive to by-catches of stocks requiring protection such as Celtic Sea cod and Northern hake.

The Celtic Sea herring SSB has been stable in the last fifteen years. The recruitment has been above average in three of the last four years.

The mackerel caught in the area belong to the Southern and Western spawning components. The Western horse mackerel is declining rapidly due to one extremely strong year class being fished down and will, at present F, continue to decline.

For many of the stocks in this area there are insufficient data for an assessment. It is, therefore, not possible to evaluate their status but it is likely that several of these stocks are fully exploited.

3.9.2 Cod in Divisions VIIe-k

State of stock/fishery: The stock is considered to be outside safe biological limits. Fishing mortality has generally fluctuated above the proposed F_{pa} but was particularly high during 1986–1994. SSB has fluctuated widely, depending on the size of each recruiting year class. Recent year classes have been above average maintaining SSB above the proposed B_{pa} since 1992.

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 F_{pa} and to increase or maintain spawning stock biomass above B_{pa}.

Advice on management: ICES recommends that fishing mortality should be reduced below the proposed F_{pa} (0.68), corresponding to landings of no more than 9 200 t in 1999. This would give a low probability of SSB falling below B_{pa} in the short and medium-term.

Reference points:

ICES considers that:	ICES proposes that:
B_{lim} is 4 500 t, the lowest observed spawning stock biomass.	B_{pa} be set at 8 000 t. This is the previously proposed MBAL. Biomass above this affords a high probability of maintaining SSB above B_{lim}, taking into account the uncertainty assessments.
F_{lim} is 0.90, the fishing mortality estimated to lead to potential stock collapse.	F_{pa} be set at 0.68. This F is considered to have a high probability of avoiding F_{lim} and maintaining SSB above B_{pa} in the medium term taking into account the uncertainty assessments.

Technical basis:

B_{lim}:B_{loss}	B_{pa} : former MBAL
F_{lim}:F_{loss}	F_{pa}: approximate 5 th percentile of F_{loss}; implies a less than 10% probability ($SSB_{MT}< B_{pa}$)

Relevant factors to be considered in management: As last year, this assessment covers Divisions VIIe,f,g,h,j and k. The TAC covers the above Divisions, together with Sub-area VII, IX and X and the CECAF area. The TAC for Division VIIa is based on a separate assessment for that Division and has a separate TAC. The assessment of the stock in Division VIId is combined with that of Sub-area IV. A separate TAC for VIId is based on a percentage (0.27% equivalent to about 4 000 t), of the combined TAC for both areas. If it is necessary to calculate a TAC for Sub-area VII - excluding Divisions VIIa and VIId - and including Sub-areas VIII, IX and X, then 1 000 t representing the average catches from the non-assessed areas should be added to the proposed TAC for Divisions VIIe–k.

Catch forecast for 1999:

Basis: F(98 = F(95–97) = 0.83; Landings(98) = 12.6; SSB(99) = 14.3

F(99) onwards	Basis	Catch(99)	Landings(99)	SSB (2000)	Medium-term effect of fishing at given level
0.33	$0.4F_{95-97}$		5.3	18.4	Low probability of SSB falling below B_{pa}
0.50	$0.6F_{95-97}$		7.3	15.6	Low probability of SSB falling below B_{pa}
0.66	$0.8F_{95-97}$		9.1	13.2	Low probability of SSB falling below B_{pa}
0.68	F_{pa}		9.2	13.0	10% probability of SSB falling below B_{pa}
0.83	$1.0F_{95-97}$		10.6	11.1	20% probability of SSB falling below B_{pa}
1.00	$1.2F_{95-97}$		11.9	9.4	High probability of SSB falling below B_{pa}

Weights in '000 t.

Shaded scenarios considered inconsistent with the precautionary approach.

Elaboration and special comment: Cod in Divisions VIIe-k are taken as a component of 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. The UK (England and Wales) account for about 9% and Ireland for 13%, while Belgian vessels take about 4%. Landings are made throughout the year, but mainly in the winter months during November to April.

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 either east or west 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.

Some tags from cod tagged in the Celtic Sea were returned from the Irish Sea, but most were recaptured in the area of release and there was no evidence of any movement into the Western Channel. Juveniles dispersed to the south and west and, by spring the following year, the maturing cod were well distributed in the Western Approaches and Celtic Sea. Tagged mature cod were subsequently found in the Trevose spawning area. Mature cod tagged off north Cornwall were recaptured all along the west coast of Britain, others subsequently returned to the spawning area.

Adult cod tagged during March on the County Down spawning grounds or off south-east Ireland in October demonstrated a rapid migration between the County Down spawning ground and south-east Ireland. Many cod less than one year old tagged in the north-east Irish Sea were recaptured in the Celtic Sea during the first year after release, and were subsequently recaptured during January to April on the spawning areas in the northern Irish Sea. This suggests that these cod are part of a group which regularly returns to the spawning area off north Cornwall, though a component of cod landings from the Celtic Sea are fish which spawn in the Irish Sea.

Analytical assessment based on landings and commercial CPUE data for three commercial fleets for a short series (1988–1996) where age data were both available in Division VIIe and in Divisions VIIf,g,h and Divisions VIIj,k. A conflict between survey data (not used in final assessment) and matrix of catch at age suggests a problem of misreporting in landings.

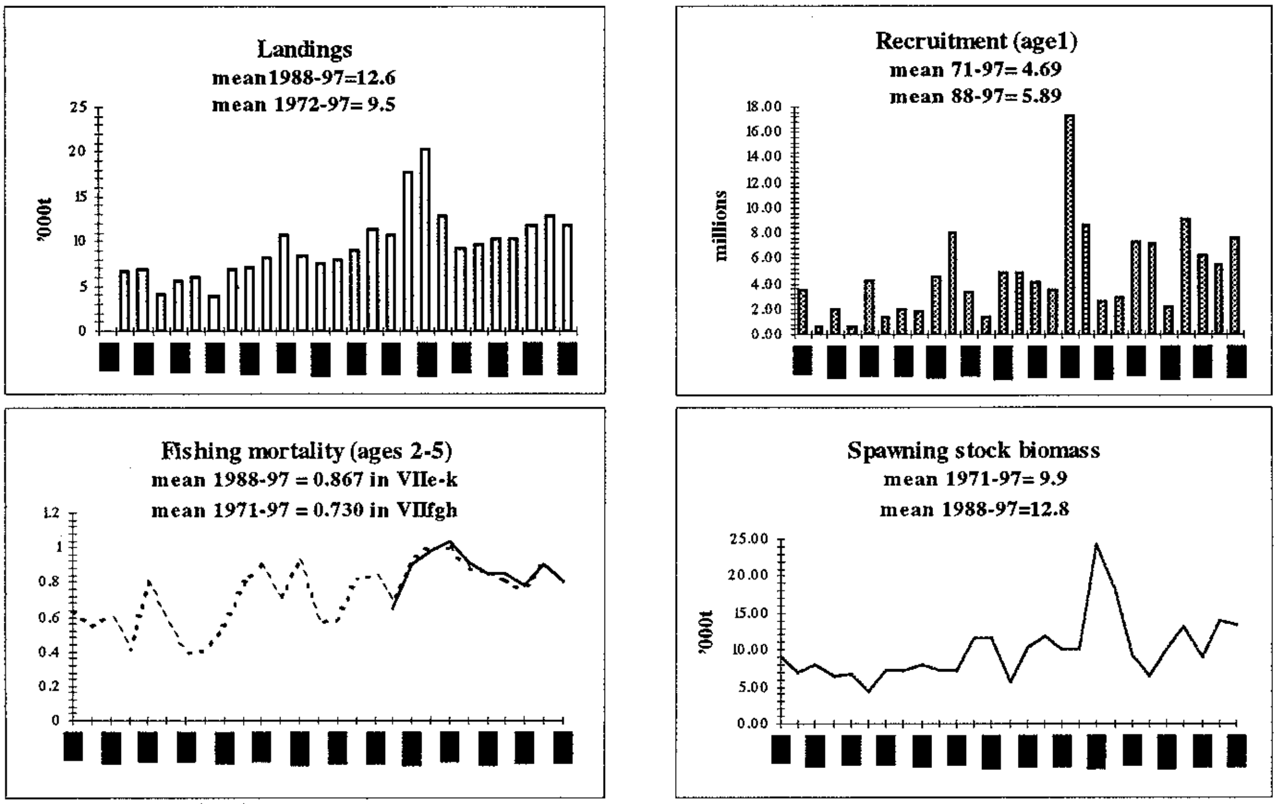
Results of this assessment are consistent with those of last year in the same area.

Source of information: Report of the Working Group on the Assessment of Southern Shelf Demersal Stocks, September 1998 (ICES CM 1999/ACFM:4).

Catch data (Tables 3.9.2.1–3):

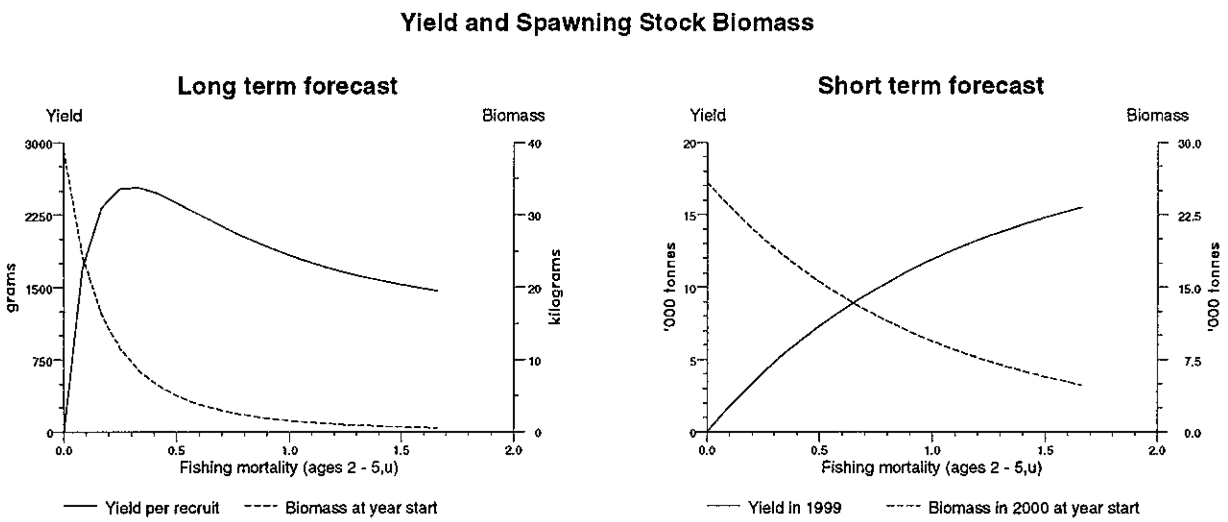
Year	ICES advice	Predicted catch corresp. to advice	Agreed TAC[1]	ACFM Landings
1987	Reduce F	< 6.4[2]		-
1988	No increase in F; TAC	7.0[2]		17.7
1989	No increase in F; TAC	8.6[2]		20.3
1990	No increase in F; TAC	9.2[2]		12.9
1991	TAC; SSB = mean	4.5[2]		9.3
1992	Appropriate to reduce F	-		9.6
1993	20% reduction in F	6.5[2]	17.5	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	
1999	Reduce F below $\mathbf{F}_{pa}$	9.2[4]		

[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. Weights in '000 t.



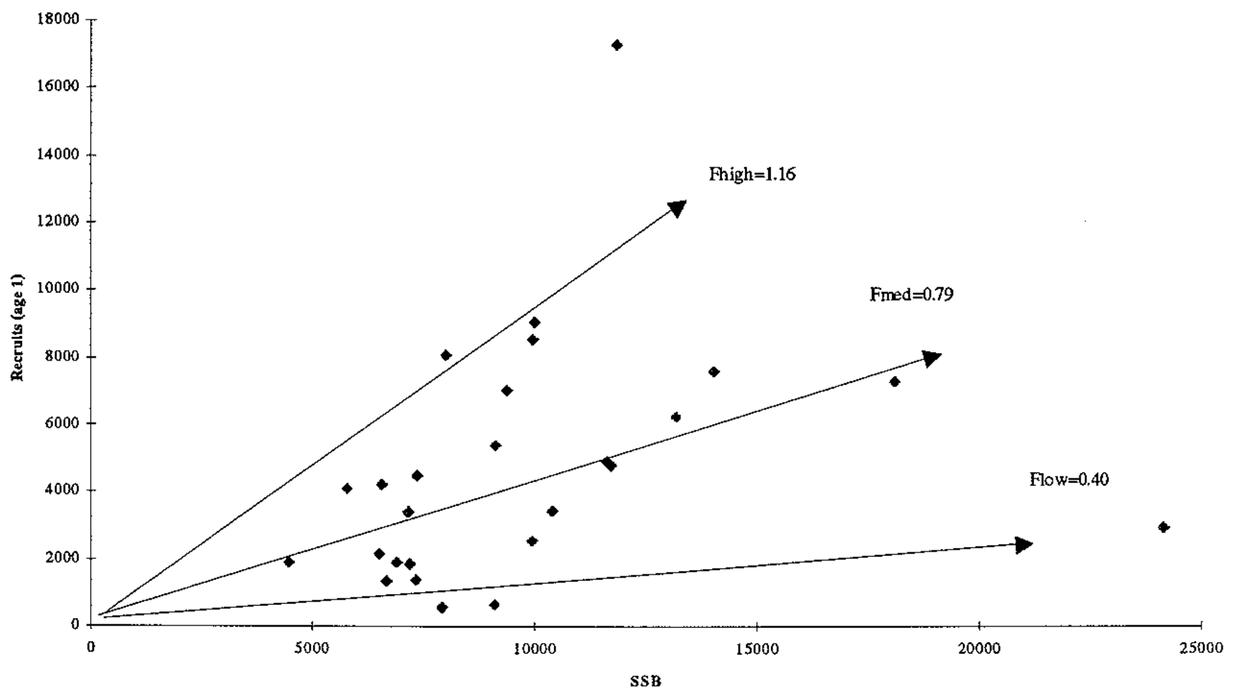
Landings data before 1988 refer to Table 3.9.2.1. 1971 data removed as they included VIIa and VIId. Source of landings data before 1988 : ICES. Bull. Fish. Stat. Scaled SSB and recruitment data before 1988.

Cod in Divisions VIIe-k



SSB and recruitment before 1988 scaled from VII f,g,h assessment values.

Figure 4.1.7 Cod in Divisions VIIe-k. Stock-recruitment plot (data scaled from 1987 back to 1971)



Precautionary Approach Plot

Cod, Fishing Areas VIIe – VIIk

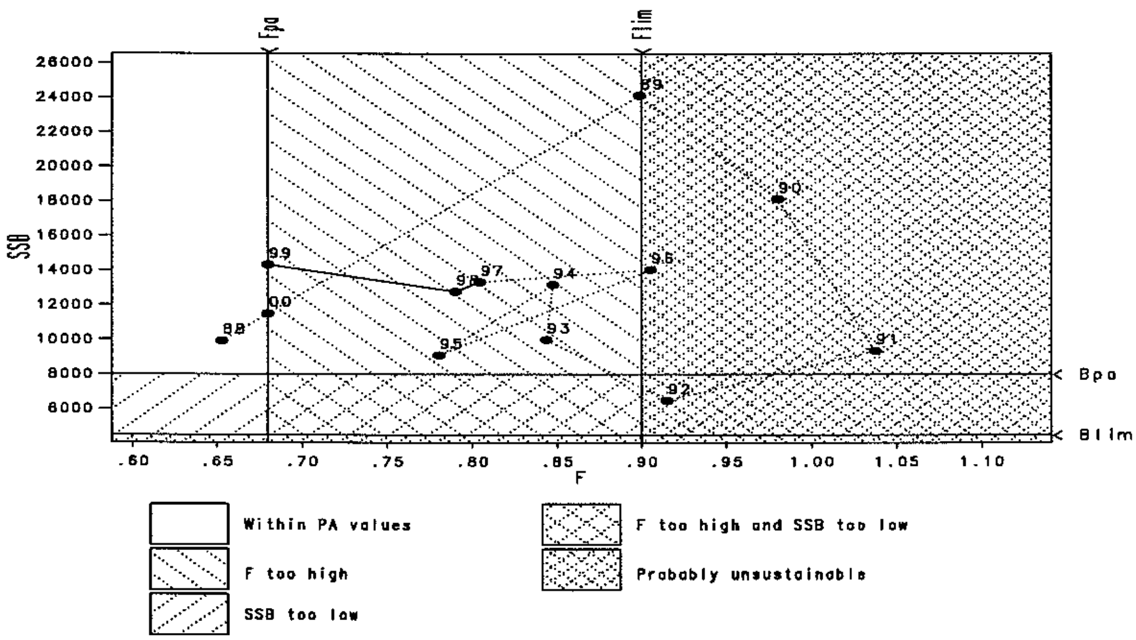


Table 3.9.2.1 Nominal landings of cod in Divisions VIIf–h, VIIe, VIIe–h, VIIj–k, VIIe–k as used by the Working Group in 1998.

Divisions VII f,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	7627	397	554		9266

Divisions VII e

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*	0	624		441		1066

Divisions VII e,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	8251	397	995	0	10332

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	151	1116	168		1440

Divisions VII e,f,g,h,j,k

Year	Belgium	France	Ireland	UK	Others	Total
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	8402	1513	1163	0	11772

* provisional

Table 3.9.2.2 Cod in Divisions VIIf-h.

	RECRUITS	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	FBAR 2-5
	Age 1					
1971	2697	9729	7429	4647	0.6256	0.6339
1972	511	8061	5631	3807	0.6761	0.5504
1973	1460	7678	6464	3227	0.4992	0.6002
1974	436	6822	5368	2329	0.4338	0.4092
1975	3257	7423	5459	3209	0.5878	0.8003
1976	1016	6951	3659	3872	1.0581	0.5819
1977	1458	7610	5869	2458	0.4188	0.3999
1978	1420	8238	6000	2931	0.4885	0.4072
1979	3443	9483	6547	3737	0.5708	0.5536
1980	6208	12006	5848	5821	0.9953	0.7908
1981	2604	13969	5977	8516	1.4249	0.8976
1982	1052	12957	9526	7045	0.7396	0.7052
1983	3774	12754	9581	7748	0.8087	0.9406
1984	3694	10645	4727	5329	1.1273	0.5692
1985	3162	14883	8502	6683	0.7861	0.581
1986	2649	14810	9688	8418	0.8689	0.8296
1987	13292	18228	8154	8220	1.0081	0.8484
1988	6011	25853	8228	13619	1.6553	0.6839
1989	2080	26497	19162	16674	0.8701	0.9216
1990	2327	17612	13770	10093	0.7329	1.0035
1991	5700	12479	7250	6883	0.9494	1.0003
1992	5818	13745	5358	7605	1.4193	0.8753
1993	1609	15546	8901	8971	1.0078	0.8668
1994	6628	17833	11588	8790	0.7586	0.8169
1995	4796	17204	7827	9317	1.1903	0.7548
1996	3985	18809	11585	10420	0.8994	0.9015
1997	4179	16983	10846	9266	0.8543	0.797
Mean	3528	13511	8109	7024	0.8687	0.7304
	(Thousands)	(Tonnes)	(Tonnes)	(Tonnes)		

Table 3.9.2.3 Cod in Divisions VIIe,f,g,h,j,k.

Year	Recruitment Age 1	Spawning Stock Biomass	Landings	Fishing Mortality Age 2-5
1988	8.57	9.92	17.70	0.653
1989	2.57	24.14	20.27	0.899
1990	2.93	18.12	12.91	0.980
1991	7.29	9.36	9.28	1.037
1992	7.05	6.48	9.58	0.915
1993	2.16	9.99	10.21	0.844
1994	9.06	13.18	10.30	0.848
1995	6.26	9.09	11.71	0.780
1996	5.39	14.04	12.75	0.905
1997	7.61	13,33	11.77	0.804
1998	.	12.78	.	.
Average	5.89	12.77	12.65	0.867
Unit	Millions	1000 tonnes	1000 tonnes	-

3.9.3 Whiting in Divisions VIIe–k

State of stock/fishery: The stock is considered to be within safe biological limits. The SSB fluctuated widely depending on each recruiting year class and is currently above the proposed $\mathbf{B_{pa}}$ The 1990–1993 year classes were well above average while the 1994 and 1995 year classes are well below average. Fishing mortality on this stock has displayed a declining trend since 1991.

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 $\mathbf{B_{pa}}$.

Advice on management: ICES recommends that F should not be allowed to increase. Assuming average recruitment, this would correspond to landings in 1999 of no more than 12 400 t. This would keep SSB above the proposed $\mathbf{B_{pa}}$ (21 000 t) with a high probability in the short term.

Reference points:

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 assessments.
$\mathbf{F_{lim}}$ not defined.	$\mathbf{F_{pa}}$ not proposed because of uncertainty in estimates of recruitment precluding meaningful medium term projections

Technical basis:

$\mathbf{B_{lim}}$:$\mathbf{B_{loss}}$	$\mathbf{B_{pa}}$: $\mathbf{B_{lim}}$ x 1.4
$\mathbf{F_{lim}}$:Not defined	$\mathbf{F_{pa}}$:No proposal

Relevant factors to be considered in management: This year the assessment area has been expanded and now covers Divisions VIIe–k, the major part of the TAC area which is all of Sub-area VII - except for Divisions VIIa and VIId. The TAC for Division VIIa is based on a separate assessment for that Division and has a separate TAC. The assesment for Division VIId is included with that for Sub-area IV and the TAC for Division VIId is also included with that for Sub-arca IV. If it is necessary to calculate a TAC for Sub-area VII - excluding VIIa - then a TAC of 17 487 t is suggested. This is based on a TAC of 12 400 for Divisions VIIe–k, together with a catch of 1 200 t for Divisions VIIb–c (the average catches in recent years) and a catch of 3 887 t for Division VIId, i.e., 11.5% of the total human consumption catch recommended for Sub-area IV and Division VIId. This TAC may prove restrictive.

Catch forecast for 1999:

Basis: F(98) = F(95–97) = 0.59, Landings(98) = 13.3, SSB(99) = 31.5.

F(99) onwards)	Basis	Catch(99)	Landings(99)	SSB (2000)	Medium-term effect of fishing at given level
0.36	0.6 F_{95-97}		8.3	37.0	No medium-term predictions
0.48	0.8 F_{95-97}		10.5	34.7	
0.59	1.0 F_{95-97}		12.4	32.6	
0.71	1.2 F_{95-97}		14.2	30.7	
0.83	1.4 F_{95-97}		15.8	29.0	

Weights in '000 t.

Shaded scenarios considered inconsistent with the precautionary approach.

Elaboration and special comment: Celtic Sea whiting are taken in mixed species (cod, whiting, hake, *Nephrops*) fisheries. French trawlers report about 65% of the total landings, Ireland (23%) and the UK (England and Wales) (9%), while Belgian vessels take less than 2%. The French *Nephrops* trawlers have for several years adopted a larger mesh following by-catch restrictions and market demand for larger *Nephrops.*

The main Irish fisheries in VIIf,g,h are inshore and offshore otter trawlers and seiners based in Dunmore East and Kilmore Quay. The main UK fisheries in

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 to the west of Scotland.

Division VIIj–k whiting are taken in a mixed species fisheries (cod/whiting/*Nephrops*/megrim). The main gears used are otter trawl and seiners and landings are taken by Ireland (90%) and France (7%).

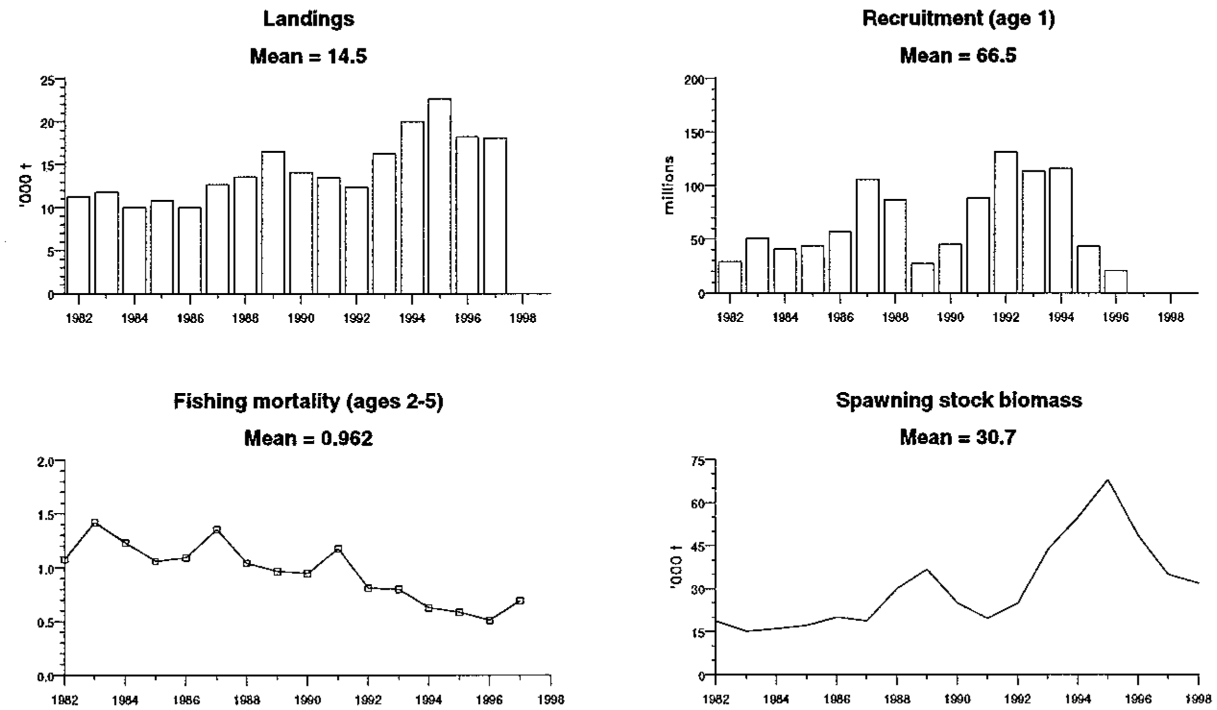
Analytical assessment based on landings and commercial CPUE data. No recruitment indices are available for this stock. No data are available on discarding of whiting, which is thought to be considerable.

Source of information: Report of the Working Group on the Assessment of Southern Shelf Demersal Stocks, September 1998 (ICES CM 1999/ACFM:4).

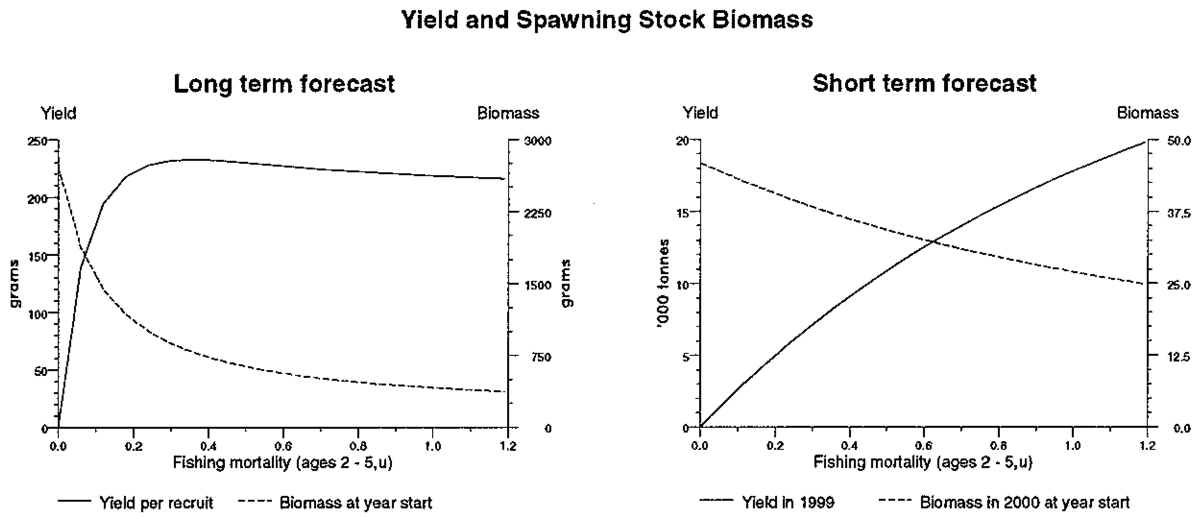
Catch data (Tables 3.9.3.1–3):

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC[1]	ACFM landings
1987	*Status quo* F; TAC	7.1[2]		12.8
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]		14.2
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	17.0
1997	At least 20% reduction in F	< 7.3[4]	27.0	18.1
1998	At least 20% reduction in F	< 8.2[4]	27.0	
1999	No increase in F	12.4[4]		

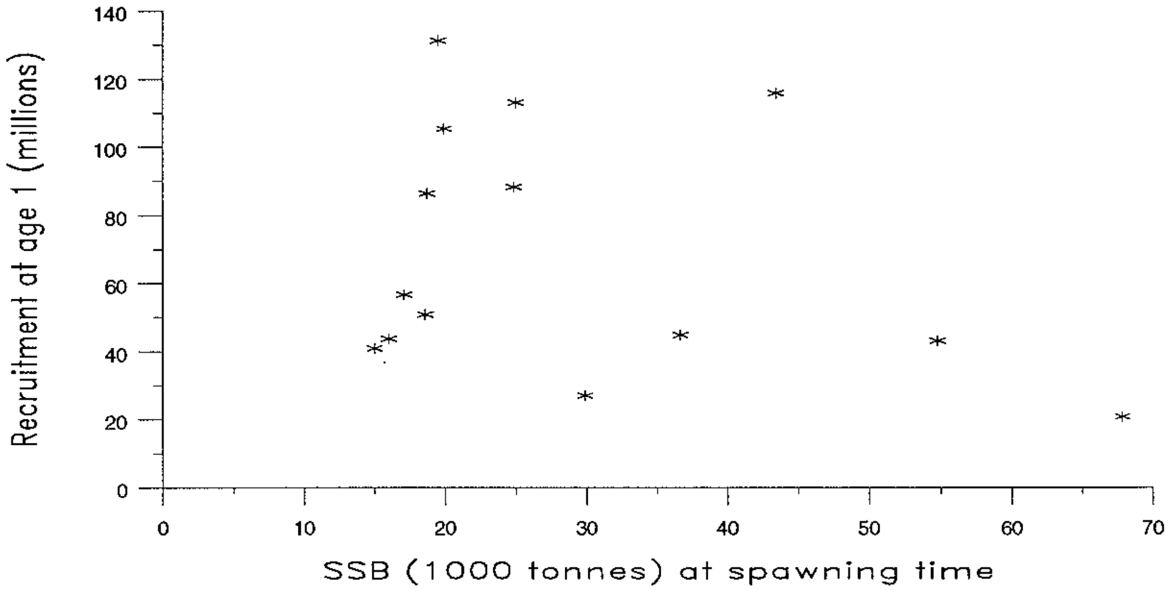
[1] TAC covers Sub-area VII (except Division VIIa). [2] For the VIIf+g stock component, [3] For the VIIf-h stock component, [4] For the VII e-k stock component. Weights in '000 t.



Whiting in Divisions VIIe-k



Stock - Recruitment



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Precautionary Approach Plot

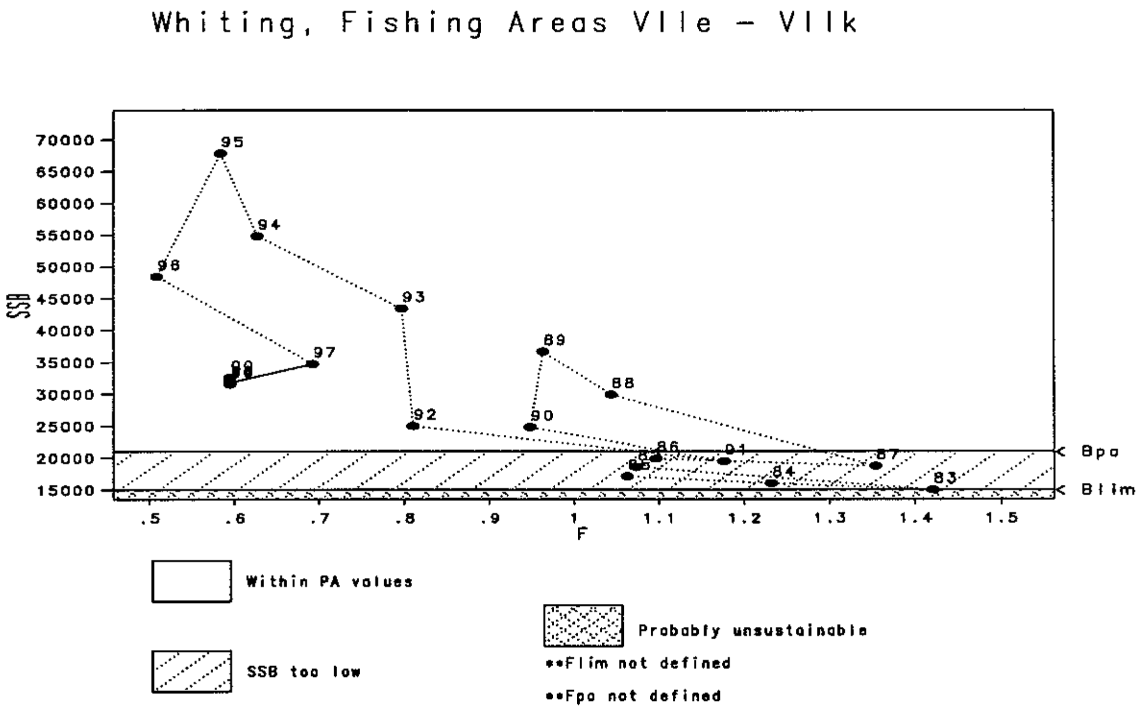


Table 3.9.3.1 Whiting in Divisions VIIe-k. Nominal Landings (tonnes) used by the Working Group.

VIIe-k	1982[2]	1983[2]	1984[2]	1985[2]	1986[2]	1987[2]	1988	1989	1990	1991	1992	1993	1994	1995	1996[1,2]	1997[1]
Denmark												0	0	0	0	0
France	8,355	8,982	7,171	7,820	7,647	10,054	11,410	12,171	10,464	9,956	9,165	10,771	12,634	13,095	9,992	11,664
Germany											14	0	0	0	0	0
Ireland	1,481	1,487	1,301	2,241	1,309	1,452	398	2,817	1,478	1,258	1,691	3,631	5,618	7,609	6,392	4,134
Belgium	78	135	161	167	107	111	159	296	308	292	107	145	228	204	267	586
Netherlands	68	0	398	0	124	0	0	0	0	0	0	0	0	0	0	0
UK (E&W)	1,243	1,177	954	610	765	1,035	1,598	1,252	1,782	1,969	1,379	1,756	1,548	1,748	1,609	1,683
UK(Scotland)							1	5	74	33	8	17	6	22	0	0
TOTAL	**11,225**	**11,781**	**9,985**	**10,838**	**9,952**	**12,652**	**13,566**	**16,541**	**14,106**	**13,508**	**12,364**	**16,320**	**20,034**	**22,678**	**18,260**	**18,067**

[1] = Preliminary
[2] = Revised. Data from *1982 to 1987 revised. Data for 1996 revised*

Table 3.9.3.2 **Whiting** in Sub-areas VIII, IX and X. Nominal landings (tonnes) as officially reported to ICES.

	France	Others	Total
1989	2,284	428	2,712
1990	2,167	299	2,466
1991	2,577	159	2,736
1992	2,389	216	2,605
1993	3,016	323	3,339
1994	3,537	444	3,981
1995	2,645	174[1]	2,819
1996	1,855	191[1]	2,046
1997	2,600*	143[1]	

*Preliminary.
[1]No Spanish data available.

Table 3.9.3.3 Whiting in Divisions VIIe,f,g,h,j,k.

Year	Recruitment Age 1	Spawning Stock Biomass	Landings	Fishing Mortality Age 2-5
1982	28.68	18.56	11.23	1.074
1983	50.83	14.98	11.78	1.420
1984	40.97	15.98	9.99	1.232
1985	43.79	17.07	10.84	1.062
1986	56.66	19.87	9.95	1.096
1987	105.24	18.68	12.65	1.354
1988	86.25	29.88	13.57	1.043
1989	27.06	36.64	16.54	0.963
1990	44.89	24.80	14.11	0.948
1991	88.29	19.45	13.51	1.176
1992	131.21	24.94	12.36	0.810
1993	113.00	43.39	16.32	0.797
1994	115.84	54.79	20.03	0.627
1995	43.22	67.81	22.68	0.584
1996	20.84	48.45	18.26	0.509
1997	.	34.71	18.07	0.692
1998	.	31.75	.	.
Average	66.45	30.69	14.49	0.962
Unit	Millions	1000 tonnes	1000 tonnes	-

3.9.4 Celtic Sea plaice (Divisions VIIf and g)

State of stock/fishery: The stock is considered to be outside safe biological limits. SSB rose to a peak in the late 1980s, but has since declined to below the proposed $\mathbf{B_{pa}}$. Fishing mortality has fluctuated around the proposed $\mathbf{F_{pa}}$ throughout the time series. Recruitment since 1989, excepting the average 1994 year class, has been well below average, and it is unlikely that SSB will increase in the short term at the current fishing mortality in the absence of strong recruitment.

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 $\mathbf{B_{pa}}$.

Advice on management: ICES reiterates its advice of last year, that fishing mortality be reduced by 20% from F(94–96), to F = 0.45, corresponding to landings of 670 t in 1999. This represent a reduction of 35% of the F(95–97), and would result in an F in 1999 below the proposed $\mathbf{F_{pa}}$, but SSB in 2000 will still be below $\mathbf{B_{pa}}$. If F is reduced only slightly below the proposed $\mathbf{F_{pa}}$ (0.60), SSB will take longer to rebuild above $\mathbf{B_{pa}}$ in the medium term.

Reference points:

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.	$\mathbf{F_{pa}}$ be set at 0.60. 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 assessments.

Technical basis:

$\mathbf{B_{lim}}$:$\mathbf{B_{loss}}$	$\mathbf{B_{pa}}$: $\mathbf{B_{lim}}$ x 1.64
$\mathbf{F_{lim}}$:Not defined	$\mathbf{F_{pa}}$: ~ $\mathbf{F_{med}}$; implies a less than 5% probability that (SSB_{MT}< $\mathbf{B_{pa}}$)

Relevant factors to be considered in management: Plaice and sole in the Celtic Sea are taken in the same fishery, and the implications of departures from *status quo* fishing mortality must be considered for both species. However, a reduction in F from F (95–97) on plaice of at least 20% is necessary to prevent further decline in SSB below the 1998 value, which is the lowest in 20 years.

Catch forecast for 1999:

Basis: F(98) = Fsq(95–97,u) = 0.70; Landings (98) = 1.01; SSB(99) = 1.45.

F(99)	Basis	Catch(99)	Landings(99)	SSB(2000)	Medium-term effect of fishing at given level
0.35	0.5 F_{95-97}		0.55	1.75	High probability of SSB being above $\mathbf{B_{pa}}$
0.42	0.6 F_{95-97}		0.64	1.67	High probability of SSB being above $\mathbf{B_{pa}}$
0.45	0.65F_{95-97}		0.67	1.64	High probability of SSB being above $\mathbf{B_{pa}}$
0.56	0.8 F_{95-97}		0.80	1.52	High probability of SSB being above $\mathbf{B_{pa}}$
0.60	$\mathbf{F_{pa}}$		0.84	1.49	10% probability of SSB staying below $\mathbf{B_{pa}}$
0.70	1.0 F_{95-97}		0.94	1.39	> 50% probability of SSB staying below $\mathbf{B_{pa}}$
0.84	1.2 Fsq		1.07	1.28	High probability of SSB staying below $\mathbf{B_{pa}}$

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

Elaboration and special comment: The fisheries taking plaice in the Celtic Sea mainly involve vessels from France and Belgium: France accounts for 39% of the total landings, Belgium takes 30%, England and Wales report 24%, and Ireland the remaining 7%.

In the 1970s, the 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 the South and West Wales coasts move southwards to join the adult population off the north Cornish coast during spawning.

Annual beam-trawl surveys indicate that, unlike in the Irish Sea, immature plaice up to 2 years old are not restricted to the shallow, inshore waters and may be found with the adults in water of 20–40 m depth.

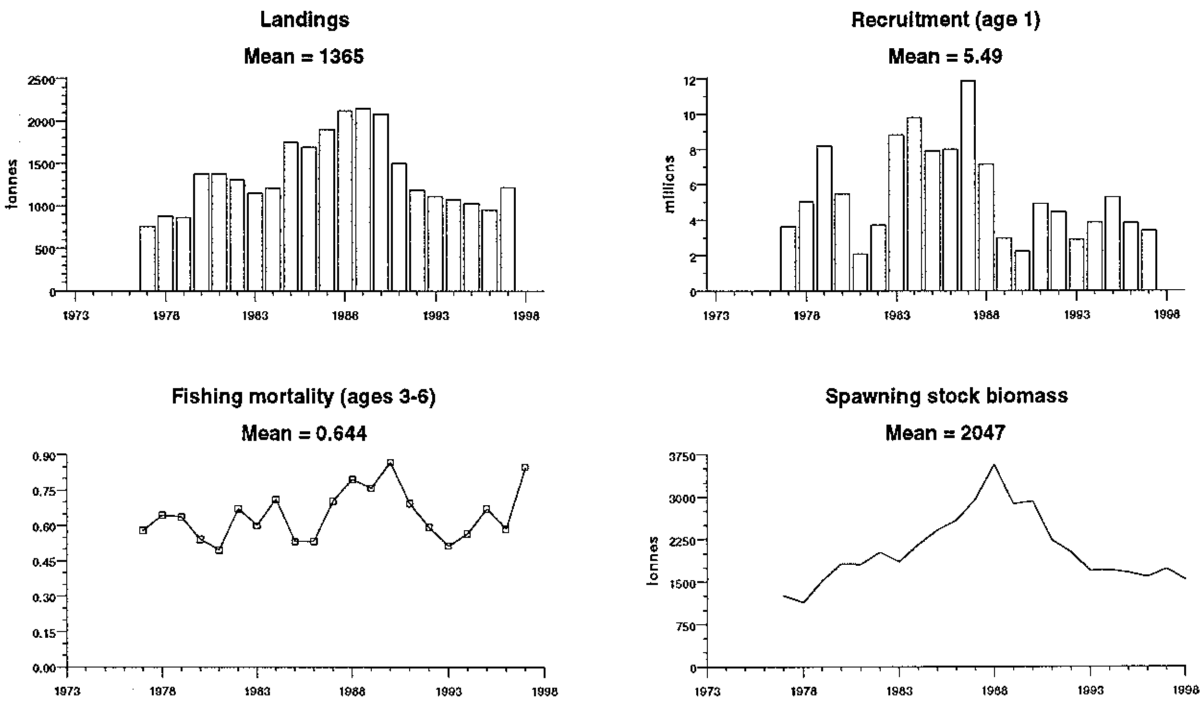
Analytical age-based assessment using landings, survey and commercial CPUE data. There is insufficient biological sampling of this stock, in part within national landings and also because of landings through foreign ports.

Source of information: Report of the Working Group on the Assessment of Southern Shelf Demersal Stocks, September 1998 (ICES CM 1999/ACFM:4).

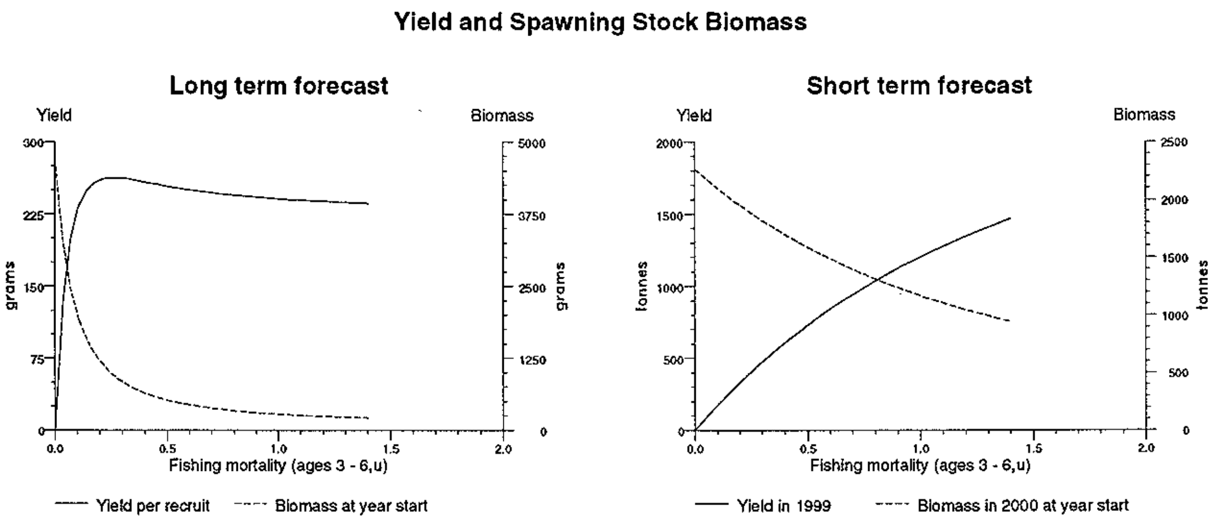
Catch data (Tables 3.9.4.1–2):

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	1.9	1.9
1988	TAC not to be restrictive on other species	-	2.5	2.1	2.1
1989	TAC not to be restrictive on other species	-	2.5	2.2	2.2
1990	F likely to be F(88)	~1.9	1.9	2.1	2.1
1991	F likely to be F(89)	~1.7	1.9	1.5	1.5
1992	No long-term gains in increasing F	-	1.5	1.2	1.2
1993	No long-term gains in increasing F	-	1.4	1.1	1.1
1994	No long-term gains in increasing F	-	1.4	1.1	1.1
1995	No increase in F	1.29	1.4	1.0	1.0
1996	20% reduction in F	0.93	1.1	0.9	0.9
1997	20% reduction in F	1.10	1.1	1.2	1.2
1998	20% reduction in F	1.00	1.1		
1999	35% reduction in F	0.67			

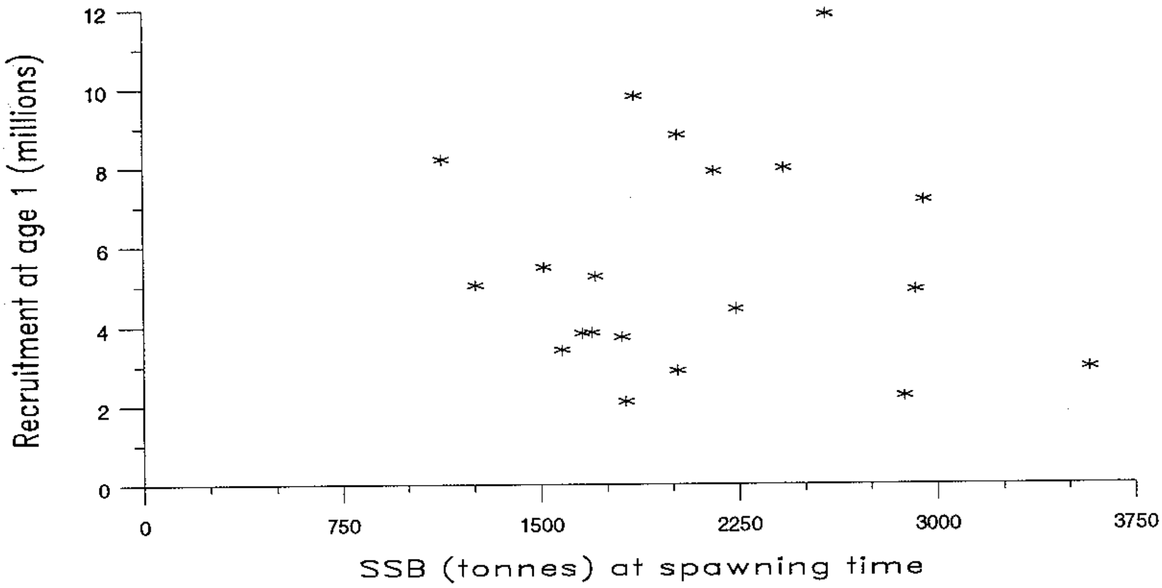
Weights in '000 t.



Plaice in the Celtic Sea (Divisions VIIf and VIIg)



Stock - Recruitment



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Precautionary Approach Plot

Plaice, Celtic Sea (Fishing Areas VIIf and VIIg)

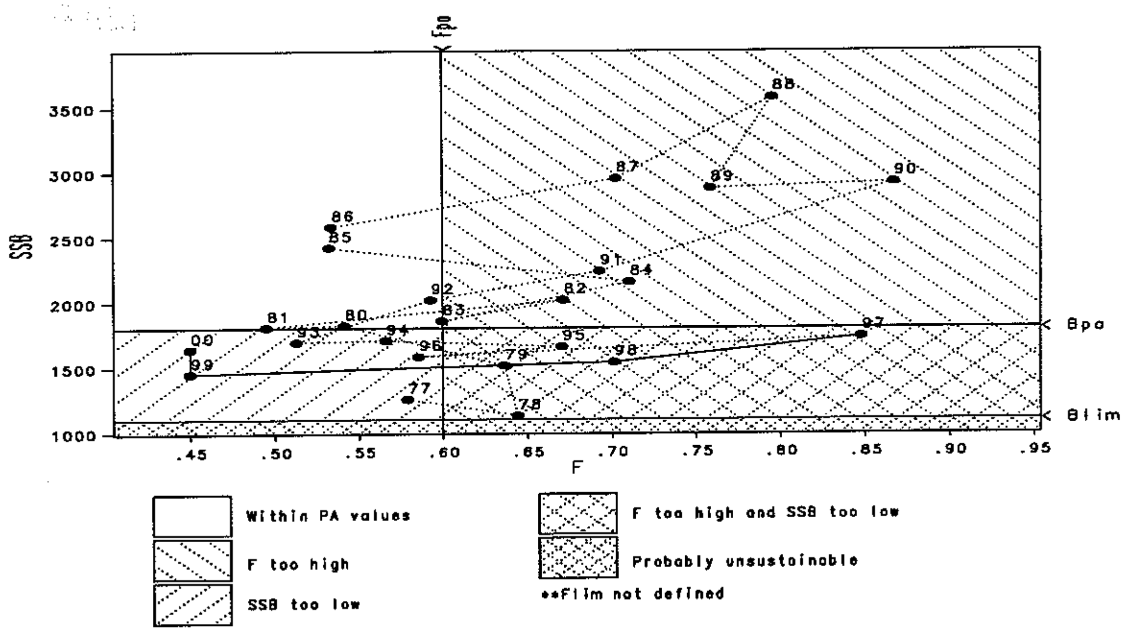


Table 3.9.4.1 Celtic Sea plaice. Nominal landings (tonnes) in Divisions VIIf+g, as used by Working Group.

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	323	143	259	0	1,219	0	1,219

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 Plaice in the Celtic Sea (Divisions VIIf and VIIg).

Year	Recruitment Age 1	Spawning Stock Biomass	Landings	Fishing Mortality Age 3-6
1977	3.62	1.25	0.76	0.579
1978	5.02	1.13	0.88	0.644
1979	8.20	1.51	0.86	0.636
1980	5.48	1.82	1.37	0.541
1981	2.09	1.81	1.38	0.495
1982	3.72	2.02	1.30	0.671
1983	8.81	1.85	1.15	0.600
1984	9.79	2.15	1.21	0.710
1985	7.89	2.42	1.75	0.532
1986	7.97	2.58	1.69	0.533
1987	11.86	2.95	1.90	0.703
1988	7.14	3.58	2.12	0.795
1989	2.94	2.88	2.15	0.759
1990	2.21	2.92	2.08	0.867
1991	4.90	2.24	1.50	0.693
1992	4.42	2.02	1.19	0.593
1993	2.87	1.69	1.11	0.513
1994	3.84	1.71	1.07	0.566
1995	5.25	1.66	1.03	0.670
1996	3.81	1.58	0.95	0.585
1997	3.39	1.73	1.22	0.848
1998	.	1.54	.	.
Average	5.49	2.05	1.37	0.644
Unit	Millions	1000 tonnes	1000 tonnes	-

3.9.5 Celtic Sea sole (Divisions VIIf and g)

State of stock/fishery: The stock is considered to be outside safe biological limits. Fishing mortality has increased since the late 1970s and is above the proposed $\mathbf{F_{pa}}$. SSB has declined steadily since the early 1970s, reaching a record low value in 1991 and is forecast to fall below the proposed $\mathbf{B_{pa}}$ in 1999. Recent recruitment has been around the long-term average with occasionally large year classes.

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 $\mathbf{B_{pa}}$.

Advice on management: ICES recommends that the fishing mortality should be reduced below the proposed $\mathbf{F_{pa}}$, = 0.37, corresponding to landings of no more than 810 t in 1999. This is equivalent to a reduction of 20% from *status quo* F, and will promote an increase in SSB above $\mathbf{B_{pa}}$ (2 200 t) in the short term.

Reference points:

ICES considers that:	ICES proposes that:
$\mathbf{B_{lim}}$ is not defined	$\mathbf{B_{pa}}$ be set at 2 200 t. There is evidence of high recruitment at the lowest biomass observed and $\mathbf{B_{pa}}$ can therefore 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 the medium term taking into account the uncertainty 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}< $\mathbf{B_{pa}}$)

Relevant factors to be considered in management: 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 advice should also take into account measures proposed for Celtic Sea plaice. A reduction of 20% in *status quo* F will lead to F on both sole and plaice being below their respective $\mathbf{F_{pa}}$ values, and will give a high probability that SSB of sole will be above $\mathbf{B_{pa}}$ in year 2000.

Catch forecast for 1999:

Basis: F(98) = F(95–97) = 0.48; Landings(98) = 0.8; SSB(99) = 2.0

F(99)	Basis	Catch(99)	Landings(99)	SSB (2000)	Medium-term effect of fishing at given level
0.19	$0.4F_{95-97}$		0.46	2.77	High probability of SSB being above $\mathbf{B_{pa}}$
0.29	$0.6\ F_{95-97}$		0.66	2.54	High probability of SSB being above $\mathbf{B_{pa}}$
0.37	$\mathbf{F_{pa}}$		0.81	2.37	High probability of SSB being above $\mathbf{B_{pa}}$
0.48	F_{95-97}		1.01	2.15	High probability of SSB staying below $\mathbf{B_{pa}}$
0.58	$1.2\ F_{95-97}$		1.16	1.98	High probability of SSB staying below $\mathbf{B_{pa}}$

Weights in '000 t.

Shaded scenarios considered inconsistent with the precautionary approach.

Elaboration and special comment: The fisheries for sole in the Celtic Sea and Bristol Channel involve vessels from Belgium, taking 59%, the UK 29%, France 9% and Ireland 3% of the total landings. The sole fishery is concentrated on the north Cornish coast off Trevose Head and around Lands End, and reported landings have generally declined since the mid 1980s.

Sole are taken mainly in a beam-trawl fishery that commenced 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. The beam- and otter-trawl fleets also target plaice, rays, brill, turbot and anglerfish in the Celtic Sea.

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.

Many sole tagged on nursery grounds in the Bristol Channel were recaptured as mature adults, 2 or more years after release, off the north coasts of Devon and Cornwall and over a wide area in the eastern Celtic Sea and St. George's Channel. The results suggest that once an adult sole has recruited to an area, it tends to remain there and that there is only limited movement of sole between the Bristol Channel and adjoining areas.

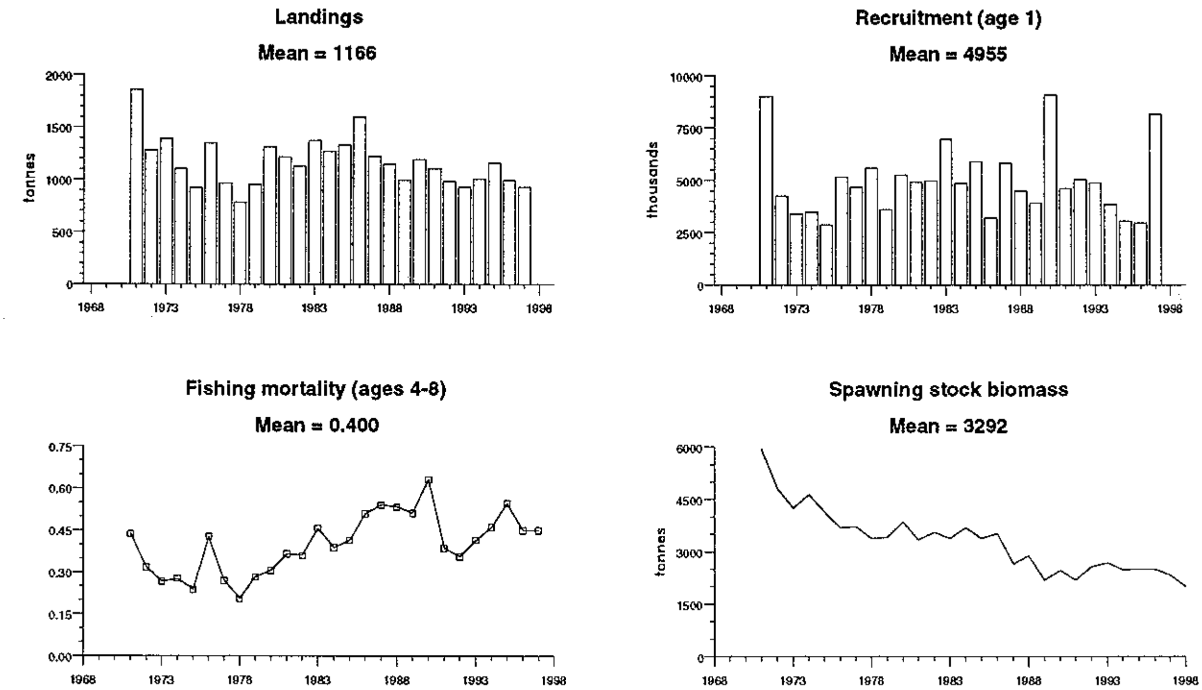
Age-based analytical assessment using catch-per-unit effort data from two commercial fleets and one survey.

Source of information: Report of the Working Group on the Assessment of Southern Shelf Demersal Stocks, September 1998 (ICES CM 1999/ACFM:4).

Catch data (Tables 3.9.5.1–2):

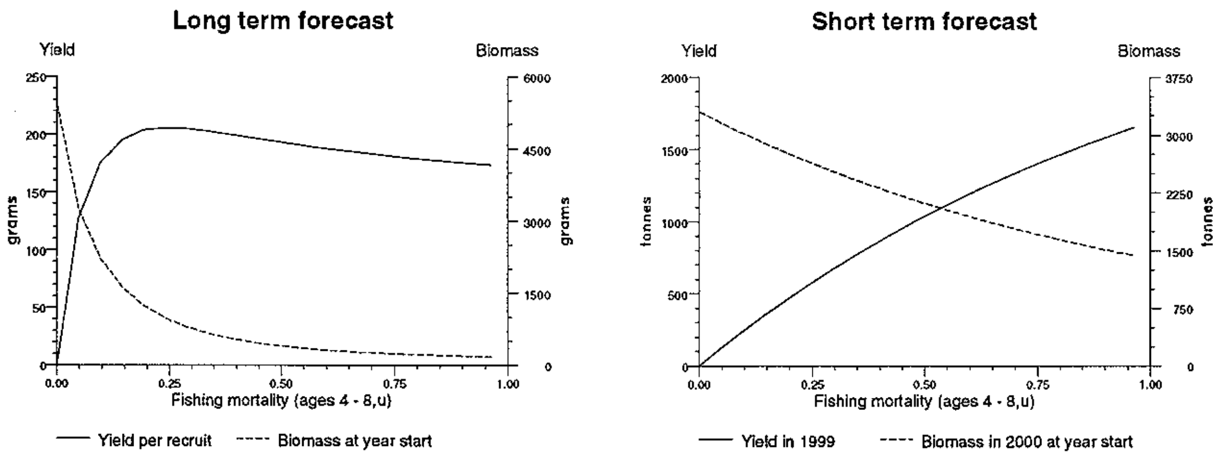
Year	ICES advice	Predicted catch corresp. to advice	Agreed TAC	ACFM Landings
1987	*Status quo* F; TAC	1.6	1.6	1.2
1988	F = F(pre-86); TAC	0.9	1.1	1.1
1989	F at F(81–85); TAC	1.0	1.0	1.0
1990	No increase in F	1.2	1.2	1.2
1991	No increase in F	1.1	1.2	1.1
1992	No long-term gains in increasing F	1.1	1.2	1.0
1993	No long-term gains in increasing F	-	1.1	0.9
1994	No long-term gains in increasing F	-	1.1	1.0
1995	No increase in F	1.0	1.1	1.2
1996	20% reduction in F	0.8	1.0	1.0
1997	20% reduction in F	0.8	0.9	0.9
1998	20% reduction in F	0.7	0.85	
1999	Reduce F below $\mathbf{F}_{pa}$	0.81		

Weights in '000 t.

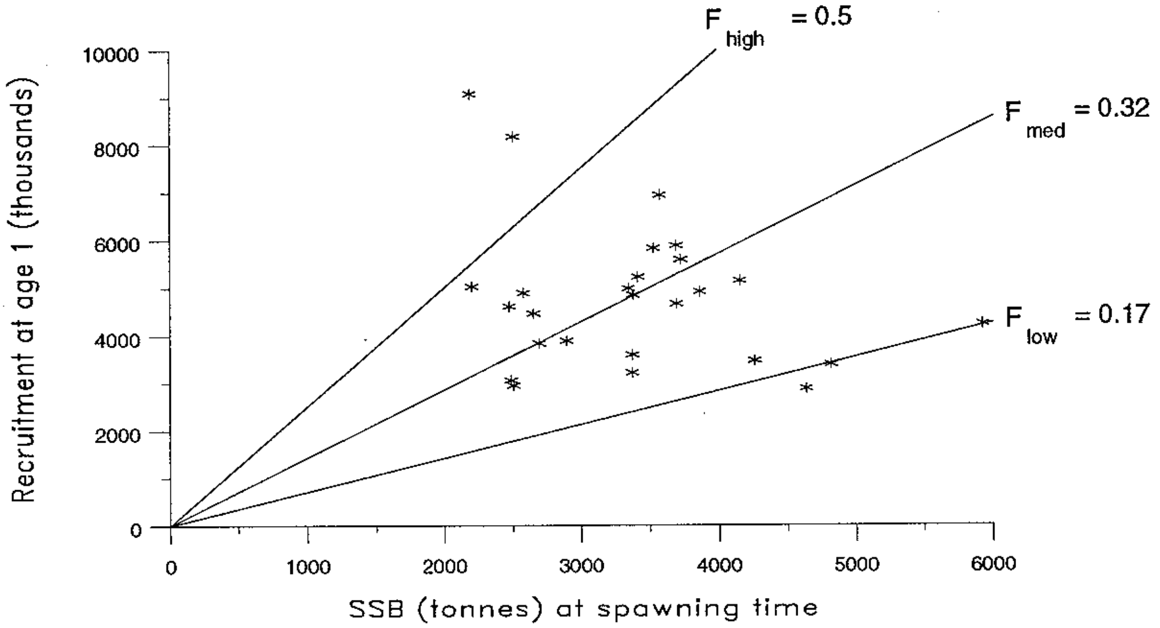


Celtic Sea Sole

Yield and Spawning Stock Biomass



Stock - Recruitment



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Precautionary Approach Plot

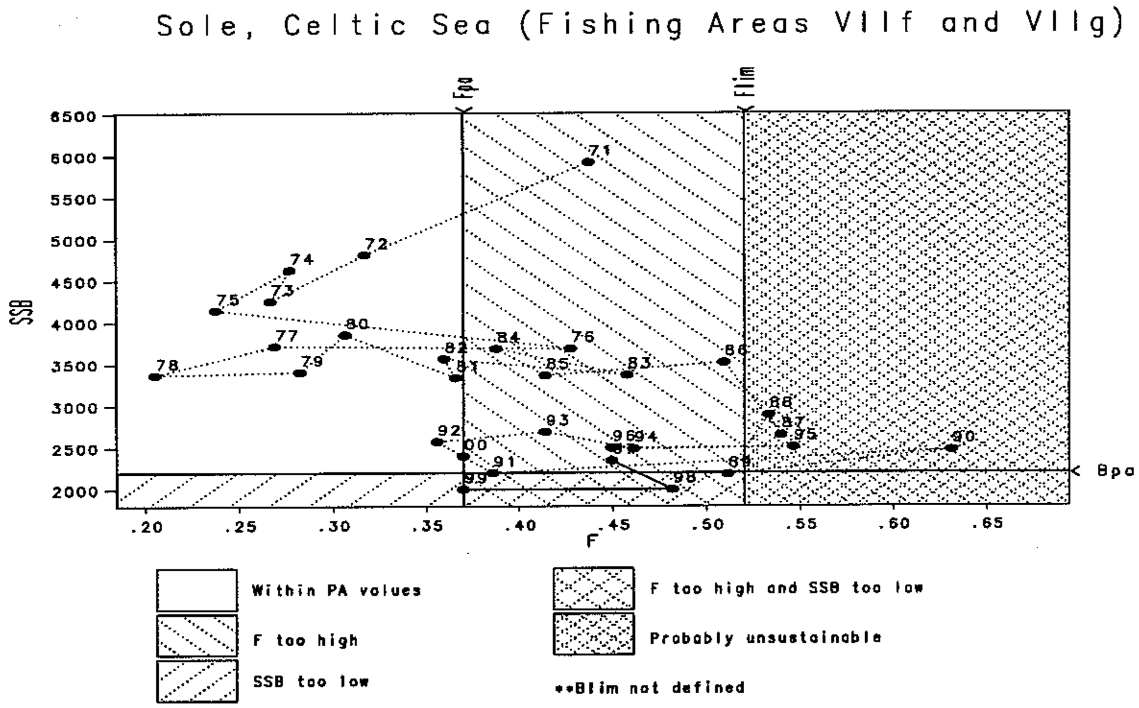


Table 3.9.5.1 Celtic Sea SOLE. Divisions VIIf and VIIg. Nominal landings (tonnes), 1984–1997. Data used by the Working Group.

Country	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997[1]
Belgium	786	786	1,092	704	725	660	689	839	516	512	612	728	610	562
France	115	126	92	72	89	97	100	80	136	103	86	89	97	79
Ireland	4	13	12	9	15	32	41	N/A	4	28	47	45	23	36
UK(Engl.& Wales)	361	403	404	437	317	203	359	395	325	285	264	294	265	251
Others	-	-	-	-	-	-	-	10	-	-	-	-		
Total	1,266	1,328	1,600	1,222	1,146	992	1,189	1,324	981	928	1,009	1,157	995	928
Unallocated	-	-	-	-	-	-	-	-217	-	-	-	-	-	-1
Total used in assessment	1,266	1,328	1,600	1,222	1,146	992	1,189	1,107	981	928	1,009	1,157	995	927

[1]Preliminary

Table 3.9.5.2 Sole in the Celtic Sea (Divisions VIIf and VIIg).

Year	Recruitment Age 1	Spawning Stock Biomass	Landings	Fishing Mortality Age 4-8
1971	8.99	5.92	1.86	0.437
1972	4.23	4.82	1.28	0.317
1973	3.39	4.26	1.39	0.267
1974	3.47	4.63	1.11	0.277
1975	2.88	4.15	0.92	0.237
1976	5.15	3.69	1.35	0.427
1977	4.66	3.72	0.96	0.269
1978	5.58	3.37	0.78	0.205
1979	3.59	3.41	0.95	0.282
1980	5.23	3.86	1.31	0.306
1981	4.92	3.34	1.21	0.366
1982	4.98	3.57	1.13	0.359
1983	6.94	3.37	1.37	0.457
1984	4.85	3.69	1.27	0.388
1985	5.89	3.37	1.33	0.414
1986	3.22	3.52	1.60	0.509
1987	5.83	2.65	1.22	0.540
1988	4.47	2.89	1.15	0.533
1989	3.89	2.18	0.99	0.511
1990	9.08	2.47	1.19	0.631
1991	4.61	2.20	1.11	0.386
1992	5.02	2.57	0.98	0.356
1993	4.89	2.69	0.93	0.414
1994	3.83	2.49	1.01	0.461
1995	3.06	2.51	1.16	0.546
1996	2.95	2.50	1.00	0.449
1997	8.18	2.35	0.93	0.449
1998	.	2.00	.	.
Average	4.96	3.29	1.17	0.400
Unit	Millions	1000 tonnes	1000 tonnes	-

3.9.6 Plaice in Division VIIe (Western English Channel)

State of stock/fishery: The stock is considered to be outside safe biological limits. SSB peaked in 1989–1990, following a series of good year classes in the mid 1980s, but has declined rapidly to well below the proposed $\mathbf{B}_{pa}$. Fishing mortality has been increasing throughout the assessment period, and is currently above the proposed $\mathbf{F}_{pa}$. Recruitment has been low since 1989.

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 $\mathbf{B}_{pa}$.

Advice on management: ICES recommends that fishing mortality in 1999 should be reduced below $\mathbf{F}_{pa}$, corresponding to landings of less than 1 100 t in 1999. This will promote an increase in SSB above the proposed $\mathbf{B}_{pa}$ (2 500 t) in the medium term.

Reference points:

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	$\mathbf{F}_{pa}$:less than 10% probability that (SSB_{MT}< $\mathbf{B}_{pa}$)

Relevant factors to be considered in management: The TAC for plaice in the English 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 is unlikely to constrain fishing mortality on this stock. To achieve a decrease in fishing mortality, a direct reduction in fishing effort, or a separate catch control, is necessary.

Plaice are taken as part of a mixed demersal species otter trawl fishery, and as a by-catch in the sole beam-trawl fishery. Management advice should therefore be considered in conjunction with that for VIIe sole. There is anecdotal evidence of strategic mis-reporting of landings from this stock.

Catch forecast for 1999:

Basis: F(98) = F(95–97) = 0.68, Landings (98) = 1.6, SSB(99) = 1.9.

F(99)	Basis	Catch(99)	Landings(99)	SSB(2000)	Medium-term effect of fishing at given level
0.20	0.3 $\mathbf{F}_{sq}$		0.56	2.8	Low probability of SSB falling below $\mathbf{B}_{pa}$
0.27	0.4 $\mathbf{F}_{sq}$		0.72	2.72	Low probability of SSB falling below $\mathbf{B}_{pa}$
0.34	0.5 $\mathbf{F}_{sq}$		0.88	2.58	Low probability of SSB falling below $\mathbf{B}_{pa}$
0.45	$\mathbf{F}_{pa}$		1.10	2.35	Low probability of SSB falling below $\mathbf{B}_{pa}$
0.54	0.8$\mathbf{F}_{sq}$		1.29	2.22	50% probability of SSB staying below $\mathbf{B}_{pa}$
0.68	1.0 $\mathbf{F}_{sq}$		1.52	2.01	High probability of SSB staying below $\mathbf{B}_{pa}$
0.82	1.2 $\mathbf{F}_{sq}$		1.72	1.83	High probability of SSB staying below $\mathbf{B}_{pa}$

Weights in '000 t.

Shaded scenarios considered inconsistent with the precautionary approach.

Elaboration and special comment: The fisheries taking plaice in the Western Channel mainly involve vessels from the bordering countries: English vessels report 75% of the total landings, France accounts for 22% and Belgium takes 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.

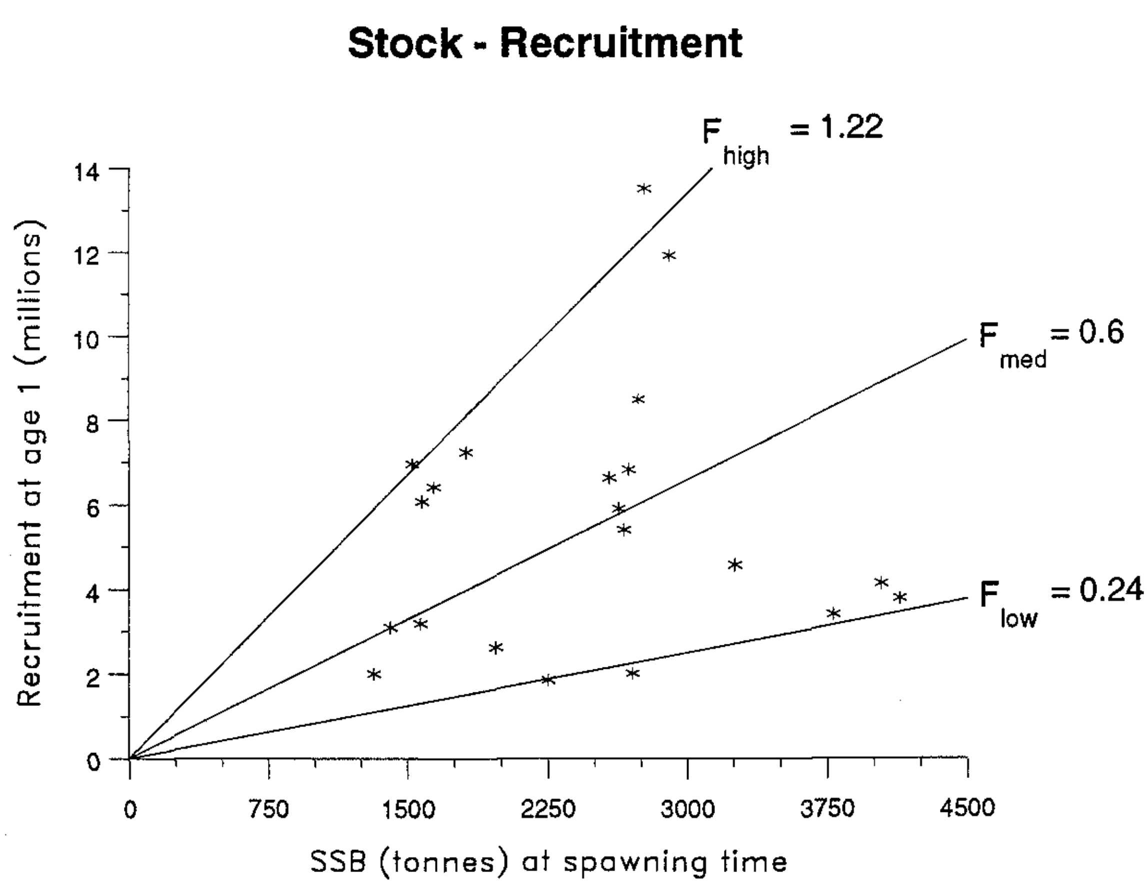
Analytical age-based assessment based on landings, survey and commercial CPUE data. Mis-reporting of landings is known to occur.

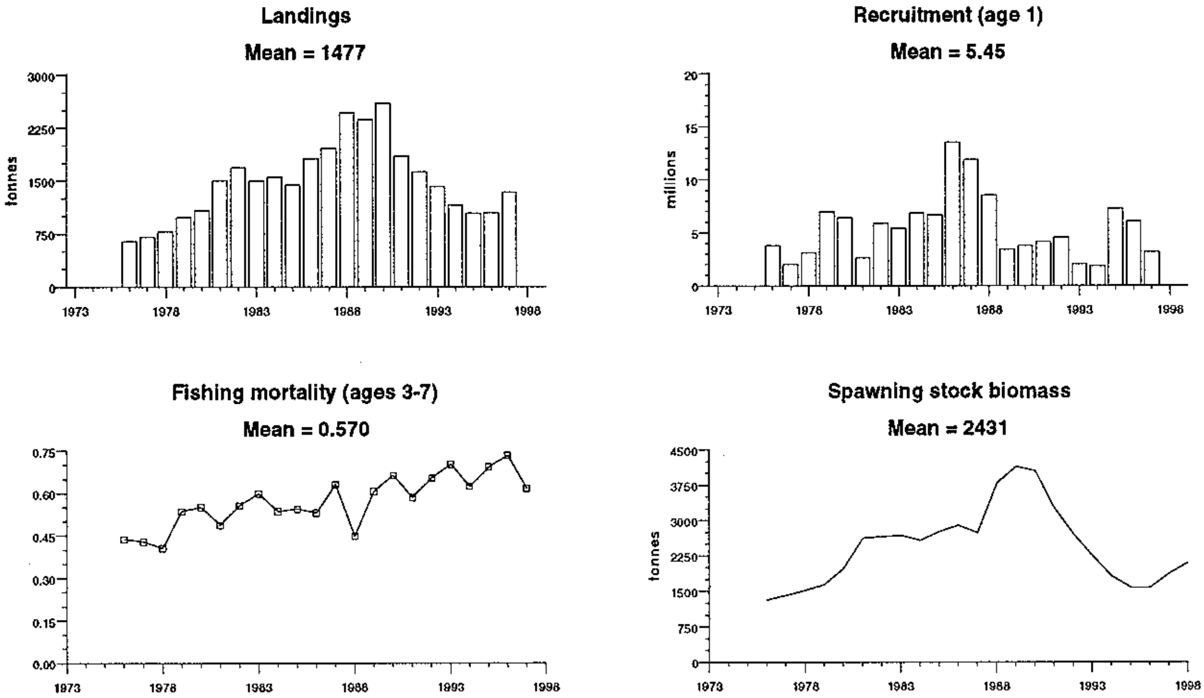
Source of information: Report of the Working Group on the Assessment of Southern Shelf Demersal Stocks, September 1998 (ICES CM 1999/ACFM:4).

Catch data (Tables 3.9.6.1–2):

Year	ICES Advice	Predicted catch corresp. to advice[1]	Agreed TAC[1]	Official Landings	ACFM Landings
1987	Precautionary TAC	6.8	8.3	1.9	2.0
1988	Precautionary TAC	6.9	9.96	2.3	2.5
1989	No increase in effort; TAC	11.7	11.7	2.2	2.4
1990	No increase in F; TAC	10.7	10.7	2.0	2.6
1991	50% reduction in F in VIIe	8.8	10.7	1.6	1.8
1992	Sq. F gives over mean SSB	2.0[2]	9.6	1.6	1.6
1993	Not outside safe biological	-	8.5	1.4	1.4
1994	Within safe biological limits	-	9.1	1.2	1.2
1995	No increase in F	1.4[2]	8.0	1.0	1.0
1996	60% reduction in F	0.6[2]	7.5	1.0	1.0
1997	60% reduction in F	0.51[2]	7.09	1.3	1.3
1998	60% reduction in F	0.5[2]	5.7		
1999	Reduce F below F_{pa}	1.1[2]			

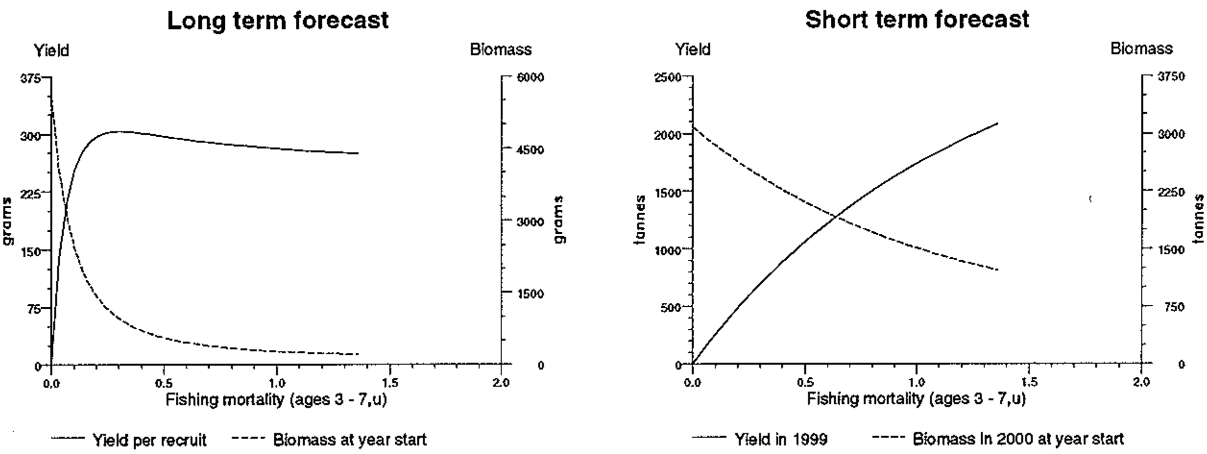
[1]TACs for Divisions VIId,e. [2]For Division VIIe only. Weights in '000 t.





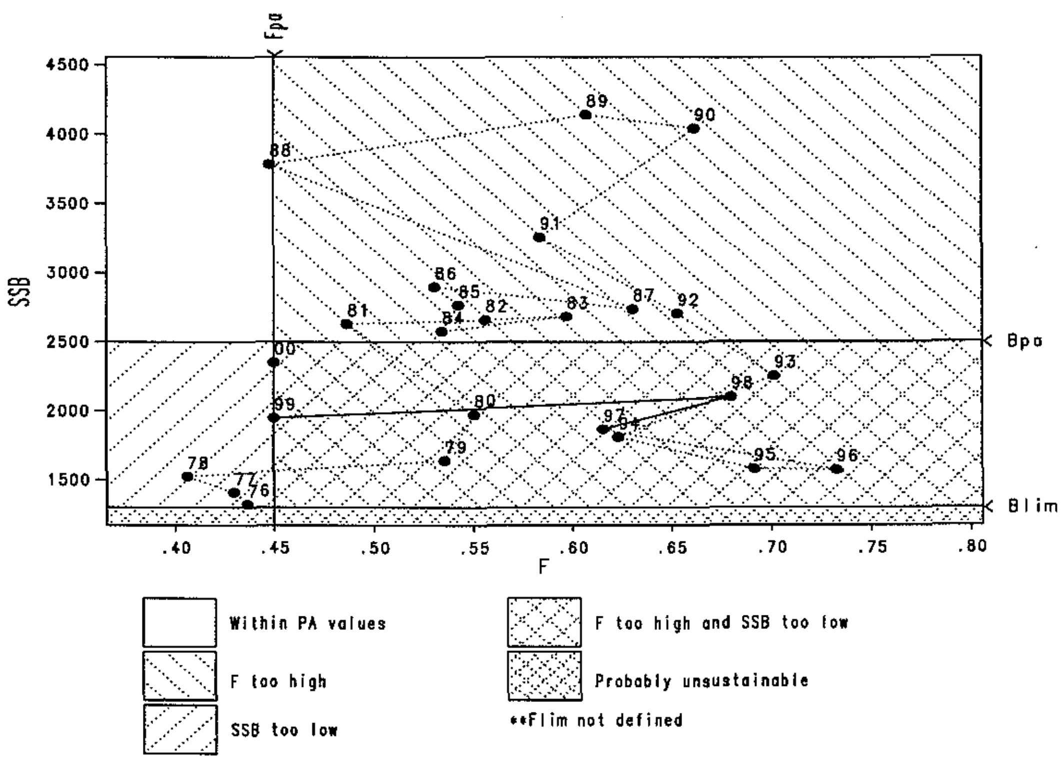
Plaice in Division VIIe (Western English Channel)

Yield and Spawning Stock Biomass



Precautionary Approach Plot

Plaice, Western English Channel (Fishing Area VIIe)



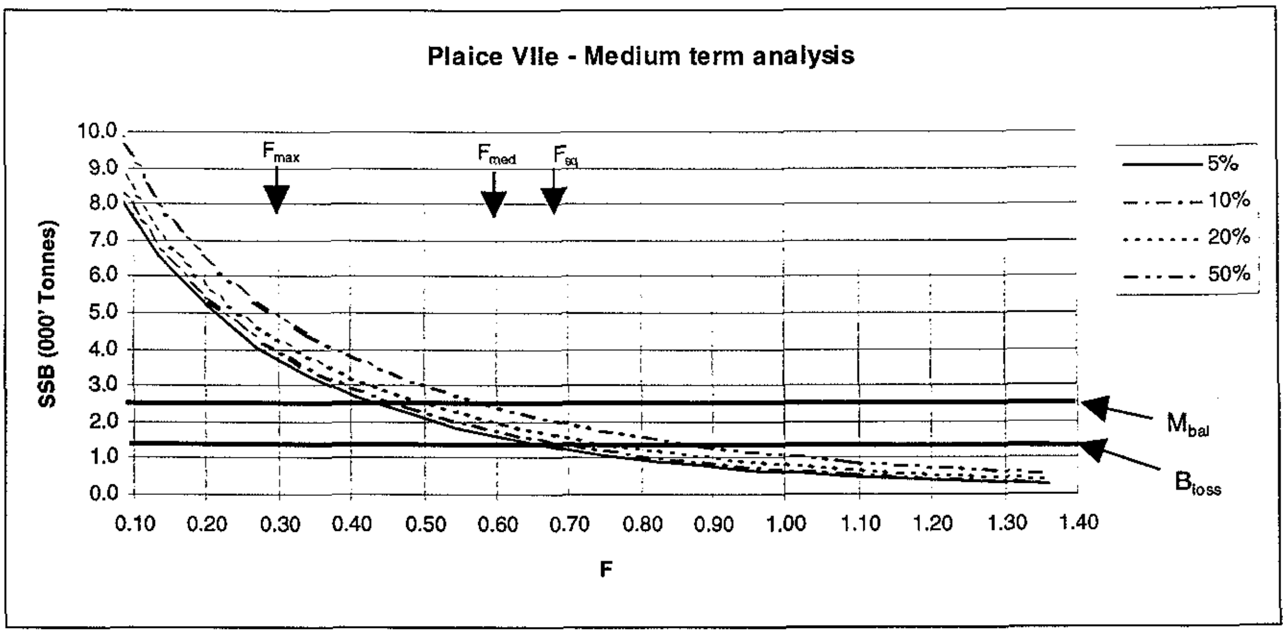


Table 3.9.6.1 English Channel PLAICE. Nominal landings (tonnes) in Division VIIe, as used by Working Group.

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	-	277	855	-	1,136	-92	1,044
1997	6	-	292[2]	1,032	-	1,330	5	1,335

[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 the Western English Channel (Division VIIe).

Year	Recruitment Age 1	Spawning Stock Biomass	Landings	Fishing Mortality Age 3-7
1976	3.76	1.32	0.64	0.436
1977	2.00	1.41	0.70	0.430
1978	3.10	1.52	0.78	0.406
1979	6.96	1.64	0.98	0.536
1980	6.41	1.97	1.08	0.550
1981	2.63	2.63	1.50	0.486
1982	5.90	2.66	1.69	0.556
1983	5.41	2.68	1.50	0.597
1984	6.83	2.58	1.55	0.534
1985	6.63	2.77	1.44	0.542
1986	13.52	2.90	1.81	0.530
1987	11.91	2.74	1.96	0.630
1988	8.49	3.78	2.46	0.448
1989	3.40	4.14	2.36	0.607
1990	3.78	4.04	2.59	0.662
1991	4.14	3.26	1.85	0.584
1992	4.58	2.70	1.62	0.653
1993	2.01	2.25	1.42	0.701
1994	1.85	1.81	1.16	0.623
1995	7.25	1.58	1.03	0.691
1996	6.07	1.57	1.04	0.733
1997	3.19	1.87	1.34	0.616
1998	.	2.10	.	.
Average	5.45	2.43	1.48	0.570
Unit	Millions	1000 tonnes	1000 tonnes	-

3.9.7 Sole in Division VIIe (Western English Channel)

State of stock/fishery: The stock is considered to be outside safe biological limits. SSB has declined since 1980 due to high fishing mortality and has remained stable below the proposed $\mathbf{B_{pa}}$ since 1989. Although fishing mortality has declined in recent years, it remains higher than during in the early 1970s, and is currently above the proposed $\mathbf{F_{pa}}$. Since the strong 1989 year class, only the 1995 year class appears to have been above average.

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 $\mathbf{B_{pa}}$.

Advice on management: ICES recommends that F should be reduced below the proposed $\mathbf{F_{pa}}$ (0.26), corresponding to landings of no more than 670 t in 1999. This will promote an increase in SSB above the proposed $\mathbf{B_{pa}}$ (2 500 t) in the short term.

Reference points:

ICES considers that:	ICES proposes that:
$\mathbf{B_{lim}}$ is 1 800 t, the lowest observed spawning stock biomass.	$\mathbf{B_{pa}}$ be set at 2 500 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 0.36, the fishing mortality estimated to lead to potential stock collapse.	$\mathbf{F_{pa}}$ be set at 0.26. 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 in assessments.

Technical basis:

$\mathbf{B_{lim}}$:$\mathbf{B_{loss}}$	$\mathbf{B_{pa}}$ ~ $\mathbf{B_{lim}}$ x 1.4
$\mathbf{F_{lim}}$:$\mathbf{F_{loss}}$	$\mathbf{F_{pa}}$:$\mathbf{F_{lim}}$ x 0.72; implies a less than 10% probability that (SSB_{MT}< $\mathbf{B_{pa}}$)

Relevant factors to be considered in management: Since 1991, TACs have generally exceeded ICES advice. Fisheries for sole also take plaice as a by-catch. This needs to be taken into account in management.

Catch forecast in 1999:

Basis: F(98) = F(95–97 mean) = 0.33; Landings(98) = 0.78; SSB(99) = 2.3

F(99)	basis	Catch(99)	Landings(99)	SSB (2000)	Medium-term effect of fishing at given level
0.13	$0.4F_{95-97}$	0.4	0.4	2.8	High probability of SSB being above $\mathbf{B_{pa}}$
0.20	$0.6F_{95-97}$	0.5	0.5	2.6	High probability of SSB being above $\mathbf{B_{pa}}$
0.26	$\mathbf{F_{pa}}$	0.67	0.7	2.5	High probability of SSB being above $\mathbf{B_{pa}}$
0.33	F_{95-97}	0.8	0.8	2.4	> 50% probability of SSB staying below $\mathbf{B_{pa}}$
0.40	$1.2F_{95-97}$	1.0	1.0	2.2	High probability of SSB staying below $\mathbf{B_{pa}}$
0.47	$1.4F_{95-97}$	1.1	1.1	2.1	High probability of SSB staying below $\mathbf{B_{pa}}$

Weights in '000 t.

Shaded scenarios considered inconsistent with the precautionary approach.

Elaboration and special comment: Total landings reached a peak in the early 1980s, initially because of high recruitment in the late 1970s and later because of an increase in exploitation. In recent years, English vessels have accounted for 65% 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 catches plaice and anglerfish.

In the Western English Channel the peak spawning period of sole is in 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 for subsequent emigration from the Western Channel. Coupled with the localised spawning areas in the western Channel, this suggests that adult sole there 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. A new maturity ogive has been used since 1997, which affects the absolute values of SSB, but the trends apparent in previous assessments remain the same. The new information resulted in a downward adjustment of MBAL to 2 500 t, from 3 000 t in 1997.

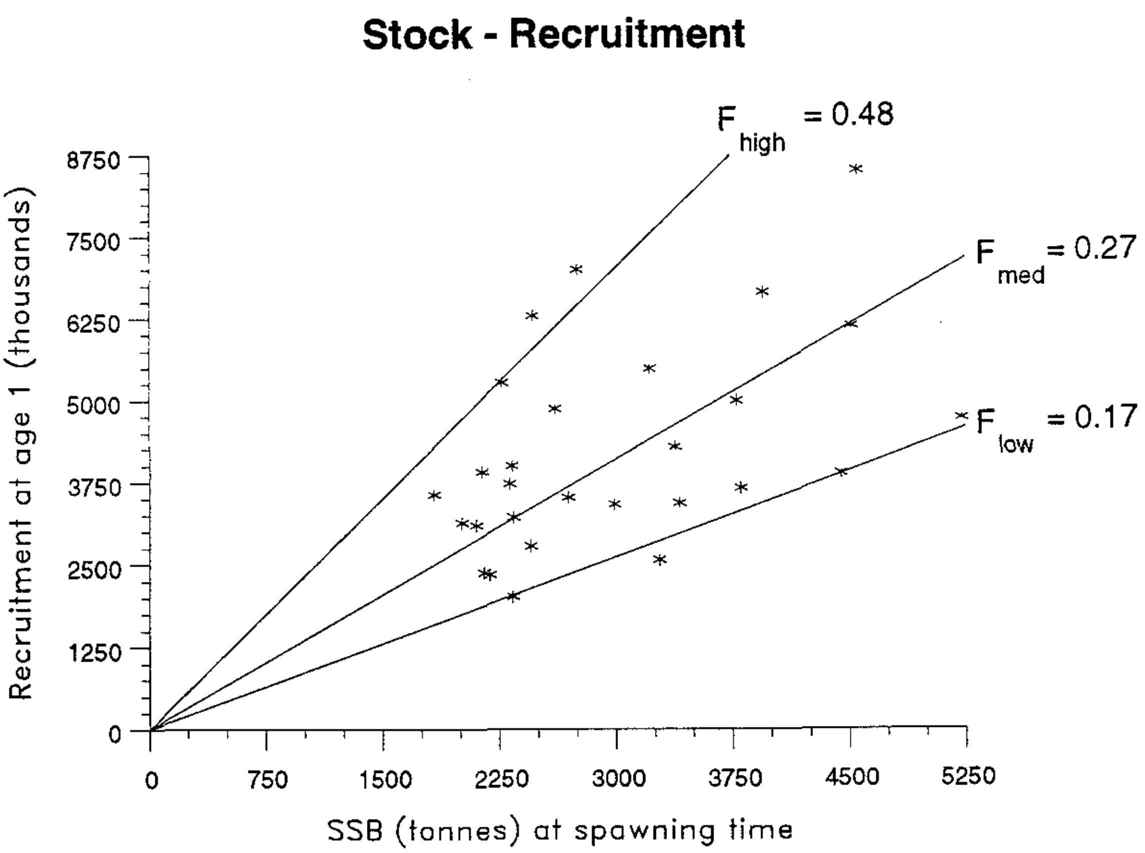
There is anecdotal evidence of strategic mis-reporting of landings from this stock which may compromise the assessment.

Source of information: Report of the Working Group on the Assessment of Southern Shelf Demersal Stocks, September 1998 (ICES CM 1999/ACFM:4).

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	1.1	1.2
1988	No decrease in SSB; TAC	1.3	1.3	0.9	1.4
1990	SSB = 3,000 t; TAC	0.9	0.9	0.8	1.1
1991	TAC	0.54	0.8	0.8	0.7
1992	70% of F(90)	0.77	0.8	0.8	0.8
1993	35% reduction in F	0.7	0.9	0.8	0.8
1994	No increase in F	1.0	1.0	0.8	0.7
1995	No increase in F	0.86	0.95	0.9	0.8
1996	$F_{96} < F_{94}$	0.68	0.7	0.8	0.6
1997	No increase in F	0.69	0.75	0.8	0.8
1998	No increase in F	0.67	0.67		
1999	Reduce F below $\mathbf{F_{pa}}$	0.67			

Weights in '000 t.



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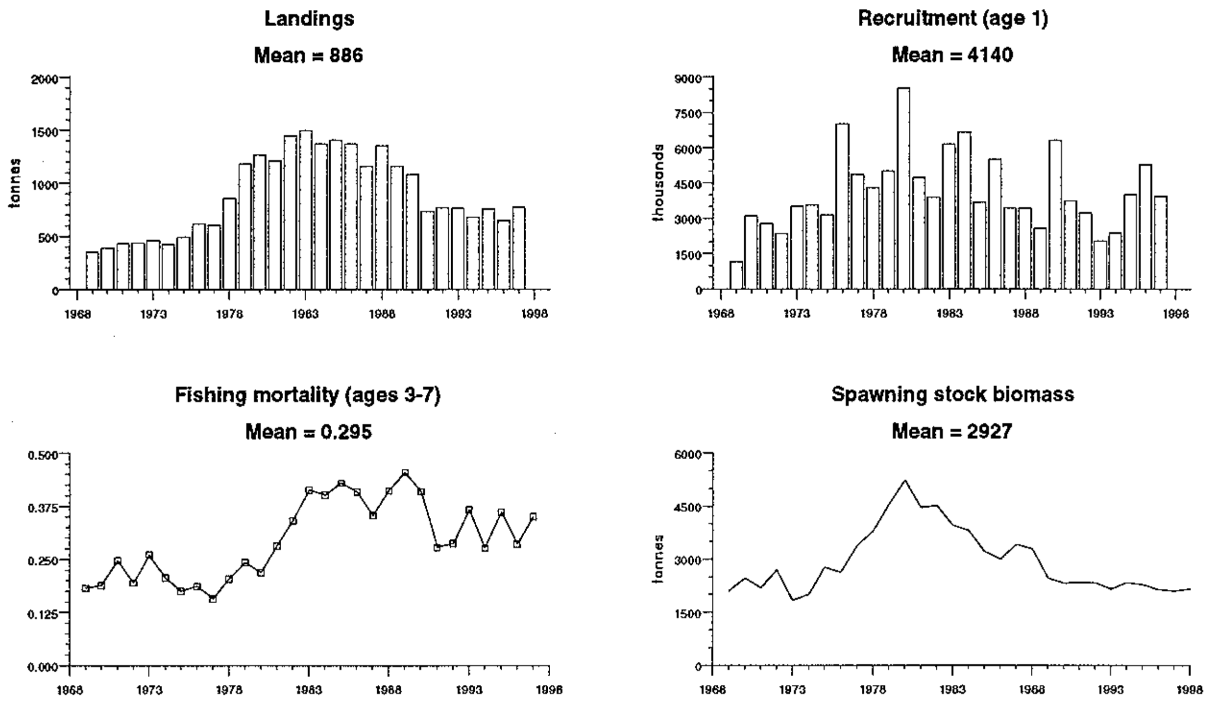
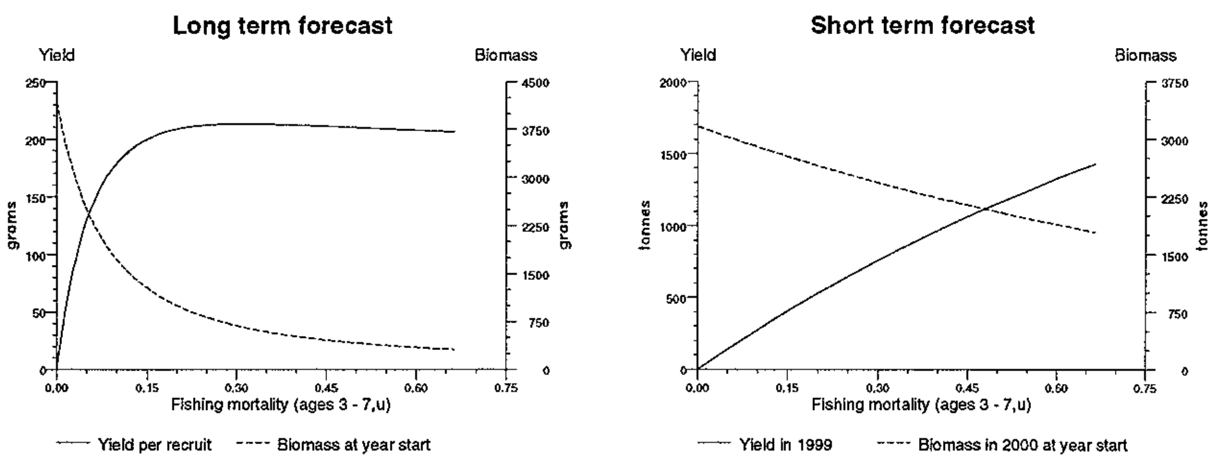


Sole in Division VIIe
(Western English Channel)

Yield and Spawning Stock Biomass



Precautionary Approach Plot

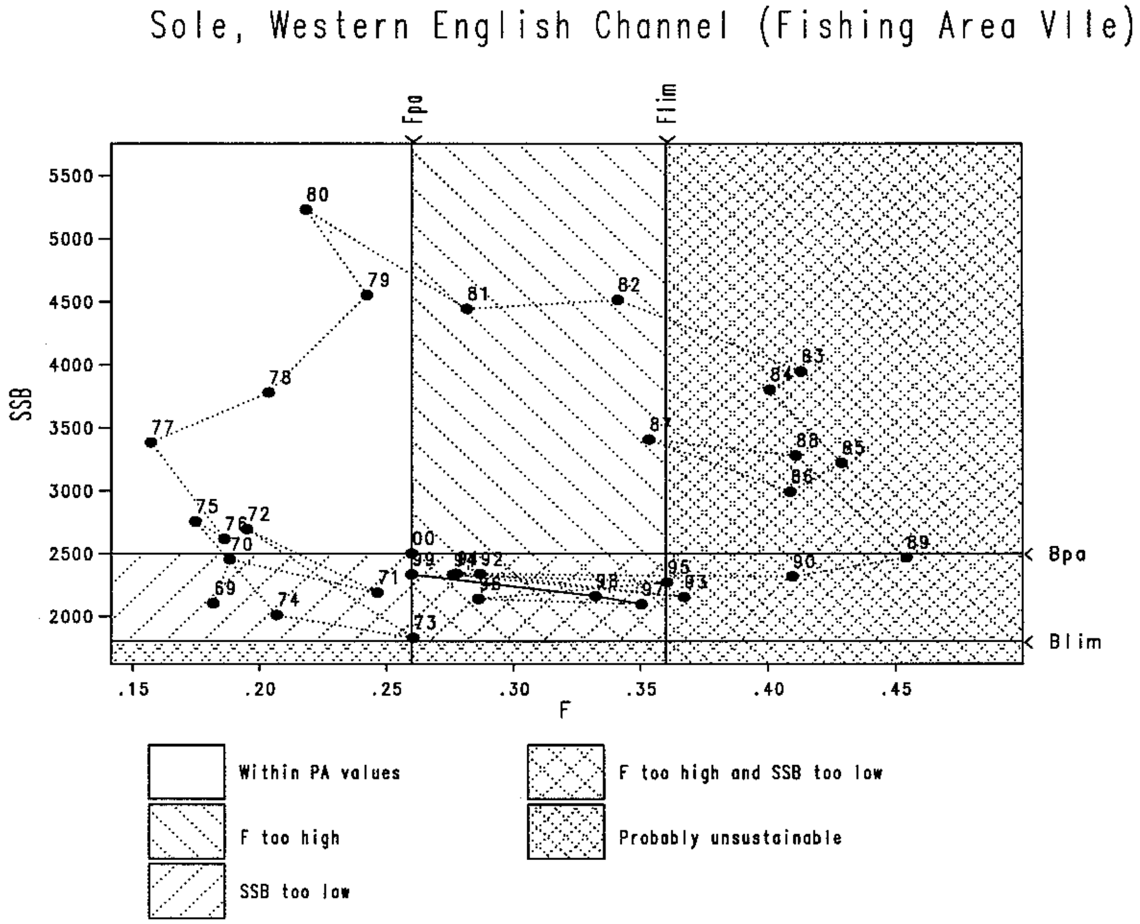


Table 3.9.7.1 Division VIIe SOLE. Nominal landings (tonnes), 1972–1997 used by Working Group.

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	-31	762
1994	33	257[3]	548	-	838	-160	678
1995	21	294	565	-	880	-124	756
1996	8	308	437	-	753	-106	647
1997	13	280[3]	483	-	776	-2	774

[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 the Western English Channel (Division VIIe).

Year	Recruitment Age 1	Spawning Stock Biomass	Landings	Fishing Mortality Age 3-7
1969	1.16	2.10	0.35	0.182
1970	3.09	2.45	0.39	0.188
1971	2.78	2.19	0.43	0.247
1972	2.35	2.69	0.44	0.195
1973	3.52	1.83	0.46	0.261
1974	3.56	2.01	0.43	0.207
1975	3.14	2.75	0.49	0.175
1976	7.00	2.62	0.62	0.186
1977	4.87	3.38	0.61	0.157
1978	4.29	3.78	0.86	0.203
1979	5.00	4.55	1.18	0.242
1980	8.51	5.23	1.27	0.218
1981	4.72	4.45	1.22	0.282
1982	3.88	4.52	1.45	0.341
1983	6.14	3.95	1.50	0.413
1984	6.66	3.80	1.37	0.401
1985	3.66	3.22	1.41	0.429
1986	5.49	2.99	1.37	0.409
1987	3.42	3.41	1.16	0.353
1988	3.44	3.28	1.35	0.411
1989	2.57	2.47	1.16	0.454
1990	6.29	2.32	1.08	0.410
1991	3.73	2.34	0.73	0.278
1992	3.22	2.34	0.77	0.287
1993	2.01	2.15	0.76	0.367
1994	2.38	2.33	0.68	0.276
1995	4.00	2.27	0.76	0.360
1996	5.27	2.14	0.65	0.286
1997	3.91	2.10	0.77	0.350
1998	.	2.16	.	.
Average	4.14	2.93	0.89	0.295
Unit	Millions	1000 tonnes	1000 tonnes	-

3.9.8 Sole in Divisions VIIIa,b (Bay of Biscay)

State of stock/fishery: The stock is considered to be outside safe biological limits. Fishing mortality is above the proposed $\mathbf{F_{pa}}$. SSB has increased slightly over the range of years of the assessment and is above the proposed $\mathbf{B_{pa}}$. There is no obvious trend in recruitment.

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 $\mathbf{B_{pa}}$.

Advice on management: ICES recommends that fishing mortality be decreased below $\mathbf{F_{pa} = 0.40}$, corresponding to landings in 1999 of less than 5 000 t.

Reference points:

ICES considers that:	ICES proposes that:
$\mathbf{B_{lim}}$ not defined.	$\mathbf{B_{pa}}$ be set at 11 300 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.
$\mathbf{F_{lim}}$ not defined.	$\mathbf{F_{pa}}$ be set at 0.40. 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:

$\mathbf{B_{lim}}$:Not defined	$\mathbf{B_{pa}}$: $\mathbf{B_{loss}}$
$\mathbf{F_{lim}}$:Not defined	$\mathbf{F_{pa}}$: less than 10% probability that (SSB_{MT}< $\mathbf{B_{pa}}$)

Relevant factors to be considered in management: The exploitation pattern on this stock has improved over the assessment period, and this has benefited the present state of the stock. ICES notes that long-term yield would be higher at lower fishing mortality rates.

Catch forecast for 1999:

Basis: F(98) = F(95–97) = 0.45, Landings (98) = 5.7, SSB(99) = 12.2

F(99 and onwards)	Basis	Catch(99)	Landings(99)	SSB(2000)	Medium-term effect of fishing at given level
0.18	0.4 F_{95-97}	2.6	2.5	16.4	High probability of SSB being above $\mathbf{P_a}$
0.27	0.6 F_{95-97}	3.7	3.6	15.1	High probability of SSB being above $\mathbf{B_{pa}}$
0.36	0.8 F_{95-97}	4.7	4.5	13.9	High probability of SSB being above $\mathbf{B_{pa}}$
0.40	$\mathbf{F_{pa}}$	5.1	5.0	13.3	High probability of SSB being above $\mathbf{B_{pa}}$
0.45	1.0 F_{95-97}	5.6	5.4	12.8	High probability of SSB being above $\mathbf{B_{pa}}$
0.54	1.2 F_{95-97}	6.4	6.2	11.8	High probability of SSB being above $\mathbf{B_{pa}}$

Weights in '000 t.

Shaded scenarios considered inconsistent with the precautionary approach.

Elaboration and special comment: This year's assessment suggests that the two most recent recruitments have been below average and SSB is predicted to decrease in the short term at F *status quo*.

Catches have increased continuously in the last two decades. Since 1984, catches of sole by French small-mesh shrimp trawlers decreased markedly, and the gill-net and trammel-net fishery has expanded and now accounts for 59% of the French landings. Landings by Belgium beam trawlers increased rapidly in the late 1980s and ,since 1991, have been relatively constant at 8% of the total.

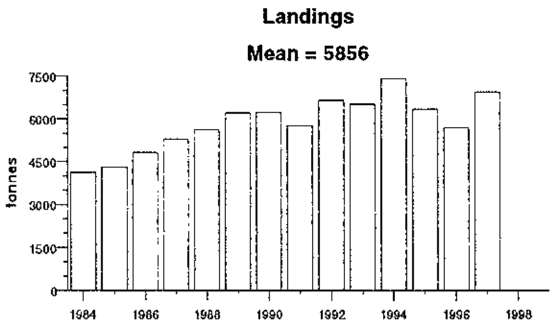
Analytical assessment based on landings and CPUE data. No recruitment indices are available for this stock. Data prior to 1984 are not considered reliable.

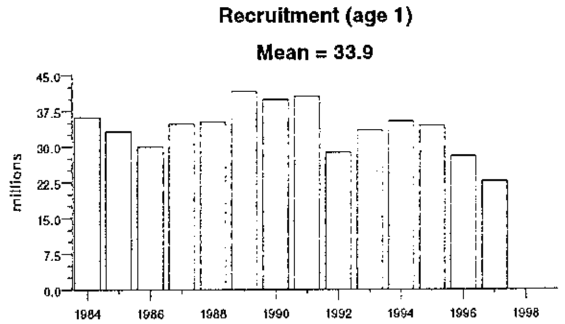
Source of information: Report of the Working Group on the Assessment of Southern Shelf Demersal Stocks, September 1998 (ICES CM 1999/ACFM:4).

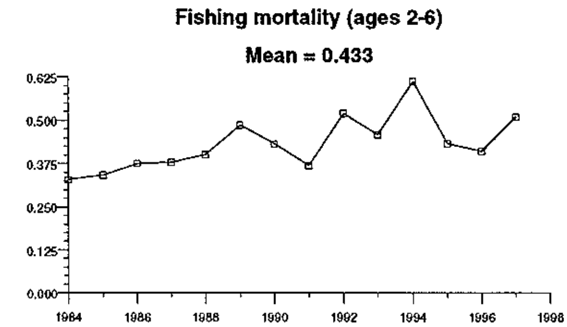
Catch data (Tables 3.9.8.1–2):

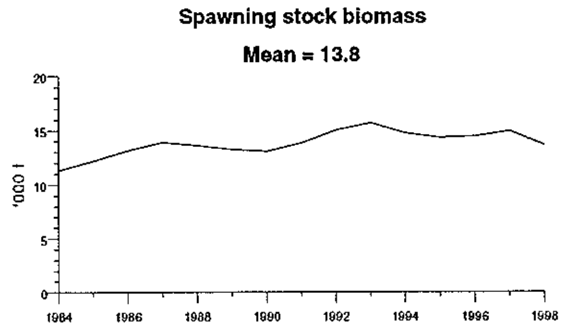
Year	ICES advice	Predicted catch corresp. to advice	Agreed TAC	Official landings	ACFM Landing	Disc. slip	ACFM Catch
1987	Not assessed	-	4.4	4.4	5.1	0.2[3]	5.3
1988	Precautionary TAC	3.7	4.0	4.5	5.4	0.3[3]	5.7
1989	No increase in effort; TAC	4.5	4.8	5.8[1]	5.8	0.4[3]	6.2
1990	No increase in F; TAC	5.1	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 $\bar{F}$	-	5.7	6.0	6.4	0.1[3]	6.5
1994	No long-term gain in increasing $\bar{F}$	-	6.6	6.9	7.2	0.2[3]	7.4
1995	No long-term gain in increasing $\bar{F}$	5.4[2]	6.6	5.9	6.2	0.1[3]	6.3
1996	No increase in F	5.0	6.6	5.4	5.7	0.1[3]	5.8
1997	40% reduction in F	3.1	5.4	5.0	6.8	0.1	6.9
1998	No increase in F	7.6	6.0				
1999	Reduce F below $\mathbf{F_{pa}}$	< 5.0					

[1]Not reported for all countries. [2]Landings at *status quo* F. [3] Discards revised in 1998. Weights in '000 t.

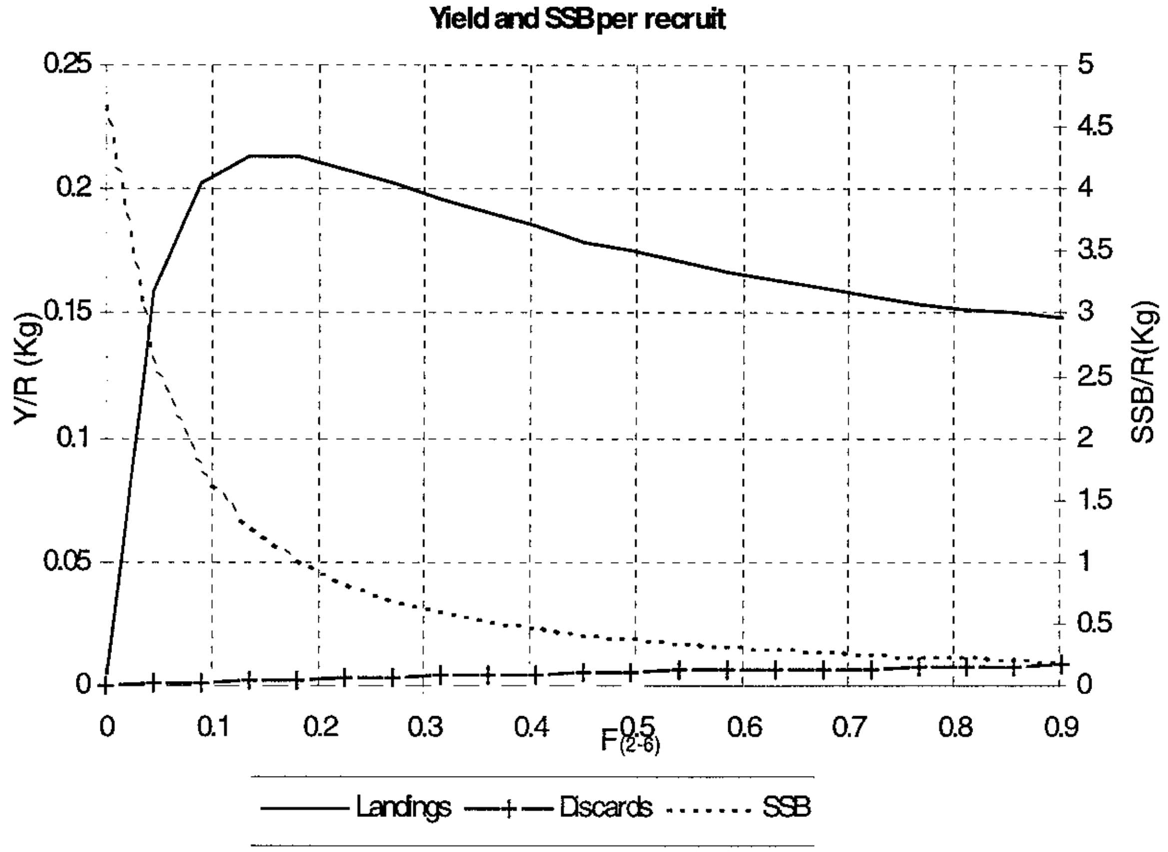


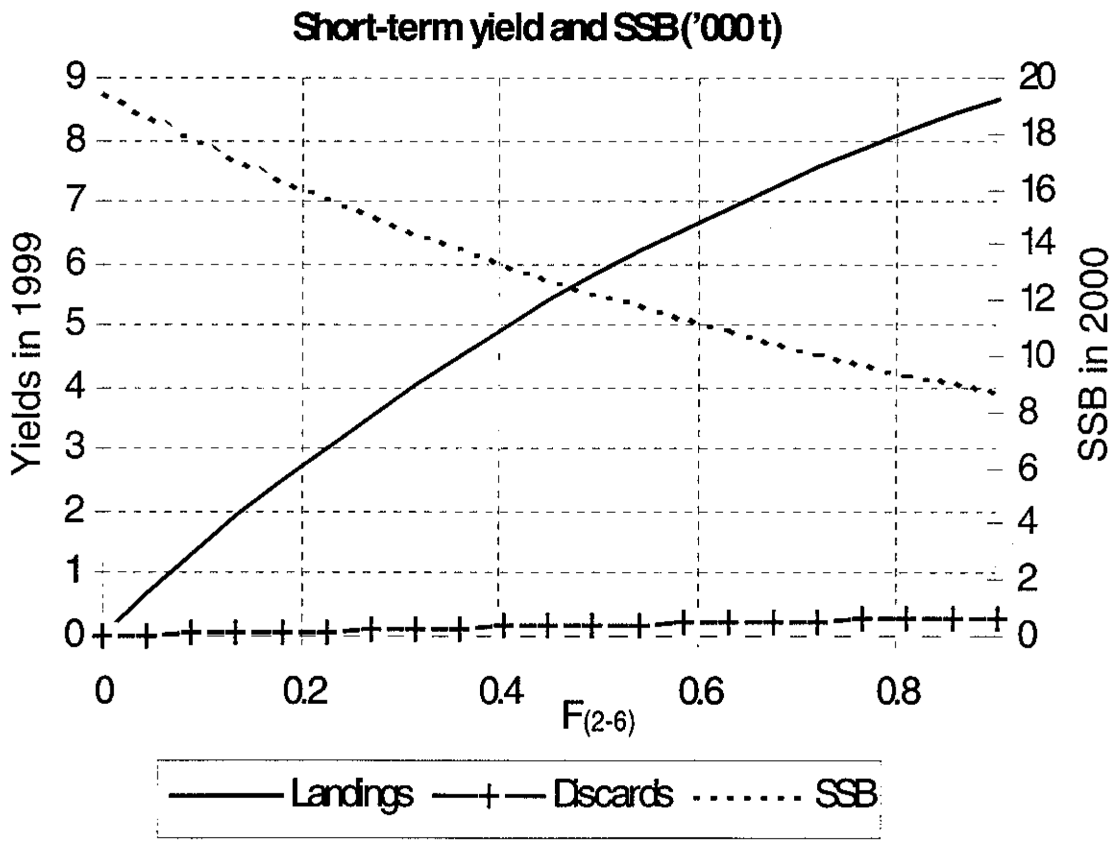




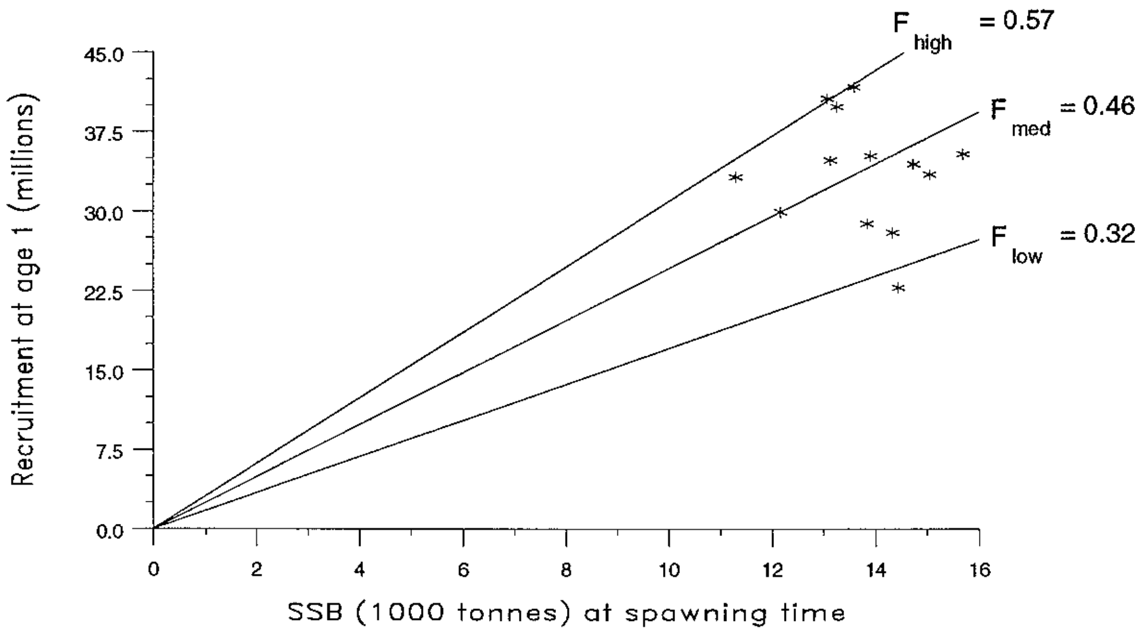


Sole in Divisions VIIIa,b (Bay of Biscay)





Stock - Recruitment



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Precautionary Approach Plot

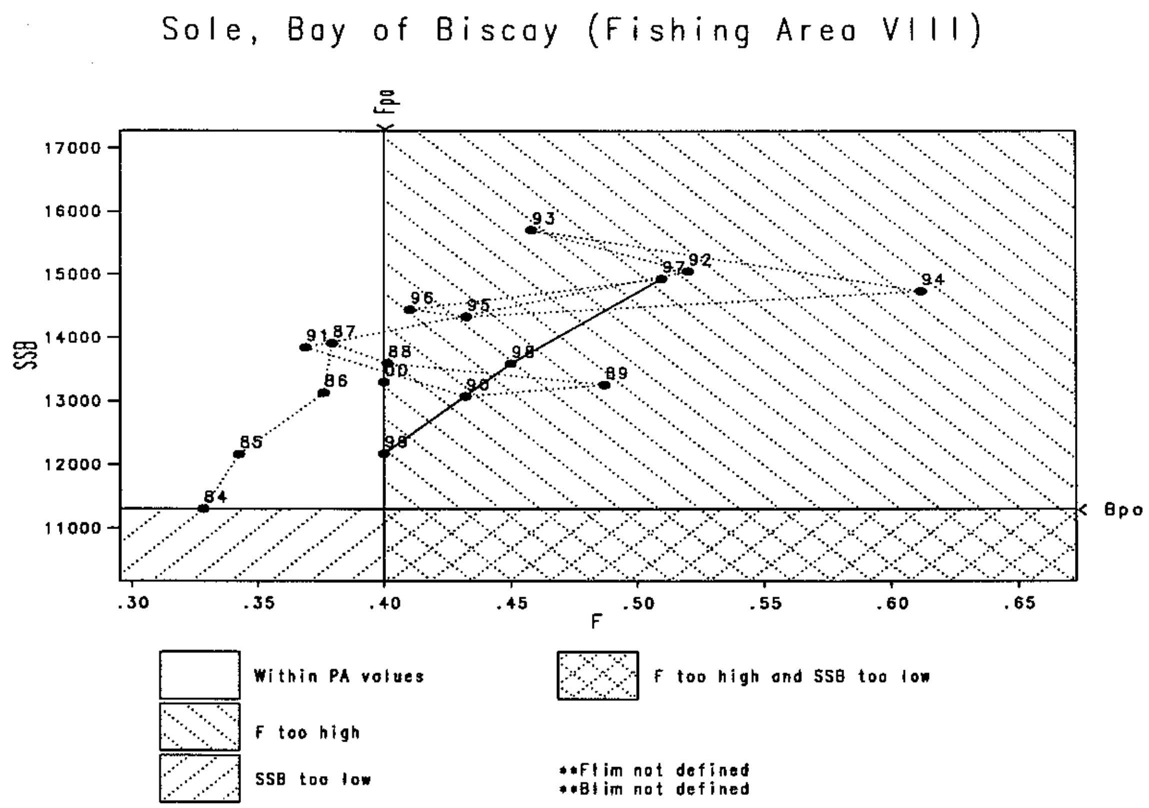


Table 3.9.8.1 Bay of Biscay sole (Division VIIIa,b). International landings and catches used by Working Group (in tonnes).

Years	Official landings	Unallocated landings	Total Landings	Discards	Total Catches
1979	2,443	176	2,619	-	-
1980	2,689	297	2,986	-	-
1981	2,684	252	2,936	-	-
1982	1,764	2,049	3,813	-	-
1983	2,669	959	3,628	-	-
1984	3,183	855	4,038	99	4,137
1985	3,925	326	4,251	64	4,315
1986	4,567	238	4,805	27	4,832
1987	4,379	707	5,086	198	5,284
1988	4,451	931	5,382	254	5,636
1989	5,790	55	5,845	356	6,201
1990	5,537	379	5,916	303	6,219
1991	4,707	862	5,569	198	5,767
1992	6,360	190	6,550	117	6,667
1993	6,023	397	6,420	104	6,524
1994	6,879	347	7,226	184	7,410
1995	5,858	347	6,205	135	6,340
1996	5,393	148	5,541	163	5,704
1997	4991	1,855	6846	101	6,947
Mean	4,436	598	5,035	165	5,856

Table 3.9.8.2 Sole in the Bay of Biscay (Sub-area VIII).

Year	Recruitment Age 1	Spawning Stock Biomass	Landings	Fishing Mortality Age 2-6
1984	36.19	11.30	4.14	0.328
1985	33.26	12.16	4.32	0.342
1986	29.95	13.13	4.83	0.376
1987	34.78	13.91	5.28	0.379
1988	35.25	13.60	5.64	0.401
1989	41.73	13.26	6.20	0.487
1990	39.88	13.07	6.22	0.432
1991	40.66	13.85	5.77	0.369
1992	28.86	15.05	6.67	0.520
1993	33.46	15.70	6.52	0.458
1994	35.44	14.74	7.41	0.612
1995	34.45	14.33	6.34	0.432
1996	27.96	14.44	5.70	0.410
1997	22.80	14.94	6.95	0.510
1998	.	13.59	.	.
Average	33.90	13.80	5.86	0.433
Unit	Millions	1000 tonnes	1000 tonnes	-

3.9.9 Celtic Sea and Division VIIj herring

State of stock/fishery: The stock is at present considered to be harvested outside safe biological limits as defined by the proposed reference points, although the spawning stock biomass is above the proposed B_{pa}. Average fishing mortality over the past 20 years has been high but this is not considered to be sustainable as equilibrium calculations indicate that F = 0.4 is close to a non-sustainable fishing regime. At present the SSB is being maintained above B_{pa} by the strong year classes of 1992 and 1993.

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 F_{pa} and spawning stock biomass should be maintained above B_{pa}.

Advice on management: A value of F_{pa} has not yet been proposed but is likely to be less than the current fishing mortality rate. **Nevertheless, SSB is currently well above B_{pa} and ICES therefore advises that the fishing mortality in 1999 should be no greater than in 1997 (0.4). This corresponds to a catch of no more than 19 000 t and given recent good recruitment would not lead to any short-term decline in SSB towards B_{pa}.**

Proposed reference points: Analyses of stock and recruitment data indicate that this stock is very sensitive to increases in fishing mortality rate. Rates in excess of 0.4 appear to carry a high probability of long-term decline and would put the stock at risk if recruitment were low for more than a few consecutive years. F_{med} is 0.27 and is associated with a much lower probability of reducing the SSB. It would be a natural choice for F_{pa}. The stock, however, has seldom been harvested at this F in the past. This apparent discrepancy between analysis and experience is probably due to changes in weights at age and, in particular, the exploitation pattern in recent years, and it is likely that $F = F_{med} = 0.27$ would be an appropriate F_{pa}. Before this F_{pa} is proposed, however, there is a need to explore the issue more fully.

Examination of the stock recruitment data suggests that the probability of poor recruitment increases at SSBs below 60 000 t. The lowest observed SSBs are about 27 000 t. In order to have a high probability of avoiding these low values, management action to reduce fishing mortality below F_{pa} would be required at measured SSBs of 44 000 t. *It is suggested that B_{pa} be set at* 44 000 t.

Maintaining fishing mortality at F_{med} would be expected to result in the SSB fluctuating around an equilibrium value of approximately 80 000 t and as a result would not trigger the B_{pa} threshold frequently.

Relevant factors to be considered management: The fishery exploits a stock which is considered to consist of two spawning components (autumn and winter). Spawning takes place on well known inshore grounds along the Irish coast from October to February. There are serious potential threats to some of the more important spawning beds from possible gravel extraction, dumping of dredge spoil and the location of fish farms. This may impair spawning success.

Catch forecast for 1999:

Basis TAC catch of 22 000 t, F(98) = 0.48 = 70 000 t assuming geometric mean recruitment = 561 million at age 1 in 1998.

Basis	F(99)	SSB(99)	Landings(99)	SSB(2000)	Long-term effect of fishing at given level
0.4F(97)	0.16	72000	8400	84000	Equilibrium SSB large, loss of long term yield
0.6F(97)	0.24	72000	12000	79000	Equilibrium SSB large, loss of long term yield
0.8F(97)	0.32	71000	15600	75000	Expected equilibrium SSB = 70 000 t (B_{MSY})
F_{pa}*	0.27	71000	14000	77000	Expected equilibrium SSB = 80 000 t
1.0F(97)	0.40	70000	19000	72000	Expected equilibrium SSB = 55 000 t

*A likely candidate for F_{pa}.

Elaboration and special comments: In 1996 and 1997 marketing conditions were very difficult and this combined with an increase in the number of regulatory officers led to a significant reduction in effort.

The stock collapsed in the late seventies due to a combination of poor recruitment and high fishing mortality rates.

The present assessment, based on an analysis of catch at age and survey data, is consistent with that reported last year. However, there was no acoustic survey carried out in 1997 which means the most recent estimate of stock size will have lower precision.

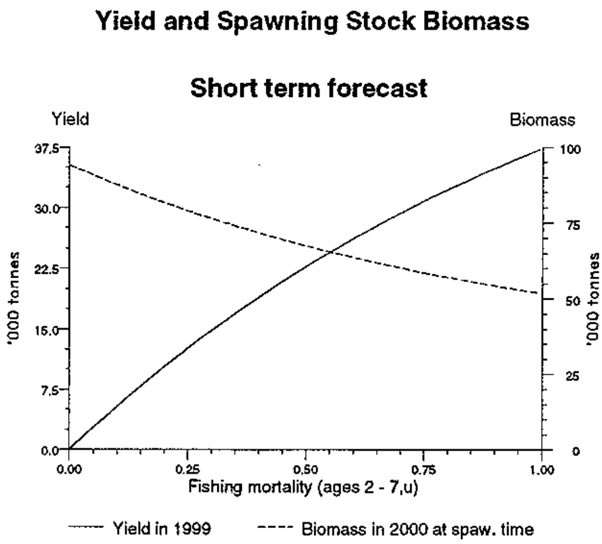
Discarding was not thought to be problem in 1997.

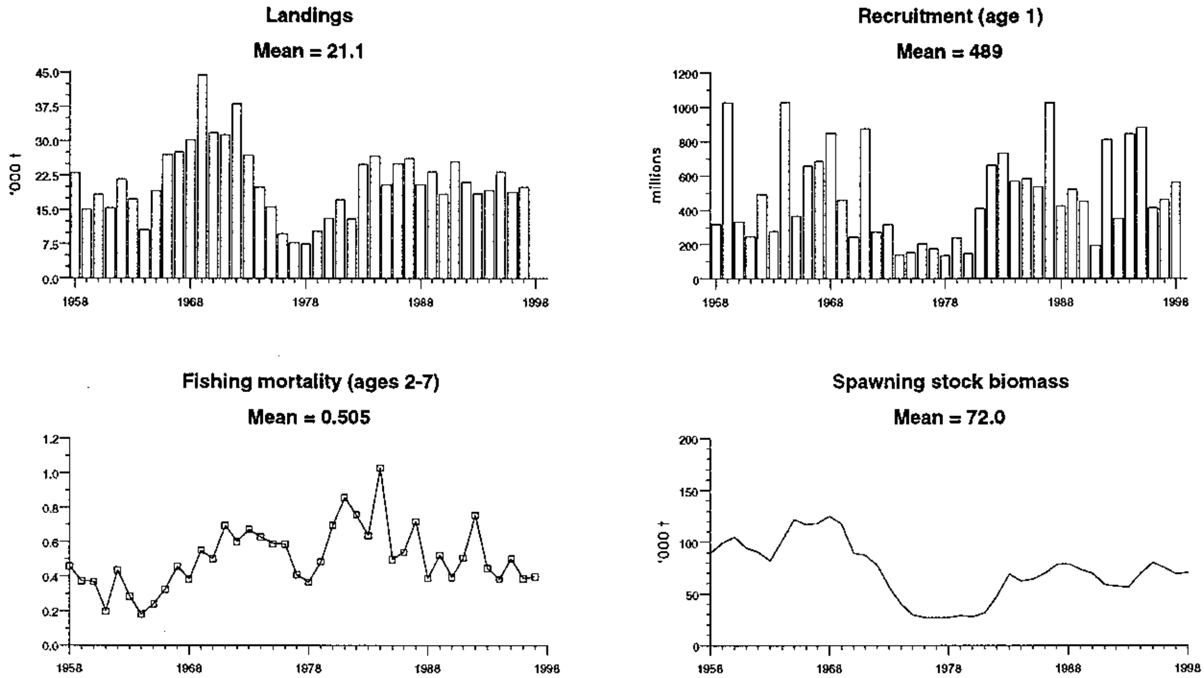
Source of information: Report of the Herring Assessment Working Group for the Area South of 62°N, March 1998 (ICES CM 1998/ACFM:14).

Catch data (Tables 3.9.9.1–3):

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	21	0.7	18.8
1998	Catches below 25	< 25	22			
1999	F = 0.4	19				

[1]By calendar year.
[2]Revised during 1996 after ACFM May meeting. Weights '000 t.





Celtic Sea and Division VIIj herring

Table 3.9.9.1 Celtic Sea and Division VIIj herring landings by calendar year (t), 1987–1997. (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
1987	800	-	15,500	1,500	-	5,300	4,200	27,300
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]	1,300	0	18,000	1,400		-2,600	700	18,800

[1]Preliminary

Table 3.9.9.2 Celtic Sea and Division VIIj herring landings (t) by season (1 April–31 March) 1987/1988-1997/1998. (Data provided by Working Group members. 1997/98 figures are preliminary).

These figures may not in all cases correspond to the offical statistics and cannot be used for management purposes.

Year	France	Germany	Ireland	Netherlands	U.K.	Unallocated	Discards	Total
1987/1988	800	-	15,500	1,500	-	4,400	4,000	26,200
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]	1,300		19,900	1,400		-2600	0	20,000

[1] Preliminary

Table 3.9.9.3 Herring South and South West of Ireland (Celtic Sea and VIIj).

Year	Recruitment Age 1	Spawning Stock Biomass	Landings	Fishing Mortality Age 2-7
1958	316.66	88.92	22.98	0.457
1959	1,026.55	99.20	15.09	0.372
1960	332.12	104.28	18.28	0.368
1961	247.19	93.83	15.37	0.197
1962	489.82	90.25	21.55	0.436
1963	275.13	81.48	17.35	0.284
1964	1,028.60	101.55	10.60	0.181
1965	366.27	122.00	19.13	0.239
1966	658.80	117.08	27.03	0.324
1967	685.49	118.12	27.66	0.458
1968	848.22	124.70	30.24	0.384
1969	456.81	117.60	44.39	0.551
1970	241.52	89.00	31.73	0.501
1971	873.77	87.03	31.40	0.694
1972	273.35	77.40	38.20	0.602
1973	315.34	56.33	26.94	0.673
1974	137.51	40.07	19.94	0.627
1975	152.27	29.32	15.59	0.589
1976	206.46	26.87	9.77	0.587
1977	173.72	26.95	7.83	0.410
1978	135.30	26.91	7.56	0.366
1979	237.35	28.62	10.32	0.484
1980	145.58	27.27	13.13	0.695
1981	409.09	31.07	17.10	0.856
1982	661.16	47.37	13.00	0.758
1983	731.70	68.79	24.98	0.637
1984	566.99	62.08	26.78	1.029
1985	582.23	63.87	20.43	0.499
1986	535.91	69.75	25.02	0.541
1987	1,025.08	78.40	26.20	0.719
1988	425.65	78.43	20.45	0.389
1989	522.86	73.45	23.25	0.523
1990	449.38	69.19	18.40	0.394
1991	194.48	58.63	25.56	0.506
1992	811.21	57.06	21.13	0.755
1993	348.85	55.73	18.62	0.447
1994	843.30	69.20	19.30	0.385
1995	880.11	80.18	23.31	0.502
1996	414.70	74.72	18.82	0.387
1997	461.59	68.53	19.99	0.398
1998	560.80	70.02	.	.
Average	489.00	71.98	21.11	0.505
Unit	Millions	1000 tonnes	1000 tonnes	-

3.9.10 Sprat in Divisions VIId,e

State of stock/fishery: The state of the stock is not known.

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

Proposed reference points: None available.

Elaboration and special comment: Only 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 1997 catch was at the same low level as in the last 3 years.

Source of information: Report of the Herring Assessment Working Group for the Area South of 62°N, March 1998 (ICES CM 1998/ACFM:14).

Catch data (Tables 3.9.10.1–2):

Year	ICES advice	Predicted catch corresp. to advice	Agreed 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	
1999	No advice	-		

Weights in '000 t.

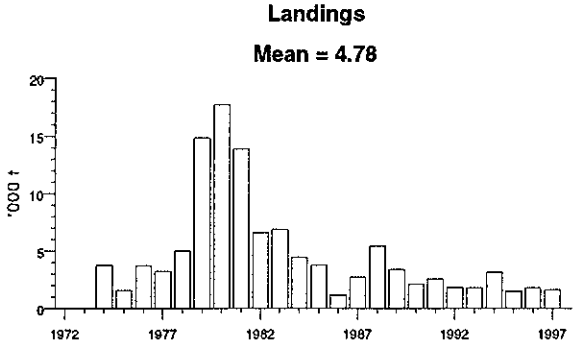


Table 3.9.10.1 Nominal catch of sprat (t) in Divisions VIId,e, 1984–1997.

Country	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996[1]	1997[1]
Belgium	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Denmark	1,417	-	15	250	2,529	2,092	608	-	-	-	-	-	-	-
France	47	14	-	23	2	10	-	-	35	2	1	+	-	-
Germany	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Netherlands	589	-	-	-	-	-	-	-	-	-	-	-	-	-
Norway	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UK (Engl.& Wales)	2,402	3,771	1,163	2,441	2,944	1,319	1,508	2,567	1,790	1,798	3,177	1,515	1,789	1,621
Total	4,455	3,785	1,178	2,714	5,475	3,421	2,116	2,567	1,825	1,800	3,177	1,515	1,789	1,621

[1]Preliminary

Table 3.9.10.2 Sprat in the English Channel (Fishing Areas VIId,e).

Year	Landings
1974	3,793
1975	1,571
1976	3,724
1977	3,237
1978	4,999
1979	14,833
1980	17,732
1981	13,890
1982	6,612
1983	6,911
1984	4,455
1985	3,785
1986	1,178
1987	2,714
1988	5,475
1989	3,421
1990	2,116
1991	2,567
1992	1,825
1993	1,800
1994	3,177
1995	1,515
1996	1,789
1997	1,621
Average	4,781
Unit	tonnes

3.9.11 Megrim (*L. whiffiagonis*) in Sub-area VII and Divisions VIIIa,b,d,e

State of stock/fishery: The stock is considered to be within safe biological limits. SSB was high from 1984 to 1988 then declined until 1990 and has been stable above the proposed $\mathbf{B_{pa}}$ since then. The fishing mortality has declined from the 1991 peak and remains stable at about $\mathbf{F_{med}}$, the proposed $\mathbf{F_{pa}}$. Recruitment has been relatively stable.

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 $\mathbf{B_{pa}}$.

Advice on management: ICES recommends that fishing mortality should be below the proposed $\mathbf{F_{pa}}$ (0.30), corresponding to landings less than 13 900 t in 1999. Taking into account a 5% contribution of *L. boscii* in the landings, the equivalent TAC for the two species combined would be 14 600 t.

Reference points: ***L. whiffiagonis***

ICES considers that:	ICES proposes that:
$\mathbf{B_{lim}}$ is not defined.	$\mathbf{B_{pa}}$ be set at 55 000 t. There is evidence of high recruitment at the lowest biomass observed and $\mathbf{B_{pa}}$ can therefore set equal to the lowest observed SSB.
$\mathbf{F_{lim}}$ is 0.44, the fishing mortality estimated to lead to potential stock collapse.	$\mathbf{F_{pa}}$ 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:

$\mathbf{B_{lim}}$: $\mathbf{B_{loss}}$	$\mathbf{B_{pa}}$: $\mathbf{B_{loss}}$
$\mathbf{F_{lim}}$: $\mathbf{F_{loss}}$	$\mathbf{F_{pa}}$: $\mathbf{F_{med}}$; implies a less than 5% probability that (SSB_{MT}< $\mathbf{B_{pa}}$)

Relevant factors to be considered in management: The exploitation pattern has recently been poor and resulted in a large proportion (up to 40%) of the catch being composed of undersized fish.

Catch forecast for 1999:

Basis: F(98) = F(95–97) = 0.32; Landings(98) = 15.2; SSB(99) = 65.

F(99)	Basis	Catch(99)	Landings(99)	SSB(2000)	Medium-term effect of fishing at given level
0.06	0.2 F(98)	4.2	3.5	81.9	n/a
0.13	0.4 F(98)	8.1	6.7	77.2	n/a
0.19	0.6 F(98)	11.8	9.7	72.9	n/a
0.26	0.8 F(98)	15.2	12.5	68.8	n/a
0.30	$\mathbf{F_{pa}}$	17.4	14.4	66.2	n/a
0.32	1.0 F(98)	18.4	15.2	65.0	n/a
0.38	1.2 F(98)	21.4	17.6	61.5	n/a

Weights in '000 t.

Shaded scenarios considered inconsistent with the precautionary approach.

Elaboration and special comment: Megrim to the west of Britain 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. Megrim landings have remained fairly stable over the period 1986–1997. Discards are estimated to be about 15% of the total catches by weight and comprise fish over a large range of sizes. Most UK landings of megrim are made by beam trawlers fishing in ICES 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 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 south-west 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 four commercial fleets and one survey. Discard estimates used. Use of a new maturity ogive has resulted in a revision of the SSB series, though the pattern remains unaltered.

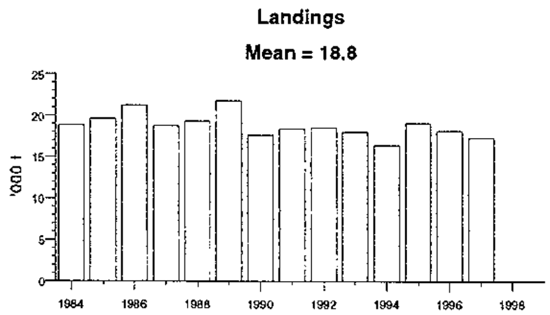
Source of information: Report of the Working Group on the Assessment of Southern Shelf Demersal Stocks, September 1998 (ICES CM 1999/ACFM:4).

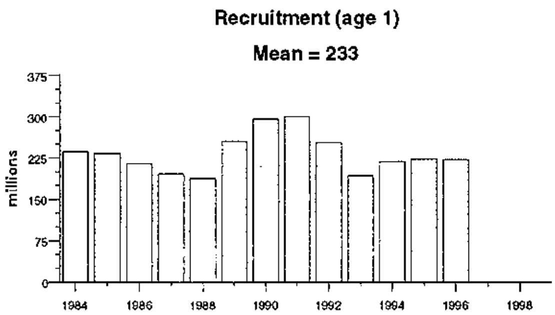
Catch data (Tables 3.9.11.1–2):

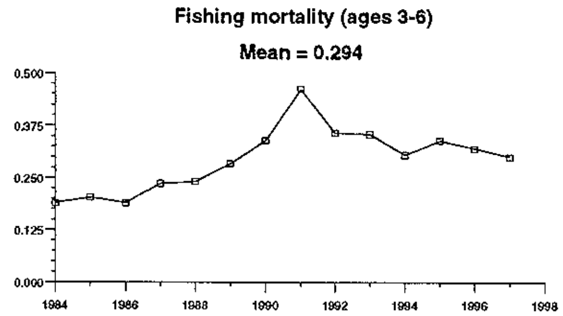
Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC[1]	ACFM landings	Disc slip.	ACFM catch
1987	Not assessed	-	16.46	17.1	1.7	18.8
1988	Not assessed	-	18.1	17.6	1.7	19.3
1989	Not assessed	-	18.1	19.2	2.6	21.8
1990	Not assessed	-	18.1	14.4	3.3	17.7
1991	No advice	-	18.1	15.1	3.3	18.4
1992	No 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	16.6[2]	21.20	15.1	3.0	18.1
1997	No advice	14.3[2]	25.0	14.2	3.1	17.3
1998	No increase in F	15.2[2]	25.0			
1999	Reduce F below $\mathbf{F}_{pa}$	14.6[2,1]				

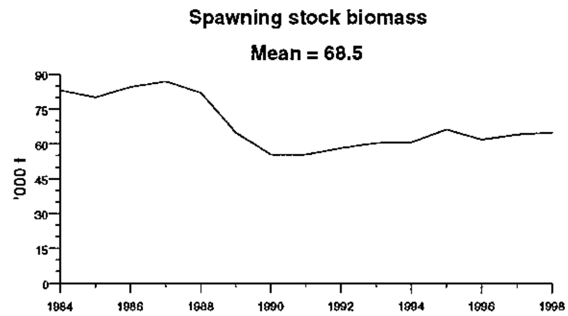
[1]Includes *L. boscii.* [2]Landings at *status quo* F. Weights '000 t.

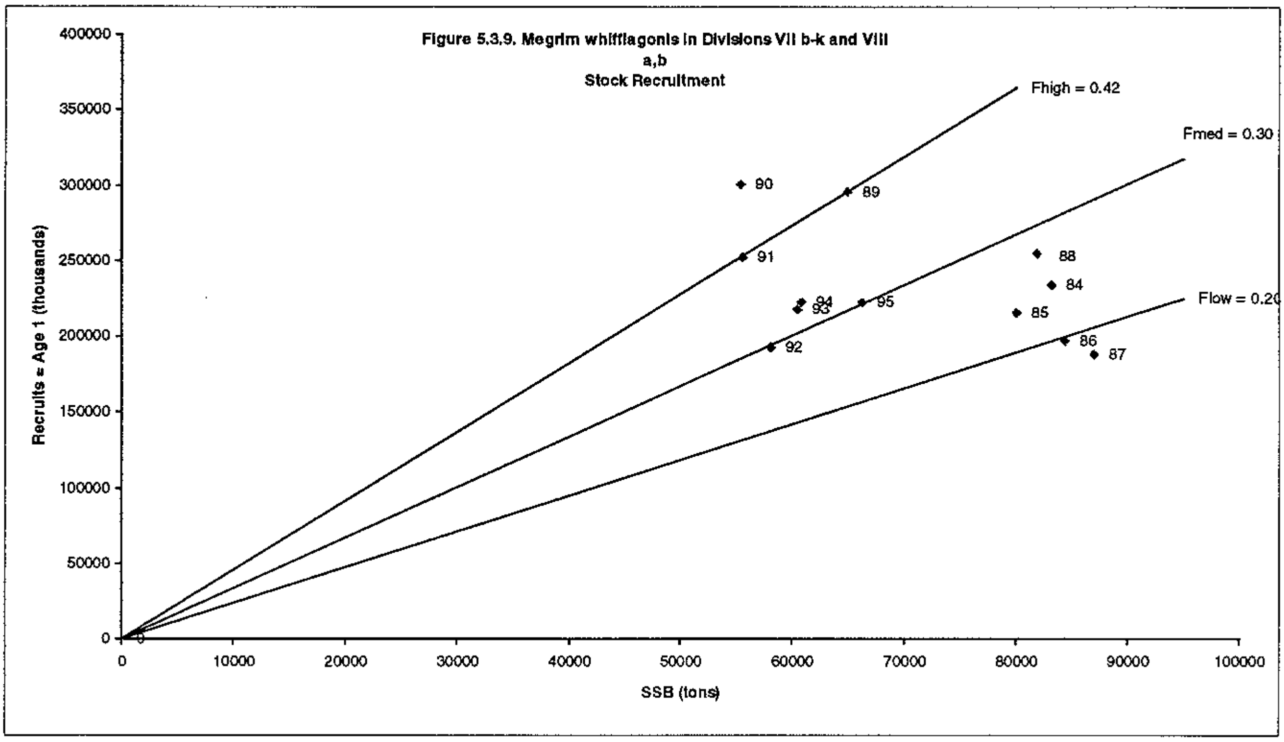
Landings in graph below includes discards











Precautionary Approach Plot

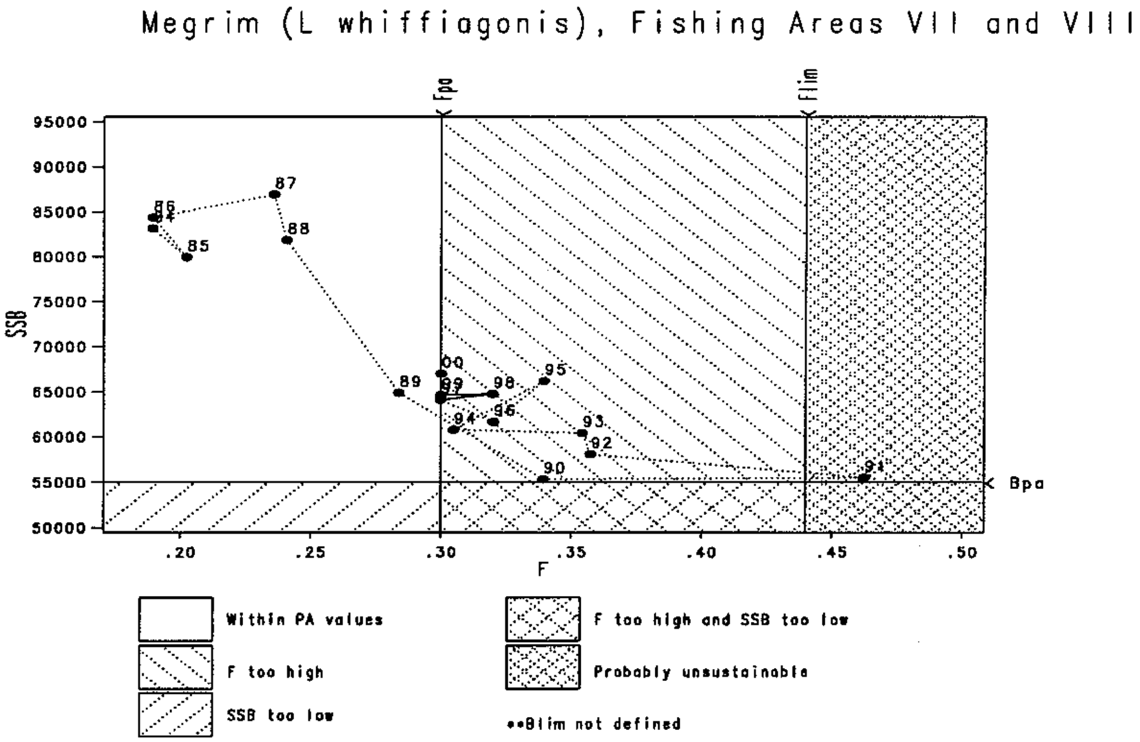


Table 3.9.11.1 Megrim (*L. whiffiagonis*) in sub-areas VIIb-k and VIIIa,b. Nominal landings and catches (t) provided by the Working Group.

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997**
Total landings*	16659	17865	18927	17114	17577	19233	14371	15094	15600	14929	13685	15862	15109	14236
Total discards*	2169	1732	2321	1705	1725	2582	3284	3282	2988	3108	2700	3206	3026	3068
Total catches	18828	19597	21248	18819	19302	21815	17655	18376	18588	18037	16385	19068	18135	17304
Agreed TAC (1)				16460	18100	18100	18100	18100	18100	21460	20330	22590	21200	25000

(1) include VIIa
* Revised 1986 to 1996
**Preliminary

Table 3.9.11.2 Megrim (*L. whiffiagonis*) in Sub-areas VII and VIII.

Year	Recruitment Age 1	Spawning Stock Biomass	Catch	Fishing Mortality Age 3-6
1984	236.74	83.18	18.83	0.189
1985	233.57	79.97	19.60	0.202
1986	215.06	84.36	21.25	0.189
1987	196.79	86.92	18.82	0.236
1988	187.67	81.86	19.30	0.241
1989	254.90	64.88	21.82	0.284
1990	295.64	55.34	17.66	0.339
1991	300.79	55.52	18.38	0.462
1992	252.53	58.10	18.59	0.357
1993	192.96	60.44	18.04	0.354
1994	217.91	60.80	16.39	0.305
1995	222.28	66.20	19.07	0.339
1996	222.20	61.67	18.14	0.320
1997	.	64.12	17.30	0.300
1998	.	64.77	.	.
Average	233.00	68.54	18.80	0.294
Unit	Millions	1000 tonnes	1000 tonnes	-

3.9.12 Anglerfish in Divisions VIIb–k and VIIIa,b (*L. piscatorius* and *L. budegassa)*

State of stocks/fishery: Both stocks are considered to be within safe biological limits. The SSB of both stocks decreased continuously from 1986 until 1993–1995, but have since increased to well above the proposed $\mathbf{B}_{pa}$. For *L. piscatorius,* fishing mortality has generally been above the proposed $\mathbf{F}_{pa}$ over the time series, and F_{97} is estimated to be at the proposed $\mathbf{F}_{pa}$. For *L. budegassa,* F has recently been around the time-series average and above $\mathbf{F}_{med}$ (0.11).

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 $\mathbf{B}_{pa}$.

Advice on management: ICES recommends that fishing mortality on these stocks should not be allowed to increase, corresponding to landings of no more than 32 900 t in 1999 for both species combined (23 700 t *L. piscatorius* and 9 200 t *L. budegassa*). This will keep both stocks within safe biological limits.

Reference points: *L. piscatorius*

ICES considers that:	ICES proposes that:
$\mathbf{B}_{lim}$ is not defined	$\mathbf{B}_{pa}$ be set at 27 000 t. There is evidence of high recruitment at the lowest biomass observed and $\mathbf{B}_{pa}$ can therefore 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	$\mathbf{B}_{pa}$: $\mathbf{B}_{loss}$
$\mathbf{F}_{lim}$:$\mathbf{F}_{loss}$	$\mathbf{F}_{pa}$: $_{Flim}$ x 0.72

Reference points: *L. budegassa*

ICES considers that:	ICES proposes that:
$\mathbf{B}_{lim}$ is not defined.	$\mathbf{B}_{pa}$ be set at 13 300 t. There is evidence of high recruitment at the lowest biomass observed and $\mathbf{B}_{pa}$ can therefore set equal to the lowest observed SSB.
$\mathbf{F}_{lim}$ is not defined	$\mathbf{F}_{pa}$ be set at $\mathbf{F}_{med}$ = 0.11. 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.

Relevant factors to be considered in management: At the current fishing mortality rate landings of both stocks are expected to decrease in 1999, and the SSB will decrease in 2000.

L. piscatorius and *L. budegassa* are both caught on the same grounds by the same fleets, and are usually not separated by species in markets; therefore, management measures for both species must be considered together and in conjunction with other species taken by these fisheries (sole, cod, rays, megrim and hake).

Catch forecast for 1999:

Basis: *L. piscatorius*: F(98) = F(95–97) = 0.25, Catch(98) = Landings (98) = 24.4; SSB(99) = 54.2.
L. budegassa: F(98) = F(95–97) = 0.19, Catch(98) = Landings (98) = 10.1; SSB(99) = 19.1.

L. piscatorius				*L. budegassa*			
F(99)	Basis	Landings(99)	SSB(2000)	F(99)	Basis	Landings(99)	SSB(2000)
0.10	0.4 F(95–97)	10.6	64.2	0.08	0.4 F(95–97)	4.2	22.8
0.15	0.6 F(95–97)	15.3	59.3	0.12	0.6 F(95–97)	6.1	21.5
0.20	0.8 F(95–97)	19.7	54.8	0.15	0.8 F(95–97)	7.7	19.5
0.25	1.0 F(95–97)	23.7	50.7	0.19	1.0 F(95–97)	9.2	18.0
0.30	1.2 F(95–97)	27.5	46.9	0.23	1.2 F(95–97)	10.6	16.7

Weights in '000 t.

At options A-C, SSB of *L. piscatorius* is predicted to increase in 2000, and for all options, there is high probability that SSB will remain above $\mathbf{B}_{pa}$ in the medium term.
At options A-C, SSB of *L. budegassa* is expected to be stable or to increase above the average for 1986–1997. There is 20% probability that SSB will fall below $\mathbf{B}_{loss}$ in medium term.
Shaded scenarios considered inconsistent with the precautionary approach.

Elaboration and special comment: Anglerfish landings from the west of Britain and in the northern Bay of Biscay comprise two species - *L. piscatorius* and *L. budegassa*. *L. piscatorius* has a wide distribution in water down to 500 m 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 and tends to be found in deeper water.

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 have returned to the level 10 years ago, when France and Spain have 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* is 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 increase significantly the overall efficiency of the French fleet. In Sub-Area VI, which are not cover by this assessment, French landings of anglerfish have fluctuated around 2 000 t over the last two decades. 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. Little is known about the location and timing of spawning of either species of anglerfish. Eggs are released in long gelatinous ribbons and have been recorded in March on the shelf edge in the Celtic Sea and off the west coast of Britain between May and July. Juvenile anglerfish have been caught both in deep water and along the shoreline and discrete nursery areas have not been identified.

Age-based assessment using CPUE and survey data. A new maturity ogive has been applied to the whole time period and SSB values have been revised compared to those estimated last year, though the trends remained similar. No recruitment indices are available for these stocks, and there was a downward revision of the estimates of abundance of *L. piscatorius* recruits in 1993–1995, and for *L. budegassa* recruits in 1995 and 1996, due to a lack of small fish and ageing changes. Short-term predictions of SSB are not sensitive to assumed recruitment because of the late maturity.

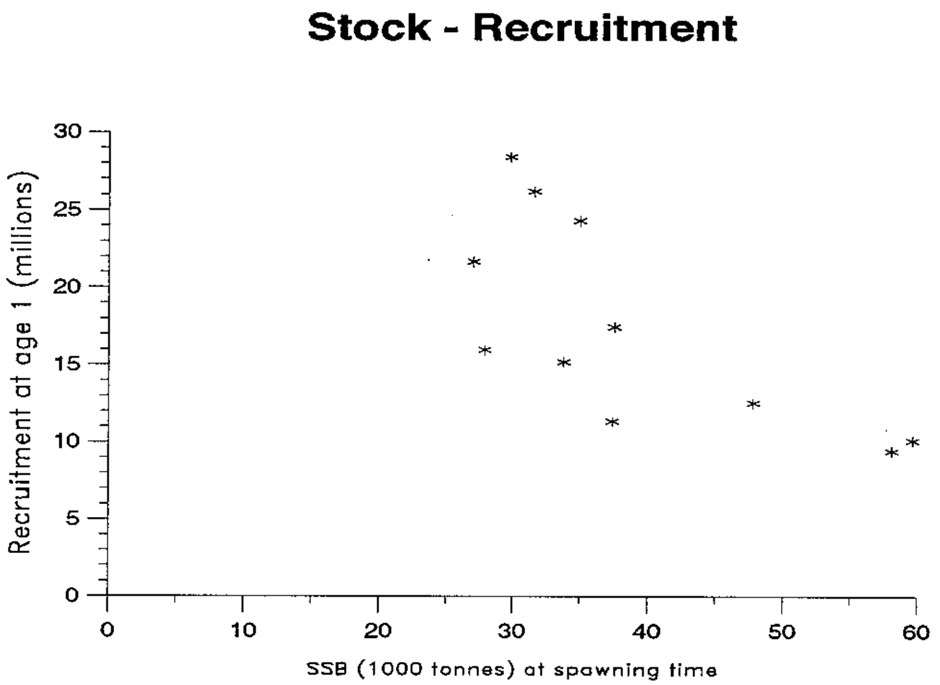
Source of information: Report of the Working Group on the Assessment of Southern Shelf Demersal Stocks, September 1998 (ICES CM 1999/ACFM:4).

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	29.3	19.7	9.6
1991	No advice	-	42.99	25.0	16.2	8.8
1992	No advice	-	42.99	21.1	12.8	8.3
1993	Concern about *L. pisc.* SSB decrease	-	25.1[2]	20.1	13.5	6.7
1994	SSB decreasing, still inside safe biological	-	23.9[2]	21.9	16.1	5.8
1995	No increase in F	20.0	23.2[2]	26.8	19.7	7.1
1996	No increase in F	30.3	30.4[2]	30.2	22.1	8.1
1997	No increase in F	34.3	34.3	28.9	20.9	8.0
1998	No increase in F	33.0	34.3			
1999	No increase in F	32.9				

[1]Includes Division VIIa; applies to both species. [2]Includes Divisions VIIId,e. Weights in '000 t. [3]Revised.

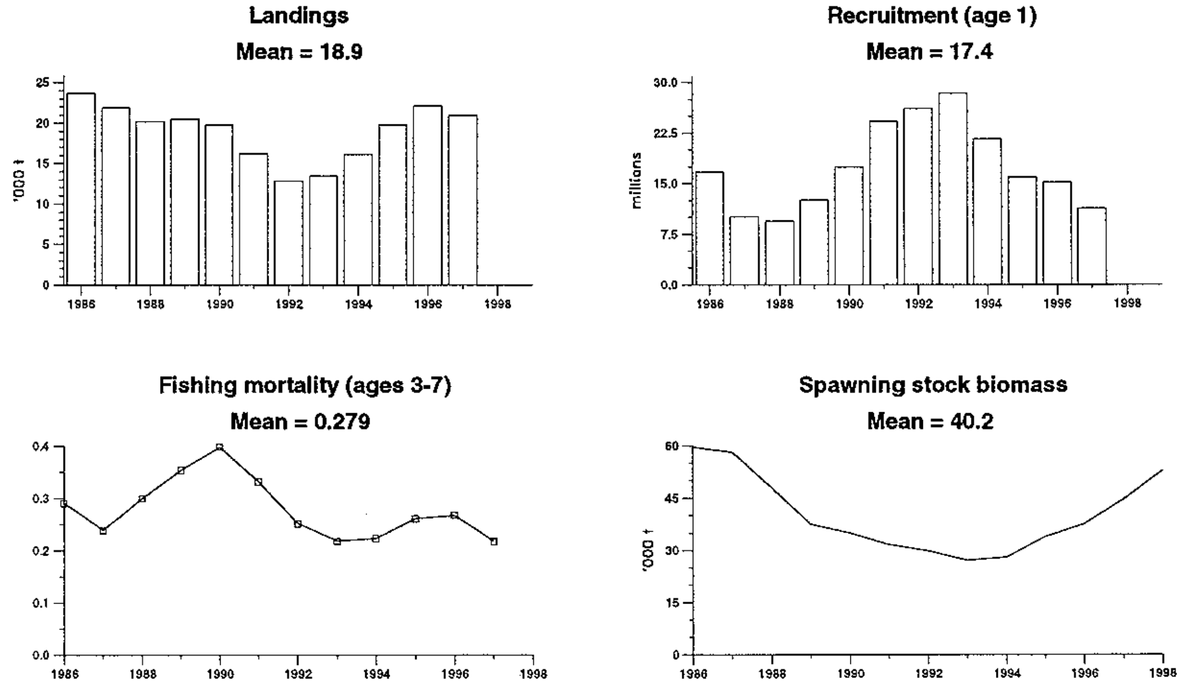
Anglerfish (*L. piscatorius*) in Fishing Areas VII and VIIIa,b



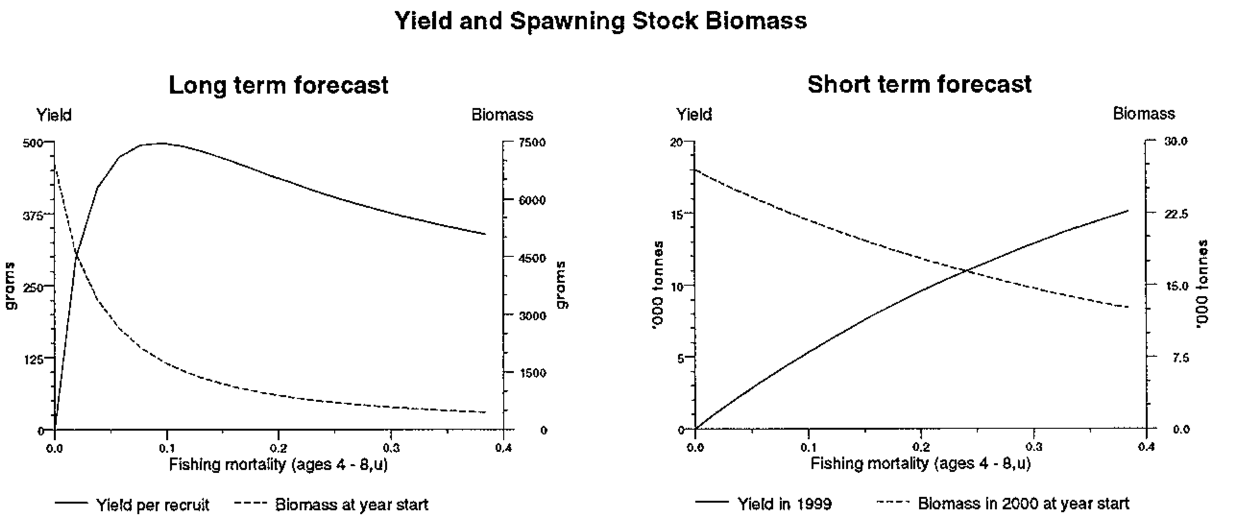
(run: XSAALA05)

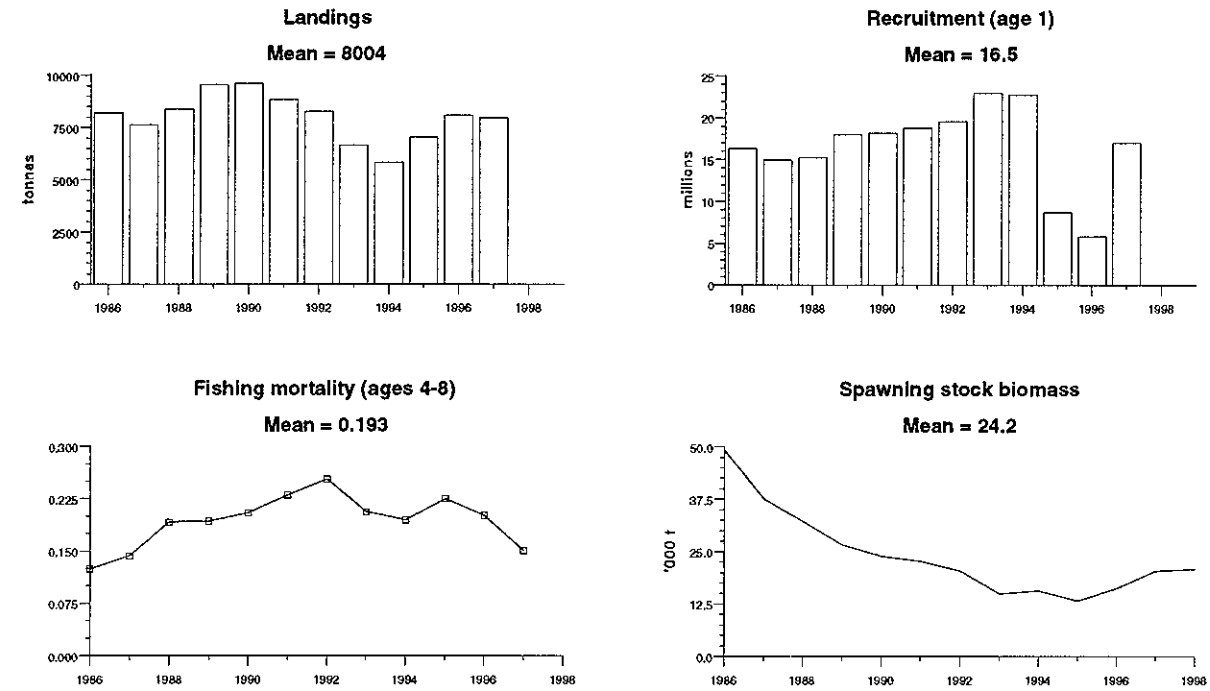
Anglerfish (*L. budegassa*) in Fishing Areas VII and VIIIa,b

(run: XSAALB04)



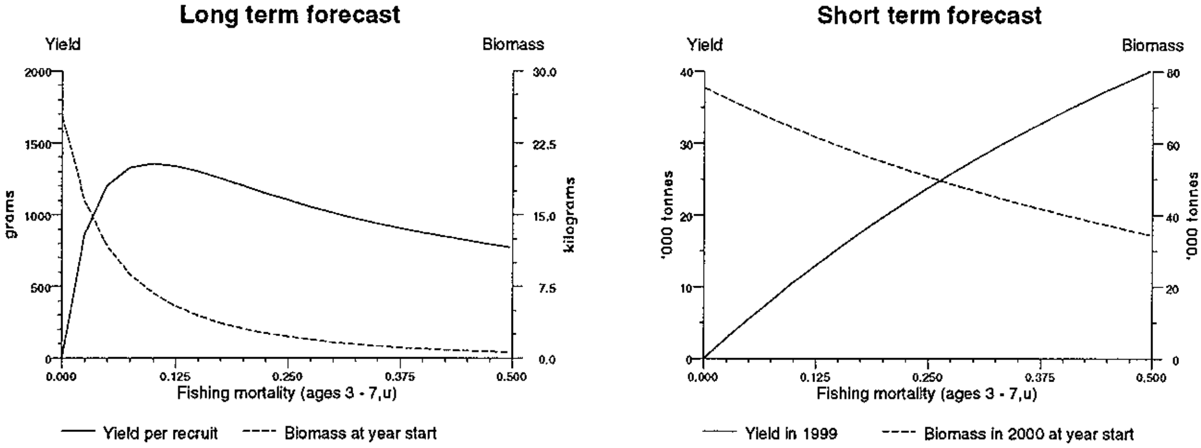
L. piscatorius





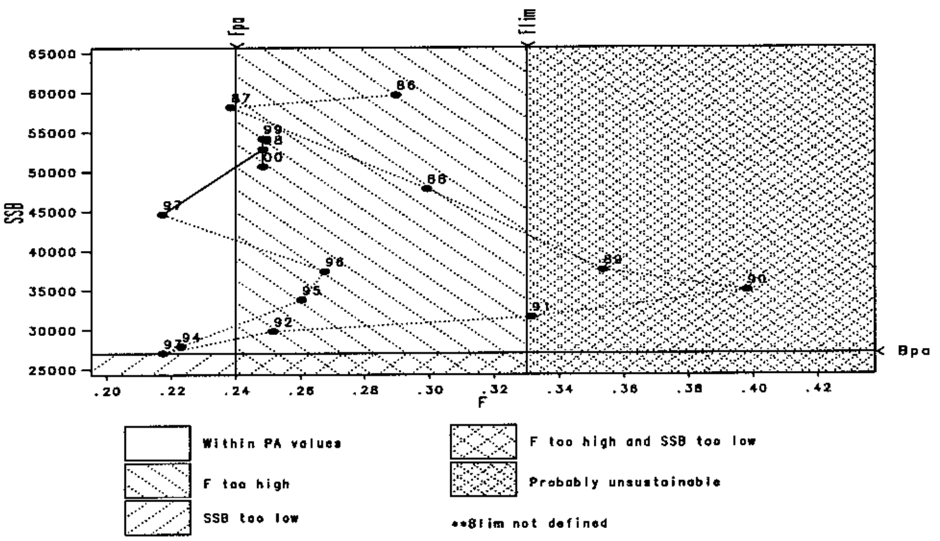
L. budegassa

Yield and Spawning Stock Biomass

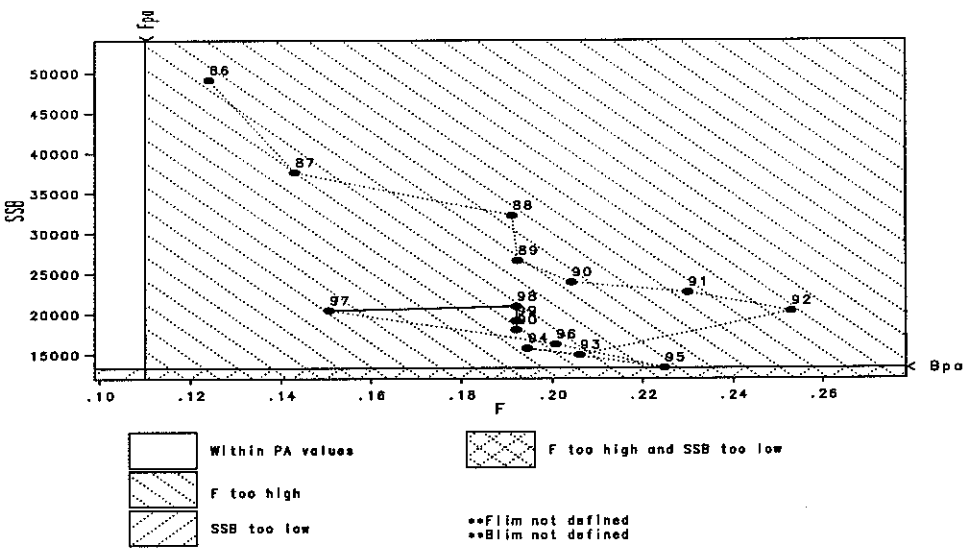


Precautionary Approach Plots

Anglerfish (L. piscatorius), Fishing Areas VII and VIIIa,b



Anglerfish (L. budegassa), Fishing Areas VII and VIIIa,b



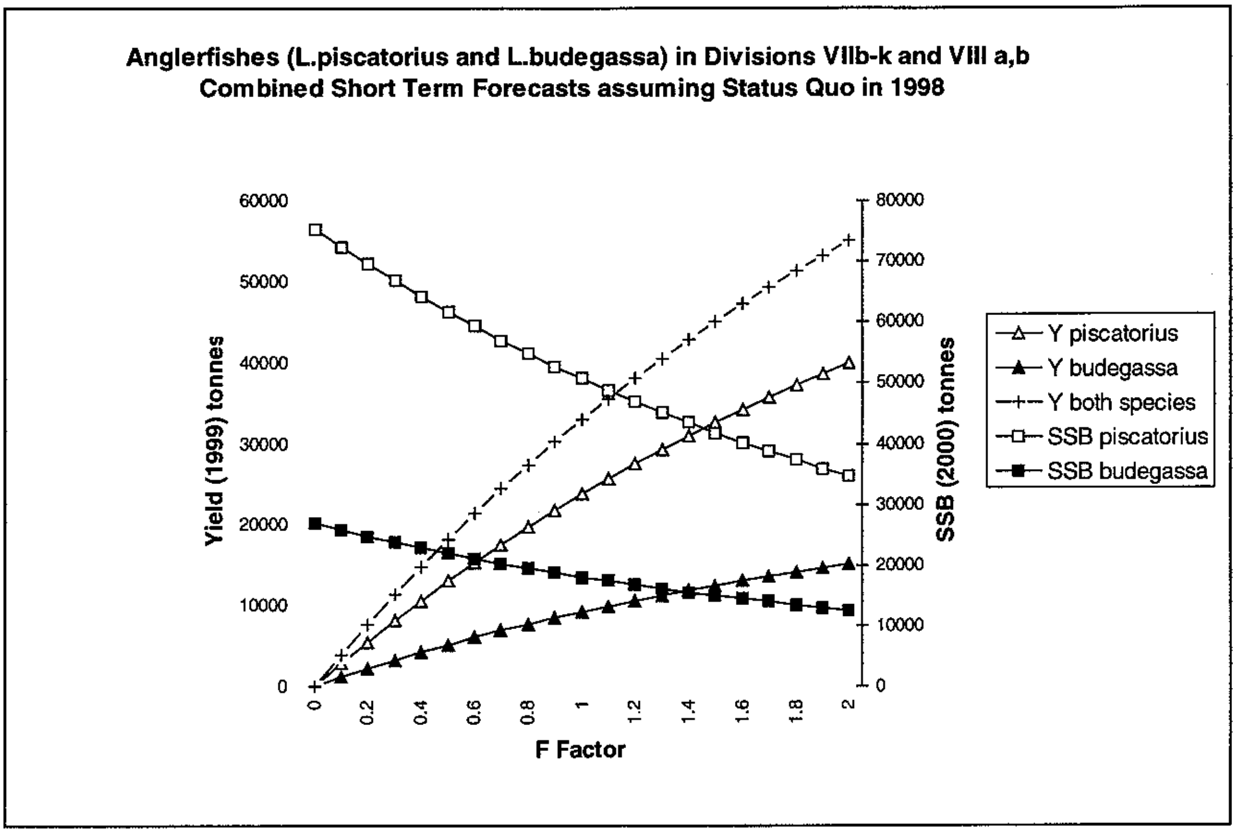


Table 3.9.12.1 Landings (tonnes) of both anglerfish in species of Divisions VIIb-k and VIIIa,b,d
Working group estimates

Year	VIIb-k	VIIIa,b,d	Total
1977*			19895
1978*			23445
1979*			29738
1980*			38880
1981*			39450
1982*			35285
1983*			38280
1984*	28847	7909	36756
1985*	28491	7161	35652
1986	25987	5897	31883
1987	22295	7233	29528
1988	22494	5983	28477
1989	24730	5276	30006
1990	23381	5950	29331
1991	20363	4684	25047
1992	17537	3530	21066
1993	16633	3507	20140
1994	18093	3841	21934
1995	21922	4862	26784
1996*	24132	6102	30233
1997**	23073	5846	28919

* revised
** preliminary

Table 3.9.12.2 Landings (tonnes) of *L. piscatorius* in Divisions VIIb-k and VIIIa,b,d

Working group estimates

Year	VIIb-k	VIIIa,b,d	Total
1980*			27663
1981*			28067
1982*			25104
1983*			27234
1984*	23056	5416	28472
1985*	23193	4568	27761
1986	19544	4122	23666
1987	17180	4729	21909
1988	16147	3948	20095
1989	17581	2889	20470
1990	16344	3379	19723
1991	14054	2158	16212
1992	11442	1362	12804
1993	11894	1587	13481
1994	14075	2045	16120
1995	16618	3113	19730
1996*	18153	3988	22141
1997**	17026	3917	20943

* revised

** preliminary

Table 3.9.12.3 Landings (tonnes) of *L. budegassa* in Divisions VIIb-k and VIIIa,b,d

Working group estimates

Year	VIIb-k	VIIIa,b,d	Total
1980*			11217
1981*			11381
1982*			10180
1983*			11043
1984*	5791	2493	8284
1985*	5298	2593	7891
1986	6443	1775	8217
1987	5115	2504	7619
1988	6347	2035	8382
1989	7149	2387	9536
1990	7037	2571	9608
1991	6308	2526	8835
1992	6094	2168	8262
1993	4739	1919	6659
1994	4018	1796	5814
1995	5304	1749	7053
1996*	5978	2114	8092
1997**	6047	1929	7976

* revised

** preliminary

Table 3.9.12.4 Anglerfish (*L.piscatorius)* in Fishing Areas VII and VIIIa,b.

Year	Recruitment Age 1	Spawning Stock Biomass	Landings	Fishing Mortality Age 3-7
1986	16.74	59.66	23.67	0.290
1987	10.11	58.13	21.91	0.238
1988	9.43	47.80	20.10	0.299
1989	12.53	37.53	20.47	0.353
1990	17.46	34.97	19.72	0.398
1991	24.29	31.58	16.21	0.331
1992	26.20	29.81	12.80	0.251
1993	28.40	27.02	13.48	0.217
1994	21.65	27.89	16.12	0.223
1995	15.95	33.78	19.73	0.260
1996	15.20	37.38	22.14	0.267
1997	11.33	44.63	20.94	0.217
1998	.	52.82	.	.
Average	17.44	40.23	18.94	0.279
Unit	Millions	1000 tonnes	1000 tonnes	-

Table 3.9.12.5 Anglerfish (*L.budegassa)* in Fishing Areas VII and VIIIa,b.

Year	Recruitment Age 1	Spawning Stock Biomass	Landings	Fishing Mortality Age 4-8
1986	16.31	49.16	8.22	0.124
1987	14.94	37.61	7.62	0.143
1988	15.29	32.20	8.38	0.191
1989	18.04	26.60	9.54	0.192
1990	18.17	23.91	9.61	0.204
1991	18.77	22.66	8.84	0.230
1992	19.53	20.31	8.26	0.253
1993	22.96	14.92	6.66	0.206
1994	22.70	15.73	5.81	0.195
1995	8.65	13.31	7.05	0.225
1996	5.77	16.23	8.09	0.201
1997	17.00	20.43	7.98	0.151
1998	.	20.91	.	.
Average	16.51	24.15	8.00	0.193
Unit	Millions	1000 tonnes	1000 tonnes	-

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, whiting, hake, 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.

Landings in 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 3.10.3, 3.9.9, 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 covers Divisions VIIe-k.

State of the Stocks

In 1998 further exploratory assessments, using swept areas, surplus production and VPA, were used to estimate biomass. Exploitation levels were also studied using catch curves, yield per recruit and VPA.

These groups of fish may be only components of larger stock complexes. The fishing mortality rates were compared with those in adjacent areas but 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.

Stock monitoring programmes and annual groundfish and young fish surveys are in place and will eventually permit more elaborate assessments. 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. 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 1995 ACFM report). Catch per unit of effort has been stable and has fluctuated without trend over recent years. There is a TAC for all of Sub-area VII. There is an overview of *Nephrops* stocks in Section 2.1.1 in the 1995 ACFM report.

3.10.2 Demersal Stocks

Officially reported landings of cod, whiting, plaice and sole in Divisions VIIb,c,h-k are given in Tables 3.10.2.1–2..

Table 3.10.2.1 ICES Divisions VIIb,c nominal international landings as reported to the Working Group.

COD Landings, Divisions VIIb,c

Country	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
France	591	474	206	112	36	120	156	92	158[2]	82*
Germany, Fed. Rep.	-	1	-	-	-	-	-	-	-	-
Ireland	388	915	795	612	507	357	462	552	427	232*
Norway	2	9	29	11	39	+	7	3	1	6
UK (England and Wales)[1]	23	7	12	33	62	17	29	25	-	37
UK (Scotland)	5	34	300	177	148	73	93	66	-	7
UK									45	
Total	**1009**	**1440**	**1342**	**945**	**792**	**567**	**747**	**738**	**631**	**364**

* Preliminary [1] 1989-1995 N. Ireland included with England, Wales and
[2] Revised Norwegian catches, on Russian quotas are included for 1992 and 1993

WHITING Landings, Divisions VIIb,c

Country	1988	1989	1990	1991	1992	1993	1994	1995*	1996	1997
France	113	56	63	40	27	31	27	58	146[2]	76*
Germany, Fed. Rep.	+	-	-	-	-	-	-	-	-	-
Ireland	922	1199	770	540	730	826	1151	2084	1268	474*
UK (England and Wales) [1]	12	2	2	14	14	23	18	24	-	75
UK (Scotland)	+	32	36	80	155	147	117	71	-	4
UK									112	
Total	**1047**	**1289**	**871**	**674**	**926**	**1027**	**1313**	**2237**	**1526**	**629**

* Preliminary [1] 1989-1995 N. Ireland included with England and [2] Revised

SOLE Landings, Divisions VIIb,c

Country	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
France	2	+	-	5	2	2	1	2	4[2]	3*
Ireland	34	38	41	46	43	59	70	63	64	50*
UK (England and Wales) [1]	1	+	+	+	+	-	-	-	+	1
Total	**37**	**38**	**41**	**51**	**45**	**61**	**71**	**65**	**68**	**54**

* Preliminary [1] 1989-1995 N. Ireland included with England and [2] Revised

PLAICE Landings, Divisions VIIb,c

Country	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
France	9	1	11	9	3	5	2	7	19[2]	6*
Ireland	157	159	130	179	180	191	209	316	250	210
UK (England and Wales) [1]	2	1	2	-	6	1	2	1	-	+
UK (Scotland)	+	13	90	3	3	2	3	1	-	-
UK									3	-
Total	**168**	**174**	**233**	**191**	**192**	**199**	**216**	**325**	**272**	**216**

* Preliminary [1] 1989-1995 N. Ireland included with England and [2] Revised

Table 3.10.2.2 ICES Divisions VIIj,k nominal international landings as reported to the Working Group.

COD Landings, Divisions VIIj,k

Country	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Denmark	+	-	-	+	-	-	-	-	-	-
France	407	508	276	115	202	143	117	193[2]	233*	151
Ireland	868[1]	857[1]	1064[1]	1413[1]	872[1]	435[1]	650[1]	1126	1033*	1116
Norway	-	13	20	-	-	-	-	-	-	-
UK (England and Wales)	53	14	47	96	187	67	117	147	154	168
UK (N. Ireland)	-	-	2	-	-	-	-	-	-	-
UK (Scotland)[1]	2	-	127	20	13	4	6	8	-	-
Total	**1330**	**1392**	**1536**	**1644**	**1274**	**649**	**890**	**1474**	**1341**	**1440**

* Preliminary [1] Includes VIIh [2] Revised

WHITING Landings, Divisions VIIj,k

Country	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Belgium	-	-	-	-	-	-	-	-	-	154
Denmark	-	+	-	-	-	-	-	-	-	-
France	209	356	235	178	170	171	142	170[2]	125*	195
Germany, Fed. Rep.	-	-	+	-	14	-	na	-	-	-
Ireland	209[1]	1483[1]	1304[1]	1068[1]	1455[1]	2977[1]	3709[1]	5193	4673*	2500
UK (England and Wales)	77	32	18	57	143	175	238	329	390	333
UK (Scotland)[2]	1	-	33	12	8	12	6	22	-	-
Total	**496**	**1871**	**1590**	**1315**	**1790**	**3335**	**4095**	**5714**	**5188**	**3182**

* Preliminary [1] Includes VIIh [2] Revised

SOLE Landings, Divisions VIIj,k

Country	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Belgium	-	-	-	-	-	-	-	-	-	51
France	1	2	2	1	2	2	1	1	3[2]	5*
Ireland	182[1]	206[1]	266[1]	306[1]	255[1]	237[1]	184[1]	207	191	110*
UK (England and Wales)	7	16	+	8	15	8	2	6	1	2
UK (Scotland)[1]	-	-	-	-	2	5	2	-	-	-
Total	**190**	**224**	**268**	**315**	**274**	**252**	**189**	**214**	**195**	**168**

* Preliminary [1] Includes VIIh [2] Revised

PLAICE Landings, Divisions VIIj,k

Country	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Belgium	-	-	-	-	-	-	-	-	-	49
Denmark	+	+	-	+	-	+	-	+	-	-
France	18	22	21	11	14	10	7	13	24[2]	12*
Ireland	369[1]	454[1]	338[1]	478[1]	477[1]	383[1]	271[1]	317	281*	324*
UK (England and Wales)	27	4	9	18	73	46	60	86	36	31
UK (Scotland)	1	-	1	+	6	7	1	4	-	-
Total	**415**	**480**	**369**	**507**	**570**	**446**	**339**	**420**	**341**	**416**

* Preliminary [1] Includes VIIh [2] Revised

3.10.3 Herring in Divisions VIa (South) and VIIb,c

State of the stock/fishery: It is problematic to judge the status of this stock due to a lack of fishery independent data. Qualitative information based on reports from fishermen suggests the stock is in a poor state and some analytical assessments are consistent with this interpretation. The stock is at present considered to be harvested outside safe biological limits as defined by the proposed reference points. Weak evidence indicates that fishing mortality has increased in recent years and that SSB has declined as the large 1986 year class has been fished out.

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

Advice on management: ICES recommends that F in 1999 should be reduced by 30% to F = 0.41 in order to rebuild the SSB. This corresponds to a catch of 19 000 t in 1999.

The proposed F_{pa} for this stock is substantially below the fishing mortality estimated for the most recent years. If it is not possible to reduce F below the precautionary threshold in a single year, implying a catch of 11 500 t in 1999, it is desirable to agree a multi-annual recovery plan to reduce the fishing mortality rate as rapidly as possible.

Proposed reference points: Establishing a basis for precautionary limits is marred by the low precision of stock size and mortality estimates for the most recent years. Excluding the most recent five years and using data believed to be in the more reliable part of the historical time series, suggests that fishing mortalities in excess of 0.4 have a high probability of leading the stock below the lowest observed SSB. A fishing mortality close to F_{med} (0.22) has a high probability of maintaining the stock above the lowest levels. This is also close to $F_{0.1}$. It is suggested that F_{pa} be set at 0.22.

The lowest reliably estimated SSB is 81 000 t. In order to have a high probability of avoiding this value, management action to reduce fishing mortality below F_{pa} would be required at measured SSBs of 110 000 t. It is suggested that B_{pa} be set at 110 000 t.

Sustained fishing at F_{med} is likely to result in the SSB fluctuating around an equilibrium value of 127 000 t.

Relevant factors to be considered in management: The fishery now exploits a mixture of autumn and winter/spring spawning fish. The winter/spring component appears to have increased in recent years. This component is distributed in the northern part of the area and does not appear to have suffered the serious decline of the autumn spawning component. The latter component has a more southerly distribution in Divisions VIaS and VIIb. Traditional fisheries in this area were based on the winter/spring component and the stock composition may now be reverting to its earlier form.

There has been considerable misreporting of catches both into the area from the North Sea and out of the area into Division VIaN. The actual catches prior to 1996 taken from this stock have greatly exceeded the recommended TAC mainly due to misreporting into Division VIaN.

Catch Forecast for 1999:
Basis TAC = 28 000 t, F(98) = 0.60, SSB(98) = 56 000 t and recruitment of 583 million at age 1 in 1998.

Basis	F(99 onward)	SSB(99)	Landings(99)	SSB(2000)	Medium-term effect of fishing at given level
0.4F(97) = F_{pa}	0.23	64 000	11 500	74 000	SSB expected equilibrium 127 000 t
0.6F(97)	0.35	60 000	16 500	65 000	SSB expected equilibrium 95 000 t
0.7F(97)	0.41	58 000	19 000	61 000	SSB expected equilibrium 82 000 t
0.8F(97)	0.46	56 000	21 000	58 000	SSB expected equilibrium 70 000 t
1.0F(97)	0.58	53 000	25000	51 000	SSB expected equilibrium 60 000 t

Shaded scenarios considered inconsistent with the precautionary approach.

Elaboration and special comments: The absence of adequate fishery independent data prevents the reliable estimation of recent stock trends. The present assessment relies on catch at age analysis with a strong assumption about and increasing trend in recent fishing mortality. The assessment is sensitive to this assumption. It is essential to initiate a programme of fishery independent stock size estimates if adequate management is to be implemented.

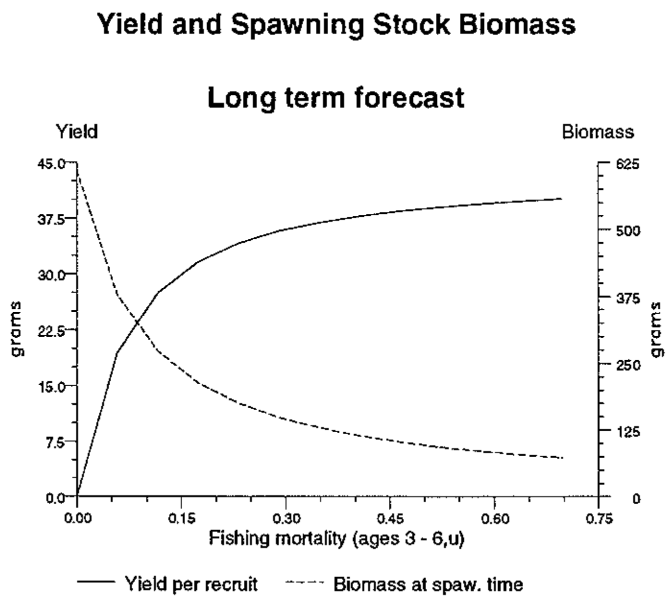
Last year, the Working Group did not carry out an assesment; ACFM carried out its own assessment assuming no trend in F in recent years. The results suggested that the stock was stable and capable of sustaining a TAC of about 25 000 t. This year, the Working Group updated the catch data but still had no fishery-independent information available to "tune" the assessment. The Working Group therefore carried out an analysis of the connection between recruitment and terminal F in order to define a range of consistent erminal F's to be used in the assessment. The analysis indicated that either recent recruitment has been exceptional or there has been a considerable increase in fishing mortality. Experience in the fishery suggests that the latter result is the most likely. An assessment carried out using the resulting terminal F's indicates a low stock size (consistent with observations from fishermen in 1997). With this new perception of stock size, catch forecasts indicate lower catches than suggested last year if the stock is not to decline further.

Source of information: ACFM working document and Report of the Herring Assessment Working Group for the Area South of 62°N, March 1998 (ICES CM 1998/ACFM:14).

Catch data (Tables 3.10.3.1–2):

Year	ICES advice	Predicted catch corresp. to advice	Agreed TAC	Official Landing	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	0.2	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	0.7	27
1998	Catches below 25	< 25	28			
1999	F 70% of F(97)	19				

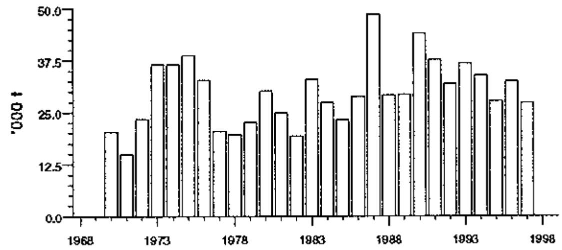
Weights in '000 t.



Herring West of Ireland & Porcupine Bank (Fishing Area VIa South)

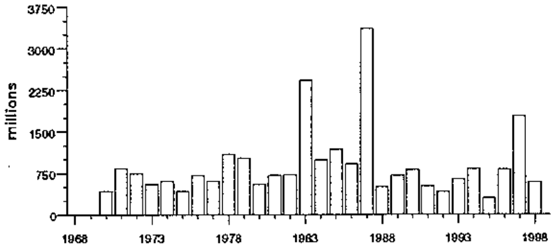
Landings

Mean = 29.7



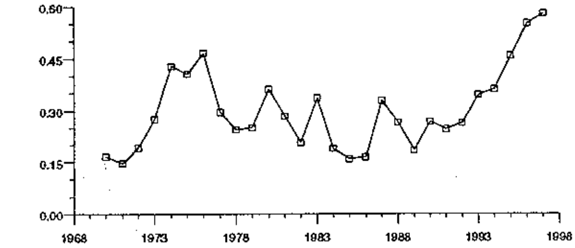
Recruitment (age 1)

Mean = 887



Fishing mortality (ages 3-6)

Mean = 0.301



Spawning stock biomass

Mean = 142

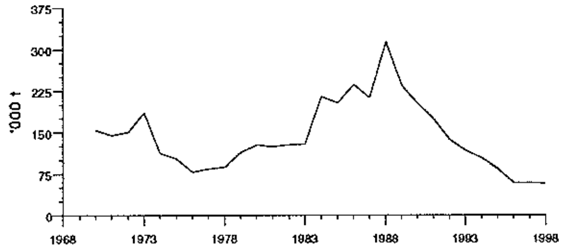


Table 3.10.3.1 Estimated Herring catches in tonnes in Divisions VIa (South) and VIIb,c, 1986–1996. These figures do not in all cases correspond to the official statistics and cannot be used for management purposes.

Country	1986	1987	1988	1989	1990	1991
France	-	-	-	-	+	-
Germany, Fed.Rep.	-	-	-	-	-	-
Ireland	15,540	15,000	15,000	18,200	25,000	22,500
Netherlands	1,550	1,550	300	2,900	2,533	600
UK (N.Ireland)	-	5	-	-	80	-
UK (England + Wales)	-	51	-	-	-	-
UK Scotland	-	-	-	+	-	+
Unallocated	11,785	31,994	13,800	7,100	13,826	11,200
Total landings	28,785	48,600	29,100	28,200	41,439	34,300
Discards	-	-	-	1,000	2,530	3,400
Total catch	28,785	48,600	29,100	29,200	43,969	37,700

Country	1992	1993	1994	1995	1996[1]	1997
France	-	-	-	-	-	-
Germany, Fed.Rep.	250	-	-	11	-	
Ireland	26,000	27,600	24,400	25,450	23,800	24,400
Netherlands	900	2,500	2,500	1,207	1,800	3,400
UK (N.Ireland)	-	-	-	-	-	
UK (England + Wales)	-	-	50	24	-	
UK (Scotland)	-	200	-	-	-	
Unallocated	4,600	6,250	6,250	1,100	6,900	-700
Total landings	31,750	36,550	33,200	27,792	32,500	27,100
Discards	100	250	700	-	-	50
Total catch	31,850	36,800	33,900	27,792	32,500	27,150

[1]Provisional

Table 3.10.3.2 Herring West of Ireland and Procupine Bank (Fishing Area VIa South).

Year	Recruitment Age 1	Spawning Stock Biomass	Landings	Fishing Mortality Age 3-6
1970	416.27	153.46	20.31	0.167
1971	834.14	144.85	15.04	0.147
1972	749.57	150.02	23.47	0.193
1973	545.82	185.37	36.72	0.275
1974	604.77	112.18	36.59	0.429
1975	421.31	101.50	38.76	0.407
1976	711.49	77.80	32.77	0.467
1977	601.81	83.96	20.57	0.296
1978	1,084.51	87.43	19.72	0.245
1979	1,022.64	113.94	22.61	0.251
1980	548.31	127.89	30.12	0.361
1981	706.25	123.46	24.92	0.283
1982	725.50	127.13	19.21	0.206
1983	2,425.91	128.00	32.99	0.336
1984	985.95	214.43	27.45	0.190
1985	1,181.50	202.84	23.34	0.160
1986	915.33	236.09	28.79	0.165
1987	3,361.30	211.62	48.60	0.329
1988	501.94	313.43	29.10	0.265
1989	711.99	234.14	29.21	0.185
1990	810.64	201.94	43.97	0.267
1991	515.32	172.68	37.70	0.246
1992	412.38	136.46	31.86	0.264
1993	635.48	116.76	36.76	0.345
1994	827.61	103.58	33.91	0.362
1995	300.63	84.05	27.79	0.458
1996	807.29	58.55	32.53	0.552
1997	1,784.77	58.74	27.23	0.581
1998	583.00	56.94	.	.
Average	887.36	142.04	29.72	0.301
Unit	Millions	1000 tonnes	1000 tonnes	-

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 due to the northerly wind and current system in the area. This region is characterized by a large number of commercial and non-commercial fish species.

The fisheries in the region are of a typical mixed nature. Different kinds of Spanish and Portuguese fleets operate in the Iberian Region: one is the mixed trawl fleet (single, pair and crustacean trawlers) fishing for species such as hake, blue whiting, horse mackerel, megrim, anglerfish, mackerel, *Nephrops*, bib and cephalopods as the main species. Other fleets fishing for different target species are longliners fishing for hake and mackerel, fixed nets used for hake, anglerfish and mackerel and purse seiners which target sardine and anchovy, and secondly 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 and molluscs (*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 fleets operating gillnets and long lines have also declined in number of boats 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 in Division VIIIc 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 was located in the Gulf of Cadiz (Sub-division IXa South) except in 1995 when the bulk of the fishery was located to the North of Portugal and to the West of Galicia (Sub-Division IXa North) and very reduced in the Gulf of Cadiz, given to exceptional availability of anchovy in the Northern part of the Division IXa.

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.

Management measures

The fisheries in the Iberian Region are managed by a TAC system and technical measures. Common mesh sizes for trawls are 65 mm, except for trawlers directed to blue whiting or horse mackerel (40 mm). In the Gulf of Cadiz the legal trawl mesh size is 40 mm. Other measures are minimum landing sizes and seasonal closures to protect juvenile hake.

There are management measures enforced in the sardine fishery at national level for seasonal closures and a minimum landing size.

State of stocks

The major data problems in the Iberian Region are the short time series of landing statistics, notably in the Gulf of Cadiz, little information about length composition for demersal species in the landings in that area, lack of routine estimates of discards (only available for Northern Spanish waters in 1994). For most of the stocks the sampling level of the landings is considered adequate for assessment purposes. Southern horse mackerel are very well covered by the sampling programme. The low level of samples of discards, particularly of undersized hake, is considered a problem. There are still some problems in consistency in age reading of hake.

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.

The stock of hake is considered to be outside safe biological limits. SSB decreased very sharply between 1984 and 1986 and is near to the lowest recorded level. Recruitment has declined steadily since 1984, though the three most recent year classes appear to be well above average. Fishing mortality in 1997 was considerable lower than in the two previous years.

The anglerfish stocks (*L. piscatorius* and *L. budegassa*) are considered to be outside safe biological limits. Total biomass of both stocks in recent years is estimated to be below B_{pa} for both species.

Catches of megrim *Lepidorhombus boscii*, which is the most abundant of the two species of megrim in the Iberian Region, have declined since 1989 and stabilized in the most recent years. The megrim stocks (*L. boscii* and *L. whiffiagonis*) are considered to be 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. For the overall management areas 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 considered to be within safe biological limits. The spawning stock is the highest in the short series and F is within the range where SSB has been increasing.

The Iberian sardine stock is considered to be outside safe biological limits. The spawning stock biomass in 1997 is estimated to be one of the lowest observed since 1977. Recruitment has been below average since 1992. The three lowest recorded recruitments were in 1993, 1994 and 1995. However, the 1996 and 1997 year classes seem to have improved.

3.11.2 Hake - Southern stock (Divisions VIIIc and IXa)

State of stock/fishery: The stock is considered to be outside safe biological limits. SSB decreased very sharply between 1984 and 1986 and is near the lowest recorded and below the proposed $\mathbf{B_{pa}}$. Fishing mortality in 1997 (0.26) was estimated to be below the proposed $\mathbf{F_{pa}}$, but has been above it over most of the assessment period. Recruitment has declined steadily since 1984, though the 1995 and 1996 year classes appear to be well above average.

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 $\mathbf{B_{pa}}$.

Advice on management: ICES recommends that fishing mortality in 1999 should be reduced below the proposed $\mathbf{F_{pa}}$ = 0.20, corresponding to landings of less than 9 500 t in 1999. This will rebuild the SSB above the proposed $\mathbf{B_{pa}}$, in the short term.

Reference points:

ICES considers that:	ICES proposes that:
$\mathbf{B_{lim}}$ is 11 000 t, the lowest observed spawning stock biomass.	$\mathbf{B_{pa}}$ be set at 18 500 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 0.48, the fishing mortality estimated to lead to potential stock collapse.	$\mathbf{F_{pa}}$ be set at 0.20. 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 in assessments.

Technical basis:

$\mathbf{B_{lim}}$:$\mathbf{B_{loss}}$	$\mathbf{B_{pa}} \sim \mathbf{B_{lim}}$ x 1.64
$\mathbf{F_{lim}}$:$\mathbf{F_{loss}}$	$\mathbf{F_{pa}}$: implies a less than 10% probability that ($SSB_{MT} < \mathbf{B_{pa}}$)

Relevant factors to be considered in management: Last year's advice was based on SSB recovery to an MBAL of 23 000 t; the proposed $\mathbf{B_{pa}}$ is 18 500 t. The management advice given above is based on the assumption that F97 (Fsq) was considerably lower than in the two previous years, and that the 1995 and 1996 year classes (which together provide 60% of the forecast catch in 1999) were near the highest abundance in the time series. It should be noted that these year classes are associated with historically low SSB levels and were strongly revised upwards from last year's assessment, in which the stock status appeared much more depleted than at present. Except in 1995, agreed TACs have consistently exceeded both the advice and actual landings. In order to protect juveniles, fishing is prohibited in some areas during part of the year, and measures should be considered to avoid catches of small hake in fisheries where discarding is high.

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 1999:

Basis: F(98) = F(97) = 0.26, Landings(98) = 9.9, SSB(99) = 13.2.

F(99) onwards	Basis	Catch(99)	Landings(99)	SSB (2000)	Medium-term effect of fishing at given level
0.16	0.6F97		7.4	21.5	< 5% probability of SSB > $\mathbf{B_{pa}}$
0.20	$\mathbf{F_{pa}}$		9.5	20.0	< 10% probability of SSB > $\mathbf{B_{pa}}$
0.26	F97		11.5	18.7	High probability of SSB < $\mathbf{B_{pa}}$
0.31	1.2F97		13.3	17.5	High probability of SSB < $\mathbf{B_{pa}}$

Weights in '000 t.

Shaded scenarios considered inconsistent with the precautionary approach.

Elaboration and special comment: This stock is exploited in a mixed fishery by Spanish and Portuguese fleets using trawls, gillnets and longlines. The data series is short and the recruitment variability in the stock-recruitment model used for the medium-term projections may thus be underestimated.

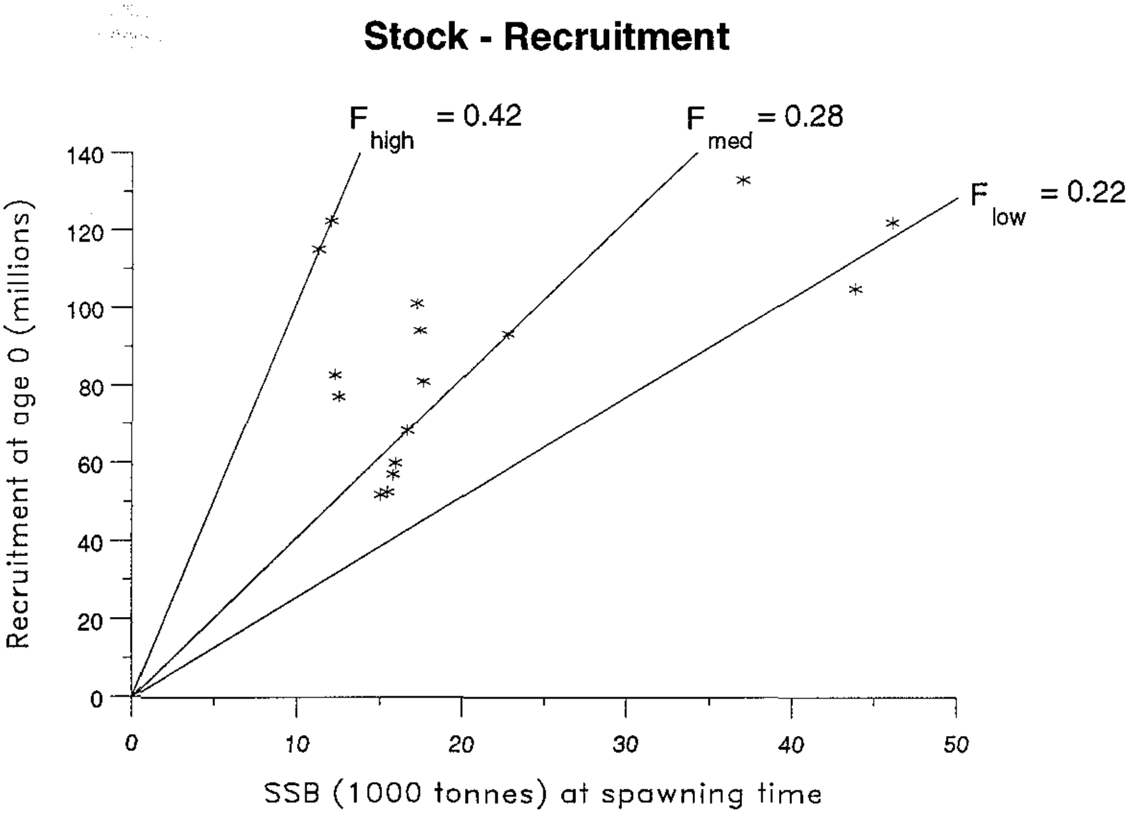
Analytical assessment using commercial CPUE and survey data. Catch-at-age data derived by numerical conversion of length to age compositions. Work is in hand to improve catch-at-age data and to provide estimates of discards. Estimates of F, SSB and recruitments have been revised substantially from previous assessments.

Source of information: Report of the Working Group on the Assessment of Southern Shelf Demersal Stocks, September 1998 (ICES CM 1999/ACFM:4).

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	15.2
1988	TAC; juvenile protection	15.0	25.0	15.4
1989	TAC; juvenile protection	15.0	20.0	12.9
1990	TAC; juvenile protection	15.0	20.0	12.0
1991	Precautionary TAC	10.0	18.0	11.6
1992	Precautionary TAC	10.3	16.0	12.8
1993	F = 10% of F 91	1.0	12.0	10.9
1994	F lowest possible at least reduced by 80%	2.0	11.5	9.5
1995	F lowest possible	-	8.5	11.8
1996	F lowest possible	-	9.0	8.9
1997	F lowest possible	-	9.0	7.6
1998	60% reduction in F	4.0	8.2	
1999	Reduce F below $\mathbf{F_{pa}}$	9.5		

Weights in '000 t.



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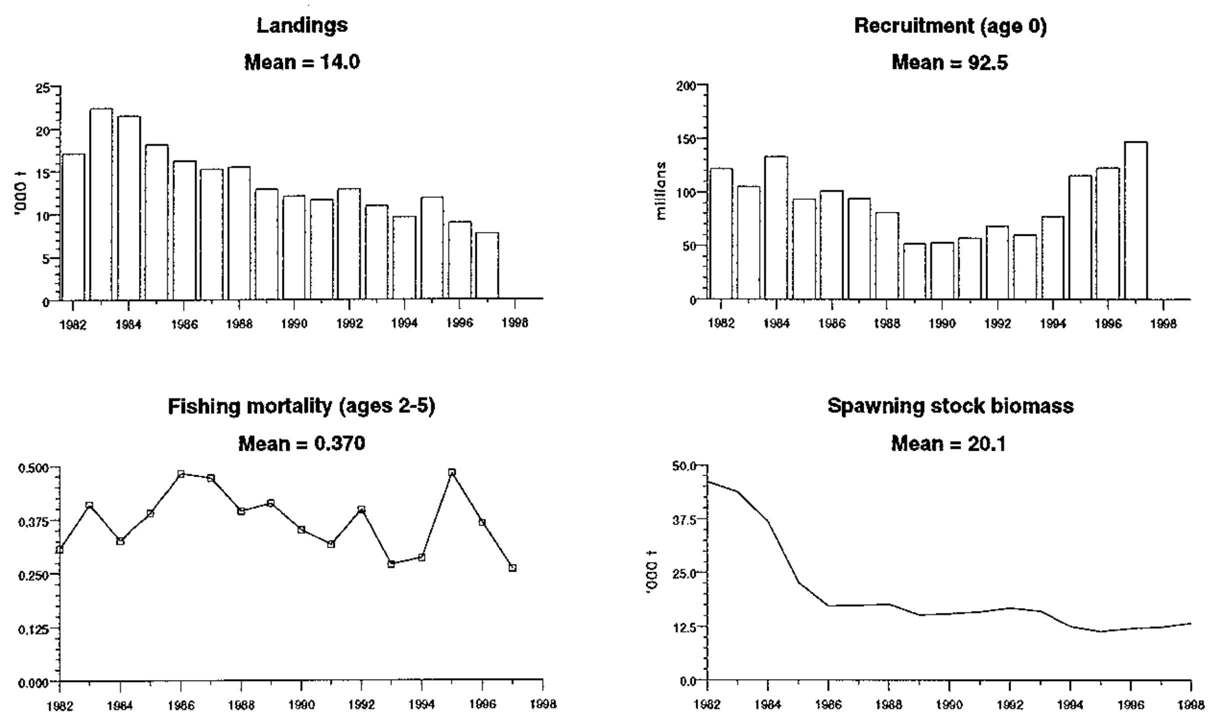
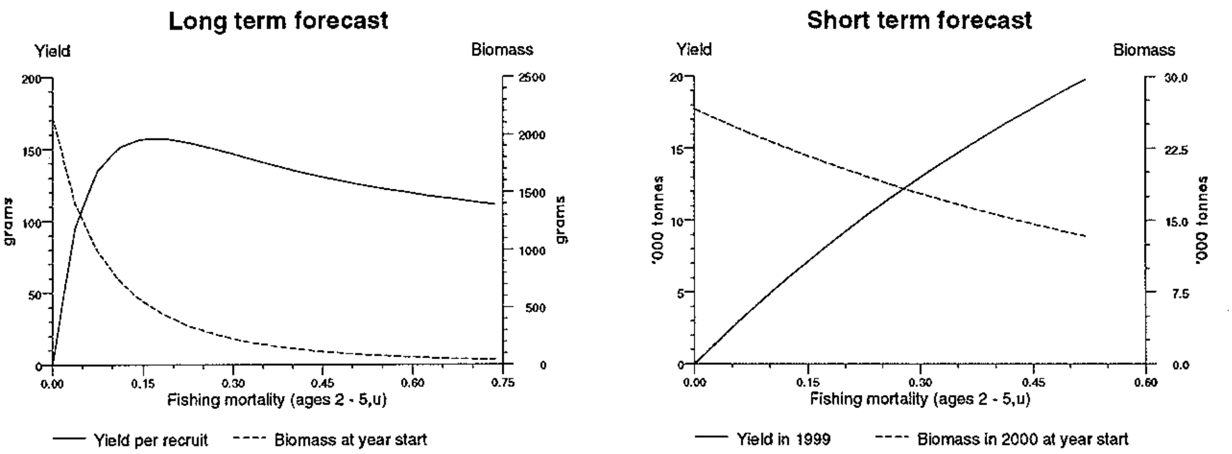


Hake - Southern stock (Divisions VIIIc and IXa)

Yield and Spawning Stock Biomass



Precautionary Approach Plot

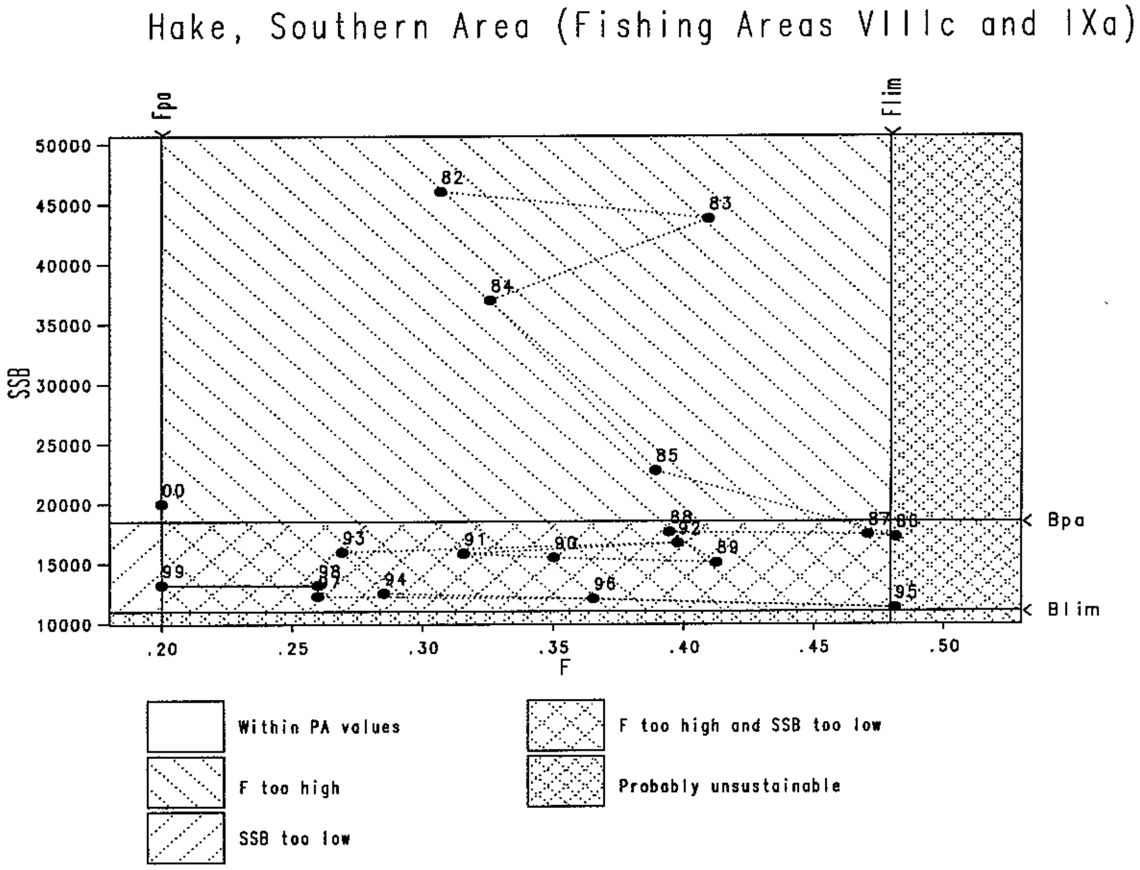


Table 3.11.2.1 HAKE - SOUTHERN STOCK - Landings estimates ('000 t) for the Southern Hake Stock (Divisions VIIIc and IXa) by country and gear as determined by the Working Group, 1972–1997.

YEAR	Spain						Portugal			France	TOTAL STOCK
	Gillnet	Small Gillnet	Longline	**Total Artisanal**	Trawl	**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	7.3	5.3	12.6	4.5	2.3	6.8	-	19.4
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	3.9	9.6	5.0	2.5	7.5	-	17.1
1983	2.1	0.4	6.6	9.0	5.3	14.3	5.2	2.9	8.0	-	22.4
1984	2.3	0.3	7.5	10.1	5.8	16.0	4.3	1.2	5.5	-	21.5
1985	1.8	0.8	4.4	7.0	5.3	12.3	3.8	2.1	5.8	-	18.2
1986	2.1	0.8	3.5	6.4	4.9	11.2	3.2	1.8	4.9	0.0	16.2
1987	2.0	0.5	4.4	6.9	3.5	10.4	3.5	1.3	4.8	0.0	15.2
1988	2.0	0.7	3.0	5.6	3.7	9.4	4.3	1.7	6.0	0.0	15.4
1989	1.9	0.6	2.0	4.4	3.9	8.3	2.7	1.8	4.6	0.0	12.9
1990	1.7	0.6	2.1	4.4	4.1	8.6	2.3	1.1	3.4	0.0	12.0
1991	1.4	0.4	2.2	4.0	3.6	7.7	2.7	1.2	4.0	0.0	11.6
1992	1.5	0.4	2.1	3.9	3.8	7.7	3.8	1.3	5.1	-	12.8
1993	1.3	0.4	2.8	4.4	2.7	7.0	3.0	0.9	3.9	-	11.0
1994	1.9	0.4	1.5	3.7	2.7	6.5	2.3	0.8	3.1	-	9.5
1995	1.6	0.4	1.0	2.9	5.3	8.2	2.6	1.0	3.6	-	11.8
1996	1.2	0.2	1.0	2.3	3.6	6.0	2.0	0.9	2.9	-	8.9
1997	1.0	0.3	0.8	2.1	3.1	5.2	1.5	0.9	2.4		7.6

Table 3.11.2.2 Hake in the Southern Area (Divisions VIIIc and IXa).

Year	Recruitment Age 0	Spawning Stock Biomass	Landings	Fishing Mortality Age 2-5
1982	121.96	46.02	17.11	0.307
1983	104.87	43.76	22.38	0.410
1984	132.87	36.97	21.49	0.326
1985	93.27	22.76	18.15	0.389
1986	101.04	17.21	16.19	0.482
1987	94.04	17.41	15.23	0.471
1988	80.93	17.61	15.41	0.394
1989	51.83	15.07	12.89	0.413
1990	52.53	15.48	11.99	0.350
1991	57.06	15.81	11.62	0.316
1992	68.33	16.70	12.82	0.398
1993	59.96	15.96	10.94	0.269
1994	76.98	12.50	9.54	0.285
1995	114.99	11.28	11.78	0.481
1996	122.28	12.05	8.88	0.365
1997	146.82	12.26	7.62	0.260
1998	.	13.17	.	.
Average	92.48	20.12	14.00	0.370
Unit	Millions	1000 tonnes	1000 tonnes	-

3.11.3 Megrim (*L. boscii* and *L. whiffiagonis*) in Divisions VIIIc and IXa

State of stocks/fishery: The stocks of both species are considered to be outside safe biological limits. SSB of both species has decreased over most of the assessment period, and are now below the proposed $\mathbf{B_{pa}}$. Fishing mortality has fluctuated with no clear trend, and the estimated F in 1997 (0.24 in *L. boscii* and 0.35 in *L. whiffiagonis*) are below $\mathbf{F_{med}}$ for both species and the proposed $\mathbf{F_{pa}}$ in *L. boscii.* Fishing mortality on *L. boscii* has been above the proposed $\mathbf{F_{pa}}$ over the time series. Recruitment in both species appears to be falling and was very low for the 1993 year class for *L. boscii.*

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 $\mathbf{B_{pa}}$.

Advice on management: ICES reiterates its advice from 1996 and 1997, that a reduction in F of at least 50% from $\mathbf{F_{sq}}$ (F(95–97)) should be implemented, corresponding to landings in 1999 of 800 t of *L. boscii* and 200 t of *L. whiffiagonis*. At the advised catches SSB will rebuild above the proposed $\mathbf{B_{pa}}$ for *L. whiffiagonis* in the short term, but will remain below the proposed $\mathbf{B_{pa}}$ for *L. boscii.*

Reference points: *L. boscii*

ICES considers that:	ICES proposes that:
$\mathbf{B_{lim}}$ is 4 700 t, the lowest observed spawning stock biomass.	$\mathbf{B_{pa}}$ be set at 6 500 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 0.25, the fishing mortality estimated to lead to potential stock collapse.	$\mathbf{F_{pa}}$ be set at 0.20. This F is considered to have a high probability of avoiding $\mathbf{F_{lim}}$ taking into account the uncertainty in assessments.

Technical basis:

$\mathbf{B_{lim}}$:$\mathbf{B_{loss}}$.	$\mathbf{B_{pa}}$ ~ $\mathbf{B_{lim}}$ x 1.4.
$\mathbf{F_{lim}}$:$\mathbf{F_{loss}}$. The time series is short and $\mathbf{F_{loss}}$ is poorly defined.	$\mathbf{F_{pa}}$:$\mathbf{F_{lim}}$ x 0.8.

Reference points: *L. whiffiagonis*

ICES considers that:	ICES proposes that:
$\mathbf{B_{lim}}$ is 900 t, the lowest observed spawning stock biomass.	$\mathbf{B_{pa}}$ be set at 1 500 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 not defined.	$\mathbf{F_{pa}}$: no proposal.

Technical basis:

$\mathbf{B_{lim}}$:$\mathbf{B_{loss}}$.	$\mathbf{B_{pa}}$ ~ $\mathbf{B_{lim}}$ x 1.64.
$\mathbf{F_{lim}}$: Not defined.	$\mathbf{F_{pa}}$: No proposal.

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. For *L. whiffiagonis*, there is a low probability of SSB remaining below the proposed $\mathbf{B_{pa}}$ in 2000 at the recommended fishing mortality, but a greater reduction in F would be required to enable the SSB of *L. boscii* to reach the proposed $\mathbf{B_{pa}}$ by 2000. At 0.5 F_{97}, however, the SSB of *L. boscii* has a high probability of recovering to above $\mathbf{B_{pa}}$ in the medium term.

Management should take into account that both megrim species are caught together in fisheries which contain a large number of other commercial species, including southern hake.

Catch forecast for 1999:

L. boscii: Basis: F(98) = F(95–97) = 0.33, Landings (98) = 1.5, SSB(99) = 5.0

F(99) onwards	Basis	Catch(98)	Landings(98)	SSB (2000)	Medium-term effect of fishing at given level
0.07	0.2 F(95–97)		0.34	6.08	n/a
0.16	0.5 F(95–97)		0.79	5.56	n/a
0.20	F_{pa}		0.39	5.40	n/a
0.26	0.8 F(95–97)		1.18	5.11	n/a
0.33	F(95–97)		1.42	4.85	n/a
0.39	1.2 F(95–97)		1.63	4.61	n/a
0.46	1.4 F(95–97)		1.83	4.39	n/a

Weights in '000 t.

L. whiffiagonis: Basis: F(98) = F(95–97) = 0.25, Landings(98) = 0.3, SSB(99) = 1.4

F(99) onwards	Basis	Catch(98)	Landings(98)	SSB (2000)	Medium-term effect of fishing at given level
0.13	0.5 F(95–97)		0.20	1.53	n/a
0.15	0.6 F(95–97)		0.23	1.49	n/a
0.20	0.8 F(95–97)		0.30	1.42	n/a
0.25	F(95–97)		0.36	1.36	n/a
0.30	1.2 F(95–97)		0.41	1.29	n/a
0.35	1.4 F(95–97)		0.46	1.24	n/a

Weights in '000 t.

Shaded scenarios considered inconsistent with the precautionary approach.

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 both ICES Divisions VIIIc and IXa, and *L. whiffiagonis* is distributed in both ICES Divisions with its highest abundance in Division VIIIc.

No landings data are available for these stocks before 1986. However, some Spanish harbours 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. Nevertheless, the Spanish survey shows an opposite tendency than the landings in the last two years.

In Division VIIIc and IXa the peak spawning period of both megrims species is in March.

Age-based analytical assessment using commercial CPUE and survey data. A new maturity ogive was used in this assessment for *L. boscii*, which affects the absolute values of SSB, but the trends remain the same as in previous assessments . This assessment for *L. boscii* is consistent with the 1997 assessment. In particular, the Spanish survey has helped to improve the XSA estimates for most of the ages.

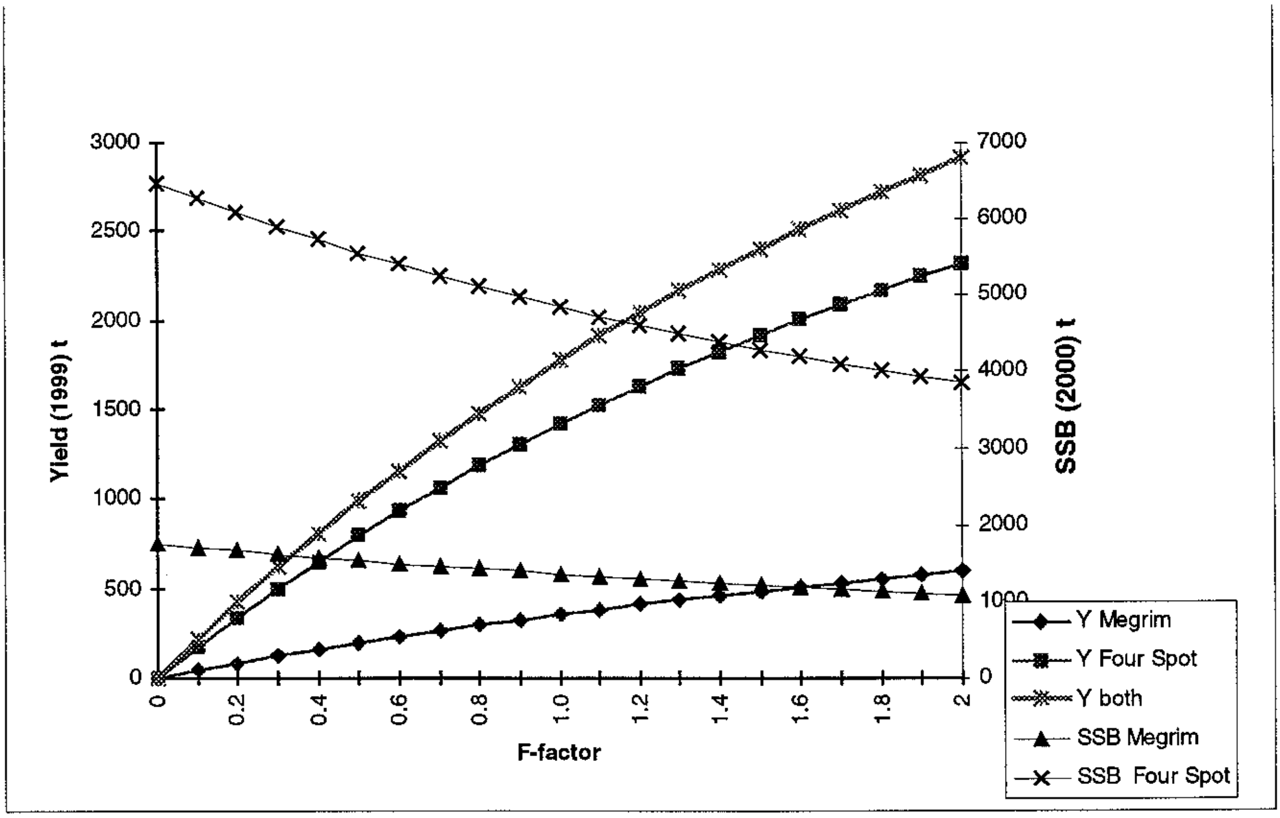
Source of information: Report of the Working Group on the Assessment of Southern Shelf Demersal Stocks, September 1998(ICES CM 1999/ACFM:4).

Catch data (Tables 3.11.3.a.1–2 and Tables 3.11.3.b.1–2):

Year	ICES advice	Predicted catch 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	-	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	0.9	0.36
1998	Reduce F by at least 50%	0.9[1]	6.0			
1999	Reduce F by at least 50%	1.0[1]				

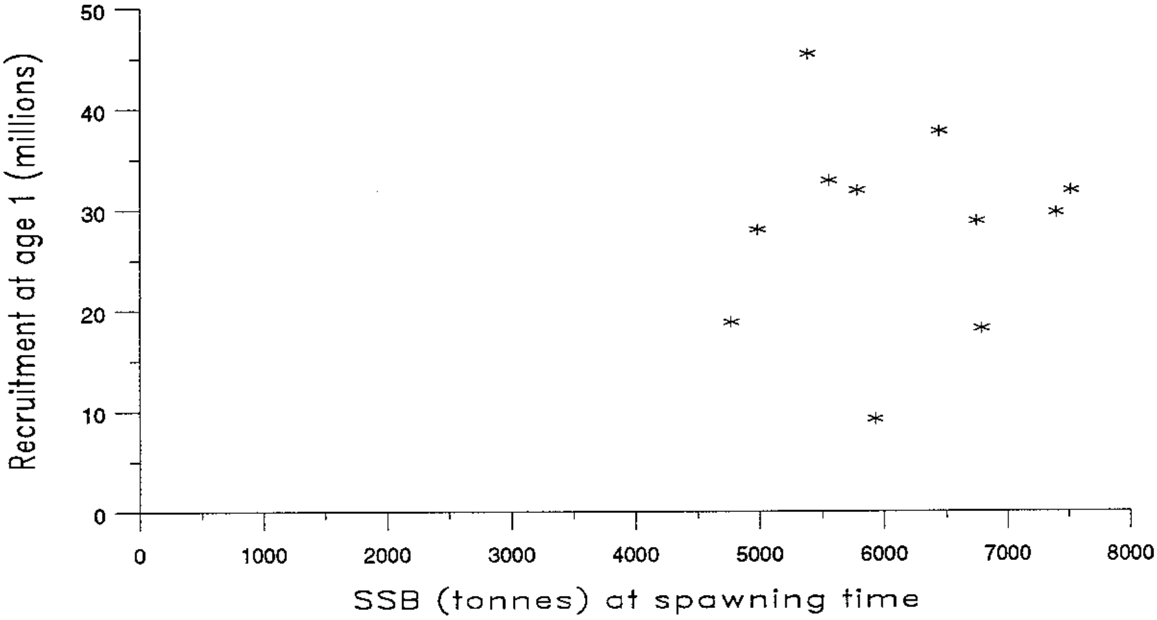
[1]Including *L. whiffiagonis*+ *L. boscii*. Weights in '000 t.

Megrim's combined short-term forecasts in Divisions VIIIc and IXa



Megrim (*L.boscii*) in Divisions VIIIc and IXa

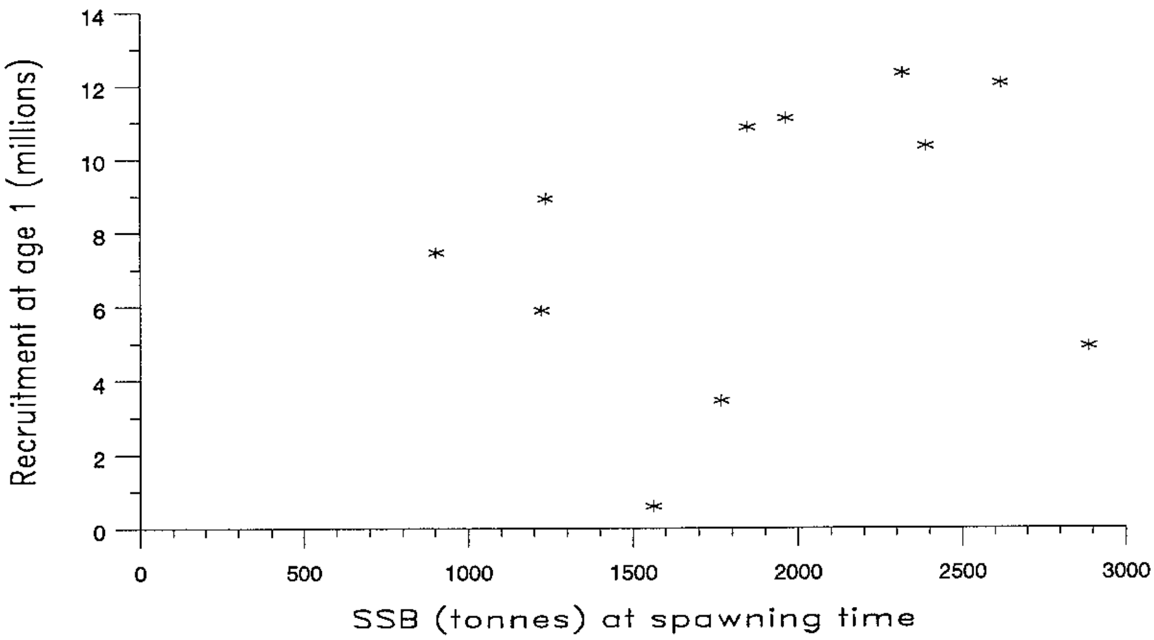
Stock - Recruitment



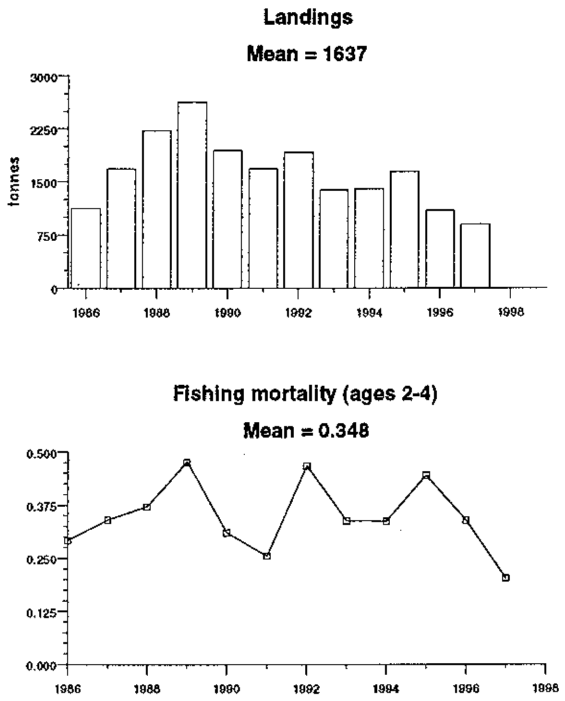
(run: XSANEL09)

Megrim (*L.whiffiagonis*) in Divisions VIIIc and IXa

Stock - Recruitment

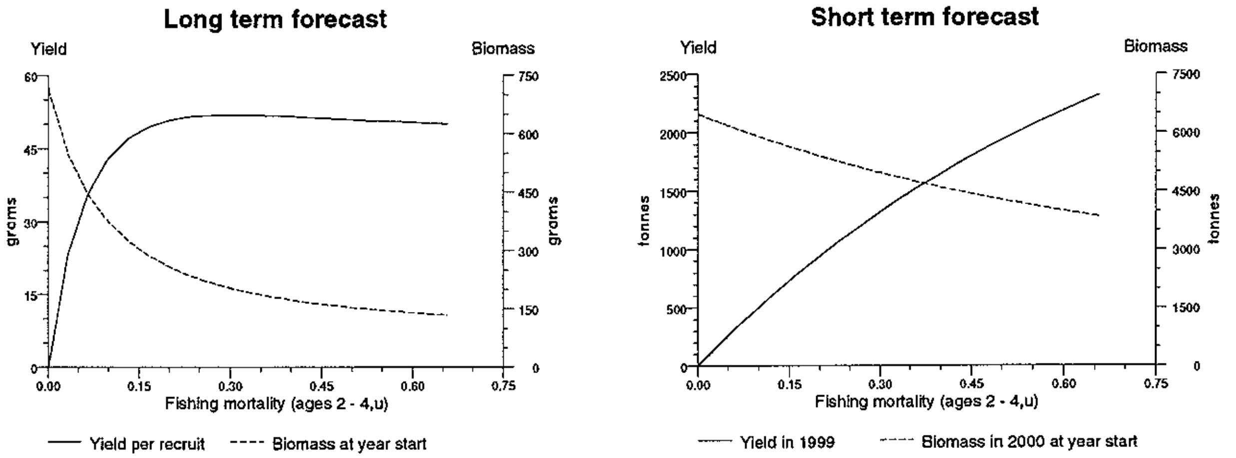


(run: XSANEL06)



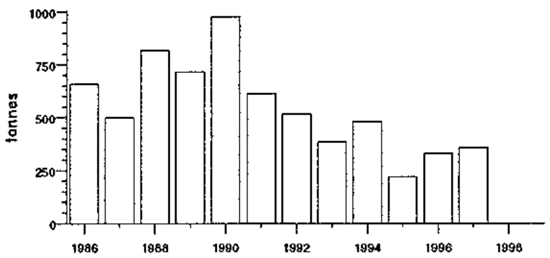
L. boscii

Yield and Spawning Stock Biomass



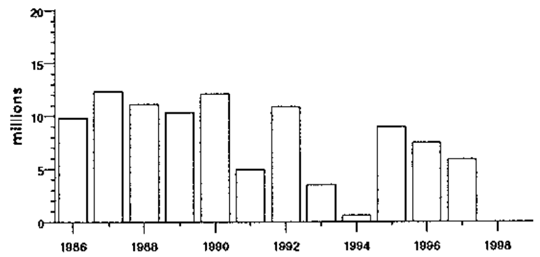
Landings

Mean = 547



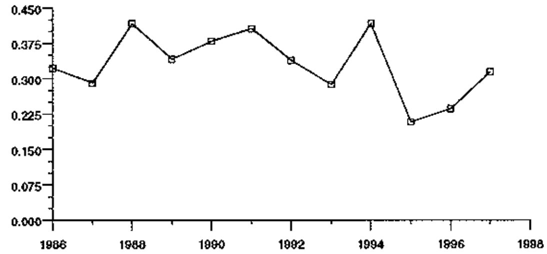
Recruitment (age 1)

Mean = 8.14



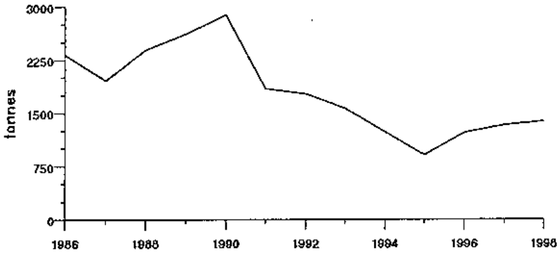
Fishing mortality (ages 2-4)

Mean = 0.329



Spawning stock biomass

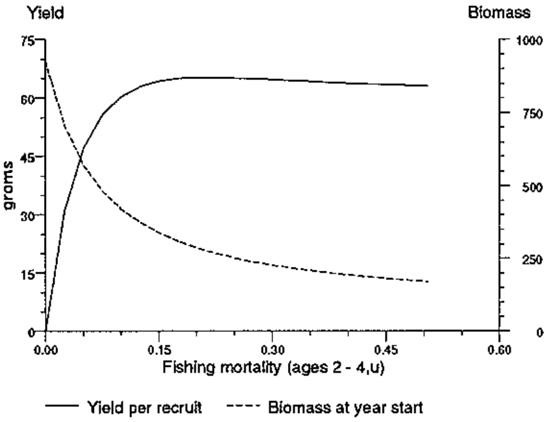
Mean = 1800



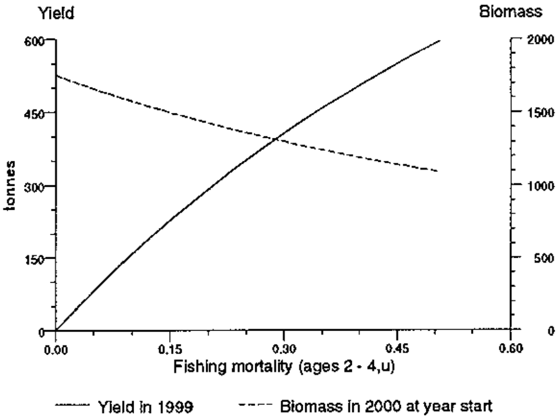
L. whiffiagonis

Yield and Spawning Stock Biomass

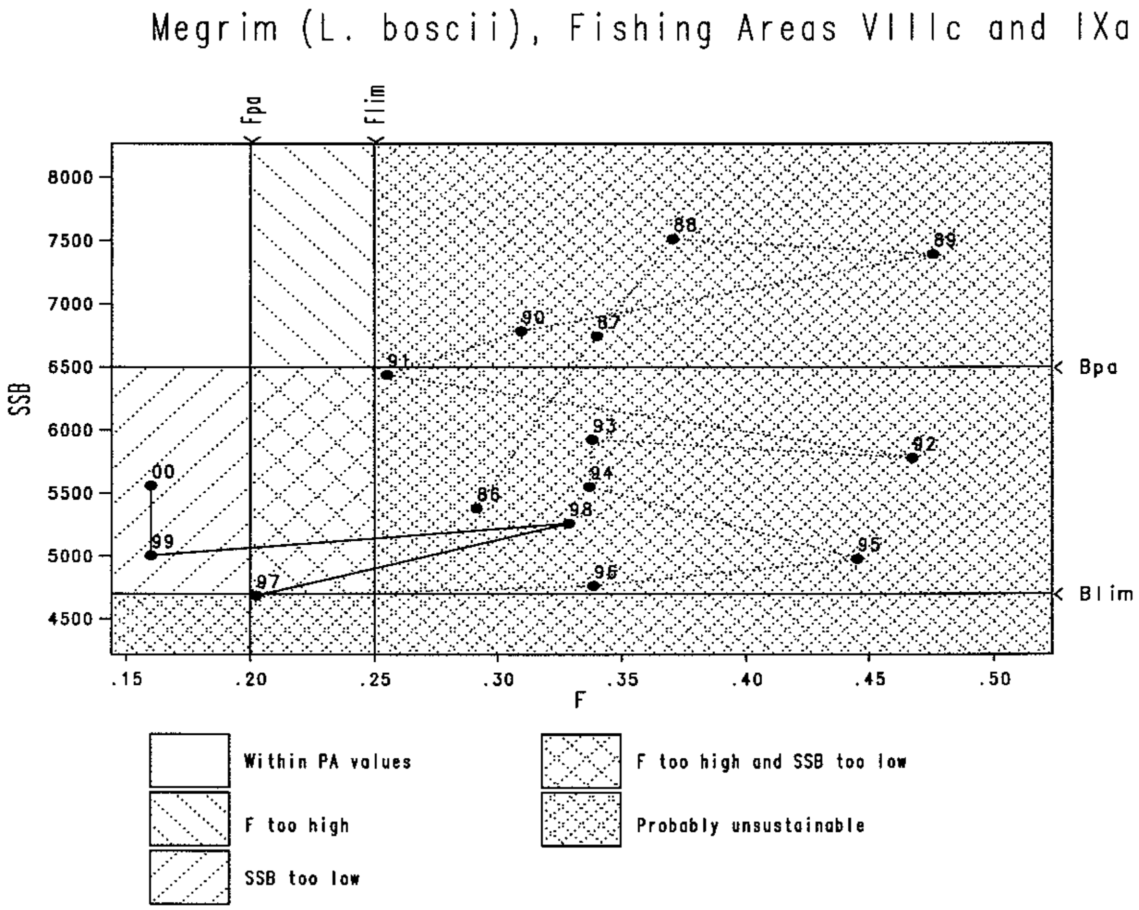
Long term forecast



Short term forecast



Precautionary Approach Plot



Precautionary Approach Plot

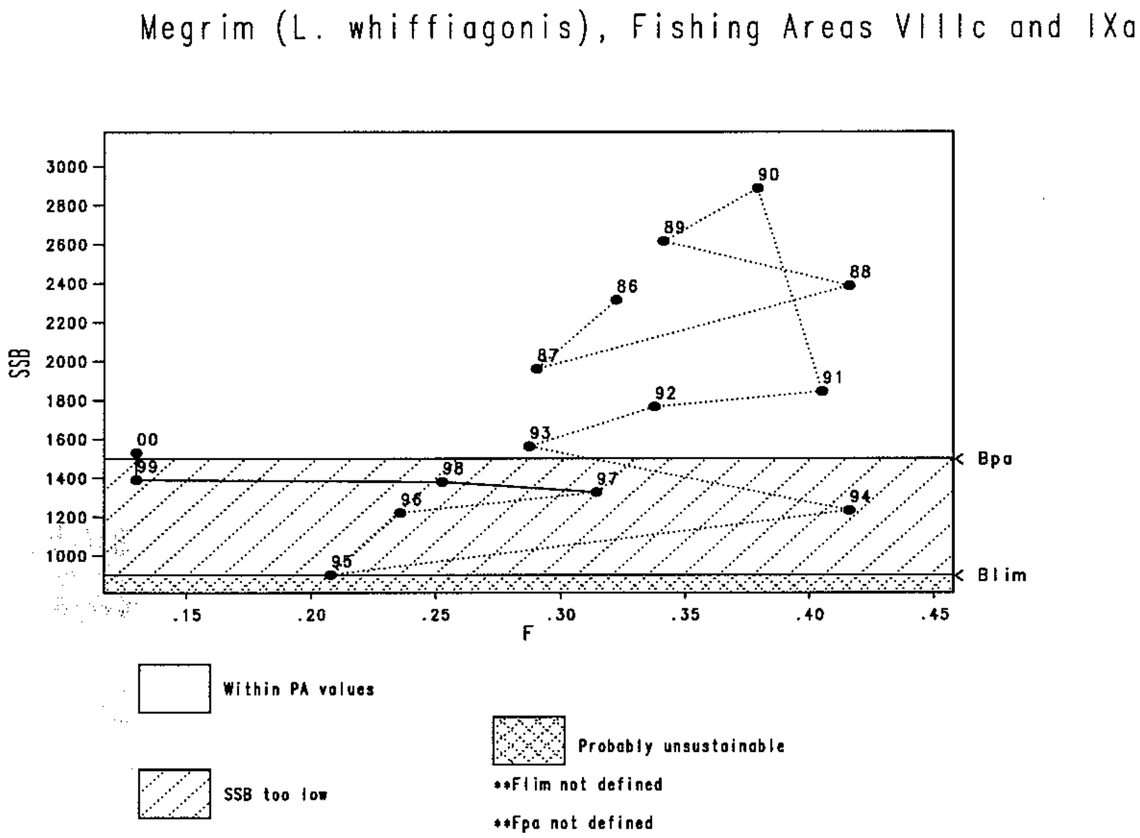


Table 3.11.3.a.1 Four Spot Megrim (*L. boscii*) in Divisions VIIIc, IXa. Total landings (t).

	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

Table 3.11.3.a.2 Megrim (*L. boscii*) in Divisions VIIIc and IXa.

Year	Recruitment Age 1	Spawning Stock Biomass	Landings	Fishing Mortality Age 2-4
1986	50.35	5.38	1.12	0.291
1987	45.34	6.75	1.69	0.340
1988	28.81	7.51	2.22	0.371
1989	31.85	7.39	2.63	0.476
1990	29.65	6.79	1.95	0.310
1991	18.15	6.44	1.68	0.255
1992	37.70	5.78	1.92	0.467
1993	31.85	5.92	1.38	0.338
1994	9.18	5.55	1.40	0.337
1995	32.85	4.98	1.65	0.445
1996	27.96	4.76	1.10	0.339
1997	18.82	4.69	0.90	0.202
1998	.	5.26	.	.
Average	30.21	5.94	1.64	0.348
Unit	Millions	1000 tonnes	1000 tonnes	-

Table 3.11.3.b.1 Megrim (*L. whiffiagonis*) in Divisions VIIIc, 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

Table 3.11.3.b.2 Megrim (*L. whiffiagonis*) in Divisions VIIIc and IXa.

Year	Recruitment Age 1	Spawning Stock Biomass	Landings	Fishing Mortality Age 2-4
1986	9.78	2.31	0.66	0.322
1987	12.33	1.96	0.50	0.290
1988	11.11	2.39	0.82	0.416
1989	10.34	2.62	0.71	0.341
1990	12.06	2.89	0.98	0.379
1991	4.92	1.84	0.61	0.405
1992	10.86	1.77	0.52	0.338
1993	3.45	1.56	0.38	0.287
1994	0.59	1.23	0.48	0.416
1995	8.92	0.90	0.22	0.208
1996	7.46	1.22	0.33	0.236
1997	5.88	1.33	0.36	0.314
1998	.	1.38	.	.
Average	8.14	1.80	0.55	0.329
Unit	Millions	1000 tonnes	1000 tonnes	-

3.11.4 Anglerfish in Divisions VIIIc and IXa (*L. piscatorius* and *L. budegassa*)

State of stocks/fishery: Both stocks are considered to be outside safe biological limits. Biomass of both stocks in recent years is estimated to have been below the proposed $\mathbf{B}_{pa}$ and fishing mortality has been above the proposed $\mathbf{F}_{pa}$.

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 $\mathbf{B}_{pa}$.

Advice on management: ICES advises that F for both species should be reduced to $\mathbf{F}_{pa}$, corresponding to landings in 1999 of no more than 2 600 t of *L. piscatorius* and 1 600 t of *L. budegassa*. This advice corresponds to a 50% reduction in F_{97} for *L. piscatorius* and a 30% reduction from F_{97} for *L. budegassa.* If F is kept below the advised value the biomasses of both species are expected to recover above the proposed $\mathbf{B}_{pa}$ in the medium term.

Reference points: *L. piscatorius*

ICES considers that:	ICES proposes that:
$\mathbf{B}_{lim}$ is 2 000 t, the rounded value of the lowest observed spawning stock biomass.	$\mathbf{B}_{pa}$ be set at 7 300 t. Biomass above this affords a high probability of maintaining SSB above $\mathbf{B}_{lim}$, taking into account the uncertainty in assessments. This value is equal to the biomass estimated to provide maximum sustainable yield.
$\mathbf{F}_{lim}$ is not defined.	$\mathbf{F}_{pa}$ be set at 0.66. This F is consistent with the proposed $\mathbf{B}_{pa}$ and approximates $\mathbf{F}_{MSY}$.

Technical basis: General production model (ASPIC)

$\mathbf{B}_{lim}$: $\mathbf{B}_{loss}$.	$\mathbf{B}_{pa}$: $\mathbf{B}_{MSY}$.
$\mathbf{F}_{lim}$:	$\mathbf{F}_{pa}$: $\mathbf{F}_{MSY}$.

Reference points: ***L. budegassa***

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 3 700 t. Biomass above this affords a high probability of maintaining SSB above $\mathbf{B}_{lim}$, taking into account the uncertainty in assessments. This value is equal to the biomass estimated to provide maximum sustainable yield.
$\mathbf{F}_{lim}$ not defined.	$\mathbf{F}_{pa}$ be set at 0.57. This F is consistent with the proposed $\mathbf{B}_{pa}$ and approximates $\mathbf{F}_{MSY}$.

Technical basis: ASPIC

$\mathbf{B}_{lim}$: $\mathbf{B}_{loss}$.	$\mathbf{B}_{pa}$: $\mathbf{B}_{MSY}$.
$\mathbf{F}_{lim}$:	$\mathbf{F}_{pa}$: $\mathbf{F}_{MSY}$.

Relevant factors to be considered in management: Previous TACs have been well above landings and unrestrictive. Management of these fisheries harvesting these stocks should take into account that *L. piscatorius* and *L. budegassa* are caught together with other species in mixed trawl fisheries.

Catch forecast for 1999:
White anglerfish (*L. piscatorius*)
Basis: F(98) = F(97) = F/F_{MSY} = 2.0, Landings(98) = 3.0, $B/B_{MSY}(99)$ = 0.3

$F/\mathbf{F}_{MSY}$(99)	Basis	Catch(99)	Landings(99)	$B/\mathbf{B}_{MSY}$ (2000)	Medium-term effect of fishing at given level
0.79	$0.4F_{97}$	2.5	2.5	0.8	n/a
1.00	$\mathbf{F}_{pa}$	2.6	2.6	0.7	n/a
2.00	F_{97}	2.7	2.7	0.2	n/a

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

Black anglerfish (*L. budegassa*)

Basis: F(98) = F(97) = F/F_{MSY} = 1.51, Landings(98) = 1.7, B/B_{MSY}(99) = 0.54

F/F_{MSY}(99)	Basis	Catch(99)	Landings(99)	B/B_{MSY} (2000)	Medium-term effect of fishing at given level
0.91	0.6F_{97}	1.5	1.5	0.8	n/a
1.00	F_{pa}	1.6	1.6	0.7	n/a
1.51	F_{97}	1.7	1.7	0.5	n/a

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.

Last year, an alternative assessment methodology to XSA was used for these stocks by applying a new length-VPA analysis. This year, a surplus production model incorporating covariates was 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. The results are dependent on how well the relative changes in CPUE reflect the stock changes.

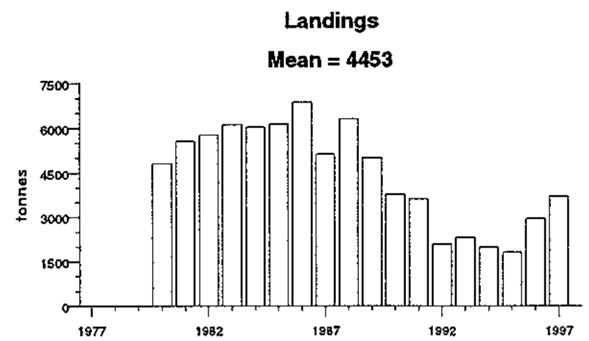
Source of information: Report of the Working Group on the Assessment of Southern Shelf Demersal Stocks, September 1998 (ICES CM 1999/ACFM:4).

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	2.1	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			
1999	Reduce F to F_{pa}	4.2[1]				

[1]For both species combined. Weights in '000 t.

L. piscatorius



L. budegassa

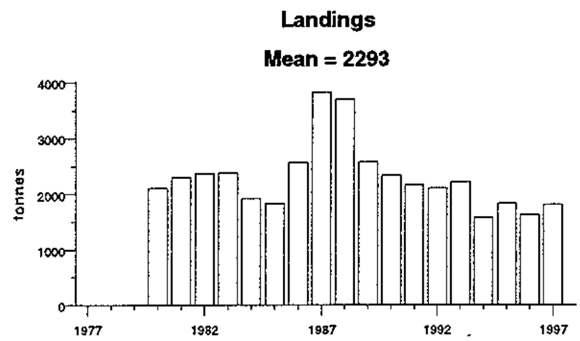


Table 3.11.4.1 ANGLERFISH (*L. piscatorius*) - Divisions VIIIc and IXa. Tonnes landed by the main fishing fleets for 1978–1997 as determined by the Working Group.

	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	2111
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

Table 3.11.4.2 ANGLERFISH (*L. budegassa*) - Divisions VIIIc and IXa. Tonnes landed by the main fishing fleets for 1978–1997 as determined by the Working Group.

YEAR	VIIIc			IXa				VIIIc+IXa
	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

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/fishery: The stock is considered to be close to safe biological limits. The spawning stock is above the proposed $\mathbf{B}_{pa}$, and the highest in the short series. F is above the proposed $\mathbf{F}_{pa}$, but within the range when SSB has been increasing.

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 $\mathbf{B}_{pa}$.

Advice on management: Fishing mortality should not be allowed to increase from 1997, corresponding to landings of 58 000 t in 1999. ICES recommends that the TAC for this stock should only apply to *Trachurus trachurus* and that other species of horse mackerel be excluded.

Reference points:

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 estimated to lead to potential stock collapse.	$\mathbf{F}_{pa}$ 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:

$\mathbf{B}_{lim} = \mathbf{B}_{loss}$.	$\mathbf{B}_{pa} = \mathbf{B}_{loss}$ x 1.5.
$\mathbf{F}_{lim} = \mathbf{F}_{loss}$.	$\mathbf{F}_{pa} = \mathbf{F}_{lim}$ x 1.63, $\mathbf{F}_{max} = 0.16$, $\mathbf{F}_{med} = 0.165$.

Relevant factors to be considered in management: The TAC up to 1996 was including catches of other species of horse mackerel.

Catch forecast for 1999:

Basis: F(98) = F(95–97) = 0.18; Landings (98) = 56.

F(99)	Basis	SSB (99)	Catch (99)	Landings (99)	SSB (2000)
0.04	0.2 $F_{(95-97)}$	238		13	259
0.07	0.4 $F_{(95-97)}$	236		25	249
0.11	0.6 $F_{(95-97)}$	235		37	239
0.14	0.8 $F_{(95-97)}$	233		48	230
0.16	0.9 $F_{(95-97)}$	232		53	226
0.18	$F_{(95-97)}$	245		58	235
0.21	1.2 $F_{(95-97)}$	229		69	213

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

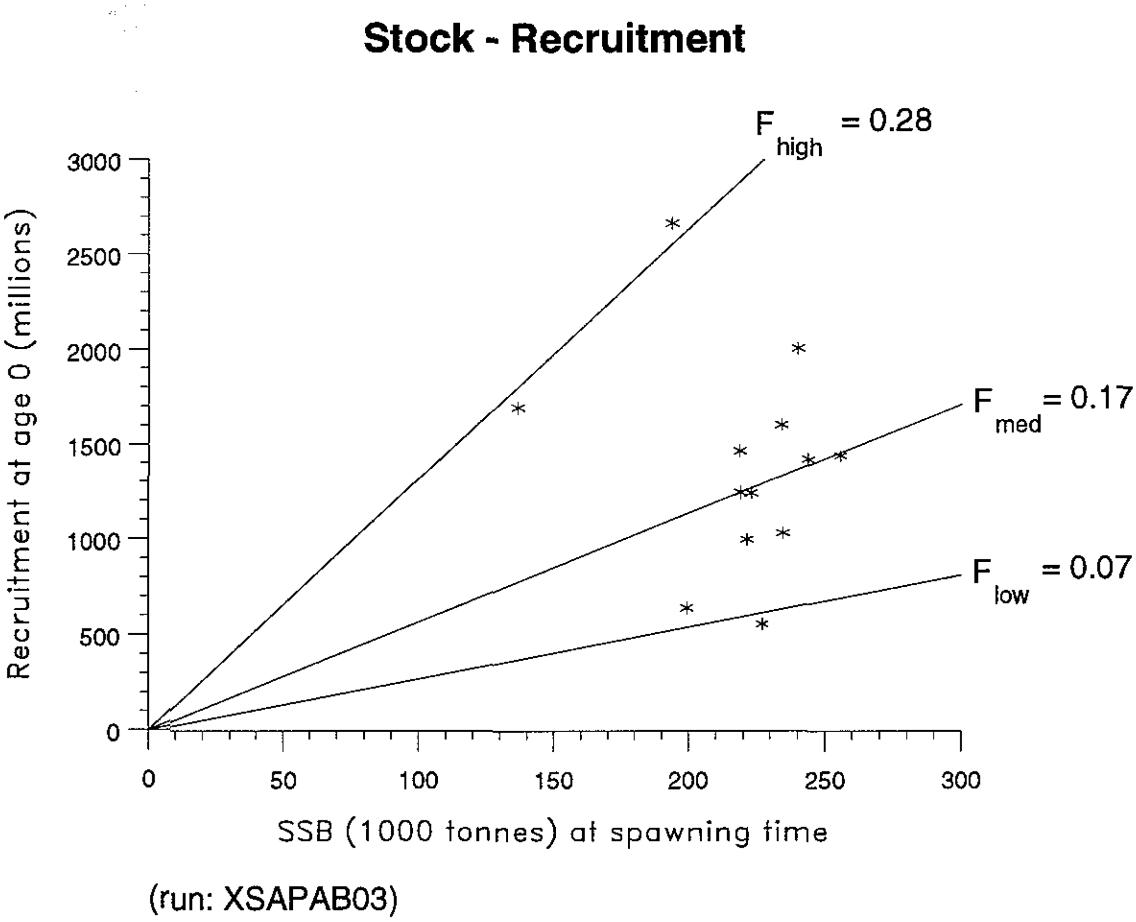
Elaboration and special comment: This stock is exploited by trawl and purse seine fisheries. This year's assessment shows close agreement with last year's assessment. The spawning stock biomass estimated from the 1995 egg surveys is in good agreement with the 1995 SSB estimated by the final VPA using CPUE at age series of two October surveys, the July survey and of two commercial fleets. The increase of F in 1997 is due principally to the higher catches obtained by the Spanish purse seiners and to a lesser extent by the Portuguese trawlers and purse seiners. The increase of the Spanish purse seiners catches can be explained by the decrease in abundance of target species like sardine, which has forced the fleet to target other species like horse mackerel.

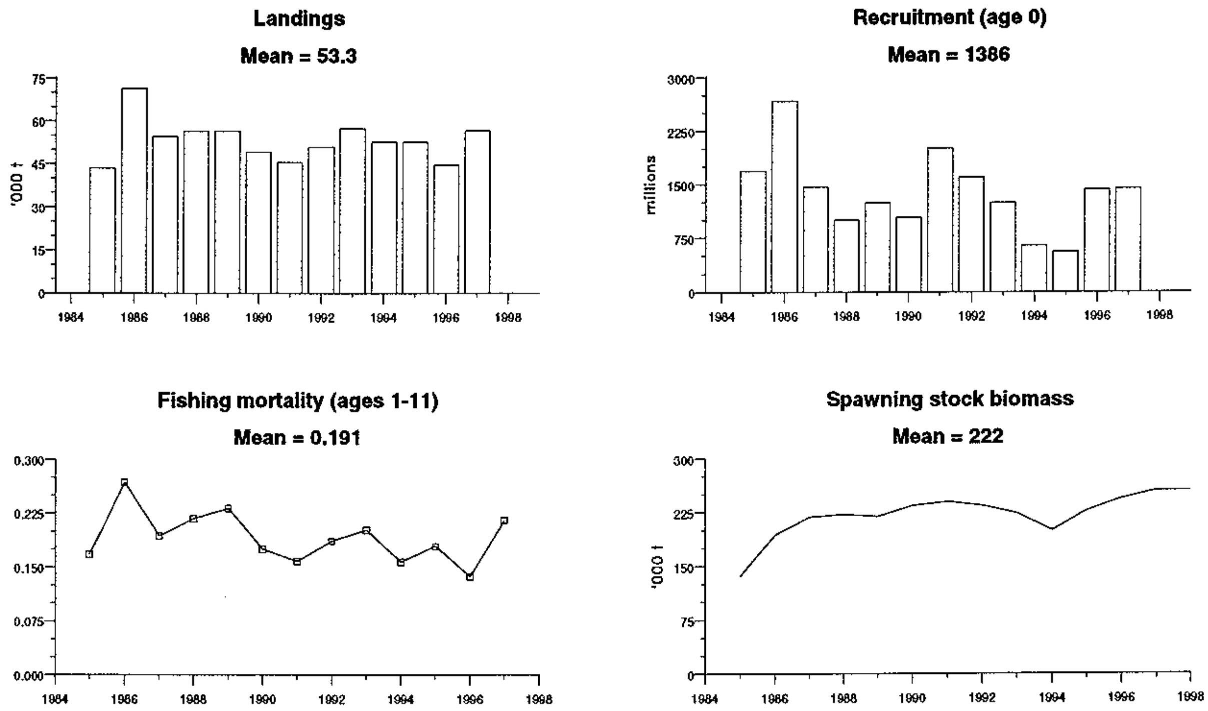
Source of information: Report of the Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine and Anchovy, September 1998 (ICES CM 1999/ACFM:6).

Catch data (Tables 3.11.6.1–3):

Year	ICES advice	Predicted catch corresp. to advice[2]	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 $F_{0.1}$; 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	
1999	No increase in F	58		

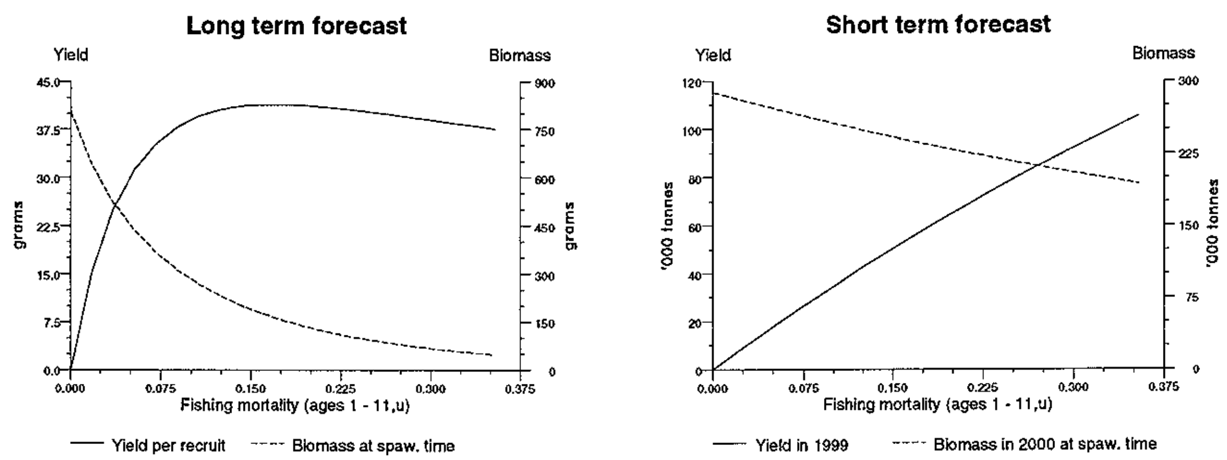
[1]Includes all *Trachurus* spp. [2]Includes only *Trachurus trachurus* L. [3]Division VIIIc, Sub-areas IX and X, and CECAF Division 34.1.1 (EC waters only). [4]Division VIIIc and Sub-area IX. [5]Catch at *status quo* F. Weights in '000 t.





Southern Horse Mackerel (*Trachurus trachurus*) (Divisions VIIIc and IXa)

Yield and Spawning Stock Biomass



Precautionary Approach Plot

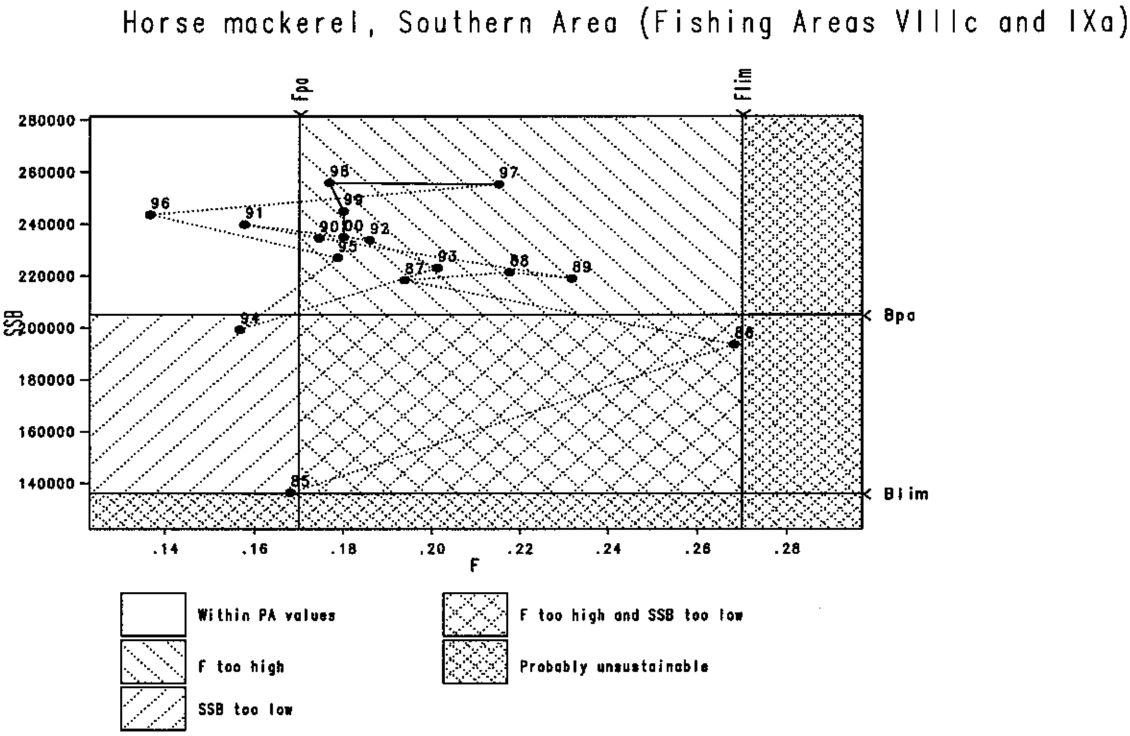


Table 3.11.6.1 Annual catches (tonnes) of SOUTHERN HORSE MACKEREL by countries by gear in Divisions VIIIc and IXa. Data from 1984–1997 are Working Group estimates.

Year	Portugal (Division IXa)				Spain (Divisions IXa + VIIIc)					Total VIIIc+IXa
	Trawl	Seine	Artisanal	Total	Trawl	Seine	Hook	Gillnet	Total	
1962	7,231	46,345	3,400	56,976	-	-	-	-	53,202	110,778
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

[1]Estimated value.
[2]Not available by gear.

Table 3.11.6.2 Landings (t) of HORSE MACKEREL in Sub-area VIII by country. (Data submitted by Working Group members).

Country	1980	1981	1982	1983	1984
Denmark	-	-	-	-	-
France	3,361	3,711	3.073	2,643	2,489
Netherlands	-	-	-	-	-[2]
Spain	34,134	36,362	19,610	25,580	23,119
UK (Engl. + Wales)	-	+	1	-	1
USSR	-	-	-	-	20
Total	37,495	40,073	22,683	28,223	25,629

Country	1985	1986	1987	1988	1989	1990
Denmark	-	446	3,283	2,793	6,729	5,726
France	4,305	3,534	3,983	4,502	4,719	5,082
Germany	-	-	-	-	-	-
Netherlands	-[2]	-[2]	-[2]	-	-	6,000
Spain	23,292	40,334	30,098	26,629	27,170	25,182
UK (Engl. + Wales)	143	392	339	253	68	6
USSR	-	656	-	-	-	-
Unallocated + discards	-	-	-	-	-	1,500
Total	27,740	45,362	37,703	34,177	38,686	43,496

Country	1991	1992	1993	1994	1995	1996	1997[1]
Denmark	1,349	5,778	1,955	-	340	140	729
France	6,164	6,220	4,010	28	-	7	8,690
Germany	80	62	-		-	-	-
Netherlands	12,437	9,339	19,000	7,272	-	14,187	2,944
Spain	23,733	27,688	27,921	25,409	28,349	29,428	31,081
UK (Engl. + Wales)	70	88	123	753	20	924	430
USSR	-	-	-		-	-	-
Unallocated + discards	2,563	5,011	700	2,038	-	3,583	-2,944
Total	46,396	54,186	53,709	35,500	28,709	48,269	40,930

[1]Preliminary.
[2]Included in Sub-area VII.

Table 3.11.6.3 Southern horse mackerel (Divisions VIIIc and IXa).

Year	Recruitment Age 0	Spawning Stock Biomass	Landings	Fishing Mortality Age 1-11
1985	1,692.39	136.36	43.53	0.168
1986	2,665.05	193.58	71.49	0.268
1987	1,465.91	218.47	54.65	0.194
1988	1,001.73	221.43	56.39	0.218
1989	1,247.57	219.03	56.40	0.232
1990	1,034.93	234.62	49.21	0.174
1991	2,004.52	239.87	45.51	0.158
1992	1,603.39	233.86	50.96	0.186
1993	1,245.10	223.10	57.43	0.201
1994	644.04	199.32	52.59	0.157
1995	558.29	227.00	52.68	0.179
1996	1,420.35	243.64	44.69	0.137
1997	1,440.49	255.37	56.77	0.215
1998	.	255.88	.	.
Average	1,386.44	221.54	53.25	0.191
Unit	Millions	1000 tonnes	1000 tonnes	-

3.11.7 Sardine

3.11.7.a Sardine in Divisions VIIIc and IXa

State of stock/fishery: The stock is considered to be outside safe biological limits. The SSB in 1997 is estimated to be one of the lowest observed since 1977 and below the proposed $\mathbf{B}_{pa}$. Recruitment has been below average since 1992. The three lowest recorded recruitments were in 1993, 1994 and 1995. However, the 1996 and 1997 year classes seem to have improved.

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 $\mathbf{B}_{pa}$.

Advice on management: ICES recommends that fishing mortality be reduced to F = 0.20 in order to achieve a low probability of further decline in stock size and to promote recovery of the stock. This corresponds to a catch of about 38 000 t in 1999.

Reference points:

ICES considers that:	ICES proposes that:
$\mathbf{B}_{lim}$ is 220 000 t, the lowest observed biomass in recent history.	$\mathbf{B}_{pa}$ be established at 300 000 t. This affords a high probability of maintaining SSB above $\mathbf{B}_{lim}$, taking into account the uncertainty of the assessment.
No F reference points are proposed; a rebuilding strategy has been recommended.	

Technical basis:

$\mathbf{B}_{lim} = \mathbf{B}_{loss}$ (recent time series).	$\mathbf{B}_{pa} \sim \mathbf{B}_{loss}$ x 1.4.

Relevant factors to be considered in management: During the last 20 years this stock has shown three periods of low SSB (1977, 1991 and 1997) and two periods of higher abundance (1981–1986 and 1992–1995). The recruitment indices for the entire time series show a declining trend. The estimated fishing mortality is relatively stable between 1977 and 1995 and since then there is a clear increase to 0.7, the highest value in the time series. The present assessment indicates that a major reduction in F is required in order to make the harvest consistent with the current below-average productivity of the stock. There is clearly a need to reduce fishing.

Recruitment of sardine has been shown to be related to the Gulf Stream and the North Atlantic Oscillation. An improvement in recruitment may, therefore, depend on favourable environmental conditions as well as on protection of the spawning stock.

Acoustic surveys of Division IXa in November and March (when sardine aggregate to spawn) indicate an increase in abundance, whereas surveys in VIIIc show a decrease over the past 3 years. It is not known to what degree a movement of sardines into VIIIa,b may have influenced surveys in VIIIc.

An assessment which includes the Portuguese November acoustic survey series gives a more optimistic view of the stock status, but there have been gaps in the time series and additional years are required to confirm the 1997 result.

If the recommended reduction in F cannot be implemented in one year a recovery plan should be applied by steps aiming at an increase of biomass of 20% in 2000 which will amount to decreasing fishing mortality by 40% in 1999 in relation to 1997. In recent years there have been changes in the sardine distribution. Rebuilding of the depressed SSB would be assisted by allowing the incoming year classes to mature and spawn, and not be harvested as juveniles.

Catch forecast for 1999:

Basis: F(98) = F(97) = 0.70, Landings (98) = 108.

F (99)	Basis	SSB (99)	Catch (99)	Landings (99)	SSB (2000)
0.14	0.2 F_{97}	269		27	321
0.2	0.28F_{97}	266		38	309
0.28	0.4 F_{97}	262		52	294
0.42	0.6 F_{97}	256		74	270
0.56	0.8 F_{97}	251		94	249
0.70	F_{97}	245		112	230

Weights in '000 t. Recruitment at 4 917 million fish (the geometric mean of the last six years in the time series). Shaded scenarios considered inconsistent with the precautionary approach.

Elaboration and special comment: The assessment model was extensively revised. Several models have been evaluated for various data treatment and selection pattern and to use supplementary information as necessary. Only data consistently aged to 6+ were included (years 1989 and later). Nevertheless, due to changes in selection pattern, it is difficult to obtain a meaningful comparison between the stock size and the fishing mortality in the mid 1970s and the late 1990s.

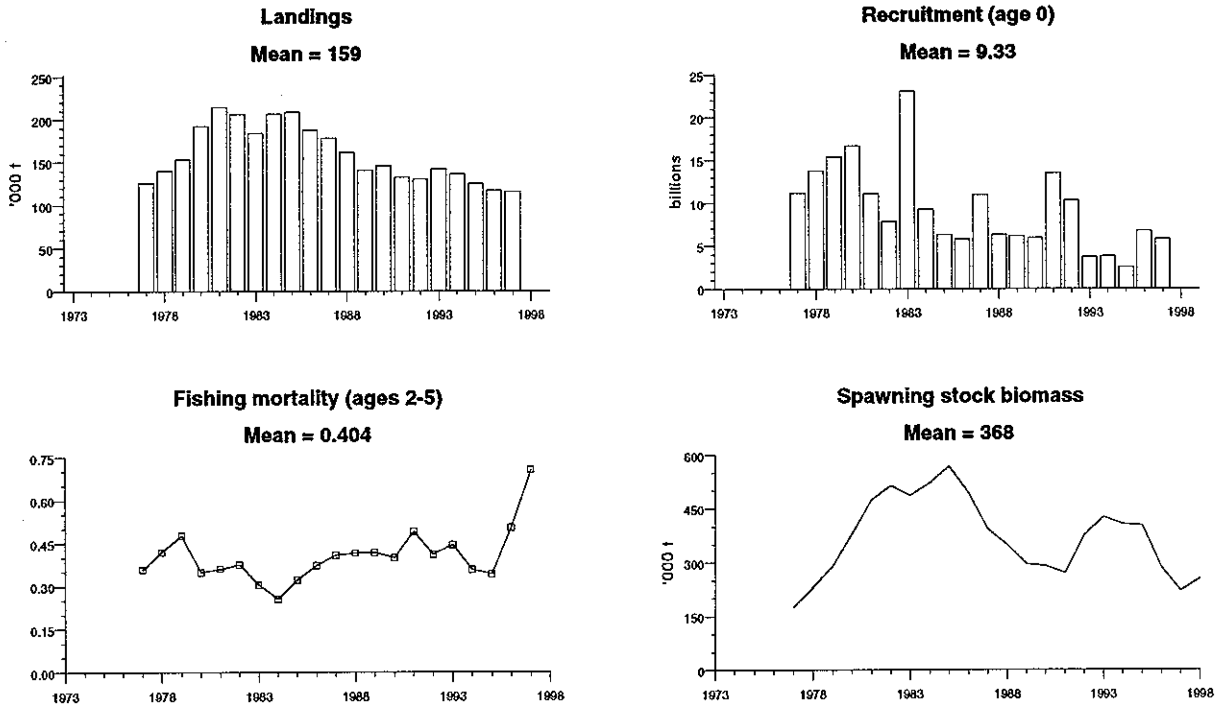
Following agreements with the purse-seiner owner associations and the Portuguese Government the closure of purse-seine sardine fishery during one week per month was legislated on 30 th of April 1997. The maximum number of fishing days per vessel was fixed by fishing area. The maximum amount of sardine as by-catch of purse seine fisheries directed to other species was limited to 10% of the total catch retained onboard each vessel by fishing day. The closure of the trawl fisheries during 24 consecutive hours in each week was also legislated on the 30th of April 1997. During the closure, the fishing vessels had to stay in the harbour, except the crustacean trawlers. Given the ICES advice from May 1998, the Portuguese Government legislated (1 July 1998) that in 1998 the catches of sardine had to be reduced by 10% relatively to 1997, for what individual vessel quotas where negotiated. For the Spanish fleet the maximum catch per vessel was reduced in 1998. This is the first time restrictive management measures have been adopted for the sardine fishery.

Source of information: Report of the Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine and Anchovy, September 1998 (ICES CM 1999/ACFM:6).

Catch data (Tables 3.11.7.a.1–2):

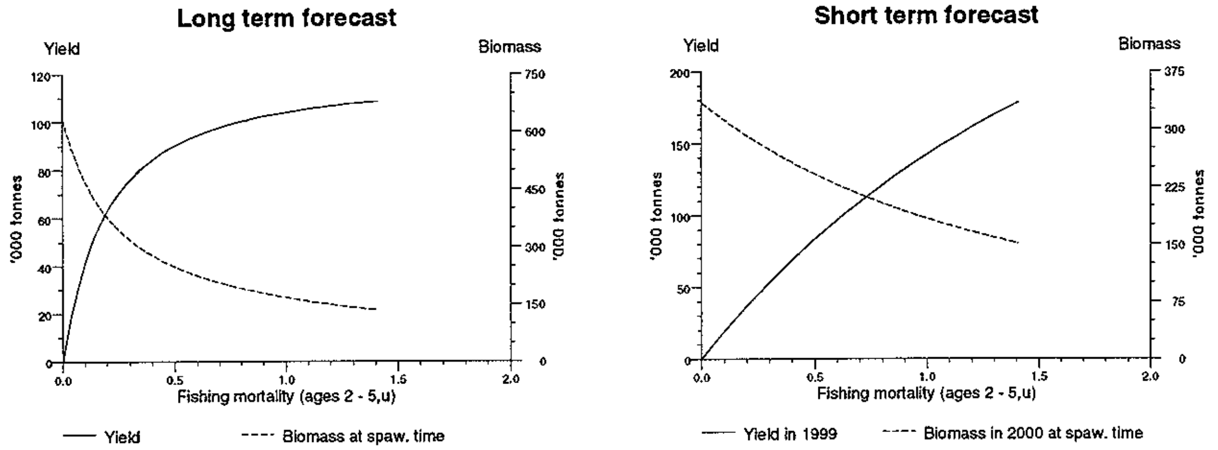
Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC	Official Landings	ACFM Landings
1987	No increase in F; TAC	140	-		178
1988	No increase in F; TAC	150	-	167	162
1989	No increase in F; TAC	212	-	146	141
1990	Room for increased F	227[2]	-	150	146
1991	Precautionary TAC	176	-	135	133
1992	No advice	-	-		130
1993	Precautionary TAC	135	-		142
1994	No advice	118[1]	-		137
1995	No advice; apparently stable stock	-	-		125
1996	Lowest possible level	-	-		117
1997	Lowest possible level	-	-		115
1998	Significant reduction	-			
1999	Reduce F to 0.2	38			

[1]Estimated catch at *Status quo* F. [2]Catch corresponding to 20% increase in F. Weights in '000 t.

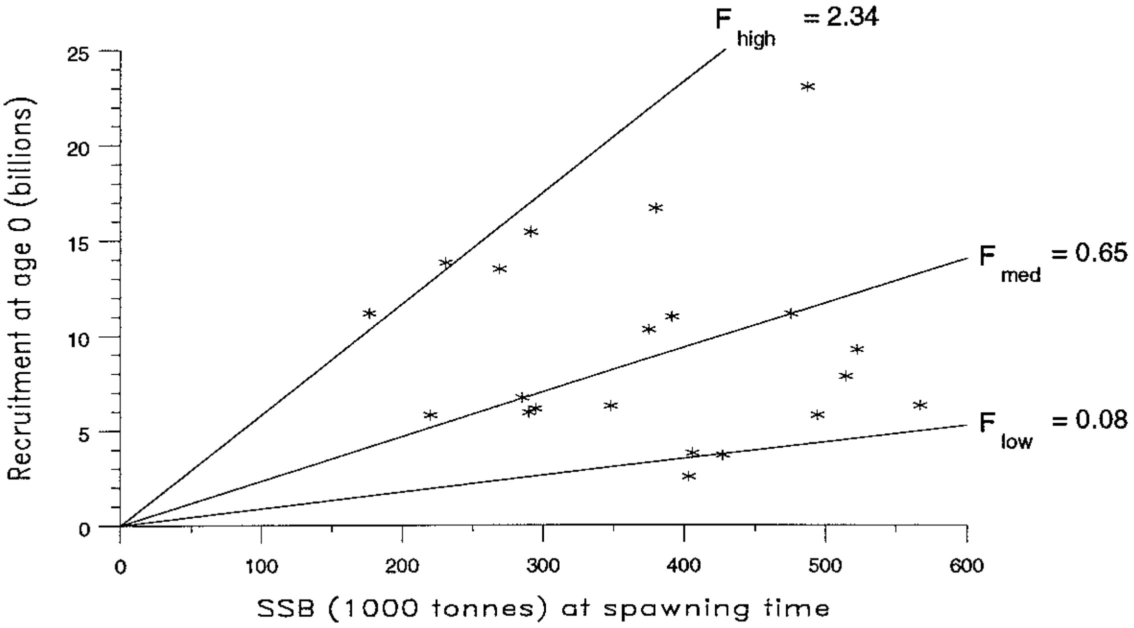


Sardine in Divisions VIIIc and IXa

Yield and Spawning Stock Biomass



Stock - Recruitment



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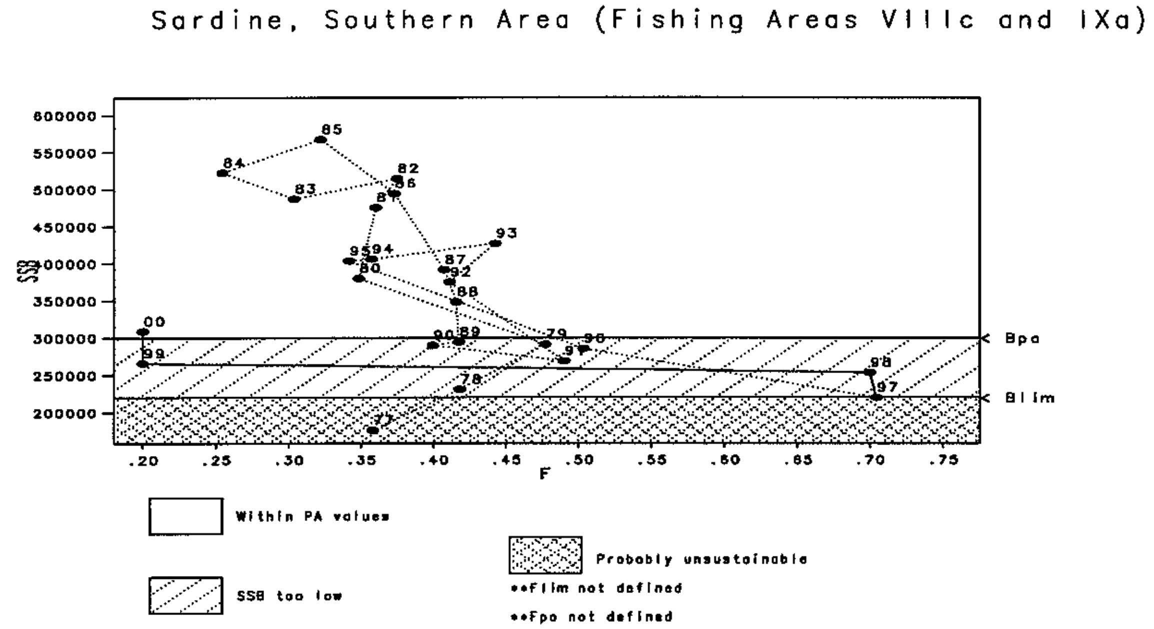
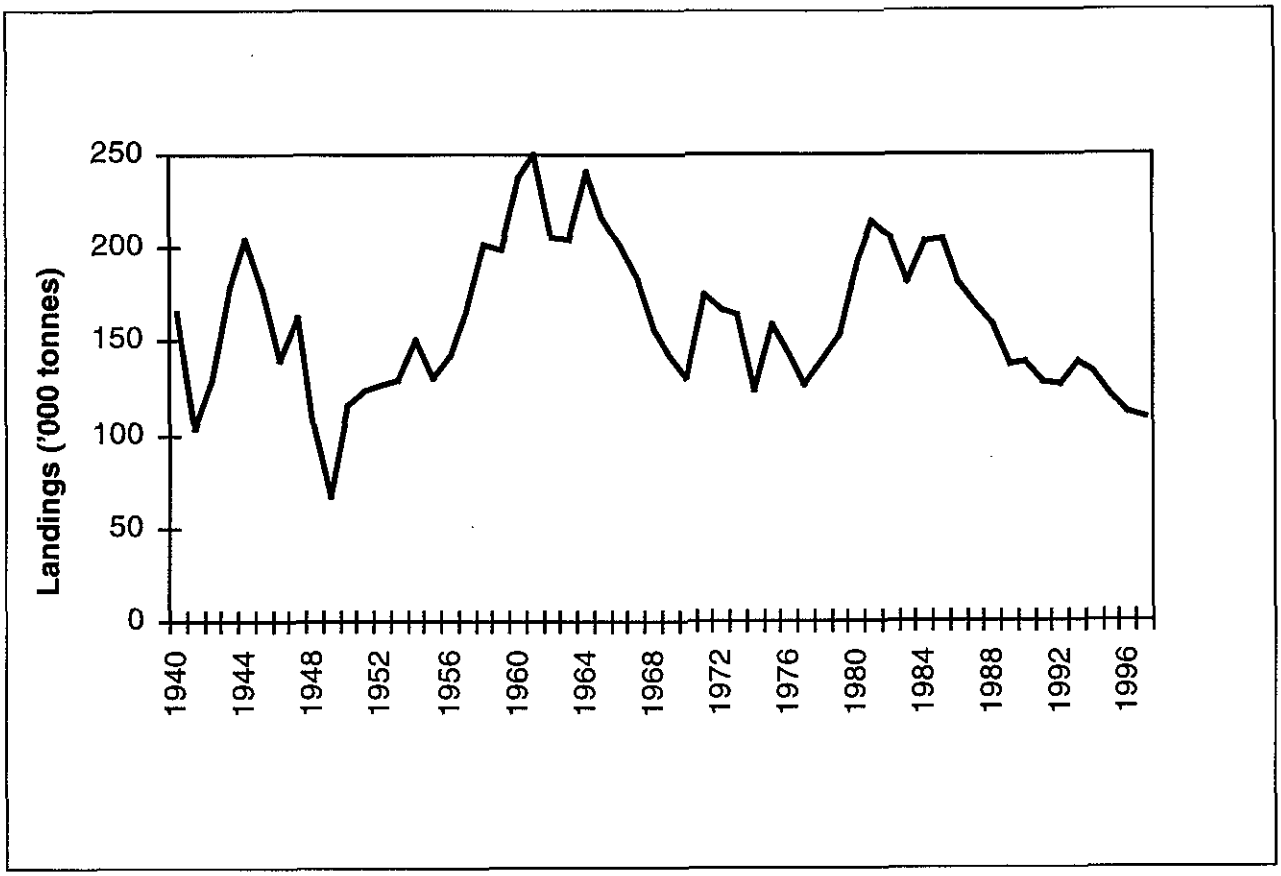
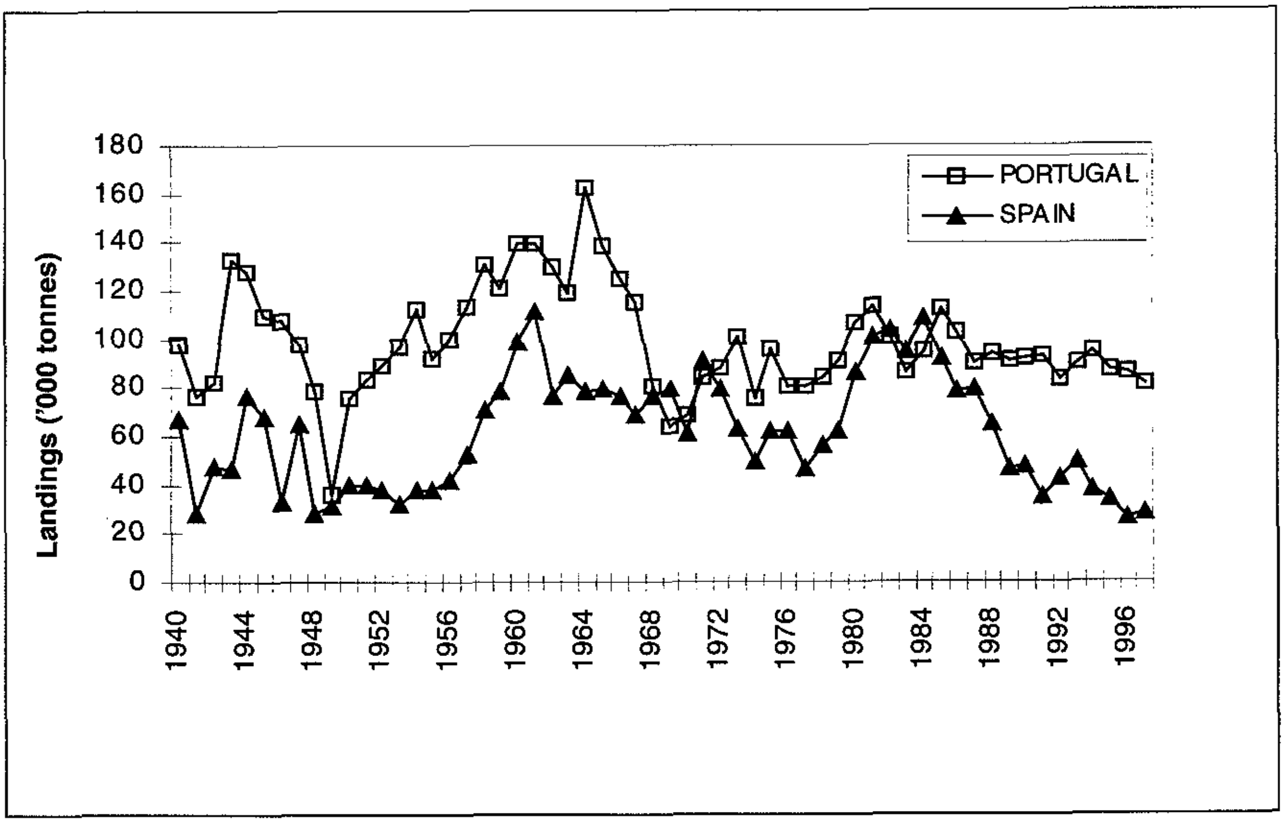
Precautionary Approach Plot





Total landings of sardine in Divisions VIIIc and IXa from 1940–1997.



Landings of sardine in Divisions VIIIc and IXa by country during 1940–1997.

Table 3.11.7.a.1 Annual landings (t) of SARDINE in Divisions VIIIc and IXa by country.

COUNTRY	1977	1978	1979	1980	1981	1982	1983
Portugal	79,819	83,553	91,294	106,302	113,253	100,859	85,922
Spain	45,931	56,437	62,147	85,380	100,880	103,645	95,217
Cadiz (IXa South, Spain)		5,619	3,800	3,120	2,384	2,442	2,688
Total*	125,750	139,990	153,441	191,682	214,133	204,504	181,139

COUNTRY	1984	1985	1986	1987	1988	1989	1990
Portugal	95,110	111,709	103,451	90,214	93,591	91,091	92,404
Spain	107,576	92,398	77,155	78,611	64,949	46,035	46,753
Cadiz (IXa South, Spain)	3,319	4,333	6,757	8,870	2,990	3,835	6,503
Total*	202,686	204,107	180,606	168,825	158,540	137,126	139,157

COUNTRY	1991	1992	1993	1994	1995	1996	1997
Portugal	92,638 (1)	83,315	90,404	94,468	87,818	85,757	81,156
Spain	35,118	42,739	48,391	38,332	33,566	25,674	27,878
Cadiz (IXa South, Spain)	4,834	4,196	3,664	3,782	3,996	5,304	6,780
Total*	127,756	126,054	138,795	132,800	121,384	111,431	109,034

*not including Cadiz

(1) Discards included

Table 3.11.7.a.2 Sardine in the Southern Area (Fishing Areas VIIIc and IXa).

Year	Recruitment Age 0	Spawning Stock Biomass	Landings	Fishing Mortality Age 2-5
1977	11,148.50	176.43	125.75	0.358
1978	13,793.90	230.72	139.99	0.418
1979	15,430.40	291.19	153.44	0.477
1980	16,669.00	379.75	191.68	0.349
1981	11,116.10	475.24	214.13	0.360
1982	7,840.25	514.52	206.01	0.375
1983	23,032.90	486.95	183.83	0.304
1984	9,233.14	522.39	206.01	0.254
1985	6,306.83	567.11	208.44	0.322
1986	5,781.68	494.14	187.36	0.373
1987	10,948.90	391.38	177.70	0.407
1988	6,263.52	347.98	161.53	0.416
1989	6,129.95	294.46	140.96	0.418
1990	5,926.84	289.82	145.66	0.400
1991	13,455.80	268.95	132.59	0.490
1992	10,284.40	374.90	130.25	0.411
1993	3,685.52	426.75	142.46	0.443
1994	3,778.01	405.81	136.58	0.357
1995	2,539.41	403.16	125.38	0.342
1996	6,712.79	285.40	116.74	0.503
1997	5,792.75	219.90	115.81	0.704
1998	.	253.49	.	.
Average	9,327.17	368.20	159.16	0.404
Unit	Millions	1000 tonnes	1000 tonnes	-

3.11.7.b Updated advice for Sardine in Divisions VIIIc and IXa, May 1998

Response to request for advice from the European Commission, Directorate General for Fisheries, 22 January 1998:

The stock of sardine in ICES Divisions VIIIc and IX is subject to several management measures, adopted by national authorities from the concerned EU Member States, following the delicate state of the stock described in recent ACFM reports.

Given the seriousness of the situation, it has become evident that a closer follow-up of the stock status is required in order to take any further remedial action.

With this in mind, ICES is requested to review, in the course of the 1998 May meeting of ACFM, the assessment carried out in 1997 in the light of any new scientific information available. In particular, it is requested to consider the results of the acoustic surveys conducted at the end of 1997 and in spring of 1998, as well as the catch figures for 1997.

State of stock/fishery: The stock is at present considered to be outside safe biological limits. From the twenty year data series available (1977–1997) it is indicated that stock size increased from the late seventies to the mid eighties because of a period of very strong recruitments. There was a pulse of improved recruitment in the early 1990s which lead to a temporary increase in stock size. In the most recent five years recruitments have been the lowest recorded, and the estimated SSB in 1997 is the lowest of the time series (1977–1997).

Periods of good recruitment lead to increases in spawning biomass. However, since 1984 there have been only two brief pulses of moderate recruitment (1987 and 1991–1992), and otherwise recruitment was poor. In the last five years both SSB and recruitment are very low. Fishing mortality was fairly stable between 0.13 and 0.2 from the 1970s to the mid 1980s, and then increased to between 0.3 and 0.4 until 1995. In the last two years it seems to have increased substantially to about 0.65 in 1997.

Management objectives: A coordinated recovery plan is being developed for this stock, and will specify rebuilding objectives.

Management advice: This stock is in a serious state. To prevent further decline in the stock during this period of poor recruitment, an immediate and significant reduction of at least 80% in fishing mortality is required in 1998.

Relevant factors to be considered in management: This species has not been managed on the basis of a TAC.

The Portuguese national management measures include seasonal closure of the fishery during the spawning time, and in 1997 an EU regulation legislated a minimum landing size of 11 cm.

Surveys suggest that the distribution of the stock has changed in the spring with a considerably more restricted range compared with the 1980s. Sardine schools seem to be thicker and bigger than in the 1980s, they also are located closer to the coast, where these concentrations may give an erroneous impression of high abundance. However, in autumn in Portuguese waters the sardine distribution traditionally expanded to the 200 m bathymetric, and this feature appears not to have changed.

It is unclear how the various spawning areas and recruitment areas are interrelated and appropriate definition of unit stocks for sardine remain unclear. There are also significant abundances of this species in Bay of Biscay (VIIIa,b) and indications of the presence of sardines up to the Celtic Sea. However, insufficient information is currently available to advise on a redefinition of stocks units.

Year classes since the 1993 year class have been in the lowest quartile of the time series.

Any rebuilding of the depressed SSB requires these year classes to mature and spawn, and not be harvested as juveniles.

Catch forecast:

Basis: F(98) = F(97), Landings (97) = 113.

F (98)	Basis	SSB (98)	Landings (98)	SSB (99)
0.0	0.0 F_{sq}	222	0	243
0.13	$0.2F_{sq}$	217	21	227
0.27	$0.4F_{sq}$	211	39	212
0.40	$0.6F_{sq}$	207	57	198
0.53	$0.8F_{sq}$	202	73	186
0.66	$1.0F_{sq}$	198	87	174

Weights in ‘000 t. Recruitment at 3679 million fish (the geometric mean of the 5 most recent values of the low recruitment period in the time series).

Shaded scenarios considered inconsistent with the precautionary approach.

Elaboration and special comment: Catches and survey data for 1997 were updated, and revisions were made to include sardine catches from the Gulf of Cadiz

(Division IXa). An analytical assessment was run using age 0–7+ data from the commercial fishery (1977–1997) and March acoustic surveys, as opposed to age 0–11+ data as used previously. This was necessary to deal with the large number of zero catches in older age classes in earlier years. The 1995 acoustic survey data were excluded because of a difference in survey timing that year.

The selection pattern is highly variable for this stock, both because different fleets exploit different ages, and because it is highly dependent on recruitment. Migrations may also influence the accessibility of sardine for the various fleets as well as the detected change in the distribution pattern. How this will influence the perception of the stock-recruitment relationship has not yet been investigated.

Directed fisheries on sardine are only exerted by Portugal and Spain in the corresponding national areas in Divisions VIIIc and IXa.

Catch data from these fisheries were made available from 1940 to 1997 (Figures 3.11.7.b.1-2). These show three periods of decreasing trend: 1944–1949, 1961–1977 and 1985–1997. The highest landings occurred in 1961 (250 000 t) and the lowest in 1949 (67 000 t). The trend in the catches in both countries has been similar in recent years. Nevertheless, after a period of high catches from 1980 to 1985 the Spanish catches have shown a decreasing trend while the Portuguese catches have remained quite stable. The sardine is a target species for the Portuguese and Spanish purse seine fleets. The highest catches occur in the second half of the year. The catches show a decreasing trend since 1985 and the 1997 catches are the lowest recorded since the early 1950s The fishery has become highly dependent on recruiting year classes.

The present assessment still indicates that a major reduction in F is required in order to make the harvest consistent with the current low productivity of the stock.

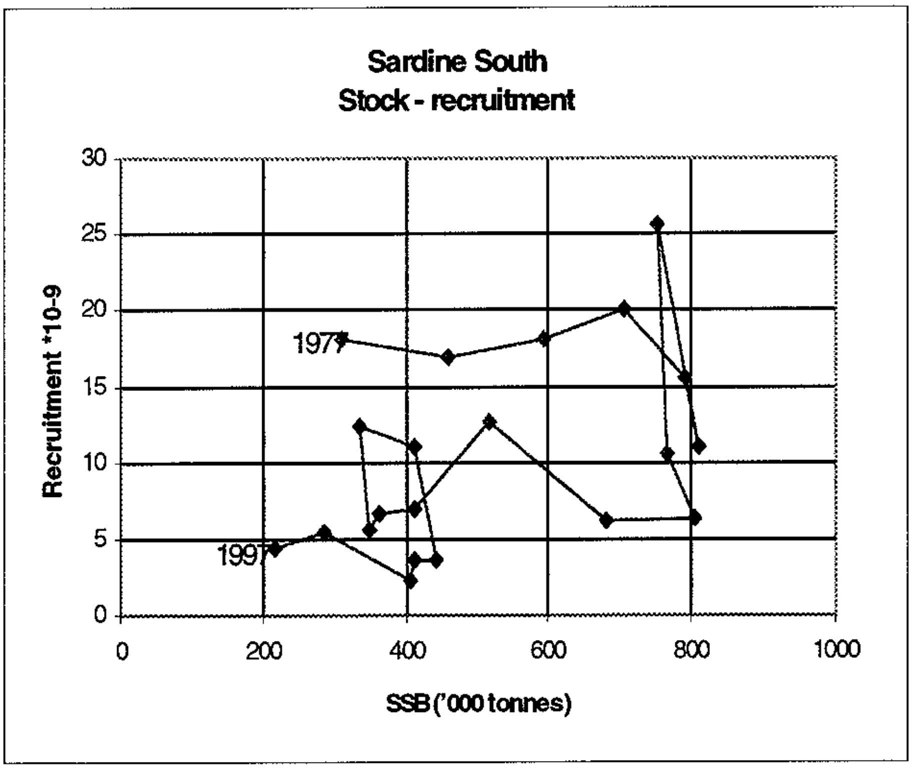
The 1997 assessment suggested that the SSB was less than half of its historic minimum. Revisions to landings, survey data and improvements to the biological formulation of the assessment model, indicate that the SSB is only slightly below the SSB in the late 1970s. The present assessment still indicates that the current productivity of the stock is low, that it is experiencing a period of low recruitment, and that a major reduction in F is required.

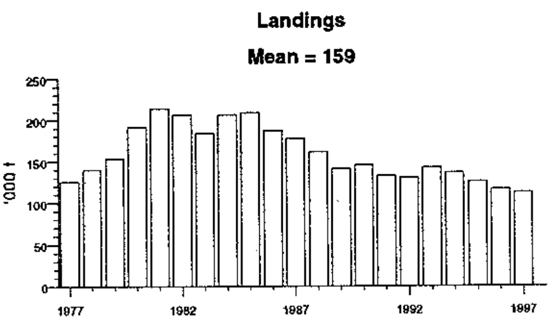
Source of information: Report of the Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine and Anchovy, September 1997 (ICES CM 1998/Assess:6): Report to ACFM of a group of experts meeting in Vigo, Spain, 4–8 May 1998.

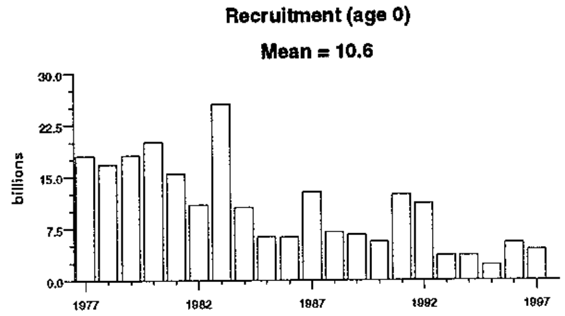
Catch data (Table 3.11.7.b.1):

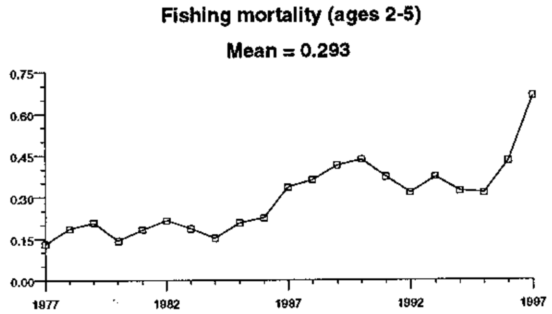
Year	ICES advice for next year	Landings corresp. to advice	Agreed TAC	Official Landings	ACFM landings
1987	No increase in F; TAC	140	-		177
1988	No increase in F; TAC	150	-	167	162
1989	No increase in F; TAC	212	-	146	141
1990	Room for increased F	227[2]	-	150	146
1991	Precautionary TAC	176	-	135	133
1992	No advice	-	-		130
1993	Precautionary TAC	135	-		142
1994	No advice	118[1]	-		137
1995	No advice; apparently stable stock	-	-		125
1996	Lowest possible level	-	-		117
1997	Lowest possible level	-	-		113
1998	Significant reduction[3]	-	-		

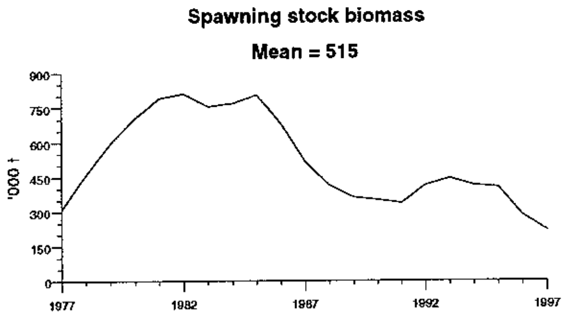
[1]Estimated catch at *Status quo* F. [2]Catch corresponding to 20% increase in F. [3] Revision from May 1998. Weights in '000 t.





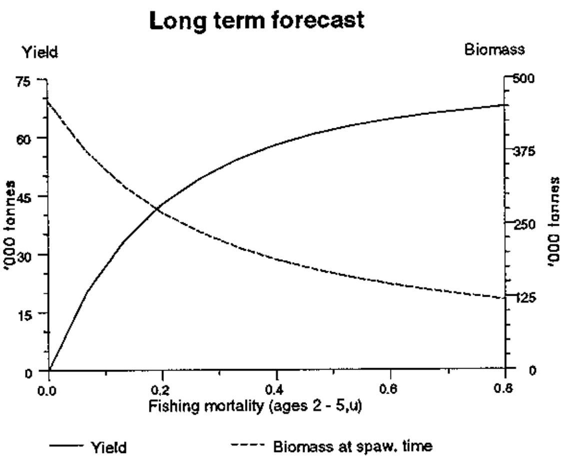






Sardine in the Southern Area (Fishing Areas VIIc and IXa)

Yield and Spawning Stock Biomass



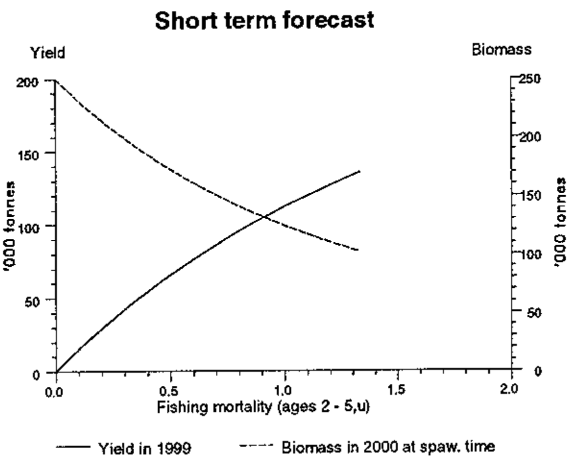


Table 3.11.7.b.1 Sardine in the Southern Area (Fishing Areas VIIc and IXa).

Year	Recruitment Age 0	Spawning Stock Biomass	Landings	Fishing Mortality Age 2-5
1977	18,054.78	310.41	125.75	0.131
1978	16,843.32	459.00	139.99	0.185
1979	18,115.20	594.45	153.44	0.207
1980	20,071.70	704.71	191.68	0.142
1981	15,461.85	790.97	214.13	0.182
1982	10,963.63	810.20	206.01	0.214
1983	25,562.96	753.78	183.83	0.186
1984	10,523.40	767.76	206.01	0.151
1985	6,320.32	804.40	208.44	0.207
1986	6,194.44	680.52	187.36	0.224
1987	12,728.17	515.38	177.70	0.334
1988	6,958.11	411.59	161.53	0.361
1989	6,591.41	361.34	140.96	0.413
1990	5,573.95	348.24	145.66	0.434
1991	12,416.47	336.34	132.59	0.372
1992	11,068.08	411.51	130.25	0.315
1993	3,593.56	442.95	142.46	0.372
1994	3,544.86	412.15	136.58	0.320
1995	2,201.62	405.38	125.38	0.313
1996	5,434.03	284.81	116.74	0.429
1997	4,421.21	217.55	112.71	0.663
Average	10,602.05	515.40	159.01	0.293
Unit	Millions	1000 tonnes	1000 tonnes	-

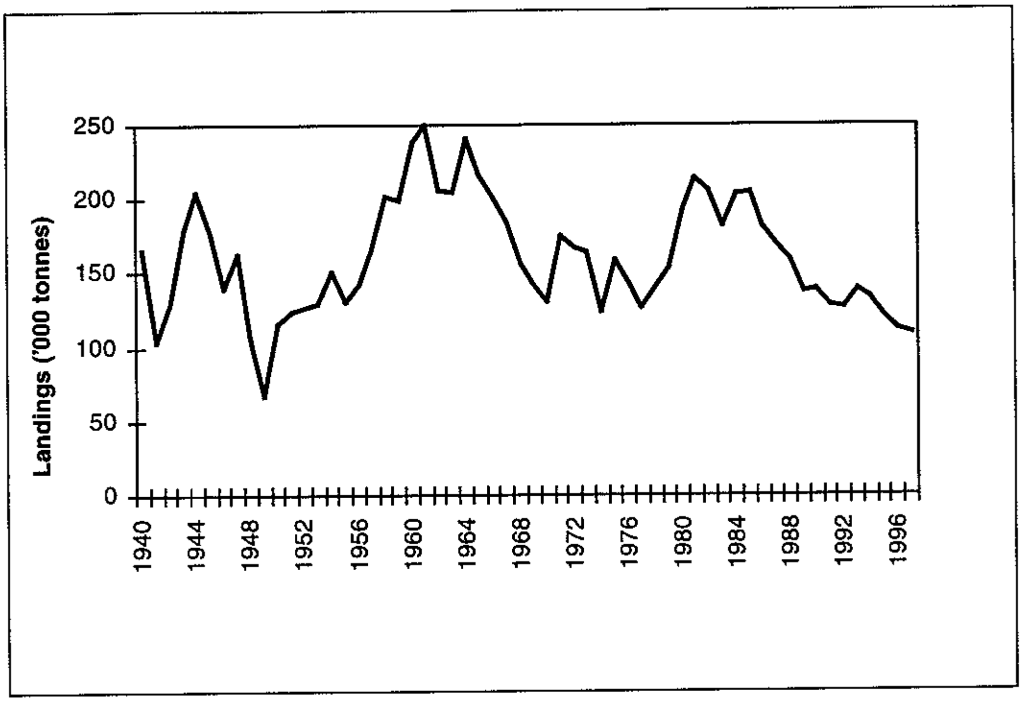


Figure 3.11.7.b.1 Total landings of sardine in Divisions VIIIc and Ixa from 1940–1997.

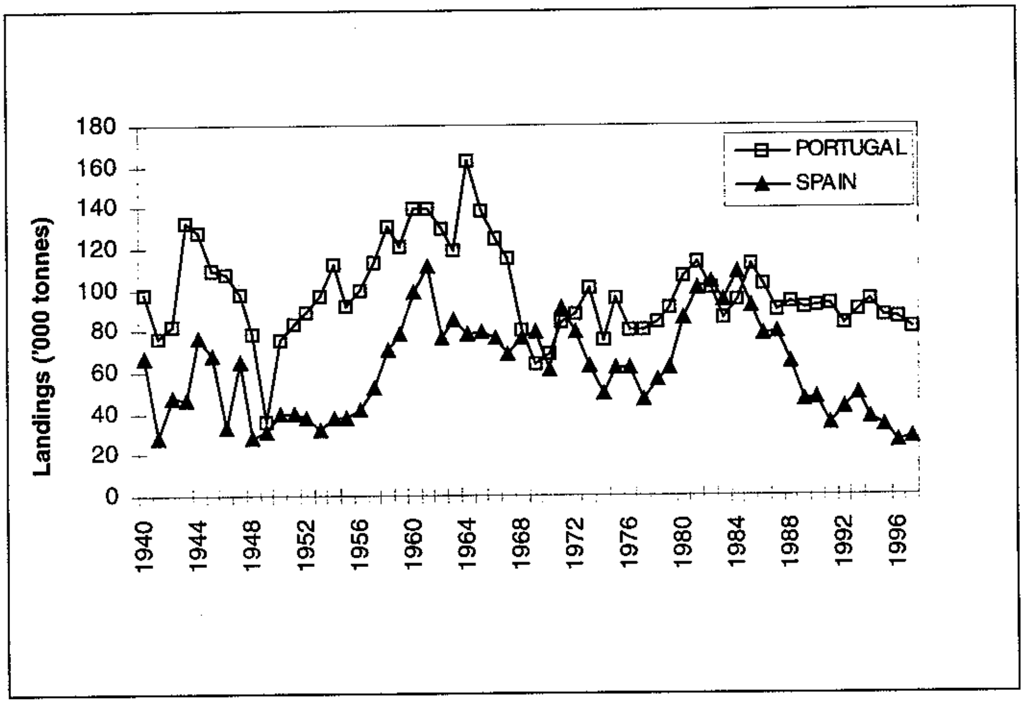


Figure 3.11.7.b.2 Landings of sardine in Divisions VIIIc and Ixa by country during 194–1997.

3.11.8 Anchovy

3.11.8.a Anchovy in Sub-area VIII (Bay of Biscay)

State of stock/fishery: The stock is considered to be within safe biological limits. SSB is above the proposed $\mathbf{B}_{pa}$. Poor recruitment is anticipated in 1999. The relatively low catches in the 1980s and the change in the exploitation pattern (the catches now mainly consisting of age-1 fish), suggest a relatively low spawning stock biomass in recent years compared to the 1960s when average catches were at about 60 000 t. Compared with the 1960s the distribution area of the stock has decreased also.

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 $\mathbf{B}_{pa}$.

Advice on management: ICES reiterates the advice given in 1997 that a reduced fishing mortality on juvenile anchovy will increase the spawning biomass without a major loss in total yield. This may be achieved by closing fishing areas with high abundance of 1-group anchovy. Fishing for anchovy should be prohibited between January and June inclusive within the area defined by the following boundaries:

- from the Spanish coast north along longitude 1°35'W to latitude 44°45'N
- west to longitude 1°45'W
- north to latitude 46°00'N
- and east to the French mainland.

Reference points:

ICES considers that:	ICES proposes that:
$\mathbf{B}_{lim}$ is 18 000 t, the lowest observed biomass.	$\mathbf{B}_{pa}$ be set at 36 000 tonnes, the SSB which allows the stock size to remain above $\mathbf{B}_{lim}$ in the following year in the event of a weak recruitment.
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.	$\mathbf{B}_{pa}$: see above.
	$\mathbf{F}_{pa}$: F for 50% spawning potential ratio, i.e., the F at which the SSB/R is half what it would have been in the absence of fishing.

Relevant factors to be considered in management: The assessment of the fishing mortality and actual size of the stock depends entirely on the provision of estimates of biomass by the implementation of direct surveys (Daily Egg Production Method (DEPM) and Acoustic). If a quantitative assessment of this population is desired, the continuity of direct surveys for anchovy should be maintained by the countries involved in the fishery.

As the catches of this short-lived species are largely dependent on the annual recruitment it is difficult to provide advice on the appropriate catch one year in advance. Any recommendation on catch has therefore to be based on obtaining an estimate of incoming recruitment, either from a recruitment survey or from some other sources (e.g., environmental predictors). Presently, the environmental Upwelling index for the Bay of Biscay is the only available predictor index for the recruitment of anchovy and it has for the first time been used in the catch projection. However, a better index of the strength of recruitment could be provided from acoustic surveys specifically designed to estimate the strength of recruitment prior to the beginning of the main fishery.

Catchability is expected to change inversely with changes in stock size. It is therefore necessary to protect against undue increases in fishing mortality when stock size is expected to be low. Given the expected weak recruitment in 1998 and 1999, and the uncertainties on natural mortality, it seems that catches above 28 000 t in 1999 will likely increase the average fishing mortalities for 1995–1997.

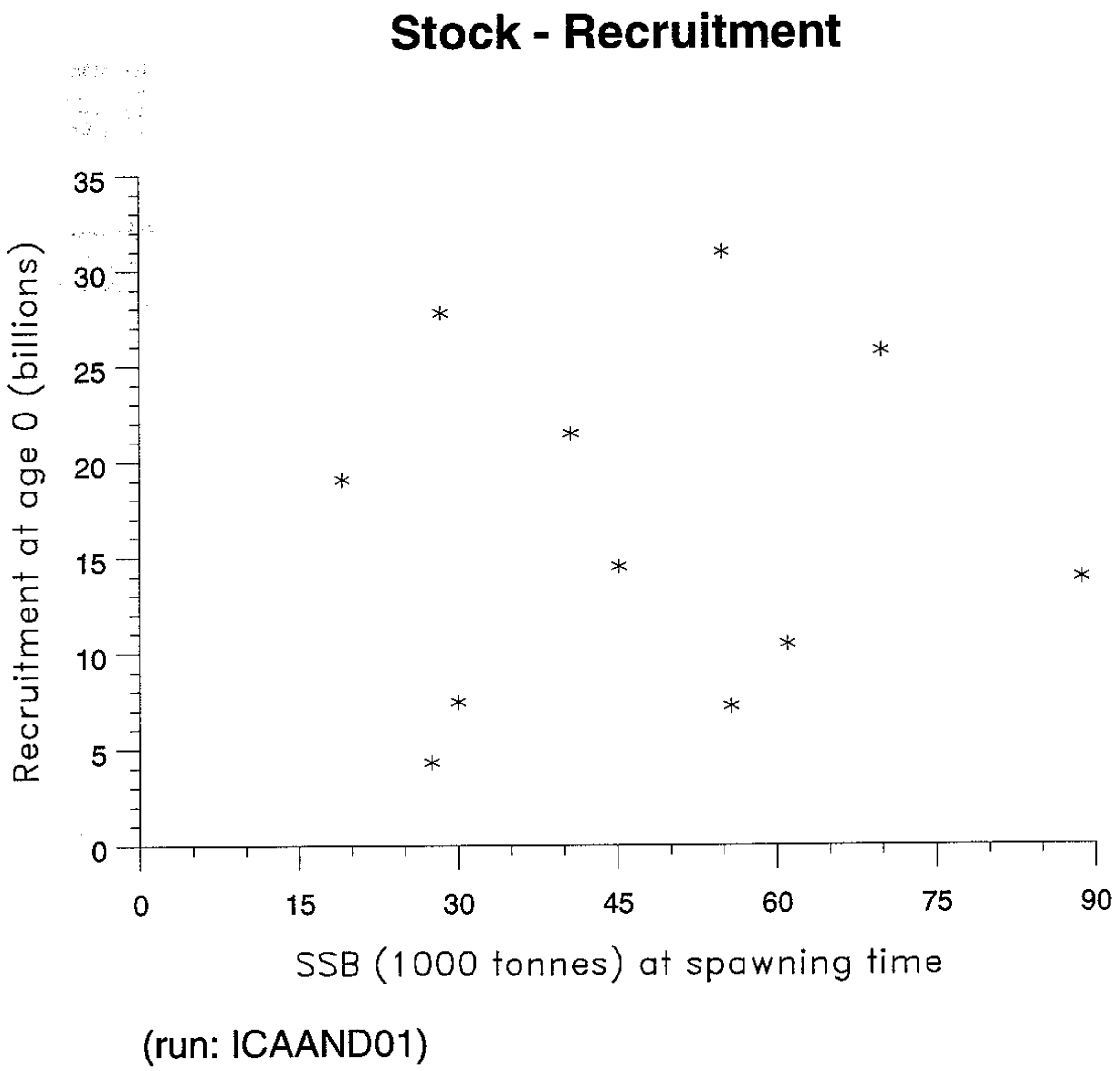
Elaboration and special comments: An analytical assessment (ICA) used catch-at-age data from French and Spanish fisheries, stock biomass estimates from egg (1987–1998) and acoustic surveys (1989–1998). This assessment is in agreement with the 1997 assessment. Surveys indicate an SSB of about 58 000 t in 1997 and 115 000 t in 1998. The stock is likely to fluctuate widely due to the large variations in recruitment and much of this variations is driven by environmental factors.

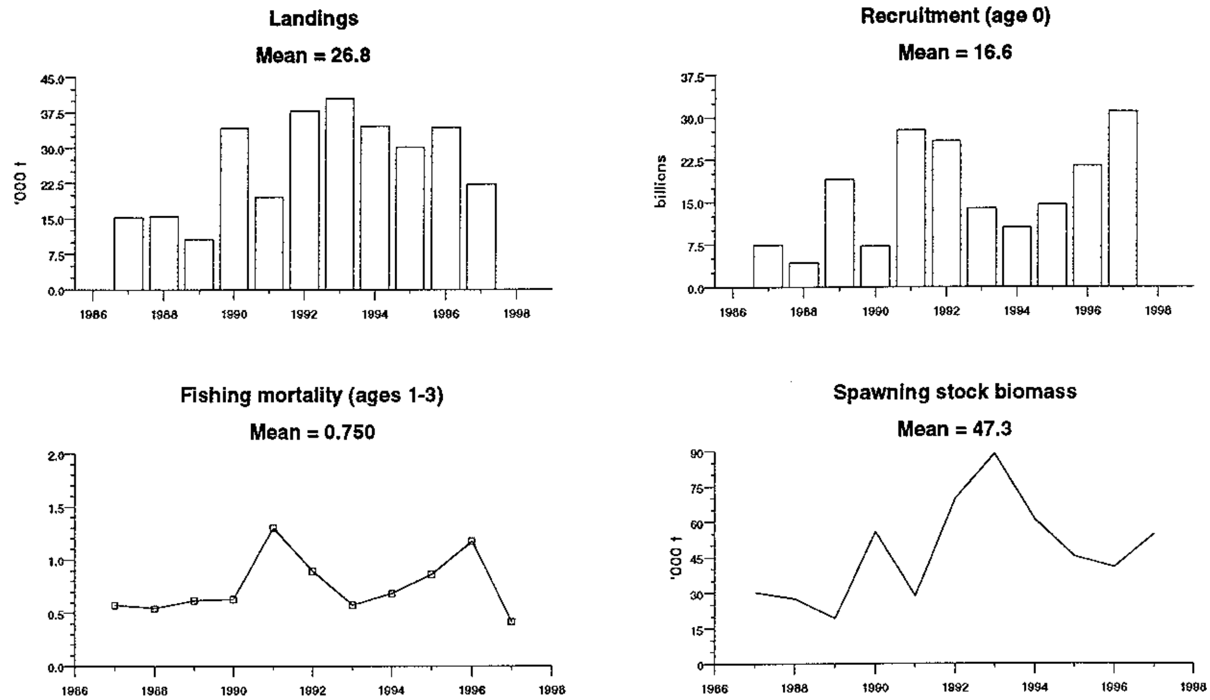
Source of information: Report of the Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine and Anchovy, September 1998 (ICES CM 1999/ACFM:6).

Catch data (Tables 3.11.8.a.1–2):

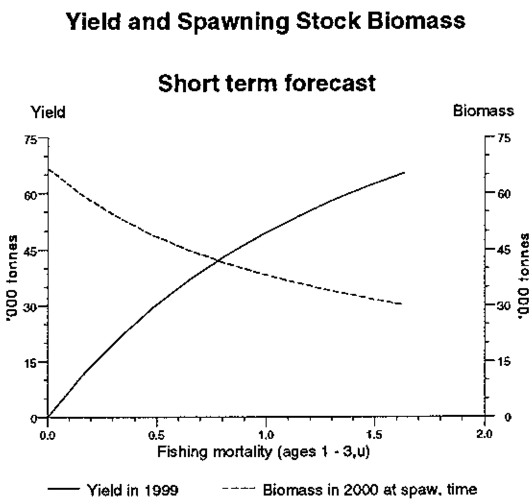
Year	ICES advice	Predicted catch corresp. to advice	Agreed TAC	Official landings	ACFM landings
1987	Not assessed	-	32	14	15
1988	Not assessed	-	32	14	15
1989	Increase SSB; TAC	10.0[1]	32	n/a	10
1990	Precautionary TAC	12.3	30	n/a	34
1991	Precautionary TAC	14.0	30	n/a	19
1992	No advice	-	30	n/a	38
1993	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	n/a
1999	Reduced F on juveniles, closed area				

[1]Mean catch of 1985–1987. Weights in '000 t. n/a: not available.





Anchovy in Sub-area VIII (Bay of Biscay)



Precautionary Approach Plot

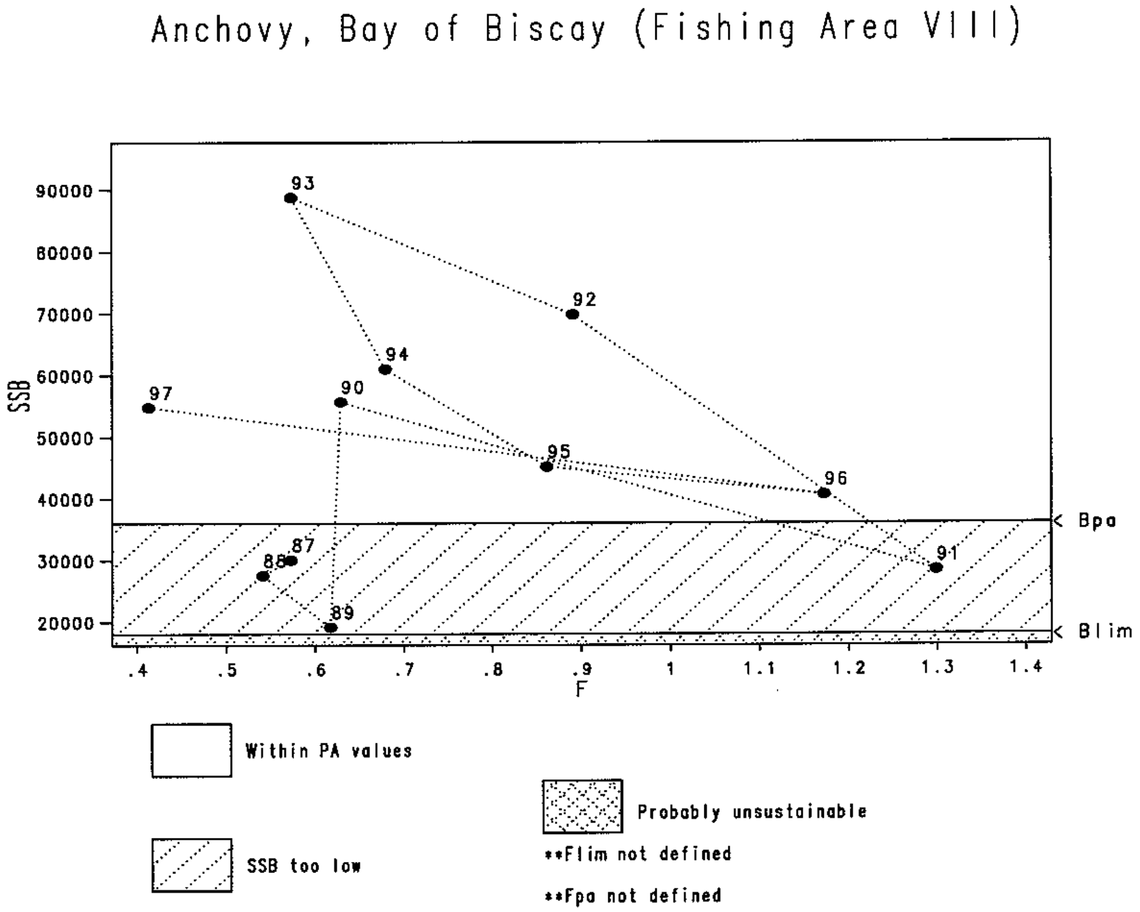


Table 3.11.8.a.1 Annual catches (in tonnes) of Bay of Biscay anchovy (Sub-area VIII). As estimated by the Working Group members.

COUNTRY	FRANCE	SPAIN	SPAIN	INTERNATIONAL
YEAR	VIIIab	VIIIbc, 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	11,200	6,250		17,450 (*)
AVERAGE (1960–97)	4,971	29,058	317	34,121

(*) Preliminary data up to july for the French fishery

Table 3.11.8.a.2 Anchovy in the Bay of Biscay (Fishing Area VIII).

Year	Recruitment Age 0	Spawning Stock Biomass	Landings	Fishing Mortality Age 1-3
1987	7,423.87	30.03	15.31	0.573
1988	4,293.75	27.52	15.58	0.541
1989	19,052.10	19.11	10.61	0.617
1990	7,206.18	55.65	34.27	0.629
1991	27,766.90	28.39	19.64	1.299
1992	25,764.40	69.74	37.89	0.891
1993	13,876.80	88.69	40.39	0.573
1994	10,454.30	60.98	34.63	0.679
1995	14,501.30	45.13	30.12	0.862
1996	21,443.50	40.62	34.37	1.172
1997	30,950.20	54.78	22.34	0.414
Average	16,612.12	47.33	26.83	0.750
Unit	Millions	1000 tonnes	1000 tonnes	-

3.11.8.b Anchovy in Division IXa

State of stock/fishery: The state of the stock is unknown in relation to safe biological limits. By analogy with the anchovy stock in Sub-area VIII (Section 3.11.8.a) it seems likely that this stock will also fluctuate widely due to variations in recruitment largely driven by environmental factors.

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 $\mathbf{B_{pa}}$.

Reference points:

ICES considers that:	ICES proposes that:
There is not sufficient information to estimate appropriate reference points.	

Relevant factors to be considered in management: The current TAC is believed to exceed the sustainable catch potential. If a traditional TAC is required it should be set at the average landings since 1988 excluding 1995, that is, 4 600 t. However, a traditional TAC management system may not be appropriate for this short lived species, in which variations in recruitment are largely driven by environmental factors. Lack of biological information for this stock hampers the provision of advice on more appropriate management measures. Monitoring of the stock would require regular sampling, together with information from a series of acoustic and egg surveys.

Elaboration and special comments: Anchovy is a target species for Spain in Sub-division IXa South (Gulf of Cadiz). The Spanish and Portuguese purse-seine fleets in the northern part of Division IXa target anchovy when abundance is high, due to high market prices, as occurred in 1995. The Spanish catch in Sub-division IXa South made up about 86% of the total catch during the period 1988–1994 and 1996–1997.

From 1943–1987 catch data are available for Portugal only. In the period 1943–1968 high catches occurred. This was followed by a period with very low catches. High catches again occurred in the 1980s, but gradually decreased. Since 1988 the anchovy fishery in Division IXa was situated in the Gulf of Cadiz (Sub-division IXa South), except in 1995. In 1995, a sudden increase in catches was observed mainly in Sub-division IXa North (Galician waters) and Sub-division IXa Central-North (Portuguese waters), due to the recruitment of a strong year class. However, in 1996 and 1997 the catches decreased again. Catches from Sub-division IXa South, which had decreased sharply in 1995, increased in 1996 to the same level as those of 1993 and in 1997 increased again registering the highest catches of the last 6 years. The differences of the length distributions between Sub-division IXa South (Gulf of Cadiz) and Sub-division IXa North suggest that the populations inhabiting these areas may have different biological characteristics.

Source of information: Report of the Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine and Anchovy, September 1998 (ICES CM 1999/ACFM:6).

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	6.7
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	5.2
1998	No advice		12	
1999	If required, TAC at pre-95 catch level	4.6		

[1]TAC for Sub-areas IX and X and CECAF 34.1.1. Weights in '000 t.

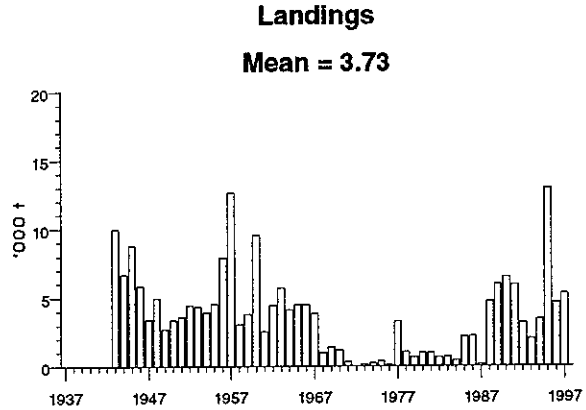


Table 3.11.8.b.1 Portuguese and Spanish annual landings of ANCHOVY in Division IXa. (From Pestana, 1989 and 1996 and Working Group members).

	Portugal				Spain			
Year	**IXa C-N**	**IXa C-S**	**IXa South**	**Total**	**IXa North**	**IXa South**	**Total**	**TOTAL**
	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

(-) 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 some of whose stock units 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 fisheries for many of these species are summarised in the area overviews, and in this section of the report the detailed assessments are given for those stocks which are distributed over more than one area, namely Northern hake, mackerel, Western horse mackerel and blue whiting.

Most of the stocks concerned are fished throughout their area of distribution.

3.12.2 Hake – Northern stock (Division IIIa, Sub-areas IV, VI and VII, and Divisions VIIIa,b)

State of stock/fishery: The stock is considered to be outside safe biological limits. Fishing mortality has declined from high's in 1992–1995, but it remains above the proposed $\mathbf{F_{pa}}$. SSB reached a peak in 1985, decreased until 1994 and has since remained stable well below the proposed $\mathbf{B_{pa}}$. Recruitment has been relatively stable and the decline in the spawning stock mainly originates from too high a fishing mortality.

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 $\mathbf{B_{pa}}$.

Advice on management: ICES recommends that fishing mortality should be reduced below $\mathbf{F_{pa}}$ (0.20), corresponding to landings of less than 36 000 t in 1999. This will maintain SSB above the lowest observed value in the medium term. A recovery plan should be implemented for this stock in order to give a high probability of SSB exceeding $\mathbf{B_{pa}}$ in the medium term.

Reference points:

ICES considers that:	ICES proposes that:
$\mathbf{B_{lim}}$ is 120 000 t, the lowest observed biomass.	$\mathbf{B_{pa}}$ 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 estimated to lead to potential stock collapse.	$\mathbf{F_{pa}}$ be set at 0.20. 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 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 ($\mathbf{SSB_{MT}} < \mathbf{B_{pa}}$).

Relevant factors to be considered in management: F would have to be reduced by 90% to enable SSB to reach the proposed $\mathbf{B_{pa}}$ in the short term. Large numbers of juvenile hake are still being caught and measures to effectively reduce such catches will contribute to the advised reduction in F.

Compliance with technical measures regarding mesh sizes of trawls and minimum landing size is known to be poor.

Catch forecast for 1999:

Basis: F(98) = F(95–97) = 0.27, Landings(98) = 45.5, Catch(98) = 46.6; SSB(99) = 129.0.

F(99)	Basis	Catch (99)	Landings (99)	SSB (2000)
0.03	$0.1F_{95\text{-}97}$	5.3	5.1	165.0
0.11	$0.4\ F_{95\text{-}97}$	20.2	19.5	149.8
0.16	$0.6\ F_{95\text{-}97}$	29.4	28.4	140.7
0.20	$\mathbf{F_{pa}}$	37.0	36.0	132.5
0.27	$F_{95\text{-}97}$	46.0	44.4	124.3
0.33	$1.2\ F_{95\text{-}97}$	53.6	51.8	116.8

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

Elaboration and special comment: After an increase in 1995 and 1996, a decrease in SSB is expected for 1997 and 1998 at *status quo* fishing mortality.

Since the 1930s, hake has been the main species supporting trawl fleets on the Atlantic coasts of France and Spain, and is present in the catches of nearly all fisheries in Sub-areas VII and VIII. Spain takes 60% of the landings, France 25%, and the UK reports about 10%.

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 (E & W, Spain and France) and otter-trawls (all countries). By-catches of mainly juvenile hake are taken in the *Nephrops* fisheries in the Northern Bay of Biscay.

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 in the fishery. From the beginning of the year until March/April hake are present in Northern Biscay. They appear on the shelf edge in the Celtic Sea in June and July. Between August and December the hake fishery is centered to the west and south-west of Ireland, with a decline in catch rates in shallower waters.

Length composition data by fishery unit available annually for 1978–1989 and quarterly for 1990–1997. Prior to 1992, these were converted to age compositions by numerical methods. For 1992–1997, age readings were used. Data include discards estimates. Shortage of age determinations for fish > 50 cm, so plus group reduced from 10+ to 8+ this year and forecast used mean of recent years for stock number of 8+ at 1 January 1998. Reference F changed from 1–4 to 2–6.

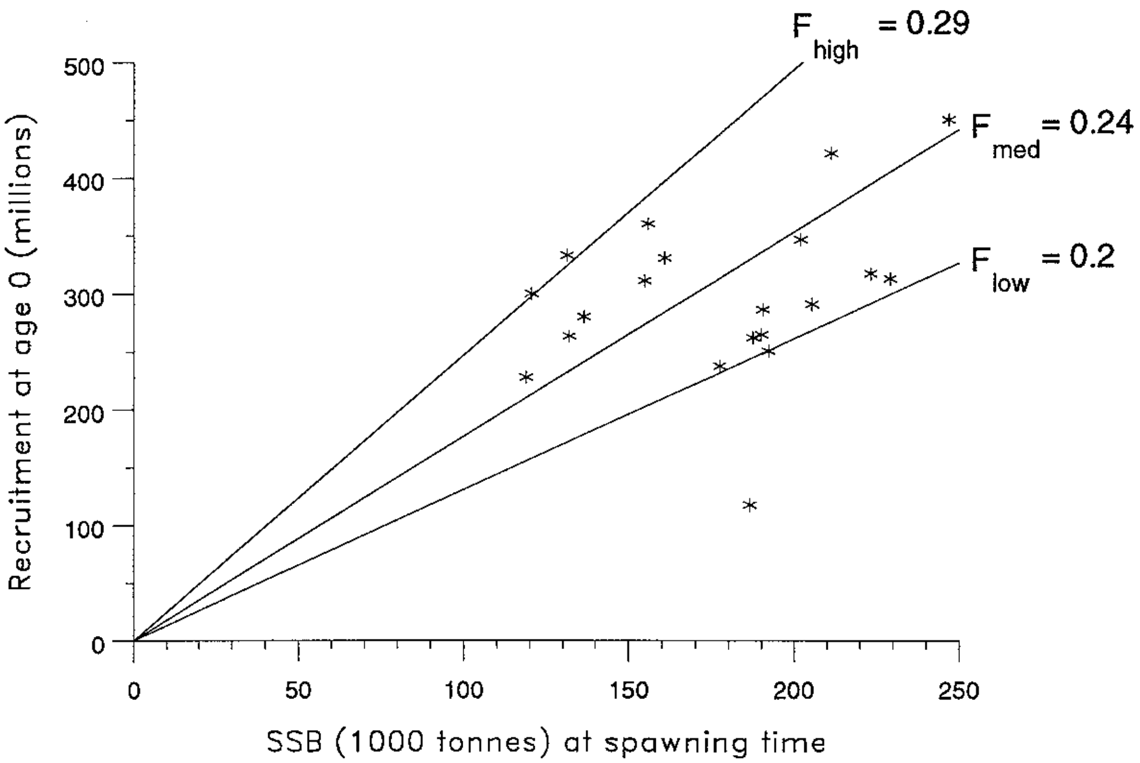
Source of information: Report of the Working Group on the Assessment of Southern Shelf Demersal Stocks, September 1998 (ICES CM 1999/ACFM:4).

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	-	63.46	63.4	2.0	65.3
1988	Precautionary TAC; juvenile protection	54	66.16	64.8	2.0	66.8
1989	Precautionary TAC; juvenile protection	54	59.67	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	42.5	1.8	44.2
1998	20% reduction in F	45[2]	59.1			
1999	Reduce F below $\mathbf{F}_{pa}$	<36[2]				

[1]Sum of area TACs corresponding to Northern stock plus Division IIa (EC zone only). [2]Landings. Weights in '000 t.

Stock - Recruitment



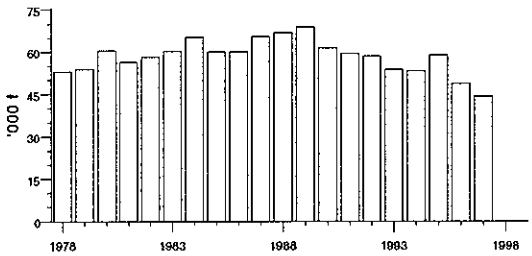
(run: XSAVAL03)

Hake - Northern Stock

Landings in graph below includes discards

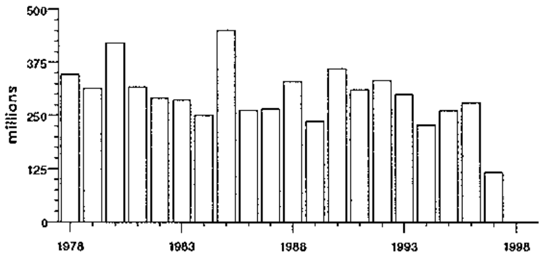
Landings

Mean = 58.3



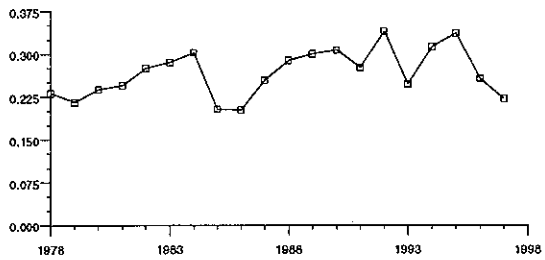
Recruitment (age 0)

Mean = 298



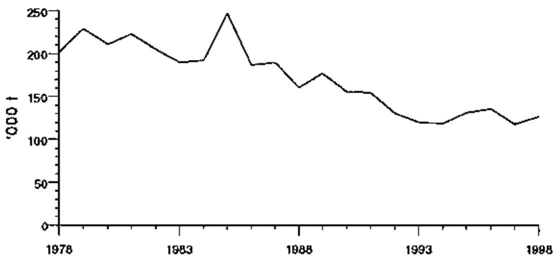
Fishing mortality (ages 2-6)

Mean = 0.267



Spawning stock biomass

Mean = 172



Precautionary Approach Plot

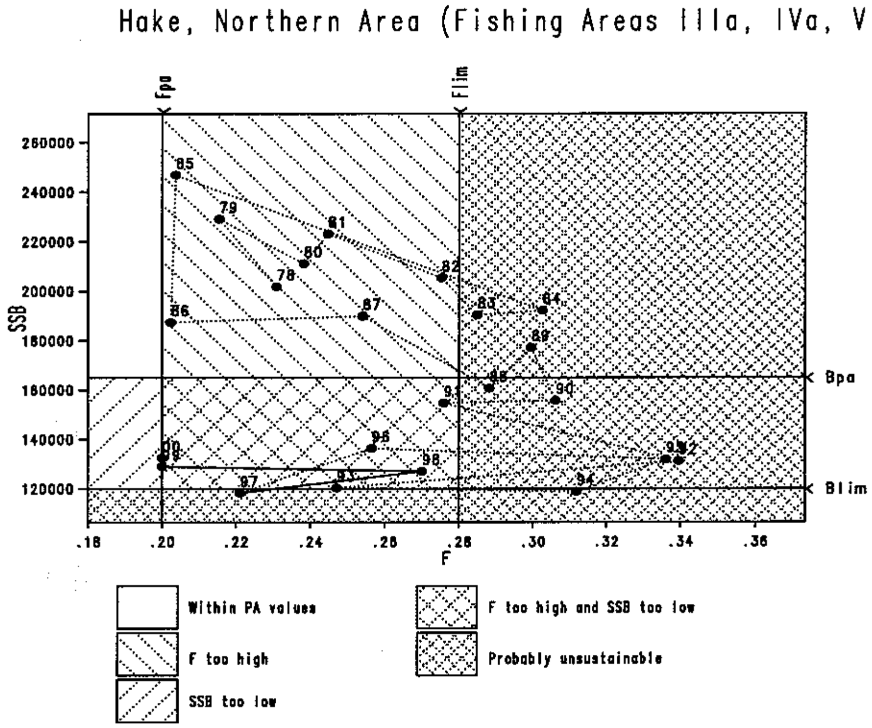


Table 3.12.2.1 Estimates of catches ('000 t) for the Northern Hake by area for 1961–1997.

	Landings (1)					Discards (2)	Catches (3)
Year	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	**3.2**	**18.9**	**20.3**	0	**42.5**	**1.8**	**44.2**

(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 VIIIIa,b.

(3) From 1978 total catches used for the Working Group. Highlighted data have been revised, or added (for 1997).

Table 3.12.2.2 Hake in the Northern Area (IIIa, IVa, VIa, VII, VIIIa,b).

Year	Recruitment Age 0	Spawning Stock Biomass	Catch	Fishing Mortality Age 2-6
1978	346.89	201.88	52.91	0.231
1979	313.32	229.17	53.80	0.215
1980	421.47	211.13	60.46	0.238
1981	317.52	223.19	56.26	0.245
1982	291.18	205.35	58.06	0.275
1983	286.56	190.42	60.13	0.285
1984	250.76	192.13	65.15	0.303
1985	450.54	246.90	59.94	0.204
1986	262.35	187.42	60.05	0.202
1987	264.95	189.90	65.32	0.254
1988	330.89	160.76	66.82	0.288
1989	237.78	177.26	68.78	0.300
1990	360.43	155.76	61.41	0.306
1991	311.37	154.69	59.29	0.276
1992	332.98	131.24	58.29	0.340
1993	299.93	120.45	53.64	0.247
1994	227.78	118.87	53.14	0.312
1995	263.28	131.92	58.86	0.336
1996	280.18	136.39	48.76	0.256
1997	117.59	118.30	44.24	0.221
1998	.	127.12	.	.
Average	298.39	171.92	58.26	0.267
Unit	Millions	1000 tonnes	1000 tonnes	-

3.12.3 Mackerel

3.12.3.a Mackerel (combined Southern, Western and North Sea spawning components)

State of stock/fishery: The combined stock, which is dominated by the Western component (85%), is considered to be outside safe biological limits. The spawning stock biomass is close to $\mathbf{B_{pa}}$, but the fishing mortality is above $\mathbf{F_{pa}}$ and is considered to be unsustainable.

The SSB of the North Sea component was last estimated at 110 000 t by egg surveys in 1996 and that 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. The stock identity of these fish is still uncertain. The SSB of the Western component declined in the 1970s from above 3.0 million t, but was estimated in 1997 to be above 2.0 million t (the MBAL previously defined for this component). The size of the Southern component is not known, but its development is considered to be similar to that of the Western component. The overall fishery, which was reduced by 190 000 t from 1995 to 1996, showed a minor increase in 1997.

Management objectives: The management plan for this fishery, agreed between Norway and the EU in 1997, states: *"The parties noted that the implementation of a mortality based harvesting strategy had resulted in improvement in the size of the western mackerel stock. They agreed to continue to apply a multi-annual management strategy to achieve the objective of keeping the level of the spawning stock biomass above the historic low level prior to 1995 (2.3 million tonnes). For 1999, the Parties agreed to adopt a TAC consistent with a fishing mortality of 0.15, unless future scientific advice requires modification of this agreement, and to request ICES for appropriate advice on this matter. The Parties agreed that, to provide increased security and greater potential yield, the stock needs to be rebuilt to progressively higher levels."* ICES considers that the agreed fishing mortality of F = 0.15 is consistent with a precautionary approach.

Advice on management: ICES advises a reduction in fishing mortality in 1999 to below $\mathbf{F_{pa}}$. The fishing mortality agreed between Norway and the EU (0.15) is consistent with the precautionary approach and corresponds to landings in 1999 of 437 000 t inclusive of those taken in international waters.

The North Sea spawning component still needs the maximum possible protection and ICES therefore reiterates its previous recommendations, which were first formulated in 1987, that:

- 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 January–31 July.

Reference points:

ICES considers that:	ICES proposes that:
There is currently no biological basis for defining $\mathbf{B_{lim}}$.	$\mathbf{B_{pa}}$ be set at 2.3 million t, the lowest observed SSB.
$\mathbf{F_{lim}}$ 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 of assessments.

Technical basis:

$\mathbf{F_{lim}}$: $\mathbf{F_{loss}}$: 0.26.	$\mathbf{B_{pa}}$: $\mathbf{B_{loss}}$: 2.3 million t.
	$\mathbf{F_{pa}}$: $\mathbf{F_{lim}}$ x 0.65, $\mathbf{F_{0.1}}$ = 0.17.

Relevant factors to be considered in management: Little is known about discards in the mackerel fishery since only one country provides data. Closure of Division IVa for fishing during the first half of the year until the Western Mackerel component enters the North Sea in July early August, has been recommended for several years. The Western fish stay there until late December or January the following year before migrating back to the spawning areas. The implemented restrictions for fishing in the North Sea have, particularly during the first quarter, resulted in large scale misreporting from the Northern part of the North Sea (Division IVa) to Division VIa. Allowing a fishery during the first quarter might solve the misreporting problem. This would have implications for North Sea mackerel which traditionally partly have overwintered in this area. However, the percentage of North Sea mackerel in this area during this quarter is uncertain. In view of the present distribution of mackerel there is a need to review the closure in the Northern North Sea.

The closure of the mackerel fishery in Divisions IVb,c and IIIa throughout the whole year will 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 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 is 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. **ICES recommends that observers should be placed on vessels in order to estimate discards in those horse mackerel fisheries where discarding is perceived to be a problem.**

Catch forecast for 1999:

Forecasts below show the anticipated catches in the different areas for various fishing mortalities.

Basis: F(98) = F(97) = 0.22, Landings(98) = 621, F(95–97) = 0.23.

F(99)	Basis	SSB(99)	Catch(99)	Landings(99) N	Landings(99) S	Landings(99) Total	SSB (2000)
0.15	EU-Norway agreement =0.65F(95–97)	2734		414	23	437	2866
0.17	F_{pa}=0.76F(95–97)	2710		477	27	504	2788
0.20	0.87F(95–97)	2687		540	30	571	2711
0.23	1.0 F(95–97)	2656		620	35	654	2617

Weights in '000 t.

N: Northern area comprising the Western areas, North Sea, Skagerrak and Norwegian Sea (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.

These catch forecasts are based on the assumption that the exploitation patterns in each area, which are very different, will be maintained. Partial Fs for each area were calculated, using the average ratio of the fleets catch at age and the total catch at each age for the years 1995–1997.

Elaboration and special comment:

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 1997 catch is similar to that of 1996.

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.

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 (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. Catches from the southern component have been increasing in recent years and in 1997 reached a maximum of 41 000 t. For the Southern component catch at age data from the Spanish and Portuguese fleets are available. CPUE from commercial trawlers, handliners and indices from Spanish and Portuguese bottom trawl surveys are also available.

Combined Assessment: No new assessment was made this year, but the stock estimate from last year was projected one year ahead using the catches from 1997. The most recent survey on the Western and Southern components was carried out in 1998, the results are still preliminary, and are consistent with the projected estimate. The last survey on the North Sea component was in 1996, and a new survey is planned for 1999.

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[3] 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[5]	549			
1999	F of 0.15 consistent with	437				

[1]Data on discards and slipping from only two fleets, [2]Landings and discards from IIa, IIIa, IV, Vb, VI, VII, VIII and IXa. [3]As reported to ICES by August 1997, [4]All areas except some catches in international waters in II. [5] Highest tabulated option in precautionary range. 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	$F = F_{0.1}$; TAC; closed area; landing size	430	573[1]	36	628
1989	Halt SSB decline; TAC	355	495[1]	7	567
1990	TAC; $F = F_{0.1}$	480	525[1]	16	606
1991	TAC; $F = F_{0.1}$	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	530
1997	No separate advice	-	416[1]	19	529
1998	No separate advice		514[1]		
1999	No separate advice				

[1]TAC for mackerel taken in all areas VI, VII, VIIIa,b,d, Vb, IIa, IIIa, IV (excluding VIIIc, IXa and some catches in international waters). [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+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	
1999	Maximum protection; closed areas and seasons; min landing size	LPL		

[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):

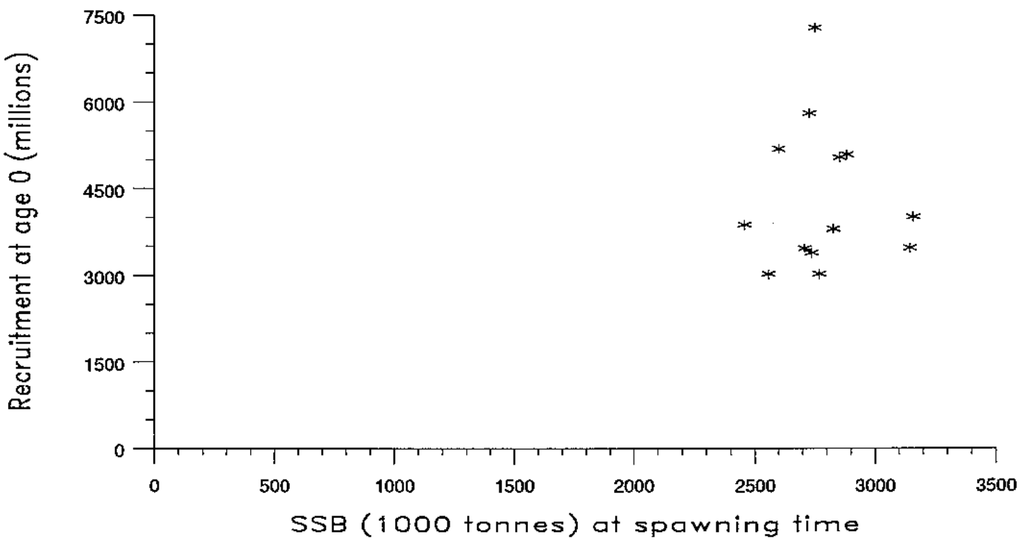
Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC[1]	ACFM landings
1987	Reduce juvenile exploitation	-	36.57	22
1988	Reduce juvenile exploitation	-	36.57	25
1989	No advice	-	36.57	18
1990	Reduce juvenile exploitation	-	36.57	21
1991	Reduce juvenile exploitation	-	36.57	21
1992	No advice	-	36.57	18
1993	No advice	-	36.57	20
1994	No advice	-	36.57	25
1995	No advice	-	36.57	28
1996	Significant red. in F	-	30.00	34
1997	Significant red. in F	-	30.00	41
1998	Significant red. in F	-	35.00	
1999	Significant red. in F	-	35.00	

[1]Division VIIIc, Sub-Areas IX and X, and CECAF Division 34.1.1 (EU waters only). Weights in '000 t.

Source of information: Report of the Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine and Anchovy, September 1998 (ICES CM 1999/ACFM:6).

Mackerel Combined Area

Stock - Recruitment



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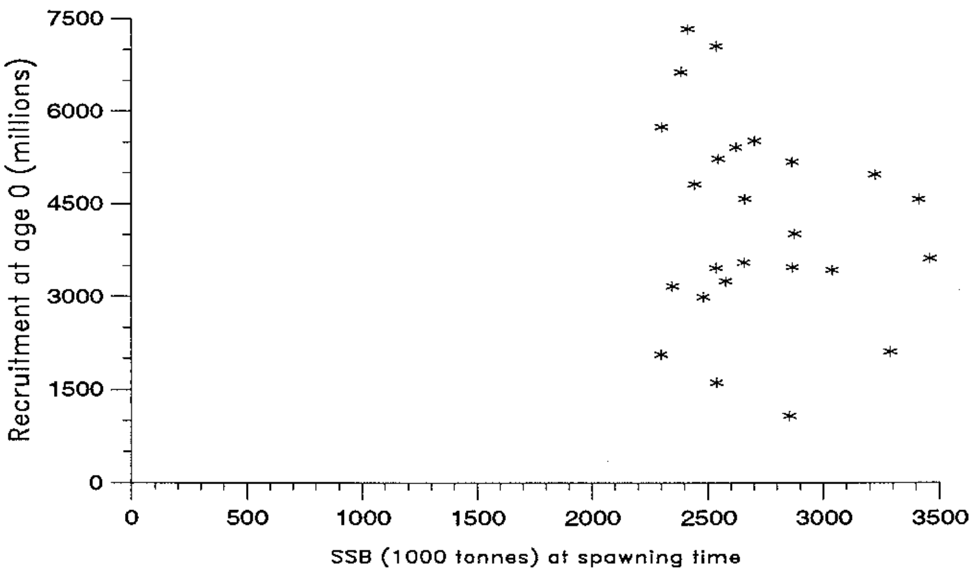
Stock - Recruitment



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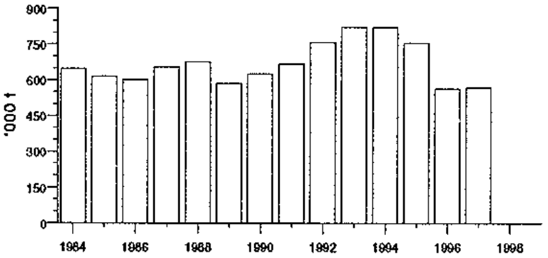
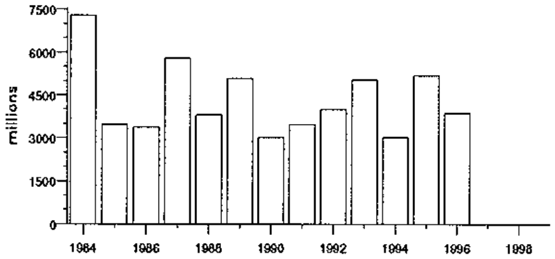
Mackerel Combined Area

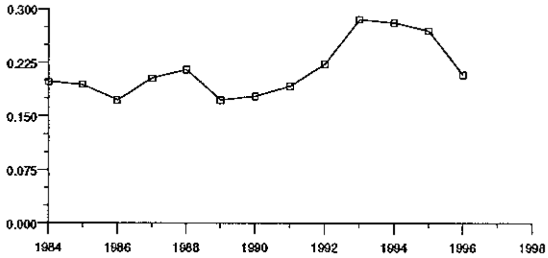
Landings
Mean = 669



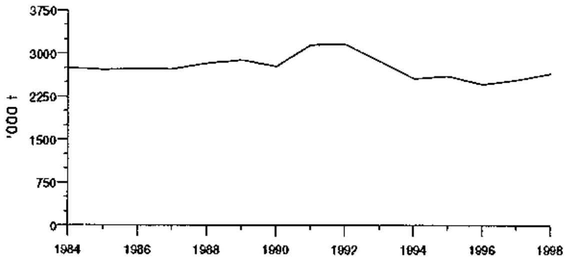
Recruitment (age 0)
Mean = 4342



Fishing mortality (ages 4-8)
Mean = 0.215

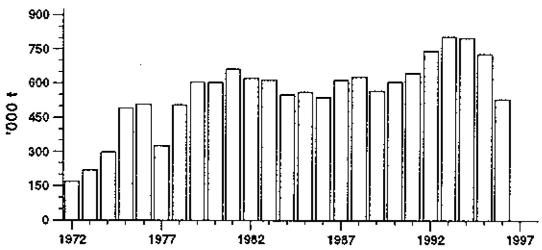


Spawning stock biomass
Mean = 2756

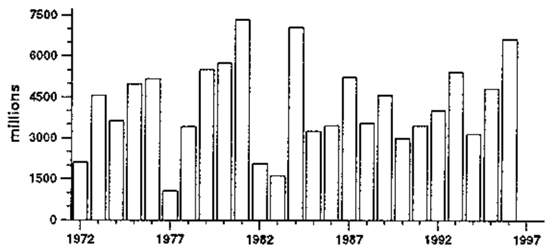


Mackerel Western Area

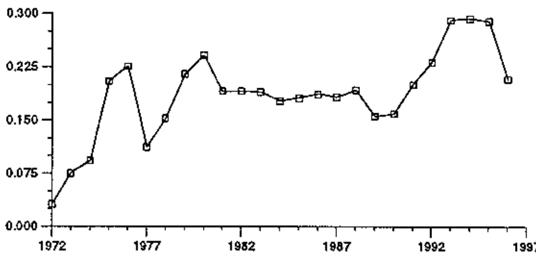
Landings
Mean = 558



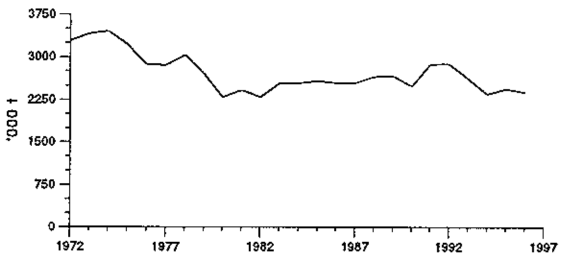
Recruitment (age 0)
Mean = 4193



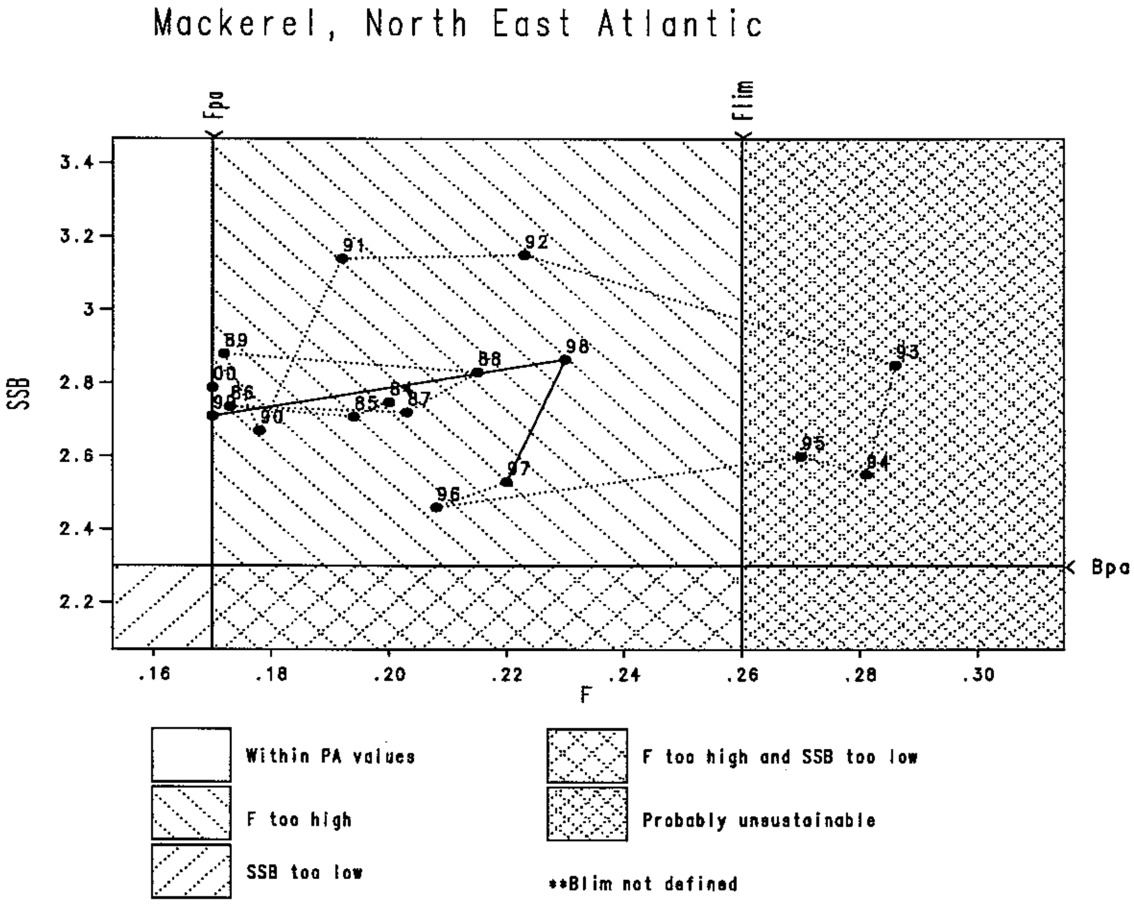
Fishing mortality (ages 4-8)
Mean = 0.187



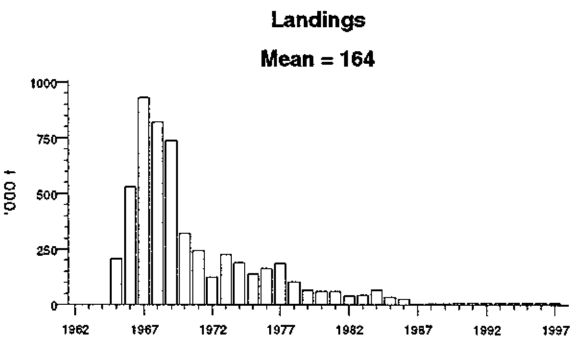
Spawning stock biomass
Mean = 2717



Precautionary Approach Plot



Mackerel North Sea



Mackerel Southern Area

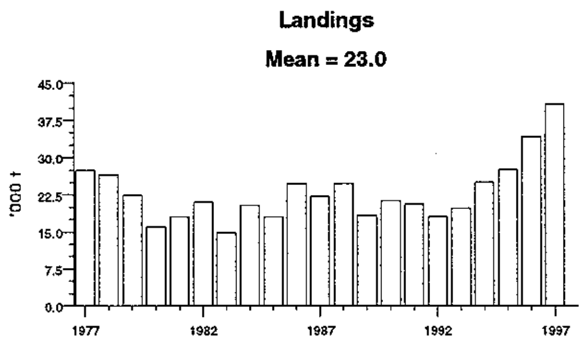


Table 3.12.3.a.1 Catches of MACKEREL by area. Discards not estimated prior to 1978. (Data submitted by Working Group members.)

Year	Sub-area VI			Sub-area VII and Divisions VIIIa,b,d,e			Sub-area IV and Division IIIa			Divs. IIa, 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

*Preliminary.
[1]For 1976–1985 only Division IIa.
[2]Discards estimated only for one fleet in recent years.

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
Poland						
United Kingdom			2,131	157	1,413	
USSR	4,293	9,405	11,813	18,604	27,924	12,088
Discards						
Total	98,222	78,096	101,112	47,186	120,404	90,488

Country	1990	1991	1992	1993	1994	1995	1996	1997[1]
Denmark	6,800	1,098	251			4,746	3,198	37
Estonia			216		3,302	1,925	3,741	4,422
Faroe Islands	3,100	5,793	3,347	1,167	6,258	9,032	2,965	7,628
France		23	6	6	5	5	0	270
Germany							1	-
Iceland							92	925
Latvia			100	4,700	1,508	389	233	-
Netherlands							561	-
Norway	77,200	76,760	91,900	110,500	140,708	93,315	47,992	41,000
Russia			42,440	49,600	28,041	44,537	44,545	50,207
United Kingdom	400	514	802		1,706	194	48	938
USSR[2]	28,900	13,631[2]						
Poland								22
Misreported (IVa)					-109,625	-18,647	-	-
Discards	2,300						-	-
Total	118,700	97,819	139,062	165,973	71,903	135,496	103,376	105,449

[1]Preliminary.
[2]Russia.

Table 3.12.3a.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	1984	1985	1986	1987	1988	1989	1990
Belgium	68		49	14	20	37	
Denmark	10,088	12,424	23,368	28,217	32,588	26,831	29,000
Estonia							
Faroe Islands		1,356				2,685	5,900
France		322	1,200	2,146	1,806	2,200	1,600
Germany, Fed. Rep.	112	217	1,853	474	177	6,312	3,500
Ireland						8,880	12,800
Latvia							
Netherlands	340	726	1,949	2,761	2,564	7,343	13,700
Norway	27,311	30,835	50,600	108,250	59,750	81,400	74,500
Sweden	1,440	760	1,300	3,162	1,003	6,601	6,400
United Kingdom	15	170	559	19857	1,002	38,660	30,800
USSR (Russia from 1990)							
Romania							
Misreported (IIa)							
Misreported (VIa)			148,000	117,000	180,000	92,000	126,000
Unallocated	-	-	7,391	8,948	29,630	6,461	-3,400
Discards	202	3,656	7,431	10,789	29,776	2,190	4,300
Total	39,576	50,466	243,700	301,618	338,316	281,600	305,100

Country	1991	1992	1993	1994	1995	1996	1997[1]
Belgium	125	102	191	351	106	62	114
Denmark	38,834	41,719	42,502	47,852	30,891	24,057	21,934
Estonia		400					-
Faroe Islands	5,338		11,408	11,027	17,883	13,886	1,367
France	2,362	956	1,480	1,570	1,599	1,316	1,532
Germany, Fed. Rep.	4,173	4,610	4,940	1,479	712	542	213
Ireland	13,000	13,136	13,206	9,032	5,607	5,280	280
Latvia		211					-
Netherlands	4,591	6,547	7,770	3,637	1,275	1,996	951
Norway	102,350	115,700	112,700	115,741	108,785	88,444	96,300
Sweden	4,227	5,100	5,934	7,099	6,285	5,307	4,714
United Kingdom	36,917	35,137	41,010	27,479	21,609	18,545	19,204
Russia							3,525
Romania				2,903			-
Misreported (IIa)				109,625	18,647	-	-
Misreported (VIa)	130,000	127,000	146,697	134,765	106,987	51,781	73,523
Unallocated	16,758	13,566	-	-	983	236	1,102
Discards	7,200	2,980	2,720	1,150	730	1,387	2,807
Total	365,875	367,164	390,558	473,977	322,099	212,839	227,566

[1] Preliminary.

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
Denmark	200	400	300	100		1,000	
Faroe Islands	9,200	9,900	1,400	7,100	2,600	1,100	1,000
France	12,500	7,400	11,200	11,100	8,900	12,700	17,400
Germany	11,200	11,800	7,700	13,300	15,900	16,200	18,100
Ireland	84,100	91,400	74,500	89,500	85,800	61,100	61,500
Netherlands	99,000	37,000	58,900	31,700	26,100	24,000	24,500
Norway	34,700	24,300	21,000	21,600	17,300	700	
Poland							
Spain	100				1,500	1,400	400
United Kingdom	198,300	205,900	156,300	200,700	208,400	149,100	162,700
USSR	200						
Unallocated	18000	75100	49299	26000	4700	18900	11,500
Misreported (IVa)			-148,000	-117,000	-180,000	-92,000	-126,000
Discards	12,100	4,500			5,800	4,900	11,300
Grand Total	479,600	467,700	232,599	284,100	197,000	199,100	182,400

Country	1991	1992	1993	1994	1995	1996	1997[1]
Denmark	1,573	194		2,239	1,443	1,271	-
Estonia					361		-
Faroe Islands	4,095		2,350	4,283	4,248	-	2,158
France	10,364	9,109	8,296	9,998	10,178	14,347	19,114
Germany	17,138	21,952	23,776	25,011	23,703	15,685	15,161
Ireland	64,827	76,313	81,773	79,996	72,927	49,033	52,849
Netherlands	29,156	32,365	44,600	40,698	34,514	34,203	22,749
Norway			600	2,552			-
Spain	4,020	2,764	3,162	4,126	4,509	2,271	7,842
United Kingdom	162,588	196,890	215,265	208,656	190,344	127,612	128,836
Unallocated	-3,802	1,472	0	4,632	28,245	10,603	4,577
Misreported (IVa)	-130,000	-127,000	-146,697	-134,765	-106,987	-51,781	-73,523
Discards	23,550	22,020	15,660	4,220	6,991	10,028	16,057
Grand Total	183,509	236,079	248,785	251,646	270,476	213,272	195,820

[1] Preliminary

Table 3.12.3.a.5 Landings (tonnes) of mackerel in Divisions VIIIc and IXa, 1977–1997. Data submitted by Working Group members.

Country	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
Spain[1]	19,852	18,543	15,013	11,316	12,834	15,621	10,390	13,852	11,810	16,533
Portugal[2]	1,743	1,555	1,071	1,929	3,108	3,018	2,239	2,250	4,178	6,419
Spain[2]	2,935	6,221	6,280	2,719	2,111	2,437	2,224	4,206	2,123	1,837
Poland[2]	8	-	-	-	-	-	-	-	-	-
USSR[2]	2,879	189	111	-	-	-	-	-	-	-
Total[2]	7,565	7,965	7,462	4,648	5,219	5,455	4,463	6,456	6,301	8,256
TOTAL	27,417	26,508	22,475	15,964	18,053	21,076	14,853	20,308	18,111	24,789

[1]Division VIIIc.

[2]Division IXa.

Country	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Spain[1]	15,982	16,844	13,446	16,086	16,940	12,043	16,675	21,146	23,631	28,386	35,015
Portugal[2]	5,714	4,388	3,112	3,819	2,789	3,576	2,015	2,158	2,893	3,023	2,080
Spain[2]	491	3,540	1,763	1,406	1,051	2,427	1,027	1,741	1,025	2,714	3,613
Poland[2]	-	-	-	-	-	-	-	-	-	-	-
USSR[2]	-	-	-	-	-	-	-	-	-	-	-
Total[2]	6,205	7,928	4,875	5,225	3,840	6,003	3,042	3,899	3,918	6,737	5,693
TOTAL	22,187	24,772	18,321	21,311	20,780	18,046	19,719	25,045	27,549	34,123	40,708

[1]Division VIIIc.
[2]Division IXa.

Table 3.12.3.a.6 Mackerel in the North East Atlantic.

Year	Recruitment Age 0	Spawning Stock Biomass	Landings	Fishing Mortality Age 4-8
1984	7,281.32	2,748.70	648.08	0.198
1985	3,463.65	2,708.07	614.28	0.194
1986	3,386.45	2,736.81	602.13	0.173
1987	5,799.15	2,725.60	654.81	0.203
1988	3,805.09	2,827.00	676.29	0.215
1989	5,086.01	2,883.12	585.92	0.172
1990	3,026.78	2,768.66	625.61	0.178
1991	3,473.24	3,144.92	667.88	0.192
1992	4,007.43	3,157.60	760.35	0.223
1993	5,039.51	2,853.05	825.04	0.286
1994	3,020.78	2,556.34	822.57	0.281
1995	5,185.07	2,598.04	756.19	0.270
1996	3,872.00	2,456.11	563.59	0.208
1997	.	2,530.00	569.54	.
1998	.	2,648.68	.	.
Average	4,342.04	2,756.18	669.45	0.215
Unit	Millions	1000 tonnes	1000 tonnes	-

Table 3.12.3.a.7 Mackerel in the Western Area (Fishing Areas VI, VII and VIII).

Year	Recruitment Age 0	Spawning Stock Biomass	Landings	Fishing Mortality Age 4-8
1972	2,107.32	3,289.31	170.78	0.032
1973	4,567.74	3,411.80	219.45	0.076
1974	3,612.71	3,459.73	298.05	0.093
1975	4,974.74	3,222.51	491.38	0.205
1976	5,174.55	2,866.24	507.18	0.226
1977	1,073.15	2,853.98	325.97	0.112
1978	3,425.13	3,037.11	503.91	0.153
1979	5,516.17	2,701.48	605.74	0.215
1980	5,746.32	2,301.20	604.76	0.241
1981	7,329.03	2,412.90	661.76	0.191
1982	2,064.17	2,298.72	623.82	0.191
1983	1,611.00	2,539.12	614.29	0.190
1984	7,052.74	2,535.59	550.93	0.177
1985	3,245.05	2,577.12	561.29	0.181
1986	3,461.88	2,537.27	537.62	0.187
1987	5,226.31	2,545.32	615.38	0.183
1988	3,546.49	2,657.56	628.00	0.193
1989	4,575.76	2,661.11	567.40	0.156
1990	2,988.99	2,481.04	605.94	0.160
1991	3,471.52	2,866.26	646.17	0.200
1992	4,014.76	2,876.95	742.31	0.231
1993	5,418.49	2,622.01	805.04	0.291
1994	3,167.10	2,347.32	797.69	0.293
1995	4,813.22	2,442.84	728.64	0.289
1996	6,637.00	2,384.15	529.46	0.208
Average	4,192.85	2,717.15	557.72	0.187
Unit	Millions	1000 tonnes	1000 tonnes	-

Table 3.12.3.a.8 North Sea Mackerel (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	133[5]	67[4]
1985		35[4]
1986	45[5]	25[4]
1987		3[4]
1988	37[5]	6
1989		7
1990	78[5]	10
1991		-[6]
1992		-[6]
1993		-[6]
1994		-[6]
1995		-[6]
1996	110[5]	-[6]
1997		-[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

6 Since 1990 assumed by the Working Group to be 10,000 t

3.12.3.b Response to NEAFC Request on the Spatial Distribution of Mackerel

The North-East Atlantic Fisheries Commission has requested ICES to:

Collect and evaluate the available data on the area distribution of mackerel in the NEAFC area for juvenile as well as parental components and advise NEAFC on what further research is needed in order to give a comprehensive description of the distribution and possible technical interaction.

Response:

Summaries of the available information compiled at the NEAFC Study Group which met in Aberdeen in June 1998 and updated at the ICES Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine and Anchovy (WGMHSA) in September 1998 are provided below, based on international catches, egg surveys, tagging experiments and trawl surveys. Compilation of mackerel catch distributions was problematic as NEAFC did not provide permission for ICES to use a database of spatially-distributed mackerel catch data that had been compiled at a workshop held in June 1998 under NEAFC auspices. Eventually, member governments provided permission individually for the relevant information to be used.

Distribution of Commercial Catches

A database of commercial catches by country, month and rectangle from 1977 to 1997 was assembled at a NEAFC Workshop in Aberdeen 14–18 June 1998. As stated in the report from that meeting, the database has been updated at the WGMHSA meeting to include full Norwegian and Faroese data. The data available to the database otherwise remain as stated in the NEAFC Workshop report.

The database is now substantially complete for the period 1977 to 1997. The main weakness was the missing Norwegian data for years other than ICES triennial mackerel egg survey years, and this has now been amended. It is now possible to query the database for any combination of country, month, year, rectangle and ICES Division. Maps are presented of total catch by rectangle for all nations for 1997, 1996 and 1995 (Figures 3.12.3.b.1–3). Maps showing mean annual distributions for the early 1990s, late 1980s, early 1980s, and late 1970s are presented in Figures 3.12.3.b.4–7. These figures represent means and so tend to be smoother and of lower amplitude than single year data. The outputs offered in this report only represent the potential of the database and ideally it should be used to answer specific questions pertaining to management. As an example data could be grouped by year to illustrate known changes in the pattern of the fishery, e.g. the development in international waters or the changes in time and space of the pre-spawning migration.

Distribution of Juveniles

Data on juvenile distributions are mainly derived from the results of bottom trawl surveys in the North Sea and NE Atlantic areas. Some of these data were assembled for the EU-funded Shelf Edge Fisheries and Oceanography Studies Project (SEFOS) and exist as a database held in Aberdeen. This covers the years 1983 to quarter 1 1997. These surveys are mainly carried out in the first and fourth quarters of the year. Data from small numbers of surveys in the second and third quarters were also included, but these are far from complete.

Evaluation

The surveys represent a good coverage of the distributions of young mackerel (up to 2 years old) for the North Sea and western shelf in the first and fourth quarters. They do not cover the second and third quarters. They do not cover the shelf off the Norwegian coast, Faroe Islands, Rockall or Iceland, all of which may be important juvenile areas. The other main problem with these data is that of unsampled rectangles. Not all rectangles are sampled in all years, so there are problems in comparing catch rates from one area to another. One solution to this problem would be to use the data as it exists and develop inclusive contoured maps. This would allow more quantitative comparisons to be made. This has not been done to date. Maps are presented for 1990–1994 of mean catch rates for ages 0 and 1 in quarter 4 and ages 1 and 2 for quarter 1 (Figures 3.12.3.b.8–11).

Distribution of Adults

Distributions from egg surveys

Historical information is available on the distribution of stage 1 mackerel eggs from triennial surveys in the western area from 1977 to 1998, the southern area since 1992 and regular surveys in the North Sea since 1967. Stage 1 eggs are less than three days old and their distribution can therefore be used to provide a detailed record of the temporal and spatial distribution of spawning adults. Maps of the mean egg distributions by month from the egg surveys 1977 to 1995 are presented in Figures 3.12.3.b.12–16. A distribution for mackerel spawning in the North Sea is presented in Figure 3.12.3.b.17.

The data show that spawning occurs along the Portuguese and Spanish coasts, along the Cantabrian Shelf and northwards from southern Biscay through the Celtic Sea to west of Ireland and off the west coast of Scotland. Spawning also occurs in the central North Sea.

Spawning begins in the southern area in late January and extends through to June off the Cantabrian coast. It begins in February in southern Biscay and extends through to July in the western area. In the North Sea spawning is later, beginning in mid May and extending through to the end of July.

Spawning in the southern and western areas tends to be strongly associated with the shelf edge particularly early in the season, but does eventually spread over the shelf. In recent years in the western area there has been a noticeable increase in the spawning off the shelf edge over very deep water.

The time series of surveys in the western area show that there has been a gradual extension of the spawning area northwards although the major egg densities still occur in the vicinity of the Little Sole and Great Sole Banks.

Distributions from tagging

Between the early 1970s and 1997 several tagging experiments on mackerel were conducted in order to clarify the major migration pattern of this species (Eaton 1980, Hamre 1980, Rankine and Walsh 1982, Bakken and Westgard 1986, Iversen and Skagen 1989). A summary of these results was presented by Lockwood (1988) and in ICES (1990/H:5). These tagging experiments demonstrated that in the early 1980s western mackerel moved further to the north and east on its feeding migration in summer and autumn time compared to previous years. Since the beginning of the 1980s up to the present adult mackerel reach Divisions IIa, IVa and Vb in a larger proportion during the second half of the year than during the 1970s and there it mixes with the North Sea stock.

Recent tagging experiments made in the 1990s have shown that adult mackerel spawning off the North of the Iberian Peninsula also join the northern migration to Divisions IIa, IVa and Vb during the second half of the year: In 1994 a tagging experiment was carried out within the international project co-funded by the European Commission, entitled *"Shelf Edge Fisheries and Oceanography Studies"* (SEFOS project, AIR92-CT1905), which first showed the connections between the southern and northern mackerel (Figures 3.12.3.b.18–21). In 1997 an international tagging programme (EU Study Project contract 96-035, Uriarte *et al.* 1998) has confirmed the parallel migration patterns of adult mackerel from the southern or western areas.

Distributions from acoustic, trawl and other surveys

The only full scale specific fisheries independent survey for mackerel is the ICES triennial mackerel and horse mackerel egg survey. This can be used to infer adult distributions, in the first half of the year. Smaller scale studies of the distribution of mackerel during their pre and post spawning migrations were carried out as part of the SEFOS project, and these provide valuable data on the distribution of the fish in some parts of the NEA area at some times. However, these studies were intended primarily as research and not assessment surveys. The surveys were carried out by Norway, Scotland and the Netherlands. The Scottish and Dutch surveys covered the start of the pre-spawning migration in the northern North Sea and VIa in the winter of 94/95, 95/96 and 96/97. The Norwegian surveys covered the start of the post spawning migration in an area bounded by the Faroes, Tampen Bank and the Scottish west coast in July 1994, 1995 and 1996.

There are also a number of other surveys carried out from which valuable data on mackerel distributions could be extracted. These fall into two main categories: acoustic surveys and trawl surveys. The following sections represent the surveys known to ICES which may provide useful data and which should be evaluated.

Acoustic surveys

1. ICES combined Atlanto-Scandian herring survey in the Norwegian Sea. May to August. Iceland, Faroes, Norway, Russia and EU. These surveys are targeted on AS herring, but it may be possible to produce mackerel distributions over a large part of the Norwegian Sea from existing acoustic survey data and pelagic trawl haul data.

2. ICES co-ordinated herring acoustic survey of the North Sea and adjacent areas. June to July. Scotland, Ireland, Norway, Denmark, Germany and the Netherlands. These surveys are targeted on herring, but it may be possible to produce mackerel distributions over most of the North Sea and Divisions VIa and VIIb from existing acoustic survey data and pelagic trawl haul data.

3. Irish Celtic Sea herring acoustic surveys. October to January. Ireland and Scotland. These surveys are targeted on herring, but it may be possible to produce mackerel distributions over parts of the Celtic Sea and Division VII from existing acoustic survey data and pelagic trawl haul data.

4. French pelagic acoustic surveys in Biscay. May. France. These surveys are targeted on all pelagic species including mackerel and produce mackerel distributions over most of the Biscay shelf area off France. These are primarily fisheries ecology surveys but mackerel distributions are available.

5. Spanish acoustic surveys for sardine. March. Spain. These surveys are targeted on sardine, but it may be possible to produce mackerel distributions on the Galician coast, Cantabrian Sea and south Biscay from existing acoustic survey data and pelagic trawl haul data.

6. Portuguese acoustic surveys for sardine. March and November. Portugal. These surveys are targeted on

sardine, but it may be possible to produce mackerel distributions in Division IXa from existing acoustic survey data and pelagic trawl haul data.

Actually extracting usable mackerel data from the historical analyses of these surveys may be impossible. However, the operators are encouraged to at least consider mackerel in the planning and analysis of these surveys in the future.

Bottom trawl surveys

There are many bottom trawl surveys carried out across the European shelf. For the purposes of the study of mackerel distribution these are most useful for recruit distributions. However, adult mackerel are also caught in these surveys, and it may be possible to analyse these data to give presence/absence distributions or to apply some simple categorical abundance scale.

Pelagic trawl surveys

Only one specific pelagic trawl survey is known of by ICES. This is a shorts series of pilot surveys conducted by the Faroes using pair trawls. These surveys provide some data on the distribution of mackerel around the Faroes in August 1996–98 (Belikov *et al.* 1998).

Aerial surveys

Russian aerial sighting surveys for mackerel and herring conducted in the Norwegian Sea in June–September 1997 (Shatokhin *et al.* WD 1998) and in July–August 1998 (Zabavnikov *et al.* WD 1998) are a promising new method to survey the summer and autumn distribution of mackerel in the Northeast Atlantic. The aerial flights were initially intended to scout large areas of the Norwegian Sea to guide the fishing fleet to the areas where pelagic schools were observed. The flights first revealed the temperature and frontal zones in the sea with high likelihood for concentrations of pelagic species. If schools were observed the fleet was contacted so that they could fish the observed schools to identify the species (mackerel or herring). A second flight was then undertaken in the area using specific methods in order to get an estimate of the size of the schools and possibly a biomass estimate after the vessels had identified the species in the schools (for more detail, see Shatokhin *et al.* WD 1998 and Zabavnikov *et al.* WD 1998). An overview of the technique and equipment in this monitoring system at PINRO and STC-Complex Systems is shown in Figure 3.12.3.b.22. A preliminary quantitative rapid biomass estimate of mackerel found in the surveyed area (63°-71°N 10°-06° W) with an allowance for mean size, weight, calculated size of schools discovered was about 400,000 tonnes. However, this method has not been evaluated and so this biomass figure should be treated as preliminary only. Furthermore, information on the distribution and behaviour of mackerel in schools can be obtained from these aerial surveys.

By-catch data

There are at least three current projects on discarding by commercial vessels, which may provide data on mackerel distributions. These are all EU-funded projects and are directed at both pelagic and demersal fisheries. The projects involve Ireland, Spain, Portugal, France, Scotland, Norway and others.

Advice on Further Research

The current knowledge of distributions of juvenile mackerel is restricted to the European shelf in quarters 1 and 4 for juveniles. For adults the distribution in the second quarter can be inferred from the egg surveys, and some parts of the distribution in the remainder of the year from commercial data. Commercial data have the drawback that they are restricted spatially and temporally by quotas, management regimes and fleet behaviour, and so can only provide a partial and potentially biased representation of the true adult distribution.

For juveniles, the main research requirements are to establish the distributions in quarters 2 and 3 from other available bottom trawl survey data. The primary source of continuing data collection remains the mackerel recruit and IBTS bottom trawl surveys, and the intensity of these surveys should be returned to historic levels.

For adults, the main requirement is to develop an understanding of the post spawning migration and distribution in the third and fourth quarters. Currently only commercial data are available on a usable scale. As mentioned above these are likely to be biased, A number of attempts have been made to produce a comprehensive appraisal of the post-spawning migration, e.g. the mackerel migration map produced for the SEFOS project and presented in modified form in the report of the June 1998 NEAFC Workshop in Aberdeen, or the migration described from Russian/Faroes data presented at the Lisbon 1998 ICES ASC (Belikov *et al.* 1998). Such descriptions invariably result in controversy as they are produced using partial data. ICES considers it essential that all the potential data sources be 1) evaluated by all interested parties to derive the best possible appraisal of the pattern of migration and the interannual variability in this, and 2) to develop as comprehensive as possible distribution data. It should be emphasised that any interpretation of migration based on incomplete data can only be subjective.

To this end it is proposed that as a first step a workshop should be convened under the joint auspices of ICES and NEAFC. This workshop should:

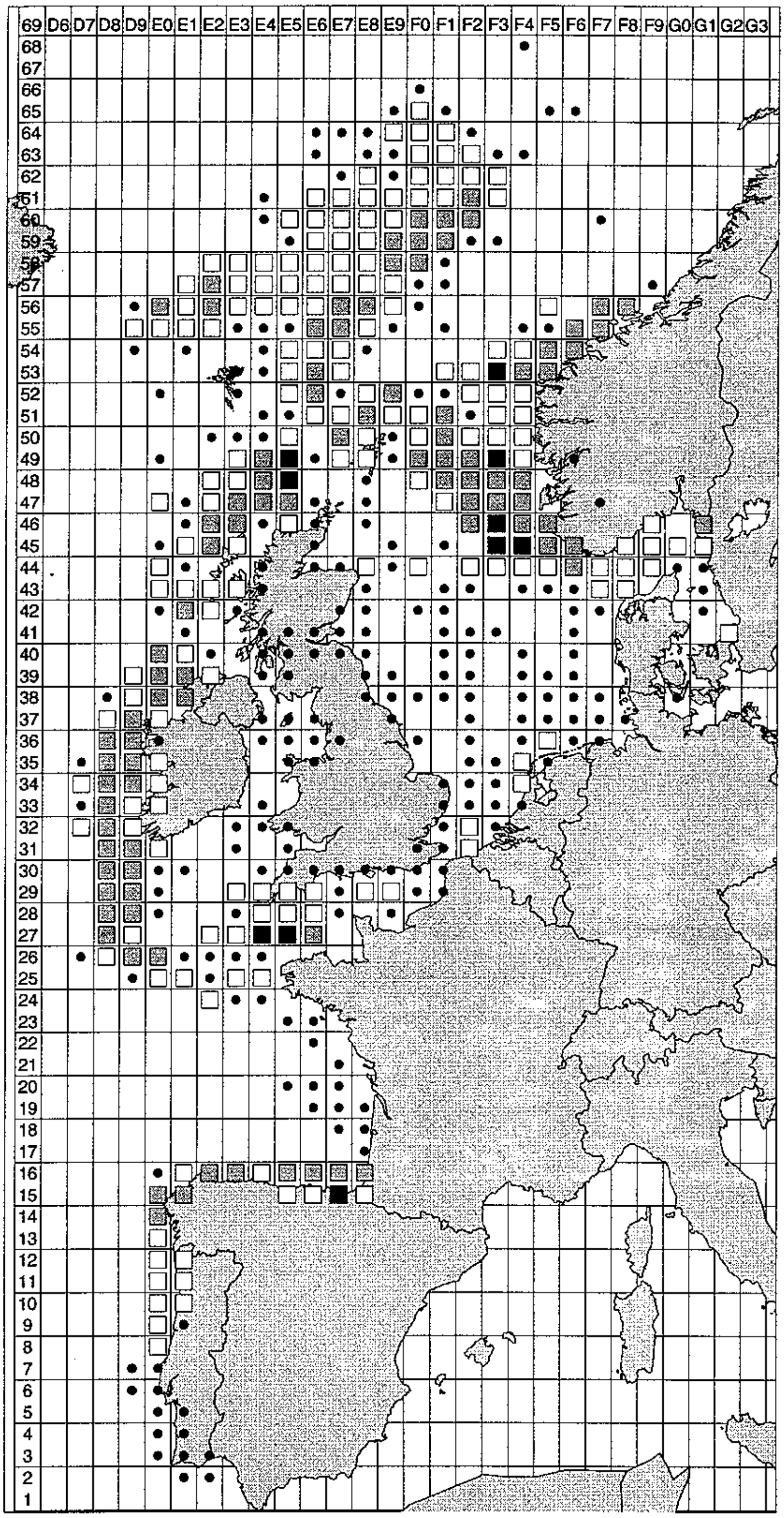
- Find out what relevant data are available,
- Evaluate these data,
- Assemble the data,
- Produce agreed distributions for all time periods but particularly 3rd and 4th quarters.

It is also clear that understanding of distributions and migrations would be improved a great deal by extensive study of the distribution of adult mackerel in the second half of the year. This could be by the use of traditional research vessel surveys (combined acoustic, sonar and trawl). However, strong consideration should be given to the type of aerial survey used recently by Russia to study the mackerel distribution. If achievable this would be a rapid and cost effective way of acquiring data over an extensive area like the Norwegian Sea. This could be combined with research vessel work.

Conclusions

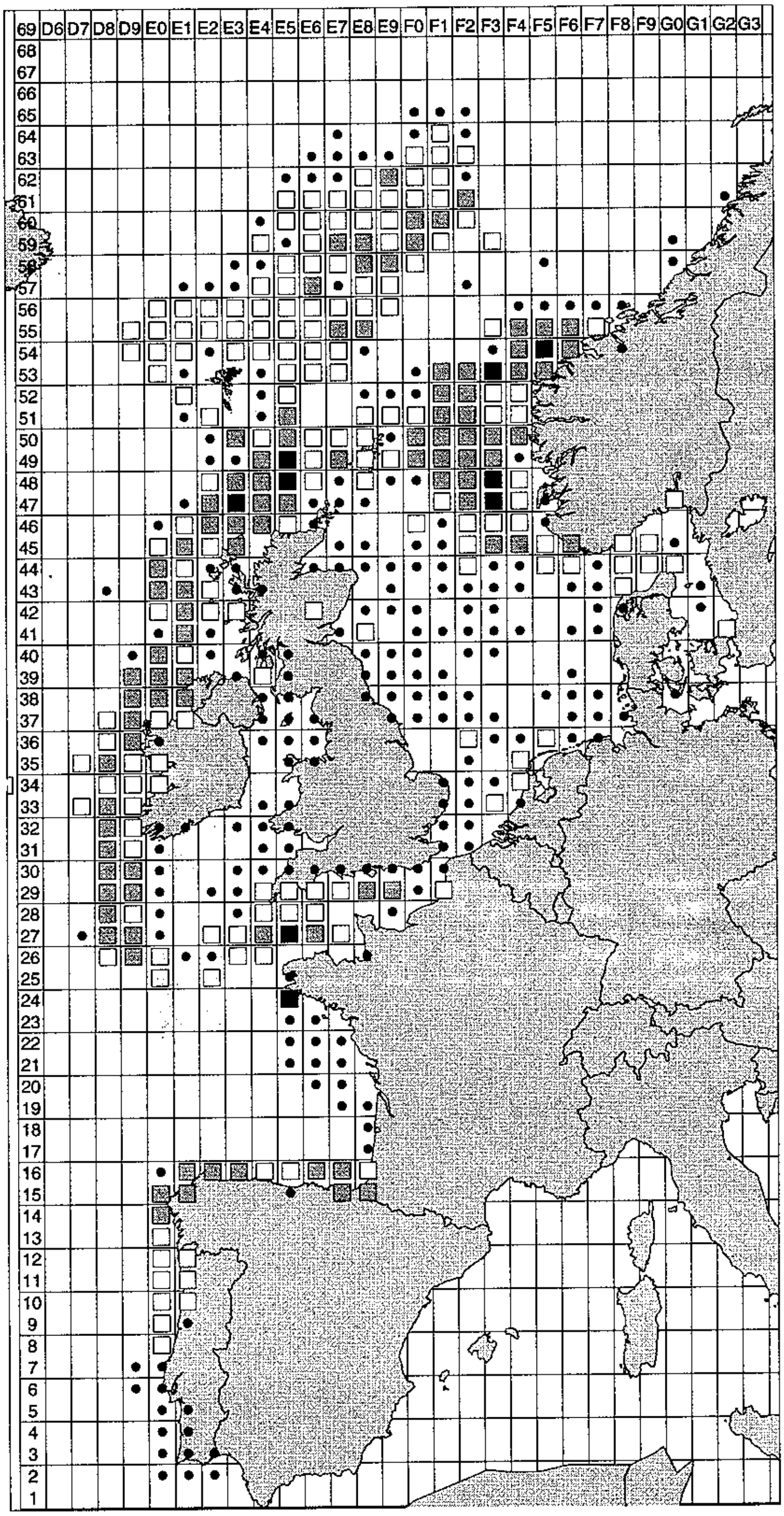
The request from NEAFC to ICES was to collect and evaluate data on the area distribution of mackerel in the NEAFC area for juvenile and parental components and to advise NEAFC on further research in order to give a comprehensive description of the distribution and possible technical interaction. Little further progress on the collection of data has been made since the NEAFC Workshop held in June in Aberdeen with the exception of the updating of the Faroese and Norwegian data. The evaluation of the existing data is presented above. In the absence of requests for specific interrogations of the database, or of responses to the data presented in the report of the June 1998 NEAFC Workshop in Aberdeen, ICES has not attempted any further analysis of the data.

The advice on research requirements is centred on the need to broaden the temporal and spatial coverage in the existing data sets to cover all parts of the year and all relevant areas, most importantly, the path of the migrations into the Norwegian Sea in the second half of the year, and the juvenile distributions in quarters 2 and 3.



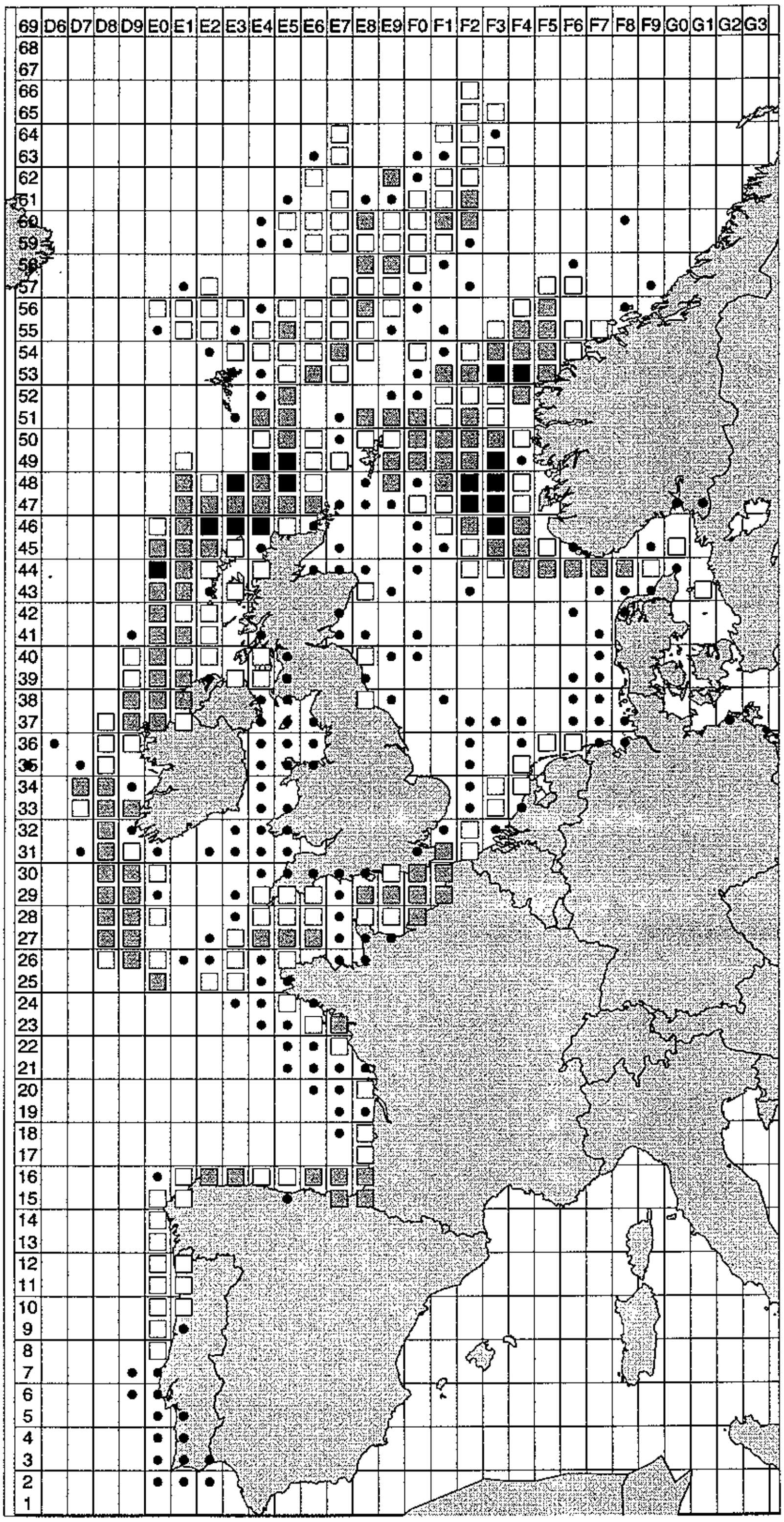
■ > 10,000 tonnes
▩ 1,000 to 10, 000 tonnes
□ 100 to 1,000 tonnes
• < 100 tonnes

Figure 3.12.3.b.1 Distribution of mackerel catches 1997 (WG 1998 data).



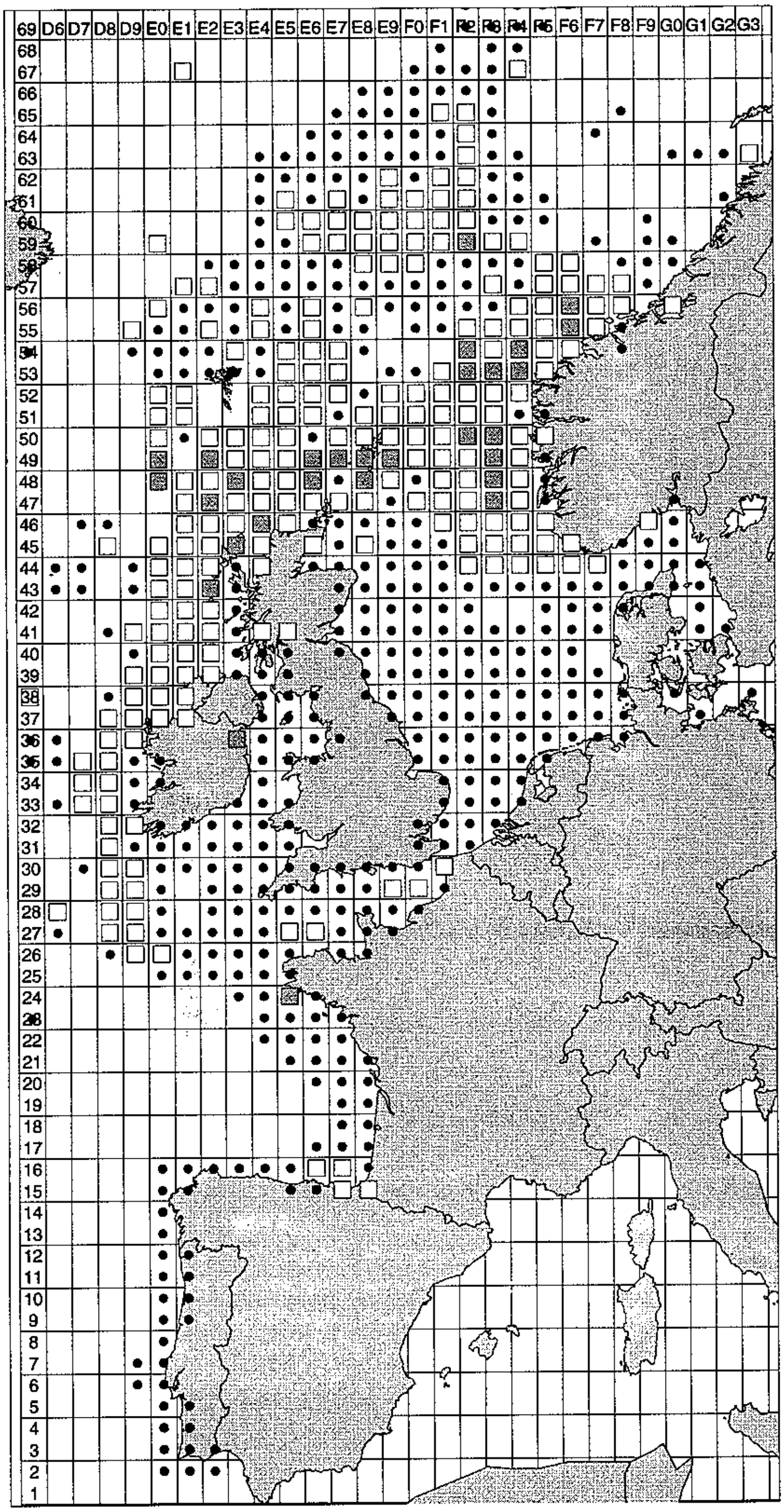
■ > 10,000 tonnes
▩ 1,000 to 10, 000 tonnes
□ 100 to 1,000 tonnes
• < 100 tonnes

Figure 3.12.3.b.2 Distribution of mackerel catches 1996 (NEAFC database data).



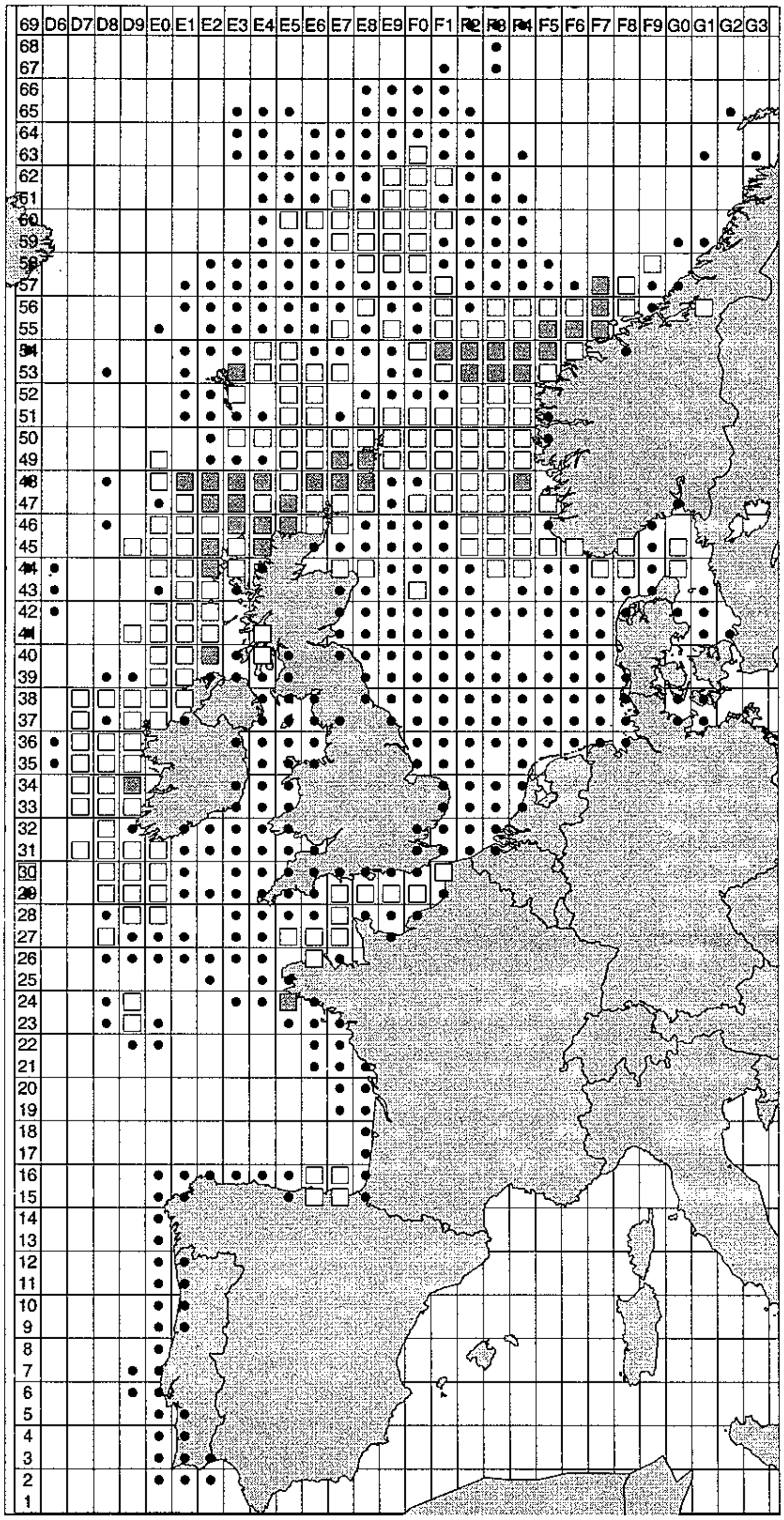
■ > 10,000 tonnes
▩ 1,000 to 10, 000 tonnes
□ 100 to 1,000 tonnes
• < 100 tonnes

Figure 3.12.3.b.3 Distribution of mackerel catches 1995 (NEAFC database data).



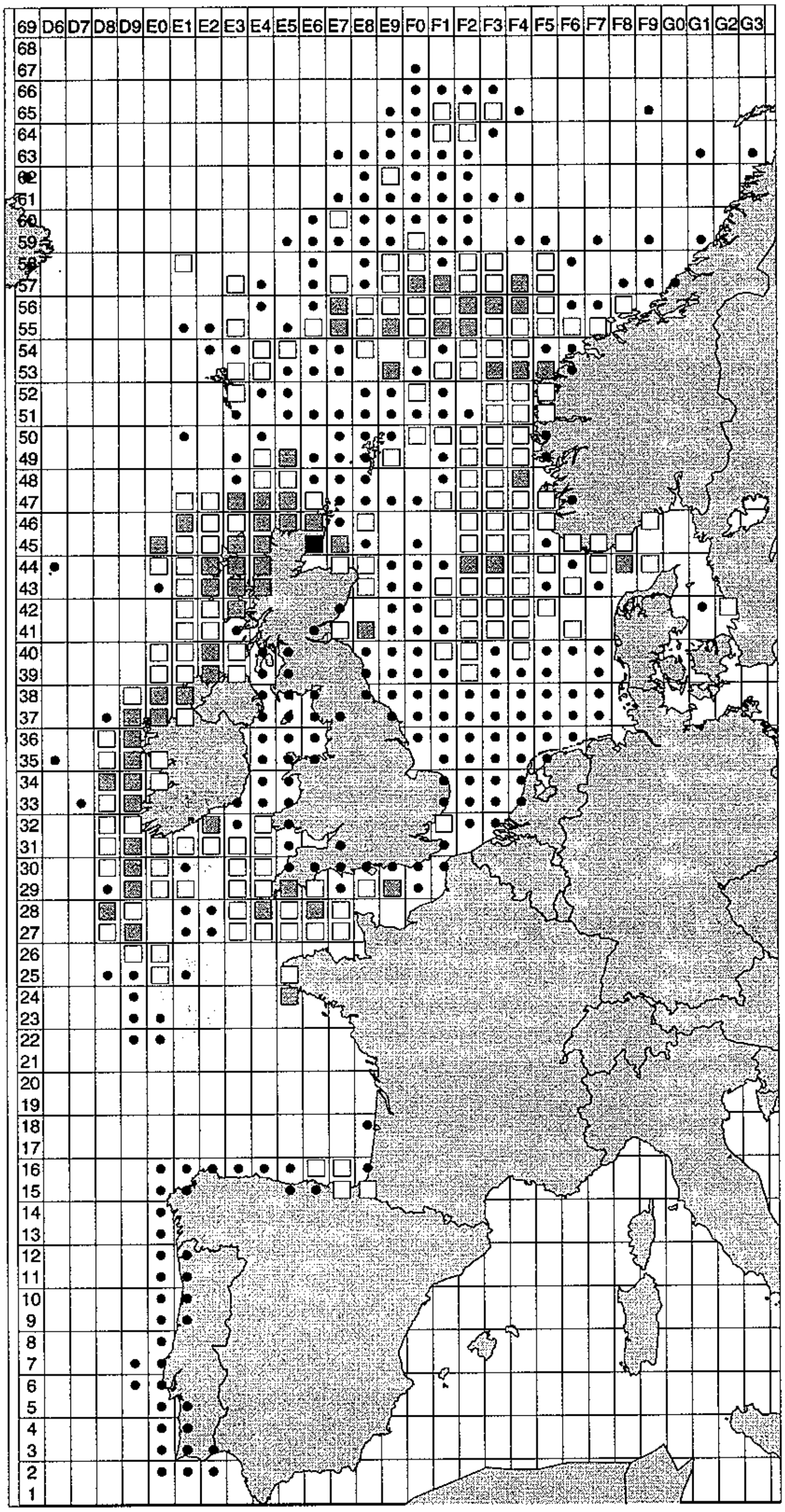
■ > 10,000 tonnes
▩ 1,000 to 10, 000 tonnes
□ 100 to 1,000 tonnes
• < 100 tonnes

Figure 3.12.3.b.4 Mean distribution of mackerel catches 1990 - 94 (NEAFC database data).



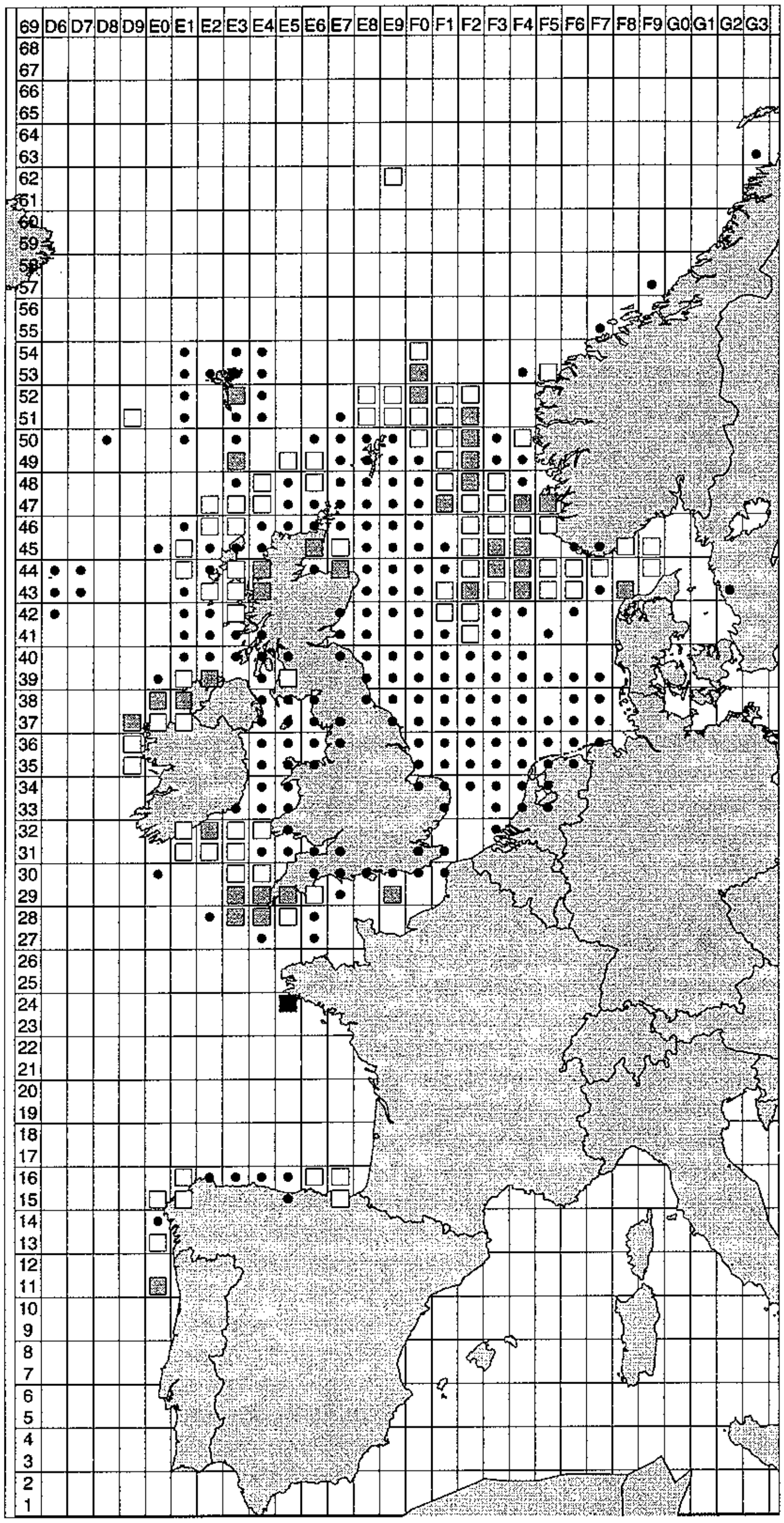
■ > 10,000 tonnes
▩ 1,000 to 10, 000 tonnes
□ 100 to 1,000 tonnes
• < 100 tonnes

Figure 3.12.3.b.5 Mean distribution of mackerel catches 1985 - 89 (NEAFC database data).



■ > 10,000 tonnes
▩ 1,000 to 10, 000 tonnes
□ 100 to 1,000 tonnes
• < 100 tonnes

Figure 3.12.3.b.6 Mean distribution of mackerel catches 1980 - 84 (NEAFC database data).



■ > 10,000 tonnes
▩ 1,000 to 10, 000 tonnes
□ 100 to 1,000 tonnes
• < 100 tonnes

Figure 3.12.3.b.7 Mean distribution of mackerel catches 1977 - 79 (NEAFC database data).

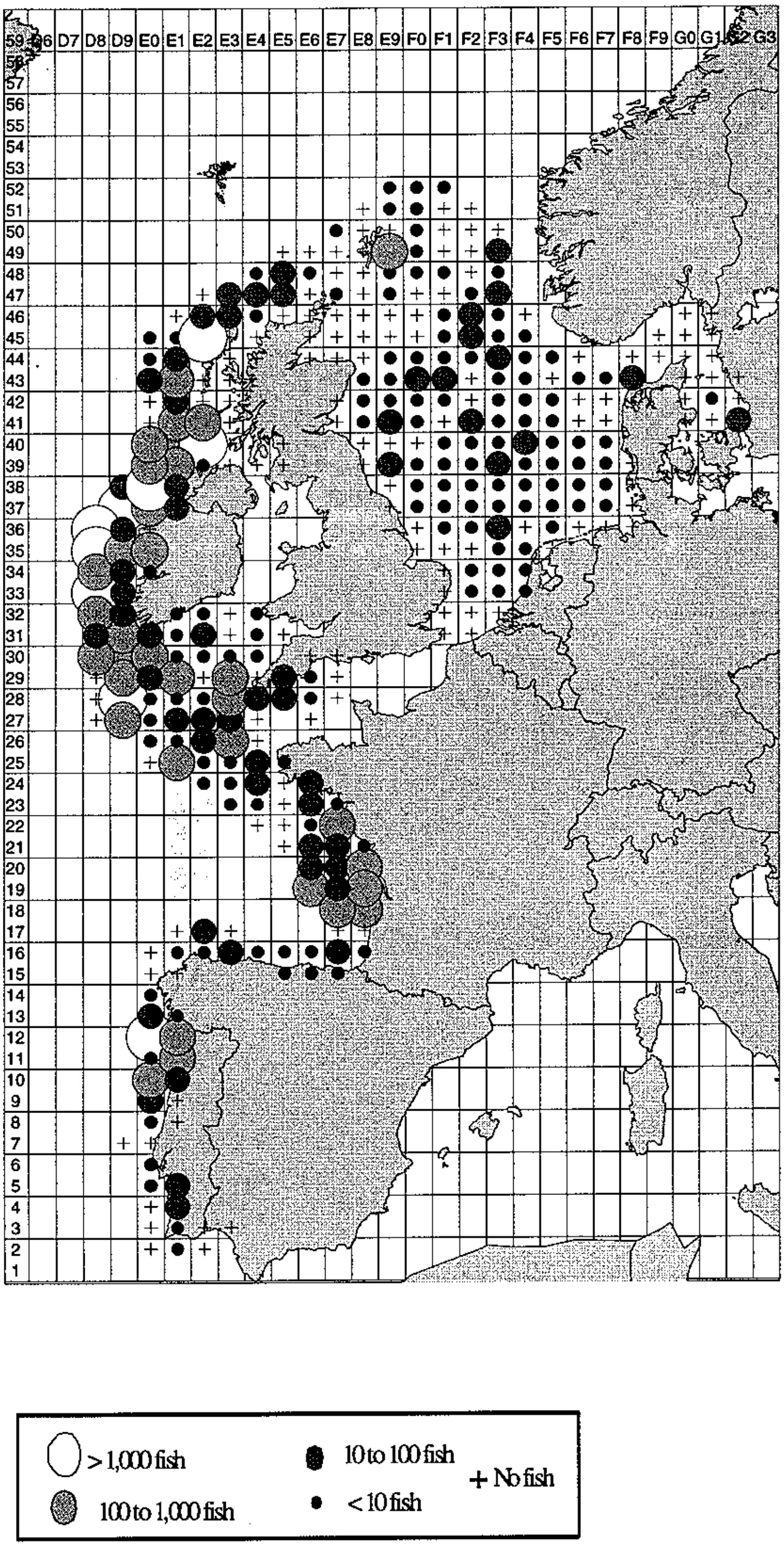


Figure 3.12.3.b.8 Mean distribution of mackerel recruits. Quarter 4 – Age 0 1990 - 94 (Catch rates per hour).

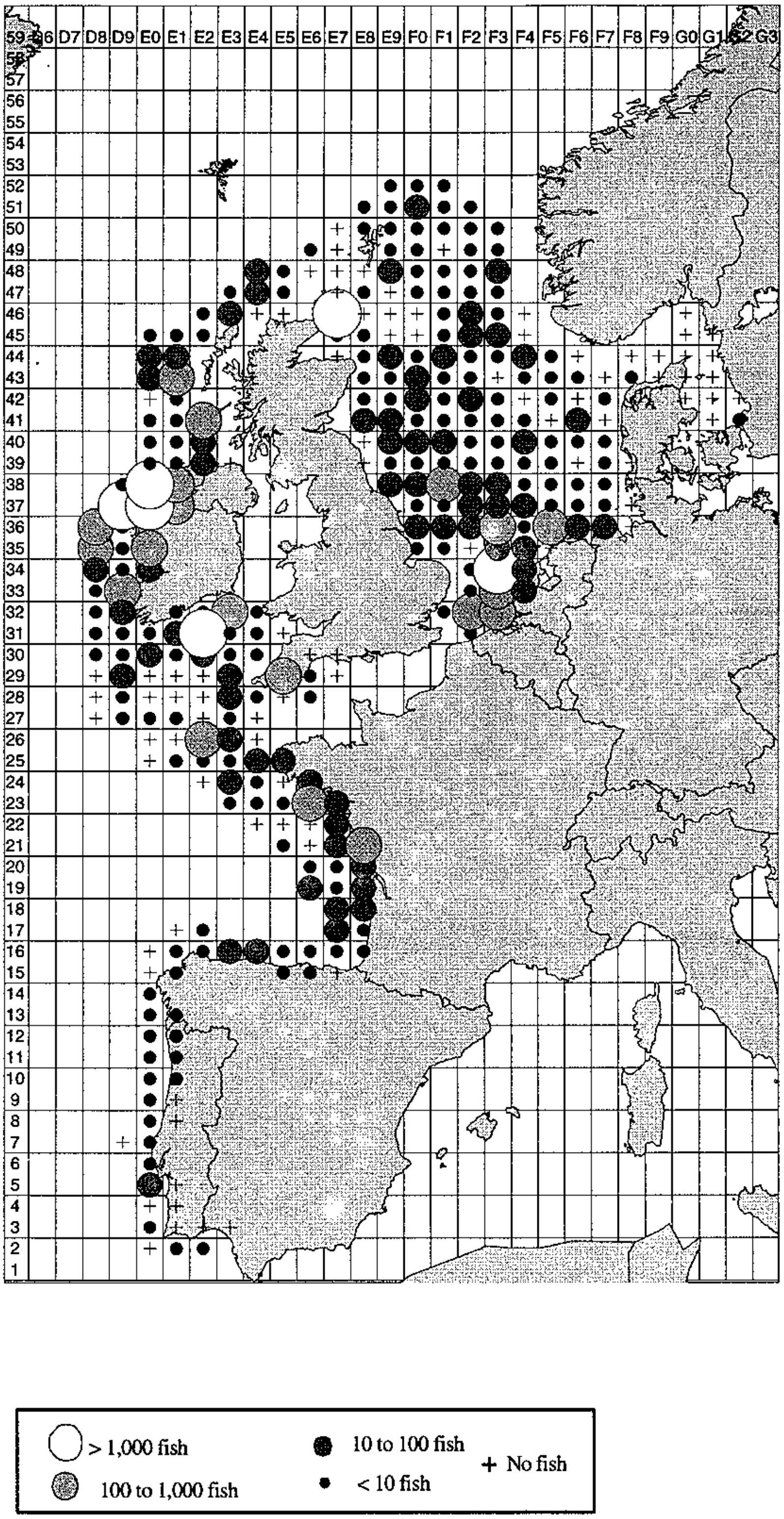


Figure 3.12.3.b.9 Mean distribution of mackerel recruits. Quarter 4 – Age 1 1990–1994 (Catch rates per hour).

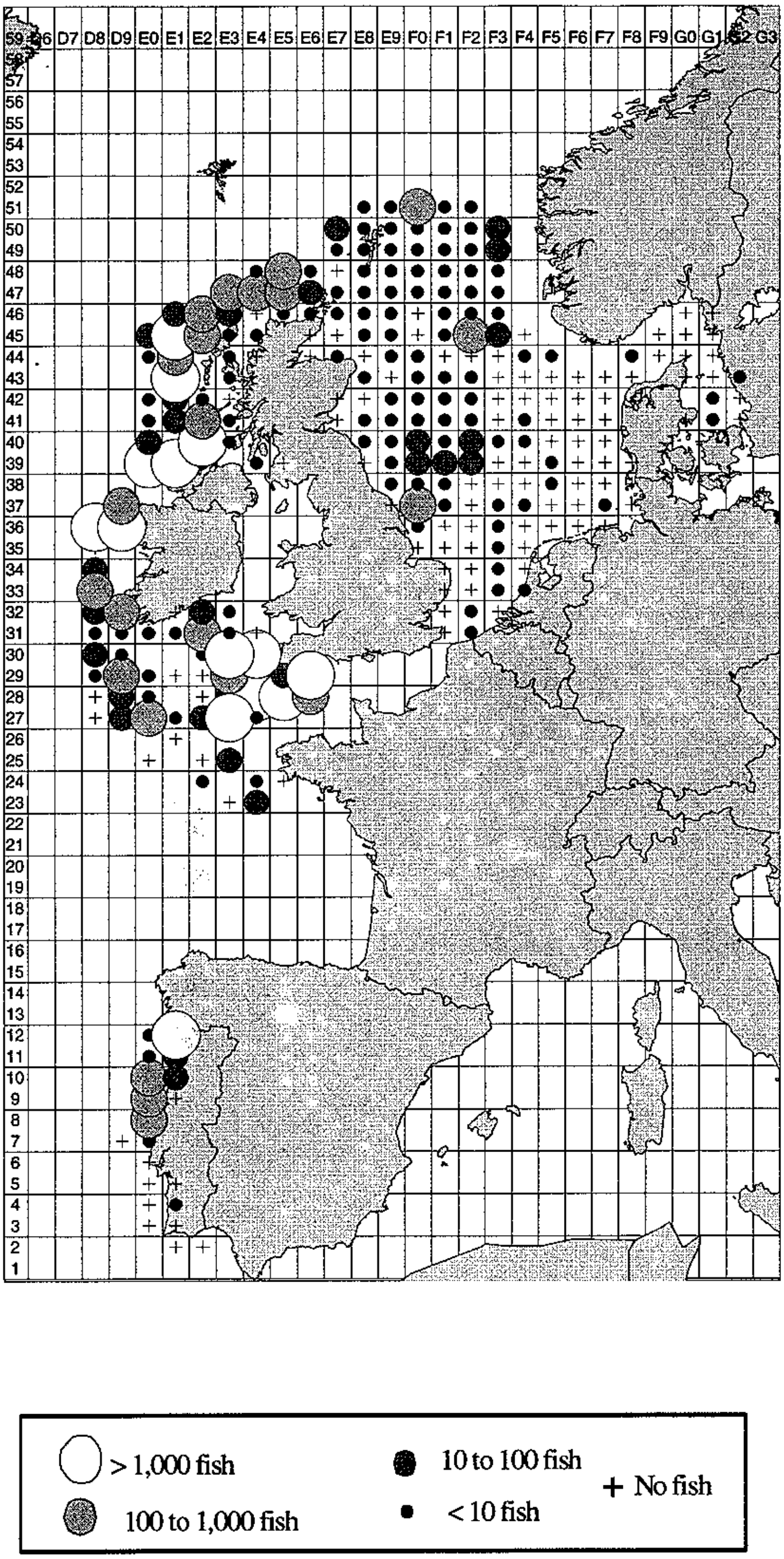


Figure 3.12.3.b.10 Mean distribution of mackerel recruits. Quarter 1 – Age 1 1990–1994 (Catch rates per hour).

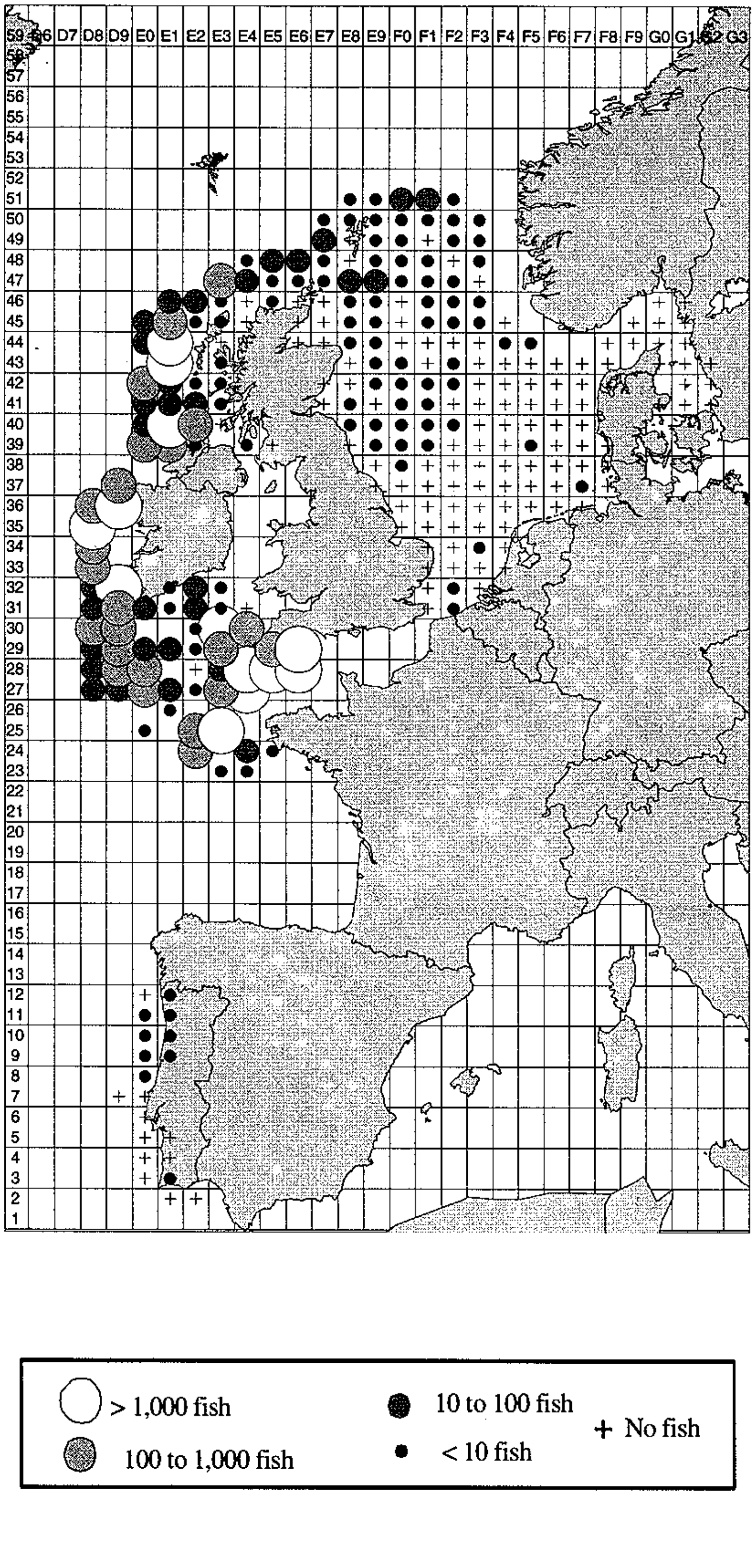


Figure 3.12.3.b.11 Mean distribution of mackerel recruits. Quarter 1 – Age 2 1990–1994 (Catch rates per hour).

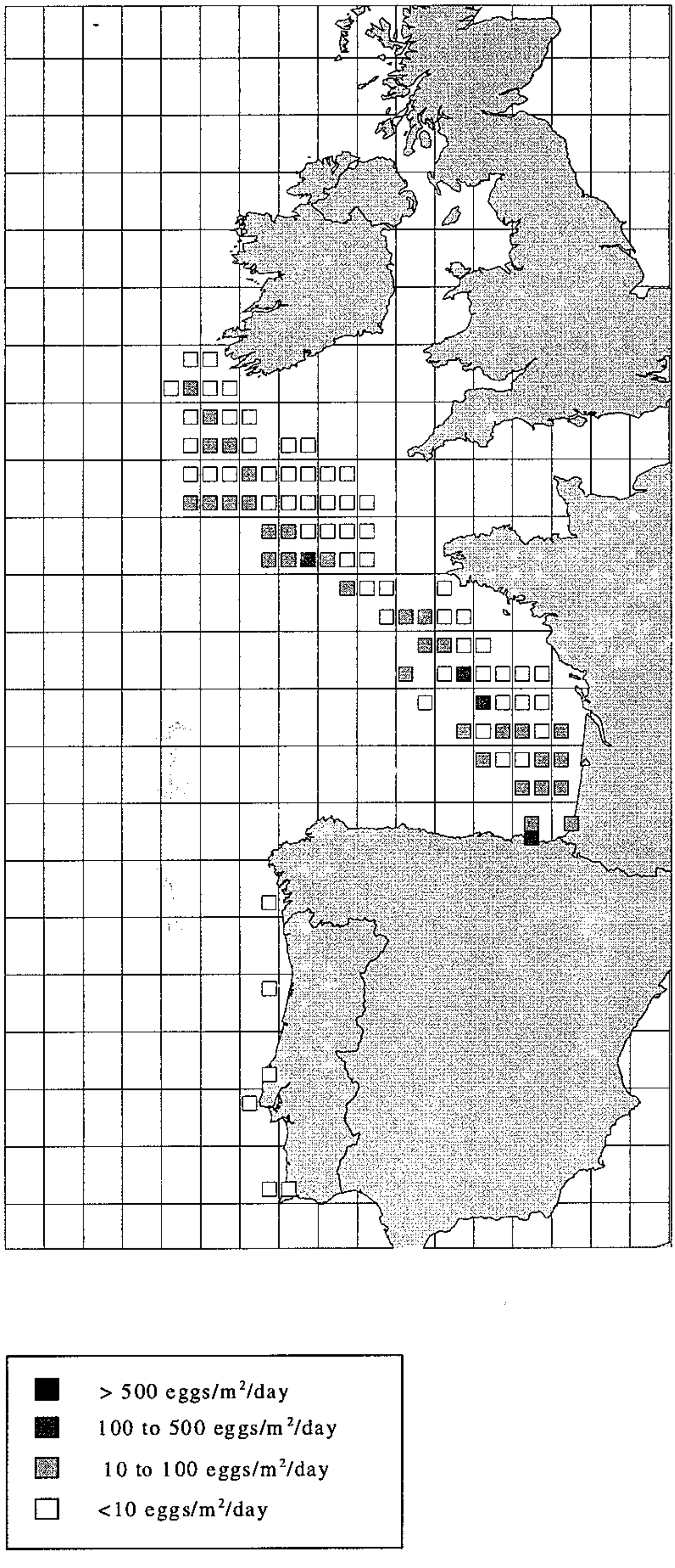


Figure 3.12.3.b.12 Mean mackerel stage 1 egg distributions from egg surveys. March 1977 to 1995.

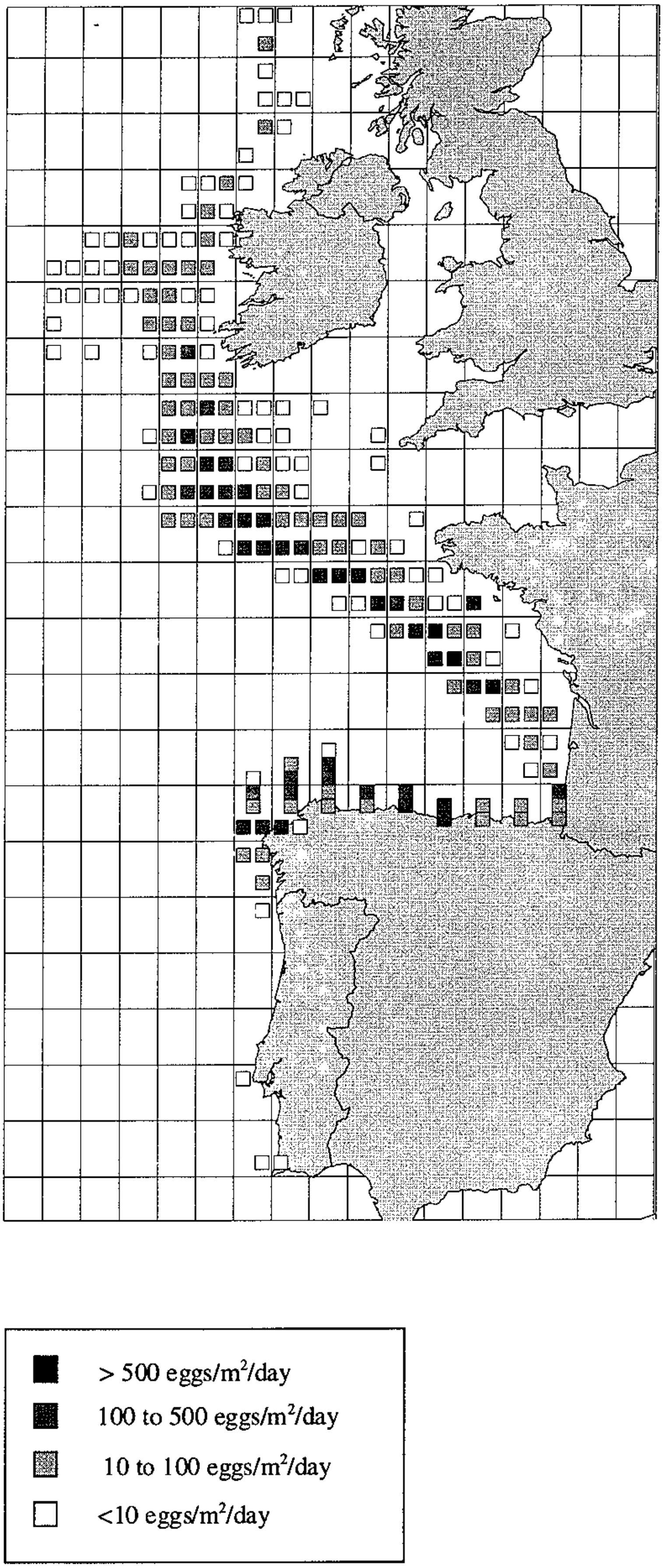
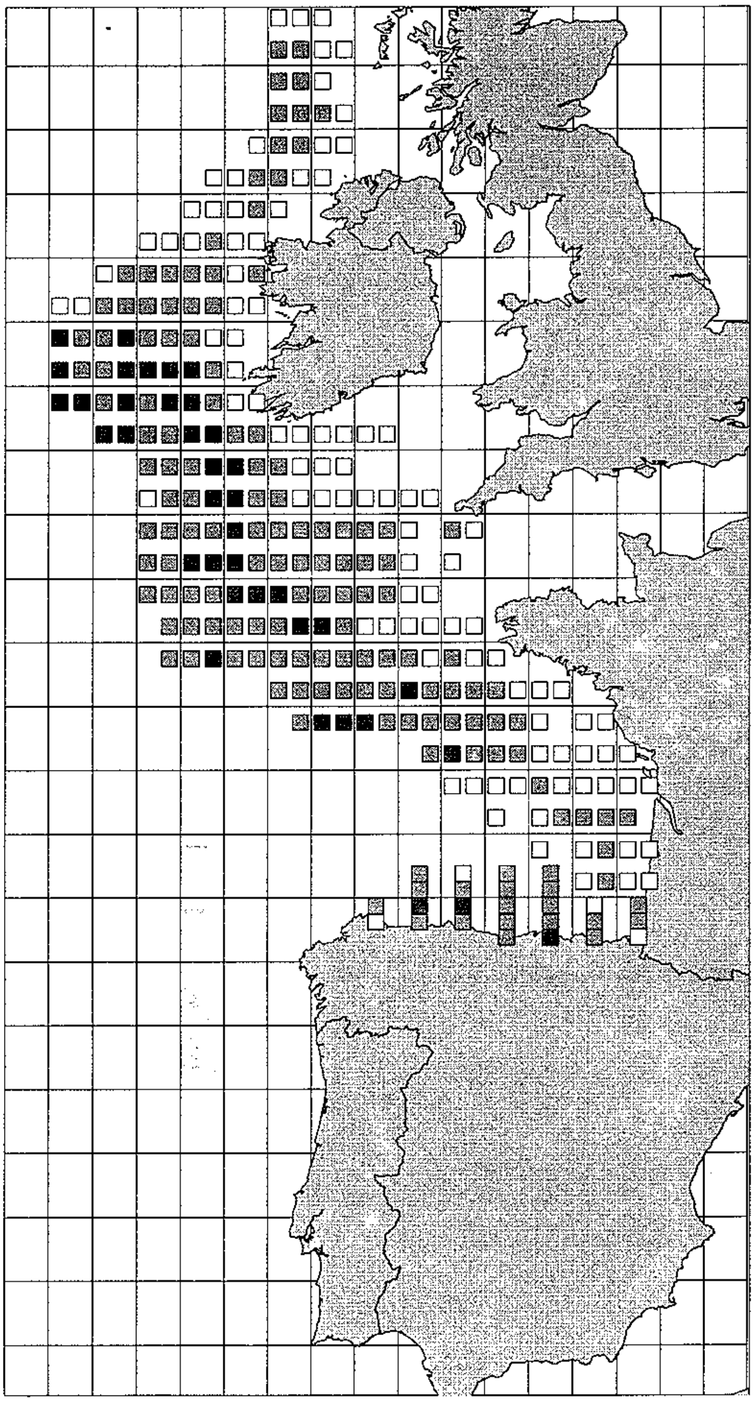


Figure 3.12.3.b.13 Mean mackerel stage 1 egg distributions from egg surveys. April 1977 to 1995.



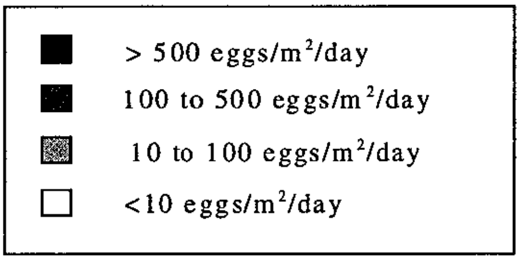
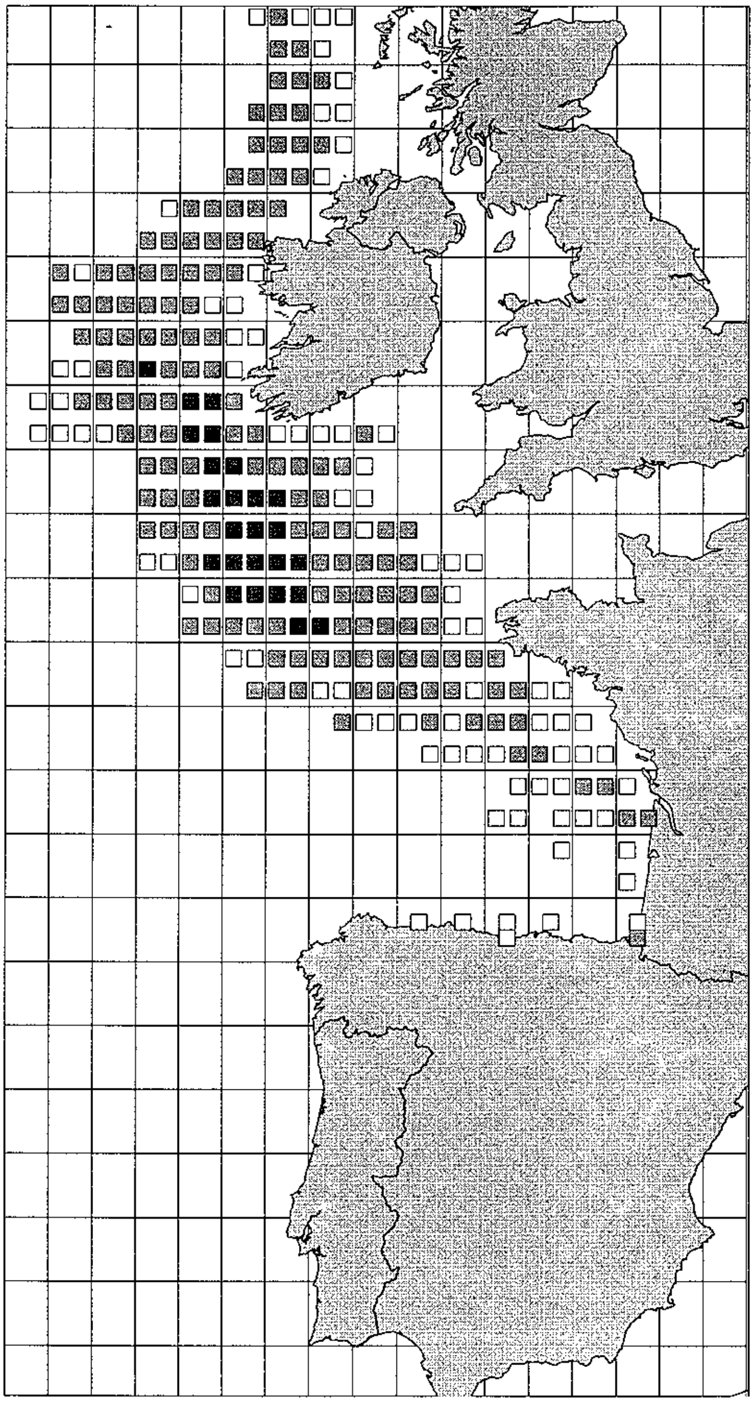


Figure 3.12.3.b.14 Mean mackerel stage 1 egg distributions from egg surveys. May 1977 to 1995.



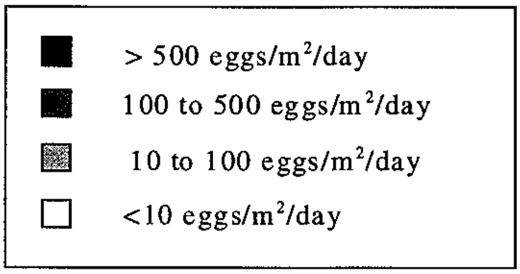
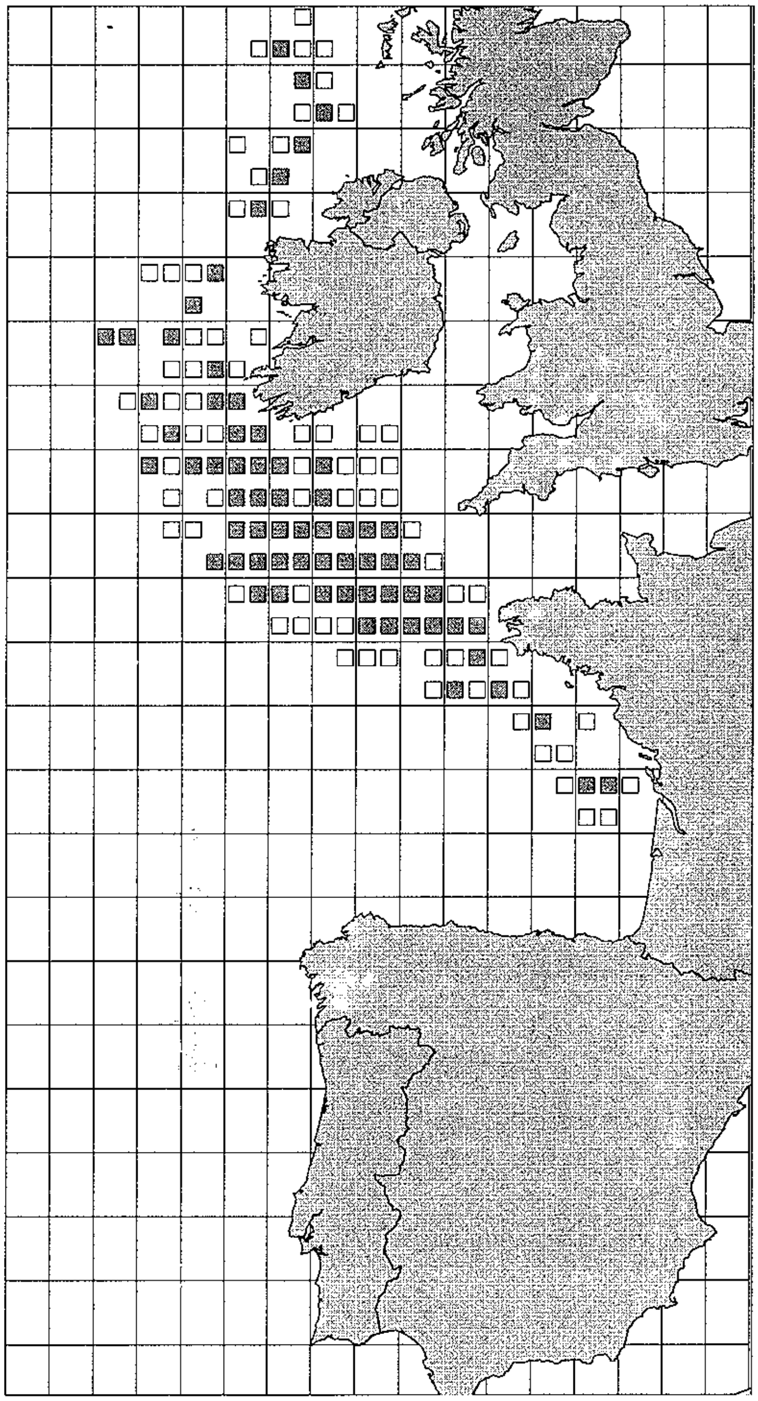


Figure 3.12.3.b.15 Mean mackerel stage 1 egg distributions from egg surveys. June. 1977 to 1995.



■	> 500 eggs/m²/day
■	100 to 500 eggs/m²/day
▒	10 to 100 eggs/m²/day
□	< 10 eggs/m²/day

Figure 3.12.3.b.16 Mean mackerel stage 1 egg distributions from egg surveys. July 1977 to 1995.

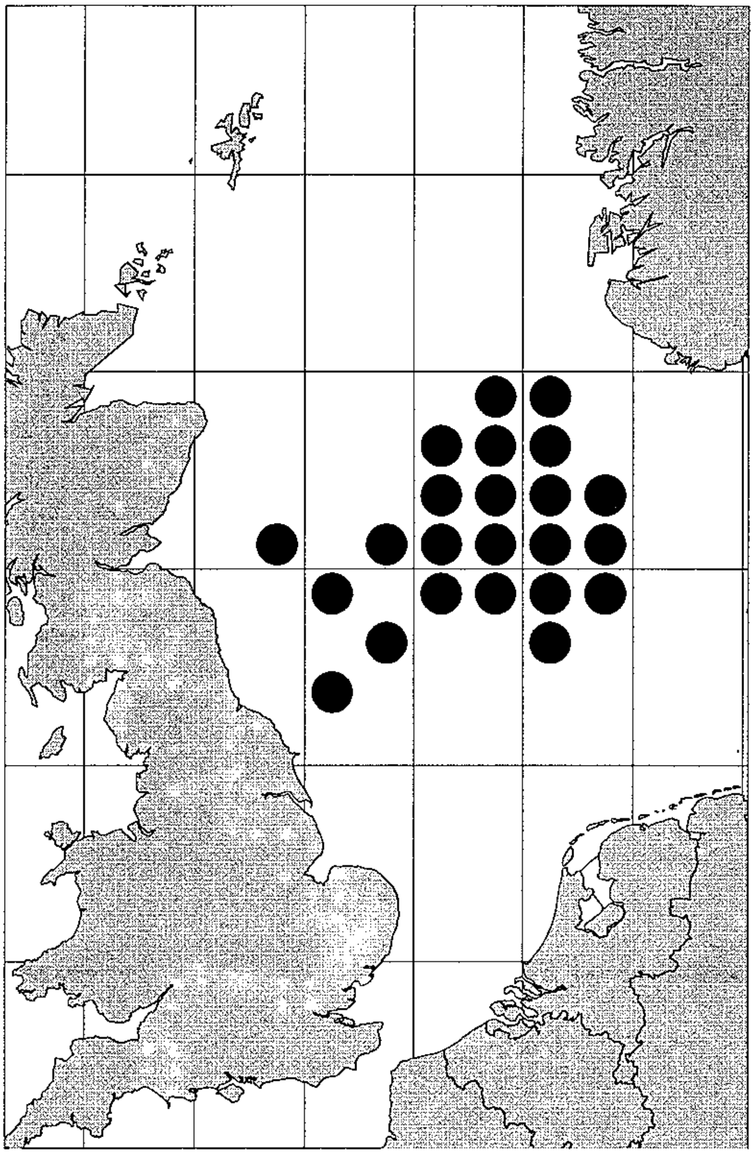


Figure 3.12.3.b.17 The main mackerel spawning area in the North Sea.

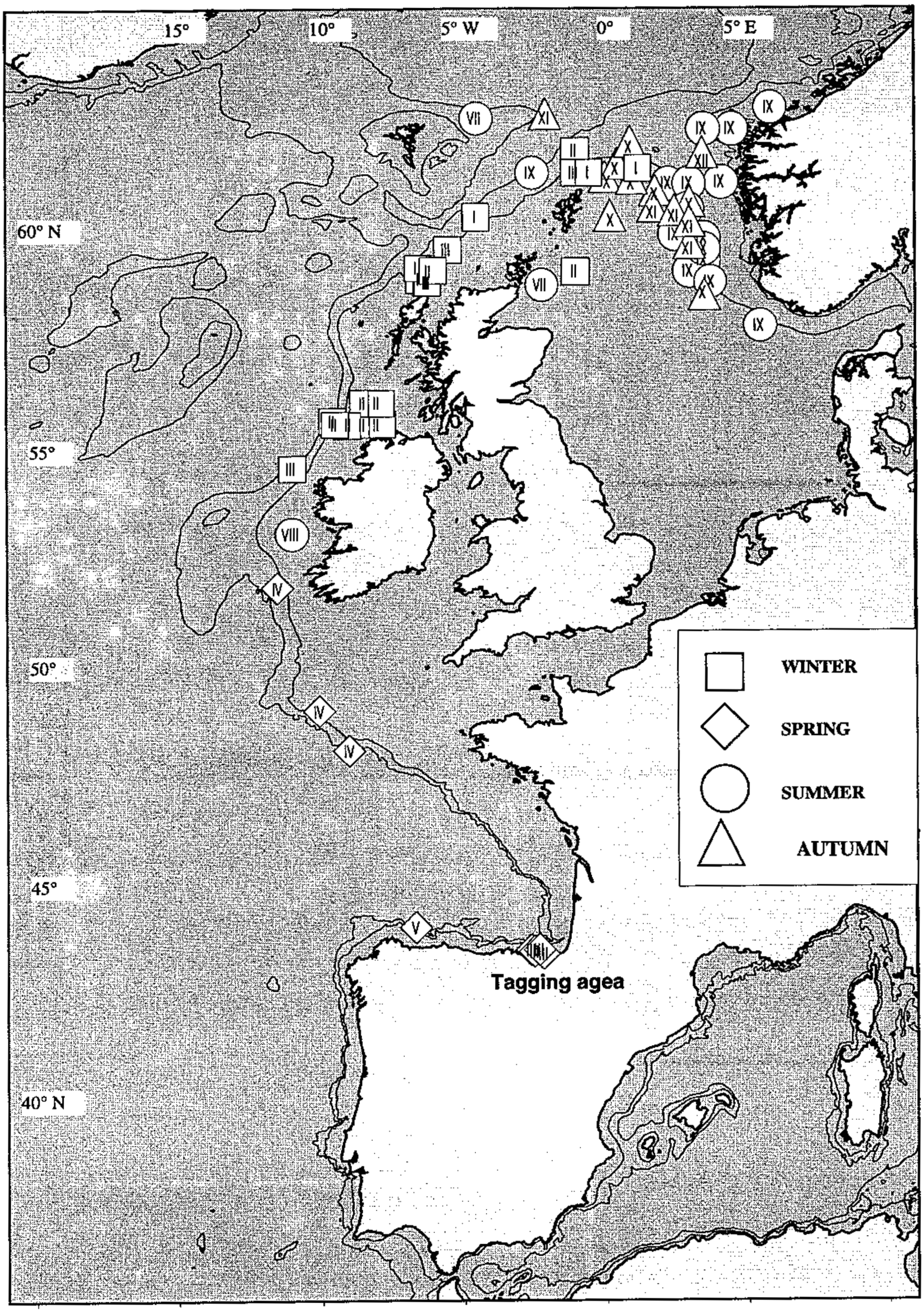


Figure 3.12.3.b.18 Recaptures obtained from the 1994 tagging survey on mackerel carried out in the south east corner of the Bay of Biscay. (Uriarte and Lucio, in press).

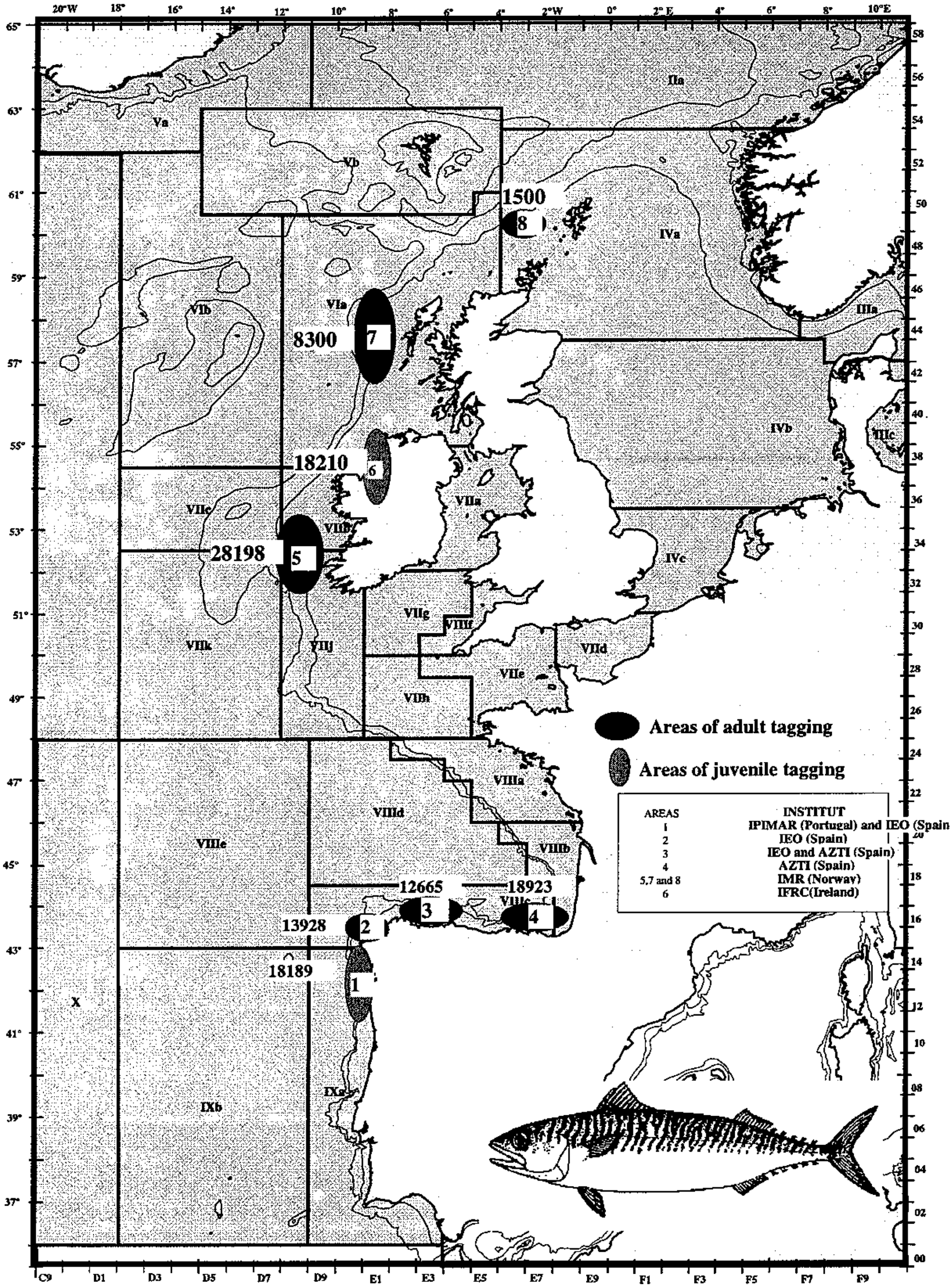


Figure 3.12.3.b.19 Areas of tagging of adult and juvenile mackerel in 1997 in the North east Atlantic within the frame of the project 96-035, with indication of the participant Institutes and total number of mackerel tagged per area.

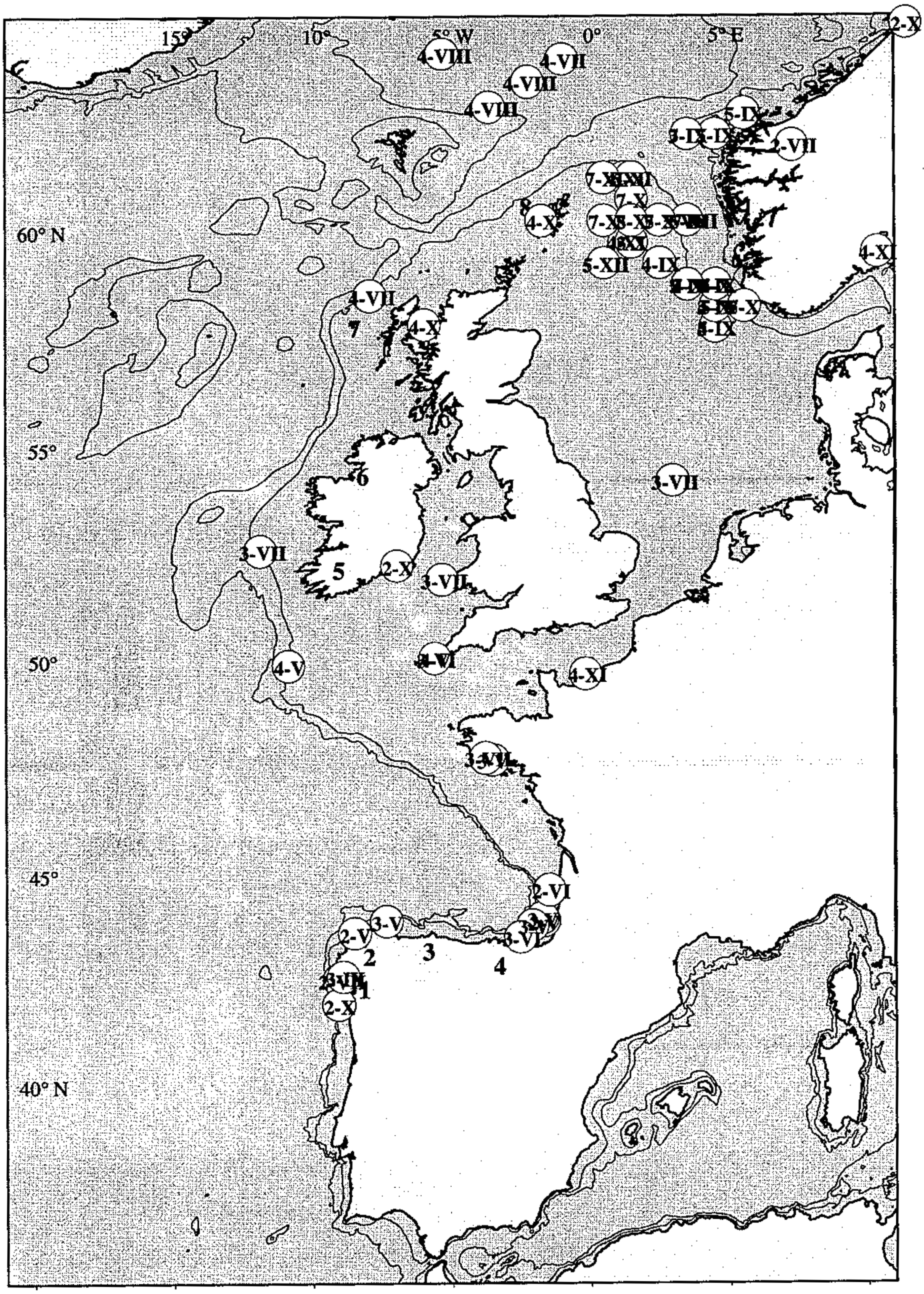


Figure 3.12.3.b.20 1997 recaptures of mackerel tagged in adult areas in spring of that year. Numbers inside the circles refer to tagging area (cardinal numbers) and month of the recapture (roman numbers). (EU Study Project 96–035, Uriarte *et al.* WD 1998).

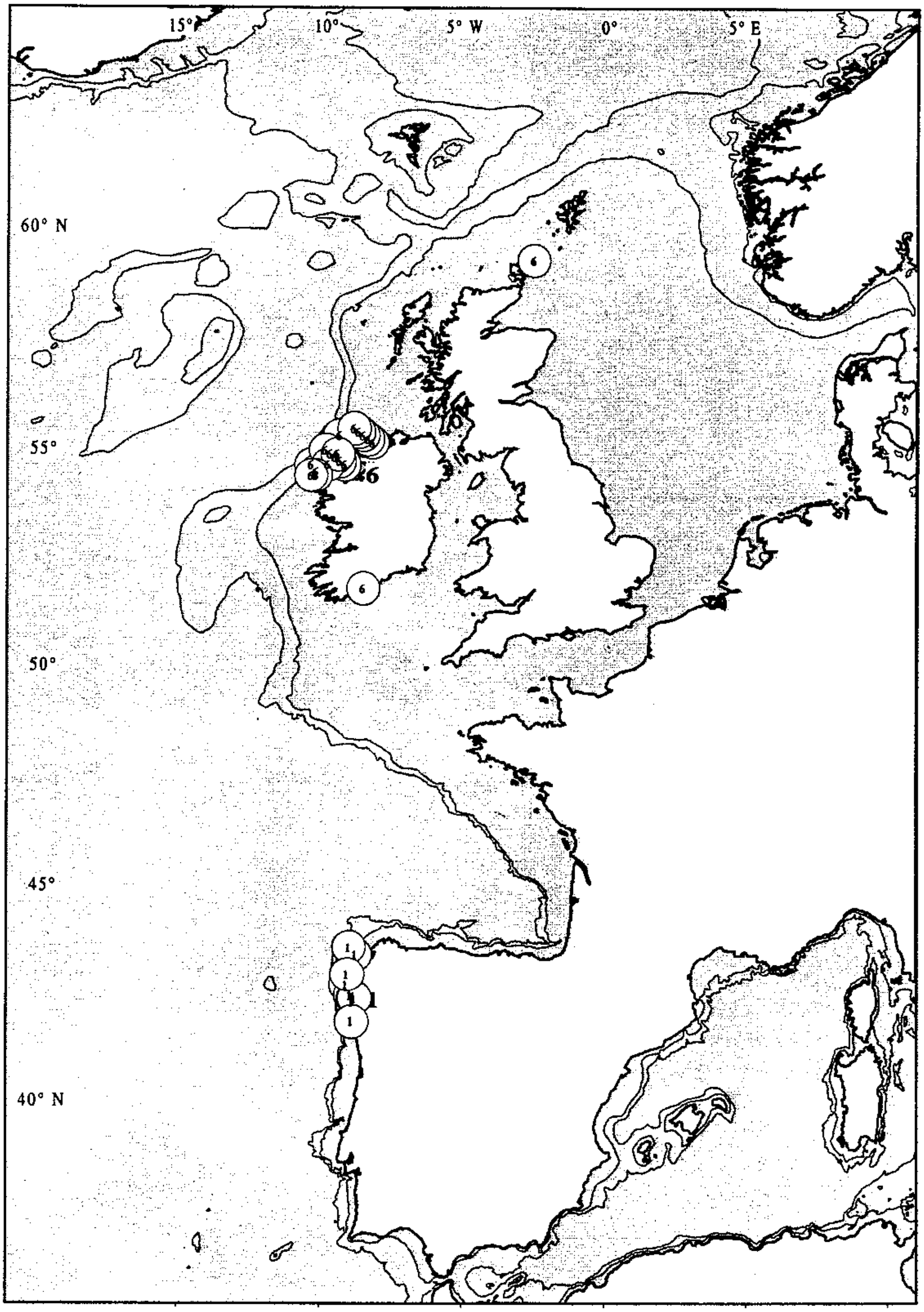


Figure 3.12.3.b.21 1997 recaptures of mackerel tagged in juvenile areas in that year. Numbers inside the circles refer to tagging areas (cardinal numbers). (Study Project 96–035, Uriarte *et al.* WD 1998).

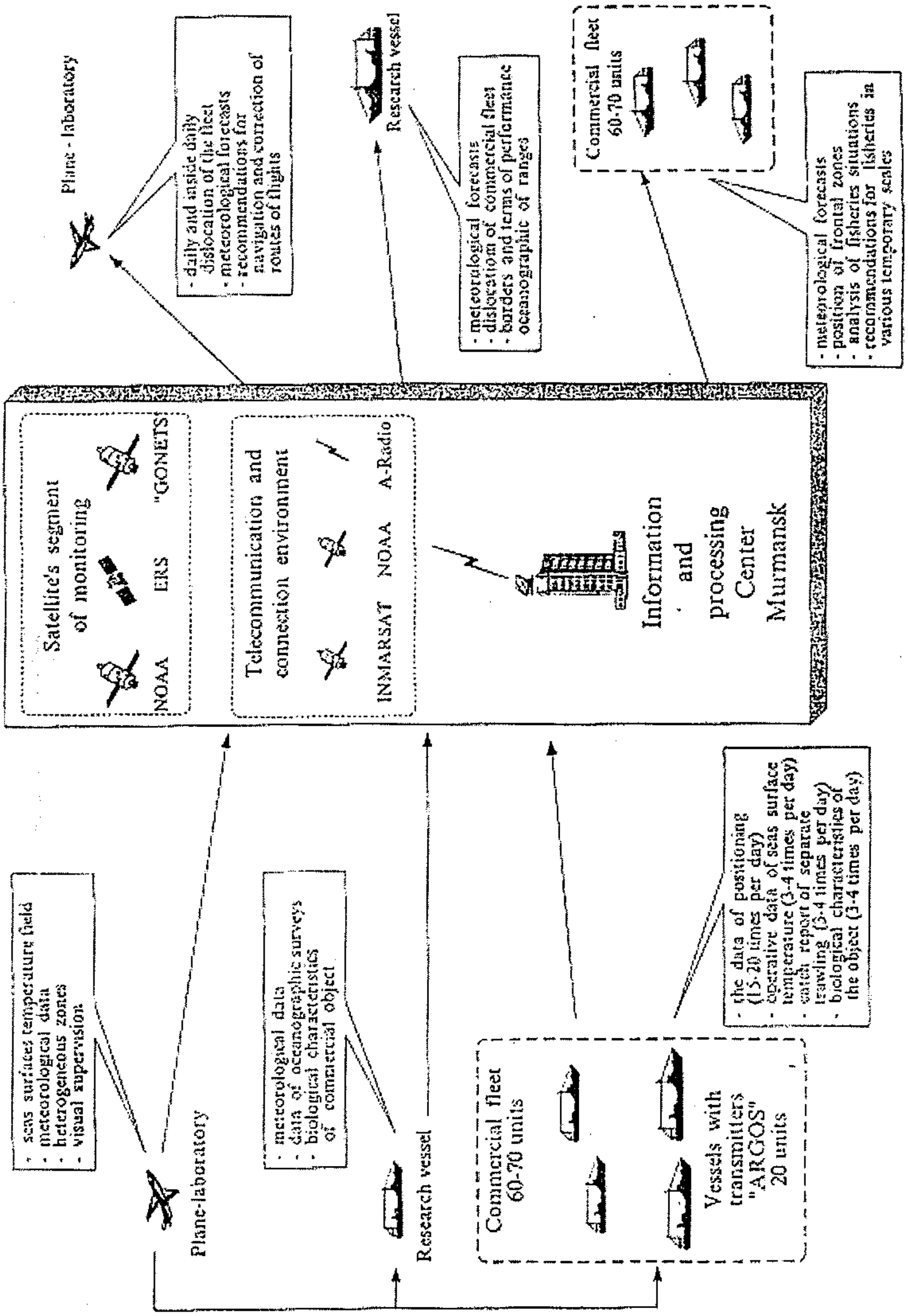


Figure 3.12.3.b.22 New information technologies of monitoring fisheries of mackerels in the Norwegian Sea (summer 1997 year).

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Zabavnikov, V.B., F.M. Troyanovsky, V.I. Chernook, B.M. Shatokhin. 1998. Preliminary results from comprehensive air investigations to estimate distribution of mackerel concentrations in the Norwegian Sea in 1998. WD presented to the WGMHSA, Copenhagen, 28 September-7 October 1998, 5p.

3.12.4 Western horse mackerel (*Trachurus trachurus*) (Divisions IIa, IVa, Vb, VIa, VIIa–c,e–k, VIIIa,b,d,e)

State of stock/fishery: The stock is considered to be outside safe biological limits. Neither the absolute biomass of western horse mackerel nor the fishing mortality exerted on it are precisely known, but there is no doubt that the biomass has decreased compared with the mid 1980s, and will continue to do so, even at low fishing mortality, in the absence of large year classes. Considering that catches have generally increased since 1988, and that biomass declined, it is concluded that fishing mortality increased since 1988. Current catches are not considered to be sustainable at present recruitment.

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 $\mathbf{B_{pa}}$.

Advice on management: In the absence of outstanding year-classes, sustainable yield is unlikely to be higher than about 200 000 t. Medium-term simulations show that the stock would increase at constant catches of 100 000 t, but would decrease at constant catches of 200 000 t. It is therefore clear that catches will have to be decreased at some future date unless another outstanding year-class is produced. **ICES therefore advises that catches in 1999 be effectively limited to no more than 200 000 t.**

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), Vb, IVa, VIIa–c, e–k, VIIIa,b,d,e. The present TAC area covers Divisions Vb, VI, VII, VIIIa,b,d,e, XII and IX.

Reference points:

ICES considers that:	ICES proposes that:
$\mathbf{B_{lim}}$ is not defined.	$\mathbf{B_{pa}}$ be set at 500 000 t, the estimated size of the SSB that produced the exceptionally strong 1982 year class.
$\mathbf{F_{lim}}$ is not defined.	F reference points can not be established.

Relevant factors to be considered in management: The extraordinarily strong 1982 year class was 20 times larger than average and 7 times larger than the second largest, the 1993 year class, in the documented history of the fishery 1982–1997. The 1982 year class reached its maximum biomass in 1987 and has decreased by at least 80% since then because of removals by fishing and natural mortality.

This stock may be considered as one normally exhibiting a low SSB, but which occasionally produces a strong year class. The management strategy could then be to shift from a harvesting strategy in the years following the recruitment of a strong year class to a preservation strategy when the SSB is low. At present, because of the doubts that surround the stock size, it is not possible to decide when to change from a harvesting to a preservation strategy.

The EU is setting a TAC applicable to EU vessels for this stock. This TAC applies only to EU waters which covers only parts of the distribution area of this stock. The EU TAC has been 300 000 t during the period 1994–1997 and was set as 320 000 t in 1998 while ICES had recommended a substantial reduction in fishing mortality, at least to 0.15 which corresponded to landings of 150 000 t.

Elaboration and special comment: The assessment of this stock is considered uncertain. There is limited information on fishing mortality, natural mortality and on the onset of maturity. A Bayesian assessment method explicitly taking into account the uncertainty in those parameters has been used.

The catches increased in the 1980s with the appearance of the extremely strong 1982 year class. Changes in migration pattern became evident at the end of the 1980s when the largest fish in the stock (mainly the 1982 year class) migrated into Divisions IIa and IVa during the 3rd and 4th quarters. Since 1987 considerable catches have been taken by the Norwegian purse seine fleet in an industrial fishery, particularly in Division IVa in October, while most catches of other countries have been taken for human consumption purposes in Sub-areas VI, VII and Divisions VIIIa,b,d,e. The Norwegian catches dropped considerably (by 84%) in 1996. In 1997 the Norwegian catches increased to 46 000 t.

The recent history of this stock reflects the development of a single large year class within the period of 15 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 on their catches. The lack of this biological data severely hampers the assessment. The maturity ogive is not well estimated and there is uncertainty about natural mortality.

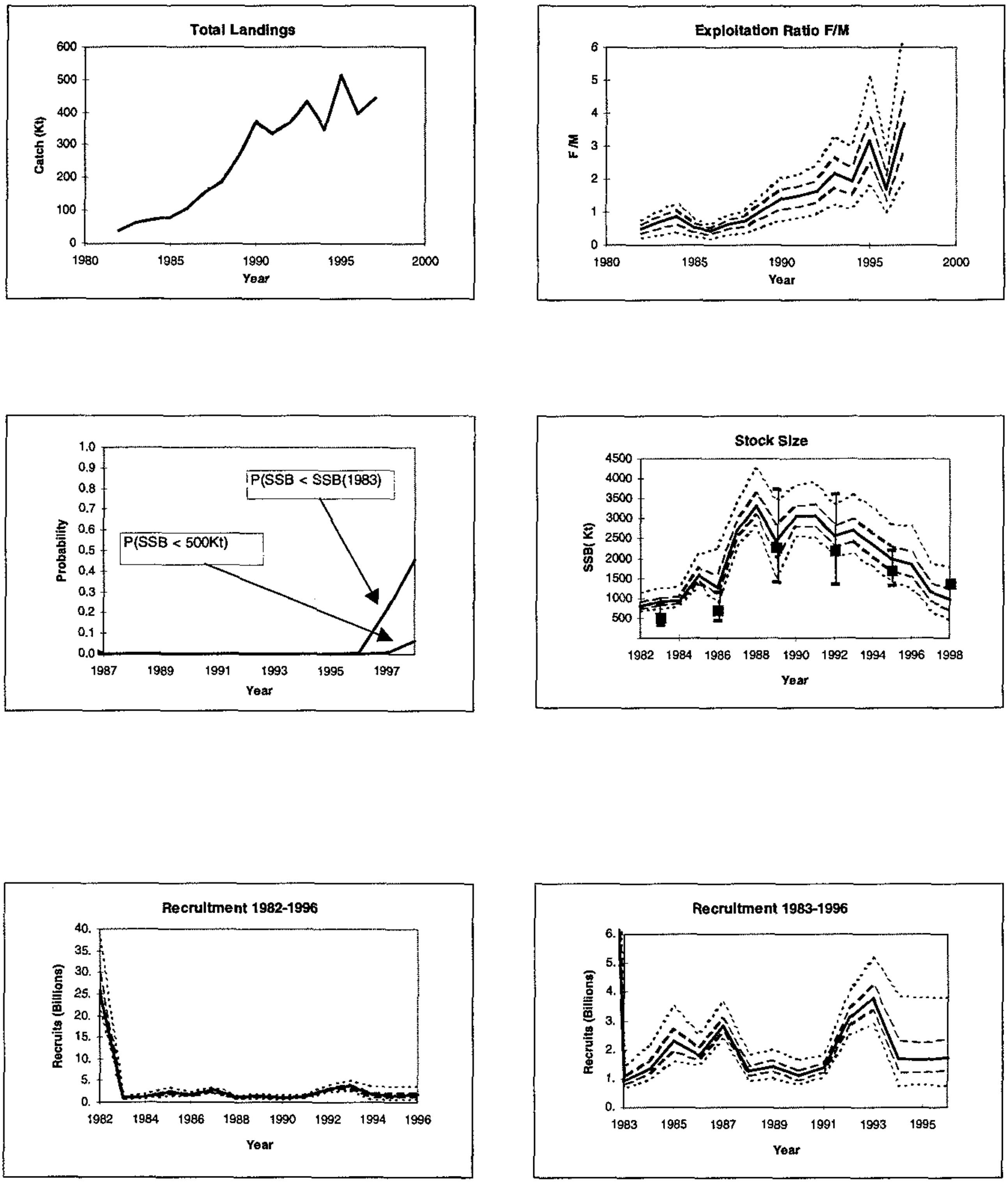
The assessment carried out uses the results of the international horse mackerel egg surveys. An egg survey on this stock was carried out in 1998. Only preliminary results from this egg survey are available at present and a final spawning stock size estimate will be available for the ACFM May 1999 meeting.

Source of information: Report of the Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine and Anchovy, September 1998 (ICES CM 1999/ACFM:6).

Catch data (Tables 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			
1999	Effectively limit catches to no more	200				

[1]Division Vb (EU waters only), Sub-areas VI and VII, Divisions VIIIa,b,d,e. Weights in '000 t.



Western Horse Mackerel. Estimated historic stock trajectories for some population dynamics parameters. Fishing mortality calculated as population-weighted mean over ages 5 to 14 and referenced to natural mortality. Square markers indicate egg survey biomass estimates, +/- 95% confidence intervals based on 25% CV. Bold lines, medians. Dashed lines, 25th and 25th percentiles. Dotted lines, 5th and 95th percentiles.

Table 3.12.4.1 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 horse mackerel					
	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	5,689
1995	240		7,948	30	8,666	16,756
1996	1,657		7,558	212	9,416	18,843
1997	2,037[4]		15,504[5]	10	5,452	19,540

	Western horse mackerel							Southern horse mackerel			Total
	IIa	IVa	VIa	VIIa-c,e-k	VIIIa,b,d,e	Discards	Total	VIIIc	IXa	Total	All stocks
1982	-	-	6,283	32,231	3,073	-	41,587	19,610	39,726	59,336	104,958
1983	412	-	24,881	36,926	2,643	-	64,862	25,580	48,733	74,313	147,195
1984	23	94	31,716	38,782	2,510	500	73,625	23,119	23,178	46,297	149,400
1985	79	203	33,025	35,296	4,448	7,500	80,551	23,292	20,237	43,529	150,830
1986	214	776	20,343	72,761	3,071	8,500	105,665	40,334	31,159	71,493	201,806
1987	3,311	11,185	35,197	99,942	7,605	-	157,240	30,098	24,540	54,638	223,512
1988	6,818	42,174	45,842	81,978	7,548	3,740	188,100	26,629	29,763	56,392	268,163
1989	4,809	85,304[2]	34,870	131,218	11,516	1,150	268,867	27,170	29,231	56,401	358,533
1990	11,414	112,753[2]	20,794	182,580	21,120	9,930	373,463	25,182	24,023	49,205	441,430
1991	4,487	63,869[2]	34,415	196,926	25,693	5,440	333,555	23,733	21,778	45,511	391,066
1992	13,457	101,752	40,881	180,937	29,329	1,820	370,550	24,243	26,713	50,955	436,548
1993	3,168	134,908	53,782	204,318	27,519	8,600	433,145	25,483	31,945	57,428	504,190
1994	759	106,911	69,546	194,188	11,044	3,935	388,875	24,147	28,442	52,589	447,153
1995	13,133	90,527	83,486	320,102	1,175	2,046	510,597	27,534	25,147	52,681	580,034
1996	3,366	18,356	81,259	252,823	23,978	16,870	396,652	24,290	20,400	44,690	460,185
1997	2,617	63,647	40,145	318,101	11,677	2,921	442,571	29,129	27,642	56,771	518,882

[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 (Danish and Swedish catches).
[5]Norwegian catches in IVb (1,426 t) included in Western horse mackerel.

Table 3.12.4.2 Landings (t) of HORSE MACKEREL in Sub-area II. (Data as submitted by Working Group members).

Country	1980	1981	1982	1983	1984
Denmark	-	-	-	-	-
France	-	-	-	-	1
Germany, Fed.Rep.	-	+	-	-	-
Norway	-	-	-	412	22
USSR	-	-	-	-	-
Total	-	+	-	412	23

Country	1985	1986	1987	1988	1989	1990	1991
Faroe Islands	-	-	-	-	-	964[3]	1,115
Denmark	-	-	39	-	-	-	-
France	1	-[2]	-[2]	-[2]	-	-	-
Germany, Fed.Rep.	-	-	-	64	12	+	-
Norway	78	214	3,272	6,285	4,770	9,135	3,200
USSR	-	-	-	469	27	1,298	172
UK (England + Wales)	-	-	-	-	-	17	-
Total	79	214	3,311	6,818	4,809	11,414	4,487

	1992	1993	1994	1995	1996	1997[1]
Faroe Islands	9,157[3]	1,068	-	950	1,598	799[3]
Denmark	-	-	-	200	-	-
France	-	-	55	-	-	-
Germany	-	-	-	-	-	-
Norway	4,300	2,100	4	11,300	887	1,170
Russia	-	-	700	1,633	881	648
UK (England + Wales)	-	-	-	-	-	-
Total	13,457	3,168	759	14,083	3,366	2,617

[1]Preliminary.
[2]Included in Sub-area IV.
[3]Includes catches in Division Vb.

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 + discards						-19,168	-13,897	-7,255	-
Total	8,724	11,134	6,283	24,881	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	-	44	-	-	-	-	-	-	-
Unallocated + discards	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

[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
Belgium	-	1	1	-	-
Denmark	5,045	3,099	877	993	732
France	1,983	2,800	2,314	1,834	2,387
Germany, Fed.Rep.	2,289	1,079	12	1,977	228
Ireland	-	16	-	-	65
Netherlands	23,002	25,000	27,500[2]	34,350	38,700
Norway	394	-	-	-	-
Spain	50	234	104	142	560
UK (Engl. + Wales)	12,933	2,520	2,670	1,230	279
UK (Scotland)	1	-	-	-	1
USSR	-	-	-	-	-
Total	45,697	34,749	33,478	40,526	42,952

Country	1985	1986	1987	1988	1989	1990
Faroe Islands	-	-	-	-	-	28
Belgium	+	+	2	-	-	+
Denmark	1,477[2]	30,408[2]	27,368	33,202	34,474	30,594
France	1,881	3,801	2,197	1,523	4,576	2,538
Germany, Fed.Rep.	-	5	374	4,705	7,743	8,109
Ireland	100	703	15	481	12,645	17,887
Netherlands	33,550	40,750	69,400	43,560	43,582	111,900
Norway	-	-	-	-	-	-
Spain	275	137	148	150	14	16
UK (Engl. + Wales)	1,630	1,824	1,228	3,759	4,488	13,371
UK (N.Ireland)	-	-	-	-	-	-
UK (Scotland)	1	+	2	2,873	+	139
USSR	120	-	-	-	-	-
Unallocated + discards	-	-	-	-	28,368	7,614
Total	39,034	77,628	100,734	90,253	135,890	192,196

Country	1991	1992	1993	1994	1995	1996	1997[1]
Faroe Islands	-	-	-	-	-	-	-
Belgium	-	-	-	1	-	-	18
Denmark	28,888	18,984	16,978	41,605	28,300	43,330	60,412
France	1,230	1,198	1,001	-	-	-	27,201
Germany, Fed.Rep.	12,919	12,951	15,684	14,828	17,436	15,949	28,549
Ireland	19,074	15,568	16,363	15,281	58,011	38,455	43,624
Netherlands	104,107	109,197	157,110	92,903	116,126	114,692	81,464
Norway	-	-	-	-	-	-	-
Spain	113	106	54	29	25	33	-
UK (Engl. + Wales)	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)	1,992	5,008	3,123	9,015	10,522	11,241	7,931
USSR	-	-	-	-	-	-	-
Unallocated + discards	24,541	15,563	4,010[3]	14,057	68,644	26,795	58,718
Total	201,326	188,135	221,000	200,256	330,705	279,100	326,474

[1]Provisional.
[2]Includes Sub-area VI.
[3]Includes a negative unallocated catch of -4,000 t.
[4]Includes 5 t from Jersey.

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
Denmark	-	-	-	-	-
France	3,361	3,711	3.073	2,643	2,489
Netherlands	-	-	-	-	-[2]
Spain	34,134	36,362	19,610	25,580	23,119
UK (Engl. + Wales)	-	+	1	-	1
USSR	-	-	-	-	20
Total	37,495	40,073	22,683	28,223	25,629

Country	1985	1986	1987	1988	1989	1990
Denmark	-	446	3,283	2,793	6,729	5,726
France	4,305	3,534	3,983	4,502	4,719	5,082
Germany	-	-	-	-	-	-
Netherlands	-[2]	-[2]	-[2]	-	-	6,000
Spain	23,292	40,334	30,098	26,629	27,170	25,182
UK (Engl. + Wales)	143	392	339	253	68	6
USSR	-	656	-	-	-	-
Unallocated + discards	-	-	-	-	-	1,500
Total	27,740	45,362	37,703	34,177	38,686	43,496

Country	1991	1992	1993	1994	1995	1996	1997[1]
Denmark	1,349	5,778	1,955	-	340	140	729
France	6,164	6,220	4,010	28	-	7	8,690
Germany	80	62	-		-	-	-
Netherlands	12,437	9,339	19,000	7,272	-	14,187	2,944
Spain	23,733	27,688	27,921	25,409	28,349	29,428	31,081
UK (Engl. + Wales)	70	88	123	753	20	924	430
USSR	-	-	-		-	-	-
Unallocated + discards	2,563	5,011	700	2,038	-	3,583	-2,944
Total	46,396	54,186	53,709	35,500	28,709	48,269	40,930

[1]Preliminary.
[2]Included in Sub-area VII.

Table 3.12.4.6 Western Horse Mackerel. Summary results of Bayesian stock assessment. Percentiles of the distribution of fishing mortality relative to natural mortality (Population mean fishing mortality over ages 4 to 14 divided by natural mortality), spawning stock size, and recruitment by year from 1982–1996. Percentiles calculated from 1000 drawn parameter vectors from the Markov Chain.

a. Fishing Mortality relative to Natural Mortality (F 4-14w/M)

Percentile	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
5	0.22	0.31	0.40	0.26	0.21	0.32	0.38	0.56	0.75	0.82	0.92	1.25	1.10	1.80	0.95	1.98
25	0.36	0.51	0.63	0.41	0.33	0.49	0.57	0.84	1.09	1.17	1.29	1.73	1.53	2.49	1.34	2.86
50	0.51	0.71	0.86	0.55	0.44	0.64	0.74	1.08	1.41	1.50	1.64	2.18	1.93	3.15	1.69	3.67
75	0.63	0.87	1.05	0.67	0.54	0.77	0.90	1.30	1.69	1.79	1.98	2.65	2.37	3.88	2.12	4.66
95	0.75	1.05	1.26	0.81	0.64	0.91	1.06	1.56	2.04	2.17	2.43	3.31	3.00	5.13	2.88	6.70
Expectation	0.50	0.69	0.84	0.54	0.43	0.63	0.73	1.07	1.39	1.49	1.64	2.20	1.97	3.25	1.77	3.88

b. Spawning Stock Size (Thousand t at spawning time)

Percentile	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
5	679	756	796	1318	889	2283	2812	1451	2562	2550	2074	2138	1785	1435	1265	713
25	743	838	870	1446	1065	2500	3087	1987	2827	2825	2322	2420	2053	1718	1558	945
50	812	909	948	1577	1275	2699	3318	2422	3054	3073	2559	2692	2342	2000	1857	1173
75	920	1030	1058	1763	1607	2968	3634	2827	3337	3363	2825	2998	2645	2306	2182	1417
95	1154	1281	1287	2121	2250	3483	4239	3414	3864	3917	3346	3609	3268	2868	2819	1917
Expectation	851	951	982	1632	1394	2771	3400	2423	3123	3137	2613	2755	2399	2057	1922	1221

c. Recruitment (Millions of fish aged 0)

Percentile	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
5	21225	676	938	1621	1442	2377	919	1045	790	1074	2531	2919	782	796	772	764
25	23413	791	1147	1967	1635	2609	1101	1242	965	1228	2826	3353	1226	1231	1283	1187
50	25734	911	1334	2275	1810	2824	1261	1420	1126	1368	3097	3770	1679	1632	1734	1698
75	29582	1072	1597	2700	2054	3110	1466	1634	1314	1533	3408	4240	2318	2259	2383	2345
95	37744	1408	2135	3527	2508	3672	1850	2040	1680	1847	3994	5187	3872	3816	3836	3545
Expectation	27176	961	1412	2394	1877	2899	1315	1470	1169	1406	3161	3866	1907	1871	1933	1873

d. Natural Mortality (all ages) (approx.)

Percentile	M
5	0.052
25	0.055
50	0.063
75	0.077
95	0.103
Expectation	0.070

3.12.5 Blue whiting combined stock (Sub-areas I–IX, XII and XIV)

State of stock/fishery: The stock is at present considered to be harvested within safe biological limits as defined by the proposed reference points. The strong 1989 year class is no longer a major part of the fishery, but surveys and the fishery indicate that the 1995 and 1996 year classes are strong. This was apparent from the considerable Norwegian landings of the 1995 year classes in the mixed industrial fishery in the North Sea during autumn 1995, and further in the total catch during the 1996 and 1997 fishery.

Management objectives: It has been suggested by NEAFC, based on previous ICES advice, that this fishery should be managed with a constant catch of 650 000 t.

Advice on management: It is recommended that catches not exceed 650 000 t until more information about the stock is available. Catches above 650 000 t may not be sustainable in the long run and therefore, not consistent with the precautionary approach.

Proposed reference points: This stock has been fished with an average exploitation rate of $F = 0.32 = F_{med}$, without any apparent negative effects on recruitment. It is proposed that $F_{pa} = 0.32$. The lowest observed spawning stock biomass is 1.5 million t. Taking this as B_{lim} and accounting for uncertainty, B_{pa} is proposed at 2.25 million t.

Relevant factors to be considered in management: The blue whiting is widely distributed in the eastern North Atlantic, extending from the Barents Sea to the Straits of Gibraltar. It is treated as one stock as it has not been possible to demonstrate significant differences between fish from various parts of the distribution area, or to define an unambiguous borderline between populations. The spawning stock estimate is uncertain due to inconsistent indications in the data available. Survey estimates (which are abundance indices) of the spawning stock indicate a level of less than 1.4 to 6 million t, whereas catch analysis indicates a stock size in 1999 of 3.1 million t.

Although the stock is not in any immediate danger of being overfished, medium term projections indicate a 17% probability that the current fishing pressure will reduce the SSB below the lowest observed of 1.5 million t within 5 years.

Catch forecast for 1999:

Basis: Catch(98) = 750, F(98) = 0.41, SSB(99) = 3110.

F(99)	Basis	Landings (99)	SSB (2000)	Medium term effect of fishing at given level
0.16	$0.5F_{pa}$	404	3094	Low probability of SSB less than B_{lim}
-	constant catch from 1999	650	2868	
0.32	F_{pa}	761	2766	14% probability of SSB less than B_{lim} in 2007
0.41	$1.0F_{sq}$	924	2618	24% probability of SSB less than B_{lim} in 2007

Weights in '000 t, Mean F, ages 3–7.

Shaded scenarios considered inconsistent with the precautionary approach.

Assuming a catch in 1998 of 750 000 t, the spawning stock will increase from 2.7 million t in 1998 to 3.1 million t in 1999 due to the recruitment of the strong 1995 and 1996 year classes. However, the SSB will decrease again in year 2000 for all F's above 0.16. Fishing at F_{pa} (0.32) will decrease the SSB to 2.8 million t, while fishing at the current F (0.41) will reduce the SSB in year 2000 to 2.6 million t. This is higher than the SSB's estimated in the last decade. A catch of 650 000 t in 1998 implies an F below 0.32.

Elaboration and special comment: The fishery for blue whiting was fully established in 1977. 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 they are also caught in an industrial mixed fishery in Sub-area IV and Division IIIa and in the pelagic trawl fishery in the northern areas (Sub-areas I and II, Divisions Va, XIVa,b). These fisheries in the northern area have taken 340 000–630 000 t per year in the last ten years while catches in the southern fishery (Sub-areas VIII, IX, Divisions VIId,e and g–k) have been stable in the range 25 000–34 000 t.

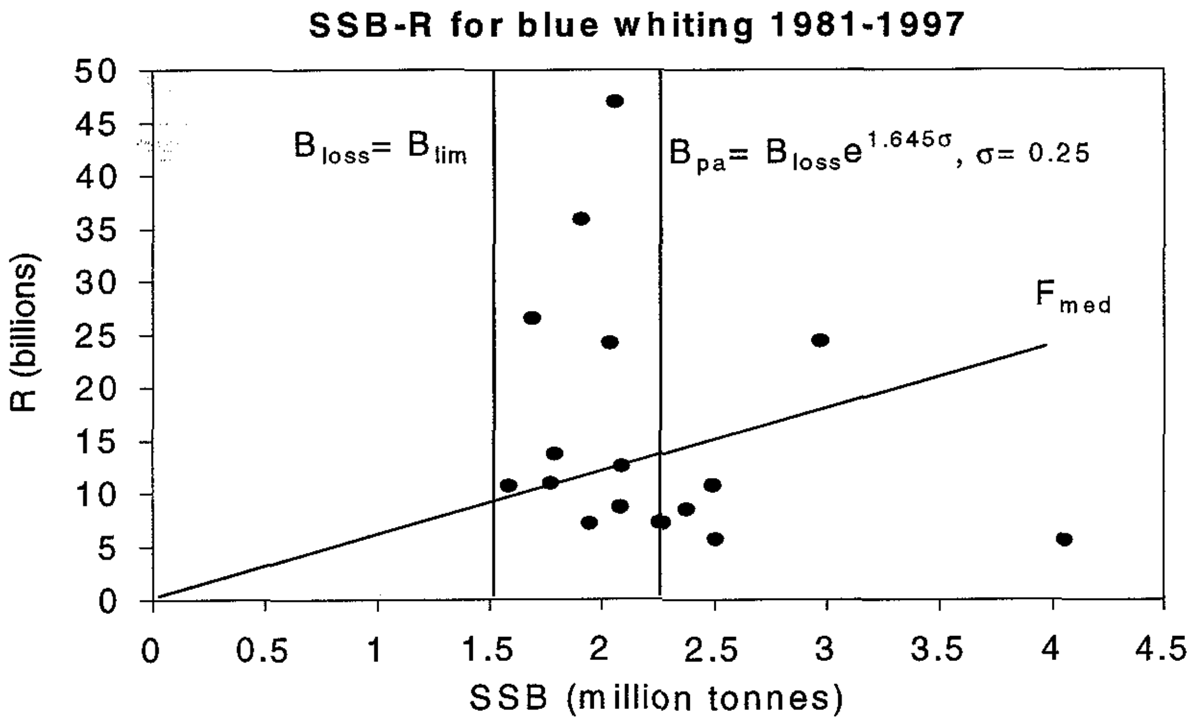
Analytical assessment, based on catch data, acoustic and bottom trawl surveys and commercial CPUE data. The various data sources are not consistent, but the assessment is considered to indicate historical stock trends.

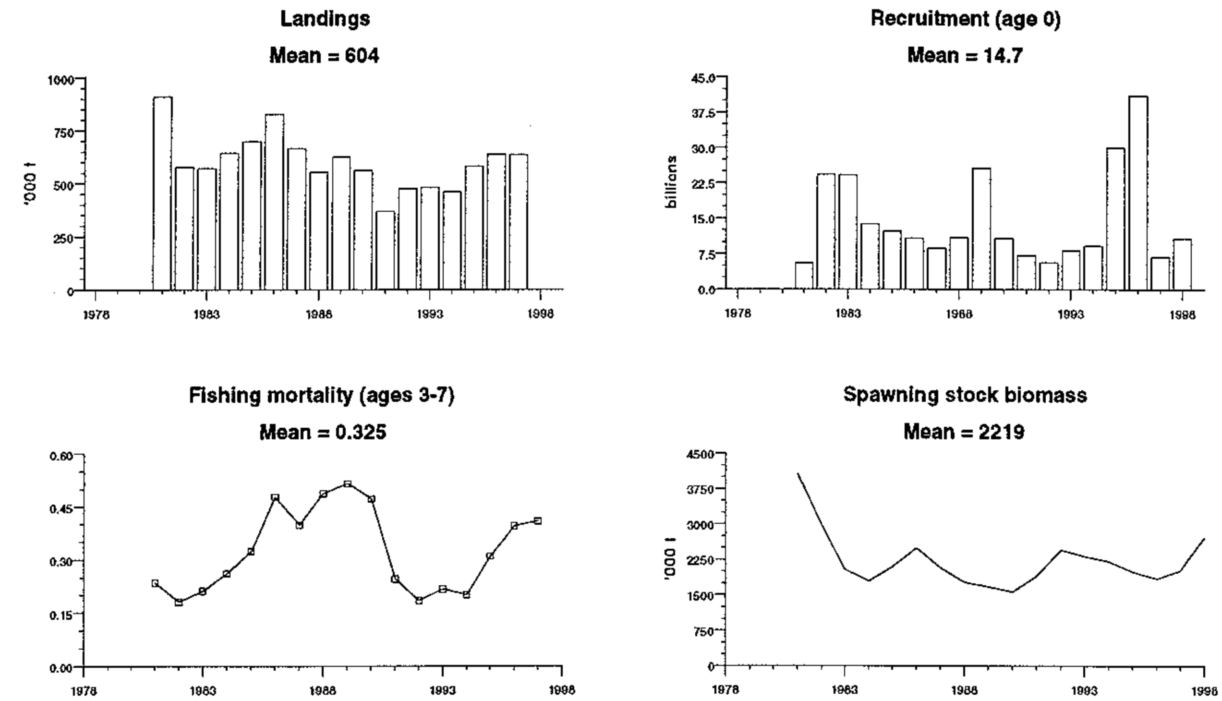
Source of information: Report of the Northern Pelagic and Blue Whiting Fisheries Working Group, April/May 1998 (ICES CM 1998/ACFM:18).

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	-	664
1988	TAC for northern areas; no advice for southern areas	832	-	553
1989	TAC for northern areas; no advice for southern areas	630	-	625
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	-	-	474
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]	638
1997	Precautionary TAC for combined stock	540		634
1998	Precautionary TAC for combined stock	650		
1999	Catches above 650 000 t may not be sustainable in the long run.	650		

[1]NEAFC proposal for NEAFC regions 1 and 2. Weights in '000 t.





Blue whiting combined stock (Sub-areas I–IX, XII and XIV)

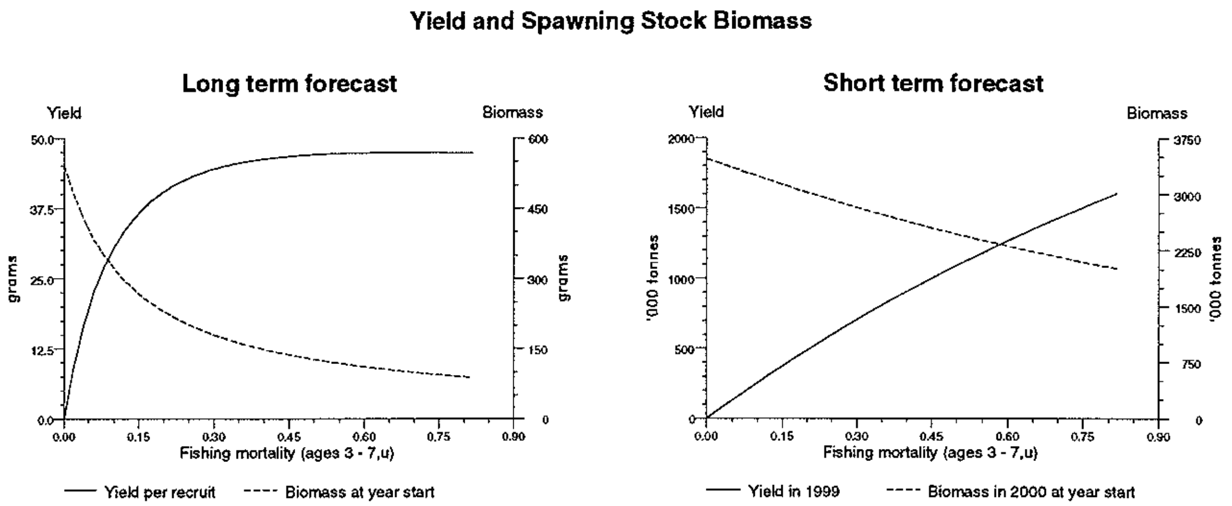


Table 3.12.5.1 Landings (tonnes) of BLUE WHITING from the main fisheries, 1988-1997, as estimated by the Working Group.

Area	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Norwegian Sea fishery (Sub-areas I+II and Divisions Va,XIVa-b)[1]	55,829	42,615	2,106	78,703	62,312	43,240	22,674	23,733	23,447	62,570
Fishery in the spawning area (Divisions Vb, VIa, VIb, VIIbc and VIIg-k)	421,636	473,165	463,495	218,946	317,237	347,101	378,704	423,282	469,926	476,423
Industrial mixed fishery (Divisions IVa-c, Vb and IIIa)	45,143	75,958	63,192	39,872	65,974	58,082	28,563	104,004	119,359	65,091
Subtotal northern fishery	522608	591738	528793	337521	445523	448423	429941	551019	612,732	604,084
Southern fishery (Sub-areas VIII+IX, Divisions VIId,e)	30,838	33,695	32,817	32,003	28,722	32,256	29,473	27,664	25,099	30,122
Grand total	553446	625,433	561,610	369,524	474,245	480,679	459,414	578,683	637,831	634,206

[1)] Including Icelandic industrial fishery in Division Va: in 1989, 1995 and 1996.

Table 3.12.5.2 Landings (tonnes) of BLUE WHITING from the directed fisheries in the Norwegian Sea (Sub-areas II and Division Va) 1988–1997, as estimated by the Working Group.

Country	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Faroes	-	1,047	-	-	-	-	-	-	345	-
Germany	3	1341	-	-	-	-	2	3	32	-
Iceland [3)]	-	4,977	-	-	-	-	-	369	302	10,464
Netherlands	-	-	-	-	-	-	-	72	25	-
Norway	-	-	566	100	912	240	-	-	58	1,386
Poland	10	-	-	-	-	-	-	-	-	-
USSR/Russia [1)]	55,816	35,250	1,540	78,603	61,400	43,000	22,250 [2)]	23,289	22,308	50,559
Estonia	-	-	-	-	-	-	-	-	377	161
Latvia	-	-	-	-	-	-	422	-	-	-
Total	55,829	42,615	2,106	78,703	62,312	43,240	22,674	23,733	23,447	62,570

[1]) From 1992 only Russia.
[2]) Includes Vb.
[3]) Icelandic mixed fishery in Va.

Table 3.12.5.3 Landings (tonnes) of BLUE WHITING from directed fisheries in the spawning area (Division Vb,VIa,b, VIIb,c. VIIg-k and Sub-area XII) 1988–1997, as estimated by the Working Group.

Country	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Denmark	797	25	-	-	3,167	-	770	-	269	-
Faroes	79,339	70,711	43,405	10,208 [1]	12,731	14,984	22,548	26,009	18,258	22,480
France	-	2,190	-	-	-	1,195	-	720	-	-
Germany	5,263	4,073	1,699	349	1,307	91	0	6,310	6,844	4,724
Ireland	245	-	-	-	-	-	3	-	-	-
Netherland	800	2,078	7,280	17,359	11,034	18,436	21,076	26,703	17,644	23,676
Norway	208,416	258,386	281,036 [1]	114,866 [1]	148,733 [1]	198,916	226,235	261,272	337,434	318,531
UK	5,071	8,020	6,006	3,541	6,849	2,032	4,465	10,583	14,325	33,398
USSR/Russia [2]	121,705	127682	124,069	72,623	115,600	96,000	94,531	83,931	64,547	68,097
Japan	-	-	-	-	918	1,742	2,574	-	-	-
Estonia	-	-	-	-	6,156	1,033	4,342	7,754	10,605	5,517
Latvia	-	-	-	-	10,742	10,626	2,160	-	-	-
Lithauen	-	-	-	-	-	2,046	-	-	-	-
Total	421,636	473,165	463,495	218,946	317,237	347,101	378,704	423,282	469,926	476,423

[1] Including direced fishery also in Division IVa. (H6).
[2] From 1992 only Russia.

Table 3.12.5.4 Landings (tonnes) of BLUE WHITING from the mixed industrial fisheries and caught as by-catch in ordinary fisheries in Divisions IIIa, IVa and Vb,1988–1997, as estimated by the WG.

Country	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Denmark	18,144	26,605	27,052	15,538	31,189	41,053	19,686	12,439	51,832	26,270
Faroes	492	3,325	5,281	355	705	1,522	1,794	-	6,068	6,066
Germany [1]	280	3	-	-	25	9	-	-	-	-
Netherlands	-	-	20	-	2	46	-	-	-	793
Norway	24,898	42,956	29,336 [2]	22,644	31,977	12,333	3,408	78,565	57,458	27,394
Sweden	1,229	3,062	1,503	1,000	2,058	2,867 [3]	3,675	13,000	4,000	4,568
UK [1]	100	7	0	335	18	252	0	0	1	-
Total	45,143	75,958	63,192	39,872	65,974	58,082	28,563	104,004	119,359	65,091

[1]) Including directed fishery also in Division IVa.
[2]) Including mixed industrial fishery in the Norwegian Sea.
[3]) Unprecise estimates. Reported catch of 34 265 t in 1993; the mean of 1992 and 1994, i.e. 2 867 t, is used in the VPA-RUN.

Table 3.12.5.5 Landings (tonnes) of BLUE WHITING from the Southern areas (Sub-areas VIII and IX) as estimated by the Working Group.

Country	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Netherlands			450	10						
Portugal	5,979	3,557	2,864	2,813	4,928	1,236	1,350	2,285	3,561	2,439
Spain	24,847	30,108	29,490	29,180	23,794	31,020	28,118	25,379	21,538	27,683
UK	12	29	13				5			
France		1								
Total	30838	33695	32817	32003	28722	32256	29473	27664	25099	30122

Table 3.12.5.6 Blue whiting, combined stock.

Year	Recruitment Age 0	Spawning Stock Biomass	Landings	Fishing Mortality Age 3-7
1981	5,551.94	4,057.85	909.56	0.235
1982	24,355.40	2,973.43	576.42	0.181
1983	24,139.20	2,036.08	570.07	0.211
1984	13,701.60	1,787.35	641.78	0.261
1985	12,281.50	2,084.39	695.60	0.324
1986	10,807.60	2,486.58	826.99	0.477
1987	8,580.35	2,075.37	664.43	0.398
1988	10,862.90	1,756.44	553.41	0.488
1989	25,689.50	1,670.71	625.43	0.515
1990	10,736.30	1,565.77	561.61	0.472
1991	7,096.83	1,895.40	369.52	0.245
1992	5,591.23	2,444.19	474.25	0.185
1993	8,155.06	2,318.72	480.67	0.217
1994	9,187.33	2,204.69	459.41	0.201
1995	30,014.90	1,992.75	578.69	0.310
1996	41,147.30	1,848.12	637.83	0.395
1997	6,851.26	2,020.77	634.21	0.409
1998	10,719.00	2,718.31	.	.
Average	14,748.29	2,218.72	603.52	0.325
Unit	Millions	1000 tonnes	1000 tonnes	-

Answer to NEAFC Requests

Precautionary reference points

This part of the NEAFC request is dealt with above.

Short term projections

A short term projection (Table 3.12.5.7), assuming a catch in 1998 of 750 000 t shows that:

- Fishing at the current F (0.41) generates a catch of 924 000 t in 1999, a total stock size of 3.6 million t and a spawning stock size of 2.6 million t in year 2000.

- Fishing at F_{med} (0.32) generates a catch of 760 000 t in 1999, a total stock size of 3.7 million t and a spawning stock size of 2.8 million t in year 2000.

Medium term projections

Medium term projections (10 years) were assuming either different constant fishing mortality or constant TAC's starting in 1998 with the same input data as in the short-term prediction. The maturity ogive, the natural mortality and the weight-at-age were taken as average for the period 1994–1997. The stock-recruitment relationship used geometric mean recruitment over the observed SSB range and a linear decrease down to the origin for SSB's lower than those observed in the past. Seven runs were made, with 200 simulations per run; 4 with various F-constraints and 3 with catch ceilings at 634 000 t (1997 catch), 800 000 t and 1 million t. The results are summarised in Tables 3.12.5.8 and 3.12.5.9. Runs 1 - 7 show the results of the projection for the various runs.

- F = 0.1 implies a 0% probability that the SSB will fall below 1.5 million t in the next 10 years, and generates average catches at the end of the period of about 470 000 t (95% confidence limits of 290 000 to 855 000 t);

- F = 0.21 implies a 3% probability that the SSB will fall below 1.5 million t during the next 10 years, and generates average catches at the end of the period of about 670 000 t. (95% confidence limits of 435 000 to 1 160 000 t);

- F = 0.32 implies a 14% probability that the SSB will fall below 1.5 million t in the next 10 years, and generates average catches at the end of the period of about 700 000 t (95% confidence limits of 373 000 to 1 370 000 t);

- Catch ceiling of 634 000 t (*status quo* catch) implies a 9% probability that the SSB will fall below 1.5 million t during the next 10 years, and this catch can be kept throughout the period with a high probability;

- Catch ceiling of 800 000 t implies a 23% probability that the SSB will fall below 1.5 million t during the next 10 years, and there is about 25% probability that this catch level cannot be kept throughout the period;

- Catch ceiling of 1 000 000 t implies a 54% probability that the SSB will fall below 1.5 million t during the next 10 years, and there is more than 25% probability that this catch level cannot be sustained throughout the period.

Harvesting regimes

Having defined an F_{pa} , B_{pa} and B_{lim} the following harvest regime is suggested:

- F higher than F_{pa}: The fishing pressure should be reduced to F_{pa};.

- B lower than B_{pa}: The fishing pressure should be reduced so that the stock is rebuilt with a high probability, using linear decrease of F towards zero when B decreases towards B_{lim}.

Table 3.12.5.7 Blue whiting combined stock.

```
                                                   1973: Area BAL22 - BAL32                        08:40 Friday, May 29, 1998
Blue whiting, combined stock

                                                         Prediction with management option table
```

Year: 1998					Year: 1999					Year: 2000	
F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	Stock biomass	Sp.stock biomass
0.9993	0.4085	4656752	2718312	750000	0.0000	0.0000	4483210	3110901	0	4551186	3467512
.	.	.	.	.	0.1000	0.0409	.	3110901	105892	4438660	3369350
.	.	.	.	.	0.2000	0.0818	.	3110901	208486	4329686	3274413
.	.	.	.	.	0.3000	0.1226	.	3110901	307897	4224140	3182585
.	.	.	.	.	0.4000	0.1635	.	3110901	404237	4121902	3093754
.	.	.	.	.	0.5000	0.2044	.	3110901	497613	4022854	3007813
.	.	.	.	.	0.6000	0.2453	.	3110901	588127	3926886	2924659
.	.	.	.	.	0.7000	0.2862	.	3110901	675880	3833889	2844194
.	.	.	.	.	0.8000	0.3270	.	3110901	760966	3743761	2766321
.	.	.	.	.	0.9000	0.3679	.	3110901	843478	3656402	2690949
.	.	.	.	.	1.0000	0.4088	.	3110901	923504	3571716	2617990
.	.	.	.	.	1.1000	0.4497	.	3110901	1001128	3489611	2547358
.	.	.	.	.	1.2000	0.4906	.	3110901	1076434	3409997	2478973
.	.	.	.	.	1.3000	0.5314	.	3110901	1149500	3332791	2412755
.	.	.	.	.	1.4000	0.5723	.	3110901	1220401	3257909	2348629
.	.	.	.	.	1.5000	0.6132	.	3110901	1289212	3185272	2286522
.	.	.	.	.	1.6000	0.6541	.	3110901	1356003	3114803	2226364
.	.	.	.	.	1.7000	0.6950	.	3110901	1420841	3046430	2168087
.	.	.	.	.	1.8000	0.7358	.	3110901	1483792	2980081	2111627
.	.	.	.	.	1.9000	0.7767	.	3110901	1544920	2915688	2056920
.	.	.	.	.	2.0000	0.8176	.	3110901	1604285	2853185	2003908
-	-	Tonnes	Tonnes	Tonnes	-	-	Tonnes	Tonnes	Tonnes	Tonnes	Tonnes

```
Notes: Run name                : MANXAN02
       Date and time           : 05MAY98:19:53
       Computation of ref. F: Simple mean, age 3 - 7
       Basis for 1998          : TAC constraints
```

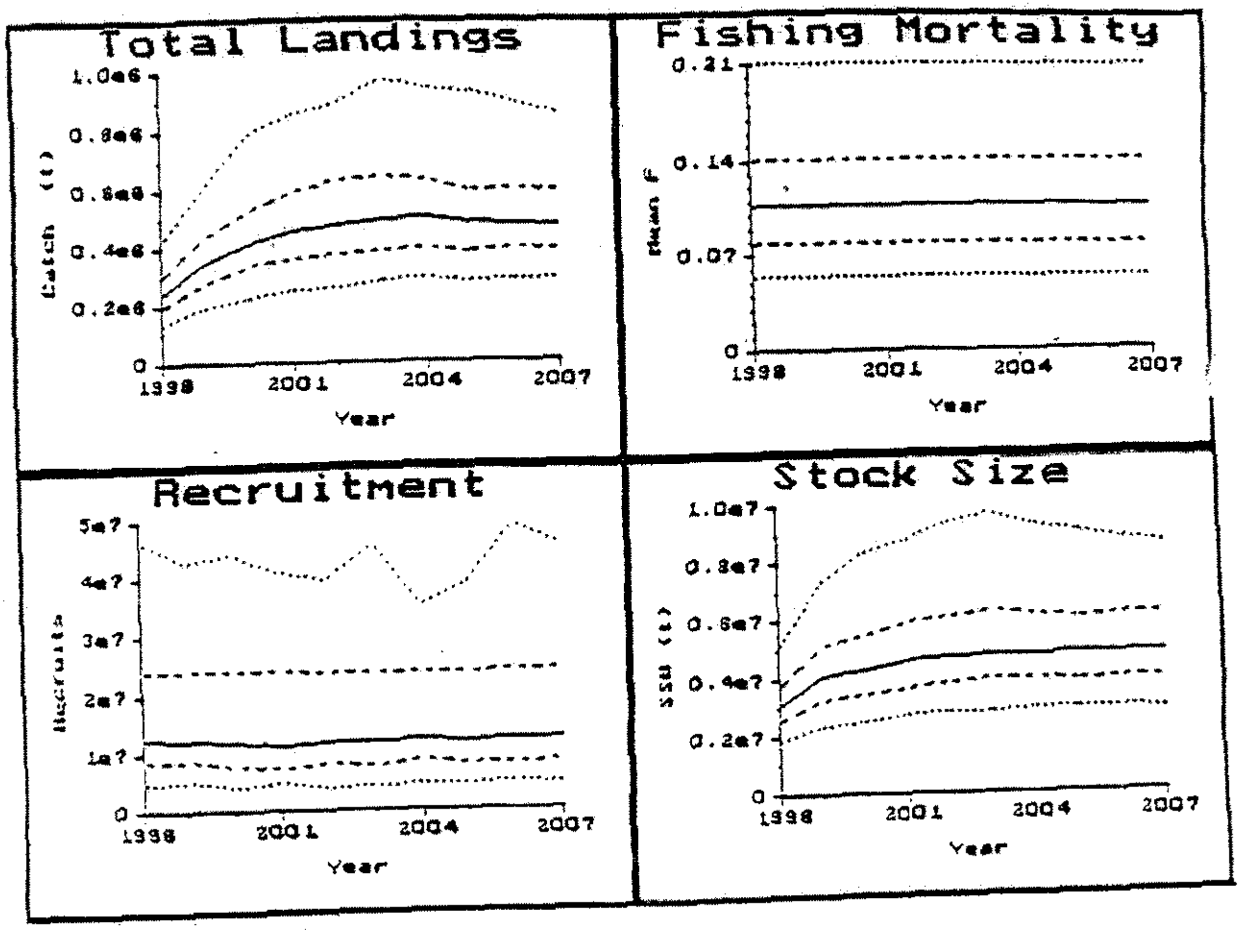
Table 3.12.5.8 Blue whiting, results of medium term projection. Risk of SSB falling below B_{lim} of 1 500 000 t in various years in the projection period.

Run no.	F	Catch ceiling (t)	Risk of SSB falling below B_{lim} of 1 500 000 t				
			1999	2001	2003	2005	2007
1	0.1	-	0.00	0.00	0.00	0.00	0.00
2	0.21 ($F_{med}e^{-1.645\sigma}$)	-	0.00	0.02	0.01	0.03	0.03
3	0.32 (F_{med})	-	0.02	0.07	0.11	0.14	0.14
4	0.41 (F_{sq})	-	0.05	0.12	0.17	0.22	0.24
5	-	634,000 (C_{sq})	0.02	0.04	0.04	0.08	0.09
6	-	800,000	0.05	0.10	0.16	0.20	0.23
7	-	1,000,000	0.05	0.21	0.34	0.48	0.54

Table 3.12.5.9 Blue whiting, results of medium term projection. Catch in the last year of the projection period.

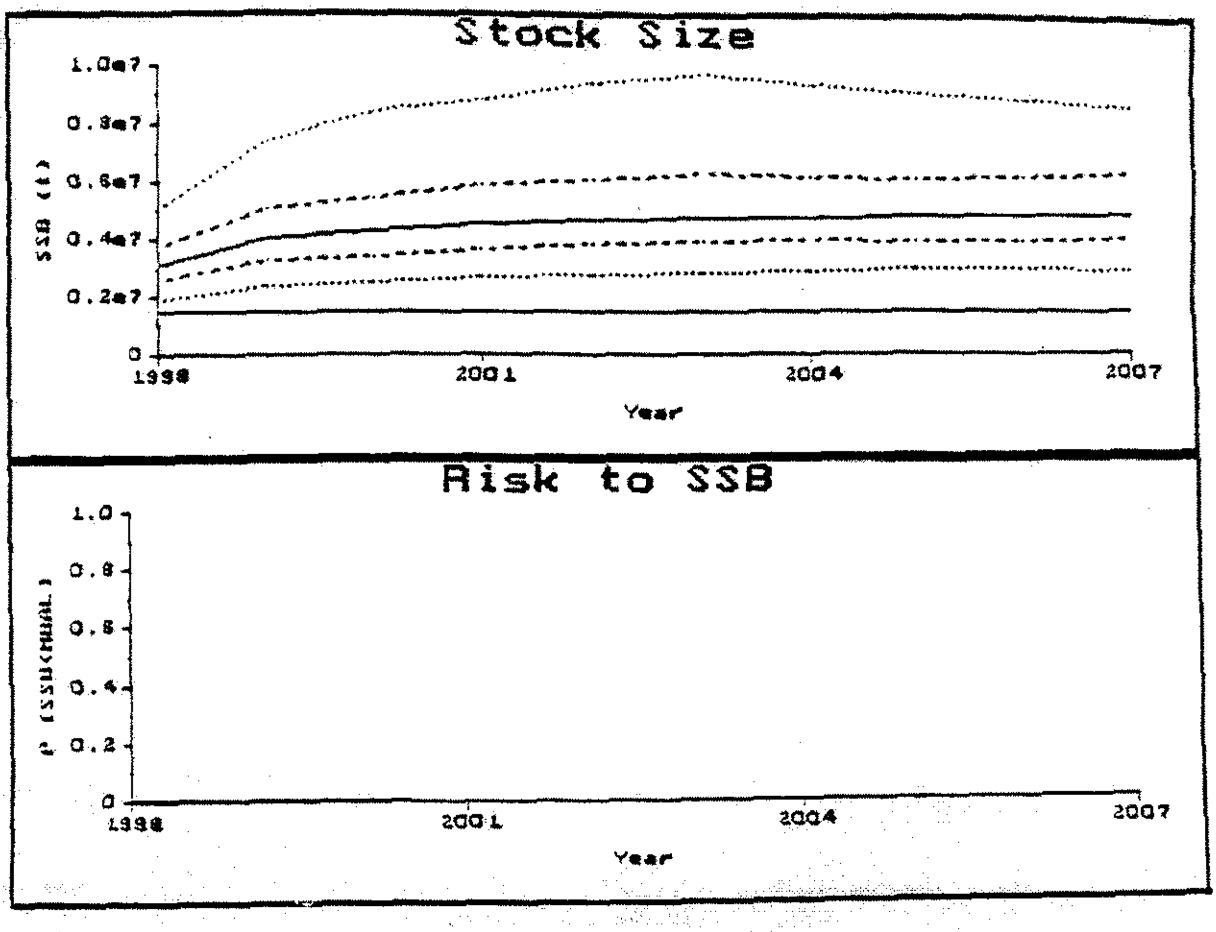
Run no.	F	Catch ceiling (t)	Catch in year 2007 ('000 t)				
			Percentiles				
			5%	25%	50%	75%	95%
1	0.1	-	290	390	471	587	855
2	0.21($F_{med}e^{-1.645\sigma}$)	-	435	549	668	836	1160
3	0.32 (F_{med})	-	373	575	696	892	1370
4	0.41 (F_{sq})	-	322	554	725	957	1280
5	-	634,000 (C_{sq})	634	634	634	634	634
6	-	800,000	518	799	800	800	800
7	-	1,000,000	140	982	1000	1000	1000

Run 1

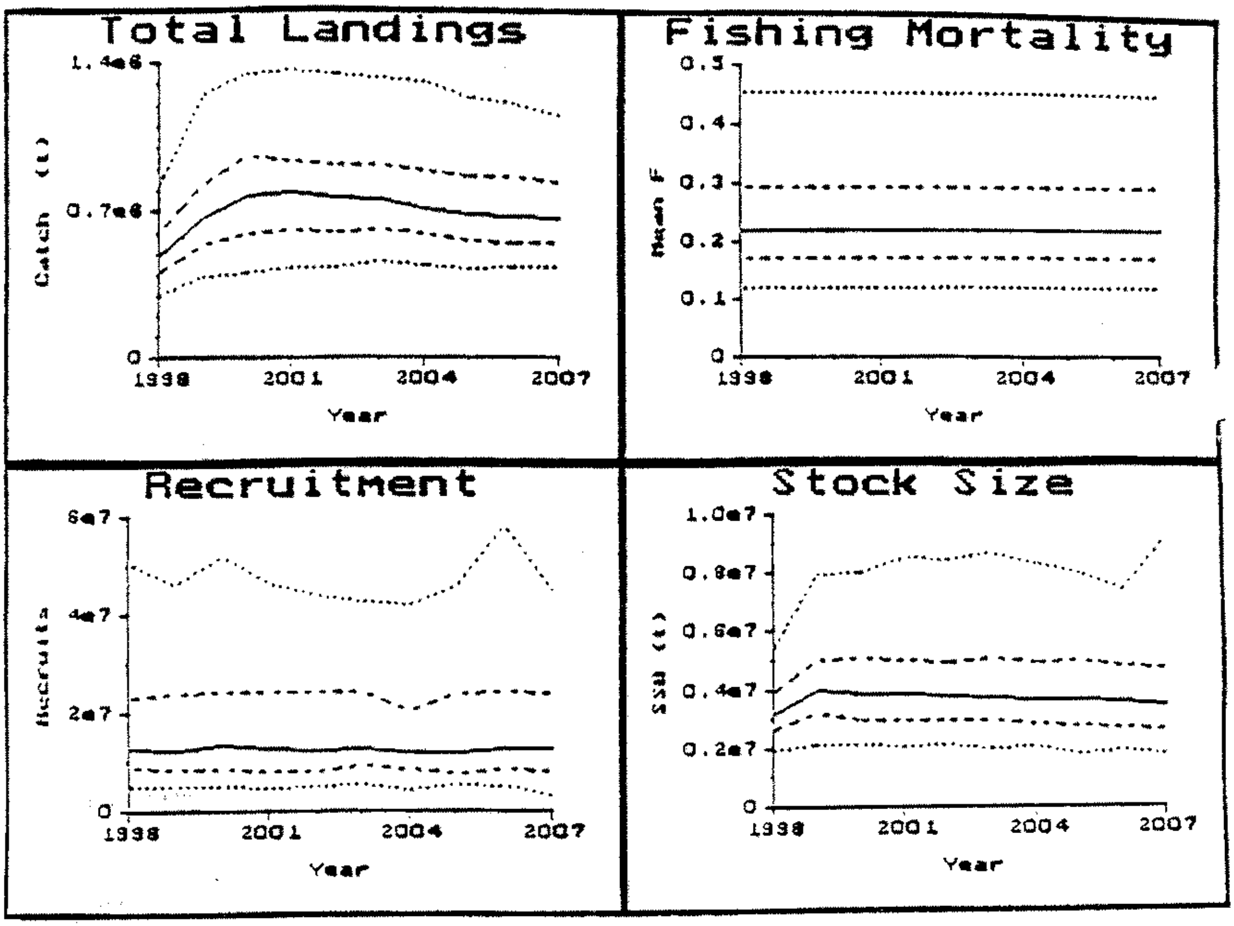


Total Landings
1.0e6
0.8e6
0.6e6
0.4e6
0.2e6
0
Catch (t)
1998
2001
2004
2007
Year
Fishing Mortality
0.21
0.14
0.07
0
Mean F
1998
2001
2004
2007
Year
Recruitment
5e7
4e7
3e7
2e7
1e7
0
Recruits
1998
2001
2004
2007
Year
Stock Size
1.0e7
0.8e7
0.6e7
0.4e7
0.2e7
0
SSB (t)
1998
2001
2004
2007
Year

Run 1a


Stock Size
SSB (t)
1.0e7
0.8e7
0.6e7
0.4e7
0.2e7
0
1998
2001
2004
2007
Year
Risk to SSB
1.0
0.8
0.6
0.4
0.2
0
1998
2001
2004
2007
Year

Run 2



Total Landings
Catch (t)
1.4e6
0.7e6
0
1998
2001
2004
2007
Year
Fishing Mortality
Mean F
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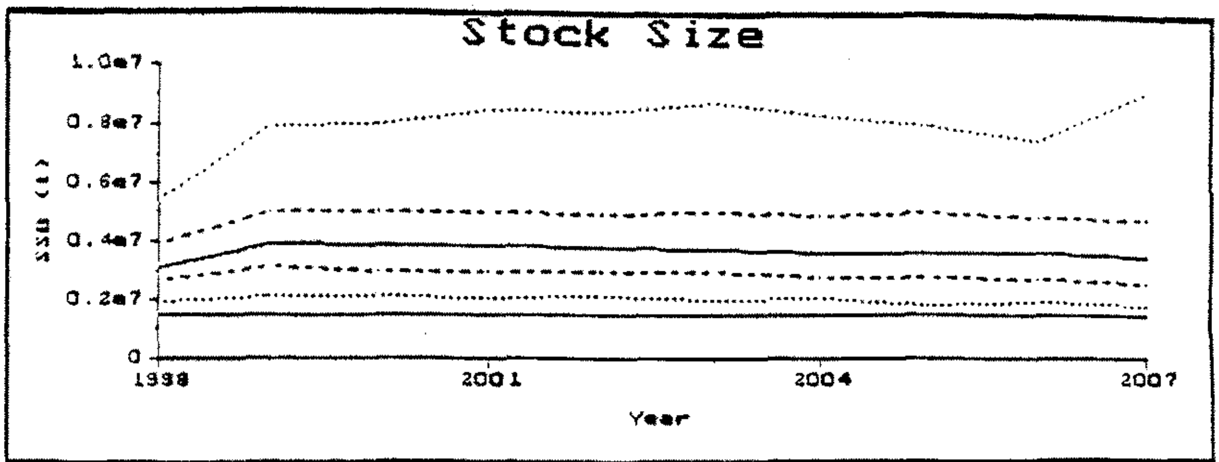
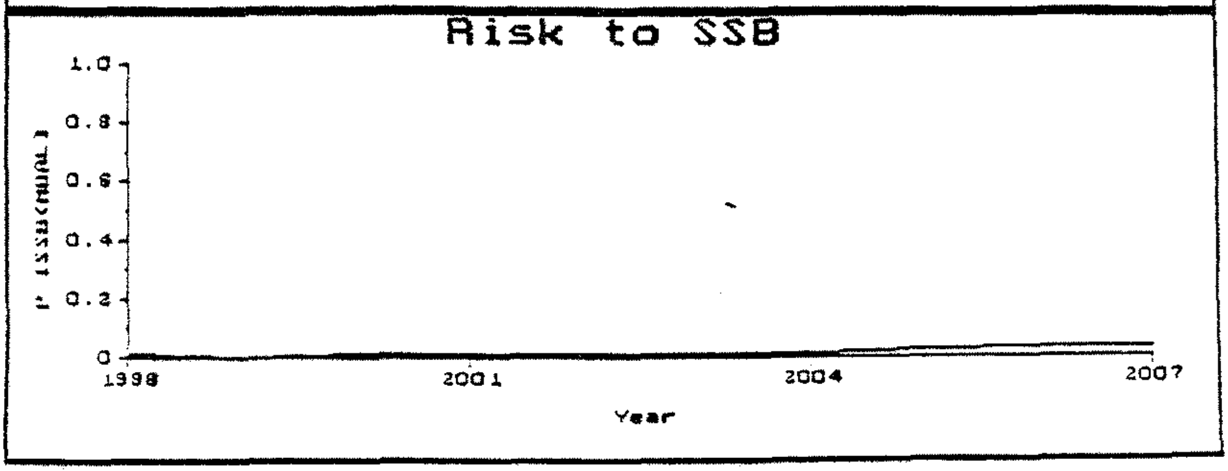
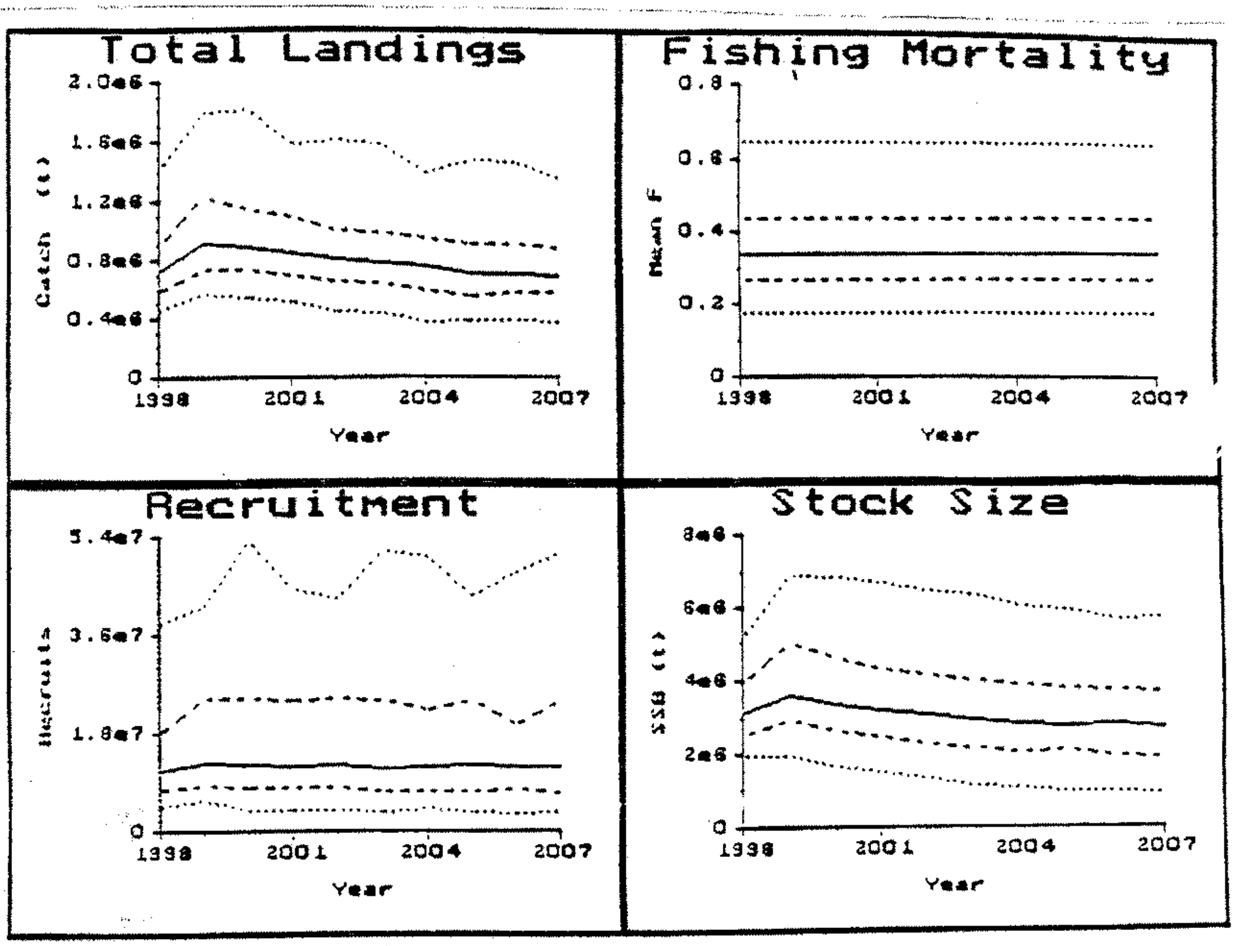
0.4
0.3
0.2
0.1
0
1998
2001
2004
2007
Year
Recruitment
Recruits
6e7
4e7
2e7
0
1998
2001
2004
2007
Year
Stock Size
SSB (t)
1.0e7
0.8e7
0.6e7
0.4e7
0.2e7
0
1998
2001
2004
2007
Year

Run 2a

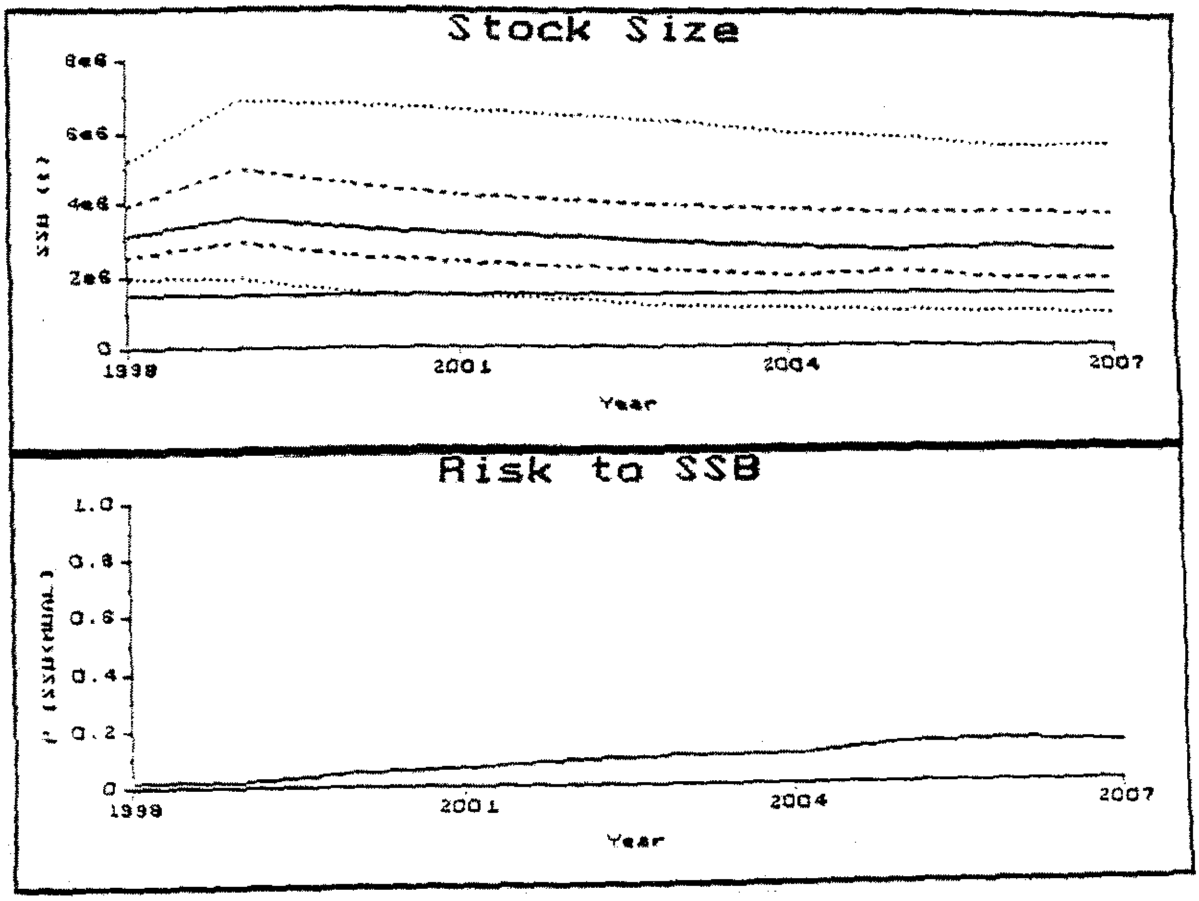

Stock Size
1.0e7
0.8e7
0.6e7
0.4e7
0.2e7
0
SSB (t)
1998
2001
2004
2007
Year


Risk to SSB
1.0
0.8
0.6
0.4
0.2
0
1998
2001
2004
2007
Year

Run 3


Total Landings
2.0e6
1.6e6
1.2e6
0.8e6
0.4e6
0
Catch (t)
1998
2001
2004
2007
Year
Fishing Mortality
0.8
0.6
0.4
0.2
0
Mean F
1998
2001
2004
2007
Year
Recruitment
5.4e7
3.6e7
1.8e7
0
Recruits
1998
2001
2004
2007
Year
Stock Size
8e6
6e6
4e6
2e6
0
SSB (t)
1998
2001
2004
2007
Year

Run 3a



Stock Size
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6e6
4e6
2e6
0
SSB (t)
1998
2001
2004
2007
Year
Risk to SSB
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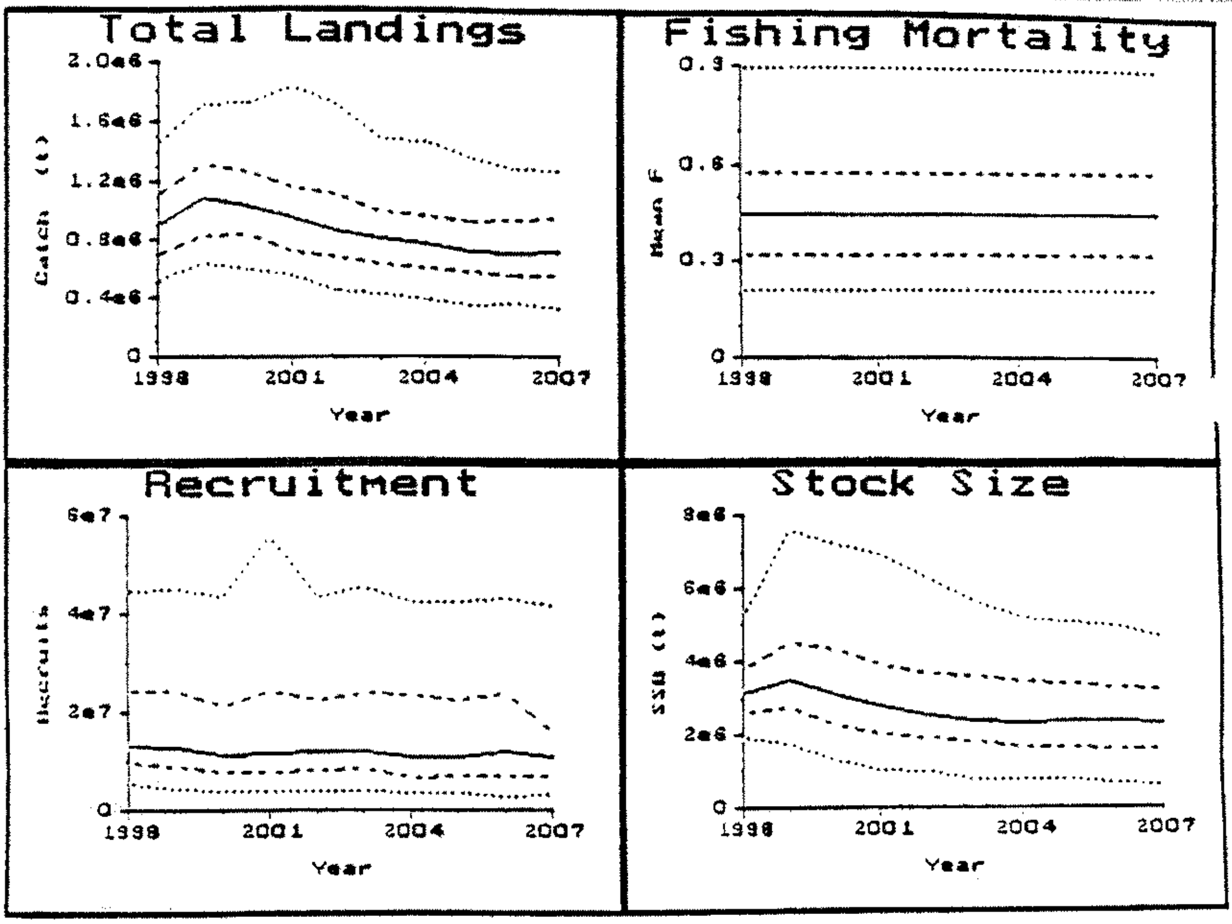
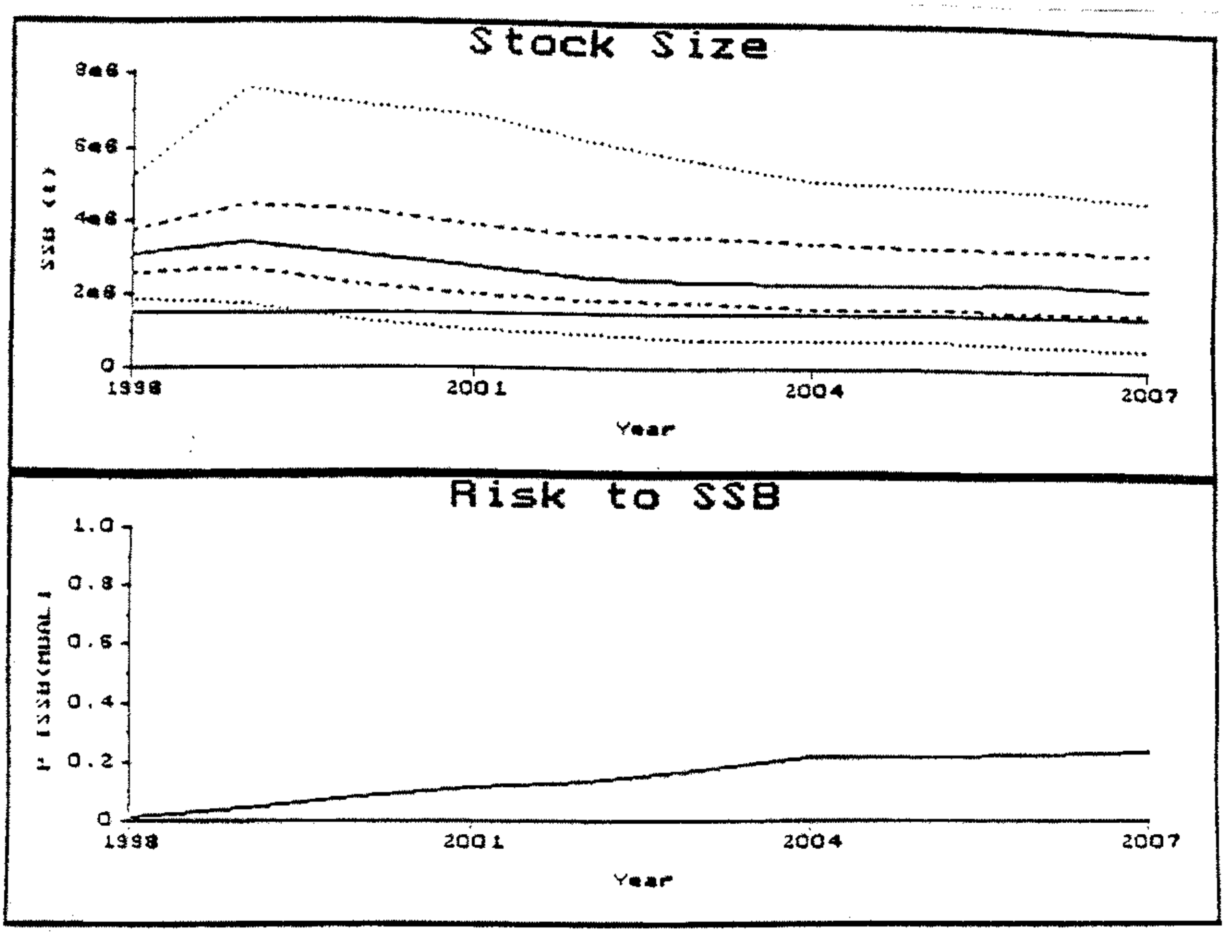
0.8
0.6
0.4
0.2
0
1998
2001
2004
2007
Year

Run 4

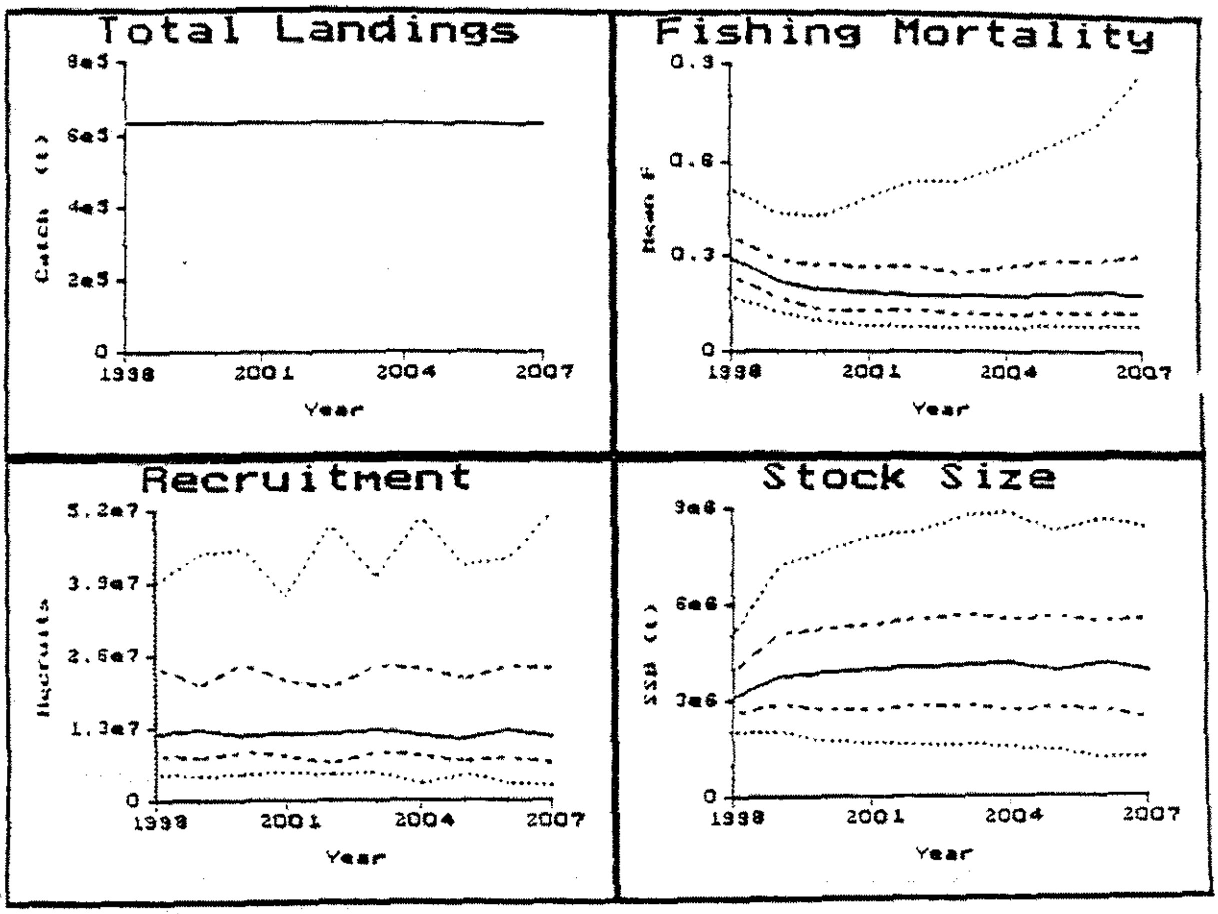


Total Landings
2.0e6
1.6e6
1.2e6
0.8e6
0.4e6
0
Catch (t)
1998
2001
2004
2007
Year
Fishing Mortality
0.9
0.6
0.3
0
Mean F
1998
2001
2004
2007
Year
Recruitment
6e7
4e7
2e7
0
Recruits
1998
2001
2004
2007
Year
Stock Size
8e6
6e6
4e6
2e6
0
SSB (t)
1998
2001
2004
2007
Year

Run 4a

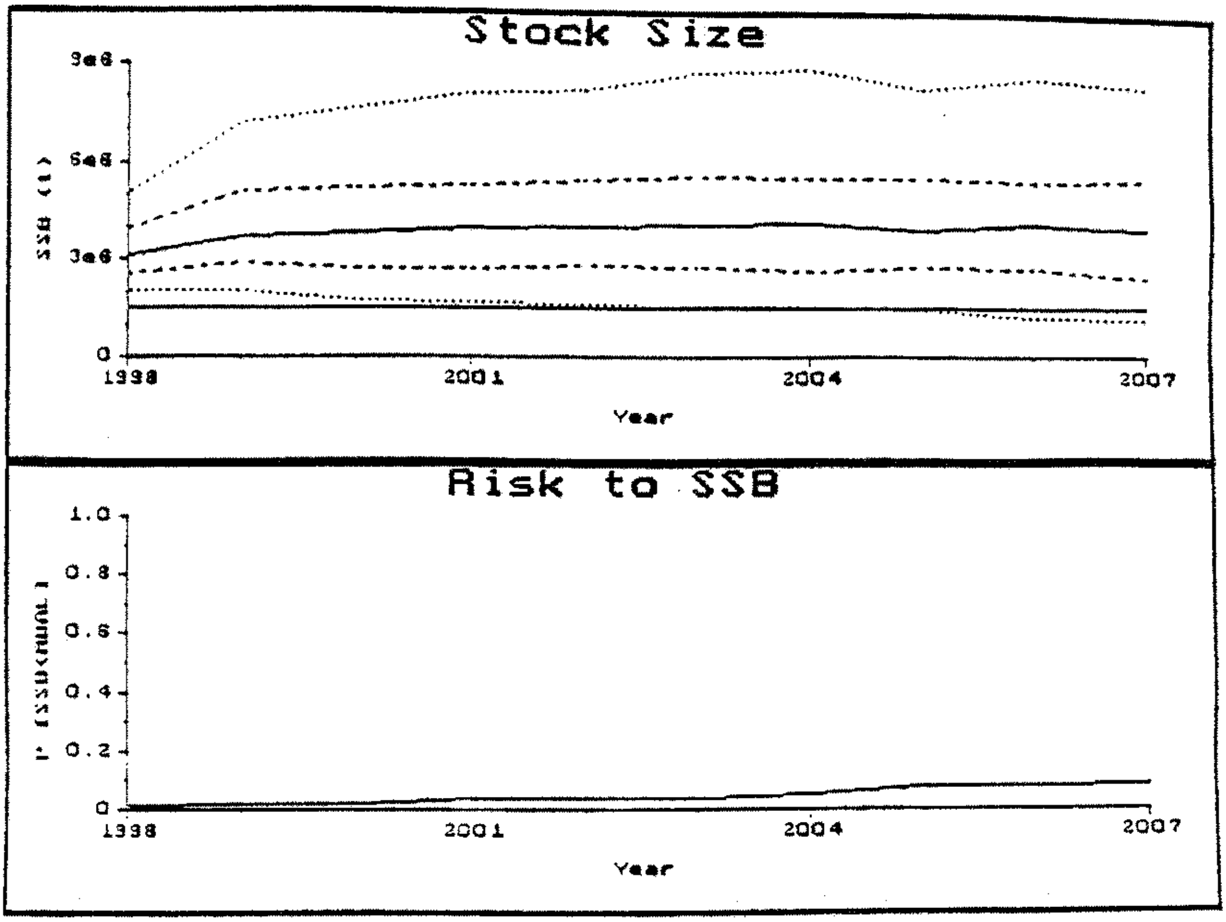

Stock Size
8e6
6e6
4e6
2e6
0
1998
2001
2004
2007
Year
Risk to SSB
1.0
0.8
0.6
0.4
0.2
0
1998
2001
2004
2007
Year

Run 5



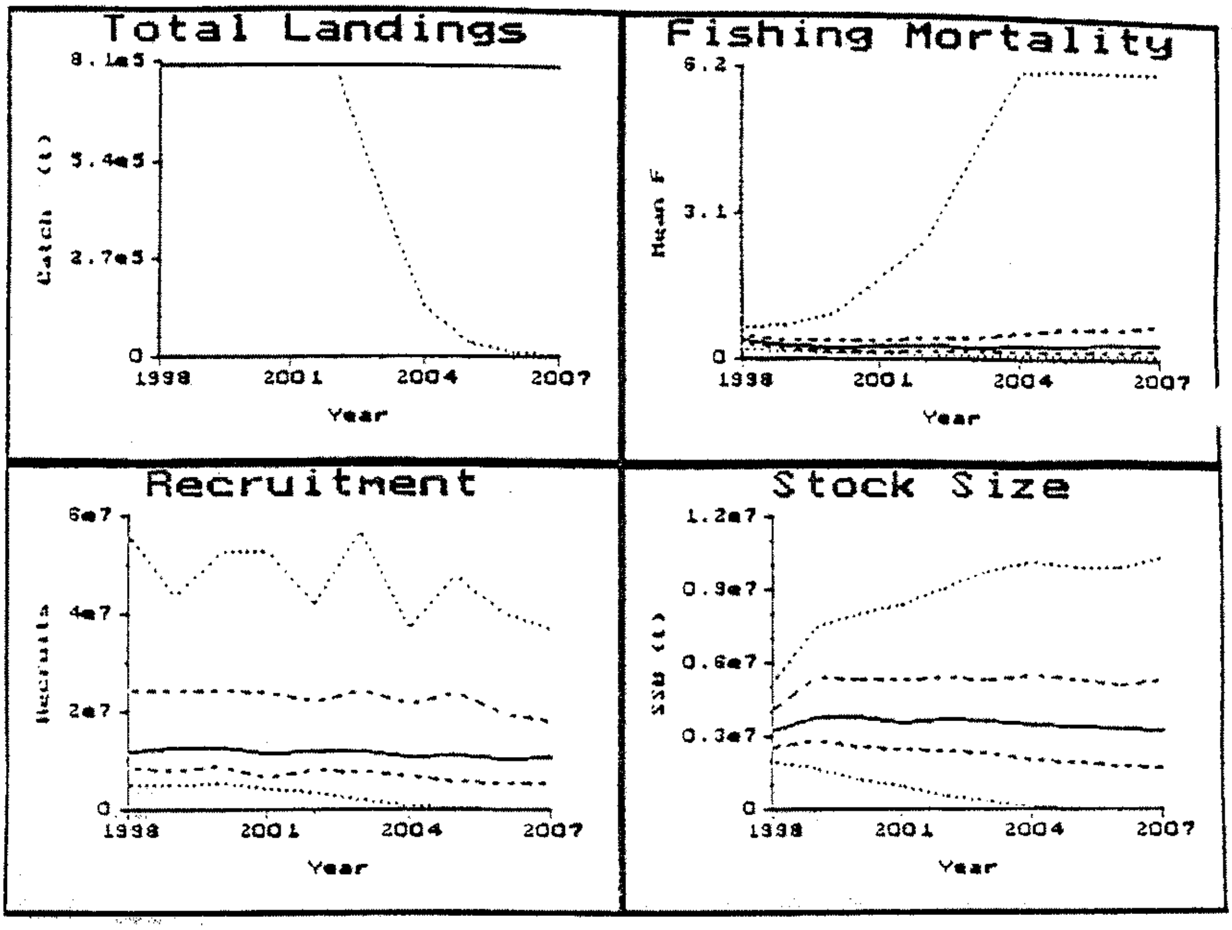
Total Landings
Catch (t)
Year
Fishing Mortality
Mean F
Year
Recruitment
Recruits
Year
Stock Size
SSB (t)
Year

Run 5a



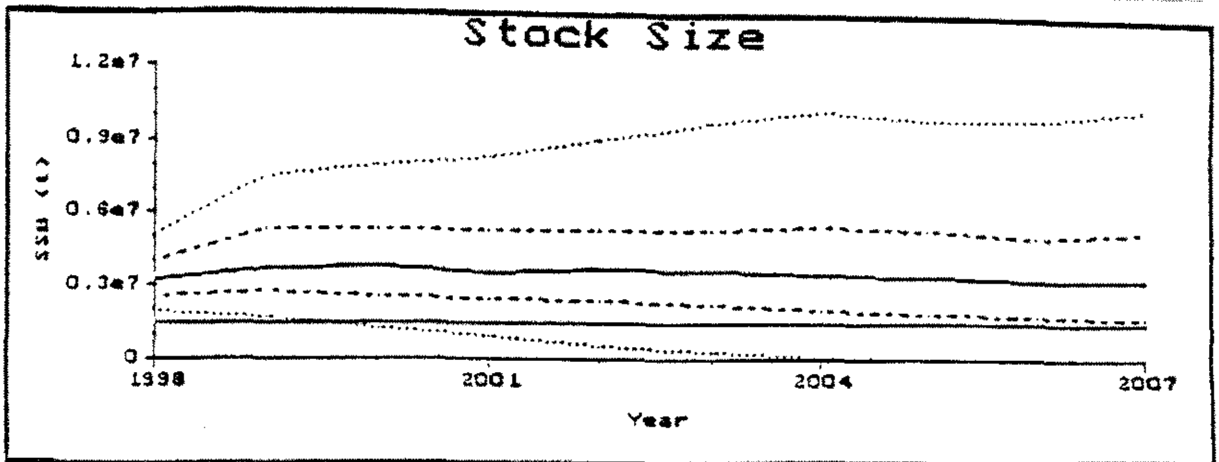
Stock Size
9e6
6e6
3e6
0
SSB (t)
1998
2001
2004
2007
Year
Risk to SSB
1.0
0.8
0.6
0.4
0.2
0
1998
2001
2004
2007
Year

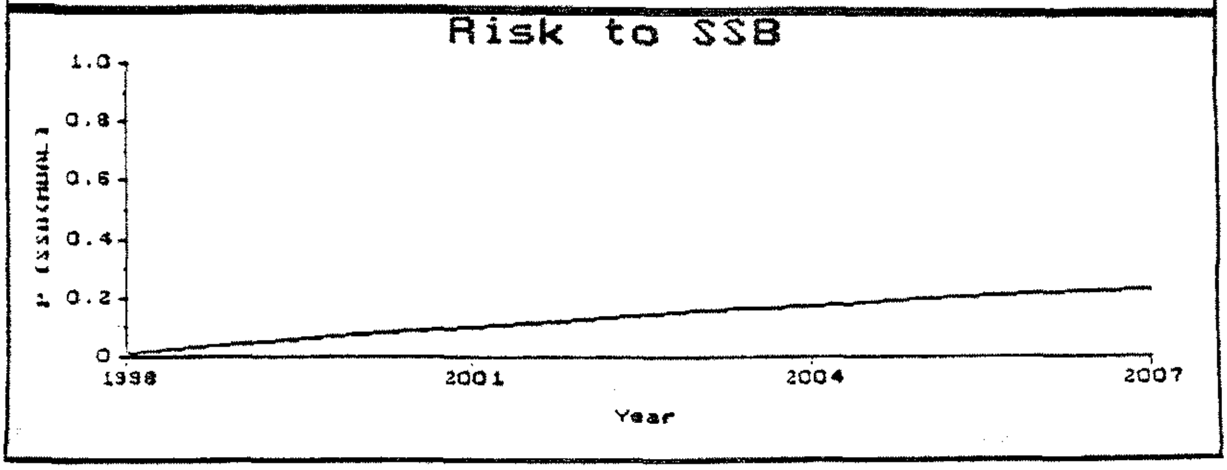
Run 6



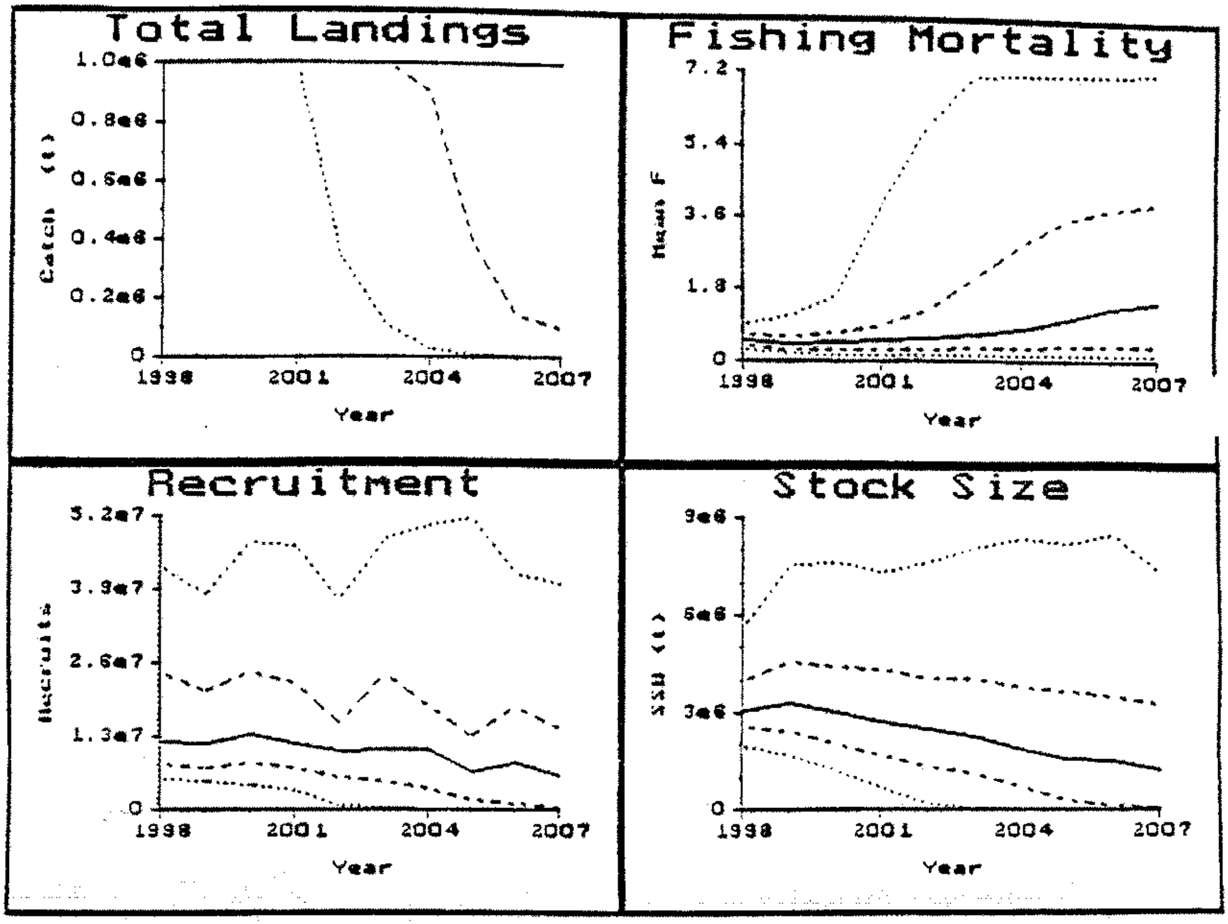
Total Landings
8.1e5
5.4e5
2.7e5
0
Catch (t)
1998
2001
2004
2007
Year
Fishing Mortality
6.2
3.1
0
Mean F
Year
Recruitment
6e7
4e7
2e7
Recruits
Year
Stock Size
1.2e7
0.9e7
0.6e7
0.3e7
SSB (t)
Year

Run 6a


Stock Size
1.2e7
0.9e7
0.6e7
0.3e7
0
SSB (t)
1998
2001
2004
2007
Year

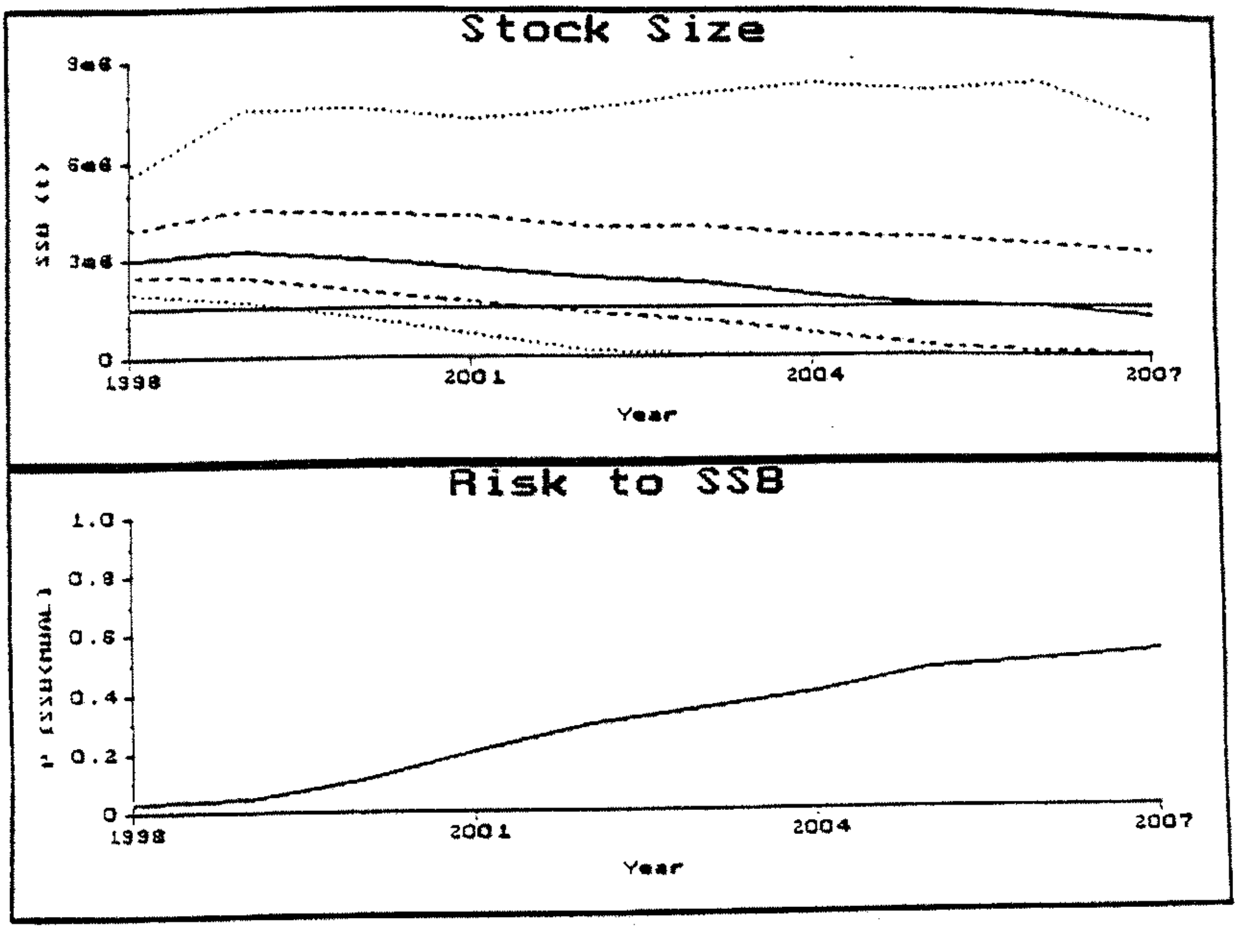

Risk to SSB
1.0
0.8
0.6
0.4
0.2
0
1998
2001
2004
2007
Year

Run 7



Total Landings
Catch (t)
Year
Fishing Mortality
Mean F
Year
Recruitment
Recruits
Year
Stock Size
SSB (t)
Year

Run 7a



Stock Size
9e6
6e6
3e6
0
SSB (t)
1998
2001
2004
2007
Year
Risk to SSB
1.0
0.8
0.6
0.4
0.2
0
1998
2001
2004
2007
Year

3.12.6 Deep-water Fisheries Resources south of 63°N

1. Background

During the past two or three decades a certain amount of research and exploratory work has been undertaken on deep-water resources. Dwindling resources on the continental shelves of the North Atlantic have encouraged the development of fisheries in deeper waters. There has been a tendency for fisheries for species such as anglerfish and Greenland halibut to extend into deeper waters and new fisheries have developed to target new deep-water species found there. In recent years deep-water species such as the argentine or greater silver smelt (*Argentina silus*), roundnose grenadier (*Coryphaenoides rupestris*) and orange roughy (*Hoplostethus atlanticus*) which were previously by-catch species are now being targeted within the ICES area.

In some parts of the north-east Atlantic where the continental shelf is virtually non-existent, such as off Portugal (including Madeira and the Azores), there are traditional fisheries which have been exploiting deep-water species for many years.

Experience in other parts of the world has shown that fisheries on deep-water species can develop rapidly and that the resources which they exploit may be especially vulnerable to overfishing. There is concern that species/stocks such as these will be depleted before appropriate management measures can be implemented.

2. The species

The term deep-water was defined to include waters of depths greater than 400 m. The following were identified as some of the most important deep-water species.

DEEP-WATER SPECIES LIST

Alepocephalus bairdii	Baird's smoothhead
Aphanopus carbo	Black scabbardfish
Argentina silus	Argentine, greater silver smelt
Beryx decadactylus	Red bream, alfonsino
Brosme brosme	Tusk
Beryx splendens	Golden eye perch
Chimaera monstrosa	Rabbitfish
Conger conger	Conger eel
Coryphaenoides rupestris	Roundnose grenadier
Epigonus telescopus	Big eye, Deep-water cardinal fish
Helicolenus dactylopterus	Bluemouth
Hoplostethus atlanticus	Orange roughy
Hoplostethus mediterraneus	Silver roughy
Lepidopus caudatus	Silver scabbardfish
Macrourus berglax	Roughhead grenadier
Molva molva	Ling
Molva dypterygia	Blue ling
Mora moro	Mora
Pagellus bogaraveo	Red (=blackspot) seabream
Phycis blennoides	Greater forkbeard
Polyprion americanus	Wreckfish
Trachyrhynchus trachyrhynchus	Roughnose grenadier
Sharks, various	
Chaecon (Geryon) affinis	Deep-water red crab
Aristeomorpha foliacea	Giant red shrimp

The main shark species caught in deep-water fisheries are:

Centrophorus granulosus	Gulper shark
Centrophorus squamosus	Leafscale gulper shark
Centroscyllium fabricii	Black dogfish
Centroscymnus coelolepis	Portuguese dogfish
Centroscymnus crepidater	Longnose velvet dogfish
Dalatias licha	Kitefin shark
Deania calcea	Birdbeak dogfish
Etmopterus princeps	Great lantern shark
Etmopterus spinax	Velvetbelly
Scymnodon ringens	Knifetooth dogfish

Advice on some other species, which might be considered as deep-water species, is already provided elsewhere in the ACFM report:

Micromesistius poutassou	Blue whiting
Reinhardtius hippoglossoides	Greenland halibut
Sebastes spp.	Redfish

In addition, there are other species which have been fished on the continental shelf but whose distribution extends into deeper waters. This group includes hake (*Merluccius merluccius*), anglerfish (*Lophius* spp.) and megrim (*Lepidorhombus* spp.) and recent years have seen an extension of fishing into deeper waters for these species in ICES Sub-areas VI, VII, VIII, and IX. Advice is provided on these species elsewhere in the ACFM report.

3. Descriptions of Deep-Water Fisheries by Sub-area

In **ICES Sub-area II** there is a directed bottom and pelagic trawl fishery for greater silver smelt (*Argentina silus*). This species is also caught as a by-catch in the *Pandalus* fishery and in industrial trawl fisheries. There is also a directed fjord fishery for roundnose grenadier (*Coryphaenoides rupestris*). There are directed longline fisheries for ling and tusk. Roughhead grenadier (*Macrourus berglax*) are taken in the gillnet fishery for Greenland halibut.

In **ICES Sub-area III** there is a targeted trawl fishery for greater silver smelt and this species is also a by-catch in the *Pandalus* fishery. Roundnose grenadier is caught as a by-catch in both these fisheries.

In **ICES Sub-area IV** there is a by-catch of greater silver smelt, from the industrial trawl fishery. There is a longline fishery for tusk and ling with roughhead grenadier as a by-catch. There is a by-catch of some deep-water species in the trawl fisheries targeting *Lophius* spp. and Greenland halibut.

In **ICES Sub-area V** there are trawl fisheries which target blue ling, redfish and occasionally orange roughy (*Hoplostethus atlanticus*). By-catch species are typically roundnose grenadier, roughhead grenadier, black scabbardfish (*Aphanopus carbo*), anglerfish (*Lophius piscatorius*), bluemouth (*Helicolenus dactylopterus*), Mora (*Mora moro*), greater forkbeard (*Phycis blennoides*), greater silver smelt, deep-water cardinal fish (*Epigonus telescopus*) and rabbitfish (*Chimaera monstrosa*). There are traditional longline fisheries for ling, tusk and blue ling. There are also targeted deep-water trawl and gillnet fisheries for Greenland halibut and *Lophius* spp. which have by-catch. There have been trap fisheries for the deep-water red crab (*Chaceon* (formerly *Geryon*) *affinis*).

In **ICES Sub-areas VI and VII** there are directed trawl fisheries for blue ling, roundnose grenadier, orange roughy, black scabbard fish and the deepwater sharks *Centroscymnus coelolepis* and *Centrophorus squamosus*. By-catch species include bluemouth, mora, greater forkbeard, argentine, deep-water cardinal fish and rabbit fish. In some years there are considerable by-catches of *Argentina silus* in the blue whiting fishery and *A. silus* has been targeted in some years. There are directed longline fisheries for ling and tusk and also for hake. Deep-water sharks are a by-catch of the longline fisheries. There are targeted fisheries for sharks in Sub-area VII.

In **ICES Sub-area VIII** there is a longline fishery which mainly targets deep-water sharks but is occasionally directed to mora and greater forkbeard. There are also some trawl fisheries targeting species such as hake, megrim, angler fish and *Nephrops* which have a by-catch of deep-water species. These include *Molva* spp., *Phycis phycis*, *Phycis blennoides*, *Pagellus bogaraveo*, *Helicolenus dactylopterus*, *Polyprion americanus* and *Beryx* spp.

In **ICES Sub-area IX** some deep-water species are a by-catch of the trawl fisheries for crustaceans. Typical species are bluemouth, greater forkbeard, conger eel (*Conger conger*), blackmouth dogfish (*Galeus melastomus*), kitefin shark (*Dalatias licha*) and gulper shark (*Centrophorus squamosus*). There is a directed longline fishery for black scabbard fish with a by-catch of the gulper shark. There is also a longline fishery for *Pagellus bogaraveo*.

In **ICES Sub-area X** the main fisheries are by handline and longline and the main species landed are red (=blackspot) seabream (*Pagellus bogaraveo*), wreckfish (*Polyprion americanus*), conger eel (*Conger conger*), bluemouth, golden eye perch (*Beryx splendens*) and alfonsino (*Beryx decadactylus*). There is also a directed fishery for kitefin shark by hand line and gillnet.

In **ICES Sub-area XII** there are trawl fisheries on the Mid Atlantic Ridge for golden eye perch (*Beryx splendens*), orange roughy cardinal fish (*Epigonus telescopus*), black scabbard fish (*Aphanopus carbo*) and wreckfish. There is also a targeted roundnose grenadier fishery on the Mid Atlantic Ridge. There is a multi-species trawl fishery on Hatton Bank.

In **ICES Sub-area XIV** roundnose grenadier and roughhead grenadier (*Macrourus berglax*) are a by-catch, which is sometimes landed, of the Greenland halibut (trawl and longline) and redfish (trawl) fisheries.

4. Landings data

The data provided on landings for all areas and by ICES Sub-areas and Divisions for all deep-water species including blue ling, ling and tusk, are given in Figures 3.12.6.1–10. The data were compiled from the database of statistics officially reported to ICES, national data supplied by study group members and some published data. The data for 1997 are provisional. Landings for Alfonsinos (*Beryx* spp.), greater forkbeard, red (blackspot) sea bream, roughhead grenadier, sharks (various), silver scabbardfish (*Lepidopus caudatus*) and wreckfish by ICES Sub-areas and country are given in Tables 3.12.6.1–7.

5. Description of the fisheries by species and state of stocks

Red (=blackspot) seabream (*Pagellus bogaraveo*)

There is a directed handline and longline fishery in Sub-area X. Red seabream appears as by-catch in the trawl fishery on hake, megrim, angler and *Nephrops* in Sub-area VIII. In Sub-area IX the landings are from the longliner fleet. The greatest landings are from Sub-area X where the state of the stock is unknown. The stock in other areas has apparently collapsed.

Year	ACFM Catch
1988	1397
1989	1645
1990	1503
1991	1241
1992	1440
1993	2031
1994	2230
1995	1935
1996	1979
1997*	1546

*Preliminary. Weights in t.

Greater forkbeard (*Phycis blennoides*)

The landings of greater forkbeard are mainly by-catch from both trawl and longline fisheries. Fluctuations in landings are probably the result of changing effort on different target species. The increase in landings in Sub-areas VIII and IX probably represents a directed longline fishery. The state of the stock is unknown.

Year	ACFM Catch
1988	2025
1989	2015
1990	2381
1991	2044
1992	2127
1993	1442
1994	1575
1995	2605
1996	4118
1997*	1944

*Preliminary. Weights in t.

Alfonsinos/Golden eye perch (*Beryx* spp.)

In most cases the landings refer to both species combined (*Beryx splendens* and *B. decadactylus*). Most of the landings of *Beryx* are from handlines and longlines within the Azorean EEZ of Sub-area X and by trawl outside the EEZ. The state of the stock is unknown.

Year	ACFM Catch
1988	225
1989	272
1990	353
1991	371
1992	460
1993	729
1994	1506
1995	380
1996	437
1997*	139

*Preliminary Weights in t.

6. Assessment

Very few time series based on the regular sampling of commercial landings exist. Basic statistics on catches and effort are of poor quality and in some cases lacking. There is often little information on the general biology of these species, in particular on age and growth, seasonal behaviour, migration, and stock discrimination. However, a Nordic Project on blue ling, ling and tusk, has considerably improved the quality of data on these species for some areas. Similarly for some other species historical data are being compiled and new data on landings, discards and biological parameters relevant to assessment are being collected as part of the EC FAIR Deep-fisheries Project.

However, the possibilities for traditional age-structured assessments are still limited, although VPAs have been attempted for red seabream in the Azores area and black scabbardfish in Sub-area IX. Assessments using some alternative methodologies such as De Lury constant recruitment models and Schaefer production models were attempted. In some cases these have been used to provisionally assess the state of the stocks.

Developments in acoustic survey techniques may lead to biomass estimates for some species. In the shorter term the use of trawl surveys may be the best method for monitoring some of these stocks.

7. Management considerations

Experience from other parts of the world shows that there is no doubt that deep-sea stocks can be depleted very quickly and that recovery will be slow. These populations generally have a high proportion of fish of high age, their fecundities are low, and growth can be very slow. The unusual body shape of many deep-water fish combined with a high age/length at maturity often means that there can be a high fishing mortality of immature fish. Some species, such as blue ling, orange roughy, golden eye perch and alfonsinos aggregate in shoals, often associated with seamounts, and can provide high catch rates once the shoals are located. A danger for these species is that high catch rates can be maintained by moving from one concentration to another and progressively depleting the stock. Regeneration and growth are so slow that stock numbers may not increase in the depleted areas in the short or medium term. Furthermore, many deep-sea fisheries are on mixtures of species, making it difficult, and often inappropriate, to manage the component species individually.

Very little information is currently available on the state of deep-water species. Fisheries for deep-water species are developing in areas inside and outside national jurisdictions. As a result exploitation must be increasing on a number of species, as fishing extends into deeper waters or new areas, but the actual exploitation rates are unknown. Moreover, in some recently developed fisheries, information is being withheld for commercial reasons. The quantities that are recorded are probably not well estimated, and some landings are reported in grouped categories because of difficulties in separating species. In many cases significant proportions of the catch are discarded at sea and not recorded. All these factors mean that it is not possible, at present, to determine whether exploitation is sustainable.

The survival rates of discards and of fish encountering gears and escaping are unknown, but most species are expected to be very vulnerable to injury, and therefore would be expected to die even if they escaped through meshes.

The impact of fishing gears on the sea bottom in deep-water has not been determined.

Management advice: Most deep-water species are, at present, considered to be harvested outside safe biological limits as embodied in the precautionary approach. **ICES recommends immediate reduction in fisheries that cannot be shown to be sustainable. All remaining fishing activity should be conducted in the context of effective management which emphasizes documentation of fishing activity, and which can react appropriately to biological characteristics of the populations.**

Deep-water species are inherently vulnerable. Localized populations can be quickly depleted by fisheries, even within a single season. Some populations (e.g. red sea bream, blue ling and orange roughy) are known to have collapsed in some areas, and there is insufficient data on other stocks to determine what level of fishing is sustainable.

The Code of Conduct for Responsible Fishing 7.5.4 (and the UN Agreement on Straddling Stocks 6) states:

> *"In the case of new or exploratory fisheries, States should (shall) adopt as soon as possible cautious conservation and management measures, including, inter alia, catch limits and effort limits. Such measures should (shall) remain in force until there are sufficient data to allow assessment of the impact of the fisheries on the long-term sustainability of the stocks, whereupon conservation and management measures based on that assessment should (shall) be implemented. The latter measures should (shall), if appropriate, allow for the gradual development of the fisheries."*

Fisheries on deep-water species often develop and expand before sufficient information is available on which to base management advice. **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. Although there have been some improvements in recent years in data acquisition, a comprehensive data collection system is urgently required, and research on the stocks should be increased to provide the data necessary for assessment.**

Continued fishing without biological data collection is not in accordance with the precautionary approach. **ICES therefore recommends that provision should be made for reporting landings to ICES at the species level for all species, including sharks. Provision should be retained, or made, for reporting at genus and higher grouped levels to allow for reports of landings which have not been sorted to the species level.** In this context the use of a hierarchical system of reporting should be encouraged.

Source of information: Report of the Study Group on the Biology and Assessment of Deep-Sea Fisheries Resources, February 1998 (ICES CM 1998/ACFM:12).

Table 3.12.6.1 Alfonsinos. Study Group estimates of landings (tonnes).

ALFONSINOS (*Beryx* spp.) IV

Year	France	TOTAL
1988	0	**0**
1989	0	**0**
1990	1	**1**
1991	0	**0**
1992	2	**2**
1993	0	**0**
1994	0	**0**
1995	0	**0**
1996	0	**0**
1997*	0	**0**

ALFONSINOS (*Beryx* spp.) Vb

Year	Faroes	France	TOTAL
1988			**0**
1989			**0**
1990		5	**5**
1991		0	**0**
1992		4	**4**
1993		0	**0**
1994		0	**0**
1995	1	0	**1**
1996	0	0	**0**
1997*	0	0	**0**

ALFONSINOS (*Beryx* spp.) VI and VII

Year	France	UK (EW)	Spain	TOTAL
1988				
1989	12			**12**
1990	8			**8**
1991				**0**
1992	3			**3**
1993	0		1	**1**
1994	0		5	**5**
1995	0		3	**3**
1996	0		178	**178**
1997*	0	4	0	**4**

ALFONSINOS (*Beryx* spp.) VIII and IX

Year	France	Portugal	Spain	TOTAL
1988				
1989				
1990	1			**1**
1991				**0**
1992	1			**1**
1993	0			**0**
1994	0		2	**2**
1995	0	75	7	**82**
1996	0	43	45	**88**
1997*	0	34		**34**

Continued...

Table 3.12.6.1 (continued)

ALFONSINOS (*Beryx* spp.) X

Year	Faroes	Norway	Portugal	Russia	TOTAL
1988			225		**225**
1989			260		**260**
1990			338		**338**
1991			371		**371**
1992			450		**450**
1993		195	533		**728**
1994		0	635	864	**1499**
1995	0	0	192(1)	100	**292**
1996	0		171(1)		**171**
1997*	5		96(1)		**101**

(1) *B. decadactylus* only

ALFONSINOS (*Beryx* spp.) XII

Year	Faroes	TOTAL
1988		**0**
1989		**0**
1990		**0**
1991		**0**
1992		**0**
1993		**0**
1994		**0**
1995	2	**2**
1996	0	**0**
1997*	0	**0**

Table 3.12.6.2 Study Group estimates of landings (tonnes)

GREATER FORKBEARD (*Phycis blennoides*) I and II

Year	Norway	TOTAL
1988	0	**0**
1989	0	**0**
1990	23	**23**
1991	39	**39**
1992	33	**33**
1993	1	**1**
1994	0	**0**
1995	0	**0**
1996	0	**0**
1997	0	**0**

GREATER FORKBEARD (*Phycis blennoides*) III and IV

Year	France	Norway	UK (EWNI)	UK (Scot)(1)	TOTAL
1988	12	0	3	0	**15**
1989	12	0	0	0	**12**
1990	18	92	5	0	**115**
1991	20	161	0	0	**181**
1992	13	130	0	2	**145**
1993	0	28	0	0	**28**
1994				1	**1**
1995	2			1	**3**
1996	1	10		6	**17**
1997*					**0**

(1) Includes Moridae

GREATER FORKBEARD (*Phycis blennoides*) Vb

Year	France	Norway	TOTAL
1988	2	0	**2**
1989	1	0	**1**
1990	10	28	**38**
1991	8	44	**52**
1992	16	33	**49**
1993	0	22	**22**
1994			**0**
1995			**0**
1996	6		**6**
1997*			**0**

GREATER FORKBEARD (*Phycis blennoides*) VI and VII

Year	France	Ireland	Norway	Spain	UK (EWNI)	UK (Scot)(1)	TOTAL
1988	252	0	0	1584	62	0	**1898**
1989	342	14	0	1446	13	0	**1815**
1990	454	0	88	1372	6	1	**1921**
1991	476	1	126	953	13	5	**1574**
1992	646	4	244	745	0	1	**1640**
1993	0	0	53	824	0	4	**881**
1994		111		1002	0	6	**1119**
1995	430	163		722	808	15	**2138**
1996	519	154		1428	1434	55	**3590**
1997*		119	8		1460		**1587**

(1) Includes Moridae

Continued...

Table 3.12.6.2 Continued

GREATER FORKBEARD (*Phycis blennoides*) VIII and IX

Year	France	Portugal	Spain	**TOTAL**
1988	7	0	74	**81**
1989	7	0	138	**145**
1990	16	0	218	**234**
1991	18	4	108	**130**
1992	9	8	162	**179**
1993	0	8	387	**395**
1994		0	320	**320**
1995	54	0	330	**384**
1996	25	2	429	**456**
1997*		1	356	**357**

GREATER FORKBEARD (*Phycis blennoides*) X

Year	Portugal	**TOTAL**
1988	29	**29**
1989	42	**42**
1990	50	**50**
1991	68	**68**
1992	81	**81**
1993	115	**115**
1994	135	**135**
1995	71	**71**
1996	45	**45**
1997*		

GREATER FORKBEARD (*Phycis blennoides*) XII

Year	Spain	**TOTAL**
1988		
1989		
1990		
1991		
1992		
1993		
1994		
1995		
1996	48	**48**
1997*		

Table 3.12.6.3 Study Group estimates of landings (tonnes).

RED (=BLACKSPOT) SEABREAM (*Pagellus bogaraveo*) VI and VII

Year	France	Ireland	Spain	UK (EW)	UK (C. Isles)	TOTAL
1988	52	0	47	153	0	**252**
1989	44	0	69	76	0	**189**
1990	22	3	73	36	0	**134**
1991	13	10	30	56	14	**123**
1992	6	16	18	0	0	**40**
1993	5	7	10	0	0	**22**
1994	n/a	0	9	0	1	**10**
1995	n/a	3	5	0	0	**8**
1996	n/a	8	24	1	0	**33**
1997*	n/a			24		**24**

RED (=BLACKSPOT) SEABREAM (*Pagellus bogaraveo*) VIII

Year	France	Portugal	Spain	UK (England)	TOTAL
1988	37	1	91	9	**138**
1989	31	0	234	7	**272**
1990	15	2	280	17	**314**
1991	10	1	124	0	**135**
1992	5	0	119	0	**124**
1993	3	5	172	0	**180**
1994	n/a	27	131	0	**158**
1995	n/a	8	110	0	**118**
1996	n/a	19	23	0	**42**
1997*	n/a			9	**9**

RED (=BLACKSPOT) SEABREAM (*Pagellus bogaraveo*) IX

Year	Portugal	Spain	TOTAL
1988	370		**370**
1989	260		**260**
1990	166		**166**
1991	109		**109**
1992	166		**166**
1993	235	765	**1000**
1994	150	854	**1004**
1995	204	509	**713**
1996	209	659	**868**
1997*	184	516	**700**

RED (=BLACKSPOT) SEABREAM (*Pagellus bogaraveo*) X

Year	Portugal	TOTAL
1988	637	**637**
1989	924	**924**
1990	889	**889**
1991	874	**874**
1992	1110	**1110**
1993	829	**829**
1994	983	**983**
1995	1096	**1096**
1996	1036	**1036**
1997*	813	**813**

Continued...

Table 3.12.6.3 (continued)

RED (=BLACKSPOT) SEABREAM (*Pagellus bogaraveo*) XII

Year	Latvia	**TOTAL**
1988		**0**
1989		**0**
1990		**0**
1991		**0**
1992		**0**
1993		**0**
1994	75	**75**
1995		**0**
1996		**0**
1997*		**0**

* Preliminary

Table 3.12.6.4 Study Group estimates of landings (tonnes).

ROUGHHEAD GRENADIER (*Macrourus berglax*) I and II

Year	Germany	Norway	**TOTAL**
1988			**0**
1989			**0**
1990	9	580	**589**
1991		829	**829**
1992		424	**424**
1993		136	**136**
1994			**0**
1995			**0**
1996			**0**
1997*		17	**17**

ROUGHHEAD GRENADIER (*Macrourus berglax*) III and IV

Year	France	Norway	**TOTAL**
1988		0	**0**
1989		0	**0**
1990		0	**0**
1991		0	**0**
1992		7	**7**
1993		0	**0**
1994			**0**
1995			**0**
1996			**0**
1997*	36		**36**

ROUGHHEAD GRENADIER (*Macrourus berglax*) Va

Year	Iceland	**TOTAL**
1988		**0**
1989		**0**
1990		**0**
1991		**0**
1992		**0**
1993		**0**
1994		**0**
1995		**0**
1996	15	**15**
1997	4	**4**

ROUGHHEAD GRENADIER *(Macrourus berglax*) XIV

Country	Greenland	Norway	**TOTAL**
1988		0	**0**
1989		0	**0**
1990		0	**0**
1991		0	**0**
1992		0	**0**
1993	18	34	**52**
1994	5		**5**
1995	2		**2**
1996			**0**
1997*			**0**

* preliminary

Table 3.12.6.5 Study Group estimates of landings (tonnes).

SHARKS VARIOUS I and II

Year	Russia/USSR	**TOTAL**
1988	37	**37**
1989	15	**15**
1990	0	**0**
1991	0	**0**
1992	0	**0**
1993	0	**0**
1994	0	**0**
1995	0	**0**
1996	0	**0**
1997	0	**0**

SHARKS VARIOUS III and IV

Year	France	Germany, F.R.	UK (England)	UK (Scotland)	**TOTAL**
1988	1	0	4	0	**5**
1989	0	0	2	14	**16**
1990	0	0	1	10	**11**
1991	0	5	4	5	**14**
1992	0	0	2	5	**7**
1993	0	4	2	6	**12**
1994	n/a	2	3	8	**13**
1995	n/a	1	2	6	**9**
1996	n/a	2	3	8	**13**
1997*	n/a	3	69		**72**

* Preliminary

SHARKS VARIOUS Va

Year	Iceland (1)	**TOTAL**
1988	0	**0**
1989	31	**31**
1990	54	**54**
1991	58	**58**
1992	70	**70**
1993	39	**39**
1994	42	**42**
1995	45	**45**
1996	65	**65**
1997*	70	**70**

*preliminary (1) Includes Greenland shark

SHARKS VARIOUS Vb

Year	Faroes	France	FRGermany	UK (England)	**TOTAL**
1988	0		0	0	**0**
1989	0		0	0	**0**
1990	0		0	0	**0**
1991	3		0	0	**3**
1992	36		0	5	**41**
1993	376		2	9	**387**
1994			43		**43**
1995		193			**193**
1996		257	31	1	**289**
1997*			27	20	**47**

Table 3.12.6.5 (Continued)

SHARKS VARIOUS VI and VII

Year	Faroes	France	Germany, F.R.	Spain	UK (England)	UK (Scotland)	TOTAL
1988	0	21	0	66	19	0	**106**
1989	0	21	0	0	32	8	**61**
1990	0	383	0	0	38	5	**426**
1991	0	1167	0	0	201	53	**1421**
1992	3	2727	0	0	503	133	**3366**
1993	0	3441	124	0	821	447	**4833**
1994		n/a	395		742	727	**1864**
1995		2343	2		1315	782	**4442**
1996		2815	276		1345	555	**4991**
1997*		4118 (1)	71		2753		**6942**

*preliminary (1) Includes landings of deepwater sharks from all areas.

SHARKS VARIOUS VIII and IX

Year	Portugal (1)	UK (England)	UK (Scotland)	Spain	TOTAL
1988				3545	**3545**
1989				1789	**1789**
1990				n/a	**0**
1991				2850	**2850**
1992		0	0	3740	**3740**
1993			0	n/a	**0**
1994			4	n/a	**4**
1995		32	7	n/a	**39**
1996		25	0	n/a	**25**
1997*		20			**20**

*preliminary (1) A detailed breakdown of the Portuguese landings of deepwater sharks from IXc is given in the table below.

SPECIES OF DEEPWATER SHARKS LANDED BY PORTUGAL FROM IXa

Species	*Galeus melastomus*	*Centrophorus granulosus*	*C. squamosus*	*Dalatias licha*	*Centroscymnus coelolepis*
1988	21	995	560	149	
1989	17	1027	507	57	
1990	17	1056	475	7	
1991	17	577	420	12	
1992	16	683	421	11	
1993	20	555	338	11	
1994	37	169	577	11	
1995	29	193	544	7	784
1996	35	122	411	4	757
1997*	29	188	356	4	841

*Excluding December

SHARKS VARIOUS X

Year	Portugal	Spain	TOTAL
1988	549		**549**
1989	560	1583	**2143**
1990	602	n/a	**602**
1991	896	2072	**2968**
1992	761	2719	**3480**
1993	592	n/a	**592**
1994	n/a	n/a	**0**
1995	925	n/a	**925**
1996	901	n/a	**901**
1997*			**0**

*preliminary

Table 3.12.6.6 Silver Scabbardfish. Study Group estimates of landings (tonnes).

SILVER SCABBARDFISH (*Lepidopus caudatus*) VI and VII

Year	Germany	TOTAL
1988		**0**
1989		**0**
1990		**0**
1991		**0**
1992		**0**
1993	2	**2**
1994		**0**
1995		**0**
1996		**0**
1997*		

SILVER SCABBARDFISH (*Lepidopus caudatus*) VIII and IX

Year	Portugal	Russia/USSR	TOTAL
1988	2666		**2666**
1989	1385		**1385**
1990	547	37	**584**
1991	808		**808**
1992	1264	110	**1374**
1993	2397		**2397**
1994	1054		**1054**
1995	5672		**5672**
1996	1237		**1237**
1997*	1723		**1723**

*excl. December

SILVER SCABBARDFISH (*Lepidopus caudatus*) X

Year	Latvia	Portugal	TOTAL
1988		70	**70**
1989		91	**91**
1990		120	**120**
1991		166	**166**
1992	1905	255	**2160**
1993	1458	264	**1722**
1994		373	**373**
1995	8	781	**789**
1996		815	**815**
1997*		980	**980**

*excl. December

SILVER SCABBARDFISH (*Lepidopus caudatus*) XII

Country	Russia/USSR	TOTAL
1988		**0**
1989	102	**102**
1990	20	**20**
1991		**0**
1992		**0**
1993	19	**19**
1994		
1995		
1996		
1997*		

Table 3.12.6.7 Study Group estimates of landings (tonnes).

WRECKFISH (*Polyprion americanus*) VI and VII

Year	France	Spain	TOTAL
1988	7		**7**
1989	0		**0**
1990	2		**2**
1991	10		**10**
1992	15		**15**
1993	0		**0**
1994			**0**
1995			**0**
1996	4	79	**83**
1997*			

WRECKFISH (*Polyprion americanus*) VIII and IX

Year	France	Portugal	Spain	UK (EW)	TOTAL
1988	1	188	9		**198**
1989	1	283	0		**284**
1990	2	161	0		**163**
1991	3	191	0		**194**
1992	1	268	0		**269**
1993	0	338	0		**338**
1994		406	3		**409**
1995		372	19	2	**393**
1996	3	214	69	8	**294**
1997*		163	44		**207**

WRECKFISH (*Polyprion americanus*) X

Year	France	Portugal	Norway	TOTAL
1988	0	191	0	**191**
1989	0	235	0	**235**
1990	0	224	0	**224**
1991	0	170	0	**170**
1992	3	234	0	**237**
1993	0	308	3	**311**
1994		428		**428**
1995		240		**240**
1996		240		**240**
1997*		166		**166**

* Preliminary

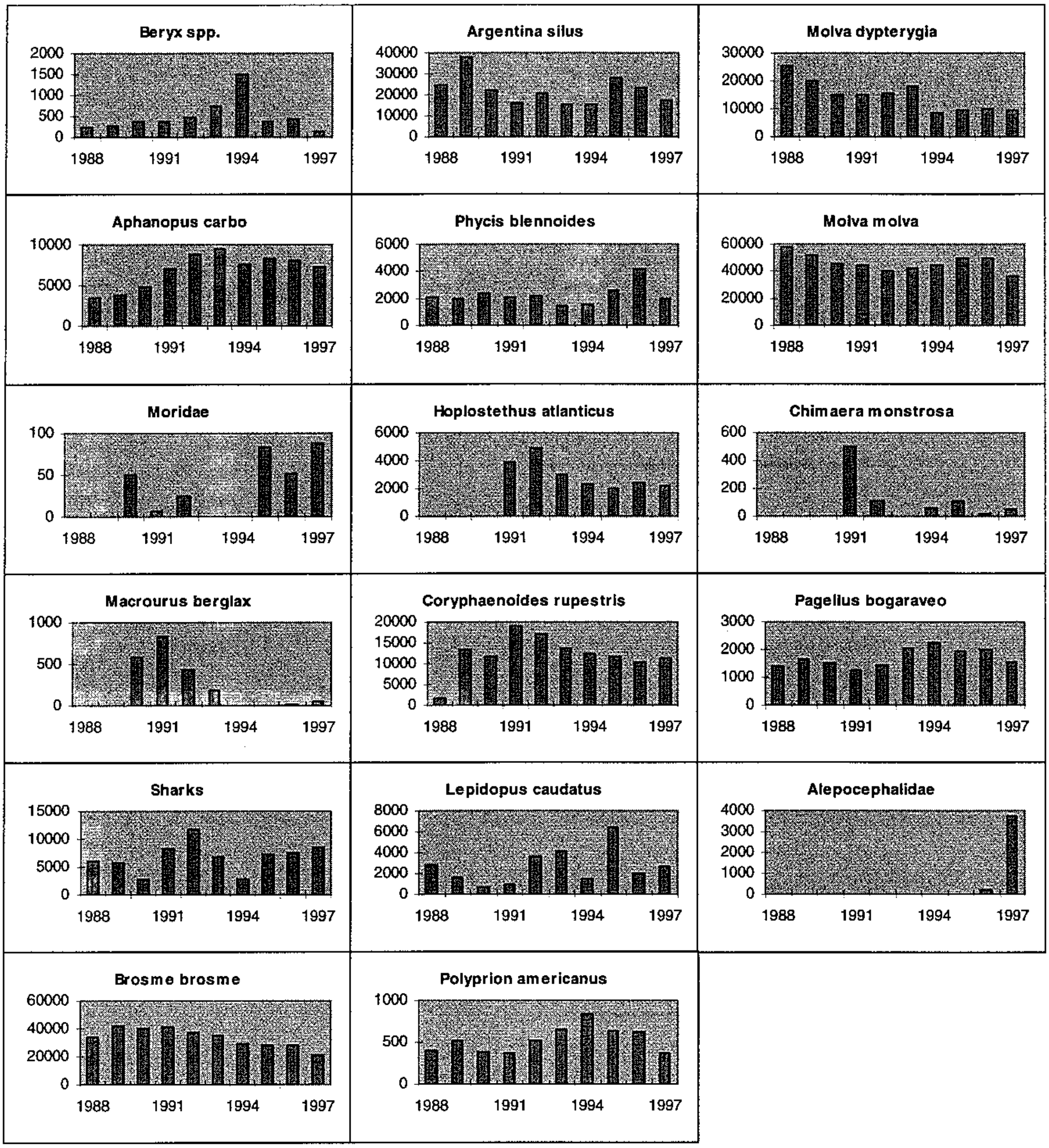


Figure 3.12.6.1 Estimated landings (tonnes) of deep-water species in all areas combined.

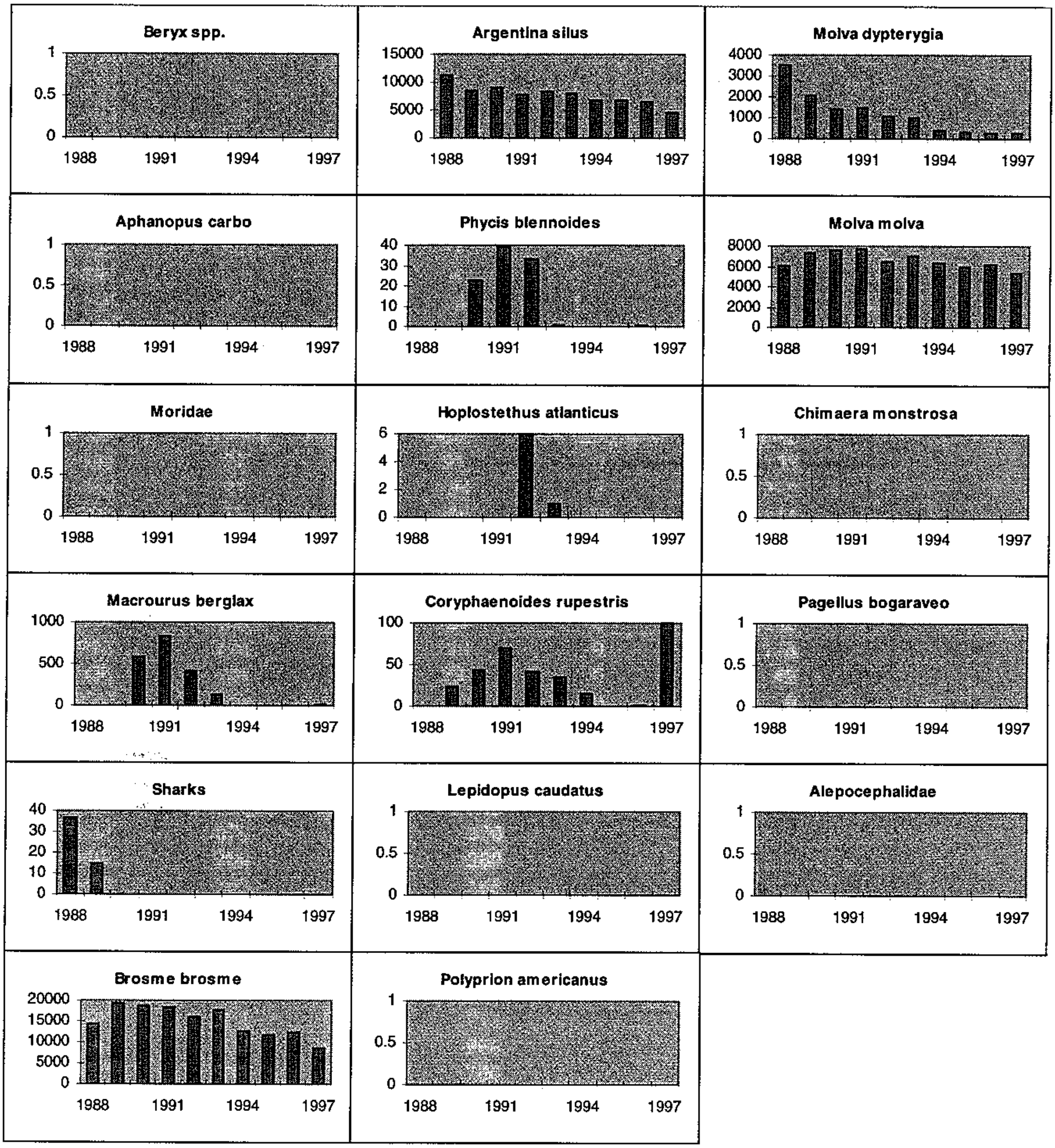


Figure 3.12.6.2 Estimated landings (tonnes) of deep-water species in I and II.

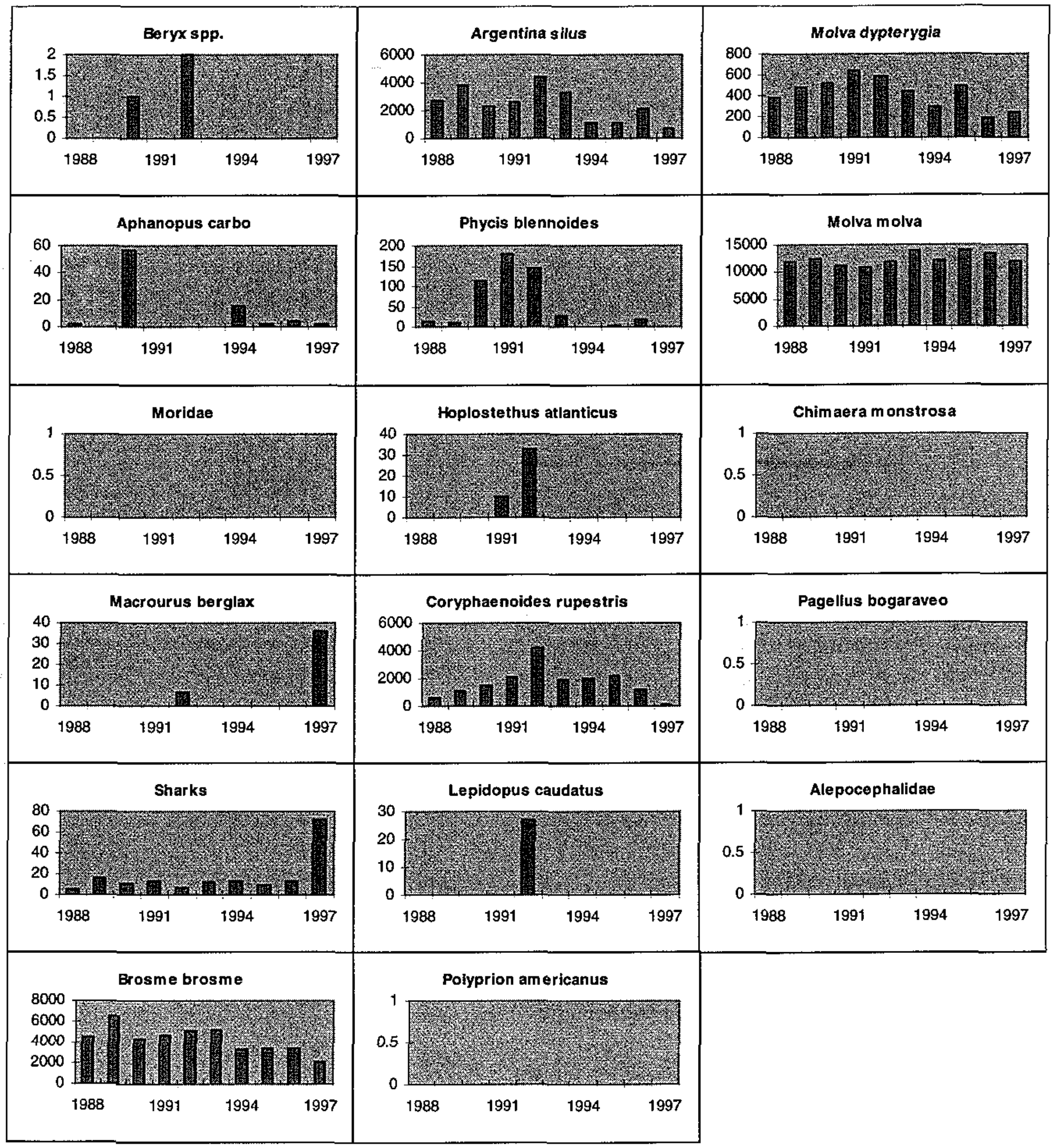


Figure 3.12.6.3 *Estimated landings (tonnes) of deep-water species in III and IV.*

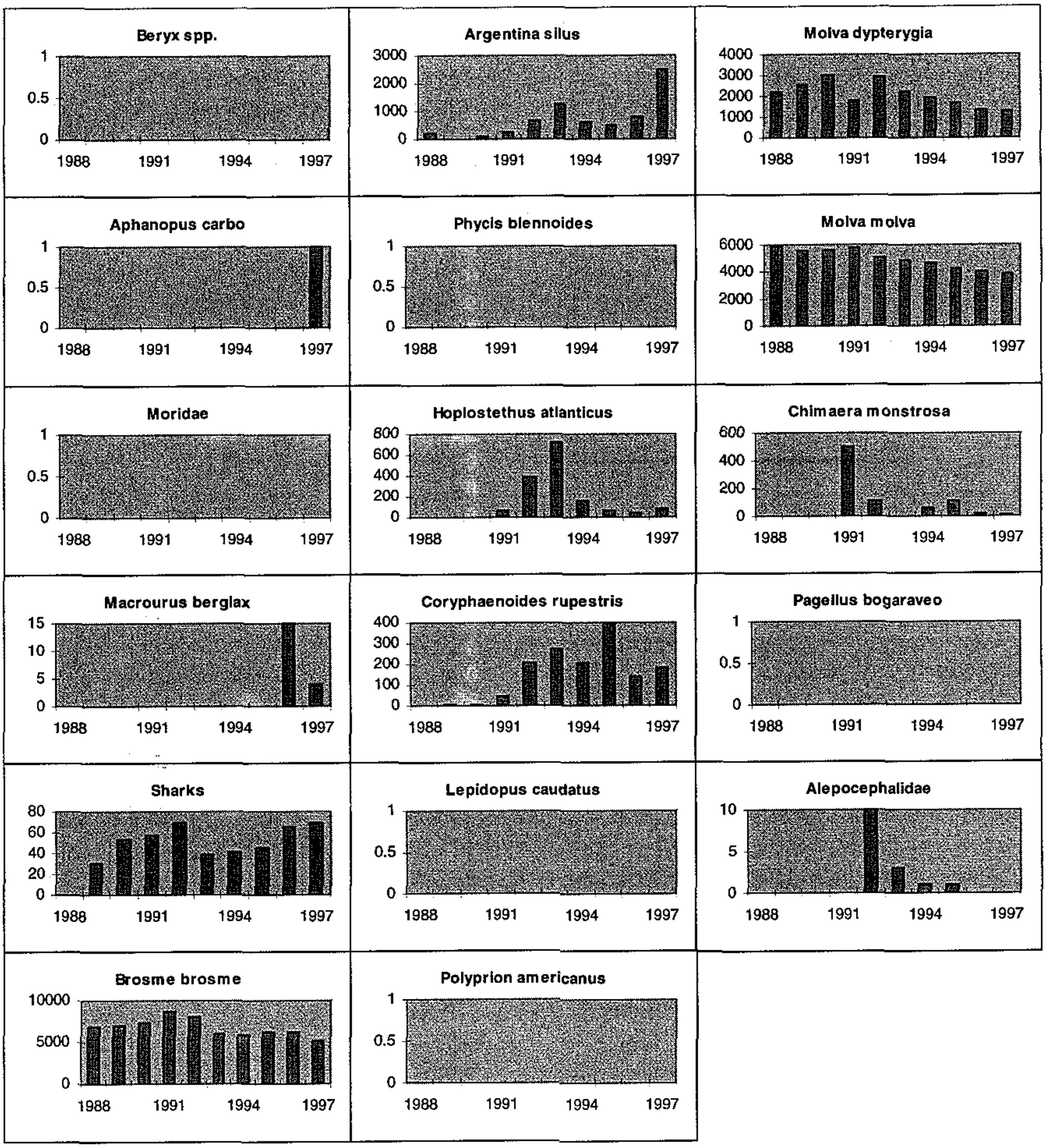


Figure 3.12.6.4 Estimated landings (tonnes) of deep-water species in Va.

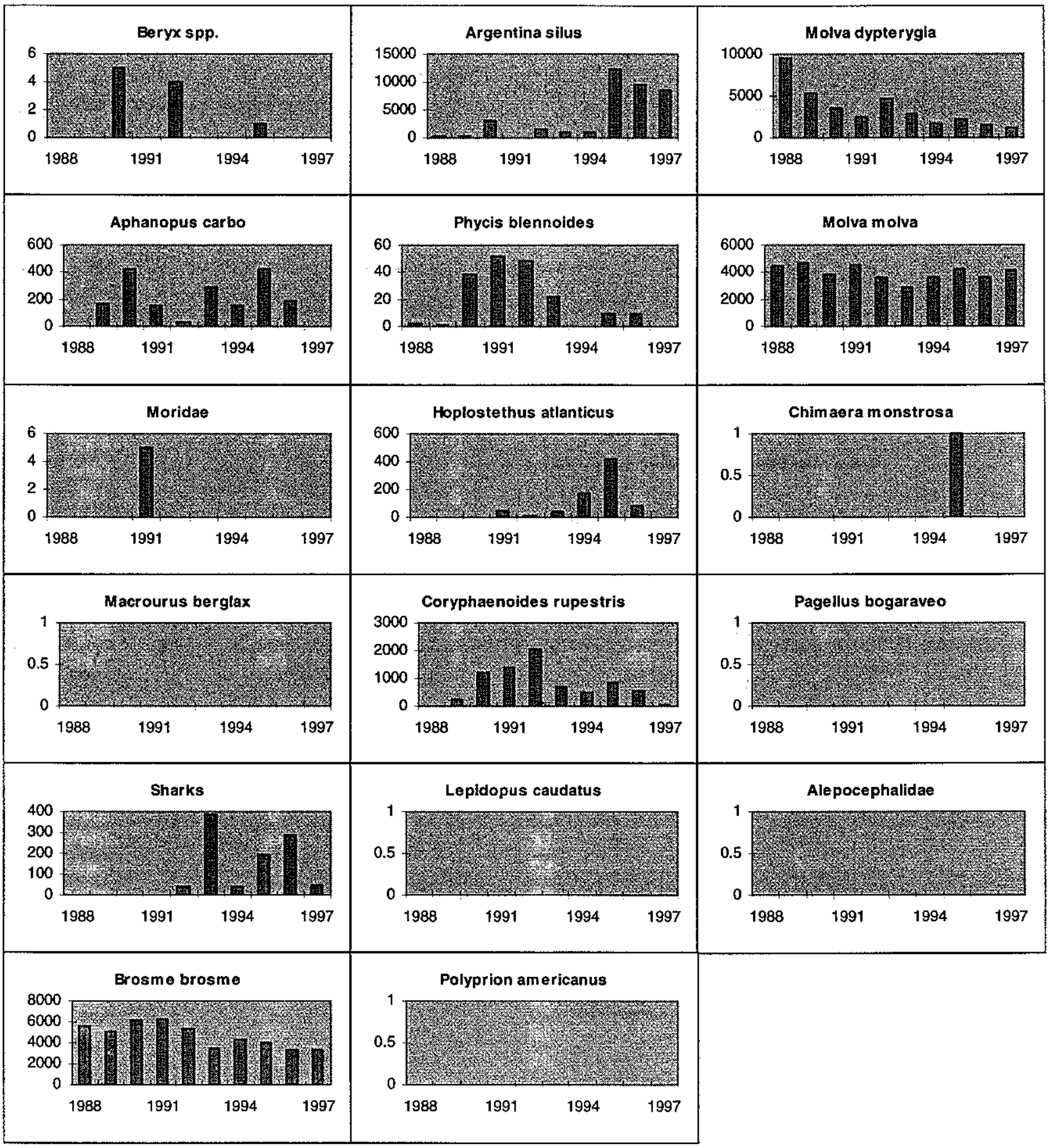


Figure 3.12.6.5 Estimated landings (tonnes) of deep-water species in Vb.

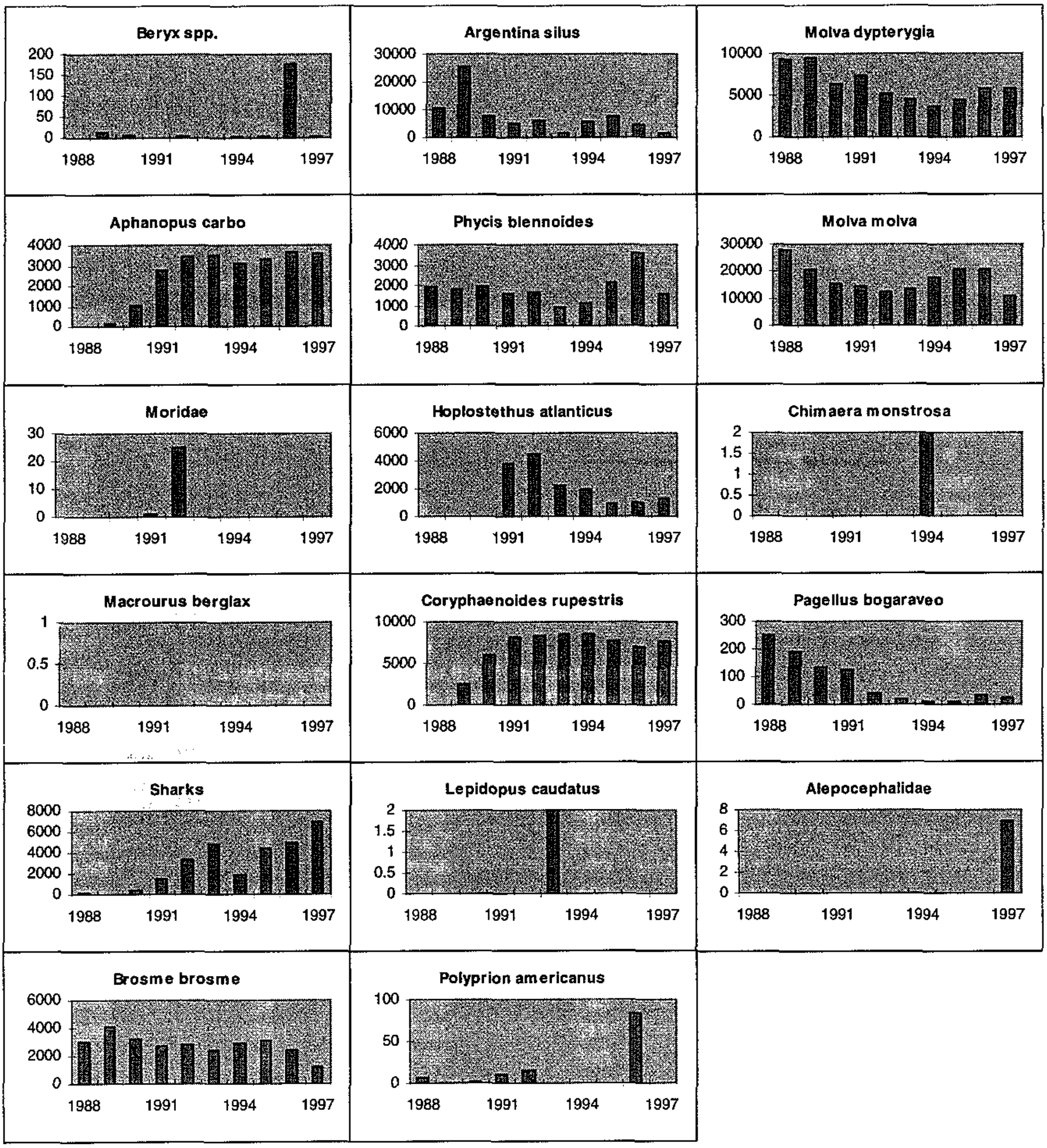


Figure 3.12.6.6 Estimated landings (tonnes) of deep-water species in VI and VII.

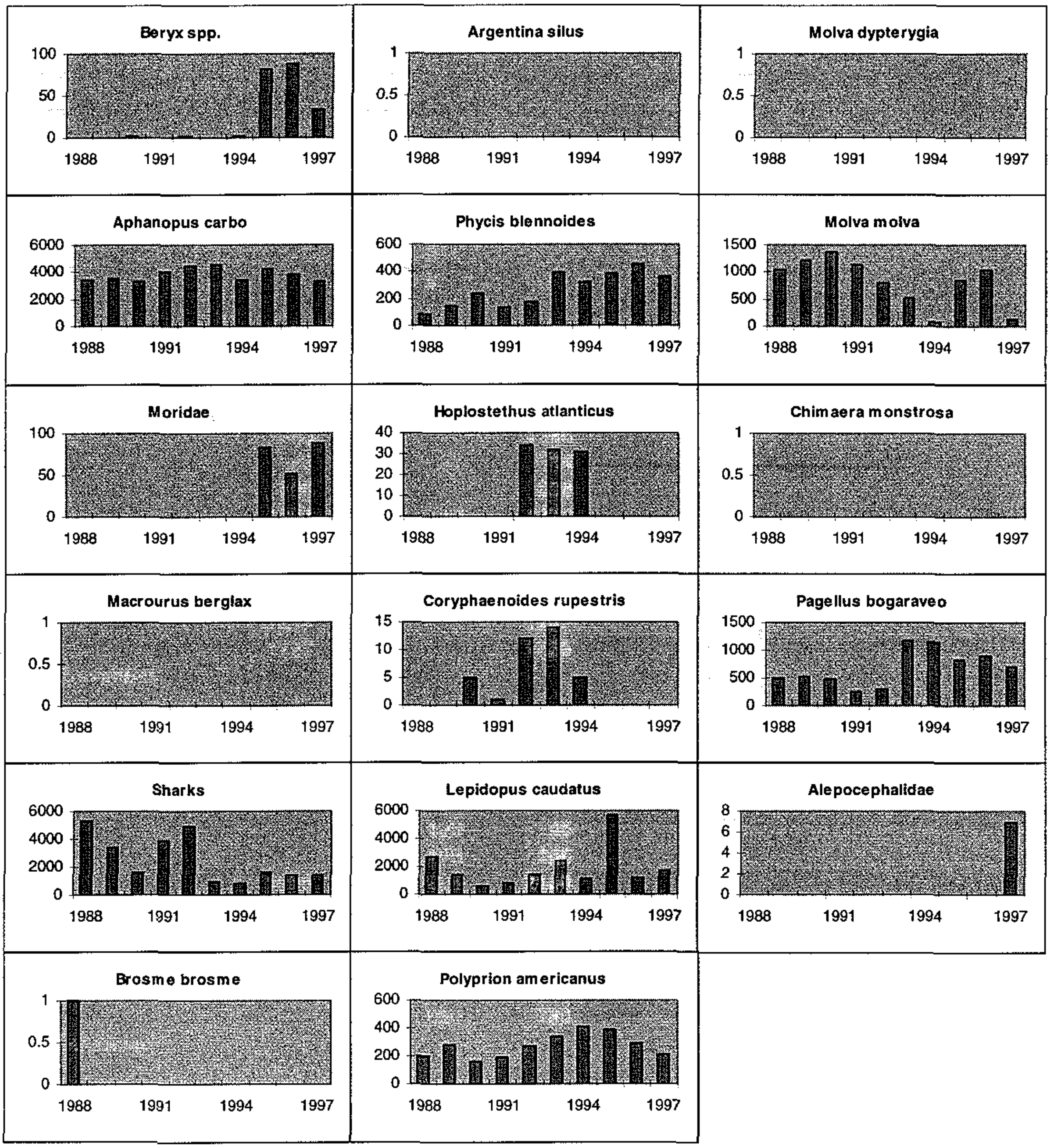


Figure 3.12.6.7 Estimated landings (tonnes) of deep-water species in VIII and IX.

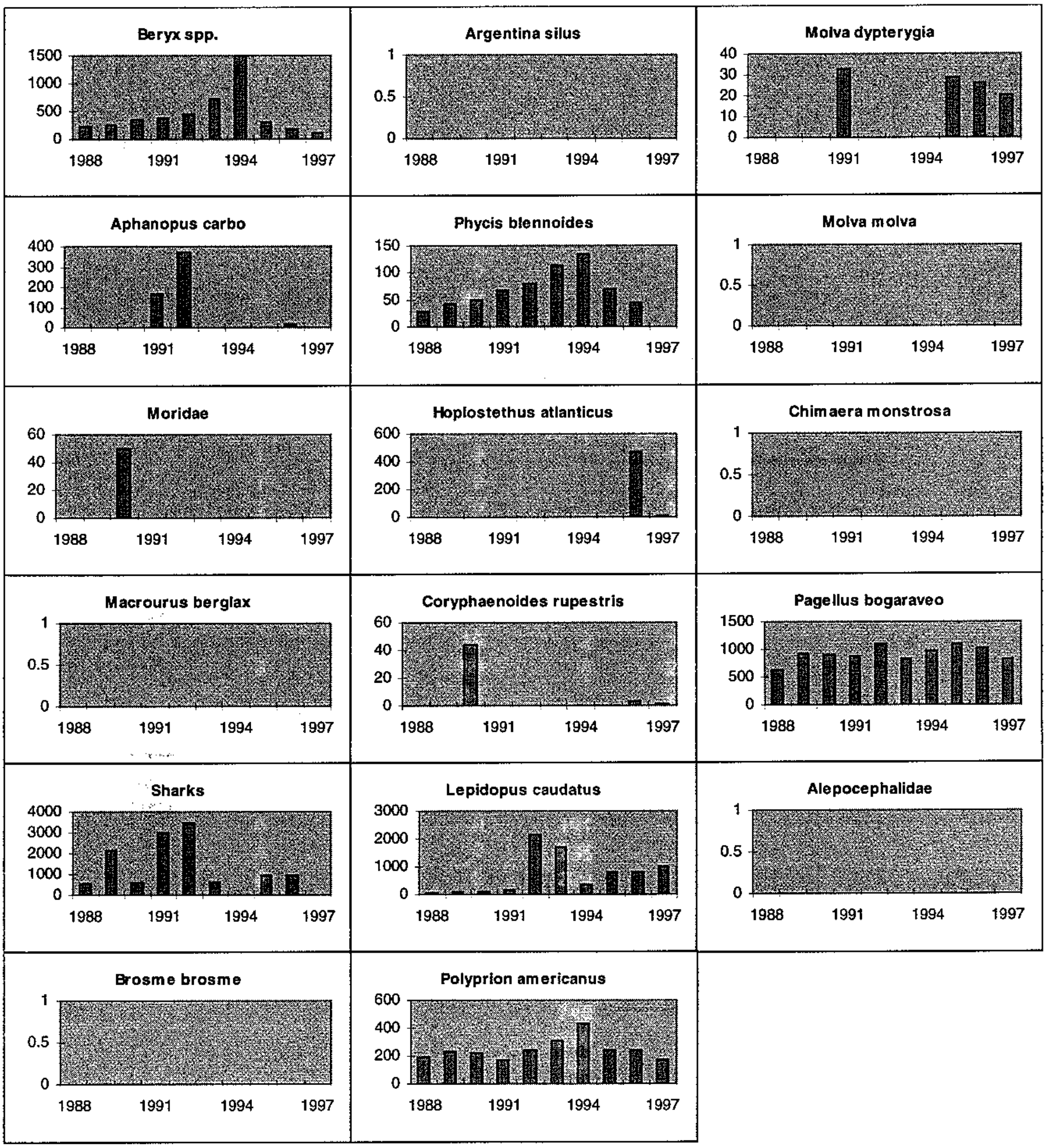


Figure 3.12.6.8 Estimated landings (tonnes) of deep-water species in X.

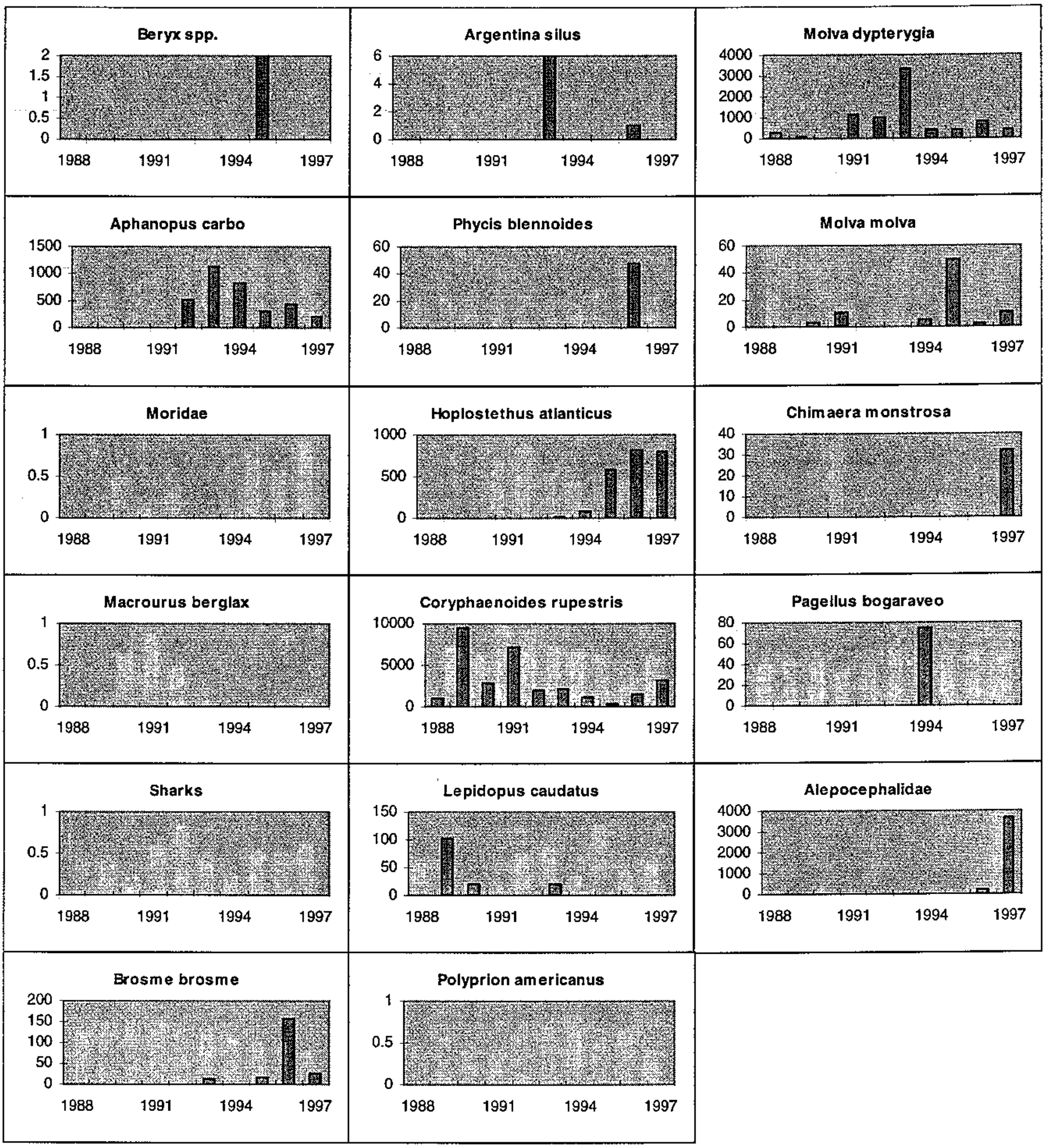


Figure 3.12.6.9 Estimated landings (tonnes) of deep-water species in XII.

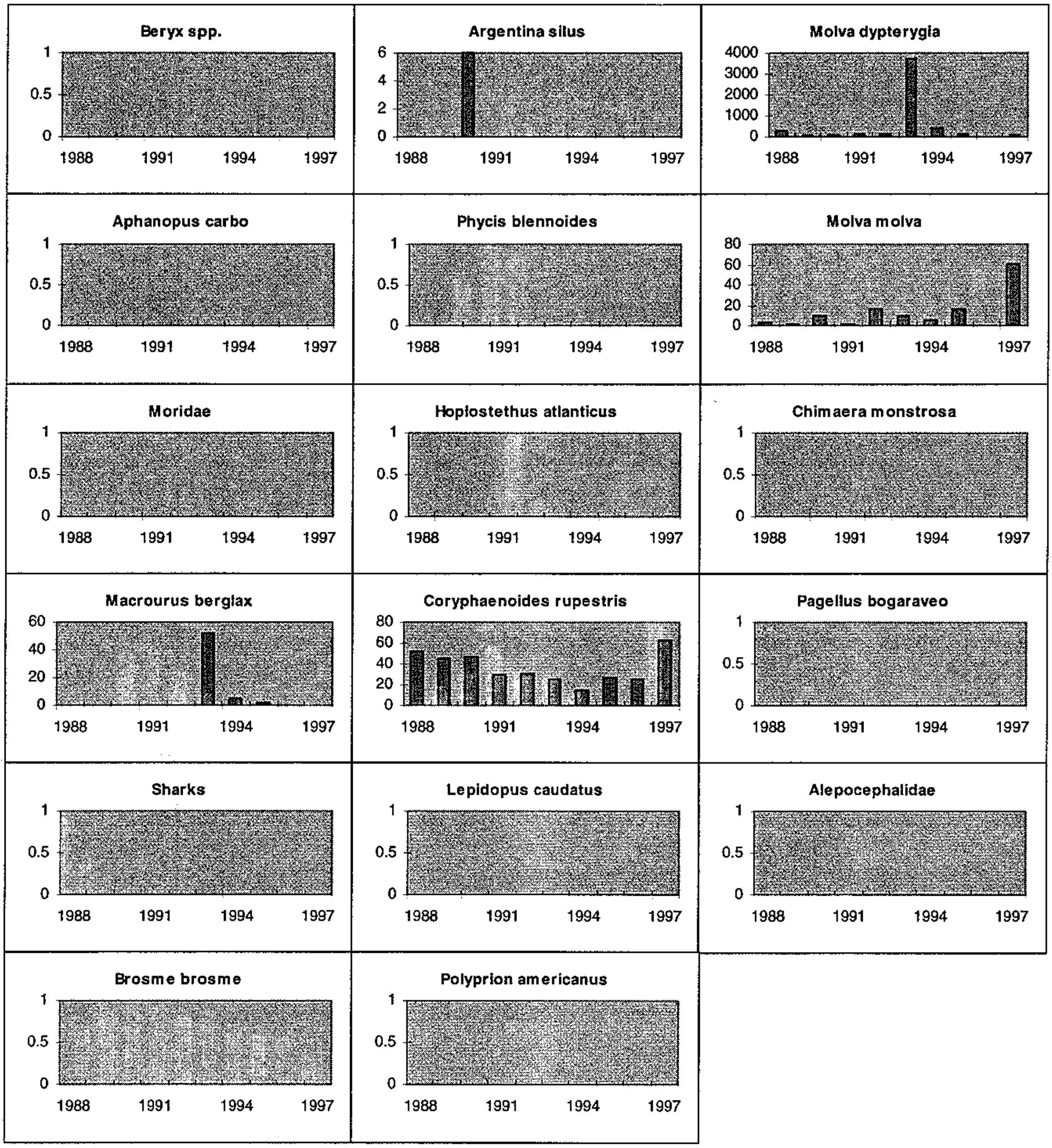


Figure 3.12.6.10 Estimated landings (tonnes) of deep-water species in XIV.

3.12.7 Deep-water Species in the ICES Area

3.12.7.a Blue Ling (*Molva dypterygia*)

State of the stock/fishery: It is considered that in Divisions Va and Vb and Sub-area VI the exploitable biomass are below U_{pa} and are at or slightly above U_{lim}.

Management objectives: No specific objectives are agreed on.

Advice on management: ICES recommends that F be reduced and the possibility of reducing effort in spawning areas be considered.

Proposed reference points: U_{lim} and U_{pa} can be set at $0.2*U_{max}$ and $0.5*U_{max}$ respectively. For this species CPUE in Vb and VI indicates the relative state of the stock with regard to these reference points.

Relevant factors to be considered in management: A major part of this fishery is on spawning aggregations and experience in Va and Vb indicates that once stocks are fished down they do not recover. Little is known of the early life history. Age estimation is still a problem in this species.

Elaboration and special comments: Summaries of the total landings for all areas and by grouped Sub-areas and by Divisions are given in Figures 3.12.6.1–10.

Catch forecast: Not available.

Catch data (Table 3.12.7.a.1):

Year	ACFM catch
1988	25
1989	20
1990	15
1991	15
1992	15
1993	18
1994	9
1995	10
1996	10
1997*	9

[1]Preliminary. Weights in '000 t.

Landings by ICES Sub-areas and Division by country are given in Table 3.12.7.a.1.

Landings from Division IIa are mainly taken in a gillnet fishery off mid-Norway. The relatively minor landings from Sub-area III and Division IVa are by-catches in trawl fisheries. In Division Va blue ling have mainly been taken by trawlers in the redfish and Greenland halibut fisheries in recent years. In this division a directed fishery on spawning concentrations was carried out from 1980 to 1984 in a very limited area. In 1993 a fishery on spawning concentrations was conducted on the Reykjanes Ridge at the border between Division Va and Sub-area XIV. The fishery in Division Vb is mainly a bottom trawl fishery on spawning aggregations. The trawl fishery is also predominant in Sub-area VI.

There are indications of two stocks in the ICES area, one in Sub-area XIV and Division Va with a component in Division Vb and another in Sub-area VI and adjacent waters of Division Vb.

Source of information: Report of the Study Group on the Biology and Assessment of Deep-Sea Fisheries Resources, February 1998 (ICES CM 1998/ACFM:12).

Table 3.12.7.a.1

BLUE LING IIa+b

Year	Faroes	France	FRGerma	Greenlan	Norway	UK (EW)	UK	**Total**
1988	77	37	5	-	3,416	2	-	**3,537**
1989	126	43	5	-	1,883	2	-	**2,059**
1990	228	49	4	-	1,128	4	-	**1,413**
1991	47	24	1	-	1,408	-	-	**1,480**
1992	28	19	+	3[1]	987	2	-	**1,039**
1993	-	12	2	3[1]	1003	+	+	**1,020**
1994	-	n/a	2	-	399	9	-	**410**
1995	0	11	1	2	342	1		**357**
1996	0	7	1		253	2		**263**
1997*	0	[2]	1		280	1		**282**

*Preliminary. [1] Includes IIb. [2] Included in VI

BLUE LING III

Year	Denmar	Norway	Sweden	**Total**
1988	10	11	1	**22**
1989	7	15	1	**23**
1990	8	12	1	**21**
1991	9	9	3	**21**
1992	29	8	1	**38**
1993	16	6	1	**23**
1994	14	4	-	**18**
1995	16	4		**20**
1996	8	3		**11**
1997*	14			**14**

* Preliminary

BLUE LING IVa

Year	Denmar	Faroes	France	FRGerm	Norway	UK (EW)	UK	**Total**
1988	1	13	223	6	116	2	2	**363**
1989	1	-	245	4	196	12	+	**458**
1990	+	-	319	8	162	4	+	**493**
1991	1	31	370	7	178	2	32	**621**
1992	1	-	237	9	263	8	36	**554**
1993	2	101	74	2	186	1	44	**410**
1994	+		-	3	241	15	19	**278**
1995	-	2	72	+	201	8	193	**476**
1996		0	41	3	67	4	52	**167**
1997*		0	[1]	+	61	169		**230**

Preliminary. [1] Included in VI

N.B. 1997 values for UK (EW) are preliminary **UK** values

Table 3.12.7.a.1 continued

BLUE LING IVb

Year	France	U K (EW)	**Total**
1988		-	**-**
1989		-	**-**
1990		-	**-**
1991		-	**-**
1992		-	
1993		3	**3**
1994		-	**-**
1995		3	**3**
1996		5	**5**
1997*			

'*Preliminary

BLUE LING IVc

Year	U K (EW)	**Total**
1988	-	**-**
1989	-	**-**
1990	-	**-**
1991	-	**-**
1992	-	
1993	-	**-**
1994	3	**3**
1995	-	**-**
1996		
1997*		

'*Preliminary

BLUE LING Va

Year	Faroes	FRGermany	Iceland	Norway	**Total**
1988	271	-	1,893	7	**2,171**
1989	403	-	2,125	5	**2,533**
1990	1,029	-	1,992	-	**3,021**
1991	241	-	1,582	1	**1,824**
1992	321	-	2,584	1	**2,906**
1993	40	-	2,193		**2,233**
1994	89	1	1,831		**1,921**
1995	113	2	1,519	-	**1,634**
1996	36	3	1284		**1,323**
1997*	25		1230		**1,255**

*Preliminary.

Table 3.12.7.a.1 continued

BLUE LING Vb1

Year	Faroes	France	FRGerma	Norway	UK	UK (Scot)	**Total**
1988	3,487	3,038	49	94	-		**6,668**
1989	2,468	1,802	51	228	-		**4,549**
1990	946	1,707	71	450	-		**3,174**
1991	1,573	562	36	196	1		**2,368**
1992	1,918	315	21	390	4		**2,648**
1993	2,088	151	24	218	19		**2,500**
1994	1065	140	3 (2)	173	-		**1,381**
1995	1,606	317	2	38	4		**1,967**
1996	1100	157	3	82			**1,342**
1997*	778	(6)	+	64	11		**853**

*Preliminary. (1) Included in Vb2. (2) Includes Vb2 '(6) Included in VI
N.B. 1997 values for UK (EW) are preliminary **UK** values

BLUE LING Vb2

Year	Faroes	Norway	UK (Scot)	**Total**
1988	2,788	72	-	**2,860**
1989	622	95	-	**717**
1990	68	191	-	**259**
1991	71	51	21	**143**
1992	1,705	256	1	**1,962**
1993	182	22	91	**295**
1994	239	16	11	**266**
1995	162	36	4	**202**
1996	42	62		**104**
1997*	300	48		**348**

*Preliminary. (1) Includes Vb1.

BLUE LING VIa

Year	Faroes	France	FRGerma	Ireland	Norway	Spain (inc	UK	UK	**Total**
1988	14	6,616	2	-	29		2	1	**6,664**
1989	6	7,383	2	-	143		-	+	**7,534**
1990	-	4,487	44	-	54		-	1	**4,586**
1991	8	3,226	18	-	63		1	35	**3,351**
1992	4	3,330	4	-	129		-	24	**3,491**
1993	-	3,116	48	3	27		13	42	**3,249**
1994	-	2610	24	73	90	433	1	91	**3,322**
1995	0	2743	+	11	96	392	34	738	**4,014**
1996	0	3024	4		50	681	9	1407	**5,175**
1997*	0	4157 (1)	+	1	29		1804		**5,991**

*Preliminary. (1) Includes VIb   N.B. 1997 values for UK (EW) are preliminary **UK** values

Table 3.12.7.a.1 continued

BLUE LING VIb

Year	Faroes	France	FRGerma	Norway	UK	UK (Scot)	**Total**
1988	2,000	499	37	42	9	14	**2,601**
1989	1,292	60	22	217	-	16	**1,607**
1990	360	1,125	-	127	-	2	**1,614**
1991	111	3,531	6	102	5	15	**3,770**
1992	231	1,272	2	50	2	14	**1,571**
1993	51	840	109	50	66	57	**1,173**
1994	5		104	33	3	25	**170**
1995	1	26	160	12	11	38	**248**
1996	0	86	92	7	37	74	**296**
1997*	0	[2]		6	626		**632**

*Preliminary. [1] Includes XII. [2] Included in N.B. 1997 values for UK (EW) are preliminary **UK**

BLUE LING VIIa

Year	France	UK	**Total**
1988	-	-	**-**
1989	-	-	**-**
1990		-	**-**
1991		1	**1**
1992		-	**-**
1993		-	**-**
1994		-	**-**
1995		-	**-**
1996			
1997*			

*Preliminary. [1] Included in VIa

BLUE LING VIIb,c

Year	France	FRGerm	Ireland	Norway	Spain	UK (EW)	UK	**Total**
1988	22	1	-	-		-	-	**23**
1989	279	-	-	2		-	-	**281**
1990	159	-	-	-		-	-	**159**
1991	152	-	-	-		-	-	**152**
1992	116	-	-	3		-	6	**125**
1993	102	-	-	2		11	28	**143**
1994	100	-	1	1		6	22	**130**
1995	95	-	3	-		3	11	**112**
1996	111			1		14	57	**183**
1997*			9	2		40		**51**

*Preliminary. [1] Included in VIIg- N.B. 1997 values for UK (EW) are preliminary **UK** values

Table 3.12.7.a.1 continued

BLUE LING VIId,e

Year	France	Total
1988		-
1989		-
1990		-
1991		-
1992		-
1993		-
1994		
1995		
1996		
1997*		

*Preliminary. [1] Included in VIa

BLUE LING VIIg-k

Year	France	FRGerm	Spain [2]	UK (EW)	UK	Ireland	Total
1988				-	-		
1989				-	-		
1990				-	-		
1991				-	-		
1992				-	-		
1993				5	2		**7**
1994			4	3	4		**11**
1995			13	40	5		**58**
1996			21	41	40		**102**
1997*		8		146		9	**154**

*Preliminary. [1] Included in VIa [2] N.B. 1997 values for UK (EW) are preliminary **UK**

BLUE LING X

Year	Faroes	Portugal	France		Total
1988			-	-	
1989			-	-	
1990			-	-	
1991			33		**33**
1992			-	-	
1993			-	-	
1994			n/a		
1995	0	29			**29**
1996	1	25			**26**
1997*	0	20	[1]		**20**

*Preliminary. [1] Included in VIa

Table 3.12.7.a.1 continued

BLUE LING XII

Year	Faroes	France	FRGerma	Spain	UK	UK (Scot)	Total
1988		263					**263**
1989		70					**70**
1990		5					**5**
1991		1,147					**1147**
1992		971					**971**
1993	654	2,591	90				**3335**
1994	382	(1)	25				**407**
1995	376	46			12		**434**
1996	445	(1)		368		19	**832**
1997*	1			411	5		**417**

*Preliminary. (1) Included in VIa

BLUE LING XIV

Year	Faroes	France	FRGerma	Greenlan	Iceland	Norway	UK	UK	Total
1988	21	-	218	3	-	-	-	-	**242**
1989	13	-	58	-	-	-	-	-	**71**
1990	-	-	64	5	-	-	10	-	**79**
1991	-	-	105	5	-	+	45	-	**155**
1992	-	-	27	2	-	50	27	4	**110**
1993	-	390	16	-	3,124	173	21	1	**3725**
1994	1	-	15	-	300	11	57	-	**384**
1995	0	-	4		117	-	19		**140**
1996	0	(1)	12						**12**
1997*	68						2		**70**

*preliminary

3.12.7.b Ling

State of the stock/fishery: CPUE declining in all areas except Va. Norwegian longline data suggest that exploitable biomass in the most heavily exploited areas are below U_{pa} and may be near U_{lim}. Estimates of Z range from 0.4 to 1.0 and average 0.6 indicating $F>F_{pa}$ for all areas.

Management objectives: No specific objectives are agreed on.

Advice on management: ICES recommends that F be reduced in all areas. Catch, effort and biological information should be collected for all fisheries.

Proposed reference points: U_{lim} and U_{pa} can be set at $0.2*U_{max}$ and $0.5*U_{max}$, respectively. For this species CPUE in Vb and VI indicates the relative state of the stock with regard to these reference points. A precautionary fishing mortality F_{pa} can be set at F_{pa} = M where it is likely that M is <0.2.

Catch forecast: Not available.

Elaboration and special comment: Summaries of the total landings for all areas and by grouped Sub-areas and by Divisions are given in Figures 3.12.6.1–10. Landings by ICES Sub-area, Division and nation are given in Table 3.12.7.b.1.

The major fishery in Division IIa is the Norwegian longline fishery. This fishery also operates in other Sub-areas and Divisions. The catches in Division Va are by-catches in longline, gillnet and bottom trawl fisheries. In Division Vb the majority of the catches is taken by longliners rather than trawlers. In Sub-areas VI and VII trawl fisheries are predominant. There is currently no evidence of separate stocks within the ICES area.

In interpreting the data, full allowance may not have been made for increasing longline efficiency in the CPUE time series. The assessment may therefore be optimistic.

Source of information: Report of the Study Group on the Biology and Assessment of Deep-Sea Fisheries Resources, February 1998 (ICES CM 1998/ACFM:12).

Catch data (Table 3.12.7.b.1):

Year	ACFM catch
1988	58
1989	52
1990	45
1991	45
1992	41
1993	43
1994	44
1995	50
1996	49
1997*	36

[1] Preliminary. Weights in '000 t.

Table 3.12.7.b.1 Ling. Study Group estimates of landings (tonnes).

LING IIa

Year	Faroes	France	FRGer	Norway	UK	UK	**Total**
1988	3	29	10	6,070	4	3	**6,119**
1989	2	19	11	7,326	10	-	**7,368**
1990	14	20	17	7,549	25	3	**7,628**
1991	17	12	5	7,755	4	+	**7,793**
1992	3	9	6	6,495	8	+	**6,521**
1993	-	9	13	7032	39	-	**7,093**
1994	101	n/a	9	6169	30	-	**6,309**
1995	14	6	8	5,921	3	2	**5,954**
1996	0	2	17	6,059	2	3	**6,083**
1997*	0	n/a	7	5,343	8		**5,358**

*Preliminary

LING IIb

Year	Norway	U K (EW)	**Total**
1988		7	**7**
1989		-	
1990		-	
1991		-	
1992		-	
1993		-	
1994		13	**13**
1995		-	
1996	127		**127**
1997*	5		**5**

*Preliminary

LING III

Year	Belgium	Denmark	FRGer	Norway	Sweden	UK	**Total**
1988	2	165	-	135	29	-	**331**
1989	1	246	-	140	35	-	**422**
1990	4	375	3	131	30	-	**543**
1991	1	278	-	161	44	-	**484**
1992	4	323	-	120	100	-	**547**
1993	3	343	-	150	131	15	**642**
1994	2	244	+	116	112	-	**474**
1995	4	222	-	113	83	-	**422**
1996		212	1	124	65		**402**
1997*		164	+	105	26		**295**

*Preliminary

LING IVa

Year	Belgium	Denmark	Faroes	France	FRGerm	Netherl	Norwa	Sweden	UK	UK	UK	**Total**
1988	3	408	13	1,143	262	4	6,473	5	55	1	2,856	**11,223**
1989	1	578	3	751	217	16	7,239	29	136	14	2,693	**11,677**
1990	1	610	9	655	241	-	6,290	13	213	-	1,995	**10,027**
1991	4	609	6	847	223	-	5,799	24	197	+	2,260	**9,969**
1992	9	613	2	414	200	-	5,945	28	330	4	3,208	**10,753**
1993	9	629	14	395	726	-	6522	13	363	-	4,138	**12,809**
1994	20	528	25	n/a	770	-	5355	3	148	+	4,645	**11,494**
1995	17	406	51	290	425	-	6,148	5	181		5517	**13,040**
1996	8	512	25	241	448		6622	4	193		4650	**12,703**
1997*	3	640	6		316		4718	3	5407			**11,093**

*Preliminary. (1) Includes IVb 1988-1993.

LING IVb,c

Year	Norway	U K (EW)	UK	FRGer	**Total**
1988	100	173	106	-	**379**
1989	43	236	108	-	**387**
1990	59	268	128	-	**455**
1991	51	274	165	-	**490**
1992	56	392	133	-	**581**
1993	26	412	96	-	**534**
1994	42	40	64	-	**146**
1995	39	301	135	23	**498**
1996	100	187	106	45	**438**
1997*	57	383		48	**488**

* Preliminary

Table 3.12.7.b.1 continued

LING

Year	Belgium	Faroes	FRGerman	Iceland	Norway	U K (EW)	Total
1988	134	619	-	5,098	10		**5,861**
1989	95	614	-	4,898	5		**5,612**
1990	42	399	-	5,157	-		**5,598**
1991	69	530	-	5,206	-		**5,805**
1992	34	526	-	4,556	-		**5,116**
1993	20	501	-	4,333			**4,854**
1994	3	548	+	4,053			**4,604**
1995		463	+	3,729	-		**4,192**
1996		358		3670	20	12	**4,060**
1997		299		3515	0		**3,814**

*Preliminary.

LING

Year	Denmark	Faroes	France [3]	FRGerm	Norway	UK (EW)	UK (Scot)	Total
1988	4 [2]	1,383	53	4	884	1	5	**2,330**
1989	-	1,498	44	2	1,415	-	3	**2,962**
1990	-	1,575	36	1	1,441	+	9	**3,062**
1991	-	1,828	37	2	1,594	-	4	**3,465**
1992	-	1,218	3	+	1,153	15	11	**2,400**
1993	-	1,242	5	1	921	62	11	**2,242**
1994	-	1,541	6	13	1047	30	20	**2,657**
1995		2,789	4	13	446	2	32	**3,286**
1996		2672				12	28	**2,712**
1997		3224				37		**3,261**

*Preliminary. [1] Includes Vb2. [2] Includes 1 t reported [3] Includes Vb2 and Va.

LING

Year	Faroes	Norway	UK (EW)	UK	Total
1988	832	1,284	-		**2,116**
1989	362	1,328	-		**1,690**
1990	162	633	-		**795**
1991	492	555	-		**1,047**
1992	577	637	-		**1,214**
1993	282	332			**614**
1994	479	486			**965**
1995	281	503			**784**
1996	102	798			**900**
1997	526	397			**923**

*Preliminary. (1) Included in Vb1.

LING

Year	Belgium	Denmark	Faroes	France (1)	FRGermany	Ireland	Norway	Spain (1)	UK (EW)	UK (Isle of Man)	UK (NI)	UK (Scot)	Total
1988	4	+	-	5,381	6	196	3,392	3575	1,075	-	53	874	**14,556**
1989	6	1	6	3,417	11	138	3,858		307	+	6	881	**8,631**
1990	-	+	8	2,568	1	41	3,263		111	-	2	736	**6,730**
1991	3	+	3	1,777	2	57	2,029		260	-	10	654	**4,795**
1992	-	1	-	1,297	2	38	2,305		259	+	6	680	**4,588**
1993	+	+	-	1,513	92	171	1937		442	-	13	1,133	**5,301**
1994	1	1		1713	134	133	2034	1027	551	-	10	1,126	**6,730**
1995	-	2	0	1970	130	108	3,156	927	560	n/a		1994	**8,847**
1996			0	1762	370	106	2809	1064	269			2197	**8,577**
1997			0		135	70	2229		2597				

*Preliminary. (1) Includes VIb

LING

Year	Faroes	France (2)	FRGerman	Ireland	Norway	Spain (2)	UK (EW)	UK (N.	UK	Total
1988	196		-	-	1,253		93	-	223	**1,765**
1989	17		-	-	3,616		26	-	84	**3,743**
1990	3		-	26	1,315		10	+	151	**1,505**
1991	-		-	31	2,489		29	2	111	**2,662**
1992	35		+	23	1,713		28	2	90	**1,891**
1993	4		+	60	1179		43	4	232	**1,522**
1994	104		-	44	2116		52	4	220	**2,540**
1995	66		+	57	1,308		84		123	**1,638**
1996	0		124	70	679		150		101	**1,124**
1997	0		41	28	504		236			**809**

*Preliminary. (1) Includes XII. (2) See Ling VIa.

Table 3.12.7.b.1 continued

LING VII

Year	France	**Total**
1988	5,057	**5,057**
1989	5,261	**5,261**
1990	4,575	**4,575**
1991	3,977	**3,977**
1992	2,552	**2,552**
1993	2,294	**2,294**
1994	2,185	**2,185**
1995	(1)	
1996	(1)	
1997*	(1)	

*Preliminary (1) Reported by Division

LING VIIa

Year	Belgium	France	Ireland	UK (EW)	UK (Isle of Man)	UK (NI)	UK (Scot)	**Total**
1988	14	(1)	100	49	-	38	10	**211**
1989	10	(1)	138	112	1	43	7	**311**
1990	11	(1)	8	63	1	59	27	**169**
1991	4	(1)	10	31	2	60	18	**125**
1992	4	(1)	7	43	1	40	10	**105**
1993	10	(1)	51	81	2	60	15	**219**
1994	8	(1)	136	46	2	76	16	**284**
1995	12	9	143	106	1	(2)	34	**305**
1996	11	6	147	29			17	**210**
1997*			15	69				**84**

*Preliminary. (1) French catches in VII not split into divisions, see Ling VII
(2) Included with UK (EW)

LING VIIb,c

Year	France	FRGerman	Ireland	Norway	Spain (3)	UK (EW)	UK (NI)	UK (Scot)	**Total**
1988	(1)	-	50	57		750	-	8	**865**
1989	(1)	+	43	368		161	-	5	**577**
1990	(1)	-	51	463		133	-	31	**678**
1991	(1)	-	62	326		294	8	59	**749**
1992	(1)	-	44	610		485	4	143	**1,286**
1993	(1)	97	224	145		550	9	409	**1,434**
1994	(1)	98	225	306		530	2	434	**1,595**
1995	78	161	465	295		630	(2)	315	**1,944**
1996	57	234	283	168		1117	(2)	342	**2,201**
1997*		251		418		880	(2)		**1,549**

*Preliminary. (1) See Ling VII. (3) Included with VII g-k
(2) Included with UK (EW)

LING VIId,e

Year	Belgium	Denmark	France	Ireland	UK (EW)	UK (Scot)	**Total**
1988	36	+	(1)	-	743	-	**779**
1989	52	-	(1)	-	644	4	**700**
1990	31	-	(1)	22	743	3	**799**
1991	7	-	(1)	25	647	1	**680**
1992	10	+	(1)	16	493	+	**519**
1993	15	-	(1)	-	421	+	**436**
1994	14	+	(1)	-	437	0	**451**
1995	10	-	885	2	492	0	**1,389**
1996	15		960		499	3	**1,477**
1997*	12				372		**384**

*Preliminary. (1) See Ling VII.

Table 3.12.7.b.1 continued

LING VIIf

Year	Belgium	France (1)	Ireland	UK (EW)	UK (Scot)	**Total**
1988	77	(1)	-	367	-	**444**
1989	42	(1)	-	265	3	**310**
1990	23	(1)	3	207	-	**233**
1991	34	(1)	5	259	4	**302**
1992	9	(1)	1	127	-	**137**
1993	8	(1)	-	215	+	**223**
1994	21	(1)	-	379	-	**400**
1995	36	110	-	456	0	**602**
1996	40	121		238	0	**399**
1997*	30			313		**343**

*Preliminary. (1) See Ling VII.

LING VIIg-k

Year	Belgium	Denmark	France (1)	FRGerman y	Ireland	Norway	Spain (2)	UK (EW)	UK (Isle of Man)	UK (N I)	UK (Scot)	**Total**
1988	35	1	(1)	-	286	-	2,652	1,439	-	-	2	**4,415**
1989	23	-	(1)	-	301	163		518	-	+	7	**1,012**
1990	20	+	(1)	-	356	260		434	+	-	7	**1,077**
1991	10	+	(1)	-	454	-		830	-	-	100	**1,394**
1992	10	-	(1)	-	323	-		1,130	-	+	130	**1,593**
1993	9	+	(1)	35	374			1,551	-	1	364	**2,334**
1994	19	-	(1)	10	620		184	2,143	-	1	277	**3,254**
1995	33	-	1597	40	766	-	195	3046		(3)	454	**6,131**
1996	45		1626	169	771		583	3209			447	**6,850**
1997*	37			155	490			2568				**3,250**

*Preliminary. (1) See Ling VII. (2) Includes VIIbc (3) Included in UK (EW)

LING VIII

Year	France	FRGerman	Spain	U K (EW)	**Total**
1988	1,018			10	**1,028**
1989	1,214			7	**1,221**
1990	1,371			1	**1,372**
1991	1,127			12	**1,139**
1992	801			1	**802**
1993	508			2	**510**
1994	n/a		77	8	**85**
1995	693		106	46	**845**
1996	825	23	170	23	**1,041**
1997*	n/a		103	38	**141**

*Preliminary

LING XII

Year	Faroes	Norway	U K (EW)	**Total**
1988			-	**-**
1989			-	**-**
1990			3	**3**
1991			10	**10**
1992			-	**-**
1993			-	**-**
1994			5	**5**
1995	5		45	**50**
1996	0	2		**2**
1997*	0		10	**10**

*Preliminary

LING XIV

Year	Faroes	FRGerman	Iceland	Norway	UK (EW)	UK (Scot)	**Total**
1988		3	-	-	-	-	**3**
1989		1	-	-	-	-	**1**
1990		1	-	2	6	-	**9**
1991		+	-	+	1	-	**1**
1992		9	-	7	1	-	**17**
1993		-	+	1	8	-	**9**
1994		+	-	4	1	1	**6**
1995	0	-		14	3	0	**17**
1996	0			0			**0**
1997*	1			60			**61**

*Preliminary.

3.12.7.c Tusk (*Brosme brosme*)

State of the stock/fishery: The stock is at present considered to be harvested outside safe biological limits as defined by the proposed reference points. CPUE declining in all areas except perhaps in Va. Norwegian longline data suggest that exploitable biomass in the most heavily exploited areas are below U_{pa} and may be near U_{lim}. Estimates of Z range from 0.4 to 1.0 and average 0.6 indicating $F>F_{pa}$ for all areas.

Management objectives: No specific objectives are agreed on.

Advice on management: ICES recommends that F be reduced in all areas. Catch, effort and biological information should be collected for all fisheries.

Proposed reference points: U_{lim} and U_{pa} can be set at $0.2*U_{max}$ and $0.5*U_{max}$ respectively. A precautionary fishing mortality F_{pa} can be set at $F_{pa} = M$ where it is likely that M is <0.2.

Relevant factors to be considered in management: There is currently no evidence of separate stocks within the ICES area. Landings are mainly by-catches in longline fisheries directed at ling and blue ling in Divisions IIa, Va, Vb and VIa. In Division Vb tusk is also taken as a by-catch in trawl fisheries.

Catch forecast: Not available.

Elaboration and special comment: Summaries of the total landings for all areas and by Sub-area/Division are given in Figures 3.12.6.1–10. Landings by Sub-area/Division and nation are given in Table 3.12.7.c.1.

Age estimation has improved significantly and new information for Va will soon be available.

Source of information: Report of the Study Group on the Biology and Assessment of Deep-Sea Fisheries Resources, February 1998 (ICES CM 1998/ACFM:12).

Catch data (Table 3.12.7.c.1):

Year	ACFM catch
1988	34
1989	42
1990	40
1991	41
1992	37
1993	35
1994	29
1995	28
1996	27
1997[1]	21

[1]Preliminary. Weights in '000 t.

Table 3.12.7.c.1 Tusk. Study Group estimates of landings (tonnes).

TUSK IIa

Year	Faroes	France	FRGermany	Greenland	Norway	UK (EW)	UK (Scot)	Total
1988	115	32	13	-	14,241	2	-	**14,403**
1989	75	55	10	-	19,206	4	-	**19,350**
1990	153	63	13	-	18,387	12	+	**18,628**
1991	38	32	6	-	18,227	3	+	**18,306**
1992	33	21	2	-	15,908	10	-	**15,974**
1993	-	23	2	11	17,545	3	+	**17,584**
1994	281	n/a	2	-	12,266	3	-	**12,552**
1995	77	15	3	20	11,271	1		**11,387**
1996	0	11	5		12029	1		**12,046**
1997*	1		+		8634	1		**8,636**

*Preliminary. 1 Includes IIb.

TUSK IIb

Year	Norway	UK (EW)	Total
1988		-	**0**
1989		-	**0**
1990		-	**0**
1991		-	**0**
1992		-	**0**
1993		1	**1**
1994		-	**0**
1995	229	-	**229**
1996	161		**161**
1997*	91	2	**93**

*Preliminary

TUSK III

Year	Denmark	Norway	Sweden	Total
1988	8	51	2	**61**
1989	18	71	4	**93**
1990	9	45	6	**60**
1991	14	43	27	**84**
1992	22	46	15	**83**
1993	19	48	12	**79**
1994	6	33	12	**51**
1995	4	33	5	**42**
1996	6	32	6	**44**
1997*	2	25		**27**

*Preliminary

TUSK IVa

Year	Denmark	Faroes	France	FRGermany	Norway	Sweden (1)	UK (EW)	UK (NI)	UK (Scot)	Total
1988	83	1	201	62	3,998	-	12	-	72	**4,429**
1989	86	1	148	53	6,050	+	18	+	62	**6,418**
1990	136	1	144	48	3,838	1	29	-	57	**4,254**
1991	142	12	212	47	4,008	1	26	-	89	**4,537**
1992	167	-	119	42	4,435	2	34	-	131	**4,930**
1993	102	4	82	29	4,768	+	9	-	147	**5,141**
1994	82	4	n/a	27	3,001	+	24	-	151	**3,289**
1995	81	6	68	24	2,988		10		171	**3,348**
1996	120	8	47	47	2970		11		164	**3,367**
1997*	137	0	224	19	1763	+	16			**2,159**

*Preliminary. (1) Includes IVb 1988-1993.

Table 3.12.7.c.1 continued

TUSK IVb

Year	Denmark	Norway	FRGermany	U K (E & W)	UK (Scot)	Total
1988			-	-		
1989			-	1		**1**
1990			-	-		**0**
1991			-	-		**0**
1992			-	1		**1**
1993			-	-		**0**
1994			-	2		**2**
1995	4	5	1	3	2	**15**
1996	4	21	4	3	1	**33**
1997*	6	23	2	2		**33**

*Preliminary.

TUSK Va

Year	Faroes	Germany	Iceland	Norway	Total
1988	3,757	-	3,078	20	**6,855**
1989	3,908	-	3,143	10	**7,061**
1990	2,475	-	4,816	-	**7,291**
1991	2,286	-	6,446	-	**8,732**
1992	1,567	-	6,442	-	**8,009**
1993	1,329	-	4,746	-	**6,075**
1994	1212	-	4,612	-	**5,824**
1995	979	1	5,245	-	**6,225**
1996	872	1	5226	3	**6,102**
1997*	575		4630		**5,205**

*Preliminary.

TUSK Vb1

Year	Denmark	Faroes	France	FRGermany	Norway	UK (EW)	UK (Scot) (1)	Total
1988	+	2,827	81	8	1,143	-		**4,059**
1989	-	1,828	64	2	1,828	-		**3,722**
1990	-	3,065	66	26	2,045	-		**5,202**
1991	-	3,829	19	1	1,321	-		**5,170**
1992	-	2,796	11	2	1,590	-		**4,399**
1993	-	1,647	9	2	1202	2		**2,862**
1994	-	2,649	n/a	1 (2)	747	2		**3,398**
1995		3,059	15	1 (2)	270	1		**3,345**
1996		1,636	8	1	1083			**2,728**
1997*		1,849			868			**2,717**

*Preliminary. (1) Included in Vb2. (2) Includes Vb2.

TUSK Vb2

Year	Faroe Islands	Norway	UK (EW)	UK (Scot) (1)	Total
1988	545	1,061	-	+	**1,606**
1989	163	1,237	-	+	**1,400**
1990	128	851	-	+	**979**
1991	375	721	-	+	**1,096**
1992	541	450	-	1	**992**
1993	292	285	-	+	**577**
1994	445	462	+	2	**909**
1995	225	404	(2)	2	**631**
1996	46	536			**582**
1997*	157	420			**577**

*Preliminary. (1) Includes Vb1. (2) See Vb1.

Table 3.12.7.c.1 continued

TUSK VIa

Year	Denmark	Faroe Islands	France (1)	Germany, Fed. Rep.	Ireland	Norway	UK (EW)	UK (NI)	UK (Scot)	United Kingdom	**Total**
1988	-	-	766	1	-	1,310	30	-	13		**2,120**
1989	+	6	694	3	2	1,583	3	-	6		**2,291**
1990	-	9	723	+	-	1,506	7	+	11		**2,247**
1991	-	5	514	+	-	998	9	+	17		**1,538**
1992	-	-	532	+	-	1,124	5	-	21		**1,682**
1993	-	-	386	4	3	783	2	+	31		**1,209**
1994	+		n/a	6	1	865	5	-	40		**917**
1995		0	332	+	33	990	1	...	79		**1,435**
1996		0	354	1	5	890	1		126		**1,377**
1997*		0	(3)	+	3	750	1				**754**

*Preliminary. (1) Reported for Sub-area VI. Not allocated by divisions. (3) Included in IV.

TUSK VIb

Year	Faroes	France	FRGermany	Ireland	Norway	Spain (3)	UK (EW)	UK (NI)	UK (Scot)	United Kingdom	**Total**
1988	217		-	-	601		8	-	34		**860**
1989	41		-	-	1,537		2	-	12		**1592**
1990	6		-	-	738		2	+	19		**765**
1991	-		+	5	1,068		3	-	25		**1101**
1992	63		+	5	763		3	1	30		**865**
1993	12		+	32	899		3	+	54		**1000**
1994	70		+	30	1673		6	-	66		**1845**
1995	79		+	33	1,415		1		35		**1563**
1996	0			30	836		3		69		**938**
1997*	0			20	359		2				

*Preliminary. (1) See VIa. (2) Includes XII. (3) Included in VIa.

TUSK VII

Year	France	**Total**
1988	15	**15**
1989	22	**22**
1990	20	**20**
1991	15	**15**
1992	16	**16**
1993	9	**9**
1994	n/a	
1995	3	**3**
1996	4	**4**
1997*	(1)	

'* Preliminary. (1) Included in IV.

TUSK VIIa

Country	France (1)	UK (EW)	UK (Scot)	**Total**
1988		-	+	
1989		-	+	
1990		+	+	
1991		-	1	**1**
1992		+	2	**2**
1993		+	+	
1994		-	+	
1995			1	**1**
1996				
1997*	(2)			

*Preliminary. (1) French catches not split into divisions, (2) Included in IV.

Table 3.12.7.c.1 continued

TUSK VIIb,c

Year	France (1)	Ireland	Norway	Spain (3)	UK (EW)	UK (NI)	UK (Scot)	United Kingdom	**Total**
1988		-	12		5	-	+		**17**
1989		-	91		-	-	-		**91**
1990		3	138		1	-	2		**144**
1991		7	30		2	1	1		**41**
1992		8	167		33	1	3		**212**
1993		15	70		17	+	12		**114**
1994		9	63		9	-	8		**89**
1995		20	18		6	...	1		**45**
1996		11	38		4		1		**54**
1997*	(2)	33	61		1				**95**

*Preliminary. (1) French catches not split into divisions, see Tusk VII. (2) included in IV. (3) Included in VIIg-k.

TUSK VIIg-k

Year	France (1)	FRGermany	Ireland	Norway	Spain (3)	UK (EW)	UK (Scot)	United Kingdom	**Total**
1988			-	-		5	-		**5**
1989			-	82		1	-		**83**
1990			-	27		0	+		**27**
1991			-	-		8	2		**10**
1992			-	-		38	-		**38**
1993			17	-		7	3		**27**
1994			12	-		12	3		**27**
1995			8	-		18	8		**34**
1996			20			3	3		**26**
1997*	(2)	4	2						

*Preliminary. (1) French catches not split into divisions, see Tusk VII. (2) Included in IV (3) Includes VIIb,c.

TUSK VIIIa

Year	U K (EW)	**Total**
1988	1	**1**
1989	-	**-**
1990	-	**-**
1991	-	**-**
1992	-	**-**
1993	-	**-**
1994	-	**-**
1995	-	**-**
1996		
1997*		

* Preliminary.

TUSK XII

Year	Faroes	France	Iceland	Norway	**Total**
1988		1			**1**
1989		1			**1**
1990		0			**0**
1991		1			**1**
1992		1			**1**
1993		12	+		**12**
1994		n/a	+		**0**
1995	8	n/a	10		**18**
1996	7		9	142	**158**
1997*	10		+	18	**28**

*Preliminary.

3.12.7.d Roundnose grenadier (*Coryphaenoides rupestris*)

State of the stock/fishery: The stock in Sub-area VI and VII is at present considered to be harvested inside safe biological limits as defined by the proposed reference points with exploitable biomass above U_{pa} and F at or below F_{pa}. There has been a decline in catch and catch rates in Vb. The state of the stock in other Sub-areas or Divisions is unknown.

Management objectives: No specific objectives are agreed on.

Advice on management: ICES recommends immediate reduction in fisheries that cannot be shown to be sustainable. All remaining fishing activity should be conducted in the context of effective management which emphasizes documentation of fishing activity, and which can react appropriately to biological characteristics of the populations.

Proposed reference points: U_{lim} and U_{pa} can be set at $0.2*U_{max}$ and $0.5*U_{max}$ respectively. A precautionary fishing mortality F_{pa} can be set at $F_{pa} = M$ where it is likely that M is <0.1 given the age range.

Relevant factors to be considered in management: In Sub-areas VI and VII the effort directed to roundnose grenadier is variable. CPUE data have improved by using a reference fleet. Discard data are also available from the commercial fishery. The distribution of the species extends beyond the depths normally associated with the commercial fisheries and the assessment of the stock, in fact, could be viewed as conservative. There are probably unreported landings from international waters.

Catch forecast: Not available.

Elaboration and special comment: Summaries of the total landings for all areas and by Sub-area/Division are given in Figures 3.12.6.1–10. Landings by Sub-area/Division and nation are given in Table 3.12.7.d.1.

There is a directed fjord fishery on roundnose grenadier in Sub-area II. In Sub-areas III and IV landings are mainly from the directed fishery in the Skagerrak by Danish bottom trawl and by-catch from Norwegian shrimp fishery. Landings from Sub-area V are mainly from the directed trawl fishery by the French fleet. Landings from Faroes vessels represent by-catch in the past three years. There is a directed trawl fishery in Sub-areas VI and VII. There is a variable directed trawl fishery in Sub-area XII and a possibility that some landings from international waters are unreported. Landings in Sub-areas VIII and IX represent by-catch from the French trawl fishery.

Source of information: Report of the Study Group on the Biology and Assessment of Deep-Sea Fisheries Resources, February 1998 (ICES CM 1998/ACFM:12).

Catch data (Table 3.12.7.d.1):

Year	ACFM catch
1988	2
1989	13
1990	12
1991	19
1992	17
1993	14
1994	12
1995	12
1996	10
1997*	11

*Preliminary. Weights in '000 t.

Table 3.12.7.d.1 Roundnose grenadier. Study Group estimates of landings (tonnes).

ROUNDNOSE GRENADIER (*Coryphaenoides rupestris*) I and II

Year	Denmark	France	FRGermany	Norway	Russia/USSR	GDR	TOTAL
1988							
1989		3	2		16	3	**24**
1990		26	2		12	3	**43**
1991		39	3	28			**70**
1992	1	11	0	29			**41**
1993		33	0	2			**35**
1994		3	12				**15**
1995		n/a					**0**
1996		1					**1**
1997*				100			**100**

*Preliminary.

ROUNDNOSE GRENADIER (*Coryphaenoides rupestris*) III and IV

Year	Denmark	France	FRGermany	Norway	Sweden	UK (Scot)	TOTAL
1988	612		1		5		**618**
1989	884	164	1		1	2	**1052**
1990	785	462	2	280	2		**1531**
1991	1214	538	4	304	10		**2070**
1992	2856	421		211	755	4	**4247**
1993	1591	218	4	55			**1868**
1994	1910	14	2		42		**1968**
1995	2227	n/a	1		1	15	**2244**
1996	1174	6				5	**1185**
1997*				124		10	**134**

*Preliminary

ROUNDNOSE GRENADIER (*Coryphaenoides rupestris*) Va

Year	Faroes	Iceland***	TOTAL
1988		2	**2**
1989	2	2	**4**
1990		7	**7**
1991		48	**48**
1992		210	**210**
1993		276	**276**
1994		210	**210**
1995	0	398	**398**
1996	1	139	**140**
1997*	0	183	**183**

*Preliminary *** includes other grenadiers.

ROUNDNOSE GRENADIER (*Coryphaenoides rupestris*) Vb

Year	Faroes	France	Norway	FRGermany	Russia/USSR	TOTAL
1988				1		1
1989	20	166		5	52	**243**
1990	75	1129		4		**1208**
1991	22	1394	7	1		**1424**
1992	551	1480	1	6		**2038**
1993	339	345(1)		14		**698**
1994	286	211(1)		1		**498**
1995	405	464(1)				**869**
1996	93	479(1)		2		**574**
1997*	53	(2)				**53**

*Preliminary
(1) Includes Va (2) Included in VI and VII

Table 3.12.7.d.1 (continued)

ROUNDNOSE GRENADIER (*Coryphaenoides rupestris*) VI and VII

Year	Faroes	France	FRGermany	Ireland	Norway	Spain	UK (EW)	UK (Scot)	TOTAL
1988	27		4				1		**32**
1989	2	2433	3					2	**2440**
1990	29	5944	2						**5975**
1991		8159	7						**8166**
1992	99	8019	142		5		2	112	**8379**
1993	263	8214	1					1	**8479**
1994		8525	15	14				11	**8565**
1995	0	7602	2	59				82	**7745**
1996	0	6799						156	**6955**
1997*	0	7463(1)				5		200	**205**

*Preliminary
*provisional (1) Includes V

ROUNDNOSE GRENADIER (Coryphaenoides rupestris) VIII and IX

Year	France	TOTAL
1988		**0**
1989		**0**
1990	5	**5**
1991	1	**1**
1992	12	**12**
1993	14	**14**
1994	5	**5**
1995	0	**0**
1996	0	**0**
1997*	n/a	

*Preliminary

ROUNDNOSE GRENADIER (*Coryphaenoides rupestris*) X

Year	Faroes	France	TOTAL
1988			
1989		0	**0**
1990		0	**0**
1991		44	**44**
1992		0	**0**
1993		0	**0**
1994		0	**0**
1995	0	0	**0**
1996	3	0	**3**
1997*	1	n/a	**1**

*Preliminary

ROUNDNOSE GRENADIER (*Coryphaenoides rupestris*) XII

Year	Faroes	France	FRGermany	Iceland	Latvia	Russia/USSR	Spain	TOTAL
1988						1060		**1060**
1989						9495		**9495**
1990						2838		**2838**
1991		10			4296	2900		**7206**
1992		72			1684	295		**2051**
1993		0	39		2176			**2215**
1994	457	0	9		675			**1141**
1995	359**	0						**0**
1996	136	0		77		208*	1136	**1349**
1997*	138	n/a				1297	1800	**3235**

*Preliminary '** includes some from VIb

Table 3.12.7.d.1 (continued)

ROUNDNOSE GRENADIER (*Coryphaenoides rupestris*) XIV

Country	Faroes	FRGermany	Greenland	Iceland***	Norway	UK (EW)	UK (Scot)	**TOTAL**
1988		45	7					**52**
1989	3	42						**45**
1990		45	1			1		**47**
1991		23	4			2		**29**
1992		19	1	4	6		1	**31**
1993		4	18	4				**26**
1994		10	5					**15**
1995	0	13	14					**27**
1996	0	6	19					**25**
1997*	6	34	12		11			**63**

*Preliminary
*** includes other grenadiers

3.12.7.e Black scabbardfish (*Aphanopus carbo*)

State of the stock/fishery: Unknown.

Management objectives: No specific objectives are agreed on.

Advice on management: ICES recommends immediate reduction in fisheries that cannot be shown to be sustainable. All remaining fishing activity should be conducted in the context of effective management which emphasizes documentation of fishing activity, and which can react appropriately to biological characteristics of the populations.

Relevant factors to be considered in management: Little is known about the stocks of black scabbardfish. The fishery in Sub-areas VI and VII is on immature fish of a mean length of about 100 cm. In Sub-area IX the fishery is on mature fish but they are not in spawning condition. Mature fish have also been found in Sub-area XII. Spawning fish have only been found off Madeira. The eggs and smallest juveniles are unknown and juveniles are very rare in both trawl and longline catches.

Catch forecast: Not available.

Elaboration and special comment: Summaries of the total landings for all areas and by Sub-area/Division are given in Figures 3.12.6.1–10. Landings by Sub-area/Division and nation are given in Table 3.12.7.e.1.

There are directed trawl fisheries in Sub-areas VI and VII and directed longline fisheries in Sub-areas VIII and IX. *In Sub-area XII a new directed trawl fishery* developed recently. Black scabbardfish is caught as by-catch in the trawl fisheries on blue ling and redfish in Sub-area V.

Source of information: Report of the Study Group on the Biology and Assessment of Deep-Sea Fisheries Resources, February 1998 (ICES CM 1998/ACFM:12).

Catch (Table 3.12.7.e.1):

Year	ACFM catch
1988	3
1989	4
1990	5
1991	7
1992	9
1993	9
1994	8
1995	8
1996	8
1997*	7

*Preliminary. Weights in '000 t.

Table 3.12.7.e.1 Black scabbardfish. Study Group estimates of landings (tonnes).

BLACK SCABBARDFISH (*Aphanopus carbo*) III and IV

Year	France	Germany	UK(Scot)	TOTAL
1988	2			**2**
1989	0			**0**
1990	57			**57**
1991	0			**0**
1992	0			**0**
1993	0			**0**
1994	13	3		**16**
1995			2	**2**
1996	3		1	**4**
1997*			2	**2**

*Preliminary

BLACK SCABBARDFISH (*Aphanopus carbo*) Va

Year	Iceland	TOTAL
1988		**0**
1989		**0**
1990		**0**
1991		**0**
1992		**0**
1993	0	**0**
1994	1	**1**
1995	+	**+**
1996	0	**0**
1997*	1	**1**

*Preliminary

BLACK SCABBARDFISH (*Aphanopus carbo*) Vb

Year	Faroes	France	Germany	TOTAL
1988				
1989		166		**166**
1990	12	407		**419**
1991	1	151		**152**
1992	4	29		**33**
1993	202	76	9	**287**
1994	114	45	1	**160**
1995	249	175		**424**
1996	57	129		**186**
1997*	18	(1)		**18**

*Preliminary
(1) included in VI and VII

Table 3.12.7.e.1 (Continued)

BLACK SCABBARDFISH (*Aphanopus carbo*) VI and VII

Year	Faroes	France	Germany	Ireland	Spain	UK (Scot)	UK(EWNI)	**TOTAL**
1988								
1989	46	108						**154**
1990		1060						**1060**
1991		2759						**2759**
1992	3	3433						**3436**
1993	62	3411	48	8				**3529**
1994		3050	46	3		2		**3101**
1995		3257	3			18		**3278**
1996		3650	2			36	1	**3689**
1997*	3	3362(1)			1	234	2	**3602**

*Preliminary
(1) including V

BLACK SCABBARDFISH (*Aphanopus carbo*) VIII and IX

Year	France	Portugal	Spain	**TOTAL**
1988		3385		**3385**
1989		3553		**3553**
1990	0	3330		**3330**
1991	1	3995		**3996**
1992	0	4427		**4427**
1993	0	4520		**4520**
1994	0	3429		**3429**
1995		4272		**4272**
1996	126	3686	3	**3815**
1997*		3350	0	**3350**

*Preliminary

BLACK SCABBARDFISH (*Aphanopus carbo*) X

Country	Faroes	Portugal	**TOTAL**
1988			
1989			
1990			
1991		166	**166**
1992	370		**370**
1993		2	**2**
1994			**0**
1995		3	**3**
1996	11	0	**11**
1997*	3	0	**3**

*Preliminary

Table 3.12.7.e.1 (Continued)

BLACK SCABBARDFISH (*Aphanopus carbo*) XII

Year	Faroes	France	Germany	Spain	**TOTAL**
1988					
1989					
1990					
1991					
1992		512			**512**
1993	1051		93		**1144**
1994	779		45		**824**
1995	301#				**301**
1996	187	4		253	**191**
1997*	102			98	**102**

#includes VIb Hatton Bank
*preliminary

3.12.7.f Greater silver smelt or argentine (*Argentina silus*)

State of the stock/fishery: CPUE data are unreliable because this is a semi-pelagic shoaling species. A high proportion of the landings are fish of 15 years and older.

Management objectives: No specific objectives are agreed on.

Advice on management: ICES recommends immediate reduction in fisheries that cannot be shown to be sustainable. All remaining fishing activity should be conducted in the context of effective management which emphasizes documentation of fishing activity, and which can react appropriately to biological characteristics of the populations.

Catch forecast: Not available.

Elaboration and special comment: Summaries of the total landings for all areas and by Sub-area/Division are given in Figures 3.12.6.1–10. Landings by Sub-area/Division and nation are given in Table 3.12.7.f.1.

In Sub-areas I and II the decline in landings probably represents a change in target species. In Sub-areas III and IV the argentine is both targeted and a by-catch fishery. In Divisions Va and Vb the fishery has changed from a by-catch to a targeted fishery. The fishery in Sub-areas VI and VII is on spawning aggregations but the effort varies according to the availability of other species such as scad and blue whiting. ICES recommends that existing data on this species be analysed and made available for assessment purposes. Acoustic surveys may be useful in some areas.

Source of information: Report of the Study Group on the Biology and Assessment of Deep-Sea Fisheries Resources, February 1998 (ICES CM 1998/ACFM:12).

Catch data (Table 3.12.7.f.1):

Year	ACFM catch
1988	25
1989	38
1990	22
1991	16
1992	21
1993	15
1994	15
1995	28
1996	24
1997*	18

* Provisional. Weights in '000 t.

Table 3.12.7.f.1 Argentines. Study Group estimates of landings (tonnes).

ARGENTINES (*Argentina silus*) I and II

Country	Germany	Netherlands	Norway	Poland	Portugal	Russia/USSR	UK (Scot)	**TOTAL**
1988			11332	5		14		**11351**
1989			8367			23		**8390**
1990		5	9115					**9120**
1991			7741					**7741**
1992			8234					**8234**
1993			7913					**7913**
1994			6217				590	**6807**
1995	357		6418					**6775**
1996			6604					**6604**
1997*			4463					**4463**

*Preliminary

ARGENTINES (*Argentina silus*) III and IV

Country	Denmark	Faroes	France	Germany	Netherlands	Norway	UK (Scot)	**TOTAL**
1988	1062			1		1655		**2718**
1989	1322				335	2128	1	**3786**
1990	737			13		1571		**2321**
1991	1421		1	0	3	1123	6	**2554**
1992	3565			1	70	698	101	**4435**
1993	2353				298	568	56	**3275**
1994	1118					4	24	**1146**
1995	1061					1	20	**1082**
1996	1446	370				213	22	**2051**
1997*				1		704	19	**724**

*Preliminary

ARGENTINES (*Argentina silus*) Va

Country	Iceland	**TOTAL**
1988	206	**206**
1989	8	**8**
1990	112	**112**
1991	247	**247**
1992	657	**657**
1993	1255	**1255**
1994	613	**613**
1995	492	**492**
1996	808	**808**
1997*	2499	**2499**

*Preliminary

ARGENTINES (*Argentina silus*) Vb

Country	Faroes	Russia/USSR	UK (Scot)	**TOTAL**
1988	287			**287**
1989	111	116		**227**
1990	2885	3		**2888**
1991	59		1	**60**
1992	1439	4		**1443**
1993	1063			**1063**
1994	960			**960**
1995	5534	6752		**12286**
1996	9495		3	**9498**
1997*	8433			**8433**

*Preliminary

Table 3.12.7.f.1 (Continued)

ARGENTINES (*Argentina silus*) VI and VII

Country	Faroes	France	Germany	Ireland	Netherlands	Norway	UK (EW)	UK (Scot)	UK (NI)	TOTAL
1988				5454		4984				**10438**
1989	188			6103	3715	12184	198	3171		**25559**
1990	689		37	585	5871			112		**7294**
1991		7		453	4723			10	4	**5197**
1992		1		320	5118			467		**5906**
1993					1168			409		**1577**
1994			43	150	4137			1377		**5707**
1995	1597		357	6	5440			146		**7546**
1996			1394	295	3953			221		**5863**
1997*			1496	702				20		**2218**

*Preliminary

'ARGENTINES (*Argentina silus*) XII

Country	Faroes	TOTAL
1988		
1989		
1990		
1991		
1992		
1993	6	**6**
1994		
1995		
1996	1	**1**

*Preliminary

ARGENTINES (*Argentina silus*) XIV

Country	Norway	TOTAL
1988		
1989		
1990	6	**6**
1991		
1992		
1993		
1994		
1995		
1996		
1997*		

*Preliminary

3.12.7.g Orange roughy (*Hoplostethus atlanticus*)

State of the stock/fishery: The stock in Sub-area VI is at present considered to be harvested outside safe biological limits as defined by the proposed reference points with exploitable biomass below U_{lim} and in Sub-area VII below U_{pa}. The state of the stocks in other areas is unknown.

Management objectives: No specific objectives are agreed on.

Advice on management: ICES recommends immediate reduction in fisheries that cannot be shown to be sustainable. All remaining fishing activity should be conducted in the context of effective management which emphasizes documentation of fishing activity, and which can react appropriately to biological characteristics of the populations.

Proposed reference points: U_{lim} and U_{pa} can be set at $0.2*U_{max}$ and $0.5*U_{max}$ respectively. For this species CPUE in Vb and VI indicates the relative state of the stock with regard to these reference points.

Relevant factors: Orange roughy can grow very old. Unvalidated age estimates suggest ages of up to 100 years (c.f. South Pacific).

The main fishery is on spawning aggregations and started west of the British Isles in 1991. The highest catch in VI and VII was in 1992. When catches decreased, the fishery moved to Vb, where the highest catch was reached in 1995. In recent years the fishery moved to deeper waters in the Mid-Atlantic Ridge area (XII).

Catch forecast: Not available.

Elaboration and special comment: Summaries of the total landings for all areas and by Sub-area/Division are given in Figures 3.12.6.1–10. Landings by Sub-area/Division and nation are given in Tables 3.12.7.g.1.

The main fishery is on spawning aggregations. Unvalidated age estimates suggest ages of up to 100 years (c.f. South Pacific).

There is a directed trawl fishery in Sub-areas VI and VII and occasionally in Sub-area V, X and XII.

Source of information: Report of the Study Group on the Biology and Assessment of Deep-Sea Fisheries Resources, February 1998 (ICES CM 1998/ACFM:12).

Catch data (Table 3.12.7.g.1):

Year	ACFM catch
1988	0
1989	0
1990	+
1991	4
1992	5
1993	3
1994	2
1995	2
1996	2
1997*	2

*Preliminary. Weights in '000 t.

Table 3.12.7.g.1 Orange roughy. Study Group estimates of landings (tonnes).

ORANGE ROUGHY (*Hoplostethus atlanticus*) II

Country	France	**TOTAL**
1988	0	**0**
1989	0	**0**
1990	0	**0**
1991	0	**0**
1992	6	**6**
1993	1	**1**
1994	0	**0**
1995	0	**0**
1996	0	**0**
1997*	0	**0**

*Preliminary

ORANGE ROUGHY (*Hoplostethus atlanticus*) III and IV

Country	France	UK (Scot)	**TOTAL**
1988			**0**
1989			**0**
1990			**0**
1991	10		**10**
1992	33		**33**
1993	0		**0**
1994	0		**0**
1995	0		**0**
1996	0	+	**0**
1997*	0		**0**

*Preliminary

ORANGE ROUGHY (*Hoplostethus atlanticus*) Va

Country	Iceland	**TOTAL**
1988		**0**
1989		**0**
1990		**0**
1991	65	**65**
1992	382	**382**
1993	717	**717**
1994	158	**158**
1995	64	**64**
1996	40	**40**
1997*	75	**75**

*Preliminary

Table 3.12.7.g.1 (Continued)

ORANGE ROUGHY *(Hoplostethus atlanticus)* Vb

Country	Faroes	France	**TOTAL**
1988			**0**
1989			**0**
1990		5	**5**
1991		48	**48**
1992	1	12	**13**
1993	36	1	**37**
1994	170	0	**170**
1995	419	0	**419**
1996	77	2	**79**
1997*	3	0	**3**

*Preliminary

ORANGE ROUGHY (*Hoplostethus atlanticus*) VI and VII

Country	Faroes	France	France VI	France VII	UK (EW)	UK (Scot)	Spain	**TOTAL**
1988		0						**0**
1989		0						**0**
1990		3						**3**
1991		3781						**3781**
1992		4462						**4462**
1993			426	1758				**2184**
1994			178	1723				**1901**
1995	40		71	831		2		**944**
1996	0		113	879		0		**992**
1997*	29	1294			1		1	**1325**

*Preliminary

ORANGE ROUGHY (*Hoplostethus atlanticus*) VIII

Country	France	**TOTAL**
1988	0	**0**
1989	0	**0**
1990	0	**0**
1991	0	**0**
1992	34	**34**
1993	32	**32**
1994	31	**31**
1995	(1)	
1996	(1)	
1997*	(1)	

*Preliminary (1) Included in VII

Table 3.12.7.g.1 (Continued)

ORANGE ROUGHY (*Hoplostethus atlanticus*) X

Country	Norway	Faroes	**TOTAL**
1988			**0**
1989			**0**
1990			**0**
1991			**0**
1992			**0**
1993	1		**1**
1994			**0**
1995			**0**
1996		470	**470**
1997*		6	**6**

*Preliminary

ORANGE ROUGHY (*Hoplostethus atlanticus*) XII

Country	Faroes	France	Iceland	**TOTAL**
1988				**0**
1989				**0**
1990				**0**
1991				**0**
1992				**0**
1993	24			**24**
1994	89			**89**
1995	580			**580**
1996	779	33	3	**815**
1997*	802			**802**

*Preliminary

3.13 Stocks in the Baltic

3.13.1 Overview

The main fisheries for cod in the Baltic are those using 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 main body of the sprat catch is taken by pelagic pair trawling and used for industrial purposes. There has been an increase of catches of sprat in the most recent years and 1997 catches were at a record high of 529 000 t in the whole Baltic. Baltic salmon is exploited by drift net, trap net and longline fisheries.

An overview of catches of fish in the Baltic until 1996 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.

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. 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. The fleet capacity and fishing effort have now been reduced to some extent but, in fact 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 1996–1997.

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 allow the possibility of improved recruitment but did not ensure it. Since 1993 there has 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 at the most for two spawning seasons (about 1.5 years) 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 have been seen in both the western (Sub-divisions 22 and 24) 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. Recruitment in the western stock has been well below the long-term average in the last twelve years, except for the 1994 year class which was above average. 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 decrease with the present exploitation pattern and low recruitment. The estimate of 1996 year class is still uncertain. In the eastern stock the last ten year classes have been below the long-term average 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.

Unfavourable market conditions and decreasing quality of **herring** have been reflected in decreased landings for human consumption but the landings of **sprat** for industrial purposes have increased markedly during the last few years. 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 on biological grounds and the practical constraints such as in what units catch figures are available and possibilities for correctly allocating individual fish to particular stocks.

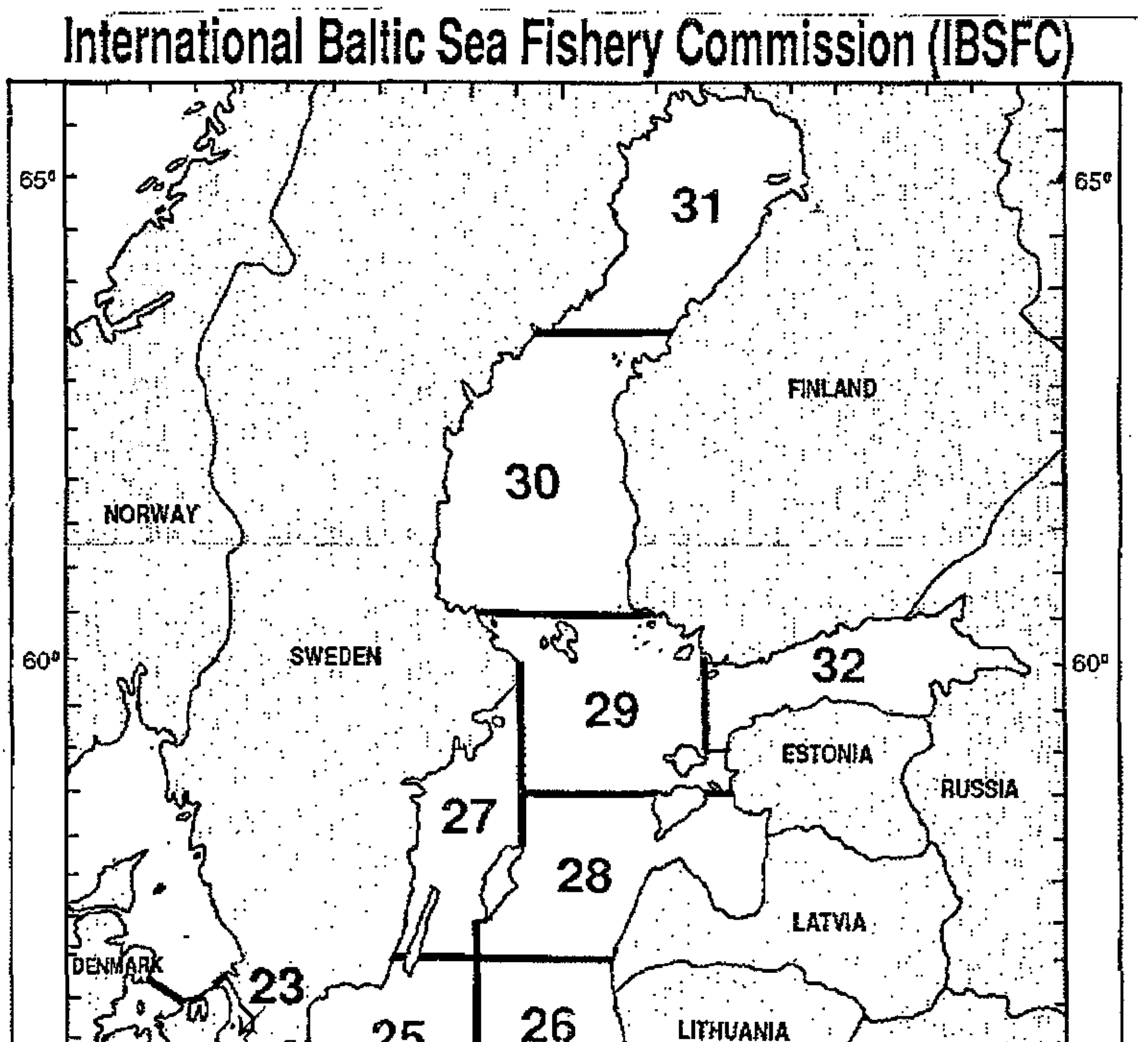
Sprat is assessed as one unit for the entire Baltic.

The exploitation rate of pelagic stocks in the Baltic has increased since the mid-1990s. The stock biomasses or stock numbers are at or above their respective long-term average levels. 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 within safe biological limits. 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). 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, until 1996, 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 level of fishing mortality, should be closely monitored.

The spring-spawning stock of herring 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 no reliable assessment being available for the spring-spawning stock of herring in Sub-divisions 22–24 and Division IIIa.

For **Baltic salmon and sea trout** reference is made to the overview in Section 3.13.11.



3.13.2 Nominal catches in the Baltic Area

Officially reported catches in the Baltic until 1996 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 by some countries figures are reported by the larger Divisions IIIb, c, and d. The trends in Tables 3.13.2.1–5 may not, therefore, correspond with 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 1973-1996 (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

[1]Preliminary.

Table 3.13.2.2 Nominal catch (tonnes) of HERRING in Divisions IIIb,c,d, 1963-1996. (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]

[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, 1963–1996. (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]

[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.

Table 3.13.2.4 Nominal catch (tonnes) of COD in Divisions IIIb,c,d, 1963–1996. (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]

[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, 1963-1996. (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]

[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

3.13.3.a Herring in Sub-divisions 22–24 and Division IIIa (spring-spawners)

State of stock/fishery: The state of the stock is uncertain due to problems with splitting in proportion of spring and autumn spawners in the historical data and the lack of a coordinated comprehensive survey. Neglecting the precise levels of SSB and F the trends seen from 1991–1996 have changed. The SSB in 1997 is above the 1996 estimate and the F in 1997 is below that seen in recent years.

Herring of this stock are taken in Division IIIa and Sub-divisions 22–24. In Division IIIa there are directed fisheries by trawlers and purse seiners (fleet c). In Sub-divisions 22–24 there are directed trawl, gill-net and trap-net fisheries (fleet f). The herring by-catches taken in Division IIIa in the small mesh trawl fishery for Norway pout and sandeel (fleet e) and the "mixed clupeoid fishery" (until 1997) (fleet d) are mainly autumn spawners from the North Sea stock. After a period of high landings in the early 1980s the landings have decreased to below the long-term average.

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

Advice on management: ICES recommends that the fisheries on herring in Division IIIa should be managed in accordance with the management advice given on autumn-spawning herring in Section 3.5.8 (provided as an annex to this Extract). If a catch limit is required in Sub-divisions 22–24, ICES advises that it should not exceed recent catches in that area.

Proposed reference points: None available.

Relevant factors to be considered in management: A considerable part of the landings of juvenile herring in Division IIIa originate from the North Sea stock.

Historical catch-at-age data are uncertain due to low sampling intensity but the intensity improved in 1997. It was assumed that all year classes > 3 ringers were spring spawners. In 1997 a new method (otolith microstructure analysis) to split autumn and spring spawners demonstrated a considerable number of autumn spawners in the catches of older age classes in Division IIIa and Sub-divisions 22–24.

The TACs in Division IIIa in 1997 were 1) for the directed fishery 80 000 t and 2) for by-catch in the mixed clupeoid fishery 10 000 t, and 3) for by-catch in other small mesh fisheries 20 000 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 (Sub-divisions 22–29S and 32) 560 000 t.

The agreed TACs for 1998 are 80 000 t for directed fishery and a total of 17 000 t for by-catches in the small mesh fisheries. The "mixed clupeoid " TAC was deleted from the management agreement between Norway and EU.

In the Baltic the TAC for herring applies 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. The herring TAC for the Baltic should be split and individual TACs applied on the stocks, i.e., Sub-divisions 22–24, 25–29 + 32, 30 and 31.

Catch forecast: No projection is available.

Source of information: Report of the Herring Assessment Working Group for the Area South of 62°N, March 1998 (ICES CM 1998/ACFM:14).

Catch data: Catches of Baltic spring spawners are given in Table 3.13.3.a.1 and of autumn and spring spawners in Table 3.13.3.a.2.

Year	ICES Advice	Pred. cat corresp. to advice	Agreed TAC	ACFM catch of stock 22–24	IIIa	Total[1]
1987	Reduction in F	224		102	59	175
1988	No increase in F	196		99	129	251
1989	TAC	174		95	71	186
1990	TAC	131		78	118	204
1991	TAC	180		70	113	192
1992	TAC	180		85	75	168
1993	Increased yield from reduction in F; reduction in juvenile	188		81	81	171
1994	TAC	130–180		66	84	164
1995	If required, TAC not exceeding recent catches	168–192		74	90	173
1996	If required, TAC not exceeding recent catches	164–171		58	73	130
1997	IIIa: managed together with autumn spawners 22–24: if required, TAC not exceeding recent catches	*66–85*[2]		42	63	105
1998	Should be managed in accordance with North Sea autumn	-				
1999	IIIa: managed together with autumn spawners 22–24: if required, TAC not exceeding recent catches	-				

[1]Including catches of Baltic spring spawners in North Sea. [2]Catch in Sub-divisions 22–24. Weights in '000 t.

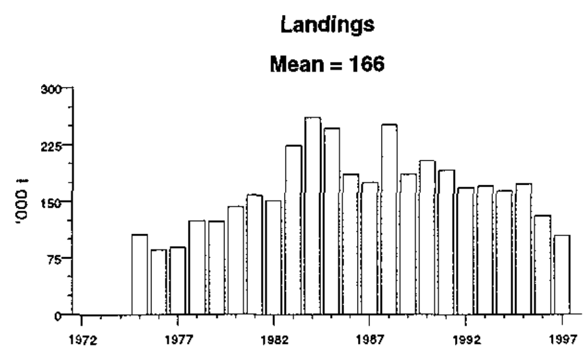


Table 3.13.3.a.1 Herring in Division IIIa and Sub-divisions 22–24 (Baltic spring-spawners).

Year	Landings
1975	106
1976	86
1977	89
1978	124
1979	124
1980	143
1981	158
1982	151
1983	224
1984	261
1985	247
1986	186
1987	175
1988	251
1989	186
1990	204
1991	192
1992	168
1993	171
1994	164
1995	173
1996	130
1997	105
Average	166
Unit	1000 tonnes

Table 3.13.3.a.2 **Herring (Baltic spring spawners and North Sea autumn spawners) in Division IIIa and Sub-Divisions 22-24, 1985–1997.** Landings in thousands of tonnes.
(Data provided by Working Group members).

Year	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997[1]
Skagerrak													
Denmark	88.2	94.0	105.0	144.4	47.4	62.3	58.7	64.7	87.8	44.9	43.7	28.7	14.3
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	16.7	9.4	8.8
Sweden	40.3	43.0	51.2	57.2	47.9	56.5	54.7	88.0	56.4	66.4	48.5	32.7	32.9
Total	133.5	139.1	157.4	207.3	96.9	124.4	121.5	166.6	168.4	129.0	108.9	70.8	56.0
Kattegat													
Denmark	69.2	37.4	46.6	76.2	57.1	32.2	29.7	33.5	28.7	23.6	16.9	17.2	8.8
Sweden	39.8	35.9	29.8	49.7	37.9	45.2	36.7	26.4	16.7	15.4	30.8	27.0	18.0
Total	109.0	73.3	76.4	125.9	95.0	77.4	66.4	59.9	45.4	39.0	47.7	44.2	26.8
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	36.8	34.4	30.5
Germany	54.6	60.0	53.1	54.7	56.4	45.5	15.8	15.6	11.1	11.4	13.4	7.3	12.8
Poland	16.7	12.3	8.0	6.6	8.5	9.7	5.6	15.5	11.8	6.3	7.3	6.0	6.9
Sweden	11.4	5.9	7.8	4.6	6.3	8.1	19.3	22.3	16.2	7.4	15.8	9.0	14.5
Total	98.6	92.2	101.4	99.0	92.9	76.9	65.9	80.3	77.1	64.6	73.3	56.7	64.7
Sub-div. 23													
Denmark	6.8	1.5	0.8	0.1	1.5	1.1	1.7	2.9	3.3	1.5	0.9	0.7	2.2
Sweden	1.1	1.4	0.2	0.1	0.1	0.1	2.3	1.7	0.7	0.3	0.2	0.3	0.1
Total	7.9	2.9	1.0	0.2	1.6	1.2	4.0	4.6	4.0	1.8	1.1	1.0	2.3
Grand Total	349.0	307.5	336.2	432.4	286.4	279.9	257.8	311.4	294.9	234.4	231.0	172.7	149.8

[1] Preliminary data.

3.13.3.b Herring in Sub-divisions 25–29 (including Gulf of Riga) and 32

State of stock/fishery:. The stock is considered to be harvested outside safe biological limits as defined by the proposed reference points because of the continued decline in SSB and increase in F. The assessment is uncertain due to the stock complexity in this area. The trends in numbers and biomass differ reflecting a change in the relative productivity between stock components (see Figure 3.13.3.b.1). Fishing mortality is above the proposed F_{pa}.

Management objectives: There are no explicit management objectives for this stock. For any management objective to meet precautionary criteria, F should be less than F_{pa} and spawning stock biomass should be greater than B_{pa}.

Advice on management: ICES recommends that F in 1999 should be reduced below F_{pa} = 0.17 to ensure that the SSB is increased toward B_{pa}. The TAC for herring in Sub-divisions 22–29, 32 should be set such that a catch in 1999 of this stock of less than 117 000 t is implied.

Proposed reference points: The B_{lim} = 750 000 t is taken as close to the lowest observed SSB as possible. Medium-term simulations (assuming that the mean weights at age remain at their present low level) has shown that a fishing mortality close to F = 0.17 (F_{pa}) has a high probability of maintaining the stock above B_{lim} and a lower probability to increase it above B_{pa} in the medium-term. In order to take into account uncertainty of the stock falling below B_{lim}, B_{pa} = 1 000 000 t is proposed. These results are also dependent on the assumed level of natural mortality, which to a large extent is determined by the predation on herring by cod. In the above simulations cod biomass was assumed to be low in the next decade. The value of F_{pa} will be reduced if natural mortality increases.

Relevant factors to be considered in management: There has been a decrease in mean weight at age for herring. Moreover the seasonal variation in mean weights is large, with high weights during spawning time (2nd quarter) and much lower weights during the feeding season when the mixture of herring from different spawning regions is largest. This is linked to the increasing proportion in the catches of slow growing fish mainly from the Gulf of Finland and Gulf of Riga and the decreasing growth rate of some stock components. The spawning stock in numbers increased in the 1990s when compared to the 1980s.

Catch forecast for 1999: Basis: F(98) = F(95–97) = 0.28, Catch(98) = 190, SSB(98) = 715.

F(99)	Basis	SSB(99)	Landings(99)	SSB (00)	Medium effects of fishing at a given level
0.14	0.5F(95-97)	740	99	819	75% probability of SSB increasing above B_{pa}
0.17	F_{pa}	734	117	796	30% probability of SSB increasing above B_{pa}
0.28	1.0F(95-97)	708	186	709	85% probability of SSB remaining below B_{lim}

Weights in '000 t.

Shaded scenario considered inconsistent with the precautionary approach.

If the agreed TAC (approx. 426 000 t) were to be caught in both 1998 and 1999, the resulting SSB in year 2000 would be about 250 000 t.

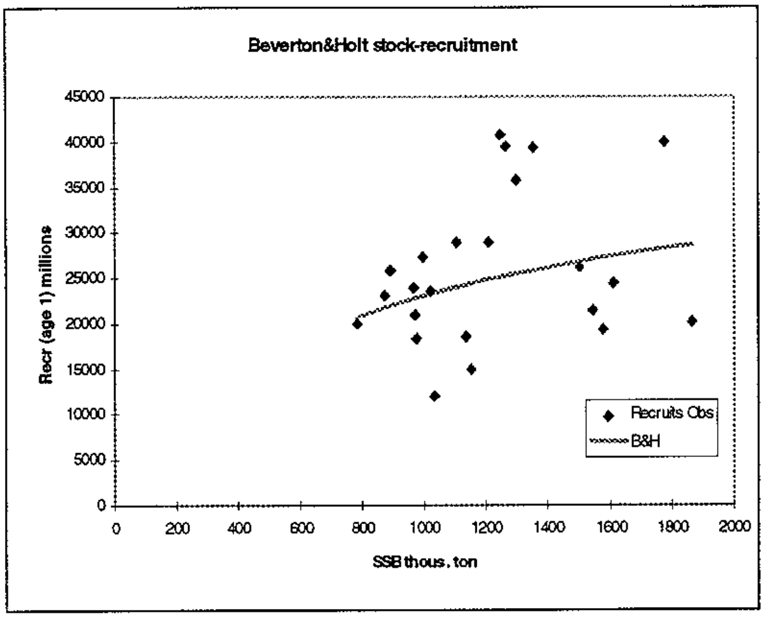
Elaboration and special comment: From the beginning of the 1970s to 1985 annual landings fluctuated around 300 000 t. Due to market problems the landings decreased and in the last four years have been around 200 000 t. Traditionally the fishery was dominated by trapnets, gillnets and bottom trawls; recent development has been towards a dominance of pelagic trawls. The proportion of the catches used for industrial purposes has increased during the last few years.

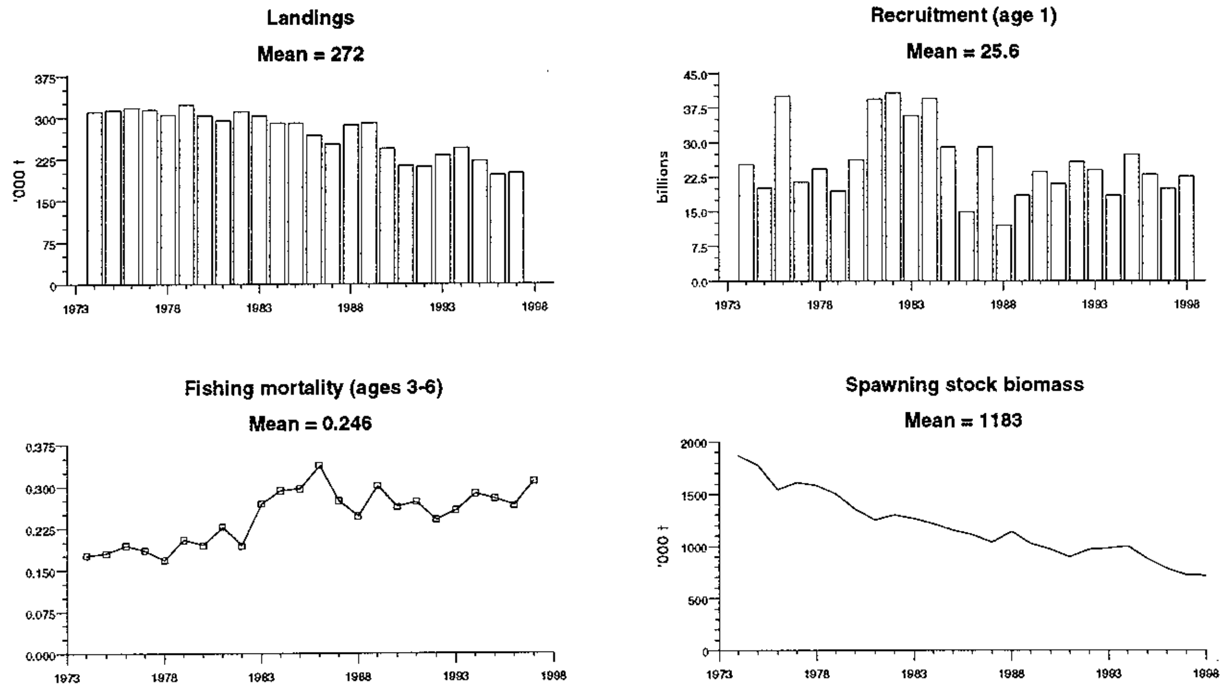
Source of information: Report of the Baltic Fisheries Assessment Working Group, April 1998 (ICES CM 1998/ACFM:16).

Catch data (Tables 3.13.3.b.1–2):

Year	ICES advice	Predicted catch corresp. to advice	Agreed TAC[1]	ACFM catch
1987		200	399	252
1988		204	399	286
1989		176	399	290
1990		112	399	244
1991	TAC for entire area	293	402	213
1992	F near present level	343	402	210
1993	Increase in yield att higher F	371	560	231
1994	Increase in yield att higher F	317–463	560	242
1995	TAC	394	560	221
1996	TAC	394	560	195
1997	No advice	-	560	199
1998	No advice	-	560	
1999	$F_{pa} = (0.17)$	117		

[1] TAC is for Sub-divisions 22–24 **and** 25–29, 32. If total TAC is split on stocks in proportion to catches, the TAC for this stock would be ca 426 000 t. Weights in '000 t.





Herring in Sub-divisions 25–29 (including Gulf of Riga) and 32

Yield and Spawning Stock Biomass

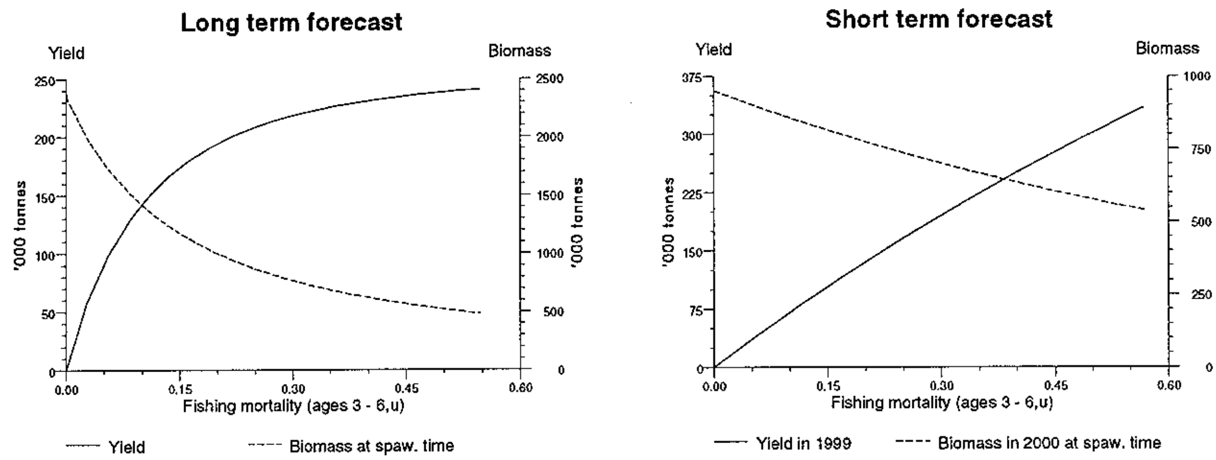


Table 3.13.3.b.1 Herring catches in Sub-divisions 25–29, 32 (thousand tonnes).

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	21.1	0.0	33.6	3.3	26.2	12.5	38.5	199.3

* preliminary, ** in 1977-1990 sum of catches by Estonia, Latvia, Lithuania and Russia.

Table 3.13.3.b.2 Herring in Baltic Fishing Areas 25 to 29 and 32 plus Gulf of Riga.

Year	Recruitment Age 1	Spawning Stock Biomass	Landings	Fishing Mortality Age 3-6
1974	25,251.20	1,865.69	310.00	0.176
1975	20,190.20	1,776.30	313.00	0.179
1976	39,987.40	1,543.05	318.00	0.194
1977	21,417.30	1,611.23	314.00	0.185
1978	24,300.60	1,575.49	305.00	0.168
1979	19,390.90	1,499.49	323.00	0.204
1980	26,180.10	1,351.91	304.00	0.195
1981	39,376.30	1,245.35	294.00	0.227
1982	40,760.10	1,297.70	311.00	0.193
1983	35,777.90	1,261.48	302.00	0.269
1984	39,488.60	1,209.41	290.00	0.293
1985	28,971.40	1,152.19	290.00	0.296
1986	14,908.00	1,104.94	268.00	0.338
1987	28,991.00	1,032.09	252.00	0.274
1988	11,968.00	1,134.99	286.00	0.247
1989	18,445.40	1,021.61	290.00	0.301
1990	23,563.00	969.23	244.00	0.264
1991	20,948.20	891.03	213.00	0.272
1992	25,750.60	966.39	210.00	0.240
1993	23,939.90	975.40	231.00	0.257
1994	18,428.20	997.48	244.00	0.287
1995	27,331.40	873.36	221.00	0.278
1996	23,064.90	784.46	195.11	0.266
1997	20,041.80	718.30	199.32	0.309
1998	22,648.00	714.68	.	.
Average	25,644.82	1,182.93	271.98	0.246
Unit	Millions	1000 tonnes	1000 tonnes	-

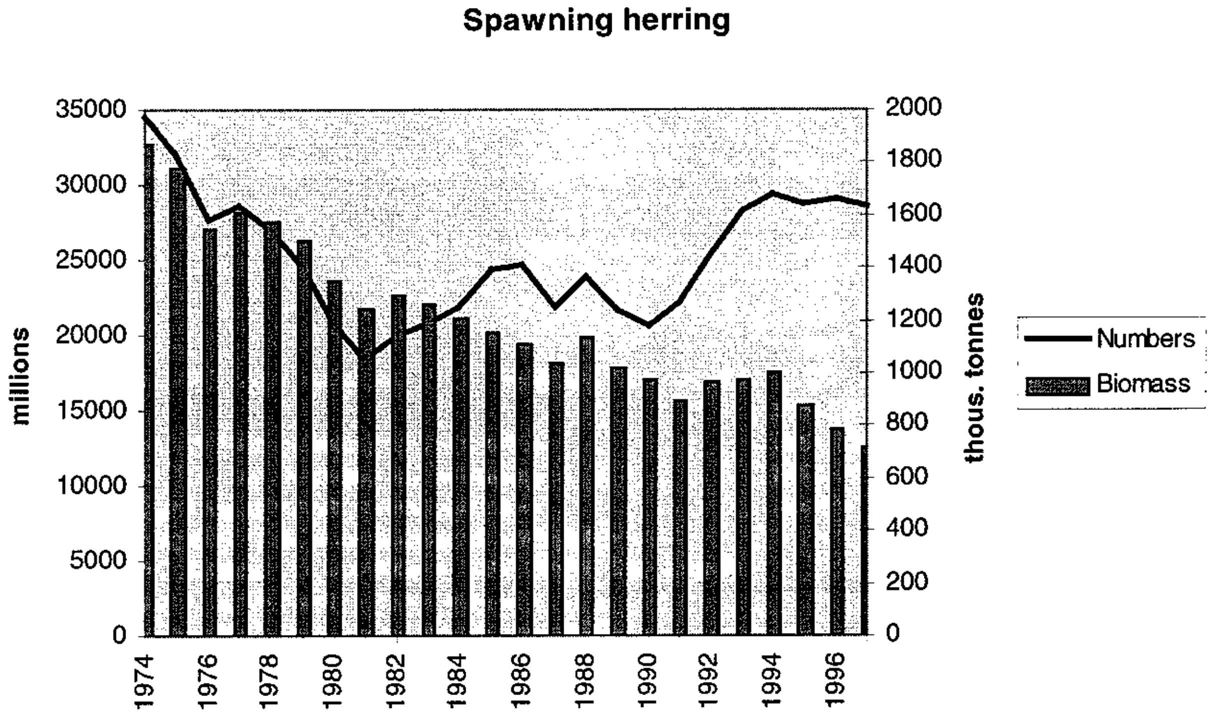


Figure 3.13.3.b.1 Herring in Sub-divisions 25–29, 32. Spawning stock in millions of fish and thousands of tonnes.

Herring in the Gulf of Riga

State of stock/fishery: The stock is at present considered to be harvested within safe biological limits. SSB and recruitment have been high since 1990.

Management objectives: There are no explicit management objectives set.

Advice on management: With current exploitation rate the stock will stay within safe biological limits.

Proposed reference points: An MBAL of 50 000 t was previously established. No new reference points are proposed at this time.

Catch forecast for 1999: Basis: *Status Quo* F in 1998 = F(97) = 0.33, Catch(98) = 35.3.

F(99)	Basis	SSB(99)	Catch (1999)	SSB(2000)	Medium term effect of fishing at given level
0.30	0.9(F97)	142	31.5	127	high probability of SSB being above MBAL
0.33	Fsq	141	34.4	124	high probability of SSB being above MBAL
0.40	1.2F(97)	141	40.5	118	high probability of SSB being above MBAL

Weights in '000 t.

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.

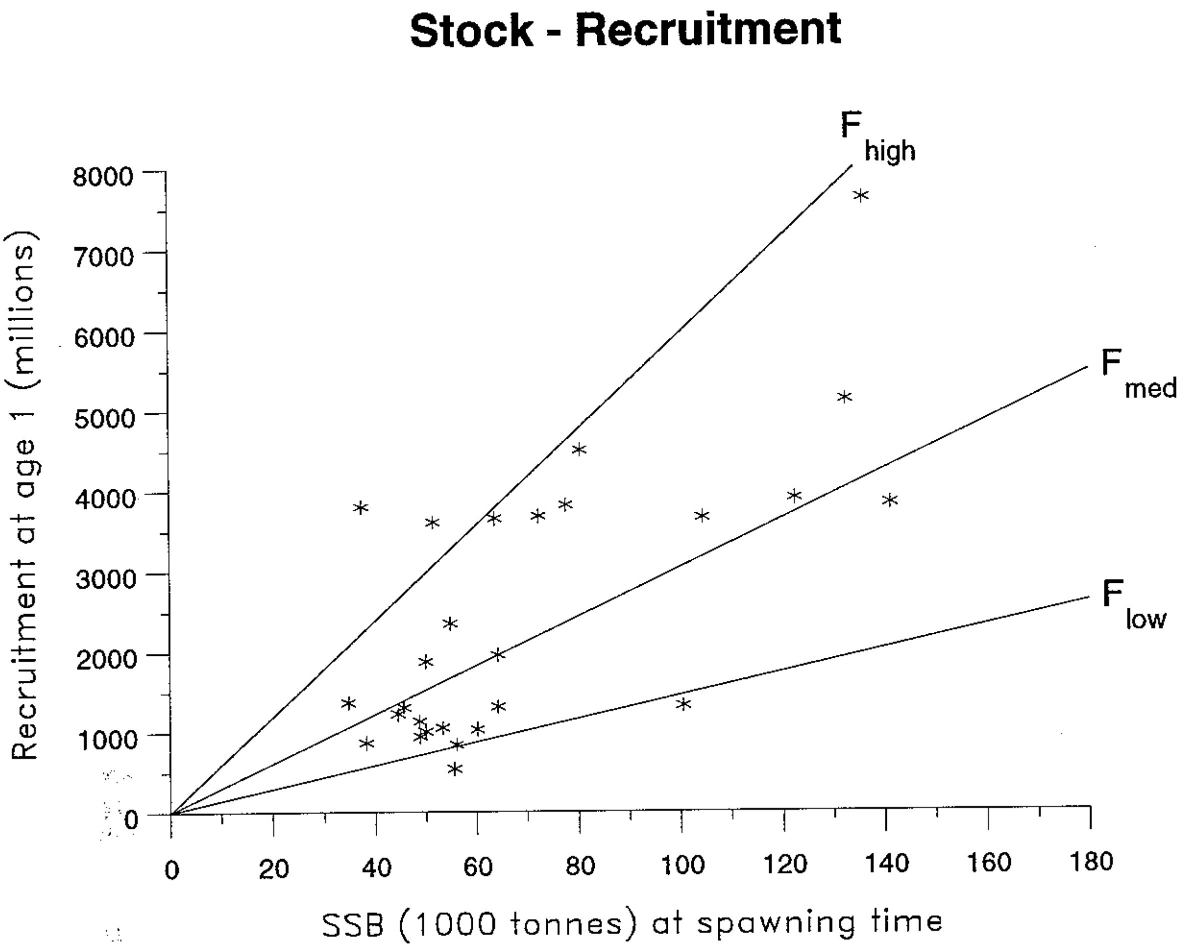
Analytical assessment is based on catch data and CPUE series. Gulf of Riga herring is a component of the herring in Sub-divisions 25–29 and 32 separated in the landings by means of otolith structure. The 1998 assessment is very close to the assessment made in the previous year.

Source of information: Report of the Baltic Fisheries Assessment Working Group, April 1997 (ICES CM 1998/ACFM:16)

Catch data (Table 3.13.3.b.3):

Year	ICES advice	Predicted catch corresp. to advice	Agreed TAC	ACFM catch
1987	Reduce F towards $F_{0.1}$	8	-	13
1988	Reduce F towards $F_{0.1}$	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	-	
1999	Current exploitation rate within safe biological limits	34		

Weights in '000 t.



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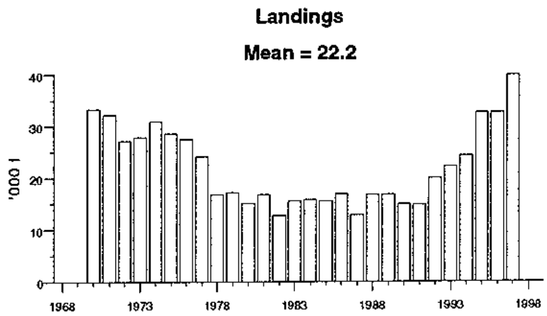
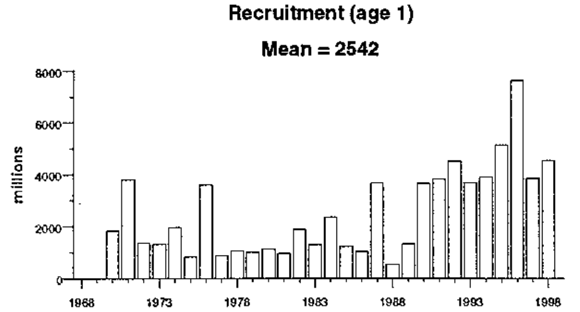
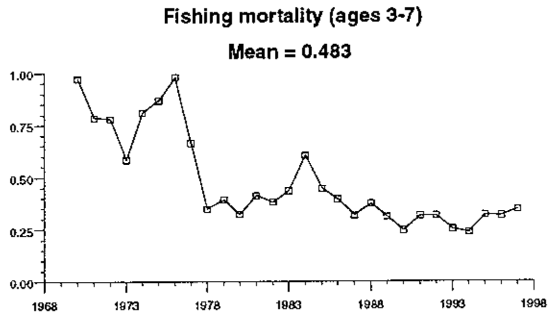
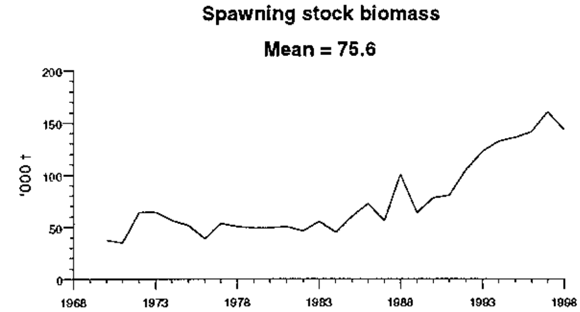


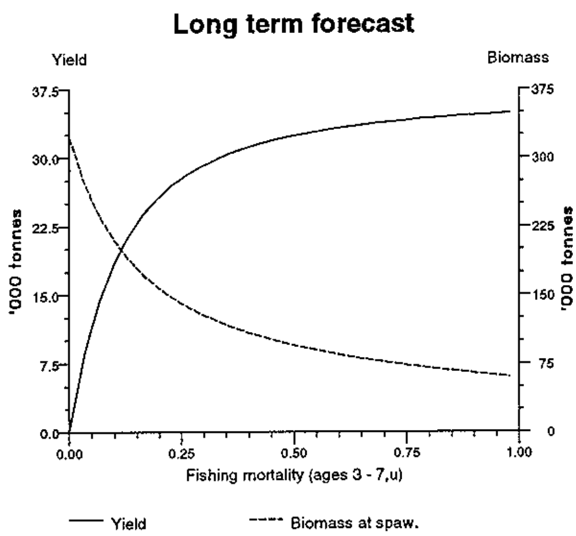






Herring in the Gulf of Riga

Yield and Spawning Stock Biomass



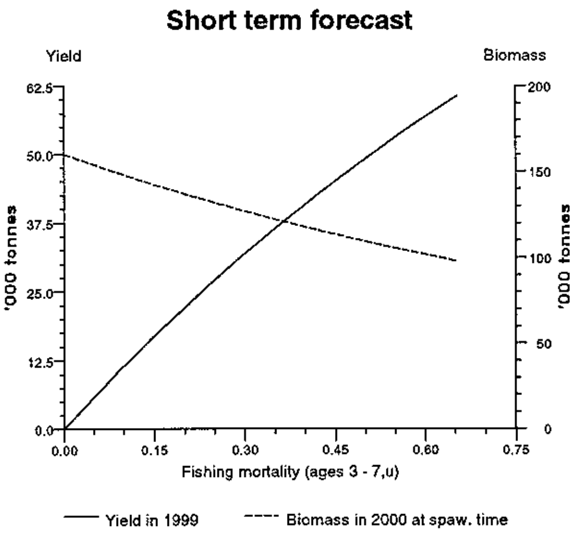


Table 3.13.3.b.3 Herring in the Gulf of Riga.

Year	Recruitment Age 1	Spawning Stock Biomass	Landings	Fishing Mortality Age 3-7
1970	1,824.29	37.40	33.20	0.971
1971	3,805.09	34.73	32.18	0.786
1972	1,366.27	64.27	27.15	0.779
1973	1,313.53	64.22	27.90	0.584
1974	1,957.84	56.04	30.85	0.809
1975	835.88	51.49	28.52	0.869
1976	3,609.37	38.27	27.42	0.980
1977	865.54	53.31	24.19	0.664
1978	1,052.36	50.00	16.73	0.348
1979	1,001.60	48.81	17.14	0.393
1980	1,130.40	48.93	15.00	0.323
1981	938.03	49.98	16.77	0.412
1982	1,878.07	45.61	12.78	0.380
1983	1,305.78	54.82	15.54	0.435
1984	2,351.67	44.53	15.84	0.604
1985	1,223.35	60.16	15.58	0.445
1986	1,029.35	72.24	16.93	0.394
1987	3,685.39	55.64	12.88	0.317
1988	534.83	100.52	16.79	0.374
1989	1,321.34	63.65	16.78	0.310
1990	3,655.16	77.59	14.93	0.245
1991	3,822.11	80.36	14.79	0.315
1992	4,507.41	104.37	20.00	0.316
1993	3,668.76	122.48	22.20	0.250
1994	3,907.23	132.43	24.30	0.236
1995	5,131.68	135.88	32.66	0.319
1996	7,625.05	141.12	32.58	0.316
1997	3,843.01	160.16	39.84	0.344
1998	4,526.97	142.97	.	.
Average	2,541.98	75.58	22.19	0.483
Unit	Millions	1000 tonnes	1000 tonnes	-

3.13.3.c Herring in Sub-division 30, Bothnian Sea

State of stock/fishery: The stock has been considered to be inside safe biological limits. At present the state of the stock is very difficult to judge because of low precision of the assessment. Catches have been increasing and they were record high in 1997 (65 530 t). There has been substantial increase in fishing effort in 1990s which presumably resulted in increased fishing mortality. In the trawl fishery new more effective trawl types has been introduced.

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

Advice on management: ICES advises that fishing mortality should be reduced through decreases in catches.

Elaboration and special comment: About 90% of the total catch is taken by trawl fishery, and trapnet fishery is of minor importance. A large but varying proportion of the catches is used as animal fodder depending on the markets.

An assessment based on catch and effort data and revised CPUE series from pelagic and bottom trawls taking into account changes in the trawl size was not accepted.

Source of information: Report of the Baltic Fisheries Assessment Working Group, April 1998 (ICES CM 1998/ACFM:16).

Catch data (Table 3.13.3.c.1):

Year	ICES advice	Predicted catch corresp. to advice	ACFM catch
1987			25
1988			28
1989			29
1990			31
1991	TAC for eastern part of SD, allowance for western part	32+	26
1992	*Status quo* F	39	39
1993	*Status quo* F	39	40
1994	No specific advice	41[1]	56
1995	TAC	73	61
1996	TAC	73	56
1997	F(97) = 1.4 * F(95)	78	65
1998	*Status quo* F	50	
1999	Reduce catches	-	

[1]Catch at $F_{0.1}$. Weights in '000 t.

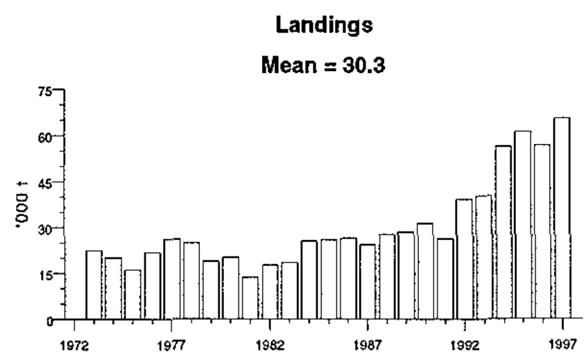


Table 3.13.3.c.1 Herring catches in Sub-division 30 (tonnes).

Year	Finland	Sweden	Total
1971	24284	5100	29384
1972	24027	5700	29727
1973	20027	6944	22531
1974	17597	6321	20294
1975	13567	6000	16264
1976	19315	4455	22012
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	28658
1990	29875	2467	31282
1991	26105	3000	26219
1992	35536	3700	39310
1993	36489	3579	40179
1994	53716	2520	56380
1995	58662	2280	61086
1996	55078	1737	56109
1997*	63531	1995	65527

* preliminary.

3.13.3.d Herring in Sub-division 31, Bothnian Bay

State of stock/fishery: The stock is considered to be within safe biological limits. The state of this stock is uncertain and the actual levels of SSB and fishing mortality are not known. Production models indicate that there have not been major changes in spawning stock biomass in the available time series. Catches have been low and in recent years there has been a reduction in total fishing effort. Spawning stock biomass estimates, CPUE as well as decreased fishing effort indicate that there is no change in fishing mortality rate and the stock is considered to be very lightly exploited.

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

Advice on management: The advice given in 1995–1998 is maintained for 1999: "The stock is hardly exploited and ICES considers that yield can be increased by increasing fishing mortality". Historically landings have averaged 7 300 t and have not exceeded 10 000 t.

Elaboration and special comment: Within the last 10 years landings have fluctuated without trend. In 1997 they were at the lowest level since 1973. The fishery is mainly conducted with bottom trawls but the share of the trapnet fishery and pelagic trawls has increased in recent years.

Source of information: Report of the Baltic Fisheries Assessment Working Group, April 1998 (ICES CM 1998/ACFM:16).

Catch data (Table 3.13.3.d.1):

Year	ICES advice	Predicted catch corresp. to advice	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	-	
1999	Increase in yield by increasing F	-	

Weights in '000 t.

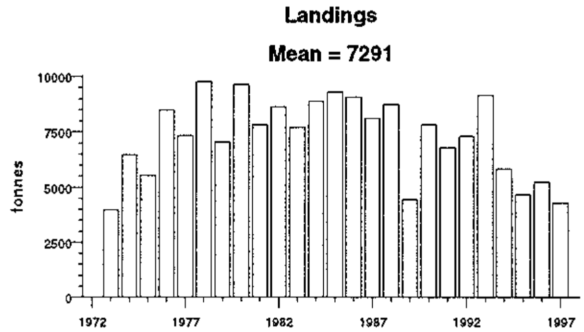


Table 3.13.3.d.1 Herring catches in Sub-division 31 (tonnes).

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

* preliminary.

3.13.3.e Stock components of Baltic herring

Response to a request from the Government of Estonia to "explore the possibilities of re-establishment, at least in the northeastern Baltic, of the management system of herring, used prior to 1990".

Background

Herring in the Baltic Sea form a number of populations, which have different biological characteristics. The spring spawning herring component has dominated all areas of the Baltic Sea since the late 1960s and the autumn spawning component is of minor importance. In most of the cases the boundaries between Baltic herring populations are not clear-cut. Baltic herring spawn along the whole Baltic Sea coast, from south to north, where suitable spawning grounds are available. Baltic herring populations tend to have discrete spawning grounds and homing behaviour has been observed. The spawning of spring spawning herring starts in the southern Baltic earlier (March-April) than in the northern areas (May-June).

After spawning some of these herring populations migrate over long distances between spawning sites and feeding areas whereas others are more stationary. The three main basins (Gotland Basin, Gdansk Basin and Bornholm Basin) serve as feeding areas for the herring populations, which have spawning grounds along the western, eastern, southern and northern coasts. In the Central Baltic Sea there is a mixture of herring of different origin during the feeding period and also in winter. Similar feeding migrations exist for herring spawning along the coasts of Bothnian Sea and Bothnian Bay. After spawning they migrate offshore. The spring spawners of the western Baltic Sea migrate after spawning via Kattegat and Skagerrak as far as the eastern North Sea to feed. After feeding the herring migrate back to their spawning sites in the western Baltic Sea. Discrimination between populations is fairly easy during the time of spawning whereas during the feeding period the monitoring of discrete populations in the catches is very difficult.

The management of the Baltic Sea herring by the IBSFC is based on two management units at present. Management unit I includes Sub-divisions 22–29S and 32 and management unit III includes Sub-divisions 29N, 30 and 31. The scientific advice given by ICES to IBSFC concerning the herring fishery in the Baltic Sea includes at the moment five assessment units:

- Herring in IIIa and 22–24
- Herring in 25–29 (including Gulf of Riga) and 32
- Herring in 30
- Herring in 31
- Gulf of Riga

An additional assessment has been attempted of herring stocks in Sub-divisions 29 and 32. There is no doubt that the large assessment unit that includes the whole Central Baltic Sea and the Gulf of Finland consists of a number of herring populations with partly different growth characteristics and also different strength of recruitment in certain years. In general the growth rate of Baltic herring decreases in the Baltic from west to east and from south to north following the decreasing salinity.

TACs are set for IBSFC management units. For these large management units, overfishing of one or more small stocks is possible.

Stock components of herring in the northeastern Baltic

The Gulf of Finland herring stock has been assessed earlier as a unit stock, but in 1990 the assessments of both Gulf of Riga and Gulf of Finland herring stocks were combined with the Baltic Main Basin stocks. The reason for combination of stocks was to solve the problem of mixing between stocks and lack of estimates of migration between Sub-divisions 28, 29 and 32. Separate Gulf of Riga herring assessment unit was re-established in 1997.

Herring in the northern Baltic Proper, the Archipelago Sea and Åland Sea (Sub-divisions 28 and 29)

The annual migration of the various spring spawning stocks in the Gulf of Riga, Ventspils-Saaremaa, Hiiumaa and in the east coast of Gotland (Sub-division 28) follow the general seasonal pattern observed in the neighbouring stocks and populations. There might be migrations out of the north-eastern Baltic to the south with different intensities from year to year depending on feeding conditions in these areas. Because of few and inconclusive tagging experiments, the migration patterns have not been very well documented.

The migration pattern of spring-spawning coastal herring in the Archipelago Sea and in the Åland Sea (Sub-division 32) has been rather well documented. The spawning migration of the adults from the feeding areas occurs during winter and early spring. The feeding areas of adults are located in the outer parts of the archipelago near to the open sea and in the open sea areas. The migration activity of older specimens is higher than that of younger age groups and they may extend to central parts of the Baltic and sometimes even to the southern Baltic, but in general such long migrations are rare.

Herring in the Gulf of Finland (Sub-division 32)

The seasonal variation in length distribution of commercial catches, age-structured CPUE data and hydroacoustic surveys made in successive seasons indicate migration of older herring out of the Gulf of Finland to the northern Baltic Proper. Herring return to the Gulf of Finland in early- and midwinter. Hydroacoustic survey results indicate that about 50% of total estimated biomass is found outside the Gulf of Finland in late summer and early autumn. Tagging results also indicate migrations between the western and eastern parts of Gulf of Finland as well as to some extent to the Baltic Proper.

Conclusions

ICES defines the most appropriate assessment units reflecting the existing knowledge of the stock structure, the available data and management needs. As mentioned above Baltic herring 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 on biological grounds and the practical constraints such as in what units catch figures are available and possibilities for correctly allocating individual fish to particular stocks.

While it is important to maintain all spawning components, the migration and mixing of stocks summarised above, makes it very difficult to separately assess the individual populations. The distribution pattern and migrations of Baltic herring between Sub-divisions 29 and 32 show, that there is no arguments to assess stocks on a Sub-division basis in the northern Baltic Proper (Sub-division 29) and in the Gulf of Finland (Sub-divisions 32). Such a re-establishment of management units or assessment units do not cover present natural boundaries of the distribution area of populations.

3.13.3.f Medium-term strategies for herring and sprat

Response to a request from IBSFC to "advice on medium-term strategies for Herring and Sprat stocks".

Basis for medium-term harvesting strategy for Baltic herring

The basic objective when managing the Baltic herring must be to keep as many as possible of the spawning populations (stock components) within safe biological limits. As long as this goal is fulfilled other, complementary objectives of economical/political nature could be defined and established.

At present Baltic herring is assessed as four (five) units *viz.* Sub-divisions 22–24 together with spring-spawners in Divisions IIIa, Sub-divisions 25–29 and 32, Sub-divisions 30 (Bothnian Sea) and Sub-divisions 31 (Bothnian Bay). The herring in Gulf of Riga is included in the assessment for Sub-divisions 25–29, 32, but one component of the herring spawning in the Gulf of Riga is also assessed separately in order to give a better basis for quota allocation in that area.

These assessment units are to be regarded as a compromise between using the larger number of populations that have been identified on biological grounds and constraints such as in what units catch data are available and the possibilities for correctly allocating individual fish to particular stocks.

ICES has in Section 3.13.3 given advice and proposed reference points for these stock units consistent with the precautionary approach.

Both the present knowledge of biological features and the amount of relevant information on which to base an assessment, differs between stock units.

The advice for the stock units can be summarized as:

Stock unit (Sub-div)	Reference points		Average medium term catches ('000 t)	Basis
	B_{pa} ('000 t)	F_{pa}		
22–24	n.a.	n.a.	70	recent catches
25–29,32	1000	0.17	140	Medium-term prediction at F_{pa}
30	n.a.	n.a.	50	recent catches - excl.97
31	n.a.	n.a.	10	historical maximum
Sum			270	

In the medium-term considerations, some of the uncertainty in the actual stock size and in the relation between stock size and subsequent recruitment has been taken into account. It has further been assumed that the present low mean weight at age will prevail and that the predation on herring by cod will remain at the present relatively low level. A fishing mortality at the present value of 0.28 will in the medium-term reduce SSB to below B_{lim} (Figure 3.13.3.f.1 and Table 3.13.3.f.1). Catches will decline to about 150 000 t in the medium term (Table 3.13.3.f.1).

It is important, in order to keep the stock units within safe biological limits, that the distribution of the yearly catches between stocks is in accordance with the values given above.

The instrument so far used by IBSFC in managing Baltic herring (i.e., TACs for **two** separate management units) will not necessarily result in the recommended catch distribution between stocks.

Sprat

The management of the Baltic Sea sprat by IBSFC is based on one management unit for the whole Baltic. In recent years the total TAC has been 500 000–550 000 t. The medium-term simulations and multispecies analysis have been used as a basis for the discussions presented below.

The fishing mortality this stock can sustain is highly dependent on the abundance of cod. At present the sprat SSB is high due to strong recruitment and low predation by cod, but the SSB is predicted to decrease markedly in the medium term under the present fishing intensity. If the cod stock recovers, a higher natural mortality is implied and this will change the present reference points, which then should be re-evaluated.

The present low predation rate by cod has been assumed in the medium-term considerations.

ICES has proposed the following reference points for sprat in the Baltic:

B_{lim}	B_{pa}	F_{pa}
200 000 t	275 000 t	0.42

Medium-term predictions indicate an equilibrium SSB of about 450 000 t if *status quo* fishing mortality is applied (Figure 3.13.3.f.2 and Table 3.13.3.f.2). The uncertainties included in the calculations lead to a probability of about 20% that the SSB will fall below B_{pa} in the medium-term (Figure 3.13.3.f.3). ICES advises that - in the medium-term - fishing mortality should not be increased above the present level. That would imply average catches around 250 000 t (Figure 3.13.3.f.4).

Table 3.13.3.f.1 Medium-term projections for Baltic herring in SD 25–29, 32.

Stocastic forecast,Beverton&Holt recruitment
F-bar(3-6) 0.28 1 times F s.q.

SSB at Spawn.time

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
5%	634	619	596	569	535	522	497	496	507	494
10%	658	635	625	586	564	551	541	529	524	516
25%	682	677	661	637	622	606	597	595	584	573
50%	726	726	712	689	668	662	656	645	641	641
75%	772	771	751	749	741	732	736	719	707	694
90%	815	822	811	806	804	782	778	765	765	766
95%	850	860	850	831	836	826	800	820	815	809

Yield

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
5%	190	165	160	155	146	140	135	133	136	134
10%	190	170	165	159	151	147	146	144	142	140
25%	190	181	177	172	165	164	161	159	156	151
50%	190	193	189	185	179	176	173	172	170	171
75%	190	203	201	200	197	196	196	192	189	187
90%	190	220	217	214	212	208	206	206	206	206
95%	190	225	225	224	220	218	210	215	214	216

Stocastic forecast,Beverton&Holt recruitment
F-bar(3-6) 0.21 1 times F s.q.

SSB at Spawn.time

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
5%	656	640	661	664	662	653	647	657	644	642
10%	670	663	681	682	682	676	669	683	661	693
25%	709	697	725	733	729	728	742	743	744	749
50%	752	754	772	793	801	803	803	817	827	831
75%	809	821	844	862	865	887	883	896	918	935
90%	851	884	908	937	943	955	961	980	1003	1023
95%	877	904	946	964	989	984	997	1031	1070	1099

Yield

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
5%	190	129	133	135	135	133	132	131	130	131
10%	190	135	137	139	137	137	136	135	136	140
25%	190	141	147	149	148	149	149	151	151	151
50%	190	152	155	160	161	161	163	164	166	167
75%	190	165	170	173	174	177	178	180	183	186
90%	190	174	181	188	188	190	194	196	203	205
95%	190	183	186	193	196	199	202	203	212	216

Stocastic forecast,Beverton&Holt recruitment
F-bar(3-6) 0.17 1 times F s.q.

SSB at Spawn.time

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
5%	657	641	657	692	688	712	731	755	777	797
10%	673	657	686	711	734	757	780	798	815	822
25%	707	703	747	779	803	840	856	868	890	907
50%	752	752	807	838	872	916	934	948	972	978
75%	809	820	884	925	959	1004	1011	1039	1066	1070
90%	845	868	939	987	1018	1045	1097	1148	1162	1188
95%	868	906	973	1031	1050	1088	1168	1211	1251	1291

Table 3.13.3.f.1 Continued

Yield

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
5%	190	103	106	114	115	118	121	124	126	127
10%	190	106	112	117	119	123	126	130	133	134
25%	190	114	121	127	131	136	139	141	143	147
50%	190	122	130	138	141	147	152	153	157	159
75%	190	132	142	149	156	161	163	169	170	171
90%	190	139	149	159	165	170	175	182	189	190
95%	190	145	156	164	170	177	185	194	203	207

Stocastic forecast,Beverton&Holt recruitment
F-bar(3-6) 0.14

SSB at Spawn.time

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
5%	663	631	678	710	738	784	820	828	858	876
10%	677	652	704	747	797	827	865	874	906	907
25%	722	706	776	826	850	892	919	959	988	1009
50%	766	769	841	880	922	978	1012	1061	1106	1123
75%	812	819	898	955	1011	1058	1117	1155	1205	1221
90%	861	876	952	1039	1103	1176	1223	1262	1266	1316
95%	896	916	987	1066	1142	1231	1290	1311	1307	1365

Yield

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
5%	190	85	91	98	101	107	110	113	116	119
10%	190	88	95	103	107	111	117	121	123	122
25%	190	95	105	112	116	121	125	129	133	137
50%	190	104	113	120	126	133	138	143	148	152
75%	190	110	121	130	136	143	150	156	162	164
90%	190	118	128	140	150	159	166	171	171	176
95%	190	123	133	145	155	165	172	176	177	185

Table 3.13.3.f.2 Medium-term projections for Baltic sprat in SDs 22–32.

Reference F=averageF(3-5) =0.42

SSB											
F-factor=0.6											
Fractiles		**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
	10%	795	714	618	504	440	388	362	354	343	349
	25%	836	778	700	587	542	503	472	476	442	456
	50%	896	853	820	723	696	635	635	616	616	626
	75%	966	963	980	932	933	865	828	854	834	856
	90%	1028	1090	1212	1226	1257	1224	1206	1141	1161	1125
F-factor=0.8											
Fractiles		**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
	10%	735	644	532	429	376	338	317	327	320	323
	25%	794	694	601	515	468	420	415	415	410	404
	50%	858	784	723	621	612	576	550	589	563	534
	75%	920	909	882	786	813	792	724	761	781	734
	90%	994	1029	1095	969	1116	1032	964	1066	964	959
F-factor=1.0											
Fractiles		**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
	10%	723	580	445	345	318	294	248	251	249	256
	25%	785	643	516	424	398	348	348	341	334	338
	50%	832	712	638	535	491	482	455	468	476	454
	75%	911	812	766	687	662	656	612	639	634	600
	90%	979	991	976	902	874	857	790	873	835	809
F-factor=1.2											
Fractiles		**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
	10%		544	379	296	253	209	204	201	203	211
	25%	763	597	449	347	310	285	275	270	271	270
	50%	833	673	567	443	415	391	375	375	370	373
	75%	895	778	706	592	573	542	528	528	526	524
	90%	955	881	891	821	796	749	729	730	719	722
F-factor=1.4											
Fractiles		**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
	10%	702	494	351	252	197	179	170	158	160	163
	25%	740	536	402	302	255	241	230	221	217	217
	50%	793	600	487	389	358	322	313	314	308	308
	75%	854	695	603	542	511	457	437	441	447	434
	90%	911	807	757	720	736	686	672	631	632	616
Catches											
F-factor=0.6											
Fractiles		**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
	10%	198	178	151	123	109	98	92	89	86	91
	25%	208	194	170	147	133	124	119	117	116	117
	50%	226	217	198	181	169	160	159	156	156	154
	75%	244	246	239	230	230	217	210	220	205	212
	90%	260	280	289	300	306	292	294	283	283	270
F-factor=0.8											
Fractiles		**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
	10%	249	214	175	145	129	117	112	115	114	110
	25%	266	238	198	175	156	145	142	146	143	139
	50%	287	268	238	210	205	194	195	198	189	183
	75%	312	312	285	264	274	266	253	257	260	247
	90%	340	348	355	327	362	339	325	341	326	338
F-factor=1.0											
Fractiles		**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
	10%	304	243	184	150	136	127	114	113	112	114
	25%	324	269	217	182	166	156	152	149	146	144
	50%	349	304	260	226	213	206	203	205	204	203
	75%	383	349	319	282	278	278	264	271	269	258
	90%	411	420	387	372	365	352	352	350	360	346
F-factor=1.2											
Fractiles		**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
	10%	359	275	192	152	132	114	106	111	113	114
	25%	387	299	224	185	157	155	146	148	144	147
	50%	415	343	276	227	218	206	198	197	201	200
	75%	448	401	350	310	292	291	274	272	280	270
	90%	478	466	434	408	398	384	372	362	363	354

Table 3.13.3.f.2 Continued

F-factor=1.4

Fractiles	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
10%	407	290	207	148	128	117	106	104	103	107
25%	429	320	232	188	166	153	143	142	140	146
50%	464	364	286	242	218	204	202	199	195	191
75%	503	413	365	331	317	282	271	283	274	272
90%	534	491	449	439	435	409	400	398	369	360

Average catch in years:

	1999-2001	**1999-2003**	**1999-2007**	**2003-2007**
F=0.6	199	185	172	157
F=0.8	239	223	209	192
F=1	263	242	225	204
F=1.2	282	254	230	200
F=1.4	297	263	233	198

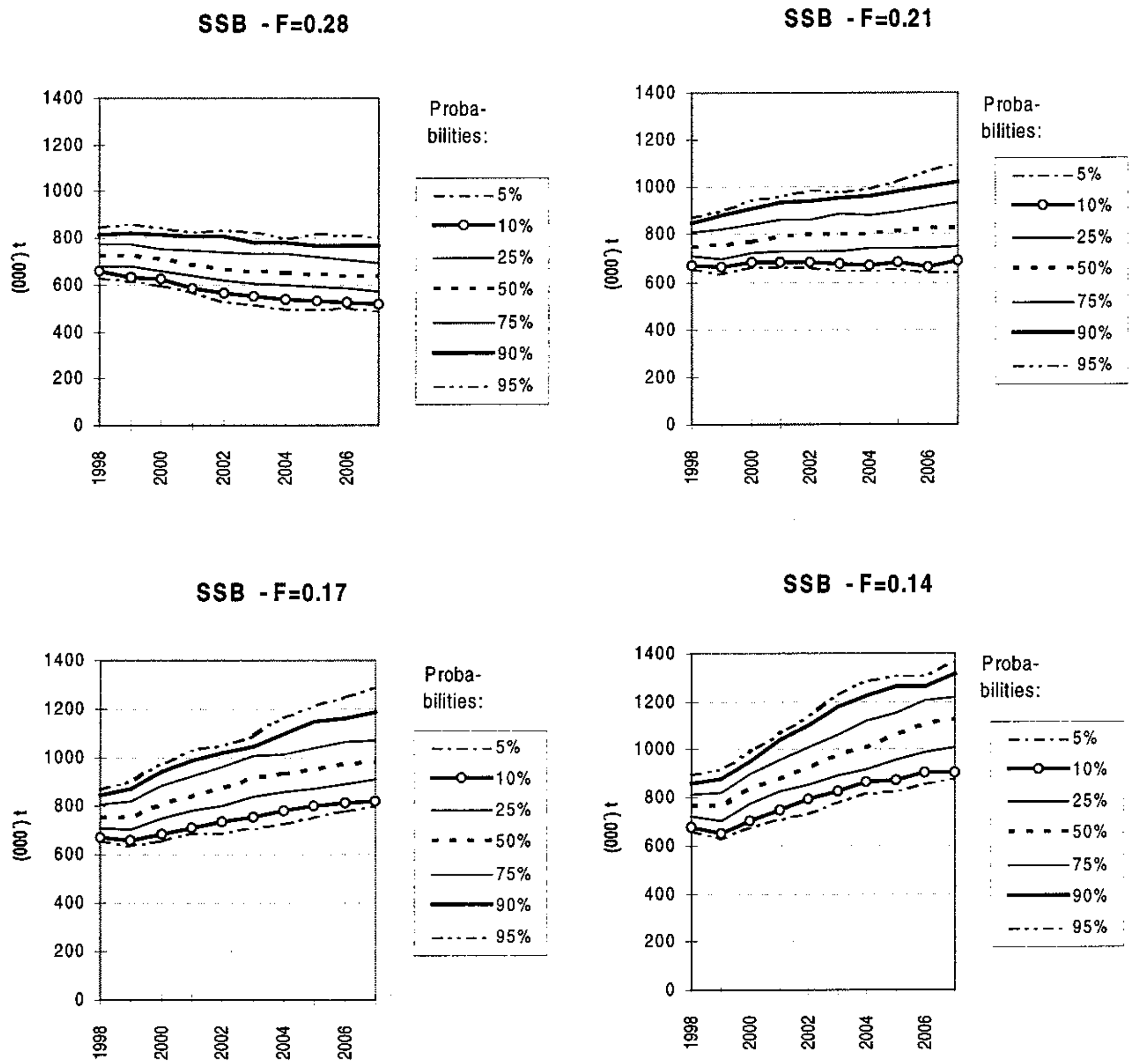


Figure 3.13.3.f.1 Herring 25–29, 32. Medium-term projections of SSB according to various fishing mortalities.

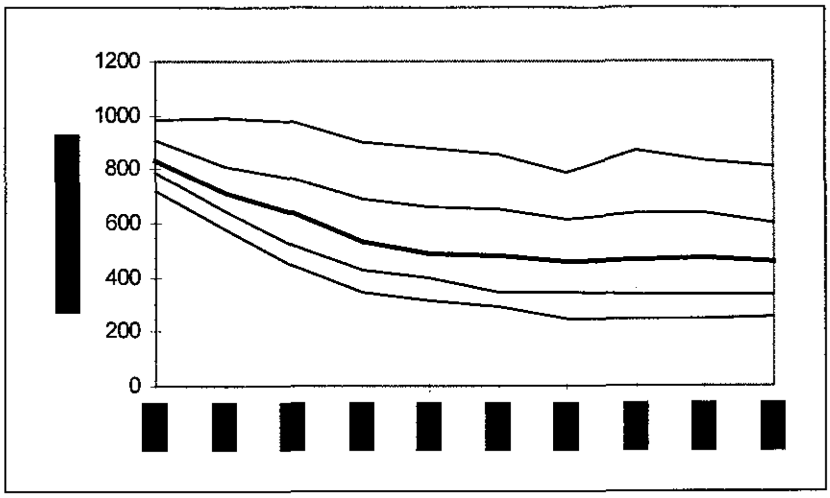


Figure 3.13.3.f.2 Sprat 22–32. Medium-term projections of SSB according to *status quo* fishing mortality (=0.42) (dashed line = 275 000 t).

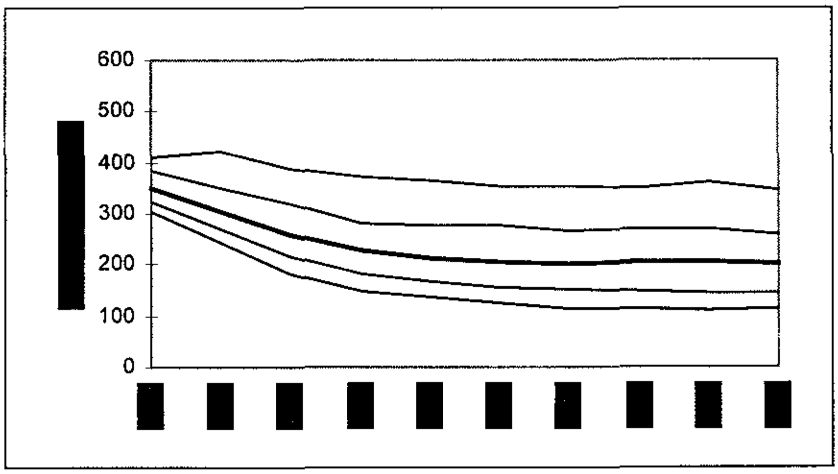


Figure 3.13.3.f.3 Sprat 22–32. Medium-term projections of catches according to *status quo* fishing mortality (=0.42).

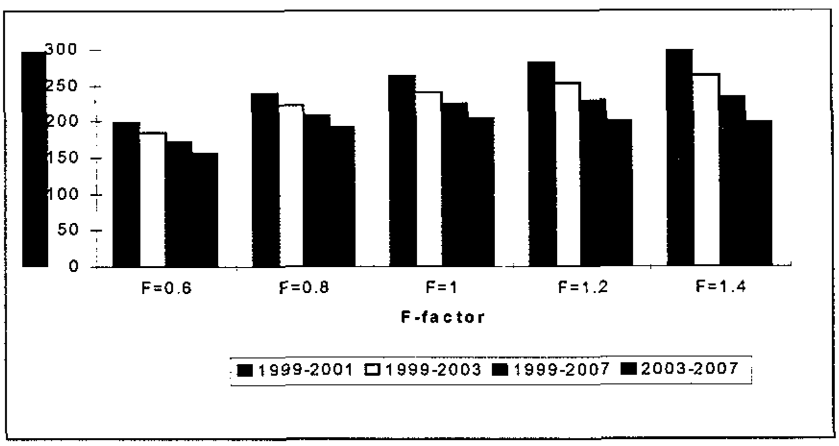


Figure 3.13.3.f.4 Annual catches of sprat in selected periods and selected fishing mortalities. F=1 refers to *status quo* fishing mortality (=0.42).

3.13.4 Sprat in Sub-divisions 22–32

State of stock/fishery: The stock is at present considered to be harvested within safe biological limits as defined by the proposed reference points. SSB has increased in recent years and in 1994 attained its highest historical level. Since then the SSB decreased slightly. Fishing mortality nearly doubled from 1994 to 1997 and is now approximately equal to $F_{0.1}$. The 1994 and 1995 year classes are both among the highest on record. The 1996 year class is, however, estimated to be very poor while the 1997 year class is predicted to be strong.

Landings increased from 1983 to 1997, reaching their record high value in 1997. 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 70%) and herring. 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.

Currently the estimated fishing mortality (0.42) as well as SSB (1.1 millions) are at or above F_{pa} and B_{pa}.

Management objectives: No specific objectives have been articulated for this stock by fishery management agencies.

Advice on management: ICES recommends that fishing mortality should not be allowed to increase above the proposed F_{pa} of 0.42. If the 1997 catch of 530 000 t is continued in 1998 and 1999, SSB will decline to 280 000 t in 2000, i.e. to B_{pa}.

Proposed reference points: Stock recruitment analyses presented previously indicated a B_{lim} of 200 000 t. In order to take into account uncertainty of the stock falling below B_{lim}, B_{pa} = 275 000 t is proposed. F_{med} = 0.42 is proposed as F_{pa}.

Relevant factors to be considered in management: The fishing mortality this stock can sustain is dependent on natural mortality, which is linked to the abundance of cod. At present the sprat SSB is high due to strong recruitment and low predation in recent years but the SSB is predicted to decrease markedly in the medium term under present fishing intensity. If the cod stock recovers a much lower exploitation level on sprat is implied.

Catch forecast for 1999: Basis: F(98) = F(97), Landings(98) = 345, SSB(98) = 827.

F (99)	Basis	Lndgs (99)	SSB (99)	SSB (2000)	Medium term effect of fishing at given level
0.25	0.6F(97)	194	767	768	high probability of SSB being above B_{pa}
0.34	0.8F(97)	251	745	703	high probability of SSB being above B_{pa}
0.42	1.0F(97)	304	723	644	15% probability of SSB being below B_{pa}
0.50	1.2F(97)	353	702	591	25% probability of SSB being below B_{pa}
0.59	1.4F(97)	400	682	542	35% probability of SSB being below B_{pa}

Weights in '000 t.

Shaded scenarios are considered to be inconsistent with the precautionary approach.

Forecast assuming catches in 1998 equal to catches in 1997:

Basis: Catch (98) = Catch(97), F(98) = 0.72, Landings (98) = 530, SSB(98) = 740

F (99)	Basis	Lndgs (99)	SSB (99)	SSB (2000)
1.1	F(98)	530	460	280

Weights in '000 t.

In the above predictions the spawning stock will decrease and for *status quo* F of 0.42 will fall below or be close to the long-term average.

Medium-term considerations: The medians of spawning stock biomass under *status quo* fishing mortality tend to result in an equilibrium of about 430 000 t SSB (Figure 3.13.4.1). The SSB of 430 000 t is higher than the preliminary estimate of a B_{pa} of 275 000 t. However, there is about 20% probability of SSB falling below B_{pa} in the medium-term.

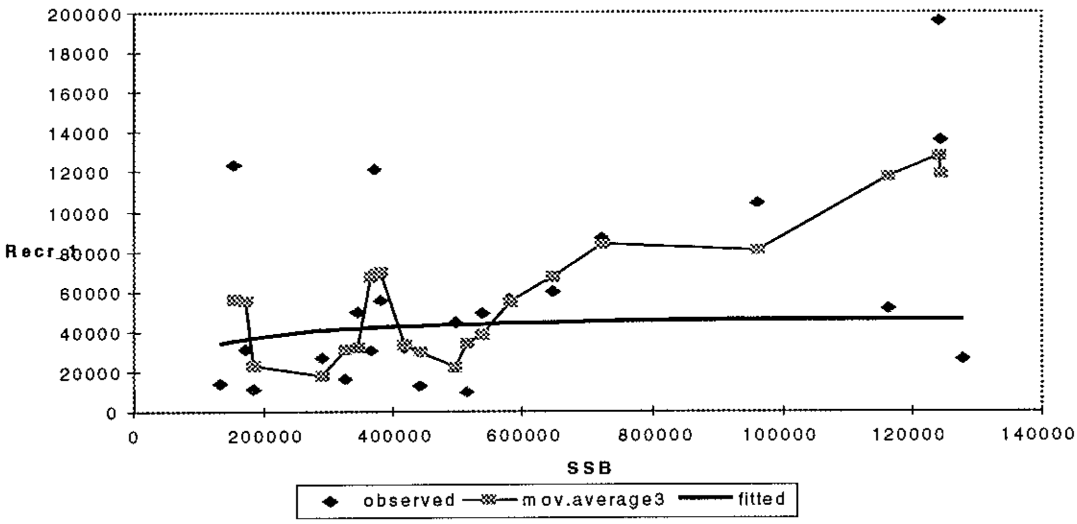
Elaboration and special comment: The assessment is based on catch data and acoustic surveys. Sampling has improved the quality of the data input to the assessment.

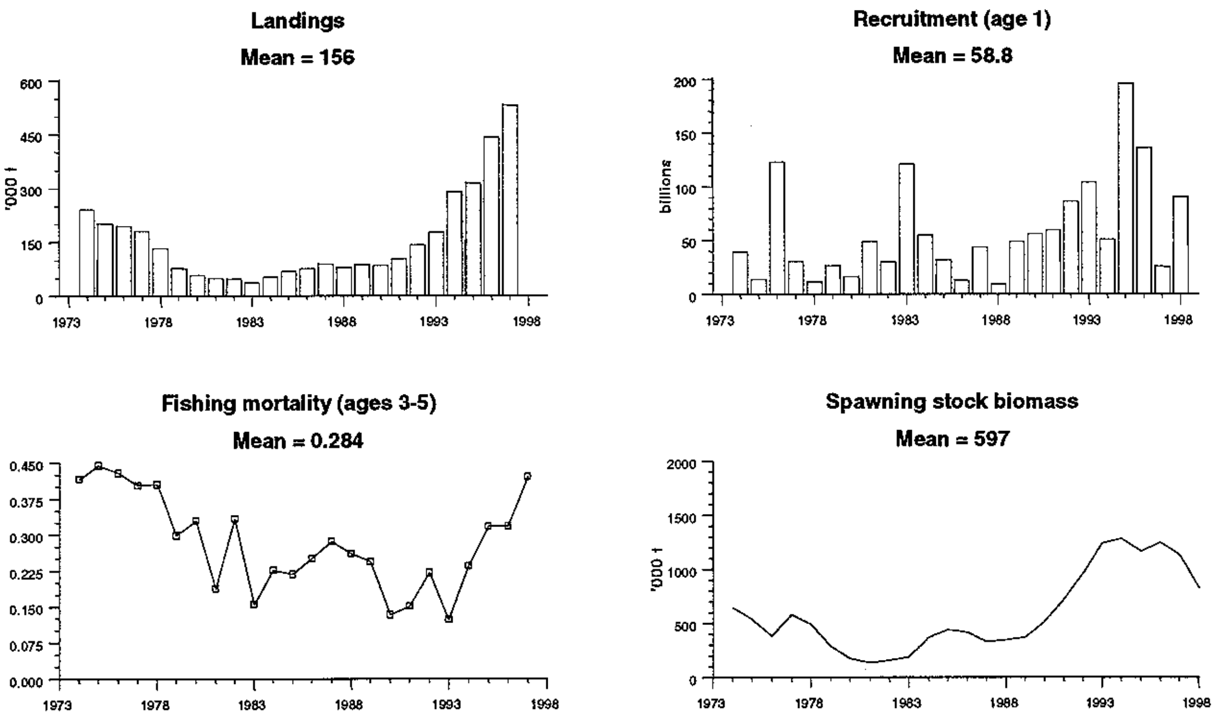
Source of information: Report of the Working Group on Baltic Fisheries Assessment, April 1998. (ICES CM 1998/ACFM:16).

Catch data (Tables 3.13.4.1-3):

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	
1999	F_{pa} (=0.42)	304		

Weights in '000 t.





Sprat in the Baltic Sea (Fishing Areas 22 to 32)

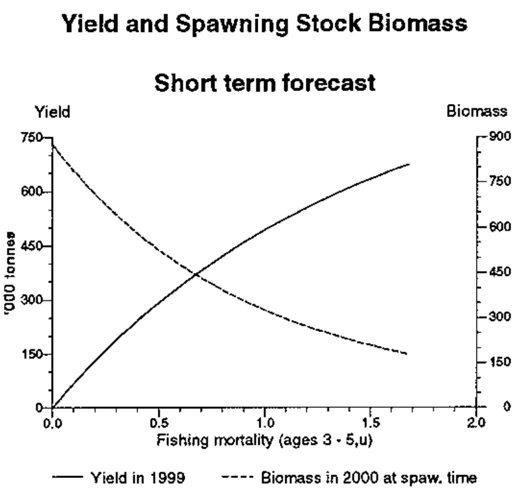


Table 3.13.4.1 Sprat catches in Sub-divisions 22-32 (thousand tonnes).

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	288.7
1995	64.1	13.1	5.2	0.2	24.4	2.9	44.2	14.8	143.7	313.0
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

* Sum of catches by Estonia, Latvia, Lithuania and Russia.

Table 3.13.4.2 Sprat catches in the Baltic Sea by country and Sub-division ('000 t).

Year 1996

Country	Total catch	22	23	24	25	26	27	28	29	30	31	32
Denmark	109.1	7.7	-	0.5	100.9	-	-	-	-	-	-	-
Estonia	21.2	-	-	-	-	-	-	1.1	5.4	-	-	14.7
Finland	17.4	-	-	-	-	-	-	0.0	8.3	1.7	-	7.4
Germany	0.2	0.1	-	0.0	-	-	-	-	-	-	-	-
Latvia	34.2	-	-	-	-	4.0	-	30.2	-	-	-	-
Lithuania	10.2	-	-	-	-	10.2	-	-	-	-	-	-
Poland	72.4	-	-	0.3	30.0	42.1	-	-	-	-	-	-
Russia	18.2	-	-	-	-	18.2	-	-	-	-	-	-
Sweden	158.2	-	-	0.9	22.6	62.4	33.7	37.5	1.1	-	-	-
Total	**441.1**	**7.9**	**0.0**	**1.7**	**153.5**	**136.9**	**33.7**	**68.8**	**14.9**	**1.7**	**0.0**	**22.1**

Year 1997

Country	Total catch	22	23	24	25	26	27	28	29	30	31	32
Denmark	137.4	8.1	-	0.8	128.6	-	-	-	-	-	-	-
Estonia	38.9	-	-	-	-	-	-	3.3	17.7	-	-	17.9
Finland	24.4	-	-	0.5	3.8	2.0	0.1	0.8	10.3	2.3	0.0	4.5
Germany	0.4	0.4	-	0.0	-	-	-	-	-	-	-	-
Latvia	49.3	-	-	-	-	3.6	-	45.7	-	-	-	-
Lithuania	4.8	-	-	-	-	4.8	-	-	-	-	-	-
Poland	99.9	-	-	1.1	33.2	65.5	-	-	-	-	-	-
Russia	22.4	-	-	-	-	22.4	-	-	-	-	-	-
Sweden	151.9	-	-	2.6	38.0	26.9	45.1	30.5	8.7	-	-	-
Total	**529.4**	**8.5**	**0.0**	**5.0**	**203.7**	**125.2**	**45.2**	**80.3**	**36.8**	**2.3**	**0.0**	**22.4**

Table 3.13.4.3 Sprat in the Baltic Sea (Fishing Areas 22 to 32).

Year	Recruitment Age 1	Spawning Stock Biomass	Landings	Fishing Mortality Age 3-5
1974	39,752.90	648.16	241.70	0.416
1975	14,000.50	537.49	201.43	0.444
1976	123,052.00	379.75	194.78	0.429
1977	30,946.90	581.53	180.80	0.403
1978	11,014.70	495.40	132.36	0.405
1979	26,692.30	289.13	77.10	0.299
1980	16,431.90	173.39	58.10	0.330
1981	49,278.60	133.32	49.30	0.188
1982	30,333.60	154.62	48.70	0.334
1983	121,308.00	184.11	37.32	0.155
1984	55,208.70	366.38	52.56	0.227
1985	31,769.00	442.06	69.50	0.218
1986	12,769.90	416.52	75.80	0.251
1987	43,962.00	326.97	88.28	0.286
1988	9,267.59	344.65	80.30	0.261
1989	49,034.20	372.15	85.82	0.244
1990	56,144.50	514.48	85.58	0.133
1991	59,727.50	721.95	103.20	0.151
1992	86,211.80	960.88	142.20	0.221
1993	104,109.00	1,241.29	178.10	0.123
1994	50,904.40	1,280.24	288.70	0.235
1995	195,912.00	1,162.74	313.00	0.317
1996	135,842.00	1,247.17	441.10	0.318
1997	25,634.60	1,134.41	529.40	0.420
1998	90,347.00	826.86	.	.
Average	58,786.22	597.43	156.46	0.284
Unit	Millions	1000 tonnes	1000 tonnes	-

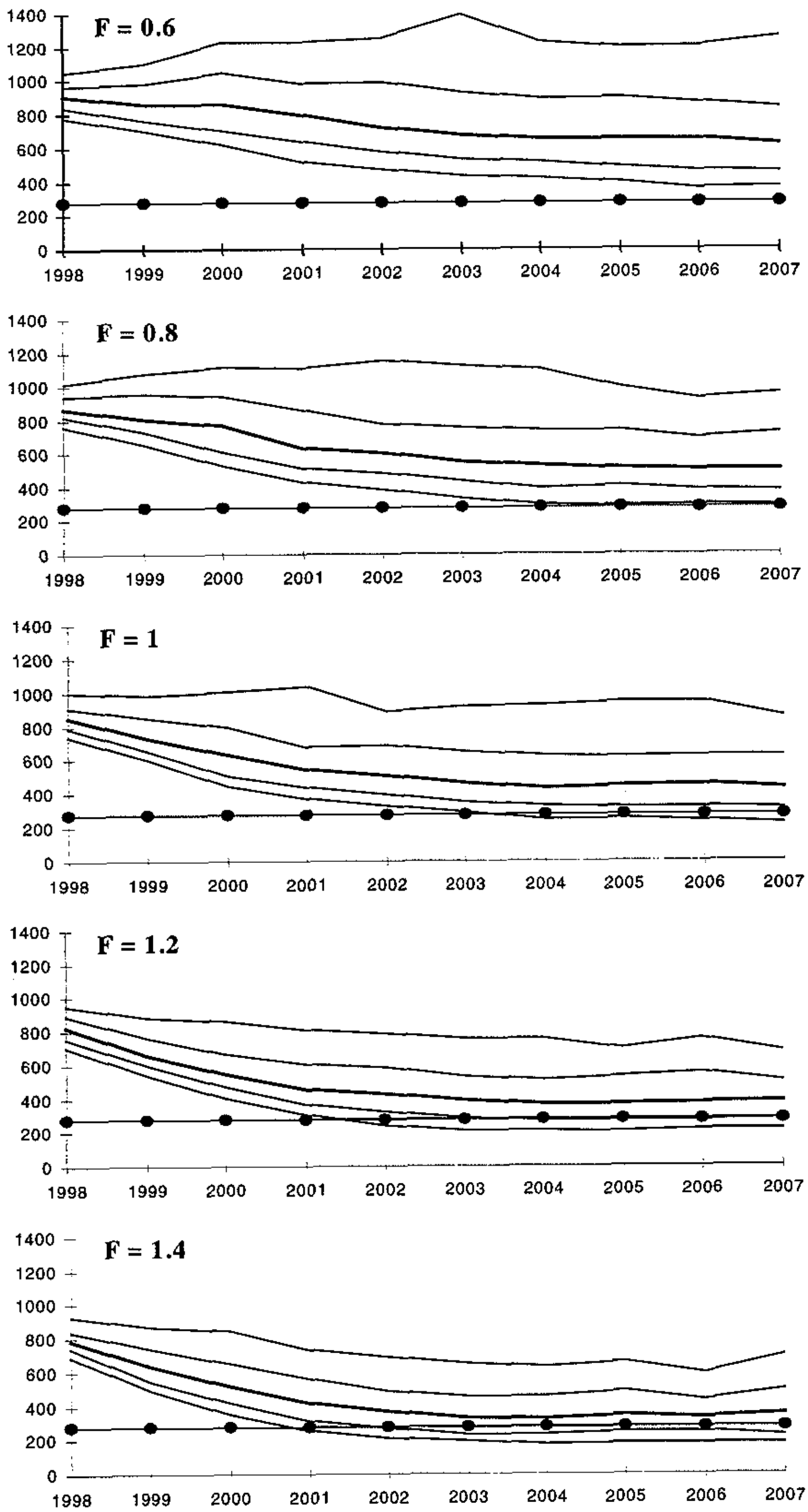


Figure 3.13.4.1 SPRAT in SD 22-32. Medium-term projections of SSB ('000 t).
F=1 refers to *status quo* fishing mortality (=0.42).
Fishing pattern: 1995-1997 mean.
Lines present 10, 25, 50, 75 and 90 percentile of biomass distribution.
Line with dots presents B_{pa}.

3.13.5 Cod

Catches of cod in the Baltic are given by country in Table 3.13.5.1 and by country and Sub-division in Table 3.13.5.2.

3.13.5.a Cod in Sub-divisions 22–24 (including Sub-division 23)

State of the stock/fishery: The stock is probably being harvested within safe biological limits as defined by the proposed reference points. The SSB is about 30 000 t and the fishing mortality is about 1.2 per year. However, the estimates of stock size and fishing mortality are uncertain. The stock is rebuilding from its historically low level in 1992 as a result of strong recent recruitment (especially from the 1994 year class), the spawning stock biomass increased above the long-term average level in 1996. Survey data suggest that the 1996 and 1997 year-classes appear to be strong, but have high uncertainty. Fishing pressure on the young ages has increased and the fishery is very much recruitment dependent.

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

Advice on management: ICES recommends that fishing mortality in 1999 should be no greater than at present. A catch of 38 000 t has a 50% probability of maintaining the fishing mortality at or below the 1997 *status quo* and would correspond to expected 1998 catches.

Proposed reference points: The previously established MBAL of 23 000 t is considered sufficient to afford a high probability that SSB will be kept above B_{lim} = 9 000 t, the lowest observed. Therefore, an SSB of 23 000 t is proposed as B_{pa}. The stock has historically been fished at a very high level, the average F for 1970 to 1997 is 1.15 and it has never been below 0.93 except in 1994 when it was artificially low because of misreporting. F_{med} is 1.19 per year and that implies an F_{pa} of approximately 0.7. There is doubt if the assessment reflects the actual mortality levels on the Western Baltic cod, but until further information is available this value is proposed as F_{pa}.

Relevant factors to be considered in management: The catch forecast is sensitive to the size of the 1996 and 1997 year classes which are imprecisely estimated. Projected catches for 1998 based on the catch rates of Swedish and Danish vessels are around 25 000 t.

Catch forecast for 1999: Basis: F(98) = F(97).

A stochastic forecast was made and the probability profiles are given below. From these it can be seen that a catch in 1999 of 38 000 t has a 50% probability of maintaining the fishing mortality at or below *status quo* F. There is also a 50% probability of the SSB in year 2000 to be at or above 28 000 t at *status quo* F.

Elaboration and special comment: From 1965 to 1984 the landings varied between 40–50 000 t. They thereafter decreased to below 20 000 t in the period 1989–1992, but has recently returned to the former levels.

In the period 1992–1994 landings are uncertain due to incomplete reporting, however, the data quality improved significantly since then. It is nevertheless clear that landings have increased further.

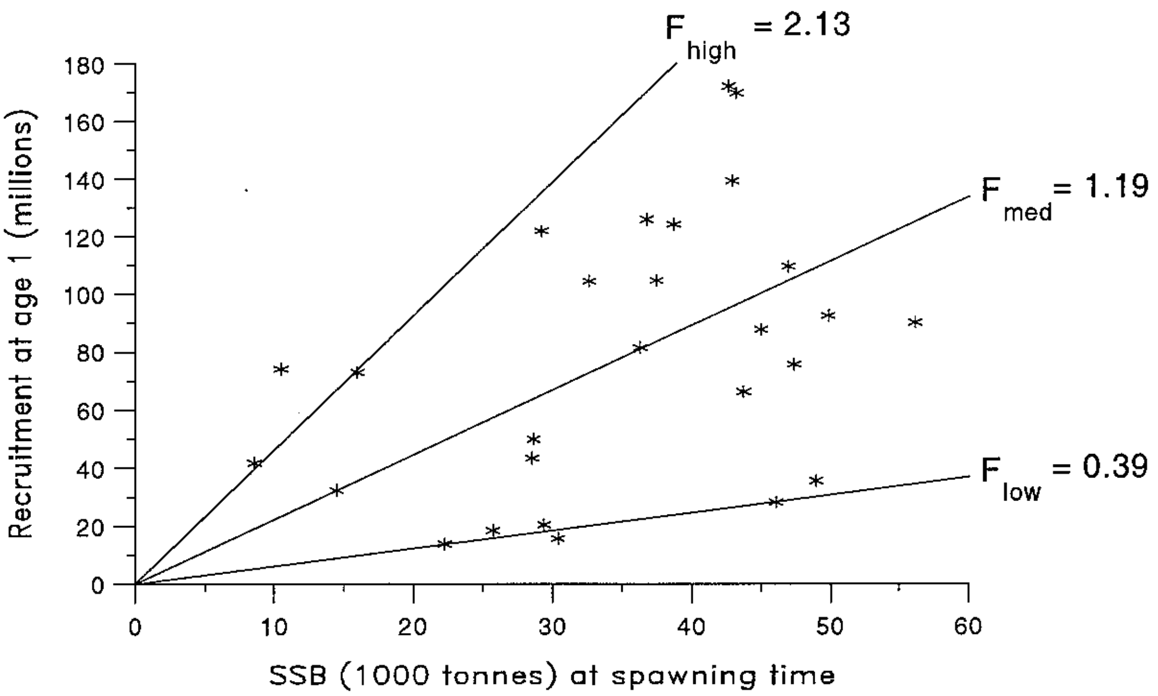
Source of information: Report of the Baltic Fisheries Assessment Working Group, April 1998 (ICES CM 1998/ACFM:16).

Catch data (Tables 3.13.5.a.1–2):

Year	ICES advice	Predicted catch corresp. to advice	Agreed TAC[1]	ACFM catch
1987	TAC	9		29
1988	TAC	16		29
1989	TAC	14		19
1990	TAC	8		18
1991	TAC	11		17
1992	Substantial reduction in F	-		18
1993	F at lowest possible level	-		21
1994	TAC	22		31
1995	30% reduction in fishing effort from 1994 level	-		34
1996	30% reduction in fishing effort from 1994 level	-		51
1997	Fishing effort should not be allowed to increase above level in recent years	-		43
1998	20% reduction in F from 1996	35		
1999	At or below F_{sq} with 50% probability	38		

[1] Included in TAC for total Baltic. Weights in '000 t.

Stock - Recruitment



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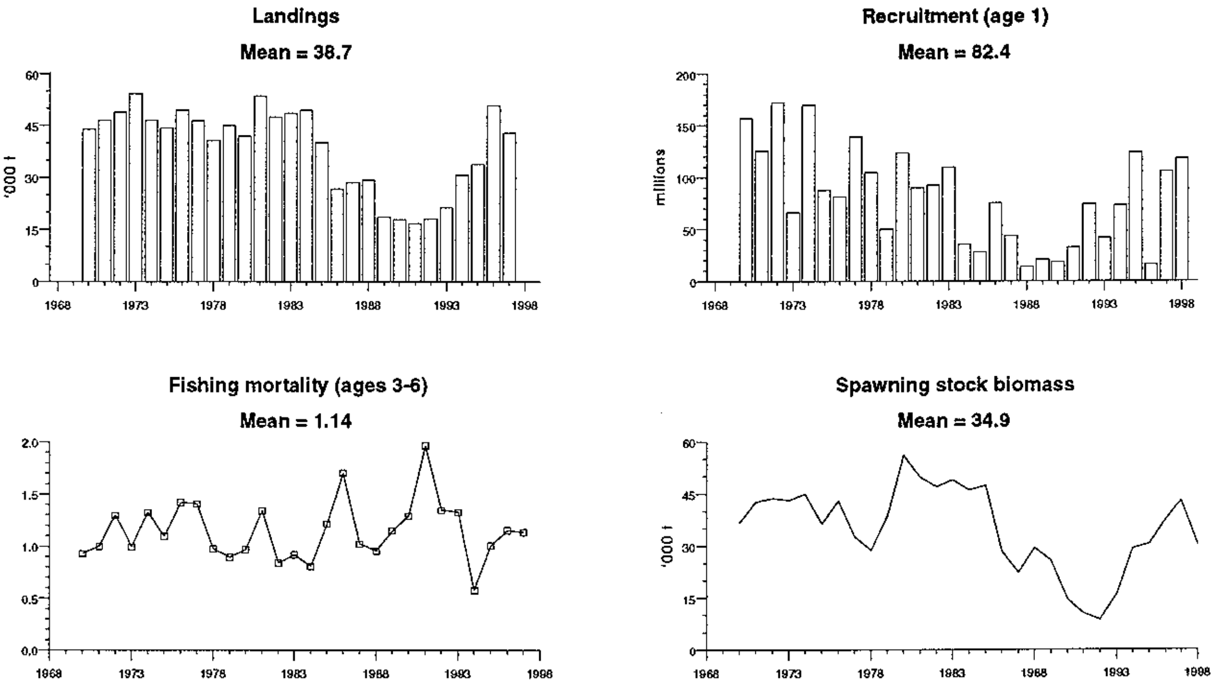


Cod in Sub-divisions 22–24 (including Sub-division 23)

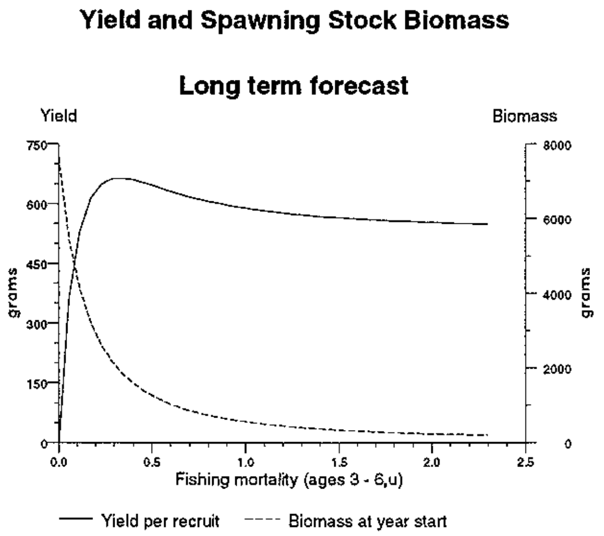
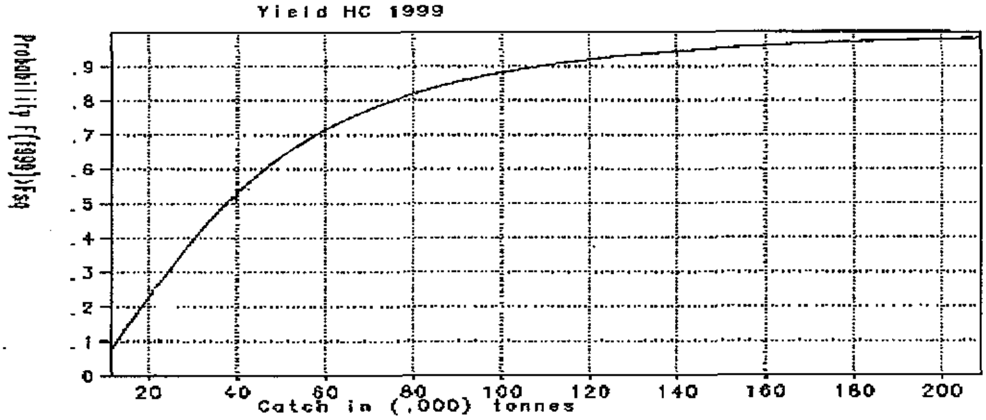


Figure COD,22-24. Probability profiles for short term forecast.



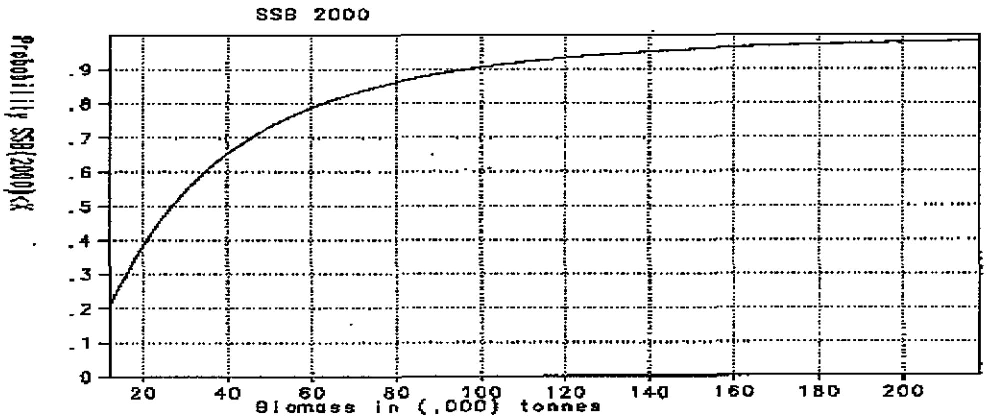


Table 3.13.5.1 Total landings (t) of COD in Sub-divisions 22–32 by country.

Year	Denmark	Estonia	Finland	German Dem.Rep.[2]	Germany, Fed. Rep.	Latvia	Lithuania	Poland	Russia	Sweden	USSR	Faroe Islands[4]	Norway	Unallocated[3]	Total
1965	35,313		23	10,680	15,713			41,498		21,705	22,420				147,352
1966	37,070		26	10,589	12,831			56,007		22,525	38,270				177,318
1967	39,105		27	21,027	12,941			56,003		23,363	42,980				195,446
1968	44,109		70	24,478	16,833			63,245		24,008	43,610				216,353
1969	44,061		58	25,979	17,432			60,749		22,301	41,580				212,160
1970	42,392		70	18,099	19,444			68,440		17,756	32,250				198,451
1971	46,831		53	10,977	16,248			54,151		15,670	20,910				164,840
1972	59,717		76	13,720	15,516			57,093		16,471	30,140				192,733
1973	66,050		95	14,408	28,706			49,790		18,389	20,083				197,521
1974	57,810		160	10,976	22,224			48,650		16,435	38,131				194,386
1975	62,524		298	14,742	24,880			69,318		17,965	49,289				239,016
1976	77,570		287	8,552	26,626			70,466		20,188	49,047				252,736
1977	73,505		310	10,967	30,806			47,702		18,127	29,680				211,097
1978	50,611		1,437	9,345	15,122			64,113		16,793	37,200				194,621
1979	59,704		2,938	8,997	19,375			79,754		23,093	75,034	3,850			272,745
1980	75,529		5,962	7,406	18,407			123,486		33,201	124,350	1,250			389,591
1981	92,648		5,681	12,936	18,281			120,901		44,330	87,746	2,765			385,288
1982	91,927		8,126	11,368	21,860			92,541		46,548	86,906	4,300			363,576
1983	107,624		8,927	10,521	25,154			76,474		53,740	92,248	6,065			380,753
1984	113,701		9,358	9,886	42,031			93,429		65,927	100,761	6,354			441,447
1985	107,627		7,224	6,593	31,798			63,260		54,723	78,127	5,890			355,242
1986	98,464		5,633	3,179	22,422			43,236		49,572	52,148	4,596			279,250
1987	83,844		3,007	5,114	18,816			32,667		47,429	39,203	5,567			235,647
1988	74,742		2,904	4,634	18,295			33,351		54,968	28,137	6,915			223,946
1989	65,935		2,254	2,147	15,342			36,855		55,919	14,722	4,520			197,694
1990	56,700		1,731	1,629	7,745			32,028		54,474	13,461	3,558			171,326
1991	50,606	1,810	1,711		9,443	2,627	1,865	25,748	3,299	39,490		2,611			139,210
1992	30,420	1,368	485		6,449	1,250	1,266	13,314	1,793	15,940		593			72,878
1993	17,667	70	225		5,126	1,333	605	8,909	892	12,048		558		18,978	66,411
1994	24,805	952	594		7,079	2,831	1,887	14,335	1,257	25,530		779		44,000	124,049
1995	38,204	1,049	1,861		14,692	6,653	4,513	25,000	1,612	27,966		777	293	18,993	141,613
1996	48,494	1,388	3,139		19,358	8,741	5,524	34,855	3,306	36,119		706	289	10,815	172,734
1997[1]	40,549	1,420	1,687		14,484	6,187	4,601	31,659	2,803	28,374		600			132,364

[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 3.13.5.2 Total landings (t) of COD in Sub-divisions 22-32 by sub-division and country.

Year	Denmark				Faroe Island[6]	Finland						Federal Republic of Germany					
	22	23	24	25-28	25-28	24	25-28	29	30[2]	31	32	22	24	25	26	27	28
1972	17,717		7,928	34,072					76			10,531	1,782	3,193	10		
1973	21,400		9,195	35,455					95			12,833	900	9,100	5,200		673
1974	18,300		7,482	32,028					160			9,998	395	5,242	5,769		820
1975	15,981		7,500	39,043				270	8		20	12,415	497	8,809	1,975		1,184
1976	19,764	712	9,682	47,412				81	24		182	12,312	581	7,526	4,490		1,717
1977	17,726	1,166	10,213	44,400				85	26		199	10,807	879	3,649	13,803		1,668
1978	12,641	1,177	6,527	30,266				249	323	6	859	9,972	880	2,178	1,793		299
1979	16,093	2,029	7,232	34,350	3,850			707	518	16	1,697	8,910	688	7,616	2,149		12
1980	16,033	2,425	7,367	49,704	1,250			2,163	880	45	2,874	5,968	689	10,985	673		92
1981	15,502	1,473	7,152	68,521	2,765			3,036	684	11	1,950	9,095	2,165	7,021			
1982	11,669	1,638	7,469	71,151	4,300			4,557	1,368	42	2,159	7,394	666	13,069	662		69
1983	14,100	1,257	7,861	84,406	6,065			5,322	2,013	36	1,556	8,937	323	14,179	1,599		116
1984	13,867	1,703	8,042	90,089	6,354			5,433	2,741	7	1,177	11,340	208	21,948	7,926		609
1985	15,563	1,076	7,461	83,527	5,890			4,646	1,706	7	865	4,992	531	12,733	11,572		1,970
1986	8,914	748	7,281	81,521	4,596			3,571	1,306	2	754	2,236	666	10,545	8,399		576
1987	7,990	1,503	5,470	68,881	5,567			1,389	1,143	2	473	3,611	645	7,757	5,009		1,794
1988	5,680	1,121	7,505	60,436	6,915		614	998	1,257	1	34	3,670	547	11,321	2,577		180
1989	3,422	636	4,637	57,240	4,520		392	603	1,097	1	161	2,099	399	12,201	640		3
1990	3,235	722	5,349	47,394	3,558		833	187	685		26	1,997	1,057	3,232	1,427		32
1991	5,536	1,431	3,847	39,792	2,611		1,061	228	404		18	1,648	1,231	5,419	1,114	8	23
1992	7,567	2,449	2,379	18,025	593		253	48	174		10	2,320	1,336	2,187	586		20
1993	4,901	1,001	3,765	8,000	558		61	11	142	2	9	2,395	1,689	902	140		
1994	6,078	1,073	7,753	9,901	779		232	240	108		14	2,151	1,872	2,858	134		64
1995	11,851	2,547	6,911	16,895	777	132	1,704	3	18		4	5,085	4,111	4,960	225		311
1996	15,380	2,999	12,566	17,549	706	50	3,081		4		4	6,037	5,981	6,520	582		238
1997[1]	15,196	1,886	13,691	9,776	600	10	1,652	2	15	1	7	6,770	2,499	4,632	393		190

continued

Table 3.13.5.2 continued

Year	German Dmocratic Republic[5]							Poland			Poland								
	22	24	25	26	27	28	29	24	25[4]	26	23	24	25	26	27[3]	28	29	30	31
1972	4,560	5,105	1,950	2,072		33			24,926	32,167		1,277	13,842		876	440		36	
1973	4,004	4,370	4,065	1,912		57			29,010	20,780		1,655	15,224		971	485		54	
1974	3,028	5,431	1,469	996		52			25,221	23,429		1,937	11,950		1,682	825		41	
1975	3,471	2,571	3,320	5,250	50	60	20		35,373	33,945		1,932	12,511		2,052	1,367	103		
1976	1,292	3,290	800	3,150	10	10			26,082	44,384		1,800	14,109		1,979	2,180	115	5	
1977	977	2,471	324	5,996	73	1,119	7		18,172	29,530	550	1,516	11,775		2,584	1,560	120	22	
1978	1,619	5,466	414	1,714	1	131			31,161	32,952	600	1,730	9,017	26	3,207	1,740	417	55	1
1979	1,024	6,570	54	1,301	1	46	1		40,146	39,608	700	1,800	13,628	50	3,458	2,665	641	145	6
1980	880	4,700	5	1,818		3			50,832	72,654	1,300	2,610	18,694	88	6,014	3,185	790	516	4
1981	1,743	9,916	2	1,275					50,698	70,203	900	5,700	24,600	260	7,200	4,450	712	500	8
1982	1,908	8,707		728		25			41,830	50,711	140	7,933	20,429	2,279	4,109	9,264	687	1,669	38
1983	1,441	7,656		1,402		22			35,153	41,321	120	6,910	27,630	1,810	6,490	9,200	1,260	320	
1984	1,851	6,242		1,793					35,261	58,168	228	6,014	33,493	4,413	8,223	11,947	1,338	271	
1985	1,508	3,870		1,215					19,332	43,928	263	4,895	22,737	8,170	7,068	9,523	1,115	929	23
1986	825	2,173	1	180					18,297	24,939	227	3,622	19,214	7,764	7,554	9,606	1,233	298	54
1987	504	4,392	1	217					12,254	20,413	137	4,314	15,173	7,833	5,708	7,507	903	5,817	37
1988	330	4,302	1	1					14,910	18,441	155	5,849	20,893	7,453	6,674	7,946	535	5,456	7
1989	217	1,927	3						20,819	16,036	192	4,987	28,068	6,742	7,703	6,829	440	927	31
1990	129	1,500							14,528	17,500	120	3,671	23,311	13,512	6,702	6,525	252	353	28
1991									9,853	15,895	232	2,768	18,413	7,034	5,096	5,548	180	207	12
1992									5,449	7,865	290	1,655	7,169	2,133	2,145	2,153	93	301	1
1993									5,039	3,870	274	1,675	5,872	2,161	940	972	40	114	
1994									9,659	4,676	555	3,711	16,675	846	2,845	842	17	39	
1995									18,761	6,239	611	2,632	18,699	2,765	2,180	992	56	29	2
1996									22,806	12,049	1,032	4,418	22,645	2,871	3,622	1,512	17	2	
1997[1]								263	18,884	12,512	777	2,525	19,838	2,035	2,417	770	12		

continued

Table 3.13.5.2 continued

Year	USSR						Estonia					
	25	26	27	28	29	32	24	25	26	28	29	32
1972		23,951		6,189								
1973		8,768	1	11,250	50	14						
1974	811	18,633		17,677	1,010							
1975	946	17,884	3	28,677	1,735	44						
1976	8,855	25,302	126	14,645	106	13						
1977	390	17,880	4	11,304	91	11						
1978	12	18,010	78	18,623	166	311						
1979	13	30,776		39,875	1,575	2,795						
1980	7	45,734		59,892	4,575	14,142						
1981	2	44,254		32,195	3,733	7,562						
1982	5	33,221		40,876	3,308	9,496						
1983		33,600		39,464	6,095	13,089						
1984		39,871		43,802	6,185	10,903						
1985		32,096		27,137	8,822	10,072						
1986		22,818		21,840	3,289	4,201						
1987		22,652		11,457	1,654	3,440						
1988		15,928		10,868	172	1,169						
1989		8,440		6,058	121	103						
1990		10,020		3,420	3	18						
1991									1,537	273		
1992									1,011	352	5	
1993									61	8		1
1994								147	579	208	17	1
1995								338	246	465		
1996							50	1,020	113	205		
1997							6	1,189	138	87		

Year	Latvia						Lithuania			Russia			Norway	Unallo-cated	Total
	24	25	26	27	28	29	25	26	28	26	28	32	26		
1972															192,733
1973															197,521
1974															194,386
1975															239,016
1976															252,736
1977															211,097
1978															194,621
1979															272,745
1980															389,591
1981															385,288
1982															363,576
1983															380,753
1984															441,447
1985															355,242
1986															279,250
1987															235,647
1988															223,946
1989															197,694
1990															171,326
1991			1,190		1,432	5		1,854	11	3,034	264	11			139,210
1992			383		867			1,266		1,793					72,878
1993			761		572			605		892				18,978	66,411
1994		630	1,619		582			1,887		1,257				44,000	124,049
1995	15	1,124	3,649	1	1,864			4,513		1,612			293	18,993	141,613
1996	32	1,217	6,268		1,224			5,524		3,306			289	10,815	172,734
1997		1,354	4,052		781		1,871	2,730		2,803					132,364

[1]Provisional. [2]Finland: 1972-1974 sub-divisions combined. [3]Sweden: 1972-1974 sub-divisions combined.
[4]Poland: Some catches from Sub-divisions 24 included. [5]Includes landinds from Oct.-Dec. 1990 of Fed. Rep. of Germany.
[6]Faroe Island: For 1997 landings not officially reported, landings estimated by WG

Table 3.13.5.a.1 Total landings (t) of COD in Sub-divisions 22, 23, 24.

Year	Denmark		Finland	German dem. Rep.	Germany, Fed. Rep.	Estonia	Latvia	Sweden		Total					22–24 Unallocated
	23	22+24	24	22+24	22+24	24	24	23	24	22	23	24	Unalloc.	22+24	
1965		19,457		9,705	13,350				2,182	27,867		7,007		34,874	34,874
1966		20,500		8,393	11,448				2,110	27,864		14,587		42,451	42,451
1967		19,181		10,007	12,884				1,996	28,875		15,193		44,068	44,068
1968		22,593		12,360	14,815				2,113	32,911		18,970		51,881	51,881
1969		20,602		7,519	12,717				1,413	29,082		13,169		42,251	42,251
1970		20,085		7,996	14,589				1,289	31,363		12,596		43,959	43,959
1971		23,715		8,007	13,482				1,419	32,119		14,504		46,623	46,623
1972		25,645		9,665	12,313				1,277	32,808		16,092		48,900	48,900
1973		30,595		8,374	13,733				1,655	38,237		16,120		54,357	54,357
1974		25,782		8,459	10,393				1,937	31,326		15,245		46,571	46,571
1975		23,481		6,042	12,912				1,932	31,867		12,500		44,367	44,367
1976	712	29,446		4,582	12,893				1,800	33,368	712	15,353		48,721	48,721
1977	1,166	27,939		3,448	11,686			550	1,516	29,510	1,716	15,079		44,589	44,589
1978	1,177	19,168		7,085	10,852			600	1,730	24,232	1,777	14,603		38,835	38,835
1979	2,029	23,325		7,594	9,598			700	1,800	26,027	2,729	16,290		42,317	42,317
1980	2,425	23,400		5,580	6,657			1,300	2,610	22,881	3,725	15,366		38,247	38,247
1981	1,473	22,654		11,659	11,260			900	5,700	26,340	2,373	24,933		51,273	51,273
1982	1,638	19,138		10,615	8,060			140	7,933	20,971	1,778	24,775		45,746	45,746
1983	1,257	21,961		9,097	9,260			120	6,910	24,478	1,377	22,750		47,228	47,228
1984	1,703	21,909		8,093	11,548			228	6,014	27,058	1,931	20,506		47,564	47,564
1985	1,076	23,024		5,378	5,523			263	4,895	22,063	1,339	16,757		38,820	38,820
1986	748	16,195		2,998	2,902			227	3,622	11,975	975	13,742		25,717	25,717
1987	1,503	13,460		4,896	4,256			137	4,314	12,105	1,640	14,821		26,926	26,926
1988	1,121	13,185		4,632	4,217			155	5,849	9,680	1,276	18,203		27,883	27,883
1989	636	8,059		2,144	2,498			192	4,987	5,738	828	11,950		17,688	17,688
1990	722	8,584		1,629	3,054			120	3,671	5,361	842	11,577		16,938	16,938
1991	1,431	9,383			2,879			232	2,768	7,184	1,663	7,846		15,030	15,030
1992	2,449	9,946			3,656			290	1,655	9,887	2,739	5,370		15,257	15,257
1993	1,001	8,666			4,084			274	1,675	7,296	1,275	7,129	5,528	14,425	19,953
1994	1,073	13,831			4,023			555	3,711	8,229	1,628	13,336	7,502	21,565	29,067
1995	2,547	18,762	132		9,196		15	611	2,632	16,936	3,158	13,801		30,737	30,737
1996	2,999	27,946	50		12,018	50	32	1,032	4,418	21,417	4,031	23,097	2,300	44,514	46,814
1997[1]	1,886	28,887	10		9,269	6		777	2,525	21,966	2,663	18,994		40,960	40,960

[1]Provisional data. [2]Includes landings from Oct.-Dec. 1990 of Fed.Rep.Germany.

Table 3.13.5.a.2 Cod in Baltic Fishing Areas 22–24.

Year	Recruitment Age 1	Spawning Stock Biomass	Landings	Fishing Mortality Age 3-6
1970	157.13	36.75	43.96	0.927
1971	125.92	42.54	46.62	0.996
1972	172.10	43.70	48.90	1.295
1973	66.25	43.14	54.36	0.992
1974	169.80	44.95	46.57	1.326
1975	87.78	36.28	44.37	1.096
1976	81.45	42.84	49.43	1.419
1977	139.28	32.63	46.31	1.405
1978	104.51	28.60	40.61	0.973
1979	49.96	38.67	45.05	0.892
1980	124.05	56.10	41.97	0.966
1981	90.19	49.80	53.65	1.340
1982	92.49	46.94	47.52	0.840
1983	109.61	48.93	48.61	0.916
1984	35.63	46.07	49.50	0.805
1985	28.15	47.33	40.16	1.213
1986	75.62	28.52	26.69	1.703
1987	43.33	22.22	28.57	1.020
1988	13.73	29.37	29.16	0.951
1989	20.41	25.71	18.52	1.146
1990	18.42	14.46	17.78	1.289
1991	32.25	10.45	16.69	1.964
1992	74.09	8.56	18.00	1.343
1993	41.68	15.94	21.23	1.326
1994	72.88	29.20	30.70	0.574
1995	124.00	30.40	33.90	1.003
1996	15.42	37.50	50.85	1.150
1997	105.59	43.03	42.84	1.133
1998	117.60	30.03	.	.
Average	82.39	34.85	38.66	1.143
Unit	Millions	1000 tonnes	1000 tonnes	-

3.13.5.b Cod in Sub-divisions 25–32

State of stock/fishery: The stock is at present considered to be harvested outside safe biological limits as defined by the proposed reference points. The spawning stock declined from a historically high level during 1980–1984 to its lowest recorded level in 1992. With the exception of 1995 the spawning stock has remained below the proposed B_{pa} since 1989. Fishing mortality has increased since 1993. The fishing mortality in 1996 and 1997 is above the precautionary value. The 1995 year class is the 2nd lowest observed in the time series.

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

Advice on management: ICES recommends a reduction in the fishing mortality. A TAC for 1999 that implies a catch of more than 88 000 t is considered to be outside the limits defined by the precautionary approach. A recovery plan should be developed.

Management scenarios: Fishing mortality should be brought below $F_{pa} = 0.6$, and more urgently due to the spawning stock biomass being below B_{pa} (currently estimated at 240 000 t). A recovery plan could be based on scenarios presented below.

The medium-term simulations indicate that this target (SSB > 240 000 t) can be achieved at the earliest in the year 2000. The earlier the stock is brought back to an SSB above 240 000 t, the smaller the TACs will be in the intervening period.

Examples of catch and fishing mortality in 1999 needed to reach the B_{pa} (240 000 t) in different time spans and with different probabilities. F_{97} equal 0.72 per year.

	Year in which SSB> 240 000 tonnes								
Probability of SSB> 240 Kt	2000			2002			2004		
	Catch '99	f^*F_{97}	F_{99}	Catch '99	$f^* F_{97}$	F_{99}	Catch '99	$f^* F_{97}$	F_{99}
> 50%	79	0.74	0.53	92	0.89	0.64	92	0.90	0.65
> 90%	57	0.50	0.36	81	0.76	0.55	88	0.84	0.60

Proposed reference points: The previously established MBAL of 240 000 t is considered sufficient to afford a high probability that biomass will be kept above the lowest observed, and is proposed as B_{pa}. The stock has historically been fished at a very high level, the average F for 1966 to 1997 is 0.86, and selecting $F_{lim} = F_{med}$ is 0.96 per year, implies F_{pa} of approximately 0.6.

Relevant factors to be considered in management: Recruitment is influenced not only by the size of the spawning stock, but to a large extent by the environmental conditions (volume of water with high salinity and high oxygen content). In the most recent 15 years fewer and smaller influxes of saline North Sea water were observed than in earlier years. This is reflected in the recruitment pattern, with a long row of year classes below the long-term average. It is not possible to predict if and when the present regime of saltwater movements will change.

Catch forecast for 1999: Basis: F(98) = F(97) corresponding to the IBSFC TAC of 140,000 t for cod in the Baltic, Landings (98) = 106, SSB(99) = 203.

F (99)	Basis	Landings(99)	SSB (2000)	Medium term effect of fishing at given level
0.29	0.4F(97)	47	265	high probability of SSB being above B_{pa}
0.43	0.6F(97)	67	240	high probability of SSB being above B_{pa}
0.57	0.8F(97)	84	219	high probability of SSB being above B_{pa}
0.6	F_{pa}	88	214	high probability of SSB being above B_{pa}
0.72	1.0F(97)	100	199	high probability of SSB being below B_{pa}
0.86	1.2F(97)	114	183	high probability of SSB being below B_{pa}

Weights in '000 t.

Shaded scenarios considered inconsistent with the precautionary approach.

Elaboration and special comment: 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 beginning of the 1990s. The reported landings in recent years (1992–1995) are known to be incorrect due to incomplete reporting and the landings have therefore been estimated. The extent of unreported landings in 1992–1995 reflects a chaotic situation in the fishery and problems in enforcing regulations at that time. Landing statistics have improved in 1995–1996 and for 1997 it was considered that there was no unallocated landings.

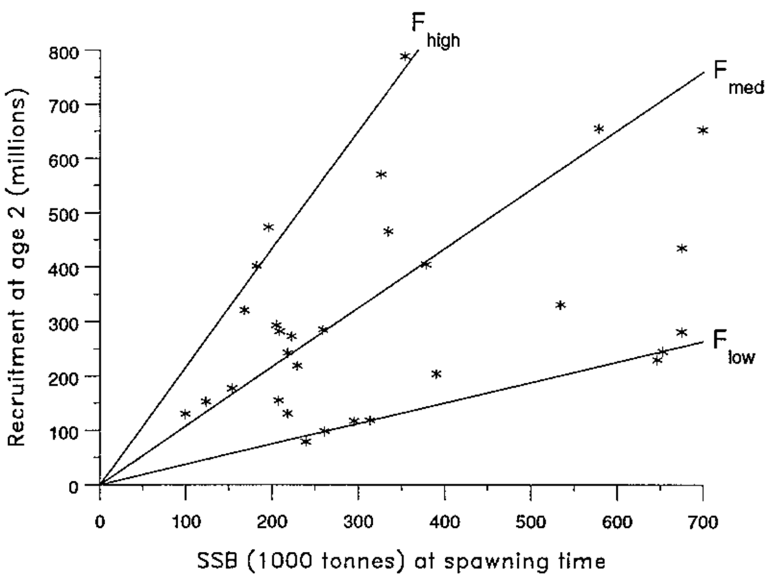
Source of information: Report of the Baltic Fisheries Assessment Working Group, April 1998 (ICES CM 1998/ACFM:16).

Catch data (Tables 3.13.5.b.1–2):

Year	ICES advice	Predicted catch corresp. to advice	Agreed TAC[1]	ACFM catch
1987	Reduce towards F_{max}	245		207
1988	TAC	150		194
1989	TAC	179	220	179
1990	TAC	129	210	153
1991	TAC	122	171	123
1992	Lowest possible level	-	100	55
1993	No fishing	0	40	45
1994	TAC	25	60	93
1995	30% reduction in fishing effort from 1994 level	-	120	108
1996	30% reduction in fishing effort from 1994 level	-	165	122
1997	20% reduction in fishing mortality from 1995	130	180	89
1998	40% reduction in fishing mortality from 1996	60	160	
1999	F_{pa} (= 0.6)	88		

[1]For total Baltic. Weights in '000 t

Stock - Recruitment



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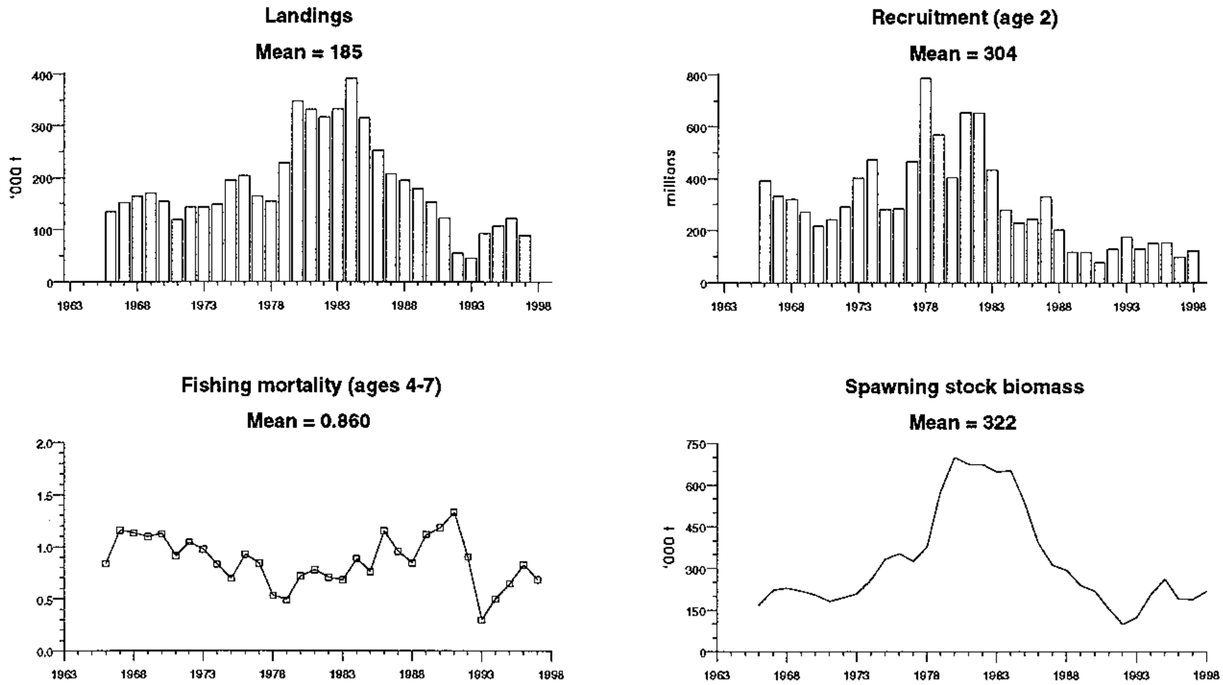


Cod in Sub-divisions 25–32

Yield and Spawning Stock Biomass

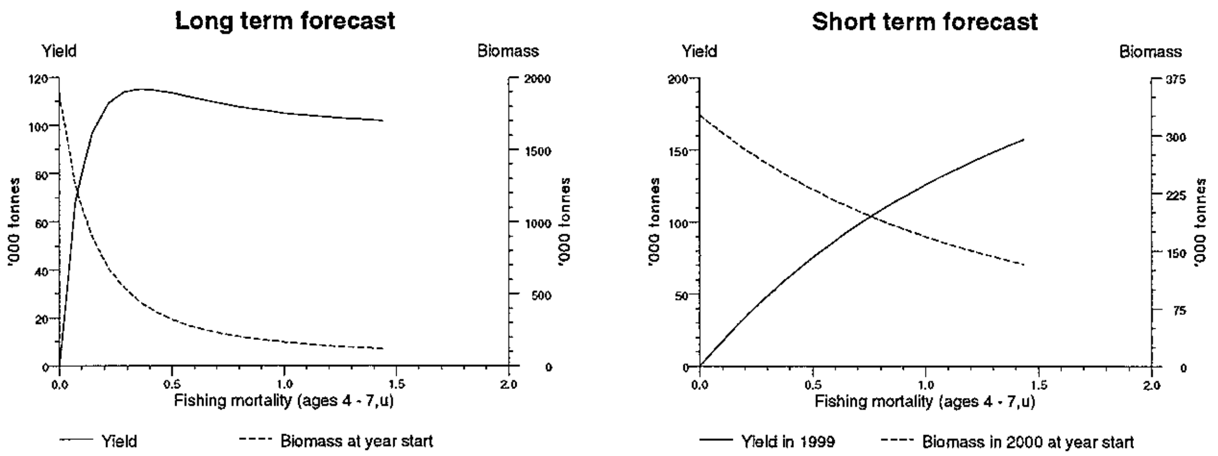


Table 3.13.5.b.1 Total landings (t) of COD in Sub-divisions 25-32 by country.

Year	Denmark	Estonia	Finland	German Dem.Rep.[2]	Germany Fed.Rep.	Latvia	Lithuania	Poland	Russia	Sweden	USSR	Faroe Islands[4]	Norway	Unallo-cated[4]	Total
1965	15,856		23	975	2,183			41,498		19,523	22,420				102,478
1966	16,570		26	2,196	1,383			56,007		20,415	38,270				134,867
1967	19,924		27	11,020	1,057			56,003		21,367	42,980				152,378
1968	21,516		70	12,118	2,018			63,245		21,895	43,610				164,472
1969	23,459		58	18,460	4,715			60,749		20,888	41,580				169,909
1970	22,307		70	10,103	4,855			68,440		16,467	32,250				154,492
1971	23,116		53	2,970	2,766			54,151		14,251	20,910				118,217
1972	34,072		76	4,055	3,203			57,093		15,194	30,140				143,833
1973	35,455		95	6,034	14,973			49,790		16,734	20,083				143,164
1974	32,028		160	2,517	11,831			48,650		14,498	38,131				147,815
1975	39,043		298	8,700	11,968			69,318		16,033	49,289				194,649
1976	47,412		287	3,970	13,733			70,466		18,388	49,047				203,303
1977	44,400		310	7,519	19,120			47,702		16,061	29,680				164,792
1978	30,266		1,437	2,260	4,270			64,113		14,463	37,200				154,009
1979	34,350		2,938	1,403	9,777			79,754		20,593	75,034	3,850			227,699
1980	49,704		5,962	1,826	11,750			123,486		29,291	124,350	1,250			347,619
1981	68,521		5,681	1,277	7,021			120,001		37,730	87,746	2,765			330,742
1982	71,151		8,126	753	13,800			92,541		38,475	86,906	4,300			316,052
1983	84,406		8,927	1,424	15,894			76,474		46,710	92,248	6,065			332,148
1984	90,089		9,358	1,793	30,483			93,429		59,685	100,761	6,354			391,952
1985	83,527		7,224	1,215	26,275			63,260		49,565	78,127	5,890			315,083
1986	81,521		5,633	181	19,520			43,236		45,723	52,148	4,596			252,558
1987	68,881		3,007	218	14,560			32,667		42,978	39,203	5,567			207,081
1988	60,436		2,904	2	14,078			33,351		48,964	28,137	6,915			194,787
1989	57,240		2,254	3	12,844			36,855		50,740	14,722	4,520			179,178
1990	47,394		1,731		4,691			32,028		50,683	13,461	3,558			153,546
1991	39,792	1,810	1,711		6,564	2,627	1,865	25,748	3,299	36,490		2,611			122,517
1992	18,025	1,368	485		2,793	1,250	1,266	13,314	1,793	13,995		593			54,882
1993	8,000	70	225		1,042	1,333	605	8,909	892	10,099		558		13,450	45,183
1994	9,901	952	594		3,056	2,831	1,887	14,335	1,257	21,264		779		36,498	93,354
1995	16,895	1,049	1,729		5,496	6,638	4,513	25,000	1,612	24,723		777	293	18,993	107,718
1996	17,549	1,338	3,089		7,340	8,709	5,524	34,855	3,306	30,669		706	289	8,515	121,889
1997[1]	9,776	1,414	1,677		5,215	6,187	4,601	31,396	2,803	25,072		600			88,741

[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 3.13.5.b.2 Cod in Baltic Sub-divisions 25–32.

Year	Recruitment Age 2	Spawning Stock Biomass	Landings	Fishing Mortality Age 4-7
1966	392.57	167.66	134.87	0.836
1967	332.90	222.64	152.38	1.157
1968	320.47	228.86	164.47	1.129
1969	272.33	217.80	169.91	1.095
1970	217.94	205.06	154.49	1.123
1971	242.11	181.67	118.22	0.912
1972	292.82	195.55	143.83	1.042
1973	400.92	208.73	143.16	0.972
1974	472.23	258.53	147.82	0.829
1975	281.37	333.71	194.65	0.694
1976	283.98	352.89	203.30	0.923
1977	465.02	325.99	164.69	0.839
1978	788.30	377.77	154.01	0.530
1979	570.03	577.88	227.70	0.488
1980	403.86	698.70	347.62	0.717
1981	654.34	674.72	330.74	0.776
1982	651.57	674.43	316.05	0.703
1983	433.79	646.25	332.15	0.680
1984	280.20	652.30	391.05	0.883
1985	228.74	533.52	315.08	0.758
1986	244.36	390.15	252.56	1.151
1987	330.33	312.85	207.08	0.953
1988	203.67	294.65	194.48	0.842
1989	118.06	239.02	179.18	1.115
1990	116.57	217.79	152.87	1.180
1991	78.68	153.81	122.89	1.327
1992	130.60	99.42	54.89	0.903
1993	176.22	123.31	45.18	0.297
1994	129.66	207.46	93.35	0.498
1995	151.97	260.49	107.72	0.645
1996	154.66	190.93	121.89	0.825
1997	97.93	188.46	88.74	0.684
1998	122.29	218.83	.	.
Average	304.26	322.18	185.22	0.860
Unit	Millions	1000 tonnes	1000 tonnes	-

3.13.5.c Effort management of the cod fishery

Response to a request from IBSFC to "advise on the appropriateness of and requirements for effort management as an alternative or supplement to TAC management for the Cod stocks on the basis of material available from the IBSFC Working Group on Standardisation of Effort for Management Purposes."

Effort management is discussed below in the light of conservation of fish stocks. Effort management can be considered as an alternative to TAC management from other points of view, e.g. economy of the industry, control and enforcement and industry acceptance of the regulations.

Effort management can be established at several levels:

- Internationally as an alternative to the IBSFC overall cod TAC and the allocation of this TAC by country;
- Nationally as a management measure used to restrict catches within the allocated national TAC;
- Internationally or nationally as a supplement to the TAC to avoid excess fleet capacity or to allow better control and enforcement.

The discussion below only addresses the first bullet.

The Baltic cod fishery is largely a single species fishery and therefore a candidate for effort regulation as an alternative to TAC regulation as the fishing fleet have less flexibility in its fishing strategy than in multispecies fisheries.

1. Introduction

To be able to use effort as the overall regulatory management measure for conservation purpose there are two requirements:

- Nominal effort reported by fleets shall be converted to standard effort units;
- The nominal effort measured in standard effort units shall be related to fishing mortality.

IBSFC established in 1996 a "Working Group on standardisation of effort for management purposes" that studied the first problem - defining a standard effort unit and the conversion of nominal effort by different fleets to this standard. The second problem is relating fishing mortality to nominal effort. There has not been a full international study on this problem for Baltic cod.

Effort management is often not sufficiently specific for regulating F on a target stock because fishing mortality generated by a nominal effort unit varies with the fishing strategy. Over time, the fishing mortality generated per nominal effort unit increases due to increased efficiency of the fleet caused by technological improvements.

2. Defining standard effort unit - Standardising fishing power

Estimates of standardised fishing power in the Baltic cod fisheries for different vessels categories have been provided by the IBSFC "Working Group on standardisation of effort for management purposes".

The analysis was carried out based on official catch and effort data for 1994–1996 and cover the Baltic Cod fisheries by Denmark, Estonia, Finland, Germany, Latvia, Poland, Russia and Sweden. There were considerable differences with regard to the recordings and the storage of the data between the various Baltic countries. Some countries could not supply information on the full 1994–1996 period. Information available also suggested that the coverage of different vessels groups differed by countries. Finally, the percentage of cod in the catch used to define a fishery as targeting on cod differed between nations.

The analyses were based on ANOVA's (multiplicative analysis), relating the catch rates (kg/fishing day) to effects of year, month, subdivision, country and vessel size.

Four vessel categories were analysed: Bottom trawl, gill-net, pelagic trawl and bottom pair trawl. The bottom trawl and the gill-net were the most important gears accounting for 61% and 32% of the total catch and 48% and 49% of the total effort.

The fishing power of the trawlers could be described by country and vessel size with both effects being highly significant. The vessel size effect increased from 200 kg/day (vessels with HP below 100) to 925 kg/day (vessels above 500 HP). The differences between countries were considerable ranging from catches of about 300 kg/day (Poland, Russia) to catches of about 750 kg/day (Denmark, Finland and Latvia).

For the gill-nets, the fishing power were described by vessel size (measured by the length of the vessels), the country and the interactions between size and country. An evaluation of the estimates indicated a general increase in fishing power with increasing vessel size. Substantial country differences were found with the fishing power of Denmark, Finland and Sweden being estimated at about 10 times that of Russia. It was noted, that measuring gill-net effort by fishing days may be inadequate, as this effort measure ignores differences in net dimensions, numbers of nets deployed and soaking time. Such parameters are however not available in several of the national databases.

Particular caution should be given to the interpretation of the country effects, as the different data collection procedures used by the various nations would mainly be absorbed in the country effects.

The objective of the IBSFC WG analysis was to derive standardised measures of fishing effort, i.e. allowing the fishing powers of different vessel categories and vessel sizes to be expressed relative to a common standard. This can be done but with considerable uncertainty.

2.1 Conclusions

The analyses found large differences between countries in the fishing power for the same type of vessel. To the extent this reflects real technological differences and not just differences in the data compilation, it shows that upgrading of the less efficient vessels could increased the effective effort significantly for the same nominal effort. Effort management will therefore need frequent updates of the estimation of the relative fishing power of the fleets if the effective effort shall be restricted.

For measuring gill-net effort the use of fishing days may be inadequate, as this effort measure ignores differences in net dimensions, numbers of nets deployed and soaking time. Such parameters are however not available in several of the national databases.

3. Relating Standardised effort to fishing mortality

To relate an effort regulation to stock conservation objectives, the estimated standardised fishing effort must be related to the fishing mortality. Before such additional analysis are carried out it will be very difficult to assess the prospects of an effort regulation of the Baltic cod fisheries.

The linkage between fishing power and the fishing mortality may be derived by computing the partial F's of individual fleets – fleets being defined by country and gear type. Such analysis requires that annual catches at age in number are available for the fleets to be analysed for a longer time period, e.g. about 10 years. The IBSFC WG report indicates that several Baltic countries cannot supply such data. Extrapolating the relation between F and effort for fleets for which these data are available would involve the uncertainties in the calculation of the conversion factors between the fishing power of different fleets. Projecting the effects of proposed effort reductions on F has additional uncertainty, because the reactions of the fleets to effort restrictions cannot be easily predicted. For example, fleets may simply be able to increase the number of hours fished per day to compensate for a decrease in number of allocated days at sea, unless the overall reduction in days at sea is substantial.

3.13.5.d Response to a request from IBSFC

Response to a request from IBSFC to "advise on a mortality-based harvesting strategy for Baltic cod, taking into account hydrographic conditions in the eastern Baltic in particular, and which will:

i in the medium term maintain the spawning stock biomass above the limit reference biomass with high probability (90-95%);

ii reduce year to year variation in TAC."

The Baltic cod fishery is managed with a single TAC covering all Sub-divisions 22–32. However, ICES considers the stocks in Sub-divisions 22–24 and Sub-divisions 25–32 as separate stocks and advice is provided on them separately. The simulations used as a basis for the discussions presented below are done separately for these two stock units. There are technical measures defined in the IBSFC fishing rules. For the purpose of the discussion below it is assumed that these rules remain unchanged.

1. Basis for a mortality-based harvesting strategy for Baltic cod

Mortality-based harvesting strategies discussed below are based on the reference points that have been proposed in Section 3.13.5. These are:

Stock	B_{pa} tonnes	F_{pa}
Western Baltic Cod (sub-divs. 22-24)	23 000	0.7
Eastern Baltic Cod (sub-divs. 25-32)	240 000	0.6

The two cod stocks have, on average, had low reproduction success in the last decade and the biomass reference points presented above reflect this situation.

The available studies indicate that a harvesting strategy based on a fixed fishing mortality at F_{pa} for the two cod stocks would meet the objective of maintaining the spawning stock biomass above the limit reference biomass with high probability (90-95%).

2. Harvesting strategies

The time series of the data go back to the 1960s. There have been periods with significant different average recruitment and growth rate. The shift in the recruitment level is considered to be controlled by shifts in the environment while changes in the growth rate is considered to mainly depend on the available food (in particular herring and sprat). The food level is itself influenced by the size of the cod stock. These multispecies considerations suggest:

- Biomass limit reference points changes dynamically in response to changes in the interaction between predators and prey;
- Biomass limit reference points may differ in single and multispecies models.

Shifts in the environmental conditions are expected to affect the stock recruitment relation. Computer simulations indicated that mortality reference points are more robust to such changes than are biomass points.

This suggests that the harvest control rule implied by the IBSFC request requires updates of the biomass reference points to track changes in the ecosystem, i.e. in sprat and herring biomass and in the environment conditions for cod reproduction.

Computer simulations comparing exploitation strategies with a fixed TAC for several years with a strategy of a constant fishing mortality indicated a pay-off between stability in the TAC with total yield. Meeting the same conservation objectives, it will be possible to fish with a higher average, but more variable, annual TAC under a fixed fishing mortality strategy than under a fixed TAC strategy. This difference depends on the variability in growth and recruitment and is in the order of 10%. Intermediate strategies where the variability in TAC between years is restricted can be devised. ICES is not yet in a position to provide a full answer to this part of the request.

3. Environmental conditions

3.1 Western Baltic Cod

Reproduction in this stock seems not to follow variations in the environment very closely. The winter distribution of young cod changes between mild and harsh winters, which influence the availability of this stock component to the fishery.

3.2 Eastern Baltic Cod

The recruitment variability in this stock has significant environmental components. The environment conditions for cod reproduction are not optimal at present.

Good cod recruitment requires oxygen concentrations > 2 ml/l at the depths where eggs are neutrally buoyant. Such conditions are often found in the Bornholm Basin and to a much lesser extent in the other spawning areas in Sub-divisions 25-32. As a result, cod egg development will be most successful in the Bornholm Basin. The hydrographic conditions during the last 40-45 years indicate that regularly successful reproduction cannot be expected in the other spawning areas. The interaction between hydrographic conditions and successful egg development is believed to be the main reason why recruitment level shifts have been observed for cod.

The oxygen conditions at cod spawning sites are controlled by the major inflows of oxygenated high salinity water from the North Sea. These events are unpredictable and occur irregularly. There have been long periods without such inflows, e.g. between 1977 and 1992. Since 1993 there has been no major inflow into the Baltic.

3.13.6 Flounder

State of stock/fishery: In general, all landings suggest that flounder are moderately exploited in the Baltic and that the abundance is more or less stable. For the stock in Sub-divisions 24+25 survey indices and XSA results indicate a slight decrease in 1996 and 1997.

Elaboration and special comment: Flounder is mainly taken as a by-catch in cod fisheries but there are also directed trawl fisheries for this species in Sub-divisions 22, 24, 25, 26 and 28. The total landings of flounder have increased during the last years. Excluding the years 1994–1995 when misreporting was observed, the landings increased from 9 742 t in 1993 to 17 064 t in 1996 (Table 3.13.6.1). In 1997 the landings decreased by 10% compared with 1996. The majority of the landings (in 1997 13 561 t) have been taken in Sub-divisions 22, 24, 25 and 26. The amount of discarded flounder is not known but it is assumed that it is high.

For most of the flounder stocks the data available are insufficient to make an analytical assessment and catch forecasts. A preliminary assessment was made for the flounder stock in Sub-divisions 24–25.

Source of information: Report of the Baltic Fisheries Assessment Working Group, April 1998 (ICES CM 1998/ACFM:16).

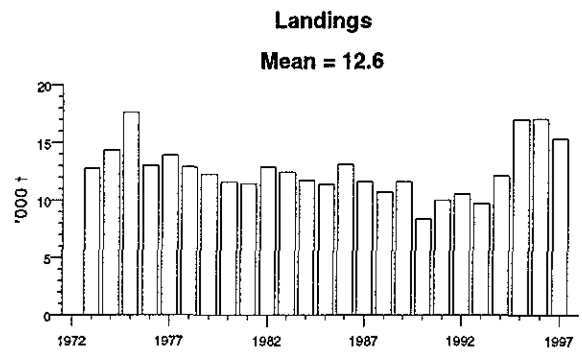


Table 3.13.6.1 Total landings (tonnes) of FLOUNDER in the Baltic by Sub-division and country. (There are some gaps in the information. Therefore "Total" is preliminary.)

	Denmark[1]					Finland				German Dem. Rep.[2]			Germany, Fed. Rep				Poland		Sweden							
	22	23	24(25)	26	28	25	29[6]	30	32[7]	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[5]	1,356		2,421	31	10	2	284	68	303				655	1,982	12	4	3,877	1,730		42	62	308	31	105	370	

Continued

Table 3.13.6.1 continued

Year	USSR				Estonia					Latvia		Lithuania[8]		Russia		Total										
	26	28	29	32	25	26	28	29	32	26	28	25	26	26	28	22	23[1]	24	25[4]	26	27	28	29	30	32	Total
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[5]					15		101	96	125	78	284			1001		2,011	42	4,465	4,202	2,883	105	769	380	68	428	15,353

[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 and 1997 no data reported

3.13.7 Plaice

Elaboration and special comment: Sub-divisions 22 and 24 are the most important areas for the plaice fishery in the Baltic. The total landings of plaice (Table 3.13.7.1) were high in the 1970s but have decreased since the 1980s to the lowest on record in 1993 (269 t), and increased again to about 1 500 t in 1996 and 1997.

Source of information: Report of the Baltic Fisheries Assessment Working Group, April 1998 (ICES CM 1998/ACFM:16).

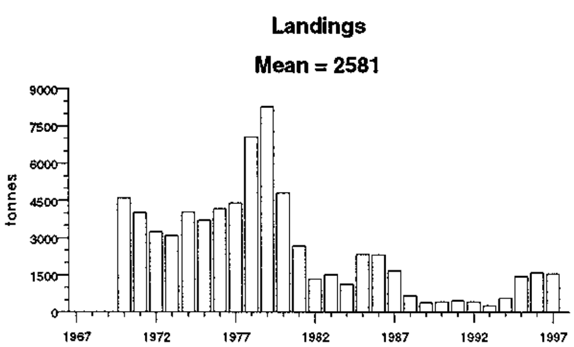


Table 3.13.7.1 Total landings (tonnes) of PLAICE in the Baltic by Sub-division and country. (There are some gaps in the information. Therefore "Total" is preliminary.)

Year	Denmark			Germ. em. 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[4]	902		201			51	56			308	3		13	7	8		1		

Continued

Table 3.13.7.1 Continued

Year	Total								
	22	23	24[3]	25	26	27	28	29	Total
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[4]	953	13	264	316	3	1			1,550

[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.

3.13.8 Dab

Elaboration and special comment: The total landings of dab (Table 3.13.8.1) were rather stable at around 2 000 t per year in the 1980s and up to 1993. The catches in 1994 increased to 3 000 t, but in 1996 they returned to the previous level. In 1997 the landings (1 248 t) decreased again. In the last years the majority of the catches have been taken from Sub-divisions 22 and 24. The increase in the landings reported for 1994 and 1995 is influenced by misreporting (over-reporting).

Source of information: Report of the Baltic Fisheries Assessment Working Group, April 1997 (ICES CM 1998/ACFM:16).

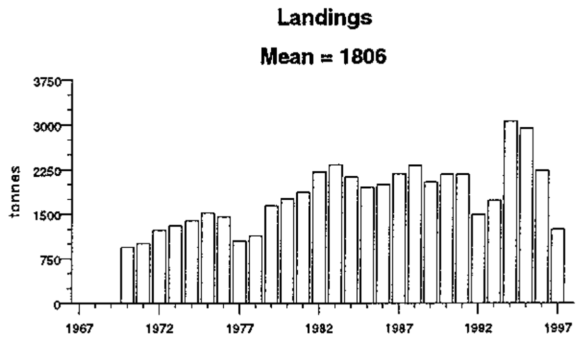


Table 3.13.8.1 Total landings (tonnes) of DAB in the Baltic by Sub-division and country. (There are some gaps in the information. Therefore "Total" is preliminary.)

Year	Denmark				Germ. Dem.Rep.[1]		Germany Fed.Rep.			
	22	23	24 (+25)	25–28	22	24	22	24	25	26
1970	845		20		11		74			
1971	911		26		10		64			
1972	1110		30		9		63			
1973	1087		58		18		118			
1974	1178		51		18		118			
1975	1273		74		20		131			
1976	1238		60		17		114			
1977	889		32		13		89			
1978	928		51		19	14	128	4		
1979	1413		50		18	25	123	1		
1980	1593		21		15	25	101			
1981	1601		32		24	39	164			
1982	1863		50		46	38	182	4		
1983	1920		42		46	28	198			
1984	1796		65		30	47	175	2		
1985	1593		58		52	51	187	2		
1986	1655		85		36	35	185	1		
1987	1706		93		14	87	276	4		
1988	1846		75		22	91	281	1		
1989	1722		48		26	19	218	1		
1990	1743		146		14	11	252	1		
1991	1731		95				340	5		
1992	1406		81				409	6		
1993	996		155				556	10		
1994	1621		163				1190	80	45	
1995	1510	47	127	10			1185	49	3	
1996	913	37	128				991	134	13	2
1997[4]	728		60				413	21	2	

Continued

Table 3.13.8.1 (continued)

Year	Sweden[2]								Total									Total
	22	23	24	25	27	28	29	30	22	23	24[3]	25[5]	26	27	28	29	30	
1970									930		20							950
1971									985		26							1,011
1972			23						1,182		53							1,235
1973			30						1,223		88							1,311
1974			34						1,314		85							1,399
1975			32						1,424		106							1,530
1976			27						1,369		87							1,456
1977			25						991		57							1,048
1978									1,075		69							1,144
1979			9						1,554		85							1,639
1980			3						1,709		49							1,758
1981			5						1,789		76							1,865
1982			6	5	8	6		1	2,091		98	5		8	6		1	2,209
1983			24	20	32	22		2	2,164		94	20		32	22		2	2,334
1984			4	3	5	4		1	2,001		118	3		5	4		1	2,132
1985			3	3	5	3		1	1,832		114	3		5	3		1	1,958
1986			1	1	1	1			1,876		122	1		1	1			2,001
1987			1	1	1	1			1,996		185	1		1	1			2,184
1988			1	1	1	1			2,149		168	1		1	1			2,320
1989			1	1	2	1			1,966		69	1		2	1			2,039
1990			8						2,009		166							2,175
1991			1						2,071		101							2,172
1992				1	1		4		1,815		87	1		1		4		1,908
1993		7	1	1			1		1,552	7	166	1				1		1,727
1994		5	1	1					2,811	5	244	46						3,106
1995		5	1	5		1			2,695	52	177	18			1			2,943
1996	3		3	4	1				1,907	37	265	17	2	1				2,229
1997[4]		5	5	10	3	1			1,141	5	86	12		3	1			1,248

[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.

3.13.9 Turbot

Elaboration and special comment: The total landings of turbot in the Baltic (Table 3.13.9.1) have been increasing since 1983 to about 1 000 t in 1993–1997. There is a directed gillnet fishery developing in Sub-divisions 25, 26 and 28. Most catches are taken from Sub-divisions 25, 22, 24 and 28 in the last years.

Source of information: Report of the Baltic Fisheries Assessment Working Group, April 1998 (ICES CM 1998/ACFM:16).

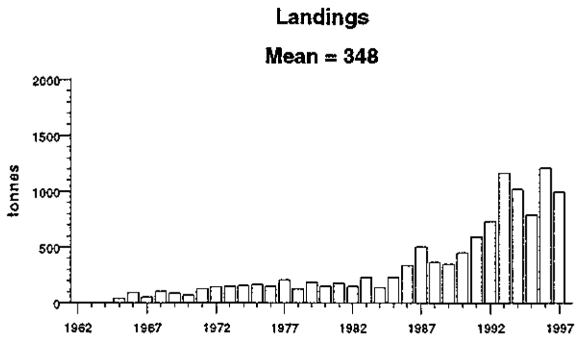


Table 3.13.9.1 Total landings (tonnes) of TURBOT in the Baltic by Sub-division and country. (There are some gaps in the information. Therefore "Total" is preliminary.)

Year	Denmark			Germ. Dem. R[1]		Germany, Fed. Rep.						Poland		Sweden[2]							Latvia		Lith-uania[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
1965				3	39																			
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	33	28		20
1996	207	12	95			36	47	4		1		288	92	1	3	15	100	5	54	104	43	3	76	25
1997[4]	151		68			60	52	3				290	70		2	6	70	1	53	86	33	28		25

Continued

Table3.13.9.1 continued

Year	Total							
	22	23	24[3]	25	26	27	28(+29)	Total
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	77	31	111	792
1996	244	15	157	392	241	55	107	1,211
1997[4]	211	2	126	363	129	53	114	998

[1] From October-December 1990 landings of Germany, Fed. Rep. are
[2] For the years 1970-1981 and 1990 the catches of Sub-divisions 25-28
[3] For the years 1970-1981 and 1990 the Swedish catches of Sub-divisions
[4] Provisional.
[5]Lithuania, for 1997 no data reported

3.13.10 Brill

Elaboration and special comment: The landings of brill are presented in Table 3.13.10.1. There are gaps in the information and the total landing figures are preliminary.

Source of information: Report of the Baltic Fisheries Assessment Working Group, April 1998 (ICES CM 1998/ACFM:16).

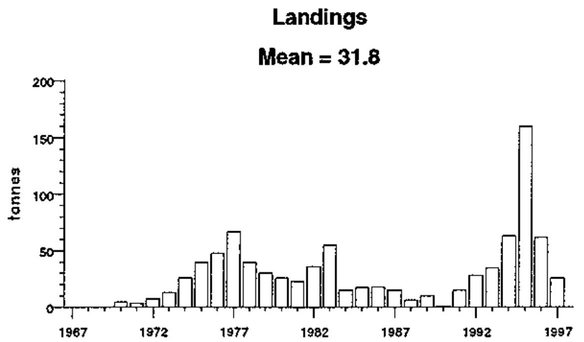


Table 3.13.10.1 Total landings (tonnes) of BRILL in the Baltic by Sub-division and country. (There are some gaps in the information. Therefore "Total" is preliminary.)

Year	Denmark			Germ. Fed.Rep	Sweden		Total			Total
	22	23	24-28	22	23	24-28	22	23	24-28	Total
1970	4						4			4
1971	3						3			3
1972	7						7			7
1973	11		2				11		2	13
1974	25		1				25		1	26
1975	38		1	1			39		1	40
1976	45		1	2			47		1	48
1977	60		2	5			65		2	67
1978	37			3			40			40
1979	30						30			30
1980	26						26			26
1981	22			1			23			23
1982	19					17	19		17	36
1983	13					42	13		42	55
1984	12					3	12		3	15
1985	16					1	16		1	17
1986	15					3	15		3	18
1987	12					3	12		3	15
1988	5					1	5		1	6
1989	9					1	9		1	10
1990						1			1	1
1991	15						15			15
1992	28						28			28
1993	29	5	1				29	5	1	35
1994	57	4	1			1	57	4	2	63
1995	134	12	1		5	8	134	17	9	160
1996	56	6					56	6		62
1997[1]	25				1		25	1		26

[1] Provisional.

3.13.11 Salmon and Sea Trout

3.13.11.a Overview

Salmon

There are 40–50 rivers in the Baltic with significant wild[1] salmon smolt production (Figure 3.13.11.a.1). Reared fish are released in many of these rivers, which makes it difficult to assess whether the salmon populations are self sustaining or not. Many rivers have been dammed and spawning and nursery areas have been completely or partially destroyed. To compensate, hatcheries have been built on these rivers where fish are reared to the smolt stage before release. These fish feed in the sea and migrate back to rivers as spawners, where they are used as broodstock to a varying extent. A total of 5.9 million hatchery-reared smolts were released in rivers and at coastal release sites in 1997. This includes the estimated number of smolts due to releases of earlier life stages in order to enhance wild stocks. It is estimated that the wild production in 1997 was about 0.4 million smolts, which was about 6.5% of the total smolt production of 6.3 million. A major part of wild and reared smolt production takes place in the northern part of the Baltic, the Gulf of Bothnia.

While feeding in the sea, salmon are caught by drift nets and long lines and during the spawning run they are caught along the coast, mainly in trap nets and fixed gillnets and to a minor extent in a trolling fishery. Where fisheries are allowed in the river mouths, set gillnets and trap nets are used. In Sweden and Finland there is also a traditional recreational angling and gillnet fishery in some of the rivers. In Sweden there is a considerable broodstock fishery in rivers having reared populations. The offshore fishery and most of the coastal fisheries exploit both wild and reared salmon. Wild salmon can normally not be distinguished from reared fish in the fisheries, and it is therefore only possible to exploit reared fish separately during the homing migration when salmon approach their release sites near rivers, that do not support wild salmon populations.

Current IBSFC management areas for salmon in the Baltic are: (1) Main Basin and Gulf of Bothnia (Sub-divisions 24-29 and 30-31, respectively) and (2) Gulf of Finland (Sub-division 32). The offshore and coastal fisheries have been managed by a single TAC since 1991. IBSFC has established the overall management objective to increase the production of wild Baltic salmon to attain by 2010 at least 50% of the natural production capacity of each river with current or potential natural production of salmon, while maintaining the catch level as high as possible.

At present wild salmon populations remain in 13 rivers in the Gulf of Bothnia. In earlier years all populations have been much below the 50% production level and they were considered to be outside safe biological limits. However, mainly due to stricter fishing regulations in 1995-97 and a strong brood-year-class in 1990, the status of populations in some rivers have improved and the number of smolts is expected to increase in 1999-2000. The numbers of spawners returning to other rivers continue to be on a very low level and some of these populations are close to extinction. In the Main Basin about 15 wild populations still exist. The populations in this area are generally considered to be in a better state than those in the Gulf of Bothnia, but quantitative data on individual populations are often insufficient to assess their status.

In the management area consisting of Gulf of Finland (Sub-division 32), wild salmon populations are believed to exist in 10-14 rivers. There is limited data available on these populations, but several of them are close to extinction, so they are outside safe biological limits.

In 1992-1996 the M74 syndrome caused high mortality among newly-hatched yolk-sac fry from sea-run females (M74 was well described in the ACFM report in 1995). According to Swedish data the incidence decreased considerably in 1997 and according to preliminary data the decrease continued to even lower levels in 1998. If these estimates are correct, they indicate that M74 now has a low influence on stock development. Similar decrease in M74 has, however, not been observed in Finnish monitorings. As the factors influencing the development of M74 are poorly understood, it is possible that the incidence of the disease may continue to fluctuate rapidly, without any possibility to predict the development.

Sea trout

There are wild sea trout populations in approximately 250 rivers and streams in the Baltic. Similar to the situation for salmon rivers, sea trout rivers have been dammed and natural reproduction capacity have disappeared. Reared smolts are in many cases released to compensate for the losses. Sea trout are also in many cases released to provide a possibility for a recreational fishery on returning spawners. Hatchery-reared smolt

[1] Wild salmon is defined as fish that have spent their entire life cycle in the wild and originate from parents which were also spawned and continuously lived in the wild. For management purposes in the Baltic, ICES will normally not impose the requirement for the parental generation to have spent their entire life cycle in the wild. Wild salmon populations ought to be self sustaining and as similar as possible to populations with no effects from releases.

production, including enhancement of wild stocks, was approximately 3.9 million in 1997. The wild smolt production, which may be about 0.5 million, constitutes about 15% of the total smolt production. 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. Coastal populations are mainly taken in gillnets or trap nets. In the Gulf of Bothnia, they are caught as a bycatch 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 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 is variable, but in general considerably better than in the Gulf of Bothnia.

Sea trout is affected by M74 to a much lower degree than salmon is. 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.

Baltic Salmon Rivers

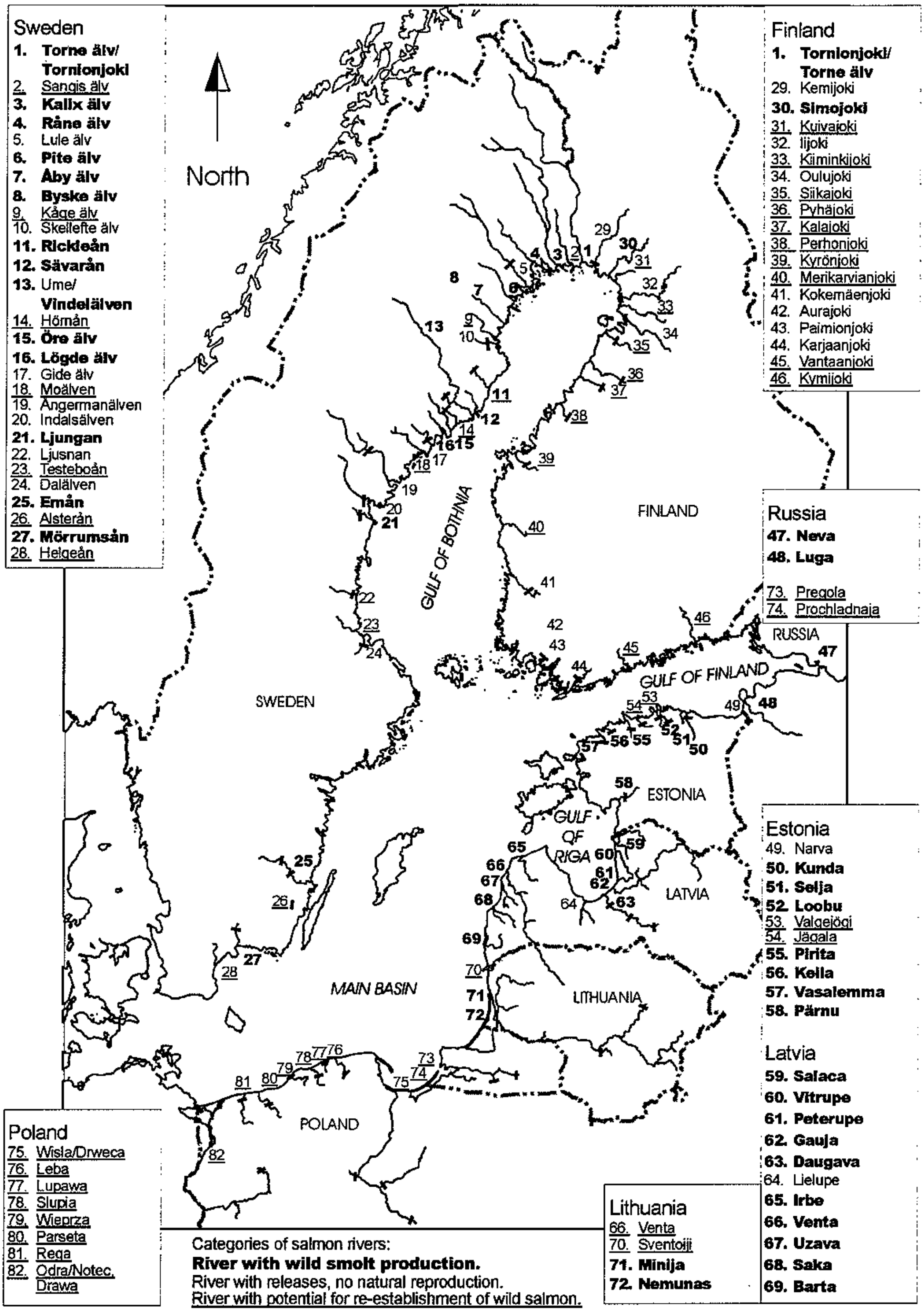


Figure 3.1.2 Baltic salmon rivers divided into three categories (see above figure). Only lower parts of rivers with current salmon production or potential for production of wild salmon are shown. The presence of dams, which prevents access to areas, are indicated by lines across rivers.

3.13.11.b Salmon in the Main Basin and the Gulf of Bothnia (Sub-divisions 24–31)

State of stocks/fishery: Although the populations in some rivers are increasing, ICES considers that the wild stocks - at the scale of the management unit - are outside safe biological limits. Catches of salmon are given in Tables 3.13.11.b.1 and 3.13.11.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[2]	0.44	5.17	5.61

[1] Data on wild smolt production since 1990s 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: At present wild salmon populations occur in 13 rivers discharging into the Gulf of Bothnia. In the beginning of the 1990s, most populations in this area were depleted producing 5-20% of their potential. The management measures taken, including the reduction in TAC and a strong brood-year-class in 1990 have increased parr densities in some of the rivers in the last 2-3 years. It is expected that the smolt production will increase in 1999-2000 and the spawning runs have increased for several years (Tables 3.13.11.b.3 and 3.13.11.b.4). In other rivers, there is still no sign of improvement in population status. The numbers of fish returning to these rivers are so low that the stocks are on the verge of extinction. In the Main Basin the situation is somewhat better and some of the stocks in this area are assessed to be within safe biological limits. Recent parr surveys in Latvian rivers suggest that these stocks are not affected by M74 and that they are in better condition than stocks in the Gulf of Bothnia.

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 and 1998, with the TAC for 1999 of 410 000 salmon would be consistent with the Salmon Action Plan. However, from a biological perspective the wild stocks should be rebuilt as quickly as possible.

Many indices show that the populations are benefiting from current measures, thereby increasing the probability of achieving the management objectives. Because of the apparent weaker or absent improvements of parr densities in small rivers compared to larger ones and the fact that the forecasts of smolt production gives values that are far outside the range of past observations, it is not yet possible to quantify risks associated with increasing TACs.

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.

Relevant factors to be considered in management: The factors influencing the development of M74 are poorly understood. The M74 mortality has varied over the years (Table 3.13.11.b.5) and sudden unpredictable changes in the incidence of the disease may occur.

The salmon fishery in the Baltic is mainly based on reared fish. In recent years reared fish would have constituted about 90% of the catch, if the estimates of smolt production of reared and wild fish are valid indicators of the recruitment to the fisheries. Data on coastal tagging and catch sampling of spawners indicate that the proportion of wild salmon in the catch *may be higher than previously considered (see Section* 3.13.11.d - Coastal regulations).

Non-reported catches are considered to be 10–25% of the reported landings (individuals) in the Gulf of Finland, Gulf of Bothnia and in some fisheries in the Main Basin. These estimates are not reliable and thus not included in the assessment, nor are discards or salmon damaged by seal.

Seals damage salmon trapped in nets. The estimated catch loss in the Swedish coastal trapnet fishery in the Gulf of Bothnia due to seal interaction with the fishery was 43% of recorded coastal salmon landings. Similar problems exist in Finnish waters, but the magnitude has not been quantified. The large impact of seals on salmon coastal fisheries may prevent a shift from offshore to coastal salmon fisheries.

Forecast: *Wild stocks:* Surveys of juvenile salmon in the Baltic rivers suggest that the wild smolt runs in 1997 were 0.44 million smolts. This is about 25% of the potential production as presently estimated. The densities of parr and number of spawners in Finnish and Swedish rivers in 1995–97 suggest that the smolt production in these rivers will increase slightly in 1998 and 1999 and probably more in 2000-2001.

Reared stocks: The production of reared smolts in 1997 was 5.20 million smolts and is expected to be 5.17 million in 1998.

Elaboration and special comment: Estimates of wild smolt production are available for each region, but estimates in the Main Basin are based on limited surveys.

At present the assessment is based on the development in aggregates of rivers having wild salmon populations. There is a tendency that the populations in the larger rivers have increased, while the status of populations in smaller, more vulnerable rivers is unchanged (Table 3.13.11.b.4).

Because of the special formulation of the management objective where the target level is 50% of the potential production level, the potential production level ought to be well defined. Ideally it ought to be based on stock-recruitment curves. However, Baltic salmon populations have been depleted for more than 30 years and there is no empirical basis for such a model. Estimates of potential production in the Baltic 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.

Because of the depleted state of many wild populations it is necessary to monitor the status for many of them. However, better future analysis of the status of salmon populations requires an intensified long-term monitoring which will have to concentrate on a few selected rivers (index rivers).

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 1998 (ICES CM 1998/ACFM:17).

Catch data (Tables 3.13.11.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				

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 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[6]	0.31	50	0.76	148	1.55	288	2.31	436	2.62	486

[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 3.13.11.b.1 Nominal landings in tonnes of Baltic salmon by country and region in 1972-1997 (1997 provisional figure) S=sea, C=coast, R=river.

Year	Main Basin (Sub-divisions 24–29)										
	Denmark	Finland	German	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 24–29																					
	Denmark	Estonia		Finland			Germany	Latvia		Lithuania		Poland			Russia	Sweden			Total			
	S	S	C	S	C	R	S	S	C	S	C	S	C	R	S	S	C	R	SEA	COAST	RIVER	GT
1981	844	23	0	310	18	0	43	167	17	36		45			56	401	0	1	1925	35	1	1961
1982	604	45	0	184	16	0	20	143	31	30		38			57	376	0	1	1497	47	1	1545
1983	697	55	0	134	18	0	25	181	105	33		76			93	370	0	2	1664	123	2	1789
1984	1145	92	0	208	29	0	32	275	89	43		72			81	549	0	4	2497	118	4	2619
1985	1345	87	0	280	26	0	30	234	90	41		162			64	842	0	5	3085	116	5	3206
1986	848	52	0	306	38	0	41	279	130	57		137			46	764	0	4	2530	168	4	2702
1987	955	82	0	446	40	0	26	327	68	62		267			81	887	0	4	3133	108	4	3245
1988	778	60	0	305	30	0	41	250	96	48		93			74	710	0	6	2359	126	6	2491
1989	850	67	0	365	35	0	52	392	131	70		80			104	1053	0	4	3033	166	4	3203
1990	729	68	0	467	46	1	36	419	188	66		195			109	949	0	9	3038	234	10	3282
1991	625	64	0	478	35	1	28	361	120	62		77			86	641	0	14	2422	155	15	2592
1992	645	19	4	354	25	1	27	204	74	20		170			37	694	0	7	2170	103	8	2281
1993	575	23	4	425	76	1	31	204	52	15		191			49	754	7	5	2283	139	6	2428
1994	737	2	4	372	80	1	10	97	33	5		184			29	574	11	8	2010	128	9	2147
1995	556	4	3	613	86	1	19	100	39	2		121	12		36	464	13	6	1915	153	7	2075
1996	525	2	4	306	53	1	12	97	53	14		124	1		35	551	8	5	1666	119	6	1791
1997	489	1	5	384	49	1	38	106	64	1	4	110	0	0	23	345	8	7	1497	130	8	1635
Mean 1992-96	608	10	4	414	64	1	20	140	50	11		158	7		37	607	8	6	2009	128	7	2144

Continued

Table 3.13.11.b.1 continued

Year	Gulf of Bothnia (Sub-divisions 30–31)											Main Basin+Gulf of Bothnia (Sub-divs. 24–		
	Denmark	Finland			Sweden			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)										Main Basin + Gulf of Bothnia (Sub-divisions 24-31) Total			
	Finland			Sweden			Total							
	S	C	R	S	C	R	S	C	R	GT	SEA	COAST	RIVER	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	51	348	145	1	284	158	52	632	303	987	1549	762	311	2622
Mean 1992-96	233	419	31	4	263	93	238	681	125	1043	2246	810	132	3188

Continued

Table 3.13.11.b.1 continued

Year	Gulf of Finland (Sub-division 32)					Baltic (Sub-divs. 24-32) Total		
	Finland			USSR				
	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)												Baltic (Sub-divs. 24–32)			
	Estonia			Finland			Russia		Total				Total			
	S	C	R	S	C	R	S	R	S	C	R	GT	SEA	COAST	RIVER	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	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	99	378	10	4	0	103	382	10	495	1652	1144	321	3117
Mean 1992-96	3	2	0	74	278	5	23	2	100	280	7	387	2347	1089	139	3575

Catches in Sub-division 24-32. Catches in sub-division 22-23 was in 1995 less than 1 t, in 1996 equal to 0.9 t and in 1997 3.9 tonnes.

Danish, Finnish, German, Polish and Swedish catches are converted from gutted to ungutted weight by multiplying by 1.1.

Estonian, Latvian, Lithuanian and Russian catches are reported ungutted.

Sea trout are included in the sea catches in the order of 3 % for Denmark (before 1983), Estonia, Germany, Latvia, Lithuania, Russia, about 5% for Poland and 10% for Finland. The amount of sea trout in Swedish catch is normally below 10%.

Non-professional catches are included in the Finnish landings based on inquiries in 1990, 1992 and 1994. In 1996 and 1997 non professional catches is estimated.

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 have from 1993 been included in the Swedish statistics.

In 1993 the Faroes caught 16 tonnes included in total landings.

Table3.13.11.b.2 Nominal landings in numbers of Baltic salmon by country and region in 1996–1997 (1997 provisional figure), S=sea, C=coast, R=river.

Year	Main Basin (Sub-divisions 24–29)																					
	Denmark	Estonia		Finland			Germany	Latvia		Lithuania		Poland			Russia	Sweden			Total			
	S	S	C	S	C	R	S	S	C	S	C	S	C	R	S	S	C	R	SEA	COAST	RIVER	GT
1996	105934	263	528	58844	8337	200	2400	19400	1057	1450	1059	27479	222	0	5199	12163	1322	633	34260	22045	833	365478
1997	87746	205	1023	67007	7704	200	6840	20033	1209	214	665	24436	0	65	4098	67117	1372	810	27769	22859	1075	301630

Year	Gulf of Bothnia (Sub-divisions 30–31)										Main Basin+Gulf of Bothnia (Sub-divisions 24–31) Total			
	Finland			Sweden			Total							
	S	C	R	S	C	R	S	C	R	GT	SEA	COAST	RIVER	GT
1996	22196	84940	1400	1181	61239	2057	23377	146179	3457	204127	365977	168224	35404	569605
1997	9528	77322	2200	251	47956	2715	9779	125278	4915	184216	287475	148137	50234	485846

Year	Gulf of Finland (Sub-division 32)												Baltic (Sub-divs. 24–32)			
	Estonia			Finland			Russia		Total				Total			
	S	C	R	S	C	R	S	R	S	C	R	GT	SEA	COAST	RIVER	GT
1996	0	396	0	20664	55840	1500	1485	296	2214	56236	1796	80181	388126	224460	37200	649786
1997	0	819	0	22687	62520	1500	1023	0	2371	63339	1500	88549	311185	211476	51734	574395

Table 3.13.11.b.3 Wild adult salmon counts to fish ladders in some rivers in the Gulf of Bothnia and the Main Basin.

Year	Number of salmon									
	Kalix älv [1]		Pite älv [2,3]		Ume/Vindelälven [2]		Mörrumsån [1,4]		Öre älv [1]
	Total	Grilse	Total	Grilse	Total	Females	Total	Females	Total
1973			45				110	40	
1974			15		1576	716	129	61	
1975					620	193			
1976					793	319			
1977					1225	456	90	29	
1978					1630	700	30	10	
1979					2116	643	38	12	11
1980	80	62			1244	449	47	13	1
1981	161	79			632	196	115	29	8
1982	45	11			424	139	104	24	2
1983	890	132			408	141	288	27	7
1984					446	177	247	40	14
1985			30		904	330	190	28	10
1986			28		227	128	262	120	1
1987			18		246	87	404	56	12
1988			28		446	258	502	65	23
1989			19		597	191	1685	72	13
1990	639	139	130		1573	492	1450	233	69
1991	437	122	59		356	189			67
1992	656	288	218	104	367	251			40
1993	567	213	146	114	1662	572			76
1994	806	144	135	108	1311	719			37
1995	1282	736	98	63	1167	251			28
1996	3781	2736	146	116	1934	1266			39
1997	5089	4425	658	638	1788	1072			101

[1]The trap catch a part of the run.
[2]The trap catch the entire run.
[3]New fish ladder in Pite älv in 1992.
[4]Some releases of unmarked reared salmon have occurred.

Table 3.13.11.b.4 Estimates of wild salmon smolt production (thousands) in Baltic rivers having natural populations in the 1980s and 1990s.

Region, Sub-division	Reprod.	Poten								Pre	Pred.	Method of estimate	
country and river	**area ha**	**tial**	**19**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**Pot.pro**	**Pres.pr**
Gulf of Bothnia, Sub-div. 31													
Finland													
Kiiminkijoki	90	30	+	+	+	+	+	+	+	+	+	3	2
Pyhäjoki	100	40	+	+	+	+	+					3	4
Simojoki	255	75	10	17	10	12	1.4	1.3	0.9	7.8	27	3	2
Finland/Sweden													
Tornionjoki;Torne älv	5000	500	75	75	123	199	75	71	50	94	93	3	2
Sweden													
Kalix älv	2500	250	50	75	88	130	42	48	61	67	82	3	4
Råne älv	390	20	+	+	+	3.2	2.1	2.2	0.5	0.3	1.9	3	4
Pite älv	435	33	+	+	+	+	3	3	5	5	5	3	5
Åby älv	80	16	+	+	+	5.8	1.9	2.3	3	7.2	9.5	3	4
Byske älv	530	80	15	18	23	35	11	12	40	55	93	3	4
Sävarån	20	4	+	+	+	+	+	+	0.1	0.7	0.1	3	4
Rickleån	15	5	+	+	+	+	+	+	0.3	0.3	0.1	3	1 and 3
Ume/Vindelälven	1000	200	25	20	23	39	15	14	13	24	90	3	4
Öre älv	100	20	+	+	+	1.4	1.4	1.4	0.1	0.7	0.3	3	4
Lögde älv	95	19	+	+	+	3.8	1.4	1.7	1.1	3.5	2.8	3	4
Sum of +			5	15	20	4	4	4					
Total Sub-div. 31	**10610**	**1292**	**18**	**220**	**287**	**433.2**	**158.2**	**160.9**	**175**	**266**	**405**		
Gulf of Bothnia, Sub-div. 30													
Ljungan	20	20	10	10	15	4	4	4	5	10	10	3	4
Total Gulf of B., Sub-divs. 30-31	**10630**	**1312**	**19**	**230**	**302**	**437**	**162**	**165**	**180**	**276**	**415**		
Main Basin, Sub-divs. 24-29													
Sweden													
Emån		15		5	5	4.5	3	2.5	4	4		3	4
Mörrumsån		100		110	90	60	30	35	60	60		3	4
Total Sweden		115		115	95	64.5	33	37.5	64	64			
Estonia													
Pärnu		15							3	2		4	3
Latvia (1)													
Salaca		30		26	22	15	15	20	20	25	25	3	2
Vitrupe				5	5	5	5	5	5	4	4	6	5
Peterupe				5	5	5	5	5	5	4	4	6	2 and 5
Gauja				20	17	13	13	14	14	13	13	6	2 and 5
Daugava				5	5	5	5	5	5	5	5	6	5 and 7
Irbe				10	10	10	8	7	7	7	7	6	5
Venta				15	15	15	15	15	12	12	12	6	2 and 5
Saka				10	10	10	10	10	8	7	7	6	5
Uzava				2	2	2	2	2	2	2	2	6	5
Barta				2	2	2	2	2	2	1	1	6	5
Total Latvia		110		100	93	82	80	85	80	80	80		
Lithuania													
Nemunas river basin		150		20	20	20	20	20	20	20		7	10
Russia								0	0	0		7	10
Total Estonia, Latvia, Lithuania and Russia		275		120	113	102	100	105	103	102			
Total Main B., Sub-divs. 24-29		390		235	208	166.5	133	142.5	167	166			

Table 3.13.11.b.4 Continued

Region, Sub-division country and river s	Reprod. area ha	Potent-tial	19	1992	1993	1994	1995	1996	19	Pred. 1998	Pred. 1999	Method of Pot.pro	Method of Pres.p
Gulf of Finland, Sub-div. 32													
Finland													
Vantaanjoki	10	20					0	0	0			3	4
Kymijoki	50	100					3	3	4	4		3	4
Total Finland	60	120					3	3	4	4			
Russia													
Neva	20	20					20	20	x	x		7	10
Luga	40	80					11	11	x	x		7	10
Sista							+	+	x	x		7	10
Voronka							+	+	x	x			
Kovashi							+	+	x	x			
Koporka							+	+	x	x		7	10
Total Russia	60	100					31	31	x	x			
Estonia													
Kunda			+	+	+	+	+	+	+			3 and 4	3 and 4
Selja			+	+	+	+	+	+	+			3 and 4	3 and 4
Loobu			+	+	+	+	+	+	+			3 and 4	3 and 4
Pirita			+	+	+	+	+	+	+			3 and 4	3 and 4
Vasalemma			+	+	+	+	+	+	+			3 and 4	3 and 4
Keila			+	+	+	+	+	+	+			3 and 4	3 and 4
Total Estonia		50	15	15	15	15	7	7	8	10			
Total Gulf of F., Sub-div. 32	**120**	**270**	**15**	**15**	**15**	**15**	**41**	**41**	**12**	**14**			
Total Baltic, Sub-divs. 24-32 (1)		**1972**		**480**	**525**	**619**	**336**	**348**	**35**	**456**			

+ = Low and uncertain production. (1) Estimate of potential production in Latvia is missing. x/ 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 3.13.11.b.5 M74-mortality (%) in selected stocks of Baltic salmon from hatching year 1985 to 1997 with projections for 1998. All data originate from hatcheries.

River	Sub-div.	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Simojoki	31								50	74	69	85	71	73	
Torne älv	31								70	74	85	66			
Lule älv	31								58	66	57	48	61	38	5
Skellefteälven	31								40	49	69	49	77	16	
Ume/Vindelälven	30	40	20	25	19	16	31	45	77	88	85	74	78	37	
Ångermanälven	30								50	77	64	45	63	21	
Indalsälven	30	4	7	8	7	3	8	7	45	72	65	52	64	22	
Ljungan	30								60	97	50	52	28	29	
Ljusnan	30							17	33	59	86	52	72	22	
Dalälven	30	28	8	9	20	11	9	21	79	85	53	55	57	38	20
Mörrumsån	25	47	49	65	46	58	72	65	55	96	90	65	56	23	
Neva/Åland	29								-	70	50				
Neva/Kymi	32								45	60-70	-	51	36	57	
Mean River Lule, Indalsälven, Dalälven		16.0	7.5	8.5	13.5	7.0	8.5	14.0	60.7	74.3	58.3	51.7	60.7	32.7	12.5[1]
Mean total		29.8	21.0	26.8	23.0	22.0	30.0	31.0	55.2	75.6	68.6	57.8	60.3	34.2	12.5

[1] Only River Lule älv and River Dalälven in 1998.

3.13.11.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, and unlike salmon in Sub-divisions 24-31 are not showing signs of increased parr densities in rivers.

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	608	623
1995[3]	10	699	740
1996[3]	10	651	692
1997	12	667	679
1998[2]	14	559	573

[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 and 1996: 31 000 smolts. Not included in table.

Wild stocks: Based on earlier evidence there are wild salmon populations in 6-8 Estonian and Finnish rivers in the Gulf of Finland. Surveys in six Estonian rivers indicate that parr densities have decreased considerably in the last years (Table 3.13.11.c.1). Some information suggests that there are wild salmon populations in six Russian rivers in the area. At present no survey or catch data are available to support this information, see Table 3.13.11.b.4.

Reared stocks: At least 80% of the total hatchery production to the Gulf of Finland originate from Finnish hatcheries. Finland do normally release 4–500 000 smolts annually.

Management objectives: The IBSFC *objective is to* increase the natural production of wild Baltic salmon to at least 50% of the natural production capacity by 2010, while retaining the catch as high as possible.

Advice on management: ICES recommends that in order to safeguard the wild stocks, and rebuild them as quickly as possible, the offshore and coastal fisheries should be closed in 1999. Considering that the second IBSFC objective is to retain the catch as high as possible, if fishing is permitted, the catch of wild salmon should be as low as possible.

Reared fish should be harvested close to their points of release where this can be achieved without fishing wild salmon (i.e. in the mouths of rivers which *support no wild stocks and at certain coastal release* sites).

Relevant factors to be considered in management: M74 caused high mortality among offspring from sea-run females in Finnish hatcheries in 1992–1996, and the M74-related mortality continued to be high in 1997. No estimates are available for the mortality in 1998 (Table 3.13.11.b.5). 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 1999: A *status quo* projection for Sub-division 32 gives a catch prediction for 1998 and 1999 of 72 000 and 54 000 fish respectively to be compared to the catch in 1997 of 87 000 fish. The TAC for 1998 of 110 000 fish is therefore not expected to be restrictive to the fishery.

Wild stocks: For Estonian rivers the wild production is similar to earlier years. On the basis of the very low densities of 0+parr in 1997, the production of smolts is expected to decrease in the coming years. The production has increased in Finnish rivers and this is probably partly caused by spawning of reared fish. Using the most recent estimate of wild production of 12 000 smolt, it represents about 2 % of the total smolt production. This is a much lower figure than in the Main Basin and Gulf of Bothnia.

Reared stocks: The smolt production is expected to decrease to about 559 000 smolt in 1998.

Elaboration and special comment: Surveys should be undertaken to improve the data on the occurrence and status of wild stocks in this region. No detailed data are available on the current status of salmon stocks in the area of the Russian Federation.

From the 1950s to the 1970s there was a small offshore long-line fishery in the Gulf of Finland based on wild salmon production and releases of reared smolts in the former USSR. With the growth of smolt-rearing programmes in Finland in the 1980s this fishery expanded and a coastal trap net fishery developed.

The analytical assessment is based on catch at age estimated from tag recoveries. Estimates of wild production are based on limited surveys not including all rivers. Lack of data on the productivity in the fresh water phase prevented a calculation of the appropriate TAC strategy to meet any target based on smolt productivity.

Source of information: Report of the Baltic Salmon and Trout Assessment Working Group, April 1998 (ICES CM 1998/ACFM:17).

Catch data (Tables 3.13.11.b.1–2):

TACs

Year	ICES advice	Catch corresp to advice	Agreed TAC	
		'000 fish	'000 t	'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	-		

[1]Equivalent of 600 t. [2]Equivalent of 400 t.

Landings

Year	River	Coast	Offshore	Coastal and offshore[2]		Total	
	t	t	t	t	'000 fish	t	'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	38
1996	12	327	93	420	78	432	80
1997[1]	10	382	103	485	87	495	89

[1]Preliminary. Table revised because of additional data.
[2]For comparison with TAC.

Table 3.13.11.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/100m²		Number of parr
		0+	1+ and older	
Kunda				
	1992	7.4	12.9	118
	1993	0	5	26
	1994	2.3	0	7
	1995	15.4	3.1	60
	1996	28.8	10.7	132
	1997	1.2	21.5	77
Vasalemma				
	1992	3.4	2.6	23
	1994	1.9	0	7
	1995	17.9	0.4	49
	1996	5.3	5.6	37
	1997	0	1.5	8
Pirita				
	1992	1.9	0.7	11
	1994	0	0	0
	1995	0	0	0
	1996	0	+	1
	1997	**	**	**
Loobu				
	1994	1.2	2.8	23
	1995	0.2	0.2	2
	1996	0	0.4	4
	1997	0	+	3
Keila				
	1994	1.1	0.9	11
	1995	14	0.6	65
	1996	15.6	1.4	148
	1997	0	5.2	47
Seljajõgi				
	1995	0.9	7	18
	1996	0	+	2
	1997	0	0	0

+ = minor production.
** = no electrofishing

3.13.11.d Review and evaluation of present management measures

Answer to a request from the IBSFC (item h) to review existing management measures for Baltic salmon in the light of IBSFC objectives:

i) to gradually increase the production of wild Baltic Salmon to attain by 2010 at least 50% of the natural production capacity of each river with current or potential natural production of Salmon.

ii) to maintain the commercial Baltic Salmon fishery as high as possible.

In preparing its response to this request, ICES made a broad overview of the existing management measures on an international and national level. The term "existing management measures" were interpreted to include developments due to the "IBSFC Salmon Action Plan 1997–2010".

Potential salmon rivers

The state of present salmon rivers has been treated in the preceeding sections (3.13.11.a-c). As stated in the IBSFC Salmon Action Plan there is also a clear intention to re-establish salmon in potential salmon rivers. Table 3.13.11.d.1 gives an overview of the current status in these rivers. The information available is not yet sufficient to apply to all rivers the guidelines proposed by ICES for identifying possible salmon rivers.

Offshore fishery

The international management measures adopted by the IBSFC regulate the salmon fishery in the convention area of the IBSFC. Regulations on minimum landing size (60 cm), minimum mesh size of driftnets (157 mm) and minimum hook size (19 mm) for longlines are designed to insure that the growth potential of feeding salmon is realized before the salmon are caught. Closing the driftnet fishery between June 1 and September 30 will also decrease effort. At that time A.1+ fish in the feeding areas are still too small (below 60 cm) and cannot be caught and A.2+ fish which spawn at age of A.3 and older fish are less numerous. The increase in yield due to a longer summer ban was treated by ICES in 1997. In the longline fishery, the closure is longer, especially in autumn, to avoid catching undersized salmon and to decrease fishing effort.

Limiting the maximum number of driftnets (600 nets per vessel) or longline hooks (2000 per vessel) limits effort per boat and may have decreased overall effort in the Main Basin. In the Bothnian Sea and Gulf of Finland, vessels seldom use the allowed maximum number of gear per boat because of narrow fishing zones and intensive ship traffic.

These regulations have been in effect more or less unchanged since the 1970s but the measures alone have not been sufficient to prevent the decline of wild salmon populations. As long as there is a restrictive TAC in numbers in the entire Baltic, the effort limiting measures normally have small effects on the stock status. Exceptions will mainly occur if discarding is prevented by the measures, such as with the minimum mesh size in driftnets.

TAC

A TAC was implemented for Baltic salmon fishery for the first time in 1991. Although the annual TAC has frequently been exceeded, it has reduced total catches (Figure 3.13.11.d.1). Some nations have closed their fishery before the end of the year as their TAC allocation was fully utilized. As offshore fisheries are restricted, greater proportions of individual populations should escape from these fisheries and appear in the coastal areas and rivers. In recent years, the proportion of tagged salmon from the Swedish rivers Ume/Vindelälven, Ljusnan and Dalälven recovered in each river, has increased while the proportion of tagged salmon from these rivers taken in the Main Basin has been decreasing. The change is highly correlated with the decreasing TAC. This suggests that the regulation have a positive effect on wild salmon conservation.

IBSFC sets salmon TACs for the two management areas, Main Basin and Gulf of Bothnia (Sub-divisions 24–31) and Gulf of Finland (Sub-division 32). There are minor salmon catches in Sub-divisions 22 and 23 (0.9 tonnes in 1996 and 3.9 tonnes in 1997) that are counted against the implemented EU TAC. For conformity these two areas should be included in the IBSFC management unit.

Landing figures used by ICES for Finland and Sweden include estimates of the recreational catches. At present these catches are not included in the statistics reported to IBSFC. In 1991–1993 the differences were marginal but from 1994 and onwards the discrepancy increased between the two datasets (Figure 3.13.11.d.2). The assessment and hence the TAC does not distinguish between commercial and non-commercial catches.

According to IBSFC procedures, catch statistics shall be broken down by month, fishery zone and management area. The statistics shall be provided both in numbers and by weight.

In addition effort data are compiled based on an obligation to keep logbooks on vessels larger than 17 m o.a. (12 m o.a. when away from harbour for more than 24 hours).

Fishing rules cover mainly an offshore fishery with larger vessels. As salmon fishery often take place under circumstances (coast, rivers, size of vessel) where these rules do not apply, the management of salmon stocks would benefit from some additional rules concerning catch statistics (numbered a-e below).

It is not clearly spelled out if the catch statistics should include non-commercial catches. In order to make the basis of the calculation of a TAC and other catch statistics more precise:

a. Include catches from all components of the salmon fisheries where these catches are retained, also those from non-commercial fisheries.

Since the IBSFC management objective for salmon refers specifically to the wild stock component it is important to supplement these statistics by investigations and statistics that allow differentiation between wild and reared salmon catches.

b. Differentiate, wherever possible, between wild fish and salmon of reared origin.

c. Weight should be whole round weight or converted to whole round weight equivalent using appropriate conversion factors where fish are landed gutted.

d. Include salmon caught in non-salmon gear where retention of fish caught in this way is legal.

In order to keep track of the development of the fisheries.

e. Information on fishing effort should, wherever possible, be obtained for all components of salmon fisheries.

Coastal regulations

In addition to the TAC-system, national regulatory measures have been adopted to restrict fishing mortality in coastal fisheries directed at homing salmon. In Finland and Sweden the date of opening coastal fisheries in the Gulf of Bothnia has been delayed to restrict the harvest of the early run when the proportion of wild salmon is the largest. These regulatory measures were strengthened beginning in 1996–97 to further increase escapement into the rivers. Tagging experiments in which salmon were tagged during their spawning migration in the coastal parts of northern Main Basin and Gulf of Bothnia support these findings. A total of 396 tags were recovered, of which 54 were found in rivers. The origin of the fish (wild/reared) was determined from scales taken when tagging the fish. Fifty per cent were classified as wild (Table 3.13.11.d.2). Assessments of fish origin based on scale pattern analysis were compared with assessments of fish origin based on the location of tag recovery (rivers with wild fish only, rivers with reared fish only, and rivers with mixed wild and reared fish). In every case, the assessments of origin based on scale pattern analysis was the same as the determinations based on recovery location suggesting that the reading of scale pattern was reliable.

The relative exploitations of wild and reared salmon from recent tagging studies are presented in Table 3.13.11.d.3. The high proportion of reared fish recovered shows that the exploitation rates of reared salmon were higher than that of wild salmon. At average, the time of year when caught the mean catch day of wild and reared fish is different (Table 3.13.11.d.4). Wild salmon are caught considerably earlier than reared fish. The tagged fish were to a considerable extent caught during the period when normal fishery was not permitted. The time closure in the coastal fishery was for safeguarding early migrating (wild and old) fish. The results suggest that this measure was effective allowing especially wild fish to escape from the coastal fishery into rivers.

The distribution of the tag recoveries is inconsistent with the distribution of the smolt production (Figure 3.13.11.d.3). The Swedish side of the southern Gulf of Bothnia is clearly underrepresented by tag recoveries as is the River Lule in the northwestern Gulf of Bothnia. These observations could partly be interpreted as differences in timing of migration or migration routes. This may be one of the factors causing the very high proportion of wild salmon among the tagged fish.

In some countries there are fishery closures near the mouths of salmon rivers. Without these closures, salmon approaching and/or entering the river will be harvested.

In areas outside rivers having reared salmon populations, special terminal fishing areas have been introduced where an intense fishery may occur. In many cases the development of a more intense fishery in these areas have been prevented by seals that interfere with salmon fishery to such a high degree that the profitability and fishing effort in these fisheries decrease. It was estimated that in the Swedish part of the coastal Gulf of Bothnia, seals caused a catch loss amounting to 43% of the recorded landings, or 121 tonnes. This interference may partially prevent the shift of fisheries from offshore to coastal areas.

Regulatory measures in the rivers

There is a total ban on fishing in a number of salmon rivers. In some rivers there are area or time closures as well as limitations of daily catches per fisherman. In 1997 greatly increased parr densities were observed in many rivers. It can be stated that limitations in the river fisheries have been beneficial for these populations and the spawning run in 1997 suggests again a good reproduction result in many rivers. However, the 1996 and 1997 spawning run was good particularly due to the exceptionally strong year class 1991. At the same time there was an increase in regulatory measures, i.e., restrictive TAC and strong coastal fishery regulations. Therefore it is not easy to estimate what was the effect of the river regulatory measures. The status of most salmon populations is still so weak that continued strict restrictions are needed also in river fishery to safeguard the populations and increase them to the target level.

Delayed release as a management instrument

On the Swedish west coast in 1997 a part of the salmon catch seem to be of Baltic origin, i.e., they are larger than normal west coast salmon and the flesh is typically more pale as is the case in the Baltic area. Recaptures of tagged salmon indicate that these salmon emanate from experiments with delayed release technique at the island Møn among the Danish Islands and at the Island of Bornholm. While in earlier years some 2–5% of the total catch were estimated as Baltic salmon, in 1997 in the county of Halland more than 15% in numbers and some more in weight were supposed to be of Baltic origin. In rivers some 7% was estimated to be of Baltic origin.

Tagging data shows that from the releases at Møn almost 9% of the recaptures were reported taken outside of the Baltic area, while from taggings at Bornholm they were almost 3%. It could be noted that total survival was almost double in the experiments at Bornholm. Using these tagging data combined with number of fish released it could be estimated that at least 600 fish were taken outside of the Baltic area. Comparing this figure to the total reported catch on the Swedish west coast, 4719 salmon, suggests that the reported proportion of Baltic salmon in the west coast fisheries may be of the correct magnitude.

ICES reiterates the advice from 1997 concerning the use of delayed release as a management tool.

Delaying smolt releases in net pens has the following outcome:

1) it significantly improves smolt survival compared to river releases, therefore an equivalent number of adults can be produced from fewer eggs using delayed release;

2) it significantly increases the straying of maturing fish to rivers;

3) intensive terminal fisheries on delayed releases can catch large numbers of sea trout which can have a significant impact on the sea trout population.

Delayed release is inconsistent with the current conservation objectives for Baltic salmon.

Overview of the single-TAC management system

The TACs have restricted the offshore fishery and allowed greater numbers of salmon to begin their spawning migration. However, without effective coastal and river mouth fishery regulations, these fish would likely have been caught in coastal or river fisheries without spawning. The restrictive fishery measures have been beneficial for wild salmon populations. Coincidently, the number of salmon entering closed rivers that are supported by annual smolt releases (compensatory releases) has increased. The current TAC prevents utilisation of surplus reared salmon in the sea and coastal fisheries. At present surplus reared production can only be taken within the rivers as this catch is not included in the TAC. Fishing in these rivers is often difficult and therefore salmon can in some cases not be caught. These fish cannot reproduce in these rivers and most are thought to die without spawning or being caught.

A goal of the IBSFC is to keep the Baltic salmon fishery as high as possible while permitting the wild populations to rebuild. The annual reared smolt production is approximately 5 million smolts. If the average postsmolt survival is 20% then about 1 million reared salmon recruit annually to the fishery. To protect the wild fish, the 1998 TAC is substantially lower (410 000) than the number of fish available for harvest. Therefore about 0.5 million surplus fish may not be harvested under the current management regime. Management measures for the inshore fisheries that allow harvest of reared fish in absence of wild salmon should be considered.

In summary, the current system of a single TAC is sub-optimal because it does not provide for fishing opportunities on surplus reared fish in locations where they are not mixed with wild fish.

Conclusions

ICES finds that the present management system has promoted a positive development of the populations in the Main Basin and the Gulf of Bothnia. ICES's advice for the Gulf of Finland has not been implemented and the development in this region has not been in accordance with the management objectives.

ICES considers that if the current advice on catch and the changes to the management system suggested in this section are implemented there is a high probability that the development of the populations will be in accordance with the agreed management objectives for many rivers in Sub-divisions 24–31. The longer the delay in implementing the plan in the Gulf of Finland, the lower the probability that the objectives will be met by 2010.

Table 3.13.11.d.1 Current status of restoration programs in Baltic potential salmon rivers.

						Restoration of salmon population				
No	River	Country	ICES - Sub-division	Potential production areas (ha)	Potential wild smolt production	Present wild smolt production	Restoration / enhancement releases (1-6)	Origin of stock	Habitat restoration (1-6)	Restriction on salmon fisheries (a-f)
2	Sangis älv	S	31	6	1,200–1,700	0	5		5	a,c
9	Kåge älv	S	31	39	7,700-11,600	0	2	Byske älv	5	a,b
14	Hörnån	S	31	15	2,700-4,100	0	5		5	a,b
18	Moälven	S	31	**	**	0	5		6	c
23	Testeboån	S	30	8	2,100-4,200	0	2	Dalälven	4	a,b
26	Alsterån	S	27	4	4,000	0	5		5	b
28	Helgeån	S	25	5	3,200	0	5		5	b
31	Kuivajoki	FI	31	58	17,000	0	1, 4	Simojoki	4	c
33	Kiiminkijoki	FI	31	110	40,000	0	2	Iijoki	5	c,d
35	Siikajoki	FI	31	32	10,000–15,000	0	4	Oulujoki	5	C
36	Pyhäjoki	FI	31	98	39,000	0	2	Tornionjoki	2	C
37	Kalajoki	FI	31	33	13,000	0	2	Iijoki	5	C
38	Perhonjoki	FI	31	5	2,000	0	(4)	**	4	C
39	Kyrönjoki	FI	30	10	4,000	0	(4)	**	5	c,d
40	Merikarvianjoki	FI	30	8	2,000	0	(4)	Neva	6	C
45	Vantaanjoki	FI	32	14	7,000	0	2	Neva	1, 2	c,d, e
46	Kymijoki	FI	32	38	3,000	0	2	Neva	1, 4	c,d,e
53	Valgejõgi	E	32	11	6000	0	1,2,4	Neva	5	a,c,e
54	Jägala	E	32	**	**	0	4	Neva	5	a,c,e
66	Venta	LI	28	**	**	**	**	**	**	**
70	Sventoiji	LI	26	**	**	**	**	**	**	**
71	Minija / Veivirzas	LI	26	**	**	**	**	**	**	**
75	Wisla / Drweca	P	26	10	**	**	2	Daugava	2	F
76	Leba	P	25	**	**	**	4		2	D
77	Lupawa	P	25	**	**	**	5		6	D
78	Slupia	P	25	34	**	**	2	Daugava	2	F
79	Wieprza	P	25	45	**	**	2	Daugava	2	F
80	Parseta	P	25	44	**	**	2	Daugava	2	E
81	Rega	P	25	39	**	**	2	Daugava	2	E
82	Odra/ Notec, Drawa	P	24	12	**	**	2	Daugava	2	F

1	Has been carried out	A	Total ban of salmon fishery in river
2	Going on	B	Regional / local bans of salmon fishery in river mouth or river
3	Not needed	c	Time limited salmon fishery in river mouth or river
4	Planned	d	Fishing gear restrictions in river mouth or river
5	Not planned	e	Limited recreational salmon fishery in river mouth or river
6	Not known	f	Professional salmon fishery in river mouth or river

** No data

Table 3.13.11.d.2 The origin of salmon (wild or reared) was determined from scale samples collected when the fish was tagged at coastal sites in the Gulf of Bothnia. When these salmon were recovered in rivers, their origin was compared with the presence of a wild, reared or mixed salmon population in the river.

Origin of fish determined from scale reading	Fish recovered in			
	Wild salmon river	Mixed salmon river	Reared salmon river	Total
Reared	0	9	18	27
Wild	8	19	0	27
Total	8	28	18	54

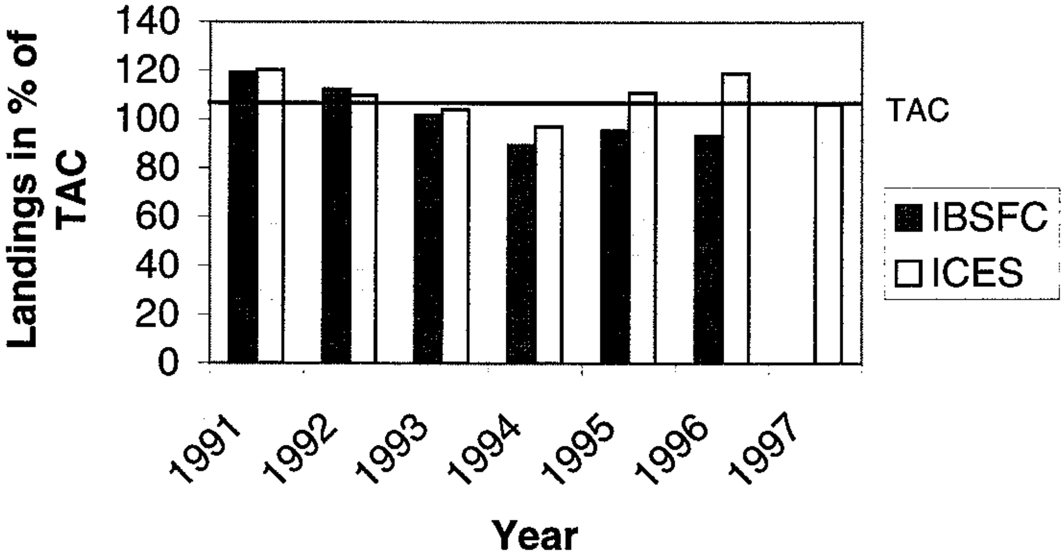
Table 3.13.11.d.3 Recoveries of salmon by origin (wild, reared) and tagging sites (combined). The quotient recoveries wild/reared compares exploitation rates.

Tagging sites combined	Origin	Tagged Number	Recoveries Number	% Recovery*	Quotient* Recovery Wild/Reared
A	Wild	102	32	33.5	
	Reared	70	32	45.7	0.733
	Total	172	64		
B	Wild	80	14	18.6	
	Reared	233	92	60.8	0.306
	Total	313	106		
C	Wild	19	5	40.6	
	Reared	48	15	53.9	0.754
	Total	67	20		
DEFJ	Wild	1	0	0.0	-
	Reared	10	4	40.0	0.000
	Total	11	4		
GHI	Wild	170	35	31.2	
	Reared	160	32	31.3	0.998
	Total	330	67		
KM	Wild	9	0	0.0	
	Reared	4	0	0.0	
	Total	13	0		
L	Wild	210	28	20.7	
	Reared	114	28	36.5	0.566
Total	Wild	591	114		
	Reared	639	203		
	Total	1230	317		

* Raised for different reporting rate of Carlin tags and DST-dummy tags.

Table 3.13.11.d.4 Mean catch day of wild and reared salmon at different tagging sites by year.

Tagging site			1995			1996			1997		Total
Combined	Data	Wild	Reared	Total	Wild	Reared	Total	Wild	Reared	Total	
A	Mean day	158.4	158.3	158.4				159.5	159.5	159.5	158.8
	No	60	39	99				42	31	73	172
B	Mean day	171.7	171.1	171.5	164.5	194.0	185.7	175.0	185.6	185.4	184.6
	No	13	9	22	66	168	234	1	56	57	313
C	Mean day	174.5	215.7	210.2	163.1	183.6	175.7				191.3
	No	4	26	30	14	22	36				66
DEFJ	Mean day	173.0	174.7	174.5							174.5
	No	1	10	11							11
GHI	Mean day	186.4	191.2	190.3	159.2	179.8	167.2	161.2	174.2	167.1	170.5
	No	9	39	48	66	42	108	94	78	172	328
KM	Mean day				164.2	163.3	163.9	156.0	156.0	156.0	160.8
	No				5	3	8	4	1	5	13
L	Mean day				159.0	158.5	158.8				158.8
	No				210	114	324				324
Total	Mean day	164.2	183.1	175.3	160.3	179.8	169.9	160.6	175.2	168.5	170.5
	No	87	123	210	361	349	710	141	166	307	1227



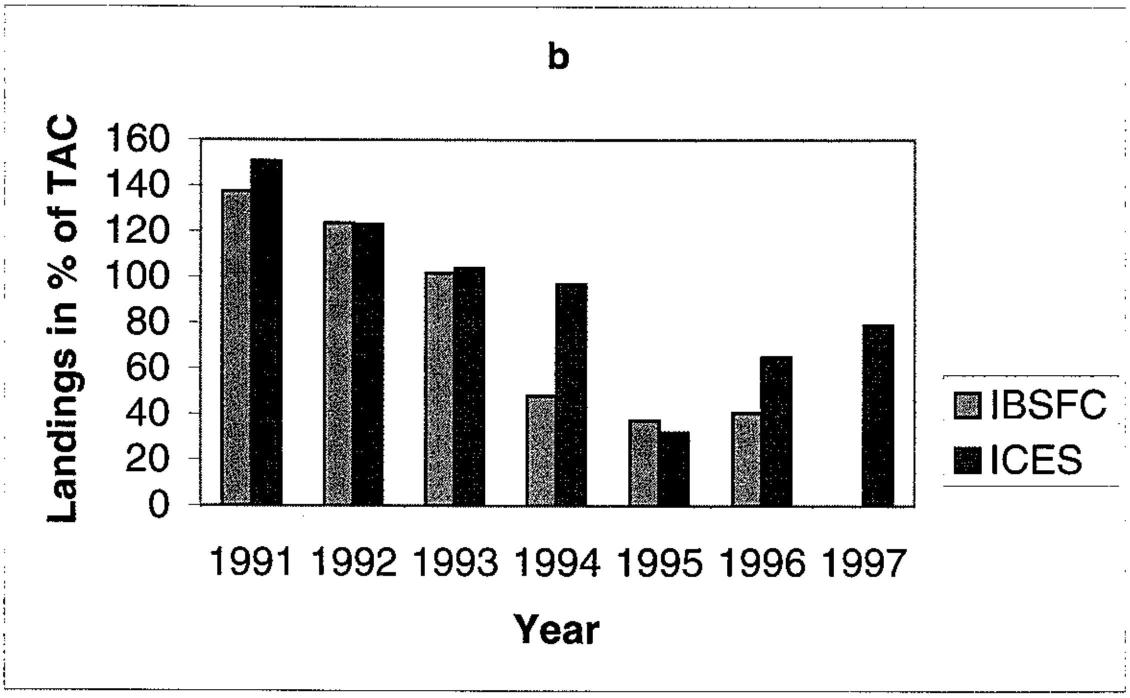


Figure 3.13.11.d.1 Landings of salmon in % of TAC according to IBSFC and ICES.

a) Landings in Main Basin and the Gulf of Bothnia, Sub-division 24–31.

b) Landings in the Gulf of Finland, Sub-division 32.

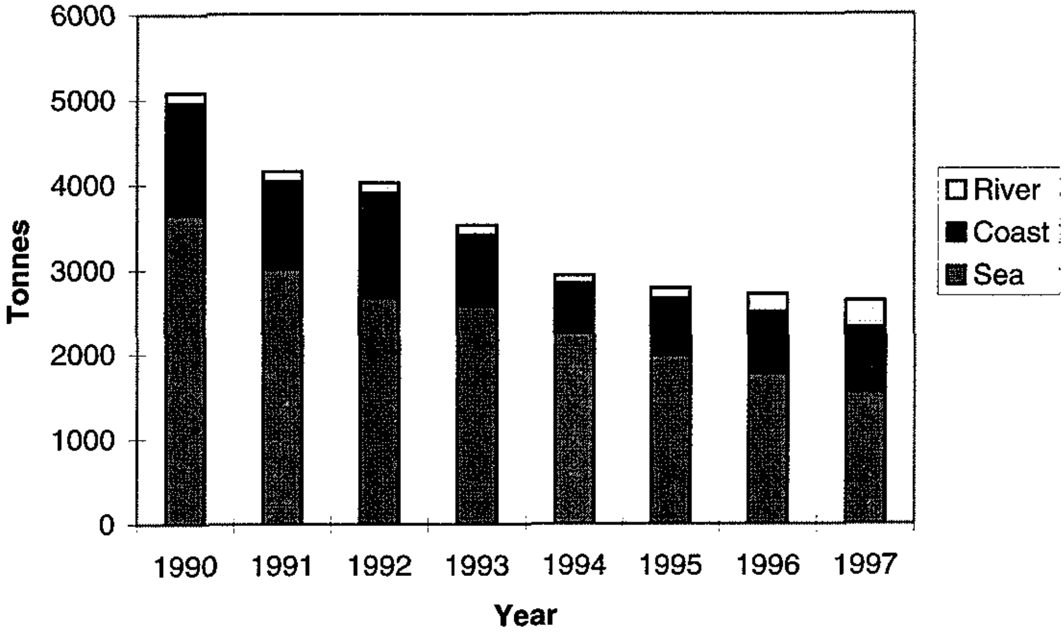


Figure 3.13.11.d.2 Salmon landings in the Main Basin and the Gulf of Bothnia in the 1990s.

Figure 3.13.11.d.3 Tagging of adult salmon spawners in 1995-1997 (sites A–M) and distribution of recoveries (dots) by area. The distribution of the smolt production in the Gulf of Bothnia in 1996 is shown by unfilled circles.

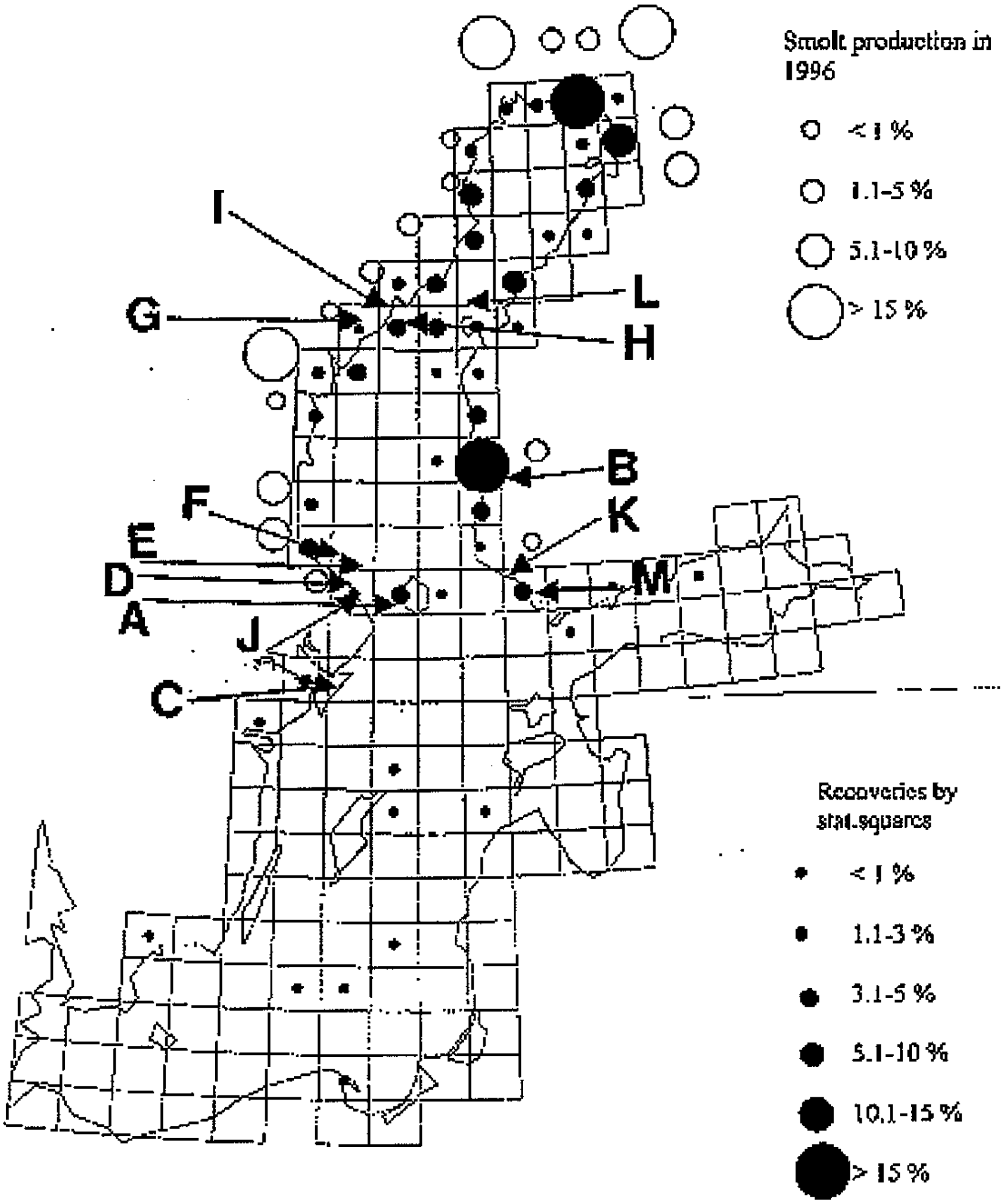


Figure 3.13.11.d.3 Tagging of adult salmon spawners in 1995–1997 (sites A–M) and distribution of recoveries (dots) by area. The distribution of the smolt production in the Gulf of Bothnia in 1996 is shown by unfilled circles.

3.13.11.e Sea trout

State of stocks/fishery: *Wild stocks:* Currently approximately 250 rivers in the Baltic 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. However, stocks in several rivers in the Main Basin are thought to be in good condition with nursery areas well utilized. The stocks in the Gulf of Bothnia, particularly in Sub-division 31, are in a poor state. Several of these populations are probably overexploited to the extent that they now mainly exist as non-migratory brown trout.

More data have become available on the status of populations in rivers in the eastern part of the Main Basin. In Lithuania and Latvia the status of populations is stable in several of the examined rivers. The population in the Swedish river Emån has become very depleted in recent years. Electrofishing surveys indicate that densities in 1994-1997 are about 5–10% of the densities in 1992–93. The decrease in density coincides with the outbreak of M74 in Baltic salmonids, but is probably not caused by this disease.

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	2541	1145	220	3906

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 1998: Not available.

Elaboration and special comment: The production of sea trout in the Baltic is dominated by reared production to a similar extent as salmon are.

Sea trout stocks in the Baltic 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 Sub-division 31, Gulf of Bothnia, sea trout are to a large extent caught in gill nets for whitefish and to a minor extent in a recreational fishery using nets or in trap nets. Changes in local fishery regulations are necessary to improve the status of the stocks in the Gulf of Bothnia which are in a poor state.

Source of information: Report of the Baltic Salmon and Trout Assessment Working Group. April 1998 (ICES CM 1998/ACFM:17).

Catch data[2] (Table 3.13.11.e.1):

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[1]	478	238	97	813

[1]Preliminary data. [2]No catch advice is given for sea trout. Catch figures do include recreational fisheries only for some countries.

Table 3.13.11.e.1 Nominal landings (tonnes) of sea trout in the Baltic. 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+C	R	S[6]	C[6]	R	C	R	S[5]	C[6]	R	C	C	R	
1979	3	-	10	-	-	-	-	81[3]	24	-	-	3	6		-	-	-	-	73		200
1980	3	-	11	-	-	-	-	48[3]	26	-	-	3	87		-	-	-	-	75		253
1981	6	-	51	-	5	-	-	45[3]	21	-	-	3	131		-	-	-	2	128		392
1982	17	-	52	1	13	-	-	80	31	-	-	3	134		-	-	-	4	140		475
1983	19	-	50	-	14	-	-	108	25	-	-	3	134		-	-	-	3	148		504
1984	29	-	66	-	9	-	-	155	30	-	-	5	110		-	-	-	2	211		617
1985	40	-	62	-	9	-	-	140	26	-	-	13	103		-	-	-	3	203		599
1986	18	-	53	-	8	-	-	91	49	7	9	8	118		1	24	-	2	178		566
1987	31	-	66	-	2	-	-	163	37	6	9	5	123		1	26	-	-	184		653
1988	28	-	99	-	8	-	-	137	33	7	12	7	196		-	44	42	3	287		903
1989	39	-	156	18	10	-	-	149	35	30	17	6	215		1	78	37	3	295		1,089
1990	48[3]	-	189	21	7	-	-	388	100	15	15	10	318		-	71	43	4	334		1,563
1991	48[3]	1	185	7	6	-	-	272	37	26	24	7	349		-	60	54	2	295		1,373
1992	27[3]	1	173	-	6	-	-	221	60	103	26	1	350		-	71	48	8	314		1,402
1993	59[3]	1	386	14	17	-	-	202	70	125	21	2	160		-	47	43	14	704[7]		1,869
1994	33[8,3]	2	384	15[8]	18	+	+	152	70	76	16	3	124		-	24	42	6	642		1,607
1995	69[8,3]	1	226	13	13	+	3	187	75	44	5	11	162		-	33	32	5	114		993
1996	71[8,3]	2	76	6	10	+	2	150	90	93	2	9	151	25	-	20	42	14	78	3	844
1997[5]	53[8,3]	2	48	+	7	+	2	200	80	72	7	7	156	12	-	16	54	8	86	3	813

[1]Additional sea trout catches are included in the salmon statistics for Denmark until 1982 (table 3.1.2).
[2]Finnish landings 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]Estimated, preliminary data.
[6]Catches reported by licensed fishermen and from 1985 also catches in trapnets used by nonlicensed fishermen.
[7]Finnish landings include about 85 % non-commercial catches in 1993.
[8]ICES Sub-div. 22 and 24.
+ Catch less than 1 tonne.

3.14 European Commission request on European eel

The EC in 1997 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), any possible actions required, and to identify gaps in knowledge about eel in order to secure a sustainable development of the eel fisheries within the European Union".

A group of eel scientists from 10 European countries joined in a Concerted Action entitled 'Enhancement of the European Eel Fishery and Conservation of the Species' financed by the European Commission. This group summarised the available information on eel biology and exploitation in Europe. The following text is primarily based on the two reports of this group (Moriarty, 1996 and Moriarty and Dekker, 1997).

3.14.1 Introduction

The European eel, *Anguilla anguilla*, is found and exploited in fresh, brackish and coastal waters in almost all of Europe (as well as in northern and western Africa), (Figure 3.14.1). Eel spawn in the open Atlantic Ocean and the larvae are transported in the Gulf Stream to the European coasts. It stays in the coastal areas, estuaries, rivers and lakes until it has grown up to a silver eel that then migrates back to the open Atlantic for spawning. The life cycle is illustrated in Figure 3.14.2. Exactly where, how and when eel spawn is not known and there is no evidence against a hypothesis of a single spawning stock. No adult eel return to Europe after spawning. They probably die.

Fisheries for eel are found throughout the entire distribution area including large parts of Eastern Europe where young eel are stocked. The target of the fisheries varies from glass eel to female maturing silver eel of 20 years of age or more.

The fisheries are generally small scale and can be commercial, semi-commercial or recreational. The processing and trade industries are organised in companies of larger size and operate on an international scale.

Aquaculture production of European eel takes place in many European countries as well as in Eastern Asia.

Stocking took place in many freshwater systems where no natural population or a low natural abundance is found, but due to the high price of the seed material in recent years (up to 500 ECU/kg), stocking rates have fallen down to almost nil.

It is not yet possible to reproduce eel artificially, so all eel production in aquaculture and stocking depends upon the collection of wild juveniles. In recent years the aquaculture industry in eastern Asia has purchased glass eel from Europe which significantly increased the total demand for glass eel.

No internationally co-ordinated management of European eel exists. There are national or local management measures, however these are not designed to provide overall protection for the stock. Table 3.14.1 gives an overview of conservation measures implemented on a country basis.

With the exception of commercial catch statistics (which are notoriously incomplete), there has been very little internationally co-ordinated monitoring of the eel stock. This is reflected in the scarcity of compiled data on the overall stock status.

3.14.2 Catches

Total international catches of eel officially reported by ICES member countries are shown in Table 3.14.2. Only Denmark, Norway and Sweden have supplied data consistently from the beginning of the century and Figure 3.14.3 shows the catches of these countries. The FAO Fishery Statistics for all countries including ICES non-member countries are given in Table 3.14.3 and the sum for capture fisheries in inland and marine areas is shown in Figure 3.14.4. Both statistics show a decrease in capture fishery catches starting in the 1960s. The increase in the reported catches from 1950 to the middle of the 1960s shown by the FAO statistics is probably an artefact created by incomplete reporting. It is known that a substantial part of eel catches are not included in the official catch statistics. According to Moriarty (1996, p.44) the actual catch in 1993 was 21 224 t in comparison to 14 882 t officially reported to FAO (Table 3.14.4). Both numbers include aquaculture production, which was 5 910 t in 1993 (Moriarty 1996).

Although the glass eel in weight accounted only for 4% of the total catch, it accounted for 97% in numbers in 1993. Due to the high price, glass eel accounted for 33% of the catch in value. 95% of the glass eel caught were used for human consumption, the rest for stocking and aquaculture. Recent aquaculture developments in eastern Asia, starting in 1995, have changed this completely. Now more than half of all glass eel catches is transported to Asia, less than 10% used for aquaculture in Europe and less than 25% used for the direct consumption market.

Table 3.14.4 shows also the catch by eel stage (glass eel, yellow eel, and silver eel).

3.14.3 State of the stock

The spawning stock seems to be historically low and recruitment declined over the last two decades. The stock is considered to be outside safe biological limits.

3.14.3.1 Glass eel

There is no time series available that shows the total recruitment of eel to the European continent. There are, however, several rivers covering the main distribution areas of eel, where long term monitoring of immigrating glass eel have taken place (Figure 3.14.5). These data show a clear and consistent picture of a decrease in recruitment in all areas over the last two decades. The exception is the river Erne, in Ireland. Unfortunately, only three data series go back more than 3 decades. These indicate that the immigration has been low at the end of the 1940's, high in the 1960's and 1970's, followed by a sudden and widespread (but not universal) decline in the 1980's.

Most rivers in western Europe have always attracted extremely high numbers of glass eel and even though the numbers are decreasing over the last 2-3 decades the immigration of glass eel is probably much higher than needed to support the local eel populations.

3.14.3.2 Yellow and Silver eel

Moriarty and Dekker (1997) extrapolated from catch data in a few systems a minimum of 595 t of silver eel escaped fishing in 1993. These constituted the spawning stock, except for those eels, which died naturally on their Atlantic Ocean migration. No other estimate of total spawning stock size is available.

Data on catch per unit effort exist from only a few sources. Danish trawl catches in the fjord Limfjorden show a dramatic decrease from about 14 eel per 30 minutes hauls to 1 from 1980 to 1990.

Biomass per area has been estimated in France by extensive surveys using electro-fishing and removal methods. In Brittany river systems the density has decreased from 70 kg/ha in 1990 to 40 kg/ha in 1996 and in Normandy river systems from 120 kg/ha to 60 kg/ha in the same period.

Semi-quantitative data show declines in density and catch of yellow and silver eel in all European countries in which fishing for these stages takes place, and some fisheries have collapsed. The exceptions are local populations, sustained by restocking. The decline seems to have started early in the 1960s.

3.14.3.3 Fishing and natural mortality

Stocking studies suggest that natural mortality from immigrant to emigrant stage is about 75% (Moriarty and Dekker 1997, p.22). If it is assumed that a silver eel is on average 10 years old this gives a natural mortality rate of 0.14 per year.

Fishing mortality on a total stock basis is not known. In lake IJsselmeer (the Netherlands) F is 0.5 and in Lough Neagh (N.Ireland) it is assumed to be of comparable magnitude. Most of the marine and brackish water habitat catches come from the northern countries, in particular from the Baltic Sea and from fjords and brackish areas in Denmark, Germany, the Netherlands and Sweden. These habitats are exploited at a high level at present (Moriarty and Dekker 1997, p.17). In France, Portugal, and Spain there is no prominent fishery on yellow and silver eel. In these areas there is, however, a large glass eel fishery for consumption and for stocking material in aquaculture and in natural habitats. In total it is likely that fishing mortality is significantly higher than the natural mortality.

Data on fishing effort are sporadic, qualitative or semi quantitative only and not internationally standardised. The overall picture is, however, that effort has over time increased in most of the main distribution areas.

3.14.4 Reasons for the stock decline

The main possible reasons for the stock decline are discussed below.

3.14.4.1 Over-fishing

Heavy fishing on all stages of eel reduces the spawning stock size and a reduced spawning stock size may produce less recruitment.

There are large catches of juvenile eel in Western Europe that includes the main glass eel distribution areas. An estimate for 1993 is 516 tonnes but precise catch data are not available. These fisheries on glass eel represent at present 97% of the total European eel catch in numbers and about 4% in weight. The glass eel fishery has a long tradition going back to at least the beginning of the century.

The correspondence in time between the decline in the eel stock and the eel recruitment indicates that over-fishing is indeed a possible reason.

3.14.4.2 Larvae starvation

The period of low recruitment coincides with a period in which the immigrating glass eel in Den Oever (the Netherlands) were significantly smaller than in the preceding decades. This has been interpreted as an indication of bad feeding conditions for the *Leptocephalus* larvae, during their oceanic migration. This could influence larval survival.

3.14.4.3 *Anguillicola crassus*

The nematode parasite *Anguillicola crassus* was introduced to Europe around 1985 from the Far East. Parasitism by *Anguillicola* is now widespread in Europe, infestation rates are commonly high and damage to the swimbladder has been observed. However, there seems to be no clear evidence of a significant effect on the yellow eel abundance. Whether a damaged swimbladder will negatively affect the ability of a silver eel to adjust its buoyancy in the oceanic mid-water on its spawning migration is unknown.

3.14.4.4 Pollution

There has been no proven significant mortality due to persistent pollutants such as heavy metals and organochemicals, except in major but isolated accidents, such as the Sandoz spill into the Rhine in 1986. Xenobiotic organochlorines are bio-accumulated but a) there is no proof of major effects on survival, b) declines in recruitment in both Europe and North America (American eel) are not clearly correlated with periods of maximum contamination by organochlorine compounds and c) the escapement of maturing eel from uncontaminated waters is estimated to greatly exceed that of eel that could have accumulated toxic levels.

3.14.4.5 Physical barriers

Physical barriers inhibit migration and hence recruitment in certain catchment areas. The impact on Europe-wide recruitment is, however, relatively low, with only about 28% of potential suitable waters rendered inaccessible by natural and only 3% by man-made barriers. Furthermore, many barriers were present several decades before the recruitment decline began.

3.14.4.6 Oceanic events

The general dynamics of the Gulf Stream for the most recent 2-4 decades seems to be unchanged and no major change compared to previous periods has been reported.

There has been a parallel decline in recruitment of *A. rostrata* in Canada and this decline occurred in the absence of any significant exploitation of glass eel or later stages. Common oceanic factors acting on both species are implied. Which factors that are involved in the growth, survival and transport of eel larvae from the open Atlantic Ocean to Europe are very poorly known and even the dynamics of the Oceanic currents in the north Atlantic and of its variation over time is poorly known. There are weak indications that the position of the north wall of the Gulf Stream is correlated with the inflow/immigration of glass eel on both sides of the Atlantic in 1978-1992 and that in the recent years eel larvae have been transported by the currents to more northerly areas. However, there is no report of increased eel recruitment in the northern areas. No information on the north wall of the Gulf Stream for earlier years seems to be available and this hypothesis is therefore difficult to fully analyse.

3.14.5 Gap in knowledge

The general knowledge about European eel is poor. A summary of past management-related research on eel and proposals for a baseline for future co-operative monitoring and research (integrating the national and international levels) is given in Moriarty and Dekker (1997, chapter 4) that also discusses the practical problems of monitoring and managing the scattered continental resource.

The research requirements can be separated into a need for improvements in the monitoring of the stock development and in research projects aimed at better understanding of the biology of eel.

3.14.5.1 Monitoring

Total landings are not known with precision and are only given where available for all eel combined. It is of paramount importance that an international co-ordinated monitoring scheme for the annual catch by country, by area (inland and marine), by fishing type, and by life stage (glass eel, elvers, yellow eel and silver eel) is implemented. Recreational catches and unreported landings should be included in the monitoring.

The monitoring of recruitment should be continued at the present monitoring sites and additional sites added especially in the Mediterranean area and in North Africa.

Monitoring of yellow and silver eel densities should be standardised and an international net of monitoring stations selected.

Monitoring of the *Anguillicola crassus* infestation rates and investigations of the resulting mortality rate and effects on the ability of infected fish to recover and be able to migrate back for spawning is also needed.

3.14.5.2 Biology

The effect of removal of glass eel has so far not been quantified. This may involve estimation of density dependent mortality in the glass eel fisheries areas particularly in France and Spain.

In order to improve the analytical basis for management advice on eel, ultimately, the unsolved spawning problem must be addressed. This requires long running, broad co-operative research projects, aiming at understanding the natural process of recruitment.

It is unknown to what extent glass eel moved from one area to another area (stocking) are able to find their way back as silver eel to the spawning areas. This also requires clarification of the genetic structure of the population. As stocking is at present at a low level, this problem is of less urgency.

3.14.6 Management advice

Stock status: The eel stock is outside safe biological limits and the current fishery is not sustainable. Recruitment is low and continues to decline and fishing mortality is probably high both on juvenile (glass eel) and older eel (yellow and silver eel).

Management objective: There is no stock-wide objective stated for this stock. Some countries, e.g. France, Germany and Sweden, have formulated national policies that include both biological and economic considerations.

Advice on management: Actions that would lead to a recovery of the recruitment are needed. The possible actions are 1) restricting the fishery and/or 2) stocking of glass eel. When the escapement of the glass eel increases, then - because of the length of the life cycle - it will take 5-20 years before positive effects of the subsequent recruitment can be expected.

Standards for escapement targets of glass eel, yellow eel and silver eel should be agreed on an international level. There are data available allowing a provisional definition of such targets. The implementation of such standards should be on a system-by-system (river or lake) basis implying control over the fisheries on all eel life stages, i.e. glass, yellow and silver eel.

In several important systems the exploitation of both glass eel and/or of older eel is too high and should be reduced, e.g. through effort control or closed areas/seasons. Management of these fisheries is only possible at a regional or even lower level.

Stockings seem not to contribute to spawner escapement and should therefore not be part of a management plan for the restoration of the eel stock. Stockings may have adverse genetic effects although this has not been demonstrated for eel.

Elaboration and Special comments: Continuous monitoring of the recruitment and spawner escapement is needed. The existing time series should be continued and preferably be supplemented. Monitoring cannot be done on a stock basis but must be based on selected index systems (river or lake) throughout the distribution area of eel. These index systems should be spread out through the distributions of European eel, i.e. include examples from the Baltic Sea, the Atlantic coast and from the Mediterranean. International co-ordination of research on this species is badly needed.

The status of the stock is poorly known and in particular the landing statistics are not complete. The biological composition of the catch is only known for a few systems.

The biology of the eel stock is poorly known. To evaluate the impact of the fisheries on the stock development, more information on the biology and the population dynamics of the eel stock is required.

Sources of information:

Moriarty, C. 1996. The European eel fishery in 1993 and 1994. Fisheries Bulletin (Dublin) 14.

Moriarty, C. and Dekker, W. 1997. Management of the European Eel. Fisheries Bulletin (Dublin) 15.

ICES 1997. Report of the EIFAC/ICES Working Group on eel. ICES CM 1997/M:1.

Table 3.14.1 Conservation measures. From Moriarty and Dekker (1997).

	Ban on comm-ercial fishing	Use of elver passes	Gear control	Close seasons	Fishing/dealing licences	Mesh size control	Other gear control	Close seasons	Fishing/ dealing licences	Size limits	Free gaps in weirs	Quotas
Sweden	*	*					*	*		*	*	
Denmark	*	*				*	*	*		*	*	
Germany	*						*		*			
Ireland (N)						*	*	*	*	*	*	*
Ireland (R)	*	*				*	*	*	*	*	*	*
Great Britain		*	*		*	*	*		*			
Nether-lands	*	*				*	*	*	*	*		
France		*	*	*	*		*	*	*			
Portugal			*	*	*		*	*				
Spain			*	*	*		*	*				
Italy					*	*	*		*	*		

Table 3.14.2 ICES Fisheries Statistics Catch of European eel in tonnes(This table is also available on the ICES homepage on the WEB (www.ices.dk))

YEAR	Denmark	Norway	Sweden	Germany	Ger., Fed.	Ger., Dem.	Nether-lands	Belgium	UK	England	England & Wales	England, Wales and N. Ireland	Scotland	N. Ireland	Ireland	USA	Poland	Canada	Latvia	Estonia	Spain	USSR	Rus. Fed.	Finland	Iceland	Portugal	France	SUM
																												0
1903	2211			19			564																					2794
1904	2486			24			586																					3097
1905	2690		273	26			415																					3405
1906	2980		290				413																					3683
1907	2776		247	40			526																					3589
1908	3287	268	243	52			453																					4303
1909	2969	327	222	70			516																					4103
1910	4099	303	737	1049			620																					6807
1911	4583	384	867	1199			988																					8021
1912	4826	187	1150	1365			720																					8248
1913	4721	213	1061	1397			679																					8071
1914	5,499	282	1,461	1,062			921																					9225
1915	4,182	143	987	923			1,285																					7520
1916	3,740	117	1,078	1,034			973																					6942
1917	3,749	44	1,284	1,029			1,280									2												7388
1918	2,920	35	884	733			1,111									1												5684
1919	3,049	64	1,145	1,159			1,026																					6443
1920	3,328	80	970	1,189			1,157																					6724
1921	3,392	79	1,072	1,235			989										28	158										6953
1922	3,672	94	926	1,125			900										78	73										6868
1923	3,277	140	948	1,175			742										83	57										6422
1924	3,983	290	1,201				91										119		23									5707
1925	4,715	325	1,714	1,571			965										66	104	14									9474
1926	4,541	341	1,707	1,964			879										74	98	22									9626
1927	4,459	354	2,011	1,889			763										150	70	29									9725
1928	3,956	325	1,040	1,639			877										122		21									7980
1929	4,201	425	1,394	1,714			1,033										138		35									8940
1930	4,570	450	1,534	1,883			1,001										106		42									9586
1931	4,018	329	1,532	1,681			1,071										128		42									8801
1932	4,844	518	1,724	1,732			1,280										107		37									10242
1933	4,737	694	1,546	1,759			2,395										118		50									11299
1934	4,947	674	1,845	1,860			2,983										140		73									12522
1935	4,099	564	1,951	2,231			2,294										110		47									11296
1936	4,139	631	1,655	2,505			2,719										162		70									11881
1937	4,109	603	1,725	2,574			3,946										152		96									13205
1938	3,645	526	1,871	2,606			2,817										141		134									11740
1939	4,410	434	1,774	2,151			2,352			22							35		134									11312
1940	3,528	143	1,626	39			275			19											84							5714
1941	3,733	174	1,629	31			94			4											93							5758
1942	2,982	131	1,132	50			55			3											65							4418
1943	3,742	136	1,546	41			25			9											24							5523
1944	4,084	150	2,001	34			28			4											57							6358
1945	4,031	102	1,673				12			14											60							5892
1946	4,109	167	1,517				51			13											79							5936
1947	4,608	268	1,914				87			16											103							6996
1948	4,242	293	1,866				89			11					161						110							6772
1949	4,318	214	1,902	353			83			8											104							6982
1950	4,510	282	2,192	413			70			6											107							7580

Table 3.14.2 Continued

YEAR	Denmark	Norway	Sweden	Germany	Ger., Fed.	Ger., Dem.	Nether-lands	Belgium	UK	England	England & Wales	England, Wales and N. Ireland	Scotland	N. Ireland	Ireland	USA	Poland	Canada	Latvia	Estonia	Spain	USSR	Rus. Fed.	Finland	Iceland	Portugal	France	SUM 0
1951	4,439	312	1,933	412			72			4											17							7189
1952	3,903	178	1,600	360			63			8											21							6133
1953	4,287	371	2,381	451			65			9				224							43							7831
1954	3,780	327	2,113	348			49			4				417							14							7052
1955	4,786	451	2,656	471			48			3				750			650				34	470						10319
1956	3,673	293	1,537	365			52			8				552			580				67	418						7545
1957	3,640	430	2,228	447			81			5				562			363				135	460						8351
1958	3,287	437	1,757	409			101			2				544			484				164	410						7595
1959	4,026	409	2,797	499			118			8				407	80		374				99	247						9064
1960	4,723	430	1,648	450			154			10				804	106		563				45	295						9228
1961	3,876	449	2,079	448			180		20						107		480				26	294						7959
1962	3,907	356	1,745	412			146		15						103		502				38	538			22			7784
1963	3,928	503	1,860	510			216		6						105		535					280				5		7948
1964	3,282	440	1,827	436			282								146		658				405	273				4		7753
1965	3,197	523	1,666		392		241				5				184		477				222	297						7204
1966	3,690	510	1,746		490		350				5			965	84		598				194	430				4		9066
1967	3,436	491	1,481		604		426				21			621	134		621				68	390						8293
1968	4,218	569	1,719		583		399				32			611	143		653				63	367						9357
1969	3,624	522	1,658		496		547				18			645	122		571				33	404						8640
1970	3,309	422	1,130		459		368				14			790	220		418				47	381						7558
1971	3,195	415	1,313		512		261				17			789	92		377					351					616	7938
1972	3,229	422	1,148		411		170				18			666	89		320				112	321					717	7623
1973	3,454	409	1,136		400	282	205				46			796	91		225					351				47	2,917	10359
1974	2,814	368	958		351	317	153				20			797	67		272					429					1,114	7660
1975	3,225	407	1,399		382	371	173				22			811			276					178				44	795	8083
1976	2,876	386	935		386	305	134				20			674			300					148		18		38	1,300	7520
1977	2,324	352	989		382	251	146				10			732			267					134		16		52	244	5899
1978	2,335	347	1,076		319	209	143				19			858			271					170		15		44	580	6386
1979	1,826	374	951		348	208	177				29			850	110		294				66	89		16		25	1,083	6446
1980	2,141	387	1,112		330	126	187				53			1,000			406				44	161				32	909	6888
1981	2,088	369	887		316	114	175				69			789	94		49					139				33	335	5457
1982	2,376	385	1,161		354	95	277				59			834	144		56				69	119				14	536	6479
1983	2,003	324	1,212		305	115	316				41			757	117		185				38	118				11	606	6148
1984	1,745	310	1,073		255	98					41			867	88		201				20	119				20	496	5333
1985	1,520	352	1,115		217	75					59			702	87		296				15	126		3		16	407	4990
1986	1,553	272	830		212	83					118			715	87		357				28	134				42	697	5126
1987	1,190	282	703		154	60					106			714	214		249				43	161					236	4112
1988	1,760	513	829		166	59	153				77			652			296				24	135					544	5208
1989	1,582	313	843		156	39	585				58						318				41	209					364	4508
1990	1568	336	813		187		137					968					113									28	272	4422
1991	1366	323	953		235		133					594					297			3	20					44	183	4151
1992	1341	372	1048		250		67					733					295			9	37		53			52	213	4470
1993	880	340	1015		253		44					700					316			10	22		19				273	3872
1994	1140	472	1127		35		48					775					290			10			25				346	4268
1995	842	454	973		34		40					43	9				237		2	6			33				300	2973
1996	701	353	945	146			36					26	11		150		266		1	19			36				188	2878

Table 3.14.3 FAO catch statistic (in tonnes).

COUNTRY	SPECIES_S	SPECIES_E	AREA	UNIT	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Algeria	Anguilla anguilla	European eel	Africa - Inland waters	MT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Morocco	Anguilla anguilla	European eel	Africa - Inland waters	MT	0	0	0	0	0	0	0	0	0	0	0	300	300	300	300	300	300	300	300	300
Tunisia	Anguilla anguilla	European eel	Africa - Inland waters	MT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Turkey	Anguilla anguilla	European eel	Asia - Inland waters	MT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Spain	Anguilla anguilla	European eel	Atlantic, Eastern Central	MT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Morocco	Anguilla anguilla	European eel	Atlantic, Eastern Central	MT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Togo	Anguilla anguilla	European eel	Atlantic, Eastern Central	MT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Germany	Anguilla anguilla	European eel	Atlantic, Northeast	MT	400	400	400	500	300	500	400	400	400	500	400	500	400	1500	1400	1000	1200	1300	1200	900
Denmark	Anguilla anguilla	European eel	Atlantic, Northeast	MT	4500	4400	3900	4300	3800	4800	3700	3600	3300	4000	4700	3900	3900	4000	3300	3200	3700	3400	4200	3700
Spain	Anguilla anguilla	European eel	Atlantic, Northeast	MT	100	0	0	0	0	0	0	0	100	100	0	0	0	200	100	100	100	100	100	100
Estonia	Anguilla anguilla	European eel	Atlantic, Northeast	MT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Finland	Anguilla anguilla	European eel	Atlantic, Northeast	MT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
France	Anguilla anguilla	European eel	Atlantic, Northeast	MT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	800	600
UK	Anguilla anguilla	European eel	Atlantic, Northeast	MT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ireland	Anguilla anguilla	European eel	Atlantic, Northeast	MT	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	200	100	100	100	100
Latvia	Anguilla anguilla	European eel	Atlantic, Northeast	MT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Netherlands	Anguilla anguilla	European eel	Atlantic, Northeast	MT	100	100	100	100	100	100	100	100	100	100	200	200	100	200	300	200	400	400	400	500
Norway	Anguilla anguilla	European eel	Atlantic, Northeast	MT	300	300	200	400	300	500	300	400	400	400	400	500	400	500	400	500	500	500	600	500
Poland	Anguilla anguilla	European eel	Atlantic, Northeast	MT	400	400	500	500	500	600	600	400	500	400	600	500	500	500	700	500	600	600	600	600
Portugal	Anguilla anguilla	European eel	Atlantic, Northeast	MT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Russian Fed.	Anguilla anguilla	European eel	Atlantic, Northeast	MT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
USSR	Anguilla anguilla	European eel	Atlantic, Northeast	MT	100	200	200	200	400	400	400	400	400	200	200	300	300	300	300	300	400	400	400	400
Sweden	Anguilla anguilla	European eel	Atlantic, Northeast	MT	2200	1900	1600	2400	2100	2600	1500	2200	1800	2800	1600	2100	1900	1900	2300	1800	2000	1600	1800	1700
Albania	Anguilla anguilla	European eel	Europe - Inland waters	MT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Belgium	Anguilla anguilla	European eel	Europe - Inland waters	MT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Switzerland	Anguilla anguilla	European eel	Europe - Inland waters	MT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Czech Rep	Anguilla anguilla	European eel	Europe - Inland waters	MT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Germany	Anguilla anguilla	European eel	Europe - Inland waters	MT	0	0	0	0	0	0	0	0	0	0	0	0	0	600	500	500	500	600	600	700
Denmark	Anguilla anguilla	European eel	Europe - Inland waters	MT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100	100	0
Spain	Anguilla anguilla	European eel	Europe - Inland waters	MT	0	0	100	100	100	600	700	400	300	400	300	300	700	1000	1600	1200	1200	1200	1200	1200
Finland	Anguilla anguilla	European eel	Europe - Inland waters	MT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
France	Anguilla anguilla	European eel	Europe - Inland waters	MT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
UK	Anguilla anguilla	European eel	Europe - Inland waters	MT	100	100	100	200	400	800	600	600	500	700	800	800	700	700	600	800	1000	600	600	600
Greece	Anguilla anguilla	European eel	Europe - Inland waters	MT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hungary	Anguilla anguilla	European eel	Europe - Inland waters	MT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ireland	Anguilla anguilla	European eel	Europe - Inland waters	MT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Italy	Anguilla anguilla	European eel	Europe - Inland waters	MT	1000	1000	1000	1000	1000	1000	2000	2000	2000	2500	2200	2200	2700	3000	3000	2700	2600	2600	2700	3000
MacedoniaFYR	Anguilla anguilla	European eel	Europe - Inland waters	MT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Netherlands	Anguilla anguilla	European eel	Europe - Inland waters	MT	4100	3600	3900	3000	2000	1600	1700	2400	2700	3300	2800	2300	1500	1700	2200	2400	2400	2700	2300	2300
Poland	Anguilla anguilla	European eel	Europe - Inland waters	MT	300	300	400	400	300	400	300	400	700	300	400	400	500	500	400	400	400	500	500	500
Portugal	Anguilla anguilla	European eel	Europe - Inland waters	MT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Slovakia	Anguilla anguilla	European eel	Europe - Inland waters	MT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sweden	Anguilla anguilla	European eel	Europe - Inland waters	MT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	68	68	70	67	72	73
Belarus	Anguilla anguilla	European eel	Former USSR area - Inland wate	MT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Estonia	Anguilla anguilla	European eel	Former USSR area - Inland wate	MT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lithuania	Anguilla anguilla	European eel	Former USSR area - Inland wate	MT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Latvia	Anguilla anguilla	European eel	Former USSR area - Inland wate	MT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Russian Fed.	Anguilla anguilla	European eel	Former USSR area - Inland wate	MT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
USSR	Anguilla anguilla	European eel	Former USSR area - Inland wate	MT	0	0	0	100	100	100	0	100	0	0	100	0	100	100	0	0	0	0	0	100
Ukraine	Anguilla anguilla	European eel	Former USSR area - Inland wate	MT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Spain	Anguilla anguilla	European eel	Mediterranean and Black Sea	MT	0	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	200	100	200
France	Anguilla anguilla	European eel	Mediterranean and Black Sea	MT	500	500	700	600	500	500	500	500	600	900	1300	1300	1300	1400	1400	1700	1300	2000	1900	1300
Greece	Anguilla anguilla	European eel	Mediterranean and Black Sea	MT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Croatia	Anguilla anguilla	European eel	Mediterranean and Black Sea	MT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Italy	Anguilla anguilla	European eel	Mediterranean and Black Sea	MT	0	0	0	0	0	0	0	0	100	500	500	400	400	500	500	500	500	500	500	400
Morocco	Anguilla anguilla	European eel	Mediterranean and Black Sea	MT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Malta	Anguilla anguilla	European eel	Mediterranean and Black Sea	MT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tunisia	Anguilla anguilla	European eel	Mediterranean and Black Sea	MT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100	200	100	100	100	100
YugoslaviaFR	Anguilla anguilla	European eel	Mediterranean and Black Sea	MT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Yugoslav SFR	Anguilla anguilla	European eel	Mediterranean and Black Sea	MT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Africa - Inland waters		0	0	0	0	0	0	0	0	0	0	0	300	300	300	300	300	300	300	300	300
			Asia - Inland waters		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Atlantic, Eastern Central		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Atlantic, Northeast		8200	7800	7000	8500	7600	9600	7100	7600	7100	8600	8200	8100	7600	9200	8900	7800	9000	8400	10200	9100
			Europe - Inland waters		5500	5000	5500	4700	3800	4400	5300	5800	6200	7200	6500	6000	6100	7500	8368	8068	8170	8367	8072	8373
			Former USSR area - Inland wate		0	0	0	100	100	100	0	100	0	0	100	0	100	100	0	0	0	0	0	100
			Mediterranean and Black Sea		500	600	800	700	600	600	600	600	800	1500	1900	1800	1800	2000	2100	2500	2000	2800	2600	2000
			Aquacultura		1000	1000	1000	1000	1000	1000	1000	900	800	700	600	500	500	400	300	200	0	0	0	0
			Total inland capture		4500	4000	4500	3800	2900	3500	4300	5000	5400	6500	6000	5800	6000	7500	8368	8168	8470	8667	8372	8773
			Tota marine		8700	8400	7800	9200	8200	10200	7700	8200	7900	10100	10100	9900	9400	11200	11000	10300	11000	11200	12800	11100
			Grand total		13200	12400	12300	13000	11100	13700	12000	13200	13300	16600	16100	15700	15400	18700	19368	18468	19470	19867	21172	19873

Table 3.14.3 Continued

1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
0	0	0	0	50	0	0	0	0	0	0	0	0	0	44	34	82	69	72	53	46	22	1	0	22	20
0	0	0	0	0	0	0	20	20	20	20	30	50	100	100	100	100	100	35	30	50	30	50	100	150	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18
400	500	200	300	588	448	499	282	283	396	224	374	424	588	616	583	517	543	756	472	230	262	245	261	329	390
0	0	0	0	445	470	0	90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	1	7	4	3	2	2	5	26	13	5	2	3	14	12	9	4	4	2	1	4	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
900	700	700	700	668	753	691	633	528	556	456	430	449	419	353	292	295	214	225	195	185	235	250	253	35	35
3300	3200	3200	3500	2814	3225	2876	2324	2335	1826	2141	2086	2376	2003	1745	1520	1552	1189	1759	1582	1568	1365	1341	1024	1140	841
100	100	500	500	0	0	0	0	0	66	44	0	69	38	35	35	52	72	55	102	159	118	142	200	160	200
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	6	2	0	8	10	10	6
0	0	0	0	0	0	19	16	15	16	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0
0	600	700	2900	1114	795	1300	244	580	1083	909	335	535	605	496	407	697	616	544	366	276	185	213	275	346	313
0	0	0	0	20	22	20	10	19	29	53	69	58	68	40	59	118	106	63	58	54	46	33	38	40	52
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	1	2
400	300	200	200	153	173	134	146	143	177	187	175	277	316	0	0	0	0	153	120	137	133	66	43	49	39
400	400	400	400	383	411	386	352	347	374	387	369	385	324	309	352	271	282	513	312	336	323	373	340	472	454
400	400	300	200	272	276	300	267	271	294	406	49	56	185	201	296	357	249	296	318	113	297	295	316	290	237
0	0	0	0	42	44	38	52	44	25	32	33	14	11	20	16	43	0	0	0	28	54	547	3	3	3
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	129	203	85	0	53	19	25	33
400	400	300	400	429	178	148	134	170	89	161	139	119	118	119	126	134	161	0	0	0	0	0	0	0	0
1200	1400	1200	1200	1034	1399	935	989	1076	956	1112	887	1161	1212	1073	1118	830	703	829	842	813	952	1048	1015	1127	972
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	177	194	143	165	81	188	180	192	186
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	48	48	48	48	78	60	155	155	155	155	155
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	10	14	13	11	11	7	7	4	5	5
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	33	36	35
700	600	600	600	617	645	631	684	634	608	595	603	578	610	558	574	592	517	521	483	791	775	776	774	550	550
100	0	100	100	56	68	50	57	44	34	113	141	162	117	126	111	210	243	324	734	813	999	1008	957	960	1012
1000	1000	1000	700	600	570	610	600	600	300	300	250	200	150	150	200	200	200	180	200	125	150	150	150	200	200
0	0	0	0	0	0	9	47	62	61	63	30	29	29	23	23	24	1	1	1	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	2582	0	0	0	30	380	1003	400	770	810	810	810	810	810	810	180
800	800	700	800	797	811	674	732	858	850	1000	789	974	1045	917	722	879	833	652	1017	985	776	749	714	833	756
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	504	518	450	500	450	450	337	341	617
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	115	90	39	249	205	454	263	501	411
200	100	100	100	67	79	150	108	76	110	75	94	144	117	88	87	87	221	215	400	256	245	234	260	300	400
1000	1000	600	600	639	663	576	592	555	665	543	530	494	449	2500	2500	2500	2700	3000	2500	2500	2922	2870	3000	2130	2550
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	70
1100	900	900	900	876	1040	1219	815	748	552	690	723	876	972	723	708	785	559	480	562	572	577	542	1625	1710	1928
600	500	600	600	619	641	374	729	670	713	504	703	839	918	1497	1041	777	713	791	791	800	800	800	800	800	390
0	0	0	0	0	0	0	0	0	0	0	0	0	0	60	60	590	566	501	6	267	270	127	502	976	7
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	19	13
70	69	74	77	72	93	88	95	86	87	93	89	89	92	103	143	151	193	369	299	307	292	327	321	353	285
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	56	46	15	14	13	14	15
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	26	72	0	0	49	44	32
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	94	81	120	16	12	10	12	10
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	8	0	0	18	18	38	26
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	98	136	133	0	16	8	8
200	200	300	700	800	590	246	852	1348	543	1079	176	96	93	359	292	296	246	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100	4	2	0	0	0	0	0
100	100	0	0	700	0	65	66	55	94	0	0	0	0	0	0	0	59	25	78	78	72	71	70	70	70
4200	4300	1900	1000	1379	795	1659	1294	1875	2061	1012	1090	934	1251	1810	1501	1224	1362	1565	1306	1398	1265	941	589	261	260
0	0	0	0	0	0	0	0	0	0	0	0	14	22	13	13	25	5	10	4	31	41	15	17	23	73
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	5	5	7
2300	2400	2300	2300	2058	2310	2101	1870	1682	1757	1721	1810	1593	1627	2461	2207	2328	2376	2665	2151	2399	2369	2057	1507	1356	1336
0	0	0	0	0	0	0	0	0	19	0	0	86	121	33	5	0	5	0	1	60	35	41	68	85	55
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3
100	100	100	800	301	78	43	136	90	93	423	441	306	349	298	116	160	120	140	280	340	234	224	373	390	130
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	8	2	9
0	100	0	100	49	35	53	43	56	38	44	35	56	39	44	52	48	49	19	10	8	5	0	0	0	0
0	0	0	0	50	0	0	20	20	20	20	30	50	100	144	134	182	169	107	83	96	52	51	100	172	138
400	500	200	300	588	448	499	282	283	396	224	374	424	588	616	583	517	543	756	472	230	262	245	261	329	390
0	0	0	0	446	477	4	93	2	2	5	26	13	6	2	3	14	12	9	4	4	2	1	4	0	0
7100	7500	7500	10000	6929	7276	6847	5167	5528	5491	5889	4573	5500	5300	4392	4221	4350	3592	4572	4104	3756	3708	4370	3536	3698	3187
5570	4969	4674	4477	4343	4610	4381	4459	4333	3980	6558	3952	4385	4499	6775	6609	7856	8004	8667	8524	9211	9514	9647	10893	10871	9750
200	200	300	700	800	590	246	852	1348	543	1079	176	96	93	359	292	296	246	283	273	376	164	44	106	116	91
6700	7000	4300	4200	4487	3218	3921	3409	3758	4062	3200	3376	2989	3409	4659	3894	3785	3976	4424	3830	4314	4021	3357	2637	2195	1943
0	0	0	0	0	0	200	500	600	1100	1300	1700	2000	2500	2949	3184	4606	5321	6269	6095	7177	7655	7155	7846	8531	7283
6170	5669	5174	5477	5781	5648	4926	5113	5384	3839	6581	2832	2955	2780	4945	4434	4245	3641	3544	3257	2736	2337	2832	3514	2957	3086
13800	14500	11800	14200	11416	10494	10768	8576	9286	9553	9089	7949	8489	8709	9051	8115	8135	7568	8996	7934	8070	7729	7727	6173	5893	5130
19970	20169	16974	19677	17197	16142	15694	13689	14670	13392	15670	10781	11444	11489	13996	12549	12380	11209	12540	11191	10806	10066	10559	9687	8850	8216

Table 3.14.4 Catch statistics for 1993. Official data from FAO vs. scientists best estimates.

Fisheries Bulletin (Dublin) 14, 1996

Table 10. FAO statistics for 1993 and group's estimates of total catch.

	FAO Yearbook data 1993				Working Party estimate for capture fishery and EIFAC/ICES estimate for aquaculture production						
	Inland waters	Atlantic/Baltic	Mediterranean	**Total (tonne)**	Year	Inland waters silver/yellow	Atlantic/Baltic glass	Atlantic/Baltic silver/yellow	Mediterranean silver/yellow	Aquaculture	**Total (tonne)**
Albania	210			**210**		210					**210**
Belarus	13			**13**		13					**13**
Belgium	125			**125**						100	**100**
Croatia			5	**5**					5		**5**
Czech Rep.	32			**32**		32					**32**
Denmark	957	880		**1,837**	1994	420		1,360		1,000	**2,780**
Estonia	49	10		**59**		85		10			**95**
Finland	0			**0**		10					**10**
France	810	181	685	**1,676**	1993	700	300	500	1,000	25	**2,525**
Germany	774	253		**1,027**	1993	800		400		100	**1,300**
Greece	337		17	**354**					17	337	**354**
Hungary	263			**263**		263					**263**
Ireland	150			**150**	1994	250	3				**253**
Italy	1,985		1,505	**3,490**		100			2,940	2,020	**5,060**
Latvia	18			**18**		18		2			**20**
Lithuania								6			**6**
Netherlands	375	43		**418**	1994	685	3	200		1,500	**2,388**
Norway		340		**340**	1994	4		400		120	**524**
Poland	800	316		**1,116**		800		316			**1,116**
Portugal	502	35		**537**	1994	100	40			100	**240**
Rússian Fed.	16	19		**35**		16		19			**35**
Slovakia	7			**7**		7					**7**
Spain	150	25	70	**245**	1994		150	192		155	**497**
Sweden	321	1,015		**1,336**		129		1,016		192	**1,337**
Switzerland	4			**4**		4					**4**
Turkey	261			**261**						261	**261**
UK Engl/ Wales	50	38		**88**	1993	300	20	50			**370**
UK N. Ireland	662			**662**	1994	735					**735**
Yugoslavia			8	**8**					8		**8**
											0
Euro-total				**14,316**							**20,548**
Algeria	23			**23**							
Morocco	100		70	**170**							
Tunisia			373	**373**				373			**373**
											0
Afro-total				**566**							**696**
World total	8,994	3,155	2,733	**14,882**		5,881	516	4,967	3,970	5,910	**21,244**

Figure 3.14.1 Distribution area of European eel. From Moriarty and Dekker (1997).

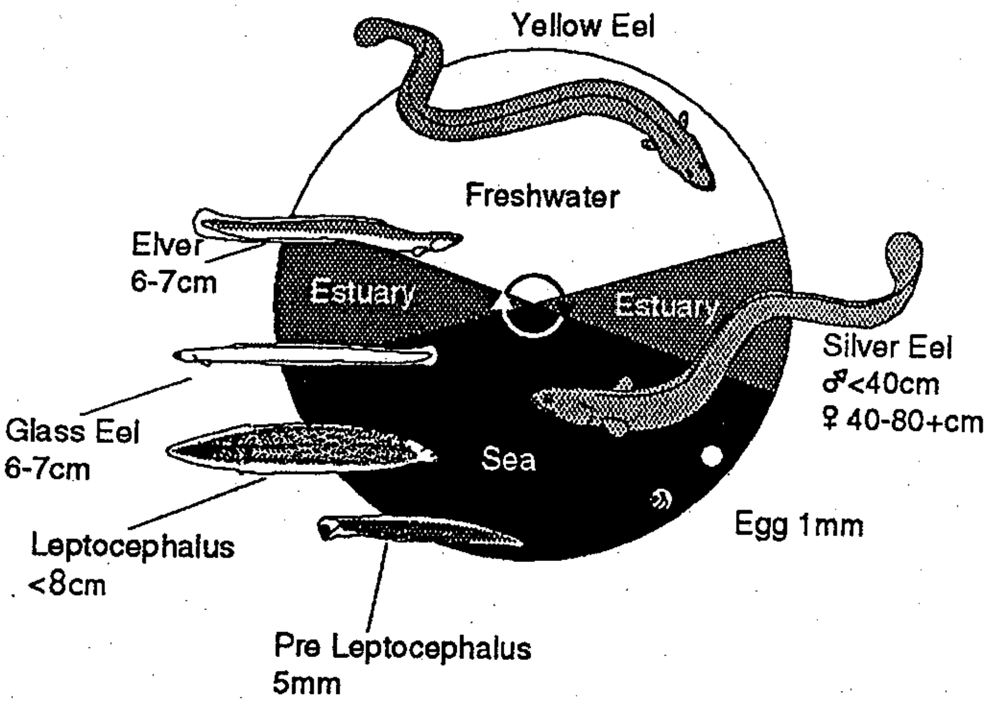


Figure 3.14.2 Life cycle of European eel.

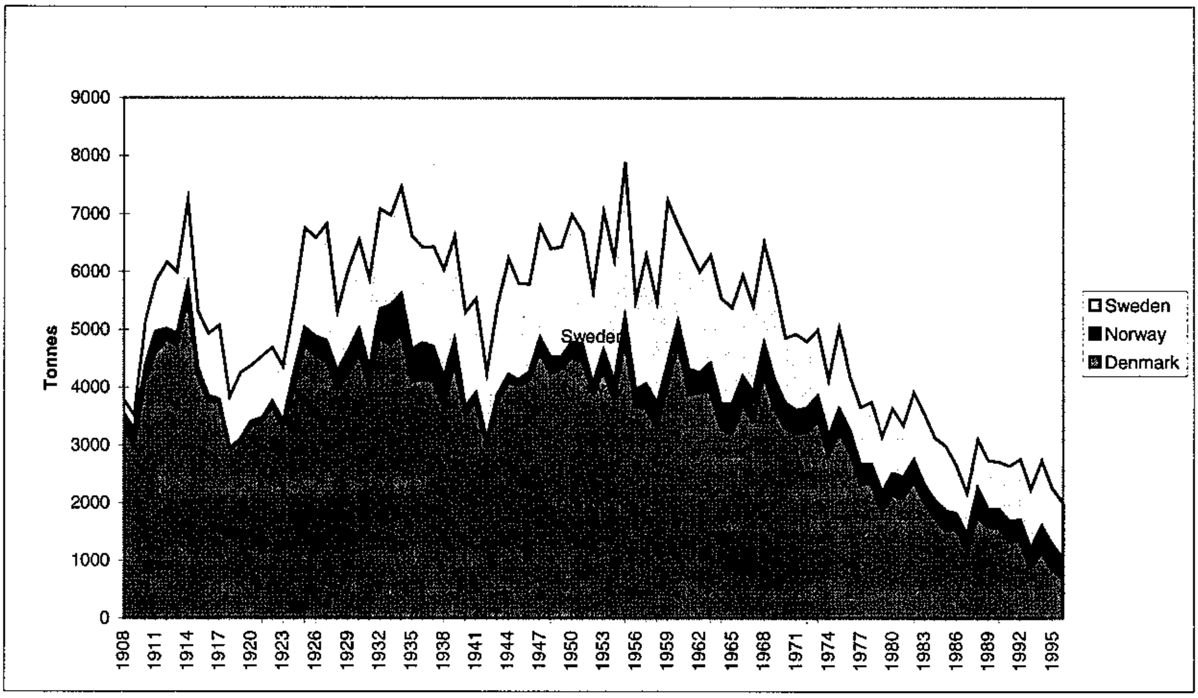


Figure 3.14.3 Eel catch by Denmark, Norway and Sweden ICES Fisheries Statistics.

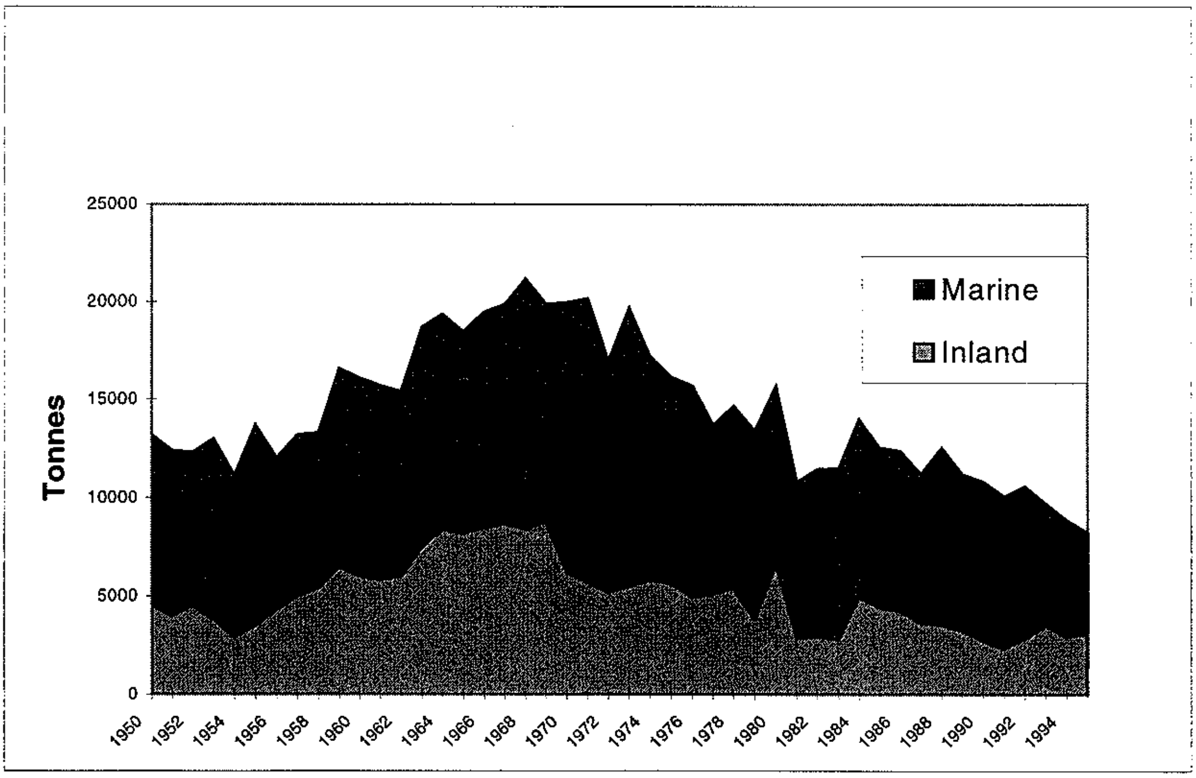


Figure 3.14.4 European eel. Capture fisheries landings. FAO Statistics.

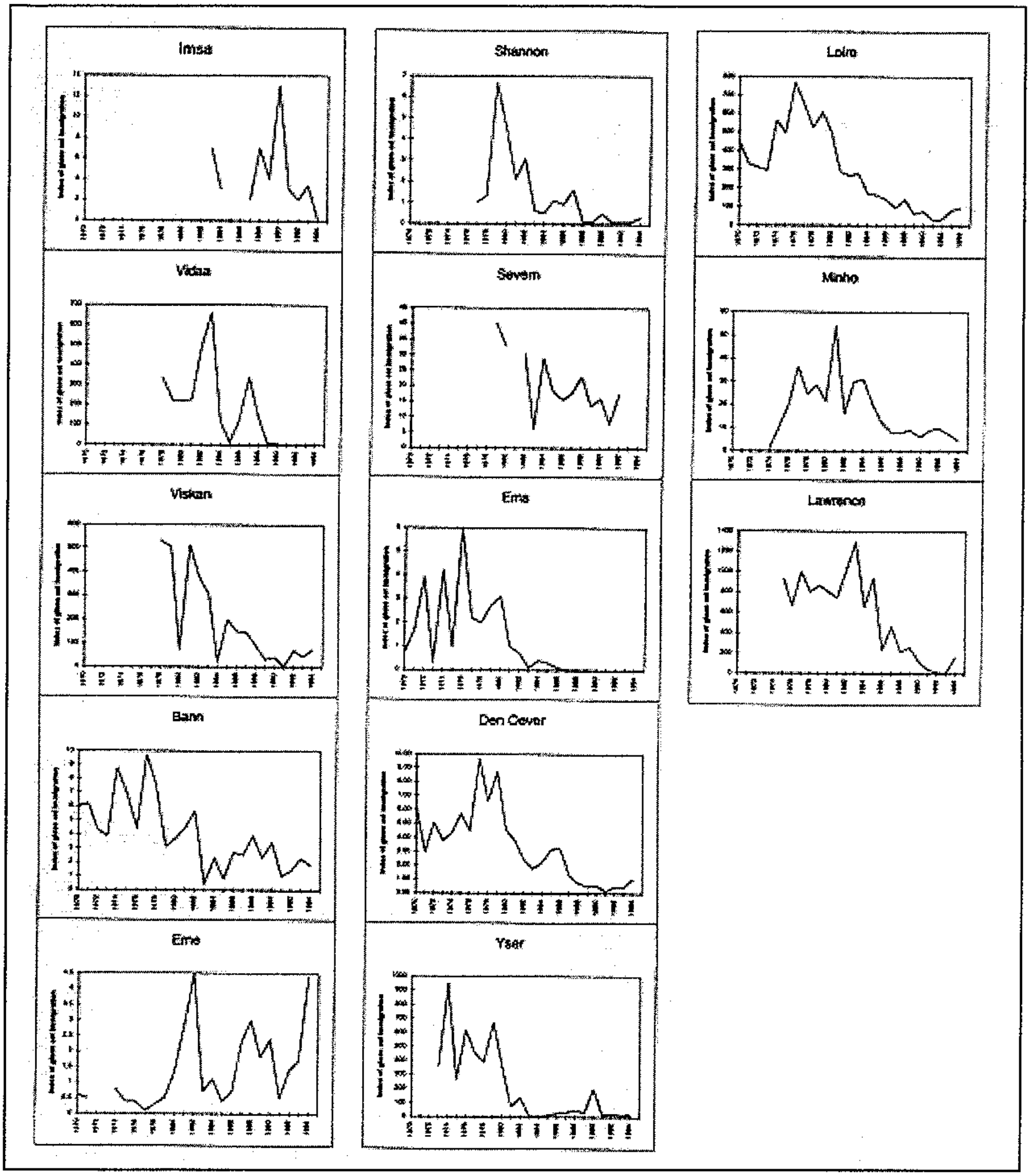


Figure 3.14.5.1 Glass eel immigration indices in 13 selected rivers in Europe.

REPORT TO THE NORTH ATLANTIC SALMON CONSERVATION ORGANIZATION

Source of information: Report of the Working Group on North Atlantic Salmon, April 1998 (ICES CM 1998/ACFM:15).

Sections 1–4 of this report are set out in the order of the questions from NASCO to ICES (Appendix 1).

1 ATLANTIC SALMON IN THE NORTH ATLANTIC AREA

1.1 Overview of Catches

1.1.1 Nominal Catches

Nominal catches of salmon by country in the North Atlantic (including ranched salmon in Iceland) for 1960-1997 are given in Table 1.1.1. Reported catches, by NASCO Commission Areas, are illustrated in Figure 1.1.1, and those for 1992–1997 are shown below (in tonnes):

Area	1992	1993	1994	1995	1996	1997
NEAC	3366	3333	3566	3271	2744	2038
NAC	524	375	358	260	292	226
WGC	242	0	0	85	92	59
Total	4132	3708	3924	3616	3128	2323

The catch data for 1997 (Table 1.1.1) are provisional and incomplete, but the final figures are unlikely to exceed 2 400 t. Catches in most countries remain below the averages of the previous 5 and 10 years. Much of the decline in catches in recent years can be accounted for by management plans which have reduced fishing effort in several countries.

1.1.2 Unreported Catches of Salmon

The total estimate of unreported catch by fishery managers/protection officers or bailiffs within the NASCO Commission areas in 1997 was 827 t (Table 1.1.1), a decrease of 26% compared with 1996 and 41% below the 1992–1996 mean of 1 413 t. There are no data available on salmon catches in international waters in 1997. Estimates for the Commission Areas are given below (in tonnes):

Area	1992	1993	1994	1995	1996	1997
NEAC	1825	1471	1157	942	947	732
NAC	137	161	107	98	156	90
WGC	n/a	12	12	<20	<20	5
International waters	25-100	25-100	25-100	n/a	n/a	n/a

1.1.3 Catch and Release of Salmon

Catch and release data for 1SW (small), MSW (large) and/or 'total' salmon were provided for some recent years by five countries. In 1997, the proportion of the total rod catch that was released included 100% of 333 fish in USA, 87% of 17 000 fish in Russia and 51% of 97 300 fish in Canada. 23%, 18% and 5% of catches in UK (England and Wales), UK (Scotland) and Iceland, respectively, were caught and released.

1.1.4 Production of Farmed and Ranched Salmon

The production of farmed salmon in the North Atlantic area in 1997 was 479 498 t. This is the largest production in the history of the industry (Figure 1.1.4) and represents a 6% increase over 1996 (451 581 t) and a 42% increase over the 1992–96 average (335 586 t).

In 1997, an additional 122 600 t, i.e., 20% of the total world production of farmed salmon, was grown outside the North Atlantic Area. Areas of largest production were Chile (72%) and western Canada (15%).

The total production of ranched salmon in countries bordering the North Atlantic in 1997 was only 55 t which is the lowest value since 1987. The majority (87%) of the ranching is conducted in Iceland where a production of 48 t in 1997 was only 20% of that of 1996 and where ranched production is now only one-half the nominal catch of wild fish.

1.2 Recent Research Developments

Post-smolt growth and marine juvenile habitat: In trying to explain the relationship between the thermal habitat and post-smolt survival, ICES examined scale circuli spacing data from historical collections of post-smolts made in the Gulf of St. Lawrence, Canada, with the aim of understanding the role of estuarine and coastal habitats as juvenile habitat for Atlantic salmon. The analysis suggests that in some years post-smolts remain in the Gulf throughout the entire summer growth season whereas in other years only slower growing fish remain in these areas. Growth patterns were compared to patterns from returns to the more southern Connecticut, Penobscot and Saint John rivers which are assumed to grow in open ocean habitats. The data suggest that in some years post-smolt growth in the Gulf is as fast as that observed for both the 1SW and 2SW returns to southern rivers and that in some years either post-smolts from other areas invade the Gulf and use it as a nursery area or, the Gulf region is continuous with a larger area of similar growth conditions where the nursery is formed.

Spatial-temporal convergence of North Atlantic salmon at sea: ICES examined scale samples from historical collections of post-smolts made in the Labrador Sea with the aim of understanding the growth dynamics of stocks at the southern end of the range versus what is hypothesised to be the juvenile nursery for post-smolts from the entire stock complex. For two of the three years examined, growth patterns for fish from the southern stocks intersected the patterns for post-smolts from the Labrador Sea collections after 4-5 circuli pairs. Since circuli pairs are laid down at a rate of approximately one per week, the data suggest that distribution patterns for regional groups begin to overlap and stocks begin to experience similar environmental conditions by July of the post-smolt year or two months after their migration to sea. In some years, it would appear that regional groups do not mix until fall.

Catch and release as a conservation measure: The practise of hook-and-release angling as a conservation measure for Atlantic salmon is a recent phenomenon that has promulgated divergent opinions among user groups on its effect on salmon mortality and reproductive success. A review of studies indicated that hook-and-release angling and associated handling at 20°C, or above, can result in grilse mortalities of between 8–40% (immediate and delayed) and that these critical temperatures can decrease survival if other stressful conditions are present, for example, soft water. Fish which had recently entered fresh water from the sea and which were hooked-and-released had an elevated rate of mortality compared to no mortality for kelts in the spring in freshwater and for salmon in the autumn that had been in the river for some time.

Information was limited on the long-term effects of hook-and-release angling; some studies using radio-tracking have documented that a large number of the fish survive for at least several months and spawning by some of these fish has been confirmed. Hook-and-release angling was deemed to be a conservation measure relative to retention angling, due to the generally low levels of mortality, but caution still must be exercised in its implementation. Mortality and resulting impact on resource conservation is potentially increased under certain river conditions and if anglers do not take care in releasing hooked fish.

1.3 Causes of Changes in Abundance

1.3.1 Linkage Between Climate, Growth and Survival

ICES re-evaluated the analysis of two long-term tagging studies of salmon on the River Figgio in southern Norway and the North Esk in eastern Scotland. The return rates for 1SW fish, the predominant age at maturity for both stocks, were highly correlated. An analysis of sea-surface temperature distributions for periods of high versus low return rate showed that when low sea surface temperatures dominate the North Sea and southern coast of Norway during May, salmon survival has been poor. Conversely, when high sea surface temperatures extend northward along the Norwegian coast during May, survival has been good.

Ocean conditions were further related to the recruitment process through growth studies with the North Esk stock. Post-smolt growth increments for 1SW and 2SW returning to the North Esk were highly correlated with survival (Figure 1.3.1) and were patterned similarly to changes in thermal habitat as shown in the 1997 report to NASCO. The results suggest that there is a link between ocean climate conditions, post-smolt growth, and post-smolt survival for salmon stocks in the North Sea area. The analysis is discreet over time and space and suggests that the ocean climate variation related to salmon survival occurs in spring when the post-smolts first enter the marine environment and occurs in the area of the North Sea and Norwegian coast.

1.3.2 Factors Potentially Influencing Recent Returns to North America

ICES reviewed a number of factors potentially contributing to lower than expected returns and sea survivals of Atlantic salmon to eastern Canada in 1997 and general declines in recent abundance of salmon. No single factor was identified that explained the cause of a decline in 1997. There are, however, indications that the ecosystem of the Northwest Atlantic has changed since the late 1980s and could be adversely affecting the overall abundance of Atlantic salmon.

Marine exploitation: Low overall catches of Atlantic salmon in commercial fisheries and lack of evidence of increasing by-catches in some inshore and offshore fisheries indicate that fisheries are unlikely to have been an important factor in the low returns of salmon in 1997.

Environmental conditions: The index of winter thermal habitat has been large when salmon abundance was high and low in recent years when abundance was low. During most of the 1990s temperatures of the waters off Labrador and Newfoundland have been relatively cold. These cold conditions continued through 1995 before warming in 1996 to above normal values. In 1997, temperatures remained well above the early 1990s values, but were lower than those observed in 1996, i.e., survival should not have declined further.

Significant large-scale ecosystem changes in the 1990s and late 1980s have been associated with the ocean climate changes. For example, Arctic cod increased in abundance on the Labrador Shelf and extended further southward onto the Grand Banks and into the Gulf of St. Lawrence. Greenland halibut extended their range further south and capelin returned to Scotian Shelf and spread eastward from the Grand Banks to the Flemish Cap. Cold waters in the 1990s delayed the inshore spawning time of capelin by approximately 1 month, and they have continued to spawn late in recent years. There have also been large scale changes in the distribution and abundance of Atlantic herring, and on the northeastern Scotian Shelf, snow crab, which prefer temperatures colder than 3°C, have increased their distribution. In addition, many important commercial species including cod and redfish declined to very low numbers, although the respective roles of fishing and the environment in this decline remain unclear.

The extent to which these changes may be affecting reductions in survival of salmon is unknown

Predation:

Birds: Based on sampling and estimates of potential consumption, common mergansers and belted kingfishers take a substantial fraction of juvenile salmon in some Maritime rivers. Similarly, double-crested cormorant colonies are known to deplete smolt runs in localised areas. However, numbers of these birds in the Maritimes have been stable in the years up to 1996.

Salmon in the diets of Funk Island gannets, large seabirds which capture fish by plunge-diving from the air, was rare in 1977–89, but increased during the 1990s. Their principal foods also shifted from warm-water species (mackerel) to cold-water species (capelin and others including salmon). Salmon are also suggested to be included in the diet of herring gulls and great black-backed gulls in Newfoundland, which markedly changed their feeding behaviour in the 1990s due to reductions in fisheries discards and plant offal as a result of closure of the ground fisheries and also due to major delays in arrival times of inshore spawning capelin.

Seals: There were an estimated 4.9 million harp seals, 0.6 million hooded, and as well, 180 000 grey and 29 000 harbour seals in Canadian waters in 1996. Harp and hooded seals spend approximately half of the year in the Arctic and Greenland waters, moving to Labrador, insular Newfoundland and into the Gulf of St. Lawrence from about mid-November until mid June i.e., their spatial and temporal distribution coincides well with Atlantic salmon. Harp seal populations have increased to their present high from 1.78 million animals in 1971. A significant negative association between pre-fishery abundance estimates of salmon in the Northwest Atlantic and harp seal populations, 1973–96, exists. However, evidence supporting large-scale predation of salmon by seals is lacking.

Fish consumption by seals (cod consumed by harp seals range from 10-40 cm in size) has been estimated by combining information on seal abundance distribution, energy requirements, and diet composition. Capelin, Atlantic cod, species of the Family Pleuronectidae, herring and window pane comprised 84% of the wet weight of diet samples collected 1982–1995, largely within the Gulf of St. Lawrence. Salmon comprised much less than 1% of the wet weight of samples and were estimated to comprise a few thousand tonnes of the annual consumption of fish by harp seals. However the reliability of the estimate was questioned because data were not presented on the number of salmon in the sample, the number of stomachs containing salmon, the size of the salmon, and the method of raising the stomach contents in what was known to be a small proportion of the herd (approx. 10%) to the potential consumption by the entire herd.

Cod: A recent shift inshore of cod distribution in Newfoundland and parts of the Gulf of St. Lawrence and possibly the eastern Scotian Shelf further suggested that cod may be preying on smolts (cod have been shown to consume about 20 % of smolts as they enter the sea in some localised areas in Norway). However, no salmon have been found in the several thousand cod stomachs examined to date although few were sampled in the mouths of rivers at the same time as salmon smolts entered the sea.

Forage: Salmon are opportunistic feeders on capelin, sand lance, squid, herring, mackerel, deepwater fishes such as blacksmelts and barracudina, and many different types of crustaceans. They exploit different prey species in different feeding areas and the diet in a particular area may vary both among and within years. The ability to exploit a wide range of prey species, even at the post-smolt stage, suggests that the abundance of any one forage species would not of itself greatly alter growth and therefore survival. However, forage abundance may affect growth rates of individual salmon and a year class composed of slow-growing individuals resulting from low prey abundance would, presumably, be more vulnerable to predators. Sizes of returning fish to most rivers of Atlantic Canada in 1997 were, however, above or near average. Increased growth in the sea has been associated with earlier age-at-maturity and thus reduced returns in 1997 are not expected to materialise as increased returns of 2SW salmon in 1998.

1.4 NASCO Working Group on the Precautionary Approach

ICES was asked to comment and advise on the Report of the NASCO Working Group on the Precautionary Approach in North Atlantic Salmon Management as it relates to the work of ICES. The issues addressed by this group that were of principal interest to ICES were *'the application of a precautionary approach to the management of North Atlantic salmon fisheries'* and *'the formulation of management advice and associated scientific research'*.

The NASCO Working Group advised that the application of a precautionary approach (PA) to fisheries management requires that managers should make use of the best available scientific information when making management decisions; that they should be more cautious when information is uncertain, unreliable or inadequate and, that the absence of adequate scientific information should not be used as a reason for postponing or failing to take conservation and management measures.

With respect to the management of salmon fisheries, the recommendations of the NASCO Working Group were broadly consistent with those of ICES. It was proposed, *inter alia* that stocks be maintained above conservation limits by the use of management targets normally set at a higher level; that account should be taken of the risks of not achieving the fisheries management objectives by considering uncertainties in i) the current state of the stocks, ii) biological reference points and iii) fishery management capabilities and, that stock rebuilding programmes (including habitat improvement, stock enhancement and fishery management actions) be developed for stocks that are below their conservation limits.

With respect to the formulation of management advice the recommendations of the NASCO Working Group were broadly consistent with current requests, i.e., advice on risks of not achieving management objectives; provision of catch options; advice on stock rebuilding programmes (where stocks are well below target levels); identification of monitoring and data collection required and, advice on the impacts of existing and new fisheries for other species. It is implicit in the NASCO Working Group's recommendations that scientists should provide an estimate of conservation limits based upon best available information and that the uncertainties in the data should be encompassed in the way that these figures are used in providing management advice, such as catch options.

ICES' mandate is to focus on scientific issues, leaving decisions on management objectives and socio-economic concerns to the managers. Conservation limits are a biological imperative and ICES is concerned about the lack of a clear definition of the word "conservation" in NASCO's objectives and uncertain whether it had the same meaning as in the term "conservation limit".

1.5 Compilation of Tag Release and Finclip Data for 1997

Data on releases of tagged and finclipped salmon in 1997 were compiled by ICES and provided under separate cover. In 1997, a total of slightly over 3 million salmon were marked, approximately 10% less than in 1996. The adipose clip was the most used primary mark (1.73 million), with microtags (0.82 million) the next most used primary mark. Microtag use was down 5 % from 1996. Secondary marks were applied to 0.84 million fish. Most marks were applied to hatchery-origin juveniles (2.95 million), while 0.06 million wild juveniles and 0.02 million adults were marked.

ICES initiated data summaries on eggs artificially spawned from sea-run adults that returned in 1997 and all egg and life stages released in 1997. The data will provide measure of the interception of ova for management purposes and broad trend information on enhancement activities.

2 ATLANTIC SALMON IN THE NORTH-EAST ATLANTIC COMMISSION AREA

2.1 Events in Fisheries and Status of Stocks

2.1.1 Fishing in the Faroese Area 1996/1997

In accordance with the agreement between the Faroese Salmon Fishermen's Association and the North Atlantic Salmon Fund, commercial fishing for salmon in Faroese territorial waters was suspended for the years 1991 to 1997. During the 1996/1997 fishing season there was, as well, no research fishery. In the 1997/1998 fishing season, for which there was no suspension of commercial fishing, one vessel completed 4 trips, Jan–Apr, 1998, and reported a catch including discards, of 3 t (approx. 1 000 salmon).

Origin of the catch: In the 1992/1993 to 1994/1995 fishing seasons, a total of about 5 500 salmon caught on long-line were tagged and released in the open sea north of the Faroes. After five fishing seasons (1993–97) 87 wild tagged fish (2 more than previously) have been reported recaptured in 10 countries. The additional recoveries did not alter previous conclusions based on recoveries adjusted for homewater exploitation and tag reporting rates, that the Faroes feeding area is particularly important to salmon of Norwegian (41.7% of tag recoveries), Scottish (20.7%) and Russian (16.5%) origin. Of 19 tagged farmed/reared fish recovered (1.9% of those tagged), 18 were reported from Norway whereas one was recovered from the west coast of Sweden.

2.1.2 Homewater Fisheries in the NEAC Area

Gear and effort: In Ireland, monofilament netting was authorised for drift net fishing in 1997. Other countries did not report changes or restrictions on fishing gear. The number of gear units was generally well below the 5-and 10-year means. In Iceland, only one coastal gillnet operated (August only), as compared to five nets in the early 1990s. In Norway, the coastal bend nets were banned in a large area along the Norwegian coast and some new regulations were introduced to bagnet and rod fisheries. The effort in the Irish fisheries was reported to have decreased somewhat, although the gear units have stayed at the same level since 1995 and in 1997 the number of net licences was capped at the 1995 level. The net fishery in the Adour River, France, was closed in July for the first time. Licenses in the French rod fishery increased by 65%, probably because of a significant reduction in license fees.

Catch: Provisional figures suggest that nominal catches of salmon in Northeast Atlantic countries in 1997 were generally below the 1996 values and for most countries still below the previous 5- and 10- year averages. In general, fishing effort in terms of licences issued has been declining substantially over the years for commercial fisheries and increasing for recreational fisheries. The provisional nominal catch for 1997 was 2 038 t; the final value (including ranched fish) for 1996 was 2 744 t, well below the 1995 value of 3 271 t. (see text table in Section 1.1.1).

CPUE: No trends were detected in the CPUE of the fixed engine fisheries of UK (England and Wales). For UK (Scotland) there is a clear, significant downward trend in CPUE in the net fishery. CPUE from recreational fisheries can be difficult to interpret. CPUE in rod fisheries in Finland, France and on the River Bush, UK (N. Ireland) show no trend for catch per angler day for the last 10 years. However, there is a marginally significant positive trend in CPUE for the whole season for rod fisheries in Finland and France over the same period of time.

Composition of catch: The proportion of 1SW fish in catches has increased for Norway, Russia and Finland compared to both long- and short-term indices. In UK (Scotland), the proportion has remained similar to the 1992–96 mean but decreased relative to the longer-term mean. In France, the proportion remained similar to the longer-term mean while decreasing relative to the 1992–96 mean. Compared to the 1992–96 mean, the proportion in the 1997 UK (England & Wales) catch remained the same while that of Sweden has decreased.

Origin of catch: New analyses of tag recoveries from fish of non-national origin in national catches were provided by Ireland and Sweden. Of 6 747 CWT tags recovered in Ireland in 1997, 2.2% were reported to be of UK (N. Ireland) origin, 0.4% of UK (Eng & Wales) origin and 0.03% of Spanish origin, i.e., approximately 97% were of Irish origin. In 1997 15% of the catch in the county of Halland, Sweden was assessed to be of Baltic origin, i.e. being larger and paler in flesh colour than normal Atlantic salmon. Some tag recaptures indicate that they emanate from Danish experiments with delayed release. Salmon from Danish releases have been recorded in the past, but accounted for only a small percentage of the catch. Of nearly 805 000 smolts tagged and released in Norway, many being of hatchery origin, 98.8% of recaptures were taken in Norway, 0.6% in Sweden, 0.3% in Denmark and 0.2% in Ireland.

Farmed salmon continue to represent a large percentage of the national reported catch in Norway (31%) and 'ranched' salmon (fish intended to mitigate lost salmon production) now account for 65% of the national catch in Sweden. Although Iceland produces a large (but decreasing) tonnage of ranched salmon, practically all this is harvested at the production sites. Farmed fish formed less than 1% of the national catches in Ireland and UK (N. Ireland).

Exploitation rates: Exploitation rates in homewater fisheries vary considerably among different river stocks. Mean rates (1992–96) for a small number of monitored stocks range from about 10% to about 80%. Exploitation rates for 23 of the 30 datasets decreased in 1997 from those of 1996. Although reported exploitation rates in some fisheries have changed, analyses indicate that there has been no overall trend for Irish, UK, Icelandic or Scandinavian stocks over 10-year or 5-year periods. However, significant downward trends in exploitation were shown for Russian rivers over these periods.

2.1.3 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 the stocks. Previous estimates of pre-fishery abundance (PFA) of 1SW and MSW salmon in the NEAC area (northern and southern components) have been updated to PFAs for each of 10 nations using estimated catch and unreported catch and bounded by estimates from a reformulated Monte Carlo simulation (1 000 simulations). Parameter values included minimum and maximum estimates of i) 1SW and MSW catch (include proportion unreported), ii) 1SW and MSW returns, iii) maturing and non-maturing 1SW recruits and, iv) 1SW and MSW spawning escapement. Minimum and maximum estimates of the average level of exploitation were used to raise catch to stock abundance and minimum (0.005) and maximum (0.015) estimates of natural mortality were applied to salmon in the sea for more than one winter where months to homewaters were also given minimum and maximum values. Proportion of unreported catches, exploitation levels, natural mortality, months between fisheries and homewaters were entered as uniform distributions with ranges given by minimum and maximum.

The uncertainties surrounding these estimates need to be emphasised. The unreported catch in the NEAC area is high (the provisional catch in 1997 was 2 038 t with an estimated 36% unreported 732 t). The returns to rivers are estimated in some cases on exploitation figures that are ill defined. The working group try to provide estimates of this uncertainty but hard data is largely not available.

Figures 2.1.3.1 and 2.1.3.2 show the range of estimates of the pre-fishery abundance of maturing 1SW (1971–97) and non-maturing (MSW) (1971–96) salmon (and spawners) in the NEAC area for northern and southern European stocks as defined below:

Southern European countries:	Northern European countries:
Ireland	
France	Finland
UK(England & Wales)	Norway
UK(Northern Ireland)	Russia
UK(Scotland)	Sweden
Greenland catches	70 % Faroes catches
30 % Faroes catches	

Note: Icelandic stocks are omitted because their distribution is thought to differ from both groups.

The maturing 1SW component of the northern European stocks has remained relatively constant despite showing marked variation in some years. The non-maturing 1SW component, on the other hand, appears to have been declining since the 1980s, with the most marked change occurring around 1986–87. However, it must be noted that these estimates include large numbers of farm escapees in the more recent years. The southern European stocks appear to have been more volatile, with large fluctuations occurring in the first half of the time series. The maturing 1SW component of these stocks appears to have fallen markedly in the 1990s to a new, relatively stable but low level, while the non-maturing 1SW component has been in steady decline since the mid 1980s.

Spawner requirements and time series of compliance data were available for 12 rivers; spawning thresholds were exceeded in five rivers in 1997. There was no significant trend noted in spawner attainment over the last 10-year period for all stocks combined, but a significant trend towards lower egg deposition was noted over the most recent 5-year period

Smolt counts or estimates of juvenile abundance are available for 21 rivers. Values for 1997 are higher than in the previous year in most areas. The values in 1997 were lower than the 5-year mean in R. Esk, UK (Scotland), but higher in all other rivers. Analyses show no significant trend in juvenile production in these rivers over the last 10- and 5-year periods.

There appears, however, to be a general decline in escapement in many of the NEAC rivers. Analysis of wild smolt returns to homewaters and freshwater did not indicate a decline in survival, but marine and freshwater survival of hatchery fish declined significantly over the previous 10- and 5-year periods.

Adult counts are available for 33 rivers in the NEAC area for the previous four or more years. The counts in 1997 were generally lower than the 5-year mean. Higher estimates were obtained for some Russian and UK (N. Ireland and Scotland) rivers. In Russia adult counts increased over the last 30- and 20-year periods but no trend was observed for the last 10- and 5-years periods. For other rivers in the NEAC area there has been a significant downward trend for the last 5 years but no trend for the last 10 years.

Coherence in recruitment patterns in pre-fishery abundance of European salmon: ICES was uncertain whether the split of NEAC countries into the northern and southern groups provided above, was the most appropriate for providing catch advice. The split is based upon very limited data which suggest that a much greater proportion of fish tagged in Scandinavian countries are recaptured in the Norwegian Sea, and a greater proportion of fish from southern rather than northern European countries have been caught at West Greenland. However, recent tagging data from some countries are sparse and, the correlation between smolt-to-adult survival for fish from the River Figgio (southern Norway) and North Esk (Scottish east coast) suggests that these rivers should be grouped together (Section 1.3.1).

ICES analysed time series of pre-fishery abundance for national stocks in Europe, disaggregated by age-at-maturity, to attempt to define stock complex borders relevant to the mixed-stock fisheries at Faroes and West Greenland. Two clustering approaches were applied to abundance data normalised by the mean of each time series. K-means clustering did not clearly show the inter-relationship between stocks. Tree clustering methods which use the dissimilarities or distances between objects when forming clusters was restricted to those stocks predominately producing wild fish and revealed two main groupings.

A large cluster of Ireland, UK (N. Ireland and Scotland), Norway, and UK (England and Wales) 1SW salmon was formed which appears distinct from Russia. This cluster suggests survival and abundance of 1SW salmon is tracking similarly for most stocks in Europe and is consistent with emerging models and observations on post-smolt survival and distribution. Normalised abundance for Ireland, Norway, and Scotland show all three stocks have declined over the past two decades and that the pattern of decline for each stock has been weakly correlated.

Clustering of the non-maturing component of national stocks, restricted to those stocks predominately producing wild fish, suggests a pattern of stock boundaries distinct from the pattern observed for maturing fish. Two extreme clusters were formed consisting of Norway and UK (Scotland) and Ireland and UK (N. Ireland). Normalised abundances for Ireland, Norway, and UK (Scotland) support the results of the cluster analysis showing similar patterns for Norway and Scotland versus Ireland, which suggests stock boundaries should be to the west of UK (Scotland). In addition, Russia is sufficiently different from Norway to suggest a third group of northern stocks may be appropriate.

This was considered to be a valuable preliminary analysis but there were concerns that production boundaries for stocks may not match patterns of utilisation in mixed-stock fisheries. It may for example be possible to define various groups of stocks and weight their contribution to the catch option assessments based upon their relative contribution to the fisheries. Other biological stock characters will be examined and tagging databases be reviewed to determine whether functional stock boundaries can be defined.

2.2 Effects of the Suspension of Commercial Fishing Activity at Faroes

Since 1991, the Faroese fishermen have agreed to suspend commercial fishing for the salmon quota set by NASCO in exchange for compensation payments. The number of fish saved from the fishery is estimated by subtracting the numbers of fish taken in the research fishery from the number that could have been caught if the commercial fishery had operated. The increase in returns to all homewaters is then estimated by subtracting the fish that would have died on their homeward migration. Most fish would be expected to return to European rivers.

Unlike the past assessment, the expected catch in the Faroese fishery was assumed to be equal to the purchased quota in each year. Means of recent discard rates, age composition, and proportion farm fish were used in the absence of new data. The estimated increased returns of wild 1SW and MSW salmon to homewaters in Europe and their contribution to the total estimated returns to the NEAC area for the years 1992–97 follow:

Year	Quota (t)	Estimated increased returns to home waters in Europe			
		1SW	%	MSW	%
1992	550	2 842	<1	70 809	6
1993	550	11 429	1	106 307	9
1994	550	21 078	1	134 159	11
1995	550	12 949	1	138 533	12
1996	470	10 573	<1	122 196	11
1997	425	9 578	<1	105 368	12

In 1997, an additional 27 000 farm fish will have escaped capture because the fishery did not take place.

Suspension of the fishery increased MSW returns to all European rivers by 6-12% and 1SW returns by around 1%. Adult tagging studies (Section 2.1) indicate that 65-75% of the MSW salmon caught in the Faroes fishery would return to Scandinavian countries, Finland and Russia. If this were the case, increased returns might have represented 9% to 20% of the MSW returns to northern Europe between 1992 and 1997. However, any increase in catches either has been too small to be detected as a statistically significant change above the normal annual variation or has been masked by other factors such as reduced marine survival or reduced exploitation rates in homewaters.

2.3 Development of Age Specific Conservation Limits

Advances in the development of conservation limits (MSY) came as a result of a Workshop held in Dublin, 10–12 March 1998. The Workshop recognised that limits set on a larger scale than that of the population level could, in practice, lead to genetic risk to some populations and that each individual country's representative would need to decide on the scale at which they felt it was appropriate to set conservation limits.

Ideally, conservation limits should be based on reference points derived from fitted stock-recruitment curves. Unfortunately, less than ten rivers in NEAC have sufficient data to give these curves and only three (the rivers Imsa, Bush and Burrishoole) have been fully developed. Other methods of establishing reference points were addressed, in particular those which are based on habitat/spawning stock indices, transporting targets and correcting for topographical and biological information on river and stock. Emphasis was placed on examining methods which could be applied in the virtual absence of specific river data. Table 2.3 outlines a hierarchy of approaches which have been used with existing data to derive targets/conservation limits for many rivers in the NEAC Area. The basic methodology of each approach and the data required to provide a target estimate or a potential target estimate are outlined. Included are the number of rivers in each country and the number for which each approach has been taken. It is implicit that the lower the rank the less precise the estimate is likely to be.

The problem of setting age-specific conservation limits is the lack of information on the proportion of each age class in the national stocks. Further, it was undecided as to whether conservation limits should be aimed at (i) conserving a historical age composition (ii) preserving the current age composition or (iii) adopting some other approaches. In reality, management on the basis of combined stock components for individual rivers even when these individual river stocks are low is probably the most that will be achievable over the next few years.

In the absence of S/R based conservation limits for UK (Scotland) and Norway, ICES continued the development of a conservation limit for all rivers combined in the NEAC area based on estimates of the pre-fishery abundance of maturing and non-maturing salmon and the relationship between estimated spawners and subsequent recruitment (lagged spawner model - Approach 13).

2.3.1 Development of Conservation Limits for the NEA Stock Complexes

Lagged spawner analysis: In order to develop conservation limits, information is required on the relationship between spawning stocks and recruitment. The PFA model provides estimates of the numbers of spawners and the numbers of 1SW recruits. However, these value cannot be used to derive stock-recruitment relationships directly because the spawners in year 'n' contribute to the recruitment over several years depending upon the relative proportions of 1- to 6-year old smolts that they produce. 1SW and MSW salmon also contribute to the recruitment in different proportions, principally because of the greater egg deposition from the MSW fish resulting from their greater size and the higher proportion of females. Since most stocks have seen significant changes in the relative proportions of 1SW and MSW salmon in the last 25 years, this difference needs to be taken into account to avoid biases caused by changes in the age composition of the spawning stock. This was addressed by converting the numbers of 1SW and MSW spawners into numbers of eggs deposited.

This approach assumes that there have been no significant changes in the egg production or in the proportion of females for 1SW and MSW salmon over the time period. Males are therefore ignored in the foregoing analysis, the assumption being that their numbers have not limited production during the period 1971–present.

The egg deposition in year 'n' may be estimated to contribute to the recruitment in years 'n+3' to 'n+8' to produce parr in year 'n+1' and 1yr smolts in year 'n+2', and these will generate 1SW recruits in proportion to the numbers of smolts produced of ages 1 to 6 years (e.g., spawners in year 'n' will produce recruits in year 'n+3'). Thus the number of 'lagged eggs' can be related to the number of 1SW recruits. The estimates of lagged eggs provides a measure of the relative spawning level which may be related to the recruitment figures derived from the PFA analysis. Plots of lagged eggs (stock) against the 1SW adults in the sea (recruits) could be considered as pseudo-stock-recruitment relationships. A number of options for setting conservation limits using these relationships were reviewed. However, in view of the preliminary status of the methods, ICES were not in a position to recommend conservation limits.

Provision of Spawning Escapement Reserves (SER). The number of lagged eggs as estimated above which produced the lowest number of recruits was adopted as the Spawning Escapement Reserve (SER) for the two NEA stock complexes. The egg depositions have been converted to numbers of 1SW and MSW spawners and are shown in Figures 2.1.3.1 and 2.1.3.2. Because of the very preliminary nature of this assessment, only historic minimum egg depositions (escapements), for the stock complexes should be used in the provision of advice this year.

Estimates of the SER are based on values of M = 0.01 and 't' of 7 months for 1SW and 17 months for MSW salmon. The SER values for the northern and southern stock complexes are plotted with PFA estimates on Figures 2.1.3.1 and 2.1.3.2.

Age composition of the estimated egg depositions are based upon the ratio of the averages of the estimated numbers of 1SW and MSW spawners for the last 10 years for each country from a simulation analysis. ICES emphasised that this is one approach that might be adopted. An appropriate choice will depend on the age composition being aimed for. Managers may wish to state explicit criteria regarding the restoration of stocks to their recent or historic compositions.

ICES noted that with further analyses in the development of conservation limits, it would be expected that the spawners required to remain above the conservation limit of these stocks will be higher than the historic minimum suggested above.

The age-specific historic minima have been based upon the average age composition of spawning stocks in the past 10 years. This is a relatively conservative approach, and it would probably be desirable to progressively change the composition towards one thought to be more ideal in the long term. If the age composition had been based upon the state of stocks further in the past, the historic minimum for MSW salmon would probably have been higher and the minimum for 1SW fish lower. As a result MSW stocks in Southern Europe would probably have been below the minimum for much of the past 25 years, while 1SW stocks might still be above that level.

2.4 Abundance of Salmon in the North-East Atlantic for 1998/1999

Pre-fishery abundance estimates could be used to provide catch advice if a forecast could be developed of recruits in the year preceding the fisheries, i.e., 1SW recruits must be predicted for 1998 if we are to provide advice for: the West Greenland fishery in 1998; the Faroes fishery (MSW stock) in 1998/99; and homewater fisheries in 1999. Because the latest estimate of non-maturing 1SW recruits is for 1996, the PFA must be forecast two years ahead, as is currently practised for the North American assessment. For maturing 1SW stocks, a single year's projection is sufficient.

2.5 Provision of Catch Options with Assessment of Risk

Catch Advice: In view of the uncertainties expressed about the most appropriate stock groupings, and the high likelihood that the final conservation limits will be higher than the preliminary Spawning Escapement Reserves (SERs) used this year (see Section 4.4), ICES cannot provide precise quantitative catch advice and risk evaluations.

Northern European 1SW stocks: Although the confidence limits on the PFA estimates for maturing 1SW salmon from northern Europe are large, the estimates in the most recent years are greater than the historic minimum SER, and appear to be relatively stable. **ICES therefore considers the 1SW salmon from northern Europe to be within safe biological limits as a stock complex (although the status of individual stocks within the complex may vary). ICES considers the continuation of exploitation of these stocks at the current rate to be acceptable, although there would be risk to the stock complex if exploitation rates were to increase, even marginally.**

Northern European MSW stocks: The PFA of non-maturing 1SW salmon from northern Europe has been declining since the late 1980s, and is now approaching the historic minimum. **ICES considers the stock complex to be within or close to safe biological limits. Because the PFA is very close to the SER value, ICES advises that great caution should be exercised in the management of these stocks, particularly in mixed-river stock fisheries. Every effort should be taken to reduce exploitation rate at least until the PFA begins to rebuild away from the preliminary SER value.**

Southern European 1SW stocks: The PFA of maturing 1SW salmon from southern Europe has been low for about 8 years. In 1997 it was very close to its historic lowest value. **ICES considers that the stock complex to be within or close to safe biological limits. Because the PFA is very close to the SER value, ICES advises that great caution should be exercised in the management of these stocks, particularly in mixed-river stock fisheries. Every effort should be taken to reduce exploitation rate at least until the PFA begins to rebuild away from the preliminary SER value.**

Southern European MSW stocks: The PFA of non-maturing MSW salmon in southern Europe has been declining steadily for about 10 years. Present analyses suggest that the PFA reached a historic minimum in 1996, and with the current trend will fall below that preliminary conservation limit in 1998. **ICES considers this stock complex to be outside or close to safe biological limits, and extreme caution should be exercised in the management of these stocks, particularly in mixed-river stock fisheries. A significant reduction in exploitation rate should be achieved in 1999, and reduced exploitation should continue until the PFA has recovered to a size giving a low probability of falling below the preliminary SER value.**

2.6 Potential By-Catch of Post-Smolts in Pelagic Fisheries

There is no new information about the by-catch of post-smolts in pelagic fisheries.

Both the fishery for mackerel and herring in the Norwegian Sea overlap spatially and temporally with the suggested routes of European post-smolts on their northward feeding migration. To date, however, there is only one record of a Carlin-tagged smolt taken in the mackerel fishery in International Waters in the Norwegian Sea.

Fishing methods used in post-smolt trawl-surveys, which to date have recovered over 850 post-smolts, may not be comparable with those used by the commercial fishery. Therefore catch rates from the scientific trawl fishery cannot be used to estimate the number of smolts taken in commercial catches. Hence, ICES will address questions concerning: i) the timing of pelagic fisheries in the ICES Areas I, IIab, IVab, Va, Vb12, VIab and VIIab; ii) specifications of the gear used; iii) catch per month per ICES statistical rectangle in the relevant Areas and iv) information on possible by-catches of salmon in the pelagic catches to the Working Group on Northern Pelagic and Blue Whiting Fisheries, the Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine and Anchovy, and the Herring Assessment Working Groups.

2.7 Data Deficiencies and Research Requirements in the NEAC Area

Estimates of marine mortality of salmon should be re-examined in the North-East Atlantic, and causes for this mortality should be identified and quantified.

ICES strongly endorses the continuation of the post-smolt surveys in the North-East Atlantic, and recommends this to be extended to presently uncovered areas.

Efforts should be made to provide estimates of by-catch of salmon in marine waters.

ICES recommends a continuation of the research fishery at Faroes.

Alternative ways to group salmon stocks, or stock complexes should be examined to improve the catch advice for salmon in the North-East Atlantic.

The quality of data used to set conservation limits in the North-East Atlantic should be improved and provided for smaller stock complexes. Furthermore, a sensitivity analysis of the input parameters to the pre-fishery abundance model should be carried out.

More information is required on a river-by-river basis relating to catches, exploitation rates and habitat assessment and this should be referenced to the appropriate scale (e.g., tributary populations etc.). Specific information on required age class composition of the stocks should be established on a river-by-river basis (historical and current).

Life history models are required for as many index rivers as possible.

Transportability of existing targets derived from known S/R relationships must be evaluated in comparison with other indices of abundance.

Further refinement is required to the model to estimate PFA and Conservation Limit, particularly with regard to the examination of the input data from each country, to explain differences between the model output and current estimates of abundance from other analyses.

Further research and development is required, particularly with regard to establishing stock size (counters) and relating productivity to suitable habitat area (catchment surveys, juvenile production studies and application of GIS and other techniques).

The implications of combining required adult escapement levels over districts, regions and countries must be examined and the scale to which this is appropriate identified.

3 ATLANTIC SALMON IN THE NORTH AMERICAN COMMISSION AREA

3.1 Events in Fisheries and Status of Stocks

3.1.1 Fisheries in the NAC Area

Gear and effort: Restrictions on commercial and recreational fisheries introduced in Canada in 1992 remained in force. In addition, further regulations were introduced in Labrador: the commercial fishery in SFA 14B (south) was closed, the quota for north Labrador was reduced from 55 t to 50 t. In Québec the commercial fishery continued in zones Q9 and Q11, at the same level as in 1996. In the recreational fishery, hook-and-release regulations for small salmon were extended to more rivers of the Maritimes Region; the retention of large salmon continued only in Québec and northern Labrador. Following river-specific in season reviews of returns, non-retention of salmon regardless of size and in some cases, complete closure, was imposed. In all insular Newfoundland, retention angling seasons were shortened as a result of low returns and/or low water conditions and warm water temperatures.

In the USA there is no commercial fishery for salmon and angling (catch-and-release only) for sea-run salmon in 1997 was permitted only in the State of Maine. No information was available to ICES for professional and recreational net fisheries in Saint-Pierre et Miquelon (France) in 1997.

Catch: The provisional landings for Canada in 1997 were 225 t, a decrease of 22% by weight from 1996 (Table 1.1.1). The landings of small salmon in numbers (57 143) and large salmon (26 530) represented decreases of 30% and 16%, respectively, from those of 1996. Recreational fisheries exploited the greatest number of small salmon in each provinces, accounting for 71% of the total small salmon harvests in eastern Canada. Commercial fishers took the largest share of large salmon (51% by number). Native peoples harvested 4% (by number) of the total small salmon and 24% of the total large salmon in eastern Canada. Unreported catch for the NAC area was estimated at 89 t.

In 1997, the first year for which estimates are complete for Canada, almost 50 000 salmon (22 000 large and 28 000 small) were caught and released. Most of the fish released were in New Brunswick (46%), followed by Newfoundland (41%), Nova Scotia (9%), Québec (4%) 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 (75%) was released in Nova Scotia, followed by New Brunswick (62%), Newfoundland (51%), Prince Edward Island (47%) and Québec (13%).

In the USA the estimated number of salmon caught and released in 1997 was 333 fish - 39% lower than in 1996 and 32% and 46% below the 5- and 10-year means. In Saint-Pierre et Miquelon (France) the harvest was not reported but rather, assumed to be 1.5 t, the value provided in 1996.

Composition and origin of catch: No external tagged fish of USA origin were reported from Canadian fisheries in 1997. 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 Bay of Fundy and along the Atlantic coast of Nova Scotia. Aquaculture escapees were sampled from the St. Croix and Magaguadavic rivers in the Bay of Fundy.

In the USA, some salmon that were caught in the sport fishery in 1997 were assumed escapees from aquaculture operations in Maine and New Brunswick (Canada). In addition, a few of those caught and released originated from captive broodstock that were released into three rivers in June.

3.1.2 Status of Stocks in the NAC Area

Total estimated (mid-point) returns to North America (prior to the Newfoundland and Labrador commercial fisheries) in 1997 were 304 385 1SW and 92 719 2SW fish (Figure 3.1.2.1). The estimate of 1SW returns is 33% lower than the estimate for 1996 and the fourth lowest observed in the 27-year time series, 1971–97. The estimates of returns are quite variable over the time series and have been in some decline over the last decade. The estimated 2SW returns are 19 % lower than returns in 1996 and the second lowest in the time series; they have declined from a peak of 226 000 fish in 1980.

The rank of the estimated *returns* in 1997 in the 1971–97 time series (Figures 3.1.2.2 and 3.1.2.3; inc. spawning targets) for six regions in North American is shown below. Estimates of returns to Quebec, 1971-1997 were revised upwards as a result of using individual river information for 117 rivers. In the following text table, the closer the rank is to 1 the better the relative performance of the stock:

	Rank of 1997 returns in 1971–1997 time series (1=highest)		Mid-point estimate of 2SW spawners as proportion of escapement requirement
Region	**1SW**	**2SW**	(%)
Labrador	4	11	47
Newfoundland	25	13	120
Québec	14	27	30
Gulf (Mainland)	25	23	84
Scotia-Fundy	27	23	19
USA	14	21	6

In most regions the returns of 2SW fish are near the lower end of the 27-year time series except Labrador and Newfoundland where they are about in the middle. Returns of 1SW salmon were at the lower end of the time series in Newfoundland, Gulf and Scotia-Fundy, about at the mid-point in Quebec and USA and near the highest in the series for Labrador.

The text table above also shows the estimated total spawning escapement of 2SW salmon in each region expressed as a percentage of the spawning escapement requirement. Only in Newfoundland were requirements exceeded, and in the Gulf of St. Lawrence approached, in 1997. The overall 2SW spawning escapement requirement for Canada could have been met or exceeded in only three (1974, 1977 and 1980) of the past 27 years (considering the mid-points of the estimates) by reduction of in-river fisheries (Figure 3.1.2.1). In the remaining years, spawning requirements could not have been met even if all in-river harvests had been eliminated.

The North American run-reconstruction model was used to update the estimates of pre-fishery abundance of non-maturing and maturing 1SW salmon from 1971–1997. The estimate of pre-fishery abundance of 127 521 of non-maturing 1SW salmon for 1996 was the lowest on record, 19% below that of 1995 and 8% below the previous low estimated for 1993 (Figure 3.1.2.4). Conversely, a 464 962 value for maturing 1SW salmon was a 38% increase over that of 1995. An estimate of 316 949 fish in 1997 is 32% less than that of 1996 and the lowest in the 27-year time series. The results suggest a continuing decline of North American salmon production. In addition to the steady decline in total recruits over the last 10 years, grilse have become an increasingly larger proportion of the total North American stock complex (Figure 3.1.2.4). This proportion has risen from about 45% at the beginning of the 1970s to between 65 and 80% in the last four years.

Egg depositions exceeded or equalled the specific river requirements in 26 of the 89 rivers which were assessed in Canada and were less than 50% of requirements in 22 other rivers. Large deficiencies in egg depositions were noted in the Bay of Fundy and Atlantic coast of Nova Scotia where 10 of the 20 rivers assessed had egg depositions which were less than 50% of requirements (Figure 3.1.2.5).

The majority of the USA returns were recorded in the rivers of Maine, with the Penobscot River accounting for about 77% of the total USA returns. Salmon returns to the Penobscot River (1 355) were 34% lower than in 1996, 21% lower than the 1992–96 average and 39% lower than the 1987–96 average. Returns to most USA rivers exhibit the same downward trend that has been shown of many Canadian stocks, are hatchery-dependent, and in total (hatchery and wild) represent about 5% of spawner requirements for all rivers.

3.2 Effects of Quota Management and Closure after 1991 in Canadian Commercial Salmon Fisheries

In 1992, a 5-year moratorium was placed on the commercial Atlantic salmon fishery in insular Newfoundland, while in Labrador and Quebec North Shore and Ungava, fishing continued under quota or allowance catch. In conjunction with the commercial salmon fishing moratorium, a commercial license retirement programme went into effect in insular Newfoundland, in SFAs 1, 2 and 14B of Labrador, and in Q7, Q8 and a part of Q9 in Québec; there were no changes in the management measures in Q11.

In 1997, ICES considered a detailed assessment of the impact of the Newfoundland-Labrador changes on Newfoundland stocks and of changes in Quebec on Quebec stocks. As an example, commercial exploitation rates on small salmon during premoratorium years (1984-91) in insular Newfoundland were estimated to have ranged from 29% to 66%, and averaged 49%. On large salmon they ranged from 64% to 98% and averaged 76%. No new evaluations were presented

3.3 Stock Conservation Requirements

Spawning requirements are now considered as threshold reference points synonymously defined as the conservation requirement. The conservation requirements for North America have been expressed in terms of the number of 2SW fish required for all production areas of North America. Requirements for USA rivers are unchanged; Canadian rivers increased by 2.2%, from 151 296 to 154 653 fish. Most of the increase was in the Scotia-Fundy sector and resulted from improved estimates of rearing habitat and biological characteristics of spawners. North American requirements now total 183 852 2SW fish.

3.4 Development of Catch Options

It is now possible to provide catch advice for the North American Commission area for two years. The first is a revised estimate for 1998 for 2SW maturing fish based on improved estimates of the 1997 pre-fishery abundance and accounting for fish which were already removed from the cohort by fisheries in Greenland and Labrador in 1997. The second is an estimate for 1999 based on the pre-fishery abundance forecast for 1998. A consequence of these annual revisions is that the catch options for 2SW equivalents in North America may either increase or decrease compared to the options developed the year before.

3.4.1 Catch Option for 1998 Fisheries on 2SW Maturing Salmon

A revised estimate of the pre-fishery abundance for 1997, of 93 326 fish (Table 3.4.1) is significantly less than the 196 858 value forecast in 1997 (see Sections 3.1.2; 4.1.1; 4.3 and 4.6.1 for explanations). A pre-fishery abundance of 93 326 in 1997 equates to 84 445 2SW salmon equivalents after adjustment for natural mortality of 1% per month for 10 months (a factor of 0.904837). There have already been harvests of 16 185 2SW salmon equivalents in 1997 as 1SW non-maturing salmon in Labrador (1 544) and Greenland (14 641) fisheries. The text table below uses the probability density projections for the revised pre-fishery abundance estimate of 93 326. Catch option values = [(PFA-spawner reserve of 205 230/0.904837) – 16 185].

Catch Options for 1998 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	11 899	0
30	29 956	0
35	46 761	0
40	62 706	0
45	78 187	0
50	93 326	0
55	108 533	0
60	123 903	0
65	140 013	0
70	156 801	0
75	174 862	0
80	195 172	0
85	218 847	0
90	248 799	23 238
95	293 386	63 582

Low returns of 2SW salmon to North America would be consistent with the generally low returns of mature 1SW fish from the same smolt class in 1997. The size of the mature 1SW fish was above or at near average values and suggested that age-at-maturity, if changed by unusual environmental conditions, would be lower rather than higher.

Catch advice for the NAC Area is included in the section relevant to West Greenland 4.6.5.

3.4.2 Catch Option for 1999 Fisheries on 2SW Maturing Salmon

The advice for 1999 is based on a prefishery abundance of 113 899 in 1998 (Table 3.4.1) and assumes a 40% Greenland/ 60% North America division of the surplus for harvest (after reserving the spawner requirement of 205 230). Catch options below are expressed as 2SW salmon equivalents (by considering 10 months of mortality at 1% per month, a factor of 0.904837). There is wide variability in the forecast abundance and caution is warranted.

Catch Options for 1999 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	14 235	0
30	36 326	0
35	56 943	0
40	76 459	0
45	95 362	0
50	113 899	0
55	132 851	0
60	151 512	0
65	171 000	0
70	191 607	0
75	213 945	4 731
80	238 851	18 253
85	268 003	34 080
90	304 873	54 096
95	360 140	84 101

The above numbers of fish refer to the composite North American fisheries and on individual rivers, where spawning requirements are being achieved, there would be little biological reasons to restrict harvests.

Catch advice for the NAC Area is included in the section relevant to West Greenland 4.6.5.

3.5 Data Deficiencies and Research Requirements

There is a need for improved habitat surveys for rivers in Labrador and Ungava so that spawner requirements can be developed on the basis of habitat characteristics.

Review possible changes in the biological characteristics (mean weight, sex ratio, sea-age composition) of returns to rivers, spawning stocks, and total recruits prior to fisheries. As new information becomes available, refine estimates of spawning requirements in USA and Canada by incorporating new information such as on biological characteristics for individual stocks, habitat measurements and stock and recruitment analysis.

Annual estimates of wild smolt-to-adult salmon survival rates need to be obtained for rivers in Labrador, New Brunswick and Nova Scotia. As well, sea survival rates of hatchery and wild salmon should be examined to determine if changes in survival of hatchery releases can be used as an index of sea survival of wild salmon.

4 ATLANTIC SALMON IN THE WEST GREENLAND COMMISSION AREA

4.1 Events in Fisheries and Status of Stocks

4.1.1 Fishery in WGC Area

Catch: In 1997 the West Greenland Commission of NASCO agreed on a 'Reserve Quota' to Greenland of 6% of the forecast PFA using the biological parameters provided by ICES in 1996. The quota was calculated to be 57 t, an amount which the Greenland authorities subsequently set as a TAC for 1997. The fishery began on August 18 and closed on September 23 when the quota was complete. The nominal catch totalled 58 t, the majority of the catch being taken in Divisions 1C, 1E and 1F during the first three weeks. Private sales are now recorded and the unreported catch was estimated to be less than 5 t.

Gear and effort: No new information was available on fishing gear and little information is available on fishing effort. However the number of actually-used licences, or persons landing salmon per season may be used as a rough estimate of the fishing effort. The total number of active persons has declined over the period 1987–95, and now numbers about 150 persons.

Origin of catches: Based on discriminant analysis of characteristics from scales sampled in the fishery in 1997, 60% of fish were of North American origin, i.e., similar to the average value for the years, 1989–95. The catch at West Greenland in 1997 was estimated to consist of 37.6 t (12 957 salmon) of North American origin and 23.0 t (8 281 salmon) of European origin.

Four tags of Canadian origin were captured at West Greenland in 1997. Two of the tagged fish were from a smolt release in the Saint John River in 1996, the other two were from kelts tagged on the west coast of Newfoundland. Eight tags of Penobscot River, USA origin were also reported from West Greenland in 1997. Five were from tag releases in 1996, the remainder were from releases in 1984.

Tshe discriminant analysis of characteristics from scales sampled in the fishery in 1996 (42% estimated to be of North American origin) was reviewed in light of analyses of nuclear and mitochondrial DNA from 181 tissue samples collected from that fishery. The scale-determined continent of origin versus DNA-determined continent of origin indicated misclassification rates of 37% and error rates of ± 23.3% in the scale discriminations. This indicated that if the DNA analyses are considered to be reliable indicators of fish origins, then the previous scale analyses correctly had classified 80% of salmon of European origin. However, the scale analysis had also classified approximately 45% of salmon actually of North American origin as being European as well. If these misclassification rates are present in all the 1996 scale analyses, then the proportion of North American salmon should be 67%, rather than 42% from the discriminant function analysis on scales. Because it will require some time to determine how widely the correction should be applied, an interim proportion North American was assumed to be 55%, the mid-point between the estimate based on scales and the estimate based on the smaller number of DNA samples. This change increased the harvest of North American salmon in West Greenland in 1996 from about 12 900 to 16 800 fish. Conversely the number of European fish was reduced from 19 150 to 15 200.

Biological characteristics of the catch: Mean lengths of 1SW North American (62.6 cm) and European (63.1 cm) fish in 1997 ended a downward trend in length observed since 1969. Mean weights of 1SW salmon at West Greenland (2.6 and 2.7 kg for NA and European fish, respectively) were similar to those observed in recent years. Mean lengths and weights of 2SW salmon were among the highest ever observed.

The proportion of river-age-3 fish among European origin salmon was 37.8%, well above the mean value of 17.5% from 1968–96, but within the range exhibited since 1992. River-age-4 fish (2.9%) approximated the long-term mean; river-age-1 fish (3.6%) comprised the smallest proportion in 23 years. Among North American fish, river-age-2 fish (18.7%) were the lowest in 19 years and of river-age-3 fish (45.3%) were the highest in 18 years.

1SW fish of North American and European origins comprised 98.0% and 98.7% of the commercial catch samples, respectively, and were the highest proportions of an 11-year data set. Conversely, 2SW and older fish comprised the lowest proportion of the data series.

4.1.2 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. While 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 North-East Atlantic: Run-reconstruction estimates of pre-fishery abundance of non-maturing 1SW salmon from southern areas (Figure 2.1.3.2) have been volatile over the period 1971–96, but in steady decline over the past 12 years. Non maturing 1SW salmon from northern stocks (Figure 2.1.3.1) appear to have been declining since the 1980s, with the most marked change occurring in 1986–87. Conservation limits have only been exceeded in 5 of 11 rivers for which data are available in the NEAC area (separate 2SW reference levels not provided for all stocks). There were no significant trends noted in the spawner attainment over the last 10 years for all stocks combined, but a significant trend towards lower egg deposition was noted over the most recent 5-year period.

In general, there has been no significant change in smolt production in the Northeast Atlantic but marine survival was lower than the previous 5-year mean. Analysis showed no significant trends in marine survival of wild stocks for the last 5- and 10-year periods. Marine survival rates for six hatchery stocks showed a significant downward trend in survival to homewaters for both 1SW and 2SW salmon.

Stocks originating in North America: Run-reconstruction estimates of pre-fishery abundance of non-maturing 1SW salmon provided a value for 1996 that is the lowest on record; although only slightly lower than the 1993 estimate (Figure 3.1.2.4). Pre-fishery abundance in 1996 has declined by 19% from the 1995 value. In addition to the steady decline in total recruits (both maturing and non-maturing 1SW salmon) over the last ten years, maturing 1SW salmon (grilse) have become an increasingly large percentage of the North American stock complex. This percentage has risen from about 45% at the beginning of the 1970s, to around 70% in 1992–95 to almost 80% in 1996.

The estimate of the total number of 2SW salmon returning to North America in 1997 is 19% lower than the estimate for 1996 and lower than the average of the previous years (1971–96) by 34%. It is the lowest observed in the past 10 years and second lowest in the 27-year time series, 1971–97 (Figure 3.1.2.1). The estimates of returns are quite variable over the time series with no trends indicated. Returns have declined from a peak of 226 000 in 1980. With the exception of Labrador, returns of 2SW fish to most regions were also near the lower end of the 27-year time series.

The estimated 2SW returns and spawners to USA rivers in 1997 was 33% below the 1996 estimate and 21% and 43% below the previous 5-year and 10-year averages, respectively. Returns to most USA rivers are hatchery-dependent. Spawning escapements remained at low levels (5%) compared to conservation requirements.

Egg depositions exceeded or equalled the specific conservation requirements in only 26 of the 89 rivers (29%) that were assessed in Canada and were less than 50% of requirements in 30 other rivers (34%). Large deficiencies in egg depositions were noted in the Bay of Fundy and Atlantic coast of Nova Scotia where 14 of the 19 rivers assessed had egg depositions that were less than 50% of requirements (Figure 3.1.2.5).

North American salmon stocks remain low relative to the 1970s. The 1SW non-maturing component continues to be depressed with river returns and total production amongst the lowest recorded. In addition, returns in 1997 of maturing 1SW salmon (grilse) to North American rivers were very low; the fourth lowest in the 27-year time series. This being the case, improvement in 2SW salmon returns and spawners is unlikely in 1998. Only insular Newfoundland achieved its spawning requirements for 2SW salmon in 1997, where 2SW salmon comprise only a small proportion of salmon production. The next highest was the Gulf of St. Lawrence at 84%, where 2SW salmon are a high proportion of production and very important in terms of their contribution to both North American and Greenland fisheries. The other areas ranged from 5% in USA to 47% in Labrador .

Despite some improvements in the annual returns to some rivers, both in European and North American areas, the overall status of stocks contributing to the West Greenland fishery remains poor, and as a result, the status of stocks within the West Greenland area is thought to be low compared to earlier (historical) levels.

4.2 Evaluation of the "Reserve Quota"

The 'Reserve Quota' was an arrangement that provided for a fishery at Greenland when the forecasted Pre-fishery Abundance (PFA) was between 0 and 300 000 North American 1SW non-maturing salmon. Below 100 000 PFA, only a subsistence fishery was allowed. Between 100 000 and 300 000 PFA, a quota was calculated based on an allocation to Greenland of 6% of the PFA (at the 50 % probability level) which was translated into quota weight using the biological parameters forecasted by ICES for the 1996 PFA. Under this approach, quotas ranged from 29 to 86 t when the possible PFAs ranged from 100 000 to 300 000 fish; for a PFA of 196 858 (50% probability level) in 1997, the quota was 57 t.

The quota allocated to Greenland was agreed to be the higher of the 'Reserve Quota' or a 'calculated quota'. The 'calculated quota' was based on a 1993 NASCO agreement (Article 2.3) which prescribed 40 % of the available surplus (after subtracting the spawner reserve for North America from the PFA at the 50% probability level) to the Greenland fishery. Under those terms the 'calculated quota" for 1997 was 0 t (i.e., PFA was less than the spawning reserve).

The use of the 'Reserve Quota' arrangement when the calculated quota is 0 t will result in an increased risk (greater than 50%) of failing to achieve the conservation limit objectives, i.e., in 1997, the level of risk for a 57 t quota was 56% if none of the surviving fish were subsequently harvested in North America. ICES previously cautioned against the use of probability levels greater than 50% and has regularly advised that a precautionary approach would consider much lower levels of risk as more appropriate. ICES also noted that Article 2.3 of the 'Reserve Quota' arrangement would have come into effect based on the revised forecast for 1997 of 93 326 fish and that there would only have been a subsistence fishery at Greenland in 1997.

4.3 Changes from the 1997 Assessment

The models (see Section 4.5) used to predict pre-fishery abundance of the North American non-maturing stock complex and subsequent quota levels for West Greenland were unchanged from those used in 1997. However, some of the input data were modified to reflect new information. These included: modified conservation requirements for the North American non-maturing stock component (see Section 3.3); improved estimates of returns to the province of Québec, 1971-97 (Section 3.1.2); improvement of the catch reporting system in the Province of Newfoundland; corrections to the discriminant model used to estimate continent of origin in Greenland (see Section 4.1.1); and, another year of data. Changes in the data resulted in approximately a 5% increase in the pre-fishery abundance estimates for most years and increases of about 12% and 18% in 1994 and 1995, respectively. The forecast pre-fishery abundance for 1997 would, however, (using 1998 models) have been fewer fish and resulted in a subsistence fishery only in West Greenland (Section 4.2).

4.4 Age-Specific Stock Conservation Limits for all Stocks 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 2SW or 3SW 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. In 1997, 98.0 and 99.7% of the sampled catch was 1SW salmon of North American and European origins, respectively. For this reason, conservation limits defined for North American stocks (see Section 3.3) have been limited to 2SW salmon that may have been at Greenland as 1SW non-maturing fish. The total requirement is 183 852 fish, with 154 653 and 29 199 prescribed for Canadian and USA rivers, respectively; the reserve spawner requirement (includes 10 months of mortality at 1%) is 205 230 fish.

Conservation limits are being developed for 1SW and MSW salmon of European and North American origin, based on possible stock/recruit relationships, possible egg to recruit relationships, and marine survival estimates. The functional relationships and estimation methods require further review and validation. In the interim a preliminary spawning escapement reserve (SER) has been estimated, based on the number of spawners required to provide the minimum egg deposition observed historically, and constant natural mortality. The approach used is described in Section 2.3.1. When it becomes possible to use more biologically complete analyses, the resultant final conservation limits have a high likelihood of being higher than these preliminary SERs. Hence the values used in developing the present advice should be considered minimum formal requirements. There is a high likelihood that they will be replaced with even higher conservation limits in future, requiring even greater SERs.

The preliminary estimate of minimum spawners for the total European stock complex in 1998 was 608 768 MSW fish. From tagging information and biological sampling at Greenland, it is clear that the area is used primarily by southern European stocks rather than northern European ones. For southern stocks the minimum number of spawners was 390 900 MSW fish. Lagging the egg production appropriately, and accounting for natural and fishing mortalities, these estimates indicate SERs of 721 575 for MSW stocks and 463 366 for non-maturing 1SW stocks are required.

4.5 Critical Examination of the 'Model' Used to Provide Catch Advice

Background: Catch advice, and associated risk, for North American stocks in West Greenland are the result of a series of steps which begin with the estimation of 2SW returns to regions of North America. The procedure encompasses a number of estimations, e.g., several models are used in estimating returns to North America, but the key estimation procedures, their method, input and output are summarised in Table 4.5.

Evaluation of the 'model': ICES has regularly listed the strengths and weaknesses of the various models contributing to catch advice. Steady improvements have been made in the thermal/lagged spawner model's predictions of pre-fishery abundances, by ensuring that data inputs are the best available, and by incorporating new, biologically relevant variables that are shown to be appropriate predictors.

Further improvements could be realised by improving the quality of the inputs to the various models (e.g., estimates of the number of salmon returning to individual rivers or to regions, confirmatory sampling off Greenland to verify the predicted pre-fishery abundances, better sampling of fish caught at Greenland to determine biological parameters and continent of origin). Useful insights might also be realised through a sensitivity analysis requiring extensive reviews of the various databases and computer simulations.

Vulnerabilities in the existing procedure to provide catch advice include:

Reductions in catch data- Catch data are critical inputs to the run-reconstruction model. As fisheries have been reduced in recent years, a smaller proportion of the salmon stocks have been sampled, and fewer data are available. The reliability of the models is therefore reduced. The catch data also includes unreported catches which are difficult to estimate.

Use of a constant for natural mortality at sea- The models used assume a constant natural mortality for salmon at sea. By contrast, it is quite likely that mortality is variable, possibly highly so, and may be correlated over years. This will introduce uncertainty to the predictions, and if changes in natural mortality persist over several years, then errors may compound over several years before model diagnostics allow the change in mortality to be identified and corrected in the model.

The use of a fixed proportion of smolts- The determination of lagged spawners relies on a fixed proportion of smolt ages (1-3) from 1974-96 which is unlikely to be the case in reality. For the purposes of this calculation 1 SW and MSW fish are combined to form one group. It is unlikely that the proportions of each age class being produced is the same for 1 SW and MSW fish.

Use of a poorly understood environmental variable- We do not understand exactly how marine environment is linked to salmon production. Because of this, the present formulation of the model is likely to fail. Ongoing studies linking marine survival and growth during the post-smolt stage suggest the importance of thermal habitat prior to the first winter at sea.

Lack of precision for small scale decisions- The resolution of the present model is too imprecise for present management needs. Based on the risk analysis, we can assess the impacts of quotas upon North American spawning requirements to the order of hundreds of tons. Managers are presently considering quotas of the order of tens of tons.

Inaccuarcy in risk and probability estimates- The data input to the run-reconstruction model usually represent all the uncertainty in numbers of recruits in individual rivers or Salmon Fishing Areas (SFAs) with a uniform distribution between bounds which have been assumed to be constant over time, and, to varying degrees, must be set arbitrarily. Moreover the uncertainties for individual rivers or SFAs are assumed to be simply additive. These problems may make risk and probability estimates inaccurate.

4.6 Catch Options with an Assessment of Risks

4.6.1 Introduction

The procedures to develop catch advice and concerns were presented in Section 4.5. The processes remain unchanged from those used in the 1997 assessment although some of the input data were modified to reflect new information (Section 4.3).

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 3.1.2.3. Estimates of 2SW returns in Labrador are derived from estimated 2SW catches in the fishery using a range of assumptions regarding exploitation rates and origin of the catch. The 1997 spawner and return estimates were adjusted to account for reductions in licensed fishing effort and season in Labrador in 1997 as well as the closure of the commercial fishery in SFA 14B. Also, the methods of calculation of returns and spawners in Québec were further refined revising the entire time series of data and hence the input values for model parameters have also changed (see Sections 3.1.2, 3.4.1 and 4.1.1).

Update of thermal habitat: Thermal habitat has been updated to include 1998 data. Two periods of decline in the available habitat are identified (1980-84 and 1988-95) in the February index (Table 3.4.1). Available habitat for February has increased considerably in 1998 over 1997, from 1594 to 1849 units; an increase of 16%. The 1998 February value is the highest value in the last 17 years and is a return to the high values experienced in the 1970s.

4.6.2 Pre-fishery Abundance Forecast for 1998

The model employed in 1997 using thermal habitat for February and lagged spawners [sum of lagged spawners from Labrador, Newfoundland, Scotia-Fundy and Québec] was updated to reflect the addition of the new data. The linear fit to the 1998 model of pre-fishery abundance versus February thermal habitat and lagged spawners (SNLQ) produced a significant relationship between observed and predicted values at less than the 5 % level. With the 1996 data point and revision of the Québec time series of lagged spawners and returns there is an improvement in fit over that of last year (R^2=0.79 in 1998 versus 0.71 in 1997 and 0.68 in 1996. The model parameters are all significant, with lagged spawners accounting for the 66% of the total sum of squares. Individually, the two predictor variables used are also significantly related to pre-fishery abundance (Figure 4.6.2).

The forecast of pre-fishery abundance for 1998 using simulation methods and the February thermal habitat and lagged spawner model is about 113 899 fish at the

50% probability level (Table 3.4.1). Application of the 1998 forecast model to forecast the 1997 value results in a forecast of 93 326 which is considerably lower than the previously reported value of 196 858. It should be noted that deterministic and simulated forecast values will show slight differences due to the method of calculation.

4.6.3 Development of Catch Options for 1998

The spawning requirement for all North American rivers is currently set at 183 852 2SW fish which is the equivalent of 205 230 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. Forecast parameter values for the proportion of the stock at West Greenland which is of North American origin [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] used in the procedure are given in Table 4.6.3.

Greenland quota levels for the forecast of pre-fishery abundance were computed with the revised model and are shown in Table 4.6.3. For the point estimate level and the stochastic regression estimate using NN1, the quota options ranged from 0 to 45 t, depending on the proportion allocated to West Greenland (FNA) and was bounded by the 25% to 75% probability levels. For the FNA level used in recent management measures for the West Greenland Commission (at the 0.4 allocation rate), the quota is 0 t at the 50 % risk level.

4.6.4 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. An analysis of the probability of not meeting the conservation requirements in the six stock areas of North America was conducted by incorporating the uncertainty in all the parameters used to evaluate the spawning escapement to North America. They included i) the conservation requirement risk plot ii) the uncertainty of the pre-fishery abundance forecast, and ii) uncertainty in the biological parameters used to translate catches (proportion North American origin, weight of 1SW North American origin, weight of 1SW European origin, age correction factor) into numbers of North American origin salmon.

Under the assumption of recruitment in direct proportion to the spawner requirement, just over 200 000 fish are required to escape to North America to produce a 50% probability of achieving the spawner requirement concurrently in all six stock areas. This value is higher than the 183 852 fish point estimate of total requirements to North America because it incorporates the annual variation in the proportion of females.

The risk analysis assumed that the management of West Greenland and North American fisheries in 1999 would be similar to that of 1997 and that exploitation rates in North America would be between 0.15 and 0.25. The impact of these fisheries on the salmon returning to homewaters in 1999 in the absence of any fishery at Greenland in 1998 results in a high risk (83%) of not meeting the conservation requirements in at least one of the six stock areas (Figure 4.6.4 lower panel). This assumes that salmon will return to each geographic area in proportion to the relative conservation requirements in each area and that the exploitation rates in each of the six stock areas are similar.

The cumulative consequences of fisheries at Greenland (1998) and in North America (1999) on the potential spawning escapements to North American stock areas increases the risk of severe underescapement (50% of conservation requirements) in North America. There is a 48 % risk of severe underescapement with no fisheries and the risk rises to greater than 50% at a Greenland catch option of 50 t and exploitation rates between 0.15 and 0.25 in North America (Figure 4.6.4). Considering the uncertainty in the assessment of the abundance of North American salmon in West Greenland in 1998, precautionary approach principles in managing both the Greenland and North American salmon fisheries are advised.

Even if fisheries are restricted to levels which provide a 50% probability that the overall escapement requirements are achieved, it is likely that some stocks will fail to meet their individual spawner requirements while others will exceed requirement levels. This unequal achievement of escapement goals may result from random variation between years or from systematic differences in the patterns of exploitation on fish from different rivers or regions. In the latter case, adoption of a 50% probability level may result in some stocks failing to meet requirement levels over several consecutive years if the full TAC is harvested. This would be likely to result in a long-term decline in those stocks.

4.6.5 Catch Advice

It is evident from indicators of stock status, including the current and predicted estimates of pre-fishery abundance, that the North American stock complex is in a tenuous condition. If the forecast is accurate then pre-fishery abundance in 1998 will be lower than any other pre-fishery abundance value previously estimated despite nearly complete closures of mixed and single stock fisheries, because of the continuing trend of below-requirement spawning escapements for 2SW salmon, and the low marine survival rates for some monitored stocks. The increasing advantage associated with each additional spawner in under-seeded river systems makes a strong case for a conservative management strategy.

ICES recommends that there should be no exploitation of the 1997 smolt cohort as non-maturing 1SW fish in North America or at Greenland in 1998, and also recommends that the cohort should not be exploited as mature 2SW fish in North America in 1999. Exceptions are in-river harvests from stocks which are above biologically-based escapement requirements. Further, fishing mortality 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. From a precautionary perspective, in light of uncertainties in changing maturity schedules and spatial distributions, ICES advises that there should be no exploitation of the 1997 smolt cohort as maturing 1SW fish in North America, except for in-river harvests from stocks which are above biologically-based escapement requirements, consistent with existing conservation measures.

4.7 Data Deficiencies and Research Requirements in the WGC area

The mean weights, sea ages and proportion of fish originating from North America and Europe are essential parameters to provide catch advice for the West Greenland fishery. As these parameters are known to vary over time, ICES recommends that the sampling programme which was carried out in 1995 and 1996 be continued and improved to cover as much of the landings as possible.

Efforts should be made to improve the estimates of the annual catches of salmon taken for local consumption at West Greenland.

The catch options for the West Greenland fishery are based almost entirely upon data derived from North American stocks. 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) ICES emphasises the need for information from these stocks to be incorporated into the assessments as soon as possible.

APPENDIX 1

CNL(97)50

REQUEST FOR SCIENTIFIC ADVICE FROM ICES

1. With respect to Atlantic salmon in the North Atlantic area:

   1.1 provide an overview of salmon catches, including unreported catches and catch and release, and worldwide production of farmed and ranched salmon in 1997;
   1.2 report on significant developments which might assist NASCO with the management of salmon stocks;
   1.3 provide any new information on the causes of changes in abundance of salmon;
   1.4 comment and advise on the Report of the NASCO Working Group on the Precautionary Approach, as it relates to the work of ICES;
   1.5 provide a compilation of microtag, finclip and external tag releases by ICES member countries in 1997.

2. With respect to Atlantic salmon in the North-East Atlantic Commission area:

   2.1 describe the events of the 1997 fisheries and the status of the stocks;
   2.2 update the evaluation of the effects on stocks and homewater fisheries of the suspension of commercial fishing activity at Faroes since 1991;
   2.3 provide age specific conservation limits for all stocks occurring in the Commission area based on best available information;
   2.4 estimate the expected abundance of salmon in the North-East Atlantic for 1998/1999;
   2.5 provide catch options with an assessment of risks relative to the objective of exceeding stock conservation limits;
   2.6 evaluate any new information on the potential by-catch of post-smolts in pelagic fisheries;
   2.7 identify relevant data deficiencies and research requirements.

3. With respect to Atlantic salmon in the North American Commission area:

   3.1 describe the events of the 1997 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 with an assessment of risks relative to the objective of exceeding stock conservation limits;
   3.5 identify relevant data deficiencies and research requirements.

4. With respect to Atlantic salmon in the West Greenland Commission area:

   4.1 describe the events of the 1997 fisheries and the status of the stocks;
   4.2 evaluate the impact of the Reserve Quota at West Greenland on salmon stocks in relation to the goal of exceeding stock conservation limits {spawning targets};
   4.3 provide a detailed explanation 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 age specific stock conservation limits {spawning targets} for all stocks occurring in the Commission area based on best available information;
   4.5 examine critically the model used to provide catch advice, looking at all the assumptions, and comment on the confidence limits on the output from the model;
   4.6 provide catch options with an assessment of risks relative to the objective of exceeding stock conservation limits {spawning targets};
   4.7 identify relevant data deficiencies and research requirements.

APPENDIX 2

COMPUTATION OF CATCH ADVICE FOR WEST GREENLAND

The North American Spawning Target (SpT) for 2SW salmon stands at 183 852 fish.

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 Requirement 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 tonnes, it is necessary to incorporate the mean weights (kg) of salmon for North America [WT1SWNA][1] and Europe [WT1SWE][1] and an 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 tonnes) at Greenland is then estimated as

Eq. 5. $Quota = (NA1SW * WT1SWNA + E1SW * WT1SWE) * ACF/1000$

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[1] New sampling data from the 1997 fishery at West Greenland were used to update the forecast values of the proportion of North American salmon in the catch (PropNA), the mean weights by continent [WT1SWNA, WT1SWE] and the age correction factor [ACF] in 1998.

PropNA =	0.584
WT1SWNA =	2.622
WT1SWE =	2.740
ACF =	1.118

Table 1.1.1 Nominal catch of SALMON by country (in tonnes round fresh weight), 1960-1997. (1997 figures include provisional data).

Year	Canada (1)	Den.	Faroes (2)	Finland	France	East Greenland	West Greenland (3)	Iceland Wild	Iceland Ranch	Ireland (4,5)	Norway (6)	Russia (7)	Spain (8)	St.P & M.	Sweden (West)	UK (E&W)	UK 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	772	21	2.5	20	208	113	1019	0.8	289	9557	-	-
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	-	865	54	20	<0.5	1077	130	17	993	1348	364	10	-	25	286	132	1092	6.4	437	8654	-	-
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	65	1730	1598	608	27	2.5	54	430	109	1271	1.9	-	9261	315	-
1987	1784	-	576	49	27	<0.5	966	181	38	1239	1385	564	18	2	47	302	56	922	1.2	-	8157	2788	-
1988	1311	-	243	36	32	4	893	217	179	1874	1076	419	18	2	40	395	114	882	0.9	-	7736	3248	-
1989	1139	-	364	52	14	-	337	140	136	1079	905	359	7	2	29	296	142	895	1.7	-	5898	2277	-
1990	911	13	315	60	15	-	274	146	280	586	930	315	7	2	33	338	94	624	2.4	-	4945	1890	180-350
1991	711	3.3	95	70	13	4	472	130	375	404	876	215	11	1	38	200	55	462	0.8	-	4136	1682	25-100
1992	522	10	23	77	20	5	237	175	461	630	867	166	11	1.3	49	186	91	600	0.7	-	4132	1962	25-100
1993	373	9	21	70	16	-	-	160	496	541	923	140	8	1.8	56	263	83	547	0.6	-	3708	1644	25-100
1994	355	6	6	49	18	-	-	140	308	804	996	138	10	2.7	44	307	91	649	-	-	3924	1276	25-100
1995	260	-	5	48	9	2	83	150	289	790	839	129	9	0.4	37	295	83	588	-	-	3616	1060	n/a
1996	290	-	1	44	14	<0.5	92	122	236	685	787	131	7	1.5	33	180	77	427	-	-	3128	1123	n/a
1997	225	-	-	45	8	1	58	106	48	570	630	111	-	1.5	17	142	93	267	-	-	2323	827	n/a
Means																							
1992-1996	360	5	11	58	15	2	82	149	358	690	882	141	9	2	44	246	85	562	<0.5	-	3702	1413	-
1987-1996	766	-	165	56	18	2	335	156	280	863	958	258	11	2	41	276	89	660	1	-	4938	1895	-

1. Includes estimates of some local sales, and, prior to 1984, by-catch.
2. Since 1991, there has only been a research fishery at Faroes. In 1997 no fishery took place.
3. Includes catches made in the West Greenland area by Norway, Faroes, Sweden and Denmark in 1965-1975.
4. From 1994, includes increased 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. These will be included in next year's report.
8. Weights prior to 1990 are estimated from 1994 mean weight. Weights from 1990 based on mean wt. from R. Asturias. Data for 1997 not yet available.
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.

Table 2.3 Hierarchy of methods to establish conservation limits.

METHOD	RANK	APPROACH	DATA REQUIRED	NUMBER OF RIVERS WHERE THESE DATA ARE AVAILABLE AND APPROACH CAN BE TAKEN							
				Irl	Norway	Russia	Sweden	UK (E/W)	UK(Scot)	UK (NI)	TOTAL
S/R relationship											
Index river	1	For all biological populations	Long time series of full census data) (multiple traps/counters)	1	1					1	3
	2	For entire river stocks	Long time series of counter/trap data)			11					11
Transporting ref. point to	3	Grade A nursery habitat used	Habitat area and utilisation with reference to index river data					77		2	79
non-index rivers	4	Grade A nursery habitat	Habitat area with reference to index river data			54					54
	5	Habitat classification matrix	Stream order and altitude with reference to index river data								
	6	All available nursery habitat	Available nursery area of all grades with reference to index river data				18				18
	7	Wetted area	Wetted area with reference to index river data								
	8	Catchment area topographically corrected	Catchment area elevation relief ratios with reference to index river data								
	9	Catchment Area	Catchment area with reference to idex river data	174						38	212
Transporting ref. Point											
Regional or grouped by area	10	Combined catchment areas	Catchment area with reference to Idex river data								
Alternative to S/R relationships											
Direct abundance estimate	11	Short time series census data (smolts and /or adults)	Full counter/trap data for recent period		1						
Indirect abundance estimates											
	12	Smolt productivity studies	Smolt production estimates referenced to habitat area/type and abundance estimate		2						
	13	Lagged spawners based on exploitation rate data	Long time series of catch and exploition data, smolt/adult age composition		665				382		1047
	14	Catches corrected by exploitation rates	Catch and exploitation rate								
	15	Partial count/trap data									
	16	Catch or historical estimate of abundance				35					35
TOTAL				175	669	Approx 100	18	77	382	41	1559

Table 3.4.1 Pre-Fishery abundance estimates, thermal habitat index for February based on sea surface temperature, lagged spawner index for North America excluding Gulf and US spawners (SNLQ), results of a jackknife cross-validation of the forecast model, and simulated forecasts.

	Pre-Fishery Abundance			Thermal Habitat	Lagged Spawners			Jackknife Cross-Validation	
Year	Low	High	Mid	February	Low	High	Mid	Prediction	Residuals
1971	578954	726699	652826	2011					
1972	557788	733183	645486	1990					
1973	672661	867737	770199	1708					
1974	623992	800812	712402	1862					
1975	710243	904537	807390	1827					
1976	610836	826772	718804	1676					
1977	506933	667717	587325	1915					
1978	288808	371345	330077	1951	35441	81978	58,710	508861.1	-178784
1979	630107	831343	730725	2058	42640	94840	68,740	601469.7	129255
1980	549069	729314	639191	1823	43222	97219	70,221	569398	69793
1981	527384	684484	605934	1912	43287	97645	70,466	613915.7	-7981
1982	439898	567062	503480	1703	43393	98396	70,895	557790.6	-54310
1983	236420	337375	286897	1416	40425	91991	66,208	403477.9	-116581
1984	245426	347472	296449	1257	37658	84098	60,878	238563.9	57885
1985	399007	538538	468772	1410	39305	83265	61,285	269111.1	199661
1986	435085	575040	505063	1688	39891	89038	64,465	443104.7	61958
1987	398154	527749	462952	1627	36298	87453	61,876	382448.2	80503
1988	317613	423435	370524	1698	37061	83602	60,332	387608.5	-17085
1989	241518	345953	293735	1642	41944	86394	64,169	442798	-149063
1990	218190	295743	256967	1503	40952	81826	61,389	342165.8	-85199
1991	249690	348471	299080	1357	37575	73152	55,364	182780.2	116300
1992	144482	217310	180896	1381	35591	71572	53,582	177352.6	3544
1993	95572	179827	137699	1252	38381	79473	58,927	229393.5	-91694
1994	109457	213387	161422	1329	38395	75957	57,176	219947.4	-58525
1995	117752	196643	157197	1310	36738	70104	53,421	151163.5	6034
1996	97940	156563	127251	1470	33488	61737	47,613	111649.6	15602
1997				1594	30356	56343	43,350	93,326[1]	
1998				1849	26327	52031	39,179	113,899[1]	

1. Simulated forecast values.

Table 4.5 Descriptions of various steps followed in the procedure to provide catch advice for West Greenland.

Step 1:	Provide estimated returns (1SW & MSW) to North American (NA) regions
Method:	Run-reconstruction models for regions in NA (various river models)
Input:	Abundance estimates, catches
Output:	Estimated number of maturing and non-maturing 1SW salmon returning to NA
Step 2:	Run-reconstruction model
Method:	Adds NA returning estimate and catches to calculate pre-fishery abundance (PFA)
Input:	No. returns and spawners from step 1, Natural mortality estimates, Catches
Output:	Back-calculated PFA
Step 3:	Predictions (forecast model) of currents year's PFA
Method:	Multiple linear regression, Jacknife prediction, Stochastic analysis
Input:	Pre-fishery abundance estimates from step 2, Thermal habitat index (for a specific period of the year), Lagged spawner estimates
Output:	Predicted PFA's and a projection of current year's PFA (uncertainity estimated with cumulative probability distribution function in 5% percentile steps)
Validation:	Compares predicted PFA's from step 3 and PFA's estimated from the run-reconstruction model in step 2
Step 4:	Catch advice model -quota projections for Greenland
Method:	Quota calculations accounting for mortality and the spawner requirement set aside for NA, proportion of NA fish at Greenland, Mean weight of 1 SW salmon, Adjust for age composition of MSW (ACF) at Greenland, Exponential smoothing model
Input:	Estimated cumulative pdf of PFA values for the current year from step 3, Estimated no. 2SW spawning escapement, Proportion of NA fish at Greenland
Output:	Allowable harvest, Quota scenario's with associated levels of risk (of not meeting the NA spawning requirements/conservation targets)
Step 5:	Risk associated of applying the Greenland quota to NA conservation requirements
Method:	Incorporate the uncertainities in all factors used to develop catch options (quota, Step 4)
Input:	Uncertanity measures (pdf's and min-max bounds) of spawning requirement, PFA forecast, biological parameters to translate catches (weights) into numbers of NA origin salmon
Output:	Risk associated of not meeting the 100% NA spawner requirement for catch opions at W Greenland

Table 4.6.3 Quota options (mt) for 1998 at West Greenland based on H2-SNLQ regression forecasts of 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 probability density function.

Prob.	Proportion at West Greenland										
level	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
25	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0
35	0	0	0	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0	0	0
45	0	0	0	0	0	0	0	0	0	0	0
50	0	0	0	0	0	0	0	0	0	0	0
55	0	0	0	0	0	0	0	0	0	0	0
60	0	0	0	0	0	0	0	0	0	0	0
65	0	0	0	0	0	0	0	0	0	0	0
70	0	0	0	0	0	0	0	0	0	0	0
75	0	4	9	13	18	22	27	31	36	40	45

Sp. res =	205,230
Prop NA =	0.5844
WT1SWNA =	2.623
WT1SWE =	2.740
ACF =	1.118

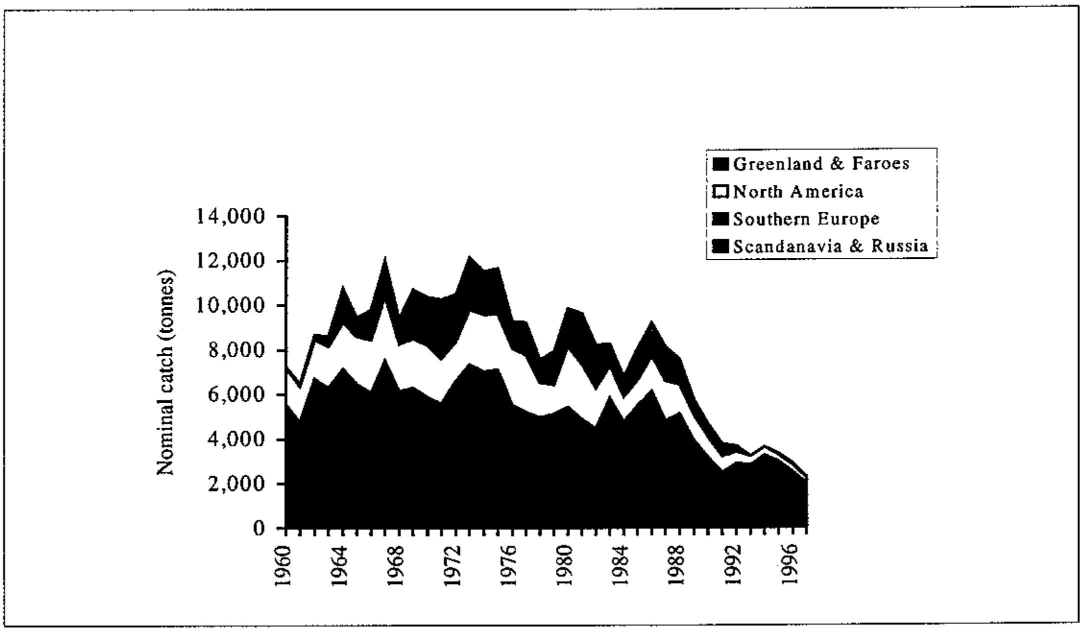


Figure 1.1.1 Nominal catches of salmon in four North Atlantic regions 1960–1997.

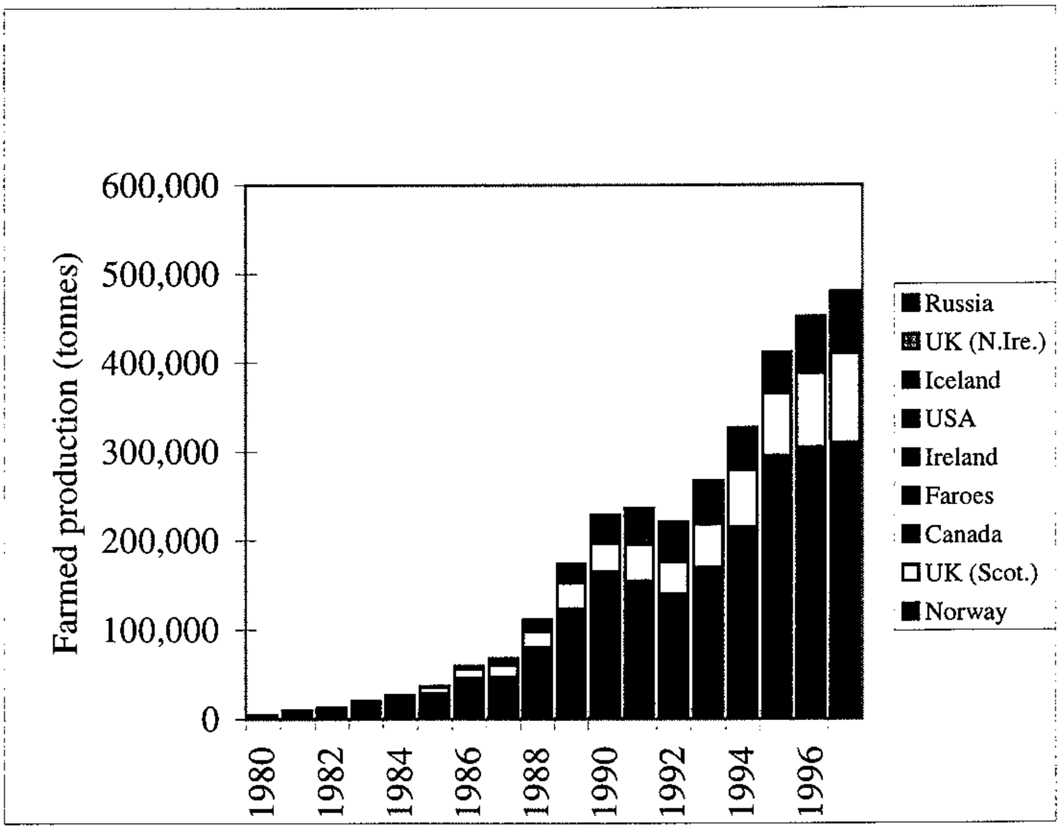


Figure 1.1.4 Production of farmed salmon (tonnes round fresh weight) in the North Atlantic, 1980–1997 (legend stacked relative to 1997 tonnages).

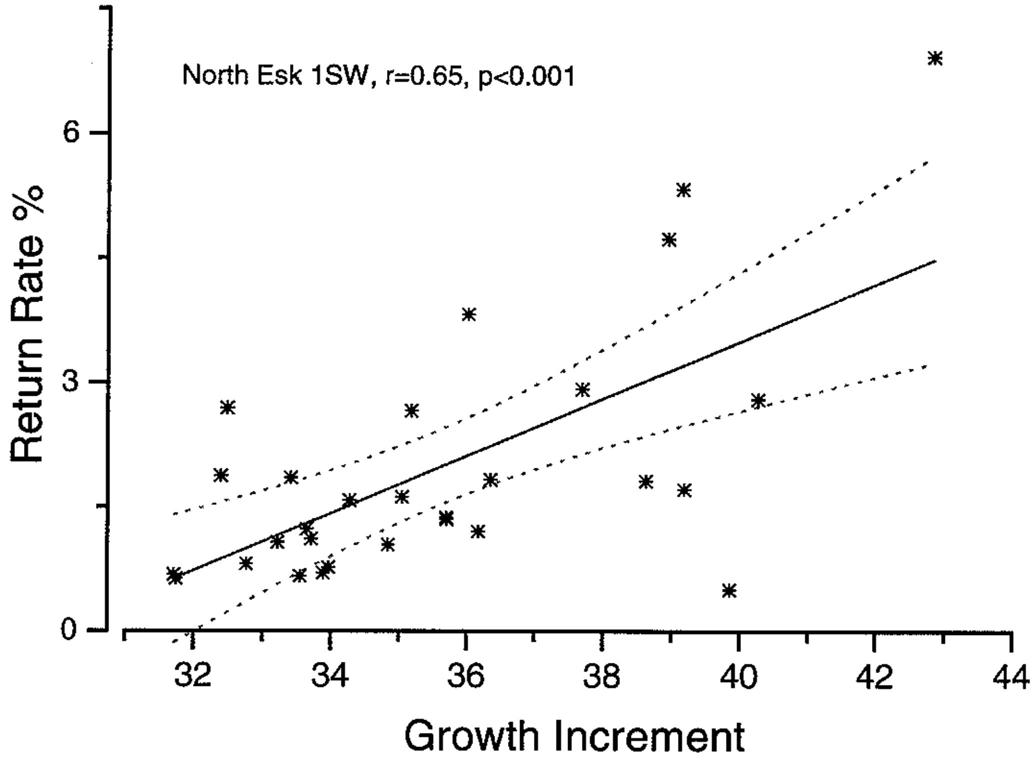
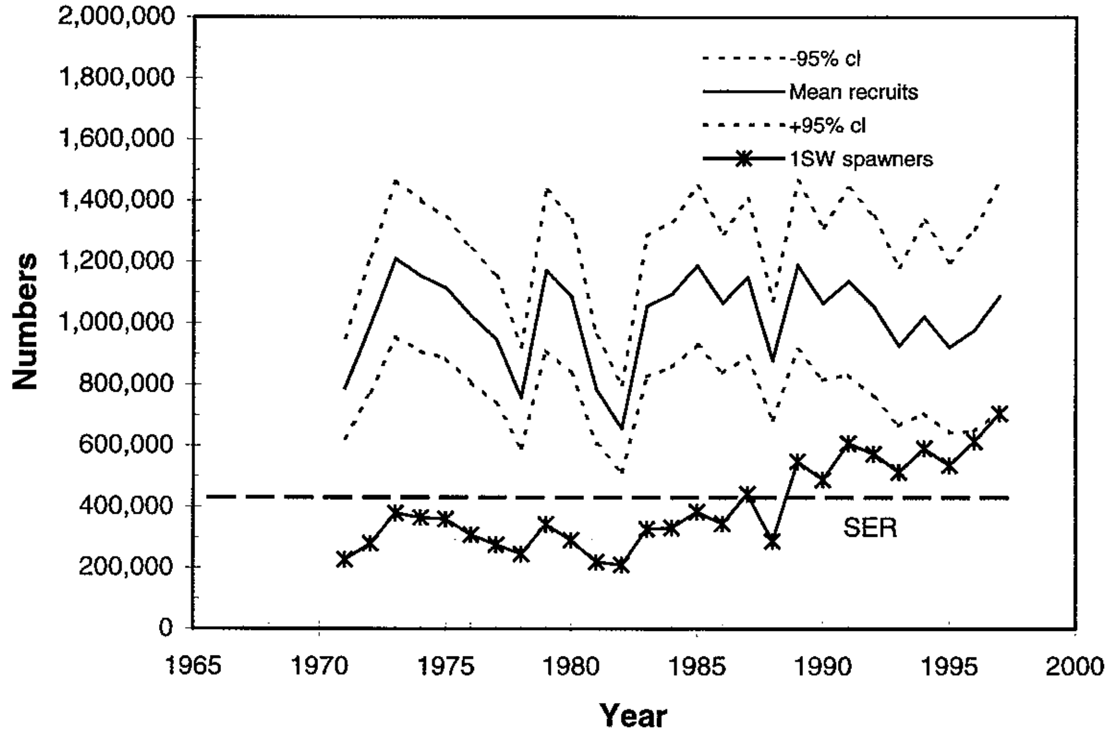


Figure 1.3.1 Scattergram and regression between 1SW return rate and post-smolt growth increment match by smolt years. Dashed line represents 95% confidence interval.

a) 1SW Salmon (Northern)



b) MSW Salmon (Northern)

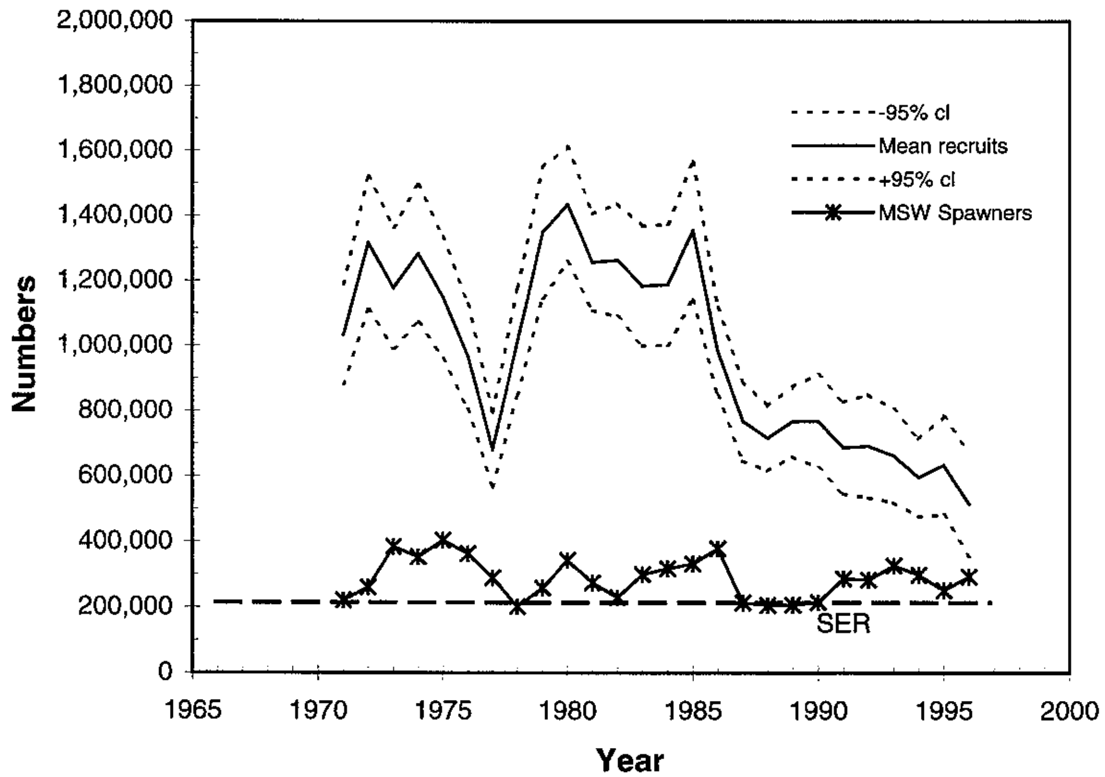
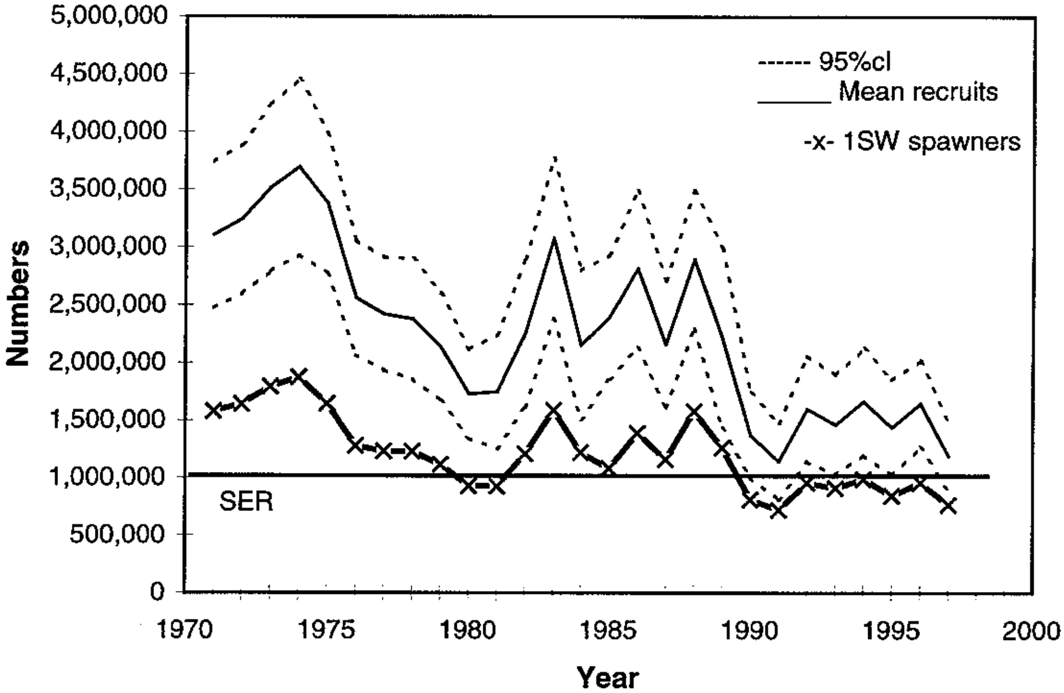


Figure 2.1.3.1 Estimates of pre-fishery abundance, number of spawners and the historic minima Spawning Escapement Reserve's (SER's) in Northern Europe, 1971–1997.

a) 1SW salmon (Southern)



b) MSW salmon (Southern)

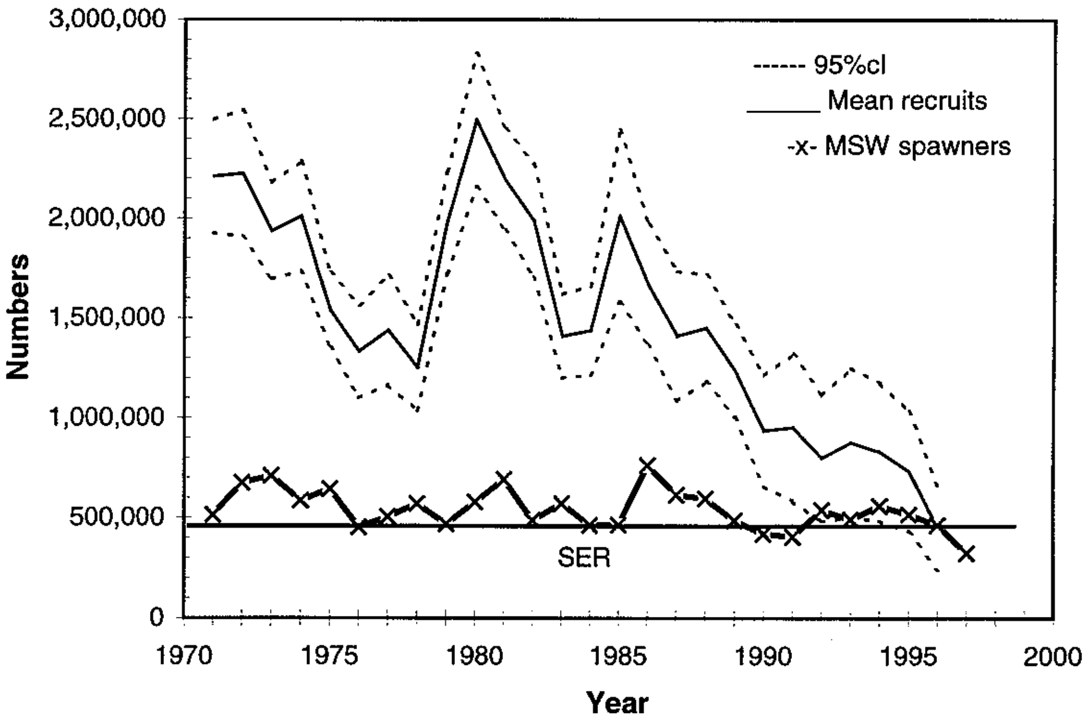
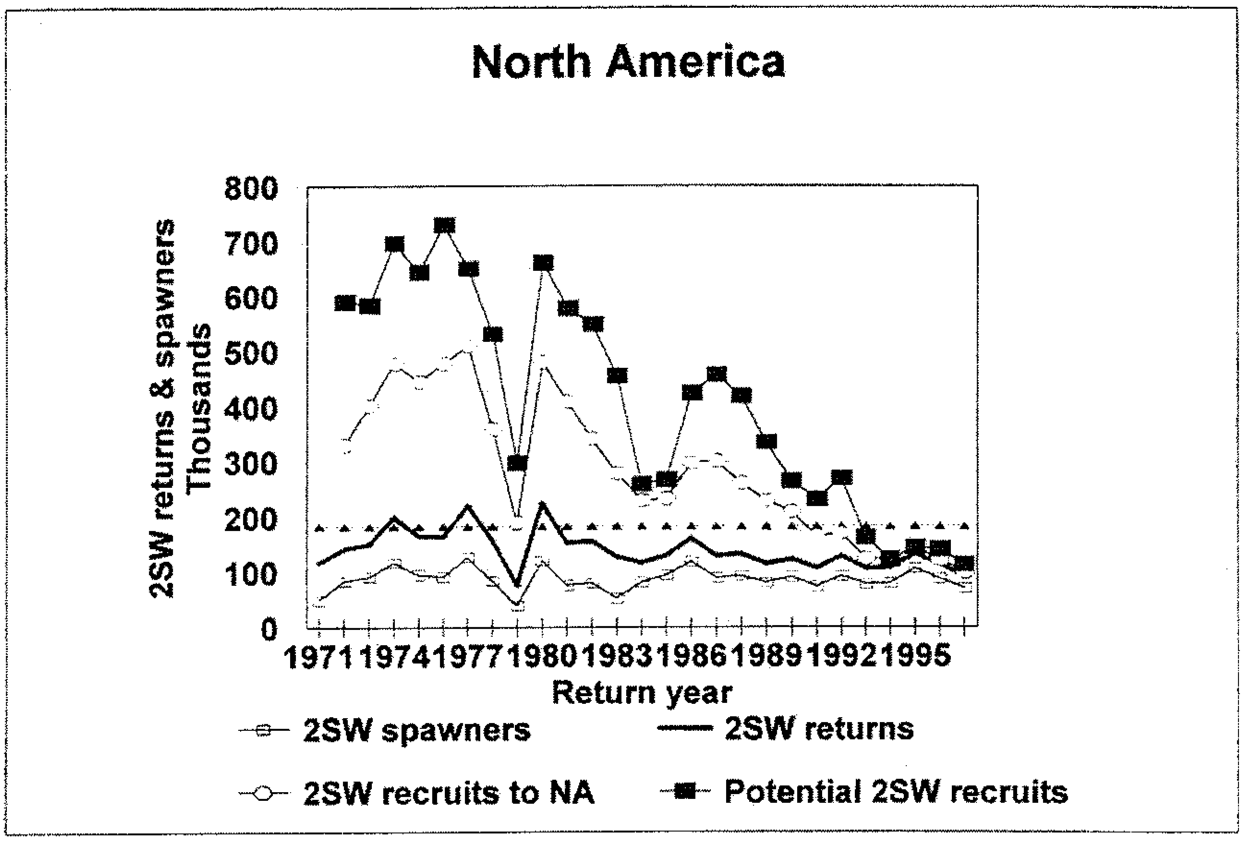


Figure 2.1.3.2 Estimates of pre-fishery abundance, numbers of spawners and historic minima Spawning Escapement Reserve's (SER's) in Southern Europe, 1971–1997.



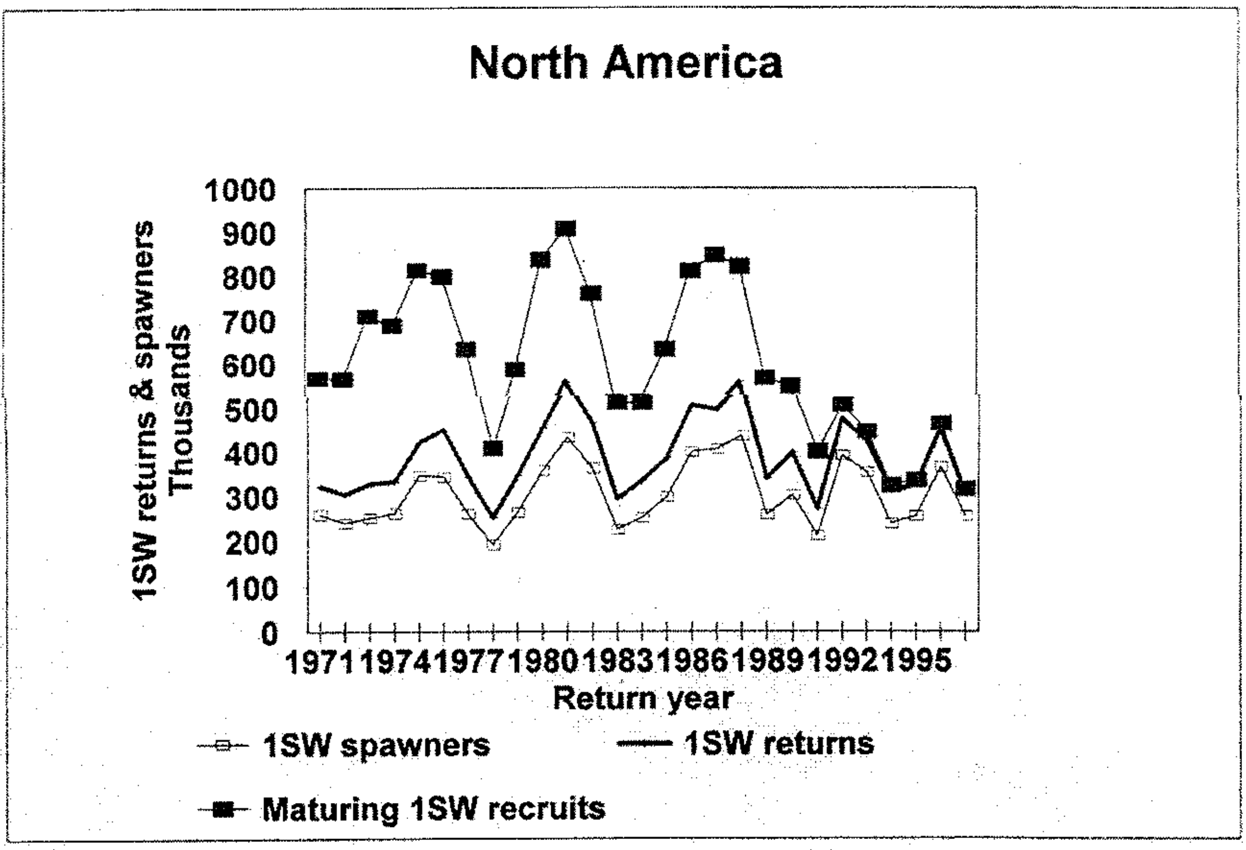


Figure 3.1.2.1 Top panel: comparison of estimated of potential 2SW production prior to all fisheries, 2SW recruits available to North America and 2SW returns and spawners for 1971–1997. Triangles indicate the 2SW spawner threshold. Bottom panel: comparison of potential maturing 1SW recruits and returns and 1SW spawners for 1971–1997 return years.

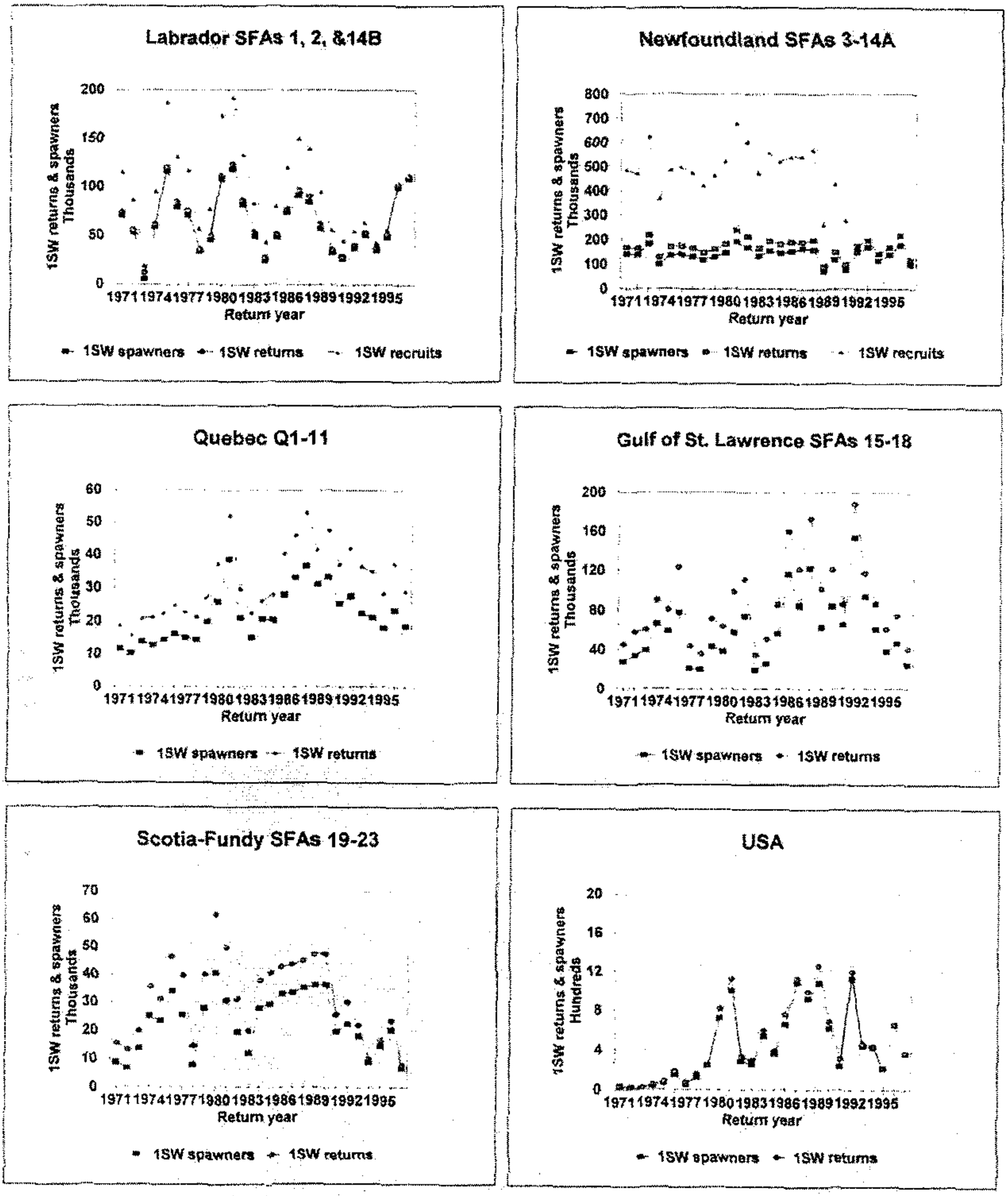
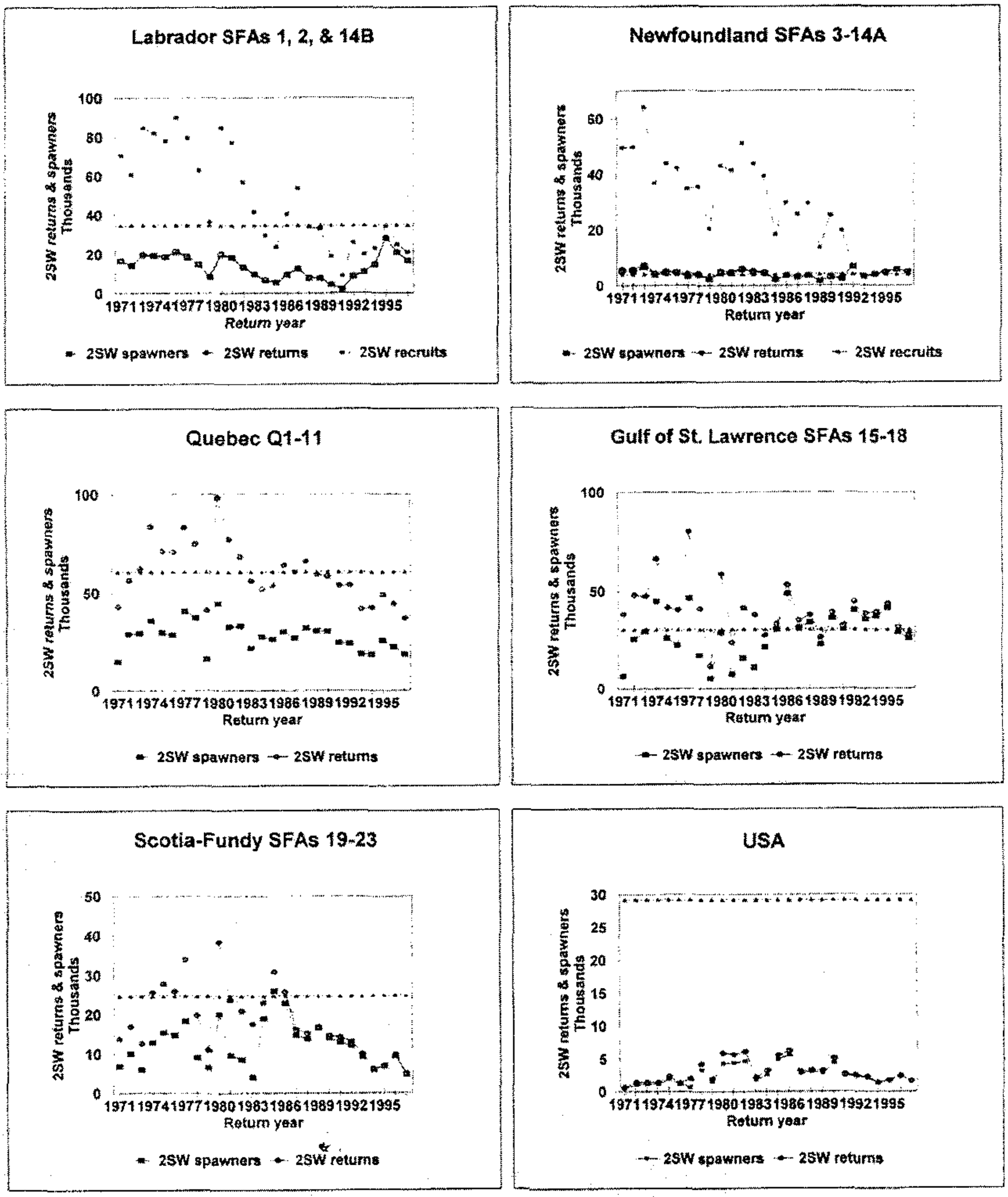


Figure 3.1.2.2 Comparison of estimated mid-points of 1SW returns (circles) to rivers of Nfld and Labrador and to SFAs of the other geographic areas, 1SW recruits of Nfld and Labrador origin before commercial fisheries in Nfld and Labrador (dashed lines), 1SW spawners (squares). Returns and spawners for Scotia-Fundy do not include those from SFA 22 and a portion of SFA 23.



Figures 3.1.2.3 Comparison of estimated mid-points of 2SW returns (circles) to rivers of Nfld and Labrador and to SFAs of the other geographic areas, 2SW recruits of Nfld and Labrador origin before commercial fisheries in Nfld and Labrador (dashed lines), 2SW spawners (squares) and 2SW conservation requirements (triangles) for 1971–1997 return years. Returns and spawners for Scotia-Fundy do not include those from SFA 22 and a portion of SFA 23.

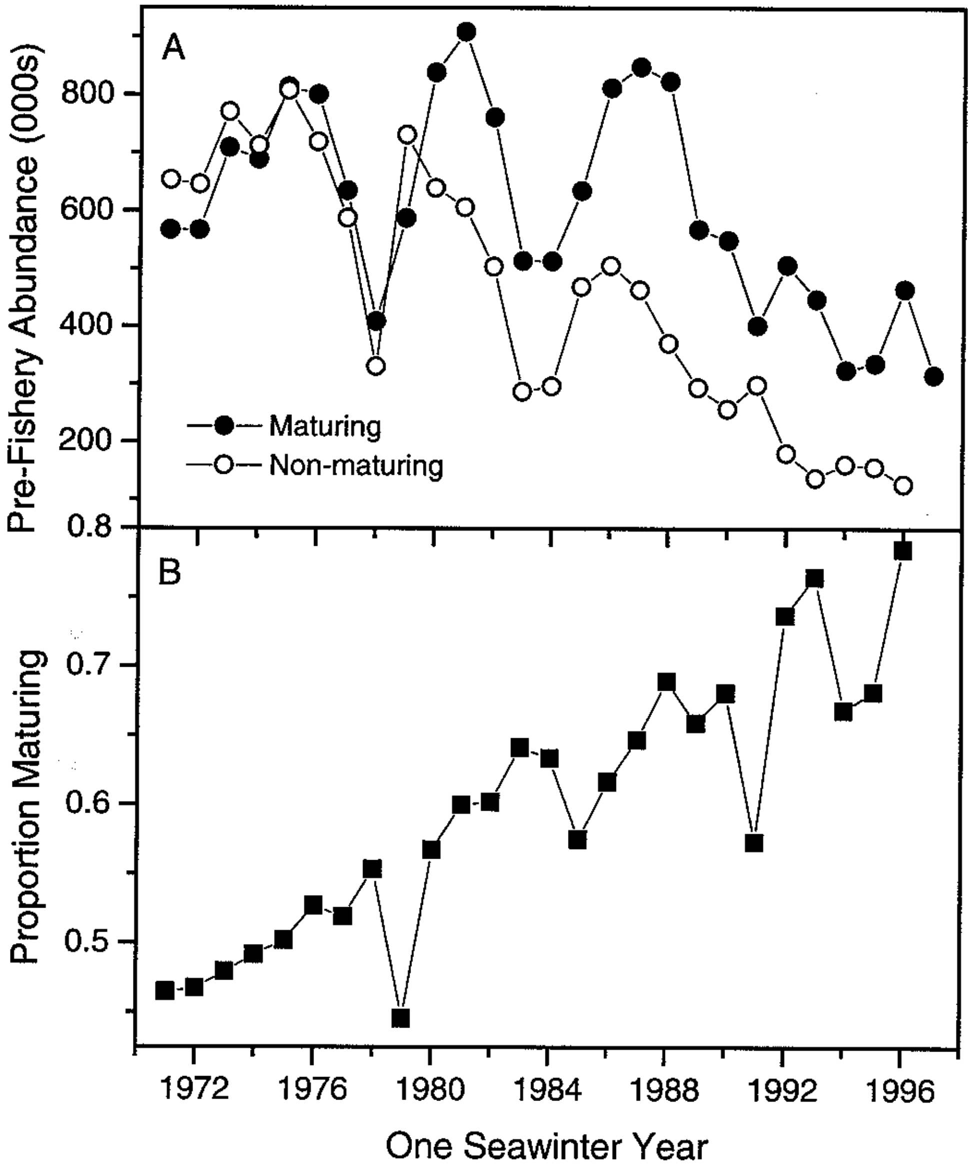
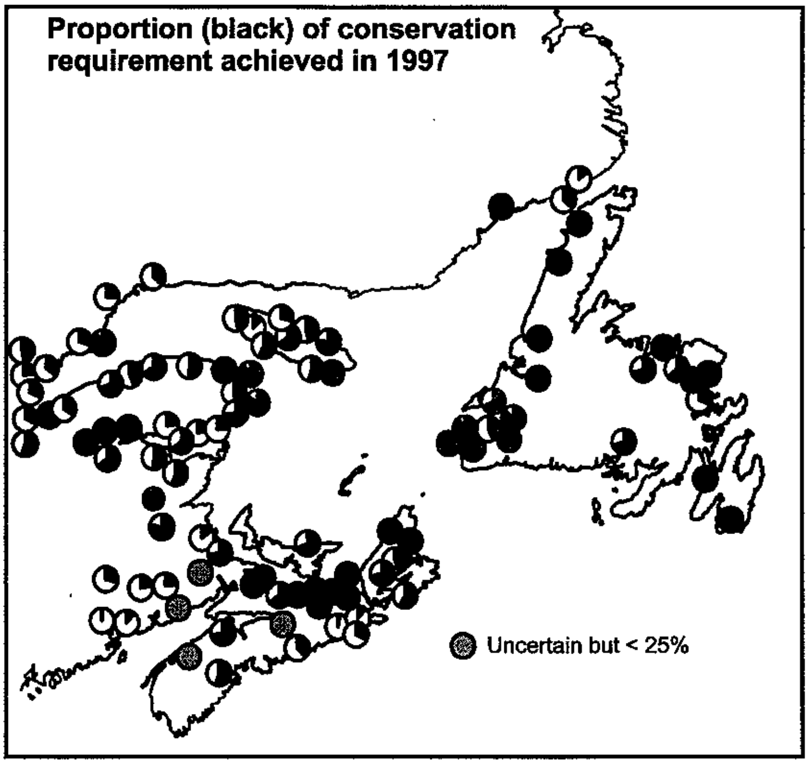


Figure 3.1.2.4 Pre-fishery abundance estimate of maturing and non-maturing salmon in North America (A), and proportion of smolt class maturing after 1SW (B).



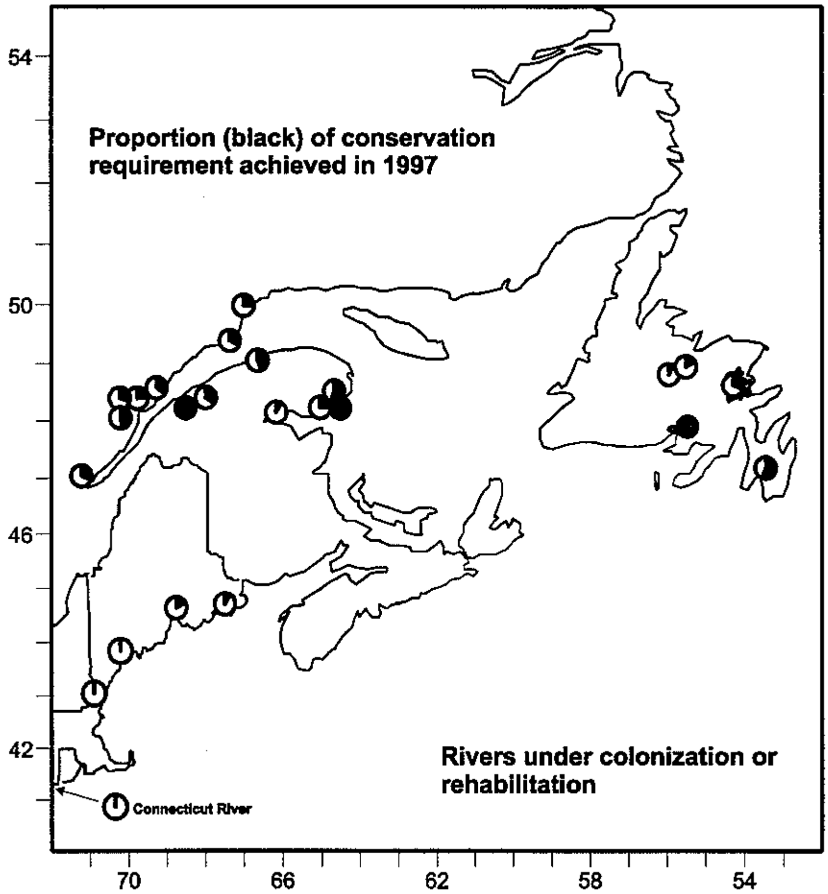


Figure 3.1.2.5 Egg depositions in 1997 relative to conservation requirements in 89 rivers (upper map) and for 19 rivers of eastern Canada under colonization or rehabilitation (lower map). The black slice represents the proportion of the conservation requirement achieved in 1997. A solid black circle indicates the egg deposition requirement was attained or exceeded.

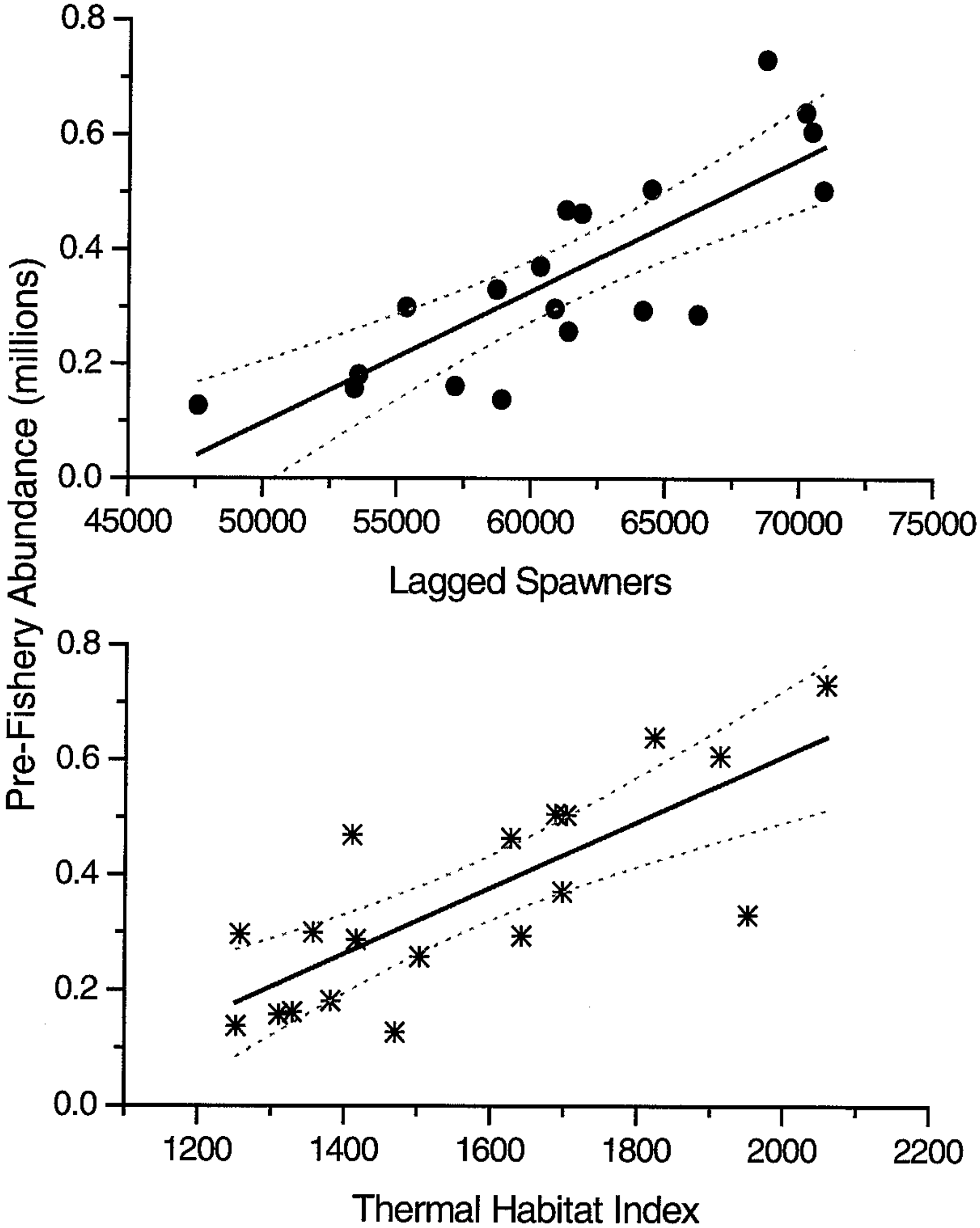
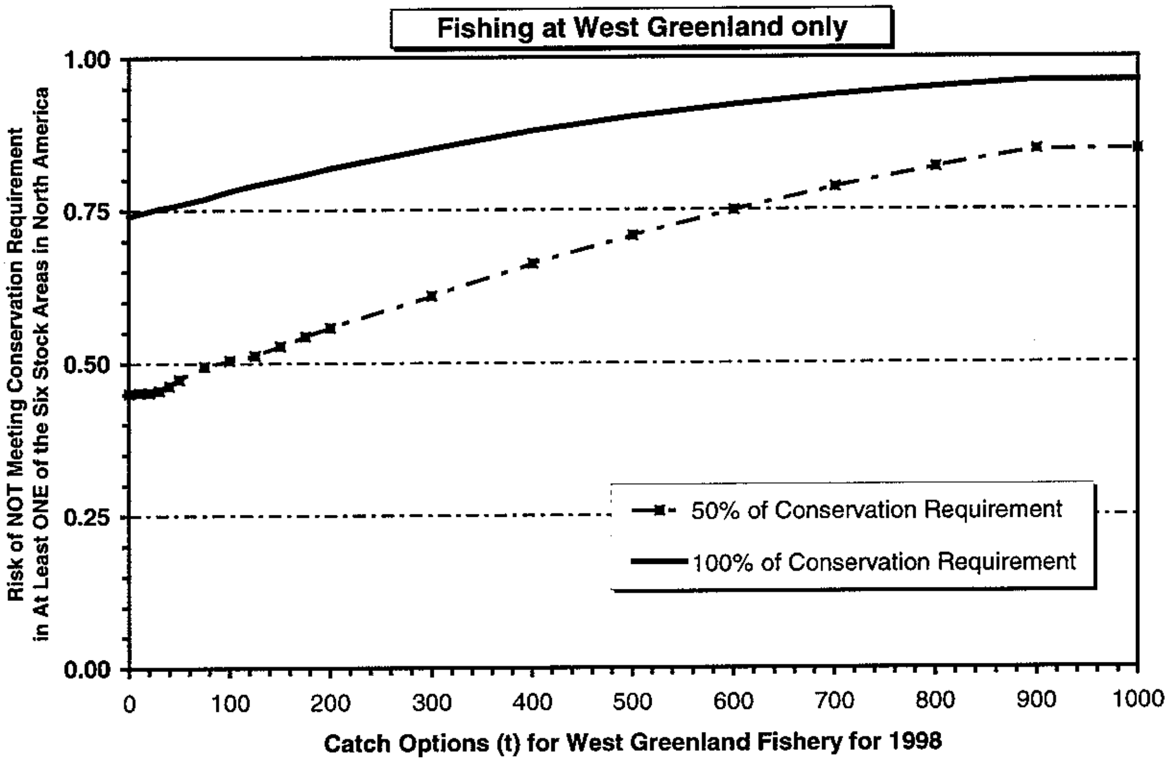


Figure 4.6.2 Bivariate relationships between independant variables lagged spawners (A) and thermal habitat (B) used in forecast model and pre-fishery abundance of non-maturing fish.



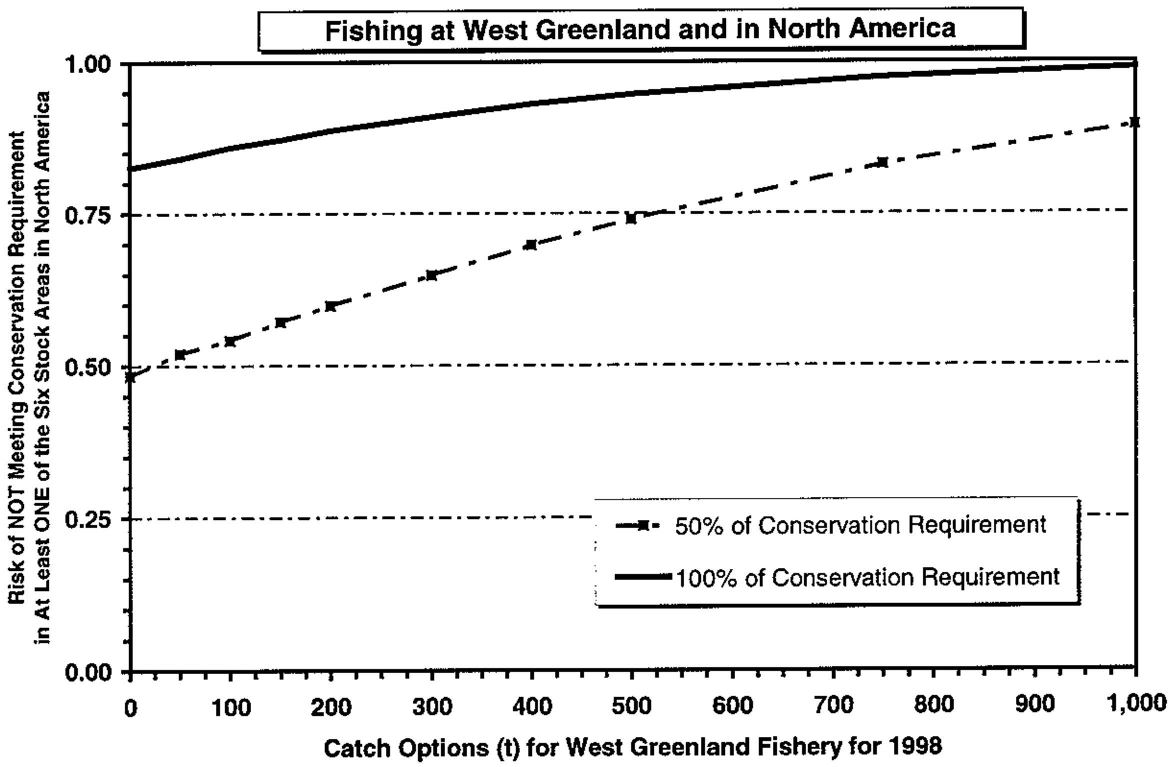


Figure 4.6.4 Risk analysis (probability of not meeting the conservation requirement in at least one of the six stock areas in North America) of catch options on the prefishery 1SW non-maturing salmon component in 1998. Risk is expressed relative to catch options at West Greenland in 1998 without fisheries in North America in 1999 (upper panel) and for combined fisheries at West Greenland in 1998 and North America in 1999 (lower panel). Exploitation rates in North America are based on the 1997 levels varying between 0.15 and 0.25 on the returning large salmon.

Joint ICES/NAFO Working Group on Harp and Hooded Seals

Greenland Sea Harp Seals

State of stock/fishery: The stock is considered to be within safe biological limits. However, the present population size is uncertain.

Although there are no estimates of the current pup production, projecting an estimate of 1991 production of 67 300 (95% C.I. 56 400–78 113) pups to 1998 results in an estimated pup production of 79 000 and a total population of 458 000. This assumes that mortality of seals one year of age and older (1+) is 0.11 while pup mortality is 0.33. Lower mortality rates would result in slightly higher estimates. ICES is unaware of any major event that affected the stock adversely since the 1993 assessment.

Catches in 1998 were not available but were reported to have remained well below the current quota of 13 100.

Management objectives: No explicit management objectives are set for this stock. ICES is asked to assess sustainable, or replacement, yields at present stock sizes and in the long term under varying options of age composition in the catch.

Advice on management: Current catches appear to be sustainable.

Relevant factors to be considered when managing this fishery: Given the lack of current data on reproductive rates and current pup production estimates for this stock, caution should be used when considering these catch options.

Catch forecast: Although no new estimates of pup production are available for this stock, 1999 catch options were estimated based upon forward projections of the 1991 pup production estimates and the 95% confidence intervals.

Biological parameters used to estimate catches are:

Mortality	$M_{1+} = 0.11$			
	$M_0 = 0.33$			
Proportion Mature	$p_4 = 0$	$p_5 = 0.1$	$p_6 = 0.5$	$p_7 = 1.0$
Pregnancy rate	$f = 0.94$			

These parameters result in a population trajectory with a slightly increasing pup production over the period 1977–1991. Extrapolating this model to 1998 assumes that this slight increase in population size continues over the period 1991–1998.

Catches resulting in constant exploitation rates (u_0 and u_{1+}) that stabilize the population size were estimated under two harvest scenarios. In the first, only 1+ animals are taken ($u_0 = 0$; i.e. no catch of pups) while in the second, only pups are harvested (i.e. $u_{1+} = 0$).

Catch options for harp seals in the Greenland Sea under different assumptions of starting pup production and age of catch are:

Catch	Exploit. rate		1999 catch		1999 Pop. Size		2009 catch		2009 Pop. size	
Option	u_0	u_{1+}	Pups	1+	Pups	1+	Pups	1+	Pups	1+
$N_{1991,0}$ = 56,000										
1+	0	0.046	0	14200	64100	308400	0	14200	62100	307400
Pups	0.443	0	29800	0	67200	300800	33300	0	75100	291600
$N_{1991,0}$ = 67,000										
1+	0	0.046	0	17500	78900	380800	0	17500	76800	380000
Pups	0.443	0	36700	0	82700	371400	41200	0	92900	360400
$N_{1991,0}$ = 78,000										
1+	0	0.046	0	20900	93800	453200	0	20800	91500	452500
Pups	0.443	0	43600	0	98300	442000	49100	0	110700	429300

Maintaining constant exploitation rates results in changes in the total population. Catches of only pups result in an increase in the numbers of pups in the stable population, but a decline in the numbers of seals one year of age and older. Catches of older seal result in slight declines of both age classes.

Elaboration and special comment: The last estimate of abundance for this stock was obtained in 1991, presented in the 1993, and updated in 1997. The present model solves for a constant exploitation rate and results in a slightly lower population. Models estimating a constant population may result in lower catch estimates.

Current catches are taken by Norway; Russia has not participated in the hunt since 1994.

Catches have remained significantly less than the quota since 1993.

In 1998 the entire quota was allowed to be taken as weaned pups with one adult considered equal to two pups.

Source of information: Report of the Joint ICES/NAFO Working Group on Harp and Hooded Seals, Tromsø, Norway, 29 September–2 October 1998 (ICES CM 1999/ACFM:7)

White Sea/Barents Sea Harp Seals

State of stock/fishery: This stock is considered to be within safe biological limits. Two aerial survey estimates of pup production in 1998 are available. Based upon the weighted average of the two estimates, pup production was estimated to be 301 000 (95% C.I. 243 000 to 359 000).

The 1998 population size of harp seals in the White Sea/Barents Sea was estimated based upon a 1998 pup production estimate of 301 000. Natural mortality (M1+) was varied between 0.09 and 0.11, a range similar to that seen in other harp seal stocks. Total population was also estimated under the assumption of M_0 = 0.5 and M_{1+} = 0.1 due to concerns about the possibility of increased mortality of pups in this stock.

Estimates of 1998 abundance of harp seals in the White Sea and Barents Sea based upon the 1998 pup production estimate of 301 000 and under different assumptions of mortality are:

M_{1+}	M_0	Numbers ('000)		
		0	1+	Total
0.09	0.27	301	2,980	2,281
0.1	0.30	301	1,922	2,223
	0.50	301	1,736	2,037
0.11	0.33	301	1,873	2,174

Reported catches declined to 14 202 in 1998 which is significantly less than the current quota of 40 000. The proportion of pups in the catch was 94%.

Management objectives: No explicit management objectives are set for this stock. ICES is asked to assess sustainable, or replacement, yields at present stock sizes and in the long term under varying options of age composition in the catch.

Advice on management: Current catches appear to be sustainable.

Relevant factors to be considered when managing this fishery: There are indications that pup mortality rates can vary substantially in the White Sea region, and that in recent years, these rates have been very high. The additional pup mortality associated with by-catch in Norwegian fishing gear in 1986–1989 and 1995 was added to the catches for these years.

Reproductive rates in this stock are lower than those observed in other harp seal stocks. Growth rates have declined and the age of maturity for both males and females has increased since the early 1960s.

Recruitment of mature females into the breeding population may have been reduced in recent years due to the apparent low 1986–1988 year classes observed in the age-composition data from moulting and breeding samples.

The low representation of the 1993, 1994 and 1995 year-classes also suggests poor survival of these cohorts and decreased recruitment to the stock. However, the poor representation of these year classes could also be related to differences between migration patterns of young and adult seals and it remains to be seen whether future age-composition data will confirm that food shortages have made an impact on these year classes.

Unusual high (but quantitatively unrecorded) mortality of weaned pups were observed in the White Sea in May/June 1998, possibly due to the unusual ice conditions.

Given that historical estimates of abundance of this population are poorly documented, the 1998 pup production estimate is based on new methods for which no comparable data exists, and that no information on population trends is available, a conservative approach should be adopted in establishing harvests. The recent anecdotal evidence for high pup mortality rates would also provide support for a conservative approach.

Catch forecast: The mortality rates of seals one year of age and older (M_{1+}) was assumed to be 0.1, as it is the closest to that estimated for the Northwest Atlantic harp seal stock. This results in a historical population that has been relatively constant since the 1950's. Pup mortality rate (M_0) was assumed to equal three times adult mortality rates.

Biological parameters used to estimate catches are:

Mortality	M_{1+} = 0.10						
	M_0 = 0.3						
Proportion Mature	p_5 = .1	P_6 = 0.18	p_7 = 0.35	p_8 = 0.6	p_9 = 0.7	p_{10} = 0.9 4	p_{11} = 1
Pregnancy rate	f = 0.84						

1999 catches resulting in constant exploitation rates (u_0 and u_{1+}) that stabilise the population size were estimated under two harvest scenarios (Table 2). In the first, only 1+ animals are taken (u_0 = 0; i.e. no catch of pups) while in the second, only pups are harvested (i.e. u_{1+} = 0). Catch options and stock size in 1999 and 2009 are provided using the point estimate and the upper and lower 95% confidence limits of the 1998 pup production estimate.

Assuming $M_{1+} = 0.10$ and $M_0 = 0.3$, catch options for harp seals in the White Sea and Barents Sea under different assumptions of starting pup production and age of catch are:

Catch	Exploit. rate		1999 catch		1999 Pop. Size		2009 catch		2009 Pop. size	
Option	u_0	u_{1+}	Pups	1+	Pups	1+	Pups	1+	Pups	1+
$N_{1998,0}$ = 243,000										
1+	0	0.032	0	50100	241500	1565000	0	45000	224100	1404000
Pups	0.385	0.000	96100	0	249500	1541000	101400	0	263200	1361000
$N_{1998,0}$ = 301,000										
1+	0	.032	0	61100	299400	1906000	0	56000	281500	1747000
Pups	0.385	0	119200	0	309300	1876000	127700	0	331300	1687000
$N_{1998,0}$ = 359,000										
1+	0.000	0.032	0	72000	357300	2248000	0	66900	338800	2089000
Pups	0.385	0.000	142200	0	369100	2211000	153900	0	399400	2012000

Maintaining constant exploitation rates as assumed in the model used to estimate catch options resulted in a decline in the population size of approximately 10% by 2009. The 2009 catches are slightly lower than the 1998 catches if only 1+ seals are harvested while they are slightly greater if only pups are taken.

Because of concerns that possible increased mortality of pups in recent years may be causing a decline in the population, catch options were estimated assuming that pup mortality equalled five times the 1+ mortality rate. Under the assumption that $M_{1+} = 0.1$ and $M_0 = 0.5$, catch options for harp seals in the White Sea and Barents Sea under different age of catch and a 1998 pup production of 301 000 are:

Catch	Exploit. Rate		1999 catch		1999 Pop. Size		2009 catch		2009 Pop. size	
Option	u_0	u_{1+}	Pups	1+	Pups	1+	Pups	1+	Pups	1+
1+	0.000	0.018	0	31600	299400	1725000	0	29400	283200	1602000
Pups	0.249	0.000	76000	0	305000	1708000	77400	0	310700	1569000

Assuming that pup mortality equalled five times the 1+ mortality, the estimates of 1999 harvests declined significantly. Catches of 1+ only decline from 61 000 to 31 600 while pup only catches are reduced from 119 000 to 76 000. Under this scenario the total population declines approximately 8% by 2009.

Elaboration and special comment: Aerial surveys of White Sea harp seals were conducted in March 1998 using traditional strip transect methodology and multiple sensors operated simultaneously.

Where appropriate the survey estimates were corrected for the temporal distributions of birth. However, the estimates are considered to be negatively biased since they were not corrected for pups which may be hidden from the camera or for pups mis-identified by the readers.

These estimates of pup production for the White Sea/Barents Sea stock are significantly higher than previously assumed for this stock. However, previous efforts to estimate abundance were based on the number of females visible in the whelping concentrations and were not accepted as reliable indicators of abundance.

The current estimate of pup production is considered preliminary. Data from another survey conducted in 1998 are available, but have yet to be analysed. These will provide a third estimate of pup production.

The current model solves for a constant exploitation rate and results in a slightly lower population. Models estimating a constant population may result in lower catch estimates.

Low Russian catches in 1998 were a result of logistic factors. Norwegian catches were low because ice movement during the period was insufficient to transport seals into international waters where they could be harvested.

Source of information: Report of the Joint ICES/NAFO Working Group on Harp and Hooded Seals, Tromsø, Norway, 29 September–2 October 1998 (ICES CM 1999/ACFM:7)

Hooded Seals

Greenland Sea Hooded Seals

State of stock/fishery: The relationship of current population size to safe biological limits for this species is unknown.

The estimate of 1997 pup production in the Greenland Sea was revised to be 23 762 pups (95% C.I. 14 819 to 32 705). This estimate is considered to be negatively biased since it was not corrected for the temporal distribution of births or for scattered pups.

The 1998 population size of hooded seals in the Greenland Sea was estimated based upon a 1997 pup production estimate of 24 000. Since natural mortality (M_{1+}) for this stock has not been estimated, abundance was estimated based upon a range between 0.09 and 0.11, by analogy with the Northwest Atlantic stock. M_0 was assumed to be $3M_{1+}$.

M_{1+}	Numbers		
	0	1+	Total
0.09	26,700	113,500	140,200
0.1	26,300	109,100	135,400
0.11	26,100	105,700	131,800

Management objectives: No explicit management objectives are set for this stock. ICES is asked to assess sustainable, or replacement, yields at present stock sizes and in the long term under varying options of age composition in the catch.

Advice on management: Recent catch levels appear to be sustainable.

Relevant factors to be considered when managing this fishery: The 1997 estimate of pup production is the only estimate available for the Greenland Sea hooded seal stock. Given the lack of information on historical trends in abundance, safe biological limits cannot be identified and caution should be used when considering these catch options.

Catch forecast: In the absence of reproductive rates for this stock, the biological parameters used to estimate catch options were based upon data obtained from the Northwest Atlantic hooded seal stock. Biological parameters used to estimate population size and catch options for Greenland Sea hooded seals are:

Catches in 1998 were not available but were reported to be similar to 1997 (approximately 3 000). This is below the quota which was reduced to 5 000.

Mortality	$M_{1+} = 0.10$							
	$M_0 = 0.30$							
Proportion Mature	$p_2 = 0.18$	$p_3 = 0.44$	$p_4 = 0.60$	$p_5 = 0.75$	$p_6 = 0.87$	$p_7 = 0.93$	$p_8 = 0.96$	$p_9 = 1$
Pregnancy rate	$f = 0.94$							

1999 catches resulting in constant exploitation rates (u_0 and u_{1+}) that stabilise the population size were estimated under two harvest scenarios. In the first, only 1+ animals are taken ($u_0 = 0$; i.e. no catch of pups) while in the second, only pups are harvested (i.e. $u_{1+} = 0$). Catch options and stock size in 1999 and 2009 are provided using the point estimate and the upper and lower 95% confidence limits of the 1997 pup production estimate.

Catch options for hooded seals in the Greenland Sea under different assumptions of starting pup production and age of catch are:

Catch	Exploit. Rate		1999 catch		1999 Pop. Size		2009 catch		2009 Pop. size	
Option	u_0	u_{1+}	Pups	1+	Pups	1+	Pups	1+	Pups	1+
$N_{1997,0}$ = 15,000										
1+	0.000	0.103	0	7300	15900	70200	0	6300	15200	61300
Pups	0.627	0.000	11100	0	17700	69300	12100	0	19300	60500
$N_{1997,0}$ = 24,000										
1+	0.000	0.103	0	11200	25700	108000	0	10200	24900	99200
Pups	0.627	0.000	18000	0	28600	106000	19800	0	31600	96400
$N_{1997,0}$ = 33,000										
1+	0.000	0.103	0	15200	35700	146800	0	14300	34800	138100
Pups	0.627	0.000	25000	0	39800	143700	27800	0	44300	133200

Maintaining constant exploitation rates results in changes in the total population. Catches of only pups result in an increase in the numbers of pups in the stable population, but a decline in the numbers of seals one year of age and older. Catches of older seal result in slight declines of both age classes.

Elaboration and special comment: The current model solves for a constant exploitation rate and results in a slightly lower population. Models estimating a constant population may result in lower catch estimates.

In 1998 catches were directed primarily towards weaned pups with two pups considered to be equal to one adult. Based upon the current estimates of catches, one adult should be considered approximately equal to 1.5 pups.

Between 1990 and 1997 about 25% of the quota was taken. 1998 catches appeared to have remained below the quota.

Current catches are taken by Norway; Russia has not participated in the hunt since 1994.

Source of information: Report of the Joint ICES/NAFO Working Group on Harp and Hooded Seals, Tromsø, Norway, 29 September–2 October 1998 (ICES CM 1999/ACFM:7).