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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

Last 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 and at risk of collapse: The spawning biomass is below the proposed $\mathbf{B}_{pa}$ and is forecast to drop well below $\mathbf{B}_{lim}$ in the short-term. Fishing mortality exceeds $\mathbf{F}_{lim}$. 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. The forecast decline in the spawning stock is due to two successive very weak year classes.

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, and the stock has been in more or less continuous decline since the early 1980s.

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 1998 were close to the lowest recorded. This resulted from a combination of declining fishing effort and a succession of below-average year classes recruited since 1987. The spawning stock 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 consequence 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 1996. However, recent recruitment has been above average so an increase in SSB in the short-term is likely.

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 outside of safe biological limits. For the last ten years F has remained high and well above Fpa and SSB far below $\mathbf{B}_{pa}$. More than 80% of the SSB is composed of a single year class.

High fishing mortality rates from the mid 1980s resulted in SSB declining sharply until 1995. SSB has stabilised at a low level and has remained far below the proposed $\mathbf{B}_{pa}$. The probability of good recruitment appears to have been reduced at the SSBs observed in the 1990s. With two consecutive poor year classes (1997 and 1998), the short term predictions indicate a serious further decline in SSB to record low level.

Management objectives: No explicit management objectives are set for this stock. However, any management objectives for this stock must involve rapid rebuilding to a much higher SSB.

Advice on management: ICES recommends that fishing mortality on cod should be reduced to the lowest level possible in 2000. A recovery plan should be developed and implemented in order to rebuild SSB above $\mathbf{B}_{pa}$ as soon as practical.

Relevant factors to be considered in management: Even with no directed harvest or by-catch of cod in 2000, SSB is forecast in the short term to be only just above the historical low. Closed areas and seasons should be investigated as part of the recovery plan.

Quota restrictions during the 1990s have resulted in misreporting of landings and deterioration of the quality of commercial catch data available for assessments.

Catch forecast for 2000:

Basis: F(99) = F_{SQ} = F(96–98) = 1.11, Landings (99) = 6.0, SSB(2000) = 4.2.

F (2000) Onwards	Basis	Catch (2000)	Landings (2000)	SSB (2001)
0	0		0	6.4
0.22	0.2 F(96-98)		0.9	5.3
0.45	0.4 F(96-98)		1.6	4.4
0.67	0.6 F(96-98)		2.2	3.7
0.72	Fpa		2.4	3.4
0.89	0.8F(96-98)		2.7	3.2
1.11	1.0F(96-98)		3.1	2.7
1.34	1.2F(96-98)		3.4	2.4

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.

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. Successive assessments have revised the estimates of recent fishing mortality upwards.

Reference points as proposed by ICES in 1998:

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:

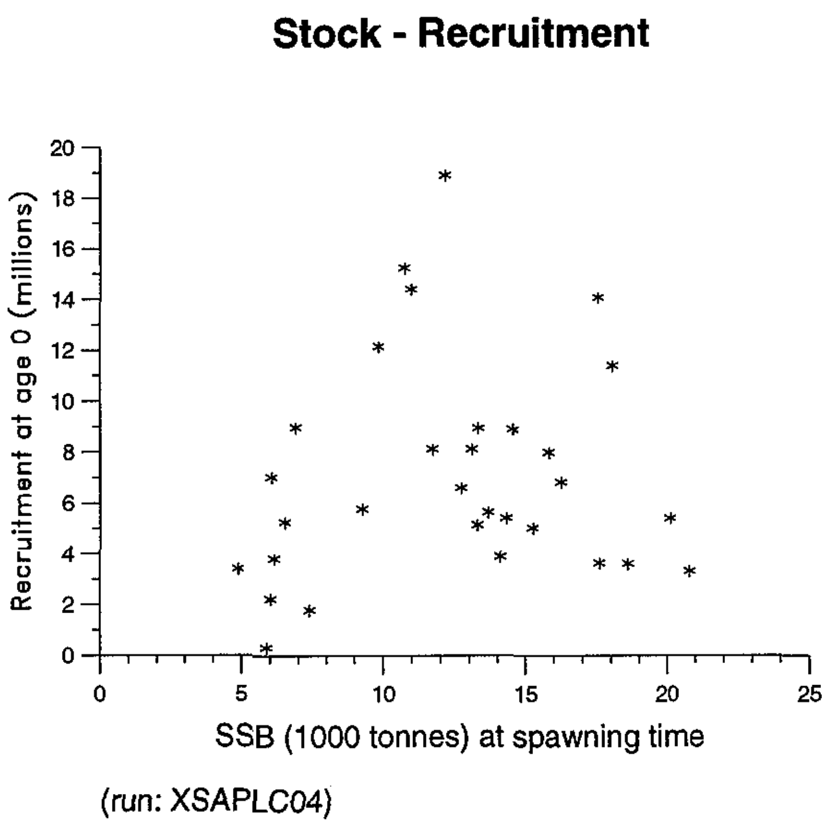
$\mathbf{B_{lim}} = \mathbf{B_{loss}}$	$\mathbf{B_{pa}}$ = Previous MBAL and signs of reduced recruitment
$\mathbf{F_{lim}} = \mathbf{F_{med}}$	$\mathbf{F_{pa}} = \mathbf{F_{med}}$ x 0.72

Source of information: Report of the Working Group on the Assessment of Northern Shelf Demersal Stocks, June 1999 (ICES CM 2000/ACFM:1).

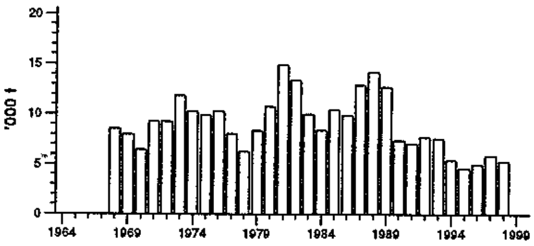
Catch data (Tables 3.8.2.1–2):

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 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	F_{med} ~ 10 200 t	10.2	11.0	5.9[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	5.3[1]	5.0[2]
1997	30% reduction in F	5.9	6.2	4.4	5.9[2]
1998	No increase in F	6.2	7.1	3.2[3]	5.3
1999	Reduce F below F_{pa}	4.9	5.5		
2000	Lowest possible F	0			

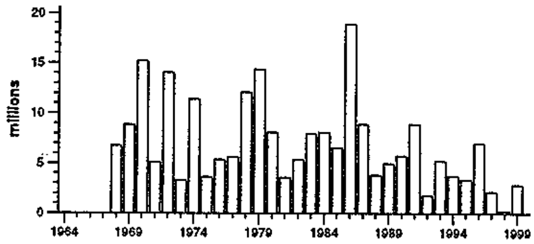
[1]Preliminary. [2]Including estimates of mis-reporting. [3]Incomplete data. Weights in '000 t.



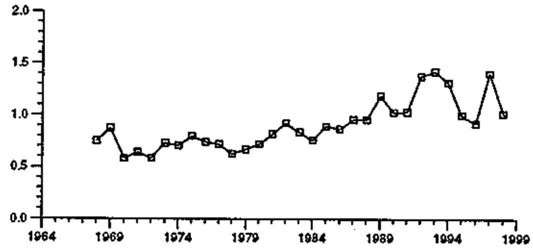
Landings
Mean = 9.03



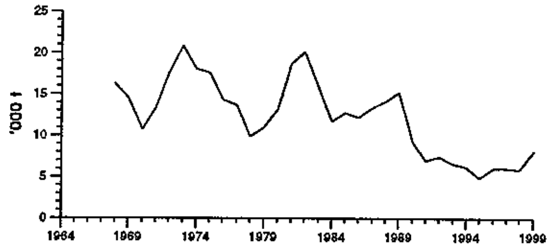
Recruitment (age 0)
Mean = 6.97



Fishing mortality (ages 2-4)
Mean = 0.897



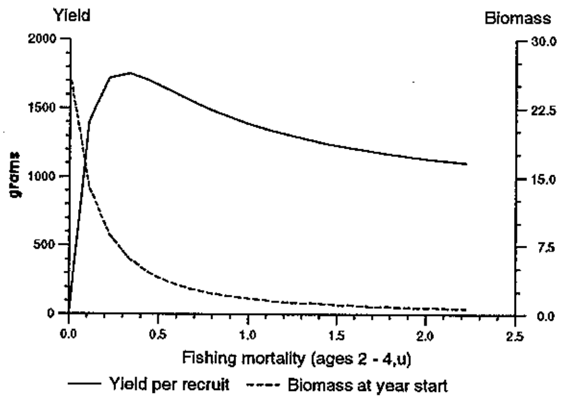
Spawning stock biomass
Mean = 12.3



Cod in Division VIIa (Irish Sea)

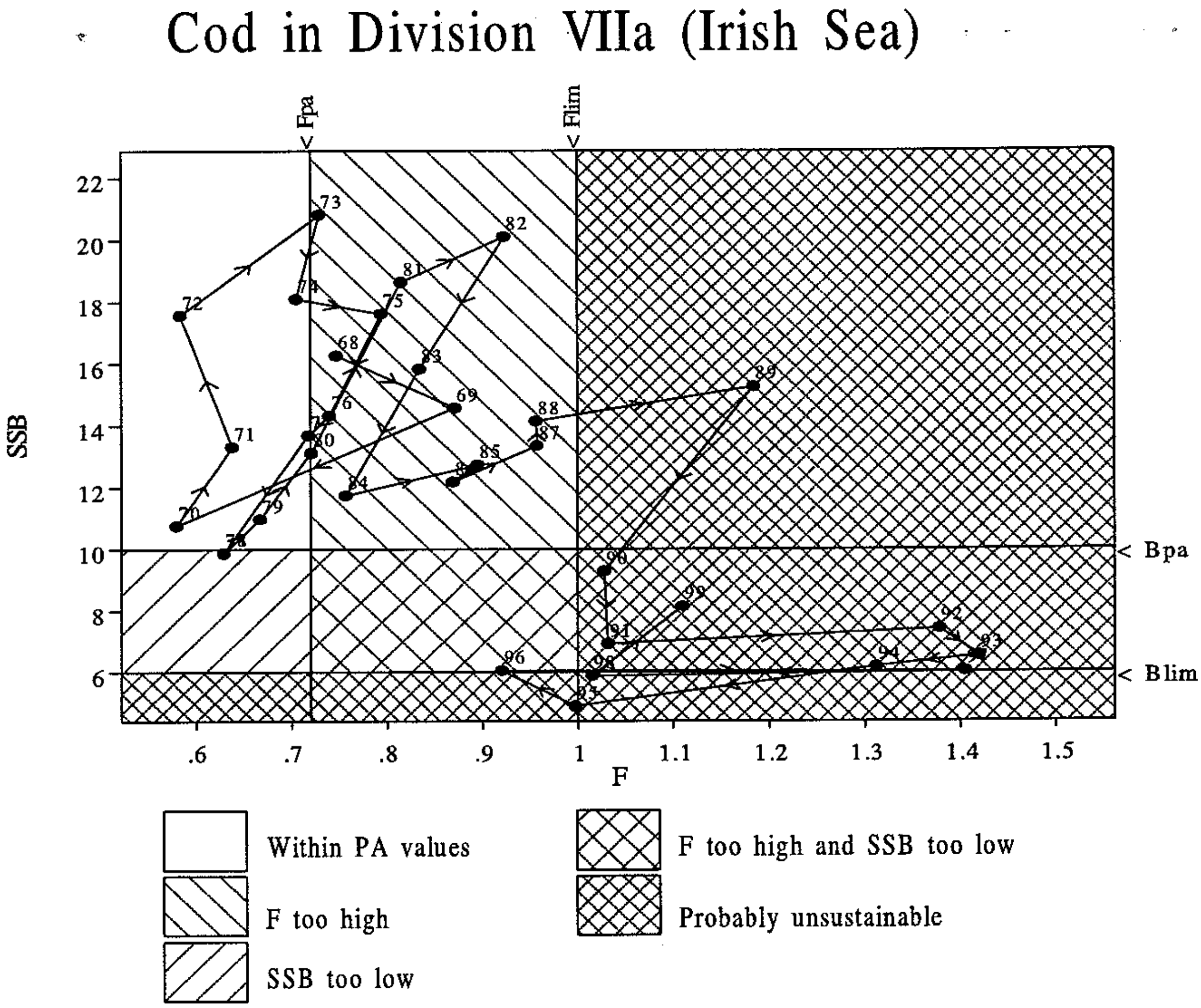
Yield and Spawning Stock Biomass

Long term forecast



Short term forecast

Precautionary Approach Plot



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Plotted on 14/10/1999 at 14:49:05

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	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998[1]
Belgium	185	222	344	269	467	310	78	174	169	121	187	142	183	316
France	1,782	1,480	1,717	2,406	352[1]	201[1]	320[1]	916	686	208	166	148	268	269
Ireland	4,121	3,991	5,017	5,821	3,656	2,800	2,364	2,260	1,328	1,506	1,414	2,476	1,492	n/a
Netherlands	104	-	-	-	-	-	-	-	-	-	-	25	29	20
UK (Engl.& Wales)[3]	1,200	847	1,922	2,667	6,320	4,752	3,562	3,529	3,244	2,274	2,330	2,359	2,370	...
UK (Isle of Man)	119	80	44	118	39	48	175	129	57	26	22	27	19	34
UK (N. Ireland)	2,541	2,992	3,565	4,080								...	...	...
UK (Scotland)	1,038	446	574	472	465	1,767	515	393	453	326	414	126	80	...
UK												...	...	2,574
Total	11,090	10,058	13,183	15,833	11,299	9,878	7,014	7,401	5,937	4,461	4,533	5,303	4,441	3,213
Unallocated	-607	-206	-289	-1,665	1,452	-2,499	81	3343	1,618	941	54	-339	1,418	2,104
Total figures used by Working Group for stock assessment	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	5,859	5,317

[1]Preliminary.
[2]Revised.
[3]1989–1998 N. Ireland included with England and Wales.

Table 3.8.2.2 COD in Division VIIa (Irish Sea).

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	15.83	10.02	0.834
1984	8.08	11.73	8.38	0.757
1985	6.55	12.73	10.48	0.895
1986	18.87	12.17	9.85	0.869
1987	8.90	13.34	12.89	0.957
1988	3.87	14.13	14.17	0.956
1989	4.99	15.25	12.75	1.184
1990	5.74	9.27	7.38	1.028
1991	8.94	6.92	7.10	1.032
1992	1.78	7.41	7.74	1.378
1993	5.21	6.53	7.56	1.420
1994	3.79	6.18	5.40	1.312
1995	3.37	4.90	4.59	0.997
1996	6.98	6.06	4.96	0.920
1997	2.21	6.04	5.86	1.405
1998	0.30	5.88	5.32	1.015
1999	2.89	8.13	.	.
Average	6.97	12.25	9.03	0.897
Unit	Millions	1000 tonnes	1000 tonnes	-

3.8.3 Haddock in Division VIIa (Irish Sea)

State of stock/fishery: This stock is harvested outside of safe biological limits. Fishing mortality in 1998 is poorly estimated but is likely to be well above $\mathbf{F_{pa}}$. 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. At such high Fs, strong year classes make only a transient contribution to increasing the SSB.

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 $\mathbf{F_{pa}}$.

Advice on management: ICES recommends that fishing mortality in 2000 should be reduced to below $\mathbf{F_{pa}}$, corresponding to a catch in 2000 of less than 2,800 t. ICES also recommends that a separate TAC for haddock taken in Division VIIa be implemented.

Relevant factors to be considered in management: A TAC is set for haddock for the whole of areas VII, VIII, IX and X. The present high availability of haddock in VIIa has resulted in substantial misreporting and/or discarding due to large by-catches of haddock taken by fleets with restrictive allocations available to them. To alleviate this problem, a separate TAC allocation was made for Division VIIa in 1999.

There are no known biological 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. This would only occur if fishing mortality is reduced substantially.

The haddock stock is mainly confined to the western Irish Sea where important mixed-species fisheries for *Nephrops*, whiting and cod take place. A directed fishery has developed for haddock and large catches of haddock are taken in the *Nephrops* fishery during periods of high abundance. The increase in abundance of haddock has caused changes in fishing patterns of whitefish fleets that will have affected other gadoid stocks in the Irish Sea.

The current relatively high abundance of haddock in the Irish Sea is likely to prove problematic given the urgent need to protect the cod stock in the same area. This should be reflected in any recovery plan to be developed for cod, and in particular in the definition of any closed areas or seasons.

Catch forecast for 2000:

Basis: F(99) = F_{sq} = F(96–98) = 1.10 Catch(99) = 6.3, Landings(99)= 6.3, SSB(2000)= 5.6.

F(2000 onwards)	basis	Catch (2000)	Landings (2000)	SSB (2000)	Medium term effect of fishing at given level
0.33	0.3 F(96 – 98)	2.0	2.0	7.8	
0.50	F_{pa}	2.8	2.8	6.9	
0.66	0.6 F(96-98)	3.4	3.4	6.2	
0.88	0.8 F(96-98)	4.2	4.2	5.4	
1.10	1.0 F(96-98)	4.8	4.8	4.7	
1.32	1.2 F(96-98)	5.3	5.3	4.2	

Weights in '000 t.

No medium-term analyses possible with this stock.

Shaded scenarios considered inconsistent with the precautionary approach

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. Production in the 1990s has exceeded that in the earlier periods and also coincides with increased abundance of haddock in the Celtic Sea. Previous productive periods, other than the recent one, are believed to have coincided with strong year classes in Sub-Area VI. Whilst the 1994 year-class was relatively strong in Divisions VIa, VIIa and VIIb-k, patterns of recruitment in subsequent years have differed markedly between areas. Growth rates of individual haddock also differ between areas, and haddock grow fastest in the Irish Sea.

Data from surveys and estimates of catches at age have provided a consistent analysis of the relative strength of incoming year classes. Perception of the stock has changed substantially with the additional information available in the current assessment. Analytical age-based assessment using landings at age and indices from research surveys.

Reference points as proposed by ICES in 1998:

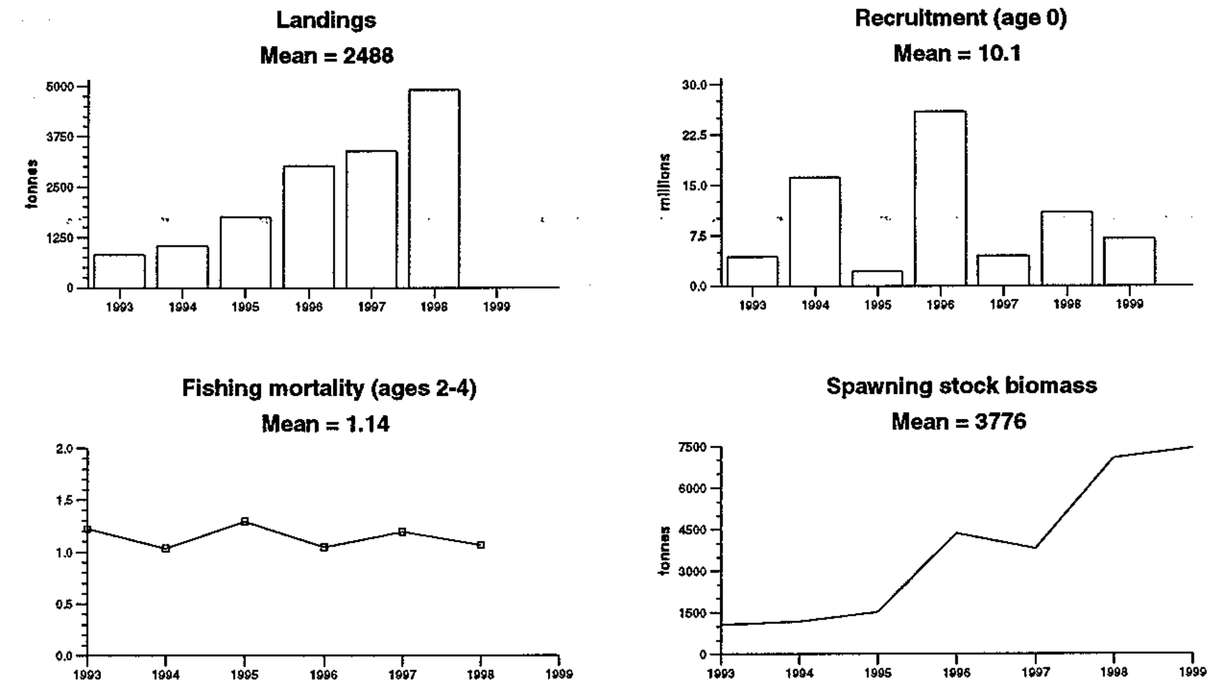
ICES considers that:	ICES proposes that
There is currently no biological basis for defining appropriate reference points, in view of the rapid expansion of the stock size over a short period.	F_{pa} be set at 0.5 by analogy with other haddock stocks.

Source of information: Report of the Working Group on the Assessment of Northern Shelf Demersal Stocks, June 1999 (ICES CM 2000/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			1.287	1.287
1988	Not dealt with			0.747	0.747
1989	Not dealt with			0.560	0.560
1990	Not dealt with			0.582	0.582
1991	Not dealt with			0.616	0.616
1992	Not dealt with			0.656[6]	0.703
1993	Not dealt with			0.730	0.813
1994	Not dealt with			0.681	1.043
1995	Not dealt with		6	0.841[6]	1.753
1996	No advice		7	1.453[6]	3.023
1997	Means of setting catch limits required		14	1.925[6]	3.391[6]
1998	Catch limit for VIIa	3.0	20	1.316[4]	4.902
1999	No increase in F; Catch limit for VIIa	7.0	25[5]		
2000	Reduce F below $\mathbf{F_{pa}}$	<2.8			

Weights in 1000 tonnes. [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. [5]Includes separate Division VIIa allocation of 4,990 t. [6]Revised figures.



Haddock in Division VIIa (Irish Sea)

Yield and Spawning Stock Biomass

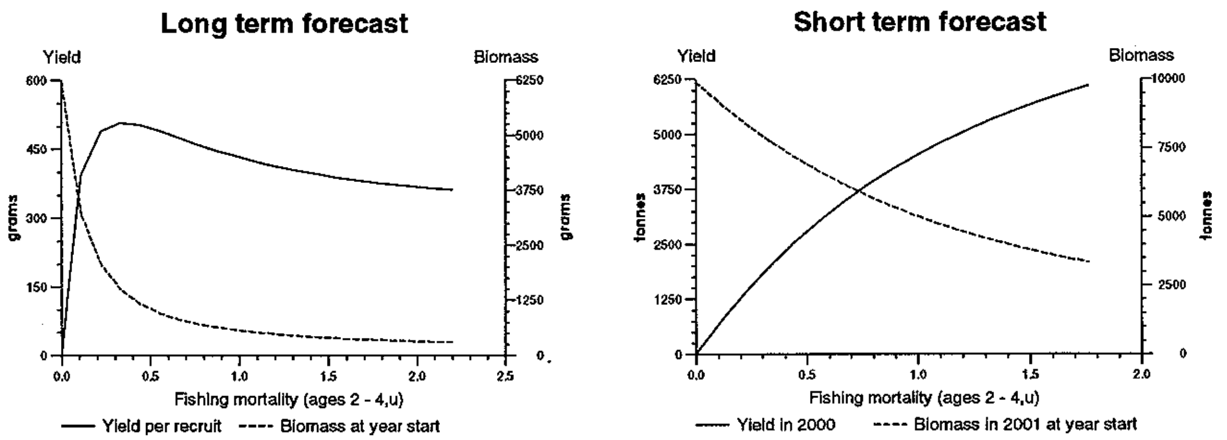


Table 3.8.3.1 Nominal landings of HADDOCK in Division VIIa, 1984–1998, as officially reported to ICES.

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	1998*
Belgium	1	8	18	22	32	34	55	104
France	n/a	26	41	22	58	105	74	86
Ireland	254	251	252	246	320	798	1,005	n/a
Netherlands	-	-	-	-	-	1	14	10
UK (England & Wales)[1]	204	244	260	301	294	463	717	...
UK (Isle of Man)	14	13	19	24	27	38	9	13
UK (N. Ireland)								
UK (Scotland)	143	114	140	66	110	14	51	...
United Kingdom								1,103
Total	616	656	730	681	841	1,453	1,925	1,316
Unallocated	0	47	83	362	912	1,570	1,466	3,586
Total figures used by Working Group	616	703	813	1,043	1,753	3,023	3,391	4,902

*Preliminary.
[1]1989–1998 Northern Ireland included with England and Wales.
n/a = not available.

Table 3.8.3.2 HADDOCK in Division VIIa (Irish Sea).

Year	Recruitment Age 0	Spawning Stock Biomass	Landings	Fishing Mortality Age 2-4
1993	4.36	1.06	0.81	1.221
1994	16.10	1.18	1.04	1.033
1995	2.11	1.53	1.75	1.292
1996	25.88	4.35	3.02	1.046
1997	4.46	3.82	3.39	1.194
1998	10.93	7.07	4.90	1.062
1999	7.02	7.42	.	.
Average	10.12	3.78	2.49	1.141
Unit	Millions	1000 tonnes	1000 tonnes	-

3.8.4 Whiting in Division VIIa (Irish Sea)

State of stock/fishery: This stock is considered to be outside safe biological limits. The current assessment indicates that fishing mortality has been above the proposed $\mathbf{F_{pa}}$ since 1980. SSB has been below the proposed $\mathbf{B_{pa}}$ since 1996. Catches and SSB have declined continuously since the early 1980's. Fishing mortality has declined in recent years but remains 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 in 2000 be reduced below the proposed $\mathbf{F_{pa}}$, corresponding to landings in 2000 of less than 1 600 t.

Reference points: The previously proposed value of $\mathbf{F_{lim}}$ of 1.1 is revised to 0.95.

ICES considers that:	ICES proposes that
$\mathbf{B_{lim}}$ is 5 000 t, the lowest observed spawning stock biomass as estimated in previous assessment. There is no clear evidence of reduced recruitment at the lowest observed SSB's.	$\mathbf{B_{pa}}$ be set at 7 000 t which is considered to be the minimum SSB required to ensure a high probability of maintaining SSB above its lowest observed value, taking into account the uncertainty of assessments.
$\mathbf{F_{lim}}$ is 0.95. This is the fishing mortality estimated to lead to a potential stock collapse.	$\mathbf{F_{pa}}$ be set at 0.65 This F is considered to have a high probability of avoiding $\mathbf{F_{lim}}$ and is consistent with a high probability of remaining above $\mathbf{B_{pa}}$ in the long run.

Technical basis:

$\mathbf{B_{lim}} = \mathbf{B_{loss}}$	$\mathbf{B_{pa}} = \mathbf{B_{loss}} \times 1.4$
$\mathbf{F_{lim}} = \mathbf{F_{loss}}$ as estimated in the current assessment	$\mathbf{F_{pa}} = 0.65$, implies an equilibrium SSB of 10.6 kt, and a relatively low probability of SSB < $\mathbf{B_{pa}}$ (= 7 kt), and is within the range of historic Fs.

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. 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. The effects of this technical measure have not been formally evaluated. Management measure for the *Nephrops* fishery should also take into account the effect on whiting.

Reference points: On the basis of the current assessment, a revision of the proposed value of $\mathbf{F_{lim}}$ from 1.1 to 0.95 is indicated.

Catch forecast for 2000:

Basis: $F(99) = F_{SQ} = F(96\text{–}98) = 0.91$, Catch(99) = 6.0, Landings(99) = 3.4, SSB(2000) = 5.7.

F(2000) (landings)	F(2000) (discards)	F(2000) (Total)	Basis[1]	Catch (2000)	Landings (2000)	SSB (2001)	Medium-term-(10 year) effect of fishing at given level
0.09	0.48	0.57	0.2F(96-98	3.6	0.9	7.7	<5% probability SSB < B_{PA}
0.17	0.48	0.65	Fpa	4.3	1.6	7.1	<5% probability SSB < B_{PA}
0.26	0.48	0.74	0.6F(96-98)	4.9	2.2	6.6	c.10% probability SSB < B_{PA}
0.34	0.48	0.82	0.8F(96-98)	5.4	2.8	6.2	c.50% probability SSB < B_{PA}
0.43	0.48	0.91	1.0F(96-98)	5.9	3.3	5.8	>50% probability SSB < B_{PA}
0.52	0.48	1.00	1.2F(96-98)	6.3	3.7	5.5	>90% probability 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.

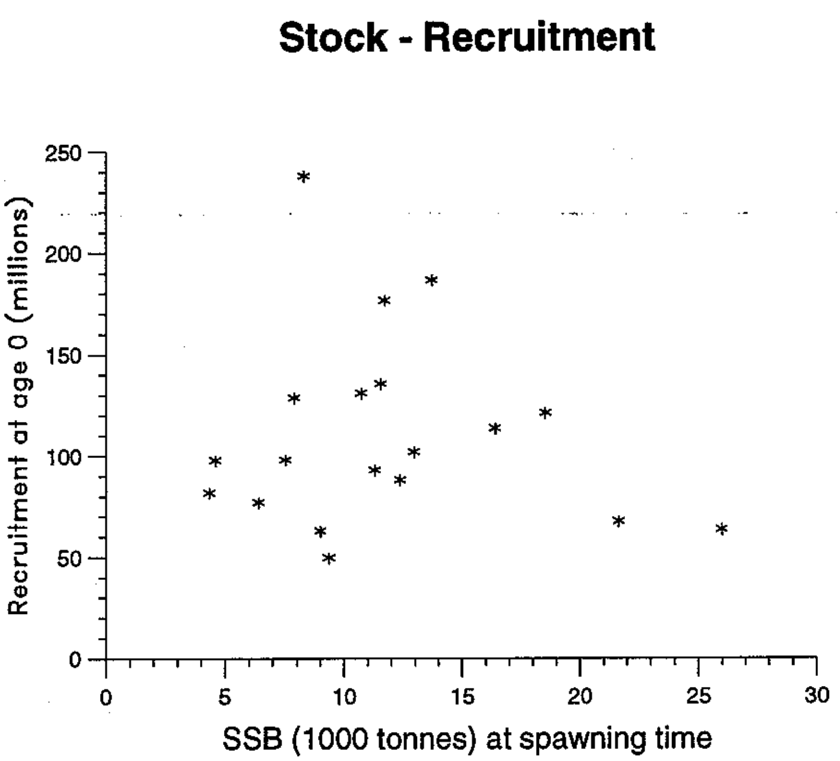
Analytical assessment based on catch-at-age, commercial CPUE and indices from surveys in Division VIIa. Estimates of discards in the *Nephrops* fisheries are included in the assessment, and estimates of misreported landings have been included since 1991. Discarding by whitefish fleets is presently being studied, but there are insufficient data for inclusion in the assessment.

Source of information: Report of the Working Group on the Assessment of Northern Shelf Demersal Stocks, June 1999 (ICES CM 2000/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	4.3	12.8[3]
1993	70% of F(91) ~ 6 500 t	6.5	8.5	6.0	2.7	9.2[3]
1994	Within safe biological limits	-	9.9	5.6	1.2	7.9[3]
1995	No increase in F	8.3[1]	8.0	5.5	2.2	7.0[3]
1996	No increase in F	9.8[1]	9.0	5.6	3.5	8.0[3]
1997	No advice given	-	7.5	4.5	1.9	4.2
1998	20% reduction in F	3.8[5]	5.0	2.1	1.3	3.5
1999	Reduce F below F_{pa}	3.5[5]	4.41			
2000	Reduce F below F_{pa}	<1.6[5]				

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



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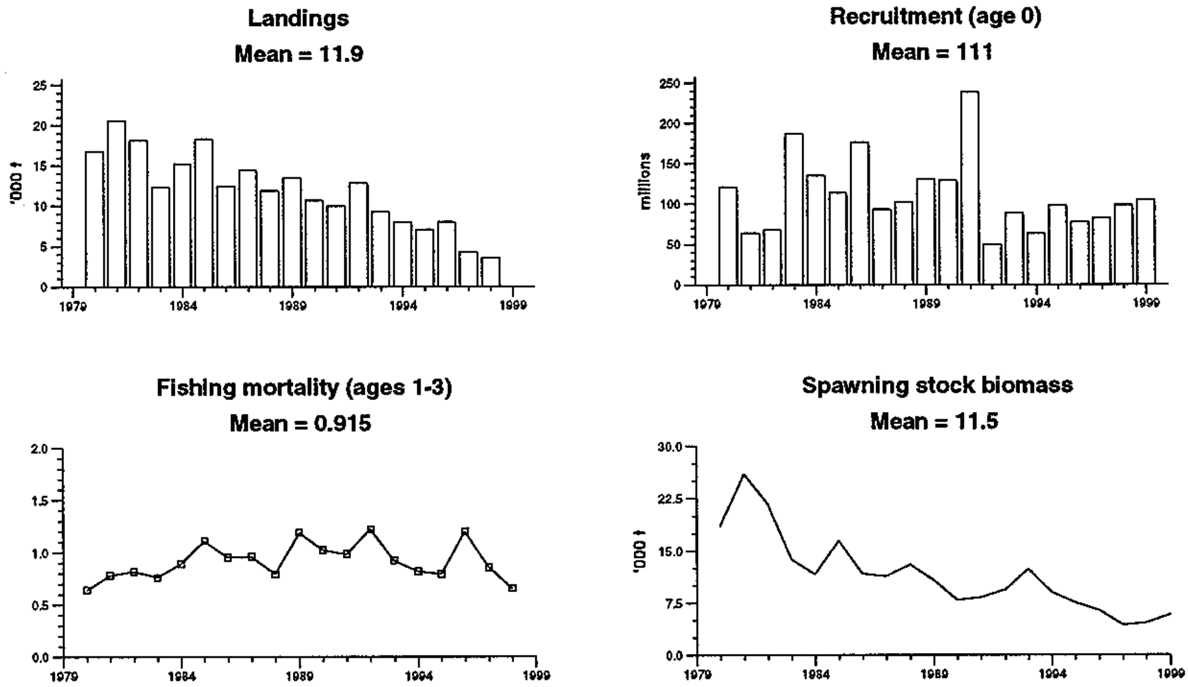
Whiting in Division VIIa (Irish Sea)

Landings graph below includes discards



Precautionary Approach Plot

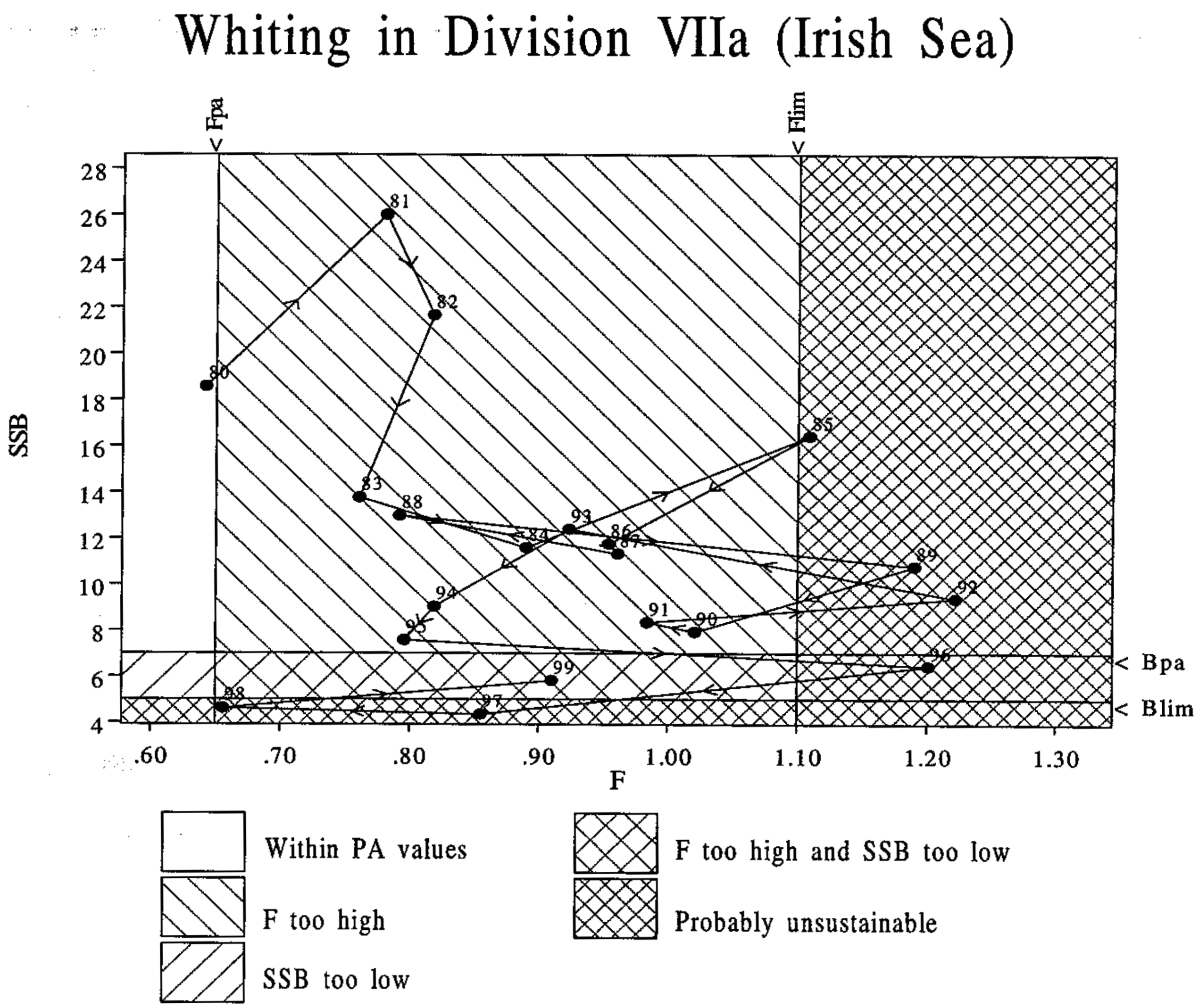


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Table 3.8.4.1 Nominal catch (tonnes) of WHITING in Division VIIa, 1986–1998, as officially reported to ICES and Working Group estimates of human consumption and discards.

Country	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998[1]
Belgium	70	109	90	92	142	53	78	50	80	92	80	47	52
France	770	826	1,063	533	528	611	509	255	163	169	78	86	81
Ireland	3,101	4,067	4,394	3,871	2,000	2,200	2,100	1,440	1,418	1,840	1,773	1,119	n/a
Netherlands	-	-	-	-	-	-	-	-	-	-	17	14	7
UK (Engl.& Wales)[3]	1,004	1,529	1,202	6,652	5,202	4,250	4,089	3,859	3,724	3,125	3,557	3,152	...
UK (Isle of Man)	25	14	15	26	75	74	44	55	44	41	28	24	33
UK (N. Ireland)	4,940	4,858	4,621	...	...	...	...	...	...	...	...	...	...
UK (Scotland)	129	281	107	154	236	223	274	318	208	198	48	30	...
UK	...	...	...	...	...	...	...	...	...	...	...	...	1,916
Total human consumption	10,039	11,684	11,492	11,328	8,183	7,411	7,094	5,977	5,637	5,465	5,581	4,472	2,089
Unallocated human consumption	16	-1,020	-1,537	65	-211	-129	1,447	551	1,119	-574	-1,109	-2,193	137
Estimated discards from Nephrops fishery[2]	2,360	3,754	1,901	2,015	2,684	2,664	4,250	2,702	1,180	2,153	3,494	1,926	1,307
Total figures used by the Working Group for stock assessment	12,415	14,418	11,856	13,408	10,656	9,946	12,791	9,230	7,936	7,044	7,966	4,205	3,533

[1]Preliminary.
[2]Based on UK (N. Ireland) and Ireland data.
[3]1989–1998 Northern Ireland included with England and Wales.
n/a = Not Available

Table 3.8.4.2 WHITING in Division VIIa (Irish Sea).

Year	Recruitment Age 0	Spawning Stock Biomass	Landings	Fishing Mortality Age 1-3
1980	121.11	18.56	16.79	0.642
1981	63.56	26.00	20.61	0.781
1982	67.63	21.66	18.11	0.818
1983	186.51	13.76	12.35	0.761
1984	135.41	11.58	15.24	0.890
1985	113.52	16.43	18.24	1.109
1986	176.65	11.75	12.42	0.954
1987	92.92	11.32	14.42	0.961
1988	101.96	12.98	11.86	0.792
1989	130.81	10.77	13.41	1.190
1990	128.49	7.93	10.66	1.021
1991	237.88	8.34	9.95	0.984
1992	49.49	9.38	12.79	1.222
1993	87.98	12.39	9.23	0.923
1994	62.75	9.03	7.94	0.819
1995	97.98	7.56	7.04	0.796
1996	77.01	6.44	7.97	1.201
1997	81.83	4.34	4.21	0.855
1998	97.78	4.61	3.53	0.656
1999	104.34	5.81	.	.
Average	110.78	11.53	11.93	0.915
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. SSB in 1999 is above $\mathbf{B_{pa}}$ and Fishing mortality in 1998 is below F_{pa}. Consistent with an overall decline in fishing effort on flatfish in the Irish Sea, the exploitation rate on this stock has declined in recent years.

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 stabilised recently due to a reduction in fishing mortality. The period of reduced recruitment started at a time of relatively high SSB, and there is no indication that it has resulted from reduced spawning biomass.

Management objectives: No explicit management objectives are set for this stock. 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 in 2000 should be maintained below the proposed $\mathbf{F_{pa}}$, corresponding to landings of less than 2 300 t in 2000.

Relevant factors to be considered in management: The stock currently experiencing reduced recruitment.

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 2000:

Basis: F(99) = F_{sq} = F(96-98) = 0.42, Landings(99) = 2.1, SSB(2000) = 4.7.

F(2000) onwards	Basis	Catch (2000)	Landings (2000)	SSB (2001)	Medium term (10 year)Probability (%) of SSB < B_{pa}
0.34	0.8F(96-98)	1.8	1.8	5.0	<5
0.38	0.9F(96-98)	2.0	2.0	4.9	<5
0.42	1.0F(96-98)	2.1	2.1	4.7	<5
0.45	Fpa	2.3	2.3	4.6	<5
0.51	1.2F(96-98)	2.5	2.5	4.4	<5

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 target sole and concentrate their effort in 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. While any increase in catching opportunities for sole in the Irish Sea may attract effort back into this area, there is only limited scope for expansion of this fishery given the reduced recruitment seen recently in this stock. Management measures for this stock should also consider the advice for sole in the same area.

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.

Reference points as proposed by ICES in 1998:

ICES considers that:	ICES proposes that:
There is no biological basis for defining $\mathbf{B_{lim}}$ or $\mathbf{F_{lim}}$.	$\mathbf{B_{pa}}$ be set at 3 100 t. There is evidence of high recruitment at the lowest biomass observed and $\mathbf{B_{pa}}$ can therefore be set equal to the lowest observed SSB.
	$\mathbf{F_{pa}}$ be set at 0.45. This F is considered to provide a high probability that SSB remains above $\mathbf{B_{pa}}$ in the long term.

Technical basis:

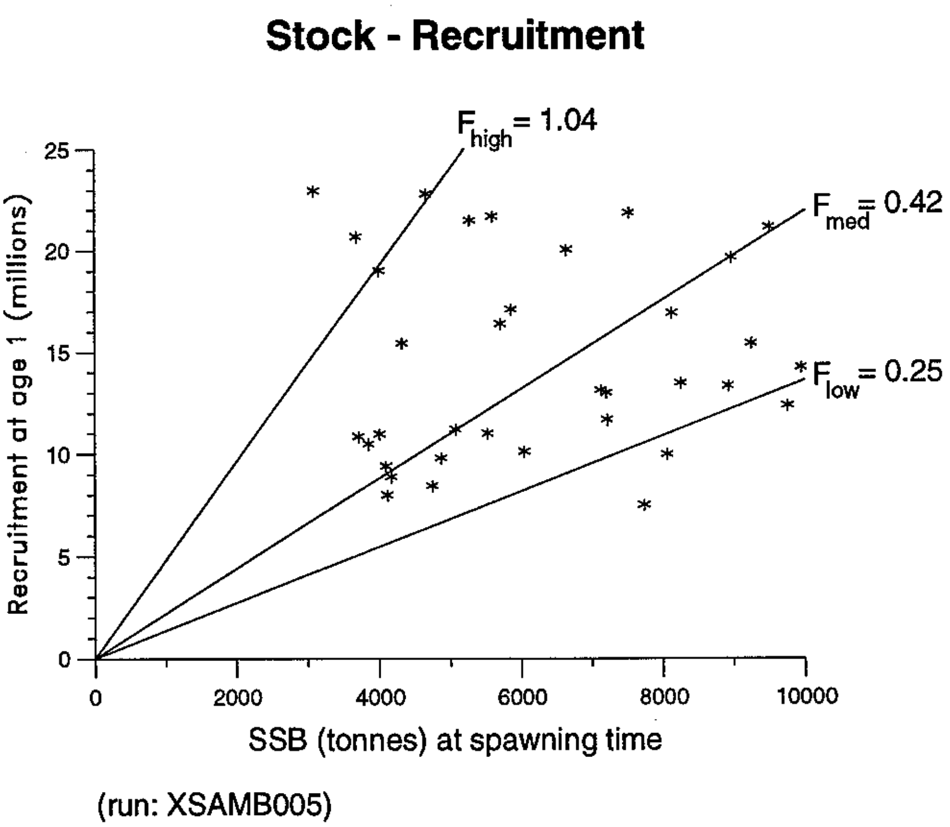
$\mathbf{B_{lim}}$ and $\mathbf{F_{lim}}$: stock-recruitment data uninformative; $\mathbf{F_{loss}}$ poorly defined.	$\mathbf{B_{pa}} = \mathbf{B_{loss}}$
	$\mathbf{F_{pa}} = \mathbf{F_{med}}$ in a previous assessment, and long term considerations

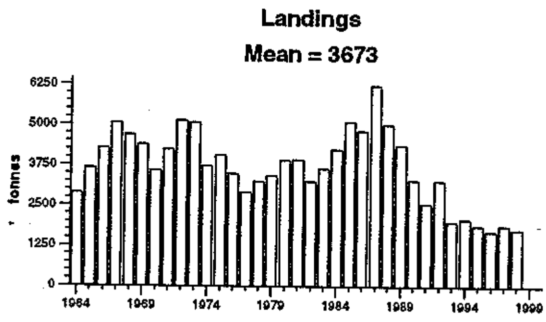
Source of information: Report of the Working Group on the Assessment of Northern Shelf Demersal Stocks, June 1999 (ICES CM 2000/ACFM:1).

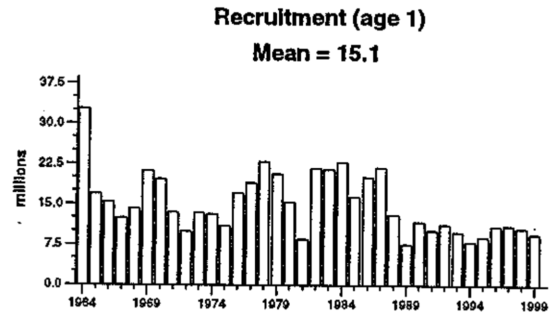
Catch data (Tables 3.8.5.1-2):

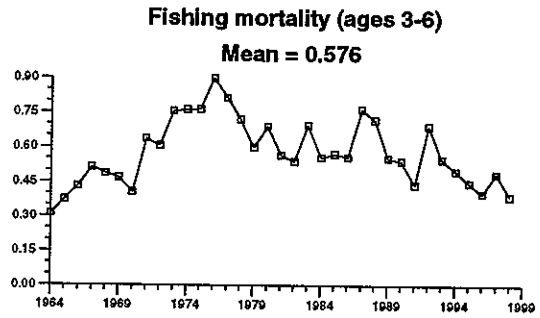
Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC	Official landings	ACFM Landings
1987	F high; no long-term gains in increasing F	5.0	5.0	5.6	6.2
1988	No increase in F	4.8	5.0	4.4	5.0
1989	80% of F(87); TAC	5.8	5.8	4.2	4.4
1990	Halt decline in SSB; TAC	5.1	5.1	4.0	3.3
1991	Rebuild SSB to 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	2.0	1.9
1998	No increase in F	2.4	2.4	1.1[2]	1.8
1999	Keep F below $\mathbf{F_{pa}}$	2.4	2.4		
2000	Keep F below $\mathbf{F_{pa}}$	<2.3			

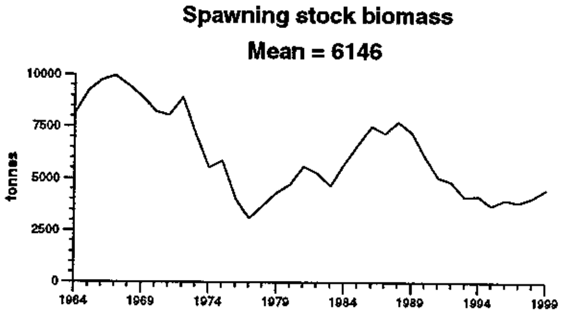
Weights in '000 t. [1]Catch at *status quo* F. [2]Incomplete data.





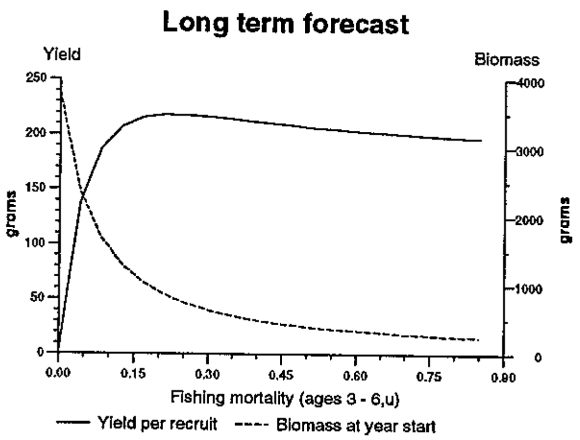


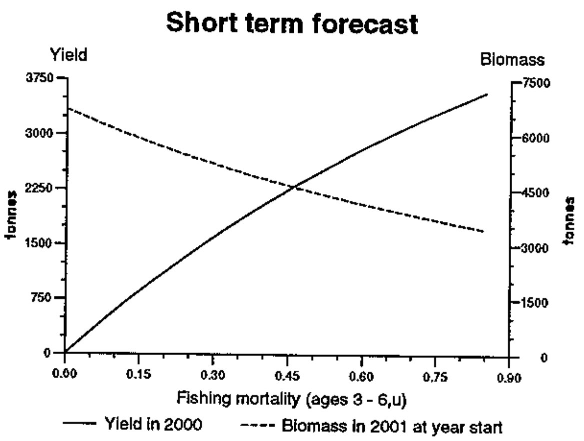




Plaice in Division VIIa (Irish Sea)

Yield and Spawning Stock Biomass





Precautionary Approach Plot

Plaice in Division VIIa (Irish Sea)

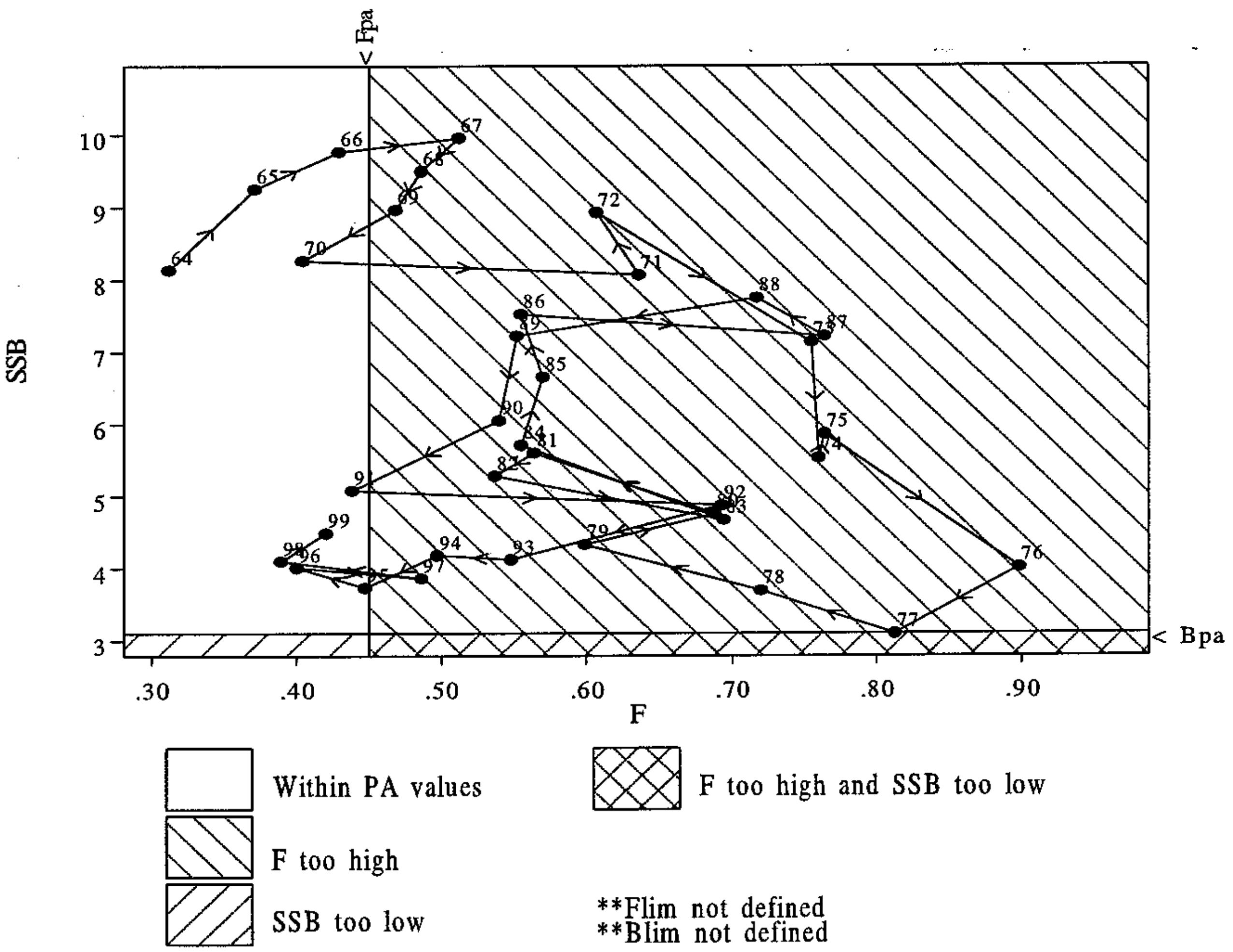


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Table 3.8.5.1 Nominal landings (t) of PLAICE in Division VIIa as officially reported to ICES.

Country	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998[1]
Belgium	285	384	403	243	265	301	138	321	128	332	327	344[3]	459	327
France	110	165	87	58	11[1]	105[1]	20[1]	42[1]	19[1]	11[1]	10[1]	12[1]	8	8
Ireland	2,000	1,858	2,132	2,009	1,406	1,350	900	1,355	654	547	557	538	543	n/a
Netherlands	1,091	-	-	-	-	-	-	-	-	-	-	69	110	27
UK (Eng.&Wales)[2]	2,295	1,774	2,366	1,630	2,409	1,959	1,584	1,381	1,119	1,082	1,050	878	798	
UK (Isle of Man)	26	12	9	12	18	27	51	24	13	14	20	16	11	14
UK (N. Ireland)	198	272	332	286										
UK (Scotland)	118	119	243	127	76	219	104	70	72	63	60	18	25	
UK (Total)														693
Total	6,123	4,584	5,572	4,365	4,185	3,961	2,797	3,193	2,005	2,049	2,024	1,875	1,954	1,069
Discards[4]	-	250	270	220	-	-	-	-	-	-	-	-	-	-
Unallocated	-1,048	-28	378	420	187	-686	-243	74	-9	17	-150	-168	-83	696
Total figures used by the Working Group for stock assessment	5,075	4,806	6,220	5,005	4,372	3,275	2,554	3,267	1,996	2,066	1,874	1,707	1,871	1,765

[1]Provisional

[2]1989–1997 N. Ireland included with England and Wales

[3]Final Statlant 27a data

{UK (Total) excludes Isle of Man data}

[4] A '-' indicates no information on discards

n/a = not available

Table 3.8.5.2 PLAICE in Division VIIa (Irish Sea).

Year	Recruitment Age 1	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	11.01	5.86	4.06	0.764
1976	17.11	4.01	3.47	0.898
1977	19.01	3.09	2.90	0.813
1978	22.94	3.69	3.23	0.720
1979	20.69	4.33	3.43	0.599
1980	15.44	4.75	3.90	0.688
1981	8.45	5.60	3.91	0.564
1982	21.69	5.28	3.24	0.537
1983	21.49	4.67	3.64	0.694
1984	22.79	5.71	4.24	0.555
1985	16.40	6.65	5.08	0.570
1986	20.04	7.52	4.81	0.555
1987	21.86	7.21	6.22	0.764
1988	13.01	7.74	5.01	0.717
1989	7.51	7.22	4.37	0.552
1990	11.68	6.05	3.28	0.540
1991	10.13	5.08	2.55	0.438
1992	11.21	4.87	3.27	0.693
1993	9.79	4.12	2.00	0.548
1994	7.99	4.18	2.07	0.497
1995	8.88	3.73	1.87	0.447
1996	10.84	4.01	1.71	0.400
1997	10.98	3.86	1.87	0.486
1998	10.48	4.10	1.77	0.389
1999	9.40	4.49	.	.
Average	15.09	6.15	3.67	0.576
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 harvested outside safe biological limits. Fishing mortality in 1998 remains above the proposed $\mathbf{F_{pa}}$. SSB in 1999 is above the proposed $\mathbf{B_{pa}}$. SSB has fluctuated around $\mathbf{B_{pa}}$ since 1990.

Three above-average year classes are recruiting to the fishery. They are the strongest year classes since the mid 1980s and represent an opportunity to rebuild the SSB to well above $\mathbf{B_{pa}}$ if fishing mortality is controlled.

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 2000 should be reduced below the proposed $\mathbf{F_{pa}}$ corresponding to landings of less than 1080 t in 2000 in order to provide a high probability of SSB remaining above $\mathbf{B_{pa}}$ in the short and medium term.

Relevant factors to be considered in management: As a result of recent above average year-classes entering the fishery, the reduction in F advised for this stock still allows an increase in the advised catch.

Catch forecast for 2000:

Basis: F(99) = F_{SQ} = F(96–98) = 0.41, Landings(99) = 1.4, SSB(2000) = 4.1.

F(2000) onwards	Basis	Landings (2000)	SSB (2001)	Medium term (10 year) Probability (%) of SSB<Bpa
0.29	0.7F(96-98)	1.02	4.31	<5
0.30	Fpa	1.08	4.24	<5
0.33	0.8F(96-98)	1.15	4.18	~10
0.37	0.9F(96-98)	1.27	4.06	~20
0.41	1.0F(96-98)	1.38	3.95	~35
0.45	1.1F(96-98)	1.50	3.83	~50

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. The expected improvement in the state of this stock may attract additional effort back onto this stock.

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

Reference points as proposed by ICES in 1998:

ICES considers that:	ICES proposes that:
$\mathbf{B_{lim}}$ is 2,800 t. The lowest observed spawning stock in an earlier assessment.	$\mathbf{B_{pa}}$ be set at 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:

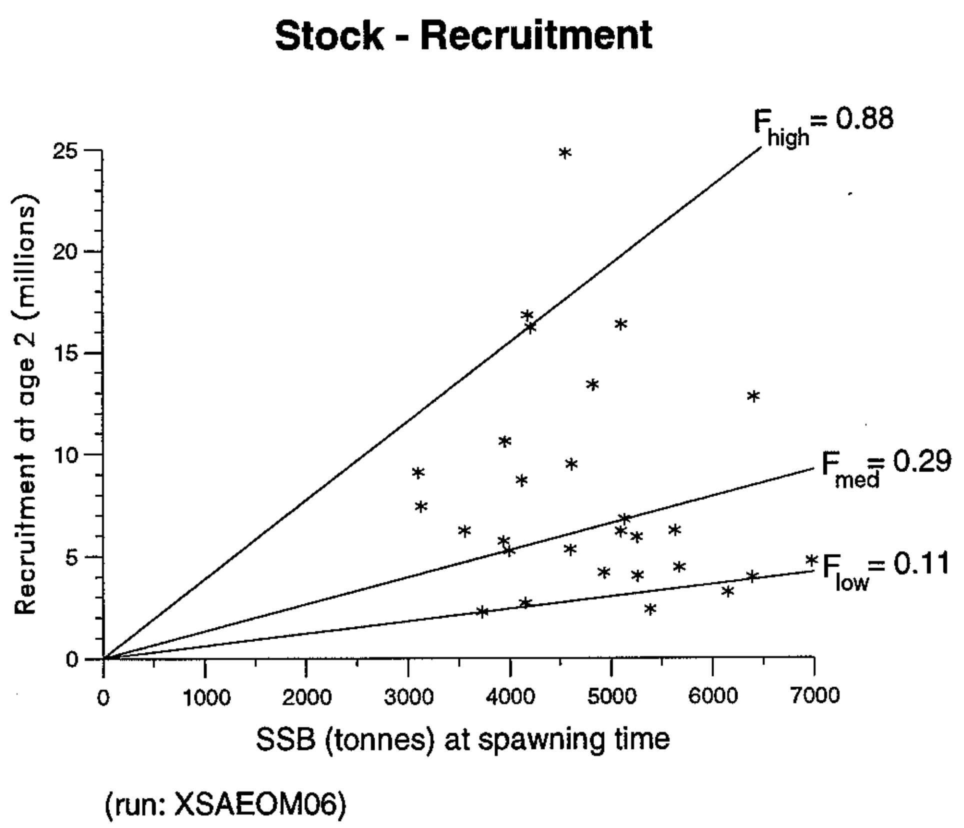
$\mathbf{B_{lim} = B_{loss}}$	$\mathbf{B_{pa} \sim B_{lim}}$ * 1.4
$\mathbf{F_{lim} = F_{loss}}$ poorly defined; based on historical considerations	$\mathbf{F_{pa}}$ = see above

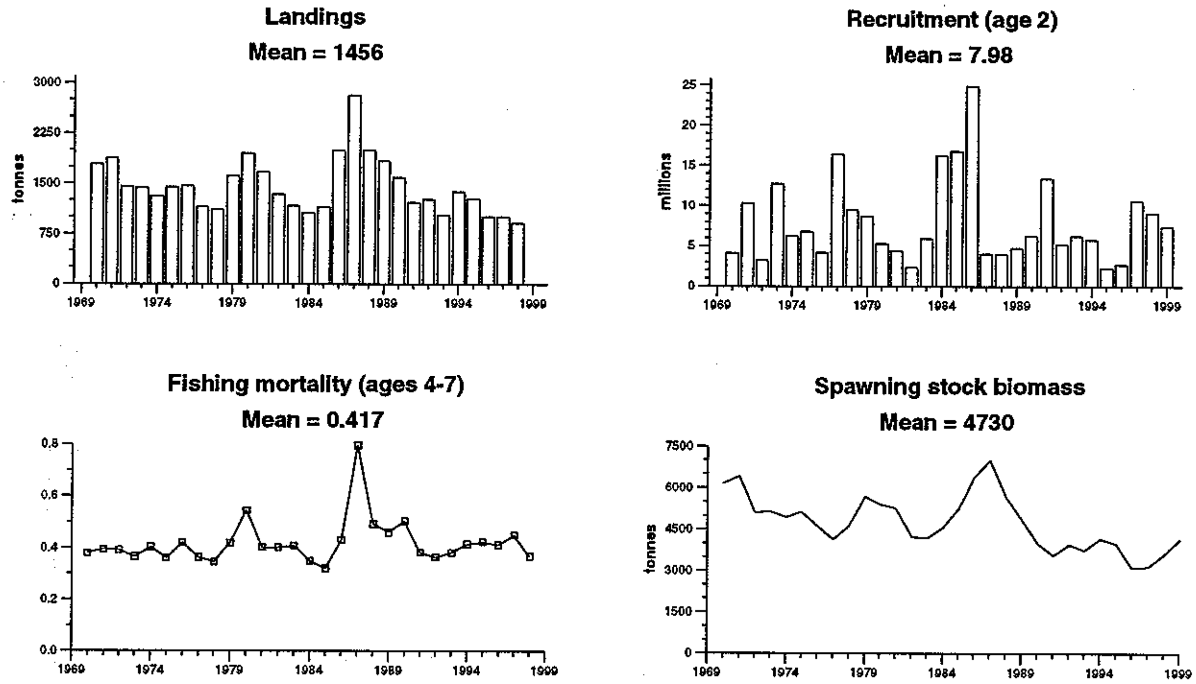
Source of information: Report of the Working Group on the Assessment of Northern Shelf Demersal Stocks, June 1999 (ICES CM 2000/ACFM:1).

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	1.0	1.0
1997	20% reduction in F	0.8	1.0	1.0	1.0
1998	20% reduction in F	0.85	0.9	0.8	0.9
1999	Reduce F below $\mathbf{F_{pa}}$	0.83	0.9		
2000	Reduce F below $\mathbf{F_{pa}}$	< 1.08			

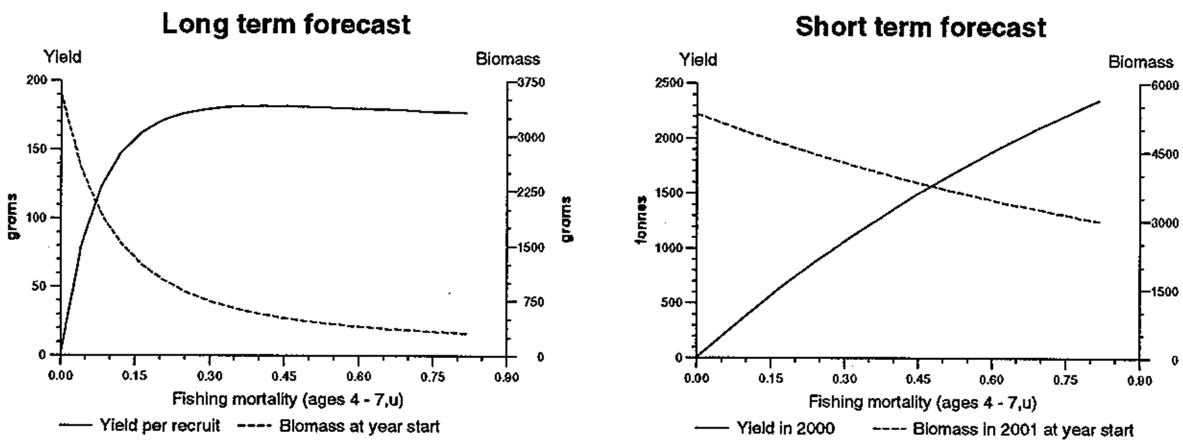
[1]Catch at *Status quo* F. [2] Not including misreporting. [3]Revised in 1990 to 1.5. Weights in '000 t.





Sole in Division VIIa (Irish Sea)

Yield and Spawning Stock Biomass



Precautionary Approach Plot

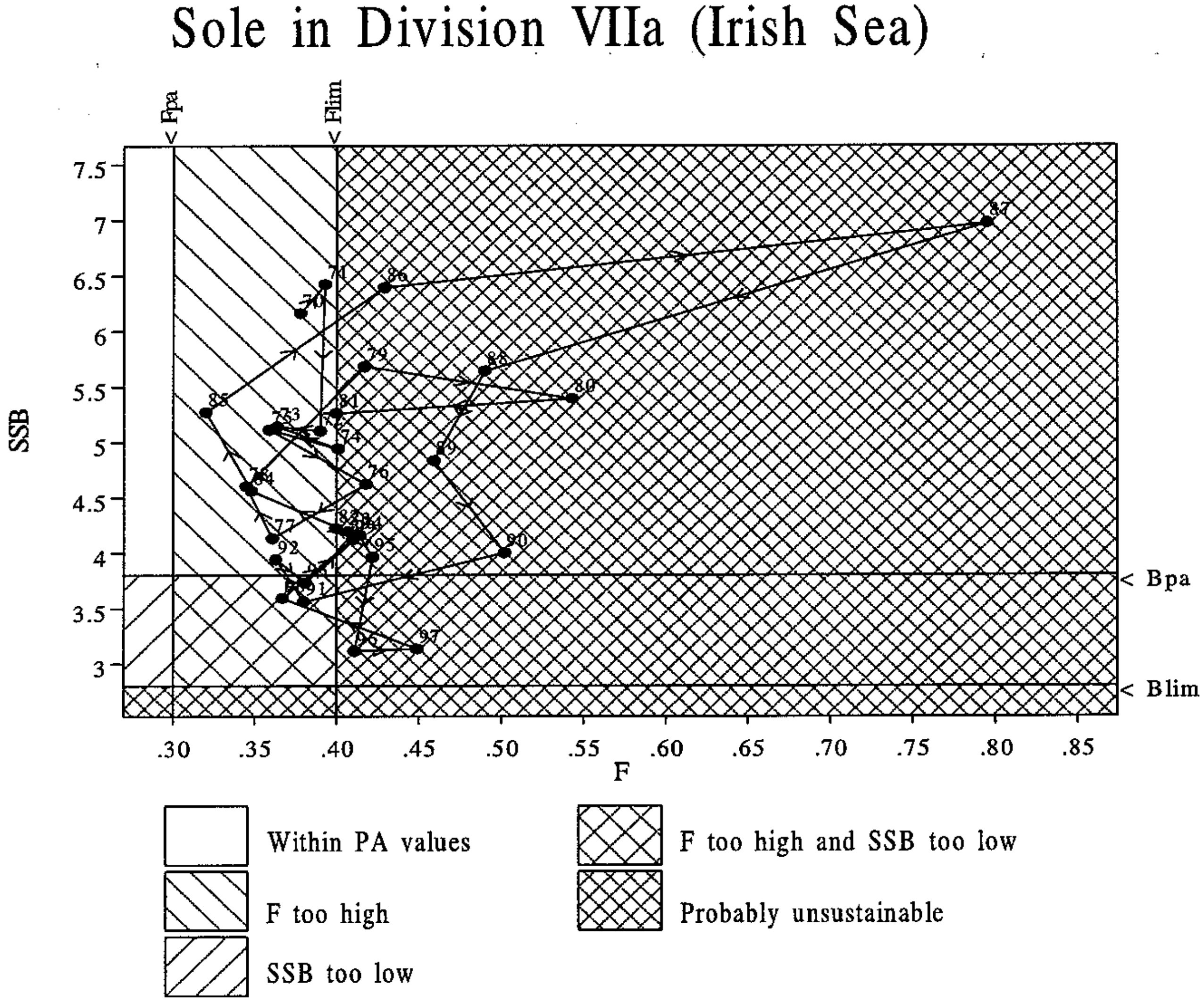


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Table 3.8.6.1 Irish Sea SOLE. Divisions VIIa. Nominal landings (tonnes), as officially reported to ICES.

Country	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998*
Belgium	589	930	987	915	1010	786	371	531	495	706	675	533	553	524
France	9	17	5	11	5	2	3	11	8	7	5	5	3	5
Ireland	180	235	312	366	155	170	198	164	98	226	176	133	130	n/a
Netherlands	546	-	-	-	-	-	-	-	-	-	-	149	123	60
UK (Engl.& Wales)[1]	269	637	599	507	613	569	581	477	338	409	424	194	189	
UK (Isle of Man)	12	1	3	1	2	10	44	14	4	5	12	4	5	3
UK (N. Ireland)[1]	36	50	72	47										
UK (Scotland)[1]	28	46	63	38	38	39	26	37	28	14	8	5	7	
United Kingdom														169
Total	1,669	1,916	2,041	1,885	1,823	1,576	1,223	1,234	971	1,367	1,300	1,023	1027	761
Unallocated	-523	79	767	114	10	7	-9	25	52	2	-34	-23	-24	149
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	1,003	910

* Preliminary
[1] 1989-1998 N. Ireland included with England & Wales
n/a Not available

Table 3.8.6.2 SOLE in Division VIIa (Irish Sea)

Year	Recruitment Age 2	Spawning Stock Biomass	Landings	Fishing Mortality Age 4-7
1970	4.05	6.16	1.79	0.378
1971	10.29	6.42	1.88	0.393
1972	3.22	5.10	1.45	0.390
1973	12.77	5.14	1.43	0.364
1974	6.19	4.94	1.31	0.401
1975	6.79	5.11	1.44	0.359
1976	4.17	4.62	1.46	0.418
1977	16.34	4.13	1.15	0.361
1978	9.47	4.60	1.11	0.345
1979	8.69	5.68	1.61	0.417
1980	5.30	5.39	1.94	0.543
1981	4.43	5.26	1.67	0.400
1982	2.37	4.22	1.34	0.400
1983	5.90	4.19	1.17	0.407
1984	16.16	4.56	1.06	0.348
1985	16.78	5.27	1.15	0.320
1986	24.81	6.39	2.00	0.429
1987	4.01	6.97	2.81	0.795
1988	3.96	5.64	2.00	0.490
1989	4.73	4.83	1.83	0.459
1990	6.23	4.00	1.58	0.502
1991	13.38	3.56	1.21	0.380
1992	5.23	3.94	1.26	0.363
1993	6.22	3.73	1.02	0.381
1994	5.72	4.16	1.37	0.414
1995	2.26	3.96	1.27	0.422
1996	2.68	3.11	1.00	0.411
1997	10.61	3.13	1.00	0.449
1998	9.09	3.59	0.91	0.367
1999	7.41	4.12	.	.
Average	7.98	4.73	1.46	0.417
Unit	Millions	1000 tonnes	1000 tonnes	-

3.8.7 Irish Sea herring (Division VIIa)

State of the stock/fishery: Although the assessment is imprecise the stock is considered to be outside safe biological limits. Fishing mortalities for the most recent years are most probably close to the proposed $\mathbf{F_{pa}}$. Spawning stock biomass has declined in the last two years to below the proposed $\mathbf{B_{pa}}$ and close to its historical low. Recent recruitment has 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 the proposed $\mathbf{F_{pa}}$ and spawning stock biomass should be greater than the proposed $\mathbf{B_{pa}}$.

Advice on management: ICES recommends that in order to bring the SSB above the proposed $\mathbf{B_{pa}}$ in the short term F in 2000 should be reduced to F=0.31. This corresponds to a catch of approximately 3 900 t.

Proposed reference points: As there has been no new information, the proposed reference points remain unaltered.

ICES considers that:	ICES proposes that:
$\mathbf{B_{lim}}$ is 6 000 t	$\mathbf{B_{pa}}$ be set at 9 500 t
$\mathbf{F_{lim}}$ is not defined	$\mathbf{F_{pa}}$ be set at 0.36

Technical basis:

$\mathbf{B_{lim}}$: lowest observed SSB	$\mathbf{B_{pa}}$: $\mathbf{B_{lim}}$ exp (1.645 σ)
$\mathbf{F_{lim}}$: not defined	$\mathbf{F_{pa}}$: $\mathbf{F_{med98}}$

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, closed areas should be maintained.

Catch forecast for 2000: Basis F(99)=F(98), Landings(99)= 4 022 t, SSB (99)=8 275 t.

Basis	F(2000)	SSB(2000)	Landings(2000)	SSB(2001)
0.4F(98)	0.14	10 556	1 849	13 073
0.6F(98)	0.21	9 913	2 683	11 643
0.8F(98)	0.28	9 312	3 461	10 379
0.9F(98)	0.31	8 025	3 920	9 829
1.0F(98)	0.35	8 749	4 188	9 262
F_{pa}	0.36	8 641	4 327	9 054

Weights in t.
Shaded scenarios considered inconsistent with the precautionary approach.

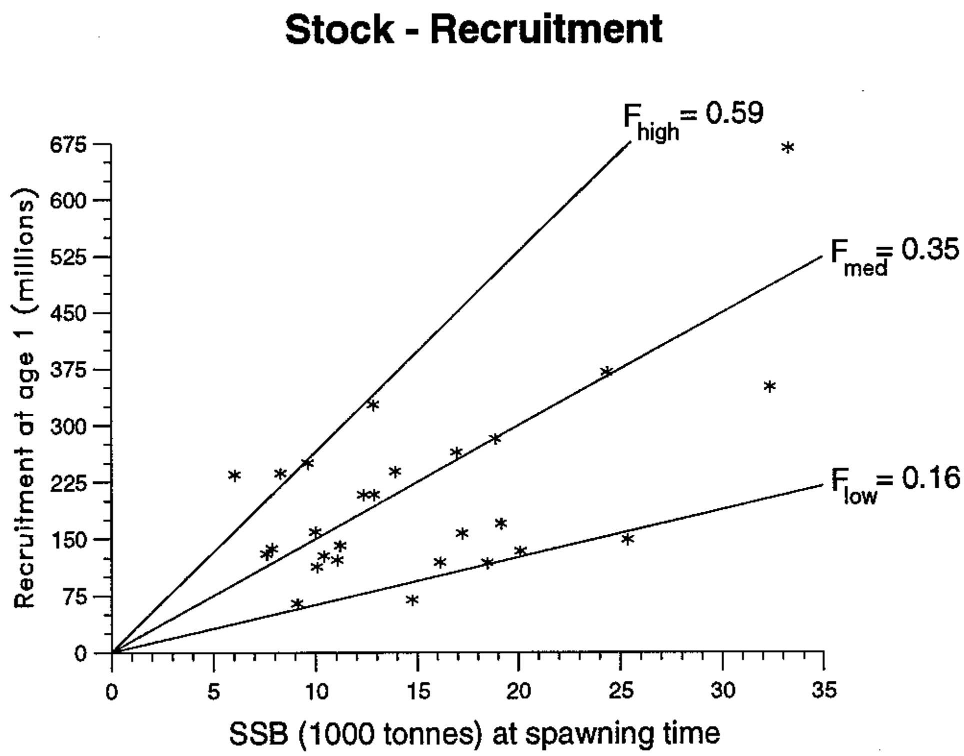
Elaboration and special comment: There were two spawning components of herring in the Irish Sea (Manx and Mourne). At present these are treated as one stock for assessment and management purposes. The Mourne component is no longer a significant part of the stock. Fishing mortality was high during the 1970s due to a transfer of effort from other closed herring fisheries and the operation of an industrial fleet. Since 1981 the size of the exploiting fleets in this area has declined and the industrial fishery has closed, fishing mortality has varied around the proposed $\mathbf{F_{pa}}$ of 0.36.

Source of information: Report of the Herring Assessment Working Group for the Area South of 62°N, March 1999 (ICES CM 1999/ACFM:12).

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	3.7
1999	F=Proposed $\mathbf{F_{pa}}$=0.36	4.9	6.6	
2000	F=90%; F(98)=0.31	3.9		

Weights in '000 t



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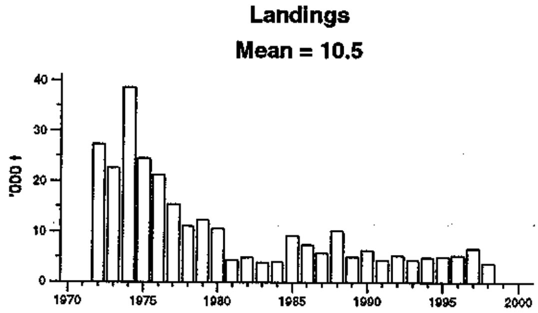
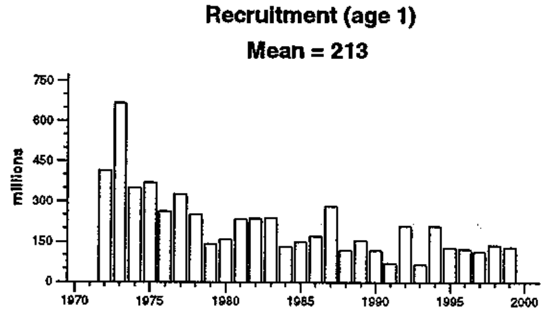
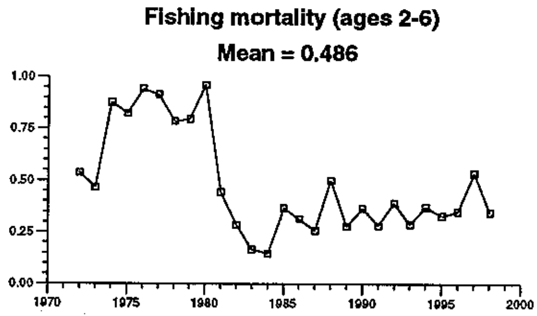
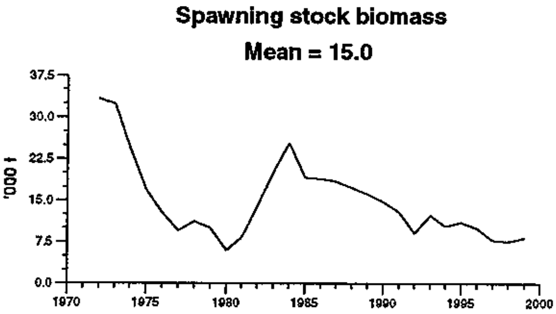


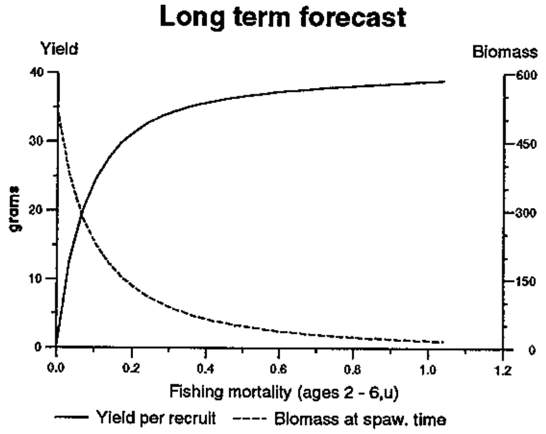


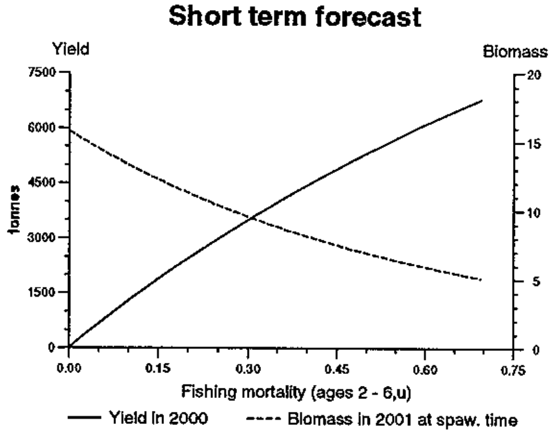




Irish Sea herring (Division VIIa)

Yield and Spawning Stock Biomass





Irish Sea herring (Division VIIa)

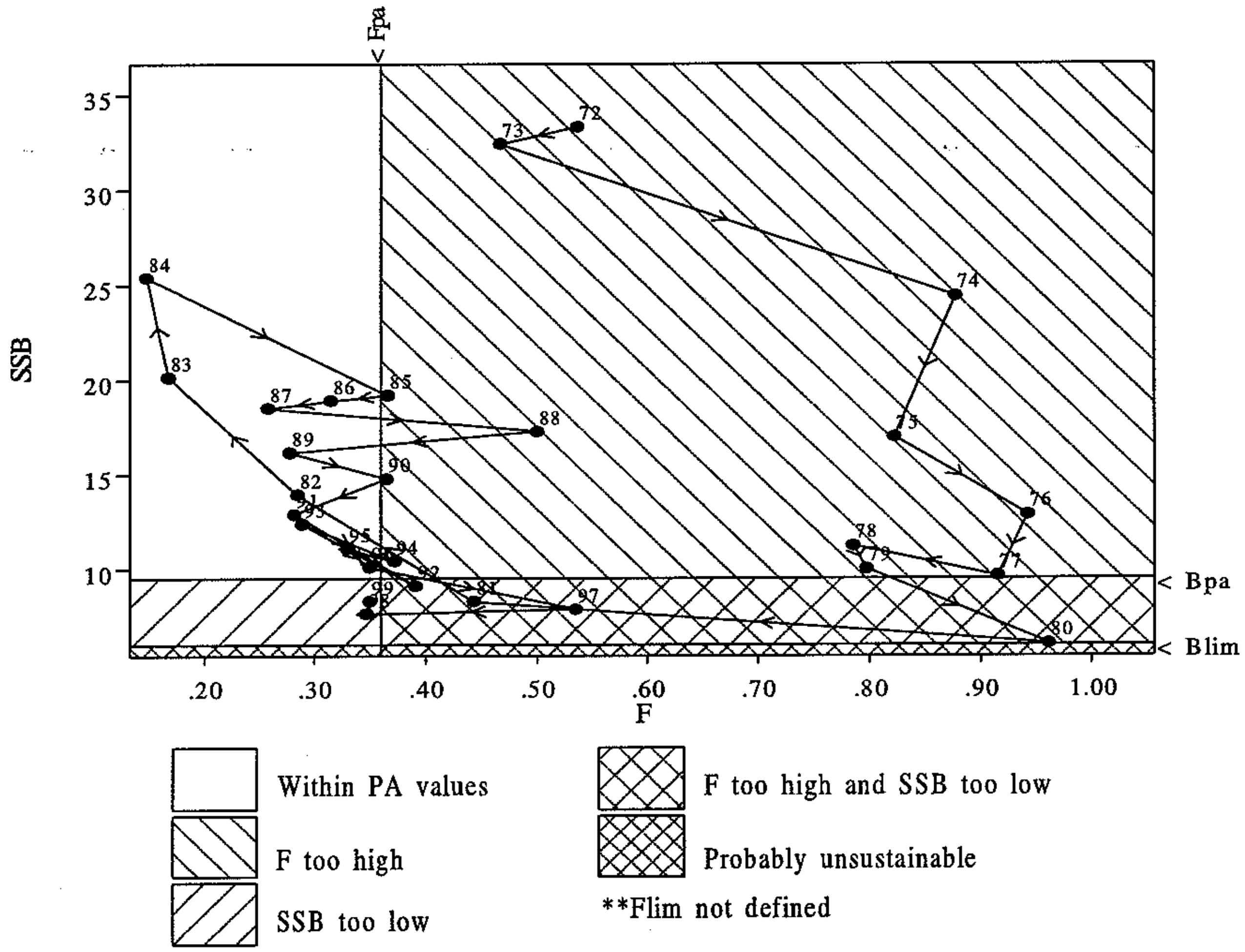


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Table 3.8.7.1 Irish Sea HERRING (Division VIIa(N)). Catch in tonnes by country, 1985-1998. These figures do not in all cases correspond to the official statistics and cannot be used for management purposes.

Country	1985	1986	1987	1988	1989	1990	1991
Ireland	1,000	1,640	1,200	2,579	1,430	1,699	80
UK	4,077	4,376	3,290	7,593	3,532	4,613	4,318
Unallocated	4,110	1,424	1,333	-	-	-	-
Total	9,187	7,440	5,823	10,172	4,962	6,312	4,398

Country	1992	1993	1994	1995	1996	1997	1998
Ireland	406	0	0	0	100	0	0
UK	4,864	4,408	4,828	5,076	5,180	6,651	4,905
Unallocated	-	-	-	-	22	-	-1,187
Total	5,270	4,408	4,828	5,076	5,302	6,651	3,718

Table 3.8.7.2 Irish Sea herring (Division VIIa).

Year	Recruitment Age 1	Spawning Stock Biomass	Landings	Fishing Mortality Age 2-6
1972	414.75	33.31	27.35	0.537
1973	667.78	32.40	22.60	0.467
1974	349.83	24.40	38.64	0.877
1975	369.95	16.96	24.50	0.822
1976	263.55	12.86	21.25	0.942
1977	326.76	9.63	15.41	0.915
1978	249.74	11.22	11.08	0.785
1979	140.80	10.00	12.34	0.797
1980	158.81	6.04	10.61	0.961
1981	234.39	8.28	4.38	0.443
1982	236.30	13.93	4.86	0.285
1983	238.29	20.14	3.93	0.167
1984	133.06	25.38	4.07	0.147
1985	148.23	19.18	9.19	0.366
1986	169.62	18.89	7.44	0.315
1987	281.77	18.50	5.82	0.258
1988	117.79	17.25	10.17	0.500
1989	157.01	16.16	4.95	0.278
1990	118.71	14.76	6.31	0.365
1991	69.29	12.89	4.40	0.282
1992	207.78	9.10	5.27	0.391
1993	64.18	12.37	4.41	0.289
1994	207.49	10.41	4.83	0.372
1995	127.17	11.07	5.08	0.330
1996	121.54	10.08	5.30	0.350
1997	112.59	7.85	6.65	0.535
1998	136.70	7.61	3.72	0.347
1999	129.59	8.28	.	.
Average	212.62	14.96	10.54	0.486
Unit	Millions	1000 tonnes	1000 tonnes	-

3.8.8 *Nephrops* in Division VIIa, North of 53° N (Management Area J)

There are two Functional Units in this Management Area: a) Irish Sea East (FU 14) and b) Irish Sea West (FU 15).

State of the stock/fishery: Both stocks are considered to be fully exploited.

a) Irish Sea East: Evidence of a fall in effort and generally increasing trend in CPUE in the most recent years.

b) Irish Sea West: CPUE and LPUE have increased in recent years. Age-based assessments indicate relative stability in terms of stock biomass and recruitment. F on females is higher than in most other *Nephrops* stocks.

Management objectives: There are no management objectives set for this fishery.

Advice on management: There is no basis to revise the advice given for 1993-99 and therefore ICES advises that the TAC should not exceed 9400 t for each of the years 2000 and 2001.

Relevant factors to be considered in management: Although exploited throughout the year, increased effort generally occurs during the summer months (especially in Irish Sea East), when females are available for capture after hatching their eggs. This results in higher annual fishing mortality rates on females than in other more northern FUs. The high F values on both sexes in Irish Sea West suggest that the situation should be very carefully monitored.

It should be noted that this Management Area is within a much larger TAC area (Sub-area VII), and that a single TAC set for the whole Sub-area, will not necessarily result in balanced exploitation in this and other parts of the Sub-area.

Elaboration and special comments: Most of the landings from this Management Area J are taken by the UK and the Republic of Ireland. Irish Sea East landings and effort increased to a peak in 1978, and have now stabilised at half that level. The low landings in 1998 are consistent with the reduction in effort in the summer months. In Irish Sea West, both landings and effort have been reasonably stable over the past 12 years.

LPUE and mean size data are available for both units. CPUE data available for Irish Sea West. Length-based assessment repeated for both units and age-based assessment for Irish Sea West.

Source of information: Report of the Working Group on *Nephrops* Stocks, April 1999 (ICES CM 1999/ACFM:13).

Catch data (Tables 3.8.8.1-2):

Year	ICES advice	Recommended TAC	Agreed TAC [1]	ACFM landings
1987				9.9
1988				9.1
1989				8.5
1990				8.9
1991		8.76		10.3
1992		8.9	20.0	8.0
1993		9.4	20.0	8.7
1994		9.4	20.0	8.1
1995		9.4	20.0	9.3
1996		9.4	23.0	7.8
1997		9.4	23.0	10.5
1998		9.4	23.0	9.4
1999		9.4	23.0	
2000		9.4		
2001		9.4		

(Weights in '000 t) [1)] Sub-area VII

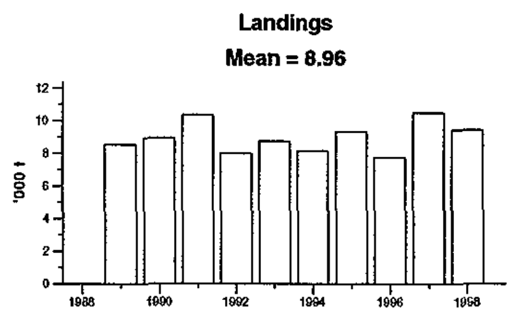


Table 3.8.8.1 *Nephrops* landings (tonnes) by Functional Unit plus other rectangles in Management Area J (VIIa, North of 53° N).

Year	FU 14	FU 15	Total
1989	438	8084	8522
1990	644	8278	8922
1991	859	9468	10327
1992	495	7502	7997
1993	618	8111	8729
1994	514	7628	8142
1995	504	8817	9321
1996	452	7304	7756
1997	586	9923	10509
1998 *	364	9058	9422
* provisional na = not available			

Table 3.8.8.2 *Nephrops* landings (tonnes) by country in Management Area J (VIIa, North of 53° N).

Year	Belgium	France	Rep. of Ireland	Isle of Man	UK	Total
1989	0	19	2484	8	6011	8522
1990	0	8	2724	25	6165	8922
1991	1	12	3390	62	6864	10327
1992	1	6	2381	14	5596	7997
1993	0	8	2750	32	5939	8729
1994	0	17	1797	16	6312	8142
1995	2	7	3269	23	6020	9321
1996	1	2	1614	10	6127	7756
1997	1	0	3320	7	7180	10509
1998 *	1	0	3008	25	6388	9422
* provisional na = not available						

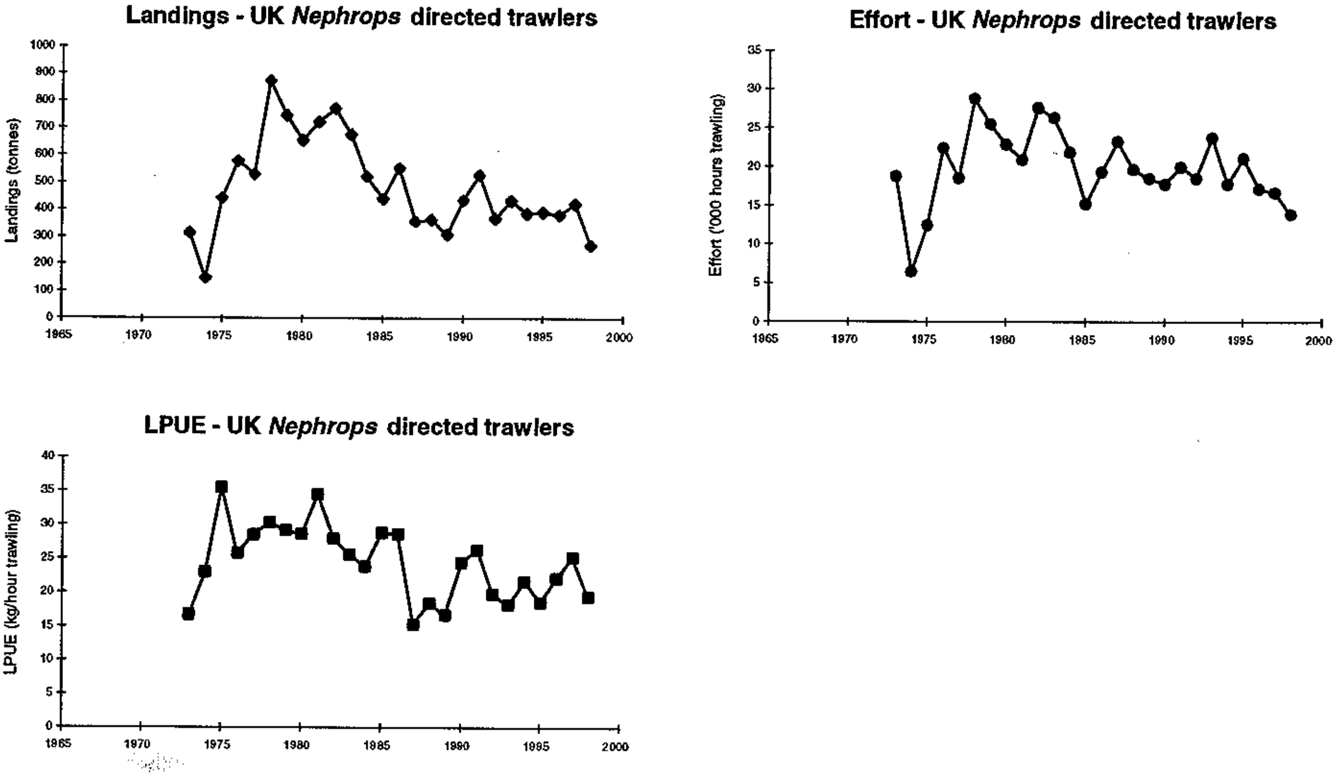


Figure 3.8.8.1 - Irish Sea East (FU 14): Long term trends in landings, effort and LPUEs of *Nephrops* in catches and landings.

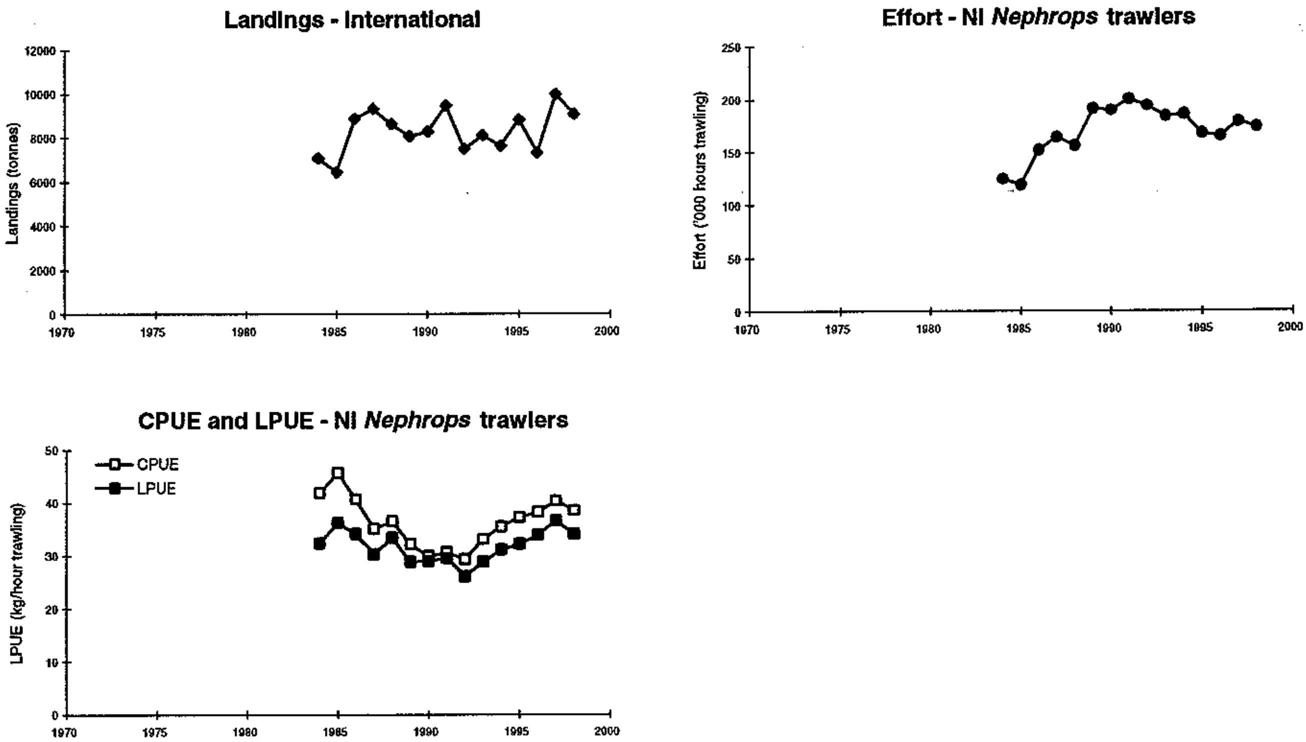


Figure 3.8.8.2 - Irish Sea West (FU 15): Long term trends in landings, effort, CPUEs and LPUEs of *Nephrops* in catches and landings.

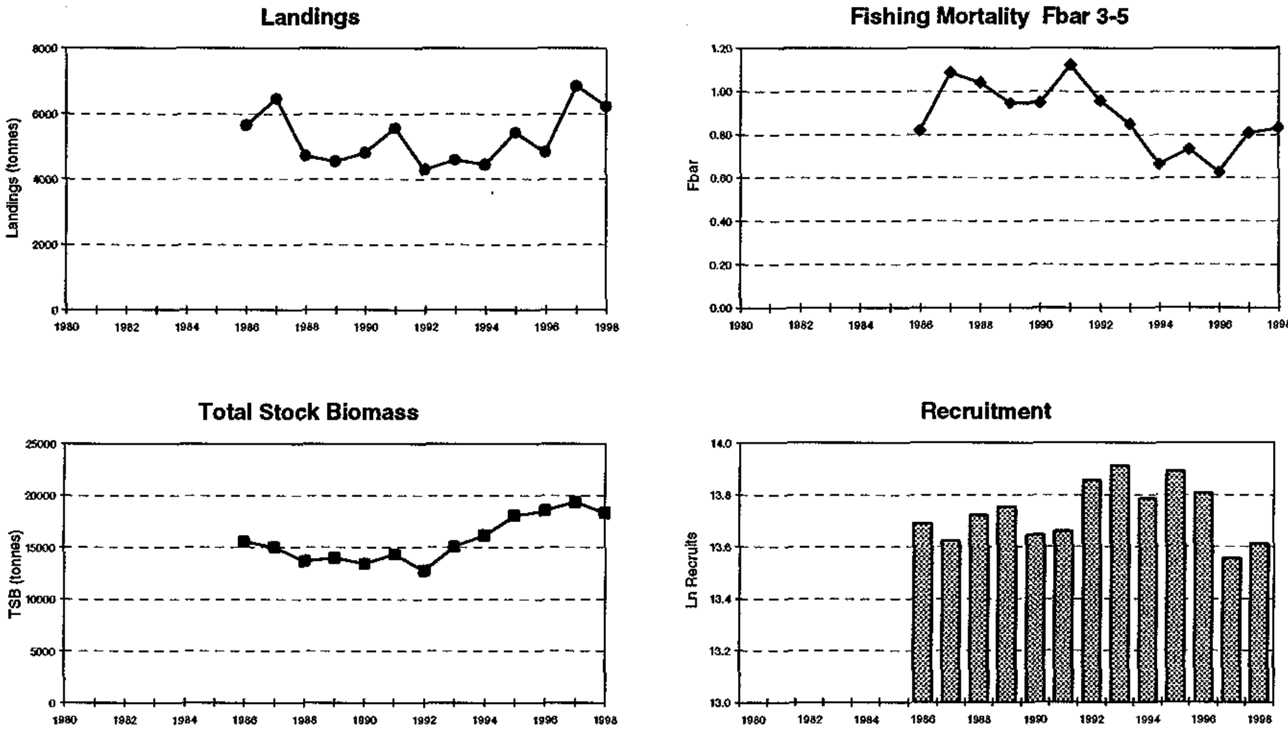


Figure 3.8.8.3 - Irish Sea West (FU 15): Output VPA males: Trends in Landings, Fbar, TSB and Recruitment.

3.8.9 Answer to special request from EC DG XIV

The EC DG XIV has requested ICES to investigate "if the recently defined conditions for closure of the Douglas Bank Box for the protection of herring in the Irish Sea a satisfactory replacement for the previously existing conditions".

Extensive studies on the timing and location of Douglas Bank herring spawning were reported to ACFM, (ref to paper). These studies all indicate that the redefined conditions for closure of the Douglas Bank Box are a satisfactory replacement under the existing conditions. **ICES advises that the redefined conditions should be made permanent.**

3.9 Stocks in the Celtic Sea (Divisions VIIf-k), Western Channel (Division VIIe) and northern parts of the Bay of Biscay (Divisions VIIIa,b,d, and e)

3.9.1 Overview

Fleets and fisheries

Most of the demersal fisheries in this area have a mixed catch. Although it is possible to associate specific target species with particular fleets, various quantities of cod, whiting, hake, anglerfish, megrim, sole, plaice and *Nephrops* are taken together, depending on gear type.

In the Celtic Sea and Western Channel, fisheries for demersal species, mainly cod, whiting, sole and plaice, are conducted by Belgium, France, Ireland and the UK. The principal gears used are otter trawls and beam trawls. The targeting of sole and plaice using beam trawls became prevalent during the mid-1970s, leading to an increase in the landings of these two species. The gradual replacement of otter trawls by beam trawls has occurred in the Belgian and UK fleets. In the Bay of Biscay there has been a substantial replacement of inshore trawling by gill-net fisheries targeting sole.

A trawl fishery for anglerfish by Spanish and French vessels developed in the Celtic Sea and Bay of Biscay in the 1970s and expanded until 1990. 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 used 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. These differences make 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 January 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 harvested outside safe biological limits. They are characterised by low spawning stock biomass and recent high fishing mortality rates. Of particular concern are Celtic Sea (VIIf,g) and Western Channel (VIIe) sole and plaice. These stocks exhibit high F, low SSB 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 this 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 harvested outside safe biological limits. Fishing mortality is above the proposed F_{pa}. SSB has fluctuated and at present is estimated to be above the proposed B_{pa}. Recent year classes 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 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} corresponding to landings of less than 7 600 t in 2000. This represents a reduction in F of at least 17%. This would give a high probability of maintaining SSB above B_{pa} in the short and medium term (10 years).

Reference points: A revision of the maturity ogive resulted in revisions of the biomass reference points. In light of this F reference points may need to be redefined in the future.

ICES considers that:	ICES proposes that:
B_{lim} is 5 400 t, the lowest observed spawning stock biomass.	B_{pa} be set at 10 000 t. 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 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} : historical development of the stock
F_{lim} : based on historical response of the stock	F_{pa} : implies a less than 10% probability (SSB_{MT}<B_{pa})

Relevant factors to be considered in management: The assessment area was expanded in 1997 to cover Divisions VIIe-k. The TAC for cod which is for all of Sub-area VII (excluding Division VIIa) includes this assessment and that for Division VIId.

Catch forecast for 2000:

Basis: F(99) = F(96–98) = 0.82; Landings(99) = 10.5; SSB(2000) = 11.5.

F(2000) onwards	Basis	Catch(2000)	Landings (2000)	SSB (2001)	Medium-term (10 years) Probability(%) of SSB < B_{pa}
0.49	$0.6F_{96\text{-}98}$		6.0	13.3	<5
0.65	$0.8F_{96\text{-}98}$		7.4	11.3	<5
0.68	F_{pa}		7.6	11.1	5-10
0.82	$1.0F_{96\text{-}98}$		8.7	9.8	>20
0.98	$1.2F_{96\text{-}98}$		9.7	8.4	>95

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. UK (England and Wales) accounts 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. However, some recapture information suggests that a component of cod landings from the Celtic Sea are fish which spawn in the Irish Sea.

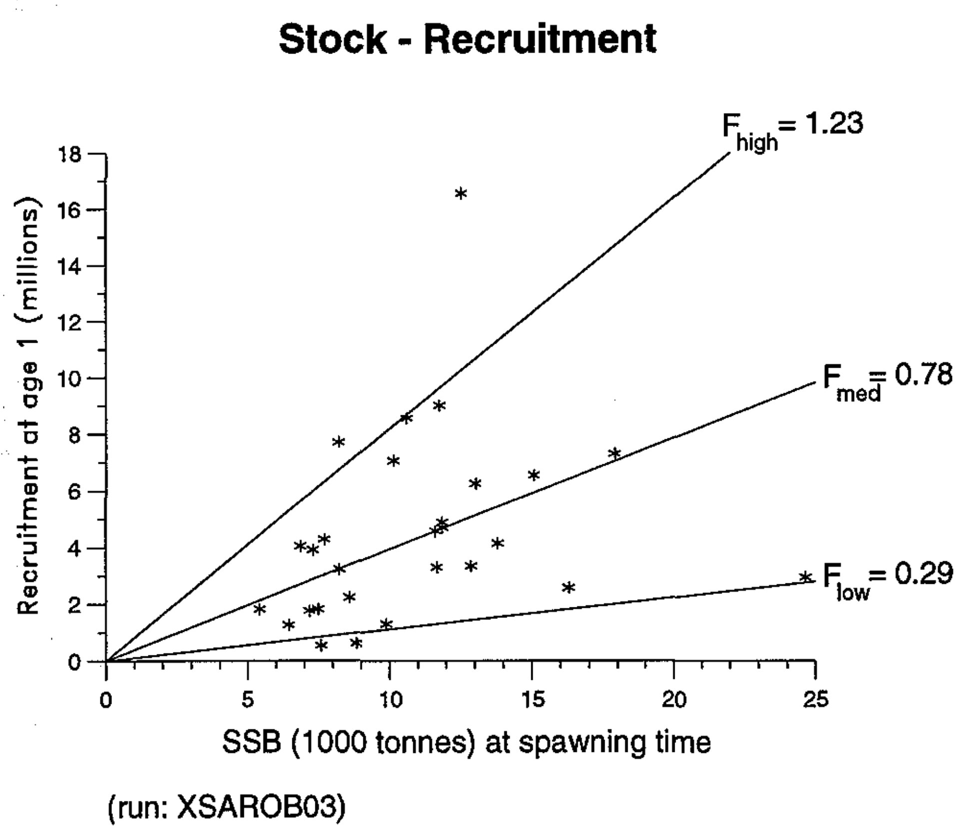
Analytical assessment was based on landings and commercial cpue data for three commercial fleets and a survey. Landing data prior to 1988 are not available for Divisions VIIe,i,j and k and have been estimated assuming the same relative area distribution of landings as observed in the period 1988-98.

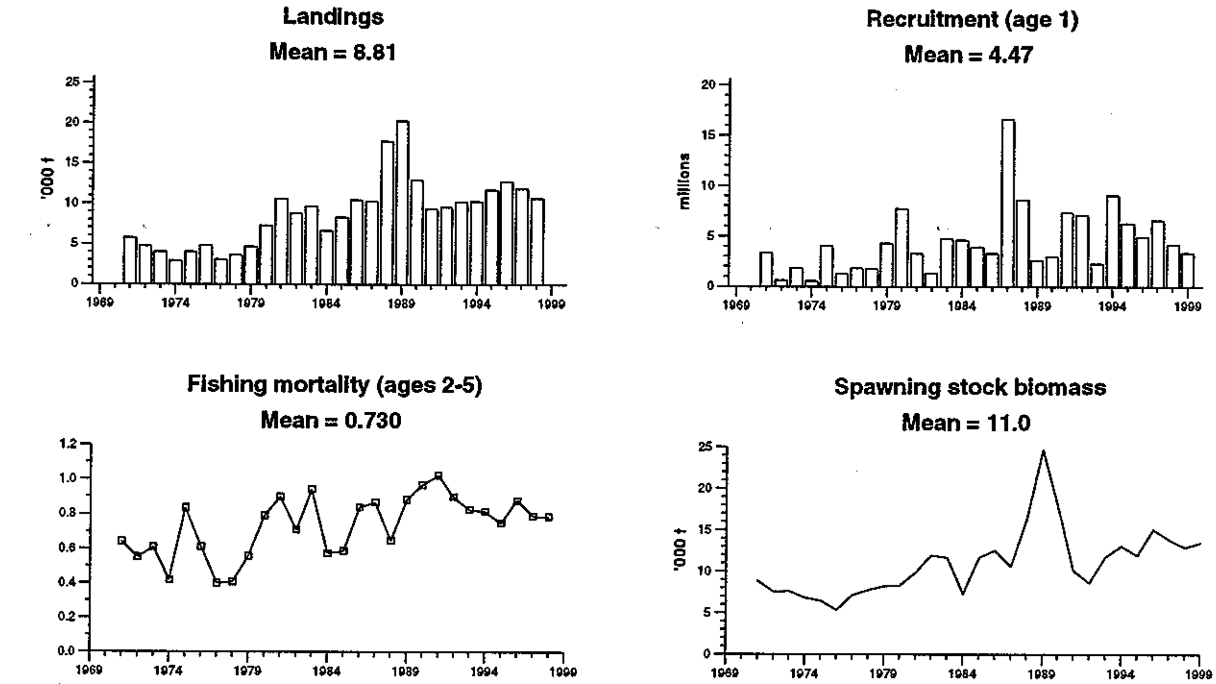
Source of information: Report of the Working Group on the Assessment of Southern Shelf Demersal Stocks, September 1999 (ICES CM 2000/ACFM:4).

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]	19.0	10.2
1994	20% reduction in F	5.6[2]	17.0	10.3
1995	20% reduction in F	4.7[3]	17.0	11.7
1996	20% reduction in F	4.7[3]	20.0	12.8
1997	20% reduction in F	7.4[4]	20.0	11.8
1998	10% reduction in F	8.8[4]	20.0	10.6
1999	Reduce F below $\mathbf{F_{pa}}$	9.2[4]	19.0	
2000	Reduce F below $\mathbf{F_{pa}}$	< 7.6[5]		

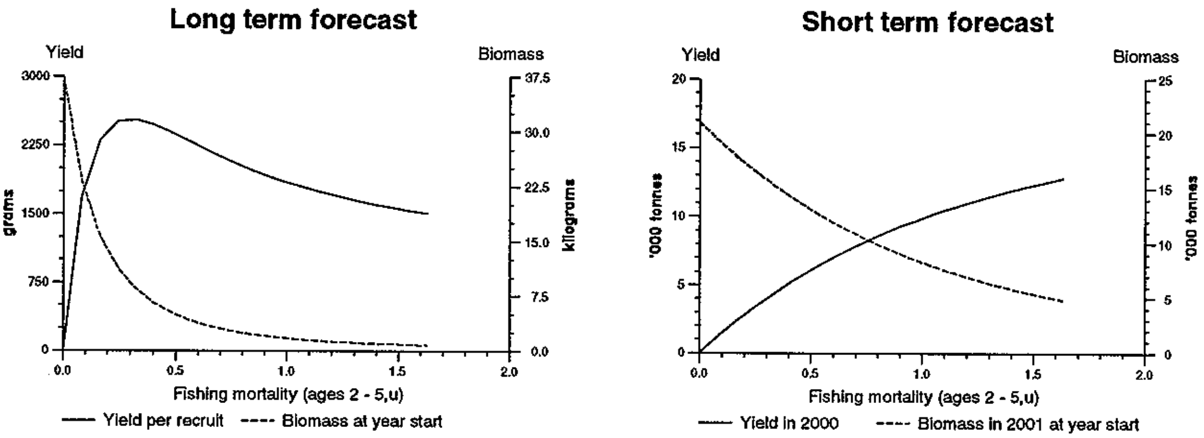
[1]TAC covers Sub-areas VII (except Division VIIa) and VIII. [2]For the VIIf+g stock component. [3]For the VIIf-h stock component. [4]For the VIIe-h stock component. 5 for VIIe-k stock component.Weights in '000 t.





Cod in Divisions VIIe-k

Yield and Spawning Stock Biomass



Precautionary Approach Plot

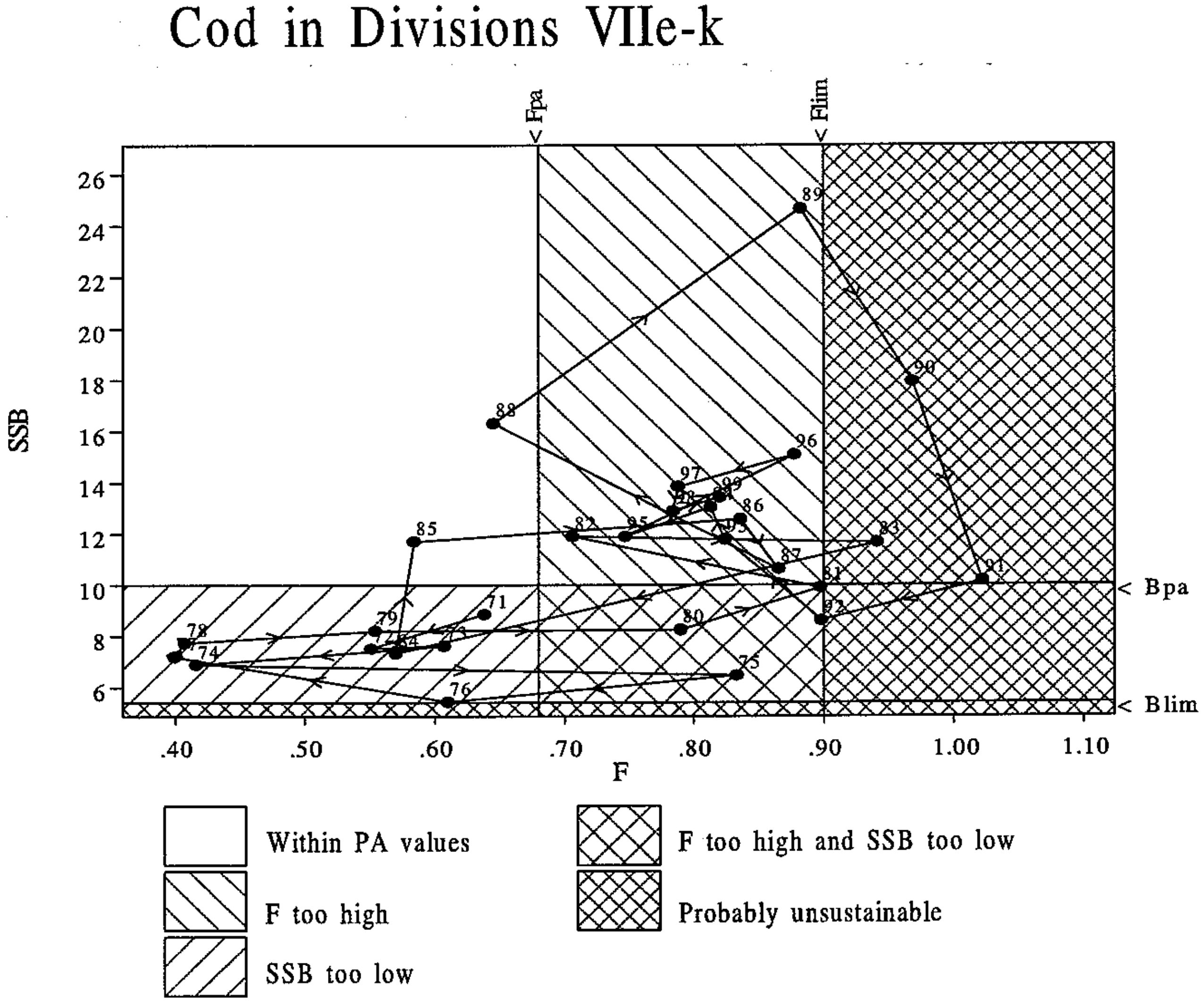


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Table 3.9.2.1 Nominal landings of COD in Divisions VIIf–h, VIIe, VIIe–h, VIIj–k, VIIe–k as used by the Working Group in 1999.

Divisions VIIf,g,h

Year	Belgium	France	Ireland	UK (E + W)	Others	Total
1971						4647
1972						3807
1973	524	2413	64	196	30	3227
1974	197	1954	24	154		2329
1975	377	2657	15	130	30	3209
1976	226	3535	13	97	1	3872
1977	107	2272	17	62		2458
1978	88	2744	30	69		2931
1979	110	3469	72	86		3737
1980	172	5187	246	209	7	5821
1981	285	7806	108	317		8516
1982	174	6391	142	338		7045
1983	262	7013	274	199		7748
1984	240	4569	204	316		5329
1985	456	5632	198	398		6684
1986	374	7473	226	345		8418
1987	216	7187	380	437		8220
1988	542	12065	612	400		13619
1989	891	14298	1003	482		16674
1990	615	8612	177	689		10093
1991	297	5750	246	590		6883
1992	193	6417	340	655		7605
1993	386	7650	331	604		8971
1994	397	6947	966	480		8790
1995	388	7571	820	539		9317
1996	550	8324	949	597		10420
1997	687	7665	397	556		9305
1998*	509	6325	659	453		7956

Division VIIe

Year	Belgium	France	Ireland	UK	Others	Total
1988	12	1899		839		2750
1989	19	1453		727	2	2201
1990	6	654		610	9	1279
1991	6	341		408		755
1992	2	331		365		698
1993	5	307		274	2	587
1994	1	308		309	2	620
1995	12	554		348		914
1996	2	497		415		914
1997	1	627		441		1069
1998*	5	955		422		1382

Continued ...

Table 3.9.2.1 Continued

Divisions VIIe,f,g,h

Year	Belgium	France	Ireland	UK	Others	Total
1988	554	13964	612	1239	0	16369
1989	910	15751	1003	1209	2	18875
1990	621	9266	177	1299	9	11372
1991	303	6091	246	998	0	7638
1992	195	6748	340	1020	0	8303
1993	391	7957	331	878	2	9558
1994	398	7255	966	789	2	9410
1995	399	8124	820	888	0	10231
1996	552	8821	949	1012	0	11334
1997	688	8292	397	997	0	10374
1998*	524	7280	659	875	0	9338

Divisions VIIj,k

Year	Belgium	France	Ireland	UK	Others	Total
1988		407	868	53	2	1330
1989		508	857	14	13	1392
1990		276	1064	47	149	1536
1991		115	1413	96	20	1644
1992		202	872	187	13	1274
1993		143	435	67	4	649
1994		117	650	117	6	890
1995		193	1126	147	8	1474
1996		233	1033	154	0	1420
1997	6	153	1116	169	0	1444
1998*	4	102	1059	118	0	1283

Divisions VIIe,f,g,h,j,k

Year	Belgium	France	Ireland	UK	Others	Total
1971						5782
1972						4737
1973						4015
1974						2898
1975						3993
1976						4818
1977						3058
1978						3647
1979						4650
1980						7243
1981						10596
1982						8766
1983						9641
1984						6631
1985						8317
1986						10475
1987						10228
1988	554	14371	1480	1292	2	17699
1989	910	16259	1860	1223	15	20267
1990	621	9542	1241	1346	158	12908
1991	303	6206	1659	1094	20	9282
1992	195	6950	1212	1207	13	9577
1993	391	8100	766	945	6	10207
1994	398	7372	1616	906	8	10300
1995	399	8317	1946	1035	8	11705
1996	552	9055	1982	1166	0	12754
1997	693	8445	1513	1166	0	11818
1998*	528	7382	1718	993	0	10621

*Provisional.

Table 3.9.2.2 COD in Divisions VIIe-k.

Year	Recruitment Age 1	Spawning Stock Biomass	Landings	Fishing Mortality Age 2-5
1971	3.34	8.85	5.78	0.638
1972	0.63	7.51	4.74	0.551
1973	1.82	7.61	4.02	0.607
1974	0.54	6.88	2.90	0.416
1975	4.05	6.46	3.99	0.833
1976	1.27	5.42	4.82	0.610
1977	1.82	7.19	3.06	0.399
1978	1.77	7.73	3.65	0.407
1979	4.28	8.21	4.65	0.554
1980	7.72	8.25	7.24	0.790
1981	3.24	9.90	10.60	0.897
1982	1.31	11.89	8.77	0.706
1983	4.70	11.65	9.64	0.941
1984	4.58	7.32	6.63	0.570
1985	3.92	11.70	8.32	0.584
1986	3.30	12.56	10.48	0.836
1987	16.57	10.62	10.23	0.865
1988	8.58	16.31	17.70	0.645
1989	2.57	24.66	20.27	0.882
1990	2.94	17.92	12.91	0.968
1991	7.31	10.16	9.28	1.022
1992	7.06	8.61	9.58	0.898
1993	2.23	11.78	10.21	0.824
1994	9.02	13.03	10.30	0.813
1995	6.25	11.89	11.71	0.747
1996	4.90	15.08	12.75	0.877
1997	6.55	13.83	11.82	0.788
1998	4.14	12.89	10.62	0.784
1999	3.35	13.42	.	.
Average	4.47	11.01	8.81	0.730
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 reached a record high in 1995 and has decreased since then, but is currently above the proposed B_{pa}. Fishing mortality on this stock has displayed a declining trend since the beginning of the assessment period.

Management objectives: There are no explicit management objectives for this stock. However, for any management objectives to meet precautionary criteria, their aim should be to maintain spawning stock biomass above $\mathbf{B}_{pa}$.

Advice on management: Whiting is taken together with cod in mixed fisheries, and based upon the advice on cod, ICES recommends a 17% reduction in fishing mortality, corresponding to landings in 2000 of less than 13 100 t. This would keep SSB above the proposed B_{pa} with a high probability in the short term.

Relevant factors to be considered in management: The assessment area was expanded in 1997 to cover Divisions VIIe-k. The TAC for whiting which is for all of Sub-area VII (excluding Divisions VIIa) includes this assessment and that for Division VIId.

Catch forecast for 2000:
Basis: F(99) = F(96–98) =0.48, Landings(99) =15.2 , SSB(2000) =45.8 .

F(2000) onwards)	Basis	Catch (2000)	Landings (2000)	SSB (2001)	Medium-term situation (10 years) Probability (%) SSB < $\mathbf{B}_{pa}$
0.29	0.6 $F_{96\text{-}98}$		9.9	50.6	<5
0.40	0.83 $F_{96\text{-}98}$		13.1	47.2	<5
0.48	1.0 $F_{96\text{-}98}$		15.1	45.1	<5
0.57	1.2 $F_{96\text{-}98}$		17.3	42.7	<5
0.67	1.4 $F_{96\text{-}98}$		19.3	40.6	<5

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 62% of the total landings, Ireland (27%) 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. However, in recent years there has been an increase in the number of Irish beamers (+6 vessels) targeting anglerfish and megrim (whiting by catch) offshore in Division VIIg. Division VIIj–k whiting are taken in a mixed species fisheries (cod/whiting/anglerfish/megrim and *Nephrops*). The main gears used are otter trawl and seiners and landings are taken by Ireland (90%) and France (7%).

The main Irish fleet in VIIjk are otter trawlers targeting mixed gadoids and which take about 10% of Divisions VIIe-k landings. 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.

Analytical assessment based on landings, commercial CPUE and Surveys data. No data are available on discarding of whiting, which is thought to be considerable.

Reference points as set in 1998:

ICES considers that:	ICES proposes that:
$\mathbf{B_{lim}}$ is 15 000t, the lowest observed spawning stock biomass	$\mathbf{B_{pa}}$ be set at 21 000t. Biomass above this affords a high probability of maintaining SSB above $\mathbf{B_{lim}}$, taking into account the uncertainty of the assessment.
$\mathbf{F_{lim}}$ is not defined	$\mathbf{F_{pa}}$ not proposed.

Technical basis:

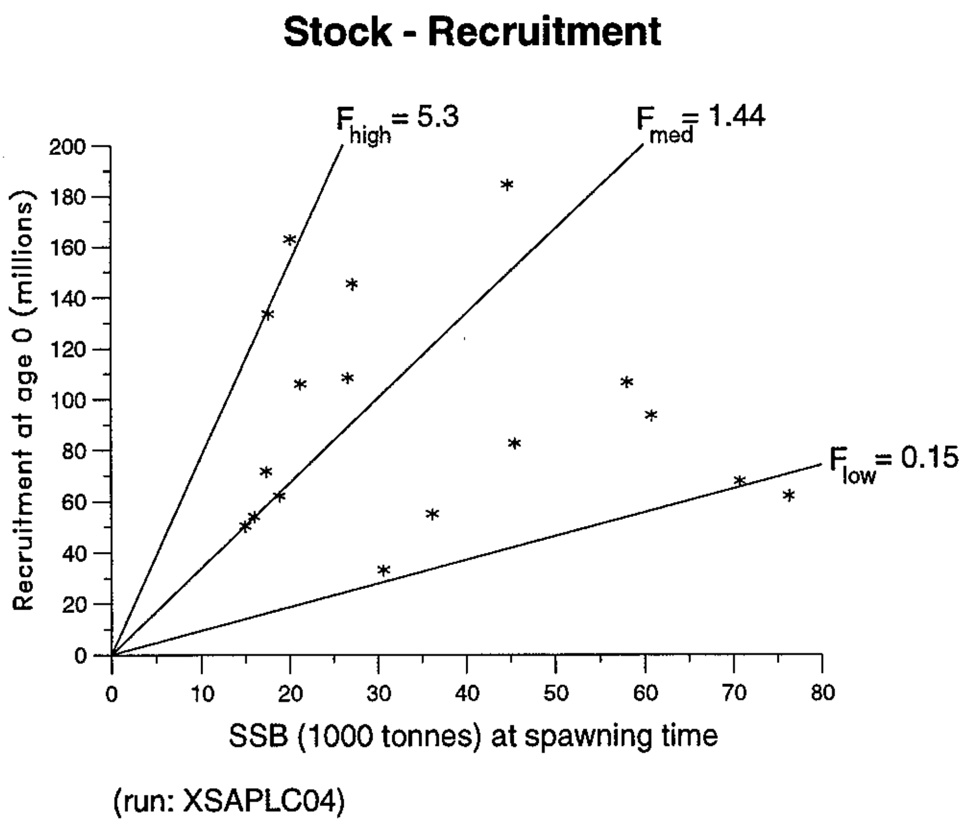
$\mathbf{B_{lim}} : \mathbf{B_{loss}}$	$\mathbf{B_{pa}} = \mathbf{B_{lim}}$ x 1.4
$\mathbf{F_{lim}}$ is not defined	$\mathbf{F_{pa}}$ not proposed

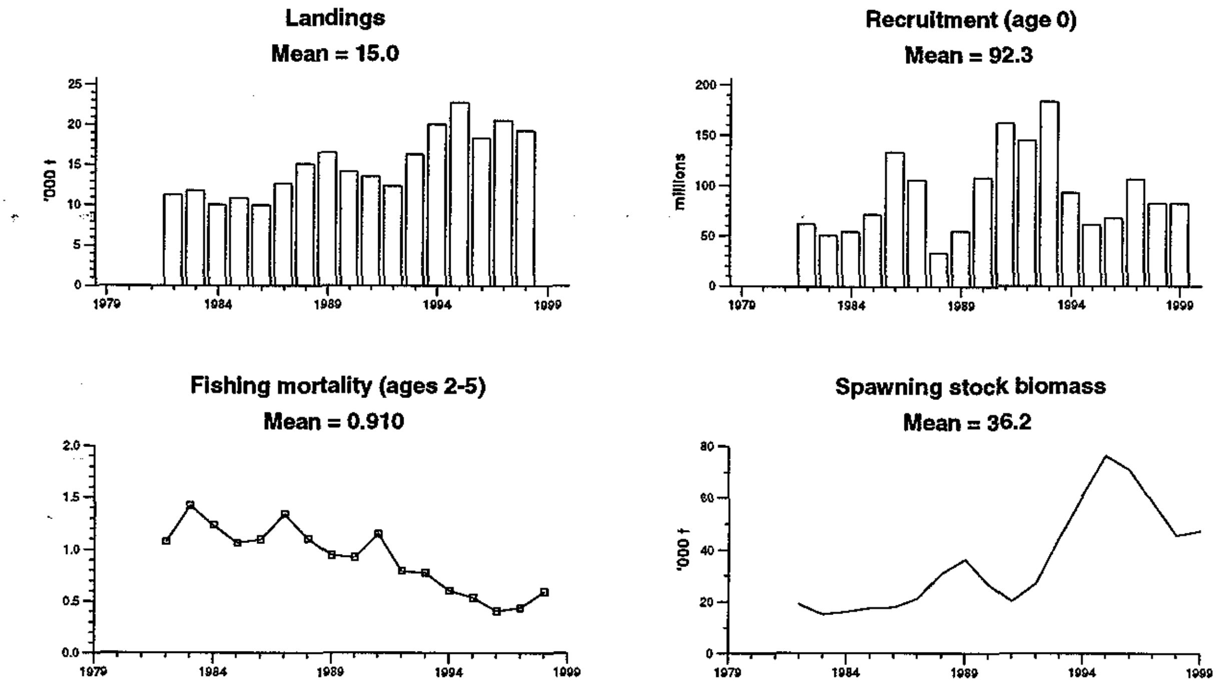
Source of information: Report of the Working Group on the Assessment of Southern Shelf Demersal Stocks, September 1999 (ICES CM 2000/ACFM:4).

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]		12.7
1988	Precautionary TAC	7.0[2]		13.6
1989	Precautionary TAC	7.9[2]		16.5
1990	No increase in F; TAC	8.4[2]		14.1
1991	Precautionary TAC	8.0[2]		13.5
1992	If required, precautionary TAC	8.0[2]		12.4
1993	Within safe biological limits	6.6[2]	22.0	16.3
1994	Within safe biological limits	< 9.4[2]	22.0	20.0
1995	20% reduction in F	8.2[3]	25.0	22.7
1996	20% reduction in F	8.6[3]	26.0	18.3
1997	At least 20% reduction in F	< 7.3[4]	27.0	20.5
1998	At least 20% reduction in F	< 8.2[4]	27.0	19.3
1999	No increase in F	12.4[4]	25.0	
2000	17% reduction in F	< 13.1[4]		

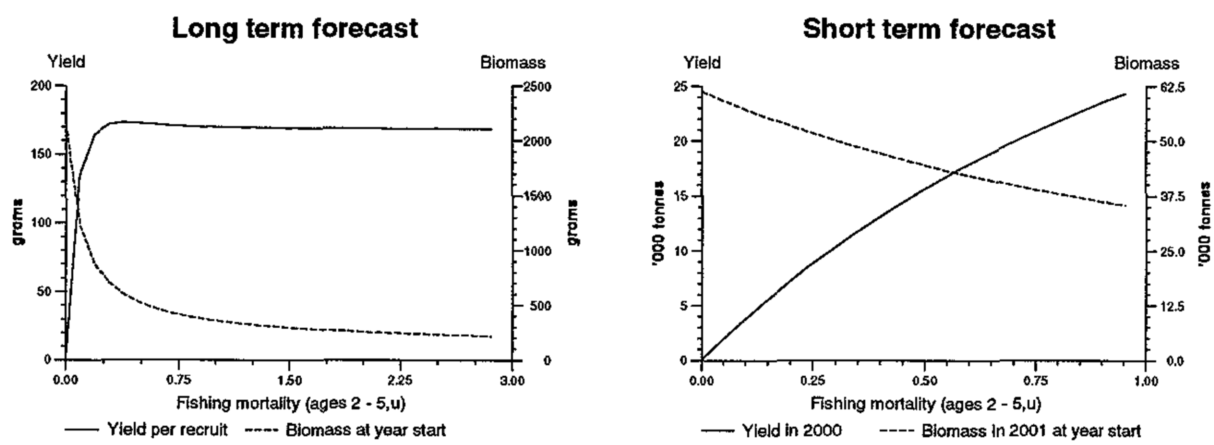
[1]TAC covers Sub-area VII (except Division VIIa). [2]For the VIIf+g stock component, [3]For the VIIf-h stock component, [4]For the VII e-k stock component. Weights in '000 t.





Whiting in Divisions VIIe–k

Yield and Spawning Stock Biomass



Precautionary Approach Plot

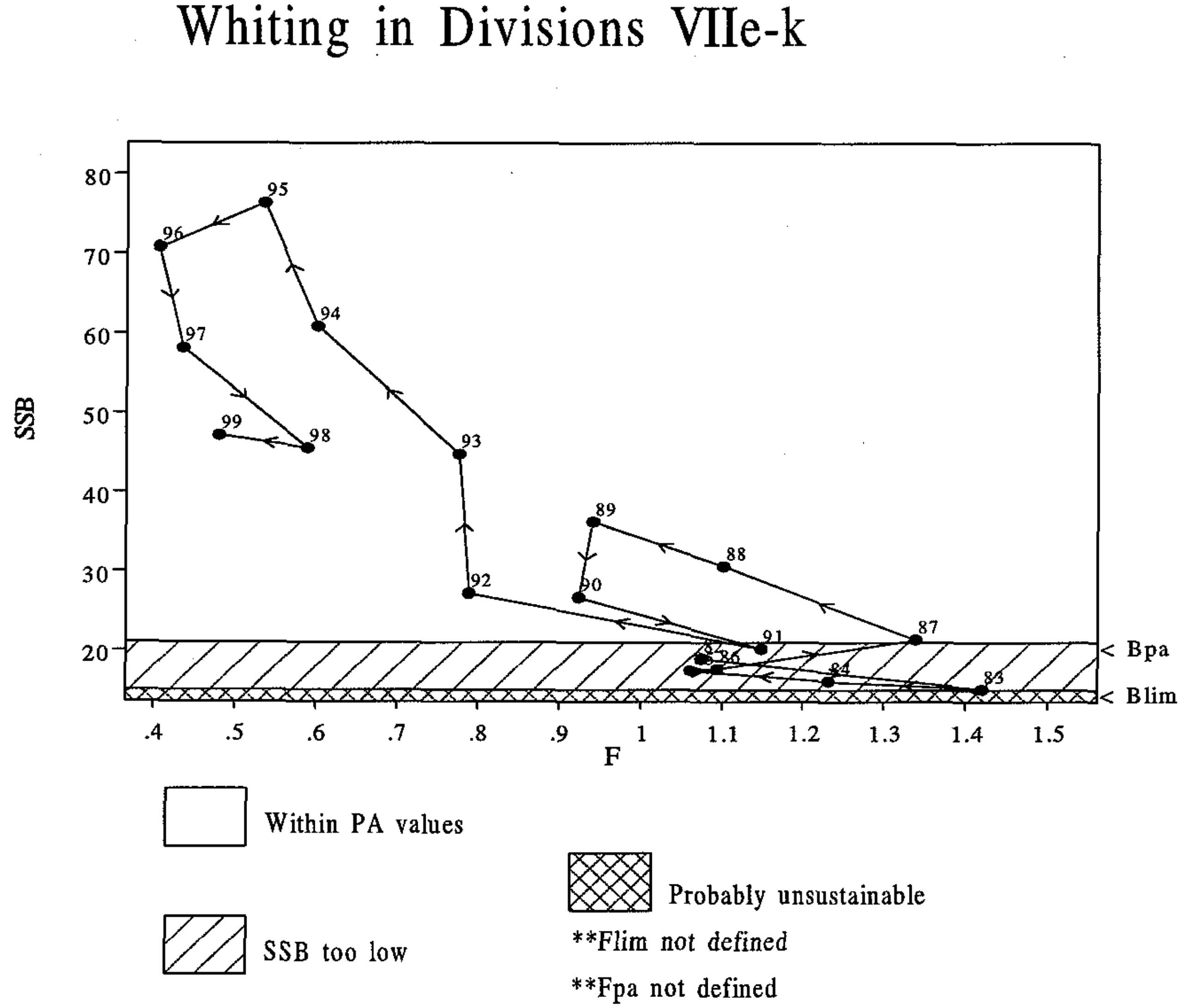


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Table 3.9.3.1 WHITING in Divisions VIIe-k. Nominal Landings (tonnes) used by the Working Group.

	1983[2]	1984[2]	1985[2]	1986[2]	1987[2]	1988	1989	1990
Denmark								
France	8,982	7,171	7,820	7,647	10,054	11,410	12,171	10,464
Germany								
Ireland	1,487	1,301	2,241	1,309	1,452	398	2,817	1,478
Belgium	135	161	167	107	111	159	296	308
Netherlands	0	398	0	124	0	0	0	0
UK (E&W)	1,177	954	610	765	1,035	1,598	1,252	1,782
UK(Scotland)						1	5	74
Total	11,781	9,985	10,838	9,952	12,652	13,566	16,541	14,106

	1991	1992	1993	1994	1995	1996[1]	1997[1,2]	1998[1]
Denmark			0	0	0	0	0	0
France	9,956	9,165	10,771	12,634	13,095	9,992	11,707	11,964
Germany		14	0	0	0	0	0	0
Ireland	1,258	1,691	3,631	5,618	7,609	6,392	6,695	5,189
Belgium	292	107	145	228	204	267	447	449
Netherlands	0	0	0	0	0	0	0	0
UK (E&W)	1,969	1,379	1,756	1,548	1,748	1,609	1,683	1,643
UK(Scotland)	33	8	17	6	22	0	0	0
Total	13,508	12,364	16,320	20,034	22,678	18,260	20,532	19,245

[1]Preliminary
[2]Revised. Data from 1982 to 1987 revised. Data for 1997 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-k.

Year	Recruitment Age 0	Spawning Stock Biomass	Landings	Fishing Mortality Age 2-5
1982	62.03	18.94	11.23	1.074
1983	50.18	15.05	11.78	1.420
1984	54.02	16.06	9.99	1.232
1985	71.67	17.44	10.84	1.062
1986	133.37	17.67	9.95	1.094
1987	105.93	21.33	12.65	1.339
1988	33.09	30.66	15.13	1.102
1989	55.01	36.21	16.54	0.941
1990	108.40	26.68	14.11	0.924
1991	162.91	20.17	13.51	1.148
1992	145.35	27.19	12.36	0.789
1993	184.44	44.76	16.32	0.776
1994	93.69	60.84	20.03	0.601
1995	62.21	76.33	22.68	0.535
1996	67.92	70.81	18.26	0.406
1997	106.61	58.11	20.53	0.435
1998	82.72	45.49	19.25	0.589
1999	82.72	47.13	.	.
Average	92.35	36.16	15.01	0.910
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 has declined sharply since the peak value in the late 1980s and remained below $\mathbf{B}_{pa}$ since 1993. Fishing mortality is estimated to be above the proposed $\mathbf{F}_{pa}$. 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.

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 a reduction in F of 30%, corresponding to landings of 700 t in 2000. This will result in F in 2000 below $\mathbf{F}_{pa}$ and increase in SSB in the medium term (10 years). It is consistent with the reduction in F recommended for sole which is the target species for the flatfish fishery in this area.

Relevant factors to be considered in management: F would have to be reduced by at least 50% to enable SSB to reach the proposed $\mathbf{B}_{pa}$ in the short term.

Catch forecast for 2000:
Basis: F(99) = Fsq(96–98) = 0.67, Landings (99) = 0.96; SSB(2000) = 1.47.

F(2000)	Basis	Catch (2000)	Landings (2000)	SSB(2001)	Medium-term situation (10 years) Probability (%) of SSB < $\mathbf{B}_{pa}$
0.34	0.5 $F_{96\text{-}98}$		0.53	1.80	<5
0.40	0.6 $F_{96\text{-}98}$		0.62	1.72	<5
0.47	0.7 $F_{96\text{-}98}$		0.70	1.64	<5
0.54	0.8 $F_{96\text{-}98}$		0.78	1.57	~5
0.60	$\mathbf{F}_{pa}$ ~ 0.9 $F_{96\text{-}98}$		0.85	1.51	~15
0.67	1.0 $F_{96\text{-}98}$		0.92	1.44	~35

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 taken throughout the year, the larger landings occur during March after the peak of spawning, and again in September.

There is some evidence from tagging that plaice from the South and West Wales coasts move southwards to join the adult population off the north Cornish coast during spawning.

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

Reference points as set in 1998:

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 10 years taking into account the uncertainty assessments.

Technical basis:

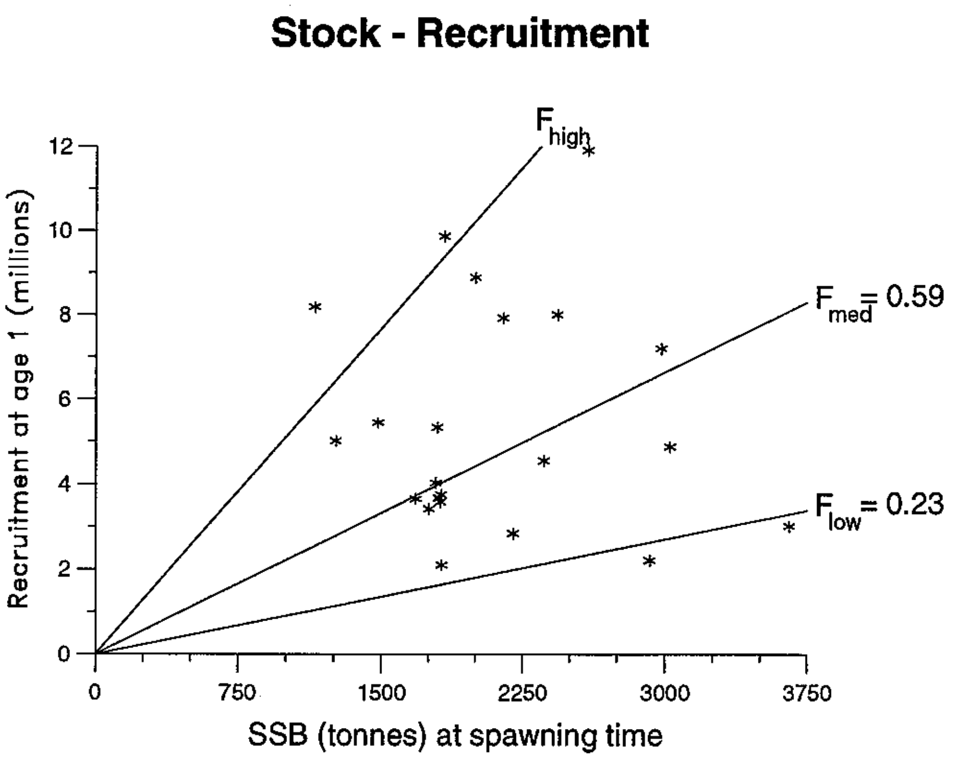
$\mathbf{B}_{lim}$:$\mathbf{B}_{loss}$	$\mathbf{B}_{pa}$: $\mathbf{B}_{lim}$ x 1.64
$\mathbf{F}_{lim}$:Not defined	$\mathbf{F}_{pa}$: ~ $\mathbf{F}_{med}$; implies a less than 5% probability that (SSB_{MT}< $\mathbf{B}_{pa}$)

Source of information: Report of the Working Group on the Assessment of Southern Shelf Demersal Stocks, September 1999 (ICES CM 2000/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	1.0
1997	20% reduction in F	1.10	1.1	1.2	1.2
1998	20% reduction in F	1.00	1.1	1.1	1.1
1999	35% reduction in F	0.67	0.9		
2000	30% reduction in F	0.70			

Weights in '000 t.



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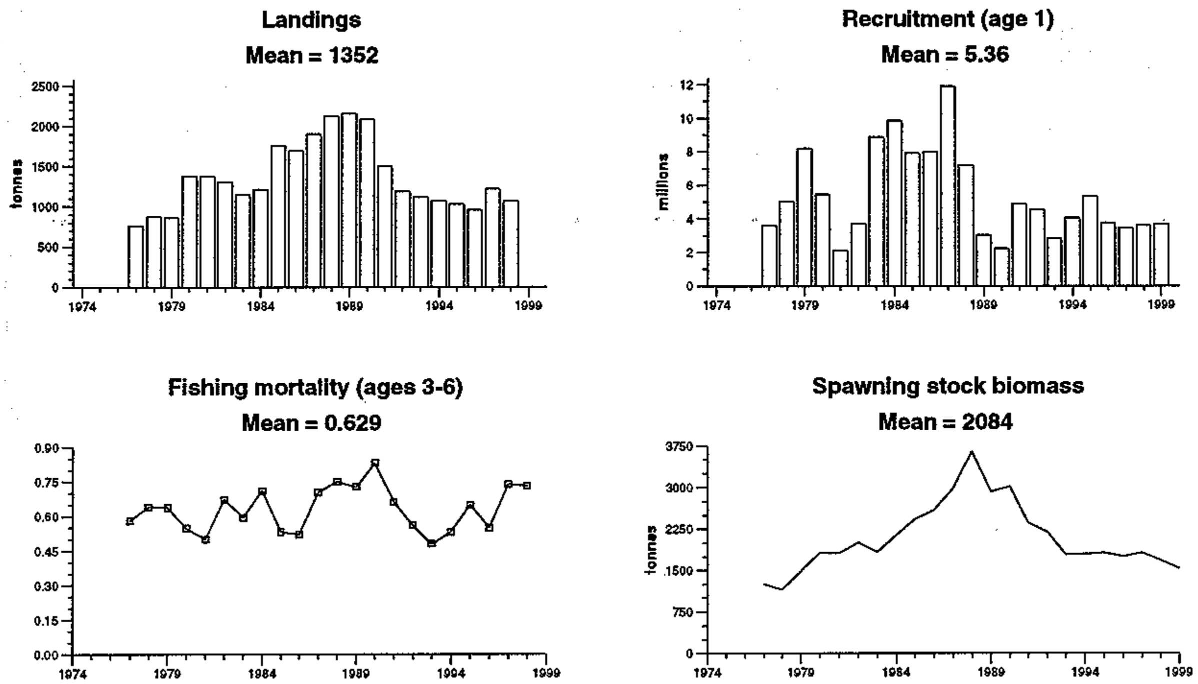
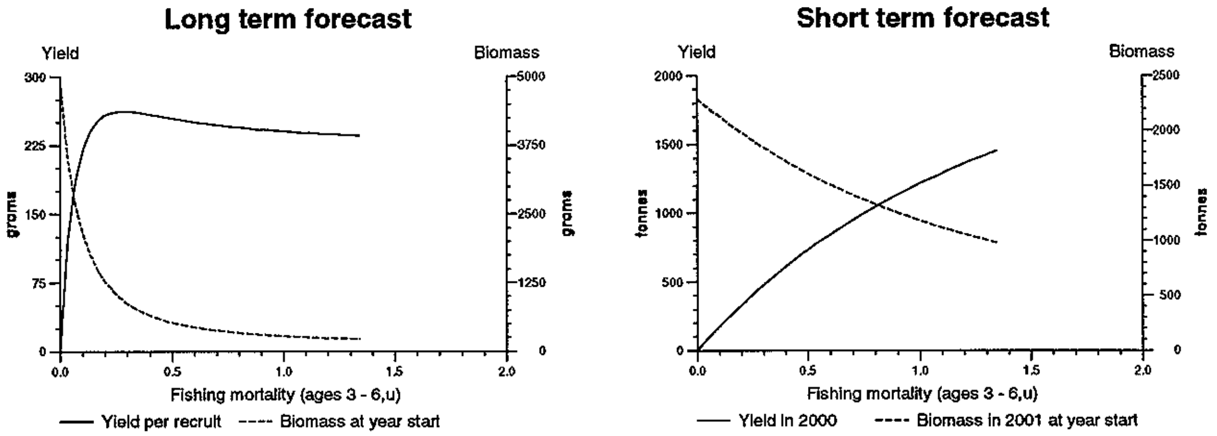


Celtic Sea plaice (Divisions VIIf and g)

Yield and Spawning Stock Biomass



Precautionary Approach Plot

Celtic Sea plaice (Divisions VIIf and g)

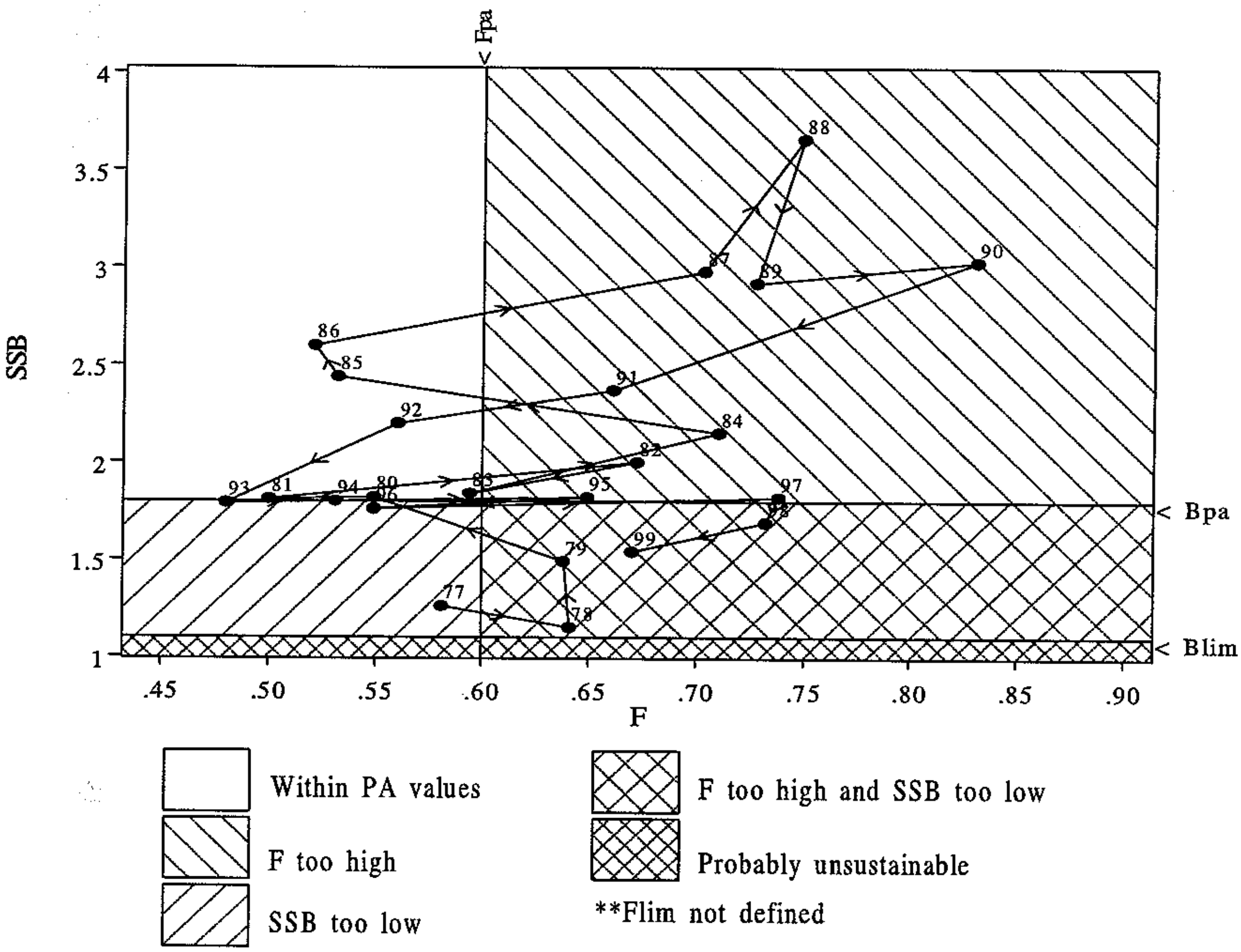


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Table 3.9.4.1 Celtic Sea PLAICE. Nominal landings (tonnes) in Divisions VIIf+g, as used by Working Group.

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	321	143	259	0	1,217	0	1,217
1998	458	298	135	176	0	1,067	0	1,067

N.B.: ICES receives statistics from some countries only for Divisions VIIg-k combined and not for each Division separately. The figures up to 1982 and 1987 onwards are provided by members of the Working Group; from 1983–1986, they are figures submitted to the EC by member states.

Table 3.9.4.2 Celtic Sea PLAICE (Divisions VIIf and g).

Year	Recruitment Age 1	Spawning Stock Biomass	Landings	Fishing Mortality Age 3-6
1977	3.61	1.26	0.76	0.581
1978	5.04	1.15	0.88	0.641
1979	8.20	1.49	0.86	0.638
1980	5.46	1.82	1.37	0.549
1981	2.11	1.81	1.38	0.500
1982	3.69	2.00	1.30	0.672
1983	8.89	1.84	1.15	0.594
1984	9.87	2.15	1.21	0.710
1985	7.93	2.44	1.75	0.532
1986	8.01	2.60	1.69	0.521
1987	11.92	2.98	1.90	0.703
1988	7.22	3.66	2.12	0.749
1989	3.02	2.92	2.15	0.727
1990	2.21	3.03	2.08	0.831
1991	4.90	2.37	1.50	0.661
1992	4.56	2.20	1.19	0.560
1993	2.85	1.79	1.11	0.480
1994	4.04	1.80	1.07	0.531
1995	5.35	1.82	1.03	0.649
1996	3.76	1.76	0.95	0.549
1997	3.43	1.82	1.22	0.738
1998	3.59	1.69	1.07	0.732
1999	3.66	1.54	.	.
Average	5.36	2.08	1.35	0.629
Unit	Millions	1000 tonnes	1000 tonnes	-

3.9.5 Sole in Divisions VIIf and g (Celtic Sea)

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 F_{pa}. SSB has declined steadily since the early 1970s, reaching a record low in 1998. Recent recruitment has been around the long-term average with occasionally large year classes. There is evidence of strong incoming 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 F_{pa} and to increase or maintain spawning stock biomass above B_{pa}.

Advice on management: ICES recommends that the fishing mortality should be reduced below the proposed F_{pa}, corresponding to landings of less than 1 160 t in 2000. This corresponds to a reduction of nearly 30% from *status quo* F, and will promote an increase in SSB above B_{pa} in the short term.

Relevant factors to be considered in management: Available data indicate large incoming year classes and SSB is expected to increase in the short term. The 1997 year class may be the strongest of the series, but its exact size is not known. This 1997 year class contributes 60% in the landings in the short term prediction.

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.

Catch forecast for 2000:

Basis: F(99) = F(96–98) = 0.52; Landings(99) = 0.98; SSB(00) = 2.39.

F(2000)	Basis	Catch (2000)	Landings (2000)	SSB (2001)	Medium-term situation (10 years) Probability (%) of SSB being below B_{pa}
0.21	0.4 $F_{96\text{-}98}$		0.70	3.63	<5
0.31	0.6 $F_{96\text{-}98}$		1.00	3.30	<5
0.37	F_{pa}~0.7 $F_{96\text{-}98}$		1.16	3.12	<5
0.41	0.8 $F_{96\text{-}98}$		1.27	3.00	<5
0.52	1.0 $F_{96\text{-}98}$		1.51	2.73	~50

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 65%, the UK 23%, France 8% and Ireland 4% of the total landings. The sole fishery is concentrated on the north Cornish coast off Trevose Head and around Lands End.

Sole are taken mainly in a beam-trawl fishery that 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.

The results of recent tagging experiments suggest 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.

Reference points as set in 1998:

ICES considers that:	ICES proposes that:
$\mathbf{B_{lim}}$ is not defined	$\mathbf{B_{pa}}$ be set at 2 200 t. There is no evidence of reduced recruitment at the lowest biomass observed and $\mathbf{B_{pa}}$ can therefore be set equal to the lowest observed SSB.
$\mathbf{F_{lim}}$ is 0.52, the fishing mortality estimated to lead to potential stock collapse.	$\mathbf{F_{pa}}$ be set at 0.37. This F is considered to have a high probability of avoiding $\mathbf{F_{lim}}$ and maintaining SSB above $\mathbf{B_{pa}}$ in 10 years taking into account the uncertainty assessments.

Technical basis:

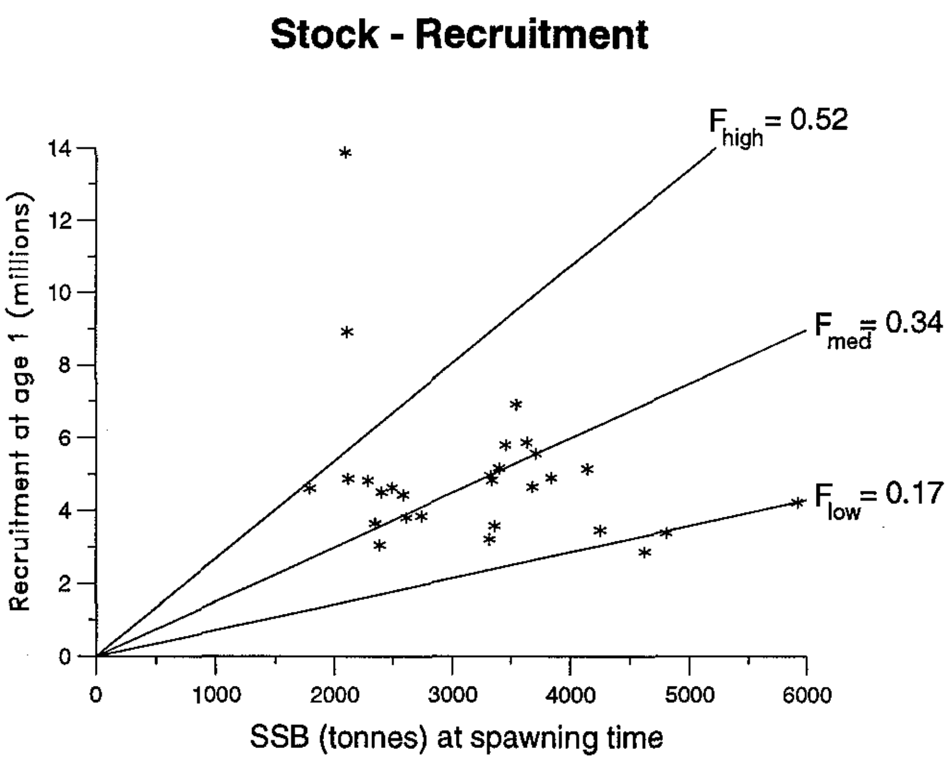
$\mathbf{B_{lim}}$:Not defined	$\mathbf{B_{pa}}$: $\mathbf{B_{loss}}$
$\mathbf{F_{lim}}$:$\mathbf{F_{loss}}$	$\mathbf{F_{pa}}$:$\mathbf{F_{lim}}$ x 0.72; implies a less than 5% probability that (SSB_{MT}< $\mathbf{B_{pa}}$)

Source of information: Report of the Working Group on the Assessment of Southern Shelf Demersal Stocks, September 1999 (ICES CM 2000/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	0.88
1999	Reduce F below $\mathbf{F}_{pa}$	0.81	0.96	
2000	Reduce F below $\mathbf{F}_{pa}$	<1.16		

Weights in '000 t.



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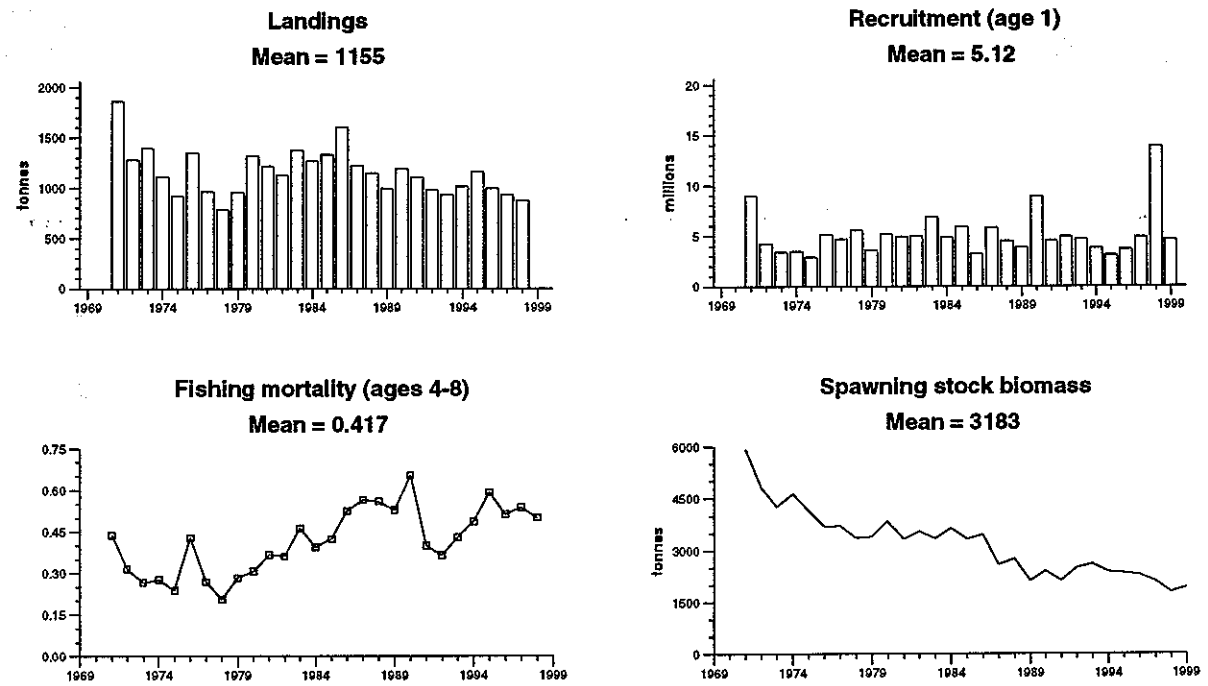
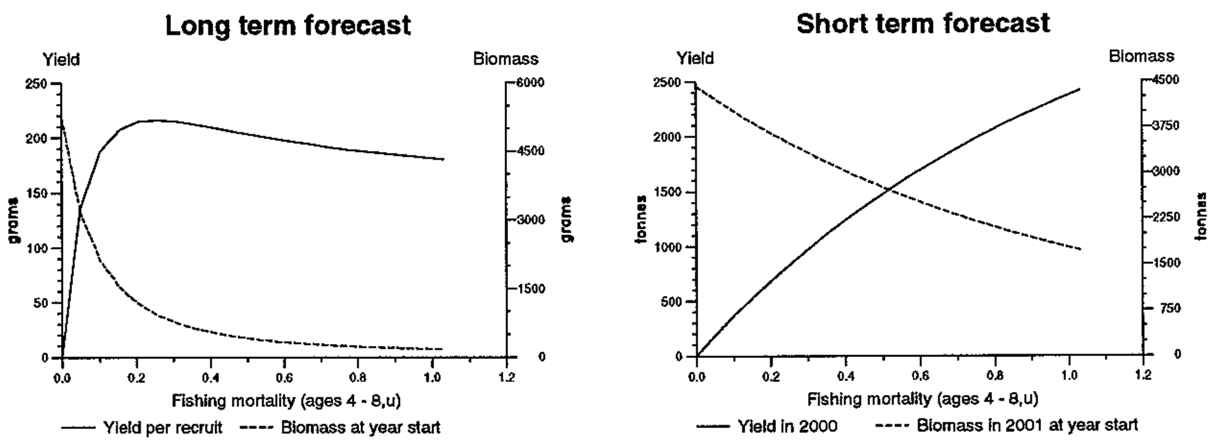


Celtic Sea sole (Divisions VIIf and g)

Yield and Spawning Stock Biomass



Precautionary Approach Plot

Celtic Sea sole (Divisions VIIf and g)

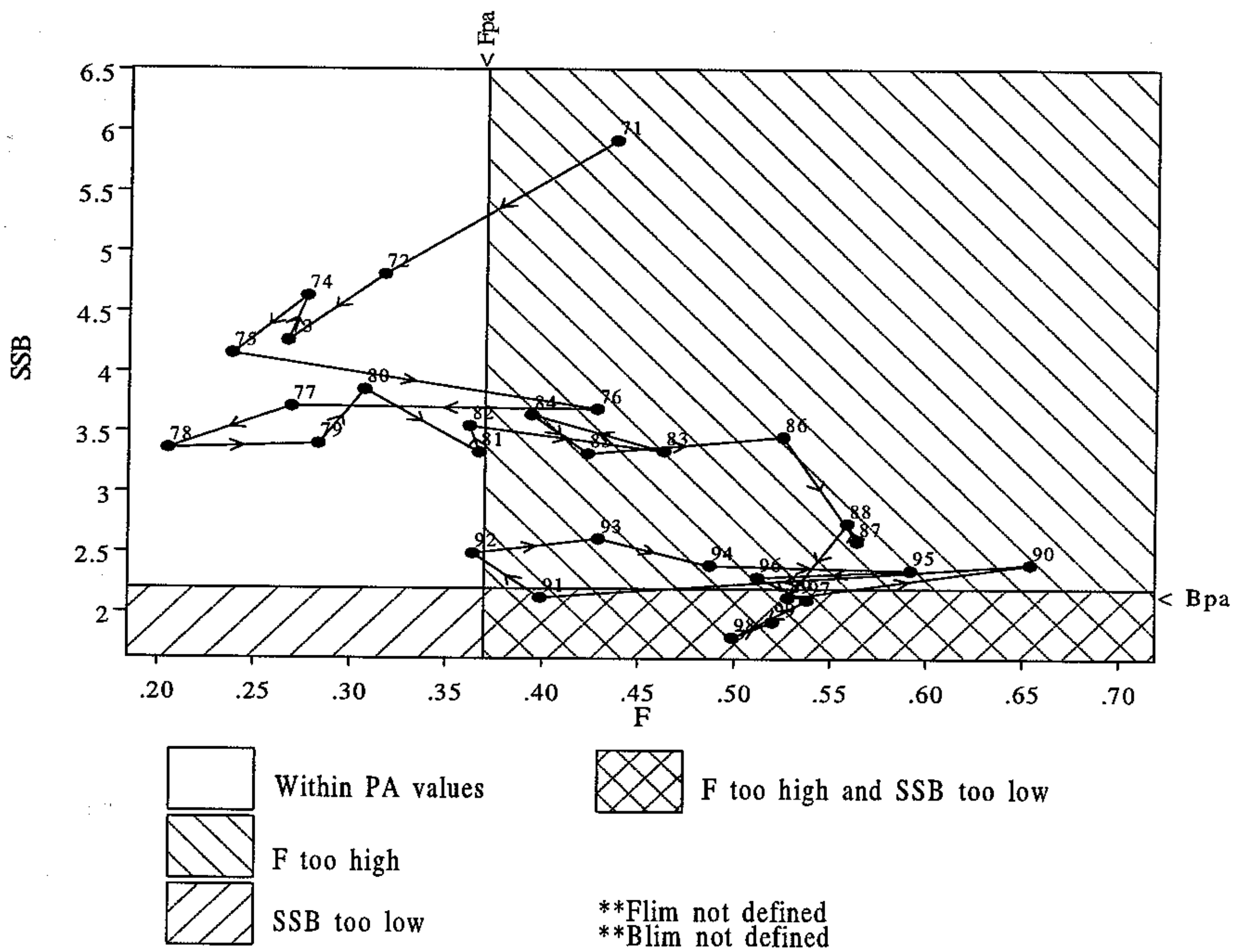


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Table 3.9.5.1 Celtic Sea SOLE. Divisions VIIf and VIIg. Nominal landings (tonnes), 1985–1998. Data used by the Working Group.

Country	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998[1]
Belgium	786	1,092	704	725	660	689	839	516	512	612	728	610	562	568
France	126	92	72	89	97	100	80	136	103	86	89	97	79	72
Ireland	13	12	9	15	32	41	N/A	4	28	47	45	23	36	37
UK(Engl.& Wales)	403	404	437	317	203	359	395	325	285	264	294	265	251	198
Others	-	-	-	-	-	-	10	-	-	-	-			
Total	1,328	1,600	1,222	1,146	992	1,189	1,324	981	928	1,009	1,157	995	928	875
Unallocated	-	-	-	-	-	-	-217	-	-	-	-	-	-1	-
Total used in assessment	1,328	1,600	1,222	1,146	992	1,189	1,107	981	928	1,009	1,157	995	927	875

[1]Preliminary

Table 3.9.5.2 Celtic Sea SOLE (Divisions CIIf and g).

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	4.81	1.28	0.317
1973	3.38	4.26	1.39	0.267
1974	3.47	4.63	1.11	0.277
1975	2.88	4.15	0.92	0.238
1976	5.14	3.69	1.35	0.428
1977	4.66	3.71	0.96	0.269
1978	5.57	3.36	0.78	0.205
1979	3.58	3.40	0.95	0.283
1980	5.17	3.85	1.31	0.307
1981	4.89	3.33	1.21	0.367
1982	4.96	3.55	1.13	0.362
1983	6.92	3.34	1.37	0.463
1984	4.83	3.64	1.27	0.394
1985	5.87	3.32	1.33	0.423
1986	3.21	3.46	1.60	0.525
1987	5.79	2.59	1.22	0.564
1988	4.44	2.74	1.15	0.559
1989	3.85	2.12	0.99	0.528
1990	8.92	2.40	1.19	0.654
1991	4.51	2.12	1.11	0.399
1992	4.88	2.49	0.98	0.364
1993	4.63	2.61	0.93	0.429
1994	3.81	2.39	1.01	0.487
1995	3.06	2.35	1.16	0.592
1996	3.65	2.29	1.00	0.512
1997	4.83	2.10	0.93	0.538
1998	13.88	1.79	0.88	0.499
1999	4.62	1.92	.	.
Average	5.12	3.18	1.16	0.417
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 1988–1990, following a series of good year classes in the mid 1980s, but has declined rapidly to well below $\mathbf{B_{pa}}$. Fishing mortality has been increasing throughout the assessment period, and is currently above $\mathbf{F_{pa}}$ and close to record high levels. 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 2000 should be reduced below $\mathbf{F_{pa}}$, corresponding to catches of less than 1 080 t in 2000. A more substantial reduction in F (40% corresponding to catches less than 970 t) would be required to promote SSB above $\mathbf{B_{pa}}$ in the short term.

Relevant factors to be considered in management: The TAC for plaice in the Channel is set for Divisions VIId,e combined, so the results from this assessment need to be considered along with those for the much larger Division VIId stock. Given that the Division VIId component dominates the TAC, a catch control 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 2000:
Basis: F(99) = F(96–98) = 0.66, Landings (99) = 1.50, SSB(2000) = 2.11.

F(2000)	Basis	Catch(2000)	Landings (2000)	SSB(2001)	Medium-term situation (10 years) Probability (%) of SSB being below $\mathbf{B_{pa}}$.
0.40	0.6 $F_{96\text{-}98}$		0.97	2.51	<5
0.45	$\mathbf{F_{pa}}$		1.08	2.41	<5
0.46	0.7 $F_{96\text{-}98}$		1.10	2.39	~5
0.53	0.8 $F_{96\text{-}98}$		1.23	2.28	~20
0.59	0.9 $F_{96\text{-}98}$		1.35	2.17	~50
0.66	1.0 $F_{96\text{-}98}$		1.46	2.07	>50

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.

Reference points as set in 1998:

ICES considers that:	ICES proposes that:
$\mathbf{B}_{lim}$ is 1 300 t, the lowest observed spawning stock biomass.	$\mathbf{B}_{pa}$ be set at 2 500 t. This is the previously proposed MBAL. Biomass above this affords a high probability of maintaining SSB above $\mathbf{B}_{lim}$, taking into account the uncertainty in assessments.
$\mathbf{F}_{lim}$ not defined	$\mathbf{F}_{pa}$ be set at 0.45. This F is considered to have a high probability of maintaining SSB above $\mathbf{B}_{pa}$ in the medium term taking into account the uncertainty in assessments.

Technical basis:

$\mathbf{B}_{lim}$:$\mathbf{B}_{loss}$	$\mathbf{B}_{pa}$: MBAL
$\mathbf{F}_{lim}$:Not defined	$\mathbf{F}_{pa}$: low probability that (SSB_{MT}< $\mathbf{B}_{pa}$)

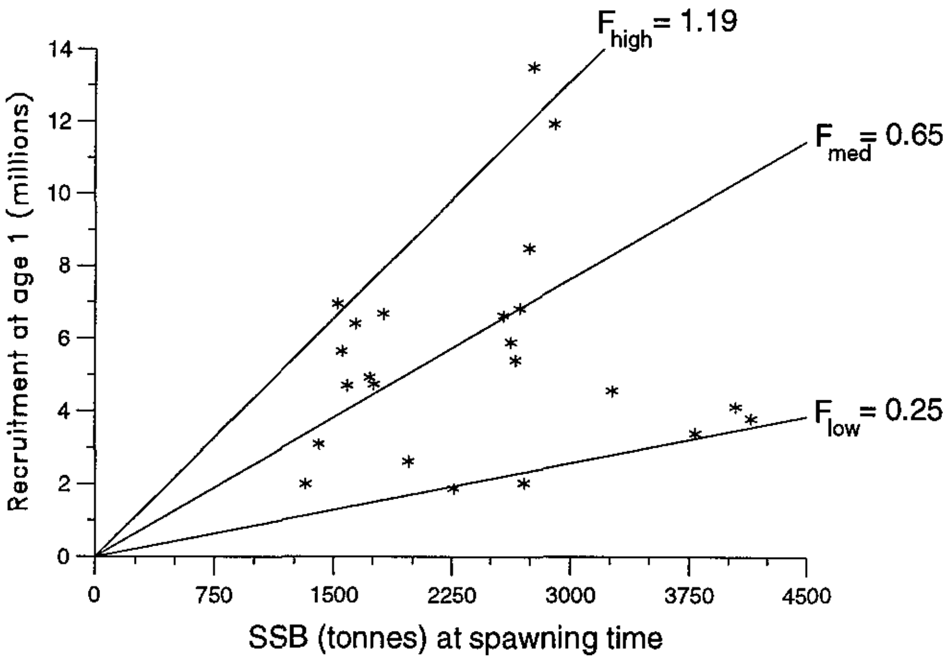
Source of information: Report of the Working Group on the Assessment of Southern Shelf Demersal Stocks, September 1999 (ICES CM 2000/ACFM:4).

Catch data (Tables 3.9.6.1–2):

Year	ICES Advice	Predicted catch corresp. to advice	Agreed[1] TAC[1]	Official Landings	ACFM Landings
1987	Precautionary TAC	6.8	8.3	1.92	1.96
1988	Precautionary TAC	6.9	9.96	2.33	2.46
1989	No increase in effort; TAC	11.7	11.7	2.25	2.36
1990	No increase in F; TAC	10.7	10.7	1.99	2.59
1991	50% reduction in F in VIIe	8.8	10.7	1.65	1.85
1992	Sq. F gives over mean SSB	2.0[2]	9.6	1.56	1.62
1993	Not outside safe biological	-	8.5	1.44	1.42
1994	Within safe biological limits	-	9.1	1.29	1.16
1995	No increase in F	1.4[2]	8.0	1.16	1.03
1996	60% reduction in F	0.6[2]	7.5	1.14	1.04
1997	60% reduction in F	0.51[2]	7.09	1.37	1.32
1998	60% reduction in F	0.5[2]	5.7	1.24	1.12
1999	Reduce F below $\mathbf{F}_{pa}$	1.1[2]	7.4		
2000	Reduce F below $\mathbf{F}_{pa}$	< 1.08[2]			

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

Stock - Recruitment



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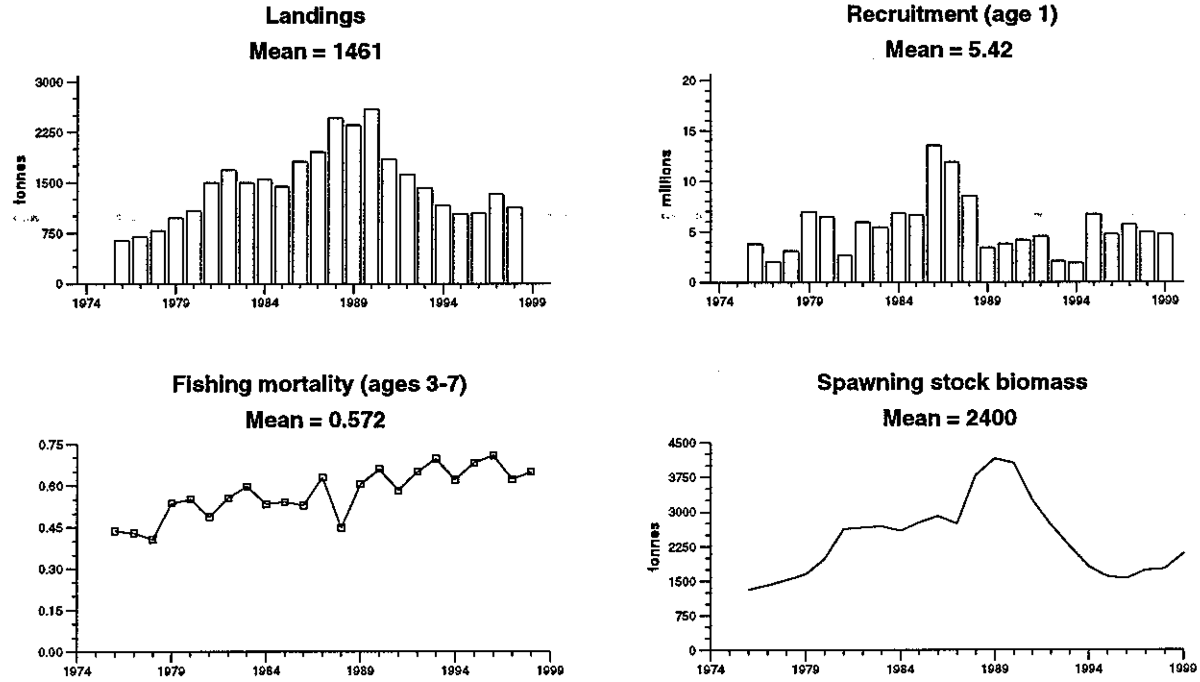
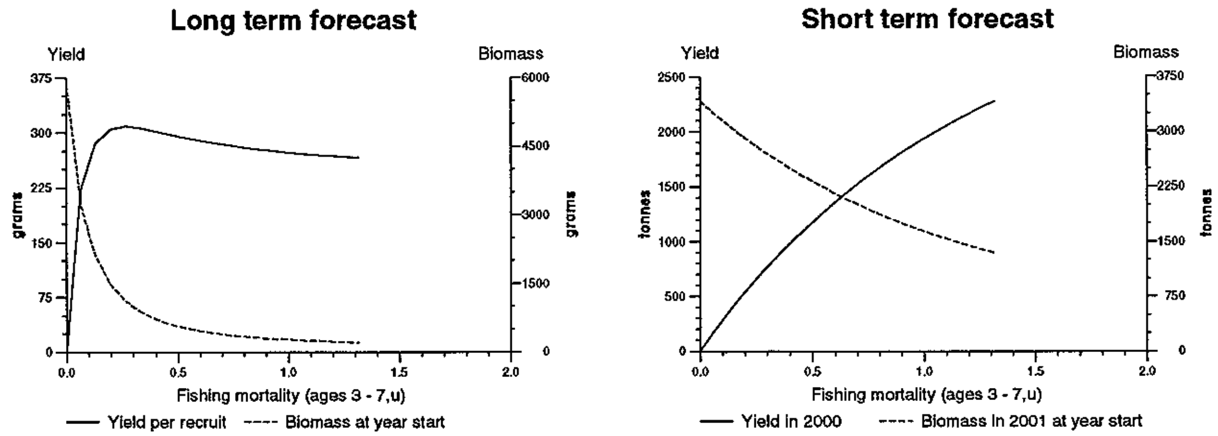


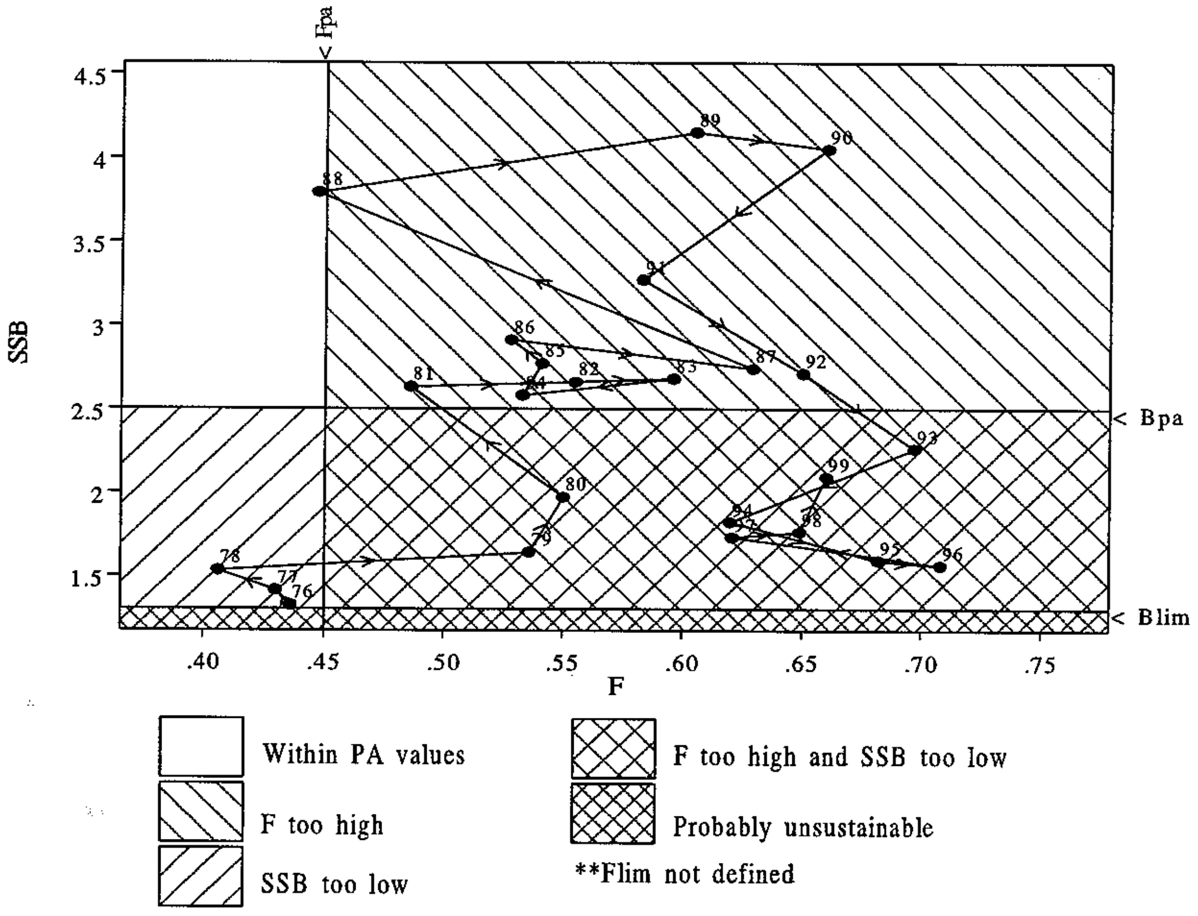
Plaice in Division VIIe (Western Channel)

Yield and Spawning Stock Biomass



Precautionary Approach Plot

Plaice Division VIIe (Western English Channel)



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Plotted on 23/10/1999 at 14:44:58

Table 3.9.6.1 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	-	329	1,032	1	1,374	-51	1,323
1998	22	-	327[2]	892	-	1,241	-117	1,124

[1]Included in Division VIId.
[2]Estimated by the Working Group.
[3]Divisions VIId,e = 4,739 t.

Table 3.9.6.2 PLAICE in Division VIIe (Western Channel).

Year	Recruitment Age 1	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	1.53	0.78	0.406
1979	6.96	1.64	0.98	0.536
1980	6.42	1.97	1.08	0.550
1981	2.63	2.63	1.50	0.486
1982	5.90	2.66	1.69	0.555
1983	5.41	2.68	1.50	0.596
1984	6.83	2.58	1.55	0.533
1985	6.64	2.77	1.44	0.541
1986	13.52	2.91	1.81	0.528
1987	11.92	2.74	1.96	0.629
1988	8.50	3.79	2.46	0.447
1989	3.40	4.15	2.36	0.605
1990	3.81	4.05	2.59	0.660
1991	4.12	3.27	1.85	0.583
1992	4.57	2.71	1.62	0.650
1993	2.04	2.26	1.42	0.697
1994	1.88	1.82	1.16	0.620
1995	6.68	1.59	1.03	0.682
1996	4.71	1.56	1.04	0.708
1997	5.66	1.73	1.32	0.621
1998	4.94	1.76	1.12	0.649
1999	4.75	2.09	.	.
Average	5.42	2.40	1.46	0.572
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 below the proposed $\mathbf{B_{pa}}$ since 1989. Although fishing mortality has declined in recent years, it remains higher than during the early 1970s, and is currently above the proposed $\mathbf{F_{pa}}$. Recruitment in recent years has been close to 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 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 $\mathbf{F_{pa}}$, corresponding to catches of less than 640 t in 2000. This will promote an increase in SSB above $\mathbf{B_{pa}}$ in the medium term. In order to increase in SSB above $\mathbf{B_{pa}}$ in the short term a more substantial decrease in F (30% reduction, corresponding to catches less than 560 t) is required.

Relevant factors to be considered in management: Fisheries for sole also take plaice as a by-catch. This needs to be taken into account in management.

Catch forecast in 2000:

Basis: F(1999) = F(96–98) = 0.32; Landings(99) = 0.76; SSB(2000) = 2.27.

F(2000)	Basis	Catch(2000)	Landings (2000)	SSB (2001)	Medium-term situation (10 years) Probability (%) of SSB being below $\mathbf{B_{pa}}$.
0.19	0.6 $F_{96\text{-}98}$	0.49	0.49	2.56	<5
0.22	0.7 $F_{96\text{-}98}$	0.56	0.56	2.49	<5
0.26	0.8 $F_{96\text{-}98}$: $\mathbf{F_{pa}}$	0.64	0.64	2.42	~5
0.29	0.9 $F_{96\text{-}98}$	0.71	0.71	2.36	~35
0.32	1.0 $F_{96\text{-}98}$	0.77	0.77	2.29	>50

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 around 60% of the total landings, with France taking approximately a third and Belgian vessels the remainder. UK landings were low and stable between 1950 and the mid-1970s, but increased rapidly after 1978 due to the replacement of otter trawlers by beam trawlers. The principal gears used are otter-trawls and beam-trawls, and sole tends to be the target species of an offshore beam-trawl fleet, which is concentrated off the south Cornish coast, and also catches plaice and anglerfish.

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

Reference points as set in 1998:

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:

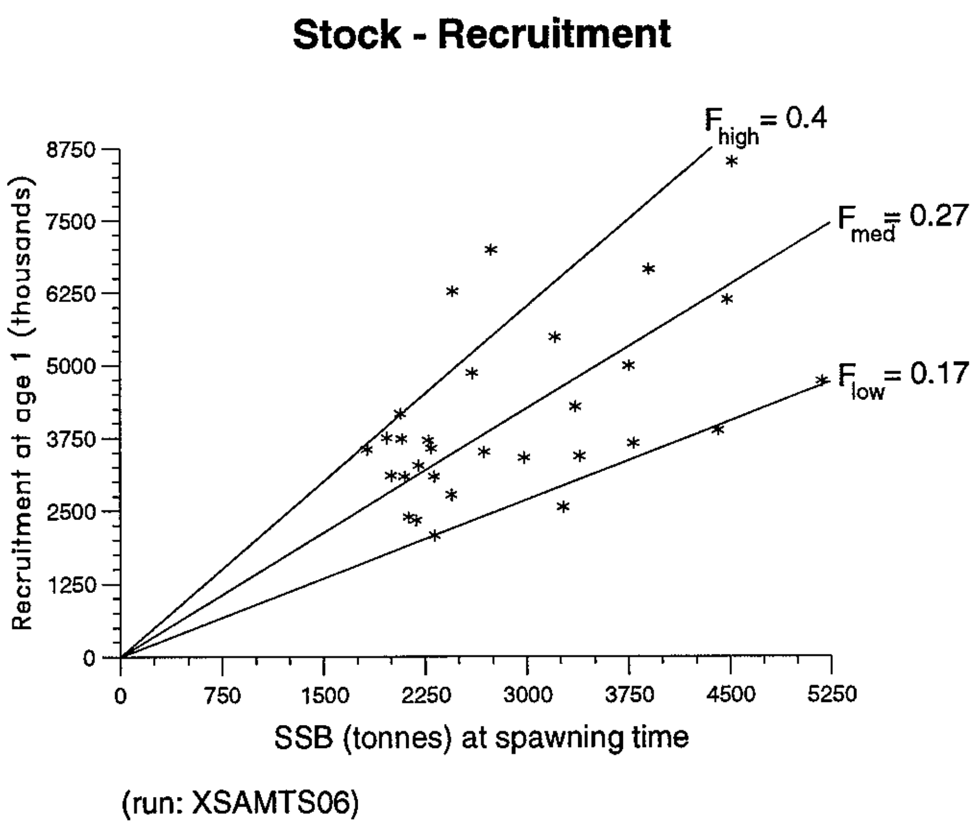
$\mathbf{B_{lim}}$:$\mathbf{B_{loss}}$	$\mathbf{B_{pa}}$ ~ $\mathbf{B_{lim}}$ x 1.4
$\mathbf{F_{lim}}$:$\mathbf{F_{loss}}$	$\mathbf{F_{pa}}$:$\mathbf{F_{lim}}$ x 0.72; implies a less than 10% probability that (SSB_{MT}< $\mathbf{B_{pa}}$)

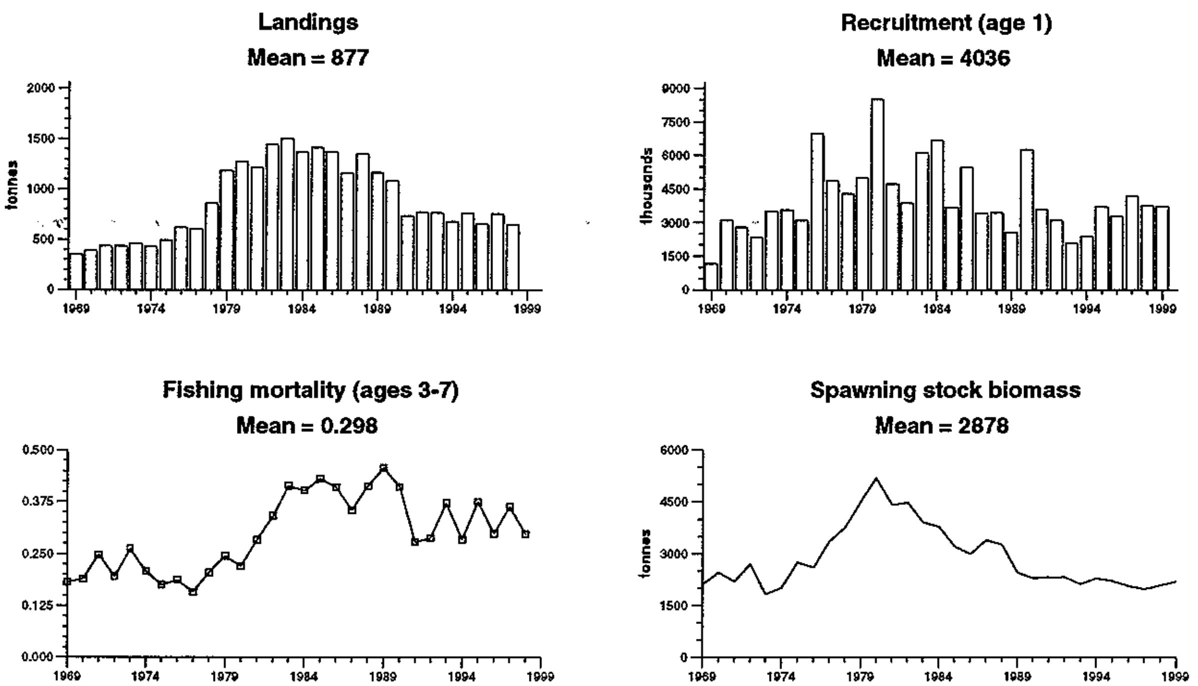
Source of information: Report of the Working Group on the Assessment of Southern Shelf Demersal Stocks, September 1999 (ICES CM 2000/ACFM:4).

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	1.11	1.16
1988	No decrease in SSB; TAC	1.3	1.3	0.95	1.35
1989	No decrease in SSB; TAC	1.0	1.0	0.8	1.16
1990	SSB = 3,000 t; TAC	0.9	0.9	0.75	1.08
1991	TAC	0.54	0.8	0.84	0.73
1992	70% of F(90)	0.77	0.8	0.77	0.77
1993	35% reduction in F	0.7	0.9	0.79	0.76
1994	No increase in F	1.0	1.0	0.84	0.68
1995	No increase in F	0.86	0.95	0.88	0.76
1996	$F_{96} < F_{94}$	0.68	0.7	0.74	0.65
1997	No increase in F	0.69	0.75	0.86	0.75
1998	No increase in F	0.67	0.67	0.77	0.64
1999	Reduce F below $\mathbf{F}_{pa}$	0.67	0.7		
2000	Reduce F below $\mathbf{F}_{pa}$	< 0.64			

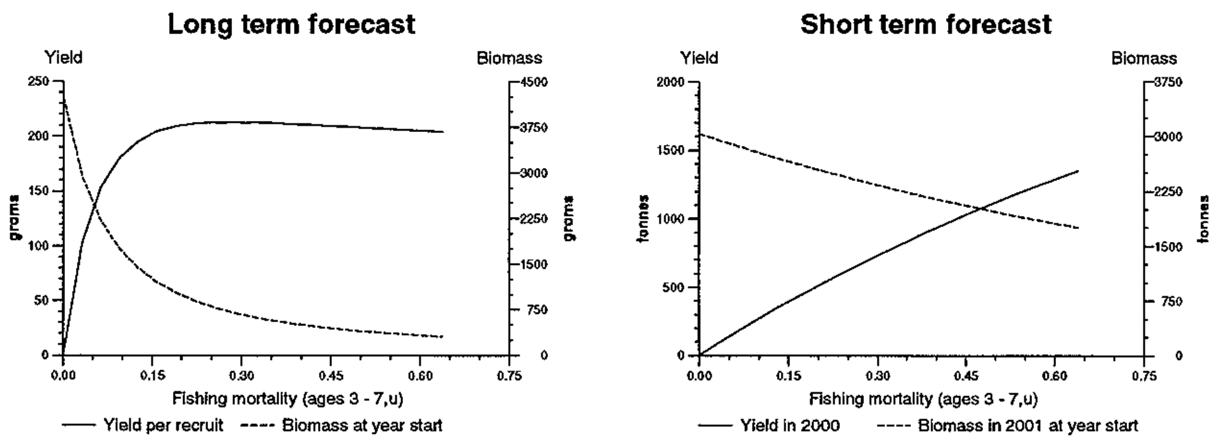
Weights in '000 t.





Sole in Division VIIe (Western Channel)

Yield and Spawning Stock Biomass



Precautionary Approach Plot

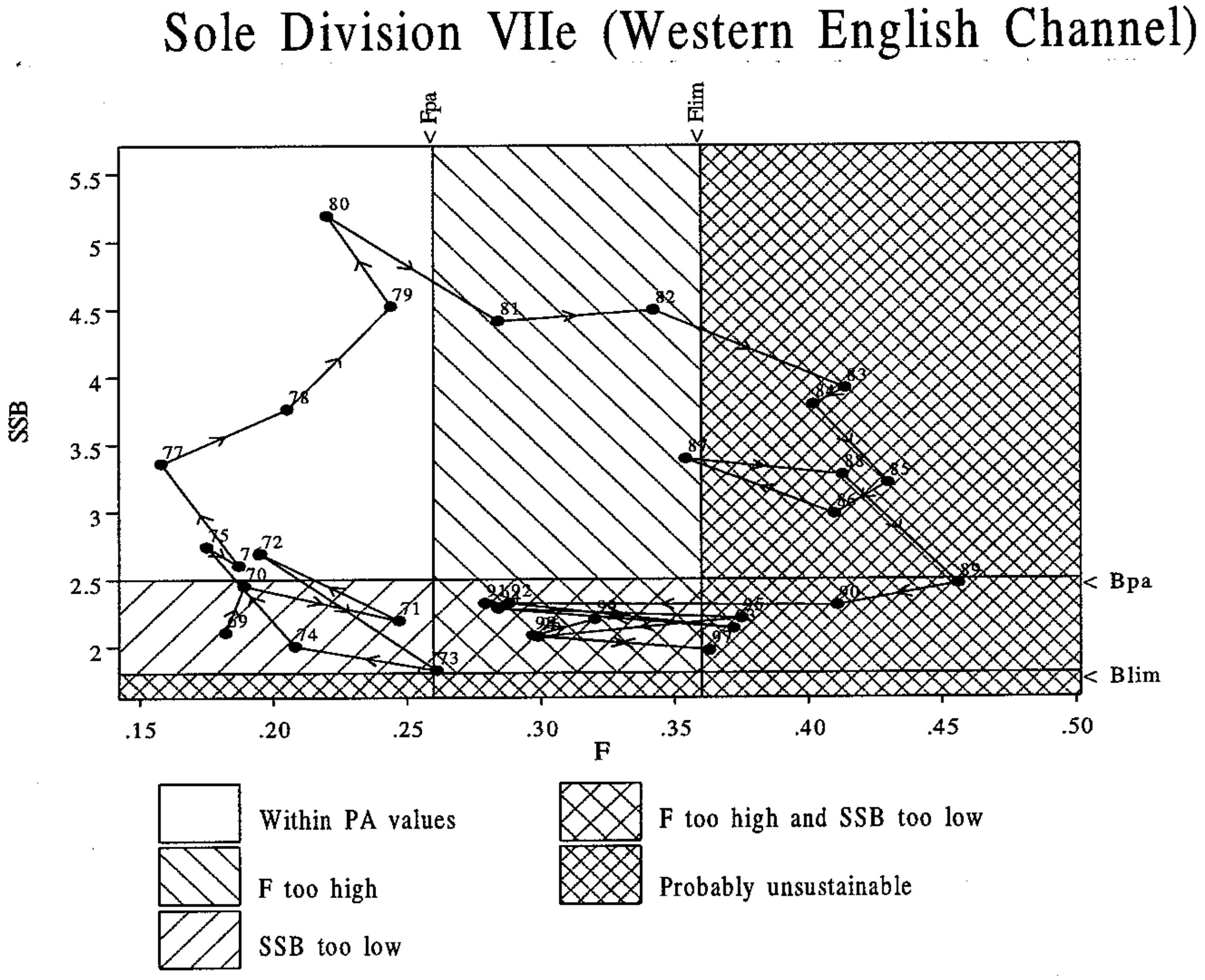


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Table 3.9.7.1 Division VIIe SOLE. Nominal landings (tonnes), 1972–1998 used by Working Group.

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	-	742	-95	647
1997	13	280[3]	483	-	858	-104	754
1998	39	216	368	21	772	-128	644

[1]Estimated from Division VIId,e total by the Working Group.
[2]Estimated by the Working Group.
[3]Provisional

Table 3.9.7.2 SOLE in Division VIIe (Western Channel).

Year	Recruitment Age 1	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	0.189
1971	2.77	2.19	0.43	0.247
1972	2.34	2.69	0.44	0.195
1973	3.51	1.82	0.46	0.261
1974	3.55	2.00	0.43	0.208
1975	3.11	2.74	0.49	0.175
1976	6.99	2.60	0.62	0.187
1977	4.87	3.36	0.61	0.158
1978	4.29	3.76	0.86	0.205
1979	4.99	4.52	1.18	0.244
1980	8.51	5.19	1.27	0.220
1981	4.72	4.41	1.22	0.284
1982	3.88	4.49	1.45	0.342
1983	6.13	3.91	1.50	0.414
1984	6.65	3.79	1.37	0.402
1985	3.66	3.21	1.41	0.430
1986	5.48	2.98	1.37	0.410
1987	3.41	3.39	1.16	0.354
1988	3.43	3.27	1.35	0.413
1989	2.57	2.46	1.16	0.456
1990	6.27	2.30	1.08	0.411
1991	3.57	2.32	0.73	0.279
1992	3.09	2.32	0.77	0.288
1993	2.08	2.13	0.76	0.372
1994	2.39	2.28	0.68	0.284
1995	3.71	2.21	0.76	0.375
1996	3.28	2.07	0.65	0.299
1997	4.17	1.97	0.75	0.363
1998	3.75	2.08	0.64	0.297
1999	3.73	2.20	.	.
Average	4.04	2.88	0.88	0.298
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 within safe biological limits. Fishing mortality is just below the proposed $\mathbf{F_{pa}}$. SSB has been relatively stable 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 maintained below $\mathbf{F_{pa}}$ corresponding to landings in 2000 of less than 5 800 t.

Reference points: $\mathbf{F_{pa}}$ was to modified from last years value of 0.40 after review of available information.

ICES considers that:	ICES proposes that:
$\mathbf{B_{lim}}$ not defined.	$\mathbf{B_{pa}}$ be set at 11 300 t. There is no evidence of reduced recruitment at the lowest biomass observed and $\mathbf{B_{pa}}$ was proposed to be set equal to the lowest observed SSB.
$\mathbf{F_{lim}}$ 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 (10 years) taking into account the uncertainty in assessments.

Technical basis:

$\mathbf{B_{lim}}$: Not defined.	$\mathbf{B_{pa}} \sim \mathbf{B_{loss}}$
$\mathbf{F_{lim}}$: Not defined.	$\mathbf{F_{pa}} \sim \mathbf{F_{med}}$; less than 5% 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. The fishing mortality has been variable but with an increasing trend.

Catch forecast for 2000 :

Basis: F(1999) = F(96–98) = 0.44, Catch (1999) = 5.9, Landings (1999) = 5.8, SSB(2000) = 13.5.

F(2000) onwards	Basis	Catch(2000)	Landings (2000)	SSB(2001)	Medium-term situation (10 years) Probability (%) of SSB < $\mathbf{B_{pa}}$
0.31	$0.7F_{96\text{-}98}$	4.4	4.3	15.8	<5
0.35	$0.8F_{96\text{-}98}$	5.0	4.8	15.2	<5
0.40	$0.9F_{96\text{-}98}$	5.5	5.3	14.7	<5
0.44	$1.0\,F_{96\text{-}98}$	6.0	5.8	14.1	<5
0.45	$\mathbf{F_{pa}}$	6.0	5.8	14.0	<5
0.49	$1.1F_{96\text{-}98}$	6.4	6.2	13.5	<5

Weights in '000 t.

Shaded scenarios considered inconsistent with the precautionary approach.

Elaboration and special comment: The 1997 year class appears weak in the assessment. However, the catches at age 1 are mainly discard estimates, and stock number at age 1 poorly estimated. A geometric mean estimate was consequently chosen as best estimate of 1997 year class in 1998. The recruitment estimates series shows limited variations over the assessment years.

Catches have increased continuously until a maximum reached in 1994 (7400 t). They decreased to 6300 t in 1995 and remained between 6000 t and 6600 t in the last years. Since 1984, catches of sole by French small-mesh shrimp trawlers decreased markedly, and the gill-net and trammel-net fishery has expanded and accounts for more than half of the French landings in the last years. Landings by Belgium beam trawlers increased rapidly in the late 1980s and, since 1991, have been relatively constant at 8% of the total.

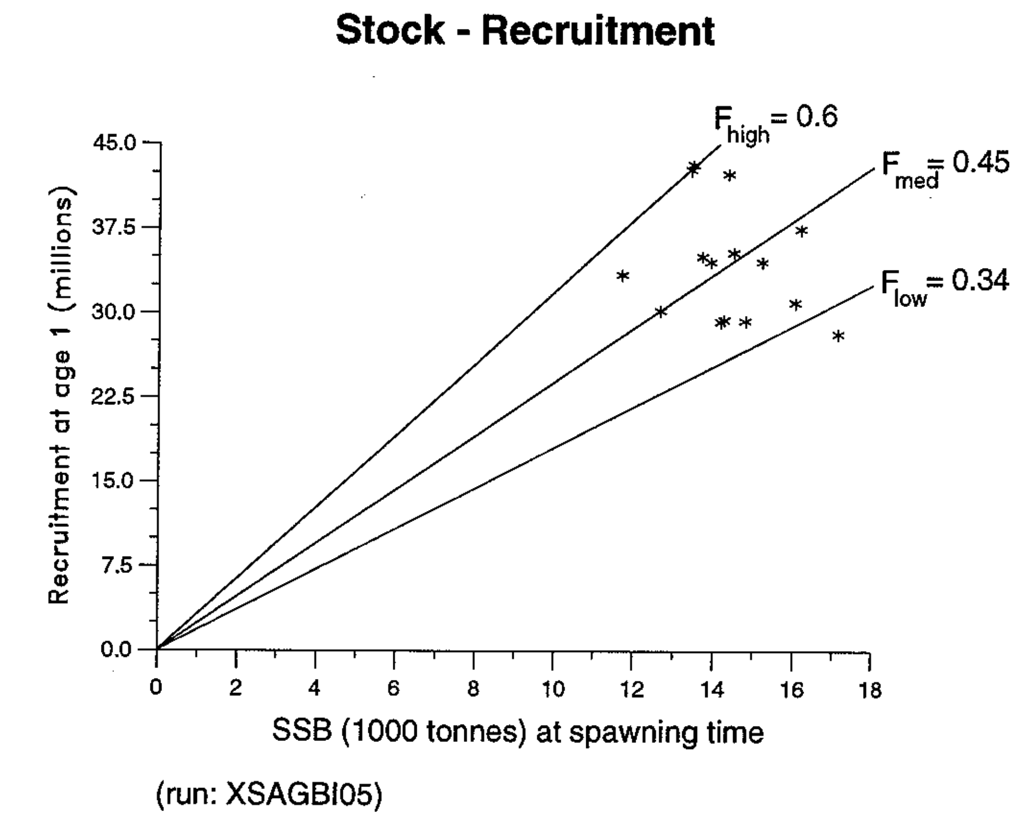
Analytical assessment based on landings and CPUE data. No recruitment indices are available for this stock. Data prior to 1984 are not considered reliable.

Source of information: Report of the Working Group on the Assessment of Southern Shelf Demersal Stocks, September 1999 (ICES CM 2000/ACFM:4).

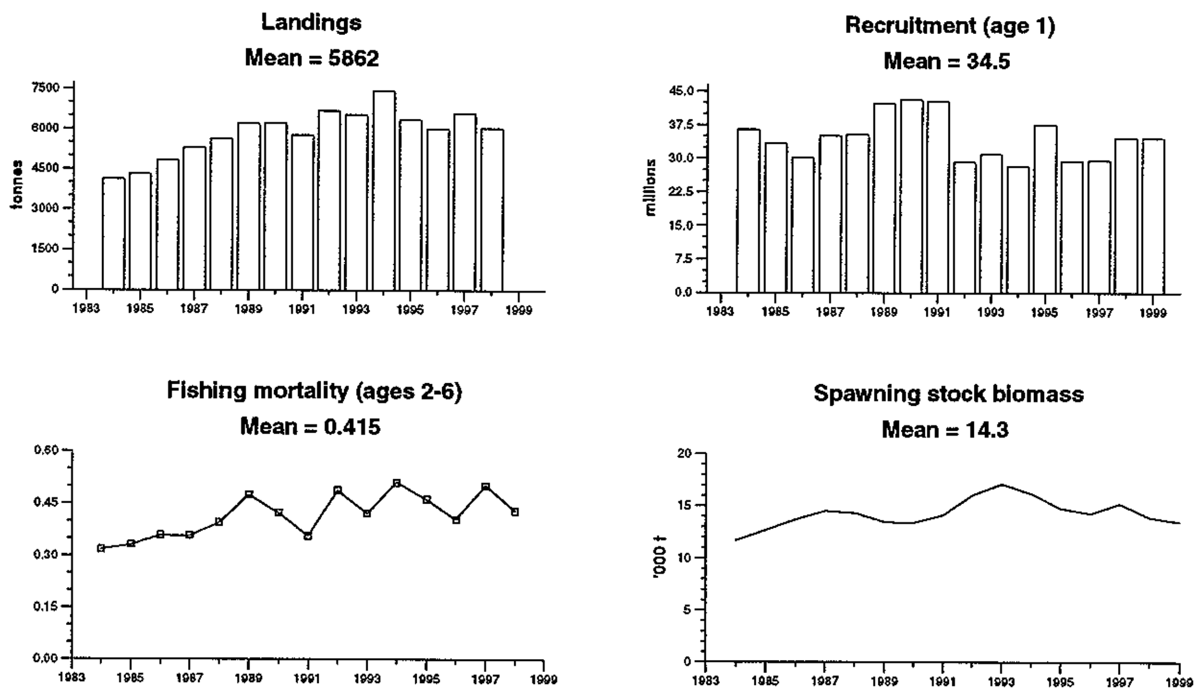
Catch data (Tables 3.9.8.1–2):

Year	ICES advice	Predicted catch corresp. to advice	Agreed TAC	Official Landings	ACFM Landings	Disc. slip.	ACFM Catch
1987	Not assessed	-	4.4	4.4	5.1	0.2[3]	5.3
1988	Precautionary TAC	3.7	4.0	4.4	5.4	0.3[3]	5.6
1989	No increase in effort; TAC	4.5	4.8	5.8[1]	5.8	0.4[3]	6.2
1990	No increase in F; TAC	5.1	5.2	5.5[1]	5.9	0.3[3]	6.2
1991	Precautionary TAC	4.7	5.3	4.7[1]	5.6	0.2[3]	5.8
1992	F = F(90)	5.0	5.3	6.4[1]	6.6	0.1[3]	6.7
1993	No long-term gain in increasing F	-	5.7	6.5	6.4	0.1[3]	6.5
1994	No long-term gain in increasing F	-	6.6	7.1	7.2	0.2[3]	7.4
1995	No long-term gain in increasing F	5.4[2]	6.6	5.9	6.2	0.1[3]	6.3
1996	No increase in F	5.0	6.6	4.7	5.9	0.1[3]	6.0
1997	40% reduction in F	3.1	5.4	4.9	6.4	0.1	6.6
1998	No increase in F	7.6	6.0	4.3	5.9	0.1	6.0
1999	Reduce F below $\mathbf{F}_{pa}$	< 5.0	5.4				
2000	F at $\mathbf{F}_{pa}$	< 5.8					

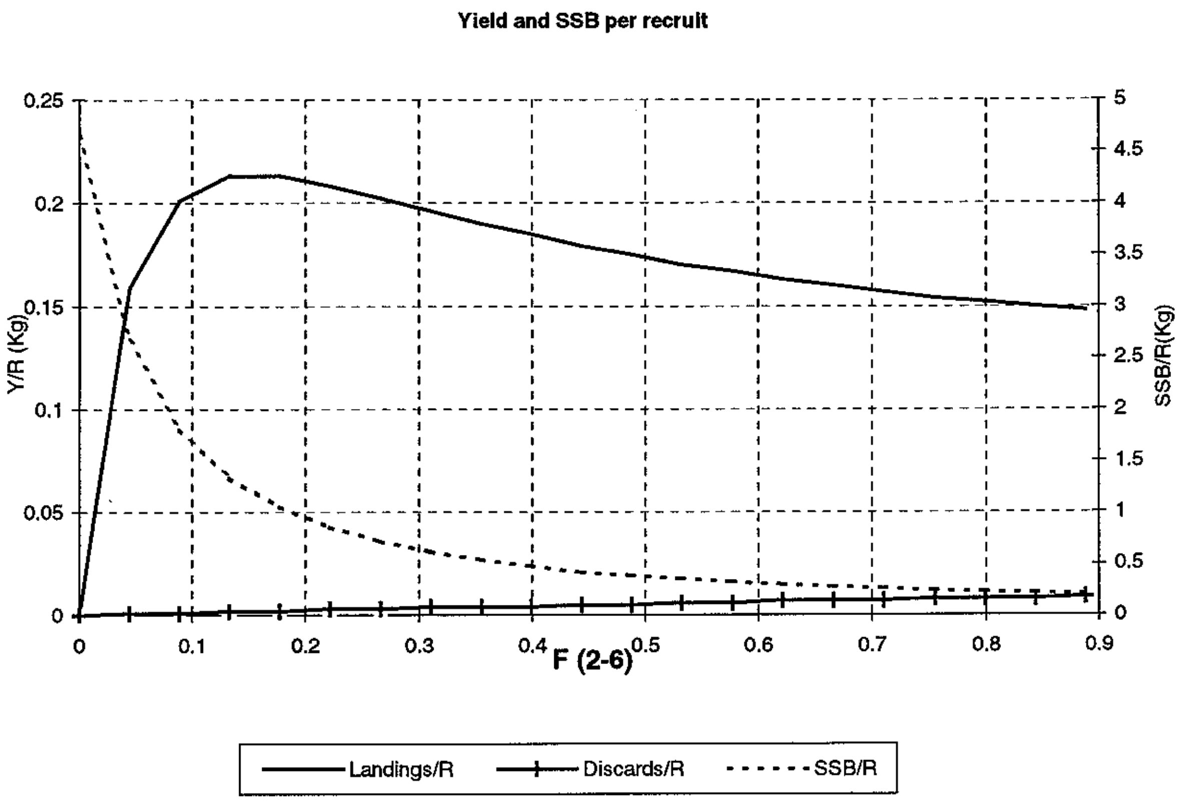
[1]Not reported for all countries. [2]Landings at *status quo* F. [3]Discards revised in 1998. Weights in '000 t.

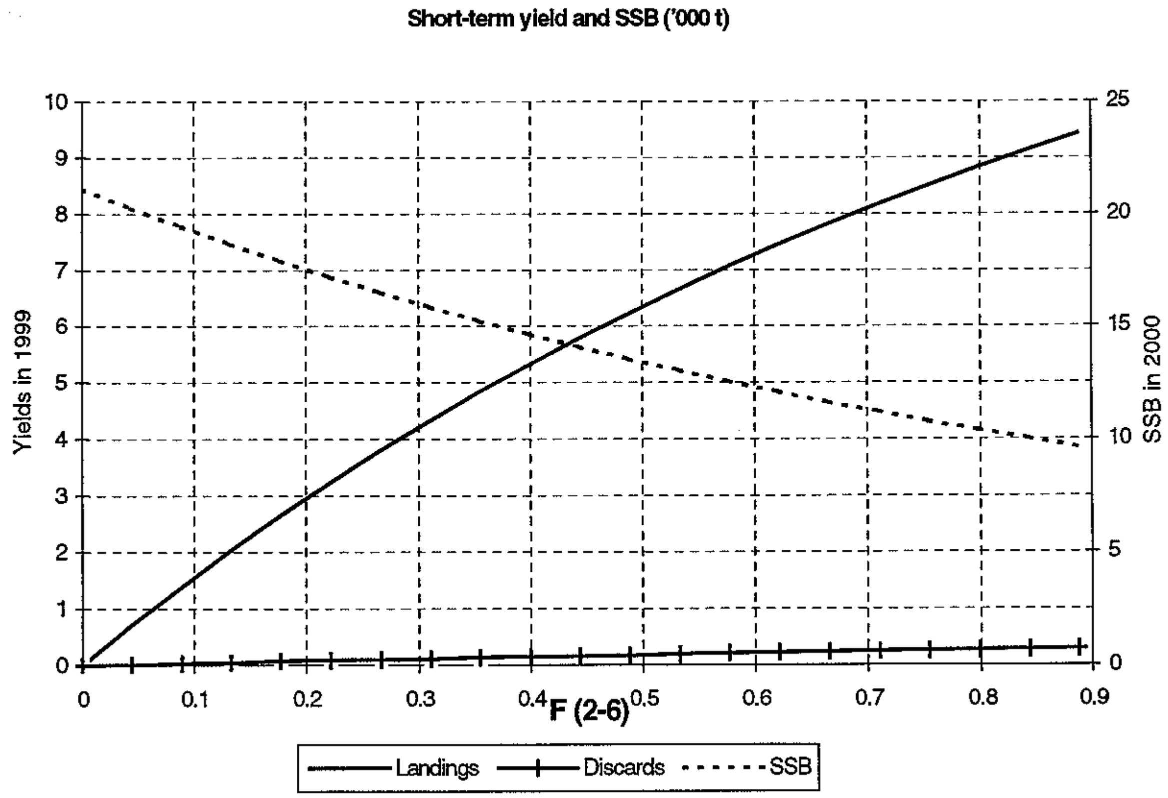


Sole in Divisions VIIIa,b (Bay of Biscay)



Sole in Divisions VIIIa,b (Bay of Biscay)





Precautionary Approach Plot

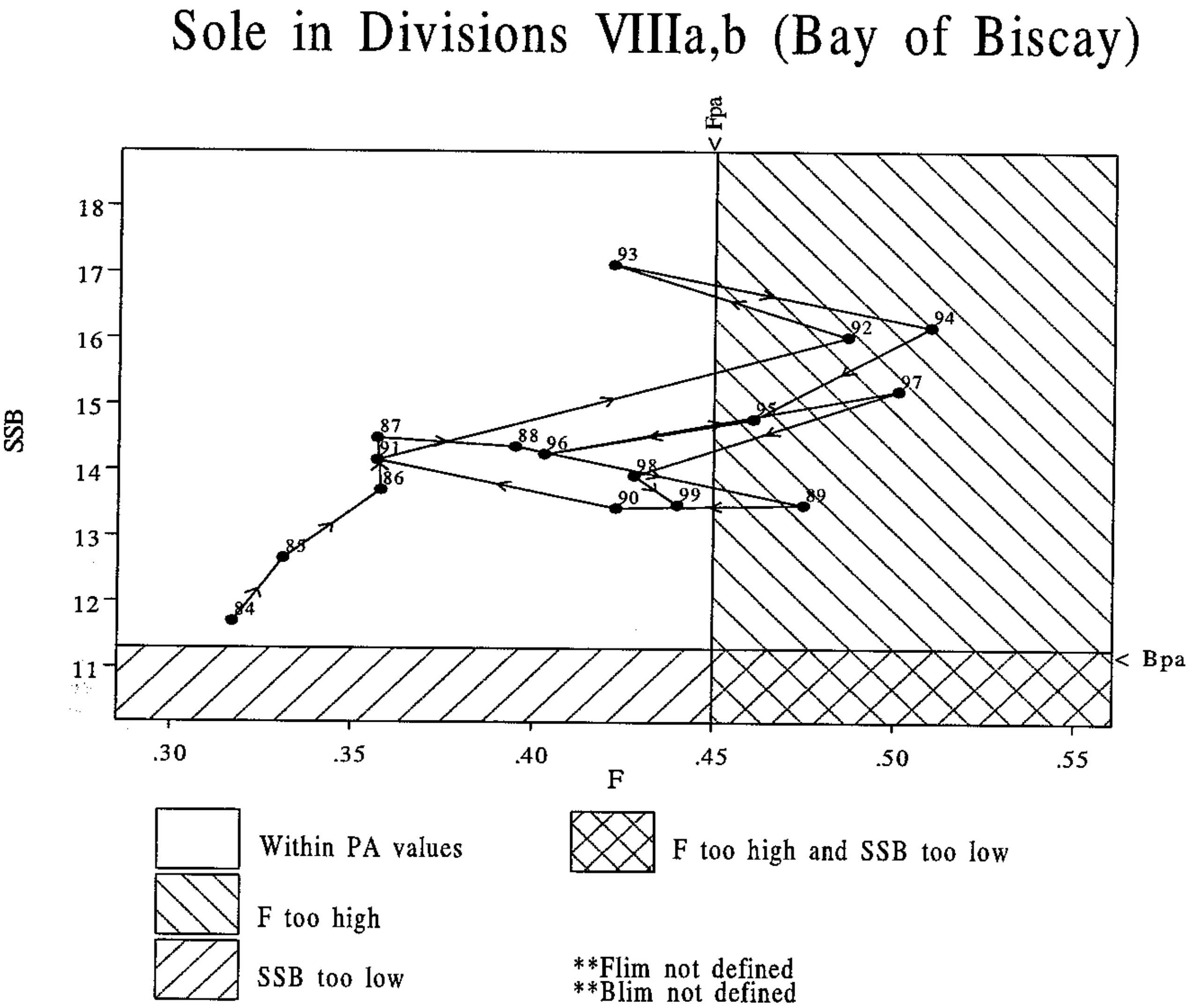


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Table 3.9.8.1 SOLE in Divisions VIIIa,b (Bay of Biscay). International landings and catches used by Working Group (in tonnes).

Year	Official Landings					Unallocated Landings	Total Landings	Discards	Total Catches
	Belgium	France	Nether.	Spain	Total				
1979	5*	2376		62*	2443	176	2619	-	-
1980	33*	2549		107*	2689	297	2986	-	-
1981	4*	2581*	13*	96*	2694	242	2936	-	-
1982	19*	1618*	52*	57*	1746	2067	3813	-	-
1983	9*	2590	32*	38*	2669	959	3628	-	-
1984		2968	175*	40*	3183	855	4038	99	4137
1985	25*	3423	169*	308*	3925	326	4251	64	4315
1986	52*	4227	213*	75*	4567	238	4805	27	4832
1987	124*	4009	145*	101*	4379	707	5086	198	5284
1988	135*	4308			4443	939	5382	254	5636
1989	311*	5471*			5782	63	5845	356	6201
1990	301*	5231			5532	384	5916	303	6219
1991	389*	4315		3	4707	862	5569	198	5767
1992	440*	5919			6359	191	6550	123	6673
1993	400*	6083		13	6496	-76	6420	104	6524
1994	466*	6620		2	7088	138	7226	184	7410
1995	546*	5325			5871	334	6205	130	6335
1996	460*	4254			4714	1139	5853	142	5995
1997	435*	4515			4950	1486	6436	141	6577
1998	469*	3816**	44		4329	1572	5901	127	6028
Mean					4428	645	5073	163	5862

*Reported in VIII
**Preliminary

Table 3.9.8.2 SOLE in Divisions VIIIa,b (Bay of Biscay).

Year	Recruitment Age 1	Spawning Stock Biomass	Landings	Fishing Mortality Age 2-6
1984	36.47	11.70	4.14	0.317
1985	33.39	12.66	4.32	0.331
1986	30.19	13.70	4.83	0.358
1987	35.01	14.49	5.28	0.357
1988	35.34	14.36	5.64	0.395
1989	42.34	13.48	6.20	0.475
1990	43.14	13.43	6.22	0.423
1991	42.69	14.16	5.77	0.357
1992	29.22	16.03	6.67	0.487
1993	30.90	17.12	6.52	0.422
1994	28.13	16.18	7.41	0.510
1995	37.42	14.78	6.34	0.461
1996	29.29	14.25	6.00	0.403
1997	29.39	15.21	6.58	0.501
1998	34.52	13.92	6.03	0.428
1999	34.52	13.48	.	.
Average	34.50	14.31	5.86	0.415
Unit	Millions	1000 tonnes	1000 tonnes	-

3.9.9 Celtic Sea and Division VIIj herring

State of stock/fishery. The stock is considered to be within safe biological limits, the SSB is at present considered to be high and well above the proposed $\mathbf{B_{pa}}$. The stock is increasing and has been augmented by two strong year classes (1992/93 and 1993/94) but because of the timing of the two most recent acoustic surveys, which are used as indices in the assessments, it is likely that the stock size is underestimated. Fishing mortality has decreased in recent years and is now slightly above $\mathbf{F_{med}}$, a likely candidate for a proposed $\mathbf{F_{pa}}$.

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

Advice on management: The SSB is currently well above the proposed $\mathbf{B_{pa}}$ and ICES advises that the F in 2000 should not be greater than 0.3. This corresponds to a catch of around 20 000 t. This, assuming average recruitment, will not lead to any short-term decline in the stock towards the proposed $\mathbf{B_{pa}}$.

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. $\mathbf{F_{med}}$ is associated with a much lower probability of reducing the SSB. It would be a natural choice for $\mathbf{F_{pa}}$. 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. It is likely that $\mathbf{F_{med}}$ would be an appropriate $\mathbf{F_{pa}}$ which is currently estimated at 0.29. Before this $\mathbf{F_{pa}}$ 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 26 000 t. In order to have a high probability of avoiding these low values, management action to reduce fishing mortality below $\mathbf{F_{pa}}$ would be required at measured SSBs of 44 000 t. It is suggested that $\mathbf{B_{pa}}$ be set at 44 000 t.

Maintaining fishing mortality at $\mathbf{F_{med}}$ 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 proposed $\mathbf{B_{pa}}$ threshold frequently.

Reference points:

ICES considers that:	ICES proposes that:
$\mathbf{B_{lim}}$ is 26 000 t	$\mathbf{B_{pa}}$ be set at 44 000 t
$\mathbf{F_{lim}}$ is not defined	$\mathbf{F_{pa}}$ is not defined

Technical basis:

$\mathbf{B_{lim}}$: The lowest stock observed	$\mathbf{B_{pa}}$: Reduced probability of low recruitment.
$\mathbf{F_{lim}}$: Not defined	$\mathbf{F_{pa}}$: Not defined

Relevant factors to be considered management: SSB is presently high. As the market is at present depressed there is an opportunity to extend the age structure of the stock if the TAC is maintained around 20 000 t. This would mean that in the event of a return to a period of reduced recruitment dramatic reductions in TACs would be less likely.

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 2000: Basis: TAC catch of 21 000 t, F(99) = 0.32 assuming geometric mean recruitment = 559 million at age 1 in 1999.

Basis	F(2000)	SSB(2000)	Landings(2000)	SSB(2001)
0.60	0.20	90 000	13 800	95 400
0.85	0.28	88 800	18 900	89 700
0.92	0.30	88 400	20 200	88 100
1.00=F98	0.32	88 100	21 700	86 400

Weights in t. Shaded scenario considered inconsistent with the precautionary approach.

Elaboration and special comments: The stock experienced a period of low recruitment in the late seventies and recovered in the early eighties. In recent years marketing conditions have been very difficult and future prospects are poor. Improved enforcement has led to a significant reduction in effort.

The present assessment, based on an analysis of catch at age and survey data, is consistent with that reported last year. Acoustic surveys were resumed in 1998 and the two most recent estimates from the 1996 and 1998 surveys gave high estimates of stock size. Reports from the fishery indicate an increased abundance of herring in recent years.

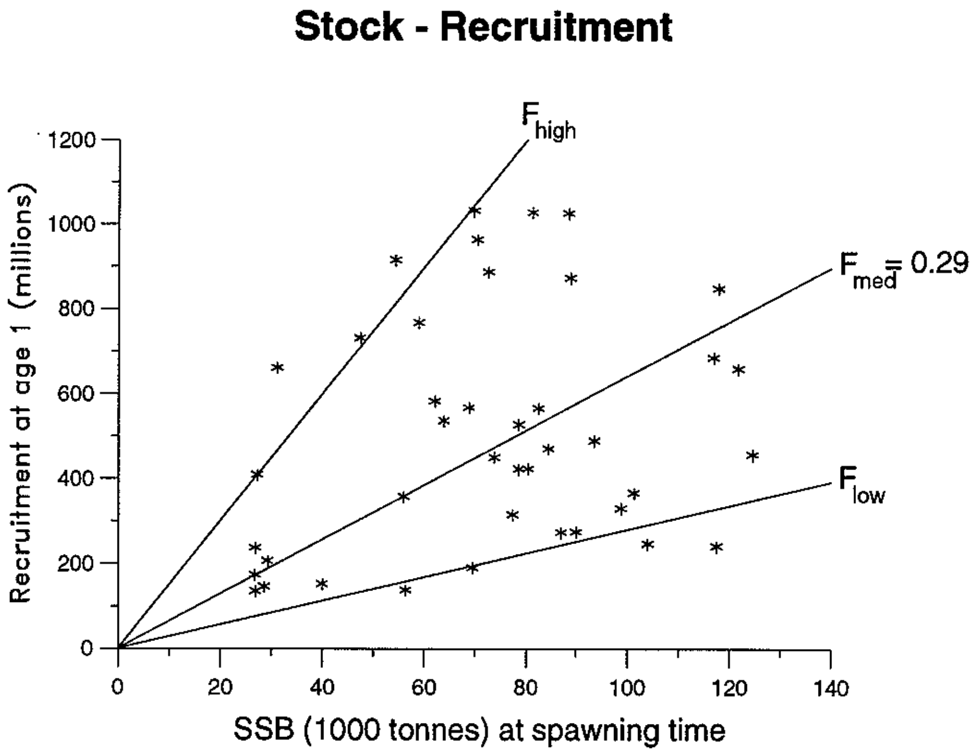
Discarding which was previously thought to be a problem in the fishery in the past, was not thought to be a problem in 1998.

Source of information: Report of the Herring Assessment Working Group for the Area South of 62°N, March 1999 (ICES CM 1999/ACFM:12).

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	20	0.0	20.3
1999	F = 0.4	19	21			
2000	F < 0.3	20				

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



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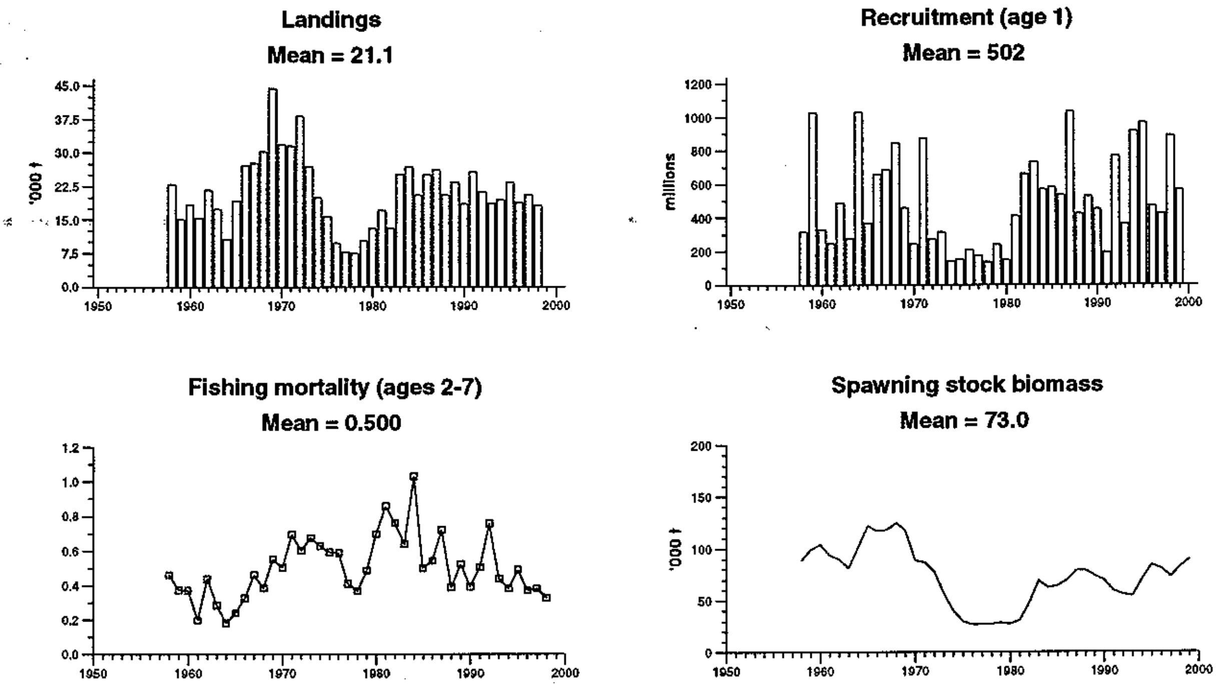


Celtic Sea and Division VIIj herring

Yield and Spawning Stock Biomass

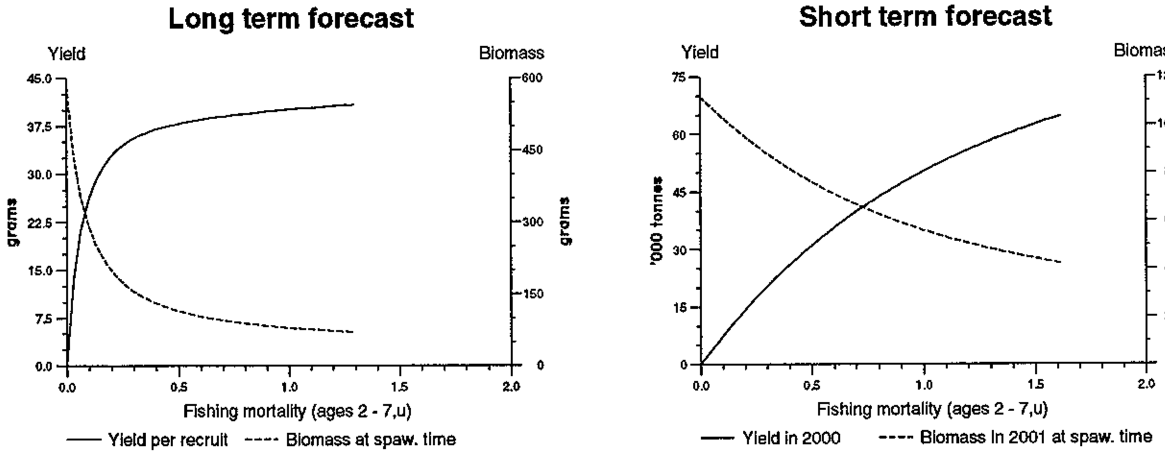


Table 3.9.9.1 Celtic Sea and Division VIIj herring landings by calendar year (t), 1988–1998. (Data provided by Working Group members.)

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

Year	France	Germany	Ireland	Netherlands	U.K.	Unallocated	Discards	Total
1988	-	-	16,800	-	-	-	2,400	19,200
1989	+	-	16,000	1,900	-	1,300	3,500	22,700
1990	+	-	15,800	1,000	200	700	2,500	20,200
1991	+	100	19,400	1,600	-	600	1,900	23,600
1992	500	-	18,000	100	+	2,300	2,100	23,000
1993	-	-	19,000	1,300	+	-1,100	1,900	21,100
1994	+	200	17,400	1,300	+	-1,500	1,700	19,100
1995	200	200	18,000	100	+	-200	700	19,000
1996	1,000	0	18,600	1,000	-	-1,800	3,000	21,800
1997	1,300	0	18,000	1,400	-	-2,600	700	18,800
1998[1]	+	-	19,300	1,200	-	-200	0	20,300

[1] Preliminary.

Table 3.9.9.2 Celtic Sea and Division VIIj herring landings (t) by season (1 April–31 March) 1988/1989-1998/1999. (Data provided by Working Group members. 1998/99 figures are preliminary.)

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

Year	France	Germany	Ireland	Netherlands	U.K.	Unallocated	Discards	Total
1988/1989	-	-	17,000	-	-	-	3,400	20,400
1989/1990	+	-	15,000	1,900	-	2,600	3,600	23,100
1990/1991	+	-	15,000	1,000	200	700	1,700	18,600
1991/1992	500	100	21,400	1,600	-	-100	2,100	25,600
1992/1993	-	-	18,000	1,300	-	-100	2,000	21,200
1993/1994	-	-	16,600	1,300	+	-1,100	1,800	18,600
1994/1995	+	200	17,400	1,300	+	-1,500	1,900	19,300
1995/1996	200	200	20,000	100	+	-200	3,000	23,300
1996/1997	1,000	-	17,900	1,000	-	-1,800	750	18,800
1997/1998	1,300	-	19,900	1,400	-	-2,100	0	20,500
1998/1999[1]	+	-	17,700	1,200	-	-700	-	18,200

[1] Preliminary

Table 3.9.9.3 Celtic Sea and Division VIIj herring.

Year	Recruitment Age 1	Spawning Stock Biomass	Landings	Fishing Mortality Age 2-7
1958	316.28	88.50	22.98	0.460
1959	1,026.36	98.88	15.09	0.374
1960	330.63	104.05	18.28	0.369
1961	246.93	93.59	15.37	0.198
1962	489.64	90.04	21.55	0.437
1963	274.97	81.33	17.35	0.285
1964	1,028.38	101.39	10.60	0.181
1965	366.30	121.79	19.13	0.240
1966	658.58	116.96	27.03	0.325
1967	685.42	117.95	27.66	0.459
1968	848.18	124.61	30.24	0.384
1969	456.55	117.54	44.39	0.551
1970	241.48	88.95	31.73	0.502
1971	873.70	86.99	31.40	0.694
1972	273.33	77.37	38.20	0.602
1973	315.17	56.28	26.94	0.674
1974	137.50	40.03	19.94	0.628
1975	152.26	29.29	15.59	0.591
1976	206.44	26.83	9.77	0.588
1977	173.71	26.93	7.83	0.410
1978	135.27	26.90	7.56	0.367
1979	237.36	28.60	10.32	0.485
1980	145.57	27.26	13.13	0.696
1981	409.08	31.06	17.10	0.856
1982	661.03	47.36	13.00	0.759
1983	731.65	68.78	24.98	0.638
1984	567.15	62.07	26.78	1.030
1985	581.94	63.86	20.43	0.499
1986	536.00	69.74	25.02	0.541
1987	1,032.70	78.61	26.20	0.720
1988	422.39	78.64	20.45	0.389
1989	527.38	73.73	23.25	0.522
1990	450.42	69.56	18.40	0.392
1991	190.46	58.91	25.56	0.503
1992	767.72	55.88	21.13	0.757
1993	357.93	54.30	18.62	0.436
1994	915.53	70.41	19.30	0.380
1995	964.01	84.46	23.31	0.488
1996	470.08	80.47	18.82	0.368
1997	423.40	72.64	20.50	0.379
1998	887.35	82.50	18.21	0.324
1999	565.50	89.32	.	.
Average	501.95	72.96	21.05	0.500
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.

Elaboration and special comment: Insufficient data are available to carry out an assessment. Sprat catches are very low and are mainly taken in the second half of the year by the Lyme Bay sprat fishery. The 1998 catch has increased to 2 024 t compared to the mean of 1 642 for the last three but one years.

Source of information: Report of the Herring Assessment Working Group for the Area South of 62°N, March 1999 (ICES CM 1999/ACFM:12).

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	2.0
1999	No advice	-	6.3	
2000	No advice	-		

Weights in '000 t.

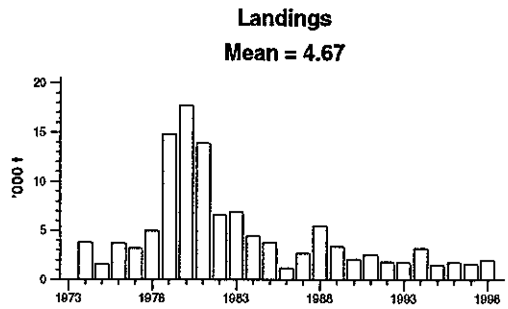


Table 3.9.10.1 Nominal catch of sprat (t) in Divisions VIId,e,1985–1998.

Country	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997*	1998*
Denmark	-	15	250	2,529	2,092	608	-	-	-	-	-	-	-	-
France	14	-	23	2	10	-	-	35	2	1	+			-
Germany	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Netherlands	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UK (Engl.&Wales)	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	2,024
Total	3,785	1,178	2,714	5,475	3,421	2,116	2,567	1,825	1,800	3,178	1,515	1,789	1,621	2,024

* Preliminary

Table 3.9.10.2 Sprat in Divisions 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	3,178
1995	1,515
1996	1,789
1997	1,621
1998	2,024
Average	4,671
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 harvested outside 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 at or above 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 reduced to below the proposed $\mathbf{F}_{pa}$ corresponding to landings less than 13 500 t in 2000. Taking into account a 5% contribution of *L. boscii* in the landings, the equivalent TAC for the two species combined would be 14 200 t.

Relevant factors to be considered in management: This stock appears in a stable condition but the exploitation pattern has recently been poor and resulted in a large proportion of the catch being composed of small fish. Until 1999, the minimum legal size of *Lepidorhombus spp.* in this area was 25 cm length. From 1st January 2000 the minimum legal size for these species will be reduced to 20 cm. Part of predicted discards may be landed legally. Possible effects of change in minimum landings size has not been taken into account in the catch forecast.

Catch forecast for 2000:

Basis: F(99) = F(96–98) = 0.32; Landings(99) = 14.3; Catch (99) = 18.1, SSB(2000) = 62.0.

F(2000)	Basis	Catch(2000)	Landings (2000)	SSB(2001)	Medium-term situation (10 years) Probability (%) of SSB < $\mathbf{B}_{pa}$
0.19	0.6 $F_{96\text{-}98}$	11.6	9.2	69.8	<5
0.26	0.8 $F_{96\text{-}98}$	14.9	11.8	65.9	<5
0.30	$\mathbf{F}_{pa}$	17.0	13.5	63.4	<5
0.32	1.0 $F_{96\text{-}98}$	18.1	14.3	62.2	<5
0.39	1.2 $F_{96\text{-}98}$	21.0	16.5	58.8	~35

Weights in '000 t.

Shaded scenarios considered inconsistent with the precautionary approach.

Elaboration and special comment: This assessment shows a tendency to under-estimate F and overestimate SSB in recent years.

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 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 landings have remained fairly stable over the period 1986–1998. Discards are estimated to be about 15% (27% in 1998) of the total catches by weight and comprise fish over a large range of sizes.

Megrim are widely distributed over the whole of sub-areas VII and VIII and are most abundant in the deeper waters of the continental shelf. Spawning takes place between January and April along the edge of the continental shelf to the 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 two commercial fleets and one survey with two components. Discard estimates used.

Reference points as set in 1998: ***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 no evidence of reduced 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:

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

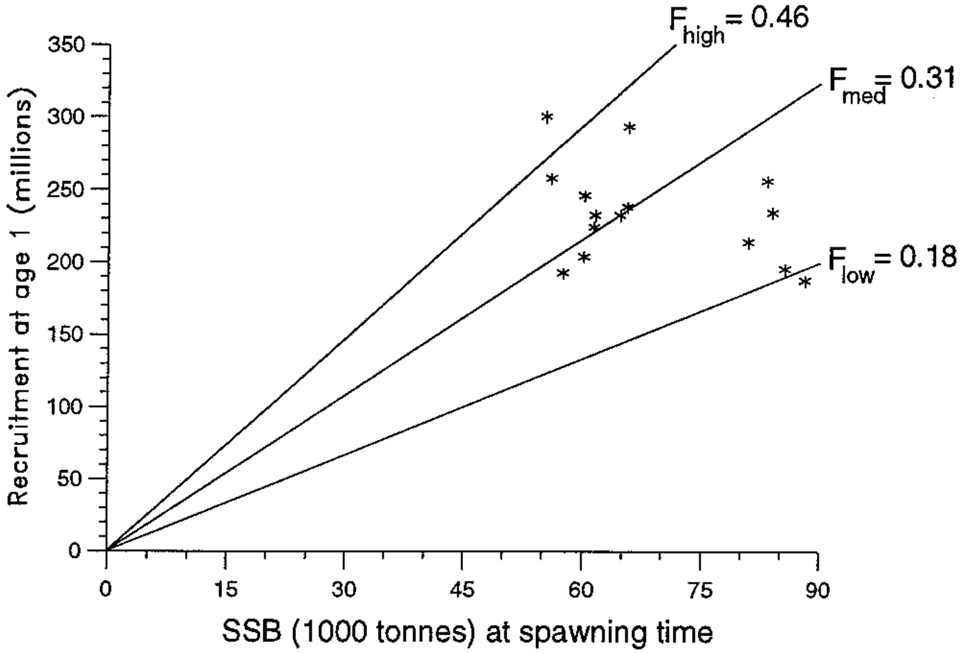
Source of information: Report of the Working Group on the Assessment of Southern Shelf Demersal Stocks, September 1999 (ICES CM 2000/ACFM:4).

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 F	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	14.3	5.4	19.7
1999	Reduce F below $\mathbf{F_{pa}}$	14.6[2,1]	25.0			
2000	Reduce F below $\mathbf{F_{pa}}$	<14.2[2,1]				

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

Stock - Recruitment



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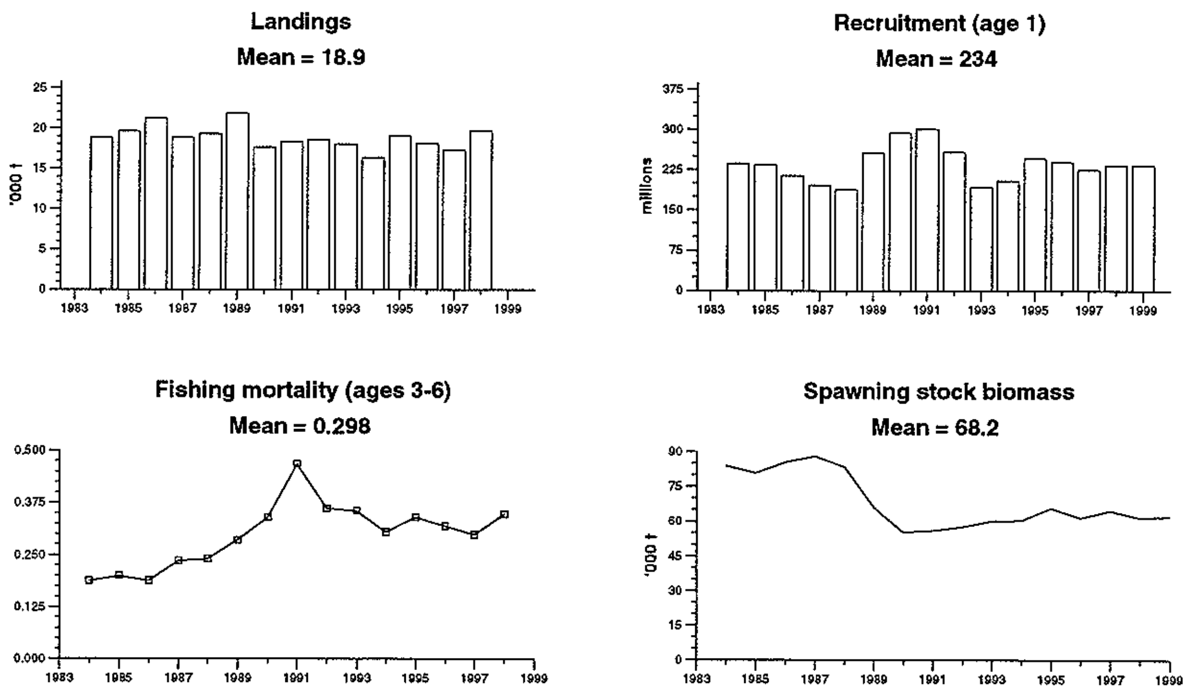
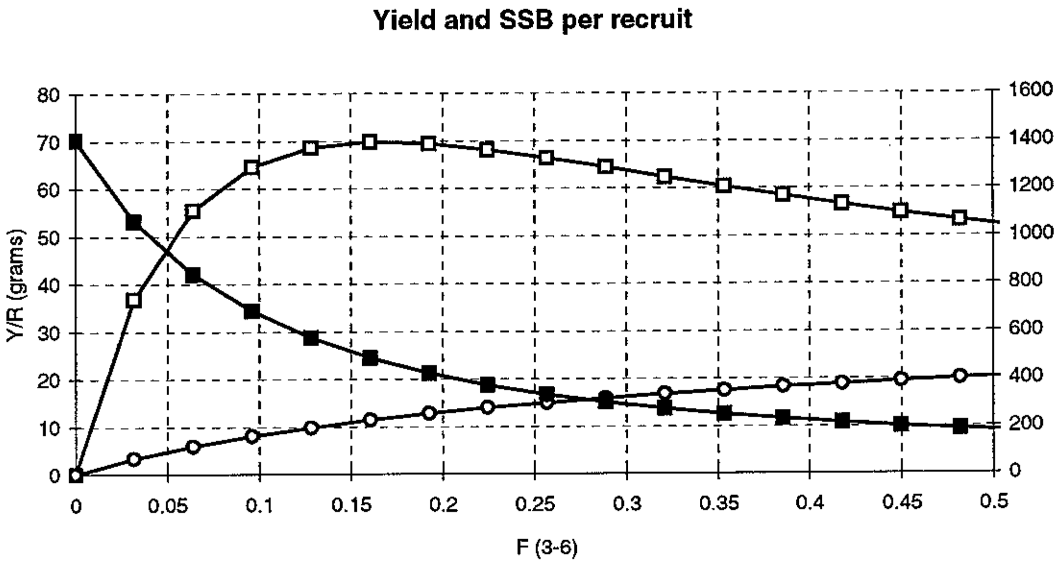
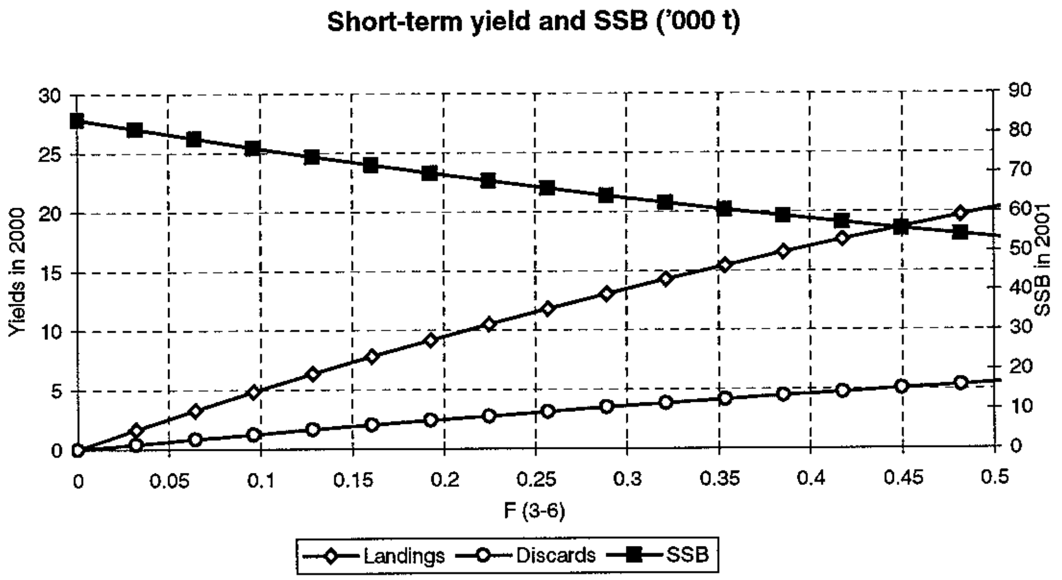
Megrim (*L. whiffiagonis*) in Sub-area VII and Divisions VIIIa,b,d,e



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





Precautionary Approach Plot

Megrim (Whiffiagonis) in VII & VIIIa,b,d,e

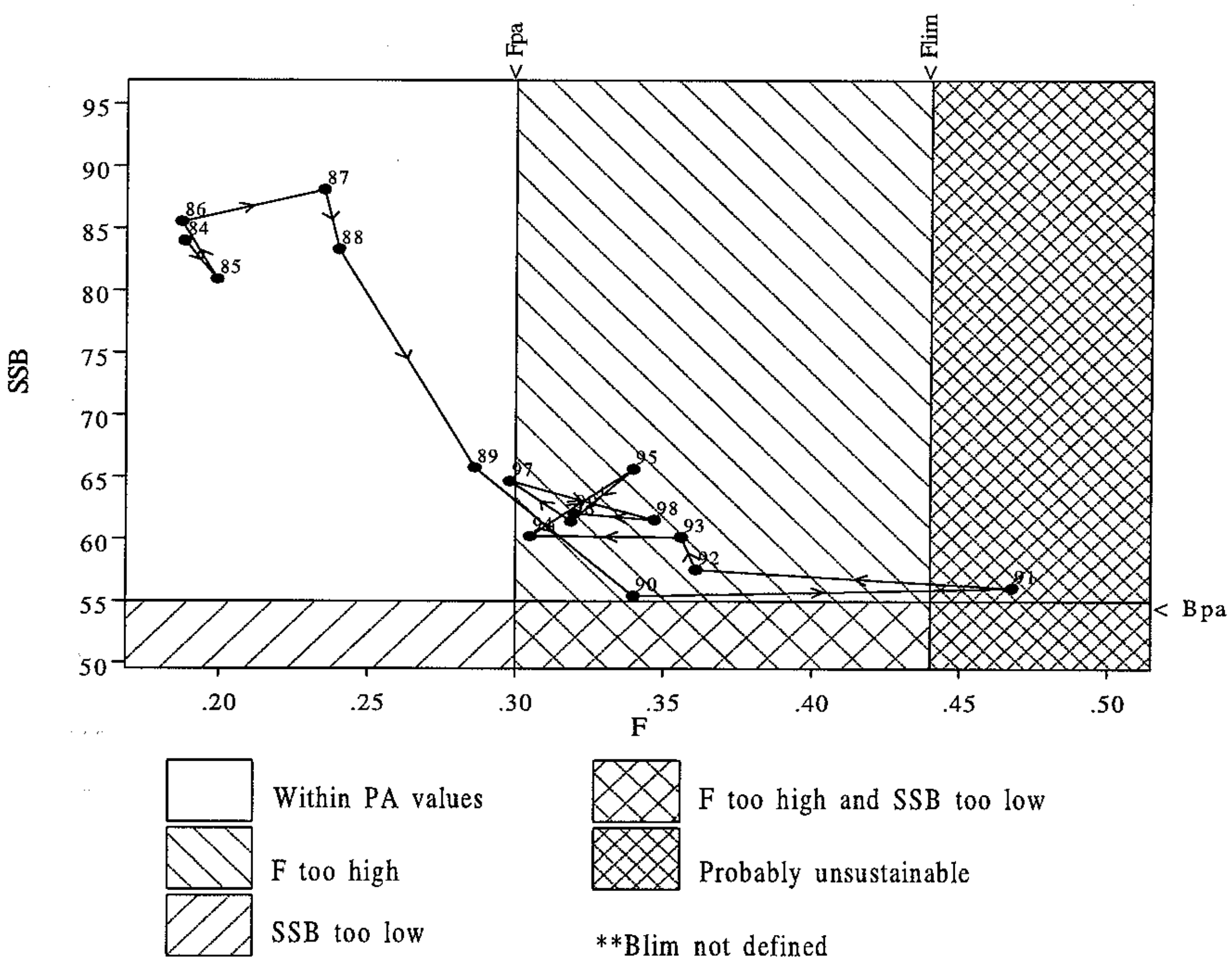


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Table 3.9.11.1 MEGRIM (*L. whiffiagonis*) in Divisions VIIb-k and VIIIa,b. Nominal landings and catches (t) provided by the Working Group.

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997*	1998**
Total landings*	17865	18927	17114	17577	19233	14371	15094	15600	14929	13685	15862	15109	14254	14345
Total discards*	1732	2321	1705	1725	2582	3284	3282	2988	3108	2700	3206	3026	3066	5371
Total catches	19597	21248	18819	19302	21815	17655	18376	18588	18037	16385	19068	18135	17320	19716
Agreed TAC [1]			16460	18100	18100	18100	18100	18100	21460	20330	22590	21200	25000	25000

[1]Includes VIIa
*Revised
**Preliminary

Table 3.9.11.2 MEGRIM (*L. whiffiagonis*) in Sub-area VII and Divisions VIIIa.b.d.e.

Year	Recruitment Age 1	Spawning Stock Biomass	Landings	Fishing Mortality Age 3-6
1984	235.67	83.96	18.83	0.188
1985	234.11	80.88	19.60	0.199
1986	213.76	85.52	21.25	0.187
1987	195.18	88.07	18.82	0.235
1988	187.21	83.28	19.30	0.240
1989	255.78	65.74	21.82	0.286
1990	293.22	55.37	17.66	0.340
1991	300.20	56.04	18.38	0.468
1992	257.66	57.49	18.59	0.361
1993	192.33	60.13	18.04	0.356
1994	203.66	60.21	16.39	0.305
1995	245.77	65.62	19.07	0.340
1996	237.81	61.40	18.14	0.319
1997	224.02	64.65	17.32	0.298
1998	232.26	61.51	19.72	0.347
1999	232.26	62.03	.	.
Average	233.81	68.24	18.86	0.298
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: These stocks are considered to be harvested outside safe biological limits. The SSB of both stocks decreased continuously from 1986 until 1993–1995, but have since increased to above the proposed $\mathbf{B}_{pa}$. For both stocks, fishing mortality has generally been above the proposed $\mathbf{F}_{pa}$ over the time series. F_{98} is estimated to be below the average but still 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 recommends that F be reduced to below $\mathbf{F}_{pa}$ for both species. This will be achieved with a reduction of fishing mortality by at least 20%, corresponding to landings of less than 22 300 t in 2000 for both species combined (14 300 t *L. piscatorius* and 8 000 t *L. budegassa*). This should bring both stocks within safe biological limits.

Relevant factors to be considered in management: *L. piscatorius* and *L. budegassa* are both caught on the same grounds by the same fleets, and are usually not separated by species in 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). The management area for this stock also includes VIIa where catches in recent years have been between 800 and 1400 t.

Catch forecast for 2000:

Basis: *L. piscatorius*: F_{99} = F(96-98) = 0.31, Catch(99) = Landings (99) = 20.3; SSB(2000) = 29.5.
L. budegassa: F_{99} = F(96-98) = 0.13, Catch(99) = Landings (99) = 10.2; SSB(2000) = 42.1.

L. piscatorius				*L. budegassa*			
F(2000)	Basis	Landings(2000)	SSB(2001)	F(2000)	Basis	Landings(2000)	SSB(2001)
0.13	0.4 F_{96-98}	7.8	32.6	0.05	0.4 F_{96-98}	4.2	45.7
0.19	0.6 F_{96-98}	11.2	29.5	0.08	0.6 F_{96-98}	6.2	44.0
0.25	0.8 F_{96-98} ~ $\mathbf{F}_{pa}$	14.3	26.7	0.10	0.8 F_{96-98} ~ $\mathbf{F}_{pa}$	8.0	42.3
0.31	1.0 F_{96-98}	17.0	24.2	0.13	1.0 F_{96-98}	9.9	40.6
0.38	1.2 F_{96-98}	19.6	22.0	0.15	1.2 F_{96-98}	11.6	39.1

Weights in '000 t.
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 is not covered 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. 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. The analytical assessment on *L. budegassa* is mostly carried on partially recruited ages due to the size of the plus group (about 50% of the catches in weight). Estimated fishing mortalities are low, leading to poor convergence of the XSA. Under these conditions, successive assessments will still give fluctuations in absolute estimates of biomass and fishing mortalities and in biological reference points.

Reference points as set in 1998:
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 no evidence of reduced 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	$\mathbf{B_{pa}}$: $\mathbf{B_{loss}}$
$\mathbf{F_{lim}}$:$\mathbf{F_{loss}}$	$\mathbf{F_{pa}}$: $\mathbf{F_{lim}}$ x 0.72

Reference points as set in 1998:
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 no evidence of reduced 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.

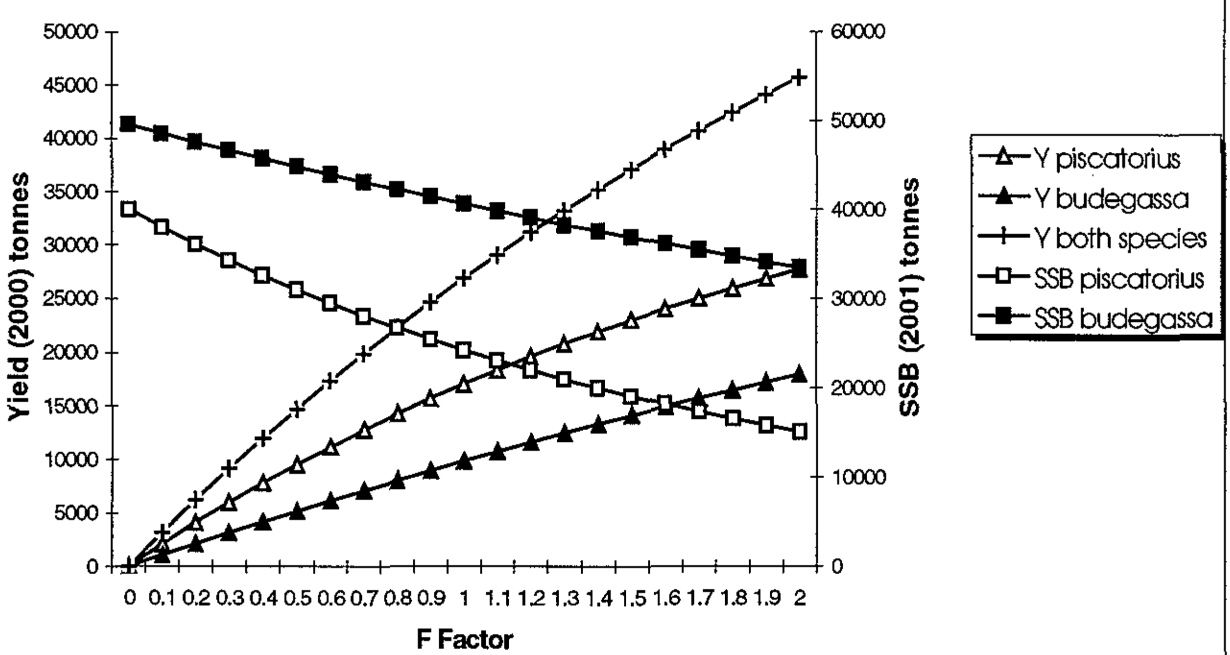
Source of information: Report of the Working Group on the Assessment of Southern Shelf Demersal Stocks, September 1999 (ICES CM 2000/ACFM:4).

Catch data (Tables 3.9.12.1–5):

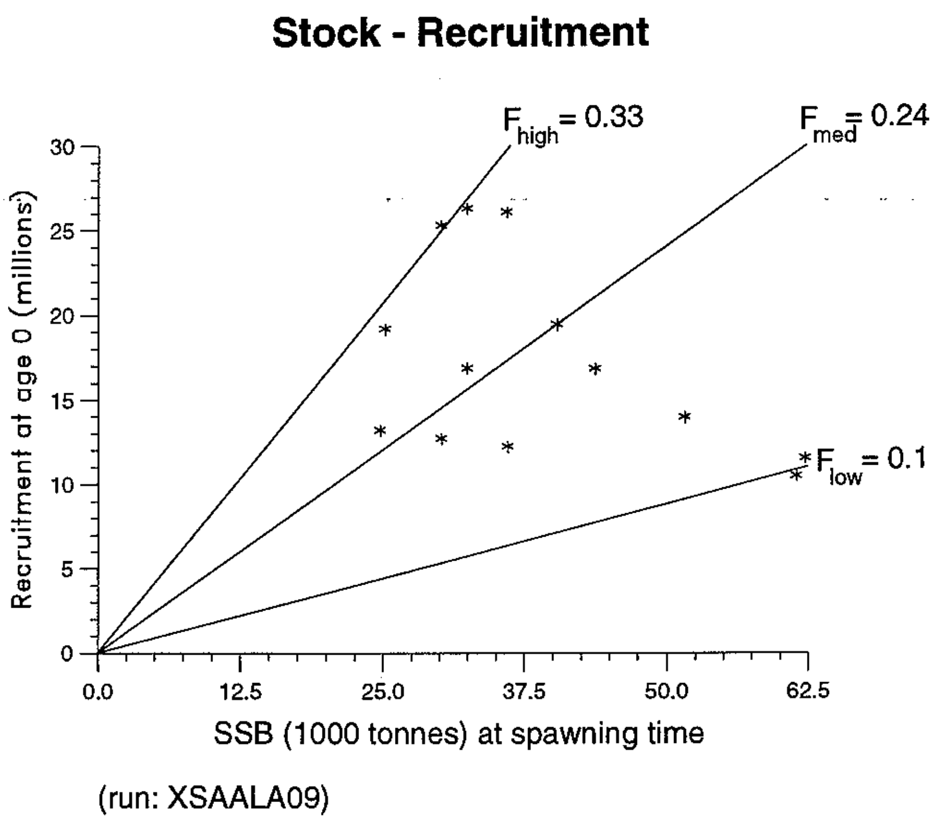
Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC[1]	ACFM Landings	Landings of *L. piscat.*	Landings of *L. budeg.*
1987	Not assessed	-	39.08	29.5	21.9	7.6
1988	Not assessed	-	42.99	28.5	20.1	8.4
1989	Not assessed	-	42.99	30.0	20.5	9.5
1990	Not assessed	-	42.99	29.3	19.7	9.6
1991	No advice	-	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 limits	-	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	29.8	21.7	8.1
1998	No increase in F	33.0	34.3	28.2	19.6	8.6
1999	No increase in F	32.9	34.3			
2000	At least 20% decrease in F	< 22.3				

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

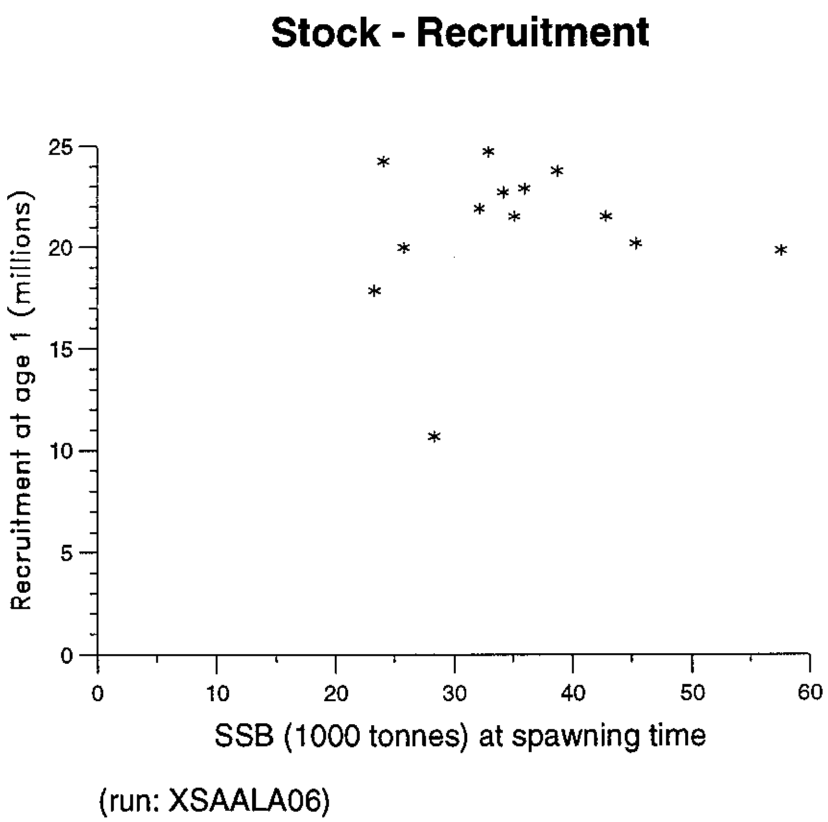
Figure 5.2.3.1 : Anglerfishes (L.piscatorius and L.budegassa) in Divisions VIIb-k and VIII a,b
Combined Short Term Forecasts assuming Status Quo in 1999

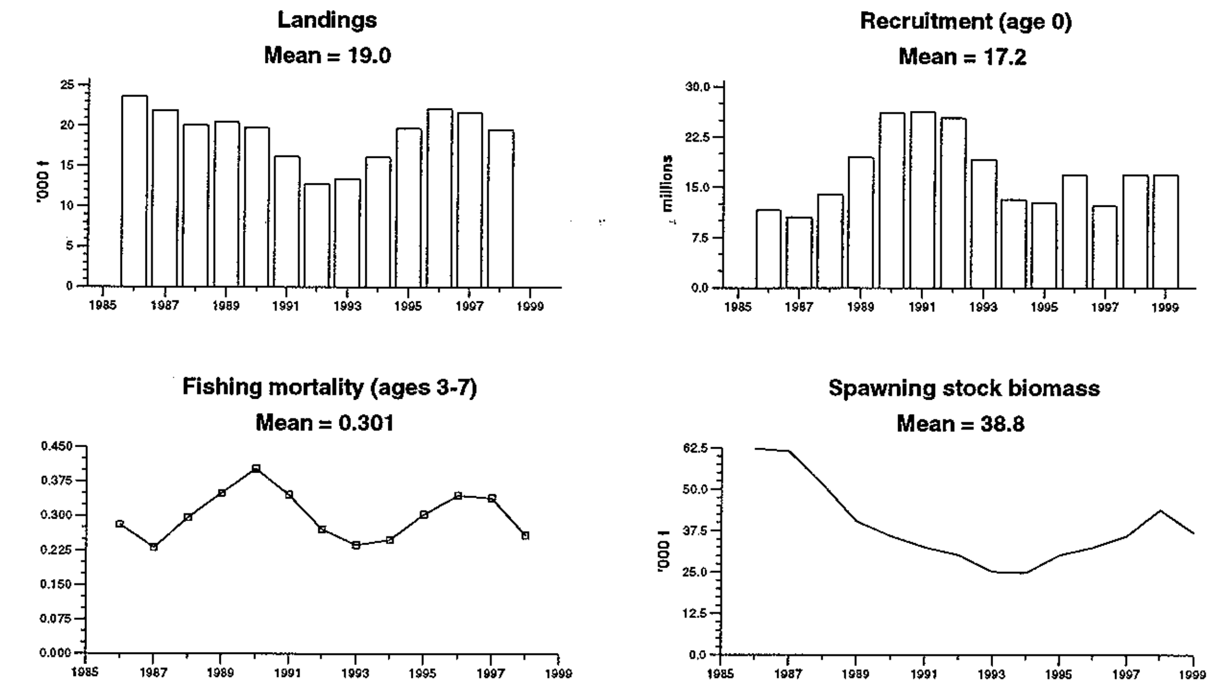


Anglerfish in Divisions VIIb–k and VIIIa,b *(L. piscatorius)*



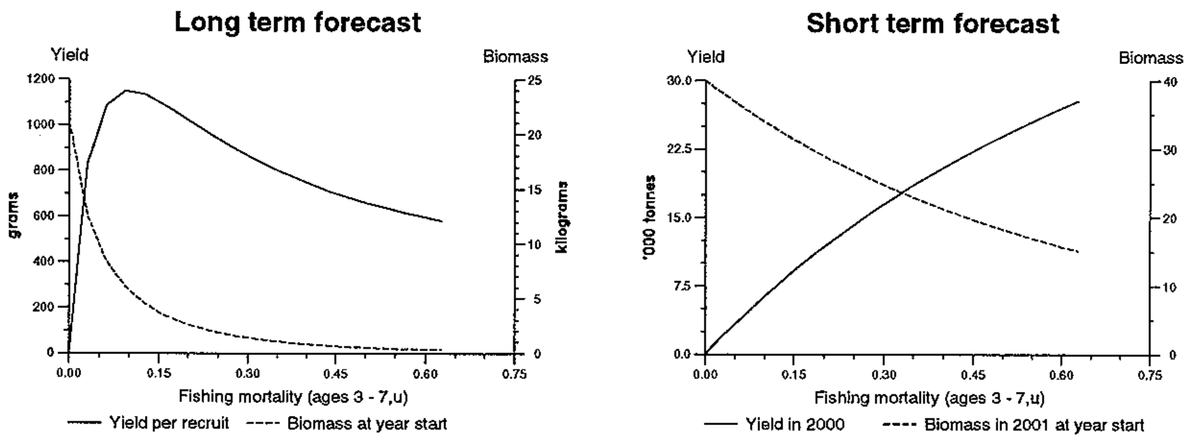
Anglerfish in Divisions VIIb–k and VIIIa,b *(L. budegassa)*

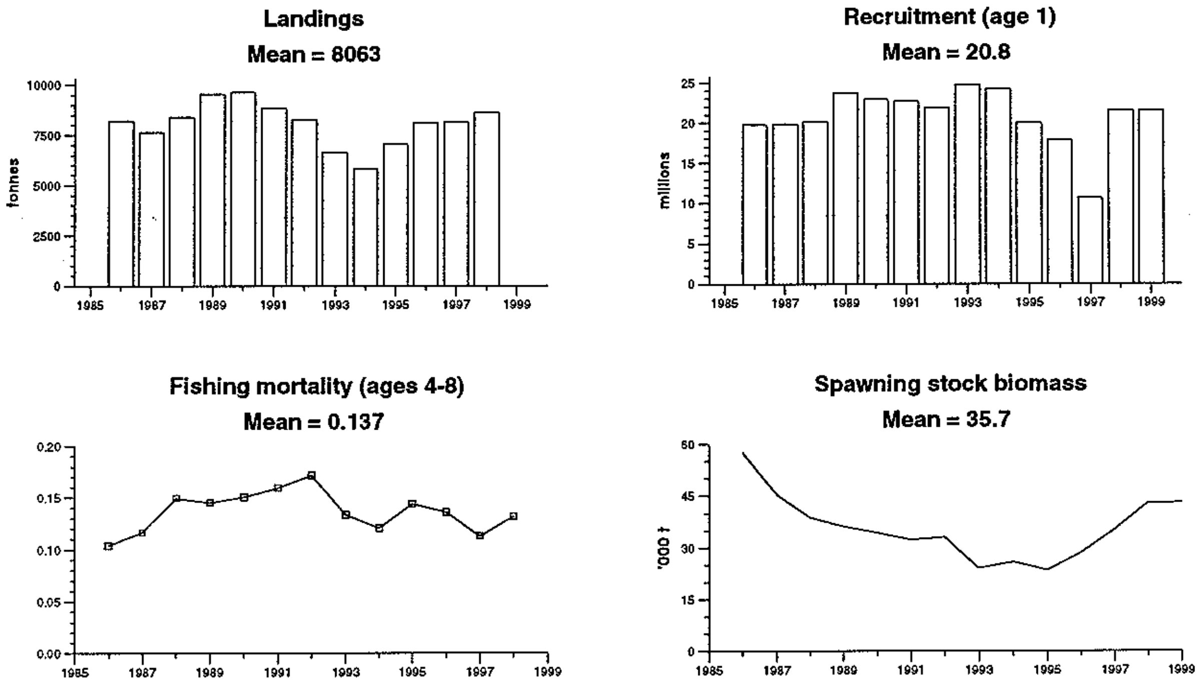




Anglerfish in Divisions VIIb–k and VIIIa,b *(L. piscatorius)*

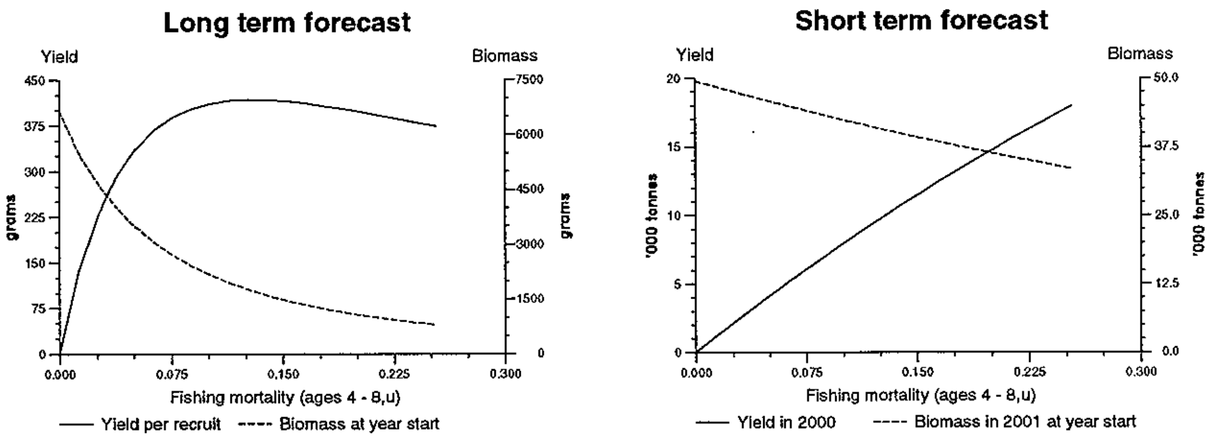
Yield and Spawning Stock Biomass



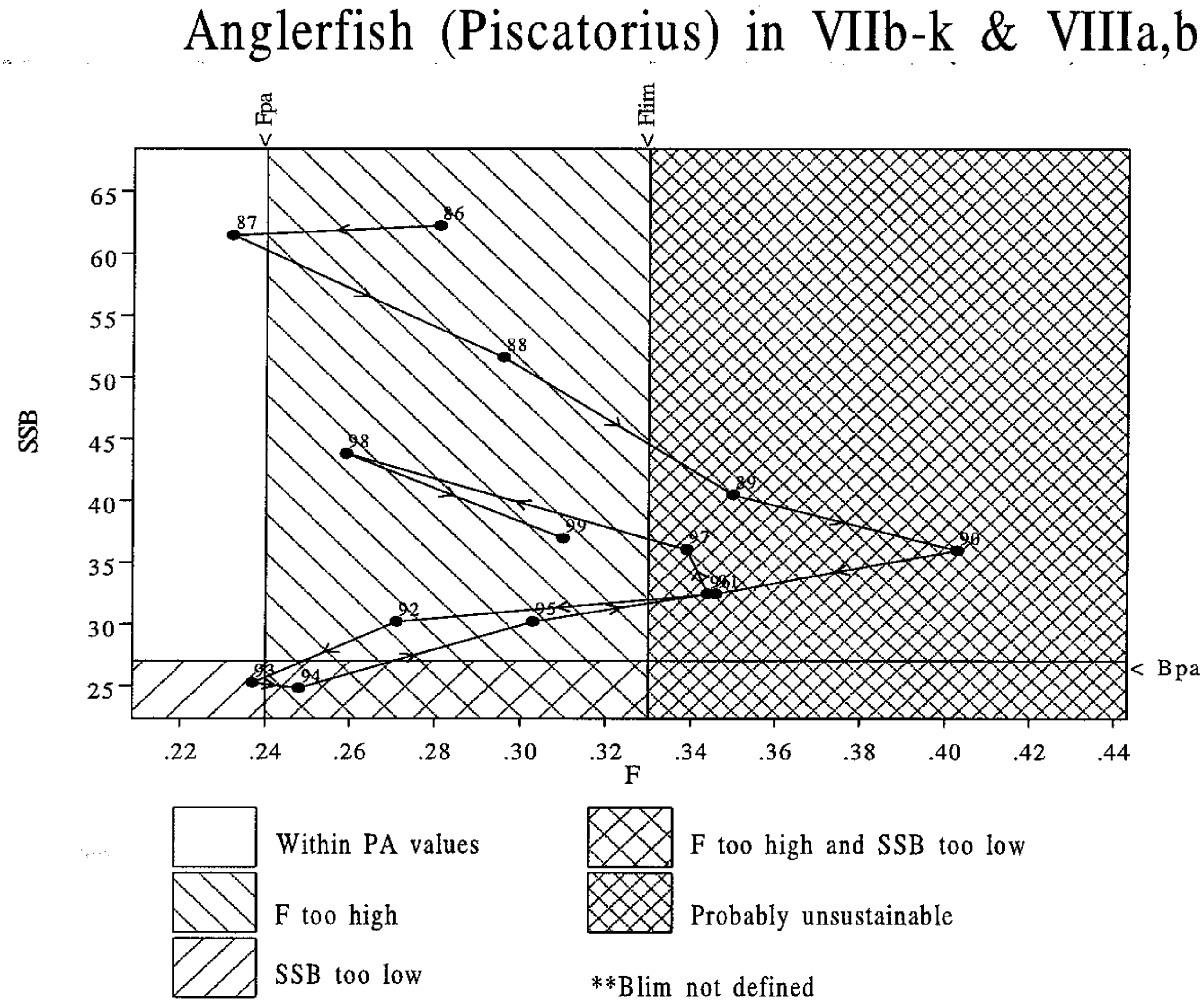


Anglerfish in Divisions VIIb–k and VIIIa,b *(L. budegassa)*

Yield and Spawning Stock Biomass



Precautionary Approach Plot



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Precautionary Approach Plot

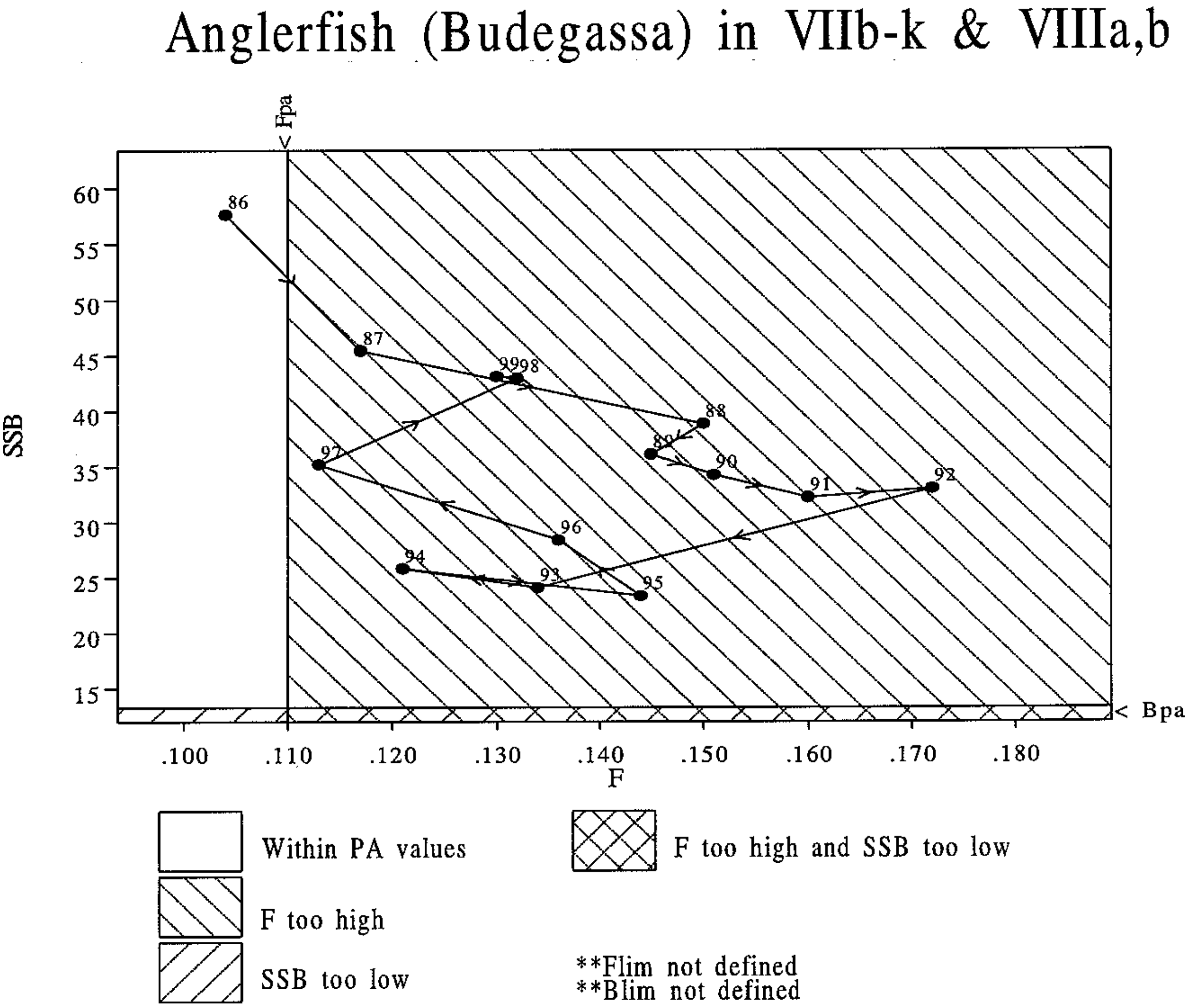

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Table 3.9.12.1 Landings (tonnes) of both ANGLERFISH in Divisions VIIb-k and VIIIa,b,d. Working Group estimates.

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*	23928	5846	29774
1998**	23295	4876	28171

*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*	17743	3917	21660
1998**	16786	2787	19572

*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*	6185	1929	8114
1998**	6510	2089	8599

*Revised.
**Preliminary.

Table 3.9.12.4 ANGLERFISH (*Piscatorius*) in Divisions VIIb-k and VIIIa,b.

Year	Recruitment Age 0	Spawning Stock Biomass	Landings	Fishing Mortality Age 3-7
1986	11.54	62.22	23.67	0.281
1987	10.51	61.46	21.91	0.232
1988	13.98	51.60	20.10	0.296
1989	19.46	40.46	20.47	0.350
1990	26.11	35.98	19.75	0.403
1991	26.31	32.46	16.23	0.346
1992	25.32	30.19	12.82	0.271
1993	19.20	25.23	13.48	0.237
1994	13.21	24.78	16.12	0.248
1995	12.71	30.20	19.73	0.303
1996	16.88	32.45	22.14	0.344
1997	12.24	36.04	21.66	0.339
1998	16.85	43.80	19.57	0.259
1999	16.85	36.95	.	.
Average	17.23	38.84	19.05	0.301
Unit	Millions	1000 tonnes	1000 tonnes	-

Table 3.9.12.5 ANGLERFISH (*Budegassa*) in Divisions VIIb-k and VIIIa,b.

Year	Recruitment Age 1	Spawning Stock Biomass	Landings	Fishing Mortality Age 4-8
1986	19.80	57.64	8.22	0.104
1987	19.85	45.41	7.62	0.117
1988	20.21	38.83	8.38	0.150
1989	23.77	36.06	9.53	0.145
1990	22.92	34.23	9.63	0.151
1991	22.73	32.21	8.84	0.160
1992	21.92	32.99	8.27	0.172
1993	24.74	24.08	6.66	0.134
1994	24.26	25.82	5.81	0.121
1995	19.99	23.34	7.05	0.144
1996	17.87	28.37	8.09	0.136
1997	10.71	35.18	8.11	0.113
1998	21.54	42.92	8.60	0.132
1999	21.54	43.09	.	.
Average	20.85	35.73	8.06	0.137
Unit	Millions	1000 tonnes	1000 tonnes	-

3.9.13.a *Nephrops* in Divisions VIIf,g,h, excluding rectangles 31 E1 and 32 E1-E2 + VIIa, south of 53° N (Management Area M)

There are three Functional Units in this Management Area: FUs 20, 21 and 22, together called the Celtic Sea.

State of stock/fishery: LPUE fell in 1989-91, slightly increased till 1995, then decreased again to 1997. VPA suggests that biomass and recruitment have been stable since 1996.

Management objectives: There are no management objectives set for this fishery.

Advice on management: There are mixed biological signals on this stock, and therefore ICES advises that the landings should not exceed the previously advised TAC of 3800 t in each of the years 2000 and 2001.

Relevant factors to be considered in management: So far, the TAC for this area has not been enforced, and this has allowed the landings to increase over 6000 t.

Attention is drawn to the fact that, as in the Irish Sea, fishing mortality on females is similar to that on males. Therefore, this stock could be more vulnerable to spawning stock depletion.

Elaboration and special comments: Landings are reported by France, Ireland and the UK. Until 1993, the French landings represented at least 80 % of the total, since then their share has dropped to roughly 65 %. Considerable increase in Irish landings, from 650-750 t in early 1990s to 1100-2000 t since. International landings decreasing since 1995.

LPUE, mean size data and length compositions of catches available. A serious delay in the processing of fishery statistics in France prevented to include the year 1998 in the assessments, as data for this year were partial only at the time of the WG meeting. Length- and age-based assessments performed on both sexes, but quality of VPA questionable due to lack of appropriate discard data for most years in the time series.

Source of information: Report of the Working Group on *Nephrops* Stocks, April 1999 (ICES CM 1999/ACFM:13).

Catch data (Tables 3.9.13.a.1-2):

Year	ICES advice	Recommended TAC	Agreed TAC [1]	ACFM landings
1987				3.4
1988				3.1
1989				3.8
1990				4.4
1991		3.83		3.3
1992		~3.8	20.0	4.3
1993		3.8	20.0	4.7
1994		3.8	20.0	5.2
1995		3.8	20.0	6.0
1996		3.8	23.0	4.5
1997		3.8	23.0	3.9
1998		3.8	23.0	3.5 [2]
1999		3.8	23.0	
2000		3.8		
2001		3.8		

(Weight in '000 t) [1] Sub-area VII [2] Highly provisional

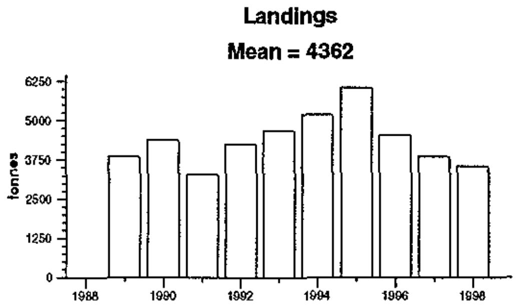


Table 3.9.13.a.1 *Nephrops* landings (tonnes) by Functional Unit plus other rectangles in Management Area M (VIIf,g,h, excluding rectangles 31 E1 and 32 E1-E2 + VIIa, South of 53° N).

Year	FUs 20-22	Other	Total
1989	3636	210	3846
1990	4123	263	4386
1991	3100	178	3278
1992	4016	236	4252
1993	4403	275	4678
1994	4901	287	5188
1995	5743	305	6048
1996	4250	281	4531
1997	3614	248	3862
1998 *	3439	108	3547
* provisional na = not available			

Table 3.9.13.a.2 *Nephrops* landings (tonnes) by country in Management Area M (VIIf,g,h, excluding rectangles 31 E1 and 32 E1-E2 + VIIa, South of 53° N).

Year	Belgium	France	Rep. of Ireland	UK	Total
1989	0	3044	784	18	3846
1990	0	3841	528	17	4386
1991	3	2617	644	14	3278
1992	0	3413	750	89	4252
1993	0	3846	770	62	4678
1994	2	3692	1426	68	5188
1995	2	3891	2031	124	6048
1996	2	3328	1115	86	4531
1997	4	2614	1149	95	3862
1998 *	1	1769	1714	63	3547
* provisional na = not available					

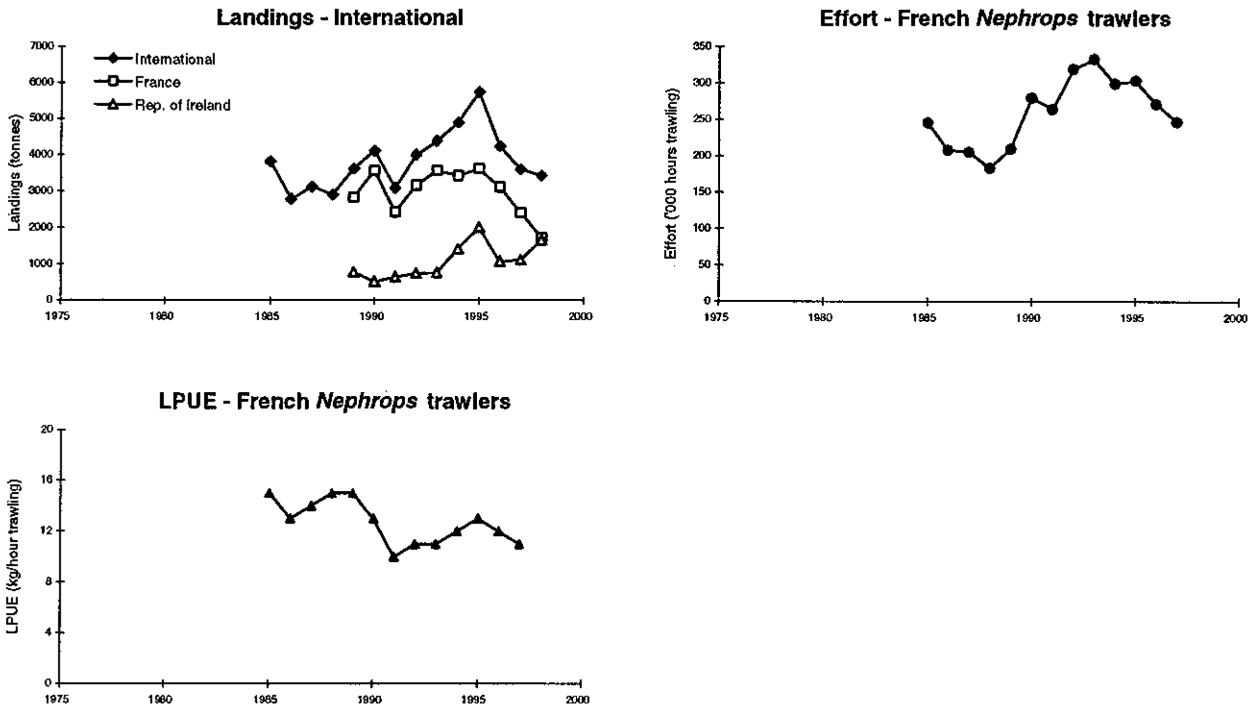


Figure 3.9.13.a.1 - Celtic Sea (FUs 20-22): Long term trends in landings, effort and LPUEs of *Nephrops* in catches and landings.

3.9.13.b *Nephrops* in Divisions VIIIa, b (Management Area N)

There are two Functional Units in this Management Area: a) Bay of Biscay North (FU 23) and b) Bay of Biscay South (FU 24).

State of stock/fishery: LPUE stable with most recent values at upper end of range. Age-based assessments suggest however that female recruitment is decreasing, while male recruitment is on the recovery after a period of decline.

Management objectives: There are no management objectives set for this fishery.

Advice on management: There are conflicting signals on the state of this stock, and therefore ICES advises that fishing effort should not be allowed to increase above its current level, which corresponds to a TAC of 4200 t (average landings for 1994–96).

Relevant factors to be considered in management: As part of the new technical regulations, that will become in force in the year 2000, the mesh size in this fishery will go up from 55 to 70 or 80 mm. It can be expected that the upcoming increase in mesh size, together with the proposed TAC reduction, will help this stock to recover.

Attention is drawn to the fact that increases in gear efficiency (following the use of twin trawls and rock hoppers, which made trawling possible in areas that were previously inaccessible, and which helped maintaining LPUE despite the decline of the stock) can reduce the expected benefits of the upcoming mesh size increase.

Elaboration and special comment: Nearly all landings from FUs 23 and 24 are taken by French trawlers. This is mostly a mixed fishery, with juvenile hake as a by-catch. Landings fluctuated until 1995, decreasing since then. Effort decreasing since 1994.

LPUE, mean sizes and length compositions of landings available. Length- and age-based assessments made for both sexes, but quality of VPA questionable due to lack of appropriate discard data for most years in the time series. As for the Celtic Sea, the delay in the processing of French fishery statistics prevented to include the year 1998 in the assessments.

Source of information: Report of the Working Group on *Nephrops* Stocks, April 1999 (ICES CM 1999/ACFM:13).

Catch data (Tables 3.9.13.b.1–2)

Year	ICES advice	Recommended TAC	Agreed TAC	ACFM landings
1987			7.5	5.7
1988			7.5	6.8
1989			7.5	5.4
1990			7.5	5.0
1991		5.19	6.5	4.8
1992		~6.8	6.8	5.7
1993		6.8	6.8	5.0
1994		6.8	6.8	4.1
1995		6.8	6.8	4.5
1996	*Status quo* TAC	6.8	6.8	4.1
1997	*Status quo* TAC	6.8	6.8	3.6
1998		4.2	5.5	2.2 [1]
1999		4.2	5.5	
2000		4.2		
2001		4.2		

(Weights in '000 t) [1)] Highly provisional

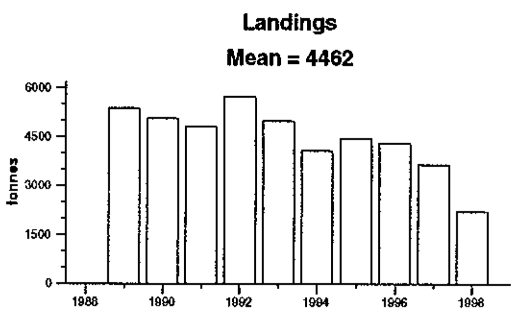
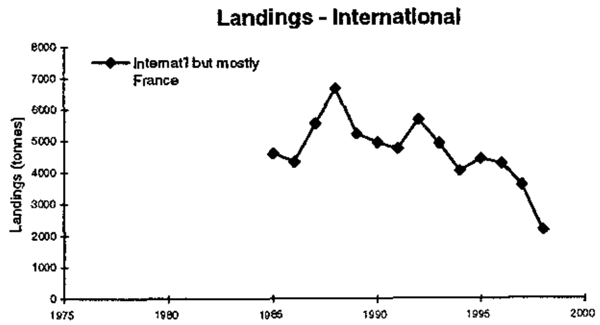


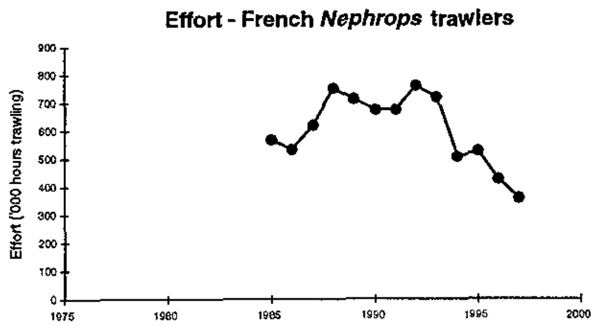
Table 3.9.13.b.1 *Nephrops* Landings (tonnes) by Functional Unit plus other rectangles in Management Area N (VIIIa,b).

Year	FU 23	FU 24	Other	Total
1989	4600	630	142	5372
1990	4603	358	88	5049
1991	4352	401	55	4808
1992	5123	558	47	5728
1993	4404	512	49	4965
1994	3687	368	27	4082
1995	4060	379	14	4453
1996	4205	88	15	4308
1997	3451	147	43	3641
1998 *	2167	5	42	2214
* provisional	na = not available			

Table 3.9.13.b.2 *Nephrops* landings (tonnes) by country in Management Area N (VIIIa,b).

Year	Belgium	France	Spain	Total
1989	0	5295	77	5372
1990	1	4961	87	5049
1991	1	4753	55	4808
1992	0	5681	47	5728
1993	0	4916	49	4965
1994	1	4055	27	4082
1995	0	4439	14	4453
1996	0	4293	15	4308
1997	2	3598	41	3641
1998 *	2	2172	40	2214
* provisional	na = not available			





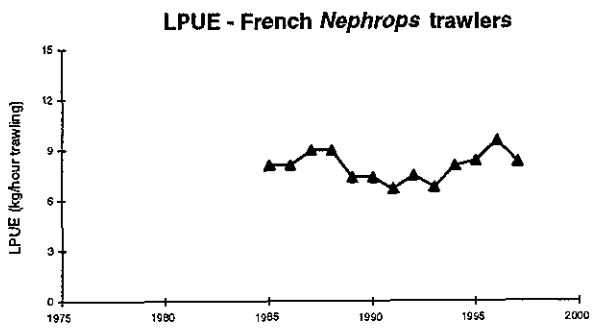


Figure 3.9.13.b.1 - Bay of Biscay (FUs 23-24): Long term trends in landings, effort and LPUEs of *Nephrops* in catches and landings.

3.9.13.c *Nephrops* in Divisions VIIId, e (Management Area P)

Advice on management: There are no reported landings of *Nephrops* from this area, so it is suggested that a zero TAC be set to prevent mis-reporting.

Source of information: Report of the Working Group on *Nephrops* Stocks, April 1999 (ICES CM 1999/ACFM:13).

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.

Landing figures for these ICES Divisions are difficult to interpret as several countries differ in the manner in which they report their landings data for the various ICES Divisions.

Other species taken in the area are herring, mackerel and blue whiting (See Sections 3.10.3, 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 1999 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 1997 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 2.5 in the 1997 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 Table 3.10.2.1.

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	1998
France	591	474	206	112	40	118	155	91	115	81	48*
Germany, Fed. Rep.	-	1	-	-	-	-	-	-	-	3	-
Ireland	388	915	795	612	507	357	289	282	353	177	180*
Norway	2	9	29	11	39	+	6	3	1	6	-
Spain	-	-	-	-	-	-	-	6	3		
UK (England and Wales)[1]	23	7	12	33	62	17	29	25	35	37	-
UK (Scotland)	5	34	300	177	148	73	93	66	12	7	-
UK											32
Total	1009	1440	1342	945	796	565	572	473	519	364	260

* Preliminary [1] 1989-1998 N. Ireland included with England and Wales.

WHITING Landings, Divisions VIIb,c

Country	1988	1989	1990	1991	1992	1993	1994	1995*	1996	1997	1998
France	113	56	63	40	30	31	26	57	76	65	53*
Germany, Fed. Rep.	+	-	-	-	-	-	-	-	-	-	
Ireland	922	1199	770	540	730	826	1042	1894	1233	403	354*
UK (England and Wales) [1]	12	2	2	14	14	23	18	24	96	75	-
UK (Scotland)	+	32	36	80	155	147	117	71	17	4	-
UK											76
Total	1047	1289	871	674	929	1027	1203	2046	1422	547	483

* Preliminary [1] 1989-1997 N. Ireland included with England and Wales.

SOLE Landings, Divisions VIIb,c

Country	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
France	2	+	-	5	1	1	1	2	2	3	2*
Ireland	34	38	41	46	43	59	60	59	52	51	54*
UK (England and Wales) [1]	1	+	+	+	+	-	-	-	+	1	+
Total	37	38	41	51	44	60	61	61	54	55	56

* Preliminary [1] 1989-1997 N. Ireland included with England and Wales.

PLAICE Landings, Divisions VIIb,c

Country	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
France	9	1	11	9	3	2	1	5	1	3	4*
Ireland	157	159	130	179	180	191	200	239	248	206	169
UK (England and Wales) [1]	2	1	2	-	6	1	2	1	2[2]	+	-
UK (Scotland)	+	13	90	3	3	2	3	1	-	+	-
UK											2
Total	168	174	233	191	192	196	206	246	251	209	175

* Preliminary [1] 1989-1997 N. Ireland included with England and Wales. [2] Revised

SOLE Landings, Divisions VIIh-k

Country	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Belgium	-	-	-	-	-	-	-	-	-	51	91
France	37	51	71	47	43	44	42	47	50	58	51*
Ireland	82	206	266	306	255	237	184	243	183	203	210*
UK (E/W/NI)	166	177	144	234	215	209	172	192	148	113	-
UK (Scotland)	-	-	+	-	2	5	2	-	+	-	-
UK											111
Total	285	434	481	587	516	495	400	482	411	425	463

* Preliminary

PLAICE Landings, Divisions VIIh-k

Country	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Belgium	-	-	-	-	-	-	-	-	-	49	74
Denmark	+	+	-	+	-	+	-	+	-	-	-
France	96	112	113	88	90	64	48	60	48	69	53*
Ireland	369	454	338	478	477	383	271	321	305	344	278*
Netherlands	-	-	-	-	-	-	-	-	52	-	13
UK (E/W/NI)	433	73	88	287	264	218	258	282	154	138	-
UK (Scotland)	1	-	1	+	6	7	1	4	1	+	-
UK											107
Total	899	639	540	853	837	672	568	667	560	600	525

* Preliminary

3.10.2.a Haddock in Divisions VIIb-k

State of stock/fishery: Unknown.

Management advice: ICES recommends that a management plan including monitoring of the development of the stock and of the fishery should be developed and implemented. ICES recommends that there be no increase in catch until the response of the stock to the fishery is known.

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 TAC currently includes an additional allocation for area VIIa. The current TAC is not restrictive on catches from this area and creates the opportunity for misreporting from other areas.

Elaboration and special comment: Catches of haddock are recorded along the entire western seaboard of the British Isles, with concentrations off the west coast of Scotland, off the NW coast of Ireland, in the Celtic Sea and in the western Irish sea. The extent of mixing between these areas is not presently known. However, recent patterns of recruitment and growth differ between areas.

An assessment was attempted but the results were not considered to be a valid basis for scientific advice.

Source of information: Report of the Working Group on the Assessment of Northern Shelf Demersal Stocks, June 1999 (ICES CM 2000/ACFM:1).

Catch data (Tables 3.10.2.a.1-2):

Year	ICES advice	Predicted catch corresp. to advice	Agreed TAC[1]	Official landings[2]	ACFM landings
1987	Not dealt with			3.0	1.3
1988	Not dealt with			4.0	0.7
1989	Not dealt with			4.2	0.6
1990	Not dealt with			2.9	0.6
1991	Not dealt with			2.6	0.6
1992	Not dealt with			2.9	0.7
1993	Not dealt with			3.4	3.2
1994	Not dealt with			4.1	3.7
1995	Not dealt with		6	4.5	4.1
1996	Not dealt with		7[3]	6.6	6.2
1997	Not dealt with		14	10.2	9.7
1998	Not dealt with		20	4.3[4]	6.8
1999	Not dealt with		22[5]		
2000	No expansion of catches				

[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. [5]Includes separate Division VIIa allocation of 4,990 t. Weights in 000' tonnes.

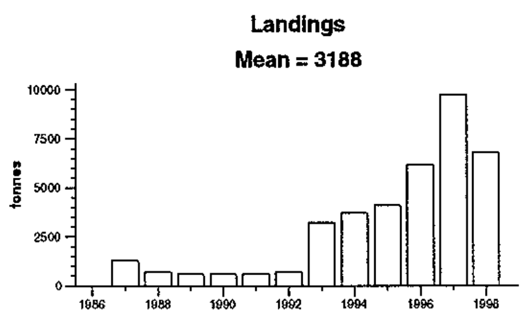


Table 3.10.2.a.1 Nominal landings of HADDOCK in Divisions VIIb,c,e-k, 1984-1998, as officially reported to ICES.

Country	1984	1985	1986	1987	1988	1989	1990	1991
Belgum		4	6	12	64	117	22	18
France	3328	2438	2279	2380	3275	3412[a]	2110[a]	1247
Ireland	646	794	317	314	275	323	461	1020
Norway	17	4	86			27	31	38
Spain	532	561						
UK (Channel Islands)								
UK (England & Wales)	340	168	188	194	405	278	123	137
UK (Scotland)	63	7	57	79	4	17	195	113
Total	4926	3976	2933	2979	4023	4174	2942	2573
Unallocated								
Total figures used by Working Group								

Country	1992	1993	1994	1995	1996	1997	1998*
Belgum	21	51	123	189	133	246	142
France	1461	1839	2788	2964	4527	6581	3674
Ireland	1073	1262	908	966	1468	2789	n/a
Norway	26		17	64	38*	31*	49
Netherlands							3
Spain				19			
UK (Channel Islands)		-	1		44		-
UK (England & Wales)	220	189	192	228	388	554	-
UK (Scotland)	86	67	47	38	7	15	-
United Kingdom							442
Total	2887	3408	4076	4468	6605	10216	4310
Unallocated		-180	-374	-364	-429	-473	2498
Total figures used by Working Group	-	3228	3702	4104	6176	9743	6808

* Preliminary
[a] Reported as total landings for Sub-areas VII & VIII
n/a = not available

Table 3.10.2.a.2 HADDOCK in Divisions VIIb-k.

Year	Landings
1987	1,300
1988	700
1989	600
1990	600
1991	600
1992	700
1993	3,228
1994	3,702
1995	4,104
1996	6,176
1997	9,743
1998	6,808
Average	3,188
Unit	tonnes

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

State of the stock/fishery: The stock is considered to be outside safe biological limits. Although the assessment of the stock is imprecise, it indicates that the SSB is probably below the proposed $\mathbf{B_{pa}}$ and close to its historical low. F is at an historical high and is substantially in excess of the proposed $\mathbf{F_{pa}}$. There has been a decreasing trend in the stock which is particularly evident in the "component" which spawns in the autumn.

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 the proposed $\mathbf{F_{pa}}$ and spawning stock biomass should be greater than the proposed $\mathbf{B_{pa}}$.

Advice on management: ICES recommends that F should be reduced to the proposed $\mathbf{F_{pa} = 0.22}$ corresponding to a catch in 2000 of 13 900 t. If it is not possible to achieve this in a single year, a multi-annual recovery plan to reduce the fishing mortality rate as rapidly as possible should be agreed.

Proposed reference points: As there has been no new information the proposed reference points remain unaltered.

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

Reference points:

ICES considers that:	ICES proposes that:
$\mathbf{B_{lim}}$ is 81 000 t	$\mathbf{B_{pa}}$ be set at 110 000 t
$\mathbf{F_{lim}}$ is 0.33	$\mathbf{F_{pa}}$ be set at 0.22

Technical basis:

$\mathbf{B_{lim}}$: Lowest reliable estimated SSB	$\mathbf{B_{pa}}$: Approximately 1.4 $\mathbf{B_{lim}}$
$\mathbf{F_{lim}}$: $\mathbf{F_{loss}}$	$\mathbf{F_{pa}}$: = $\mathbf{F_{med98}}$

Relevant factors to be considered in management: The fishery now exploits a mixture of autumn- and winter/spring- spawning fish. The ratio of winter/spring:autumn spawners appears to have increased in recent years. The winter/spring 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 2000: Basis: F(99) = F(98) =0.60, Catch(99) = 35 900 t, SSB(99) = 75 400 t and recruitment of 787 million at age 1 in 1999.

Basis	F(2000 onward)	SSB(2000)	Landings (2000)	SSB(2001)
0.3F(980	0.18	92 000	11 700	120 000
0.37F(98) = F_{pa}	0.22	86 700	13 900	101 200
0.6F(98)	0.36	80 900	21 400	88 200
0.7F(98)	0.42	78 500	24 400	83 200
0.8F(98)	0.48	76 300	27 300	78 700
1.0F(98)	0.60	71 900	32 600	70 500

Shaded scenarios considered inconsistent with the precautionary approach.

Elaboration and special comments: The most recent assessment was carried out by assuming various terminal F values on the catch at age data. This was carried out on both "components" separately and on the overall catch data. The results suggest that there has been a rising trend in F on the autumn component but it is not possible to estimate recent values. The absence of adequate fishery independent data prevents the reliable estimation of recent stock trends. It is essential to initiate a programme of fishery independent stock size estimates if adequate management is to be implemented.

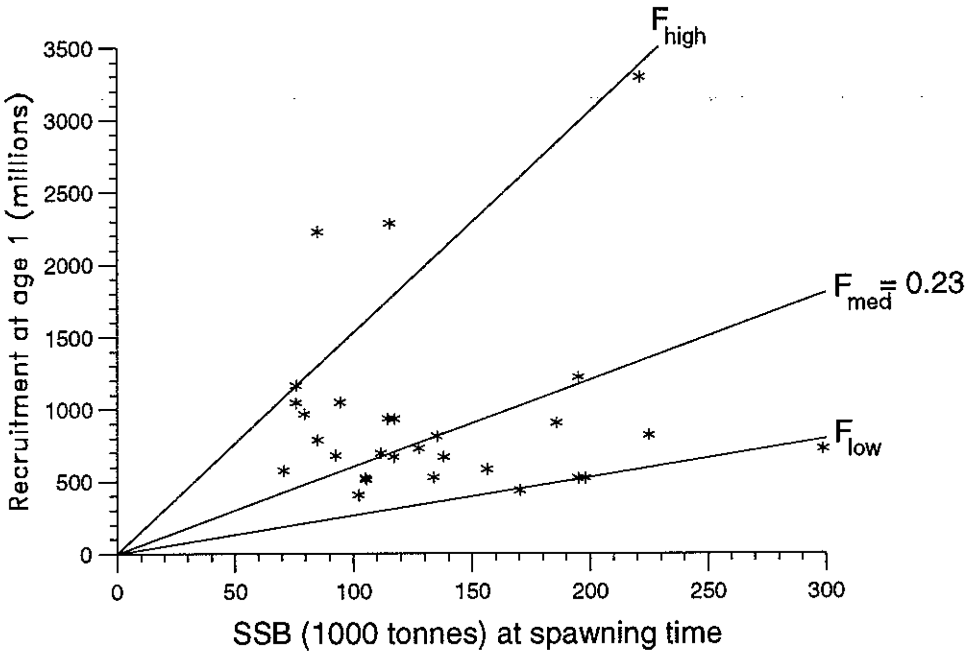
Source of information: ACFM Working Document and Report of the Herring Assessment Working Group for the Area South of 62°N, March 1999 (ICES CM 1999/ACFM:12).

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	0.3	37
1994	Precautionary TAC	28	28	27	0.7	34
1995	Precautionary TAC (including discards)	36	28	27	-	28
1996	If required, precautionary TAC	34	28	25	-	33
1997	Catches below 25	< 25	28	28	0.1	27
1998	Catches below 25	< 25	28	28	-	39
1999	F 70% of F(97)	19	21			
2000	F 40% of F(98) =Proposed $\mathbf{F}_{pa}$	14				

Weights in '000 t.

Stock - Recruitment



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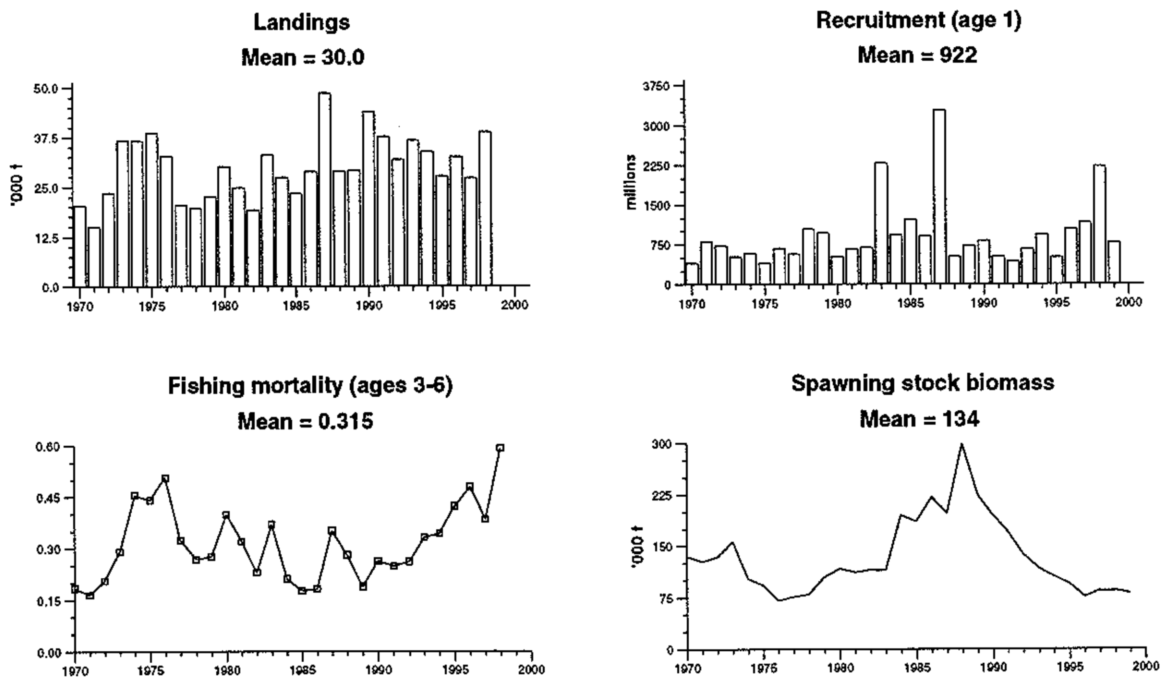
Herring in Divisions VIa (South) and VIIb,c



Herring in Divisions VIa (South) & VIIb,c

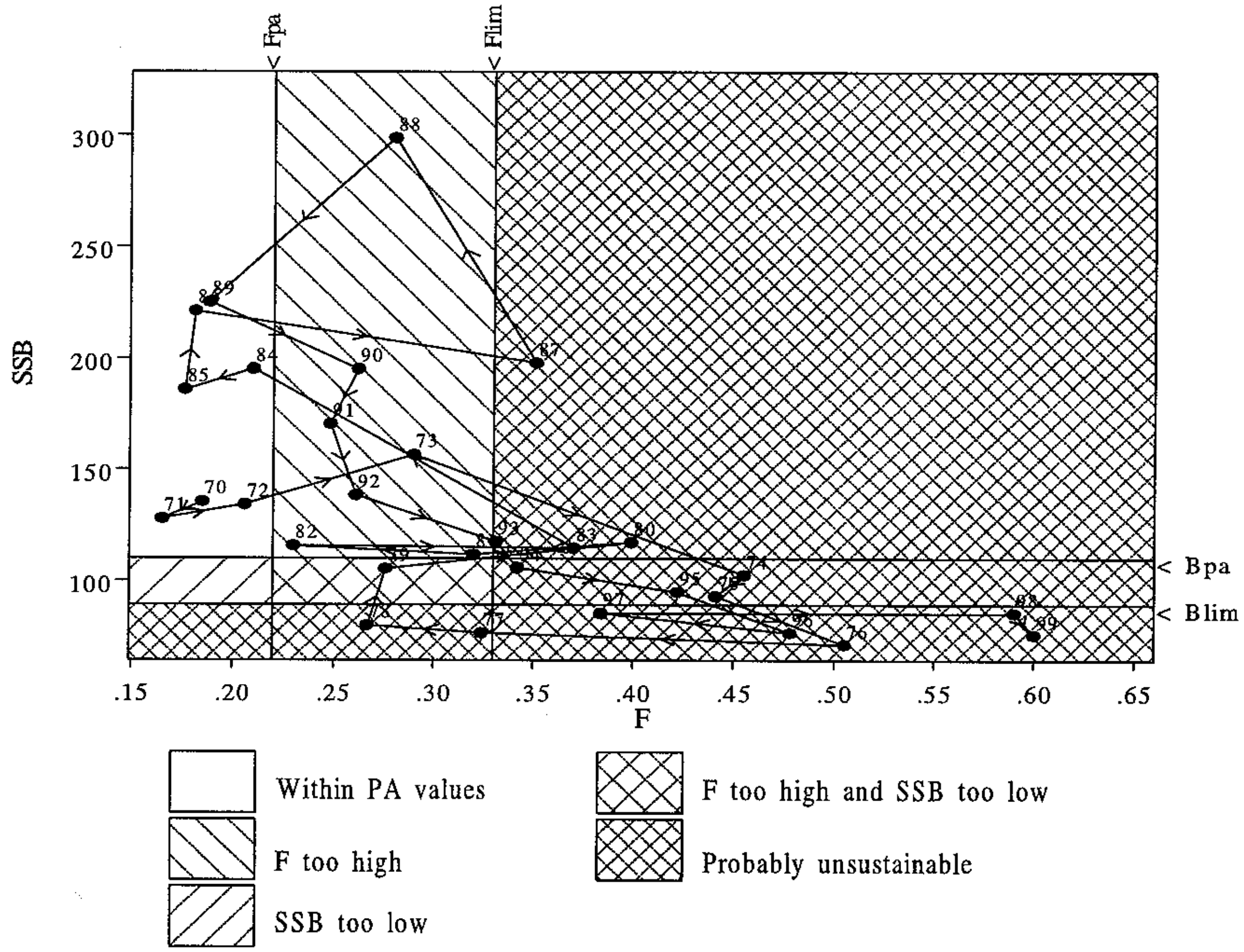


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Table 3.10.3.1 Estimated herring catches in tonnes in Divisions VIa (South) and VIIb,c, 1987–1998. These figures do not in all cases correspond to the official statistics and cannot be used for management purposes.

Country	1987	1988	1989	1990	1991	1992
France	-	-	-	+	-	-
Germany, Fed.Rep.	-	-	-	-	-	250
Ireland	15,000	15,000	18,200	25,000	22,500	26,000
Netherlands	1,550	300	2,900	2,533	600	900
UK (N.Ireland)	5	-	-	80	-	-
UK (England & Wales)	51	-	-	-	-	-
UK (Scotland)	-	-	+	-	+	-
Unallocated	31994	13,800	7,100	13,826	11,200	4,600
Total landings	48,600	29,100	28,200	41,439	34,300	31,750
Discards	-	-	1,000	2,530	3,400	100
Total catch	48,600	29,100	29,200	43,969	37,700	31,850

Country	1993	1994	1995	1996[1]	1997	1998[1]
France	-	-	-	-	-	-
Germany, Fed.Rep.	-	-	11	-	-	-
Ireland	27,600	24,400	25,450	23,800	24,400	25,200
Netherlands	2,500	2,500	1,207	1,800	3,400	2,500
UK (N.Ireland)	-	-	-	-	-	-
UK (England & Wales)	-	50	24	-	-	-
UK (Scotland)	200	-	-	-	-	-
Unallocated	6,250	6,250	1,100	6,900	-700	11,200
Total landings	36,550	33,200	27,792	32,500	27,100	38,900
Discards	250	700	-	-	50	-
Total catch	36,800	33,900	27,792	32,500	27,150	38,900

[1]Provisional according to text.

Table 3.10.3.2 Herring in Divisions VIa (South) and VIIb,c.

Year	Recruitment Age 1	Spawning Stock Biomass	Landings	Fishing Mortality Age 3-6
1970	404.05	135.36	20.31	0.185
1971	814.98	127.61	15.04	0.165
1972	730.94	133.97	23.47	0.206
1973	529.46	156.43	36.72	0.290
1974	585.70	102.34	36.59	0.455
1975	405.69	92.80	38.76	0.441
1976	680.05	70.87	32.77	0.505
1977	574.92	76.07	20.57	0.324
1978	1,045.20	79.68	19.72	0.267
1979	967.07	105.16	22.61	0.276
1980	521.74	117.07	30.12	0.399
1981	670.66	111.59	24.92	0.320
1982	695.47	115.46	19.21	0.230
1983	2,285.12	114.61	32.99	0.370
1984	935.60	195.07	27.45	0.210
1985	1,221.36	185.72	23.34	0.176
1986	906.00	221.13	28.79	0.181
1987	3,293.80	197.81	48.60	0.351
1988	524.08	298.61	29.10	0.280
1989	724.76	225.07	29.21	0.188
1990	820.66	194.97	43.97	0.262
1991	522.62	170.24	37.70	0.248
1992	440.14	138.13	31.86	0.261
1993	671.07	117.35	36.76	0.331
1994	934.01	105.63	33.91	0.342
1995	512.32	94.61	27.79	0.422
1996	1,047.39	76.23	32.53	0.478
1997	1,165.36	85.11	27.23	0.384
1998	2,228.11	85.19	38.90	0.590
1999	787.30	80.30	.	.
Average	921.52	133.67	30.03	0.315
Unit	Millions	1000 tonnes	1000 tonnes	-

3.10.4 *Nephrops* in Divisions VIIb,c,j,k (Management Area L)

There are four Functional Units in this Management Area: a) Porcupine Bank (FU 16), b) Aran Grounds (FU 17), c) Ireland NW coast (FU 18) and d) Ireland SW and SE coast (FU 19).

State of stock/fishery:

a) Porcupine Bank: LPUE of Spanish fleet slowly increased until 1994-95, but has since fallen. LPUE of French fleet at much higher levels than in early 1990s, but showing signs of a decrease.

b) Aran Grounds: Insufficient data to allow assessment.

c) Ireland coastal stocks: Insufficient data to allow assessment.

Management objectives: There are no management objectives set for this fishery.

Advice on management: There is no basis to revise the advice given for 1993–99 and therefore ICES advises that a TAC of 4000 t be set for each of the years 2000 and 2001.

Relevant factors to be considered in management: It should be noted that this Management Area includes four FUs and that a TAC set for the entire area will not necessarily result in balanced exploitation between the units. At present, this Management Area is within a much larger TAC area where the problem referred to will be even greater.

Elaboration and special comments: Fleets from France, Ireland, Spain and UK are involved in the *Nephrops* fishery on Porcupine Bank. Landings from the other FUs mostly by Republic of Ireland. Spanish landings from FU 16 continue to decrease, while French, Irish and UK landings increase. Total landings from Porcupine peaked in the early 1980s, but have decreased since. International landings from the Management Area as a whole have increased since 1993, exceeding the recommended TAC in 1994, 1995, 1996 and 1998.

CPUE, LPUE and mean size data available for Porcupine Bank, and limited mean size data for the Aran Grounds. Length-based Y/R assessments were carried out for the Porcupine Bank and the Aran Grounds.

Source of information: Report of the Working Group on *Nephrops* Stocks, April 1999 (ICES CM 1999/ACFM:13).

Catch data (Tables 3.10.4.1–2):

Year	ICES advice	Recommended TAC	Agreed TAC [1]	ACFM landings
1987				4.5
1988				3.9
1989				4.0
1990				3.1
1991		5.09		3.4
1992		3.8	20.0	3.7
1993		~4.0	20.0	3.6
1994		~4.0	20.0	4.3
1995		~4.0	20.0	5.0
1996	*Status quo* TAC	4.0	23.0	4.1
1997	*Status quo* TAC	4.0	23.0	3.7
1998		4.0	23.0	4.6
1999		4.0	23.0	
2000		4.0		
2001		4.0		

(Weights in '000 t) [1] Sub-area VII

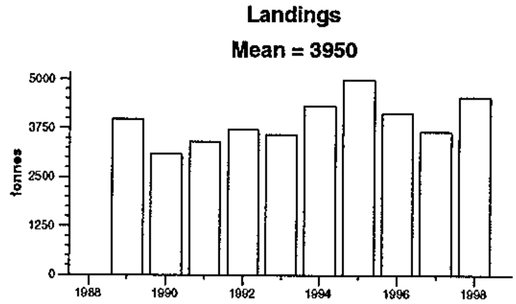


Table 3.10.4.1 *Nephrops* landings (tonnes) by Functional Unit plus other rectangles in Management Area L (VIIb,c,j,k).

Year	FU 16	FU 17	FU 18	FU 19	Other	Total
1989	2108	828	11	898	143	3988
1990	1883	345	5	754	114	3101
1991	1613	519	0	1077	196	3405
1992	1968	412	1	888	454	3723
1993	1826	372	10	904	486	3598
1994	2482	729	126	390	599	4326
1995	2933	933	25	405	694	4990
1996	2504	506	51	470	606	4137
1997	2040	813	16	261	550	3680
1998 *	1780	1427	58	703	588	4556
* provisional na = not available						

Table 3.10.4.2 *Nephrops* landings (tonnes) by country in Management Area L (VIIb,c,j,k).

Year	France	Rep. of Ireland	Spain	UK	Total
1989	583	1827	1505	73	3988
1990	544	1060	1436	59	3101
1991	590	1519	1152	144	3405
1992	909	1351	1139	325	3723
1993	1039	1310	1075	175	3598
1994	1322	1716	1069	218	4326
1995	1500	2446	767	275	4990
1996	1216	1729	875	317	4137
1997	1123	1667	554	334	3680
1998 *	819	2810	570	357	4556
* provisional na = not available					

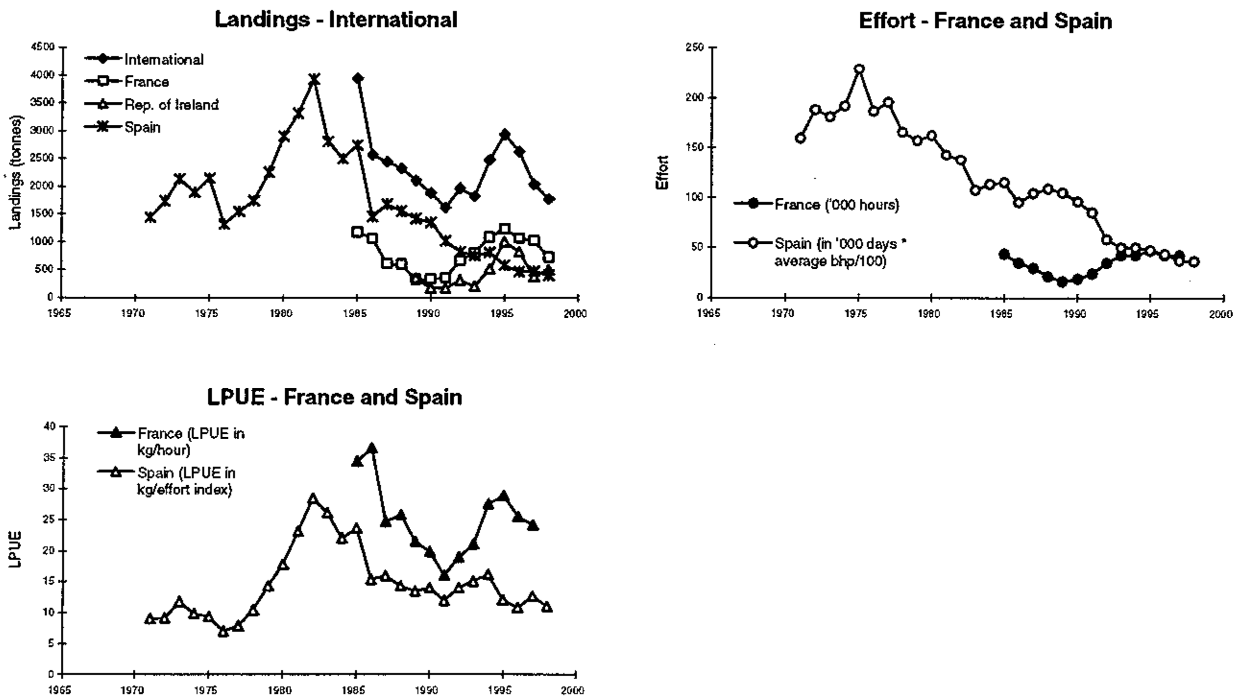


Figure 3.10.4.1 - Porcupine Bank (FU 16): Long term trends in landings, effort and LPUEs of *Nephrops* in catches.

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 is 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 recent years the bulk of the anchovy fishery in IXa is again located in the Gulf of Cadiz.

In Divisions VIIIc (East) and VIIIb the target species for the purse seine fleet change with the season - anchovy in spring and tuna in the summer. This fleet changes gear and uses trolling and bait boats to catch tuna.

The catches of horse mackerel in Divisions VIIIc and IXa have been relatively stable over the last ten years. The proportion of landings by different gears has changed, i.e., trawl catches are decreasing while the purse seine catches are increasing.

During the 1990s the purse fleets in Divisions VIIIc West usually directed to sardine redirected the effort to horse mackerel given the lower availability of sardine in VIIIc West than during the 1980s.

Mackerel is a target species for the hand line fleet during the spawning season in Division VIIIc, during which about one third of the total catches are taken. It is taken as by-catch by the trawl fleets in Division VIIIc and IXa. The highest catches (80%) from the Southern component are taken in the first half of period- mainly from Division VIIIc and consist of adult fish. In the second half of the year, catches consist of juveniles and are mainly taken in Division IXa, as by-catches of the trawl fisheries. Catches from the southern component have been increasing in recent years and in 1998 reached a maximum of 44 000 t.

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 restriction of days of absence of the ports, number of purse-seiners in activity, annual catch restriction and seasonal closures. A minimum landing size is enforced at an international level.

A TAC for southern mackerel is in place, as a part of the Northeast Atlantic mackerel TAC.

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 1982 and 1986 and gradually decreased thereafter. Recruitment has declined steadily since 1984 to 1991. However the 1996 year class is estimated to be above average and comparable to year classes produced consistently in early 1980s. Although there are indications that fishing effort has decreased since early 1990s, the last three years estimate sharp decrease in fishing mortality on hake was considered unreliable.

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

Catches of megrim *Lepidorhombus boscii*, which is the more 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 harvested outside safe biological limits. Although the spawning stock is estimated to be above the proposed B_{pa}, fishing mortality in 1997 and 1998 is still below F_{pa}.

The spatial distribution of Sardine in Divisions VIIIc and IXa changed as compared with the 1980s. The perception of the state of the stock depends of the relative contribution of the northern and southern areas. Based on fishery data and fishery-independent data the availability of sardine has decreased in the northern area but remains constant in the southern area. Spawning stock biomass increased due to increased recruitment since 1996 but it was accompanied by an increase in fishing mortality. It is not at present clear whether the observed change in distribution is due to a migration driven by climatic effects, a migration driven by a reduction in stock size, or due to a local depletion of independent population units. Whichever case pertains, a reduction in fishing mortality is advised to prevent further decline of spawning stock biomass and promote recovery.

The southern mackerel component is of the order of 25% of the Northeast Atlantic mackerel. Egg surveys also indicate that SSB of this component has increased in this area.

3.11.2 Hake - Southern stock (Divisions VIIIc and IXa)

State of stock/fishery: The state of the stock is not known with certainty, but is considered to be outside safe biological limits. SSB decreased sharply between 1982 and 1986 and gradually decreased thereafter. Between the mid 1980s and 1997 estimates of annual SSB's usually are lower than all preceding values. Fishing mortality has been variable, without trend, between 0.35 and 0.6 over that period. The analytical assessment suggests that SSB has doubled and fishing mortality has been halved in the most recent two years, but these estimates are considered unreliable. There is no independent evidence of marked improvements in the spawning biomass, and although effort in many fleets shows a slowly declining trend for the past 20 years, there is no independent evidence that F has decreased by 50% in the past two years. Recruitment declined steadily between 1984 and 1991 and was generally stable thereafter. However, the 1996 year class is estimated to be 33% above average, and comparable to year classes produced consistently in the early 1980s. The 1998 year class appears to have been the weakest on record.

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}.

Advice on management: ICES recommends a reduction in landings to below 7,700 t in 2000, corresponding to a 20% reduction in the recent (5 year) average of landings from this stock. SSB it not considered to have increased during that interval, so a further reduction in landings and fishing mortality is required, to allow the SSB to rebuild from the historic lows of the mid 1990s. Management measures to reduce landings should be introduced in ways to avoid contributing to increased discarding.

Reference points: Reference points are undefined. Biological Reference Points estimated with earlier data are no longer relevant for this stock because major revisions have been made to many data bases (landings revised 10-20% upwards, new maturity ogive, new growth parameters, use of age-length-keys) used in assessing this stock. Work is underway to develop new reference points appropriate for use in management of this stock.

Relevant factors to be considered in management: The present assessment is considered to give an accurate picture of the historic development of this stock, but estimates of biomass and fishing mortality are biased in the most recent three years, and should not be used to guide management of this stock. Reasons for the bias are likely to involve both problems with data and problems with assessment models, and assessment formulations appropriate for the stock are being investigated.

The 1996 year class is the largest in 15 years, but SSB declined markedly in the early 1980s, when several year classes of similar strength recruited and fishing mortality was between 0.4 and 0.5. Much lower fishing mortalities are likely to be required if the SSB is to benefit noticeably from this year-class.

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 2000: There is no basis for a catch forecast.

Elaboration and special comment: This stock is exploited in a mixed fishery by Spanish and Portuguese fleets using trawls, gillnets and longlines.

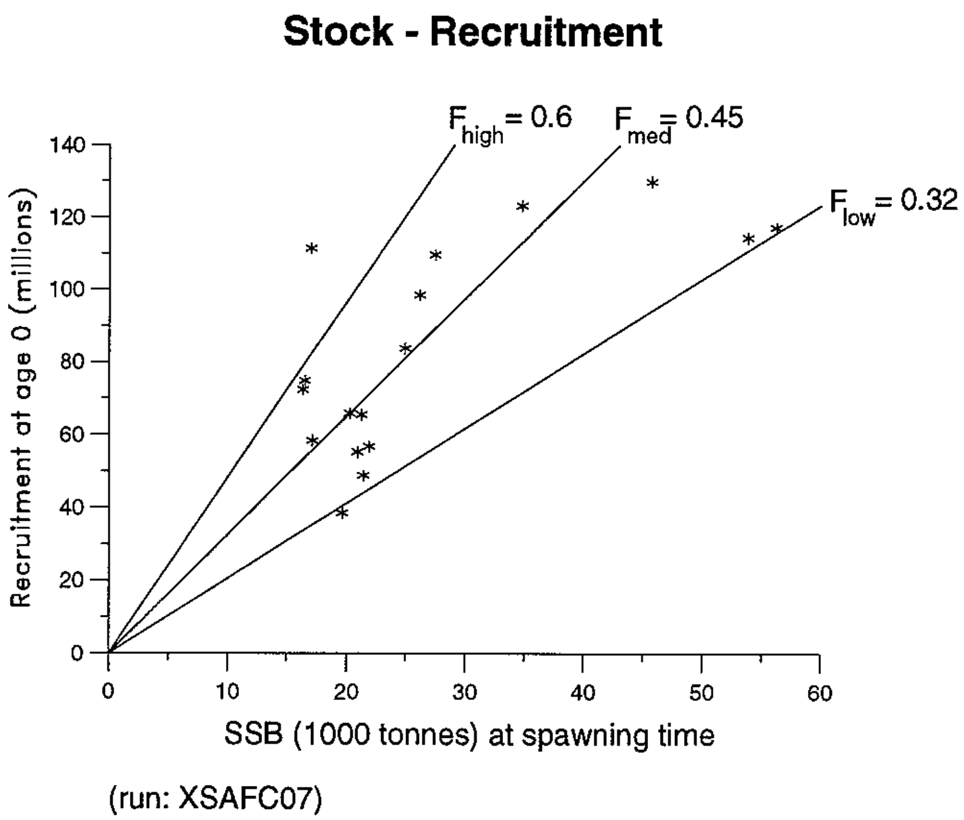
Analytical assessment using commercial CPUE and survey data. Estimates for the most recent years are considered unreliable. For the first time, catch-at-age data are derived from age length keys and Spanish landings from the Gulf of Cadiz are included since 1982. New maturity ogive and length weight relationship were used. Estimates of F, SSB and recruitment have been revised substantially from previous assessments.

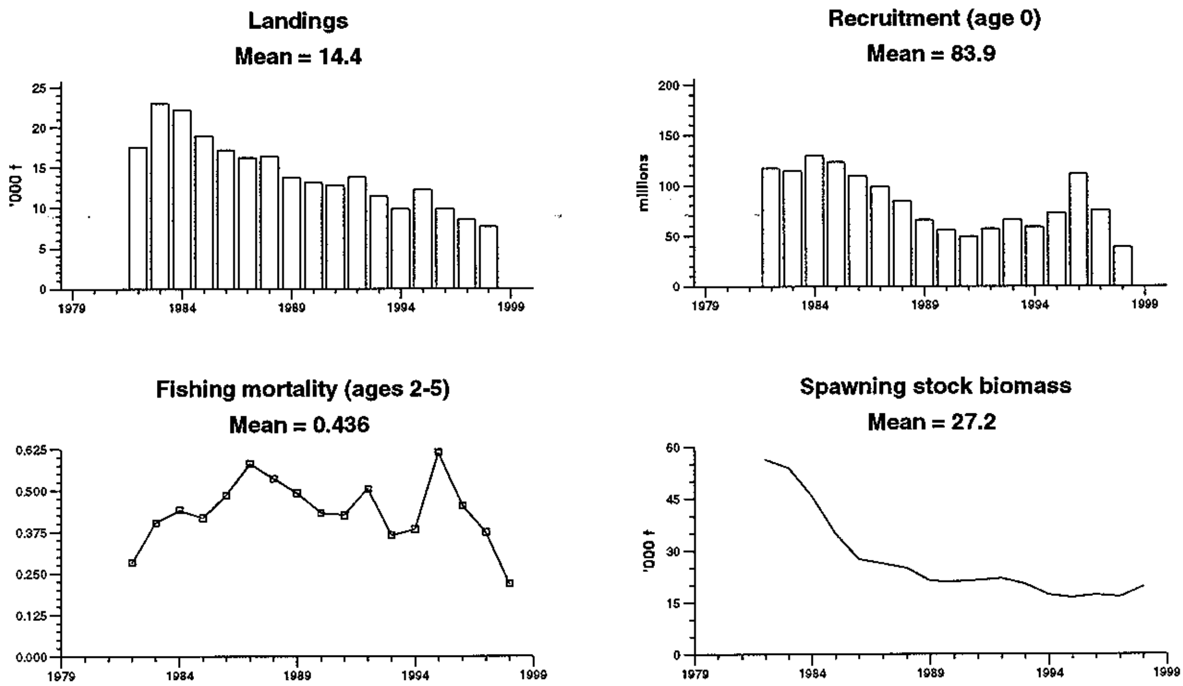
Source of information: Report of the Working Group on the Assessment of Southern Shelf Demersal Stocks, September 1999 (ICES CM 2000/ACFM:4).

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	16.2
1988	TAC; juvenile protection	15.0	25.0	16.4
1989	TAC; juvenile protection	15.0	20.0	13.8
1990	TAC; juvenile protection	15.0	20.0	13.2
1991	Precautionary TAC	10.0	18.0	12.8
1992	Precautionary TAC	10.3	16.0	13.8
1993	F = 10% of F 91	1.0	12.0	11.5
1994	F lowest possible at least reduced by 80%	2.0	11.5	9.9
1995	F lowest possible	-	8.5	12.2
1996	F lowest possible	-	9.0	9.9
1997	F lowest possible	-	9.0	8.5
1998	60% reduction in F	4.0	8.2	7.7
1999	Reduce F below $\mathbf{F_{pa}}$	9.5	9.0	
2000	20% reduction from 1994-98 average landings	< 7.7		

Weights in '000 t.





Hake - Southern stock (Divisions VIIIc and IXa)

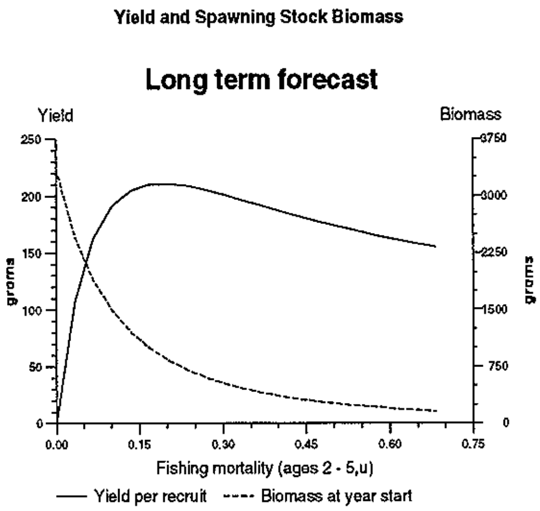


Table 3.11.2.1 Landings estimates ('000 t) for the SOUTHERN HAKE Stock (Divisions VIIIc and IXa) by country and gear as determined by the Working Group, 1972–1998.

YEAR	Spain						Portugal			France	TOTAL STOCK
	Gillnet[1]	Small Gillnet	Longline	Total Artisanal	Trawl[2]	Total	Artisanal	Trawl	Total		
1972	-	-	-	7.1	10.2	17.3	4.7	4.1	8.8	-	26.1
1973	-	-	-	8.5	12.3	20.8	6.5	7.3	13.8	0.2	34.8
1974	2.6	1.0	2.2	5.8	8.3	14.1	5.1	3.5	8.6	0.1	22.8
1975	3.5	1.3	3.0	7.8	11.2	19.0	6.1	4.3	10.4	0.1	29.5
1976	3.1	1.2	2.6	6.9	10.0	16.9	6.0	3.1	9.1	0.1	26.1
1977	1.5	0.6	1.3	3.4	5.8	9.2	4.5	1.6	6.1	0.2	15.5
1978	1.4	0.1	2.1	3.6	4.9	8.5	3.4	1.4	4.8	0.1	13.4
1979	1.7	0.2	2.1	4.0	7.2	11.2	3.9	1.9	5.8	-	17.0
1980	2.2	0.2	5.0	7.4	5.3	12.7	4.5	2.3	6.8	-	19.5
1981	1.5	0.3	4.6	6.4	4.1	10.5	4.1	1.9	6.0	-	16.5
1982	1.2	0.3	4.2	5.7	4.4	10.1	5.0	2.5	7.5	-	17.6
1983	2.1	0.4	6.6	9.0	5.9	14.9	5.2	2.9	8.0	-	23.0
1984	2.3	0.3	7.5	10.1	6.5	16.7	4.3	1.2	5.5	-	22.2
1985	1.8	0.8	4.4	7.0	6.1	13.1	3.8	2.1	5.8	-	18.9
1986	2.1	0.8	3.5	6.4	5.8	12.2	3.2	1.8	4.9	0.0	17.2
1987	2.0	0.5	4.4	6.9	4.5	11.4	3.5	1.3	4.8	0.0	16.2
1988	2.0	0.7	3.0	5.6	4.7	10.4	4.3	1.7	6.0	0.0	16.4
1989	1.9	0.6	2.0	4.4	4.8	9.2	2.7	1.8	4.6	0.0	13.8
1990	1.7	0.6	2.1	4.4	5.3	9.8	2.3	1.1	3.4	0.0	13.2
1991	1.4	0.4	2.2	4.0	4.8	8.9	2.7	1.2	4.0	0.0	12.8
1992	1.5	0.4	2.1	3.9	4.8	8.7	3.8	1.3	5.1	-	13.8
1993	1.3	0.4	2.8	4.4	3.2	7.6	3.0	0.9	3.9	-	11.5
1994	1.9	0.4	1.5	3.7	3.0	6.8	2.3	0.8	3.1	-	9.9
1995	1.6	0.4	1.0	2.9	5.7	8.7	2.6	1.0	3.6	-	12.2
1996	1.2	0.2	1.0	2.4	4.6	7.0	2.0	0.9	2.9	-	9.9
1997	1.1	0.3	0.8	2.2	4.0	6.1	1.5	0.9	2.4		8.5
1998	0.8	0.3	0.6	1.7	3.4	5.1	1.7	0.9	2.6		7.7

[1] Gulf of Cadiz landings included since 1993.
[2] Gulf of Cadiz landings included since 1982.

Table 3.11.2.2 HAKE - SOUTHERN stock (Divisions VIIIc and IXa).

Year	Recruitment Age 0	Spawning Stock Biomass	Landings	Fishing Mortality Age 2-5
1982	117.23	56.27	17.59	0.284
1983	114.49	53.89	22.95	0.403
1984	129.95	45.80	22.18	0.441
1985	123.35	34.79	18.94	0.417
1986	109.77	27.48	17.16	0.486
1987	98.61	26.18	16.18	0.580
1988	83.84	24.94	16.39	0.535
1989	65.58	21.30	13.79	0.492
1990	55.27	20.97	13.19	0.432
1991	48.85	21.44	12.83	0.426
1992	56.81	21.89	13.80	0.505
1993	65.95	20.29	11.49	0.365
1994	58.44	17.20	9.87	0.382
1995	72.43	16.37	12.24	0.614
1996	111.48	17.07	9.88	0.453
1997	74.94	16.57	8.55	0.373
1998	38.56	19.67	7.67	0.218
Average	83.85	27.18	14.39	0.436
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 close to safe biological limits. SSB of both species has decreased over most of the assessment period, but an increase is observed since 1995, and SSB are now around the proposed $\mathbf{B}_{pa}$. Fishing mortality in both species has declined during the 1990's, although some increase is apparent in recent years.

Management objectives: There are no explicit management objectives for these stocks. 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: To maintain both these stocks within safe biological limits, ICES recommends that F should not be allowed to increase above $\mathbf{F}_{pa}$ for L. *boscii* and $\mathbf{F}_{sq}$ for L. *whiffiagonis*. This corresponds to landings in 2000 of less than 1 130 t for *L. boscii* and 330 t for *L. whiffiagonis*.

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.

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 2000:

L. boscii: Basis: F(99) = F(96–98) = F_{sq} = 0.21, Landings (99) = 1.35, SSB(2000) =6.62.

F(2000) onwards	Basis	Catch (2000)	Landings (2000)	SSB (2001)	Medium-term situation (after 10 years) of fishing at given level
0.12	0.6 $F_{96\text{-}98}$		0.87	7.37	<5% probability SSB being below $\mathbf{B}_{pa}$
0.16	0.8 $F_{96\text{-}98}$		1.13	7.07	<5% probability SSB being below $\mathbf{B}_{pa}$
0.20	$\mathbf{F}_{pa}$		1.34	6.83	10-20% probability SSB being below $\mathbf{B}_{pa}$
0.21	1.0 $F_{96\text{-}98}$		1.37	6.79	20% probability SSB being below $\mathbf{B}_{pa}$
	1.2 $F_{96\text{-}98}$				

Weights in '000 t.

L. whiffiagonis: Basis: F (99) = F (96–98) =0.23, Landings (99) = 0.37, SSB(2000) = 1.51.

F(2000) onwards	Basis	Catch (2000)	Landings (2000)	SSB (2001)	Medium-term situation (after 10 years) of fishing at given level
0.14	0.6 $F_{96\text{-}98}$		0.26	1.68	<5% probability SSB being below $\mathbf{B}_{pa}$
0.18	0.8 $F_{96\text{-}98}$		0.33	1.60	10-20% probability SSB being below $\mathbf{B}_{pa}$
0.23	1.0 $F_{96\text{-}98}$		0.40	1.52	10-20% probability SSB being below $\mathbf{B}_{pa}$
0.27	1.2 $F_{96\text{-}98}$		0.46	1.45	10-20% probability SSB being below $\mathbf{B}_{pa}$

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. Recent assessments have been uncertain and underestimated SSB.

Reference points, as proposed in 1998: *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, as proposed in 1998: *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:

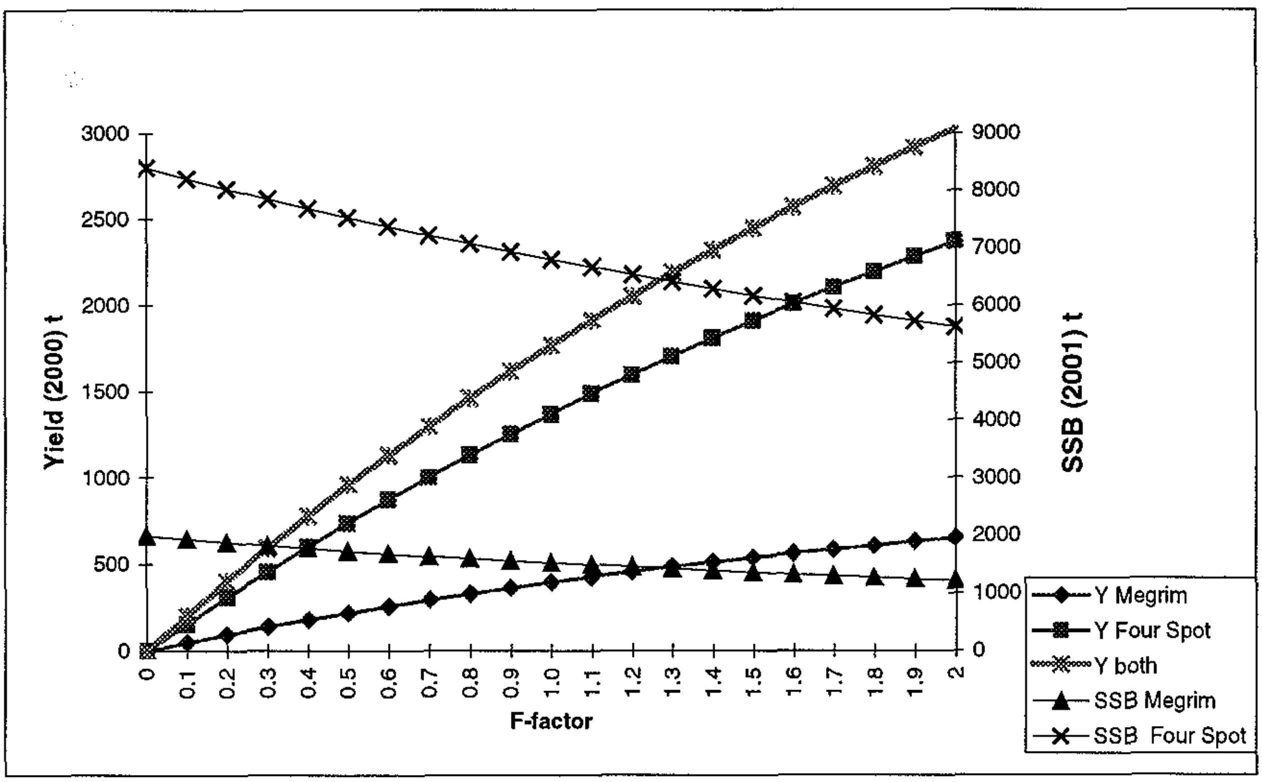
$\mathbf{B_{lim}}$:$\mathbf{B_{loss}}$.	$\mathbf{B_{pa}}$ ~ $\mathbf{B_{lim}}$ x 1.64.
$\mathbf{F_{lim}}$: Not defined.	$\mathbf{F_{pa}}$: No proposal.

Source of information: Report of the Working Group on the Assessment of Southern Shelf Demersal Stocks, September 1999(ICES CM 2000/ACFM:4).

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

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC[1]	ACFM landings[1]	Landings L. boscii	Landings L. whiff.
1987	Not dealt with	-	13.0	2.19	1.69	0.50
1988	Not dealt with	-	13.0	3.04	2.22	0.82
1989	Not dealt with	-	13.0	3.34	2.63	0.71
1990	Not dealt with	-	13.0	2.93	1.95	0.98
1991	No advice	-	14.3	2.29	1.68	0.61
1992	No advice	-	14.3	2.44	1.92	0.52
1993	*L. boscii* no long-term gain in increasing F, *L. whiff* within safe biological limits	-	8.0	1.76	1.38	0.38
1994	No long-term gains in increasing F	-	6.0	1.88	1.40	0.48
1995	Concern about low SSB	-	6.0	1.87	1.65	0.22
1996	Mixed fishing aspects	-	6.0	1.43	1.10	0.33
1997	Reduce F by at least 50%	-	6.0	1.25	0.9	0.36
1998	Reduce F by at least 50%	0.9[1]	6.0	1.57	1.12	0.45
1999	Reduce F by at least 50%	1.0[1]	6.0			
2000	Reduce F by at least 20%	< 1.5				

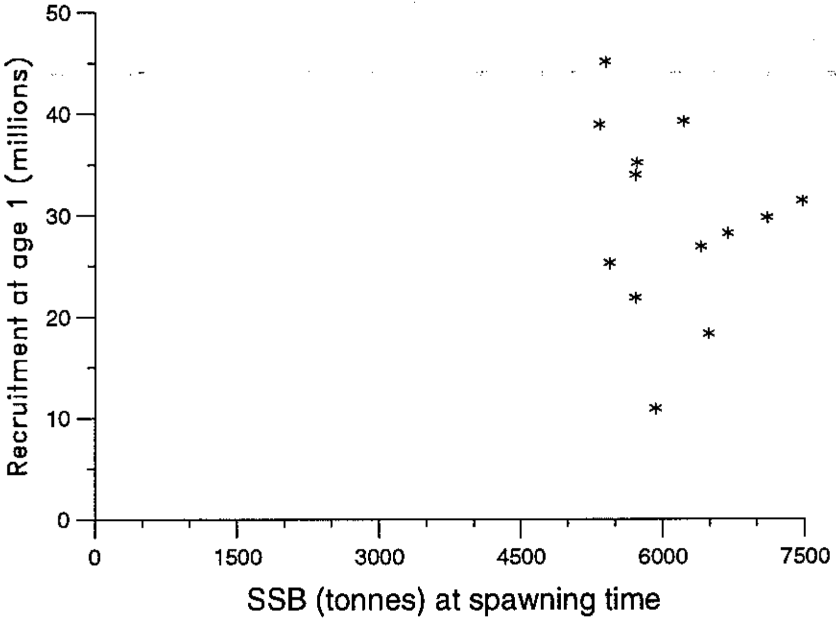
[1]Including *L. whiffiagonis*+ *L. boscii*. Weights in '000 t.



Megrims (*L. whiffiagonis and L. boscii*) in Divisions VIIIc and IXa.
Combined Short Term Forecasts assuming *status quo* in 1999.

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

Stock - Recruitment



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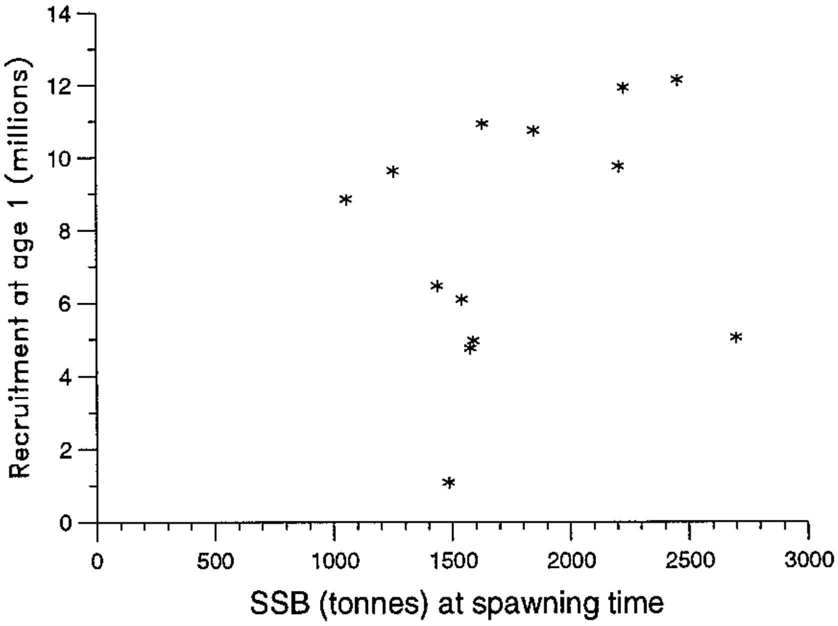
Megrim (*L. whiffiagonis*) in Divisions VIIIc and IXa

Stock - Recruitment



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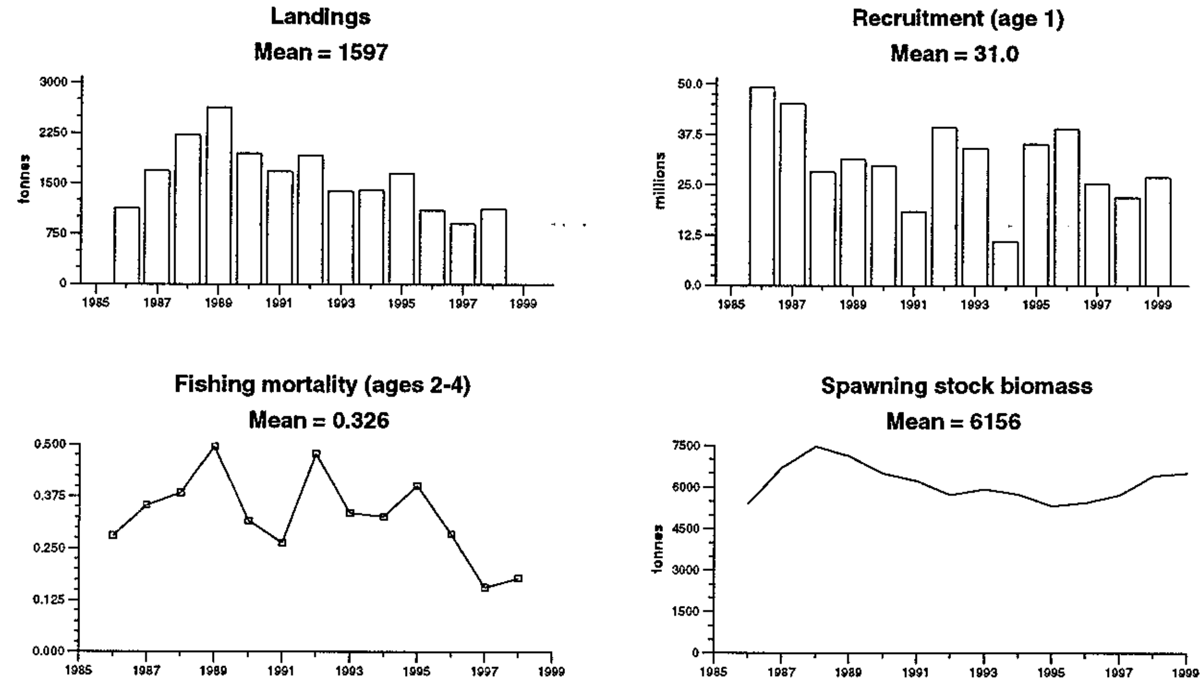
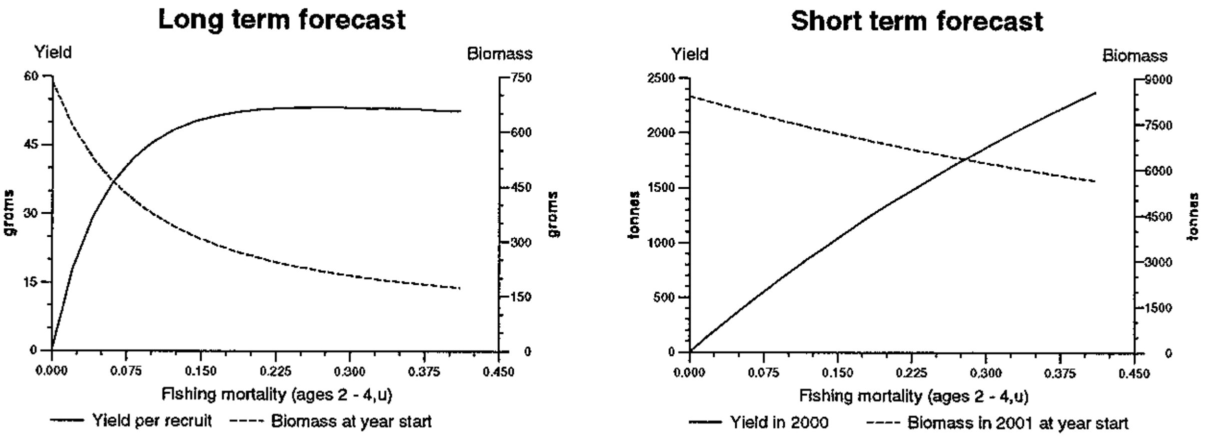
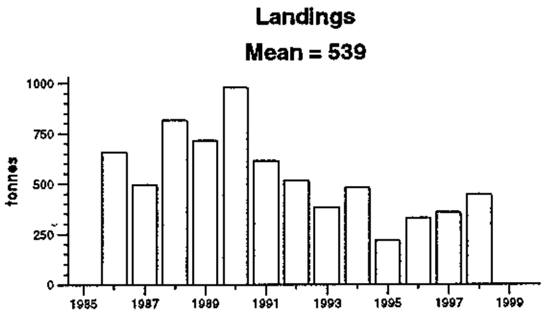
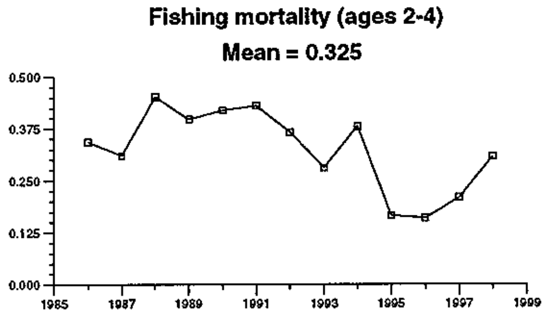


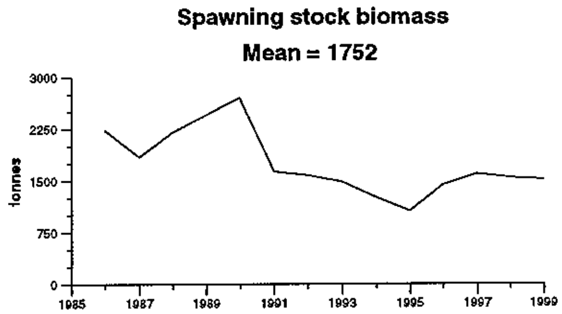
Megrim (*L. boscii*) in Divisions VIIIc and IXa

Yield and Spawning Stock Biomass



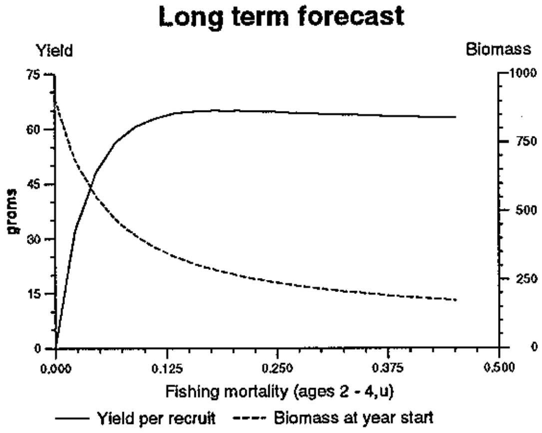


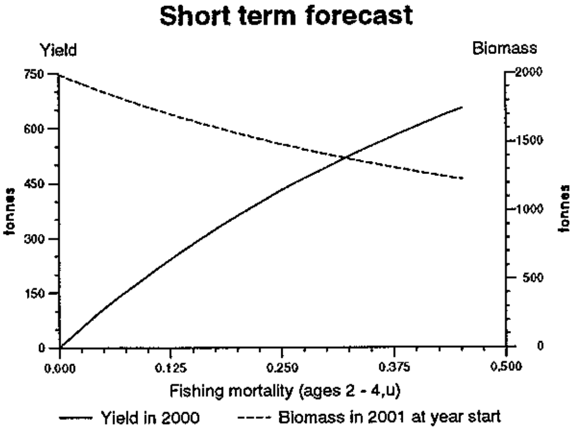




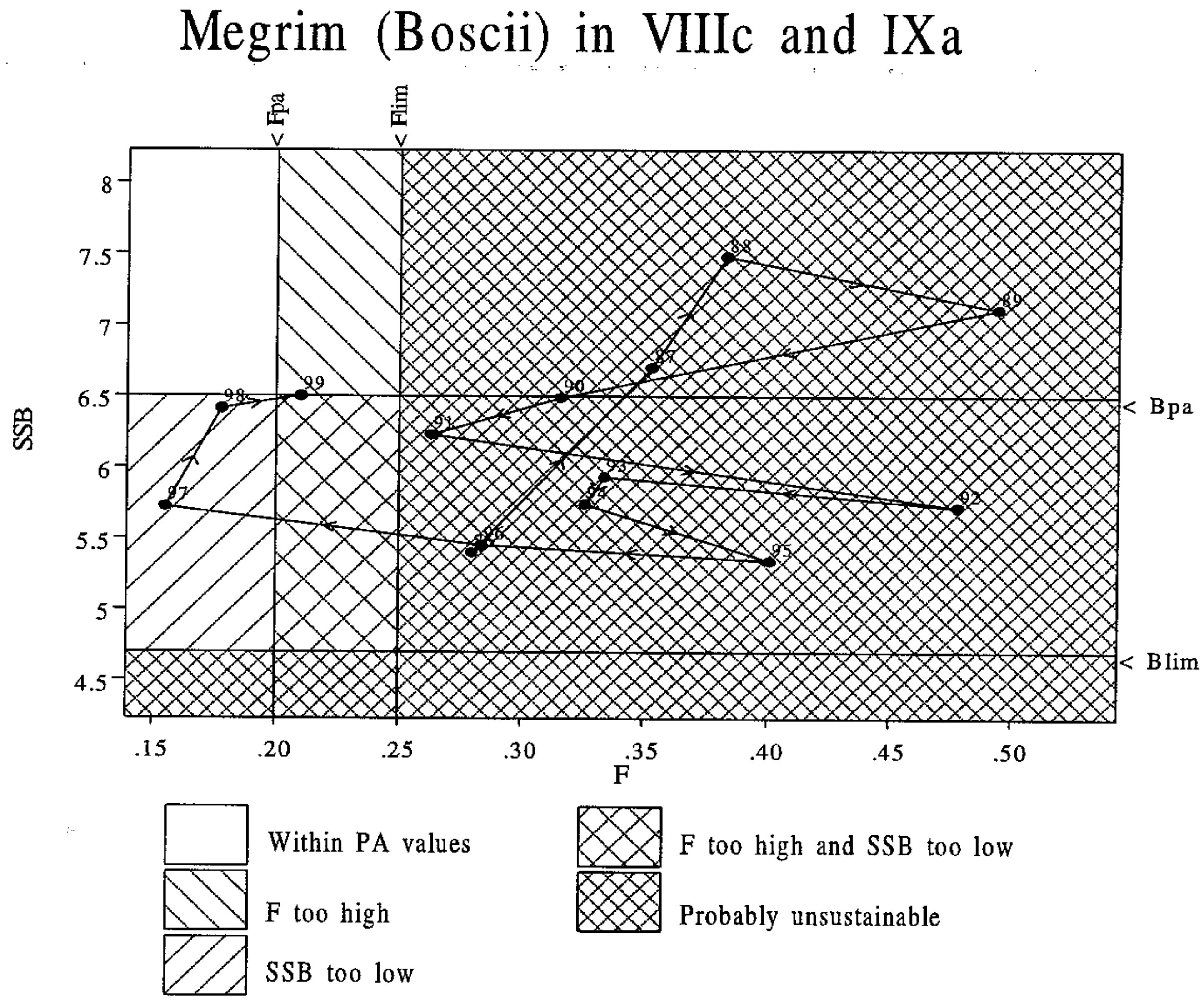
Megrim (*L. whiffiagonis*) in Divisions VIIIc and IXa

Yield and Spawning Stock Biomass





Precautionary Approach Plot



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Precautionary Approach Plot

Megrim (Whiffiagonis) in VIIIc and IXa

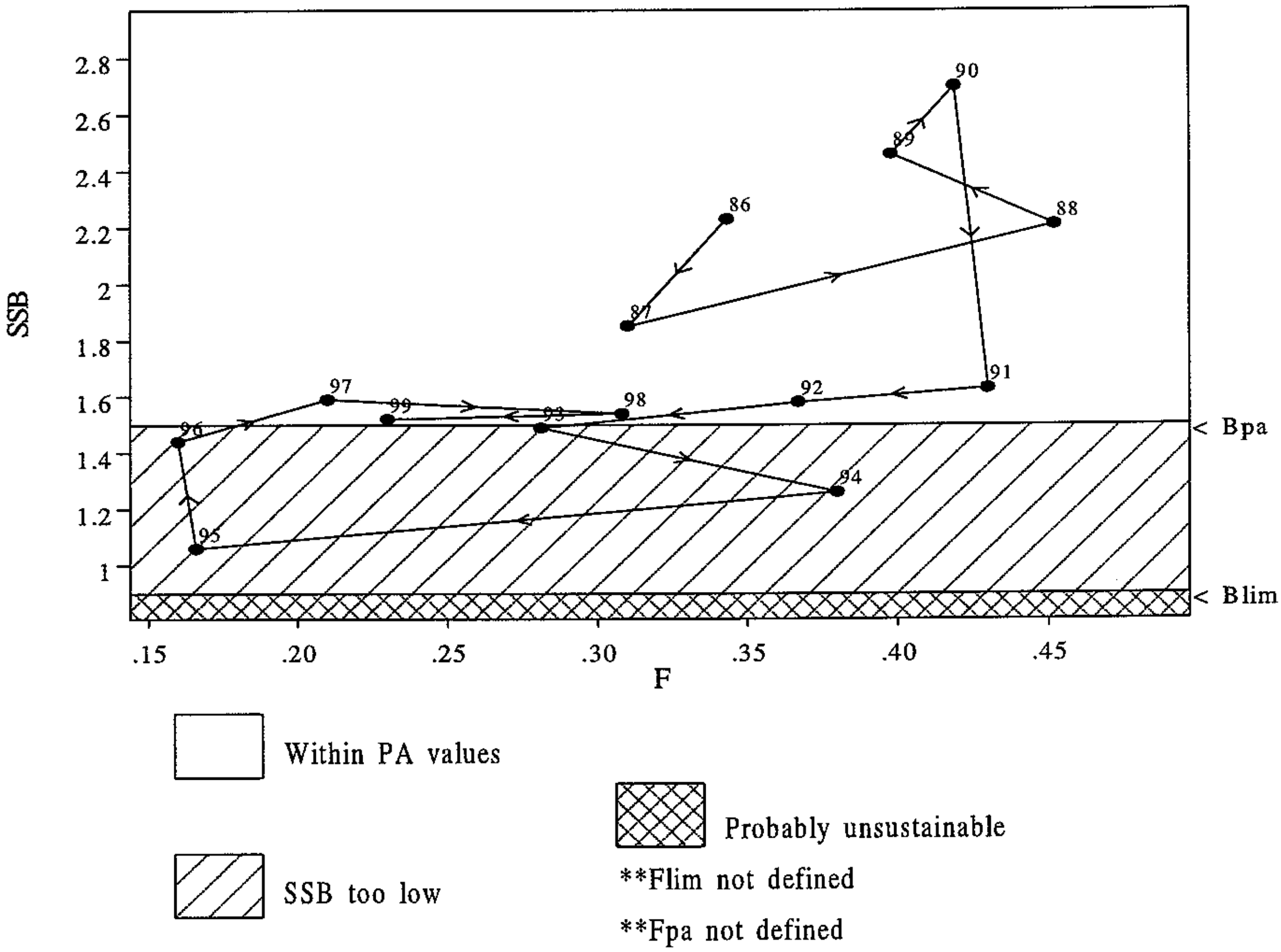

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Table 3.11.3.a.1 Four Spot MEGRIM (*L. boscii*) in Divisions VIIIc and IXa. Total landings (t).

	Spain			Portugal	Total
Year	VIIIc	IXa	Total	IXa	VIIIc, IXa
1986	799	197	996	128	1124
1987	995	586	1581	107	1688
1988	917	1099	2016	207	2223
1989	805	1548	2353	276	2629
1990	927	798	1725	220	1945
1991	841	634	1475	207	1682
1992	654	938	1592	324	1916
1993	744	419	1163	221	1384
1994	665	561	1227	176	1403
1995	685	826	1512	141	1652
1996	480	448	928	170	1098
1997	505	289	794	101	896
1998	725	284	1010	113	1123

Table 3.11.3.a.2 MEGRIM (*Boscii*) in Divisions VIIIc and IXa.

Year	Recruitment Age 1	Spawning Stock Biomass	Landings	Fishing Mortality Age 2-4
1986	49.27	5.40	1.12	0.280
1987	45.12	6.70	1.69	0.353
1988	28.17	7.48	2.22	0.383
1989	31.37	7.11	2.63	0.494
1990	29.72	6.49	1.95	0.316
1991	18.31	6.23	1.68	0.263
1992	39.24	5.72	1.92	0.478
1993	33.95	5.93	1.38	0.334
1994	10.92	5.74	1.40	0.326
1995	35.14	5.34	1.65	0.401
1996	38.88	5.45	1.10	0.284
1997	25.28	5.72	0.90	0.155
1998	21.85	6.41	1.12	0.178
1999	26.89	6.50	.	.
Average	31.01	6.16	1.60	0.326
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
1998	372	8	380	66	446

Table 3.11.3.b.2 MEGRIM (*Whiffiagonis*) in Divisions VIIIc and IXa.

Year	Recruitment Age 1	Spawning Stock Biomass	Landings	Fishing Mortality Age 2-4
1986	9.04	2.23	0.66	0.343
1987	11.92	1.85	0.50	0.310
1988	10.74	2.21	0.82	0.452
1989	9.75	2.46	0.71	0.398
1990	12.13	2.70	0.98	0.419
1991	5.03	1.63	0.61	0.430
1992	10.92	1.58	0.52	0.367
1993	4.75	1.49	0.38	0.281
1994	1.08	1.26	0.48	0.380
1995	9.62	1.06	0.22	0.166
1996	8.85	1.44	0.33	0.160
1997	6.46	1.59	0.36	0.210
1998	4.95	1.54	0.45	0.308
1999	6.08	1.52	.	.
Average	7.95	1.75	0.54	0.325
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 combined (*L. piscatorius* and L. *budegassa*) are considered to be outside safe biological limits. The biomass of both species combined is estimated to be at record low level, less than 30% of the biomass in the beginning of the assessment period, in 1986. Fishing mortality has doubled over this period.

Management objectives: There are no explicit management objectives for these stocks.

Advice on management: ICES advises that F should be reduced to less than what it was during the mid 1980's. This implies a 60% reduction in F, corresponding to landings in 2000 of 1 600 t for both species combined. This F corresponds to the best estimate available for the ratio between F and F_{MSY}.

Relevant factors to be considered in management: Given that this two species are not usually sorted in the landings and that the proportion of landings by species are based on samples taken from the various ports, an assessment with both species combined was carried out. Previous TACs have been well above landings and unrestrictive. Management of these fisheries harvesting these stocks should take into account that a portion of the catch of L. *piscatorius* and *L. budegassa* are caught together with other species in mixed trawl fisheries.

Catch forecast for 2000:

Both species combined (*L. piscatorius* + *L. budegassa*) Basis: F(99) = F(98), Landings(99) = 3.52, $B/B_{MSY}(2000) = 0.17$.

Basis	Catch(2000)	Landings (2000)	B/B_{MSY} (2001)	Medium-term situation (after 10 years) of fishing at given level
0.4 F_{98}		1.6	0.28	n/a
F_{98}		2.5	0.12	n/a

Weights in '000 t.

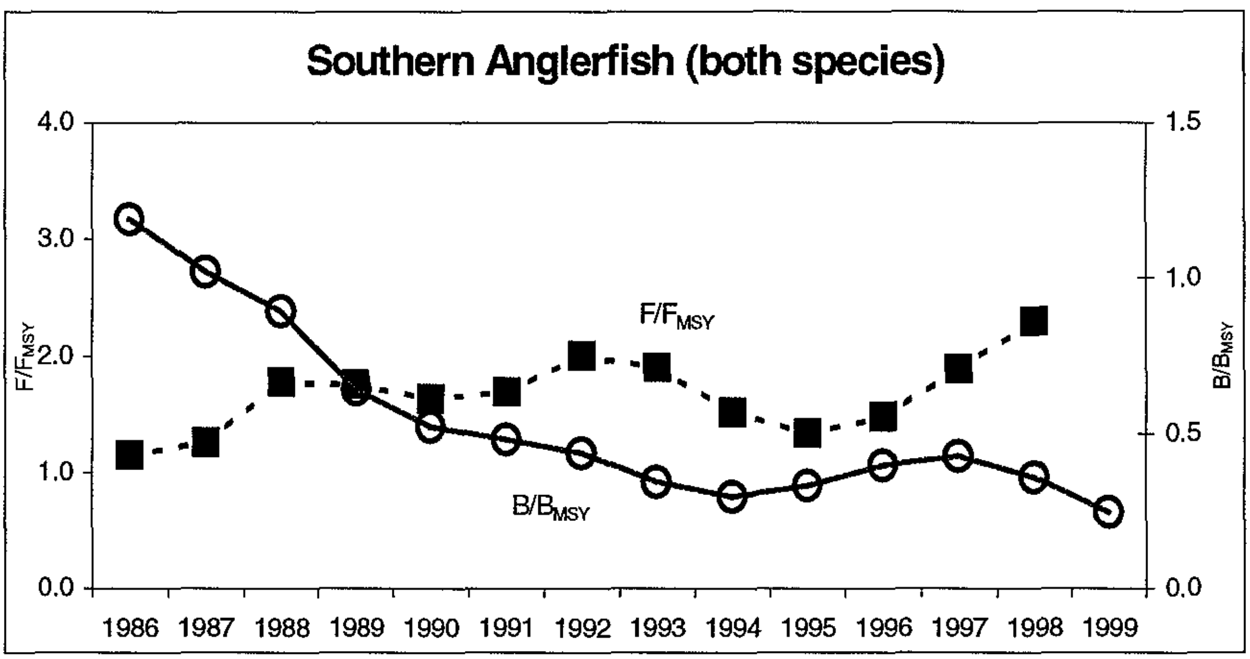
Shaded scenarios considered inconsistent with the precautionary approach.

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.

As last year, a surplus production model was used in assessing the state of the stocks. The model provides estimates of stock biomass and fishing mortality relative to the biomass and fishing mortality providing maximum sustainable yield.

Source of information: Report of the Working Group on the Assessment of Southern Shelf Demersal Stocks, September 1999 (ICES CM 2000/ACFM:4).

ANGLERFISH (*L. piscatorius* and *L. budegassa*) Divisions VIIIc and IXa
Development of relative Fishing mortality and Biomass during 1986-98.

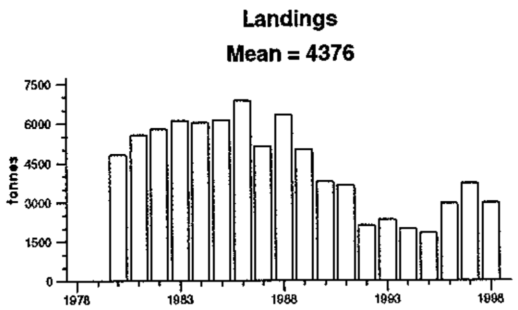


Catch data (Tables 3.11.4.1–2):

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 levels		10.0	5.1	3.0	2.1
1999	Reduce F to $\mathbf{F}_{pa}$	4.2[1]	8.5			
2000	60% reduction in F	1.6[1]				

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

L. piscatorius



L. budegassa

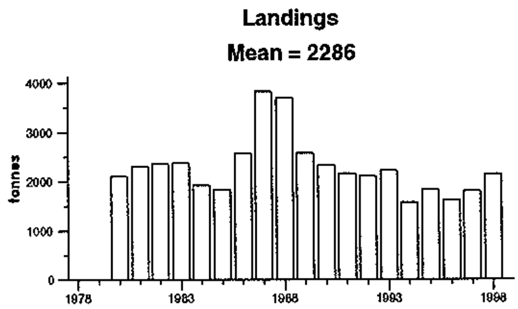


Table 3.11.4.1 ANGLERFISH (*L. piscatorius*) - Divisions VIIIc and IXa. Tonnes landed by the main fishing fleets for 1978-1998 as determined by the Working Group.

	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
1998	912	1359	2271	184	28	497	710	2981

Table 3.11.4.2 ANGLERFISH (*L. budegassa*) - Divisions VIIIc and IXa. Tonnes landed by the main fishing fleets for1978–1998 as determined by the Working Group.

	VIIIc			IXa				VIIIc+IXa
YEAR	Spain Trawl	Spain Gillnet	TOTAL	Spain Trawl	Portugal Trawl	Portugal Artisanal	TOTAL	TOTAL
1978	n/a	n/a	n/a	248	0	107	355	
1979	n/a	n/a	n/a	306	0	210	516	
1980	1203	207	1409	385	0	315	700	2110
1981	1159	309	1468	505	0	327	832	2300
1982	827	413	1240	841	0	288	1129	2369
1983	1064	188	1252	699	0	428	1127	2379
1984	514	176	690	558	223	458	1239	1929
1985	366	123	489	437	254	653	1344	1833
1986	553	585	1138	379	200	847	1425	2563
1987	1094	888	1982	813	232	804	1849	3832
1988	1058	1010	2068	684	188	760	1632	3700
1989	648	351	999	764	272	542	1579	2578
1990	491	142	633	689	387	625	1701	2334
1991	503	76	579	559	309	716	1584	2163
1992	451	57	508	485	287	832	1603	2111
1993	516	292	809	627	196	596	1418	2227
1994	542	201	743	475	79	283	837	1580
1995	913	104	1017	615	68	131	814	1831
1996	840	105	945	342	133	210	684	1629
1997	800	198	998	524	81	210	815	1813
1998	774	153	926	704	181	332	1217	2144

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 harvested outside safe biological limits. Although the spawning stock is estimated to be above the proposed $\mathbf{B_{pa}}$, fishing mortality is slightly 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: Fishing mortality should be reduced to below $\mathbf{F_{pa}}$, corresponding to landings less than 59 000 t in 2000. ICES recommends that the TAC for this stock should only apply to *Trachurus trachurus* and that other species of horse mackerel be excluded.

Relevant factors to be considered in management: The TAC up to 1997 included catches of other species of horse mackerel.

Catch forecast for 2000:

Basis: F(99) = F(96–98) = F_{sq}= 0.18; Landings (99) = 60.

F(2000)	Basis	SSB (2000)	Catch (2000)	Landings (2000)	SSB (2001)
0.07	0.4 F_{sq}	245		26	259
0.1	0.6 F_{sq}	242		38	248
0.14	0.8 F_{sq}	240		50	237
0.17	$\mathbf{F_{pa}}$	239		59	229
0.18	F_{sq}	238		61	228
0.21	1.2 F_{sq}	236		72	218

Weights in '000 t.

Shaded scenario considered inconsistent with the precautionary approach.

Elaboration and special comment: This stock is exploited by trawl, purse seine and artisanal 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 VPA using CPUE at age series of two October surveys, the July survey and of two commercial fleets. The increase of F in the last two years is due mainly to the higher catches obtained by the Spanish purse seiners and to a lesser extent by the Portuguese trawlers and purse seiners. The 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 horse mackerel and other species.

Reference points as proposed by ICES in 1998:

ICES considers that:	ICES proposes that:
$\mathbf{B_{lim}}$ is 136 000 t, the lowest observed biomass	$\mathbf{B_{pa}}$ be set at 205 000 t. This affords a high probability of maintaining SSB above $\mathbf{B_{lim}}$, taking into account the uncertainty of the assessment.
$\mathbf{F_{lim}}$ is 0.27, the fishing mortality rate above which recruitment and stock dynamics are unknown	$\mathbf{F_{pa}}$ be established at 0.17. This F is considered to provide approximately 95% probability of avoiding $\mathbf{F_{lim}}$, taking into account the uncertainty of assessments.

Technical basis:

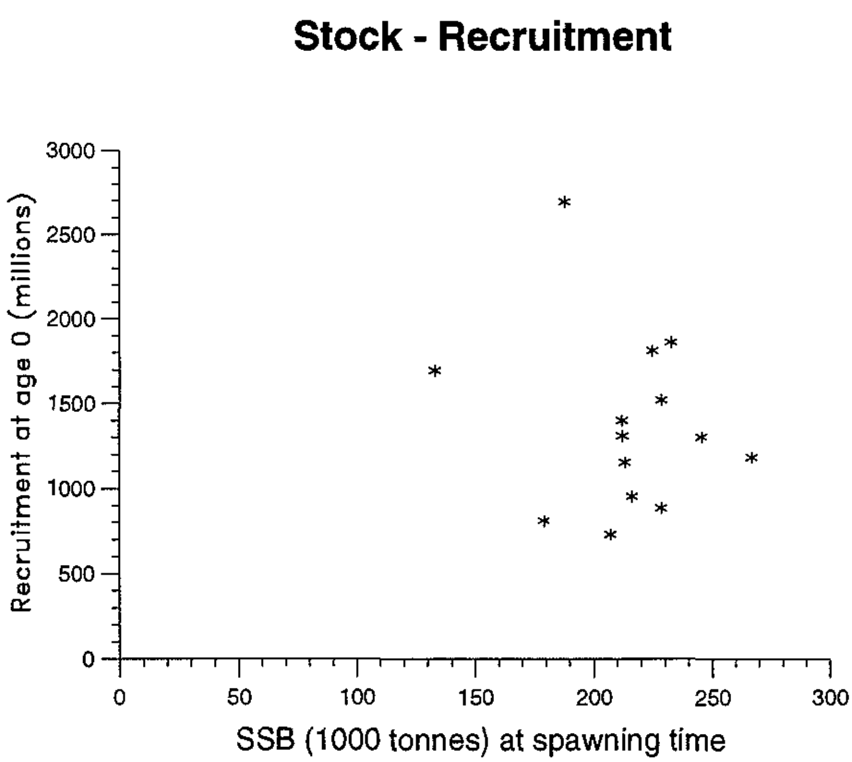
$\mathbf{B_{lim}} = \mathbf{B_{loss}}$	$\mathbf{B_{pa}} = \mathbf{B_{loss}}$ x 1.5
$\mathbf{F_{lim}} = \mathbf{F_{loss}}$	$\mathbf{F_{pa}} = \mathbf{F_{lim}}$ x 0.63, F_{max} = 0.17, $\mathbf{F_{med}}$ = 0.17

Source of information: Report of the Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine and Anchovy, September 1999 (ICES CM 2000/ACFM:5).

Catch data (Tables 3.11.6.1–2):

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	64
1999	No increase in F	58	73.0	
2000	F <$\mathbf{F}_{pa}$	<59		

[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.



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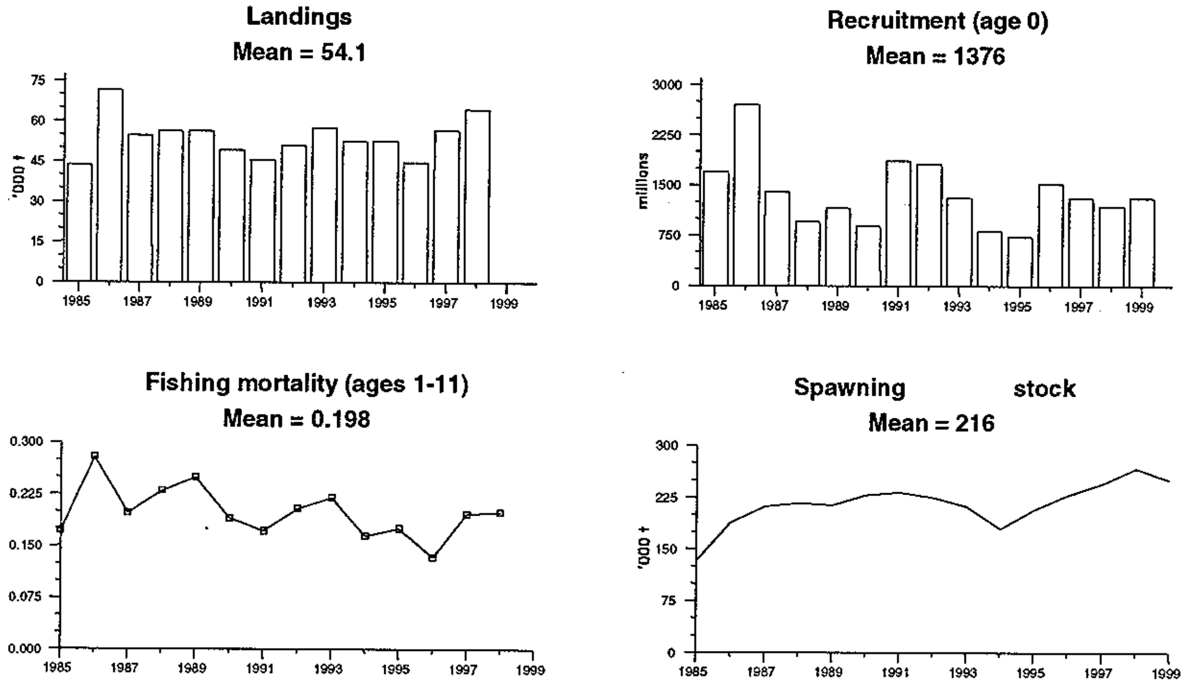
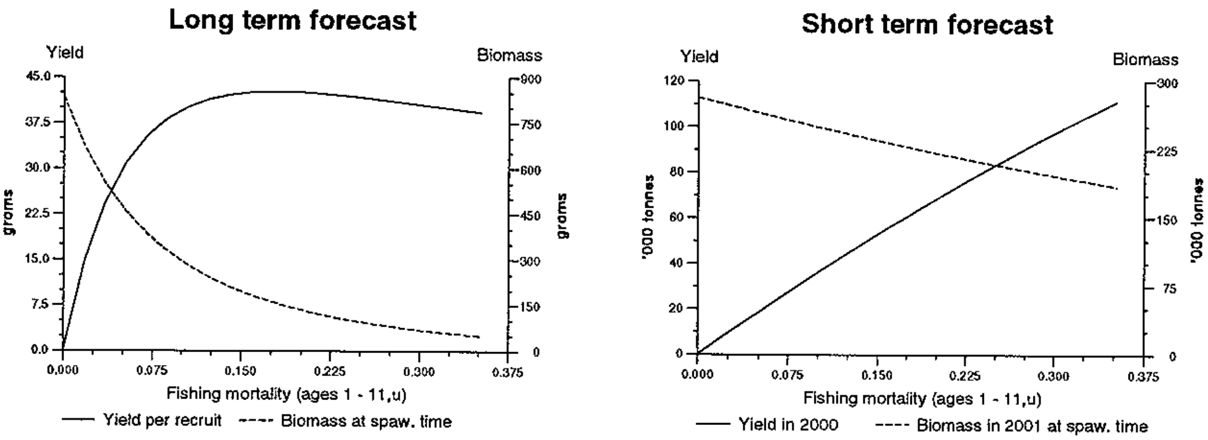


Southern horse mackerel (*Trachurus trachurus*) (Divisions VIIIc and IXa)

Yield and Spawning Stock Biomass



Precautionary Approach Plot

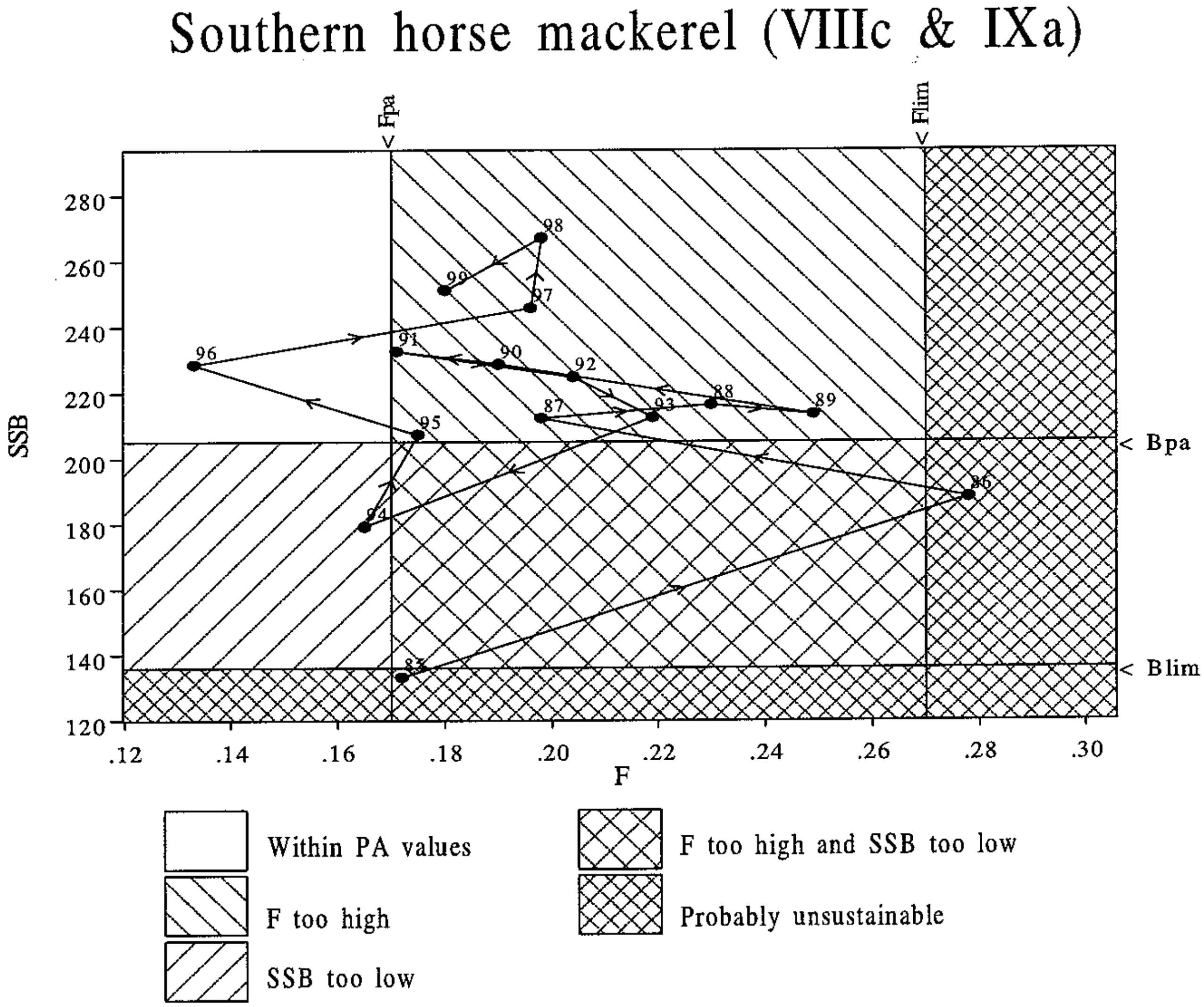


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Table 3.11.6.1 Annual catches (tonnes) of SOUTHERN HORSE MACKEREL by countries by gear in Divisions VIIIc and IXa. Data from 1984–1998 are Working Group estimates.

Year	Portugal (Division IXa)				Spain (Divisions IXa + VIIIc)					Total VIIIc+IXa
	Trawl	Seine	Artisanal	Total	Trawl	Seine	Hook	Gillnet	Total	
1980	14,646	4,575	6,003	25,224	36,489	8,948	376[1]	-	45,813	71,037
1981	11,917	5,194	6,642	23,733	28,776	19,330	376[1]	-	48,482	72,235
1982	12,676	9,906	8,304	30,886	-[2]	-[2]	-[2]	-	28,450	59,336
1983	16,768	6,442	7,741	30,951	8,511	34,054	797	-	43,362	74,313
1984	8,603	3,732	4,972	17,307	12,772	15,334	884	-	28,990	46,297
1985	3,579	2,143	3,698	9,420	16,612	16,555	949	-	34,109	43,529
1986	-[2]	-[2]	-[2]	28,526	9,464	32,878	481	143	42,967	71,493
1987	11,457	6,744	3,244	21,445	-[2]	-[2]	-[2]	-[2]	33,193	54,648
1988	11,621	9,067	4,941	25,629	-[2]	-[2]	-[2]	-[2]	30,763	56,392
1989	12,517	8,203	4,511	25,231	-[2]	-[2]	-[2]	-[2]	31,170	56,401
1990	10,060	5,985	3,913	19,958	10,876	17,951	262	158	29,247	49,205
1991	9,437	5,003	3,056	17,497	9,681	18,019	187	127	28,014	45,511
1992	12,189	7,027	3,438	22,654	11,146	16,972	81	103	28,302	50,956
1993	14,706	4,679	6,363	25,747	14,506	16,897	124	154	31,681	57,428
1994	10,494	5,366	3,201	19,061	10,864	22,382	145	136	33,527	52,588
1995	12,620	2,945	2,133	17,698	11,589	23,125	162	107	34,983	52,681
1996	7,583	2,085	4,385	14,053	10,360	19,917	214	146	30,637	44,690
1997	9,446	5,332	1,958	16,736	8,140	31,582	169	143	40,034	56,770
1998	13,221	5,906	2,217	21,334	13,150	29,805	63	118	43,136	64,480

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

Table 3.11.6.2 SOUTHERN HORSE MACKEREL (Divisions VIIIc and IXa).

Year	Recruitment Age 0	Spawning Stock Biomass	Landings	Fishing Mortality Age 2-5
1985	1,696.31	133.11	43.53	0.172
1986	2,696.00	187.98	71.49	0.278
1987	1,401.53	212.23	54.65	0.198
1988	954.76	216.23	56.39	0.230
1989	1,155.03	213.34	56.40	0.249
1990	885.91	228.69	49.21	0.190
1991	1,864.75	232.61	45.51	0.171
1992	1,814.02	224.74	50.96	0.204
1993	1,309.60	212.43	57.43	0.219
1994	812.34	179.18	52.59	0.165
1995	732.28	207.16	52.68	0.175
1996	1,522.99	228.60	44.69	0.133
1997	1,307.90	245.76	56.77	0.196
1998	1,185.49	267.10	64.48	0.198
1999	1,308.23	251.17	.	.
Average	1,376.48	216.02	54.05	0.198
Unit	Millions	1000 tonnes	1000 tonnes	-

3.11.7 Sardine

3.11.7.a Sardine in Divisions VIIIc and IXa

State of stock/fishery: No precautionary approach reference points have been proposed for this stock and the state of the stock in relation to precautionary reference points is unknown. Fishing mortality is increasing but spawning stock biomass has stabilised and may be increasing due to increased recruitment since 1996. The perception of the state of the stock depends on the perception of the relative contribution of the northern and southern areas. These relative contributions are presently unknown. The situation appears to be worse in the northern area than in the south.

Management objectives: There are no explicit management objectives for this stock. In order to conform to the precautionary approach a management plan which will reduce F and maintain or increase SSB should be developed and implemented.

Advice on management: ICES recommends that fishing mortality be reduced to below F=0.2, corresponding to a catch of less than 81 000 t in 2000 in order to prevent further short-term decline in stock size and to promote recovery of the stock.

Relevant factors to be considered in management: Information from both the fishery and from surveys indicate there has been a severe decline in abundance in the northern part of the distribution whereas abundance in the southern part of the distribution area has been stable. The reason for this change is not known. Perceptions of the overall state of the stock depend on the extent to which reliance is placed on information from the northern or southern areas, and therefore the state of the stock is considered to be uncertain.

The perceived difference in abundance in the northern and southern areas may be an indication of a contraction in the area of stock distribution. ICES considers that such a decrease in the area of distribution could lead to an increase in vulnerability of the stock to the fishery and therefore close monitoring of this stock is needed.

Catch forecast for 2000:
Basis: F(99) = F(98) = 0.39, Landings (99) = 130, 000 t.

F (2000)	Basis	SSB (2000)	Catch (2000)	Landings (2000)	SSB (2001)
0.20	F=0.50F(98)	560	81	81	564
0.30	F=0.75F(98)	551	117	117	525
0.39	F=F(98)	541	151	151	489

Weights in thousand tonnes. Recruitment at 6 676 million fish (the geometric mean of 1993-98).
Shaded scenarios likely to cause decrease in SSB

Elaboration and special comment: Since the 1940s there have been periods of high and low sardine landings (Figure 3.11.7.a.1). Because of spatial changes in fish distribution and the shift of the exploitation pattern towards older ages in the southern area it is problematic to obtain a meaningful comparison between the stock size and the fishing mortality in the mid 1980s and the late 1990s, and to provide robust estimates of the state of the stock. The assessment model has been revised on account of improved availability of data but the methodological problems have not yet been resolved. New and higher estimates of stock size provided with this model do not necessarily represent a commensurate improvement in the state of the stock, and therefore advice is formulated on the basis of recent trends in fishing mortality and recruitment.

The fishing mortality was relatively stable between 1977 and 1995 and since then increased and is estimated to be 0.39 in 1998. The stock produced three very weak year classes 1993-95 and the stock has since then produced recruitments typical of the previous 15 years. There is some indication from the 1998 Portuguese November acoustic survey that the 1998 year class is more abundant than others in recent years. This is also confirmed by the 1999 Portuguese March acoustic survey, The 1999 Spanish March acoustic survey found this year class in IXa-North but not in Division VIIIc.

As absolute values of historic stock size cannot be calculated reliably and in view of uncertainty about the biology of the stock, ICES does not propose precautionary reference points for management purposes.

It is not possible presently to distinguish whether the observed change in distribution is due to a migration driven by climatic effects, a contraction caused by a reduction in stock size, or due to local depletion of independent population units. Whichever case pertains, a reduction in the area of spawning and a reduction in the area of the fishery implies an increase in vulnerability of the stock to the fishery and therefore an increase in biological risk.

Analytical assessment used was based on catches in numbers and by age, acoustic survey results and egg surveys in 1988 and 1997.

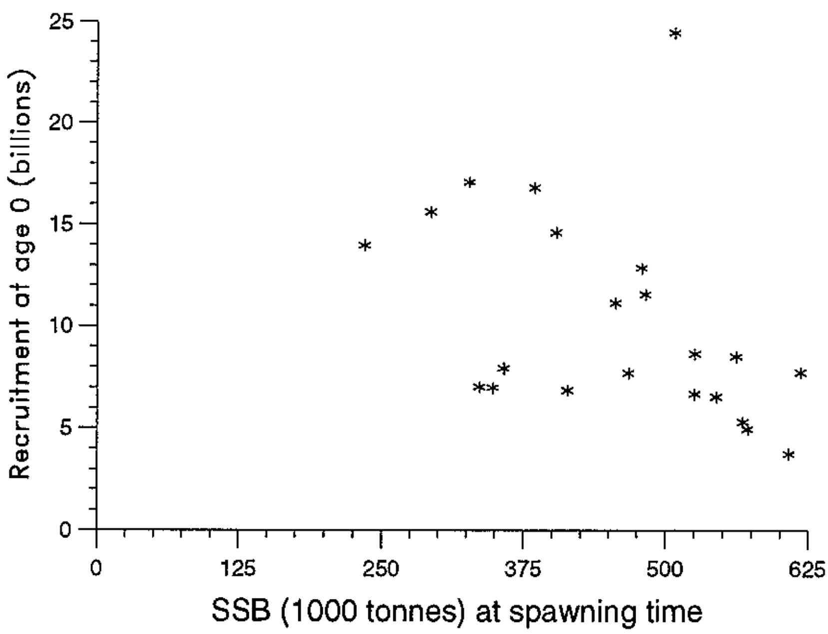
Source of information: Report of the Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine and Anchovy, September 1999 (ICES CM 2000/ACFM:5).

Catch data (Tables 3.11.7.a.1–2):

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC	Official Landings VIII & IX	ACFM Landings[3]
1987	No increase in F; TAC	140	-		178
1988	No increase in F; TAC	150	-	167	162
1989	No increase in F; TAC	212	-	146	141
1990	Room for increased F	227[2]	-	150	149
1991	Precautionary TAC	176	-	135	133
1992	No advice	-	-	139	130
1993	Precautionary TAC	135	-	153	142
1994	No advice	118[1]	-	147	137
1995	No advice; apparently stable stock	-	-	137	125
1996	Lowest possible level	-	-	134	117
1997	Lowest possible level	-	-	n/a	116
1998	Significant reduction	-		n/a	109
1999	Reduce F to 0.2	38			
2000	F below 0.2	<81			

[1]Estimated catch at *Status quo* F. [2]Catch corresponding to 20% increase in F. [3] Includes only VIIIc and IXa. Weights in '000 t.

Stock - Recruitment



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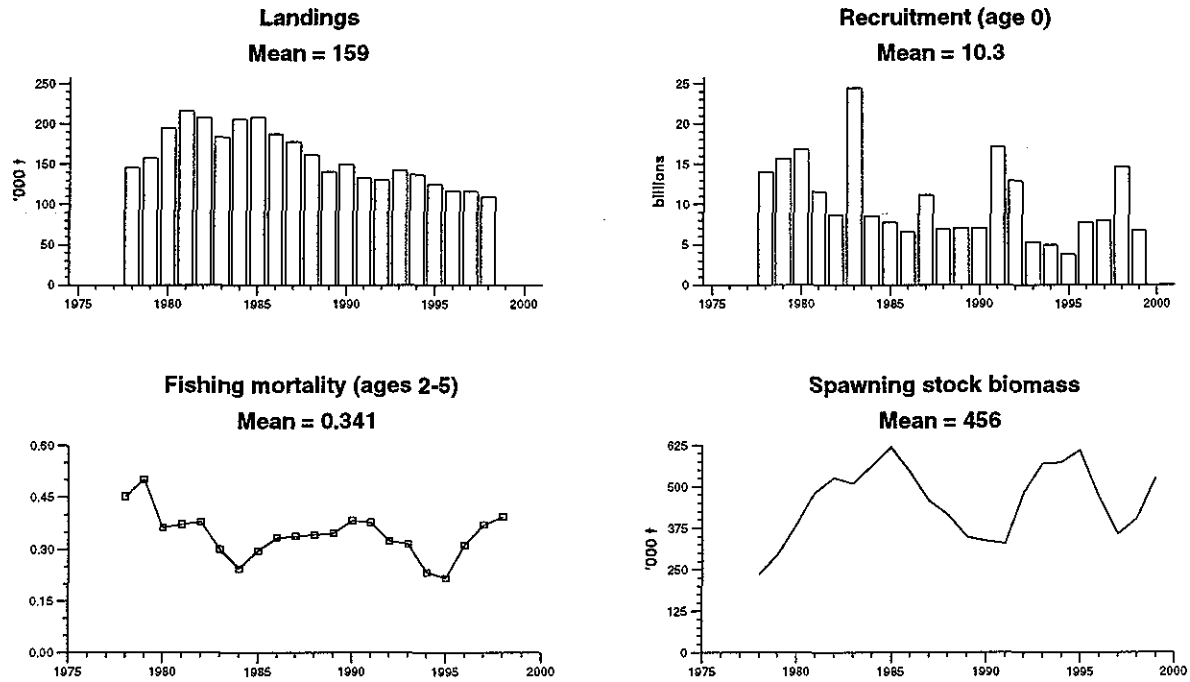


Sardine in Divisions VIIIc and IXa

Yield and Spawning Stock Biomass

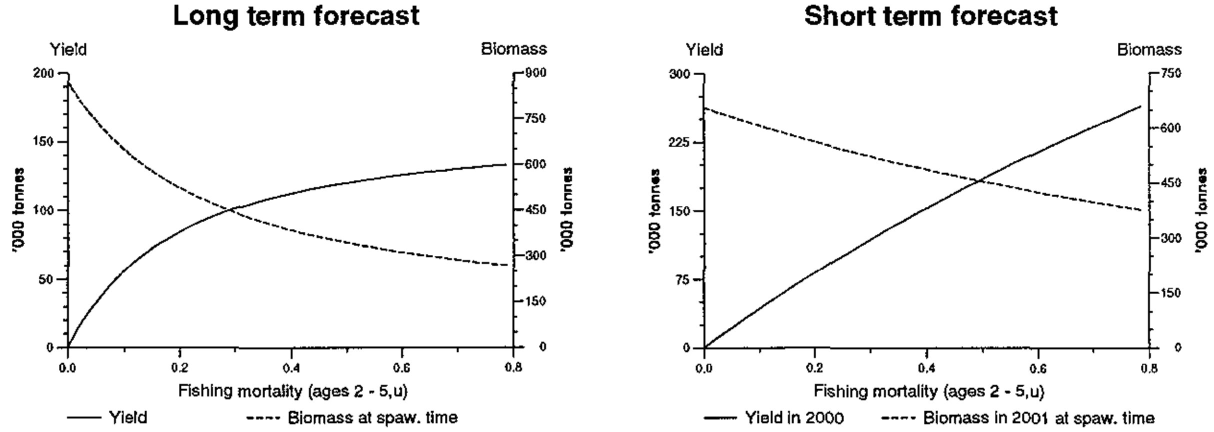


Table 3.11.7.a.1 Annual landings (t) of SARDINE in Divisions VIIIc and IXa by country.

COUNTRY	1978	1979	1980	1981	1982	1983	1984
Portugal	83,553	91,294	106,302	113,253	100,859	85,922	95,110
Spain	56,437	62,147	85,380	100,880	103,645	95,217	107,576
Cadiz (IXa South, Spain)	5,619	3,800	3,120	2,384	2,442	2,688	3,319
Total*	139,990	153,441	191,682	214,133	204,504	181,139	202,686

COUNTRY	1985	1986	1987	1988	1989	1990	1991
Portugal	111,709	103,451	90,214	93,591	91,091	96,173	92,638[1]
Spain	92,398	77,155	78,611	64,949	46,035	46,753	35,118
Cadiz (IXa South, Spain)	4,333	6,757	8,870	2,990	3,835	6,503	4,834
Total*	204,107	180,606	168,825	158,540	137,126	142,926	127,756

COUNTRY	1992	1993	1994	1995	1996	1997	1998
Portugal	83,315	90,440	94,468	87,818	85,757	81,156	82,890
Spain	42,739	48,391	38,332	33,466	25,674	27,878	19,440
Cadiz (IXa South, Spain)	4,196	3,664	3,782	3,996	5,304	6,780	6,594
Total*	126,054	138,831	132,800	121,284	111,431	109,034	102,330

*not including Cadiz.
[1] Discards included.

Table 3.11.7.a.2 SARDINE in Divisions VIIIc and IXa.

Year	Recruitment Age 0	Spawning Stock Biomass	Landings	Fishing Mortality Age 2-5
1978	13,969.42	235.52	145.61	0.452
1979	15,621.32	294.16	157.24	0.501
1980	16,819.94	385.22	194.80	0.361
1981	11,543.04	482.97	216.52	0.371
1982	8,653.78	526.23	206.95	0.377
1983	24,457.99	508.34	183.84	0.299
1984	8,506.95	562.34	206.01	0.243
1985	7,730.01	618.68	208.44	0.294
1986	6,542.52	544.97	187.36	0.333
1987	11,148.33	456.94	177.70	0.337
1988	6,855.08	414.70	161.53	0.341
1989	6,990.65	348.73	140.96	0.346
1990	7,027.80	336.98	149.43	0.382
1991	17,085.92	328.29	132.59	0.376
1992	12,858.05	479.82	130.25	0.322
1993	5,311.93	568.16	142.50	0.314
1994	4,967.88	572.09	136.58	0.232
1995	3,750.92	608.21	125.28	0.215
1996	7,702.54	467.90	116.74	0.312
1997	7,943.13	358.12	115.81	0.370
1998	14,617.17	404.57	108.93	0.394
1999	6,676.00	525.77	.	.
Average	10,308.20	455.85	159.29	0.341
Unit	Millions	1000 tonnes	1000 tonnes	-

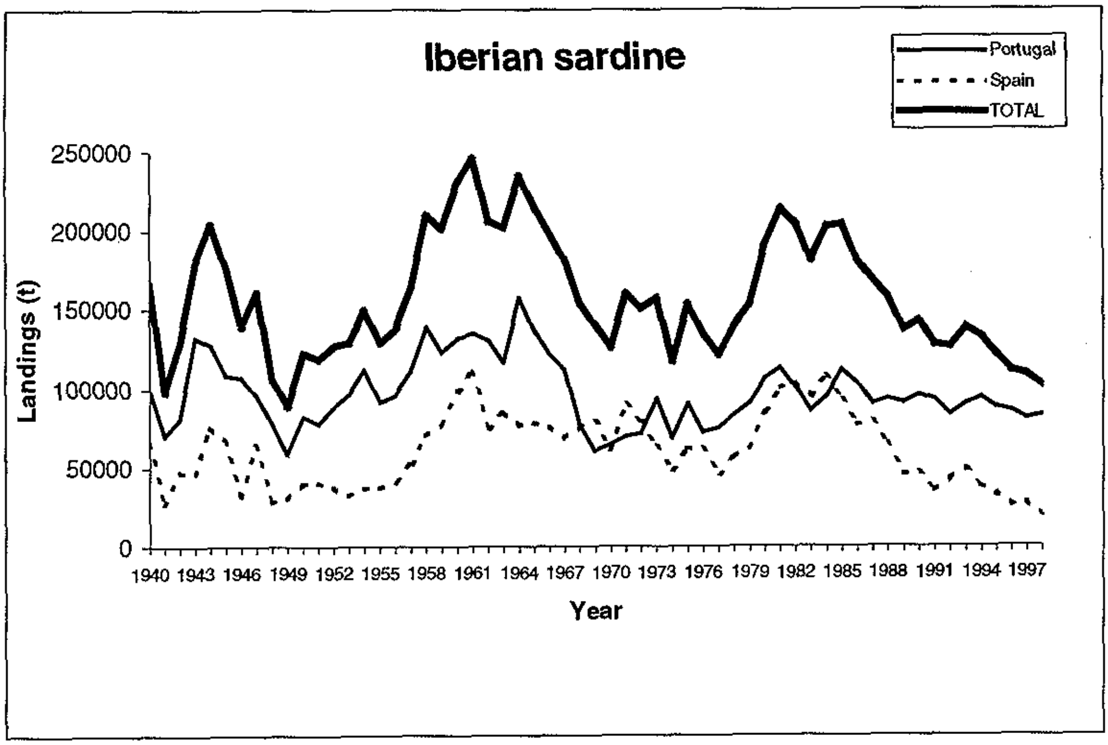


Figure 3.11.7.a.1 Sardine in Divisions VIIIc and IXa. Landings by country and total landings for the period 1940–1998.

3.11.8 Anchovy

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

State of stock/fishery: The stock size is highly variable. The biomass is above $\mathbf{B_{pa}}$ at present but is forecast to decline to well below $\mathbf{B_{pa}}$ in 2000 due to poor recruitment in 1998 and 1999.

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 increase or maintain spawning stock biomass above $\mathbf{B_{pa}}$.

Advice on management: ICES recommends that there be no fishing of anchovy until there is evidence of recruitment which would bring SSB above $\mathbf{B_{pa}}$. The 1998 year class is known to be weak while the 1999 year class is predicted to be weak based on environmental conditions. SSB is expected to decrease to unacceptable levels due to poor recruitment. A survey in April 2000 will provide additional information on the strength of the 1999 year class and this information will be reviewed by ICES when available.

Catch forecast for 2000:
Basis: Landings (99) = 25000. Recruitment at age 0 in 1998 =4774 Million (weighted average of the assessment and upwelling index for recruitment). Recruitment in 1999 is forecast using the upwelling index = 4394 Million. Recruitment in year 2000= geometric mean 1987-97 =12046 Million.

F(00)	Basis	SSB (2000)	Catch (2000)
0.0	No fishing	32	0
0.132	$0.2*F_{(96-98)}$	30	4
0.263	$0.4*F_{(96-98)}$	29	7
0.395	$0.6*F_{(96-98)}$	28	10
0.527	$0.8*F_{(96-98)}$	26	13
0.658	$F_{(96-98)}$	25	15

Weights in t.
For all scenarios the forecast biomass is lower than $\mathbf{B_{pa}}$ in 2000. See probabilistic forecast for year 2000 in Figure 3.11.8.a.1.

Relevant factors to be considered in management: A strong reduction of the spawning biomass in 2000, linked to adverse environmental conditions, is expected to bring the stock below $\mathbf{B_{pa}}$, even under conditions of no catches. For this reason, ICES advises that there should be no fishery. It is recognised that the state of the resource can change quickly, and therefore in-year monitoring and management could be appropriate.

ICES advises that when a fishery is resumed, 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.

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 countries involved in the fishery should maintain the continuity of direct surveys for anchovy.

Elaboration and special comments: An analytical assessment (ICA) used catch-at-age data from French and Spanish fisheries, stock biomass estimates from egg (1987–1999) and acoustic surveys (1989–1998). This assessment is in agreement with the 1998 assessment. Surveys indicate an SSB of about 58 000 t in 1997 and 115 000 t in 1998 and a preliminary figure of 69,000t in 1999. The stock is likely to fluctuate widely due to the large variations in recruitment and much of these variations are driven by environmental factors. Compared with the 1960s the distribution area of the stock has decreased.

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. [*The $\boldsymbol{F_{pa}}$ value is considered less useful for management purposes than the $\boldsymbol{B_{lim}}$ and $\boldsymbol{B_{pa}}$ as the aim is to ensure adequate escapement from the fishery by maintaining stock size above $\boldsymbol{B_{lim}}$.*]

Technical basis:

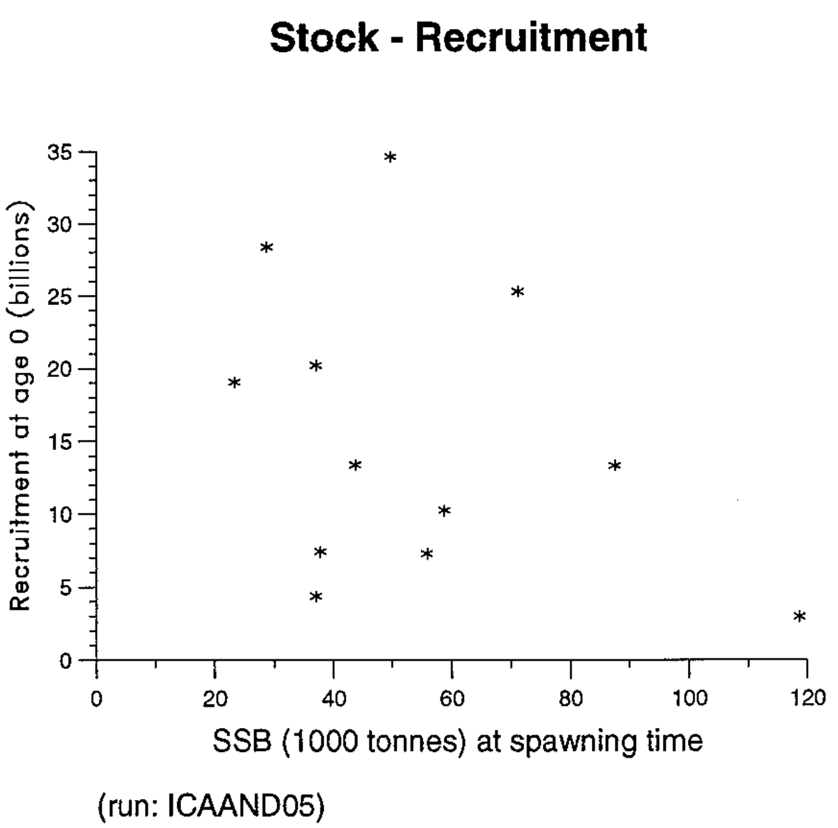
$\mathbf{B_{lim}}$: $\mathbf{B_{loss}}$: 18 000 t.	$\mathbf{B_{pa}}$: see above.
	$\mathbf{F_{pa}}$: F for 50% spawning potential ratio, i.e., the F at which the SSB/R is half what it would have been in the absence of fishing.

Source of information: Report of the Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine and Anchovy, September 1999 (ICES CM 2000/ACFM:5).

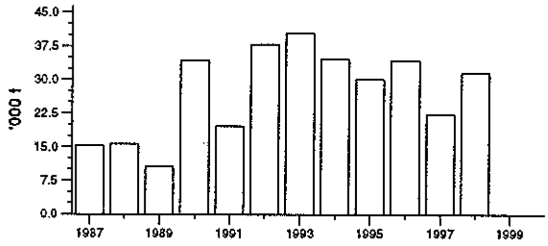
Catch data (Tables 3.11.8.a.1–2):

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC	Official landings	ACFM landings
1987	Not assessed	-	32	14	15
1988	Not assessed	-	32	14	16
1989	Increase SSB; TAC	10.0[1]	32	n/a	11
1990	Precautionary TAC	12.3	30	n/a	34
1991	Precautionary TAC	14.0	30	n/a	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	32
1999	Reduced F on juveniles, closed area	-	33	n/a	n/a
2000	No fishing until good recruitment measured	0			

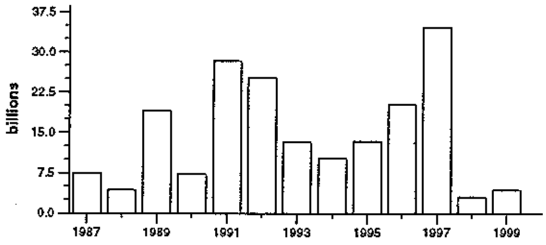
[1]Mean catch of 1985–1987. Weights in '000 t. n/a: not available.



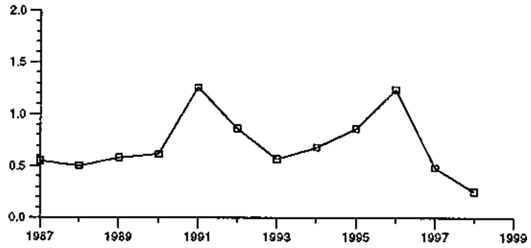
Landings
Mean = 27.2



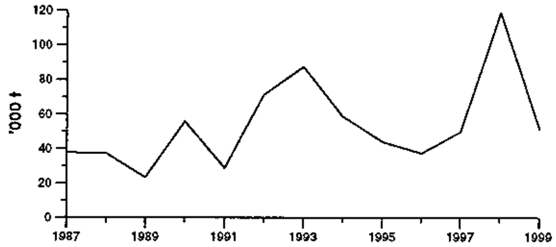
Recruitment (age 0)
Mean = 14.7



Fishing mortality (ages 1-3)
Mean = 0.704

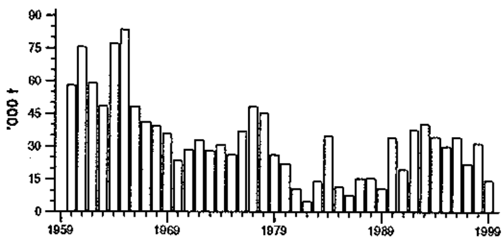


Spawning stock biomass
Mean = 53.9



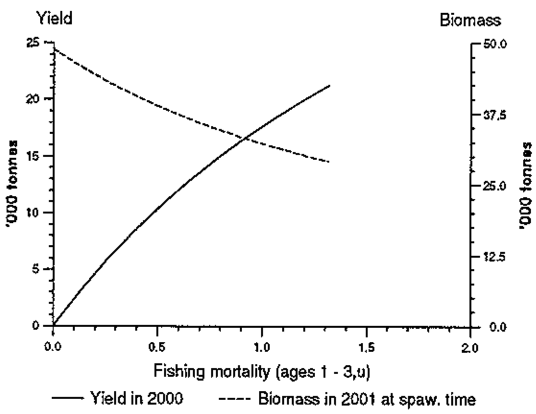
Anchovy in Sub-area VIII (Bay of Biscay)

Landings

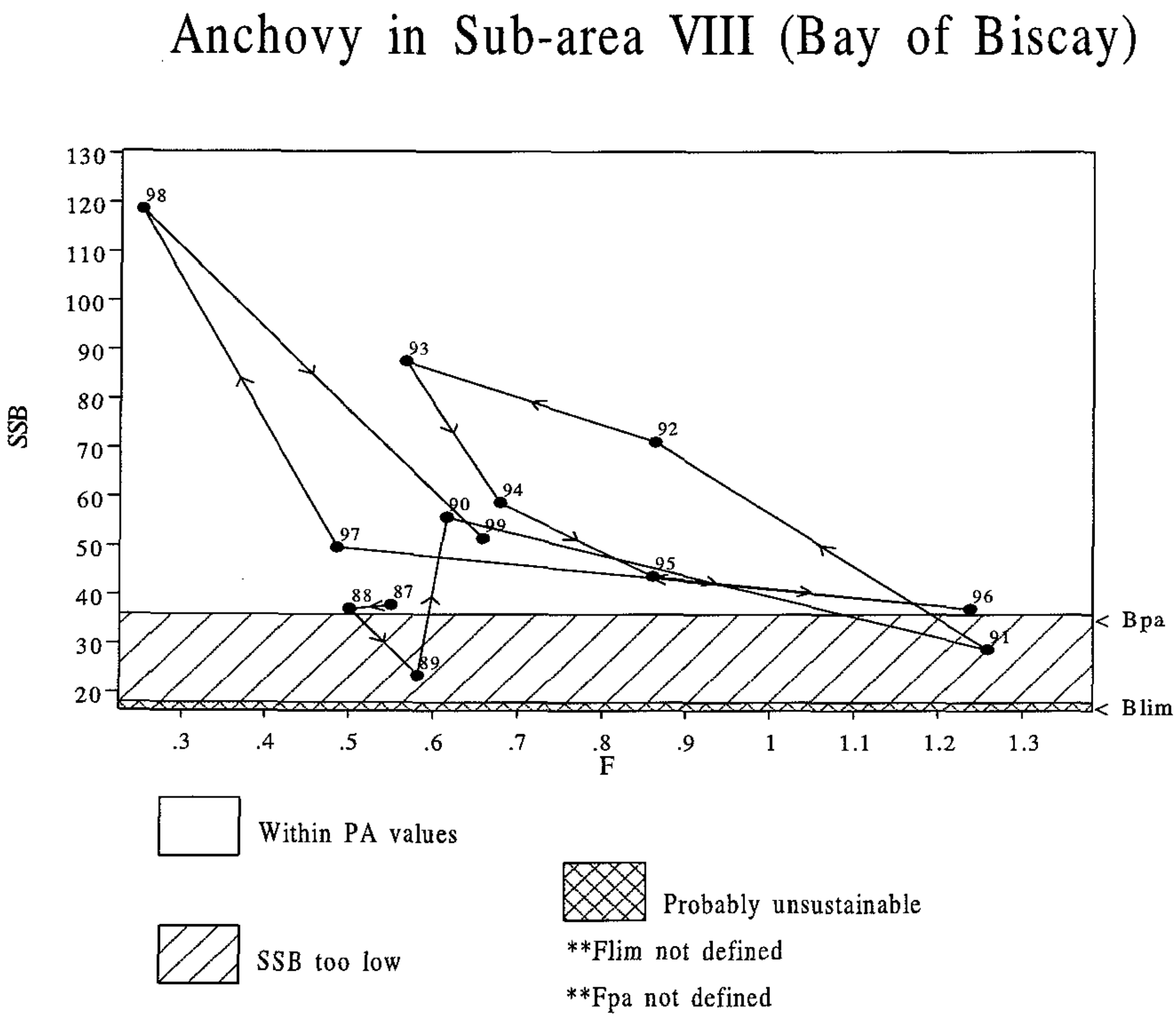


Yield and Spawning Stock Biomass

Short term forecast



Precautionary Approach Plot



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Plotted on 29/10/1999 at 16:38:19

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	22,987	8,455	176	31,617
1999	4,043	10,400		14,443 (*)
AVERAGE (1960–98)	5,433	28,530	306	34,056

(*) Preliminary data up to July for the French and Spanish fishery

Table 3.11.8.a.2 ANCHOVY in Sub-area VIII (Bay of Biscay).

Year	Recruitment Age 0	Spawning Stock Biomass	Landings	Fishing Mortality Age 1-3
1987	7,446.51	37.81	15.31	0.550
1988	4,386.75	37.07	15.58	0.501
1989	19,081.96	23.39	10.61	0.581
1990	7,318.64	55.84	34.27	0.615
1991	28,401.67	28.79	19.64	1.258
1992	25,305.27	71.24	37.89	0.863
1993	13,334.14	87.62	40.39	0.566
1994	10,275.18	58.76	34.63	0.679
1995	13,396.82	43.73	30.12	0.861
1996	20,231.37	37.10	34.37	1.238
1997	34,647.79	49.64	22.34	0.486
1998	2,977.27	118.59	31.62	0.251
1999	4,394.00	51.48	.	.
Average	14,707.49	53.93	27.23	0.704
Unit	Millions	1000 tonnes	1000 tonnes	-

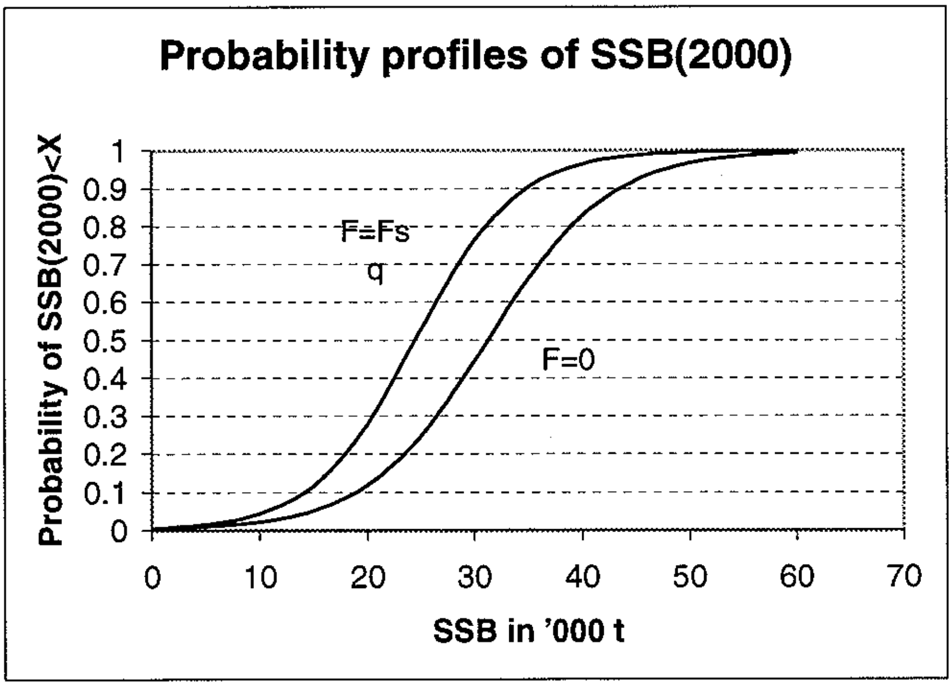


Figure 3.11.8.a.1. ANCHOVY in Sub-area VIII (Bay of Biscay). Probability profiles for short-term forecast.

3.11.8.b Anchovy in Division IXa

State of stock/fishery: No precautionary approach reference points have been proposed for this stock and the state of the stock in relation to precautionary reference points is unknown. 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.

Advice on management: ICES recommends that a management plan including monitoring of the development of the stock and of the fishery with corresponding regulations should be developed and implemented. There is no basis to change the previous advice and ICES recommends that catches be restricted to 4 600 t until the response of the stock to the fishery is known.

Relevant factors to be considered in management: The current TAC is almost three times higher that the average of the catches of recent years (excluding 1995 and 1998) which is 4 600 t. In 1998, the catch of 11 000 t was over twice this level.

It is recognised that the state of the resource can change quickly, and therefore in-year monitoring and management could be appropriate. 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 85% of the total catch during the period 1988–1994 and 1996–1998.

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 1996–1998 the catches decreased again. Catches from Sub-division IXa South, which had decreased sharply in 1995, increased in 1996 to 1998 registering a historical maximun for this area in 1998. The mean catch in Sub-division IXa South between 1988–1997 is around 3 600 t. 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. Furthermore, mean lengths at age are different between the Southern and Northern areas, which supports the suggestion that populations inhabiting these areas must have different dynamics. There is not sufficient information to estimate appropriate reference points.

Source of information: Report of the Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine and Anchovy, September 1999 (ICES CM 2000/ACFM:5).

Catch data (Table 3.11.8.b.1):

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC[1]	ACFM landings
1987	Not assessed	-	4.6	n/a
1988	Not assessed	-	6	4.7
1989	Not assessed	-	6	6.0
1990	Not assessed	-	9	6.5
1991	Not assessed	-	9	5.9
1992	Not assessed	-	12	3.2
1993	If required, precautionary TAC	-	12	2.0
1994	If required, precautionary TAC	-	12	3.4
1995	If required, precautionary TAC	-	12	13.0
1996	If required, precautionary TAC	-	12	4.6
1997	If required, TAC at pre-95 catch level	-	12	5.3
1998	No advice		12	11.0
1999	If required, TAC at pre-95 catch level	4.6	13	
2000	Fishery less than pre-95 level and develop and implement management plan	4.6		

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

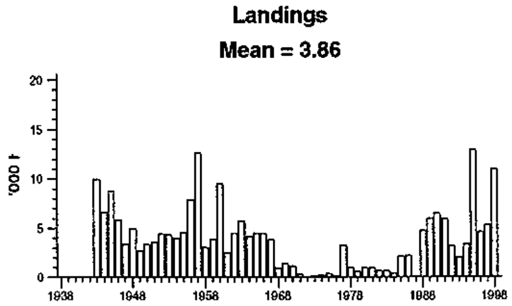


Table 3.11.8.b.1 Portuguese and Spanish annual landings of ANCHOVY in Division IXa. (From Pestana, 1989 and 1996 and Working Group members).

	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
1998	894	153	566	1613	371	8977	9349	10962

(-) Not available
(0) Less than 1 tonne

3.11.9.a *Nephrops* in Division VIIIc (Management Area O)

There are two Functional Units in this Management Area: a) North Galicia (FU 25) and b) Cantabrian Sea (FU 31).

State of stock/fishery:

Both FUs are considered to be fully exploited.

a) North Galicia: LPUE stable at a low level in 1993-1997, but long-term trend is downward.

b) Cantabrian Sea: LPUE increasing in recent years, although below the average for 1987-90.

Management objectives: There are no management objectives set for this fishery.

Advice on management: As *Nephrops* is mostly a by-catch in a primarily finfish-directed fishery, finfish effort will continue to define the level of exploitation on *Nephrops*. There is no basis to revise the advice previously given, and therefore ICES advises that a TAC of 510 t be set for each of the years 2000 and 2001.

Elaboration and special comments: All catches from these FUs are taken by Spain. Landings and effort in the North Galicia fishery have declined since the 1970s, and are now at record low levels. For the area as a whole, the landings in 1997-98 were the lowest in the time series.

LPUE (except 1998) and mean size data available for both units. Length-based assessment for both units, age-based assessment not repeated.

Source of information: Report of the Working Group on *Nephrops* Stocks, April 1999 (ICES CM 1999/ACFM:13).

Catch data (Tables 3.11.9.a.1–2):

Year	ICES advice	Recommended TAC	Agreed TAC	ACFM landings
1987			0.5	0.53
1988			0.5	0.60
1989			0.6	0.52
1990			0.8	0.46
1991		0.51	0.6	0.56
1992		~0.51	0.8	0.52
1993		0.51	1.0	0.37
1994		0.51	1.0	0.39
1995		0.51	1.0	0.37
1996	*Status quo* TAC	0.51	1.0	0.34
1997	*Status quo* TAC	0.51	1.0	0.32
1998		0.51	1.0	0.17
1999		0.51	1.0	
2000		0.51		
2001		0.51		

(Weights in '000 t)

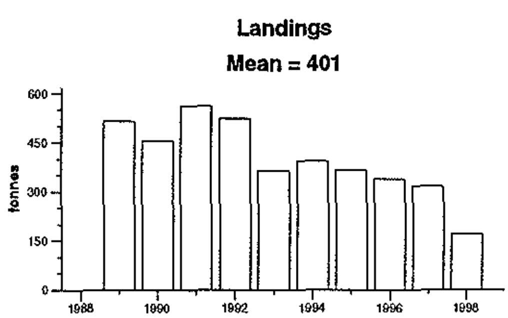


Table 3.11.9.a.1 *Nephrops* landings (tonnes) by Functional Unit plus other rectangles in Management Area O (VIIIc).

Year	FU 25	FU 31	Other	Total
1989	376	139	0	515
1990	285	172	0	457
1991	453	109	0	562
1992	428	94	0	522
1993	274	91	0	365
1994	245	148	0	393
1995	273	94	0	367
1996	209	129	0	338
1997	219	98	0	317
1998 *	103	68	0	171
* provisional na = not available				

Table 3.11.9.a.2 *Nephrops* landings (tonnes) by country in Management Area O (VIIIc).

Year	Spain	Total
1989	515	515
1990	457	457
1991	562	562
1992	522	522
1993	365	365
1994	393	393
1995	367	367
1996	338	338
1997	317	317
1998 *	171	171
* provisional na = not available		

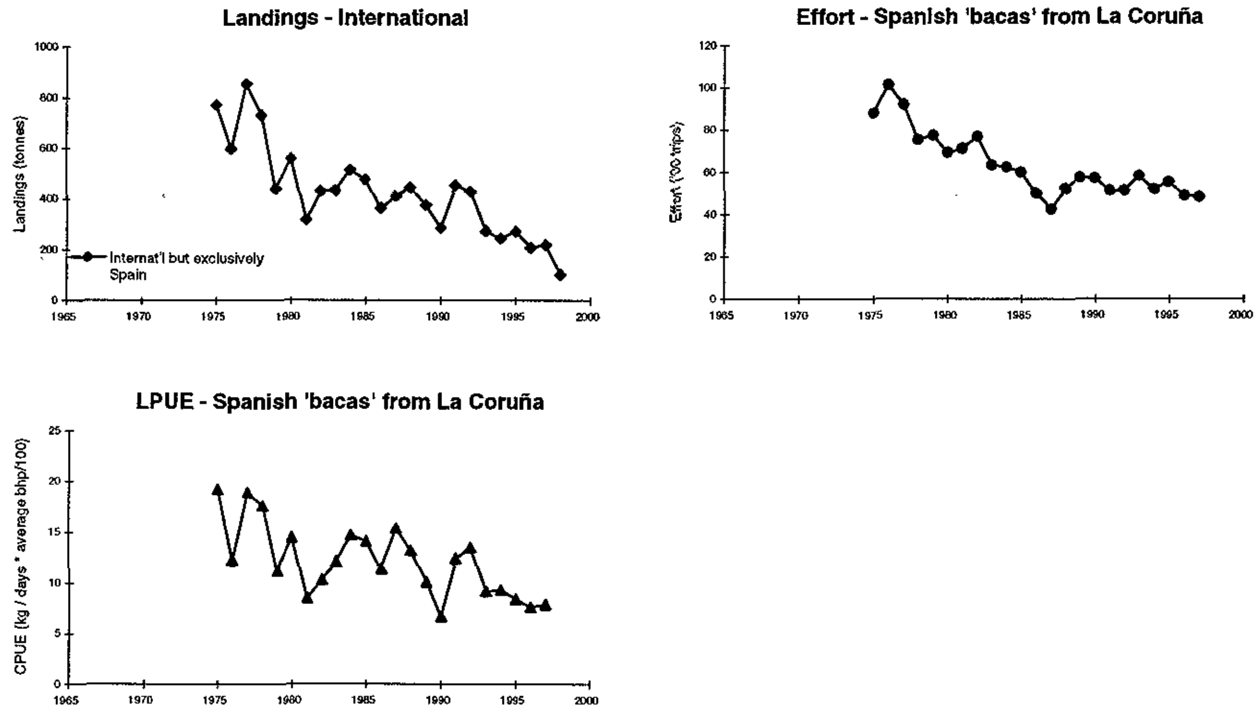


Figure 3.11.9.a.1 - North Galicia (FU 25): Long term trends in landings, effort (La Coruña trawler fleet) and CPUEs of *Nephrops* in landings.

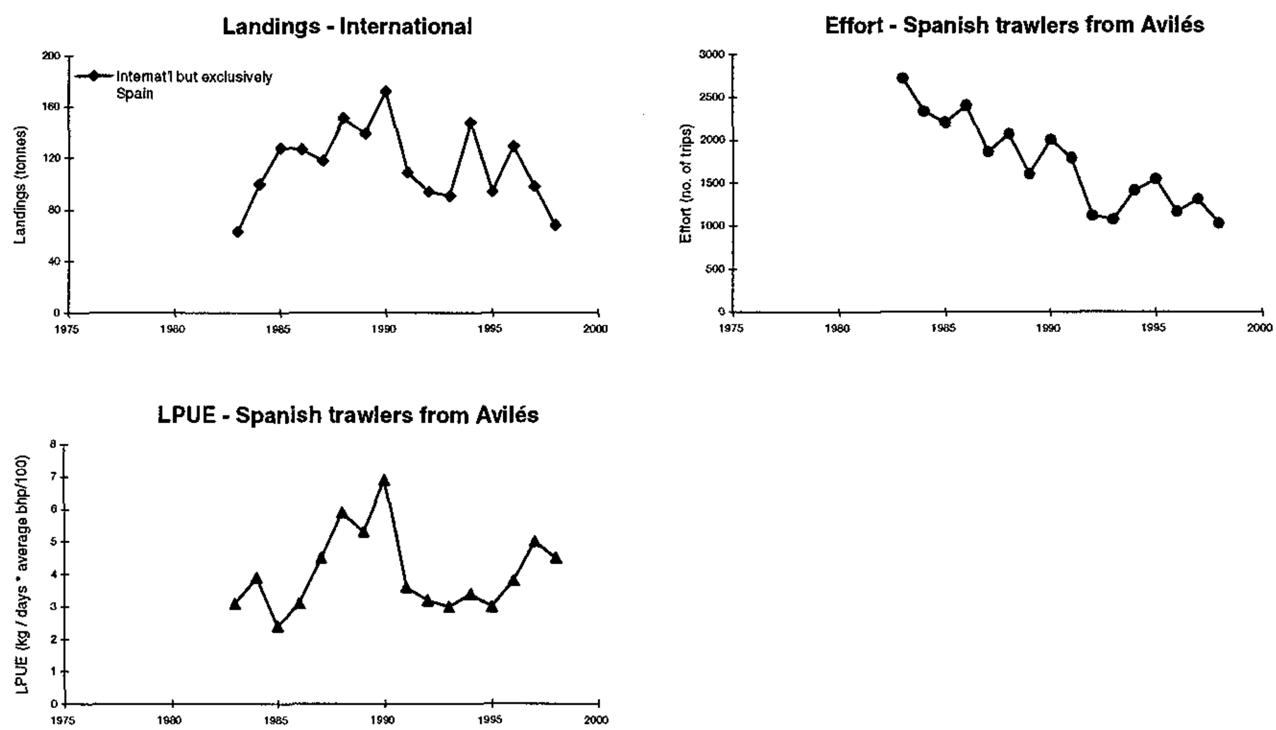


Figure 3.11.9.a.2 - Cantabrian Sea (FU 31): Long term trends in landings, effort and LPUEs of *Nephrops* in landings.

3.11.9.b *Nephrops* in Division IXa (Management Area Q)

There are five Functional Units in this Management Area: a) West Galicia (FU 26), b) North Portugal (FU 27), c) Southwest Portugal (FU 28), d) South Portugal (FU 29) and e) Gulf of Cadiz (FU 30).

State of stocks/fishery:

a) West Galicia: LPUEs fluctuating without trend, though some recent low LPUE values for one port.

b) North Portugal: Insufficient data to allow assessment.

c+d) SW and S Portugal: CPUE almost constantly declining since 1989. VPA indicates that stock biomass and recruitment have sharply decreased since 1991-92, remaining at a very low level in 1996-98.

e) Gulf of Cadiz: Insufficient data to allow assessment.

Management objectives: There are no management objectives set for this fishery.

Advice on management: In the light of the continued signs of decline in FUs 28 and 29, ICES strongly reiterates its advice from 1997, that fishing mortality and therefore the catches for this Management Area Q urgently needs to be reduced. The advised TAC for 2000 and 2001 is 500 t each year.

Relevant factors to be considered in management: ICES notes that its 1997 advice was not followed, despite the strong signs that the stocks in this area would benefit from a reduction in fishing mortality.

It should be noted that this Management Area includes five FUs, and that a TAC set for the entire area will not necessarily result in a sufficient reduction in fishing mortality in the two critical FUs 28 and 29.

Elaboration and special comments: The fishery in FUs 26, 27 and 30 is mainly conducted by Spanish vessels, and that in FUs 28 and 29 by Portuguese vessels, on deep water grounds (200-750 m). The Portuguese fleet in FUs 28 and 29 comprises two components: demersal fish trawlers and crustacean trawlers. Landings from all FUs within this Management Area have declined significantly in recent years. Effort in FUs 26 and 27 in general is declining. In FUs 28 and 29, effort fell in 1985–1989 and has since remained at that level.

CPUE and/or LPUE, effort data and mean size data available for most FUs, except FU 30 (Gulf of Cadiz). A length-based assessment was conducted in 1997 for FUs 26+27 combined. New length- and age-based assessments were carried out for FUs 28+29 combined. The 1997 mesh assessment for FUs 28+29 predicted only small gains in Y/R upon an increase of the mesh size to 70 or 80 mm, but uncertainties on the discards cast some doubts on these results.

Source of information: Report of the Working Group on *Nephrops* Stocks, April 1999 (ICES CM 1999/ACFM:13).

Catch data (Tables 3.11.9.b.1–2):

Year	ICES advice	Recommended TAC	Agreed TAC	ACFM landings
1987			4.8	1.55
1988			4.8	1.29
1989			4.8	1.35
1990			4.7	1.19
1991		1.84	3.0	1.31
1992		1.3	2.5	1.35
1993		1.3	2.5	1.06
1994		1.3	2.5	0.79
1995		1.3	2.5	0.92
1996	*Status quo* TAC	1.3	2.5	0.51
1997	*Status quo* TAC	1.3	2.5	0.57
1998		0.5	2.5	0.60
1999		0.5	2.0	
2000		0.5		
2001		0.5		

(Weights in '000 t)

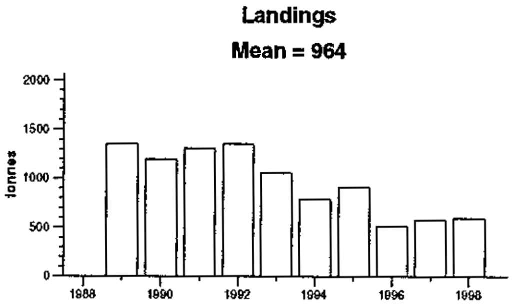


Table 3.11.9.b.1 *Nephrops* landings (tonnes) by Functional Unit plus other rectangles in Management Area Q (IXa).

Year	FU 26	FU 27	FUs 28-29	FU 30	Other	Total
1989	620 **	88	469	174	0	1351
1990	401 **	48	524	220	0	1193
1991	549 **	54	478	226	0	1307
1992	584 **	52	> 470	243	0	> 1349
1993	472 **	50	> 377	160	0	> 1059
1994	426 **	22	> 237	107	0	> 792
1995	501 **	10	> 273	132	0	> 916
1996	264	67	> 132	49	0	> 512
1997	359	74	> 136	na	0	> 570
1998 *	295	50	> 161	89	0	> 595
* provisional na = not available						
** including landings from North Portugal (FU 27)						

Table 3.11.9.b.2 *Nephrops* landings (tonnes) by country in Management Area Q (IXa).

Year	Portugal	Spain	Total
1989	557	794	1351
1990	572	621	1193
1991	533	774	1307
1992	522	> 827	> 1349
1993	427	> 632	> 1059
1994	259	> 533	> 792
1995	283	> 633	> 916
1996	149	> 363	> 512
1997	143	> 427	> 570
1998 *	169	> 426	> 595
* provisional na = not available			

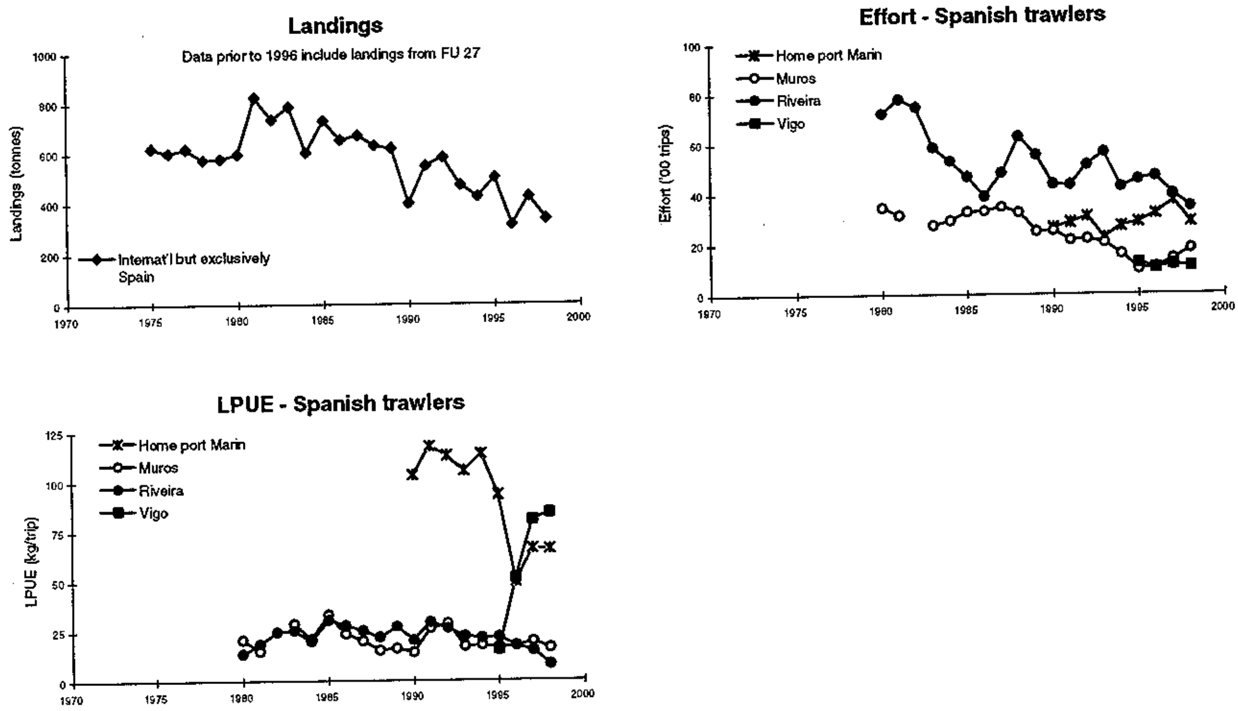


Figure 3.11.9.b.1 - West Galicia (FU 26): Long term trends in landings, effort and LPUEs of *Nephrops* in landings.

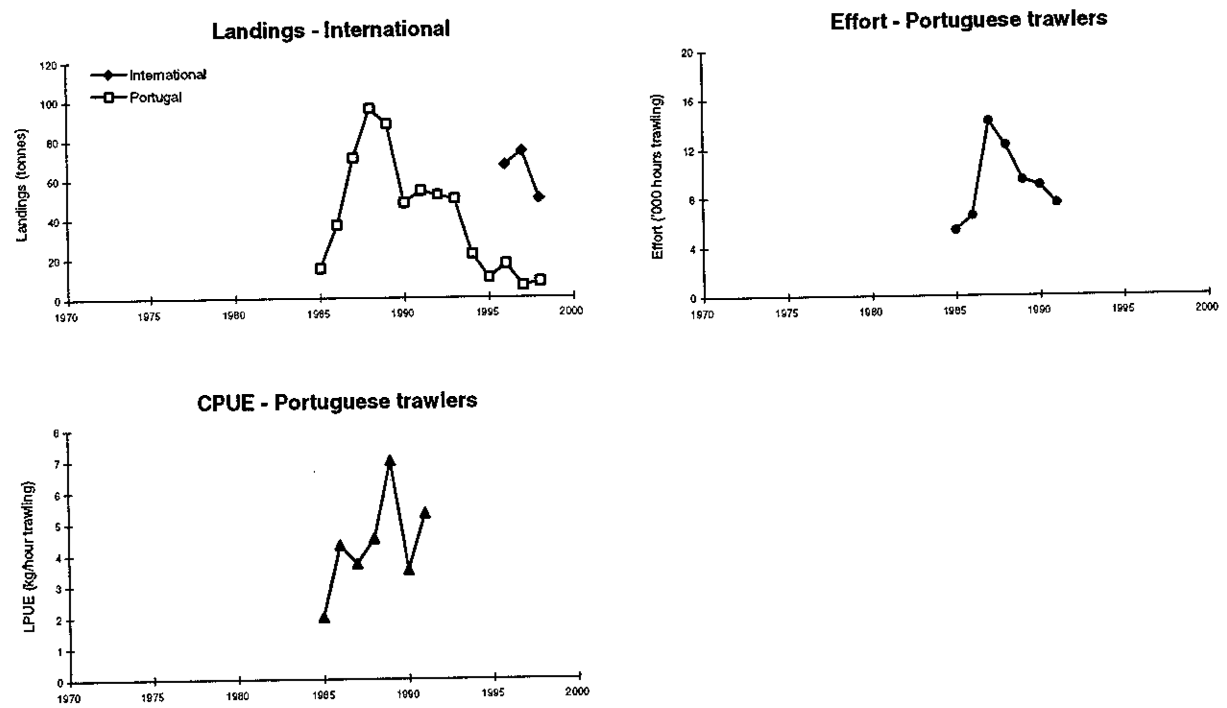


Figure 3.11.9.b.2 - North Portugal (FU 27): Long term trends in landings, effort and CPUEs of *Nephrops* in surveys and landings.

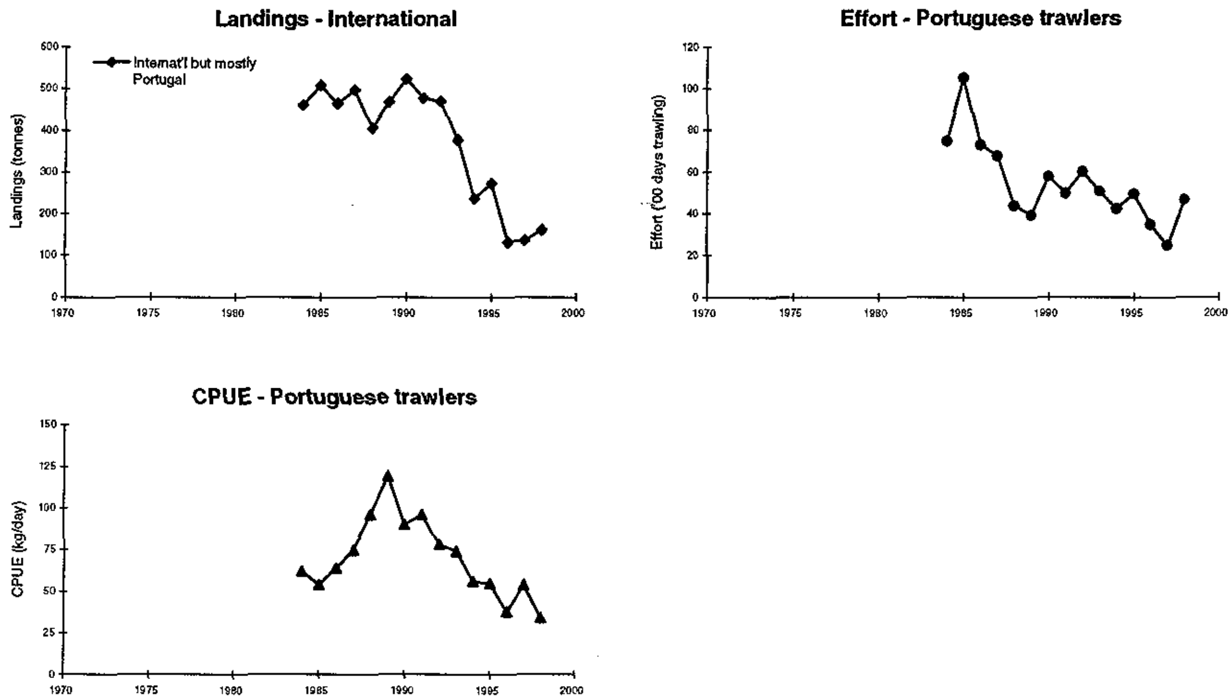


Figure 3.11.9.b.3 - SW and S Portugal (FUs 28-29): Long term trends in landings, effort and CPUEs of *Nephrops* in surveys and landings.

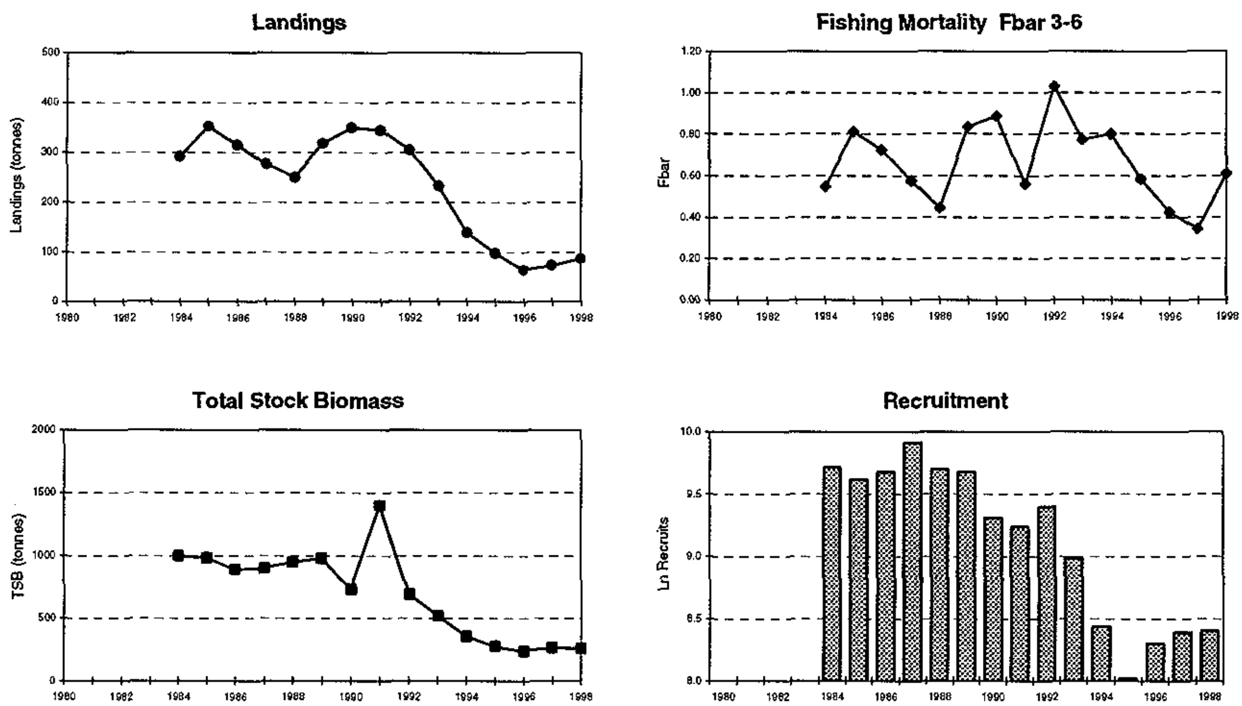


Figure 3.11.9.b.4 - SW and S Portugal (FUs 28-29): Output VPA males: Trends in Landings, Fbar, TSB and Recruitment.

3.11.9.c *Nephrops* in Division IXb and Sub-area X (Management Area R)

Advice on management: There are no reported landings of *Nephrops* from this area, so it is suggested that a zero TAC be set to prevent mis-reporting.

Source of information: Report of the Working Group on *Nephrops* Stocks, April 1999 (ICES CM 1999/ACFM:13).

3.11.10 Request by the Government of Portugal relating to an area disaggregated catch forecast for sardine in Divisions VIIIc and IXa

ICES was requested by the Government of Portugal to assess the status of the stock(s) of sardine, redefining unit stocks in accordance with updated information on the stock identification, composition, distribution and migration in relation to climatic effects, and to provide catch options for 2000 regarding the scenarios of, at least, two different units of management: 1) the management unit of Division IXa; 2) the management unit in Sub-area VIII as appropriate.

The basis for the current assumptions about stock identity was reviewed at the Working Group for the Assessment of Mackerel, Horse Mackerel, Sardine and Anchovy (ICES CM 2000/ACFM:5). ICES considers that the distribution of sardine around the Atlantic waters of the Iberian Peninsula has changed in recent years with a reduction in abundance in the north part and a stable situation in the south. ICES also considers that the updated information about sardine in VIIIc and IXa did not provided conclusive evidence to redefine the actual stock unit. Therefore it was decided to continue to assess the Iberian sardine as a single stock unit in Division VIIIc+IXa.

As a response to the request by the government of Portugal the catch forecasts were calculated for the year 2000 on the basis of partial fishing mortalities for 1998 for Divisions VIIIc and IXa separately (1991-1998 fixed exploitation pattern scaled to the 1998 fishing mortality). This forecast is based on the assumption of that the spatial distribution of the population remains unchanged since 1998. However changes in the spatial distribution have been observed in the past.

The forecast is presented below. There are small differences in the forecast catches between the area disaggregated and combined predictions because preliminary values were used for catch weights at age for each area.

Catch forecast for 2000:
Basis: F(99) = F(98) = 0.39, Landings (99) = 130, 000 t. Recruitment at 6 676 million fish (the geometric mean of 1993-98).

F (2000)	Basis	SSB (2000)	Catch in VIIIc (2000)	Landings in VIIIc (2000)	Catch in IXa (2000)	Landings in IXa (2000)	SSB (2001)
0.20	F=0.50F(98)	560	12	12	70	70	564
0.30	F=0.75(98)	551	17	17	101	101	525
0.39	F=F(98)	541	22	22	131	131	490

Weights in thousand tonnes.
Shaded scenarios likely to cause decrease in SSB

Source of information: Report of the Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine and Anchovy, September 1999 (ICES CM 2000/ACFM:5).

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.

The Northern Hake is fished throughout Sub-areas IV, VI, VII and VIII. The stock, which in 1998 was estimated to be about 134,000 t, has been at a low level for a number of years and is considered to be outside safe biological limits. The landings, which are mainly taken by Spain and France, have decreased in recent years and the 1998 landings of 35,500 t were the lowest recorded for over twenty years. Recruitment has been very poor in 1997 and 1998 and the stock is not expected to increase unless there is a substantial reduction in fishing mortality.

The North East Atlantic mackerel stock which is considered to consist of three spawning components (North Sea, Western and Southern) is fished over a very wide area extending throughout Sub-areas II, IV, VI, VII and VIII. Considerable mixing of the components occurs at various times throughout the year. The fishery is conducted by a number of countries but Norway, United Kingdom, Russia, Ireland and the Netherlands take the main catches. The total catch in 1998 was estimated to be over 667,000 t. The spawning stock has increased in recent years and in 1998 was estimated to be over 3.7 million t. This increase has been because of a number of good recruitments and this increase is expected to be maintained in the future if a reduction in fishing mortality can be achieved. Although the spawning stock is high it is still considered to be outside safe biological limits because fishing mortality is too high.

The Western horse mackerel stock is like the mackerel fished over wide areas extending throughout Sub-areas IV, VI, VII and VIII. The fishery is also exploited by a number of countries but the Netherlands and Ireland take the main catches. The catch in 1998 was estimated to be about 304,000 t, which was the lowest since 1990. The state of the stock is not known but it is thought to have declined considerably over the last ten years and is considered to be outside safe biological limits. This is because no other comparative year class has replaced the exceptional 1982 year class, which has maintained the fishery for a number of years. The stock is not expected to increase at present levels of recruitment and fishing mortality rates.

The Northern Blue Whiting stock is fished mainly throughout Sub-areas II, V, VI and VII by a number of countries, mainly by Norway, Russia, Iceland, Denmark, Faroe Islands, United Kingdom and Ireland. The 1998 catches were over 1.1 million t and were the highest recorded from the fishery. Most of these catches were landed for industrial purposes. The spawning stock, that in 1998 was estimated to be over 2.9 million t, has been boosted by the very good year classes in 1995 and 1996. However, it is expected that the stock will rapidly decline in the near future if recruitment returns to normal and will not be able to maintain the present high catches.

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

State of stock/fishery: The stock is considered to be outside safe biological limits. Although fishing mortality has declined during the mid 90s, it remains above the proposed $\mathbf{F_{pa}}$. SSB has declined until the mid 1990's, and since then has remained below the proposed $\mathbf{B_{pa}}$. Recruitment in the two last years are the lowest recorded.

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 order to prevent a further decline in SSB in the short term, ICES recommends a reduction in F of at least 50%, corresponding to landings of less than 20 000 t in 2000. A recovery plan should be implemented for this stock in order to give a high probability of SSB exceeding $\mathbf{B_{pa}}$ in the next 5 years. This is not likely to be achieved without at least a 50% reduction in fishing mortality.

Relevant factors to be considered in management: SSB will not reach the proposed $\mathbf{B_{pa}}$ in the short term. At *status quo* fishing mortality SSB is expected to decrease in 2000 and 2001. Large numbers of juvenile hake are still being caught and measures to effectively reduce such catches will contribute to the advised reduction in F. Probability of SSB falling below $\mathbf{B_{pa}}$ in the next 10 years is very sensitive to small changes in F.

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

Catch forecast for 2000:
Basis: F(99) = F(96–98) = 0.26, Landings(99) = 41.7, Catch(99) = 42.5, SSB(2000) = 126.2.

F(2000)	Basis	Catch (2000)	Landings (2000)	SSB (2001)	Probability (%) of SSB being below $\mathbf{B_{pa}}$ in 2003	Probability (%) of SSB being below $\mathbf{B_{pa}}$ in 2008
0.00	0.0 $F_{96\text{-}98}$	0	0	156	<5	<5
0.05	0.2 $F_{96\text{-}98}$	9	8	146	<5	<5
0.10	0.4 $F_{96\text{-}98}$	17	16	138	<5	<5
0.13	0.5 $F_{96\text{-}98}$	21	20	134	~50	<5
0.16	0.6 $F_{96\text{-}98}$	25	24	130	~95	<5
0.20	F_{pa}	30	30	124	>95	~50
0.26	1.0 $F_{96\text{-}98}$	39	38	115	>95	>95
0.32	1.2 $F_{96\text{-}98}$	45	44	108	>95	>95

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

Elaboration and special comment: 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. In 1998, Spain took 55% of the landings, France 25%, UK about 10% and Ireland 5%. Hake are caught throughout the year, the peak landings being made in the spring-summer months. The three main gear types used by vessels fishing for hake as a target species are lines (E & W, Spain), fixed-nets (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. These fisheries have a high proportion (80%) of small hake (less than 30 cm) in their catches, but account for less than 20% in the total international catch of small hakes.

Hake spawn from February through July along the shelf edge, the main areas extending from north of the Bay of Biscay to the south and west of Ireland. 0-groups descend to the seabed (at depths in excess of 200 m), moving to shallower water with a muddy seabed (75–120 m) by September. There are two major nursery areas: in the Bay of Biscay and off southern Ireland. Three years old hake begin to move into the shallower regions of the Bay of Biscay and Celtic Sea, but as they approach maturity they disperse to offshore regions.

Hake movements are indicated by the seasonal distribution of catches 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 1990–1998. Prior to 1992, these were converted to age compositions by numerical methods. For 1992–1998, age readings were used. Data include discards estimates. Shortage of age determinations for fish > 50 cm, so plus group reduced from 10+ to 8+ from last year assessment. Also, from last year assessment Reference F changed from 1–4 to 2–6.

Reference points as proposed by ICES in 1998:

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 a 50% probability of maintaining SSB above $\mathbf{B}_{pa}$ in the next 10 years, taking into account the uncertainty in assessments.

Technical basis:

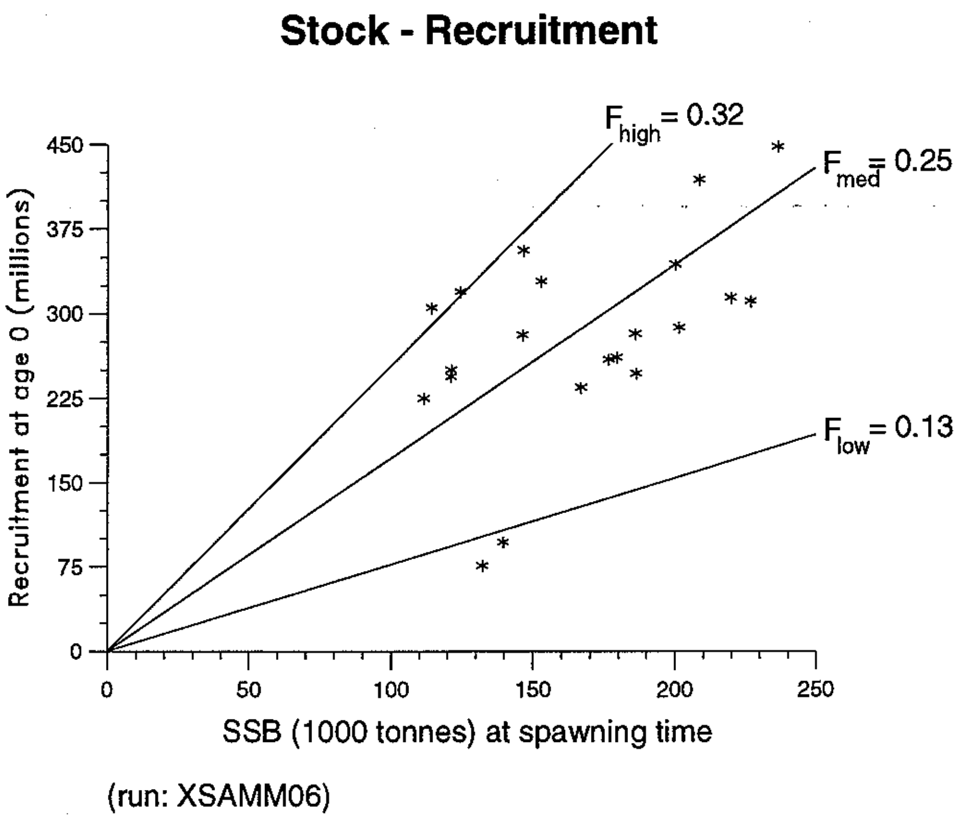
$\mathbf{B}_{lim} = \mathbf{B}_{loss}$.	$\mathbf{B}_{pa} \sim \mathbf{B}_{lim}$ x 1.4.
$\mathbf{F}_{lim} = \mathbf{F}_{loss}$.	$\mathbf{F}_{pa} \sim \mathbf{F}_{lim}$ x 0.72, implies a less than 10% probability that $(\mathbf{SSB}_{MT} < \mathbf{B}_{pa})$.

Source of information: Report of the Working Group on the Assessment of Southern Shelf Demersal Stocks, September 1999 (ICES CM 2000/ACFM:4).

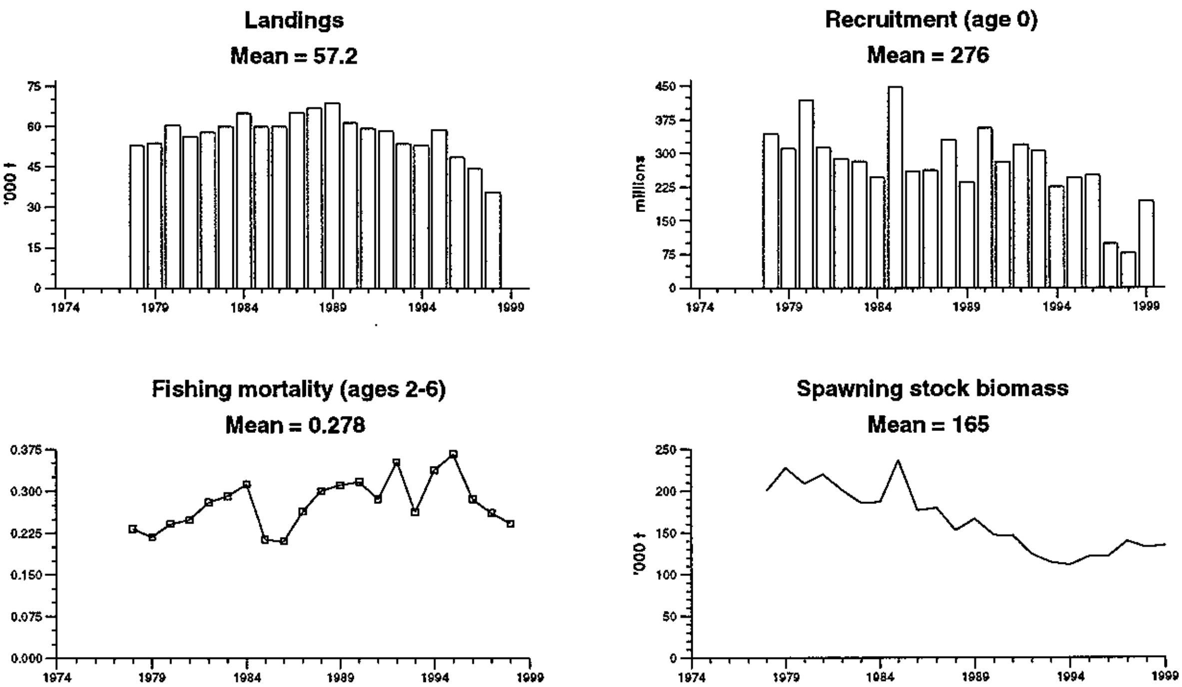
Catch data (Tables 3.12.2.1–2):

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	34.7	0.8	35.5
1999	Reduce F below $\mathbf{F}_{pa}$	<36[2]	55.1			
2000	50% reduction in F	<20[2]				

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

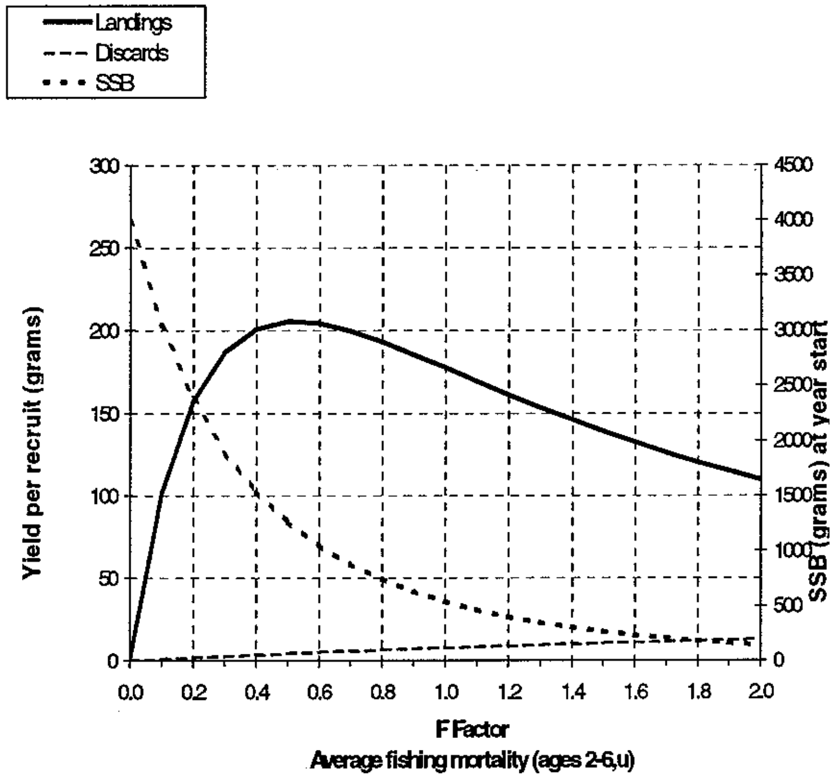


Hake – Northern stock (Division IIIa, Sub-areas IV, VI and VII, and Divisions VIIIa,b)

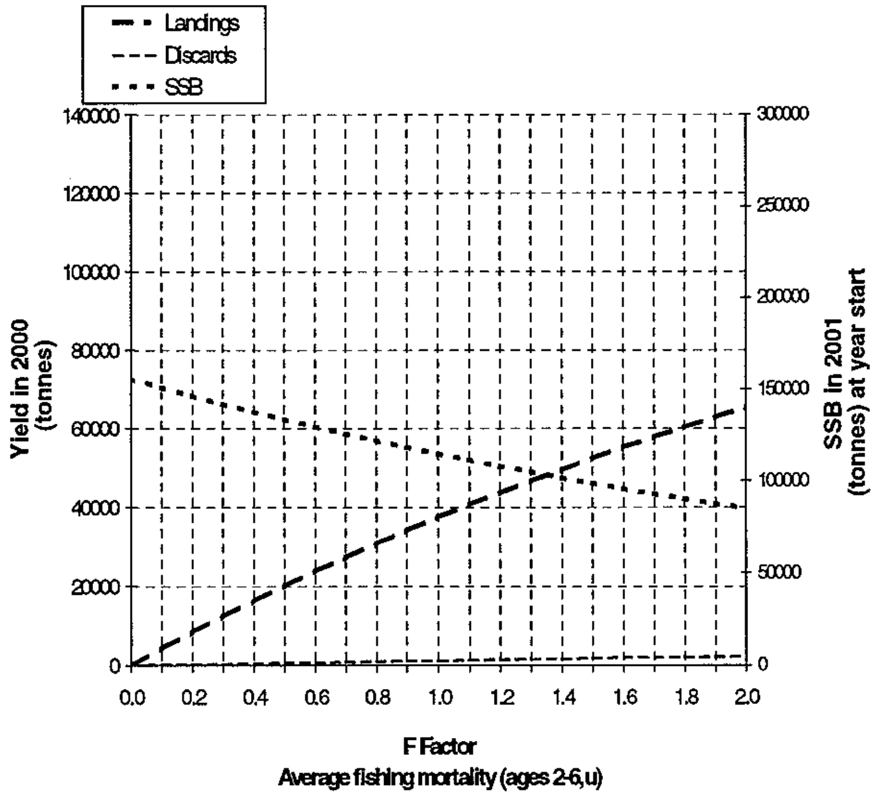


Hake – Northern stock (Division IIIa, Sub-areas IV, VI and VII, and Divisions VIIIa,b)

Long term yield and spawning stock biomass



Short term yield and spawning stock biomass



Precautionary Approach Plot

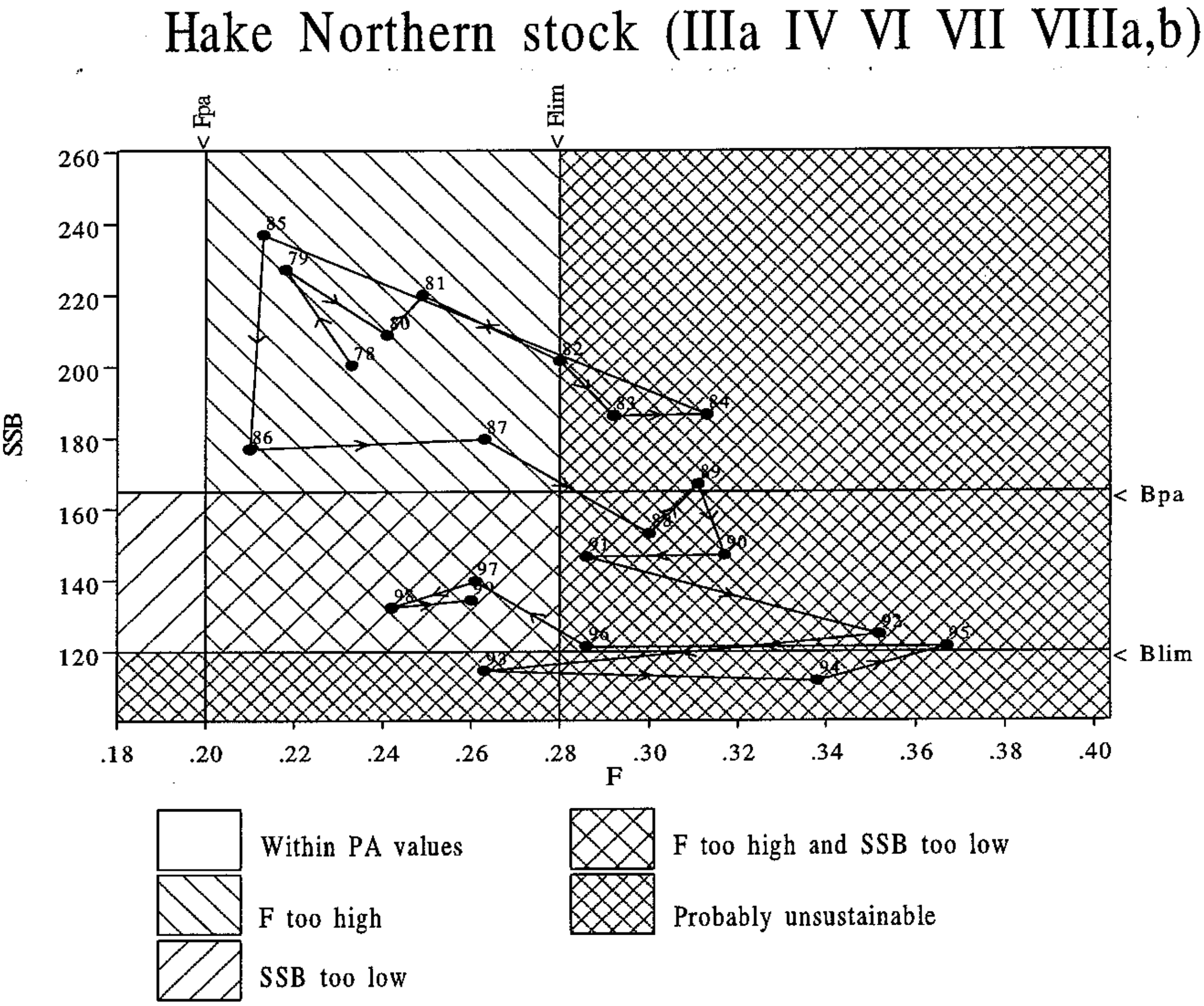


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Table 3.12.2.1 Estimates of catches ('000 t) for the NORTHERN HAKE by area for 1961–1998.

	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
1998	3.2	18.6	12.9	0	34.7	0.8	35.5

(1) Spanish data for 1961–1972 not revised, data for Sub-area VIII for 1973–1978 include data for Divisions VIIIa,b only. Data for 1979–1981 are revised based on French surveillance data. Includes Divisions IIIa, IVb,c from 1976. There are some unallocated landings (moreover for the period 1961–1970).

(2) Discards have been estimated from 1978 and only for Divisions VIIIa,b, and for French bottom beam trawlers.

(3) From 1978 total catches used for the Working Group. Highlighted data have been added (for 1998).

Table 3.12.2.2 HAKE - NORTHERN stock (Divisions IIIa, IV, VI, VII, VIIIa,b).

Year	Recruitment Age 0	Spawning Stock Biomass	Landings	Fishing Mortality Age 2-6
1978	343.30	200.42	52.91	0.233
1979	310.67	227.14	53.80	0.218
1980	418.32	208.84	60.46	0.241
1981	313.73	220.00	56.26	0.249
1982	287.42	201.57	58.06	0.280
1983	282.09	186.15	60.13	0.292
1984	246.95	186.52	65.15	0.313
1985	447.41	236.92	59.94	0.213
1986	259.15	176.86	60.05	0.210
1987	261.27	179.61	65.32	0.263
1988	328.42	153.14	66.82	0.300
1989	234.54	167.01	68.78	0.311
1990	355.94	147.12	61.41	0.317
1991	281.07	146.62	59.29	0.286
1992	319.16	124.68	58.29	0.352
1993	304.96	114.56	53.64	0.263
1994	224.77	111.69	53.14	0.338
1995	244.25	121.32	58.86	0.367
1996	249.99	121.37	48.76	0.286
1997	97.07	139.73	44.24	0.261
1998	76.03	132.32	35.55	0.242
1999	192.68	134.41	.	.
Average	276.33	165.36	57.18	0.278
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 is considered to be harvested outside safe biological limits. The spawning stock biomass is above $\mathbf{B}_{pa}$, but the fishing mortality is above $\mathbf{F}_{pa}$. The SSB of the North Sea component remains severely depleted and outside safe biological limits. The Western component, which at present makes up 75-85% of the stock, is estimated in the most recent assessment to have increased. Surveys indicate that the southern component may have increased.

Management objectives: The agreed record of negotiations between Norway and the EU in 1999, 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 the year 2000, the parties agreed to adopt a TAC consistent with a fishing mortality of 0.17, 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 = 0.17 is consistent with a precautionary approach.

Advice on management: ICES advises a reduction in fishing mortality in 2000 to no more than $\mathbf{F}_{pa}$. The fishing mortality agreed between Norway and the EU (0.17) corresponds to landings in 2000 of 642 000 t inclusive of those taken in international waters. ICES advises that the proposed TAC of 642 000 t covers all areas where North-East Atlantic mackerel are fished.

- **The North Sea spawning component still needs the maximum possible protection.**

Relevant factors to be considered in management: Little is known about discards in the mackerel fishery since only one country provides data. 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 (especially horse mackerel fisheries) in these areas as vessels at present are permitted to take only 10% of their catch as mackerel by-catch. No data on the actual size of mackerel by-catch 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.**

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. In view of the present distribution of Western and Southern mackerel, consideration should be given to permitting fishing in Division IVa in January. (See also answer to Special Request Section 3.12.3.b).

Catch forecast for 2000:
Forecasts below show the anticipated catches in the different areas for various fishing mortalities.

Basis: F(99) = F(96-98) = F_{sq} = 0.21, Landings(99) =723

F (2000)	Basis	SSB (2000)	Catch (2000)	Landings (2000) N	Landings (2000) S	Landings (2000) **Total**	SSB (2001)
0.15	0.73 x F_{sq}	3898		537	35	571	3970
0.17	F=F_{pa}, = 0.82 x F_{sq} EU-Norway agreement	3872		603	39	642	3886
0.21	1.0 x F_{sq}	3826		722	47	769	3739
0.25	1.2 x F_{sq}	3774		852	55	907	3581

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, as well as the partial fishing mortality levels, 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 1996–1998.

Elaboration and special comment: This year's assessment indicates that the stock is larger than predicted in the previous years. According to this estimate, the stock is now well above $\mathbf{B_{pa}}$, and the largest in the time series. The present stock estimate is uncertain, however, and the perception of a substantial increase in stock size depends on a limited number of observations. In particular, the abundance of the youngest year classes is poorly substantiated, and the predictions are heavily dependent on these.

Stock components: ICES currently uses the term **"North East Atlantic Mackerel"** to define the mackerel present in the area extending from ICES Division IXa in the south to Division IIa in the north, including mackerel in the North Sea and Division IIIa. The spawning grounds of mackerel from this area are widely spread, and only the area in the North Sea is sufficiently discrete to be clearly identified as a separate spawning component. Tagging experiments have demonstrated that after spawning fish from Southern and Western areas migrate to feed in the Norwegian Sea and the North Sea during the second half of the year. Here they mix with the North Sea component in the North Sea. Since it is at present impossible to allocate catches to the stocks previously considered by ICES they are at present, for practical reasons, considered as one stock: the **North East Atlantic Mackerel Stock.** Catches cannot be allocated specifically to spawning area components on biological grounds, but catches from the Southern and Western components are separated according to the area where they are taken.

In order to be able to keep track of the development of the spawning biomasses in the different spawning areas, the North East Atlantic mackerel stock is divided into three area components termed the **Western Spawning Component**, the **North Sea Spawning Component** and the **Southern Spawning Component**. according to the following spawning areas.

North-East Atlantic Mackerel			
Distributed and fished in ICES Divisions IIa, IIIa, IV, Vb, VI, VII, VIII and IXa			
Spawning component	**Western**	**Southern**	**North Sea**
Spawning Areas	VI, VII, VIIIa,b,d,e.	VIIIc, IXa.	IV, IIIa.

The Western Component is defined as mackerel spawning in the western area (ICES Divisions and Sub-Areas VI, VII, VIII a,b,d,e). This component comprises approximately 75 - 85% of the entire North East Atlantic Stock. Similarly, the Southern Component is defined as mackerel spawning in the southern area (ICES Divisions VIIIc and IXa). Although the North Sea component has been at an extremely low level since the early 1970s ACFM regards the North Sea component as still existing. This component is spawning in the North Sea and Skagerrak (ICES Sub-Area IV and Division IIIa). Current knowledge of the state of the spawning components is summarised below:

Western Component: The catches of this component were low in the 1960s, but increased to more than 800 000 t in 1993. The main catches are taken in directed fisheries by purse seiners and mid-water trawlers. Large catches of the western component are taken in the northern North Sea and in the Norwegian sea. The 1996 catch showed a large reduction of about 200 000 t, compared with 1995, because of the reduced TACs. The 1998 catch increased by nearly 100 000 t compared to that of 1997. The SSB of the Western component declined in the 1970s from above 3.0 million t, to 2.2 million tonnes in 1994, but was estimated to have increased to 2.5 million t in 1998.

North Sea Component: Very large catches were taken in the 1960s in the purse seine fishery, reaching a maximum of about 1 million t in 1967. The component subsequently collapsed and catches declined to less than 100 000 t in the late 1970s. Catches during the last five years have been assumed to be about 10 000 t. The size of the North Sea component was last estimated at 68 000 t by egg surveys in 1999 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, and did not produce an increase the spawning population in 1999. These fish are therefore likely to have been of Western origin.

Southern Component: Mackerel is a target species for the hand line fleet during the spawning season in Division VIIIc, during which about one third of the total catches are taken. It is taken as a by-catch in other fleets. The highest catches (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 1998 reached a maximum of 44 000 t. Egg surveys indicate that the size of the southern component has increased and may by now be of the order of 25% of the total stock, while it was considered to have been about 15% in previous years.

Reference points proposed in 1998:

ICES considers that:	ICES proposes that:
There is no biological basis for defining $\mathbf{B}_{lim}$	$\mathbf{B}_{pa}$ be set at 2.3 million t
$\mathbf{F}_{lim}$ is 0.26, the fishing mortality estimated to lead to potential stock collapse.	$\mathbf{F}_{pa}$ be set at 0.17. This F is considered to provide approximately 95% probability of avoiding $\mathbf{F}_{lim}$, taking into account the uncertainty in the assessments.

Technical basis:

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

Combined Assessment: Analytic assessment based on catch numbers at age for the period 1984 - 1998 and egg survey estimates of SSB from 1992, 1995 and 1998.

Source of information: Report of the Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine and Anchovy, September 1999 (ICES CM 2000/ACFM:5).

Catch data for combined area (Tables 3.12.3.a.1-6):

Year	ICES	Predicted catch corresp. to advice	Total Agreed	Official	Disc.[1]	ACFM
1987	Given by stock component		442	589	11	655
1988	Given by stock component		610	621	36	676
1989	Given by stock component		532	507	7	586
1990	Given by stock component		562	574	16	626
1991	Given by stock component		612	599	31	668
1992	Given by stock component		707	723	25	760
1993	Given by stock component		767	778	18	825
1994	Given by stock component		837	792	5	823
1995	Given by stock component		645	660	8	756
1996	Significant reduction in F	-	452	493	11	564
1997	Significant reduction in F	-	470	434	19	570
1998	F between 0.15 and 0.2	498	549		8	667
1999	F of 0.15 consistent with PA	437	562			
2000	F=0.17: $\mathbf{F_{pa}}$	642[5]				

[1]Data on discards and slipping from only two fleets, [2]Landings and discards from IIa, IIIa, IV, Vb, VI, VII, VIII and IXa., [4]All areas except some catches in international waters in II. [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	Predicted catch corresp. to advice	Agreed	Disc.	ACFM
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	529
1997	No separate advice	-	416[1]	19	529
1998	No separate advice		514[1]		623
1999	No separate advice		527[1]		
2000	No separate advice				

[1]TAC for mackerel taken in all areas VI, VII, VIIIa,b,d, Vb, IIa, IIIa, IV. [2]Landings and discards of Western component; includes catches of North Sea component. [3]Catch at *Status quo* F. Weights in '000 t.

Catch data for North Sea component (Tables 3.12.3.a.3 and 8):

Year	ICES Advice	Predicted catch corresp. to advice[1]	Agreed TAC[2]	ACFM landings[3]
1987	Lowest practical level	LPL	55	3
1988	Closed areas and seasons; min. landing size; by-catch regulations	LPL	55	6
1989	Closed areas and seasons; min. landing size; by-catch regulations	LPL	49.2	7
1990	Closed areas and seasons; min. landing size; by-catch regulations	LPL	45.2	10
1991	Closed areas and seasons; min. landing size; by-catch regulations	LPL	65.5	-[4]
1992	Closed areas and seasons; min. landing size; by-catch regulations	LPL	76.3	[4]
1993	Maximum protection; closed areas and seasons; min landing size	LPL	83.1	-[4]
1994	Maximum protection; closed areas and seasons; min landing size	LPL	95.7	-[4]
1995	Maximum protection; closed areas and seasons; min landing size	LPL	76.3	-[4]
1996	Maximum protection; closed areas and seasons; min landing size	LPL	52.8	-[4]
1997	Maximum protection; closed areas and seasons; min landing size	LPL	52.8	-[4]
1998	Maximum protection; closed areas and seasons; min landing size	LPL	62.5	-[4]
1999	Maximum protection; closed areas and seasons; min landing size	LPL	62.5	
2000	Maximum protection; closed areas and seasons; min landing size			

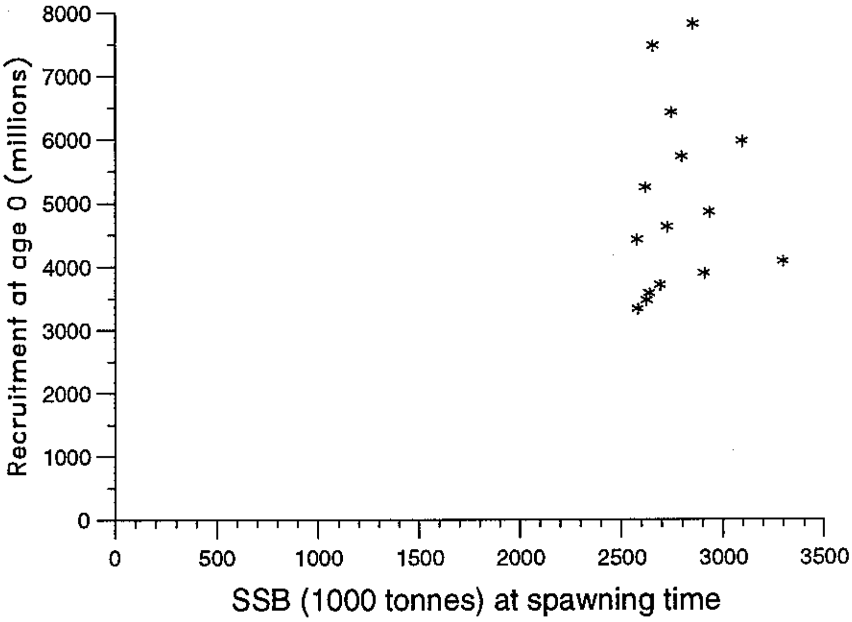
[1]Sub-area IV and Division IIIa. [2]TAC for Sub-area IV, Divisions IIIa, IIIb,c,d (EU zone) and Division IIa (EU zone). [3]Estimated landings of North Sea component. [4]No information. Weights in '000 t.

Catch data for southern component (Table 3.12.3.a.5):

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC[1]	ACFM landings
1987	Reduce juvenile exploitation	-	36.57	22
1988	Reduce juvenile exploitation	-	36.57	25
1989	No advice	-	36.57	18
1990	Reduce juvenile exploitation	-	36.57	21
1991	Reduce juvenile exploitation	-	36.57	21
1992	No advice	-	36.57	18
1993	No advice	-	36.57	20
1994	No advice	-	36.57	25
1995	No advice	-	36.57	28
1996	No separate advice	-	30.00	34
1997	No separate advice	-	30.00	41
1998	No separate advice	-	35.00	44
1999	No separate advice	-	35.00	
2000	No separate advice			

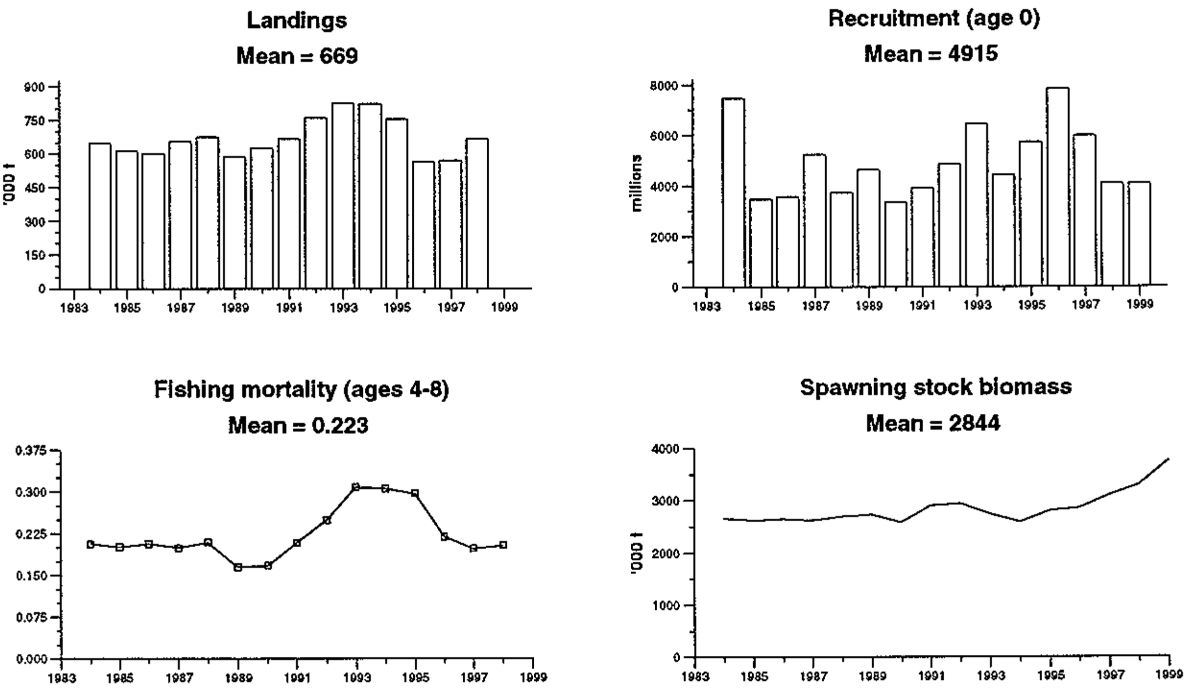
[1]Division VIIIc, Sub-Areas IX and X, and CECAF Division 34.1.1 (EU waters only). Weights in '000 t.

Stock - Recruitment

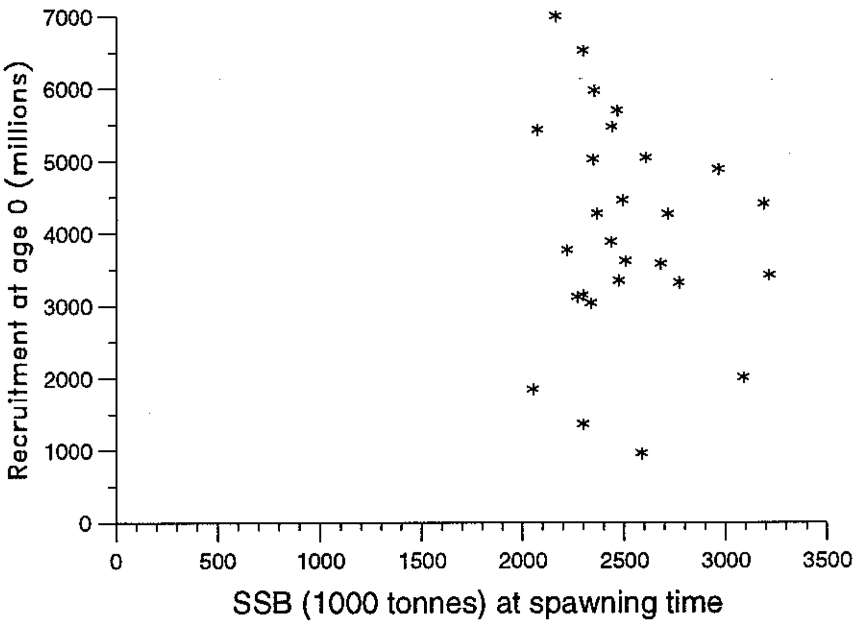


(run: ICAELT05)

North-East Atlantic Mackerel

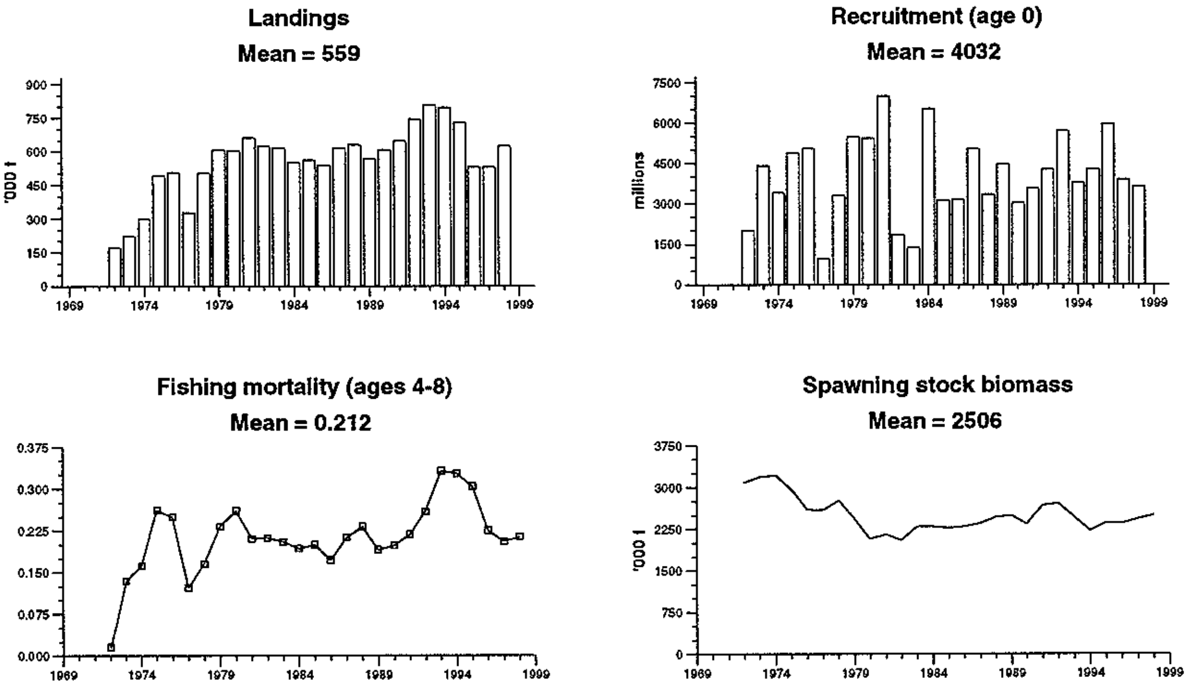


Stock - Recruitment



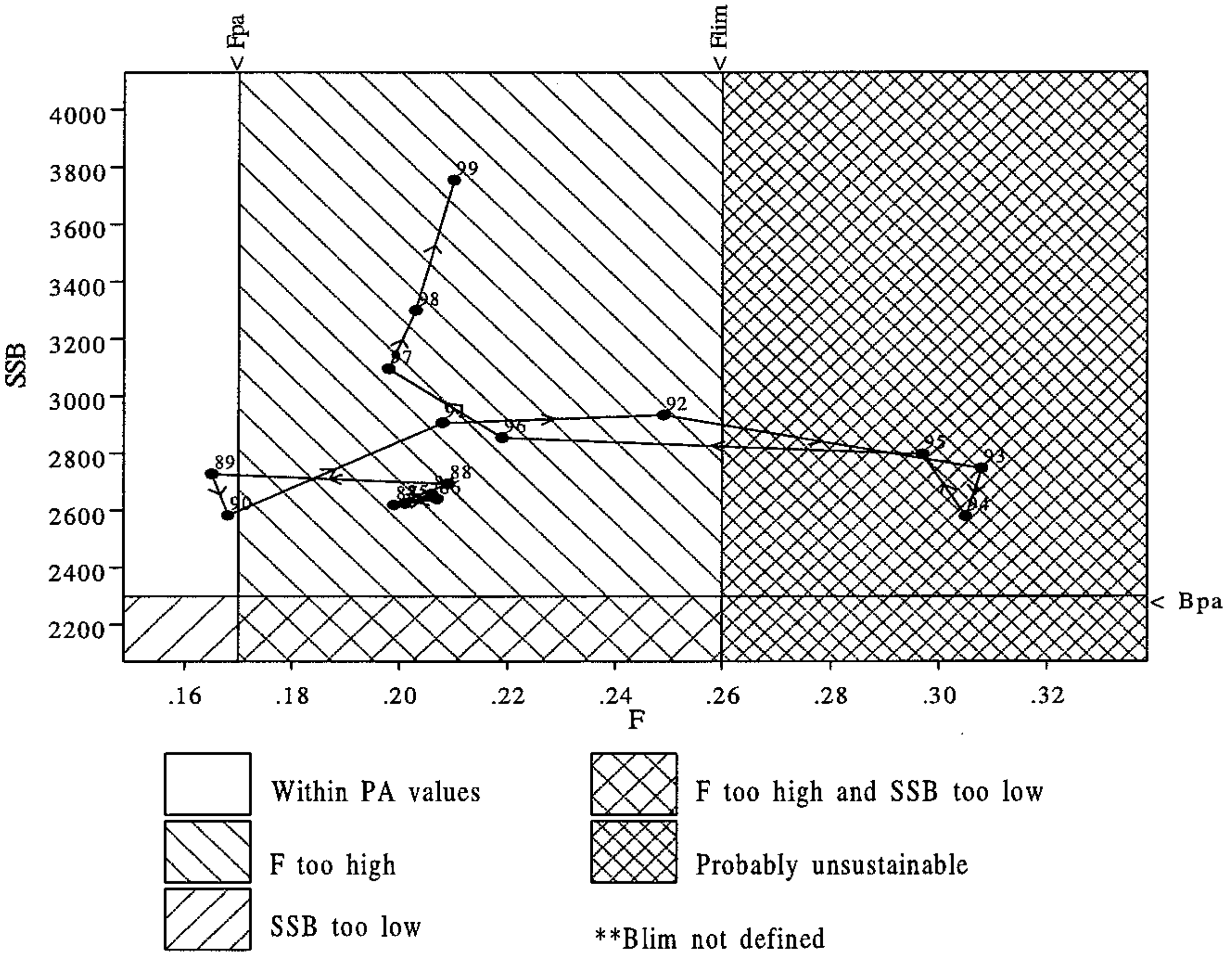
(run: ICAELT01)

Western Mackerel Component



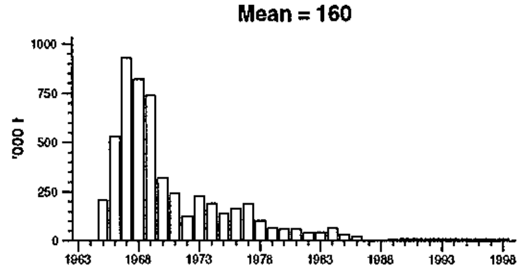
Precautionary Approach Plot

North-East Atlantic Mackerel



Data file(s):W:\acfm\wgmhsa\1999\Data\mac_nea\final\fin_papl.pa;*.sum
Plotted on 24/10/1999 at 18:44:27

Mackerel, North Sea Component



Mackerel, Southern Component

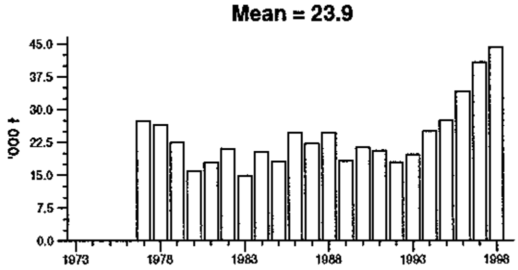


Table 3.12.3.a.1 Catches of MACKEREL by area. Discards not estimated prior to 1978. (Data submitted by Working Group members.)

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
1998*	110,141	71	110,212	105,181	3,206	108,387	264,947	4,735	269,700	134,219	44,164	658,652	8,030	666,682

*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
Total	98,222	78,096	101,112	47,186	120,404	90,488

Country	1990	1991	1992	1993	1994	1995	1996	1997	1998[1]
Denmark	6,800	1,098	251			4,746	3,198	37	2,090
Estonia			216		3,302	1,925	3,741	4,422	7,356
Faroe Islands	3,100	5,793	3,347	1,167	6,258	9,032	2,965	7,628	2,716
France		23	6	6	5	5	0	270	-
Germany							1	-	-
Iceland							92	925	357
Latvia			100	4,700	1,508	389	233	-	-
Netherlands							561	-	-
Norway	77,200	76,760	91,900	110,500	141,114	93,315	47,992	41,000	54,477
Russia			42,440	49,600	28,041	44,537	44,545	50,207	67,201
United Kingdom	400	514	802		1,706	194	48	938	199
USSR[2]	28,900	13,631[2]							-
Poland								22	-
Misreported (IVa)					-109,625	-18,647	-	-	-177
Discards	2,300						-	-	-
Total	118,700	97,819	139,062	165,973	72,309	135,496	103,376	105,449	134,219

[1]Preliminary.
[2]*Russia.*

Table 3.12.3.a.3 Catch (t) of MACKEREL in the North Sea, Skagerrak, and Kattegat (Sub-area IV and Division IIIa). (Data submitted by Working Group members).

Country	1985	1986	1987	1988	1989	1990	1991
Belgium		49	14	20	37		125
Denmark	12,424	23,368	28,217	32,588	26,831	29,000	38,834
Estonia							
Faroe Islands	1,356				2,685	5,900	5,338
France	322	1,200	2,146	1,806	2,200	1,600	2,362
Germany, Fed. Rep.	217	1,853	474	177	6,312	3,500	4,173
Ireland					8,880	12,800	13,000
Latvia							
Netherlands	726	1,949	2,761	2,564	7,343	13,700	4,591
Norway	30,835	50,600	108,250	59,750	81,400	74,500	102,350
Sweden	760	1,300	3,162	1,003	6,601	6,400	4,227
United Kingdom	170	559	19857	1,002	38,660	30,800	36,917
USSR (Russia from 1990)							
Romania							
Misreported (IIa)							
Misreported (VIa)		148,000	117,000	180,000	92,000	126,000	130,000
Unallocated	-	7,391	8,948	29,630	6,461	-3,400	16,758
Discards	3,656	7,431	10,789	29,776	2,190	4,300	7,200
Total	50,466	243,700	301,618	338,316	281,600	305,100	365,875

Country	1992	1993	1994	1995	1996	1997	1998[1]
Belgium	102	191	351	106	62	114	125
Denmark	41,719	42,502	47,852	30,891	24,057	21,934	25,326
Estonia	400					-	-
Faroe Islands		11,408	11,027	17,883	13,886	1,367	4,832
France	956	1,480	1,570	1,599	1,316	1,532	1,908
Germany, Fed. Rep.	4,610	4,940	1,479	712	542	213	423
Ireland	13,136	13,206	9,032	5,607	5,280	280	145
Latvia	211					-	-
Netherlands	6,547	7,770	3,637	1,275	1,996	951	1,373
Norway	115,700	112,700	114,428	108,890	88,444	96,300	103,700
Sweden	5,100	5,934	7,099	6,285	5,307	4,714	5,146
United Kingdom	35,137	41,010	27,479	21,609	18,545	19,204	19,755
Russia						3,525	635
Romania			2,903			-	-
Misreported (IIa)			109,625	18,647	-	-	-
Misreported (VIa)	127,000	146,697	134,765	106,987	51,781	73,523	98,432
Unallocated	13,566	-	-	983	236	1,102	3,147
Discards	2,980	2,720	1,150	730	1,387	2,807	4,753
Total	367,164	390,558	472,397	322,204	212,839	227,566	269,700

[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	1998[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	3,681
France	10,364	9,109	8,296	9,998	10,178	14,347	19,114	15,927
Germany	17,138	21,952	23,776	25,011	23,703	15,685	15,161	20,989
Ireland	64,827	76,313	81,773	79,996	72,927	49,033	52,849	66,505
Netherlands	29,156	32,365	44,600	40,698	34,514	34,203	22,749	28,790
Norway			600	2,552			-	-
Spain	4,020	2,764	3,162	4,126	4,509	2,271	7,842	3,340
United Kingdom	162,588	196,890	215,265	208,656	190,344	127,612	128,836	165,994
Unallocated	-3,802	1,472	0	4,632	28,245	10,603	4,577	8,351
Misreported (IVa)	-130,000	-127,000	-146,697	-134,765	-106,987	-51,781	-73,523	-98,255
Discards	23,550	22,020	15,660	4,220	6,991	10,028	16,057	3,277
Grand Total	183,509	236,079	248,785	251,646	270,476	213,272	195,820	218,599

[1]Preliminary

Table 3.12.3.a.5 Landings (tonnes) of MACKEREL in Divisions VIIIc and IXa, 1979–1998. Data submitted by Working Group members.

Country	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
Spain[1]	15,013	11,316	12,834	15,621	10,390	13,852	11,810	16,533	15,982	16,844
Portugal[2]	1,071	1,929	3,108	3,018	2,239	2,250	4,178	6,419	5,714	4,388
Spain[2]	6,280	2,719	2,111	2,437	2,224	4,206	2,123	1,837	491	3,540
Poland[2]	-	-	-	-	-	-	-	-	-	-
USSR[2]	111	-	-	-	-	-	-	-	-	-
Total[2]	7,462	4,648	5,219	5,455	4,463	6,456	6,301	8,256	6,205	7,928
TOTAL	22,475	15,964	18,053	21,076	14,853	20,308	18,111	24,789	22,187	24,772

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

Country	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Spain[1]	13,446	16,086	16,940	12,043	16,675	21,146	23,631	28,386	35,015	36,174
Portugal[2]	3,112	3,819	2,789	3,576	2,015	2,158	2,893	3,023	2,080	2,897
Spain[2]	1,763	1,406	1,051	2,427	1,027	1,741	1,025	2,714	3,613	5,093
Poland[2]	-	-	-	-	-	-	-	-	-	-
USSR[2]	-	-	-	-	-	-	-	-	-	-
Total[2]	4,875	5,225	3,840	6,003	3,042	3,899	3,918	6,737	5,693	7,990
TOTAL	18,321	21,311	20,780	18,046	19,719	25,045	27,549	34,123	40,708	44,164

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

Table 3.12.3.a.6 North East Atlantic MACKEREL (combined Southern, Western & N.Sea spawning components).

Year	Recruitment Age 0	Spawning Stock Biomass	Landings	Fishing Mortality Age 4-8
1984	7,476.67	2,656.51	648.08	0.206
1985	3,461.81	2,625.24	614.28	0.201
1986	3,574.45	2,640.48	602.13	0.207
1987	5,240.53	2,618.80	654.81	0.199
1988	3,702.81	2,693.26	676.29	0.209
1989	4,619.66	2,727.43	585.92	0.165
1990	3,324.44	2,582.46	625.61	0.168
1991	3,892.19	2,906.73	667.88	0.208
1992	4,851.55	2,933.04	760.35	0.249
1993	6,422.06	2,747.17	825.04	0.308
1994	4,423.49	2,578.86	823.48	0.305
1995	5,725.33	2,796.61	756.29	0.297
1996	7,818.77	2,853.94	563.59	0.219
1997	5,965.52	3,095.28	569.54	0.198
1998	4,072.00	3,298.59	667.22	0.203
1999	4,072.00	3,754.26	.	.
Average	4,915.21	2,844.29	669.37	0.223
Unit	Millions	1000 tonnes	1000 tonnes	-

Table 3.12.3.a.7 MACKEREL, Western Spawning Component.

Year	Recruitment Age 0	Spawning Stock Biomass	Landings	Fishing Mortality Age 4-8
1972	2,005.07	3,085.20	170.78	0.015
1973	4,407.13	3,186.18	219.45	0.134
1974	3,424.73	3,211.78	298.05	0.162
1975	4,882.68	2,959.92	491.38	0.262
1976	5,043.91	2,604.15	507.18	0.250
1977	954.58	2,587.35	325.97	0.123
1978	3,324.39	2,768.77	503.91	0.166
1979	5,469.37	2,436.99	605.74	0.233
1980	5,430.65	2,073.17	604.76	0.261
1981	6,997.69	2,161.69	661.76	0.211
1982	1,844.16	2,052.90	623.82	0.212
1983	1,361.47	2,298.86	614.29	0.205
1984	6,522.46	2,296.79	550.93	0.193
1985	3,121.62	2,269.31	561.29	0.200
1986	3,148.79	2,295.28	537.62	0.172
1987	5,024.80	2,347.15	615.38	0.213
1988	3,350.48	2,472.38	628.00	0.232
1989	4,460.32	2,489.55	567.40	0.190
1990	3,038.20	2,336.39	605.94	0.199
1991	3,581.57	2,678.86	646.17	0.218
1992	4,267.95	2,712.85	742.31	0.259
1993	5,696.04	2,464.61	805.04	0.332
1994	3,770.67	2,218.70	795.72	0.327
1995	4,275.12	2,365.28	728.74	0.305
1996	5,968.69	2,352.06	529.46	0.225
1997	3,885.62	2,432.31	528.84	0.205
1998	3,619.00	2,505.14	623.41	0.214
Average	4,032.49	2,506.06	559.01	0.212
Unit	Millions	1000 tonnes	1000 tonnes	-

Table 3.12.3.a.8 MACKEREL, North Sea Spawning Component (Weight in '000 t).

Year	Spawning Stock Biomass	Landings
1965	2850[1]	208
1966	2700[1]	530[2]
1967	1900[1]	930[2]
1968	1500[1]	822[2]
1969	1113[3]	739[2]
1970	550[3]	323[2]
1971	580[3]	243[2]
1972	1249[3]	125[4]
1973	1097[3]	226[4]
1974	1036[3]	190[4]
1975	826[4]	138[4]
1976	700[4]	165[4]
1977	583[4]	188[4]
1978	436[4]	103[4]
1979	336[4]	66[4]
1980	258[4]	61[4]
1981	189[4]	60[4]
1982	162[4]	40[4]
1983	168[4]	43[4]
1984	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]
1998	68[5]	-[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 request by EC on origin of the North Sea mackerel catches

The European Commission has raised three questions to ICES, which are answered below:

Question 1. Is it at present possible to positively identify mackerel or mackerel spawning products caught in the North Sea as originating from the North Sea spawning component of the North East Atlantic mackerel stock?

Answer: Individual adult mackerel can only be identified as belonging to the North Sea component mackerel if they are caught in the North Sea in spawning condition. Mackerel not caught in spawning condition cannot reliably be ascribed to a stock component.

It is possible to identify a discrete and repeatable area of mackerel spawning in the North Sea. This spawning area has been surveyed a number of times in recent years (1999, 1996, 1990). Spawning is mostly concentrated in the western part of the central North Sea and indicates a small but relatively consistent stock level.

No recent survey data for larvae are available. However, CPR (Continuous Plankton Recorder) data from the 1950s and 60s indicate a wide spread of larvae in the central North Sea which is discrete from larvae in the western area.

It is possible to identify concentrations of juvenile mackerel in the west part of the central North Sea, which may derive from spawning in the same area. However, there is only indirect evidence to confirm this interpretation.

It is not possible to identify the distribution and migrations of the adult fish. It can be assumed that the adults are in the spawning area during April to July. Historic data would suggest that they overwinter at the edge of the Norwegian Deeps close to Viking Bank. There is no recent evidence to confirm that this pattern has been maintained. It is important to note that a large fraction of the western component also now overwinters in this area and is the target of a substantial fishery. Research work to identify the involvement of the North Sea component in the winter fishery in area IVa should be a priority.

Some work on biometrics, parasitology and otolith structure has been carried out to identify the North Sea component. While most of this work was limited in scope and should be expanded and enhanced, it was able to show some differences between the fish from the two components, which could be exploited for identification purposes.

It can be concluded that there is still a North Sea mackerel component, which spawns separately from the western component, which may have a nursery area in the western North Sea and which may share its range with the western component.

Question 2. If not, what is the basis for the recommendations relating to seasonal and geographical closures for fishing mackerel in ICES Sub-area IV and ICES Division IIIa repeated by ICES since 1987?

Answer: Given the proven existence of the North Sea stock this question is not directly relevant, however, the subject of geographical and seasonal closures is dealt with in response to question 3.

Question 3. If so, and recalling that managers have been unable to agree on conditions in strict compliance with these recommendations, is there reason to consider alternative and/or augmented recommendations?

Answer: On the basis of survey work in 1994-96 and confidential commercial data, it is clear that the western mackerel component migrates out of the North Sea (ICES area IVa) during the first quarter of the year, while in the 1980s this migration took place between October and November. Prior to the migration the main concentration of mackerel remains in the North-eastern part of the North Sea in the area of Viking Bank from early October. The existing advice is for a complete ban on mackerel fishing in areas IVb and IVc, and for a closure of IVa between 1 January to 31 July.

It is recommended that the closure of areas IVb & IVc be maintained.

It is recognised that mackerel may move out of the North Sea later in recent years, and that increased fishing opportunities may be achieved by extending the fishery season in the North Sea.

Changing the closing date to the closure until 1 February is unlikely to jeopardise the North Sea component considering that:

- the observations that mackerel of the western component remain in the North Sea at least until mid February.
- the previous recommendation for closure was based on the western mackerel having migrated out of IVa by the end of December

- the timing of this closure was intended to allow fishing in this area when Western mackerel dominate.
- the pattern of migration has changed substantially in recent years and may continue to change.

The issue should be kept under review and information on changes in mackerel migrations should be updated regularly.

Source of information: Report of the Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine and Anchovy, September 1999 (ICES CM 2000/ACFM:5).

3.12.3.c Request from the European Union and Norway on medium-term projections for NEA mackerel

The European Commission and Norway requested an assessment of the medium-term (5 year) consequences of a range of management options (F = 0.15–0.20) for NE Atlantic mackerel. The answer to this request is dealt together with the North Sea stocks that were also part of that same request. The answer is given in section 3.5.18.

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 harvested outside safe biological limits. The current estimate of biomass is above $\mathbf{B}_{pa}$. Current catches are not considered to be sustainable at present recruitment. 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 if catches exceed 200,000 t, in the absence of large year classes. Considering that catches have generally increased since 1988, and that biomass has declined, it is concluded that fishing mortality has increased since 1988.

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 and to increase or maintain spawning stock biomass above $\mathbf{B}_{pa}$.

Advice on management: ICES advises that catches in 2000 be effectively limited to less than 200 000 t. This is the expected level of sustainable catches under present recruitment. ICES also recommends that the TAC for this stock should apply to all areas in which Western horse mackerel are fished, i.e. Divisions IIa, IIIa (western part), VI, Vb, IVa, VIIa–c, e–k, and VIIIa,b,d,e. The present agreed TAC area covers EU waters in Divisions Vb, VI, VII, VIIIa,b,d,e, XII and IX. ICES also advises that in Divisions VIIe,f directed horse mackerel fisheries in which juveniles are abundant, and industrial fisheries in which horse mackerel is taken as a by-catch, should be prohibited.

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 1982–1998. The 1982 year class reached its maximum biomass in 1987 and has decreased by about 90% since then because of removals by fishing and natural mortality.

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 remain stable at constant catches of between 150 000 t and 200 000 t. It is therefore clear that catches will have to be decreased unless another outstanding year class is produced.

Recently fisheries in Divisions VIIe,f have taken large catches of mainly juvenile horse mackerel from the western stock. There has been a clear change in the age-structure of the catches from older to younger fish since 1996. It is not known how abundant the more recent year classes are and fishing mortality on these year classes cannot be estimated. Therefore, ICES expresses concern about this high exploitation of juvenile fish at a time when recruitment is at a low level.

The only TAC which has been in place applies only to EU vessels and to EU waters, and covers only parts of the distribution area of this stock and the fishery. The EU TAC has been 300 000 t during the period 1994–1997, 320 000t in 1998 and was set as 265 000 t in 1999. ICES have recommended that catches for the whole stock in all the areas in which it is caught should not exceed 200 000 t.

Catch forecast for 2000:

Western Horse Mackerel. Catch option table, (a) SSB, and catch in 1999, (b) SSB in 2000, for catch = 100 to 300Kt in 2000; (c) SSB in 2001, for catch = 50 to 300Kt in 2000 and 2001.

(a) Catch (Thousand t)	1999	
	Expected SSB Thousand t	Estimated Risk in 1999
		P(SSB<500,000t)
300	1194	0.05

(b) Catch (Thousand t)	2000	
	Expected SSB Thousand t	Estimated Risk in 2000
		P(SSB<500,000t)
100	1142	0.09
150	1124	0.10
200	1105	0.11
250	1087	0.12
300	1079	0.12

(c) Catch (Thousand t)	2001	
	Expected SSB Thousand t	Estimated Risk in 2001
		P(SSB<500,000t)
100 Kt in 1999 and 2000	1211	0.08
150 Kt in 1999 and 2000	1151	0.11
200 Kt in 1999 and 2000	1090	0.15
250 Kt in 1999 and 2000	1028	0.18
300 Kt in 1999 and 2000	978	0.24

Elaboration and special comment: The assessment attempts to describe uncertainty and demonstrates the lack of precision in the estimates of biomass and fishing mortality rate. The assessment includes assumptions about recruitment which may be revised in the future, and this may affect the calculation of sustainable catches.

There have been changes in the distribution of this stock which has resulted in additional fleets exploiting the stock.

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. Although this has improved in 1998, the lack of 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, carried out in 1998 estimated the spawning stock biomass to be 1400 000t.

Reference points:

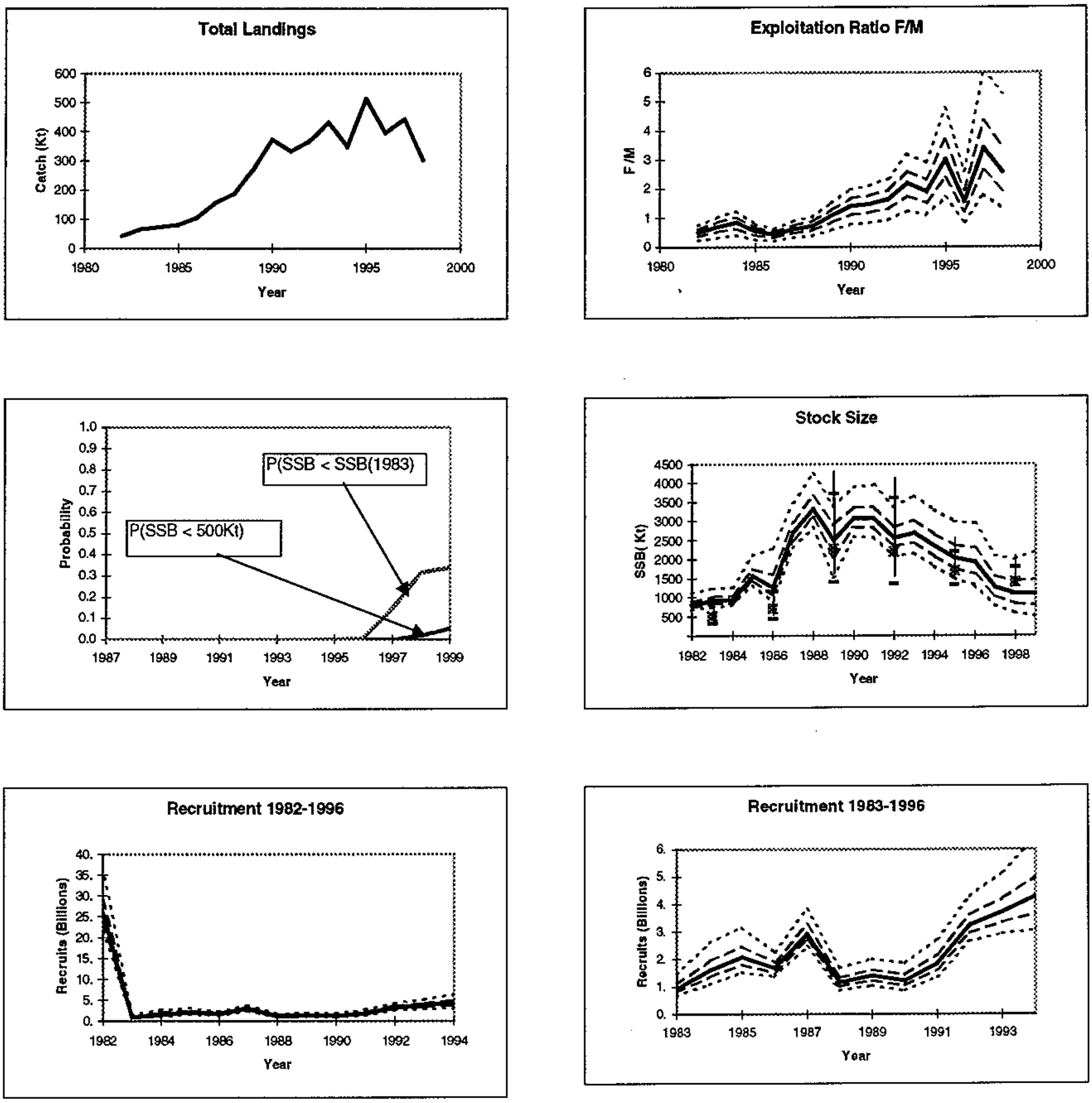
ICES considers that:	ICES proposes that:
B_{lim} is not defined.	B_{pa} be set at 500 000t, the egg survey estimate of estimated size of the SSB that produced the exceptionally strong 1982 year class.
F_{lim} is not defined.	F reference points can not be established.

Source of information: Report of the Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine and Anchovy, September 1999 (ICES CM 2000/ACFM:5).

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	296	8	304
1999	Effectively limit catches to 200 000t	200	265			
2000	Effectively limit catches to 200 000t	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						Western horse mackerel							Southern horse mackerel			Total
	IIIa		Ivb,c	Dis-cards	VIId	Total	Iia	IVa	VIa	VIIa-c,e-k	VIIIa,b,d,e	Dis-cards	Total	VIIIc	IXa	Total	All stocks
1982	-	2,788[3]	-		1,247	4,035	-	-	6,283	32,231	3,073	-	41,587	19,610	39,726	59,336	104,958
1983	-	4,420[3]	-		3,600	8,020	412	-	24,881	36,926	2,643	-	64,862	25,580	48,733	74,313	147,195
1984	-	25,893[3]	-		3,585	29,478	23	94	31,716	38,782	2,510	500	73,625	23,119	23,178	46,297	149,400
1985	1,138		22,897		2,715	26,750	79	203	33,025	35,296	4,448	7,500	80,551	23,292	20,237	43,529	150,830
1986	396		19,496		4,756	24,648	214	776	20,343	72,761	3,071	8,500	105,665	40,334	31,159	71,493	201,806
1987	436		9,477		1,721	11,634	3,311	11,185	35,197	99,942	7,605	-	157,240	30,098	24,540	54,638	223,512
1988	2,261		18,290		3,120	23,671	6,818	42,174	45,842	81,978	7,548	3,740	188,100	26,629	29,763	56,392	268,163
1989	913		25,830		6,522	33,265	4,809	85,304[2]	34,870	131,218	11,516	1,150	268,867	27,170	29,231	56,401	358,533
1990	14,872[1]		17,437		1,325	18,762	11,414	112,753[2]	20,794	182,580	21,120	9,930	373,463	25,182	24,023	49,205	441,430
1991	2,725[1]		11,400		600	12,000	4,487	63,869[2]	34,415	196,926	25,693	5,440	333,555	23,733	21,778	45,511	391,066
1992	2,374[1]		13,955	400	688	15,043	13,457	101,752	40,881	180,937	29,329	1,820	370,550	24,243	26,713	50,955	436,548
1993	850[1]		3,895	930	8,792	13,617	3,168	134,908	53,782	204,318	27,519	8,600	433,145	25,483	31,945	57,428	504,190
1994	2,492[1]		2,496	630	2,503	5,689	759	106,911	69,546	194,188	11,044	3,935	388,875	24,147	28,442	52,589	447,153
1995	240		7,948	30	8,666	16,756	13,133	90,527	83,486	320,102	1,175	2,046	510,597	27,534	25,147	52,681	580,034
1996	1,657		7,558	212	9,416	18,843	3,366	18,356	81,259	252,823	23,978	16,870	396,652	24,290	20,400	44,690	460,185
1997	2,037[4]		15,504[5]	10	5,452	19,540	2,617	63,647	40,145	318,101	11,677	2,921	442,571	29,129	27,642	56,771	518,882
1998	3,693		10,530	83	16,194	30,500	2,540[6]	17,011	35,043	232,451	15,662	830	303,543	22,906	41,574	64,480	398,523

[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.
[6]Includes 1937 t from Vb

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 (Eng. & Wales)	-	-	-	-	-	17	-
Total	79	214	3,311	6,818	4,809	11,414	4,487

Country	1992	1993	1994	1995	1996	1997	1998[1]
Faroe Islands	9,157[3]	1,068	-	950	1,598	799[3]	188[3]
Denmark	-	-	-	200	-	-	1,755[3]
France	-	-	55	-	-	-	-
Germany	-	-	-	-	-	-	-
Norway	4,300	2,100	4	11,300	887	1,170	234
Russia	-	-	700	1,633	881	648	345
UK (Eng. & Wales)	-	-	-	-	-	-	-
Estonia	-	-	-	-	-	-	22
Total	13,457	3,168	759	14,083	3,366	2,617	2,544

[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 IV by country. (Data submitted by Working Group members).

Country	1980	1981	1982	1983	1984
Belgium	8	34	7	55	20
Denmark	199	3,576	1,612	1,590	23,730
Faroe Islands	260	-	-	-	-
France	292	421	567	366	827
Germany, Fed.Rep.	+	139	30	52	+
Ireland	1,161	412	-	-	-
Netherlands	101	355	559	2,029[4]	824
Norway	119	2,292	7	322	[4]
Poland	-	-	-	2	94
Sweden	-	-	-	-	-
UK (Engl. & Wales)	11	15	6	4	-
UK (Scotland)	-	-	-	-	3
USSR	-	-	-	-	489
Total	2,151	7,245	2,788	4,420	25,987

Country	1985	1986	1987	1988	1989	1990
Belgium	13	13	9	10	10	13
Denmark	22,495	18,652[2]	7,290[2]	20,323[2]	23,329[2]	20,605[2]
Estonia	-	-	-	-	-	-
Faroe Islands	-	-	-	-	-	942
France	298	231[3]	189[3]	784[3]	248	220
Germany, Fed.Rep.	+	-	3	153	506	2,469[6]
Ireland	-	-	-	-	-	687
Netherlands	160[4]	600[4]	850[4]	1,060[4]	14,172	1,970
Norway[2]	203	776	11,728[5]	34,425[5]	84,161	117,903[2]
Poland	-	-	-	-	-	-
Sweden	-	2[2]	-	-	-	102
UK (Engl. & Wales)	71	3	339	373	10	10
UK (N. Ireland)	-	-	-	-	-	-
UK (Scotland)	998	531	487	5,749	2,093	458
USSR	-	-	-	-	-	-
Unall. & discards	-	-	-	-	-12,482[5]	-317[5]
Total	24,238	20,808	20,895	62,877	112,047	145,062

Country	1991	1992[7]	1993	1994	1995	1996	1997	1998[1]
Belgium	-	+	74	57	51	28	-	19
Denmark	6,982[2]	7,755	6,120	3,921	2,432	1,433	648	2,048[2]
Estonia	-	293	-		17	-	-	22
Faroe Islands	340	-	360	275	-	-	296	28
France	174	162	302		-	-	-	379
Germany, Fed.Rep.	5,995	2,801	1,570	1,014	1,600	7	7,603	4,620
Ireland	2,657	2,600	4,086	415	220	1,100	8,152	-
Netherlands	3,852	3,000	2,470	1,329	5,285	6,205	37,778	3,811
Norway[2]	50,000[2]	96,000	126,800	94,000	84,747	14,639	45,314	13,129
Poland	-	-	-	-	-	-	-	-
Russia		-	-	-	-	-	-	-
Sweden	953[2]	800	697	2,087	-	95	232	3,411[2]
UK (Engl. & Wales)	132	4	115	389	478	40	242	2
UK (N. Ireland)	350	-	-		-	-	-	-
UK (Scotland)	7,309	996	1,059	7,582	3,650	2,442	10,511	3,041
USSR	-							
Unall. & discards	-750[5]	-278	-3,270	1,511	-28	136	-31,615	737
Total	77,994	114,133	140,383	112,580	98,452	26,125	79,161	31,247

[1] Preliminary. [2] Includes Division IIIa. [3] Includes Division IIa. [4] Estimated from biological sampling. [5] Assumed to be misreported. [6] Includes 13 t from the German Democratic Republic. [7] Includes a negative unallocated catch of -4,000 t.

Table 3.12.4.4 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	-	-	-		-	-	-	-	-
Unall. & 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	-	-	-	-	-	-	-	-	-
Russia				-	-	-	-	-	-
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	-						
Unall. & 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

Country	1998[1]
Denmark	-
Faroe Islands	-
France	221
Germany, Fed. Rep.	414
Ireland	21,608
Netherlands	885
Norway	-
Russia	-
Spain	-
UK (Engl. & Wales)	10
UK (N.Ireland)	1,132
UK (Scotland)	10,447
Unall, & discards	98
Total	34,815

[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 3.12.4.5 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	-	-	-	-	-
Unall. & 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	1998[1]
Faroe Islands	-	-	-	-	-	-	-	-
Belgium	-	-	-	1	-	-	18	18
Denmark	28,888	18,984	16,978	41,605	28,300	43,330	60,412	25,492
France	1,230	1,198	1,001	-	-	-	27,201	24,223
Germany, Fed.Rep.	12,919	12,951	15,684	14,828	17,436	15,949	28,549	25,414
Ireland	19,074	15,568	16,363	15,281	58,011	38,455	43,624	51,720
Netherlands	104,107	109,197	157,110	92,903	116,126	114,692	81,464	91,946
Norway	-	-	-	-	-	-	-	-
Russia		-	-	-	-	-	-	-
Spain	113	106	54	29	25	33	-	-
UK (Engl. & Wales)	6,436	7,870	6,090	12,418	31,641	28,605	17,464	12,832
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	5,095
USSR	-							
Unall. & discards	24,541	15,563	4,010[3]	14,057	68,644	26,795	58,718	12,706
Total	201,326	188,135	221,000	200,256	330,705	279,100	326,474	249,446

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

Table 3.12.4.6 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	-	-	-	-
Unall. & discards	-	-	-	-	-	1,500
Total	27,740	45,362	37,703	34,177	38,686	43,496

Country	1991	1992	1993	1994	1995	1996	1997	1998[1]
Denmark	1,349	5,778	1,955	-	340	140	729	1,728
France	6,164	6,220	4,010	28	-	7	8,690	1,844
Germany	80	62	-		-	-	-	3,268
Netherlands	12,437	9,339	19,000	7,272	-	14,187	2,944	6,604
Russia		-	-	-	-	-	-	-
Spain	23,733	27,688	27,921	25,409	28,349	29,428	31,081	23,599
UK (Engl. & Wales)	70	88	123	753	20	924	430	9
USSR	-							
Unall. & discards	2,563	5,011	700	2,038	-	3,583	-2,944	1,884
Total	46,396	54,186	53,709	35,500	28,709	48,269	40,930	38,936

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

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

State of stock/fishery: The stock is considered to be harvested outside of safe biological limits. Although the SSB is estimated to be above the proposed $\mathbf{B_{pa}}$, the fishing mortality increased greatly in 1998 from around the proposed $\mathbf{F_{pa}}$ to $\mathbf{F_{lim}}$. The total of the TACs allocated in 1998 was above the ICES recommended catch of 650 000 t and the total catch reached 1 100 000 t. The 1998 landings were primarily comprised of the strong 1995 year class which has declined in 1999. The very strong 1996 year class has, however, now recruited to the spawning stock and will dominate in the 1999 fishery.

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

Advice on management: ICES advises that F should not exceed the proposed $\mathbf{F_{pa}}$=0.32. In 2000 this would correspond to a catch of not more than 800 000 t, but in the long run catches exceeding 650 000 t are not likely to be sustainable.

Reference points:

ICES considers that:	ICES proposes that:
$\mathbf{B_{lim}}$ is 1.5 mill t	$\mathbf{B_{pa}}$ be set at 2.25 million t
$\mathbf{F_{lim}}$ is 0.51	$\mathbf{F_{pa}}$ be set at 0.32

Technical basis

$\mathbf{B_{lim}}$: $\mathbf{B_{loss}}$	$\mathbf{B_{pa}}$ $\mathbf{B_{lim}}$ **exp**(1.645*σ) σ=0.25
$\mathbf{F_{lim}}$: $\mathbf{F_{loss}}$ (0.51)	$\mathbf{F_{pa}}$: $\mathbf{F_{med}}$ **(1998)**

Relevant factors to be considered in management: The blue whiting is widely distributed in the eastern North Atlantic. Its distribution extends from the Strait of Gibraltar to the Barents Sea. It consists of several populations with genetic "leakage" between them, but it is treated as one stock as it so far has not been possible to define an unambiguous border between populations.

The fishery is composed almost entirely of a few recruiting year classes. These year classes are harvested heavily before they can reproduce or reach full growth potential. The estimate of year class strength at such young age is uncertain.

The survey estimates (which are abundance indices) of the spawning stock, indicate substantially higher SSB than indicated by the catch analysis over the entire time range. The short-term projection indicates that current fishing pressure will reduce SSB, i.e. to 2.1 million t in 2001.

Catch forecast for 2000:

Basis:F(99) = F(98)=0.52, Landings (99)=1.237 million t. SSB in 1999 =2.919 million t.

F(2000) onwards	Basis	Catch (2000)	Landings(2000)	SSB in year 2000 (million t)	SSB in year 2001(million t)
0.26	0.5 (F99)		650	2.7	2.7
0.32	$\mathbf{F_{pa}}$		800	2.6	2.6
0.52	F(99)		1 200	2.5	2.1

Weights in '000 t, Mean F, ages 3–7

Shaded scenarios considered inconsistent with the precautionary approach.

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 a mixed industrial fishery in Sub-area IV and Division IIIa and in the pelagic trawl fishery in the northern areas (Sub-area I and II, Divisions Va, XIVa,b). These fisheries in the northern area have taken 340 000 – 1 100 000 t per year in the last decade while catches in the southern fisheries (Sub-area VIII, IX, Divisions VIId,e and g-k) have been stable in the range 25 000–34 000 t.

The analytical assessment is based on catch data, acoustic surveys and commercial CPUE data.

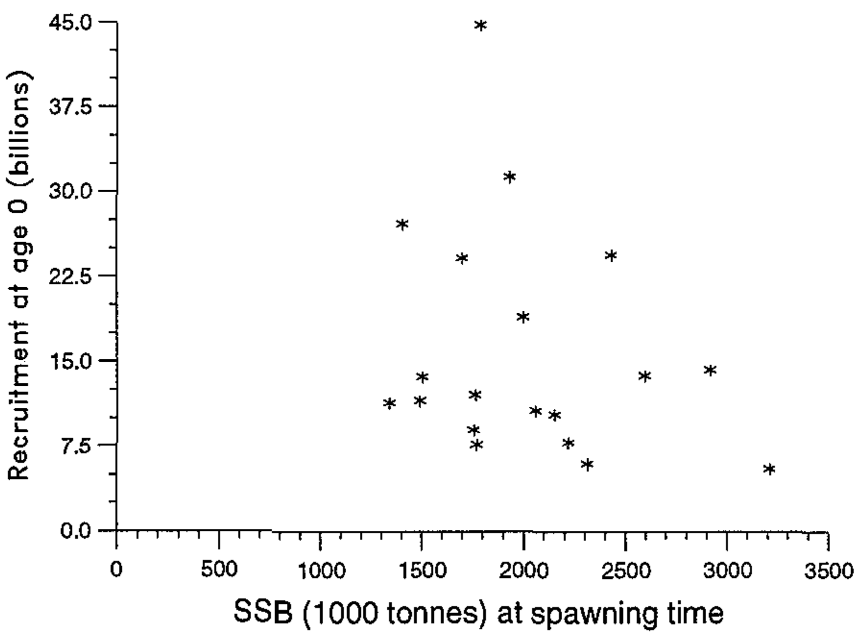
Source of information: Report of the Northern Pelagic and Blue Whiting Fisheries Working Group, April/May 1999 (ICES CM 1999/ACFM: 18).

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]	602
1997	Precautionary TAC for combined stock	540		634
1998	Precautionary TAC for combined stock	650		1125
1999	Catches above 650 000 t may not be sustainable in the long run.	650		
2000	F should not exceed the proposed $\mathbf{F}_{pa}$	800		

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

Stock - Recruitment



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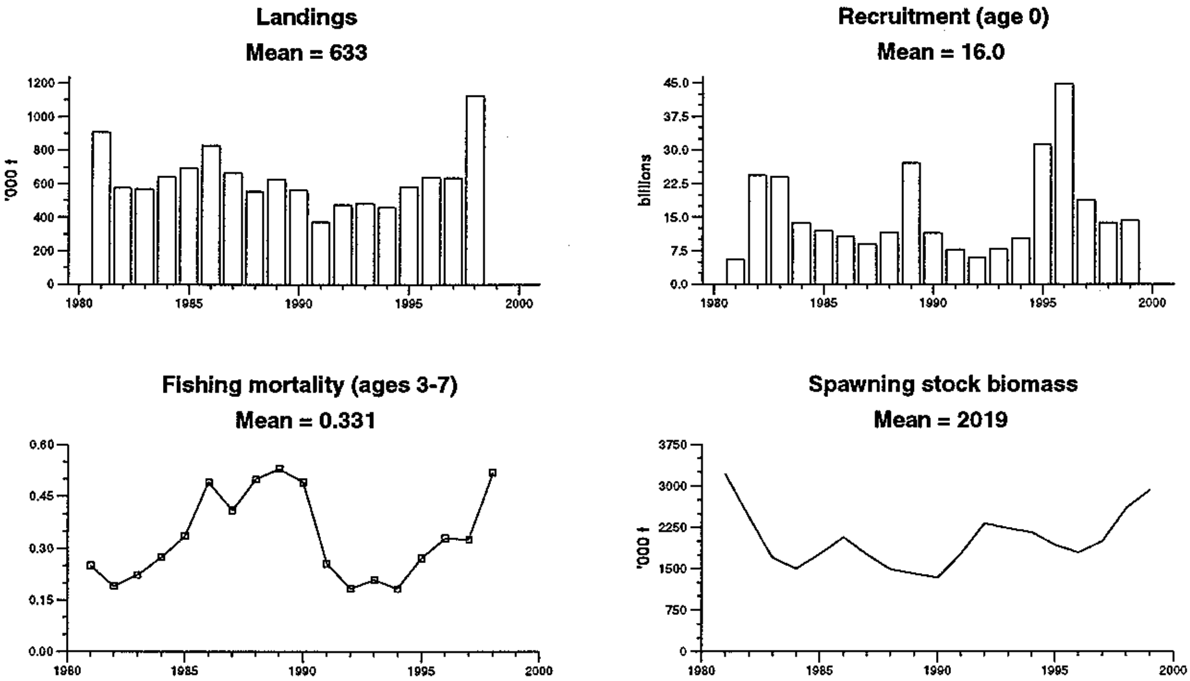
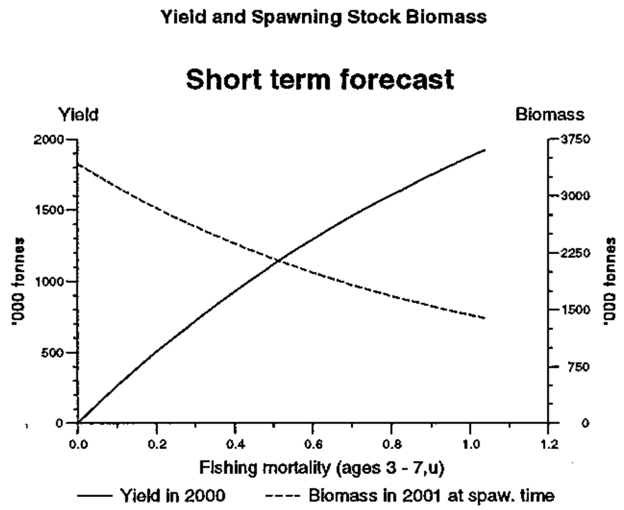


Blue whiting combined stock (Sub-areas I–IX, XII and XIV)



Blue whiting, combined stock

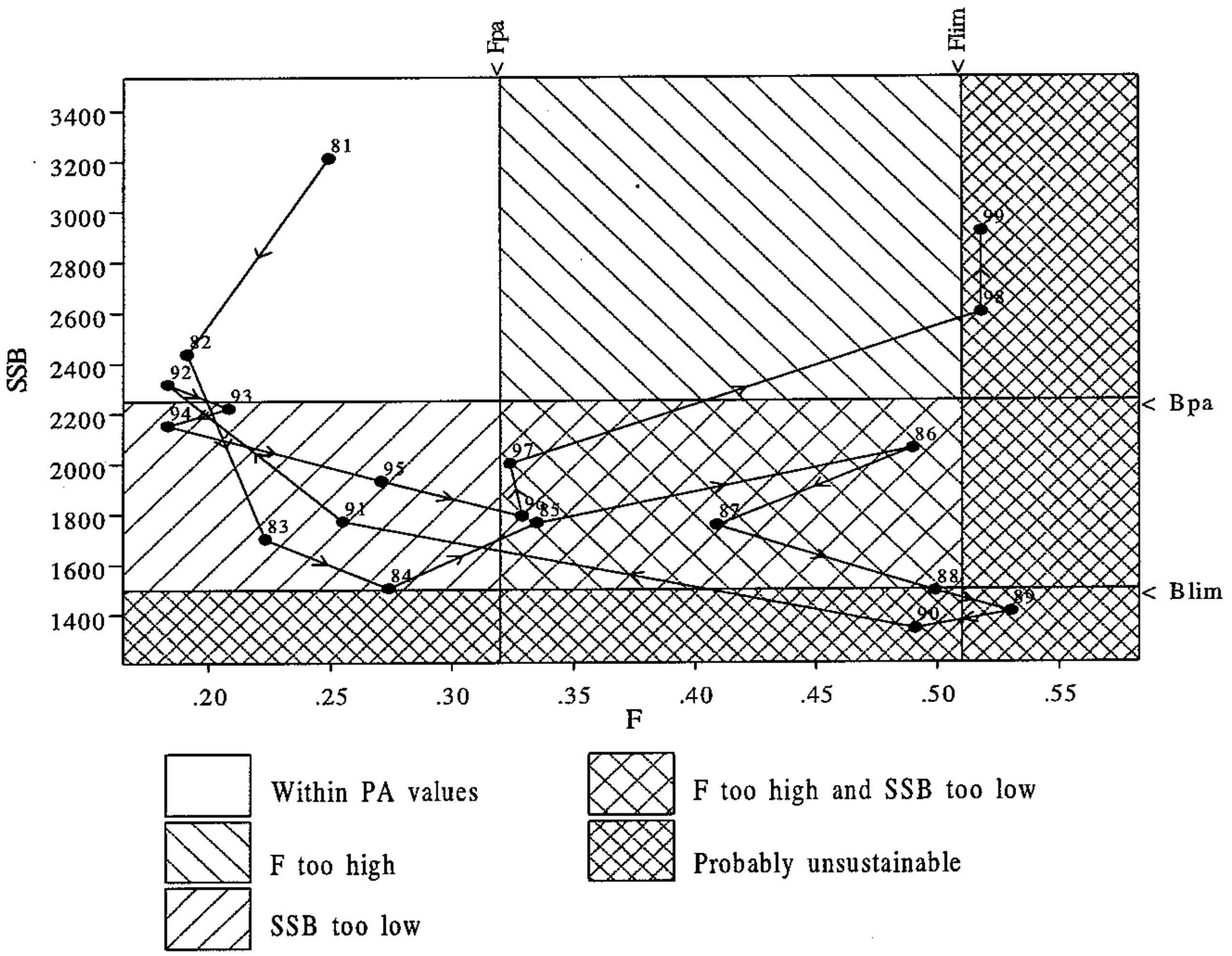


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Table 3.12.5.1 Landings (tonnes) of BLUE WHITING from the main fisheries, 1985–1998, as estimated by the Working Group.

Area	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Norwegian Sea fishery (Subareas I+II and Divisions Va,XIVa-b)	90,742	160,061	123,042	55,829	42,615	2,106	78,703	62,312	43,240	22,674	23,733	23,447	62,570	173,676
Fishery in the spawning area (Divisions Vb, VIa, VIb and VIIb-c)	464,265	534,263	445,881	421,636	473,165	463,495	218,946	317,237	347,101	378,704	423,282	476,368	488,869	827,194
Industrial mixed fishery (Divisions IVa-c, Vb and IIIa)	97,769	99,580	62,689	45,143	75,958	63,192	39,872	65,974	58,082	28,563	104,004	119,359	65,091	94,881
Subtotal northern fishery	652,776	793,904	631,612	522,608	591,738	528,793	337,521	445,523	448,423	429,941	551,019	619,174	616,530	1,095,751
Southern fishery (Subareas VIII+IX, Divisions VIId,e,g-k)	42,820	33,082	32,819	30,838	33,695	32,817	32,003	28,722	32,256	29,473	27,664	25,099	30,122	29,400
Grand total	695,596	826,986	664,431	553,446	625,433	561,610	369,524	474,245	480,679	459,414	578,683	644,273	646,652	1,125,151

Table 3.12.5.2 Landings (tonnes) of BLUE WHITING from the directed fisheries in the Norwegian Sea (Sub-areas I and II, Division Va, XIVa and XIVb) 1985–1998, as estimated by the Working Group.

Country	1985	1986	1987	1988	1989 [3])	1990	1991	1992	1993	1994 [2])	1995 [3])	1996	1997	1998
Faroes	-	-	9,290	-	1,047	-	-	-	-	-	-	345	-	44,594
Germany	1,764	3,647	1,010	3	1,341	-	-	-	-	2	3	32	-	78
Greenland	-	10	-	-	-	-	-	-	-	-	-	-	-	
Iceland	-	-	-	-	4,977	-	-	-	-	-	369	302	10,464	64,863[4]
Netherlands	-	-	-	-	-	-	-	-	-	-	72	25	-	63
Norway	-	-	-	-	-	566	100	912	240	-	-	58	1,386	12,132
Poland	-	-	56	10	-	-	-	-	-	-	-	-	-	
UK (Eng.&Wales)	-	-	-	-	-	-	-	-	-	-	-	-	-	
USSR/Russia [1])	88,978	156,404	112,686	55,816	35,250	1,540	78,603	61,400	43,000	22,250	23,289	22,308	50,559	51,042
Estonia	-	-	-	-	-	-	-	-	-	-	-	377	161	904
Latvia	-	-	-	-	-	-	-	-	-	422	-	-	-	
Total	90,742	160,061	123,042	55,829	42,615	2,106	78,703	62,312	43,240	22,674	23,733	23,447	62,570	173,676

[1]) From 1992 only Russia

[2]) Includes Vb for Russia.

[3]) Icelandic mixed fishery in Va.

[4]) include mixed in Va and directed in Vb.

Table 3.12.5.3 Landings (tonnes) of BLUE WHITING from directed fisheries in the spawning area (Division Vb,VIa,b, VIIb,c. VIIg-k and Sub-area XII) 1985–1998, as estimated by the Working Group.

Country	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998[1]
Denmark	21,104	11,364	2,655	797	25	-	-	3,167	-	770	-	269		5051
Faroes	72,316	80,564	70,625	79,339	70,711	43,405	10,208	12,731	14,984	22,548	26,009	18,258	22,480	26,328
France	-	-	-	-	2,190	-	-	-	1,195	-	720	6,442	12,446	7,984
Germany	7,465	2,750	3,850	5,263	4,073	1,699	349	1,307	91	-	6,310	6,844	4,724	17,891
Ireland	668	*16,440*	*3,300*	*245*	-	-	-	-	-	3	-	-		45635
Netherland	1,801	8,888	5,627	800	2,078	7,280	17,359	11,034	18,436	21,076	26,703	17,644	23,676	27,884
Norway	234,137	283,162	191,012	208,416	258,386	281,036	114,866	148,733	198,916	226,235	261,272	337,434	318,531	519,622
UK (Scotland)	2	3,482	3,315	5,071	8,020	6,006	3,541	6,849	2,032	4,465	10,583	14,325	33,398	92,383
USSR/Russia [2])	126,772	127,613	165,497	121,705	127,682	124,069	72,623	115,600	96,000	94,531	83,931	64,547	68,097	79,000
Japan	-	-	-	-	-	-	-	918	1,742	2,574	-	-		
Estonia	-	-	-	-	-	-	-	6,156	1,033	4,342	7754	10,605	5,517	5,416
Latvia	-	-	-	-	-	-	-	10,742	10,626	2,160	-	-		
Lithauen	-	-	-	-	-	-	-	-	2,046	-	-	-		
Total	464,265	534,263	445,881	421,636	473,165	463,495	218,946	317,237	347,101	378,704	423,282	476,368	488,869	827,194

[1]) Including some direced fishery also in Division IVa.

[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 1985–1998, as estimated by the WG.

Country	1985	1986	1987	1988	1989	1990	1991	1992	1993 [3])	1994	1995	1996	1997	1998[2]
Denmark	35,843	57,315	28,541	18,144	26,605	27,052	15,538	31,189	41,053	19,686	12,439	51,832	26,270	56,472
Faroes	3,606	5,678	7,051	492	3,325	5,281	355	705	1,522	1,794	-	6,068	6,066	296
Germany [1])	52	-	115	280	3	-	-	25	9	-	-	-	-	
Netherland	130	1,114	-	-	-	20	-	2	46	-	-	-	793	
Norway	54,522	26,941	24,969	24,898	42,956	29,336	22,644	31,977	12,333	3,408	78,565	57,458	27,394	28,814
Sweden	3,616	8,532	2,013	1,229	3,062	1,503	1,000	2,058	2,867	3,675	13,000	4,000	4,568	9,299
UK	-	-	-	100	7	-	335	18	252	-	-	1	-	
Total	97,769	99,580	62,689	45,143	75,958	63,192	39,872	65,974	58,082	28,563	104,004	119,359	65,091	94,881

[1]) Including directed fishery also in Division IVa.

[2]) Including mixed industrial fishery in the Norwegian Sea

[3]) Unprecise estimates for Sweden: reported catch of 34265 t in 1993 is replaced by the mean of 1992 and 1994, i.e. 2,867 t, and used in the assessment.

Table 3.12.5.5 Landings (tonnes) of BLUE WHITING from the Southern areas (Sub-areas VIII and IX and Divisions VIIg-k and VIId,e) 1985–1998, as estimated by the Working Group.

Country	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Netherlands	-	-	-	-	-	450	10	-	-	-	-	-	-	10[1]
Norway	-	-	4	-	-	-	-	-	-	-	-	-	-	
Portugal	6,989	8,116	9,148	5,979	3,557	2,864	2,813	4,928	1,236	1,350	2,285	3,561	2,439	1,900
Spain	35,828	24,965	23,644	24,847	30,108	29,490	29,180	23,794	31,020	28,118	25,379	21,538	27,683	27,490
UK	3	1	23	12	29	13	-	-	-	5	-	-	-	
France	-	-	-	-	1	-	-	-	-	-	-	-	-	
Total	42,820	33,082	32,819	30,838	33,695	32,817	32,003	28,722	32,256	29,473	27,664	25,099	30,122	29,400

[1]) Directed fisheries in VIIIa

Table 3.12.5.6 Blue whiting combined stock (Sub-areas I–IX, XII and XIV)

Year	Recruitment Age 0	Spawning Stock Biomass	Landings	Fishing Mortality Age 3-7
1981	5,497.21	3,211.40	909.56	0.249
1982	24,332.80	2,435.41	576.42	0.191
1983	24,047.00	1,700.87	570.07	0.223
1984	13,584.20	1,503.99	641.78	0.274
1985	11,992.00	1,763.95	695.60	0.335
1986	10,602.00	2,058.40	826.99	0.490
1987	8,904.48	1,754.73	664.43	0.409
1988	11,463.20	1,491.38	553.41	0.499
1989	27,071.90	1,407.92	625.43	0.530
1990	11,275.90	1,341.82	561.61	0.491
1991	7,627.77	1,771.47	369.52	0.255
1992	5,946.67	2,316.55	474.25	0.183
1993	7,826.36	2,220.45	480.67	0.208
1994	10,264.00	2,152.48	459.41	0.183
1995	31,241.70	1,930.77	578.69	0.271
1996	44,699.20	1,791.17	637.83	0.329
1997	18,843.70	2,000.52	634.21	0.324
1998	13,690.70	2,597.36	1,125.15	0.518
1999	14,209.00	2,918.62	.	.
Average	15,953.67	2,019.43	632.50	0.331
Unit	Millions	1000 tonnes	1000 tonnes	-

3.12.6 Deep-water fisheries resources

The European Commission is also concerned about the real fishing possibilities given by non extensively known fish stocks such as deep water fish, oceanic pelagic stocks other than tuna and swordfish, squids, etc.

Advice on deep-water fisheries resources south of 63°N was provided in the 1996 report of ACFM ICES Coop. Res. Rep. No 221 (1997)).

ICES continues to keep these fisheries under review and in particular update catch and effort data from the fisheries. There are assessments available of the Greenland halibut around Iceland (Sub-areas V and XIV) see Section 3.2, and in the Barents Sea (Sub-areas I and II) see Section 3.1.6. Redfish in the Irminger Sea are dealt with in Section 3.2.6.d while redfish in Sub-areas I and II are dealt with in Section 3.1.5.

Biological data for other species are emerging and the ICES Study Group on the Biology and Assessment of Deep-Sea Fisheries Resources will meet in 2000. ACFM will consider the possibilities of carrying out assessments for deep-sea resources and developing advice consistent with the precautionary approach.

ICES continues compilation of landings and biological data and focus on the following species deep-water species: grenadiers, scabbard fishes, orange roughy, forkbeards, sharks, ling, blue ling and tusk.

Source of Information: Report of the Study Group on the Biology and Assessment of Deep-Sea Fisheries Resources (ICES CM 1999/ACFM:21)

3.12.7 Response to request by EC on European eel

EC in 1998 requested ICES to advise on the management of European eel:

"There is an increasing concern about the situation for the European eel stock and its future development. ICES is therefore requested, to provide information about the status of eel stock(s) and the possible escapement targets that would apply and to suggest the type of management action that may lead to the required escapement".

State of stock/fishery: The eel stock is outside safe biological limits and the current fishery is not sustainable. Recruitment is low and continues to decline (Table 3.12.7.1). Fishing mortality is probably high both on juvenile (glass eel) and older eel (yellow and silver eel). Catches have decreased during the last decades (Tables 3.12.7.2 and 3). In the same period indices of abundance has declined in nearly all catchment basins.

In its 1998 ACFM report (Coop. Res. Rep. 229) ICES indicated that available data would allow provisional escapement targets for eel be defined. In 1999 the EIFAC/ICES Working Group on Eels continued its work in order to reply to the EC request. This has proved more difficult than anticipated and it is not possible to provide escapement targets at this time. ICES will, in collaboration with EIFAC, continue to work on estimating such escapement targets.

Advice on management: ICES recommends that a recovery plan should be implemented for the eel stock and that the fishing mortality be reduced to the lowest possible level until such a plan is agreed upon and implemented.

Relevant factors to be considered in management: Analyses indicate that fisheries on all life history stages (glass eel, yellow and silver eels) impact the eel stock significantly and management should reduce the fishing pressure in all these fisheries. It was not possible to identify which fishery has the higher impact on stock status, nor was it possible to determine the impact of fisheries in specific geographic areas on the stock as a whole.

The recovery plan should contain targets for escapement of glass eel, yellow eel and silver eel on a catchment area basis.

A plan for management of eel fisheries in all areas as well as monitoring of fisheries and of stock development are fundamental components in a recovery plan. Such a plan should also contain a definition of when the stock is considered to be in a recovered state.

Eel population dynamic is such that the full effects of a reduction in the fisheries could only show after 15-20 years. The first effects on glass eel production could show 5-10 years after effective management measures have been introduced.

Most eel fishing takes place under national jurisdiction, eel biology suggests that a common approach by all stakeholders to eel fisheries management is required.

Source of information: Report of the EIFAC/ICES Working Group on Eel. ICES CM 2000/ACFM:6.

Table 3.12.7.1. Trends in recruitment. Fishery dependent (D) indicates total commercial catch, independent (I) refers to scientific sampling. ↓ = downward trend ~ = no apparent trend.

	Dates of time series	Number of years	Fishery dependent (D) Independent (I)	Overall trend	Trend 1980-1999	Reference
EUROPE	1994-98	5	D	↓	↓	Gelin
NORTH SEA	1977-97	21	I	↓	↓	Westerberg
NORWAY						
Imsa	1983-96	14	I	↓	↓	Moriarty
DENMARK						
Vida	1978-90	13	D	↓	↓	Moriarty
SWEDEN						
Nation	1977-97	21	I	↓	↓	Westerberg
Ringhals	1978-99	20	I	↓	↓	Westerberg
Viskan	1978-99	22	I	↓	↓	Moriarty
N IRELAND						
Bann	1959-99	41	I	↓	↓	Rosell
R IRELAND						
Erne	1965-99	35	I	↓	~	Moriarty
Shannon	1977-99	23	I	↓	↓	Moriarty
ENGLAND						
Severn	1987-98	12	D	↓	↓	Moriarty
GERMANY						
Ems	1965-97	33	I	↓	↓	Moriarty
NETHERLANDS						
Den Oever	1965-99	35	I	↓	↓	Moriarty
BELGIUM						
Yser	1973-99	27	I	↓	↓	Moriarty
FRANCE						
Loire	1965-99	35	D	↓	↓	Moriarty
SPAIN-PORTUGAL						
Minho	1974-94	21	D	↓	↓	Moriarty
ITALY						
Nation	1982-99	18	D	↓	↓	Ciccotti
Tiber	1975-99	25	I	↓	↓	Moriarty

Table 3.12.7.2 Trends in yellow and silver eel catches and indices. Fishery dependent (D) indicates total commercial catch, independent (I) refers to scientific sampling. ↓ = downward trend ~ = no apparent trend.

Catchment	Dates of time series	Number of years	Fishery dependent (D) Independent (I)	Yellow eel		Silver eel		Reference
				Overall trend	Trend 1980-1999	Overall trend	Trend 1980-1999	
N IRELAND								
L. Neagh	1965-98	34	D	~	~	↓	↓	Rosell
R IRELAND								
Shannon	1984-98	15	D				↓	McCarthy & Cullen
SCOTLAND								
Dee	1990-96	7	D		~			Carrs et al
ENGLAND & WALES								
National	1987-98	12	D		~			Knights et al
NETHERLANDS								
Ijsselmeer	1950-98	49	D	↓	↓	↓	↓	Dekker
IJsselmeer	1950-98	49	D	↓	↓	↓	↓	Dekker
Ijsselmeer	1989-98	10	I		~			Hartgers
IJsselmeer	1989-98	10	I		~			Hartgers
Markermeer	1989-98	10	I		↓			Hartgers
FRANCE								
Bourgneuf marsh	1987-98	9	I		↓			Baisez et al
Orne	1989-97	9	I		↓			Legault & Porscher
ITALY								
Coastal lagoons	1969-96	28	D	↓	↓	↓	↓	Ciccotti et al
Lakes	1969-96	28	D	↓	↓	~	↓	Ciccotti et al

Table 3.12.7.3 Commercial catch of EEL as officially reported to ICES.

YEAR	Denmark	Norway	Sweden	Germany	FRG	GDR	Netherlands	Belgium	UK	England	England & Wales	England, Wales and N.Irelar	Scotland	N. Ireland	Ireland	Poland	Latvia	Estonia	Spain	USSR	Rus. Fed.	Finland	Iceland	Portugal	France	SUM
																										0
																										0
1903	2,211			19			564																			2794
1904	2,486			24			586																			3097
1905	2,690		273	26			415																			3405
1906	2,980		290				413																			3683
1907	2,776		247	40			526																			3589
1908	3,287	268	243	52			453																			4303
1909	2,969	327	222	70			516																			4103
1910	4,099	303	737	1,049			620																			6807
1911	4,583	384	867	1,199			988																			8021
1912	4,826	187	1,150	1,365			720																			8248
1913	4,721	213	1,061	1,397			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																			7386
1918	2,920	35	884	733			1,111																			5683
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										6795
1922	3,672	94	926	1,125			900									78										6795
1923	3,277	140	948	1,175			742									83										6365
1924	3,983	290	1,201				91									119	23									5707
1925	4,715	325	1,714	1,571			965									66	14									9370
1926	4,541	341	1,707	1,964			879									74	22									9528
1927	4,459	354	2,011	1,889			763									150	29									9655
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

Table 3.12.7.3 (Continued)

YEAR	Denmark	Norway	Sweden	Germany	FRG	GDR	Netherlands	Belgium	UK	England	England & Wales	England, Wales and N .Ireland	Scotland	N. Ireland	Ireland	Poland	Latvia	Estonia	Spain	USSR	Rus. Fed.	Finland	Iceland	Portugal	France	SUM
1950	4,510	282	2,192	413			70			6									107							7580
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			####		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			26	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				237	2927
1997	757	413	931	196			31					19	15		150	233	2	18			34				162	2961
1998	560	332	n/a	n/a			22					9	2		n/a	231	2	22			25				102	1307

n/a not available

France 1997 and 1998 are 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. The catches decreased to 470 000 t in 1998. Baltic salmon is exploited by drift net, trap net and longline fisheries.

An overview of catches of fish in the Baltic until 1997 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 1996–1998 to an almost historically low level.

The success of cod reproduction is, among other things, dependent on certain minimum levels of salinity and oxygen concentration for the fertilisation and survival of the eggs and larvae. The unusually long period with low influx of North Sea water from the late 1970s to the early 1990s was in general a period of low recruitment. The influx in 1993 resulted in improved environmental conditions which 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) in 1994–1997 and eastern (Sub-divisions 25–32) cod stocks in 1994–1995. However, fishing mortalities are still estimated to be high in the western stock and increased from a lower level in the eastern stock. In the western stock the increase in spawning stock biomass in recent years was caused mainly by the 1994 year class and it is expected that the spawning stock biomass will increase with the present exploitation pattern due to the 1997 year class which is estimated as above average. The estimate of this 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.

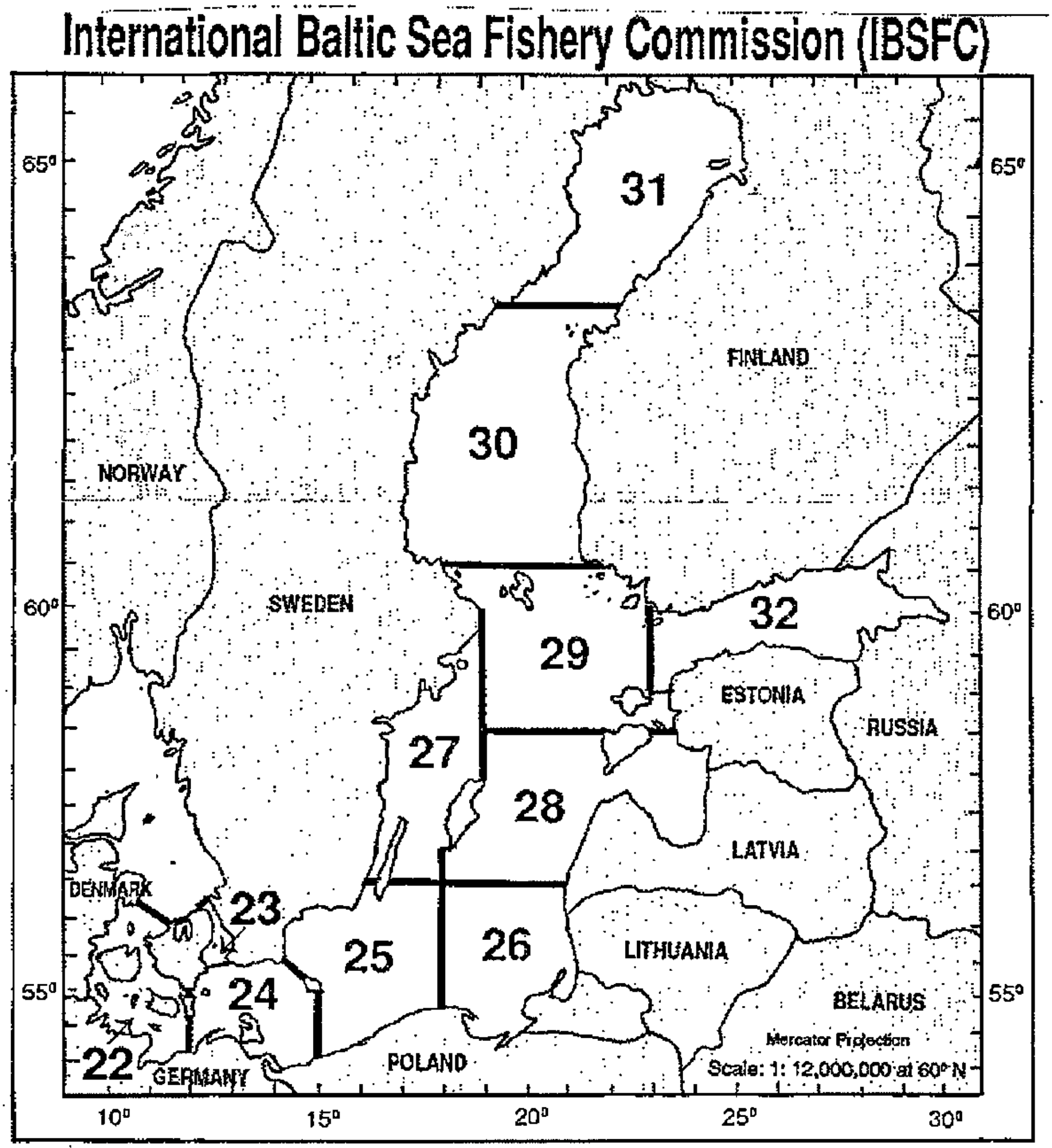
The landings of **sprat** for industrial purposes have increased markedly during the last few years. **Herring** and sprat are used mainly for human consumption when landed in the countries on the eastern Baltic coasts, but for production of fishmeal and oil in the countries on the west coast.

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 harvested outside safe biological limits. A sharp decrease in mean weight at age of sprat has been observed since 1993. A continuous decreasing trend in mean weight at age has been observed in most herring stocks in the Baltic since the mid-1980s. This decline in mean weight at age partly explains the declining trend in biomass of the herring stock in Sub-divisions 25–29, 32 (including Gulf of Riga). 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 multispecies interactions may have strong influence on state of fish stocks in the Baltic periodically, depending on abundance of cod as the main predator in the Baltic ecosystem. To take into account the multispecies effects, the data from multispecies assessment methods are used in the assessment of pelagic stocks. However, interactions with other potential top predators, such as salmon and seal, that are potentially very important in the northern Baltic, are not yet quantified and are therefore not directly included in the present ICES advice.

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 1997 are given in Tables 3.13.2.1–5. These are the catches officially reported to ICES by national statistical offices for publication in the *ICES Fishery Statistics*.

In the assessments, the working groups try to estimate discards and slipped fish, landings which are not officially reported, and the composition of by-catches. These amounts are included in the estimates of total catch for each stock and are used in the assessments; thus, they appear in the tables and figures produced by working groups. These estimates vary considerably between different stocks and fisheries, being negligible in some cases and constituting important parts of the total removals from other stocks. Further, the catches used by the working groups are broken down into sub-divisions, whereas the officially-reported catches by some countries are reported by the larger Divisions IIIb, c, and d. The trends in Tables 3.13.2.1–5 may not, therefore, correspond 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 1973-1997 (in '000 t). Anadromous species, except salmon, not included. (Data as officially reported to ICES.)

Year	Species							Total
	Cod	Herring	Sprat	Flatfish	Salmon	Freshwater species	Others	
1973	189	404	213	18	2.7	23	55	905
1974	189	407	242	21	2.9	21	54	937
1975	234	415	201	24	2.9	20	60	957
1976	255	393	195	19	3.1	21	46	932
1977	213	413	211	22	2.4	22	42	925
1978	196	420	132	23	2.0	22	44	839
1979	273	459	78	24	2.3	20	47	903
1980	388	453	57	18	2.4	14	29	961
1981	380	419	47	16	2.4	13	31	908
1982	361	442	45	17	2.2	13	30	910
1983	376	459	31	16	2.4	13	20	917
1984	442	426	52	15	3.7	13	17	969
1985	344	431	69	17	4.0	11	16	892
1986	271	401	75	18	3.5	12	19	800
1987	238	373	91	16	3.8	13	24	759
1988	225	407	86	14	3.2	13	31	779
1989	192	414	89	14	4.2	14	18	745
1990	167	360	92	12	5.6	11	18	666
1991[1]	139	295	111	14	4.6	17	19	600
1992[1]	72	339	146	12	4.7	8	13	595
1993[1]	41	352	194	12	3.4	10	7	619
1994[1]	75	353	301	18	2.9	9	8	767
1995[1]	117	343	326	22	2.7	9	17	837
1996[1]	164	326	464	22	2.6	9	6	994
1997[1]	134	370	520	20	2.6	12	9	1,068

[1]Preliminary.

Table 3.13.2.2 Nominal catch (tonnes) of HERRING in Divisions IIIb,c,d 1963-1997. (Data as officially reported to ICES.)

Year	Denmark	Finland	German Dem.Rep.	Germany, Fed.Rep.	Poland	Sweden	USSR	Total
1963	14,991	48,632	10,900	16,588	28,370	27,691	78,580[1]	225,752
1964	29,329	34,904	7,600	16,355	19,160	31,297	84,956	223,601
1965	20,058	44,916	11,300	14,971	20,724	31,082[2]	83,265	226,216
1966	22,950	41,141	18,600	18,252	27,743	30,511	92,112	251,309
1967	23,550	42,931	42,900	23,546	32,143	36,900	108,154	310,124
1968	21,516	58,700	39,300	16,367	41,186	53,256	124,627	354,952
1969	18,508	56,252	19,100	15,116	37,085	30,167	118,974	295,202
1970	16,682	51,205	38,000	18,392	46,018	31,757	110,040	312,094
1971	23,087	57,188	41,800	16,509	43,022	32,351	120,728	334,685
1972	16,081	53,758	58,100	10,793	45,343	41,721	118,860	344,656
1973	24,834	67,071	65,605	8,779	51,213	59,546	127,124	404,172
1974	19,509	73,066	70,855	9,446	55,957	60,352	117,896	407,081
1975	18,295	69,581	71,726	10,147	68,533	62,791	113,684	414,757
1976	23,087	75,581	58,077	6,573	63,850	41,841	124,479	393,488
1977	25,467	78,051	62,450	7,660	60,212	52,871	126,000	412,711
1978	26,620	89,792	46,261	7,808	63,850	54,629	130,642	419,602
1979	33,761	83,130	50,241	7,786	79,168	86,078	118,655	458,819
1980	29,350	74,852	59,187	9,873	68,614	92,923	118,074	452,873
1981	28,424	65,389	56,643	9,124	64,005	84,500	110,782	418,867
1982	40,289	73,501	50,868	8,928	76,329	92,675	99,175	441,765
1983	32,657	83,679	51,991	9,273	82,329	86,561	112,370	458,860
1984	32,272	86,545	50,073	8,166	78,326	65,519	105,577	426,478
1985	27,847	88,702	51,607	9,079	85,865	57,554	110,783	431,437
1986	21,598	83,800	53,061	9,382	77,109	39,909	115,665	400,524
1987	23,283	82,522[3]	50,037	6,199	60,616	36,446	113,844	372,947
1988	29,950	92,824[3]	53,539	5,699	60,624	41,828	122,849	407,313
1989	26,654	81,122[3]	54,828	5,777	58,328	65,032	121,784	413,525
1990	16,237	66,078[3]	40,187	5,152	60,919	55,174	116,478	360,225

Year	Denmark	Estonia	Finland	Germany	Latvia	Lithuania	Poland	Sweden	Russia	Total
1991	23,995	27,034[4]	51,546[3]	16,022	33,270	6,468[5]	45,991	59,176	31,755	295,257[6]
1992	33,855	29,556	72,171[3]	17,746	25,965	3,237[6]	52,864	75,907	27,979	339,280[6]
1993	34,945	32,982	77,353[3]	20,143	21,949	3,912[6]	50,833	86,497	23,545	352,159[6]
1994	45,190	34,493	97,674[3]	12,367	22,676	4,988[6]	49,111	70,886	15,904	353,411[6,7]
1995	37,762	43,482	94,613[3]	7,898	24,972	3,706[6]	45,676	68,019	16,970	343,099[6]
1996	34,340	45,296	93,337[3]	7,737	27,523	4,257[6]	31,246	67,116	14,780	325,632[6]
1997	30,876	52,436	90,334[3]	12,755	29,330	3,321[6]	28,939	110,463	11,801	370,255[6]

[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 1963–1997. (Data as officially reported to ICES.)

Year	Denmark	Finland	German Dem.Rep.	Germany, Fed.Rep.	Poland	Sweden	USSR	Total
1963	2,525	1,399	8,000	507	10,693	101	45,820[1]	69,045
1964	3,890	2,111	14,700	1,575	17,431	58	55,753	95,518
1965	1,805	1,637	11,200	518	16,863	46	52,829	84,898
1966	1,816	2,048	21,200	66	13,579	38	52,407	91,454
1967	3,614	1,896	11,100	2,930	12,410	55	40,582	72,587
1968	3,108	1,291	10,200	1,054	14,741	112	55,050	85,556
1969	1,917	1,118	7,500	377	17,308	134	90,525	118,879
1970	2,948	1,265	8,000	161	20,171	31	120,478	153,054
1971	1,833	994	16,100	113	31,855	69	133,850	184,814
1972	1,602	972	14,000	297	38,861	102	151,460	207,294
1973	4,128	1,854	13,001	1,150	49,835	6,310	136,510	212,788
1974	10,246	1,035	12,506	864	61,969	5,497	149,535	241,652
1975	9,076	2,854	11,840	580	62,445	31	114,608	201,434
1976	13,046	3,778	7,493	449	56,079	713	113,217	194,775
1977	16,933	3,213	17,241	713	50,502	433	121,700	210,735
1978	10,797	2,373	13,710	570	28,574	807	75,529	132,360
1979	8,897	3,125	4,019	489	13,868	2,240	45,727	78,365
1980	4,714	2,137	151	706	16,033	2,388	31,359	57,488
1981	8,415	1,895	78	505	11,205	1,510	23,881	47,489
1982	6,663	1,468	1,086	581	14,188	1,890	18,866	44,742
1983	2,861	828	2,693	550	8,492	1,747	13,725	30,896
1984	3,450	374	2,762	642	10,954	7,807	25,891	51,880
1985	2,417	364	1,950	638	22,156	7,111	34,003	68,639
1986	5,693	705	2,514	392	26,967	2,573	36,484	75,328
1987	8,617	287[2]	1,308	392	34,887	870	44,888	91,249
1988	6,869	495[2]	1,234	254	25,359	7,307	44,181	85,699
1989	9,235	222[2]	1,166	576	20,597	3,453	53,995	89,244
1990	8,858	162[2]	518	905	14,299	7,485	59,737	91,964

Year	Denmark	Estonia	Finland	Germany	Latvia	Lithuania	Poland	Sweden	Russia	Total
1991	21,781	14,124[3]	99[2]	736	17,996[4]	3,569	23,200	8,328	20,736	110,569[5]
1992	28,210	4,140	893[2]	608	17,388	1,697[5]	30,126	53,558	9,851	146,471[5]
1993	27,435	5,763	206[2]	8,267	12,553	2,798[5]	33,701	92,416	10,745	193,884[5]
1994	69,644	9,079	497[2]	374	20,132	2,789[5]	44,556	135,779	16,719	300,535[5,6]
1995	76,420	13,052	4,103[2]	230	24,383	4,799[5]	37,280	150,435	14,934	325,636[5]
1996	123,549	22,493	14,351[2]	161	34,211	10,165[5]	77,472	163,087	18,287	463,776[5]
1997	153,765	39,692	19,852[2]	428	49,314	6,000[5]	105,298	123,207	22,194	519,750[5]

[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 1963–1997. (Data as officially reported to ICES.)

Year	Denmark	Faroe Islands	Finland	German Dem.Rep.	Germany Fed.Rep.	Poland	Sweden	USSR	Total
1963	35,851		12	7,800	10,077	47,514	22,827	30,550[1]	154,631
1964	34,539		16	5,100	13,105	39,735	16,222	24,494	133,211
1965	35,990		23	5,300	12,682	41,498	15,736	22,420	133,649
1966	37,693		26	6,000	10,534	56,007	16,182	38,269	164,711
1967	39,844		27	12,800	11,173	56,003	17,784	42,975	180,606
1968	45,024		70	18,700	13,573	63,245	18,508	43,611	202,731
1969	45,164		58	21,500	14,849	60,749	16,656	41,582	200,558
1970	43,443		70	17,000	17,621	68,440	13,664	32,248	192,486
1971	47,563		3	9,800	14,333	54,151	12,945	20,906	159,701
1972	60,331		8	11,500	13,814	56,746	13,762	30,140	186,301
1973	66,846		95	11,268	25,081	49,790	16,134	20,083	189,297
1974	58,659		160	9,013	20,101	48,650	14,184	38,131	188,898
1975	63,860		298	14,740	21,483	69,318	15,168	49,289	234,156
1976	77,570		278	8,548	24,096	70,466	22,802	51,516	255,276
1977	74,495		310	10,967	31,560	47,703	18,327	29,680	213,042
1978	50,907		1,446	9,345	16,918	64,113	15,996	37,200	195,925
1979	60,071		2,938	8,997	18,083	79,697	24,003	78,730	272,519
1980	76,015	1,250	2,317	7,406	16,363	123,486	34,089	124,359	388,186[2]
1981	93,155	2,765	3,249	12,938	15,082	120,942	44,300	87,746	380,177
1982	98,230	4,300	3,904	11,368	19,247	92,541	44,807	86,906	361,303
1983	108,862	6,065	4,677	10,521	22,051	76,474	54,876	92,248	375,774
1984	121,297	6,354	5,257	9,886	39,632	93,429	65,788	100,761	442,404
1985	107,614	5,890	3,793	6,593	24,199	63,260	54,723	78,127	344,199
1986	98,081	4,596	2,917	3,179	18,243	43,237	48,804	52,148	271,205
1987	85,544	5,567	2,309	5,114	17,127	32,667	50,186	39,203	237,717
1988	75,019	6,915	2,903	4,634	16,388	33,351	58,027	28,137	225,374
1989	66,235	4,499	1,913	2,147	14,637	31,855	55,919	14,722	191,927
1990	56,702	3,558	1,667	1,630	7,225	28,730	54,473	13,461	167,446

Year	Denmark	Estonia	Faroe Islands	Finland	Germany	Latvia	Lithuania	Poland	Sweden	Russia	Total
1991	50,640	1,805[3]	2,992	1,662	8,637	2,627	1,849	25,748	39,552	3,196	138,708[4]
1992	30,418	1,369	593	460	6,668	1,250	874[4]	13,314	16,244	404	71,594[4]
1993	10,919	70	558	203	5,127	1,333	904[4]	8,909	12,201	483	40,707[4]
1994	19,822	905	779	520	7,088	2,379	1,886[4]	14,426	25,685	1,114	74,604[4]
1995	34,612	1,049	777	1,851	14,681	6,471	3,629[4]	25,001	27,289	1,612	117,265[4,5]
1996	48,505	1,392	714	3,132	20,607	8,741	5,521[4]	34,856	36,932	3,304	163,993[4,5]
1997	42,581	1,173	33	1,537	14,483	6,187	4,497[4]	31,659	29,329	2,803	134,282[4]

[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 1963-1997. (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	237	75	12,435[6]
1993	3,275	165	85	2,156	475	155[6]	5,101	271	159	11,842[6]
1994	5,094	162	79	6,634	337	270[6]	4,900	314	173	17,963[6]
1995	6,556	102	89	5,146	411	209[6]	8,964	661	268	22,406[6]
1996	6,387	297	98	3,134	336	401[6]	8,836	1,597	774	21,860[6]
1997	6,357	334	85	3,311	413	696[6]	6,168	1,374	1,131	19,869[6]

[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 the proportion of spring and autumn spawners in the historical catch data and the lack of a coordinated comprehensive survey.

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

Advice on management: ICES recommends that the fisheries on herring in Division IIIa should continue to be managed in accordance with the management advice given on autumn-spawning herring in Section 3.5.8. If a catch limit is required in Sub-divisions 22–24, ICES advises that it should not exceed recent catches in that area in the order of 60 000 t.

Relevant factors to be considered in management: A considerable part of the landings of juvenile herring in Division IIIa originates from the North Sea stock. An abundant year class of North Sea herring is expected to be present in the area as one year olds in the year 2000.

Recently, this fishery has been managed to be consistent with the North Sea. As the North Sea stock recovers, the need for separate assessment of this area increases.

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. ICES reiterates its previous advice that 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.

Elaboration and special comments: In order to improve the analytical assessment, further development of methods to split the spawning components in the historical data should be undertaken, as well ensuring comprehensive survey coverage.

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, gillnet and trapnet fisheries. The herring by-catches taken in Division IIIa in the small mesh trawl fishery for Norway pout, sandeel and sprat (fleet D&E) 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.

Historical catch-at-age data are uncertain due to low sampling in the years prior to 1997, but sampling has improved in 1997 and 1998. It has previously been 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.

The TACs in Division IIIa in 1998 of 80 000 t were in the directed fishery and 17 000 t as a by-catch in the small mesh fisheries. The TAC comprises both the autumn- and spring-spawning stocks in the area. The spring spawners are also fished in the Baltic, under the overall IBSFC herring TAC of 560 000 t (Sub-divisions 22–29S and 32).

The agreed TACs in Division IIIa for 1999 are 80 000 t for the directed fishery and a total of 19 000 t for by-catches in the small mesh fishery. In 1997 the "mixed clupeoid" TAC was deleted from the management agreement between Norway and EU.

Catch forecast: No projection is available.

Source of information: Report of the Herring Assessment Working Group for the Area South of 62°N, March 1999 (ICES CM 1999/ACFM:12).

Catch data: (Tables 3.13.3.1–2)

Year	ICES Advice	Pred. Catch 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 catches	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]		63	42	105
1998	Should be managed in accordance with North Sea autumn spawners	-		64	46	110
1999	IIIa: managed together with autumn spawners 22–24: if required, TAC not exceeding recent catches	-				
2000	IIIa: managed together with autumn spawners 22–24: if required, TAC not exceeding recent catches	~60 for Sub-divs. 22–24				

[1]Including catches of Baltic spring spawners in North Sea. [2]Catch in Sub-divisions 22–24. Weights in '000 t.

Landings
Mean = 164

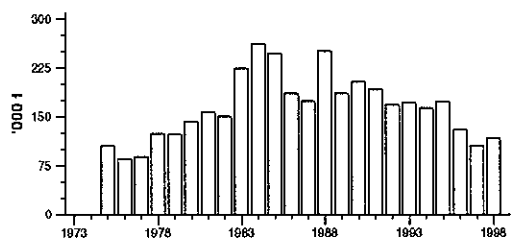


Table 3.13.3.1 Herring in Sub-divisions 22–24 and Division IIIa (spring-spawners)

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
1998	110
Average	164
Unit	1000 tonnes

Table 3.13.3.2 Herring (Baltic spring spawners and North Sea autumn spawners) in Division IIIa and Sub-Divisions 22–24, 1985–1998. 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	1998[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	10.3
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	8.0
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	46.9
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	65.2
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	14.5
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	29.9
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	44.4
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	30.1
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	9.0
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	6.5
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	4.3
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	49.9
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	13.4
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	0.3
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	13.7
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	173.2

[1] Preliminary data.

3.13.3.b Herring in Sub-divisions 25–29 (including Gulf of Riga) and 32

State of stock/fishery: Although the exact stock status is uncertain, there is high confidence that biomass is decreasing, that fishing mortality is increasing, and the stock is considered to be outside safe biological limits in both F and B. The assessment is uncertain due to the complexity of the stock structure in the area, and a particularly large inconsistency between the VPA-estimated stock size and the most recent hydroacoustic survey results.

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

Advice on management: ICES recommends that F in 2000 should be reduced below the proposed F_{pa} = 0.17 to ensure that the SSB increases toward the proposed B_{pa}. The TAC for herring in Sub-divisions 22–29, 32 should be set such that a catch in 2000 of this stock of less than 95 000 t is implied. To allow the SSB to rise above the proposed B_{pa}, a recovery plan should be developed.

If this large reduction in F cannot be made in a single year, a plan should be implemented which reduces F to below the proposed $\mathbf{F_{pa}}$ in a series of steps. Examples are given in medium-term forecasts in Table 3.13.3.b2.

Reference points:

ICES considers that:	ICES proposes that:
$\mathbf{B_{lim}}$ is 750 000 t	$\mathbf{B_{pa}}$ be set at 1 000 000 t
$\mathbf{F_{lim}}$ is 0.33	$\mathbf{F_{pa}}$ be set at 0.17

Technical basis:

$\mathbf{B_{lim}}$: is close to the lowest observed	$\mathbf{B_{pa}}$: 1.33*$\mathbf{B_{lim}}$
$\mathbf{F_{lim}}$: $\mathbf{F_{loss}}$	$\mathbf{F_{pa}}$: $\mathbf{F_{med}}$

Relevant factors to be considered in management: There has been a steady decrease in mean weight at age for herring over the past decade. 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 decreasing growth rate of some stock components and increasing proportion in the catches of slow growing fish mainly from the Gulf of Finland and Gulf of Riga. Although the spawning stock in numbers has also begun to decline recently, it increased in the 1990s when compared to the 1980s.

Catch forecast for 2000: Basis: F(99) = F(96–98) = 0.37, Catch(99) = 196, SSB(99) = 606.

F(2000)	Basis	SSB(2000)	Landings (2000)	SSB (2001)
0.15	0.4F(96-98)	646	85	743
0.17	Proposed $\mathbf{F_{pa}}$	643	95	731
0.22	0.6F(96-98)	632	124	693
0.30	0.8F(96-98)	619	161	647
0.37	1.0F(96-98)	606	195	604

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

Elaboration and special comment: The population estimate, though highly uncertain, may be optimistic as the acoustic survey indicates a steeper decrease than XSA. In addition, if weights at age continue to decrease, the prediction may overestimate future biomass.

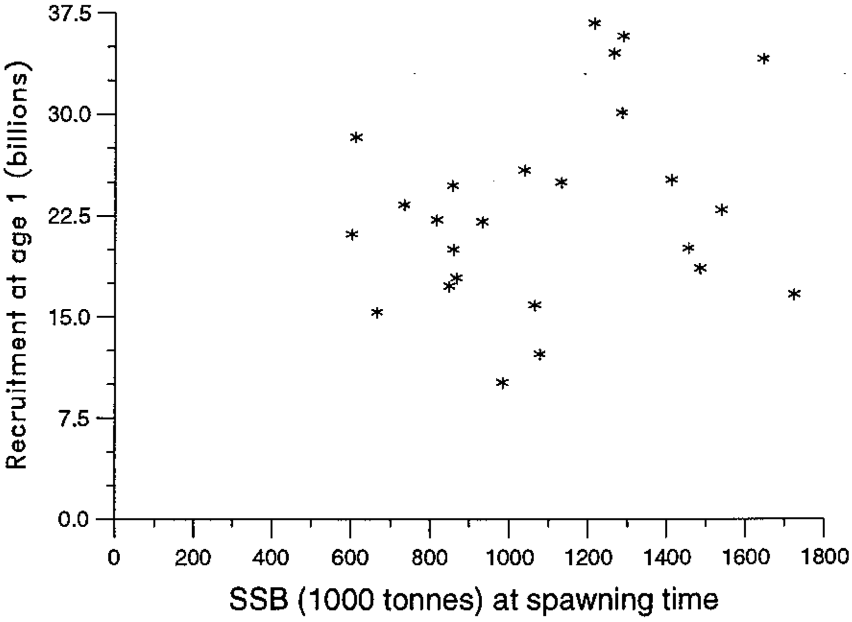
Source of information: Report of the Baltic Fisheries Assessment Working Group, April 1999 (ICES CM 1999/ACFM:15).

Catch data (Tables 3.13.3.b.1+3):

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 at higher F	371	560	231
1994	Increase in yield at higher F	317–463	560	242
1995	TAC	394	560	221
1996	TAC	394	560	195
1997	No advice	-	560	208
1998	No advice	-	560	212
1999	Proposed $\mathbf{F}_{pa=}$ (0.17)	117	476	
2000	Proposed $\mathbf{F}_{pa=}$ (0.17)	95		

[1] TAC is for Sub-divisions 22–24 and 25–29, 32. Weights in '000 t.

Stock - Recruitment



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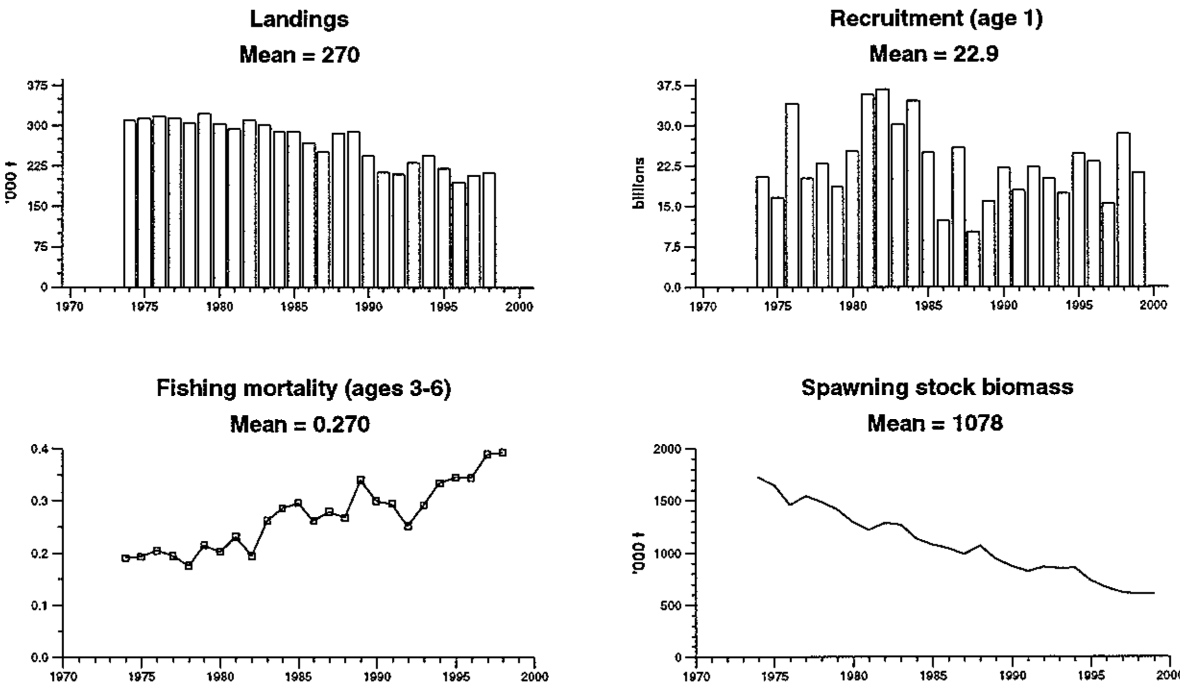
Herring in Sub-divisions 25–29 (including Gulf of Riga) and 32



Herring in 25 to 29 & 32 & Gulf of Riga

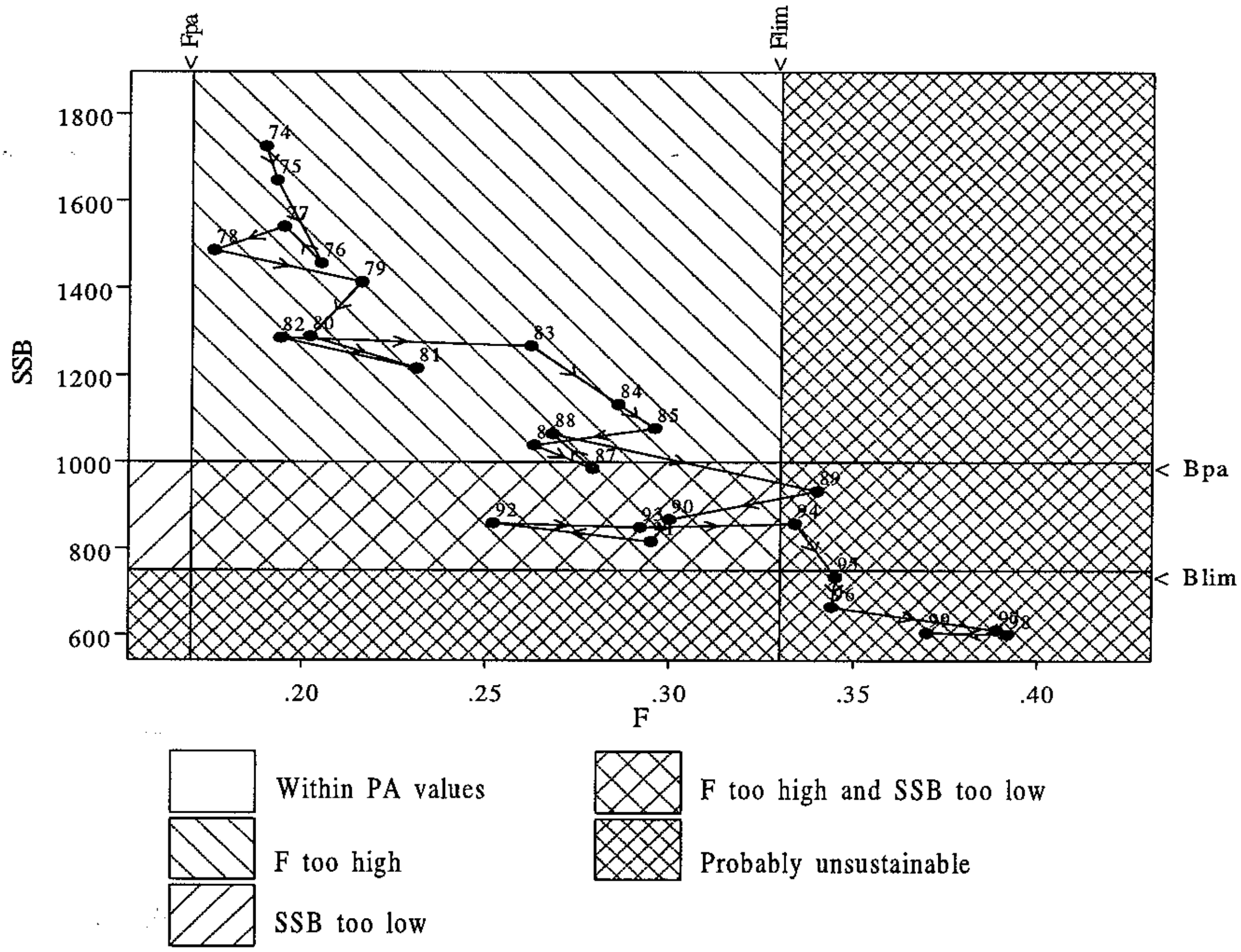


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Table 3.13.3.b.1 Herring catches in Sub-divisions 25–29, 32 (thousand tonnes).

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	23.7	0.0	33.8	3.3	26.2	12.5	44.1	207.8
1998*	13.9	42.9	24.8	0.0	27.6	2.4	19.3	10.5	71.0	212.4

* preliminary, ** in 1977–1990 sum of catches by Estonia, Latvia, Lithuania and Russia.

Table 3.13.3.b2 Medium term projections.

PREDICTION. Herring in SD. 25-29, 32 incl. GoRiga										
Start. Year:	1999									
	Stock		Nat.	Fish.	mW		mW			
Age	(milj)	SD ln	mort.	pattern	stock	SD	catch		mature	SD
1	21123	0.20	0.34	0.08	0.011	0.001	0.011		0.00	0.00
2	18458	0.19	0.25	0.15	0.015	0.001	0.015		0.70	0.00
3	6977	0.24	0.24	0.25	0.020	0.001	0.020		0.90	0.00
4	6090	0.19	0.23	0.36	0.025	0.001	0.025		1.00	0.00
5	3950	0.20	0.22	0.43	0.028	0.001	0.028		1.00	0.00
6	1556	0.18	0.22	0.46	0.032	0.001	0.032		1.00	0.00
7	933	0.20	0.21	0.44	0.035	0.000	0.035		1.00	0.00
8	541	0.21	0.21	0.37	0.038	0.004	0.038		1.00	0.00
SSB 1.Jan	710									
F: f* F(99)		**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**
Catch level	**196**									
	SSB									
Percentiles	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
10%	638	620	572	533	485	448	423	400	362	339
25%	680	654	626	589	547	518	486	448	418	382
50%	729	725	702	666	617	584	550	513	476	444
75%	778	809	787	743	723	668	619	595	558	527
90%	818	884	872	838	793	731	688	660	625	587
% >1000	0.0	2.5	1.0	0.5	0.5	0.0	0.0	0.0	0.0	0.0
B pa	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
% >750	38.5	39	34	23	16.5	8	3.5	3	1.5	2
	Catch									
Percentiles	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
10%	196	157	153	143	132	123	111	104	95	89
25%	196	171	167	159	146	136	129	117	107	101
50%	196	190	186	178	166	156	146	135	126	118
75%	196	209	209	198	189	178	165	156	147	137
90%	196	228	233	224	211	195	183	172	165	158
F: f* F(99)		**0.8**	**0.6**	**0.4**	**0.4**	**0.4**	**0.4**	**0.4**	**0.4**	**0.4**
Catch level	**196**									
	SSB									
Percentiles	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
10%	646	631	613	607	635	664	692	729	762	754
25%	682	661	667	675	710	750	785	821	857	880
50%	725	732	742	750	798	848	887	944	976	1025
75%	777	805	822	859	895	939	992	1055	1126	1167
90%	816	865	894	926	988	1066	1168	1197	1250	1283
% >1000	0.0	0.5	2.0	3.5	9.5	15.5	24.5	37.0	46.5	53.0
B pa	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
% >750	35	43	48	49.5	63.5	75	81.5	85.5	92	90.5

Table 3.13.3.b2 (continued)

	Catch									
Percentiles	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
10%	196	132	103	72	75	77	77	78	81	82
25%	196	143	112	81	84	87	91	91	92	96
50%	196	156	125	89	94	98	102	104	107	111
75%	196	172	138	100	106	110	114	119	122	128
90%	196	185	151	109	119	124	133	135	136	142
F: f* F(99)		0.6	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Catch level	196									
	SSB									
Percentiles	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
10%	644	623	647	669	670	698	725	751	775	796
25%	680	654	690	719	762	786	818	857	888	929
50%	726	716	757	813	835	877	917	958	1022	1071
75%	767	776	837	902	966	1021	1097	1146	1175	1193
90%	811	867	904	980	1051	1135	1214	1265	1298	1343
% >1000	0.0	0.5	4.5	8.0	21.0	30.5	39.0	44.0	54.0	62.5
B pa	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
% >750	31.5	36	52.5	70	77	82.5	87	90	92	94
	Catch									
Percentiles	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
10%	196	101	74	80	80	81	81	80	83	84
25%	196	109	80	87	89	91	94	93	95	99
50%	196	119	88	95	98	101	105	105	110	115
75%	196	129	99	108	114	120	124	126	129	130
90%	196	140	105	116	125	134	138	141	142	145
F: f* F(99)		0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
Catch level	196									
	SSB									
Percentiles	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
10%	646	622	659	668	682	680	718	736	753	771
25%	677	651	718	744	759	768	801	835	867	908
50%	716	718	776	821	862	893	919	975	996	1024
75%	758	787	885	919	972	1001	1043	1085	1128	1177
90%	808	866	958	1021	1054	1100	1139	1202	1240	1284
% >1000	0.0	1.5	7.0	13.5	18.5	25.5	32.5	42.0	49.0	56.0
B pa	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
% >750	29.5	37.5	63.5	74	76.5	80.5	86.5	88	90	91.5
	Catch									
Percentiles	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
10%	196	79	86	90	91	90	91	91	91	94
25%	196	84	94	99	101	101	101	103	107	111
50%	196	91	102	110	115	115	120	120	122	126
75%	196	100	115	125	128	131	135	134	140	144
90%	196	109	126	135	141	143	146	149	154	158

Table 3.13.3.b.3 Herring in Sub-divisions 25–29 (including Gulf of Riga) and 32.

Year	Recruitment Age 1	Spawning Stock Biomass	Landings	Fishing Mortality Age 3-6
1974	20,478.40	1,724.53	310.00	0.190
1975	16,656.60	1,646.22	313.00	0.193
1976	34,064.10	1,456.16	318.00	0.205
1977	20,085.60	1,539.64	314.00	0.195
1978	22,903.60	1,485.62	305.00	0.176
1979	18,595.30	1,412.72	323.00	0.216
1980	25,140.70	1,288.53	304.00	0.202
1981	35,766.80	1,214.67	294.00	0.231
1982	36,710.60	1,285.33	311.00	0.194
1983	30,113.00	1,266.20	302.00	0.262
1984	34,507.90	1,131.88	290.00	0.286
1985	24,980.90	1,077.11	290.00	0.296
1986	12,236.30	1,038.81	268.00	0.263
1987	25,853.50	984.63	252.00	0.279
1988	10,140.20	1,064.96	286.00	0.268
1989	15,871.80	932.27	290.00	0.340
1990	22,037.50	867.04	244.00	0.300
1991	17,888.00	816.69	213.00	0.295
1992	22,189.00	858.72	210.00	0.252
1993	19,991.40	848.66	231.00	0.292
1994	17,260.60	856.94	244.00	0.334
1995	24,721.20	734.47	221.00	0.345
1996	23,292.20	665.40	195.11	0.344
1997	15,355.70	612.69	207.77	0.389
1998	28,300.70	602.62	212.41	0.392
1999	21,123.00	605.82	.	.
Average	22,933.25	1,077.63	269.93	0.270
Unit	Millions	1000 tonnes	1000 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 for this stock. However, for any management objective to meet the proposed precautionary criteria, F should be less than the proposed $\mathbf{F_{pa}}$ and spawning stock biomass should be maintained above the proposed $\mathbf{B_{pa}}$.

Advice on management: At the current exploitation rate the stock is forecast to remain within safe biological limits. The expected catches in the year 2000 corresponding to this rate are 32 500 t. Adding 4 500 t for open sea herring gives a catch of 37 000 t.

Reference points:

ICES considers that:	ICES proposes that:
$\mathbf{B_{lim}}$ is 36 500 t	$\mathbf{B_{pa}}$ be set at 50 000 t
$\mathbf{F_{lim}}$ is 0.51	$\mathbf{F_{pa}}$ be set at 0.4

Technical basis:

$\mathbf{B_{lim}}$: $\mathbf{B_{pa}}$/exp (1.65*SE) SE=0.2	$\mathbf{B_{pa}}$: = MBAL=50 000 t
$\mathbf{F_{lim}}$: =$\mathbf{F_{loss}}$	$\mathbf{F_{pa}}$: from medium-term projections

Catch forecast for 2000: Basis: F(99)=F(96-98)=0.35, Catch(99) = 33.5, SSB(99)=123.

F (2000)	Basis	SSB (2000)	Catch (2000)	SSB (2001)	Medium-term effect of fishing at given level
0.35	Mean 1996–98	121	32.5	112	High probability of SSB above the proposed $\mathbf{B_{pa}}$

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 1999 assessment is very close to the assessment made in the previous year.

The assessment of Gulf of Riga herring indicates that the exploitation has been and still is high. Such persisting high fishing mortality are unusual for pelagic stocks. Estimates of total mortality from catch curve analysis show very high values in the earlier years (Z=0.96, 1970–79) but are then decreasing to about 0.5 for the last decade. The assessment is run with the assumption of low natural mortality (M= 0.15–0.25) and will consequently allocate most of the mortality to fishing. The high total mortality could be partly caused by underestimations of the numbers caught of this population. The Gulf herring is known to migrate outside the Gulf. Only catches by Latvian and Estonian fleets are analyzed in a way that permits identification of Gulf herring, whereas Gulf herring caught by other nations would not be included in the assessment. The proposed $\mathbf{F_{pa}}$ (0.4) is high for a pelagic stock. It is not based on *a priori* arguments but on medium-term forecasts starting from a relatively large stock size. Consequently, the proposed $\mathbf{F_{pa}}$ is above usual candidate BRP such as $\mathbf{F_{med}}$ (0.26) and $\mathbf{F_{loss}}$ (5^{th} percentile 0.16). These are more in line with what would be expected for pelagic stocks.

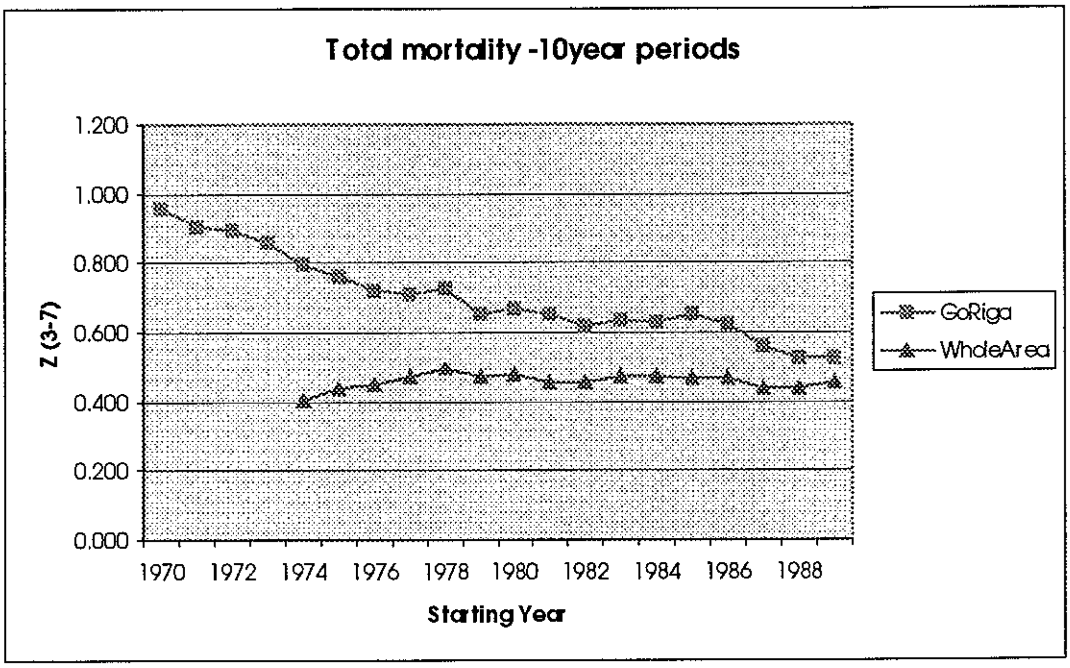
A stock-recruitment relation with stochastic variation is used for generating possible future recruitment figures. During the projection period (10 years) the spawning stock is projected to decline steadily, albeit remaining above the proposed $\mathbf{B_{pa}}$.

Source of information: Report of the Baltic Fisheries Assessment Working Group, April 1999 (ICES CM 1999/ACFM:15).

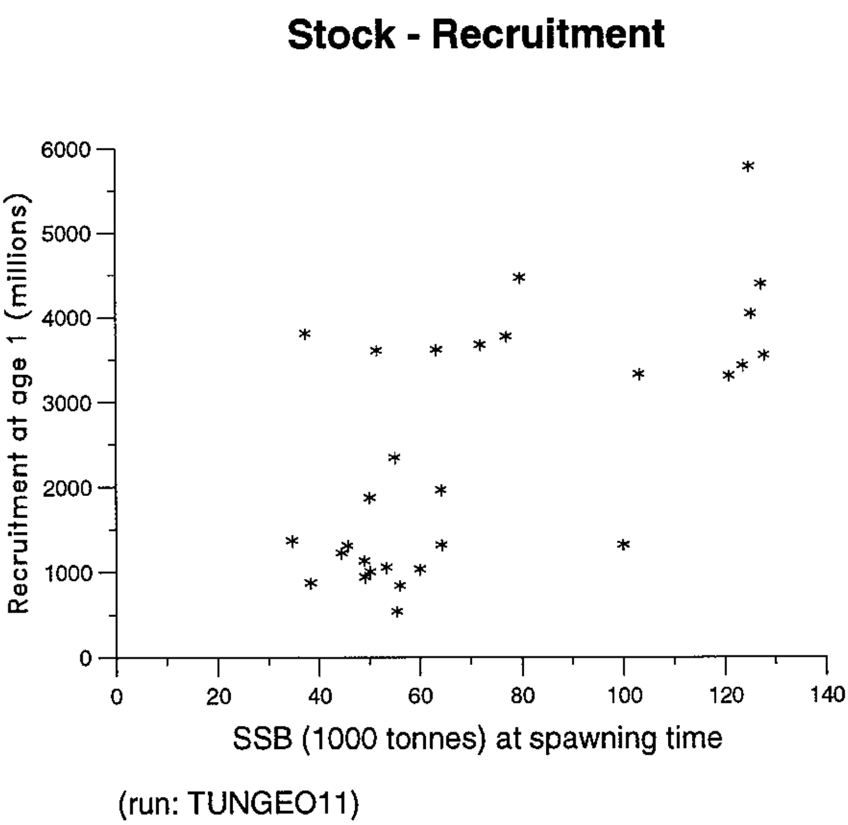
Catch data (Table 3.13.3.b.3):

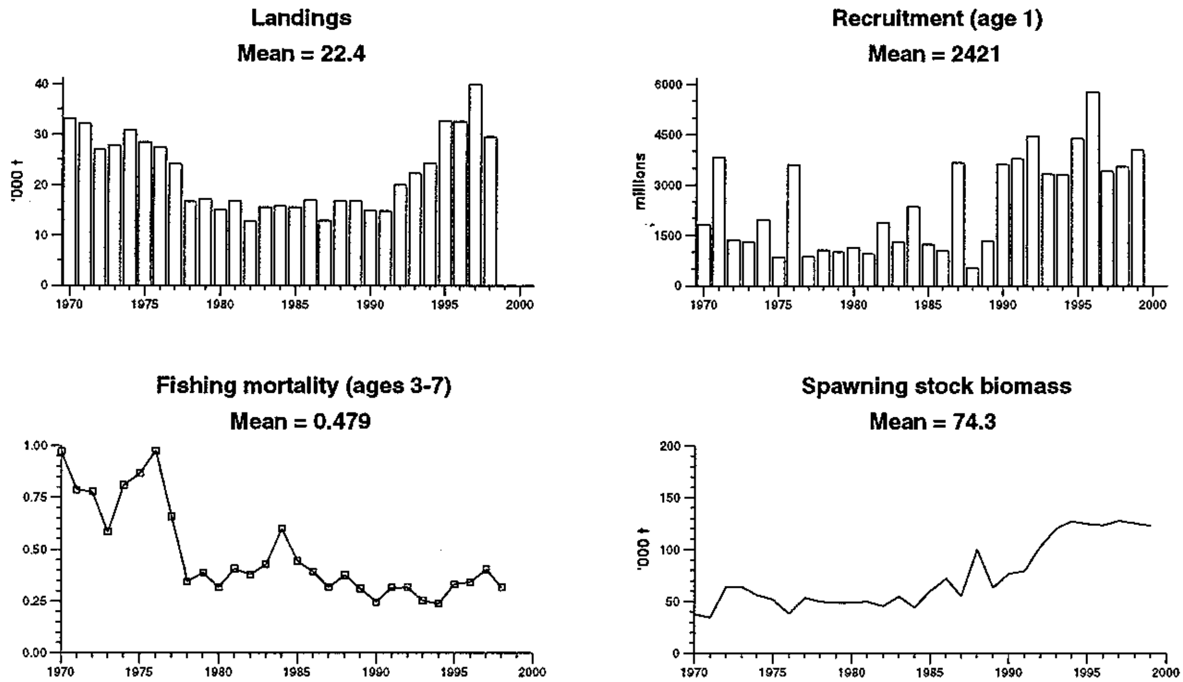
Year	ICES Advice	Predicted catch corresp. To	Agreed TAC	ACFM Catch
1987	Reduce F towards $F_{0.1}$	8	-	13
1988	Reduce F towards $F_{0.1}$	6	-	17
1989	F should not exceed present level	20	-	17
1990	F should not exceed present level	20	-	15
1991	No separate advice for this stock component	-	-	15
1992	No 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	-	29
1999	Current exploitation rate within safe biological limits	34	-	
2000	Current exploitation rate within safe biological limits	37*		

* including 32 500 t of Gulf herring and 4 500 t of open sea herring that enters the Gulf of Riga in the spawning period. Weights in '000 t.



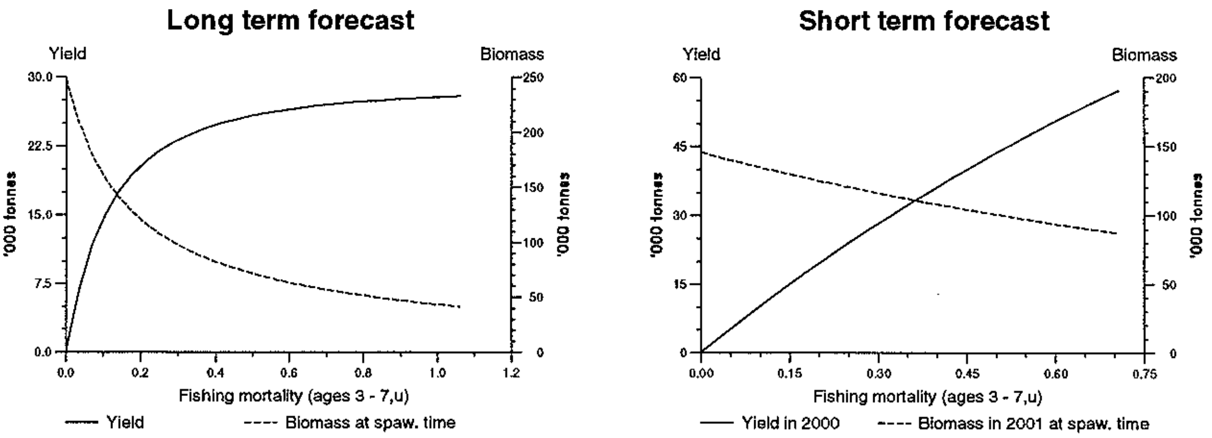
Total mortality of Gulf of Riga herring vs. that of the entire SD 25-29+32 stock.





Herring in the Gulf of Riga

Yield and Spawning Stock Biomass



Herring in the Gulf of Riga

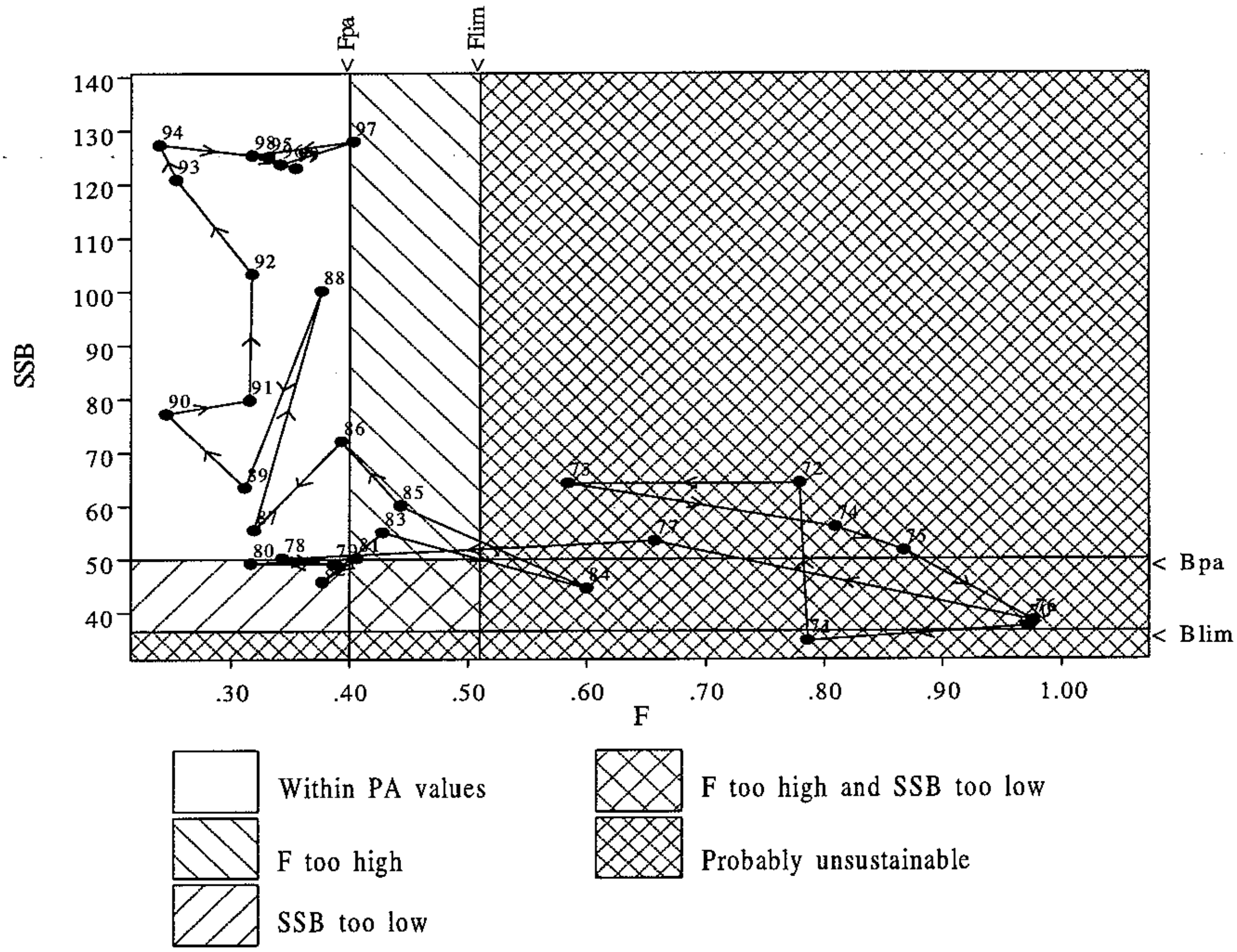


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Table 3.13.3.b.3 Herring in the Gulf of Riga.

Year	Recruitment Age 1	Spawning Stock Biomass	Landings	Fishing Mortality Age 3-7
1970	1,824.33	37.40	33.20	0.971
1971	3,805.64	34.73	32.18	0.786
1972	1,366.62	64.28	27.15	0.779
1973	1,314.25	64.24	27.90	0.584
1974	1,962.37	56.07	30.85	0.809
1975	838.89	51.58	28.52	0.867
1976	3,605.22	38.43	27.42	0.976
1977	872.80	53.40	24.19	0.657
1978	1,054.87	50.19	16.73	0.343
1979	1,002.08	49.01	17.14	0.387
1980	1,132.65	49.19	15.00	0.316
1981	937.77	50.18	16.77	0.406
1982	1,872.37	45.72	12.78	0.377
1983	1,305.46	55.04	15.54	0.428
1984	2,341.45	44.54	15.84	0.600
1985	1,223.61	60.00	15.58	0.443
1986	1,030.75	72.04	16.93	0.393
1987	3,672.00	55.45	12.88	0.319
1988	535.01	100.09	16.79	0.376
1989	1,316.76	63.41	16.78	0.311
1990	3,612.56	77.18	14.93	0.245
1991	3,770.37	79.75	14.79	0.315
1992	4,463.83	103.25	20.00	0.317
1993	3,324.39	120.90	22.20	0.253
1994	3,297.15	127.36	24.30	0.239
1995	4,383.72	125.04	32.66	0.331
1996	5,771.01	123.72	32.58	0.341
1997	3,423.19	127.96	39.84	0.403
1998	3,542.91	125.36	29.44	0.317
1999	4,033.54	122.99	.	.
Average	2,421.25	74.28	22.44	0.479
Unit	Millions	1000 tonnes	1000 tonnes	-

3.13.3.c Herring in Sub-division 30, Bothnian Sea

State of stock/fishery: 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) decreasing to 54 815 t in 1998. There has been substantial increase in fishing effort in 1990s which are believed to have resulted in substantial increases in fishing mortality and there are indications that the SSB has declined steeply since 1994.

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 ongoing study program focusing on improvement of tuning data is expected to improve the quality of the assessment.

In the trawl fishery new more effective larger trawls have been introduced.

Source of information: Report of the Baltic Fisheries Assessment Working Group, April 1999 (ICES CM 1999/ACFM:15).

Catch data (Table 3.13.3.c.1):

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC[2]	ACFM catch in SD 30-31	ACFM Catch
1987				33	25
1988				34	28
1989				33	29
1990				39	31
1991	TAC for eastern part of SD, allowance for western part	32+	84	33	26
1992	*Status quo* F	39	84	46	39
1993	*Status quo* F	39	90	49	40
1994	No specific advice	41[1]	90	62	56
1995	TAC	73	110	66	61
1996	TAC	73	110	61	56
1997	F(97) = 1.4 * F(95)	78	110	70	61
1998	*Status quo* F	50	110	60	55
1999	Reduce catches	-	94		
2000	Reduce catches	-			

[1]Catch at $F_{0.1}$. [2]TAC for the area 29N, 30, 31, Management Unit 3. Weights in '000 t.

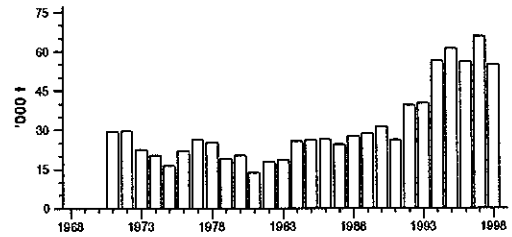


Table 3.13.3.c.1 Herring catches in Sub-division 30 (tonnes).

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	61317	1995	65527
1998*	52038	2777	54815

* 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. However, the actual SSB and fishing mortality are not known. Production models do not indicate major changes in spawning stock biomass in the available time series. The age composition of the catches is consistent with a stock which is not heavily exploited.

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

Advice on management: The advice given in 1995–1999 is maintained for 2000: "The stock is lightly 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 the lowest 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 1999 (ICES CM 1999/ACFM:15).

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	-	5.1
1999	Increase in yield by increasing F	-	
2000	Increase in yield by increasing F	-	

Weights in '000 t.

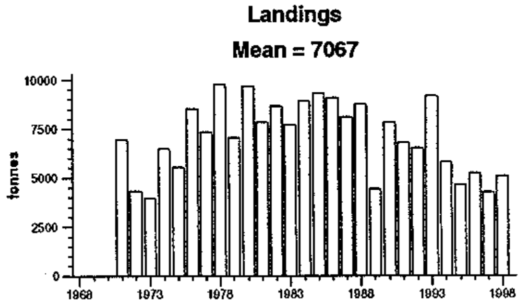


Table 3.13.3.d.1 Herring catches in Sub-division 31 (tonnes).

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
1998*	4867	224	5091

* preliminary.

3.13.4 Sprat in Sub-divisions 22–32

State of stock/fishery: The stock is considered to be harvested outside safe biological limits as defined by the proposed reference points. SSB has increased in recent years and in the middle of the 90s attained its historical maximum. Since then the SSB decreased sharply to 730 000 t although it is still well above the proposed $\mathbf{B_{pa}}$ (275 000 t). The estimates of fishing mortality doubled from 1996 to 1998 and are now 0.68 (nearly twice the proposed $\mathbf{F_{pa}} = 0.35$). The 1996 year class is estimated to be very poor while the 1997 year class is estimated to be strong. The 1998 year class is predicted to be very poor.

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

Advice on management: ICES recommends that fishing mortality should be decreased below the proposed $\mathbf{F_{pa}}$ of 0.35, corresponding to landings not exceeding 192 000 t in 2000. If this large reduction in F cannot be made in a single year, a plan should be implemented which reduces F to below the proposed $\mathbf{F_{pa}}$ in a series of steps.

Management strategies: Fishing mortality should be brought below the proposed $\mathbf{F_{pa}}$ of 0.35. This can be achieved in a few years by a reduction in catches. The earlier the fishing mortality is reduced below the proposed $\mathbf{F_{pa}}$ the higher catch reduction will have to be imposed. The table below presents the years in which the fishing mortality would be lower than the proposed $\mathbf{F_{pa}}$ with given probability, if catches has been reduced by certain percent every year since 2000. In the simulation it was assumed that the catch in 1999 will be 428 000 t.

Year in which fishing mortality is less than the proposed F_{pa} with given probability

Probability of F<proposed $\mathbf{F_{pa}}$	Catch reduction: 15% every year	Catch reduction: 25% every year	Catch reduction:30% every year
> 50%	2004	2002	2001
> 90%	2007	2004	2003

Catches in the year of F falling below the proposed F_{pa}

Probability of F<proposed $\mathbf{F_{pa}}$	Catch reduction: 15% every year	Catch reduction: 25% every year	Catch reduction:30% every year
> 50%	190	181	210
> 90%	117	102	103

Reference points:

ICES considers that:	**ICES proposes that:**
$\mathbf{B_{lim}}$ is 200 000 t	$\mathbf{B_{pa}}$ be set at 275 000 t
$\mathbf{F_{lim}}$ is not yet defined	$\mathbf{F_{pa}}$ be set at 0.35

Technical basis:

$\mathbf{B_{lim}}$: MBAL	$\mathbf{B_{pa}}$: $\mathbf{B_{lim}}$*1.38; some sources of uncertainty in assessment taken into account
$\mathbf{F_{lim}}$: –	$\mathbf{F_{pa}}$: $\mathbf{F_{med}}$

Relevant factors to be considered in management: The poor 1996 and 1998 year classes are an important consideration in the selection of a multi year strategy for returning fishing mortality to the proposed $\mathbf{F_{pa}}$. The strong 1997 year class has already supported relatively large catches in 1997 and 1998 and is expected to contribute substantially to catches in 1999. A slow reduction in catches may deplete this one strong year class somewhat more quickly than was observed for the strong 1994 and 1995 year classes, limiting options available to managers in subsequent years.

The fishing mortality this stock can sustain is dependent on natural mortality, which is linked to the abundance of cod. Strong recruitments and low predation in recent years contributed to the high SSB in the mid-1990s. However the SSB is predicted to decrease markedly in the medium term under present fishing intensity. If the cod stock recovers a much lower exploitation rate on sprat is implied.

This year's estimate of the proposed $\mathbf{F}_{pa}$ (0.35) differs from the estimate provided by ICES in 1998 (0.42). The reason for this difference is higher estimates of sprat natural mortality in most recent years provided by the latest MSVPA and a decreasing mean weight at age. As a result the stock can sustain lower fishing mortality.

Catch forecast for 2000: Basis: F(99) = F(98)=0.67, Landings(99) = 428, SSB(99) = 705.

F (2000)	Basis	Landings (2000)	SSB (2000)	SSB (2001)	Medium-term effect of fishing at given level
0.27	0.4F(98)	149	599	652	High probability of SSB being above the proposed $\mathbf{B}_{pa}$
0.35	Proposed $\mathbf{F}_{pa}$	192	583	600	High probability of SSB being above the proposed $\mathbf{B}_{pa}$
0.40	0.6F(98)	214	573	578	High probability of SSB being above the proposed $\mathbf{B}_{pa}$
0.67	1.0F(98)	326	526	458	About 10% probability of SSB being reduced below the proposed $\mathbf{B}_{pa}$

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

Forecast assuming catches in 1999 equal to catches in 1998:

Basis: Catch (99) = Catch(98), Landings (98) = 470, SSB(98) = 731

F (2000)	Basis	Lndgs (2000)	SSB (2000)	SSB (2001)
0.67	F(98)	309	495	438

Weights in '000 t.

In the above predictions the spawning stock will decrease below 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 450 000 t SSB (Figure 3.13.4.1). The SSB of 450 000 t is higher than the preliminary estimate of a proposed $\mathbf{B}_{pa}$ of 275 000 t. However, there is about 10% probability of SSB falling below the proposed $\mathbf{B}_{pa}$ in the medium term.

The trajectories of medium-term forecasts (Figure 3.13.4.1) and the schedule for achieving the advised reduction in F (see management strategies table) assume there is a relationship between recruitment and SSB. Because SSB at the start of the forecasts is relatively high, the trajectories assume poor year classes will be relatively unlikely. If SSB continues to drop in the short term, or if the recent poor year classes in 1996 and 1998 reflect a trend towards poorer recruitment, lower trajectories in Figure 3.13.4.1 may be more likely than those which are forecasted. Fisheries in 2001 and onwards will depend very heavily on the recruitment (Figure 3.13.4.2).

Elaboration and special comment: The assessment is based on catch data and acoustic surveys. Intensive sampling of industrial fisheries has improved the quality of the data input to the assessment.

Landings increased from 1983, reaching a record high in 1997. In 1998 landings decreased as a result of decreasing weight at age although the numbers caught were comparable in 1998 and 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.

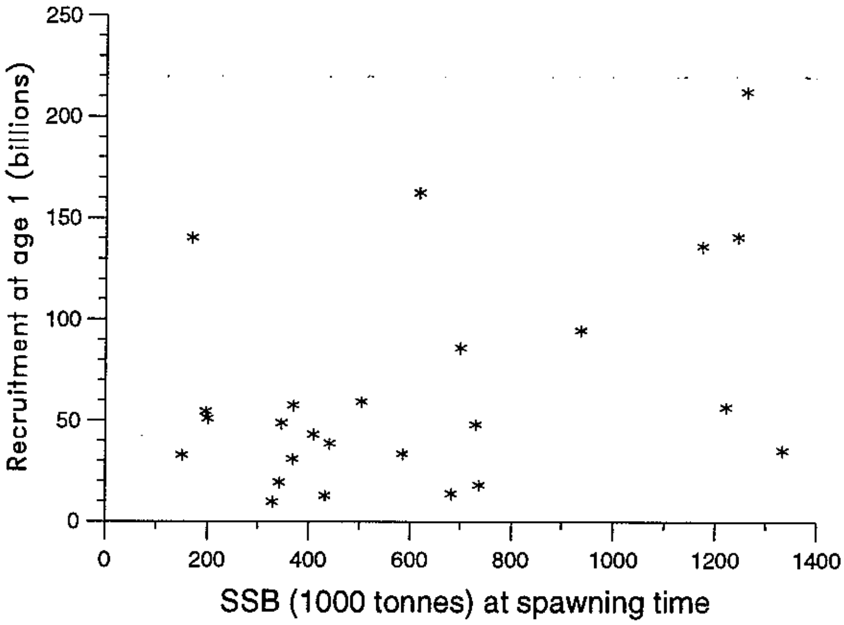
Source of information: Report of the Working Group on Baltic Fisheries Assessment, April 1999 (ICES CM 1999/ACFM:15.

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	471
1999	Proposed $\mathbf{F}_{pa}$ (= 0.42)	304	467.5	
2000	Proposed $\mathbf{F}_{pa}$ (= 0.35)	192		

Weights in '000 t.

Stock - Recruitment



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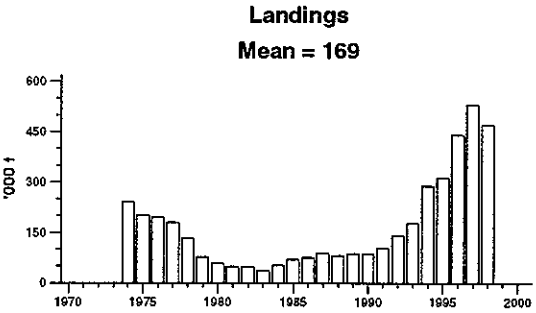
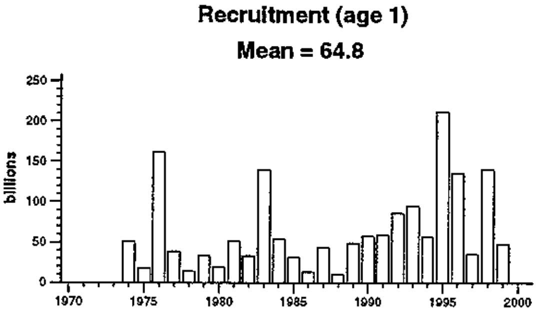
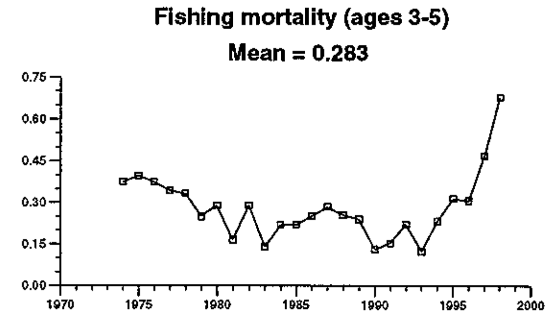
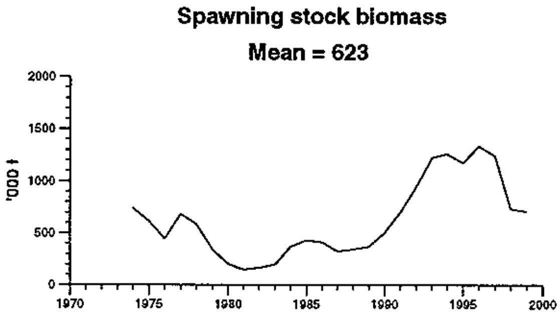
Sprat in Sub-divisions 22–32

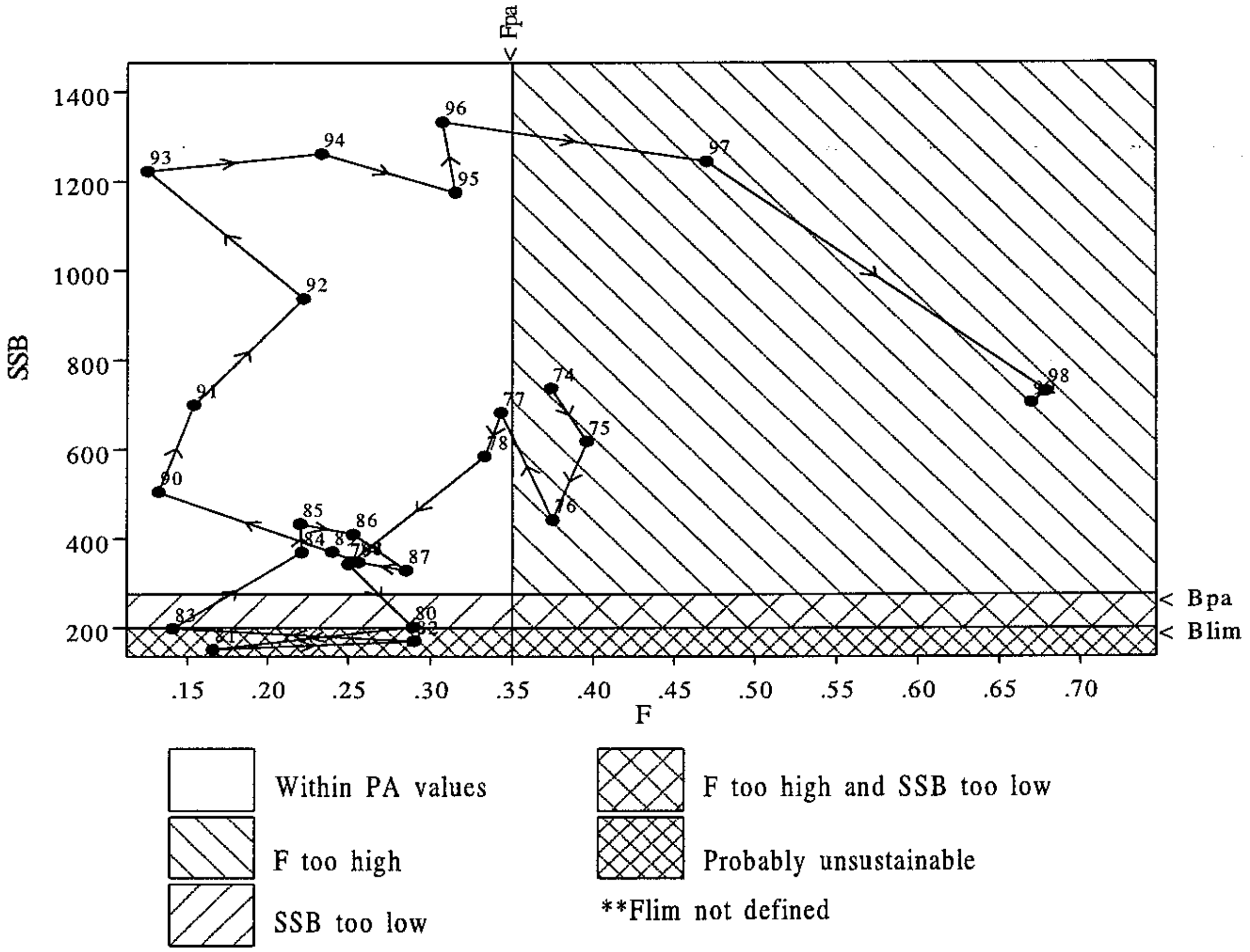








Sprat in Sub-divisions 22 to 32



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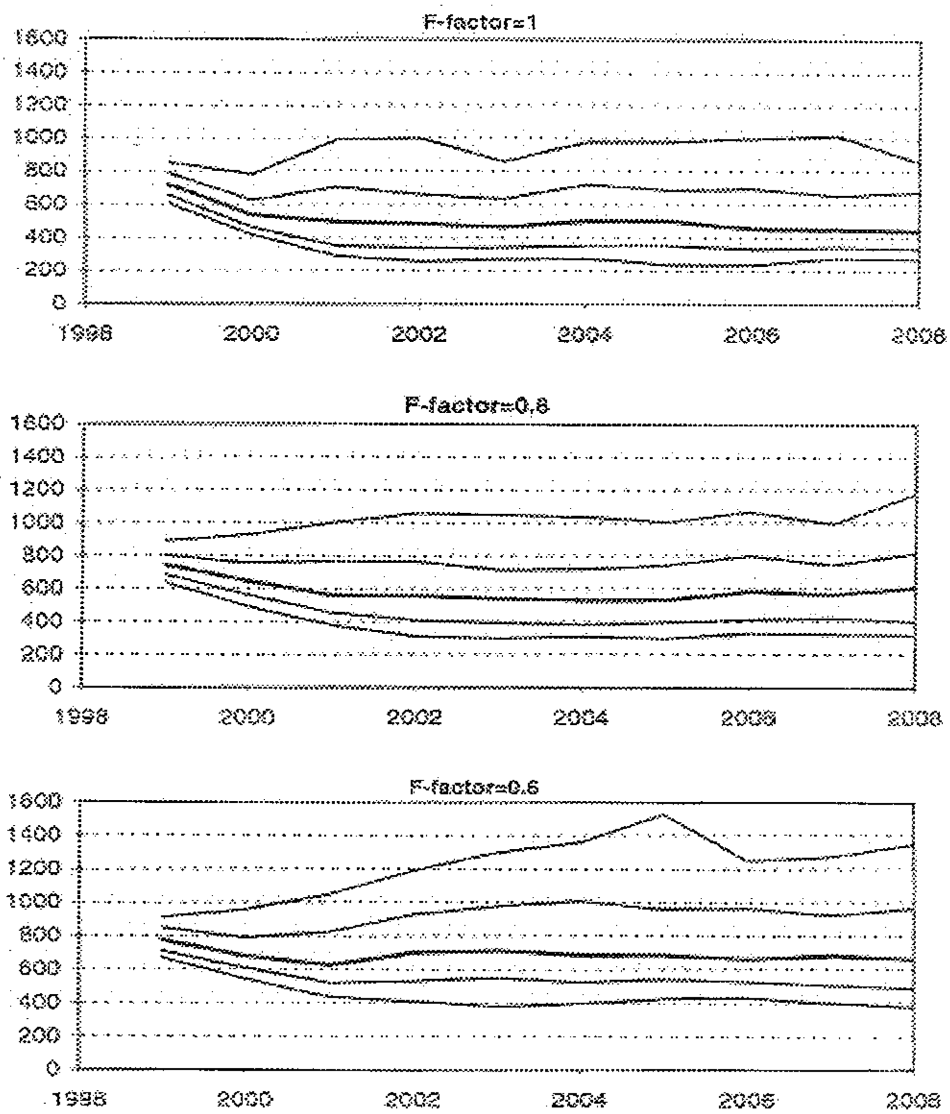


Figure 3.13.4.1 Sprat in Sub-divisions 22–32. Medium term projections of SSB.
F=1 refers to *status quo* fishing mortality (=.68).
Fishing pattern: 1996–1998 mean.

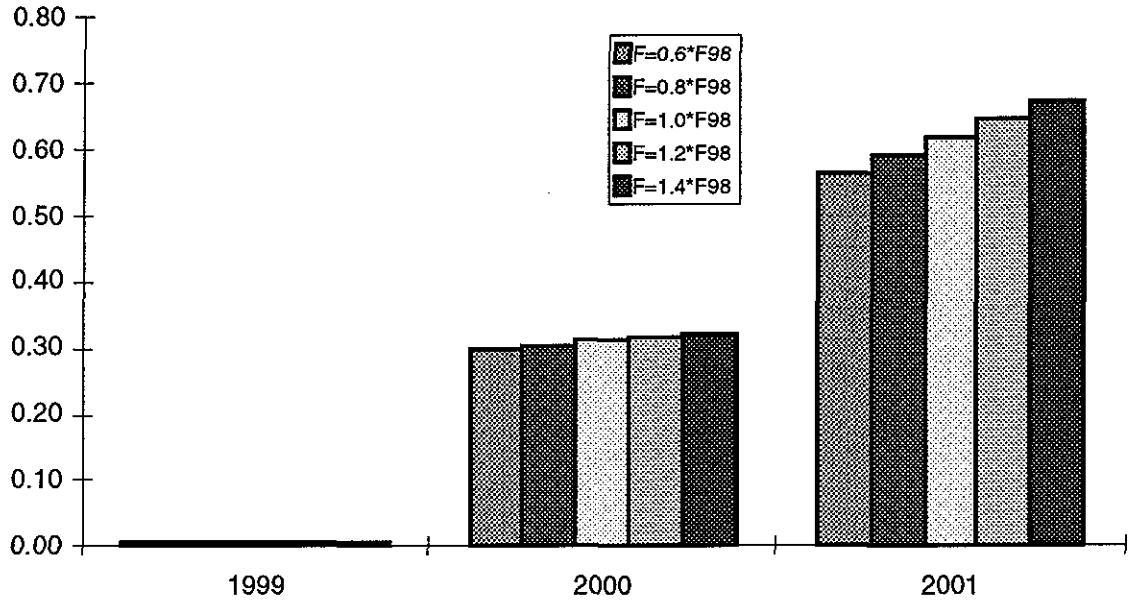


Figure 3.13.4.2 SPRAT in SD 22–32. The contribution (fraction) of the year class estimated by RCT3 (1998 y.c.) and year classes with assumed strength (1999 and 2000 y.c.) to the projected catches for different levels of F in 1999, 2000 and 2001.

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
1998	91.8	32.3	25.7	4.6	44.9	4.5	55.1	20.9	191.1	470.8

* 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 1997

Country	Total catch	22	24	25	26	27	28	29	30	31	32
Denmark	**137.42**	8.06	0.78	128.59	-	-	-	-	-	-	-
Estonia	**38.95**	-	-	-	-	-	3.32	17.73	-	-	17.90
Finland	**24.38**	-	0.50	3.80	2.00	0.10	0.80	10.33	2.35	0.00	4.50
Germany	**0.43**	0.40	0.03	-	-	-	-	-	-	-	-
Latvia	**49.31**	-	-	-	3.63	-	45.68	-	-	-	-
Lithuania	**4.79**	-	-	-	4.79	-	-	-	-	-	-
Poland	**99.86**	-	1.11	33.25	65.50	-	-	-	-	-	-
Russia	**22.37**	-	-	-	22.37	-	-	-	-	-	-
Sweden	**151.86**	-	2.59	38.03	26.86	45.15	30.50	8.73	-	-	-
Total	529.37	**8.46**	**5.01**	**203.66**	**125.16**	**45.25**	**80.30**	**36.79**	**2.35**	**0.00**	**22.40**

Year 1998

Country	Total catch	22	24	25	26	27	28	29	30	31	32
Denmark	**91.85**	2.45	0.92	88.48	-	-	-	-	-	-	-
Estonia	**32.27**	-	-	-	-	-	4.36	12.52	-	-	15.40
Finland	**25.66**	-	0.60	3.03	0.14	0.88	1.54	10.02	2.34	0.04	7.08
Germany	**4.56**	0.03	0.51	3.84	0.18	-	-	-	-	-	-
Latvia	**44.86**	-	-	-	12.32	-	32.54	-	-	-	-
Lithuania	**4.46**	-	-	-	4.46	-	-	-	-	-	-
Poland	**55.09**	-	0.29	25.96	28.83	-	-	-	-	-	-
Russia	**20.95**	-	-	-	20.95	-	-	-	-	-	-
Sweden	**191.08**	-	3.82	51.75	24.46	88.90	14.78	7.38	-	-	-
Total	470.77	**2.48**	**6.13**	**173.05**	**91.34**	**89.78**	**53.22**	**29.91**	**2.34**	**0.04**	**22.48**

Table 3.13.4.3 Sprat in Sub-divisions 22–32.

Year	Recruitment Age 1	Spawning Stock Biomass	Landings	Fishing Mortality Age 3-5
1974	50,780.60	736.75	241.70	0.374
1975	17,962.40	617.65	201.43	0.396
1976	162,506.00	441.80	194.78	0.375
1977	38,552.60	682.02	180.80	0.343
1978	13,749.90	584.62	132.36	0.333
1979	33,383.20	342.57	77.10	0.250
1980	19,338.00	201.19	58.10	0.289
1981	50,845.60	150.72	49.30	0.166
1982	32,825.00	169.62	48.70	0.290
1983	140,196.00	197.76	37.32	0.141
1984	54,214.60	368.98	52.56	0.221
1985	30,877.00	432.30	69.50	0.220
1986	12,831.00	409.67	75.80	0.253
1987	43,077.00	328.69	88.28	0.285
1988	9,698.86	347.01	80.30	0.256
1989	48,665.40	370.00	85.82	0.240
1990	57,501.70	504.25	85.58	0.132
1991	59,186.80	699.78	103.20	0.154
1992	85,866.40	937.47	142.20	0.222
1993	94,516.60	1,222.12	178.10	0.125
1994	56,438.70	1,260.73	288.70	0.233
1995	212,107.00	1,174.60	313.00	0.315
1996	136,089.00	1,332.64	441.10	0.307
1997	35,200.30	1,244.35	529.40	0.470
1998	140,574.00	730.81	470.77	0.679
1999	47,870.00	704.56	.	.
Average	64,802.06	622.79	169.04	0.283
Unit	Millions	1000 tonnes	1000 tonnes	-

3.13.5 Cod

3.13.5.a Cod in Sub-divisions 22–24 (including Sub-division 23)

State of the stock/fishery: The stock is being harvested outside safe biological limits. The present fishing mortality (average 1996–98) is about 1.3 per year and above candidate values for $\mathbf{F}_{pa}$ currently under discussion. SSB is estimated to be 26 200 t in 1999 above the proposed $\mathbf{B}_{pa}$ (23 000 t).

The stock has rebuilt from low SSB in the early 1990s as a result of strong recruitment especially from the 1994 and 1996 year classes. The 1997 year class appears very strong and the 1998 year class appears strong and may contribute to rebuilding the SSB in the future. The ability of the stock to produce strong year classes despite the very high fishing mortality suggests that the stock interact with adjacent stocks by way of recruitment dispersal and/or migration.

Management objectives: There are no explicit management objectives for this stock. However, for any management objective to meet the proposed precautionary criteria, F should be less than the proposed $\mathbf{F}_{pa}$ and spawning stock biomass should be maintained above the proposed $\mathbf{B}_{pa}$.

IBSFC is at the moment in the process of defining explicit management objectives for this stock. A meeting in the IBSFC Working Group on Long Term Management Objectives and Strategies for Cod, Herring, and Sprat took place in Visby, Sweden, in April 1999 and proposals on F and B reference points from this meeting will be considered at the regular IBSFC meeting in September 1999.

Advice on management: In the absence of an agreed $\mathbf{F}_{pa}$, ICES recommends that fishing mortality in 2000 be reduced by 20% from its 1996-1998 value, corresponding to a catch of 44 600 t.

Reference points: ACFM (May, 1998) proposed the previously established MBAL (23 000 t) as $\mathbf{B}_{pa}$ and proposed to base $\mathbf{B}_{lim}$ on the historical low SSB. As the latter value is found in the years where the catch data are considered unreliable, the proposed value by ACFM in 1998 of 9 000 t is withdrawn as the $\mathbf{B}_{lim}$. As there is doubt whether the assessment reflects actual mortality on the western Baltic cod, an $\mathbf{F}_{pa}$ should therefore be discussed with relevant management bodies.

Relevant factors to be considered in management: The catch forecast is highly sensitive to the estimated size of the 1997 and 1998 year classes which account for about 80% of the yield in 2000 and about 80% of the SSB in 2001. The fishery is largely based on recruiting year classes and improvements in the exploitation pattern would benefit the SSB.

Catch forecast. As a result of the high fishing mortality SSBs and yield is narrowly dependent on ages 2–4. The estimates of the size of the year classes attaining these ages in the forecast are uncertain being based on partly recruited fish or solely on research survey information. To account for the uncertainties the year class sizes of the recruiting year classes were reduced to their lower confidence limits.

Catch forecast for 2000: Basis: F(99) = F(96–98) = 1.33, Landings (99) = 52 700, SSB(2000) = 32 100, SSB(99)=26 200

F (2000)	Basis	Landings (2000)	SSB (2001)	Medium-term effect of fishing at given level
0.8	0.6F(96–98)	36 700	37 500	High probability of SSB being above the proposed $\mathbf{B}_{pa}$
1.06	0.8F(96–98)	44 600	30 600	About 50% probability of SSB being below the proposed $\mathbf{B}_{pa}$
1.33	1.0F(96–98)	51 000	25 200	High probability of SSB being below the proposed $\mathbf{B}_{pa}$
1.6	1.2F(96–98)	56 200	20 900	High probability of SSB being below the proposed $\mathbf{B}_{pa}$
1.86	1.4F(96–98)	60 600	17 500	High probability of SSB being below the proposed $\mathbf{B}_{pa}$

Weights in t.
Shaded scenario considered inconsistent with the precautionary approach.

If the 1999 landings correspond to the advice of 38 000 t, landings in the year 2000 and SSB in 2001 are predicted to be 25% and 20% respectively above the catch and SSB corresponding to *status quo* 1999 fishing mortality.

Elaboration and special comment: From 1965 to 1985 the landings varied between 40 000-50 000 t to decrease to values below 20 000 t in the period 1989-1992. Since then catches have fluctuated in the range 34 000-51 000 t. For the period 1992-1994 landings are uncertain due to incomplete reporting, however, the data quality has improved significantly since then.

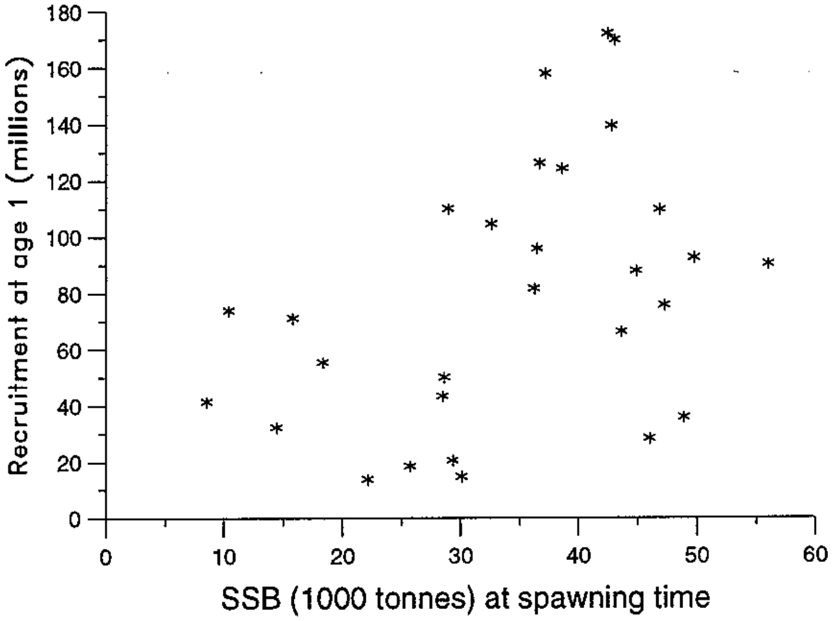
Source of information: Report of the Baltic Fisheries Assessment Working Group, April 1999 (ICES CM 1999/ACFM:15, Technical Minutes of ACFM, May 1999.

Catch data (Tables 3.13.5.a.1+3):

Year	ICES Advice	Predicted catch Corresp. to advice	Agreed TAC[1]	ACFM Catch (22–24)	ACFM Catch (22–32)
1987	TAC	9		29	236
1988	TAC	16		29	223
1989	TAC	14	220	19	198
1990	TAC	8	210	18	171
1991	TAC	11	171	17	140
1992	Substantial reduction in F	-	100	18	73[2]
1993	F at lowest possible level	-	40	21	66[2]
1994	TAC	22	60	31	124[2]
1995	30% reduction in fishing effort from 1994 level	-	120	34	142[2]
1996	30 % reduction in fishing effort from 1994 level	-	165	51	173
1997	Fishing effort should not be allowed to increase above level in recent years	-	180	44	132
1998	20% reduction in F from 1996	35	160	34	102
1999	At or below F_{sq} with 50% probability	38	126		
2000	Reduce F by 20%	44.6			

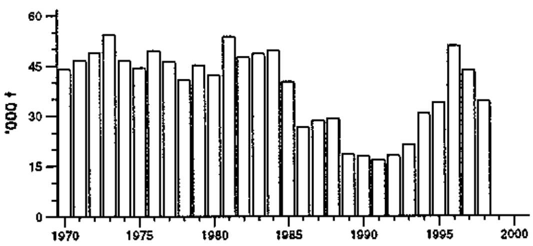
[1] Included in TAC for total Baltic. [2]The reported landings in 1992–1995 are known to be incorrect due to incomplete reporting. Weights in '000 t.

Stock - Recruitment

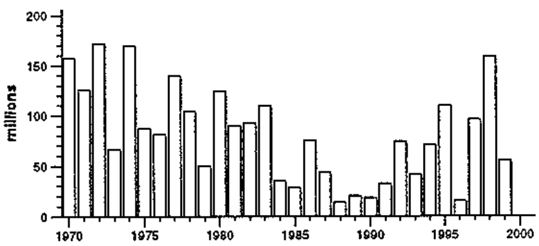


(run: XSAHS09)

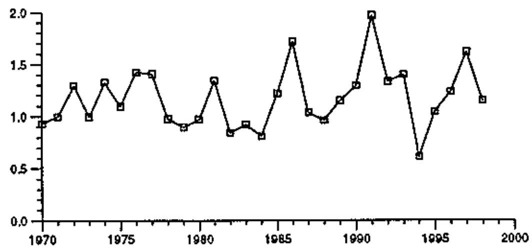
Landings
Mean = 38.5



Recruitment (age 1)
Mean = 81.9



Fishing mortality (ages 3-6)
Mean = 1.17



Spawning stock biomass
Mean = 33.9

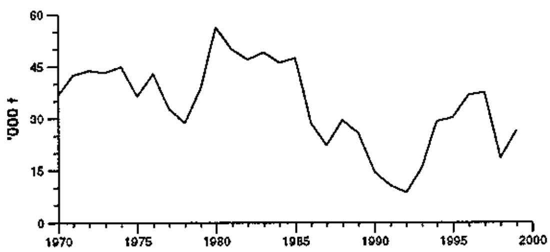


Table 3.13.5.a.1 Total landings (t) of COD in Sub-divisions 22, 23, 24.

Year	Denmark		Finland	Germ. Dem. Rep.	Germ., Fed. Rep.	Estonia	Latvia	Poland	Sweden		Total					22-24 +Unallocated
	23	22+24	24	22+24	22+24	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	49,433
1977	1,166	27,939		3,448	11,686				550	1,516	29,510	1,716	15,079		44,589	46,305
1978	1,177	19,168		7,085	10,852				600	1,730	24,232	1,777	14,603		38,835	40,612
1979	2,029	23,325		7,594	9,598				700	1,800	26,027	2,729	16,290		42,317	45,046
1980	2,425	23,400		5,580	6,657				1,300	2,610	22,881	3,725	15,366		38,247	41,972
1981	1,473	22,654		11,659	11,260				900	5,700	26,340	2,373	24,933		51,273	53,646
1982	1,638	19,138		10,615	8,060				140	7,933	20,971	1,778	24,775		45,746	47,524
1983	1,257	21,961		9,097	9,260				120	6,910	24,478	1,377	22,750		47,228	48,605
1984	1,703	21,909		8,093	11,548				228	6,014	27,058	1,931	20,506		47,564	49,495
1985	1,076	23,024		5,378	5,523				263	4,895	22,063	1,339	16,757		38,820	40,159
1986	748	16,195		2,998	2,902				227	3,622	11,975	975	13,742		25,717	26,692
1987	1,503	13,460		4,896	4,256				137	4,314	12,105	1,640	14,821		26,926	28,566
1988	1,121	13,185		4,632	4,217				155	5,849	9,680	1,276	18,203		27,883	29,159
1989	636	8,059		2,144	2,498				192	4,987	5,738	828	11,950		17,688	18,516
1990	722	8,584		1,629[2]	3,054				120	3,671	5,361	842	11,577		16,938	17,780
1991	1,431	9,383			2,879				232	2,768	7,184	1,663	7,846		15,030	16,693
1992	2,449	9,946			3,656				290	1,655	9,887	2,739	5,370		15,257	17,996
1993	1,001	8,666			4,084				274	1,675	7,296	1,275	7,129	5,528	14,425	21,228
1994	1,073	13,831			4,023				555	3,711	8,229	1,628	13,336	7,502	21,565	30,695
1995	2,547	18,762	132		9,196		15		611	2,632	16,936	3,158	13,801		30,737	33,895
1996	2,999	27,946	50		12,018	50	32		1,032	4,418	21,417	4,031	23,097	2,300	44,514	50,845
1997	1,886	28,887	11		9,269	6		263	777	2,522	21,966	2,663	18,991		40,957	43,624
1998[1]	2,467	19,192	5		9,722	8	13	623	607	1,571	15,093	3,074	16,041		31,134	34,208

[1]Provisional data. [2]Includes landings from Oct.-Dec. 1990 of Fed.Rep.Germany.

Table 3.13.5.a.2. Medium-term projections: Cod 22-24
Spawning stock biomass (tonnes)
Fishing pattern: mean 1996-98 (age groups 1-7+), F-factors 0.6-1.4
F=1 refers to status quo fishing mortality (=1.33).

F-factor=0.6

Fractiles	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
10%	23000	37000	40000	30000	24000	21000	22000	20000	20000	20000
25%	25000	41000	43000	34000	29000	29000	31000	32000	34000	31000
50%	26000	44000	47000	40000	39000	43000	43000	50000	48000	48000
75%	28000	49000	52000	51000	64000	67000	71000	77000	79000	77000
90%	30000	52000	57000	67000	92000	119000	113000	127000	114000	114000

F-factor=0.8

Fractiles	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
10%	23000	31000	29000	20000	14000	12000	12000	10000	9000	7000
25%	25000	34000	31000	22000	18000	17000	16000	14000	12000	12000
50%	26000	37000	34000	26000	24000	27000	25000	24000	24000	21000
75%	28000	40000	37000	34000	36000	43000	40000	41000	43000	39000
90%	31000	44000	41000	44000	61000	58000	64000	65000	68000	73000

F-factor=1.0

Fractiles	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
10%	23000	28000	21000	12000	8000	7000	5000	4000	4000	3000
25%	24000	30000	23000	15000	12000	10000	8000	7000	6000	6000
50%	26000	32000	26000	19000	18000	16000	15000	13000	12000	12000
75%	28000	35000	29000	26000	30000	30000	26000	23000	22000	22000
90%	30000	38000	34000	36000	48000	47000	42000	45000	39000	41000

F-factor=1.2

Fractiles	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
10%	22000	23000	16000	8000	5000	5000	3000	3000	2000	2000
25%	24000	25000	18000	10000	8000	6000	6000	4000	3000	3000
50%	26000	27000	20000	15000	14000	11000	9000	8000	7000	6000
75%	28000	30000	23000	22000	22000	19000	16000	15000	15000	13000
90%	30000	32000	25000	38000	36000	27000	29000	28000	26000	24000

F-factor=1.4

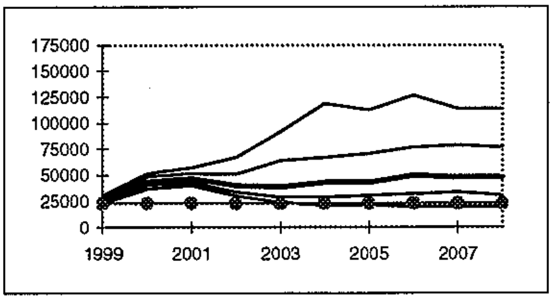
Fractiles	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
10%	22000	20000	12000	6000	3000	3000	2000	1000	1000	0
25%	24000	21000	14000	8000	6000	4000	3000	2000	1000	1000
50%	26000	23000	16000	11000	10000	7000	6000	4000	3000	3000
75%	28000	26000	18000	16000	15000	11000	10000	8000	7000	5000
90%	30000	28000	21000	26000	23000	19000	17000	17000	12000	12000

Table 3.13.5.a.3 Cod in Sub-divisions 22 to 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	124.04	56.10	41.97	0.966
1981	90.19	49.80	53.65	1.340
1982	92.47	46.93	47.52	0.840
1983	109.59	48.93	48.61	0.917
1984	35.63	46.05	49.50	0.806
1985	28.15	47.30	40.16	1.215
1986	75.62	28.49	26.69	1.712
1987	43.35	22.16	28.57	1.034
1988	13.73	29.33	29.16	0.958
1989	20.40	25.71	18.52	1.144
1990	18.40	14.46	17.78	1.290
1991	32.20	10.45	16.69	1.964
1992	73.77	8.57	18.00	1.330
1993	41.37	15.85	21.23	1.397
1994	71.08	28.96	30.70	0.606
1995	109.89	30.07	33.90	1.038
1996	14.68	36.53	50.85	1.230
1997	95.75	37.25	43.62	1.614
1998	157.85	18.38	34.21	1.148
1999	55.34	26.21	.	.
Average	81.92	33.92	38.53	1.168
Unit	Millions	1000 tonnes	1000 tonnes	-

Figure 3.13.5.a.1. Medium-term projections of SSB. F=1 refers to status quo fishing mortality (=1.33)
Fishing pattern: 1996-1998 mean
Lines present 10, 25, 50, 75 and 90 percentile of biomass distribution
Cod 22-24

F=0.6



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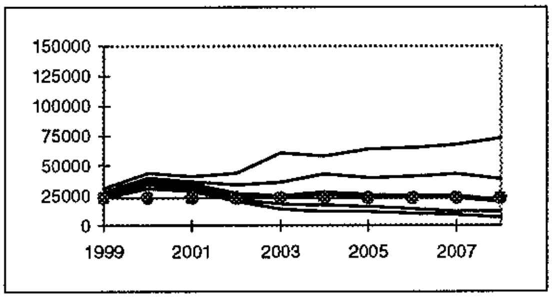
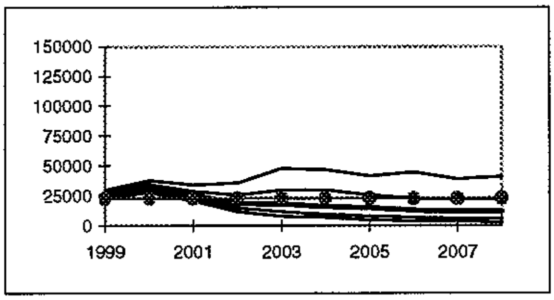
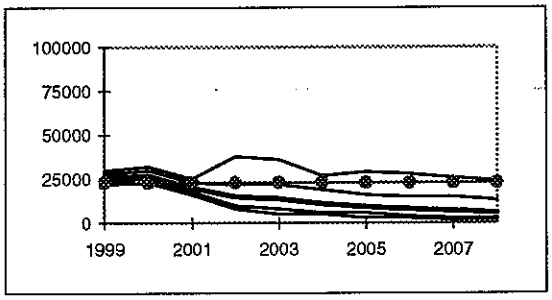


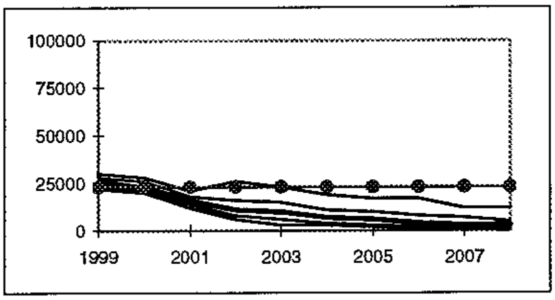
F=1.0



F=1.2



F=1.4



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. Interpretation of assessment results is impeded by disputable catch statistics for the years 1992–1995. The presently estimated SSB of 139 000 t is the second lowest observed when exempting that period and below $\mathbf{B_{lim}}$. The fishing mortality of 0.82 is above the proposed $\mathbf{F_{pa}}$.

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

IBSFC is in the process of defining explicit management objectives for this stock. A meeting of the IBSFC Working Group on Long Term Management Objectives and Strategies for Cod, Herring, and Sprat was held in Visby, Sweden, in April 1999 and proposals on F and B reference points from this meeting will be considered at the ordinary IBSFC meeting in September 1999.

Advice on management: ICES recommends a reduction in the fishing mortality by 40% from the 1996–98 value corresponding to landings of less than 60 000 t in 2000 in order to increase the SSB above $\mathbf{B_{lim}}$ in the short term. In order to allow SSB to rise to above the proposed $\mathbf{B_{pa}}$ in the medium term, a recovery plan should be developed.

Management scenarios: Fishing mortality should be brought below the proposed $\mathbf{F_{pa}}$ = 0.6, and more urgently due to the spawning stock biomass being below the proposed $\mathbf{B_{pa}}$ (currently estimated at 240 000 t).

A recovery plan could be based on scenarios presented below.

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 2000 needed to reach the proposed $\mathbf{B_{pa}}$ (240 000 t) in different time spans and with different probabilities. $\mathbf{F_{sq}}$ equal to 0.92 per year.

	Year in which SSB> 240 000 t								
Probability of SSB> 240 Kt	2001			2003			2005		
	Catch 2000	f*$\mathbf{F_{sq}}$	$\mathbf{F_{2000}}$	Catch 2000	f* $\mathbf{F_{sq}}$	$\mathbf{F_{2000}}$	Catch 2000	f* $\mathbf{F_{sq}}$	$\mathbf{F_{2000}}$
> 50%	9.6	0.08	0.075	56.7	0.56	0.52	59.6	0.59	0.55
> 90%	Not attainable			45.3	0.43	0.40	48.6	0.47	0.43

Reference points:

ICES considers that:	ICES proposes that:
$\mathbf{B_{lim}}$ is 160 000 t	$\mathbf{B_{pa}}$ be set at 240 000 t
$\mathbf{F_{lim}}$ is 0.96	$\mathbf{F_{pa}}$ be set at 0.6

Technical basis:

$\mathbf{B_{lim}}$: SSB below which recruitment is impaired	$\mathbf{B_{pa}}$: MBAL
$\mathbf{F_{lim}}$: $\mathbf{F_{med}}$98	$\mathbf{F_{pa}}$: 5 percentile of $\mathbf{F_{med}}$

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 (e.g., volume of water with high salinity and high oxygen content). Since the early 1980s fewer and smaller influxes of saline North Sea water were observed than in earlier years. This is reflected in the recruitment pattern, with 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. Even though it is not possible to predict exactly theses environmental changes, they need to be taken into account to ensure that SSB does not become further depleted during the current period of low recruitment.

Catch forecast for 2000: Basis: F(99)=F(96–98)=0.92, Landings (99)=89 000, SSB(2000)=141 000,SSB(99)=139 000.

F (2000)	Basis	Landings (2000)	SSB (2001)	Medium-term effect of fishing at given level
.37	0.4*F(98)	43,000	189,000	High probability of SSB increasing above the proposed $\mathbf{B}_{pa}$
.55	0.6*F(98)	60,000	169,000	About 25% probability of SSB increasing above the proposed $\mathbf{B}_{pa}$
F_{pa} = 0.6	0.65*F(98)	64,000	164,000	High probability of SSB remaining below the proposed $\mathbf{B}_{pa}$
.74	0.8*F(98)	75,000	151,000	High probability of SSB remaining below the proposed $\mathbf{B}_{pa}$
.92	1.0*F(98)	89,000	136,000	High probability of SSB remaining below the proposed $\mathbf{B}_{pa}$
1.1	1.2*F(98)	100,000	123,000	High probability of SSB remaining below the proposed $\mathbf{B}_{pa}$
1.29	1.4*F(98)	111,000	111,000	High probability of SSB remaining below the proposed $\mathbf{B}_{pa}$

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 1992–1995 are known to be incorrect due to incomplete reporting. 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 since and it was considered that there were no unallocated landings. Cannibalism is not considered to be a major source of mortality at current stock sizes.

This assessment estimates the SSB to be substantially lower and fisheries mortality higher from the 1998 assessment. This change in the perception of the stock results largely from the recent low survey index values and the progressive reduction of the effects of the under-reported catches in the early 1990s on the assessment.

Differences in cod ageing by countries are documented by intercalibration studies and are reflected in nationally estimated age distributions. The ambiguities in ageing imply additional uncertainties in the assessment results.

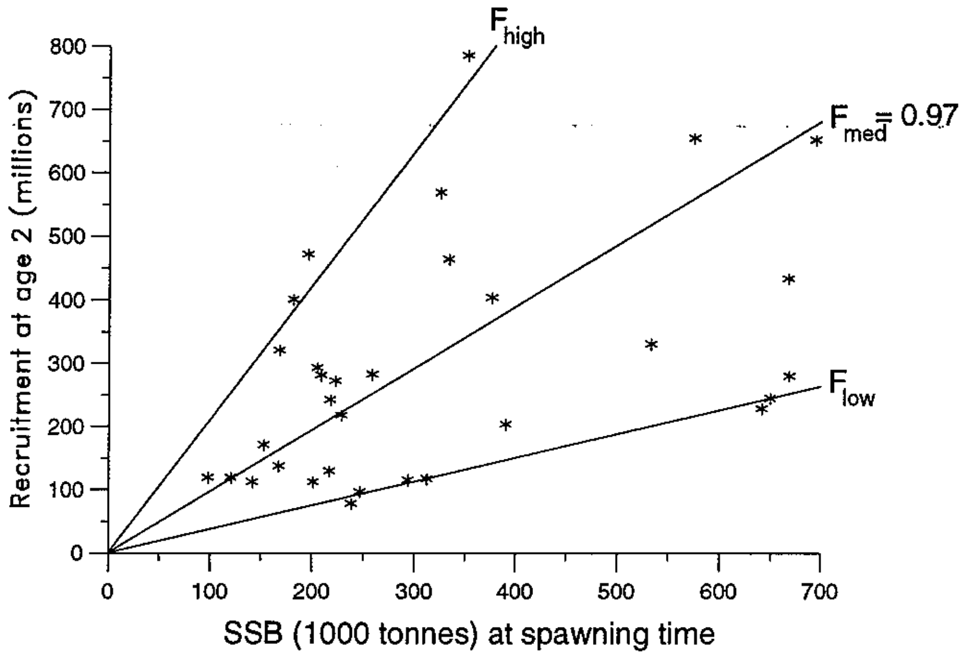
Source of information: Report of the Baltic Fisheries Assessment Working Group, April 1999 (ICES CM 1999/ACFM:15).

Catch data (Tables 3.13.5.b.2–3):

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC[1]	ACFM Catch (25–32)	ACFM Catch (22–32)
1987	Reduce towards F_{max}	245		207	236
1988	TAC	150		194	223
1989	TAC	179	220	179	198
1990	TAC	129	210	153	171
1991	TAC	122	171	123	140
1992	Lowest possible level	-	100	55[2]	73[2]
1993	No fishing	0	40	45[2]	66[2]
1994	TAC	25	60	93[2]	124[2]
1995	30% reduction in fishing effort from 1994 level	-	120	108[2]	142[2]
1996	30% reduction in fishing effort from 1994 level	-	165	122	173
1997	20% reduction in fishing mortality from 1995	130	180	89	132
1998	40% reduction in fishing mortality from 1996	60	140	67	102
1999	Proposed F_{pa} (= 0.6)	88	126		
2000	40% reduction in F from 96–98 level	60			

[1]For total Baltic. [2]The reported landings in 1992–1995 are known to be incorrect due to incomplete reporting. Weights in '000 t

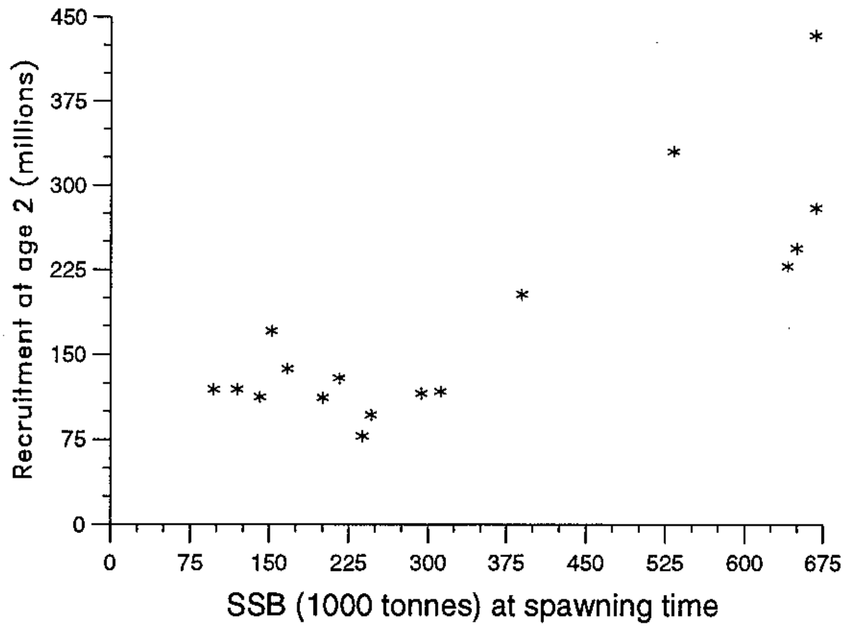
Stock - Recruitment



(run: XSAMAR11)

Stock Recruitment plot for all year classes 1966-1997

Stock - Recruitment



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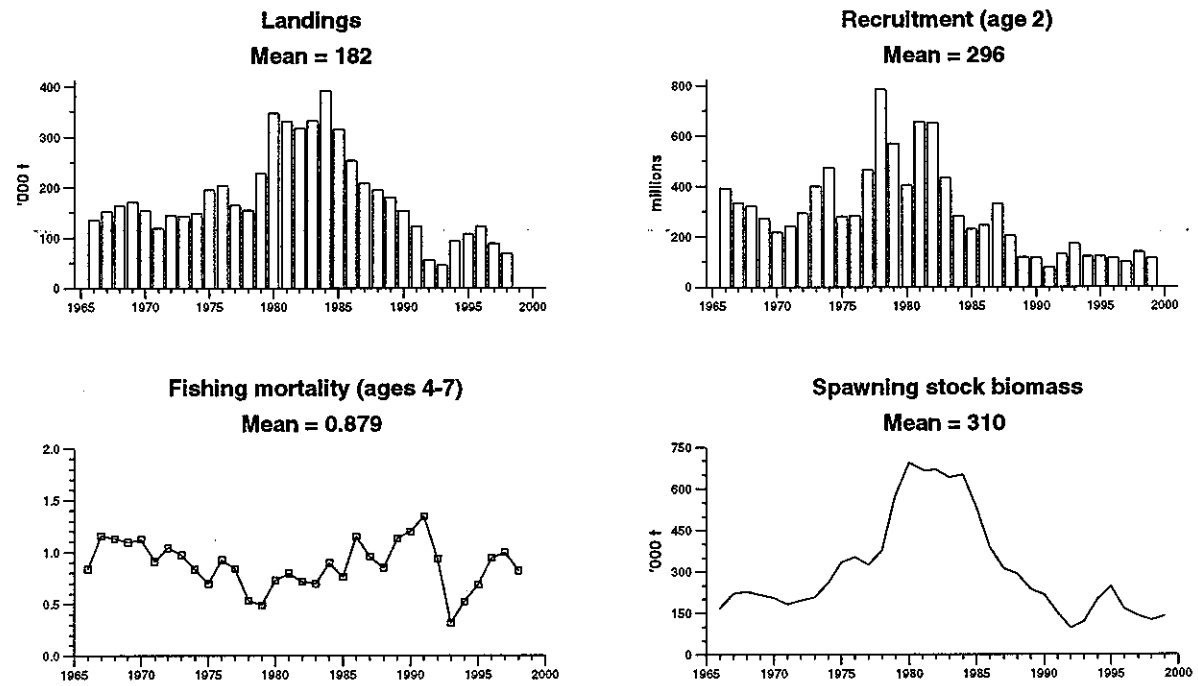
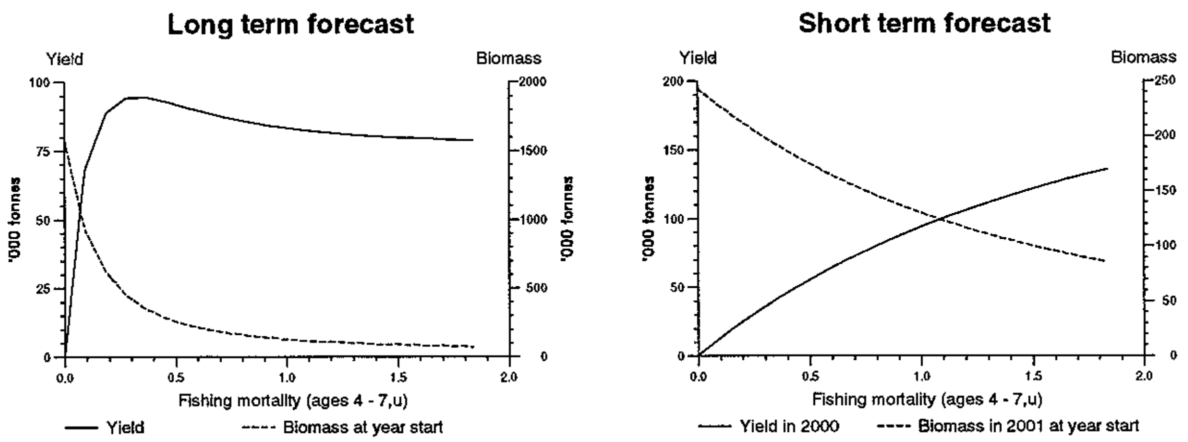
Stock recruitment plot for the year classes 1981–1997, which have been used in the medium-term projections

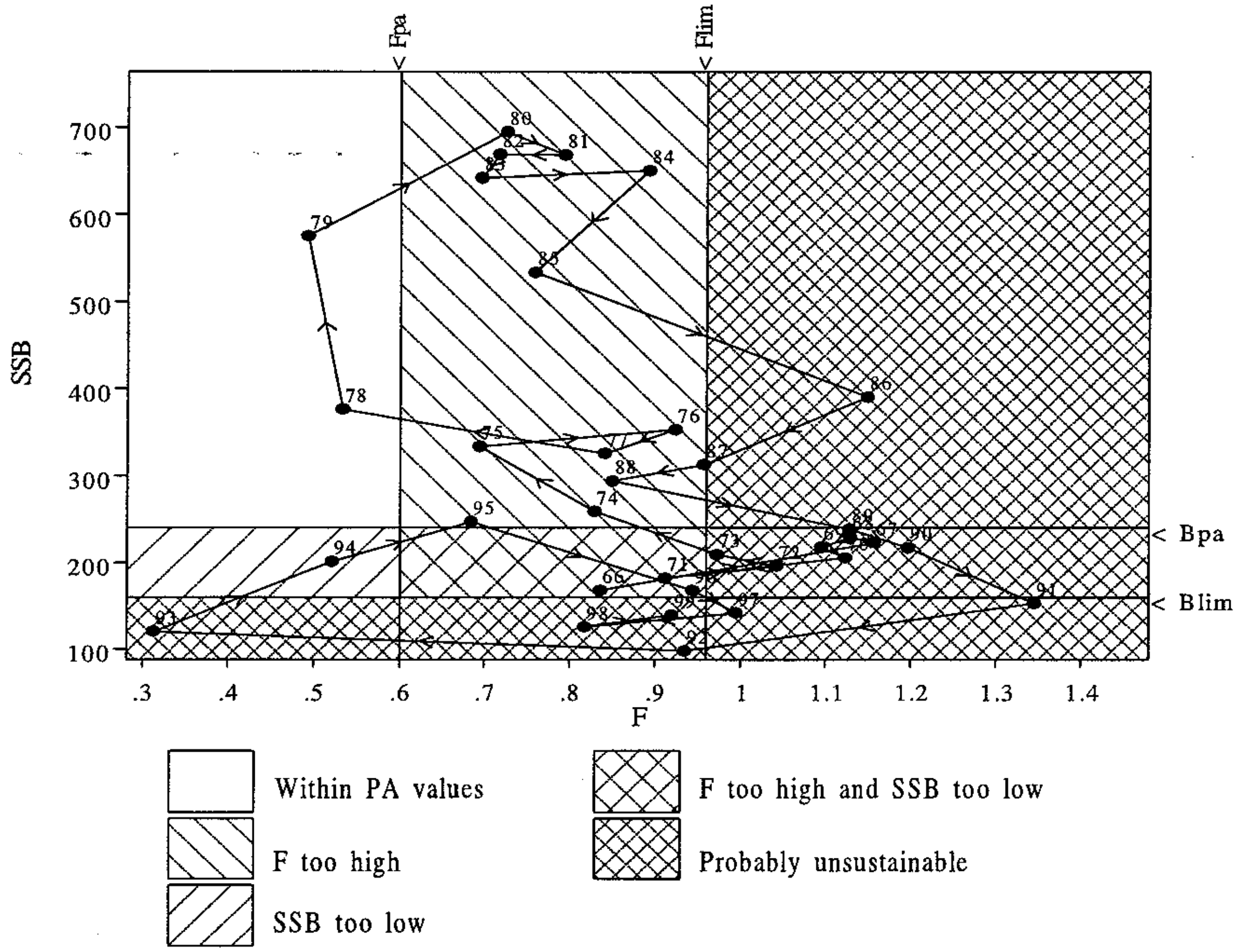


Cod in Sub-divisions 25–32

Yield and Spawning Stock Biomass



Cod in Sub-divisions 25 to 32

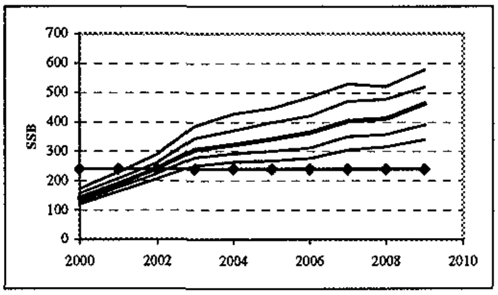


Data file(s):W:\Ifapdata\ifapexim\wgbfas\cod_2532\fin_papl.pa;*.sum
Plotted on 17/05/1999 at 16:08:38

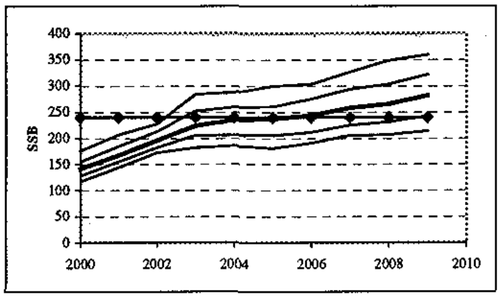
Medium-term projections of SSB ('000 t). F=1 refers to mean fishing mortality in 1996-1998 (F=0.92).
Lines show 10, 25, 50, 75, and 90 percentile of SSB distribution.
Horizontal line shows B_{pa} of 240,000 t.

Cod in Sub-divisions 25-32

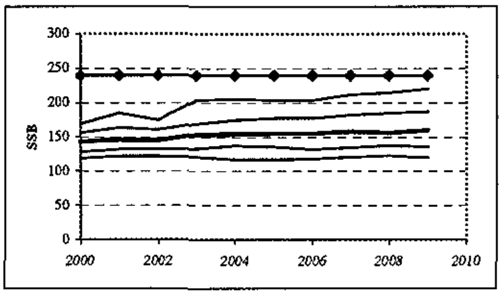
F=0.4



F=0.6



F=0.8



F=1.0

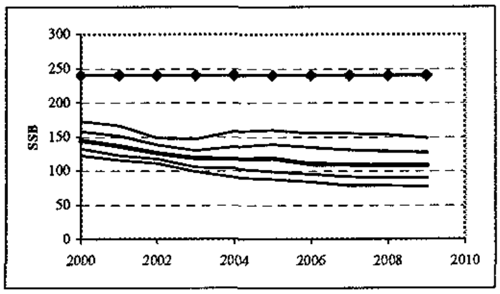


Table 3.13.5.b1 Medium-term projections for cod 25-32

SSB

year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
	240	240	240	240	240	240	240	240	240	240
F=0.1										
Fractiles										
0.01	118	199	323	462	557	637	709	816	730	862
0.25	131	218	349	509	611	705	786	903	811	962
0.5	140	235	377	564	675	787	874	1020	926	1072
0.75	155	256	401	618	741	876	985	1113	1029	1229
0.9	175	280	437	669	801	936	1051	1213	1118	1325
F=0.2										
Fractiles										
0.01	121	175	246	340	381	420	464	560	527	591
0.25	129	188	267	378	423	469	505	603	569	661
0.5	142	208	291	413	470	525	575	687	646	745
0.75	156	228	316	465	524	591	658	797	744	853
0.9	167	250	346	512	583	660	733	869	838	980
F=0.3										
Fractiles										
0.01	118	174	251	309	345	379	418	437	453	497
0.25	126	187	269	350	383	412	453	495	488	561
0.5	139	208	296	395	429	469	502	555	560	637
0.75	156	227	327	444	486	534	571	639	642	713
0.9	177	251	349	496	538	593	646	723	700	778
F=0.4										
Fractiles										
0.01	120	163	207	250	263	269	277	305	316	339
0.25	131	176	224	280	292	301	311	352	358	391
0.5	143	191	242	306	322	342	365	404	413	463
0.75	156	208	262	344	371	399	421	471	478	520
0.9	173	230	290	386	428	447	484	531	521	578
F=0.6										
Fractiles										
0.01	117	144	173	183	186	181	191	206	207	214
0.25	128	155	183	205	205	205	212	225	231	242
0.5	142	167	196	224	235	237	243	258	265	282
0.75	155	185	213	252	259	260	275	293	304	322
0.9	176	207	228	283	287	300	304	327	349	360
F=0.8										
Fractiles										
0.01	119	122	122	121	117	117	118	121	123	120
0.25	128	132	132	133	138	136	132	135	138	136
0.5	143	146	145	153	154	155	155	158	156	160
0.75	156	163	161	169	175	178	178	182	185	187
0.9	169	185	175	203	205	203	203	212	215	220
F=1										
Fractiles										
0.01	123	116	111	99	91	88	84	79	79	78
0.25	133	123	118	106	104	99	95	92	90	90
0.5	145	137	126	119	118	119	110	109	108	108
0.75	158	151	138	130	136	139	135	131	129	127
0.9	173	166	149	147	158	160	155	155	153	149

Table 3.13.5.b.2 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[3]	Norway	Unallo-cated	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	9,776	1,414	1,536		5,215	6,187	4,601	31,396	2,803	25,072		600			88,600
1998[1]	7,818	1,188	926		1,270	7,765	4,186	25,155	4,599	14,431					67,338

[1]Provisional data.
[2]Includes landings from Oct.-Dec. 1990 of Fed.Rep.Germany.
[3]1997 landings not officially reported, but estimated by the Working Group.

Table 3.13.5.b.3 Cod in 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	320.46	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	292.79	195.55	143.83	1.042
1973	400.84	208.72	143.16	0.972
1974	472.05	258.48	147.82	0.829
1975	281.11	333.60	194.65	0.694
1976	282.52	352.63	203.30	0.924
1977	464.13	325.24	164.69	0.841
1978	785.38	376.34	154.01	0.533
1979	568.91	575.02	227.70	0.492
1980	403.70	694.51	347.62	0.726
1981	654.57	667.87	330.74	0.794
1982	651.59	668.61	316.05	0.717
1983	433.60	641.44	332.15	0.696
1984	280.03	649.86	391.05	0.893
1985	228.46	533.26	315.08	0.759
1986	244.31	390.20	252.56	1.149
1987	330.28	312.34	207.08	0.957
1988	203.46	293.71	194.48	0.850
1989	117.53	238.28	179.18	1.128
1990	115.70	216.59	152.87	1.197
1991	78.04	152.72	122.89	1.345
1992	129.30	97.70	54.89	0.935
1993	170.95	120.23	45.18	0.313
1994	119.56	200.94	93.35	0.521
1995	119.39	246.74	107.72	0.684
1996	112.12	167.50	121.89	0.944
1997	96.85	141.47	88.60	0.995
1998	137.48	125.27	67.34	0.818
1999	112.58	139.00	.	.
Average	296.05	310.22	181.64	0.879
Unit	Millions	1000 tonnes	1000 tonnes	-

3.13.6 Flounder

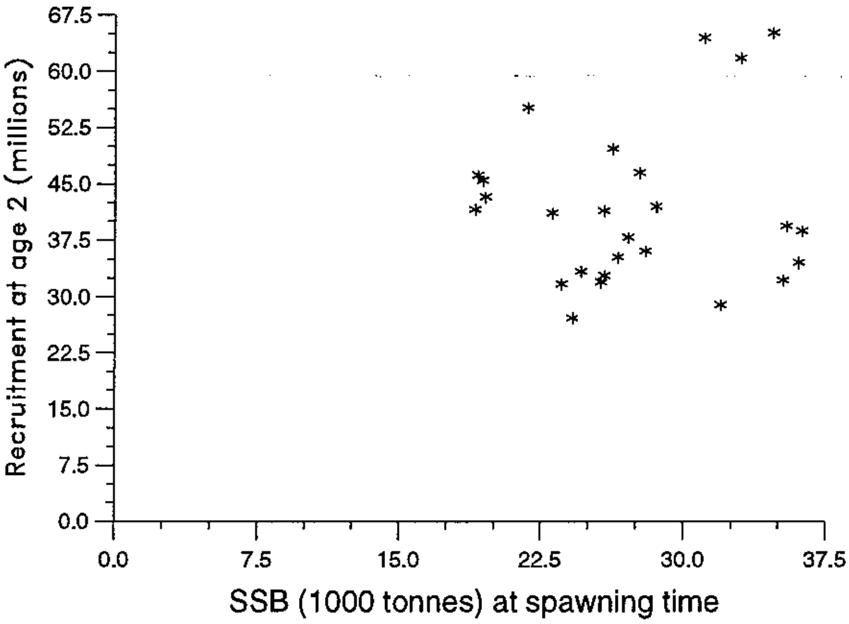
State of stock/fishery: The total landings of flounder have increased since 1994. For the stock in Sub-divisions 24+25 XSA results indicate a recent decrease of the spawning stock size from 30 000 t in 1995 to 27 000 t in 1998. The year class indices estimated in 1998 and 1999 indicate a good 1996 year class, which is expected to increase the stock.

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). From 1997 on the landings decreased and reached an amount of 14 534 t in 1998. The majority of the landings are caught 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. An assessment could be made only for the flounder stock in Sub-divisions 24–25.

Source of information: Report of the Baltic Fisheries Assessment Working Group, April 1999 (ICES CM 1999/ACFM:15).

Stock - Recruitment



(run: XSAHMU02)

Flounder in Sub-divisions 24 and 25

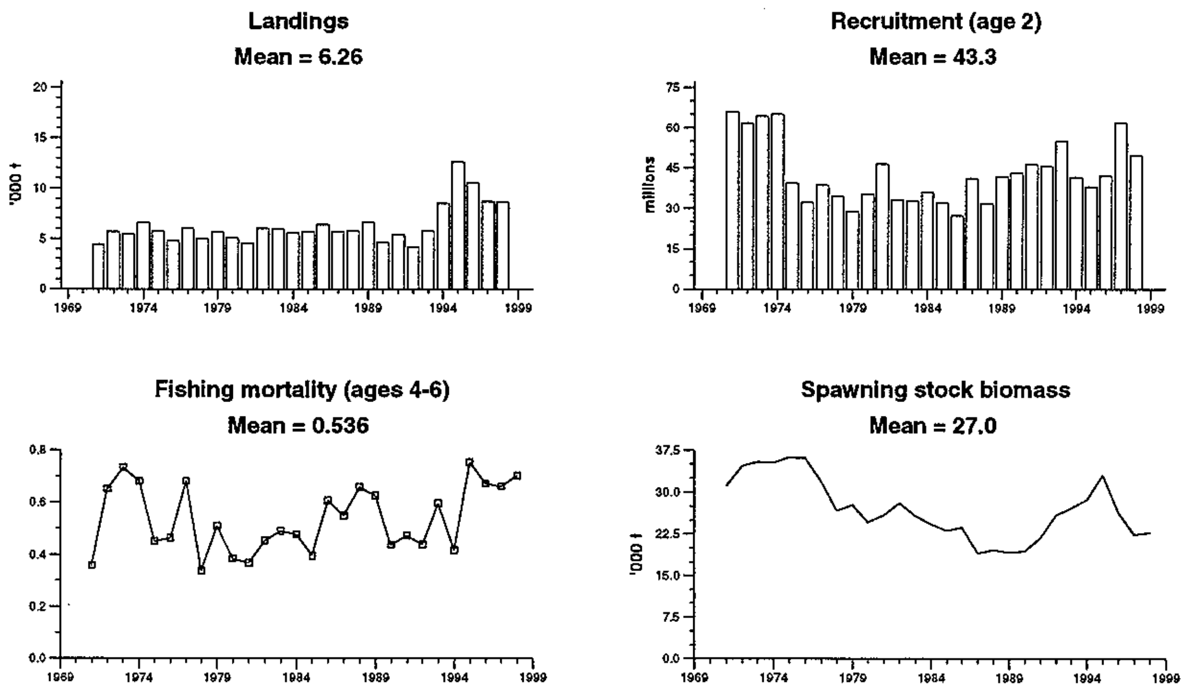


Table 3.13.6.1 Total landings (tonnes) of FLOUNDER in the Baltic by Sub-division and country. (There are some gaps in the information. Therefore "Total" is preliminary.)

Year	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	1,356		2,421	31	10	1	283	69	299				655	1,982	12	4	3,877	1,730		42	62	308	31	105	370	
1998[5]	1,370		2,386	3	4	3	277	46	342				411	1,729	2		4,215	1,370		61	49	187	18	70	117	

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					15		101	96	125	78	284			1001		2,011	42	4,465	4,201	2,883	105	769	379	69	424	15,348
1998[5]					10		146	79	87	90[9]	274			1188		1,781	61	4,164	4,417	2,669	70	541	356	46	429	14,534

[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

[9] 2 t of SD 25 are included

Table 3.13.6.2 Flounder in Sub-divisions 24 and 25.

Year	Recruitment Age 2	Spawning Stock Biomass	Landings	Fishing Mortality Age 4-6
1971	65.93	31.10	4.40	0.358
1972	61.76	34.72	5.69	0.651
1973	64.43	35.41	5.46	0.733
1974	65.11	35.24	6.60	0.680
1975	39.40	36.25	5.76	0.450
1976	32.17	36.07	4.78	0.463
1977	38.73	31.97	5.99	0.680
1978	34.52	26.56	4.96	0.337
1979	28.90	27.69	5.59	0.509
1980	35.23	24.61	5.06	0.385
1981	46.46	25.84	4.53	0.367
1982	33.35	27.98	6.00	0.452
1983	32.80	25.67	5.93	0.490
1984	36.07	24.19	5.55	0.476
1985	31.94	23.11	5.66	0.395
1986	27.13	23.59	6.40	0.605
1987	41.12	19.01	5.69	0.549
1988	31.67	19.55	5.76	0.657
1989	41.60	19.15	6.63	0.625
1990	43.26	19.40	4.61	0.436
1991	46.15	21.80	5.37	0.472
1992	45.46	25.81	4.12	0.438
1993	55.11	27.07	5.75	0.596
1994	41.43	28.57	8.49	0.416
1995	37.89	33.01	12.60	0.753
1996	41.96	26.28	10.52	0.671
1997	61.74	22.43	8.67	0.661
1998	49.69	22.72	8.58	0.700
Average	43.25	26.96	6.26	0.536
Unit	Millions	1000 tonnes	1000 tonnes	-

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). Afterwards up to 1997 an increase to about 1 500 t in 1996 and 1997 could be observed but in 1998 a slight decrease (16%) took place again.

Source of information: Report of the Baltic Fisheries Assessment Working Group, April 1999 (ICES CM 1999/ACFM:15).

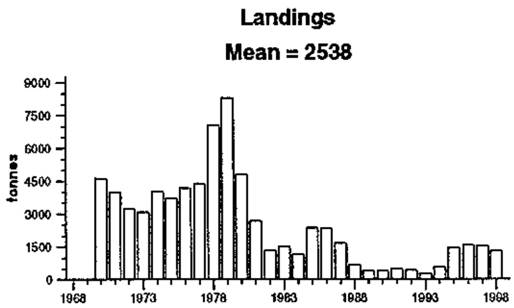


Table 3.13.7.1 Total landings (tonnes) of PLAICE in the Baltic by Sub-division and country.
(There are some gaps in the information. Therefore "Total" is preliminary.)

Year	Denmark			Germ. Dem. Rep.[1]		Germany, Fed.Rep.				Poland		Sweden[2]							
	22	23	24(25)	22	24	22	24(+25)	26	28	25(+24)	26	22	23	24	25	26	27	28	29
1970	3,757		494			202	16							149					
1971	3,435		314			160	2							107					
1972	2,726		290			154	2							78					
1973	2,399		203	2	44	163	1			174	30			75					
1974	3,440		126	36	10	166	2			114	86			60					
1975	2,814		184	11	67	302	1			158	142			45					
1976	3,328		178	11	82	302	3			164	76			44					
1977	3,452		221	5	36	348	2			265	26			41					
1978	3,848		681	33	1,198	346	3			633	290			32					
1979	3,554		2,027	10	1,604	195	7			555	224			113					
1980	2,216		1,652	5	303	84	5			383	53			113					
1981	1,193		937	6	52	74	31			239	27			118					
1982	716		393	6	25	39	6			43	64			40	6		7	1	
1983	901		297	5	12	37	14			64	12			133	20		24	2	
1984	803		166	7	2	23	8			106				23	3		4	1	
1985	648		771	68	593	26	40			119	49			25	4		5	1	
1986	570		1,019	34	372	25	7			171	59			48	7		9	1	
1987	414		794	4	142	14	16			188	5			68	10		12	1	
1988	234		323	3	16	7	1			9	1			49	7		9	1	
1989	167		149		5	7				10				34	5		6	1	
1990	236		100		1	9	1			6				50					
1991	328		112			15	9			2	1			5	2		2		
1992	316		74			11	4			6				3	1		1		
1993	171		66			16	6			4			2	4					
1994	355		159			1				43	4		6	4	7				
1995	601	64	343			75	91		1	233	2		12	13	10	1			
1996	859	81	263			43	77			183	5	1	13	28	23	10	1		
1997	902		201			51	56			308	3		13	7	8		1		
1998[4]	642		257			213	41			101	14		13	6	17		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	953	13	264	316	3	1			1.550
1998[4]	855	13	304	118	14	1			1,305

[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 reported catches in 1994 increased to 3 000 t, but in 1996 they returned to the previous level. The temporary increase of the landings reported for 1994 and 1995 is influenced by misreporting (over-reporting).

Most catches were taken from Sub-division 22 followed by Sub-division 24 with only up to 12% of the total landings.

Source of information: Report of the Baltic Fisheries Assessment Working Group, April 1999 (ICES CM 1999/ACFM:15).

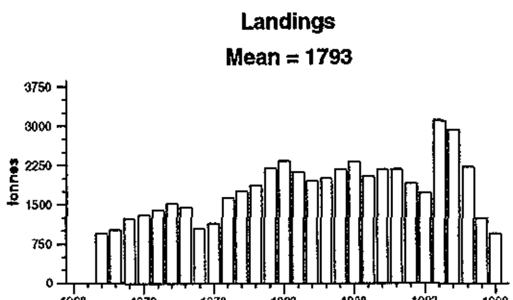


Table 3.13.8.1 Total landings (tonnes) of DAB in the Baltic by Sub-division and country. (There are some gaps in the information. Therefore "Total" is preliminary.)

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	728		60				413	21	2	
1998[4]	570		85				280	6	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		5	5	10	3	1			1,141	5	86	12		3	1			1,248
1998[4]		7	3	3	1				850	7	94	5		1				957

[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 landings of turbot in the Baltic increased continuously from 40–90 t in the 1960s to 1 000–1 200 t in the 1990s (Table 3.13.9.1). The main turbot fishery takes place in Sub-divisions 22, 24, 25, 26 and 28. Due to the high market demand a directed turbot gillnet fishery developed in the 1990s.

At present the IBSFC regulations of the turbot fishery are a temporary closure of fishing during the spawning season, and a minimum landing size. There are also additional national regulations, for example, a minimum mesh size, in some fisheries.

The landings are uncertain due to incomplete reporting.

Though there are ongoing study programs in several countries focusing on the status of turbot stocks in the Baltic, the data available are insufficient to make an evaluation of appropriateness of the present management measures in respect to the precautionary approach.

Source of information: Report of the Baltic Fisheries Assessment Working Group, April 1999 ICES CM 1999ACFM:15.

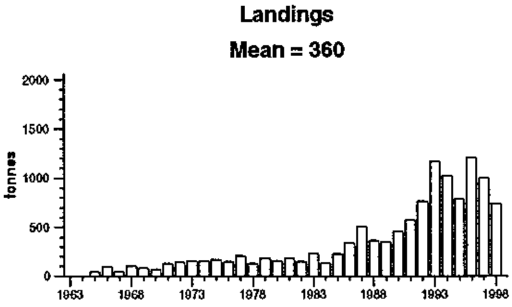


Table 3.13.9.1 Total landings (tonnes) of TURBOT in the Baltic by Sub-division and country. (There are some gaps in the information. Therefore "Total" is preliminary.)

Year	Denmark			Germ. Dem. R[1]		Germany, Fed. Rep.						Poland		Sweden[2]						
	22	23	24(25)	22	24	22	24	25	26	27	28	25(24)	26	22	23	24	25	26	27	28(29)
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
1993	159	29	152			74	56					520	72		2	4	14		13	38
1994	211	18	166			52	57	10				380	30		2	3	18	1	17	44
1995	257	11	94			65	53	4				30	15		2	3	54	9	31	83
1996	207	12	95			36	47	4		1		288	92	1	3	15	100	5	54	104
1997	151		68			60	52	3				290	70		2	6	70	1	53	86
1998[4]	138		80			44	55	1				66	68		2	4	58	1	18	69

continued

Table3.13.9.1 continued

Year	Latvia		Lith-uania[5]	Russia	Total							
	26	28	26	26	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				30	322		207	92	85	21	36	763
1993				34	233	31	212	534	106	13	38	1,167
1994				15	263	20	226	408	46	17	44	1,024
1995	33	28		20	322	13	150	88	77	31	111	792
1996	43	3	76	25	244	15	157	392	241	55	107	1,211
1997	33	28		25	211	2	126	363	129	53	114	998
1998[4]	12	24		96	182	2	139	125	177	18	93	736

[1] From October-December 1990 landings of Germany, Fed. Rep. are included.

[2] For the years 1970-1981 and 1990 the catches of Sub-divisions 25-28 are included in Sub-division 24.

[3] For the years 1970-1981 and 1990 the Swedish catches of Sub-divisions 25-28 are included in Sub-division 24.

[4] Provisional.

[5] Lithuania, for 1997 and 1998 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 1999 (ICES CM 1999/ACFM:15.

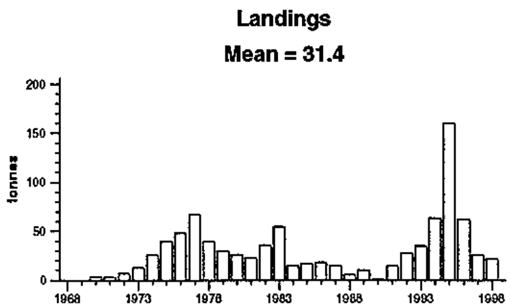


Table 3.13.10.1 Total landings (tonnes) of BRILL in the Baltic by Sub-division and country. (There are some gaps in the information. Therefore "Total" is preliminary.)

Year	Denmark			Germ. Fed.Rep	Sweden		Total			
	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	25				1		25	1		26
1998[1]	21				1		21	1		22

[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. In some rivers with compensatory releases some homing salmon succeed to reproduce so that there is small amount of natural reproduction. A total of 6.4 million hatchery-reared smolts were released in rivers and at coastal release sites in 1998. This includes the estimated number of smolts originating from releases of earlier life stages. It is estimated that the wild production in 1998 was about 0.5 million smolts, which was about 7% of the total smolt production of 6.9 million. A major part of wild and reared smolt production takes place in the Gulf of Bothnia in the northern part of the Baltic.

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, which do not support wild salmon populations.

There are two IBSFC management areas for salmon in the Baltic: (1) Main Basin and Gulf of Bothnia (Sub-divisions 22-29 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. The overall management objective of IBSFC to increase the production of wild Baltic salmon is to attain at least 50% of the natural production capacity of each river with current or potential natural production of salmon by 2010, while maintaining the catch level as high as possible.

There are 13 rivers with wild salmon populations in the Gulf of Bothnia. In earlier years all populations were 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 2000-2001. The numbers of spawners returning to other rivers continues to be very low 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), there are wild salmon populations in 9 rivers. Six of these populations are close to extinction In three other rivers natural reproduction occurs as a consequence of large long-term releases and there are no national plan for these populations to attain self-sustainability.

In 1992–1996 the M74 syndrome caused high mortality among yolk-sac fry of sea-run females (M74 was well described in the ACFM report in 1995). The incidence decreased in 1997 and there was further decrease in 1998. There is some evidence that mortality has started to increase in some rivers again in 1999 (to about 35%). It is possible that the incidence of the syndrome may continue to fluctuate rapidly, without any possibility of predicting its level.

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 reproductive capacity has ceased. Reared smolts are in many cases released to compensate for these losses. Sea trout are also in many cases released to provide recreational fishery on returning spawners. Hatchery-reared smolt production, including

[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 as this generation is normally not possible to distinguish from fish with other origin. Wild salmon populations should also be self sustaining and as similar as possible to populations with no effects from releases.

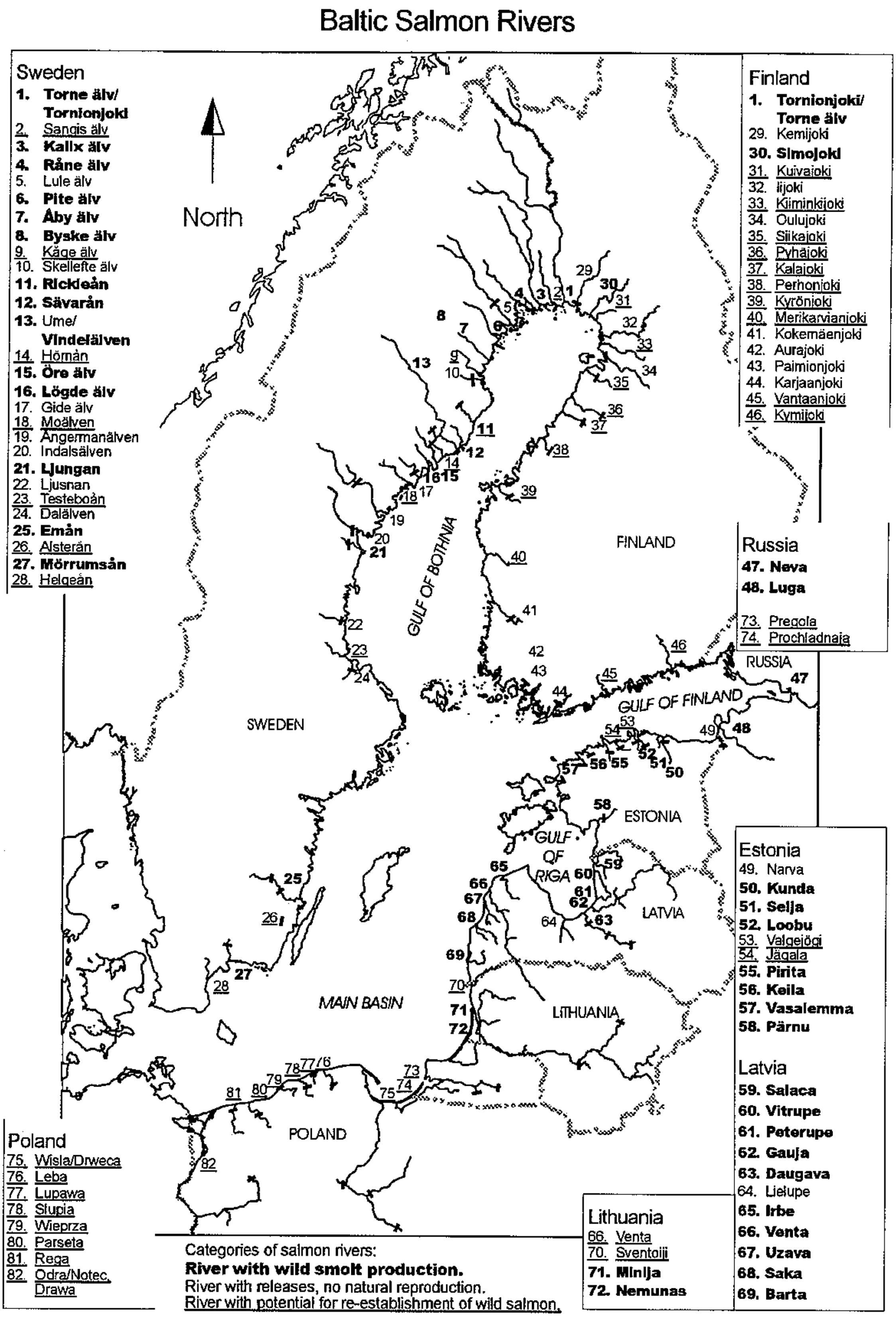
enhancement of wild stocks, was approximately 3.9 million in 1998. The wild smolt production, which may be about 0.5 million, constitutes about 15% of the total smolt production. Most of the stocks remain in the coastal area within about 150 km of the point of release, but a high proportion of those from Poland and some from southern Sweden migrate further into offshore areas. Coastal populations are mainly taken in gillnets or trap nets. In the Gulf of Bothnia, they are caught as a 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 better than in the Gulf of Bothnia.

Sea trout are affected by M74 to a much lesser degree than salmon are. Populations in some rivers in the Gulf of Finland and the southern part of Gulf of Bothnia and northernmost part of the Main Basin have exhibited a limited incidence of M74. The situation in the Main Basin is less well known.

Figure 3.13.11.a.1 Baltic salmon rivers divided into three categories (see figure below). Only lower parts of rivers with current salmon production or potential for production of wild salmon are shown. The presence of dams, which prevents access to areas, is indicated by lines across rivers.



3.13.11.b Salmon in the Main Basin and the Gulf of Bothnia (Sub-divisions 22–31)

State of stocks/fishery: Although the populations in some rivers are increasing, the wild stocks - considered as a stock complex covering the whole management area - 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	0.46	5.61	6.07
1999[2]	0.61	4.94	5.55

[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: There are wild salmon populations in 13 rivers discharging into the Gulf of Bothnia. In the early 1990s, most populations in this area were depleted, producing 5-20% of their potential. The management measures taken, including the reduction in TAC, and a strong brood-year-class in 1990 have increased parr densities in seven of these rivers in the last 2-3 years. Improved parr densities are expected to give high smolt runs in 2000-2002 (3-4 year old smolts) and good spawning runs in 2002-2005 (Table 3.13.11.b.4). In other rivers, there is still no or only little improvement in population status. The numbers of fish returning to these rivers are so low that the stocks are at the risk of extinction. The spawning run in 1998, originating from the small year-classes 1992-1993, was low and estimated egg deposition decreased significantly. The spawning runs of wild salmon are expected to be low also for the years 1999-2000, mainly because feeding population in the sea consists at present of 1993-1996 year-classes which suffered high M74 mortality (Tables 3.13.11.b.3 and 3.13.11.b.5).

In the Main Basin area the status of populations is somewhat better in terms of parr densities and number of spawners than in Gulf of Bothinia. Smolt production in the area has not decreased as much in relation to production capacity as in the Gulf of Bothnia. 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.

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 1997-1999, with the TAC for 2000 of 410 000 salmon is consistent with the Salmon Action Plan.

ICES further advises that the exploitation in rivers should be closely monitored and kept sufficiently low to allow the number of spawning fish to increase. As some rivers have reached what is considered to be full production and many more rivers may achieve this status shortly, IBSFC should consider setting spawning stock targets for these rivers.

Relevant factors to be considered in management: Many indices show that many populations are benefiting from current management measures, thereby increasing the probability of achieving the management objective. However, there is less or no improvement in parr densities in small rivers compared to larger ones, and therefore the exploitation rate must be kept very low on the Baltic salmon while the stocks are exploited in mixed fisheries. Otherwise the small stocks, which are recovering much more slowly, could suffer serious over-exploitation. From a biological perspective all wild stocks should be rebuilt as quickly as possible.

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 based mainly on reared fish. In recent years reared fish constituted about 90% of the catch, if the estimates of smolt production of reared and wild fish were valid indicators of the recruitment to the fisheries. Data on coastal tagging and sampling of spawners indicate that the proportion of wild salmon in the catch may be higher than previously considered.

Non-reported catches are considered to be 10–25% of the reported landings (in numbers) in the Gulf of Bothnia and in some fisheries in the Main Basin. These estimates are not reliable, nor are estimates on discards or salmon damaged by seal. However, the assessment of fishing mortality does not rely on these data but is based solely on tagging data.

Seals damage salmon trapped in nets. Catch losses have continued to increase and the most serious damage occurs in the Sub-divisions 30-32. The estimated catch loss in the Swedish coastal trapnet fishery in the Gulf of Bothnia due to seal interaction with the fishery was 45% (~134 tonnes) of recorded coastal salmon landings. Corresponding catch loss on the Finnish side of Gulf of Bothnia is 11% (~55 tonnes). The substantial difference between the estimates is attributed to the different method of estimation. The Swedish estimate includes both fish removed from nets by seals and fish left in the nets but partially eaten, whereas the Finnish estimate consists only of fish left in the nets but damaged by seals. These losses are not included in the TAC, so as catch losses by seals continue to increase the total number of salmon killed in the fishing gear will increase even with a *status quo* TAC, affecting achievement of rebuilding objectives.

Forecast for 2000: *Wild stocks:* From surveys of juvenile salmon in the rivers it was estimated that the wild smolt run in 1998 was 460 000. This is about 25% of the potential production as presently estimated. The number of spawners in 1995-1997 and densities of parr in 1996-1998 in Finnish and Swedish rivers suggest that the smolt production in these rivers will increase in 1999-2001 (Table 3.13.11.b.4).

Reared stocks: The production of reared smolts in 1998 was 5.61 million, and is expected to be 4.94 million in 1999.

Elaboration and special comment: In some large rivers parr densities in recent years are far above the range of historically reliable data. Although earlier studies have found no density dependency from parr to smolt or smolt to adult survivorship, that situation may not apply at the higher densities now observed. Until survivorship rates at current parr densities can be assessed, the forecasts of smolt production and adult returns in the next few years, will be uncertain.

Because the management objective is to achieve 50% of the potential production level, the potential production level should be well defined. Ideally it should 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.

At present the assessment is based on a complex of stocks from rivers having wild salmon populations. There is an indication that the populations in the larger rivers have increased, while the status of populations in smaller, more vulnerable rivers is unchanged (Table 3.13.11.b.4 and Figure 3.13.11.b.1).

Because of the depleted state of many wild populations it is necessary to monitor the status of many of them. However, better analysis of the status of salmon populations will require an intensified long-term monitoring, which will have to concentrate on a few selected rivers (index rivers).

Estimates of wild smolt production are available for each region, but estimates in the Main Basin are based on limited surveys.

The estimates of potential production in Baltic rivers have to a large extent been developed in periods when the populations were depleted, therefore they are often rather uncertain. They should be considered as average potential values, which suggest that they may be substantially exceeded for a few years.

ICES considers that it is desirable if the following guidelines can be used in development of more reliable values of potential production:

1) An inventory of the size and quality of the parr rearing habitat areas for each river according to an agreed protocol. This should preferably be combined with electrofishing surveys stratified by quality of areas;

2) Measurement of the parr and smolt production in regional index rivers for a number of years. Because of the large variation it is necessary to measure for a number of years at high production levels before estimating the potential production in a river;

3) The values for the index river are transferred to other rivers in the region via measurement of habitat area and the quality gradation of them.

The stock estimates are based on electrofishing surveys, smolt trapping, age-disaggregated catch and tagging data.

Source of information: Report of the Baltic Salmon and Trout Assessment Working Group, April 1999 (ICES CM 1999/ACFM:16).

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		410		410
2000	Same TAC and other management measures as in 1999		410		

Landings

Year	Rivers		Coast		Offshore		Coast and Offshore[4]		Total	
	'000 t	'000 fish	'000 t	'000 fish	'000 t	'000 fish	'000 t	'000 fish[5]		'000 fish[5]
1987	0.05		0.39		3.21		3.59	891	3.64	897
1988	0.06		0.41		2.43		2.85	784	2.90	791
1989	0.08		0.65		3.27		3.92	1035	4.00	1049
1990	0.13		1.31		3.65		4.96	1113	5.08	1131
1991	0.12		1.03		3.00		4.03	757	4.15	776
1992	0.12		1.24		2.66		3.90	710	4.02	727
1993	0.11		0.83		2.57		3.40	679	3.52	657
1994	0.10		0.58		2.25		2.83	584	2.93	595
1995	0.12		0.67		1.98		2.65	553	2.77	571
1996	0.21	36	0.73	168	1.77	366	2.50	534	2.65	570
1997	0.28	45	0.78	149	1.53	282	2.31	431	2.59	476
1998[6]	0.21	32	0.51	97	1.55	312	2.06	409	2.27	441

[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 1972-1998 (1998 provisional figure) S=sea, C=coast, R=river.

Year	Main Basin (Sub-divisions 24–29)										
	Denmark	Finland	Germany	Poland	Sweden		USSR		Total		
	S	S+C	S	S	S	R	S	C+R	S	C+R	GT
1972	1034	122	117	13	277	0	0	107	1563	107	1670
1973	1107	190	107	17	407	3	0	122	1828	125	1953
1974	1224	282	52	20	403	3	21	155	2002	158	2160
1975	1112	211	67	10	352	3	43	194	1795	197	1992
1976	1372	181	58	7	332	2	84	123	2034	125	2159
1977	951	134	77	6	317	3	68	96	1553	99	1652
1978	810	191	22	4	252	2	90	48	1369	50	1419
1979	854	199	31	4	264	1	167	29	1519	30	1549
1980	886	305	40	22	325	1	303	16	1881	17	1898

Year	Main Basin (Sub-divisions 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	359	44	0	38	106	64	1	4	110	0	0	23	354	9	7	1481	126	7	1614
1998	495	0	4	328	13	0	42	65	60	1	4	104	10	3	37	442	3	7	1504	104	10	1618
Mean 1993-97	576	6	4	415	68	1	22	121	48	7	4	146	4	0	34	539	10	6	1871	133	7	2011

Continued

Table 3.13.11.b.1 continued

Year	Gulf of Bothnia (Sub-divisions 30–31)											Main Basin+Gulf of Bothnia (Sub-divs. 24–31)Total		
	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	44	360	110	1	295	158	45	655	268	968	1526	781	275	2582
1998	45	179	60	2	224	137	47	403	197	647	1551	507	207	2265
Mean 1993-97	145	341	51	3	244	106	148	586	156	890	2019	719	163	2901

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) Total			
	Estonia			Finland			Russia		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	89	341	10	4	0	93	345	10	448	1619	1126	285	3030
1998	0	4	0	26	182	10	4	0	30	186	10	226	1581	693	217	2491
Mean 1993-97	1	2	0	77	263	7	19	1	97	265	8	370	2115	984	172	3271

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 are 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.

Table 3.13.11.b.2 Nominal catches in numbers, from sea, coast and river by country and region in 1996-1998 (1998 provision figures).
S=sea, C=coast, R=river.

Year	Main Basin (Sub-divisions 22-29)																					
	Denmark		Estonia		Finland			Germany	Latvia		Lithuania		Poland			Russia	Sweden			Total			
	S	C	S	C	S	C	R	S	S	C	S	C	S	C	R	S	S	C	R	SEA	COAST	RIVER	GT
1996	105934	0	263	528	58844	8337	200	2400	19400	10577	1450	1059	27479	222	0	5199	121631	1322	633	342600	22045	833	365478
1997	87746	0	205	1023	61469	7018	0	6840	20033	12095	214	665	24436	0	65	4098	68551	1415	810	273592	22216	875	296683
1998	90900	2000	0	770	60722	2000	0	8224	13605	8098	288	781	23305	1927	660	6737	99407	573	940	303188	16149	1600	320937

Year	Gulf of Bothnia (Sub-divisions 30-31)										Main Basin + Gulf of Bothnia (Sub-divisions 22-31) Total			
	Finland			Sweden			Total							
	S	C	R	S	C	R	S	C	R	GT	SEA	COAST	RIVER	GT
1996	22196	84940	14000	1181	61239	20571	23377	146179	34571	204127	365977	168224	35404	569605
1997	8205	76683	17000	251	49724	27159	8456	126407	44159	179022	282048	148623	45034	475705
1998	8946	39507	7000	329	41487	23438	9275	80994	30438	120707	312463	97143	32038	441644

Year	Gulf of Finland (Sub-division 32)												Baltic (Sub-divs. 22-32) Total			
	Estonia			Finland			Russia		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	22149	56236	1796	80181	388126	224460	37200	649786
1997	0	819	0	19577	54493	1500	1023	0	20600	55312	1500	77412	302648	203935	46534	553117
1998	22	761	76	5967	28641	1500	692	0	6681	29402	1576	37659	319144	126545	33614	479303

Data from the recreational fishery are included in Swedish and Finnish data. Recreational fishery are included in Danish data from 1998. Other countries have no, or very low catches.

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, 1973-1998.

Year	Number of salmon										
	Kalix älv		Pite älv		Åby älv		Ume/Vindelälven		Öre älv	Mörrumsån	
	MSW fish	Total	MSW fish	Total	MSW fish	Total	Females	Total	Total	Females	Total
1973				45						40	110
1974				15			716	1576		61	129
1975							193	620			
1976							319	793			
1977							456	1225		29	90
1978							700	1630		10	30
1979							643	2116	11	12	38
1980	62	80					449	1244	1	13	47
1981	79	161					196	632	8	29	115
1982	11	45					139	424	2	24	104
1983	132	890					141	408	7	27	288
1984							177	446	14	40	247
1985				30			330	904	10	28	190
1986				28			128	227	1	120	262
1987				18			87	246	12	56	404
1988				28			258	446	23	65	502
1989				19			191	597	13	72	1685
1990	139	639		130			492	1573	69	233	1450
1991	122	437		59			189	356	67		
1992	288	656	104	218			251	367	40		
1993	213	567	114	146			572	1662	76		
1994	144	806	108	135			719	1311	37		
1995	736	1282	63	98			251	1167	28		
1996	2736	3781	116	146	1	1	1266	1934	39		
1997	4425	5089	638	658	38	39	1072	1788	101		
1998	984	2459	137	338	10	15	214	1066	52		

Kalix älv: The trap catch is a part of the run.
Pite älv: New fishladder built 1992. The trap catch the entire run.
Ume älv/Vindelälven: The trap catch the entire run
Öre älv: The trap catch is a part of the run. A number of 31 females in 1998.
Mörrumsån: The trap catch is a part of the run. Some releases of unmarked reared salmon have occurred.

Table 3.13.11.b.4 Salmon smolt production in Baltic rivers with natural reproduction of salmon in the 1980's and 1990's. Estimated number of smolts from natural reproduction and releases of reared fish.

Region, Sub-div. country and river	Category	Reprod. area ha	Potential	Natural 1980s	1993	1994	1995	1996	1997	1998	Pred 1999	Pred 2000	Method of estimate Pot.prod.	Pres.prod.	Reared 1998
Gulf of Bothnia, Sub-div. 31															
Finland															
Kiiminkijoki	potential	90	30	+	+	+	+	+	+	+	+	+	3	2	30
Pyhäjoki	potential	100	40	+	+	+	+					+	3	4	111
Simojoki	wild	255	75	10	10	12	1.4	1.3	2.5	9.4	21.5	43.5	3	2	77.7
Finland/Sweden															
Tornionjoki;Torne älv	wild	5000	500	75	123	199	75	71	50	144	97	336	3	2	130
Sweden															
Kalix älv	wild	2500	250	50	88	130	42	48	61	55	77	218	3	4	0
Råne älv	wild	390	20	+	+	3.2	2.1	2.2	0.5	1	1.8	5.9	3	4	0
Pite älv	wild	435	33	+	+	+	3	3	5	5.6	4.2	5.1	3	5	
Åby älv	wild	80	16	+	+	5.8	1.9	2.3	3	6	6	7.5	3	4	0
Byske älv	wild	530	80	15	23	35	11	12	40	33	82	128	3	4	0
Sävarån	wild	20	4	+	+	+	+	+	0.1	0.7	0.7	0.6	3	4	
Rickleån	wild	15	5	+	+	+	+	+	0.3	0.3	0.4	0.7	3	1 and 3	
Ume/Vindelälven	wild	1000	200	25	23	39	15	14	13	24	141	212	3	4	
Öre älv	wild	100	20	+	+	1.4	1.4	1.4	0.1	0.7	0.4	1.2	3	4	
Lögde älv	wild	95	19	+	+	3.8	1.4	1.7	1.1	3.5	4.6	8	3	4	
Sum of +				5	20	4	4	4							
Total Sub-div. 31		**10610**	**1292**	**180**	**287**	**433.2**	**158.2**	**160.9**	**176.6**	**283.2**	**436.6**	**966.5**			
Gulf of Bothnia, Sub-div. 30															
Ljungan	mixed	20	20	10	15	4	4	4	5	10	10	10	3	4	30
Total Gulf of B., Sub-divs. 30-31		**10630**	**1312**	**190**	**302**	**437.2**	**162.2**	**164.9**	**181.6**	**293.2**	**446.6**	**976.5**			
Main Basin, Sub-divs. 22-29															
Sweden															
Emån	wild		15		5	4.5	3	2.5	4	3.5	4		3	4	
Mörrumsån	wild		100		90	60	30	35	60	60	76		3	4	
Total Sweden			115		95	64.5	33	37.5	64	63.5	80				
Estonia															
Pärnu	wild		15						3	2	1		4	3	
Latvia (1)															
Salaca	wild		30		22	15	15	20	20	29	25		3	2	
Vitrupe	wild				5	5	5	5	5	4	4		6	5	
Peterupe	wild				5	5	5	5	5	4	4		6	2 and 5	
Gauja	mixed				17	13	13	14	14	13	13		6	2 and 5	159.6
Daugava	mixed				5	5	5	5	5	5	5		6	5 and 7	747.8
Irbe	wild				10	10	8	7	7	7	7		6	5	
Venta	mixed				15	15	15	15	12	12	12		6	2 and 5	42.7
Saka	wild				10	10	10	10	8	7	7		6	5	
Uzava	wild				2	2	2	2	2	1	2		6	5	
Barta	wild				2	2	2	2	2	1	1		6	5	
Total Latvia			110		93	82	80	85	80	83	80				
Lithuania															
Nemunas river basin	wild		150		20	20	20	20	20	20	x		7	10	
Total Estonia, Latvia, Lithuania			275	0	113	102	100	105	103	105	81				
Total Main B., Sub-divs. 22-29			**390**	**0**	**208**	**166.5**	**133**	**142.5**	**167**	**168.5**	**161**				
Total Gulf of B.+Main B., Sub-divs. 22-31			**1702**		**510**	**604**	**295**	**307**	**349**	**462**	**608**				
Gulf of Finland, Sub-div. 32															
Finland															
Kymijoki	mixed	50	100				3	3	4	4	4		3	4	414
Total Finland		60	120				3	3	4	4	4				
Russia															
Neva	mixed	20	20				7	7	7	7	7		7	10	
Luga	mixed	40	80				4	4	4	4	4		7	10	
Total Russia		60	100				11	11	11	11	11				
Estonia															
Kunda	wild	2.4	3.6	+	+	+	+	+	+	+	+	+	3 and 4	3 and 4	
Selja	mixed	>15	15	+	+	+	+	+	+	0	0	0	3 and 4	3 and 4	42.9
Loobu	wild	6	6	+	+	+	+	+	+	+	0	+	3 and 4	3 and 4	
Pirita	mixed	10	10	+	+	+	+	+	+	0	0	0	3 and 4	3 and 4	4.3
Vasalemma	wild	2.5	2.5	+	+	+	+	+	+	+	+	0	3 and 4	3 and 4	
Keila	wild	3	3	+	+	+	+	+	+	+	+	0	3 and 4	3 and 4	
Total Estonia		40	40	15	15	15	7	7	8	6	2	2			
Total Gulf of F., Sub-div. 32		**160**	**260**	**15**	**15**	**15**	**21**	**21**	**23**	**21**	**17**				
Total Baltic, Sub-divs. 22-32 (1)			**1972**		**525**	**619**	**316**	**328**	**372**	**483**	**625**				

\+ = 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

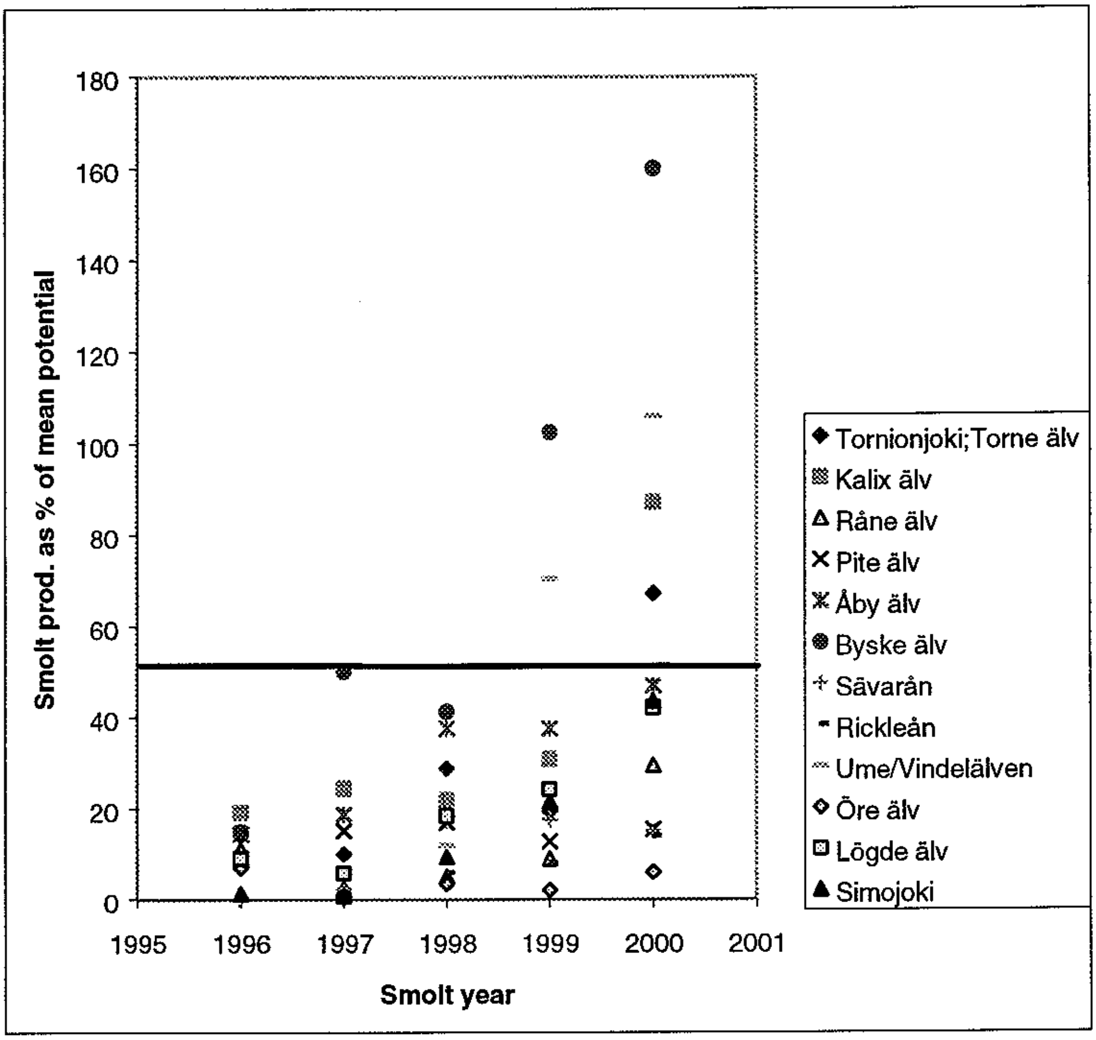
1. Complete count of smolts.
2. Sampling of smolts and estimate of total smolt run size.
3. Estimate of smolt run from parr production by relation developed in the same river.
4. Estimate of smolt run from parr production by relation developed in another river.
5. Inference of smolt production from data 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 %) of female spawners belonging to reared populations of Baltic salmon in hatching years 1985-98 with projections for 1999. All data originate from hatcheries.

River	Sub-div.	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Simojoki	31						*12*	0	53	74	*53*	92	*86*	86	31	
Torne älv	31								70	74	85	66			25	
Lule älv	31								58	66	57	48	61	38	6	34
Skellefteälven	31								40	49	69	49	77	16	4	
Ume/Vindelälven	30	40	20	25	19	16	31	45	77	88	85	74	78	37	9	
Ångermanälven	30								50	77	64	45	63	21	3	
Indalsälven	30	4	7	8	7	3	8	7	45	72	65	52	64	22	1	
Ljungan	30								*64*	*97*	*50*	56	28	*29*	10	
Ljusnan	30							17	33	59	86	52	72	22	6	
Dalälven	30	28	8	9	20	11	9	21	79	85	53	55	57	38	9	34
Mörrumsån	25	47	49	65	46	58	72	65	55	90	*80*	63	*56*	23		
Neva/Åland	29									70	50					
Neva/Kymi	32								45	60-70		57	*40*	*79*	42	
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	5.3	34.0 (1)
Mean total		29.8	21.0	26.8	23.0	22.0	26.4	25.8	55.8	75.1	66.4	59.1	62.0	37.4	13.3	34.0

1. Only River Lule älv and River Dalälven in 1999.
All estimates known to be based on material from less than 20 females in italics.

Figure 3.13.11.b.1 Estimated smolt production by river in % of the average potential for wild salmon rivers in the Gulf of Bothnia including predictions for 1999-2000. The limit of 50 % of the (uncertain) potential production is indicated.



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 populations in Sub-divisions 22–31 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	633	648
1995	10[3]	710	720
1996	10[3]	661	671
1997	12[3]	690	702
1998	10[3]	814	824
1999[2]	6[3]	847	853

[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 1995–1999: 11 000 smolts annually. Not included in table.

Wild stocks: Based on earlier evidence there are wild salmon populations in 6 Estonian rivers in the Gulf of Finland. Surveys indicate that in five rivers parr densities have declined considerably in the last few years (Table 3.13.11.c.1). Two of these populations have been supported by smolt releases in 1998. It is thought that there are wild salmon populations in two Russian rivers in the area, but no survey or catch data are available to support this information (Table 3.13.11.b.4).

Reared stocks: Most of the total hatchery production in the Gulf of Finland has traditionally originated from Finnish hatcheries, but Russia and particularly Estonia has increased releases significantly in 1998. Finland normally releases 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 of each river by 2010, while retaining the catch as high as possible.

Advice on management: ICES recommends that, in light of the precarious state of wild stocks in the Gulf of Finland and the very low wild smolt production in 1998, fisheries should only be permitted at sites where there is virtually no chance of taking wild salmon along with reared salmon. It is particularly urgent that national conservation programmes to protect wild salmon be enforced around the Gulf of Finland.

Relevant factors to be considered in management: At present wild salmon populations occur in six Estonian rivers and these populations are at risk of extinction. The potential smolt production is very small compared to all other wild salmon populations in the Baltic Sea. It is uncertain whether a much reduced TAC would affect the status of these stocks. Coastal fisheries at sites likely to be on migration path of wild salmon from Estonian rivers present a particular threat to biological viability of these wild stocks. Coastal and river fisheries intercepting these populations should be prohibited. All possible means should be used to prevent all fisheries including poaching in rivers and river mouths. Additionally enhancement releases should be continued and expanded to avoid possible extinction of these stocks.

M74 caused high mortality among offspring of sea-run females in Finnish hatcheries in 1992–1997, and the M74-related mortality continued to be high in 1998. No estimates are available for the mortality in 1999 (Table 3.13.11.b.5). Some information from hatchery experiments suggests that M74-related mortality is low in Estonian salmon populations. Tagged reared Latvian salmon recovered in the Gulf of Finland suggest that wild and reared Latvian salmon to some extent are also exploited in this area.

There are some wild salmon, originating from the Gulf of Riga salmon populations in the Gulf of Finland. The large reduction in the off-shore fishery should have reduced exploitation on these populations.

Forecast for 2000: A *status quo* projection for Sub-division 32 gives a catch prediction for 1999 and 2000 of 39 000 and 43 000 fish respectively to be compared to the catch in 1998 of 38 000 fish. The TAC for 1999 of 100 000 fish is therefore not restrictive to the fishery.

Wild stocks: In Estonian rivers the wild production is less than in earlier years. On the basis of the very low densities of 0+ parr in 1998, 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 10 000 smolts, it represents about 1% of the total smolt production. This is a much lower figure than in the Main Basin and the Gulf of Bothnia.

Reared stocks: The smolt production is expected to increase to about 847 000 smolts in 1999.

Elaboration and special comment: Considering that at present released smolts are estimated to outnumber wild smolts by approximately 50:1 in this area, the current IBSFC objective may be insufficient to ensure preservation of these stocks. Under these circumstances it would be appropriate to adopt an additional objective specifically intended to prevent the biological extinction of wild salmon in the Gulf of Finland.

Small reproduction areas and variation in the size of year-classes is characteristic of Estonian wild salmon rivers. Electrofishing surveys since 1970s indicate that there has been no spawning in some years. In spite of improvement in water quality in 1990s, the natural reproduction has not increased in these rivers.

Fishing effort in the Estonian coast increased significantly in the 1990s. This partly illegal fishery developed quickly because the coastal fish stocks, salmonids included, had been under exploited in coastal waters and catches were relatively good. The decline of agriculture and other industries in the region that resulted in decreased pollution of the streams should have had a positive effect on the salmon stocks. However, the decrease in the offshore fishery and improvement of water quality did not compensate for the effect of the increased coastal fishery, which exploits salmon and sea trout populations as bycatch.

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 in Finland. In Estonia there is no specialised salmon fishery, but almost all salmon are caught as a bycatch in the coastal gillnet fishery. No catch statistics are available for this fishery. In Russia there is a small salmon fleet operating in the area, but the catches have been low in the last two years.

Damage caused by seals to the salmon in gears have continued to increase off the Finnish coast of the Gulf of Finland. The estimated catch loss in the Finnish fishery was about 10% (~20 tonnes). Seal damage is most severe at fishing sites furthest away from the coast, which has caused the trap net fishing to move closer to the shoreline.

The assessment shows a very low initial survival for released smolts in the last two years compared to the early 1990s.

The analytical assessment is based on catch at age estimated from tag recoveries. Estimates of wild production are based on limited surveys and do not include 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 production.

Source of information: Report of the Baltic Salmon and Trout Assessment Working Group, April 1999 (ICES CM 1999/ACFM:16).

Catch data (Tables 3.13.11.b.1–2):

TACs

Year	ICES Advice	Catch corresp. to advice '000 fish	Agreed TAC '000 t	Agreed TAC '000 fish
1987	No advice	-		
1988	No advice	-		
1989	No advice			
1990	No advice			
1991	No advice		0.43	
1992	No advice		0.43	
1993	TAC for reared stock	109[1]		109
1994	TAC for reared stock	65[2]		120
1995	Catch as low as possible in offshore and coastal fisheries	-		120
1996	Catch as low as possible in offshore and coastal fisheries	-		120
1997	Offshore and coastal fisheries should be closed	-		110
1998	Offshore and coastal fisheries should be closed	-		110
1999	Offshore and coastal fisheries should be closed	-		100
2000	Only fishery on released salmon should be permitted	-		

[1]Equivalent of 600 t. [2]Equivalent of 400 t.

Landings

Year	River t	Coast t	Offshore t	Coastal and offshore[2] t	Coastal and offshore[2] '000 fish	Total t	Total '000 fish
1987	2	61	290	351		353	
1988	2	112	156	268		270	
1989	2	145	254	399		401	
1990	6	369	178	347		553	
1991	5	398	250	648		653	
1992	3	418	111	529		532	
1993	6	310	133	443		449	111
1994	7	142	106	248		255	57
1995	7	201	58	259	38	266	38
1996	12	327	93	420	78	432	80
1997	10	345	93	485	76	495	77
1998[1]	10	186	30	316	36	326	38

[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/100m^2		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
	1998	13.5	0.6	68
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
	1998	0	+	2
Pirita				
	1992	1.9	0.7	11
	1994	0	0	0
	1995	0	0	0
	1996	0	+	1
	1997	**	**	**
	1998	0	0	0
Loobu				
	1994	1.2	2.8	23
	1995	0.2	0.2	2
	1996	0	0.4	4
	1997	0	+	3
	1998	+	0	1
Keila				
	1994	1.1	0.9	11
	1995	14	0.6	65
	1996	15.6	1.4	148
	1997	0	5.2	47
	1998	0	0.6	1
Seljajõgi				
	1995	0.9	7	18
	1996	0	+	2
	1997	0	0	0
	1998	0	0	0

+ = minor production.
** = no electrofishing

3.13.11.d 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. Stocks in several rivers in the Main Basin are considered to be in good condition with nursery areas well utilized. However, the status of most stocks in the Gulf of Bothnia particularly in Sub-division 31 is poor or unknown (Table 3.13.11.d.1). 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 rivers examined. The population in the Swedish river Emån has become very depleted in recent years. Electrofishing surveys indicate that densities in 1995–1998 are about 5–10% of the densities in 1992–1994. The decrease in density coincides with the outbreak of M74 in Baltic salmonids, but is probably not caused by it.

Reared stocks: Sea trout smolt production is shown below (in thousands):

Year	Baltic Main Basin	Gulf of Bothnia	Gulf of Finland	Total
1987	994	1081	358	2433
1988	1312	1083	226	2621
1989	1537	906	198	2641
1990	1237	1035	237	2509
1991	665	1186	259	2110
1992	1023	1247	314	2584
1993	1576	1171	251	2998
1994	1485	985	285	2755
1995	1967	1243	378	3588
1996	1509	1416	139	3064
1997	2726	970	220	3916
1998	2545	943	378	3866

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 2000: 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 1999 (ICES CM 1999/ACFM:16).

Catch data[2] (Table 3.13.11.d.2):

Year	Baltic Main Basin t	Gulf of Bothnia t	Gulf of Finland t	Total t
1987	319	150	184	653
1988	331	282	290	903
1989	460	331	298	1089
1990	794	432	337	1563
1991	613	463	297	1373
1992	611	469	322	1402
1993	901	250	718	1869
1994	769	190	648	1607
1995	647	227	119	993
1996	511	238	95	844
1997	474	238	93	805
1998[1]	613	226	53	892

[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.d.1 Status of monitored wild and mixed sea trout populations (1998).

	Poor	Satisfactory	Good	Not known	Total number
Gulf of Bothnia					
Sub-div 31					
Finland	1	1			2
Finland/Sweden		1			1
Sweden	10	1	1		12
Sub-div 30					
Sweden	13	9	1	15	38
Finland		1			1
Main Basin					
Sweden	25	23	11	13	72
Estonia	11	4		1	16
Latvia	2	5	8		15
Lithuania					
Russia					
Poland	5	6	5		16
Denmark				33	33
Gulf of Finland					
Finland	5				5
Russia				15	15
Estonia	8	7	8	1	24
Total	**80**	**58**	**34**	**78**	**250**

Table 3.13.11.d.2 Nominal catches (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[9]	S + C	R	S[6]	C[6]	R	C	R	S[6]	C[6]	R	C	C	R	
1979	3	na	10	na	na	na	na	na	81[3]	24	na	na	3	6	na	na	na	na	na	73	0	200
1980	3	na	11	na	na	na	na	na	48[3]	26	na	na	3	87	na	na	na	na	na	75	0	253
1981	6	na	51	na	5	na	na	na	45[3]	21	na	na	3	131	na	na	na	na	2	128	0	392
1982	17	na	52	1	13	na	na	na	80	31	na	na	3	134	na	na	na	na	4	140	0	475
1983	19	na	50	na	14	na	na	na	108	25	na	na	3	134	na	na	na	na	3	148	0	504
1984	29	na	66	na	9	na	na	na	155	30	na	na	5	110	na	na	na	na	2	211	0	617
1985	40	na	62	na	9	na	na	na	140	26	na	na	13	103	na	na	na	na	3	203	0	599
1986	18	na	53	na	8	na	na	na	91	49	7	9	8	118	na	1	24	n.a.	2	178	0	566
1987	31	na	66	na	2	na	na	na	163	37	6	9	5	123	na	1	26	na	na	184	0	653
1988	28	na	99	na	8	na	na	na	137	33	7	12	7	196	na	na	44	42	3	287	0	903
1989	39	na	156	18	10	na	na	na	149	35	30	17	6	215	na	1	78	37	3	295	0	1,089
1990	48[3]	na	189	21	7	na	na	na	388	100	15	15	10	318	na	na	71	43	4	334	0	1,563
1991	48[3]	1	185	7	6	na	na	na	272	37	26	24	7	349	na	na	60	54	2	295	0	1,373
1992	27[3]	1	173	na	6	na	na	na	221	60	103	26	1	350	na	na	71	48	8	314	0	1,402
1993	59[3]	1	386	14	17	na	na	na	202	70	125	21	2	160	na	na	47	43	14	704[7]	0	1,869
1994	33[8,3]	2	384	15[8]	18	+	+	na	152	70	76	16	3	124	na	na	24	42	6	642	0	1,607
1995	69[8,3]	1	226	13	13	+	3	na	187	75	44	5	11	162	na	na	33	32	5	114	0	993
1996	71[8,3]	2	76	6	10	+	2	na	150	90	93	2	9	151	25	na	20	42	14	78	3	844
1997	53[8,3]	2	44	+	7	na	2	na	200	80	72	7	7	156	12	na	16	54	8	82	3	805
1998[5]	59[8,3]	2	50	+	7	na	na	209	121	75	88	3	6	166	12	na	9	39	6	44	3	892

[1] Additional sea trout catches are included in the salmon statistics for Denmark until 1982 (table 3.1.2).

[2] Finnish catches include about 70 % non-commercial catches in 1979 - 1995, 50 % in 1996-1997.

[3] Rainbow trout included.

[4] Sea trout are also caught in the Western Baltic in Sub-divisions 22 and 23 by Denmark, Germany and Sweden.

[5] Preliminary data.

[6] Catches reported by licensed fishermen and from 1985 also catches in trapnets used by nonlicensed fishermen.

[7] Finnish catches include about 85 % non-commercial catches in 1993.

[8] ICES Sub-div. 22 and 24.

+ Catch less than 1 tonne.

[9] Catches in 1979-1997 included sea and coastal catches

3.13.12 Special requests from IBSFC

3.13.12.1 Assessment of herring in Sub-divisions 25-29+32 excluding Gulf of Riga

ICES has been requested by IBSFC to make:

" *...separate assessments of the Main Basin (25-29S, excl. the Gulf of Riga)...*".

Based on catch data obtained by subtracting the catches in the Gulf of Riga from the catches in the total herring stock in Sub-divisions 25-29+32 (incl. Gulf of Riga) and on new estimates of weight at age in the catch, and in the stock, a separate assessment was made for herring in Sub-divisions 25-29+32 (excl. Gulf of Riga). Recruitment, SSB, landings and fishing mortality are given in Table 3.13.12.1.1 for the period 1974-1998.

It should be noted that the present assessment includes catches taken in Sub-division 29N as it has not yet been possible to split the entire time series of catches in Sub-division 29 into its northern and southern components.

Ideally, the result of the assessment of herring in Sub-divisions 25-29,32 (excl. Gulf of Riga herring) and the one of Gulf of Riga herring alone, should when added be similar to the assessment of herring in the Whole area. This is not the case. The summed results differ markedly in spawning stock size and in degree of exploitation (expressed as Yield/SSB) (Figure 3.13.12.1.1). The main reason for these differences is that the basic assumptions for the three assessments are profoundly dissimilar.

The assessment of the whole area assumes that:

- all herring caught in the area belong to the same stock;
- the acoustic surveys in Sub-divisions 25-29 cover - when conducted - a sufficient part of the total herring population to produce an appropriate index for stock size;
- the predation mortalities as estimated by the Multispecies assessment are applicable for the total stock (e.g. 0.26-0.86 on age 1).

The assessment of the Gulf herring (inside and outside the Gulf of Riga) assumes that:

- Gulf herring only to a lesser extent migrates out of the Gulf, so that all Gulf herring is taken by Latvian and Estonian fleets inside and outside the Gulf;
- catch per unit of effort in the trapnet fishery at spawning time in the Gulf is an appropriate index of stock size;
- natural mortalities depend only marginally on cod predation and could be assumed as 0.15 (1970–1978), 0.25 (1979–1983) and 0.20 (1984–1998).

The assessment for the herring in Sub-divisions 25-29,32 with Gulf herring excluded assumes that:

- Gulf herring only to a lesser extent migrates out of the Gulf, so that all Gulf herring is taken by Latvian and Estonian fleets inside and outside the Gulf;
- the acoustic surveys in Sub-divisions 25-29 cover - when conducted - a sufficient part of the total herring population to produce an appropriate index for stock size;
- the predation mortalities as estimated by the Multispecies assessment are applicable on the total stock (e.g. 0.26-0.86 on age 1).

The extent to which these assumptions are fulfilled will influence the results of the assessments. The assumption about the migration pattern of the Gulf herring is important. Migrations of the Gulf herring in and out of the Gulf are known to occur, but little information is available on what proportion of the stock that migrates and how migration varies over years.

If the migration in and out of the Gulf of these herrings is such that a substantial (although variable) part is caught by other fleets than the Latvian and Estonian ones, it will cause an underestimate of the total catch of Gulf herring. It will also lead to an underestimate of the natural mortality for this stock. A further consequence would be an increased variability of the proportion of the total stock that is covered by the acoustic surveys.

Mean weight at age data for a given stock are difficult to obtain because it has to be based on representative samples from the stock. As an approximation mean weight at age in the catches have been used to represent the stock in the present case. As the exploitation of the slow growing Gulf of Riga component might be larger than for the rest of the stock, the mean weight at age in the whole area might be underestimated. This will result in an underestimation of for instance SSB for the whole area.

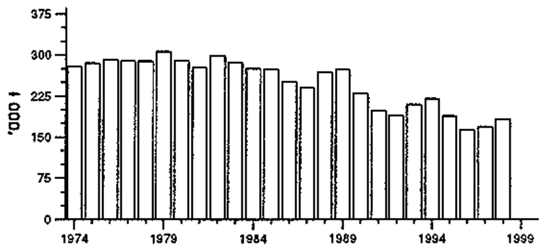
ACFM has based its advice on the assessment of the Whole area, thereby taking into account the different hypotheses on migration of Gulf herring and the imminent risks for overestimation associated with the splitting into stock components.

The assessment of the Gulf herring separately has for the last decade been provided (on request) in order to facilitate quota allocation inside the Gulf of Riga.

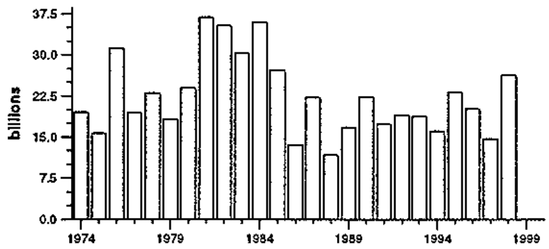
Table 3.13.12.1.1 Herring in Baltic Fishing Areas 25 to 29 and 32.

Year	Recruitment Age 1	Spawning Stock Biomass	Landings	Fishing Mortality Age 3-5
1974	19,558.80	1,814.43	279.15	0.179
1975	15,661.90	1,702.50	284.48	0.192
1976	31,216.30	1,485.28	290.58	0.168
1977	19,473.50	1,649.14	289.81	0.166
1978	22,995.00	1,586.36	288.27	0.151
1979	18,220.70	1,586.88	305.86	0.185
1980	24,018.30	1,467.10	289.00	0.177
1981	36,922.00	1,367.32	277.23	0.182
1982	35,429.50	1,466.17	298.22	0.165
1983	30,418.20	1,440.09	286.46	0.225
1984	36,017.50	1,325.76	274.16	0.243
1985	27,166.60	1,256.85	273.43	0.223
1986	13,649.80	1,199.81	251.07	0.198
1987	22,235.60	1,197.97	239.12	0.202
1988	11,692.30	1,256.86	269.21	0.186
1989	16,674.40	1,186.27	273.22	0.233
1990	22,262.20	1,081.18	229.07	0.203
1991	17,267.30	998.38	198.21	0.223
1992	18,905.10	1,041.32	190.00	0.168
1993	18,670.20	965.50	208.80	0.219
1994	16,010.90	1,000.83	219.70	0.236
1995	23,192.70	869.96	188.34	0.258
1996	20,062.80	786.31	162.53	0.241
1997	14,596.00	729.72	167.93	0.256
1998	26,235.20	688.47	182.97	0.288
Average	22,342.11	1,246.02	248.67	0.207
Unit	Millions	1000 tonnes	1000 tonnes	-

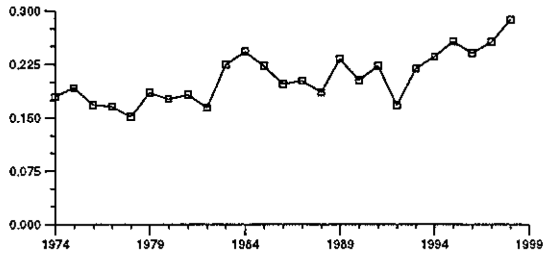
Landings
Mean = 249



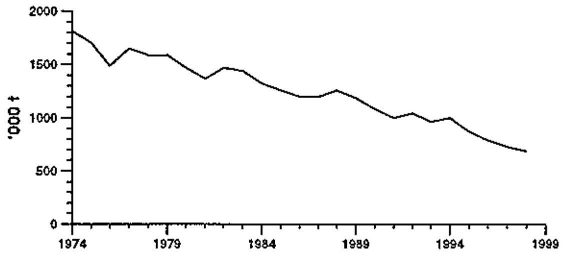
Recruitment (age 1)
Mean = 22.3



Fishing mortality (ages 3-5)
Mean = 0.207



Spawning stock biomass
Mean = 1246



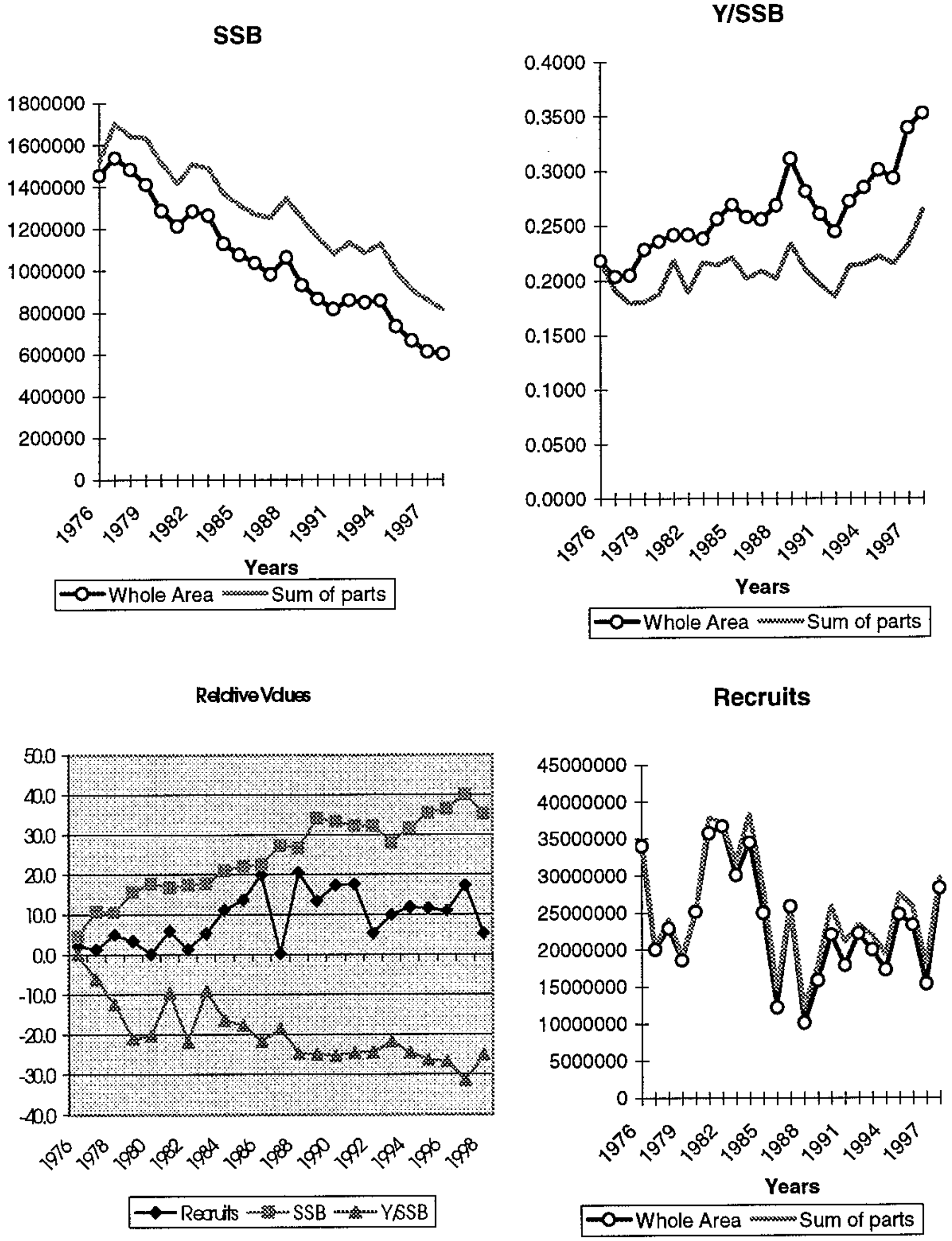


Figure 3.13.12.1.1 Comparisons between Herring assessments in Sub-divisions 25–29, 32.

3.13.12.2 Catch statistics by 29S and 29N

IBSFC has put the following request to ICES:

"IBSFC manages the Baltic herring fisheries based on two management units Sub-divisions 22-29 South + 32 and Sub-divisions 29 North, 30 and 31. IBSFC would appreciate that catch statistics, when provided on Sub-division basis are shown so it is possible to identify the catches by these management units, i.e. that Sub-division 29 South and 29 North are shown separately."

Presently, the basic catch statistics in assessments of Baltic herring is compiled by Sub-division, fleet and year-quarter basis. A part of the catch statistics time series is broken down by statistical squares and could be allocated according to different management units, the main basin management unit and management unit 3.

The text table below describes catches in 1998: In Sub-division 29 herring catches are taken by three nations: Estonia, Finland and Sweden. The Estonian catches are mainly taken in the southern part of Sub-division 29 (SD 29S) and very minor part in SD 29N. Finnish herring catches are taking mainly in SD 29N and only very minor part is taken in SD 29S. Swedish catches are taking more evenly in both areas. For 1998 the distribution of catches between two management areas is roughly 60:40.

Herring catches in 1998 in t	Estonia	Finland	Sweden	Total
Sub-division 29S	11,565	211	8,170	19,946
Sub-division 29N	1,072	15,477	5,274	21,823
Sum	12,637	15,688	13,444	41,769

However, in other areas there are also mismatch between the assessment units and management units. The following text table illustrates preliminary catch figures from 1998 in various IBSFC areas and ICES assessment areas.

ICES gives presently advice on herring stocks by assessment units, which are herring in the western Baltic (SD 22-24) and IIIa (Kattegat and Skagerrak), herring in Sub-divisions 25–29 and 32 including Gulf of Riga, herring in Gulf of Riga separately, herring in the Bothnian Sea (SD 30) and herring in the Bothnian Bay (SD 31).

Herring catches in IBSFC convention area, different assessment units and different management units in 1998 (tonnes).

Catches in the whole IBSFC convention area in 1998 (tonnes) (SD 22–32)

Denmark	Estonia	Finland	Germany	Latvia	Lithuania	Poland	Russia	Sweden	**Total**
57376	42891	81682	8991	27642	2368	25944	10520	81023	**338437**

Catches in the western Baltic (SD 22-24)

Denmark	Estonia	Finland	Germany	Latvia	Lithuania	Poland	Russia	Sweden	**Total**
43500	0	0	9000	0	0	6500	0	4700	**63700**

Catches in the management unit in the Main Basin and Gulf of Finland (including Gulf of Riga) (SD 22–29S and 32)

Denmark	Estonia	Finland	Germany	Latvia	Lithuania	Poland	Russia	Sweden	**Total**
57376	42891	24777	8991	27642	2368	25944	10520	78020	**278529**

Catches in assessment unit in 1998 (tonnes) (Assessment units 25–29,32 including Gulf of Riga).

Denmark	Estonia	Finland	Germany	Latvia	Lithuania	Poland	Russia	Sweden	**Total**
13900	42900	24800	0	27600	2400	19300	10500	71000	**212400**

Catches in assessment unit SD 30 in 1998(tonnes):

Denmark	Estonia	Finland	Germany	Latvia	Lithuania	Poland	Russia	Sweden	**Total**
0	0	52038	0	0	0	0	0	2777	**54815**

Catches in assessment unit SD 31 in 1998 (tonnes):

Denmark	Estonia	Finland	Germany	Latvia	Lithuania	Poland	Russia	Sweden	**Total**
0	0	4867	0	0	0	0	0	224	**5091**

Catches in management unit 3 (SD 29N, 30 and 31)

Denmark	Estonia	Finland	Germany	Latvia	Lithuania	Poland	Russia	Sweden	**Total**
0	1072	72382	0	0	0	0	0	8275	**81729**

3.13.12.3 Cod discard data

IBSFC requested from ICES that:

"the assessment of the cod stock should include a review of the discard information and an evaluation of the effects".

Historical data on discard from trawl catches especially in western Baltic (Sub-division 22) are available and these have been reported as ICES Annual Science Conference working documents and published in scientific literature This historical data cover the period 1978–1988 and it is based on Danish and German sampling. These data include detailed information on the discard, i.e., discard as percentage of landing per journey, age distribution and mean weight in the discard. These data will be valuable in the attempt to establish and use a time series data of discards in this area.

There are also more recent data collected in discarding. The European Union study program was initiated in 1995 for Baltic cod. The Study project has been completed in 1997 and the final report has been delivered to the Commission of the European Union (DG XIV).

This Baltic cod project was followed by a new extended sampling project called International Baltic Sea Sampling Project in 1st August 1997, which include all nationally important marine and freshwater target species (except salmon) and all countries around the Baltic Sea and Kattegat. Also in this project all assessment relevant information on both the landingpart of the catch and the discard part has been recorded.

However, the compiled common database has not been finalized and is not yet available to all participating countries and their laboratories or to ICES and IBSFC. This is because of some unexpected problems experienced when processing the final database. This situation implies that ACFM cannot for the time being commence its work on adjusting landing values to that of catches. However, ACFM expects that these problems will be solved soon and discard information will be included in the assessments in year 2000.

3.13.12.4 Herring and sprat maturity

IBSFC requested from ICES that:

"for herring and sprat IBSFC needs information on the maturity by length (maturity ogive by length) and by Sub-division".

ICES established the Study Group on Baltic Herring Maturity in 1998 in order to compile the relevant information. At the time of the meeting of the Baltic Fisheries Assessment Working Group this work was not completed. It is anticipated that the information is available in time for the assessments in year 2000.

3.13.12.5 Summer ban on cod fishing

IBSFC has requested ICES to:

"report on the effects on the cod stocks from the summer ban on cod fishing."

During the 1980s before temporal and spatial closures were enforced, the majority of cod catches in the eastern Baltic Sea were taken from February to April whereas landings were lowest from June to August (Figure 3.13.12.5.1). For more recent years the fishing pattern have changed with highest landings in March to May (Figure 3.13.12.5.2). This shift in the seasonal pattern may be explained by the fact that the fishery on pre-spawning and early spawning concentrations has been postponed due to change in peak spawning period from May to July (Figure 3.13.12.5.3).

The summer ban was introduced in 1995, but has changed somewhat with respect to periods – 1995: from 1 June to 30 August; 1996–1998: from 10 June to 20 August; 1999: from 1 July to 30 August. The effort distribution during the years 1994–1996 (based on logbook data from Denmark, Finland, Germany, Latvia, Poland, Russia and Sweden) revealed that the pattern in 1995–1996 (ban enforced) was similar to 1994 (no ban) for the most important gears (bottom trawl and gillnet), Figure 3.13.12.5.4. The pelagic and bentho-pelagic fishery generally showed larger inter-annual variability. Overall, the effect on the fishing pattern of the summer ban appears limited.

Simulation studies suggest that when a TAC regulation is applied there is little immediate expected gain in SSB of a summer closure as the catches may be taken during the remaining parts of the year. The results, measured as SSB at the end of 1st quarter in the following year and the age frequencies of the landings using different catch reallocations schemes are presented in Table 3.13.12.5.1.

If the goal of the summer ban is to protect spawning fish from being harvested and/or disturbed, the closed season may be considered as a tool. However, to evaluate the effect on the reproductive success is a difficult task. The present seasonal fishing pattern indicates that a substantial part of the spawning population is removed in April and May before spawning, while effort as well as landings in general level off in summer anyhow. Consequently, a more effective measure would be an earlier closure of the fishery, e.g. from the 15th of May onwards.

Source of information: Report of the Baltic Fisheries Assessment Working Group, April 1999 (ICES CM 1999/ACFM:15).

Table 3.13.12.5.1 Effects of closing cod fishing in quarter 3 and varying the re-allocation of yearly effort.

STOCK END OF Q1 Y+1 (in mill.)

AGE	Basic	Altered	Alt/Basic
1	159.2	159.2	1.000
2	95.3	96.1	1.009
3	50.3	50.5	1.003
4	46.7	45.9	0.982
5	22.2	22.0	0.990
6	7.0	6.7	0.959
7	2.7	2.7	1.010
+grp	1.2	1.2	0.974
SSB	**123.2**	**121.6**	**0.987**

Year Landings: Numbers (in mill.)

AGE	Basic	Altered	Alt/Basic
1	28.54	27.17	0.952
2	18.67	18.37	0.984
3	38.51	39.74	1.032
4	29.14	29.42	1.009
5	12.66	13.08	1.033
6	5.37	5.23	0.974
7	1.93	1.98	1.025
+grp	0.22	0.18	0.840
mAge	*3.02*	*3.05*	

Yield by Quarters (in thousand tons)

	Basic		Altered		Quarterly
Q	TotC	Cmd	TotC	Cmd	Factors
1	52.47	35.13	52.47	35.13	**1**
2	36.19	23.13	49.30	31.32	**1.41**
3	21.15	11.43	0.00	0.00	**0**
4	19.90	10.31	27.50	14.15	**1.41**
Year	129.70	80.00	129.26	80.60	

STOCK END OF Q1 Y+1 (in mill.)

AGE	Basic	Altered	Alt/Basic
1	159.2	159.2	1.000
2	95.3	94.5	0.992
3	50.3	49.8	0.991
4	46.7	45.8	0.981
5	22.2	22.0	0.991
6	7.0	6.6	0.944
7	2.7	2.5	0.941
+grp	1.2	1.2	0.999
SSB	**123.2**	**120.6**	**0.979**

Year Landings: Numbers (in mill.)

AGE	Basic	Altered	Alt/Basic
1	28.54	28.29	0.991
2	18.67	18.71	1.002
3	38.51	38.74	1.006
4	29.14	28.52	0.979
5	12.66	12.77	1.009
6	5.37	5.26	0.979
7	1.93	1.87	0.970
+grp	0.22	0.18	0.843
mAge	*3.02*	*3.02*	

Yield by Quarters (in thousand tons)

	Basic		Altered		Quarterly
Q	TotC	Cmd	TotC	Cmd	Factors
1	52.47	35.13	52.47	35.13	**1**
2	36.19	23.13	36.19	23.13	**1**
3	21.15	11.43	0.00	0.00	**0**
4	19.90	10.31	40.85	20.80	**2.17**
Year	129.70	80.00	129.51	79.06	

STOCK END OF Q1 Y+1 (in mill.)

AGE	Basic	Altered	Alt/Basic
1	159.2	159.2	1.000
2	95.3	96.8	1.017
3	50.3	50.7	1.007
4	46.7	45.6	0.977
5	22.2	21.8	0.983
6	7.0	6.7	0.959
7	2.7	2.8	1.042
+grp	1.2	1.1	0.950
SSB	**123.2**	**121.3**	**0.985**

Year Landings: Numbers (in mill.)

AGE	Basic	Altered	Alt/Basic
1	28.54	26.75	0.937
2	18.67	18.32	0.981
3	38.51	40.49	1.051
4	29.14	30.01	1.030
5	12.66	13.26	1.048
6	5.37	5.21	0.970
7	1.93	2.04	1.057
+grp	0.22	0.18	0.830
mAge	*3.02*	*3.06*	

Yield by Quarters (in thousand tons)

	Basic		Altered		Quarterly
Q	TotC	Cmd	TotC	Cmd	Factors
1	52.47	35.13	52.47	35.13	**1**
2	36.19	23.13	57.17	36.19	**1.67**
3	21.15	11.43	0.00	0.00	**0**
4	19.90	10.31	19.90	10.31	**1**
Year	129.70	80.00	129.53	81.63	

STOCK END OF Q1 Y+1 (in mill.)

AGE	Basic	Altered	Alt/Basic
1	159.2	159.2	1.000
2	95.3	97.8	1.027
3	50.3	51.2	1.017
4	46.7	46.4	0.994
5	22.2	22.1	0.997
6	7.0	6.9	0.986
7	2.7	2.8	1.041
+grp	1.2	1.2	1.009
SSB	**123.2**	**123.5**	**1.002**

Year Landings: Numbers (in mill.)

AGE	Basic	Altered	Alt/Basic
1	28.54	25.74	0.902
2	18.67	17.90	0.958
3	38.51	40.41	1.049
4	29.14	30.58	1.049
5	12.66	13.47	1.064
6	5.37	5.41	1.007
7	1.93	2.02	1.045
+grp	0.22	0.17	0.804
mAge	*3.02*	*3.09*	

Yield by Quarters (in thousand tons)

	Basic		Altered		Quarterly
Q	TotC	Cmd	TotC	Cmd	Factors
1	52.47	35.13	73.57	48.94	**1.47**
2	36.19	23.13	36.16	23.10	**1**
3	21.15	11.43	0.00	0.00	**0**
4	19.90	10.31	19.90	10.31	**1**
Year	129.70	80.00	129.62	82.35	

Figure 3.13.12.5.1 Relative distribution of eastern Baltic cod landings according to month 1982-90.

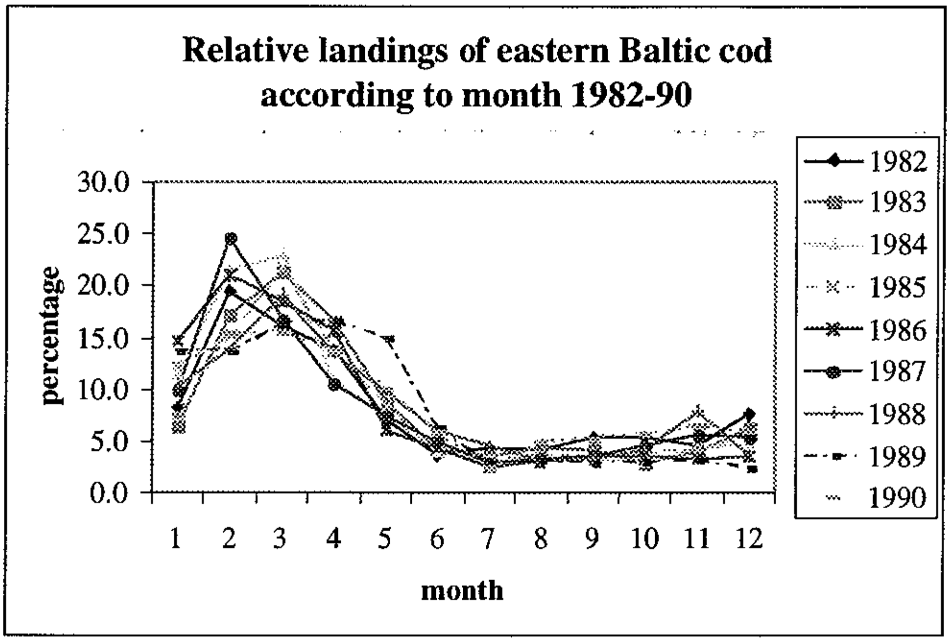
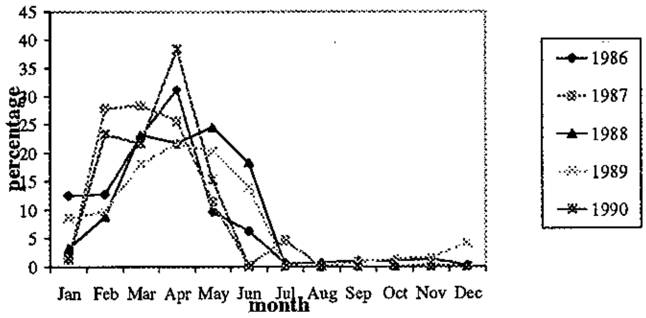


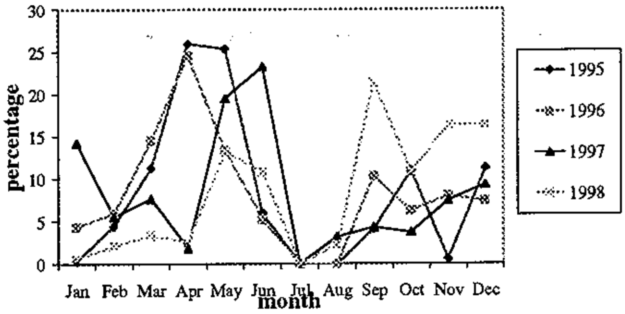
Figure 3.13.12.5.2 Relative landing level of cod caught in different Sub-divisions by different countries according to month and year.

Relative landings of cod from Subdivision 25 according to month, FRG

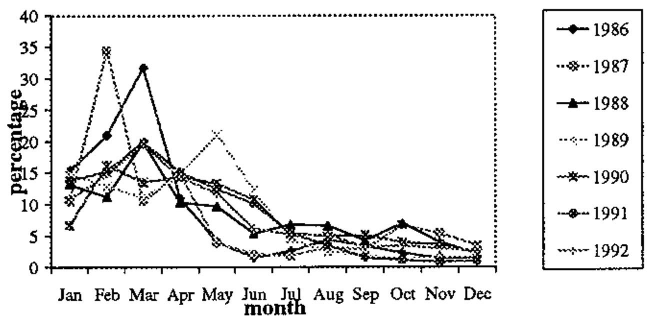


landings of cod

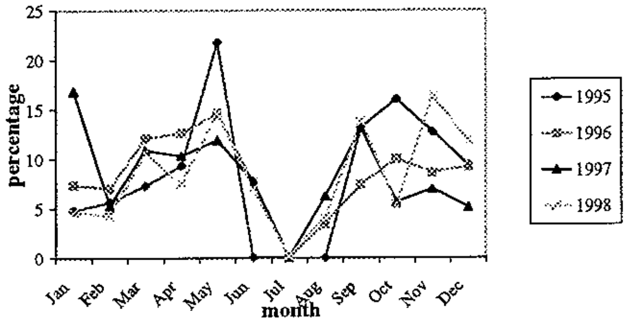
Relative landings of cod from Subdivision 25 according to month, Latvia



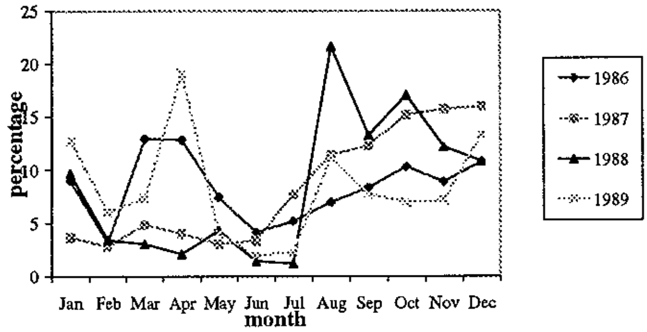
Relative landings of cod from Subdivision 25 according to month, Poland



Relative landings of Baltic cod from Subdivision 25 according to month, Poland



Relative landings of cod from Subdivision 28 according to month, USSR



Relative landings of cod from Subdivision 28 according to month, Latvia

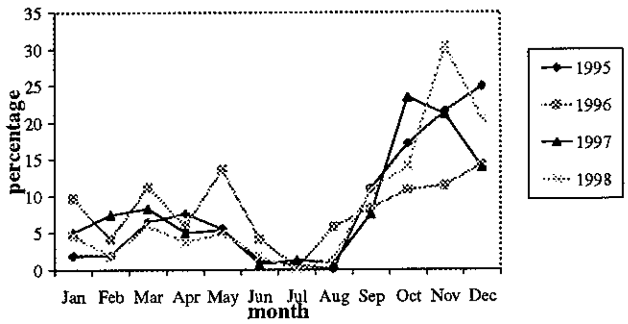
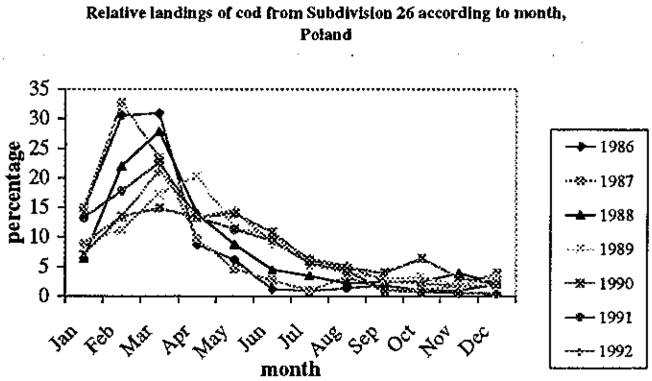
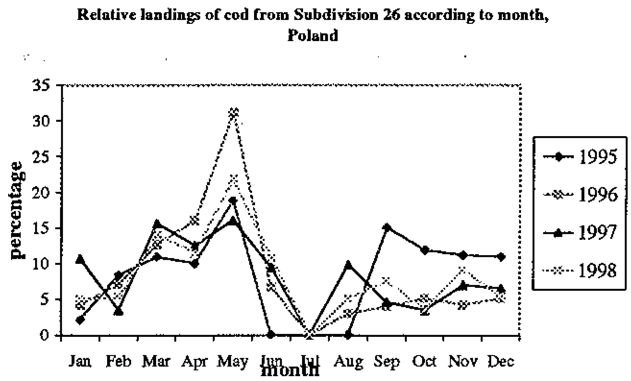
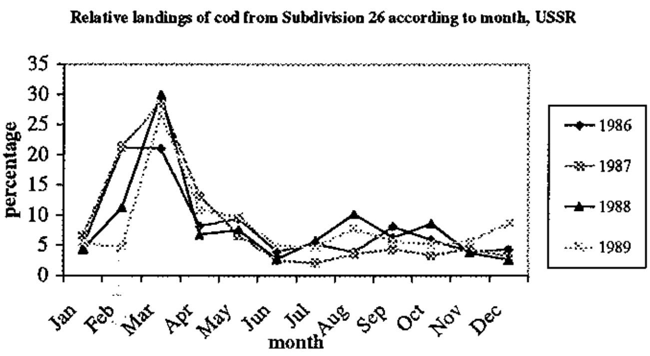
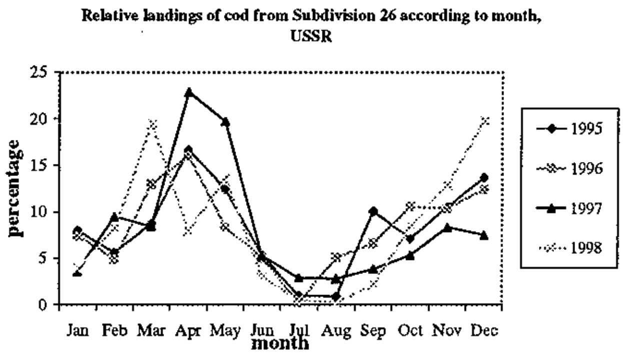


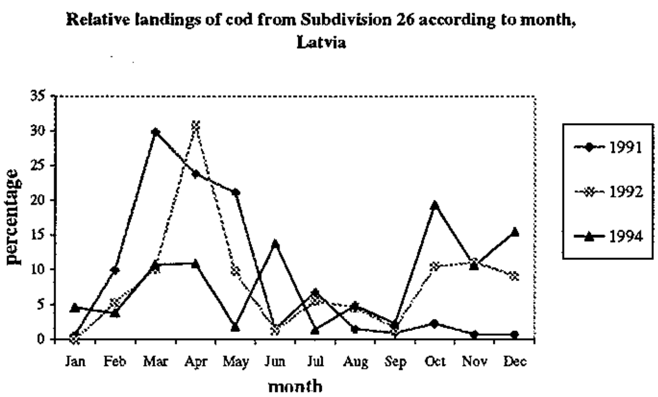
Figure 3.13.12.5.2 Continued. Relative landing level of cod caught in different Sub-divisions by different countries according to month and year.











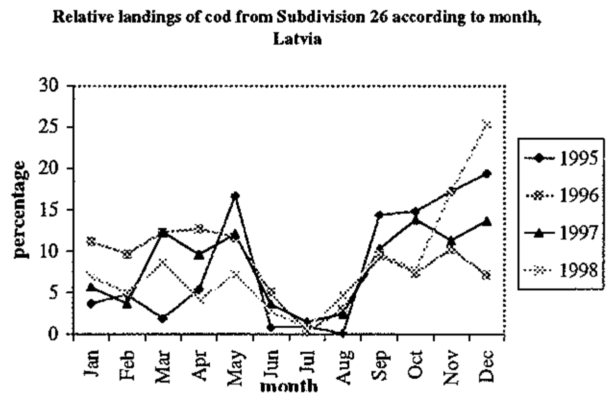


Figure 3.13.12.5.3 Shift of peak spawning time of central Baltic cod and three-months interval chosen for calculation of adjusted Reproductive Volume. Dotted circles: less certain estimates (from Wieland *et al.*, 1999).

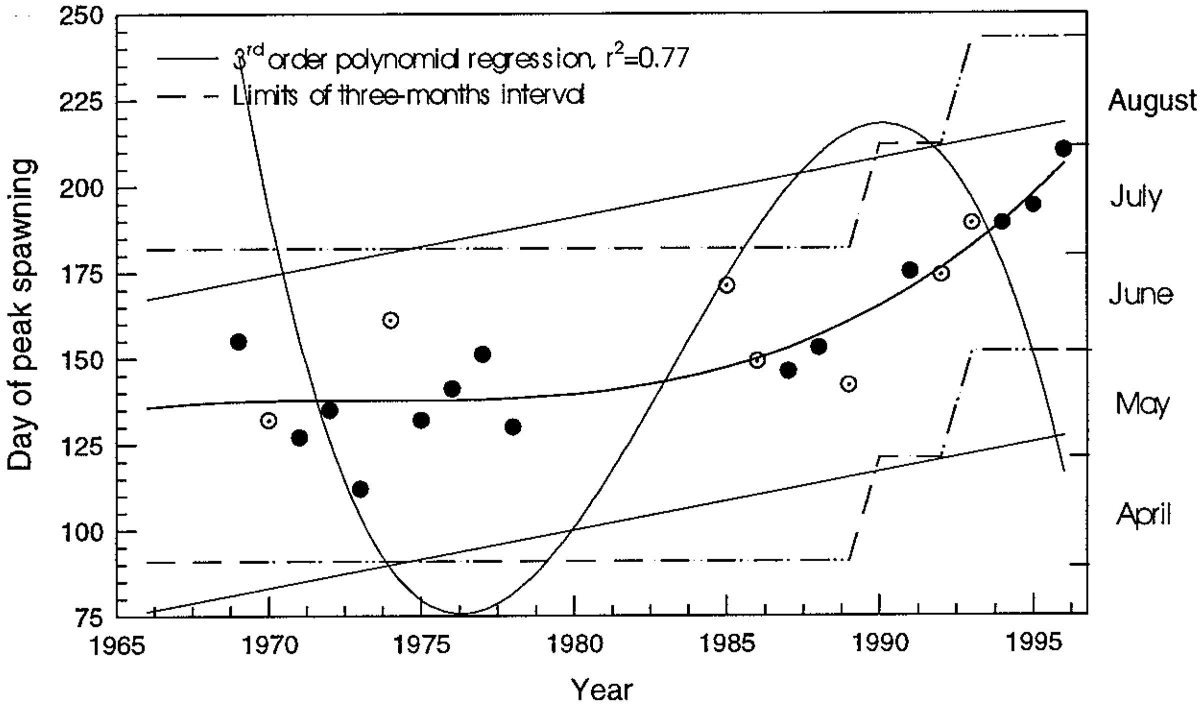


Figure 3.13.12.5.4 Effort, landings and CPUE according to month in different fisheries directed to cod, Sub-division 25 (CPUE) given for effort> 100 fishing days).

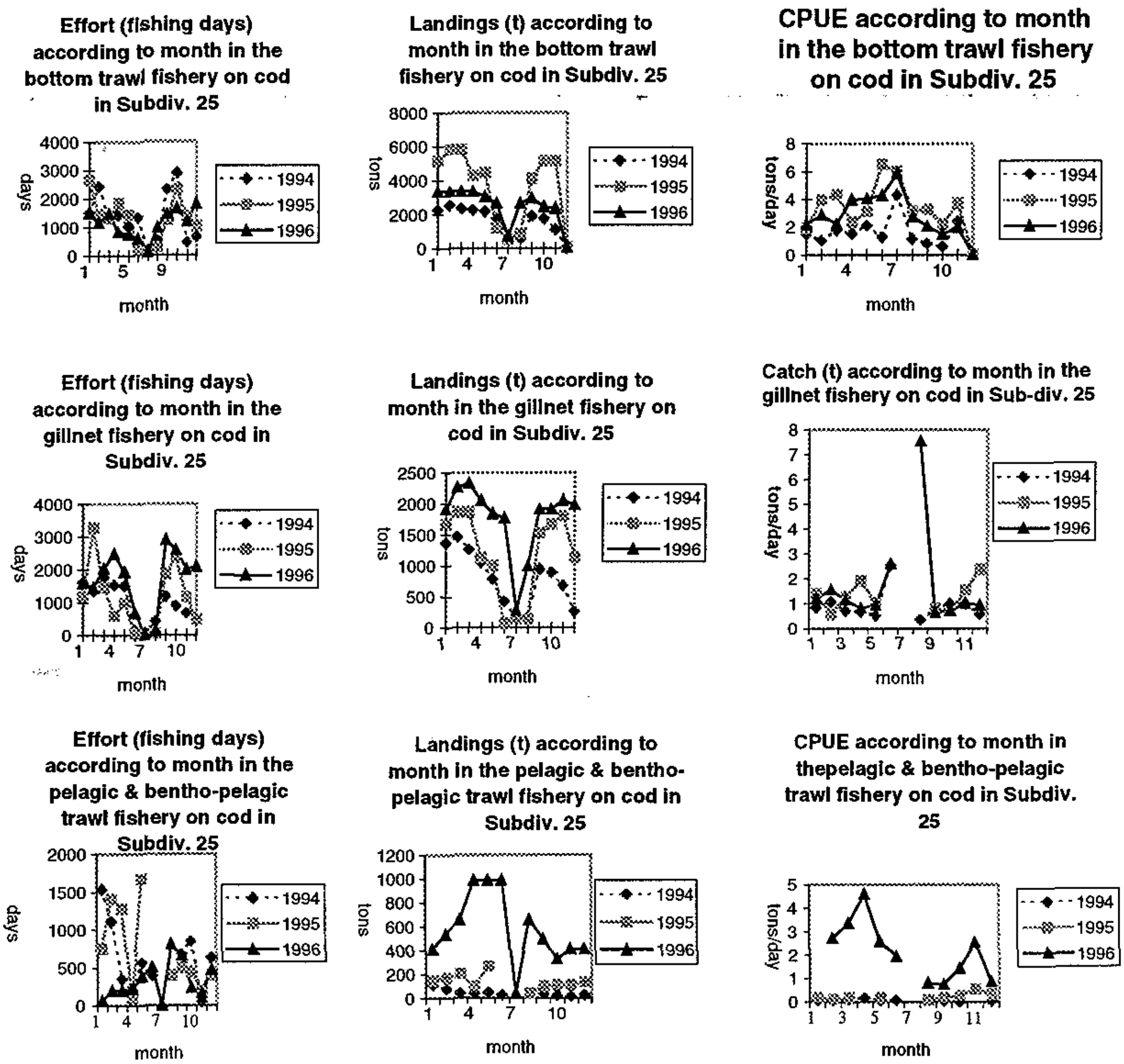
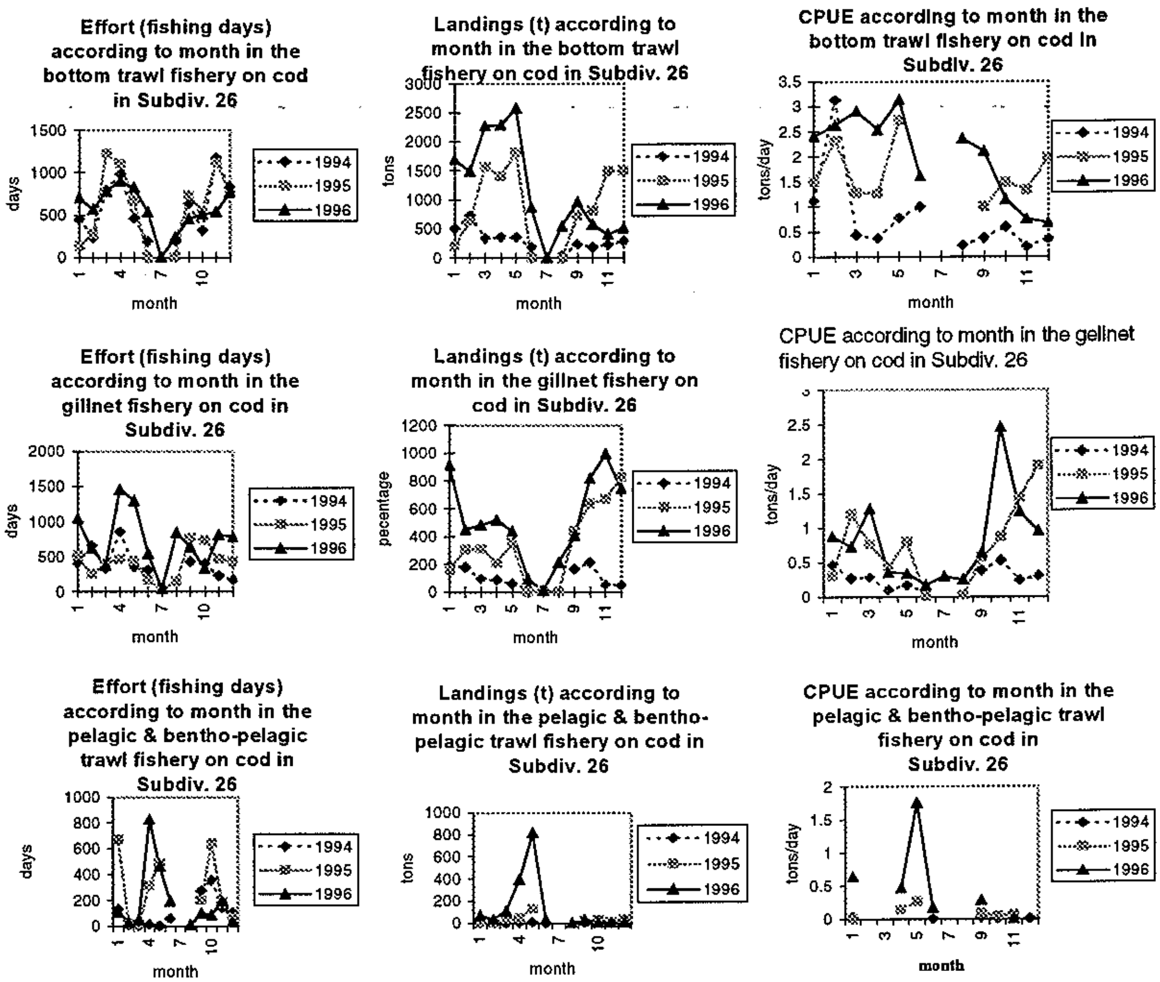


Figure 3.13.12.5.4 continued. Effort, landings and CPUE according to month in different fisheries directed to cod, Sub-division 26 (CPUE) given for effort> 100 fishing days).



3.13.12.6 Closed areas during cod spawning season in Gotland and Gdansk Deeps

IBSFC has requested ICES to:

"advice on appropriate timing and delineation of areas in the Gotland and Gdansk Deeps with the objective to establish closed areas during the cod spawning season".

The Bornholm Basin, the Gdansk Deep and the Gotland Basin cod are the principal spawning areas of the eastern Baltic cod stock. The salinity and oxygen conditions mainly define the spawning habitat of this stock as well as the water volume suited for egg and larval development. Salinity above 11 PSU are necessary to enable cod eggs to reach neutral buoyancy and an oxygen content above 2ml/l in the water volume in which the eggs float is further required for successful egg development. These conditions are potentially met in the central part of these basins (i.e. in the Bornholm Basin deeper than 60m - in the Gdansk Deep deeper than 80m and in the Gotland Basin deeper than 90m) where cod spawning takes place. However, the oxygen conditions in the eastern spawning areas are unfavourable for egg survival and development during stagnation periods. The conditions for successful egg development have been very limited in the Gotland Basin and Gdansk Deep since 1986. The hydrographic conditions may not only affect the areal distribution of cod spawning aggregation, but also the vertical distribution as a lack of oxygen at the bottom can result in pelagic aggregations of spawning cod in the mid water layer just below the halocline. During the recent stagnation period pelagic aggregations of spawning cod have been abundant in all spawning areas. The size and distribution of the spawning stock component and thus the potential egg production in the various areas has changed over time. At present the spawning stock in Sub-division 28 (central Gotland Basin) is very low.

The combination of decreasing egg production and low egg survival explains the low abundance of egg and larval in the Gdansk Deep and especially the Gotland Basin throughout the 1990s (Figure 3.13.12.6.1) as well as in most recent years (Figure 3.13.12.6.2). As a result, the Bornholm Basin is at present the main spawning area of the eastern Baltic cod stock.

At the present stagnant period a closing of the Bornholm area (e.g. areas deeper than 60 m) appears to be the most efficient way of ensuring a maximum egg production. However, the inter-annual variability in the distribution pattern of the spawners and surviving offspring makes it extremely difficult to define appropriate closures within specific spawning areas.

The spawning time of the eastern Baltic cod stock is very extended, i.e. from March to August – in some years extended into September. According to ichthyoplankton surveys conducted regularly in the Bornholm Basin, the *main spawning season lasts approximately 3 months.* Peak egg abundance was observed in May / early June in the 1970–80s, while a successive shift to later month was observed in the 1990s with highest egg abundance encountered from late June to late July. The timing of spawning seems to be relatively similar in the three main spawning areas (Figure 3.13.12.6.3) The females generally started spawning in April and continued at least into August with the majority being in spawning condition in June-July. Males reach generally spawning condition earlier and aggregate earlier in the spawning areas than females.

Source of information: Report of the Baltic Fisheries Assessment Working Group, April 1999 (ICES CM 1999/ACFM:15).

Figure 3.13.12.6.1 Egg and larval abundance of Central Baltic cod in different subdivisions.

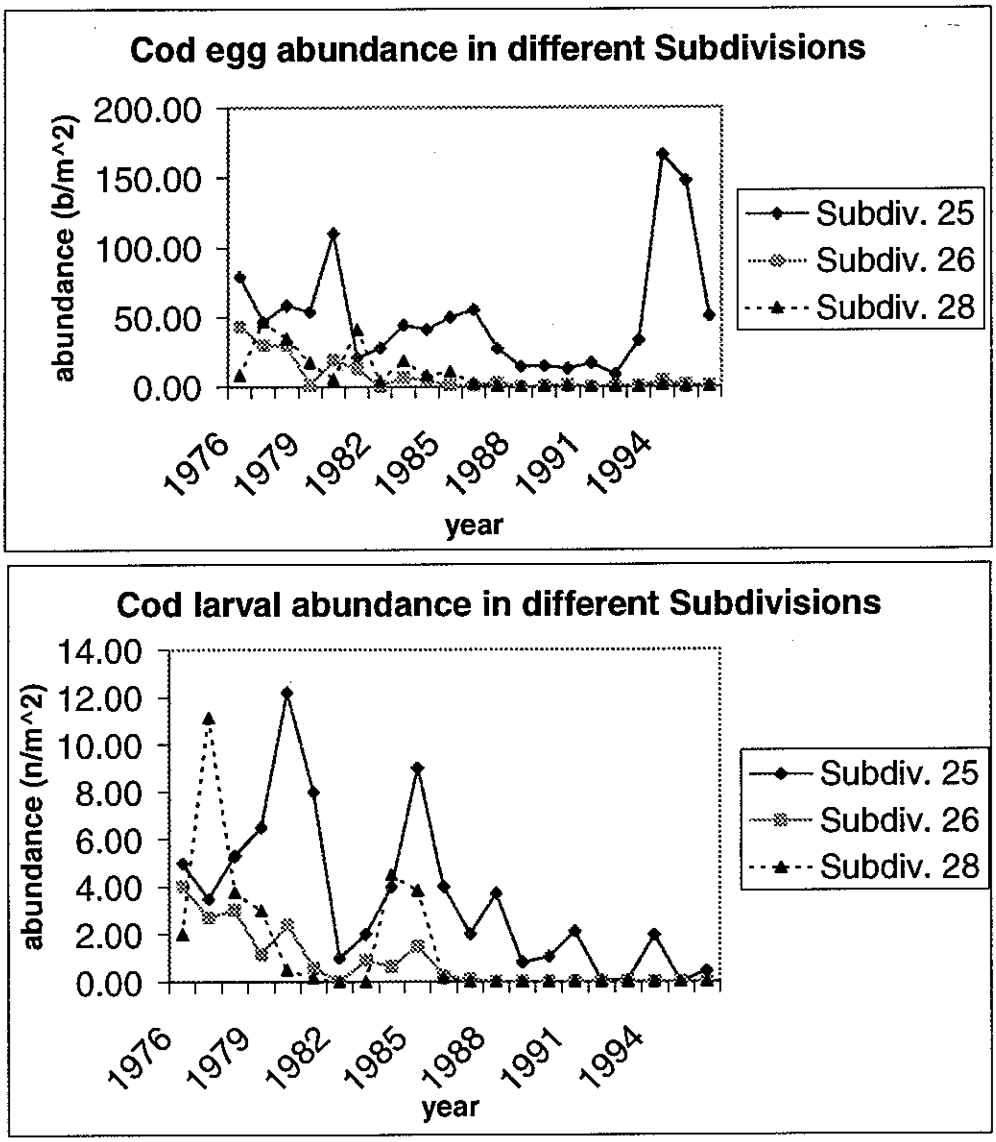


Figure 3.13.12.6.2 Distribution of cod eggs (number per m^2) in the eastern Baltic Sea in July-August 1996–1998, R/V "Alkor".

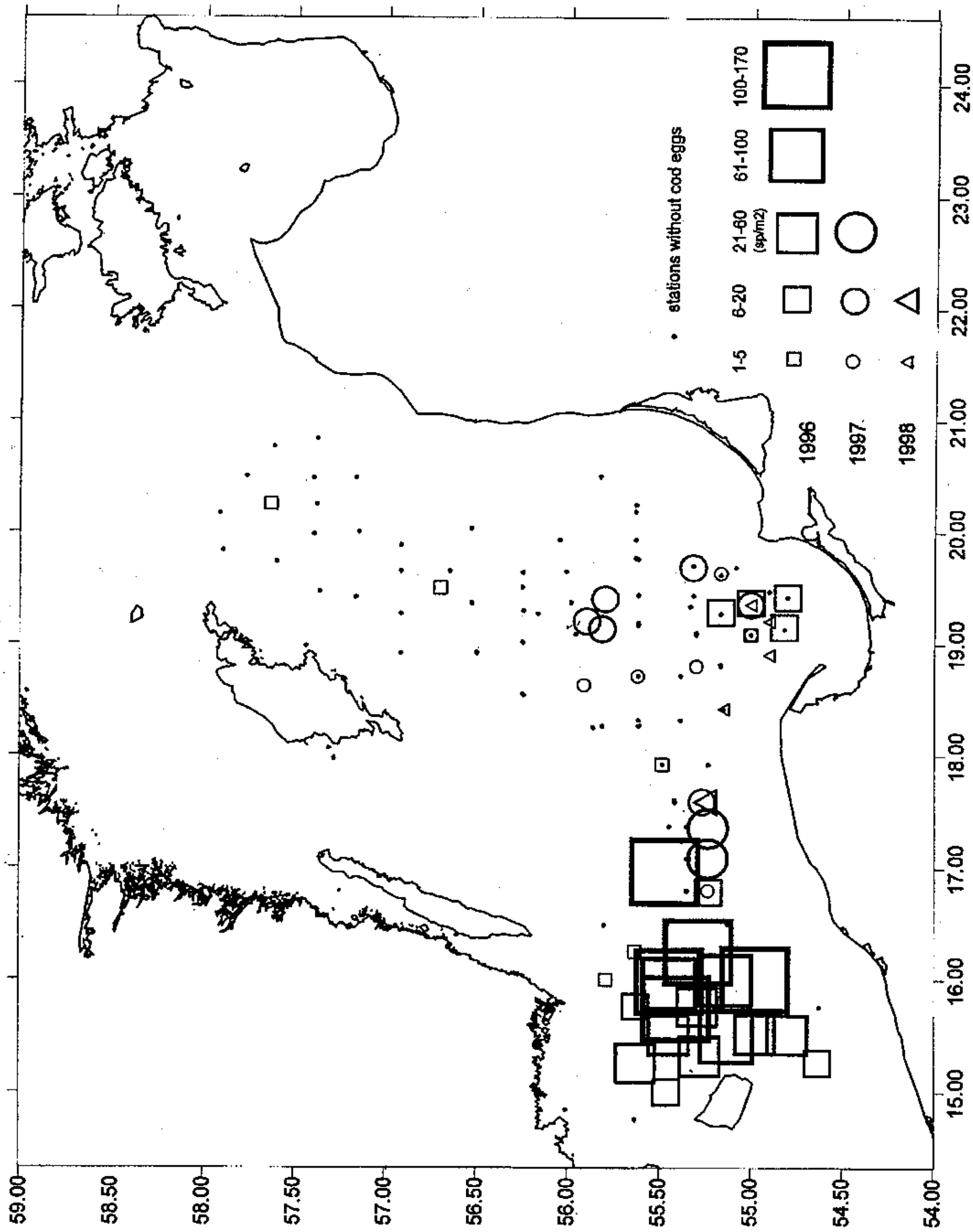


Figure 3.13.12.6.3.a. Proportion per maturity stage for females and males during the prespawning and spawning period in Sub-division 25 from surveys with R/V Dana and R/V Alkor in 1995 and 1996. The maturity stage spawning include the early and progressed spawning phases, end of spawning indicate that the sex products are almost spent, and the spent indicate specimens with gonads in recovery phase.

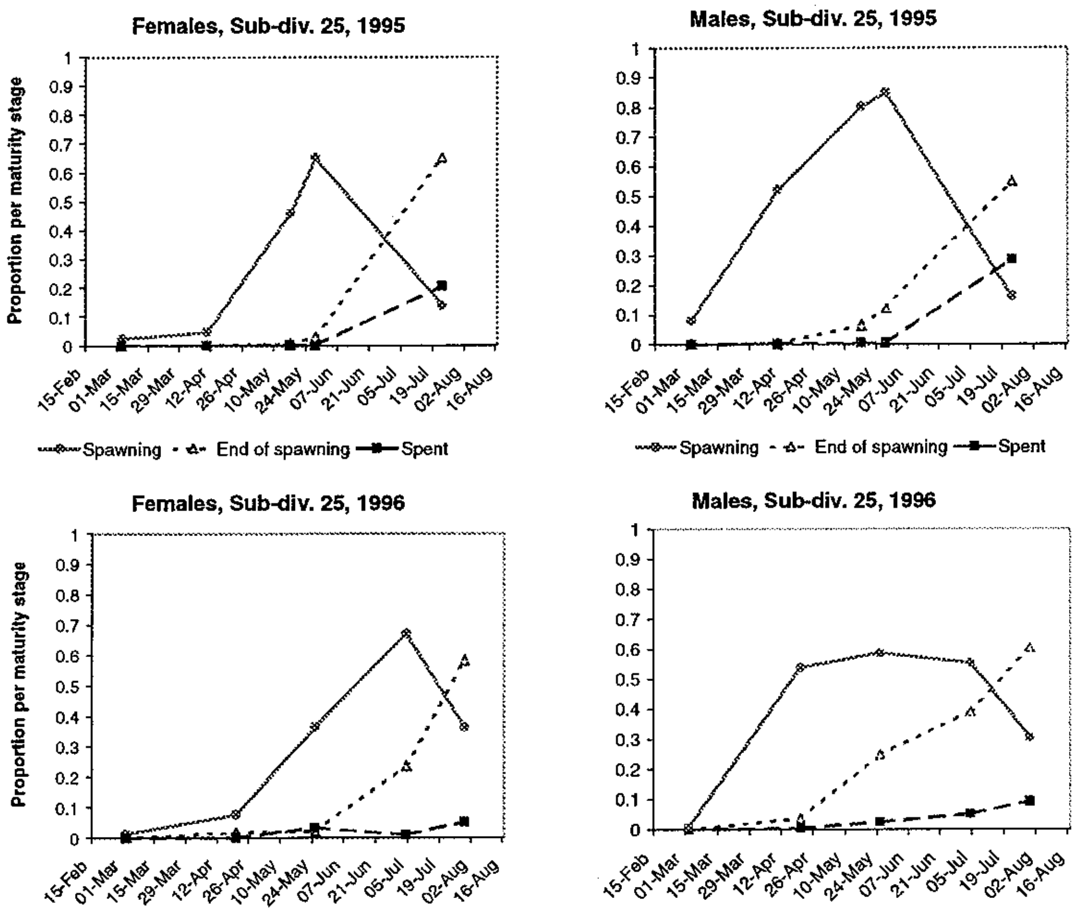
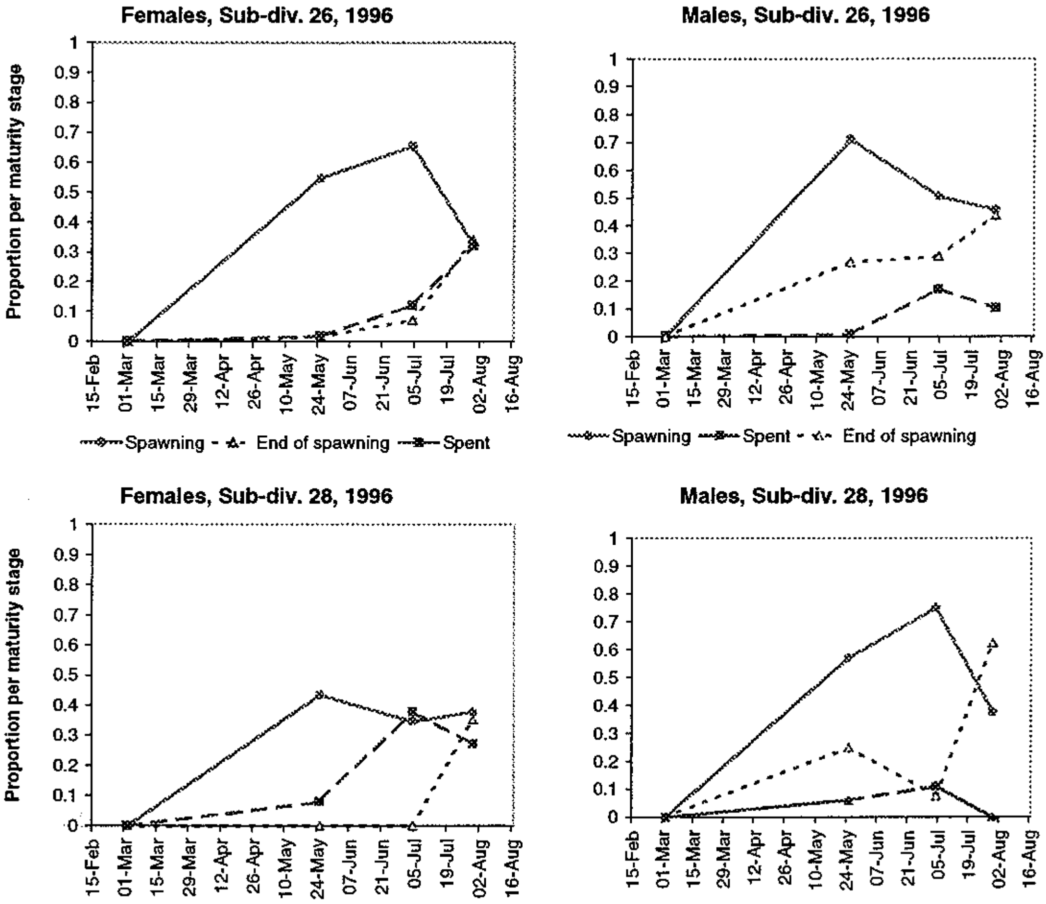


Figure 3.13.12.6.3.b Proportion per maturity stage for females and males during the prespawning and spawning period in Sub-division 26 and 28 from surveys with R/V Dana and R/V Alkor in 1996. The maturity stage spawning includes the early and progressed spawning phases, end of spawning indicates that the sex products are almost spent, and the spent indicates specimens with gonads in recovery phase.



3.13.12.7 Likely effect on cod stock from banning fishing in cod spawning areas

IBSFC has requested ICES to:

"Report on the likely effects on the cod stocks from banning fishing – either in total or cod fishing only – in the spawning area (the Bornholm Box and the Gotland and Gdansk Deeps)".

The Bornholm Basin is presently the only spawning area in the Central Baltic Sea where cod is regularly reproducing successfully as the spawning in the Gdansk Deep is to a large extend unsuccessful under stagnation conditions. In the Gotland Basin, the situation for successful spawning is even worse than in the Gdansk Deep and spawning activity in the Gotland Basin has been very low since the end of the 1980s. It may even be questioned whether the egg production is still sufficient to utilise even favourable environmental conditions. If the objective of closing a specific area would be to ensure maximum egg production in an area with suitable reproductive conditions, the obvious candidate for a closed area during stagnation periods would be the Bornholm Basin (e.g. areas deeper than 60 m).

According to results obtained by ichthyo-plankton surveys in the Bornholm Basin during the period 1986–96, high egg abundance was found mainly in the Central part of the Bornholm Basin at water depths exceeding 75m. In 1990–96, the egg production in the closed area in the Bornholm Basin, the **Bornholm Box** (55°30N–15°30E, 55°30N–16°10E, 55°15N–16°10 and 55°15N–15°30E) during the ban period (15 May to 20 August) varied between 3 and 32% based on the observed youngest egg stage abundance. For the years 1994–96, the proportion was lower (3–14%) than for the former period (17–32%) due to a change in vertical and horizontal distribution pattern caused by the 1993 inflow. This high spatial variability in observed egg abundance and production depends on hydrographical features influencing the spatial distribution of the spawning stock, the vertical distribution of eggs, and the drift pattern of the offspring.

In conclusion, the inter-annual variability in the distribution pattern of the spawners and surviving offspring makes it extremely difficult to define appropriate closures within specific spawning areas.

In case of inflow events, the extension and location of suitable areas will depend on the magnitude of the inflow, the wind forcing and the salinity of the inflowing water in relation to the bottom water. It is possible to predict whether an inflow will reach eastern spawning areas, however, prediction about whether water masses will turn South into the Gdansk Deep or North into the Gotland Basin is difficult. Timing of spawning is in this respect also important, as it will affect the potential of the stock to utilise environmental conditions conducive for egg survival. Since oxygen consumption rates are high in bottom water layers of the Central Baltic, the oxygen introduced by inflows in the beginning of the year may have been consumed to a considerably extent before the cod spawning season starts.

In conclusion, it is unlikely that banning fishing for cod in the Gdansk Deep and in the Gotland Basin will have direct positive consequences on the reproductive success of the spawning aggregations in those areas. However, opening the fishery on those aggregations while closing the Bornholm Basin would be expected to have negative effects by further reducing the size of the aggregation spawning in the Gotland Basin. Opening the Bornholm area while closing the others could have negative effects if fishing effort were reallocated to the Bornholm Basin.

Overall ICES does not consider the closure of specific spawning areas as an adequate alternative to closed seasons.

3.13.12.8 Catches of juvenile herring, sprat and cod in small meshed fisheries

IBSFC has requested from ICES that:

"The assessment of the herring and cod stocks should include a review of the information (including maps of distribution) on juvenile herring, sprat and undersized cod taken in small mesh fisheries and an evaluation of the effects of these catches".

Immature herring and immature sprat in small mesh fisheries

The share (in % of numbers) of immature herring in Sub-divisions 25–29, 32 and immature sprat in Sub-divisions 22–32 in 1974–1998 is presented in Table 3.13.12.8.1. The table shows significant fluctuations between years in the amounts of immature sprat varying between 10 and 65 % of total catch. The fluctuations are determined by the strength of the sprat year classes that may fluctuate considerably in different years. The share of immature sprat varies significantly by Sub-divisions as well, and reaches the greatest values in Sub-division 22 (Table 3.13.12.8.2). The share of immature herring in the total stock is more stable compared to sprat (Table 3.13.12.8.3). This results from low fluctuations of herring year class strength. As shown in the Table 3.13.12.8.4, the smallest amount of immature herring in years 1997–1998 was observed in Sub-division 27 and the greatest one in Sub-division 32.

Information on juvenile herring and sprat in Polish small mesh fisheries investigations

Juvenile herring and sprat always occur in the catches of small mesh fisheries; these fisheries are mostly for sprat. In the Polish investigations conducted in Sub-division 26 classified as juvenile herring fish below 17 cm and as juvenile sprat fish below 10 cm.

Samples were taken on board of fishing cutters, large trawlers catching for industrial purposes and on a research vessel. Juvenile fish is especially abundant in industrial catches. In Subdivision 26 up to 63 % in weight of catch has been observed to be juvenile herring (Table 3.13.12.8.5). Juveniles are unevenly distributed; the amount of juveniles was approximately 2–3 times higher in catches on coastal fishing grounds compared to the open sea catches (Table 3.13.12.8.6). Occurrence of juvenile herring increases especially in the IV and I quarter of the year when young and older fish form mixed shoals and the sprat fishery intensifies (Tables 3.13.12.8.7 and 3.13.12.8.8).

Taking into account the present sprat fishery, the amount of juvenile herring taken in this fishery may significantly reduce the recruitment to the stock and especially to the coastal herring population that is presently at a low level.

Information on undersized cod taken in Polish small mesh fisheries

Undersized cod were sampled at sea on Polish cutters catching sprat and herring in 1998. The minimum landing size for cod is 35 cm. In total 46 hauls were investigated. The results are presented in Table 3.13.12.8.9. The amount of undersized cod in combined bottom and pelagic herring and sprat hauls was very low and amounted to 0.16 % in weight. The catch in pelagic hauls of herring and sprat consisted of only 0.03 % of undersized cod in weight. The amount of undersized cod in bottom hauls varied with the trawling depth. The catch in bottom hauls made deeper than 50 m contained only on average 0.08 % of undersized cod in weight. However the bottom hauls made below 50 m contained 2.06 % of undersized cod in weight. A more comprehensive data set on undersized cod in small mesh fisheries is expected as a result of the ongoing EU project (International Baltic Sea Sampling Programme for Commercial Fishing Fleets).

Table 3.13.12.8.1 The share of immature sprat in the sprat fishery according to years in 1974–1998 (SD 22–29, 32).

Year	Total catch in numbers (millions)	The share immature in % of numbers			
		Age groups			
		0	1	2	Total
1974	18731.0	0.18	13.96	9.89	24.02
1975	13311.0	0.94	4.72	4.58	10.24
1976	13691.0	1.57	34.20	1.79	37.56
1977	16420.0	0.63	14.44	15.35	30.42
1978	11100.0	0.87	4.50	8.99	14.36
1979	6114.0	0.83	21.92	2.93	25.68
1980	4489.0	0.78	8.22	9.86	18.86
1981	4475.0	0.58	51.46	6.17	58.21
1982	3900.0	0.62	9.31	18.92	28.85
1983	3117.0	3.37	59.42	2.86	65.64
1984	4516.0	1.68	22.25	15.90	39.83
1985	5687.0	1.14	9.95	8.98	20.08
1986	5787.0	0.55	8.55	5.92	15.03
1987	6584.0	0.06	11.83	1.80	13.69
1988	6562.8	2.76	1.19	12.32	16.27
1989	6350.0	1.85	33.10	1.37	36.32
1990	6404.0	1.09	16.38	14.85	32.33
1991	7917.1	4.95	13.18	10.04	28.17
1992	10938.0	4.53	16.29	8.06	28.88
1993	14358.5	0.33	12.76	11.88	24.97
1994	24882.0	2.22	4.34	9.85	16.40
1995	29073.3	2.67	21.92	2.42	27.00
1996	53271.7	0.13	15.75	15.59	31.47
1997	63337.7	3.12	2.71	10.98	16.82
1998	58741.6	0.38	18.76	1.94	21.08

Table 3.13.12.8.2 The share of immature sprat in % of numbers in sprat fishery according to sub-divisions.

Year	**Sub-divisions**									
	22	24	25	26	27	28	29	30	31	32
1997	79.4	59.2	14.7	16.9	19.8	14.8	15.6	10.2	5.6	12.7
1998	87.4	15.0	17.8	30.5	5.9	29.6	22.7	6.5	7.8	35.4

Table 3.13.12.8.3 The share of immature herring in herring fishery according to years in 1974–1998 (SD 25–29cl. Gulf of Riga).

Year	Total catch in numbers (millions)	The share immature in % of numbers				
		Age groups				
		0	1	2	3	Total
1974	9481	0.28	28.89	5.88	1.47	36.52
1975	8742	0.64	22.58	6.15	1.94	31.31
1976	8282	0.25	30.42	4.90	1.69	37.25
1977	7576	0.26	17.53	10.74	1.21	29.74
1978	6538	1.32	17.68	6.41	3.03	28.43
1979	5815	0.88	8.29	7.08	1.68	17.92
1980	5656	1.43	20.12	5.48	1.90	28.94
1981	6230	1.09	22.28	8.17	1.27	32.81
1982	5988	1.10	15.81	11.89	1.55	30.35
1983	6628	0.47	11.98	8.71	3.04	24.19
1984	6279	0.96	13.79	6.35	2.45	23.55
1985	7463	0.40	16.90	9.68	1.72	28.69
1986	6559	0.00	8.57	8.42	2.82	19.80
1987	6386	0.16	15.50	3.64	2.44	21.74
1988	6673	0.57	7.19	10.29	1.29	19.34
1989	7050	1.74	12.11	2.50	3.52	19.88
1990	5967	0.76	12.26	6.43	1.09	20.54
1991	6234	1.84	7.90	8.69	2.21	20.64
1992	7182	2.78	17.59	6.18	2.88	29.42
1993	8287	1.41	12.29	8.09	2.17	23.96
1994	7864	2.17	8.28	5.44	2.45	18.35
1995	8530	0.82	12.34	4.49	2.47	20.12
1996	8678	0.90	16.30	6.54	1.59	25.33
1997	9418	1.67	8.00	7.27	2.44	19.37
1998	9917	0.92	21.30	3.72	2.33	28.28

Table 3.13.12.8.4 The share of immature herring in % of numbers in herring fishery according to sub-divisions.

Year	Subdivisions						Total
	25	26	27	28	29	32	
1997	14.4	24.0	4.3	11.4	17.0	24.9	19.0
1998	25.6	28.7	6.5	16.8	29.6	45.8	29.5

Table 3.13.12.8.5

The share of juvenile herring and sprat according to Polish investigations in Sub-division 26 in I quarter of 1998 resulted from research, consumption and industrial catches.

Date	Type of catches	Juvenile fish in % of weight	
		sprat	herring
Catches below the parallel $54^{0}50$ N - shallow waters			
07.01.98	consumption	3.4	
16.01.98	research	30.0	
21.01.98	research	25.9	
02.02.98	research	1.5	9.0
02.02.98	research	47.9	0.3
03.02.98	research	27.4	33.6
03.02.98	research	17.1	33.6
Catches on the parallel $54^{0}50$ N and above - open sea waters			
15.01.98	consumption	0.0	77.6
03.02.98	research	58.4	5.8
04.02.98	research	2.2	1.1
06.02.98	research	6.1	2.4
13.02.98	industrial	63.3	?
13.02.98	industrial	61.5	?
14.02.98	industrial	54.7	?
14.02.98	consumption	25.2	19.8
20.02.98	industrial	20.0	
22.02.98	industrial	18.0	
24.02.98	consumption	10.7	16.7
25.02.98	consumption	10.4	2.0
25.02.98	consumption	20.4	0.9
25.02.98	consumption	9.3	2.0
25.02.98	consumption	5.1	0.0
04.03.98	consumption	0.7	33.4
08.03.98	consumption	4.1	9.1

Table 3.13.12.8.6

The share of juvenile herring and sprat in Polish consumption catches of sprat in Subdivision 26 in IV quarter of the years 1995-1997.

Year	No of samples		Juvenile fish in % of weight	
	Herring	Sprat	Herring	Sprat
Catches below the parallel $54^{0}50$ N - shallow waters				
1995	3	3	12.9	24.8
1996	6	7	18.3	11.9
1997	6	9	10.2	21.0
Catches on the parallel $54^{0}50$ N and above - open sea waters				
1995	9	18	6.8	1.8
1996	19	25	6.0	2.0
1997	15	26	7.0	8.5

Table 3.13.12.8.7 The share of juvenile herring in Polish landings of sprat in Subdivision 26 in the years 1995-1997 (tonnes, %).

Year	1995			1996			1997			The average
Months	Nominal catch	juvenile herring		Nominal catch	juvenile herring		Nominal catch	juvenile herring		
	sprat (t)	(t)	(%)	sprat (t)	(t)	(%)	sprat (t)	(t)	(%)	(%)
I	2077	91	4.4	4717	290	6.1	9511	517	5.4	5.3
II	2773	136	4.9	5245	286	5.5	9035	406	4.5	5
III	4105	190	4.6	9642	1000	10.4	18954	843	4.4	6.5
IV	4386	186	4.2	6867	355	5.2	14912	627	4.2	4.5
V	3673	171	4.7	4473	239	5.3	2860	129	4.5	4.8
VI	854	36	4.2	1147	64	5.6	872	62	7.1	5.6
VII	239	19	7.9	956	52	5.4	707	26	3.7	5.7
VIII	201	26	12.9	338	20	5.9	607	22	3.6	7.5
IX	450	16	3.6	811	42	5.2	806	33	4.1	4.3
X	809	68	8.4	2413	165	6.8	648	71	11.0	8.7
XI	1063	152	14.3	4733	392	8.3	5604	571	10.2	10.9
XII	2279	193	8.5	3988	548	13.7	4669	382	8.2	10.1
Total/Average	22909	1284	5.6	45330	3453	7.6	69185	3689	5.3	

Table 3.13.12.8.8 The share of juvenile herring in Polish sprat landings in Subdivision 26 according to quarters in the years 1995-1997 (tonnes, %).

Quarter/Year	1995 Juvenile herring		1996 Juvenile herring		1997 Juvenile herring		Average 1995-1997 Juvenile herring	
	(t)	(%)	(t)	(%)	(t)	(%)	(t)	(%)
I	417	32.5	1576	45.6	1766	47.9	1253	44.6
II	393	30.6	658	19.1	818	22.2	623	22.2
III	61	4.7	114	3.3	81	2.2	85	3
IV	413	32.2	1105	32	1024	27.7	847	30.2
Total	1284	100	3453	100	3689	100	2808	100
Sprat landings (t)	22909		45330		69185		45808	
Juvenile herring (%)	5.6		7.6		5.3		6.1	

Table 3.13.12.8.9 The share of undersized cod taken in the Polish small mesh fisheries in 1998.

	Combined bottom and pelagic hauls	Pelagic hauls	Hauls on bottom below the depth of 50 meters	Hauls on bottom above the depth of 50 meters
Cod undersized in total catch of herring and sprat in % of weight	0.16	0.03	2.06	0.08

3.13.12.9 Mid-term revision of Baltic cod TAC

IBSFC has put the following request to ICES:

"The TAC's are set on information that is more than 8 months old when the TAC year begins. This is a particular problem for the cod TAC. ICES is requested to consider changes in its advice procedures that would allow more updated information to be included in the cod TAC advice or in a mid-season revision procedure of the cod TAC. Such revision procedure should take into account the seasonality of the fishery."

At the 11th Dialogue Meeting (Nantes) IBSFC joined the general wish among Commissions for ICES to be more flexible with respect to the timeliness of the advice. This wish was again repeated at the IBSFC Working Group Meeting in Visby 27–30 April 1999.

ICES is presently discussing a change in its advisory procedures that will allow a more flexible response to Commission requests including requests for in-season revisions. If approved at the ASC meeting in September 1999, the proposal could be implemented rapidly. Hence, it could be possible for ICES to meet IBSFC's request from 2000 onwards depending on the data required to advise on the revision of the cod TAC.

Technically such a revision should be based on

- Fisheries data for the most recent year available in March the following year
- Results from the March survey in the TAC year

A revision could be made at any point in time but should be based on additional data to the assessment such as data mentioned above. It therefore seems that updated advice for the current year technically would be feasible in April, at the time the Baltic Fisheries Assessment WG currently meets. ICES could therefore routinely provide preliminary advice for the year "y+1" and updated advice for the current year for cod, but also possibly for the other stocks if that was felt desirable by the IBSFC.

The following paragraph presents a proposal for an ICES procedure. This procedure however relies on how IBSFC would implement such a revision. The proposal is therefore presented for discussion with IBSFC.

1. ICES advises in April for a preliminary TAC for the following year and an updated TAC for the current year.

2. IBSFC adopts a preliminary TAC in September at its annual meeting for the following year, subject to a revision clause. In order to avoid downward revisions, this initial TAC would be set below the expected total TAC in conformity with a similar procedure used in capelin management. The capelin procedure uses 2/3 of the total expected TAC for setting the initial TAC.

3. IBSFC adopts around mid-April the following year a TAC revision on the basis of additional scientific advice. In order to have a smooth system the revision should be based on simple and objective criteria.

4. The revision rule adopted by IBSFC would be based on summary results from survey and CPUE from selected components of the commercial fishery. An example of the components in such a revision rule could be

   - The revised TAC should not be more than x % above or below the total expected TAC. If the initial TAC is set below the expected TAC it could be possible to avoid a downward revision compared to the decision in September.
   - The revision clause is based on prediction of the CPUE and survey results. The ICES assessment presented in September will be expanded to include such predictions.
   - If the observed results from the fishery and the survey are within y % of those predicted, the advice presented in September would not be modified, if more then the changed is pro rated up/down to x %.

3.13.12.10 Review and evaluation of present salmon management measures

Answer to a request from the IBSFC (item c):

"to review and evaluate the effectiveness of 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 salmon rivers has been treated in the preceding 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 3.13.12.10.1 gives an overview of the current status in these rivers. The information available is not yet sufficient to apply to all rivers in 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 realised before the salmon are caught. Closing the driftnet fishery between 1 June and 30 September 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) reduces 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 maximum allowed amount 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 3.13.12.10.1). Some nations have closed their fishery before the end of the year as their TAC allocation was fully utilised. 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 regulations have a positive effect on wild salmon conservation.

The TAC for the Gulf of Finland is more than twice the forecast returns, and at its present value, is not yielding any conservation benefits for wild stocks.

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 3.13.12.10.1). 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 (12 m when away from harbour for more than 24 hours).

Fishing rules cover mainly the offshore fishery with larger vessels. As the salmon fishery often takes 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.

e. Information on fishing effort should, wherever possible, be obtained for all components of salmon fisheries. In order to keep track of the development of the 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 share of wild salmon is the largest. These regulatory measures were strengthened beginning in 1996–1997 to further increase escapement into the rivers. The proportion of catch taken in rivers is the highest in the last three years. Recaptures of salmon tagged during the spawning migration in the northern Main Basin and Gulf of Bothnia support these findings. The proportion of wild salmon among the tagged fish were higher than would be expected on the basis of assumed wild smolt production. In the recoveries of the tagged fish the number of reared fish is higher compared to that during tagging. This shows that exploitation rates of reared salmon were higher than that of wild salmon. The mean date of catch of wild and reared fish is different. Wild salmon are caught considerably earlier than reared fish. The fish for tagging were to a large extent caught during the period when the normal fishery was not permitted. The time closure in the coastal fishery was to safeguard early migrating (wild and old) fish. The results suggest that this measure was effective especially in allowing wild fish to escape from the coastal fishery into rivers. In some countries there are fishery closures near the mouths of salmon rivers. Without these closures, salmon approaching and/or entering the rivers will be harvested.

At the fishing sites furthest away from the coast, seals interfere with salmon fisheries to such a high degree that the profitability and fishing effort in these fisheries has decreased. 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 1998 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. The decreased spawning run in wild salmon rivers in 1998 suggests a reduction in reproduction. However, the 1996 and 1997 spawning run was good particularly due to the exceptionally strong 1991 year class. 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 the effect of the river regulatory measures. The status of several salmon populations is still so weak that continued strict restrictions are also needed in river fisheries to safeguard the populations and allow them to increase to the target level.

Delayed release as a management instrument

On the Swedish west coast some concern have been expressed over the presence of typical Baltic salmon, i.e., they are larger than normal salmon at the west coast and the flesh is typically pale as in the Baltic area. Evidence from recaptures of tagged salmon, indicate that these salmon emanate from the Danish experiments with delayed release at the Island of Møn and at the Island of Bornholm. In the southern part of the Swedish west coast about 2–5% of the total catch have been estimated to be Baltic salmon before 1997, but in 1997 more than 15% of the coastal catch in numbers and some more in weight were believed to be of Baltic origin. The proportion decreased to about 9% in 1998. It has also been stated by local anglers that more than 10% of the salmon catch in some rivers in 1997 and 1998 was of Baltic origin.

Tagging data shows that from the releases at Møn about 4% of the recaptures were reported from outside of the Baltic area, while from taggings at Bornholm they were almost 1.8%. Using these tagging data combined with number of fish released it could be estimated that at least 480 fish were taken in rivers outside of the Baltic area.

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 national regulations in coastal and river mouth fishery, 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. Coincidentally, the number of salmon entering rivers with dams 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 1999 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. However, a part of this surplus falls into non-reported catches and discards due to seal damages. 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 management measures 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 22–31. 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. It is particularly urgent that national conservation programmes to protect wild salmon be enforced around the Gulf of Finland.

Table 3.13.12.10.1 Current status of restoration programs in Baltic potential salmon rivers.

No	River	Description of river						Restoration programme			Results of restoration		
		Country	ICES sub-division	Old salmon river	Cause of wild salmon population extinction	Potential production areas (ha)	Potential wild salmon smolt production (num.)	Measures	Releases	Origin of population	Spawners in the river	Parr production	Smolt production
2	Sangis älv	S	31	yes	1,2	6	1200- 1700	e	4		*	*	*
9	Kåge älv	S	31	yes	3,4	39	7700- 11600	a,f,j,n	2	Byskealven	yes	>0	?
14	Hörnån	S	31	no?	*	15	2700- 4100	e	4		*	*	*
18	Moälven	S	31	yes	3,4	*	*	e	4		*	*	*
23	Testeboån	S	30	yes	1,3	8	2100- 4200	a,e,i,m	2	Dalalven	?	>0	?
26	Alsterån	S	27	yes	2,3	4	4000	?	4		*	*	*
28	Helgeån	S	25	yes	2,3	5	3200	e	4		*	*	*
31	Kuivajoki	FI	31	yes	1,2	58	17000	b	2	Simojoki	yes	0	0
33	Kiiminkijoki	FI	31	yes	1,2	110	40000	b,c,h	2	Iijoki	yes	>0	0
35	Siikajoki	FI	31	no?	2	32	10000- 15000	b,h	3	Oulujoki	*	0	0
36	Pyhäjoki	FI	31	yes	2	98	39000	b,e	2	Tornionjoki	*	0	0
37	Kalajoki	FI	31	no?	2	33	13000	b	2	Iijoki	*	0	0
38	Perhonjoki	FI	31	no	2	5	2000	b,g	4		*	0	0
39	Kyrönjoki	FI	30	no	2	10	4000	b	4		*	0	0
40	Merikarvianjoki	FI	30	no	2	8	2000	b	4	Neva	*	0	0
45	Vantaanjoki	FI	32	no	2	14	7000	b,c,f,m	2	Neva	yes	0	0
46	Kymijoki	FI	32	yes	2	38	3000	b,c,e,m	2	Neva	yes	yes	4000
53	Valgejögi	E	32	yes	4	>20	20000	a,e	2	Neva	?	0	0
54	Jägala	E	32	yes	4	2?	2000	c	2	Neva	yes	0	0
	Vaana	E	32	no/yes	4	4	4000	b,n	3	Neva	0	0	0
66	Venta	LI	28	*	*	*	*	*	*	*	*	*	*
70	Sventoji	LI	26	*	*	*	*	*	*	*	*	*	*
71	Minija/Veivirzas	LI	26	*	*	*	*	*	*	*	*	*	*
75	Wisla/Drweca	P	26	yes	1,2,3	10	*	*	2	Daugava	*	*	*
78	Slupia	P	25	yes	1,2	34	*	*	2	Daugava	*	*	*
79	Wieprza	P	25	yes	1,2	45	*	*	2	Daugava	*	*	*
80	Parseta	P	25	yes	1,2	44	*	*	2	Daugava	*	*	*
81	Rega	P	25	*	1,2	39	*	*	2	Daugava	*	*	*
82	Odra/Notec, Drawa	P	24	yes	1,2	12	*	*	2	Daugava	*	*	*

Cause of extinction
1 Overexploitation
2 Habitat degradation
3 Dam building
4 Pollution

* No data

Restoration programme

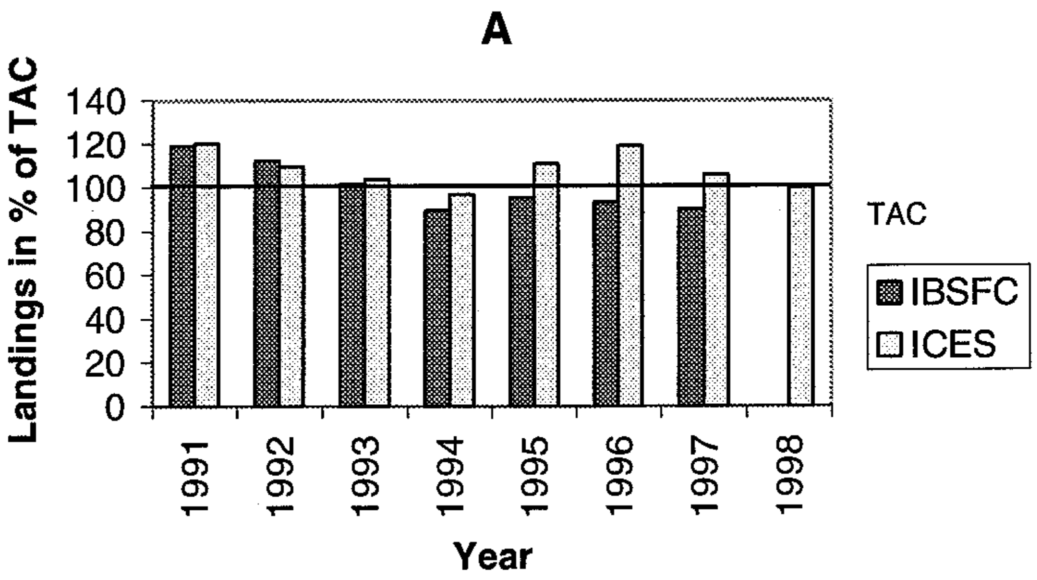
Fisheries
a Total ban of salmon fishery in the river and river mouth
b Seasonal or areal regulation of salmon fishery
c Limited recreational salmon fishery in river mouth or river
d Professional salmon fishery allowed in river mouth or/and river

Habitat restoration
e partial
f completed
g planned
h not needed

Dam removal
i planned
j completed
k not needed

Fish ladder
l planed
m completed
n not needed

Releases
1 Has been carried out, now finished
2 Going on
3 Planned
4 Not planned
5 Not known



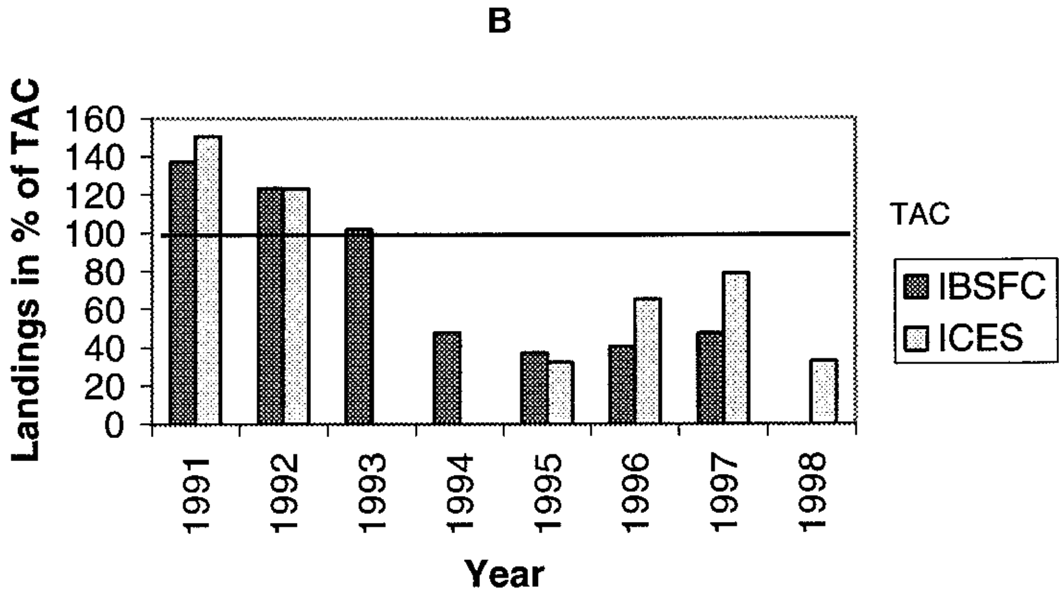


Figure 3.13.12.10.1 Landings of salmon in % of TAC according to IBSFC and ICES.
A) Landings in Main Basin and the Gulf of Bothnia, Sub-division 22-31.
B) Landings in the Gulf of Finland, Sub-division 32.

Report to the North Atlantic Conservation Organization

Source of information: Report of the Working Group on North Atlantic Salmon, April 1999 (ICES Doc. CM 1999/ACFM:14).

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 1960–1998 are given in Table 1.1.1. Reported catches (in tonnes), in four North Atlantic regions are illustrated in Figure 1.1.1, and those for NASCO Commission Areas, 1993–1998 are shown below:

Area	1993	1994	1995	1996	1997	1998
NEAC	3335	3569	3279	2746	2087	2239
NAC	376	358	261	294	231	151
WGC	0	0	85	92	59	11
Total	3711	3927	3625	3132	2377	2401

The catch data for 1998 (Table 1.1.1) are provisional and incomplete, but the final figures are unlikely to exceed 2 500 t. Catches in most countries remain below the averages of the previous 5- and 10- years. Much of the reduction in catches in recent years can be accounted for by management plans which have reduced fishing effort in several countries.

1.1.2 Catch and release of salmon

Catch and release data for 1SW (small), MSW (large) and/or 'total' salmon were provided for recent years by six countries. In 1998, the proportion of the total rod catch that was released ranged from 100% in the USA to 7% in Iceland. Eighty-one percent, 52%, 30% and 19% of catches in Russia, Canada, UK (England & Wales) and UK (Scotland), respectively, were caught and released.

1.1.3 Unreported catches of salmon

The total estimate of unreported catch within the NASCO Commission Areas in 1998 was 1 210 t (Table 1.1.1), nearly 35% of the total of reported and unreported catch. The estimate for 1998 is an increase of 46% compared with 1997 (827 t) and an increase of 2% compared to the 1993–1997 mean of 1 186 t. There are no data available on salmon catches in international waters in 1998. Estimates (in tonnes) for the Commission Areas are given below:

Area	1993	1994	1995	1996	1997	1998
NEAC	1471	1157	942	947	732	1108
NAC	161	107	98	156	90	91
WGC	12	12	<20	<20	5	11
International waters	25-100	25-100	n/a	n/a	n/a	n/a

ICES notes that for many countries the methods used to produce these estimates were developed some years ago. Recent reductions in returns of salmon to many areas and corresponding changes in management regimes may have resulted in the estimates of unreported catches being even more uncertain than in the past.

1.1.4 Production of farmed and ranched salmon

The world-wide production of farmed Atlantic salmon in 1998 was 710 342 t. This is the largest production in the history of the industry (Figure 1.1.4) and represents a 12% increase over 1997 (634 418 t) and a 50% increase on the 1993–1997 average (475 032 t). The world-wide production of farmed Atlantic salmon in 1998 was over 295 times the nominal catch of Atlantic salmon in the North Atlantic.

In 1998, the production of farmed Atlantic salmon in the North Atlantic area was 538 011 t, which was a further 7% increase compared to 1997 (501 067 t) and a 37% increase on the 1993–1997 average (391 627 t). The countries with the largest production were Norway and Scotland, which accounted for 64% and 21% of the total respectively. Production outside the North Atlantic Area reached 172 331 t, i.e. 24% of the total world production of farmed salmon. Areas of largest production outside the North Atlantic were Chile (73%) and western Canada (19%).

The total production of ranched Atlantic salmon in countries bordering the North Atlantic in 1998 was 47 t, 10 t less than in 1997. The majority (72%) of the ranching is conducted in Iceland where ranched production is now less than one third of the nominal catch of wild fish.

1.2 Evaluation of non-catch fishing mortality for all Atlantic salmon gear

Mortalities generated directly or indirectly by fishing but not included in recorded catches are referred to as non-catch fishing mortality. The following seven sources of non-catch fishing mortality for Atlantic salmon fishing gear are known to occur throughout the North Atlantic: (1) *Predation mortality* occurs when salmon caught in various types of fishing gear are subsequently removed, eaten, lost, or released from the gear (or badly damaged) by the activity of seals, otters, other species of fish, gulls or other predators; (2) *Dropout mortality* occurs when fish caught and killed by the gear but lost prior to hauling the net; (3) *Haul-back mortality* occurs when fish are caught and killed by the gear are lost as a result of hauling back; (4) *Escapement mortality occurs* when fish encounter and are temporarily caught by the gear, escape from it (or are intentionally released) or pass immediately through the gear but die later from various injuries or stress from the "encounter," or from increased predation due to their greater vulnerability to various predators; (5) *Discard mortality* occurs when fish that are caught are discarded (dead or alive) and not included in the reported catches; (6) C*atch and release mortality* (often termed hook and release) occurs in recreational angling fisheries when salmon are caught and released, either voluntarily or as a result of mandatory requirements to do so, and (7) *Unreported catch* which results from local sales, consumption of salmon by fishermen, sale of fish directly to the consumer, by-catch of salmon taken in gear not licensed to harvest salmon, and catches not otherwise recorded in official catch statistics.

The contribution of most sources of non-catch fishing mortality is low (0–10%) but highly variable, and some forms (for example, dropout and haul-back mortality) do not apply to many of the currently operating fisheries for salmon, because the fishing methods and gear used are not immediately lethal to the fish. Some of the factors known to contribute to variation in non-catch fishing mortality within and among fisheries include gear type, duration of time that the gear is fished or set, gear selectivity, fish size and state of maturity, weather conditions, and the care used in releasing fish which are not retained.

1.3 Recent research developments

1.3.1 Atlantic salmon post-smolt nurseries in the Northwest Atlantic

ICES considered temperature and chlorophyll abundance data as indicators of the nursery habitat suitability in the Northwest Atlantic. From the analysis, it was suggested that optimal thermal conditions for post-smolts and production conditions for forage species may define nursery areas in inshore and offshore waters.

1.3.2 Migration of kelts in relation to sea water temperatures in Newfoundland

Data storage tags (DST) manufactured by Kiwi Inc. were applied to 139 Atlantic salmon kelts at enumeration facilities on Western Arm Brook, Humber, Campbellton and Highlands rivers in Newfoundland. Data from 11 recaptures at large for 34–112 days indicated differences in temperatures encountered by kelts of the different rivers as well as differences among kelts within a river. Salmon spent most of their time in 4.7–16.8°C water but, unlike some Pacific salmon, did not exhibit detectable diurnal movements.

Water temperature profiles are useful for indicating water temperatures encountered by salmon in freshwater and in the sea and may prove useful for determining temperature preferences. This information is important for marine climate change models and water temperature protocols which may be used for closing angling fisheries in freshwater when water temperatures are high.

1.3.3 Release location of smolts

A total of 401 recaptures from 56 960 Carlin-tagged hatchery-reared smolts released between 1989 and 1997 in the River Dalälven (Bothnian Sea, Baltic) indicated that as little as 0.7 km distance between release sites effected significant differences in recapture locations. Smolts were produced in and released directly from two hatcheries situated 0.7 km apart. Recovery rates at a fishway located 0.8 km upstream of the upriver hatchery were significantly higher for fish originating from the upriver station than those originating at the downriver station. Salmon observed jumping at the outlet of the lower station prior to spawning suggested that hatchery return rates for the two stations could have been similar. If return rates were similar, the difference in recovery rates at the fishway may be a measure of the stray rate effected by a distance of 0.7 km.

1.3.4 Herring abundance and survival of salmon

Atlantic salmon post-smolts of European origin have been caught in the north-western Norwegian Sea a few weeks and months after leaving their home rivers. The distributions of Norwegian spring spawning herring and mackerel overlap with the timing and distribution of salmon post-smolts.

Post smolts of Atlantic salmon may compete for food and space with other marine species, and thus adult herring may be competitors with Atlantic salmon in their area of overlap. Spawning biomass of Norwegian spring spawning herring and recapture rates of salmon tagged as smolts in the River Figgjo, Southeast Norway, were inversely related (Figure 1.3.4). This observation suggests an hypothesis that the presence of a large population of Norwegian spring spawning herring in the Norwegian Sea could contribute to a decrease in recapture rate of salmon. The importance of this observation and range of possible explanatory hypotheses of mechanisms warrants further investigation.

1.3.5 Description of marine growth checks observed on the scales of salmon returning to Scottish homewaters in 1997

A substantial proportion of the scales collected and examined from salmon, in a number of fisheries throughout Scotland in 1997, exhibited summer growth "checks". For both 1SW and 2SW salmon, the incidence of checks was the highest on record. Checks were laid down in the 1996 calendar year in both sea age groups.

The incidence of checks in 2SW salmon was significantly less than in 1SW salmon and varied significantly among months of capture for 1SW. In contrast, the position of the checks on the scales was consistent across all groups. While no significant link was shown with either growth or survival, these observations further focus attention on the marine phase of the salmon's life cycle and on changes in the marine environment that may have an impact upon growth and survival.

1.3.6 Seal and seabird predation

Available data are inadequate to evaluate the hypothesis that predation by seals and sea birds has directly caused the recent decline in North American salmon returns. For a causal relationship to be important, it must be shown that seals or sea birds can account for a substantial fraction of salmon mortality at sea.

Salmon were infrequent in the diets of gannets during August on the northeast coast of Newfoundland, 1977–1989, but increased in the 1990s to a peak of 6.4% in 1993. North American sampling programmes to examine seal diets have been designed to provide estimates for consumption of groundfish prey, particularly cod, so sampling of seals has not been intensive in many habitats where salmon post smolts are thought to be relatively common. Moreover, diets are reconstructed from hard parts recovered in stomachs and scats, where again salmon otoliths may be less likely to be recovered than larger demersal otoliths from cod and other groundfish. Thus, although salmon remains were found in only 9 of over 5 000 seal stomachs, total consumption of salmon by seals may still be substantial, relative to sizes of salmon stocks present. A model based on estimated numbers of smolts leaving North American rivers, daily salmon biomass, predator vulnerability windows for various predators, and salmon consumption rates suggest that seals could have accounted for a substantial fraction of salmon mortality at sea. Results also suggested that, for these predator populations, extremely large sample sizes would be required to detect and accurately characterise salmon predation.

Populations of grey, harp, and hooded seals and of gannets and common murres have increased in eastern North America since the 1970s. The rising populations of seals and some seabirds suggest that it is plausible that consumption by these predators may have contributed to declining returns of North American salmon. However, marine trophic interactions are complex and rising predator numbers do not necessarily depress prey populations.

1.3.7 Stock-recruitment relationships to define a conservation threshold and targets for Québec salmon rivers

Conservation thresholds for Atlantic salmon in Québec are being established using stock-recruitment (SR) analysis. Ricker's parameters (α, β) were replaced respectively with the mean maximal catch over many years (Copt), and the catch rate at maximal catch, Copt (h^*). The catch rate is equal to (Copt/(Sopt + Copt)) where Sopt is the average spawner requirement need to obtain Copt. A Bayesian approach was used to assess the uncertainties around the estimates, and to provide a risk analysis for suggested management actions. The new conservation thresholds will be defined by taking the MSY points determined from available SR relationships. These MSY points will initially be precautionarily fixed at 75% probability levels ($Sopt^{75\%}$). Management targets should be higher than the conservation threshold, depending on long-term management objectives.

SR relationships, associated reference points, and probability distributions, were calculated for six rivers for which good data were available (Figure 1.3.7). To export the reference points to other rivers for which data were more limited, a measure of eggs per unit of production (UP) or eggs per m^2 which corresponded to the conservation threshold was used as a basis of comparison. UP was based on habitat suitability indices (HSI), but can as well be based on wetted area accessible to salmon.

Two regressions were derived correlating either UP ($Y=1.67*UP$; $r^2= 0.89$) or wetted areas ($Y=1.04*m^2$; $r^2= 0.96$) with $Sopt^{75\%}$ values. The equations can be used to export Sopt values to rivers where SR relationships are unavailable; the slope is the eggs per unit value, and Y is the number of eggs needed to meet the conservation threshold. Further analysis on transporting conservation limits across rivers is underway using Bayesian hierarchical analysis. The output of this analysis is both an *a posteriori* probability distribution of Sopt for each of the index rivers, and an *a posteriori* predictive probability distribution of Sopt for a new river where no SR data are available. The posterior predictive distribution was wider than those of most of the index rivers reflecting increased uncertainty in Sopt for rivers where no SR data are available.

1.3.8 Forecasting 1999 returns and assessment of alternative management options on the R. Scorff, Brittany, France

Since 1995, smolt output and adult returns have been estimated on the River Scorff (southern Brittany, France). These data and the estimate of smolt output for 1998 were used to forecast 1SW returns in 1999. The analysis was undertaken under a Bayesian framework which took into account the uncertainty of the estimates of smolt production and adult returns (measurement errors). The posterior predictive probability distribution (90% values) for the grilse returns in 1999 were 130 to 1 340 fish.

To evaluate the probability that escapement in 1999 will be above the conservation limit, the range of MSW returns, exploitation rates by sea-age class, and the current TAC based system of regulating exploitation were taken into account. The distribution of the egg deposition indicated that the probability of exceeding the conservation limit in 1999 is only 55%. Even if no fishery was allowed, the probability of falling below the conservation limit is still 30%, mainly because of the low smolt output in 1998. The probability distributions of the egg deposition obtained with or without TAC were compared and found to be mirror images, i.e. the TAC would not provide protection against overexploitation. Even a halving of the exploitation rates in 1999 from previous years would not reduce the probability of not achieving the conservation limit under the existing TAC.

Although preliminary, the analyses suggested that further evaluation of the performance of the management strategy currently applied on the salmon rivers of Brittany is required. The Bayesian statistics provide a more realistic view of stock status or management strategies than is provided by deterministic methods because they allow for a description of the uncertainty in the assessment process. Further work in this field should be promoted.

1.3.9 Salmon survey in the Labrador Sea in 1998

Experimental fishing was conducted by a Canadian research vessel fishing in the Labrador Sea in the fall of 1998. In total, nine stations were fished with surface-set fleets of monofilament gillnets of mesh size 77 mm, 89 mm, 102 mm, 115 mm, and 127 mm. In total, 38 salmon were caught, 24 of which were post-smolts, and the remainder of which were 1SW salmon. Catch rates were lower than previously experienced by research vessels fishing in the same area in the late 1980s. These data will be added to the information base of research in the Labrador Sea. More research on post-smolt and adult salmon at sea is encouraged.

1.3.10 North American salmon recruitment, smolt indices, marine habitat and harp seal populations

Significant relationships between recruitment of North American salmon, indices of smolt production based on 15 standard electrofishing sites in the Miramichi River, and either an index of salmon marine habitat (SHI) or annual population estimates of harp seals were reviewed. Development of a weighted index of North American pre-smolts followed (see Section 3.1.2) which also proved to be significantly correlated with the index of habitat, harp seals and recruitment of North American salmon (see Section 4.5). The appropriate model should be further specified and supported (see Section 4.5), a more comprehensive index of the relative change in marine predators of salmon in the Northwest Atlantic should be developed, and the assumption of direct proportionate production of smolts from the pre-smolt indices should be verified. The high degree of correlation among variables and the paucity of evidence for the consumption of salmon by harp seals prevent the derivation of specific conclusions concerning the nature of the relationships among recruits, habitat, or the harp seal population. Because these variables cannot be controlled in the experimental sense, only additional years of data may provide the natural variation required for testing the validity of these models. However, if measures are taken to alter substantially the abundance of any salmon predators (for example implementation of the Canadian Fisheries Resource Council recommendation to create "no-seal" zones in selected coastal areas of Atlantic Canada) intensive monitoring of salmon stocks in those areas would be particularly informative.

1.4 Framework for stock rebuilding programmes

The maintenance of self-sustaining stocks of salmon by means of targets or conservation limits requires that stock rebuilding programs be considered when conservation values have not been achieved. It will be necessary to consider a range of issues before a stock rebuilding program is initiated and a flow-chart (Figure 1.4.1) has been constructed to provide a framework for decision making.

The approach that has been developed envisages that a conservation limit or target has been set previously as part of a stock management plan, and that the plan requires that the stock be monitored in order to assess achievement of the target. If monitoring shows achievement of the target or conservation limit, the monitoring cycle can be resumed without further action. If a deficit is detected, a sequence of decisions must be made before the next monitoring season. In some cases, no action beyond increased vigilance during future monitoring cycles will be required, but if a stock rebuilding program is required, it will also be necessary to decide which of a range of approaches is appropriate.

In particular, it may be possible to establish causes or correlates of failure to achieve the target, by linking trends in abundance with changes in environmental or fishery variables. If the causes of failure in achieving the target can be identified, it may be possible to target action as part of the stock-rebuilding program. It is suggested that consideration of causes and correlates of failure centre on changes with time in four categories of effect: *climate, biological interactions, physical habitat* and *fisheries*. If the cause of failing to achieve target is known but no remedy is available, it may be necessary to reset the conservation value to a new, lower value before monitoring and assessment resumes. In the case of a deficit of indeterminate cause, the precautionary approach requires that a stock rebuilding program be initiated, in order to expedite recovery while further information on the underlying problem is sought.

Much of the information necessary to make further progress on providing frameworks for stock rebuilding programs is available, but the information is dispersed and requires peer review. Moreover there is no clear consensus on the methods nor the extent of stock rebuilding programmes. <u>ICES recommends that the detailed scientific background for stock rebuilding programmes should be considered in a wide scientific</u>

context, in order to develop a consensus view on the likely validity of all the possible options.

1.5 Compilation of egg collections and juvenile releases for 1998

ICES compiled 1998 data summaries of artificially spawned eggs and egg and juvenile releases in Table 1.5.1. These data were provided to estimate the effects of egg collection on wild production and to characterise the overall scale of enhancement work by ICES member countries.

1.6 Compilation of tag releases and finclip data by ICES member countries in 1998

Data on releases of tagged and fin-clipped salmon in 1998 were provided by ICES under separate cover. Slightly over 2.59 million salmon were marked in 1998, a 14% decline from the 3.02 million fish marked in 1997. The Adipose clip was the most used primary mark (1.66 million), with microtags (0.70 million) the next most used primary mark. Microtag marking declined by 5% from 1997. Secondary marks (primarily adipose fin clips) were applied to 0.87 million fish. Most marks were applied to hatchery-origin juveniles (2.53 million), while 0.04 million wild juveniles and 0.02 million adults were marked.

2 Atlantic Salmon in the North-East Atlantic Commission Area

2.1 Events of the 1998 fisheries and status of stocks

2.1.1 Fishing in the Faroese area 1997/1998

In the period 1991–1998 inclusive, the Faroese salmon quota was bought out. However, the Faroese Government continued sampling inside the 200 mile EEZ during most of the period. No commercial fishery has taken place during the 1998/1999 fishing season and no buy-out has been initiated for 1999/2000.

The salmon long-liner M/S "Polarlaks" conducted a research fishery from January to early April, 1998. Four separate trips were carried out and 31 sets were fished. The total catch was 5.8 t (1 763 salmon) including discards. The catch rate (CPUE) in 1998 was 30 salmon per 1 000 hooks employed. This is below the range of 36 to 84 fish per 1 000 hooks when the fishery was taking place from 1981 to 1995.

Composition and origin of the research catch: As in previous fishing seasons, 2SW salmon dominated (75%) with 1SW (19%) and 3+SW (6%) caught in lower proportions. The proportion 2SW fish was within the previous observed range, but the proportions of 1SW and 3+SW fish were the highest and lowest, respectively, since 1991/1992.

The proportion of discards (i.e. salmon < 60 cm) in the January-April catches was 16.9%, higher than the previous full-season range of 1.8 to 15.6%. An early fishery (October to November) normally contributed the highest proportions of discards in previous years.

2.1.2 Homewater fisheries in the NEAC area

Since the late 1980s there has been a declining trend in salmon catches in the NEAC area. This reflects attempts by many countries to reduce commercial fishing activities. Other associated factors are lower stock sizes and a reduction in the value of commercially caught salmon.

Gear and effort: The restrictive measures introduced in Ireland in 1996 to reduce fishing effort were also applied in 1998. In April 1999, new national measures were introduced in the UK (England and Wales) to protect early running MSW ("spring") salmon. In Russia, due to conservation measures, only five barrier fences were operated commercially compared to seven in the two previous years, and ten in 1995. In Iceland, the coastal gillnet fishery, which in recent years has accounted for a small percentage of the nominal catch, was permanently bought out prior to the beginning of the season. The ban on the use of bend nets along the Norwegian coast from Rogaland County to Troms County introduced in 1997 was again applied in 1998.

Catches: Provisional catch figures show an increase in salmon catch from 1997 to 1998 in most northern European countries (Iceland, Norway, Finland, Russia) and in Ireland, Spain and France (Table 1.1.1). This increase is due mainly to increased grilse catches. The provisional nominal catch for 1998 was 2 239 t which when finalised will be less than 2 500 t. The final value (including ranched fish) for 1997 was 2 087 t. (see Section 1.1.1).

CPUE: Commercial fishing effort continued to decrease in net fisheries in the UK. In Finland and France, catch per angler season shows an increasing trend. Similarly, CPUE of rod fisheries in the Russian rivers of the White Sea basin showed a significant increase, whereas that of the Barents Sea basin rivers has decreased.

Composition of catches: In Finland, France, Norway, Russia and the UK (Scotland), the proportion of 1SW fish in the 1998 catch has increased relative to long term indices. Compared to the previous 5-year mean, the proportion of the catch comprising 1SW fish in 1998 increased in UK (England and Wales), and decreased in Sweden.

Farmed salmon continue to represent a large proportion of the coast, fjord and broodstock catches in Norway (22–45%), although the proportion has remained relatively stable over the past few years. The proportion of farmed fish is generally less than 1% in fisheries in the UK, Ireland, and Finland. Ranched fish comprise 40% of the salmon catch in Sweden and 20% in Iceland, whereas the proportion in other countries is generally less than 1%.

Origin of catch: In Sweden, it was estimated that 10 % of the salmon catch in 1998 consisted of recaptures of tagged salmon which originated from Danish experimental releases at the islands of Møn and Bornholm. No other new information was made available.

Exploitation rates: Of 16 stocks for which there were data, exploitation rates increased in twelve and decreased in four stocks between 1997 and 1998. There was a significant downward trend for rivers flowing to the Barents Sea for both the past 10- and 5-year periods, and for the past 10-year period for the rivers flowing to the White Sea. For the past 5-year period there has been a significant downward trend in exploitation rates for 2SW stocks in UK Scotland, Iceland, Norway and Sweden.

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 stocks. In this Section, stock status is described for the 40 monitored rivers of which about one-half are in UK (England and Wales) and Russia. Many are of small size and contribute a proportionately small quantity of the salmon production in the NEAC area. Stock status as inferred from summed estimates of national Pre-fishery Abundances (PFAs) and spawning escapement are presented in Section 2.4.

Attainment of conservation requirements: Analysis of attainment of conservation limits (CL) on 16 rivers (five each from Russia and UK [England and Wales], three from France and one each from Ireland, UK [Northern Ireland], and UK [Scotland] indicated variable status of salmon stocks in different rivers of the NEAC area (Figure 2.1.1). Five rivers have never or seldom reached their CL over the last 10 years, whereas six rivers have been mostly or consistently above their CL. Several rivers that have reached their CL in most years show a decreasing trend in escapement, however, and no tendency to recover was observed for rivers with low escapement. Two general points emerged: first, that at low escapement there is no tendency for that stock to recover, and second, that in most instances stocks having average egg deposition equal or greater than their CL tend to exhibit some deterioration in their escapements or at best they fluctuate around the mean.

Adult returns to rivers: Cluster analysis was used to help define groups of rivers showing common features in the numbers of adults returning to rivers over time. In most cases, adult salmon counts in 33 index rivers within the NEAC area increased from 1997 to 1998. However, over the last 10 years, adult returns have been declining or showed no trend, and were improving in only one case. Regional differences in returns over the last 10 years are evident when the data are partitioned into two broad regions. In the Northeast region (Scandinavia and Russia), ten of fourteen rivers showed a decline whereas in the Southwest region (Ireland, UK and France), the split between rivers decreasing or with no trend was almost equal (9 declining against 10 stable or showing some improvement). Therefore, of the stocks examined, those of the Northeast region appear to be of more concern than those from the Southwest region. In-river catches as an index of returns indicate, however, that early-running MSW ("spring") salmon have declined throughout the Southwest region.

Smolt production: The analysis of smolt output data from 10 rivers indicated that the temporal patterns were not consistent between different rivers or regions. Some rivers showed a significant improvement in smolt production whereas the smolt output of other rivers declined. A significant downward trend was detected for wild smolt survival (1 SW returns) over the past five years and for hatchery smolt survival (1 SW and 2 SW returns) over the past ten years.

2.2 Evaluation of the 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 spared as a result of this suspension is the catch that would have been taken if the fishery had operated, minus the catch in the research fishery.

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. ICES concluded that the full quota would have been taken had the quota purchase not been in effect. Thus, the maximum catch that would have been taken in 1997/98 was 380 t.

Current discard rates, age composition, and recent 3-year mean proportion farm fish were used to evaluate the increased returns to Europe in 1998. 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 1992–1998 follow:

Year	Quota (t)	Estimated increased returns to home waters in Europe			
		1SW	%	MSW	%
1992	550	2,842	0	70,809	6
1993	550	11,429	1	106,307	10
1994	550	21,078	1	134,159	11
1995	550	12,949	1	138,533	13
1996	470	10,573	1	122,196	12
1997	425	9,578	0	105,368	14
1998	380	19,699	1	103,169	13

The calculated additional returns represent between 6% and 14% of MSW fish and 0% to 1% of 1SW fish returning to homewaters from 1992 to 1998. Approximately 65% of MSW salmon caught in the Faroes fishery would return to Scandinavian countries, Finland and Russia. If this were the case, they might have represented from 8% to 19% of MSW returns and from 0% to 1% of 1SW returns to northern European homewaters between 1992 and 1998. 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

France and UK (England and Wales) have developed conservation limits for all their rivers, although some are still provisional. Progress has also been made in the development of river-specific conservation limits in most other countries. However, in order to develop catch advice, ICES employed the lagged-egg deposition model to estimate conservation limits for NEAC countries. This approach generates pseudo-stock-recruitment relationships, i.e., plots of lagged eggs (stock) against 1SW adults in the sea (recruits) for national stocks, and ICES evaluated the most appropriate conservation limit options to use (Table 2.3.1) based on the nature of the 'pseudo-stock-recruitment relationships' and local knowledge.

In order to compare the conservation limits with the PFA, conservation limits must be raised to take account of natural mortality between 1 January in the first sea winter and the time of return to home waters to provide the spawning escapement reserve (SER). Estimates of the SER [CL/e^{-Mt}] for each conservation limit (Table 2.3.1) 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 groups are plotted on Figure 2.3.1 and Figure 2.3.2 with the PFA estimates; the dashed portion of the lines indicate that these SERs may be less appropriate for evaluating the historic status of stocks.

2.4 Expected abundance of salmon for smaller stocks in the NEAC area

NEAC-PFA model: ICES made some minor improvements to the model used to estimate pre-fishery abundance of salmon in the NEAC area. These include the addition of recruitment estimates derived from catches in the distant water fisheries of Greenland and Faroes to national estimates based upon historic tagging data. No new information was available to modify the way that stocks are grouped, but Iceland was added to the northern Europe complex. The pre-fishery abundance estimates are therefore divided into northern Europe (all Nordic countries plus Russia and Iceland) and southern Europe (Ireland, UK and France) groups (Figures 2.3.1 to 2.3.3).

Trends in the PFA for NEAC stocks: Figure 2.3.1 suggests that there has been no overall trend in the recruitment of maturing 1SW salmon (potential grilse) in the northern countries, although the numbers have fluctuated quite widely around approximately one million recruits. However, this pattern is largely driven by a simultaneous decline in Norway and an increase in Russia. Numbers of non-maturing 1SW recruits (potential MSW returns) for the northern countries appear to have fallen from approximately one million in the 1970s to about 0.6 million in the 1990s. The majority of this overall decline appears to have occurred in the mid 1980s.

For the southern European countries (Figure 2.3.2), the numbers of maturing 1SW recruits is driven largely by the Irish and UK (Scottish) stocks which have fallen substantially since the 1970s. Thus the Southern group of countries show an overall halving of the number of maturing 1SW recruits over the period, with stocks falling to their lowest in 1997. The abundance of non-maturing 1SW recruits in the Southern European countries is largely driven by the UK (Scottish) stocks which account for about 80% of the estimated numbers of recruits over the past 10 years, while Ireland and UK (England & Wales) together account for about 15% of the recruits. All these countries have shown a very marked decline in the numbers of non-maturing 1SW recruits, such that overall production has fallen relatively steadily to about one third of its size in the early 1970s.

Forecasting the PFA: In order to use the PFA estimates to provide catch advice, a forecast is required of the PFA of recruits in the year preceding the fisheries. Thus, for example, the PFA of non-maturing 1SW recruits must be predicted for 1999 in order to provide advice for the West Greenland fishery in 1999; the Faroes fishery (MSW stock) in 1999/2000; and homewater fisheries in 1999. Because the latest estimate of non-maturing 1SW recruits is for 1997, 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. No new information was presented on methods to predict future of PFA from the historic time-series and in view of the uncertainty in the PFA estimates, ICES resorted to qualitative extrapolations from the historic estimates (see Section 2.5).

2.5 Catch options or alternative management advice with an assessment of risks

ICES considers that river/stock-specific conservation limits and stock-specific exploitation rates are most appropriate for the management of homewater fisheries. The aggregate of all river/stock-specific conservation limits for rivers of nations that contribute to a distant fishery, e.g. West Greenland, would be most appropriate for the management of that fishery.

In the absence of much of the river/stock-specific data, ICES considers the use of "national" stock conservation limits and the current aggregated estimate of SERs for northern and southern European components (see Section 2.3.and Figures 2.3.1 and 2.3.2) as an important first step in furthering the understanding of the status of stock complexes However, in view of the uncertainties about the most appropriate stock groupings and the preliminary nature of the conservation limit estimates, ICES considers that it would be inappropriate to provide quantitative catch options at this stage. The following qualitative advice is based upon the PFA data and estimated SERs shown in Figures 2.3.1 and 2.3.2. ICES noted, however, that annual adjustment of the TACs for mixed stock fisheries based on changes in the mean status of the stocks is also unlikely to provide adequate protection to the individual river stocks that are most heavily exploited by the fishery or are in the weakest condition.

Northern European 1SW stocks: Very few 1SW salmon have been caught outside homewater fisheries in Europe at any stage in the time series, even when fisheries were operating in the Norwegian Sea. ***ICES considers 1SW salmon from northern Europe to be within safe biological limits as a stock complex (although it is recognised that the status of individual stocks within the complex may vary), and exploitation at the current rate is acceptable. ICES, however, advises that management of maturing 1SW salmon should be based upon local assessments of the status of river or sub-river stocks.***

Northern European MSW stocks: These are the main stocks that have contributed to the fisheries in the Norwegian Sea in past years. The PFA of non-maturing 1SW salmon from northern Europe has been declining since the mid-1980s and is now approaching the conservation limit estimates. The exploitable surplus has declined from over 800 000 recruits in the 1970s to around 250 000 recruits in 1996 and 1997. ***ICES considers the stock complex to be within, but close to safe biological limits (although it is recognised that the status of individual stocks within the complex may vary). ICES therefore advises that great caution should be exercised in the management of these stocks, particularly in mixed stock fisheries, and exploitation rates should not be allowed to increase. Management of non-maturing 1SW salmon should be based on local assessments of the status of river or sub-river stocks.***

Southern European 1SW stocks: The PFA for maturing 1SW salmon from southern Europe has been low for at least 9 years and is still close to the historic low of 1997. ***ICES considers the 1SW salmon from southern Europe to be within, but close to safe biological limits when considered as a stock complex (although it is recognised that the status of individual stocks within the complex may vary). ICES advises that measures to reduce exploitation should be taken where possible, and that management of maturing 1SW salmon should be based on local assessments of the status of river or sub-river stocks.***

Southern European MSW stocks: This group includes the main European stock contributing to the West Greenland fishery. The PFA of non-maturing 1SW salmon from southern Europe has been declining since the 1970s and ICES analysis suggests that it fell below the conservation limits in both 1996 and 1997. Projection of these data suggest that the PFA was also likely to have been below the conservation limits in 1998, resulting in low availability of MSW salmon to fisheries in 1999. ***ICES considers this stock to be outside safe biological limits and advises that extreme caution should therefore be exercised in the management of mixed stock fisheries exploiting these stocks and that reductions in exploitation rates are necessary. Management of non-maturing 1SW salmon should be based on local assessments of the status of river or sub-river stocks.***

2.6 Estimates of the by-catch of salmon post-smolts in pelagic fisheries

Surface research trawl techniques have been developed and have proved successful in capturing post smolts of salmon. Trawl surveys have now been undertaken by a number of institutes and the area investigated stretches from the south of Ireland to the northern Norwegian Sea. Concentrations of post smolts have been found along the north-west European continental shelf and extensively in the Norwegian Sea.

Post-smolt and herring overlap spatially mostly in July and early August in the areas north of 68°N. The purse seine fishery for herring takes place in the areas west of Iceland up to the Jan Mayen Island as early as April and into June and is therefore not likely to intercept young salmon. In June, 1998, an attempt was made by the Fishery Laboratory of the Faroes to collect information on salmon by-catches in a Faroese purse seine fishery for herring in these areas. Crew members on two of ten Faroese purse seine vessels were asked to look specifically for post-smolts when sampling the herring catch for mandatory documentation of weight distributions to the buyers on land. No post-smolts were reported. In addition, no post-smolts were found in a screening of 1–3 % of the landed catch of herring from one vessel and mackerel from another.

The fishery with the greatest potential for catching post-smolts in June and July is probably the trawl fishery for mackerel in the Faroes EEZ and the international area of the Norwegian Sea. This fishery is presently at a high and is not anticipated to diminish in the near future. In this regard, the Fishery Laboratory of the Faroes and the Russian Polar Institute (PINRO) have initiated a bilateral collaboration in the investigation of by-catch of salmon post-smolts in the herring and mackerel fisheries north of the Faroes in 1999.

Although preliminary investigations have been carried out, ICES was unable to provide quantitative estimates of the by-catch of post-smolts in pelagic fisheries. Observations of catch on board pelagic fishing vessels are possible but are unlikely to provide more than a qualitative assessment of post-smolt by-catch. An alternative approach is to carry out directed research fisheries with similar gear and at similar locations and time as commercial fishing boats, or conduct co-operative fishing with a commercial fishing vessel. Data forthcoming from a number of other ICES Working Groups on the number of vessels and amount of gear fished at depths less than 15 m in a number of ICES areas, their catches, swept area and effort are expected to contribute base line information for future estimates of by-catch.

2.7 Data deficiencies, monitoring needs and research requirements in the NEAC area

More research into the biology of salmon in the early marine phase is required and extension of recent research on the biology of post-smolts is recommended. Competitive interactions with other marine species should be explored. Additionally, by-catches of post-smolts in marine fisheries for other species should be monitored and estimates of mortality from this source should be derived. There is a continuing requirement to monitor trends in marine mortality for a wider range of stocks than at present, and to identify causes for current low values of marine survival.

The research fishery at Faroes should be continued, and material acquired during previous studies should continue to be analysed.

The quality of data used to set conservation limits should continue to be improved and the PFA model should continue to be developed. More and better input data should be obtained from a greater range of sources. Data collection should be targeted at catch components that are poorly represented. New ways of handling data, including GIS applications, and particularly new methods for grouping sub-divisions (e.g. populations, or alternative divisions based on biological characteristics such as sea-age or run-timing) should continue to be explored, developed and validated. In particular, sensitivity analyses are essential to assess the confidence with which data derived from the theoretical models can be used in an applied management context.

Methods to provide better estimates of unreported catches in the Northeast Atlantic area should be developed.

Assessment methods for juvenile salmon and for freshwater habitat parameters should continue to be developed. Attempts should be made to couple these parameters with adult return parameters, via life-history models of appropriate scale. Habitat and life history variables should be used together to examine the extent to which stock-recruitment relationships from a limited range of index rivers are transferable to other rivers.

The status of southern and central European rivers with respect to *Gyrodactylus* species, and particularly *G. salaris*, should be established without delay. Monitoring of the spread and occurrence of *G. salaris* should be encouraged in salmon-producing countries, and in other countries that are vulnerable to transfer of the parasite.

3 Atlantic Salmon in the North American Commission Area

3.1 Events of the 1998 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 1998. In addition, further regulations were introduced in Labrador: the commercial fishery in SFA 1 and 2 of Labrador was closed, as was the commercial fishery in zone Q11 of Ungava, Québec (see Figure 3.1.1). In Québec the commercial fishery continued in zone Q9, although reduced compared to 1997 as a result of a voluntary buyback of commercial licenses. In the recreational fishery, some areas of New Brunswick and Nova Scotia were closed to fishing and hook-and-release regulations for small salmon were extended to some rivers in Québec; 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 the USA there is no commercial fishery for salmon and angling (catch-and-release only) for sea-run salmon in 1998 was permitted only in the State of Maine.

Commercial and recreational fishing using gillnets continued in Saint-Pierre et Miquelon (France) in 1998 and effort increased from that recorded in 1997.

Catch: The provisional landings for Canada in 1998 were 149 t, a decrease of 35% by weight from 1997 (Table 1.1.1). The landings of small salmon in numbers (46 687) and large salmon (13 270) represented decreases of 21% and 49%, respectively, from those of 1997. Recreational fisheries exploited the greatest number of small salmon in each province, accounting for 88% of the total small salmon harvests in eastern Canada. Aboriginal fisheries took the largest share of large salmon (57% by number). Commercial fisheries harvested 2 % (by number) of the total small salmon and 8% of the total large salmon in eastern Canada. Unreported catch for the NAC area was estimated at 91 t.

In 1998, the second year for which catch and release estimates are complete for Canada, over 50 000 salmon (21 000 large and 30 000 small) were caught and released. Most of the fish released were in Newfoundland (45%), followed by New Brunswick (41%), Nova Scotia (7%), Québec (6%) 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 (87%) was released in Nova Scotia, followed by New Brunswick and Newfoundland (56% each), Prince Edward Island (55%) and Québec (22%).

In the USA the estimated number of salmon caught and released in 1998 was 273 fish - 18% lower than in 1997 and 32% and 33% below the 5- and 10-year means.

In Saint-Pierre et Miquelon (France) the harvest was 2.3 t, up 53% from 1997 and the highest value since 1994.

Composition and origin of catch: No external tagged fish of USA origin were reported from Canadian fisheries in 1998. 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, Magaguadavic and Saint John rivers in the Bay of Fundy, as well as three rivers of Cape Breton, Nova Scotia.

In the USA, some salmon that were caught in the sport fishery in 1998 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 four rivers.

3.1.2 Status of stocks in the NAC area

Returns, recruits and spawners: Estimated (mid-point) 1SW and 2SW returns, as well as spawners, spawner thresholds and in the case of Newfoundland, recruits, in 1998 are shown for five of six regions in North America in Figures 3.1.2.1 and 3.1.2.2. Labrador returns and thus total North American returns are unavailable in 1998. With the exception of Newfoundland, returns of 2SW fish in 1998 were similar to or lower than the low values in 1997; 1SW returns increased slightly over those of 1997.

The rank of the estimated returns in 1998 within the 1971–1998 time series and the estimated total spawning escapement of 2SW salmon in each region expressed as a percentage of the spawning threshold for each region (except Labrador) follows. The closer the rank of 1998 returns is to 1, the better the relative performance of the stock.

	Rank of 1998 returns in 1971–1998 time series (1=highest)		Mid-point estimate of 2SW spawners as proportion of escapement requirement
Region	1SW	2SW	(%)
Labrador	unknown	Unknown	unknown
Newfoundland	9	1	198
Québec	13	28	28
Gulf (Mainland)	22	27	37
Scotia-Fundy	23	28	16
USA	13	22	5

In most regions the returns of 2SW fish are near the lower end of the 28-year time series except Newfoundland where they are at the highest. However, Newfoundland comprises only a small proportion of total salmon production. Returns of 1SW salmon were at the lower end of the time series in the Gulf and Scotia-Fundy, and about at the mid-point in Newfoundland, Québec and USA.

The North American run-reconstruction model was used to update the estimates of pre-fishery abundance of non-maturing and maturing 1SW salmon from 1971–1998. The projected numbers of potential 2SW spawners that could have returned to North America in the absence of fisheries can be computed from estimates of the pre-fishery abundance taking into consideration the 11 months of natural mortality at 1% per month. These values, termed potential 2SW recruits, along with total North American 2SW returns and spawners (1971–1997) and requirements are shown in Figure 3.1.2.3, and indicate that the overall North American spawner requirement could not have been met in any of the years, 1993–1998 even in the absence of all fisheries.

There are two important changes to the calculations that determine pre-fishery abundance of non-maturing 1SW salmon for 1997. The first change was made because of the inclusion of Aboriginal food harvests of small and large salmon in the reported catches for 1998. As Aboriginal harvests occurred in both Lake Melville and coastal areas of northern Labrador, a new parameter was added to define the fraction of these catches that are immature. This was necessary because non-maturing salmon do not occur in Lake Melville where approximately half the catch originated. However, non-maturing salmon do occur in coastal marine areas in the remainder of northern Labrador.

The second change was necessitated by the closure of the commercial fishery in Labrador in 1998. In past reports, salmon returns and spawners for Labrador which make up one of the five geographical areas contributing to returns estimates for Canada were based on commercial fishery data. Since the commercial fishery was closed in Labrador in 1998, the time series also ended. However, in order to estimate pre-fishery abundance it was still necessary to include Labrador returns for 1998. Consequently, a raising factor was developed by dividing pre-fishery abundance without Labrador into pre-fishery abundance with Labrador based on the time series of Labrador recruit estimates and pre-fishery abundance data from 1971–96. The raising factor to estimate returns to Labrador for 1998 for 2SW salmon was set to the low and high range of values in the time series, which was 1.05 to 1.27.

Similar to calculations to determine non-maturing 1SW salmon, a raising factor was also required to include Labrador returns in the maturing component of pre-fishery abundance. Consequently, a raising factor was developed by dividing pre-fishery abundance without Labrador into pre-fishery abundance with Labrador based on the time series of Labrador recruit estimates and pre-fishery abundance data from 1971–97. The raising factor to estimate returns to Labrador for 1998 for 1SW salmon was set to the low and high range of values in the time series which was 1.04 to 1.59.

The estimate of pre-fishery abundance of 97 899 non-maturing 1SW salmon for 1997 was the lowest on record (Figure 3.1.2.4), and 23% below the previous year. The most recent year is shown with hollow symbols to denote the use of a raising factor for Labrador. Similarly, for maturing 1SW salmon, there was a 32% decrease from 1996 in the 1997 estimate (319 065) of pre-fishery abundance. An estimate of 412 480 maturing 1SW fish in 1998 is 29% greater than that of 1997 and the sixth lowest in the 28-year time series. The total Northwest Atlantic population of 1SW recruits (maturing and non-maturing) originating in North America in the Northwest Atlantic has varied but generally trended downwards since the 1970s, and the abundance recorded in 1993–1998 was the lowest in the time series (Figure 3.1.2.5). During 1993 to 1997, the total population was about one-half million fish, 45% of the average abundance 1972 to 1990. The decline has been more severe for the 2SW salmon component than for maturing 1SW salmon which have risen from about 45% of the total at the beginning of the 1970s to between 65 and 80% in the last five years.

The estimated 2SW returns (1 526 salmon) to USA rivers in 1998 represents about 5% of the spawner requirements for all rivers. Estimated spawning escapements in the Penobscot, Connecticut and Merrimack rivers remained very low (about 10% for the Penobscot River spawning requirement, and about 2% of requirements established for the Connecticut and Merrimack rivers).

Egg depositions: Egg depositions in 1998 exceeded or equalled the river specific conservation requirements in 21 of the 71 assessed rivers (30%) and were less than 50% of conservation in 24 other rivers (Figure 3.1.2.6). Large deficiencies in egg depositions were noted in the Bay of Fundy and Atlantic coast of Nova Scotia where eight of the 12 rivers assessed had egg depositions which were less than 50% of requirements. In insular Newfoundland, 71% of the assessed rivers met or exceeded the conservation egg requirements, almost all the others had egg depositions which were less than 50% of requirement.

Smolt production: A relative index of smolt production, (i.e. measured abundance of juveniles or smolts for river$_j$ in year$_i$ / average abundance for the years 1995–1998 in river$_j$, for Newfoundland, Québec, Gulf and Scotia-Fundy rivers weighted by the relative proportion of the conservation requirements of the zone or SFA to the total conservation egg requirements of the zones under consideration) suggests relative smolt production at three levels since 1971 - at about one-third the 1995 to 1998 average between 1971 and 1979, at about 60% of the average during 1980 to 1985, and at about average since 1986. The Miramichi River receives 45% of the total weight for the index because of its large area, so the trend in the overall index tracks the trend in Miramichi juvenile production fairly closely. The index does however correspond to the documented status of many other rivers. Smolt production from Newfoundland rivers has approximately doubled over the 1971 to 1998 time period. The Gulf smolt index is at its highest in the 1990s. The Québec smolt index has declined between 1983 and 1998, driven by de la Trinité time series which is one of the largest of the Québec index rivers, and therefore receives a high weighting. The relative index for Scotia-Fundy peaked around 1990 and has since declined.

Survival rates to 1SW and 2SW fish have been variable in recent years but with some exceptions have declined on average by 50% or more in monitored rivers of Québec, among other areas. Returns have continued to decline despite major changes in fisheries management to reduce harvest, and many populations are currently threatened with extirpation, particularly in the Bay of Fundy and Atlantic coast of Nova Scotia. Although no direct evidence yet exists that can conclusively indicate that predators contribute significantly to the salmon declines, increasing numbers of predators, particularly seals and seabirds, at the same time that marine survival is declining, suggests that there is a possibility of linkage (Figure 3.1.2.7). USA salmon stocks exhibit the same downward trend that has been shown for many Canadian salmon stocks, especially those located in the Bay of Fundy and along the Atlantic coast of Nova Scotia. Most salmon rivers in the USA are hatchery-dependent and remain at low levels compared to conservation requirements.

3.2 Effects on US and Canadian stocks and fisheries of management measures implemented after 1991 in the Canadian commercial salmon fisheries

In 1992, a moratorium was placed on the commercial Atlantic salmon fishery in insular Newfoundland, while in Labrador and Québec North Shore and Ungava, fishing continued under quota or allowance catch. In conjunction with the commercial salmon fishing moratorium, a voluntary commercial license retirement program 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. In 1997, the commercial fishery in SFA 14B of Labrador was closed and a voluntary buyback program for licences introduced. Additional restrictions were imposed in 1998 (Section 3.1.1.)

No new analyses were presented to evaluate the effects of quota management and commercial closures. Previously, ICES considered a detailed assessment of the impact of the Newfoundland-Labrador changes on Newfoundland stocks. At that time, estimates were made of commercial exploitation rates on small salmon during pre-moratorium years (1984–1991) which ranged from 29% to 66%, averaging 49% for all areas combined. On large salmon, they ranged from 64% to 98% and averaged 76%.

3.3 Age-specific stock conservation requirements

Spawning requirements are now considered as threshold reference points, and are 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 (29 199) and Canadian (154 653) rivers are unchanged; North American 2SW requirements now total 183 852 fish.

3.4 Catch options or alternative management advice with an assessment of risks

It is possible to provide catch advice for the North American Commission area for two years. The first is a revised estimate for 1999 for 2SW maturing fish based on improved estimates of the 1998 pre-fishery abundance and accounting for fish which were already removed from the cohort by fisheries in Greenland and Labrador in 1998. The second is an estimate for 2000 based on the pre-fishery abundance forecast for 1999. A consequence of these annual revisions is that the catch options for 2SW equivalents in North America may change compared to the options developed the year before.

3.4.1 Catch option for 1999 fisheries on 2SW maturing salmon

A revised estimate of the pre-fishery abundance for 1998 of 99 956 fish (Table 3.4.1.1) is less than the 113 899 value forecast in 1998. A pre-fishery abundance of 99 956 in 1998 equates to 90 444 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 2 977 2SW salmon equivalents in 1998 as 1SW non-maturing salmon in Labrador (239) and Greenland (2 738) fisheries. The text table below uses the probability density projections for the revised pre-fishery abundance estimate of 99 956. Catch option values = [(PFA-spawner reserve of 205 230) * 0.904837) - 2 977].

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	16,337	0
30	34,995	0
35	52,277	0
40	68585	0
45	84,405	0
50	99,956	0
55	115,444	0
60	131,402	0
65	147,627	0
70	164,803	0
75	183,333	0
80	204,038	0
85	228,282	17,881
90	258,795	45,491
95	304,286	86,653

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 (Section 4.6.5).

3.4.2 Catch option for 2000 fisheries on 2SW maturing salmon

The advice for 2000 is based on a pre-fishery abundance of 79 450 in 1999 (Table 3.4.1.1) 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 large uncertainty in the forecast abundance and caution is warranted.

Catch Options for 2000 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	795	0
30	18,398	0
35	34,579	0
40	49,917	0
45	64,810	0
50	79,450	0
55	94,097	0
60	108,959	0
65	124,344	0
70	140,537	0
75	158,302	0
80	177,300	0
85	200,047	0
90	229,030	12,921
95	272,057	36,281

The above numbers of fish refer to the composite North American fisheries. On individual rivers, where spawning requirements are being achieved, there would be little biological reasons to restrict harvests further than the regulations in force over the period when spawning requirements have been achieved.

Catch advice for the NAC Area is included in the section relevant to West Greenland (Section 4.6.5.).

3.5 Data deficiencies, monitoring needs and research requirements

There is an urgent need to monitor salmon returns and develop habitat-based spawner requirements in Labrador and Ungava.

There is a need to investigate changes in the biological characteristics (mean weight, sex ratio, sea-age composition) of returns to rivers, spawning stocks, and total recruits prior to fisheries. These data and new information on measures of habitat and stock recruitment are necessary to re-evaluate existing estimates of spawner requirements in Canada and USA.

There is a requirement for estimates of additional smolt-to-adult survival rates for wild salmon, especially for rivers in Labrador, New Brunswick and Nova Scotia. Sea survival rates of wild salmon from rivers stocked with hatchery smolts should also be examined to determine if hatchery return rates can be used as an index of sea survival of wild salmon elsewhere.

Further basic research is needed on the spatial and temporal distribution of salmon and their predators at sea and of predator diets to assist in explaining variability in survival rates.

4 Atlantic Salmon in the West Greenland Commission Area

4.1 Events in the 1998 fisheries and status of stocks

4.1.1 Fishery in the WGC area

Catch: In 1998, the West Greenland Commission of NASCO agreed that the catch at West Greenland should be restricted to that amount used for subsistence in Greenland, which in the past has been estimated at 20 t. The Greenland authorities subsequently set the TAC for 1998 at 20 t. The fishery began on August 16 and fishing continued through to the end of the year. The nominal catch totalled 11 t of which a substantial part was taken late in the season. No landings went to fish plants in 1998. Regulations in 1998 required that private sales and catches by food fishermen be recorded. With reporting being the responsibility of individual fishermen and the fishery being more scattered than before, unreported catches are estimated to be relatively larger than when most landings went to fish plants. The unreported catch in 1998 is estimated to be approximately 11 t.

Gear and effort: No new information was available on fishing gear and effort. However, only 49 licensed fishermen (out of 321 issued licences) reported having fished in 1998. Twenty-one non-licensed fishermen (food fishermen) reported catches. The total number of active persons in the salmon fishery has declined over the last decade and in 1998 numbered less than half of those who fished in 1997.

Origin of catches: Based on discriminant analysis of characteristics from scales sampled in the fishery, 79% of fish in 1998 were of North American origin, two percentage points higher than in 1997. The catch at West Greenland in 1998 was estimated to consist of 8.6 t (3 100 salmon) of North American origin and 2.6 t (900 salmon) of European origin. These values represent reductions of 82 and 76% from respective North American and European landings in 1997.

The 1998 analysis was based on only 540 scales of which 532 were collected in NAFO Div.1D, August 17–21. Samples of muscle tissue were also collected for identification of continent of origin based on nuclear DNA (microsatellites). ICES felt that the samples were valid for defining the continent of origin within the time frame and geographical scale collected but inadequate for defining the biological characteristics of salmon in the four month fishery.

This was the fourth year that nuclear and mitochondrial DNA had been collected from the fishery and analysed. For the DNA analysis, the overall percent North American in 1998 was 78%, a difference of 1% from the samples determined by scale analysis. Comparison of results for 1995–1997 indicated that DNA with appropriate analysis for small sample sizes will allow for better classifications with lower error rates. Use of DNA-based splits of continent of origin and resultant revisions to biological characteristics and numbers of salmon of North American and European origin harvested at West Greenland is tentatively scheduled for 2 000.

Biological characteristics of the catch: One-sea-winter fish of North American and European origins comprised 96.8% and 99.4%, respectively, of the catch samples from West Greenland in 1998, and were among the highest proportions of a 12-year data set. Two-sea-winter fish comprised the lowest proportions (0.5% North American and 0.0% European) of the data series; previous spawners comprised the remainder.

Mean lengths of 62 cm and 62.7 cm for respective North American and European 1SW fish at West Greenland, declined by about 0.5 cm over lengths in 1997 but were within the range of those values observed in the 1990s. Mean weights (2.7 and 2.8kg for NA and European fish, respectively) of 1SW fish increased slightly over those of 1997 but were also within the range of those values observed in the 1990s.

Percentage river ages among fish sampled at West Greenland in 1998 were:

River age	1	2	3	4	5	6+
N American	0.4	20.4	50.4	22.9	2.9	2.9
European	28.6	60.0	7.6	2.9	1.0	0.0

All but the 7.6 value for river-age-3 European fish were within the range of values 1968–1998. However, for the 1990s, North American river age-1 and -2 fish had the lowest and second lowest values, river-age 3 and -4 had the highest values. The pattern among the percentage European river ages in 1998 relative to those of the 1990s was the opposite. River-age 1 and -2 had the highest values while river-ages 3 and 4 had the lowest and second lowest, respectively.

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 Northeast Atlantic: Run-reconstruction estimates of pre-fishery abundance of non-maturing 1SW salmon from southern areas (Figure 2.3.2b) have been volatile over the period 1971–1997, but in steady decline over the past 13 years. In 1996 and 1997, it was estimated that even in the absence of all fisheries, the numbers of non-maturing recruits from the southern area were below the proposed spawning equivalent reserve. Non-maturing 1SW salmon from northern stocks (Figure 2.3.1b) have declined since 1985, particularly in 1986–1987.

In most cases, adult salmon counts in index rivers within the NEAC area increased from 1997 to 1998. However, over the last ten years, adult returns have been declining or showed no trend, and were improving in only one case. Analysis of attainment of conservation limits (CL) indicated variable status of salmon stocks in different rivers of the NEAC area. Some rivers have never or seldom reached their CL over the last 10 years, whereas others have been consistently above their CL. Many rivers that have reached their CL in most years show a decreasing trend in escapement, however, and no tendency to recover was observed for rivers with low escapement values.

Stocks originating in North America: The run-reconstruction estimate of pre-fishery abundance of non-maturing 1SW salmon for 1997 was 98 899 fish, 23% below that of 1996 and the lowest on record (Figure 3.1.2.4). In addition to the steady decline in non-maturing and maturing 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 1992–1995 to almost 80% in 1996 and 1997.

Total returns of 2SW fish to Labrador and thus Canada could not be estimated in 1998. However, with the exception of insular Newfoundland where 2SW salmon are only a small proportion of the total salmon production, returns to the important Gulf, Québec and Scotia-Fundy production areas were either the lowest or second lowest of the 28-year time series, 1971–1998 (Figure 3.1.2.2). The estimated 2SW returns and spawners to USA rivers in 1998 were 5% below the 1997 estimate and 18% and 41% below the previous 5-and 10-year averages, respectively. Returns to most USA rivers are hatchery-dependent. Spawning escapements remained low compared to conservation requirements.

Egg depositions exceeded or equalled the specific conservation requirements in only 21 of the 71 rivers (30%) that were assessed in Canada and were less than 50% of requirements in 24 other rivers (34%). Large deficiencies in egg depositions were noted in the Bay of Fundy and Atlantic coast of Nova Scotia where 8 of the 12 rivers assessed had egg depositions that were less than 50% of requirements (Figure 3.1.2.6).

North American salmon stocks remain low relative to the 1970s. The steady decline over the last ten years is alarming (Figure3.1.2.5). The 1SW non-maturing component continues to be depressed with river returns and total production amongst the lowest recorded. In addition, returns in 1998 of maturing 1SW salmon (grilse) to North American rivers were very low. This being the case, improvement in 2SW salmon returns and spawners is unlikely in 1999.

Thus, despite some improvements in 2SW returns to some rivers in European and North American areas, the overall status of stocks contributing to the West Greenland fishery is low compared to earlier.

4.2 Effects on European and North American stocks of the West Greenlandic management measures since 1993

There have been two significant changes in the management regime at West Greenland since 1993. First, NASCO adopted a new quota allocation model to derive TACs based upon ICES assessment of the PFA of non-maturing 1SW North American salmon and the spawner requirements for these stocks. This resulted in a substantial reduction in the TAC in 1993 from that of 1992, and further reductions in subsequent years. The second change in management was the suspension of fishing in 1993 and 1994 for compensation payments.

The estimated numbers of salmon returning to home waters in the absence of a fishery, 1993–1994, or had the fishery in 1995–1998, not taken place are:

Year	Quota T	Grnl TAC	Catch t	EU Fish	NA Fish
1993	89	89	0	12461	14017
1994	137	137	0	19188	21580
1995	77	77	83	9434	18846
1996	174	0	92	12191	14343
1997	57	0	58	7508	11429
1998	20	0	11	712	2758

Estimation of TACs for 1993 and 1994 was based on the NASCO model, biological parameters (mean weights, proportions of NA fish, and age correction factors etc.) were assumed to the same as those of 1992. For the remaining years, estimates of fish that would have returned to home waters had there not been a fishery were based on same year biological characteristics and a natural mortality between Greenland and home waters of 0.10. The mean number of potential returns per tonne caught at Greenland is 176 and 131 North American and European salmon, respectively.

In the years 1972–1992, exploitation rates in Greenland of the North American component of the salmon stock averaged about 30% but varied between 10 and 45%. The management measures in force since 1995 resulted in an average exploitation rate of 13%.

ICES notes that these calculations assume that natural mortality of salmon at sea has remained unchanged. As highlighted in several places in this document, marine survival has declined markedly, particularly for salmon of North American origin. Methods are being explored for including a downward trend in survivorship in this and various other calculations. Because this year's forecast of pre-fishery abundance in West Greenland (Section 4.6) already indicates no harvestable surplus for West Greenland, allowing for a higher natural mortality would not change current advice. In general, the effect of this improvement will be to lower harvestable surpluses for a given number of 2SW salmon, as long as current levels of natural mortality persist.

4.3 Changes to the model used to provide catch advice

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 the 1998 assessment. The same independent variables used previously were found to provide an improved fit over last year's model. However, some of the input data were modified to reflect new information. These included: improvement of the catch reporting system in the Province of Newfoundland and Labrador by inclusion of catch statistics from Aboriginal fisheries in northern Labrador; data from an estimation procedure for returns to Labrador in lieu of commercial catches (see Section 3.1.2), improvements in the procedure used to estimate continent of origin in Greenland and the addition of another year of data to all data series. In summary, the 1998 catch advice of 0 t would not have been different if the 1998 assessment had been done with the revised input data and models from this year.

4.4 Age-specific stock conservation limits for all stocks occurring in the WGC area

Sampling of the fishery at West Greenland since 1985 has shown that both European and North American stocks harvested there are primarily (greater than 90%) 1SW non-maturing salmon that would mature as either 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 1998, 96.8 and 99.4% 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.

Tagging information and biological sampling indicates that the majority of the European salmon caught at West Greenland originate from the southern group of stocks. Estimates of provisional conservation limits for MSW salmon in Europe are based on the methods developed in 1998 and revised in 1999. The provisional conservation limit for southern European MSW stocks is now approximately 470 000 fish with a spawner escapement reserve equalling about 550 000 fish (see Section 2.4).

4.5 Critical examination of the 'model' used to provide catch advice

Background: This is the second year that ICES has been asked to critique the "model" to provide catch advice. Catch advice, and associated risk, for North American stocks in West Greenland are the result of a series of steps summarised in 1998, 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. In 1999, ICES extended its critique and examined:

1. the utility of confidence limits in the pre-fishery forecast model to develop a bootstrap sample of pre-fishery abundance forecasts,
2. the impact of measurement errors in lagged spawners and PFA forecast, and
3. alternative models for characterising salmon abundance.

Confidence limits: Currently, estimates of pre-fishery abundance forecast error in the model to forecast salmon in the Northwest Atlantic are based on a series of empirically derived confidence intervals developed for some, but not all, of the variables included in the regression model. ICES considered an alternate estimation procedure that utilises the error structure from the base regression model residuals to develop a bootstrap sample of forecasts. The resultant probability density function from the bootstrap sample appeared to contain bias, a feature not uncommon for this class of models. However, ICES felt it would be premature to apply the bootstrapping approach until this bias could be better understood and a correction procedure appropriate to the data could be developed.

Impact of measurement errors: The forecast of the North American PFA is based on a two variable linear model: the lagged spawners and the February habitat. Measurement errors can have disruptive effects on model fitting and on the uncertainty of the predictions. Thus, an analysis within a Bayesian framework and Monte Carlo simulations was conducted to assess the potential effect of measurement errors on the 1999 PFA estimate and the lagged spawners (the habitat variable was regarded as being measured without error).

Measurement errors were assumed to be independent between years and between variables. The structure of the errors was defined as triangular distributions with a mode located at the point estimates currently used and ranging between a minimum and maximum representing -/+ X% of the point estimates. Three values of error were considered: -/+ 10%, -/+ 25% and -/+ 50%. The same level of error was assigned to both the PFA and the lagged spawners as a preliminary approach. A total of 5 000 simulations were conducted for each level of error. The analyses indicated that increasing measurement errors can have major disruptive effects on the both the uncertainty of the prediction and the most probable value of the 1999 PFA forecast.

The analyses suggested that the extent of the measurement error inherent in the run-reconstruction model should be estimated, that with increasing uncertainty, probability levels other than 50% should be considered, that other indices of adult salmon abundance should be examined and used as prior information, and that alternative models should be explored to provide some index of plausibility of the quantitative forecasts. Each point is reiterated in Section 4.7.

Alternative models for characterising salmon abundance: The spawning stock variable (lagged spawners) used in the PFA forecast model excludes the spawners from the Gulf and USA and therefore only considers part of the spawners contributing to PFA in the Northwest Atlantic. Also, the spawning stock variable only considers 2SW spawners while other age groups (1SW, 3SW and previous spawners) also contribute to egg depositions and undoubtedly salmon maturing as 2SW fish. Inclusion of all the spawning stock component from eastern North America is not a significant explanatory variable of PFA variability. The Gulf spawning stock has remained well above its area conservation requirement during the 1990s in contrast to other areas where spawning stock has declined.

A more useful variable for characterising salmon abundance in the ocean would be an estimate of the annual smolt output from rivers of North America. If smolt output is known, factors determining mortality at sea could be explored directly using the standard survival relationship:

$N_t/N_o = e^{-Z}$
where N_t = population size at time t (for example PFA before West Greenland fishery)
N_o = population size at an earlier time (for example smolt output)
Z= instantaneous mortality rate which in the absence of fisheries =M.

Some of the factors contributing to natural mortality could be characterised by an environment signal (as in the currently used model) and predation and the survival model could be written:

$N_t/N_o = e^{-(\alpha Pred + \beta Env + c)}$
where N_t and N_o are as previously defined
Pred = variable measuring predator abundance (absolute or relative)
Env = variable describing the environmental factor (absolute or relative)
α= coefficient of the relative instantaneous mortality per unit predator
β = coefficient of the relative instantaneous mortality per unit of environment
c = constant proportional mortality

This formulation differs from the model currently used because the variables are considered to have a proportional effect on instantaneous mortality. For both variables, the relative instantaneous mortality is constant and independent of size of the salmon. But overall mortality is a function of relative levels of the variables. For example, as relative predator abundance increases, the overall mortality increases. But the relative change in mortality rates would decline as the variables increase. The relative change in mortality is always less than the relative change in the variables. In the absence of any predator or environment effect modifying survival, then survival is proportional to abundance.

A preliminary exploration of this model was undertaken using a relative index of smolt production (see Section 3.1.2), the sum of the maturing and non-maturing components to eastern North America, the population size of harp seals in the Northwest Atlantic and the February habitat index in the Northwest Atlantic. The absence of contrasting states in the variables examined inhibited the testing of alternative hypotheses to describe the observed declines in Atlantic salmon survival rates. General conclusions were that:

1. the increased relative smolt production from North America has been insufficient to compensate for the increased mortality factors on Atlantic salmon;
2. the observed decline in relative survival associated with the increased relative smolt production is not sufficient to draw any conclusions on the nature of the mortality function, i.e. density dependent or density independent; and
3. in the absence of evidence for density-dependent mortality of Atlantic salmon at sea, the objective of achieving conservation in all salmon rivers of eastern North America remains valid.

4.6 Catch options or alternative management advice with an assessment of risks

4.6.1 Overview of provision of catch advice

ICES was asked to advise on catch that would maintain spawning escapements at conservation limits. Although advances have been made in our understanding of the population dynamics of Atlantic salmon and the exploitation occurring in the fisheries, the concerns about the implications of applying TACs to mixed stock fisheries are still relevant. In principle, adjustments in catches in mixed-stock fisheries provided by means of an annually adjusted TAC would reduce mean mortality on the contributing populations. However, there is no assurance that reductions in exploitation will affect those stocks that are not meeting conservation requirements, and benefits that might result for particular stocks would be difficult to demonstrate, in the same way that damage to individual stocks are difficult to identify.

The procedures to develop catch advice, an evaluation of the models, and vulnerabilities in the existing procedures were presented in the 1997 assessment. The processes remain unchanged in 1998 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 3.1.2.2. Estimates of 2SW returns prior to 1998 in Labrador are derived from estimated 2SW catches in the fishery using a range of assumptions regarding exploitation rates and origin of the catch. With the closure of the Labrador fishery, returns were unknown but 1998 pre-fishery numbers were estimated from a raising factor developed by dividing pre-fishery abundance without Labrador into pre-fishery abundance with Labrador based on the time series of Labrador recruit estimates and pre-fishery abundance data from 1971–1996 (see Section 3.1.2).

Update of thermal habitat: Thermal habitat has been updated to include 1999 data. Two periods of decline in the available habitat are identified (1980–1984 and 1988–1995) in the February index (Table 3.4.1.1).

Available habitat for February declined from 1 849 units in 1998 to 1 749 units in 1999, a decrease of 6%. The 1999 February value is the second highest of the last 17 years and continues the return to the high values experienced in the 1970s. The variable "February habitat" in the 1998 and 1999 forecast models of pre-fishery abundance now, however, accounts for less of the variability than it did previously (see Section 4.6.2).

4.6.2 Forecast model for pre-fishery abundance of North American 2SW salmon in 1999

The model employed in 1998 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 1999 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 (R^2=0.81). With the 1997 data point added there is an improvement in fit over that of last year (R^2=0.81 in 1999 versus 0.79 in 1998, 0.71 in 1997 and 0.68 in 1996). The model parameters are all significant, with lagged spawners accounting for most (28%) of the total sum of squares (February habitat accounting for 15%). Individually, the two predictor variables used are also significantly related to pre-fishery abundance.

The forecast of pre-fishery abundance for 1999 using simulation methods and the February thermal habitat and lagged spawner model is about 79 450 fish at the 50% probability level (Table 3.4.1.1). Application of the 1999 forecast model to forecast the 1998 value results in a forecast of 99 956 which is 12% less than the previous estimate of 113 899 fish. Deterministic and simulated forecast values will show differences due to the method of calculation.

4.6.3 Development of catch options for 1999

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 4.6.3.1.

Greenland quota levels for the forecast of pre-fishery abundance were computed with the revised model and are shown in Table 4.6.3.1. For the point estimate and the stochastic regression estimate using NN1, the quota options are 0 t at all probabilities. For the FNA 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.

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 in many of the pre-fishery abundance forecast, and iii) 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 2000 would be similar to that of recent years and that exploitation rates in North America would be at most 0.15 and 0.25. The impact of these fisheries on the salmon returning to homewaters in 2000 in the absence of any fishery at Greenland in 1999 results in a high risk (85%) of not meeting the conservation requirements in at least one of the six stock areas (Figure 4.6.4.1, 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 (1999) and in North America (2000) on the potential spawning escapements to North American stock areas increases the risk of severe under-escapement (50% of conservation requirements) in North America. There is a 55% risk of severe under-escapement with no fisheries and the risk rises to greater than 61% at a Greenland catch option of 50 t and exploitation rates between 0.15 and 0.25 in North America (Figure 4.6.4.1). Considering the uncertainty in the assessment of the abundance of North American salmon in West Greenland in 1999, precautionary approach principles in managing both the Greenland and North American salmon fisheries are advised.

Even if fisheries are restricted to harvests 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 may result in some stocks failing to meet requirements 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 1999 will be lower than any other pre-fishery abundance value previously estimated despite nearly complete closures of mixed and single stock fisheries. This is due to 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 considers this stock complex to be outside safe biological limits and recommends that there should be no exploitation of the 1998 smolt cohort as non-maturing 1SW fish in North America or at Greenland in 1999, and also recommends that the cohort should not be exploited as mature 2SW fish in North America in 2000. Exceptions are in-river harvests from stocks which can be shown to be 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 1998 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, monitoring needs 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 1995–1998 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.

The bootstrapping approach to improve confidence intervals for the pre-fishery abundance forecast error estimates shows promise, and should be explored further.

An evaluation should be made of the fraction of the PFA estimate that is directly based on catches and assessed returns (hard data), versus the fraction that results from less certain information such as scaling factors for potential productive habitat.

The extent of the measurement error inherent in the run-reconstruction model should be estimated to describe the potential bias in the model and the description of uncertainty associated with the PFA forecast.

The inclusion of measurement error in the forecast model increases the uncertainty of the forecast. Under increased uncertainty, alternative risks to the 50% point should be considered, consistent with the precautionary approach.

Other indices of adult salmon abundance should be examined and used as prior information to constrain the plausible range of abundance.

Alternative models should be explored (for example different predictive variables, model formulations, univariate time series, non-parametric change-of-state analyses) to provide some index of uncertainty of the quantitative forecasts of PFAs.

Table 1.1.1 Nominal catch of SALMON by country (in tonnes round fresh weight), 1960-1998. (1998 figures include provisional data).

Year	Canada (1)	Den.	Faroes (2)	Finland	France	East Grld.	West Grld. (3)	Iceland Wild	Iceland Ranch	Ireland (4,5)	Norway (6)	Russia (7)	Spain (8)	St. P. & M.	Sweden (West)	UK (E & W)	UK (N.Ireland) (6,9)	UK (Scotland)	USA	Other (10)	Total Reported Catch	Unreported catches NASCO Areas	Unreported catches International waters (11)
1960	1636	-	-	-	-	-	60	100		743	1659	1100	33	-	40	283	139	1443	1	-	7237	-	-
1961	1583	-	-	-	-	-	127	127		707	1533	790	20	-	27	232	132	1185	1	-	6464	-	-
1962	1719	-	-	-	-	-	244	125		1459	1935	710	23	-	45	318	356	1738	1	-	8673	-	-
1963	1861	-	-	-	-	-	466	145		1458	1786	480	28	-	23	325	306	1725	1	-	8604	-	-
1964	2069	-	-	-	-	-	1539	135		1617	2147	590	34	-	36	307	377	1907	1	-	10759	-	-
1965	2116	-	-	-	-	-	861	133		1457	2000	590	42	-	40	320	281	1593	1	-	9434	-	-
1966	2369	-	-	-	-	-	1370	104	2	1238	1791	570	42	-	36	387	287	1595	1	-	9792	-	-
1967	2863	-	-	-	-	-	1601	144	2	1463	1980	883	43	-	25	420	449	2117	1	-	11991	-	-
1968	2111	-	5	-	-	-	1127	161	1	1413	1514	827	38	-	20	282	312	1578	1	403	9793	-	-
1969	2202	-	7	-	-	-	2210	131	2	1730	1383	360	54	-	22	377	267	1955	1	893	11594	-	-
1970	2323	-	12	-	-	-	2146	182	13	1787	1171	448	45	-	20	527	297	1392	1	922	11286	-	-
1971	1992	-	-	-	-	-	2689	196	8	1639	1207	417	16	-	18	426	234	1421	1	471	10735	-	-
1972	1759	-	9	32	34	-	2113	245	5	1804	1578	462	40	-	18	442	210	1727	1	486	10965	-	-
1973	2434	-	28	50	12	-	2341	148	8	1930	1726	772	24	-	23	450	182	2006	2.7	533	12670	-	-
1974	2539	-	20	76	13	-	1917	215	10	2128	1633	709	16	-	32	383	184	1628	0.9	373	11877	-	-
1975	2485	-	28	76	25	-	2030	145	21	2216	1537	811	27	-	26	447	164	1621	1.7	475	12136	-	-
1976	2506	-	40	66	9	<1	1175	216	9	1561	1530	542	21	2.5	20	208	113	1019	0.8	289	9327	-	-
1977	2545	-	40	59	19	6	1420	123	7	1372	1488	497	19	-	10	345	110	1160	2.4	192	9414	-	-
1978	1545	-	37	37	20	8	984	285	6	1230	1050	476	32	-	10	349	148	1323	4.1	138	7682	-	-
1979	1287	-	119	26	10	<0.5	1395	219	6	1097	1831	455	29	-	12	261	99	1076	2.5	193	8118	-	-
1980	2680	-	536	34	30	<0.5	1194	241	8	947	1830	664	47	-	17	360	122	1134	5.5	277	10127	-	-
1981	2437	-	1025	44	20	<0.5	1264	147	16	685	1656	463	25	-	26	493	101	1233	6	313	9954	-	-
1982	1798	-	606	54	20	<0.5	1077	130	17	993	1348	364	10	-	25	286	132	1092	6.4	437	8395	-	-
1983	1424	-	678	58	16	<0.5	310	166	32	1656	1550	507	23	3	28	429	187	1221	1.3	466	8755	-	-
1984	1112	-	628	46	25	<0.5	297	139	20	829	1623	593	18	3	40	345	78	1013	2.2	101	6912	-	-
1985	1133	-	566	49	22	7	864	162	55	1595	1561	659	13	3	45	361	98	913	2.1	-	8108	-	-
1986	1559	-	530	37	28	19	960	232	59	1730	1598	608	27	2.5	54	430	109	1271	1.9	-	9255	315	-
1987	1784	-	576	49	27	<0.5	966	181	40	1239	1385	564	18	2	47	302	56	922	1.2	-	8159	2788	-
1988	1311	-	243	36	32	4	893	217	180	1874	1076	420	18	2	40	395	114	882	0.9	-	7738	3248	-
1989	1139	-	364	52	14	-	337	140	136	1079	905	364	7	2	29	296	142	895	1.7	-	5903	2277	-
1990	911	13	315	60	15	-	274	146	280	586	930	313	7	1.9	33	338	94	624	2.4	-	4943	1890	180-350
1991	711	3.3	95	70	13	4	472	130	345	404	876	215	11	1.2	38	200	55	462	0.8	-	4106	1682	25-100
1992	522	10	23	77	20	5	237	175	460	630	867	167	11	2.3	49	186	91	600	0.7	-	4133	1962	25-100
1993	373	9	23	70	16	-	-	160	496	541	923	139	8	2.9	56	263	83	547	0.6	-	3711	1644	25-100
1994	355	6	6	49	18	-	-	140	308	804	996	141	10	3.4	44	307	91	649	-	-	3927	1276	25-100
1995	260	-	5	48	9	2	83	150	298	790	839	128	9	0.8	37	295	83	588	-	-	3625	1060	n/a
1996	292	-	-	44	14	<0.5	92	122	239	685	787	131	7	1.5	33	180	77	427	-	-	3132	1123	n/a
1997	229	-	-	45	8	1	58	106	50	570	630	111	3	1.5	19	156	93	296	-	-	2377	827	n/a
1998	149	-	6	48	9	-	11	130	34	624	740	131	4	2.3	15	143	75	280	-	-	2401	1210	n/a
Means																							
1993-1997	302	3	7	51	13	1	47	136	278	678	835	130	7	2	38	240	85	501	<0.5	-	3354	1186	-
1988-1997	610	-	107	55	16	2	245	149	279	796	883	213	9	2	38	262	92	597	1	-	4359	1699	-

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.
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 1.5.1 Eggs taken and juvenile Atlantic salmon and eggs stocked (excluding private commercial sea ranching).

Blank fields indicate data not available.

Estimated number (nearest 1,000) of eggs spawned by artificial methods from (Year) sea-run adults in autumn/winter period of Year / Year +1).
Example = eggs artificially spawned and recorded for 1997 were spawned during the fall/winter period of 1997/1998

Country / Year	Total Eggs Artificially Spawned	Eggs Stocked (rounded to nearest 1,000)			No. Fry Stocked (rounded to nearest 1,000)			No. Parr Stocked (rounded to nearest 100)				No. Smolts (rounded to nearest 100)		
		Green	Eyed	All	Unfed	Fed	All	0+	1 & 1+	2 or >	All	1	2 or more	All
1998														
Total	38472000	1749000	1537000	3286000	21787000	6697000	28484000	4125100	1763570	10800	5899470	2808094	1101000	3909094
Belgium	0	0	0	0	0	0	0	193900	0	0	193900	4500	0	4500
Canada (1)	5234000	2000	160000	162000	1303000	332000	1635000	1492400	1046000	10800	2549200	639500	118400	757900
Denmark		0	0	0	0	68000	68000	263600	212500		476100	95500	20700	116200
Finland		0	0	0	0	0	0	0	0	0	0	0	0	0
France		0	150000	150000	188000	2228000	2416000	414300	40500	0	454800	150900	3300	154200
Iceland		0	0	0	80000	289000	369000	253100	0	0	253100	515600	44700	560300
Ireland	10591000	0	1112000	1112000	4159000	502000	4661000	348900	0	0	348900	460300	0	460300
Norway (2)														
Russia	1906000	0	0	0	0	0	0	0	33000	0	33000	0	834200	834200
Spain	950000	0	0	0	0	0	0	432000	107500	0	539500	33500	0	33500
Sweden		0	0	0	0	0	0	0	0	0	0	92300	45700	138000
UK (England - Wales		0	2000	2000	0	173000	173000	264800	158200	0	423000	124500	0	124500
UK (Northern Ireland)		1745000	0	1745000	485000	0	485000	0	0	0	0	1000	10000	11000
UK (Scotland)		2000	113000	115000	3671000	2258000	5929000	0	123100	0	123100	0	24000	24000
USA (3) (4)	19791000	0	0	0	11901000	847000	12748000	462100	42770	0	504870	690494	0	690494

(1) Total eggs artifically spawned for Canada includes 4.08 million eggs from sea run fish, and 1.16 million eggs from captive sea-run kelts.
(2) 1998 egg collection and stocking information from Norway is unavailable.
(3) Total eggs artifically spawned by the United States includes 4.77 million eggs from sea-run fish, 13.24 million eggs from captive/domestic broodstock, and 1.78 million eggs from captive sea-run kelts.
(4) The United States also stocked 6,628 captive and domestic adult Atlantic salmon.

Table 2.3.1 Conservation limit options for NEAC stock groups from lagged egg deposition analysis (options 1-3) and river specific assessments (option 4)

Option	Individual countries										European stock groupings	
	Finland	France	Iceland	Ireland	Norway	Russia	Swed'n	UK(EW)	UK(NI)	UK(Sc)		
Choice	3	4	1	3	3	1	3	4	3	2	Southern	Northern
1SW												
Opt. 1	8,189	16,103	19,329	160,969	132,633	227,742	671	29,268	12,311	476,278	694,929	369,235
Opt. 2	9,067	13,454	19,329	142,945	112,623	248,769	986	48,838	12,553	565,489	783,278	371,445
Opt. 3	12,527	20,060	27,008	224,565	155,982	274,536	1,391	60,681	16,585	637,381	959,273	444,435
Opt. 4	0	17,400	0	0	0	0	0	53,000	0	0		
Chosen	**12,527**	**17,400**	**19,329**	**224,565**	**155,982**	**227,742**	**1,391**	**53,000**	**16,585**	**565,489**	**877,039**	**397,641**
MSW												
Opt. 1	4,062	4,688	4,915	11,124	74,479	88,315	352	9,842	4,778	355,247	385,680	167,207
Opt. 2	4,497	3,916	4,915	9,879	63,242	96,469	517	16,423	4,872	421,788	456,878	164,725
Opt. 3	6,213	5,840	6,868	15,520	87,590	106,461	729	20,406	6,437	475,411	523,613	200,994
Opt. 4	0	5,100	0	0	0	0	0	17,500	0	0		
Chosen	**6,213**	**5,100**	**4,915**	**15,520**	**87,590**	**88,315**	**729**	**17,500**	**6,437**	**421,788**	**466,345**	**182,847**
Spawner escapement reserve:										**1SW**	**945,347**	**430,759**
										MSW	**552,761**	**216,730**

Table 3.4.1.1 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	578,955	726,699	652,827	2,011					
1972	557,789	733,183	645,486	1,990					
1973	672,662	867,737	770,200	1,708					
1974	623,993	800,812	712,403	1,862					
1975	710,244	904,537	807,391	1,827					
1976	610,837	826,772	718,805	1,676					
1977	506,934	667,717	587,326	1,915					
1978	288,809	371,345	330,077	1,951	35,441	81,978	58,710	495,467	-165,390
1979	630,107	831,343	730,725	2,058	42,640	94,840	68,740	602,969	127,755
1980	549,070	729,314	639,192	1,823	43,222	97,219	70,221	568,465	70,726
1981	527,385	684,484	605,935	1,912	43,287	97,645	70,466	612,907	-6,972
1982	439,899	567,062	503,481	1,703	43,393	98,396	70,895	553,105	-49,624
1983	236,421	337,375	286,898	1,416	40,425	91,991	66,208	396,013	-109,115
1984	245,428	347,472	296,450	1,257	37,658	84,098	60,878	237,111	59,338
1985	399,013	538,538	468,776	1,410	39,305	83,265	61,285	267,981	200,794
1986	435,092	575,040	505,066	1,688	39,891	89,038	64,464	442,924	62,141
1987	398,157	527,749	462,953	1,627	36,298	87,453	61,875	383,103	79,849
1988	317,617	423,435	370,526	1,698	37,061	83,602	60,331	389,013	-18,487
1989	241,038	345,076	293,057	1,642	41,944	86,394	64,169	442,898	-149,841
1990	218,194	295,743	256,969	1,503	40,952	81,826	61,389	342,161	-85,192
1991	249,702	348,471	299,086	1,357	37,575	73,152	55,364	185,746	113,339
1992	143,913	215,597	179,755	1,381	35,591	71,572	53,582	179,741	13
1993	95,337	178,931	137,134	1,252	38,381	79,473	58,927	228,371	-91,237
1994	109,491	212,937	161,214	1,329	38,395	75,957	57,176	220,273	-59,059
1995	117,379	195,601	156,490	1,311	36,738	70,104	53,421	153,143	3,346
1996	97,740	155,435	126,588	1,470	33,488	61,737	47,612	120,414	6,173
1997	69,710	126,088	97,899	1,594	29,823	55,178	42,500	81,919	15,979
1998				1,849	25,593	50,477	38,035	*99,956* 1	
1999				1,741	25,587	52,506	39,047	*79,450* 1	

1. Simulated forecast values.

Table 4.6.3.1 Quota options (mt) for 1999 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 (Fna)										
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	0	0	0	0	0	0	0	0	0	0

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, 1960–1998.

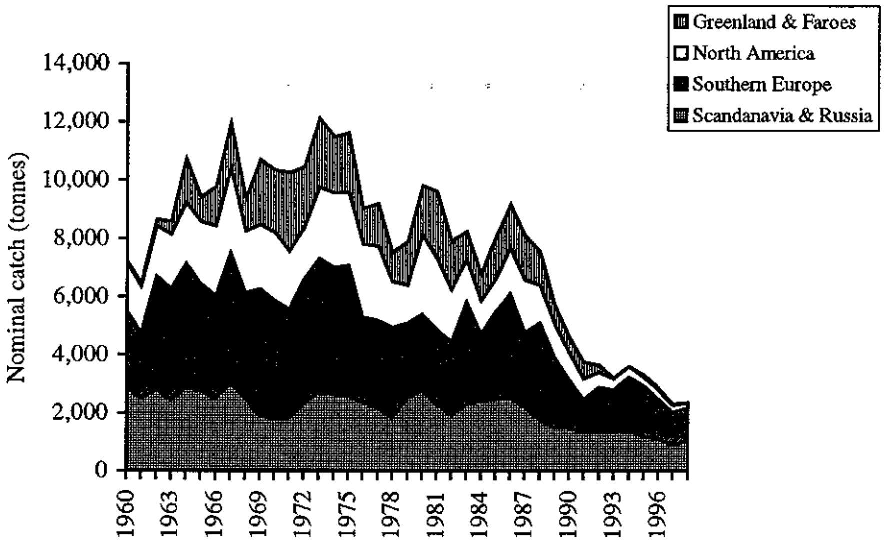


Figure 1.1.4 World wide farmed Atlantic salmon production, 1980–1998.

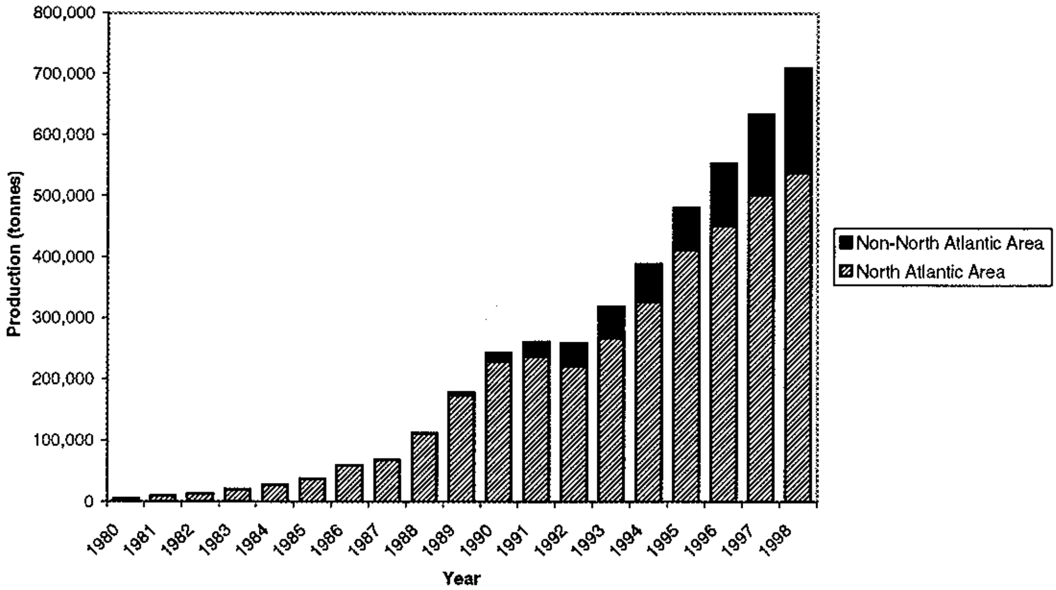
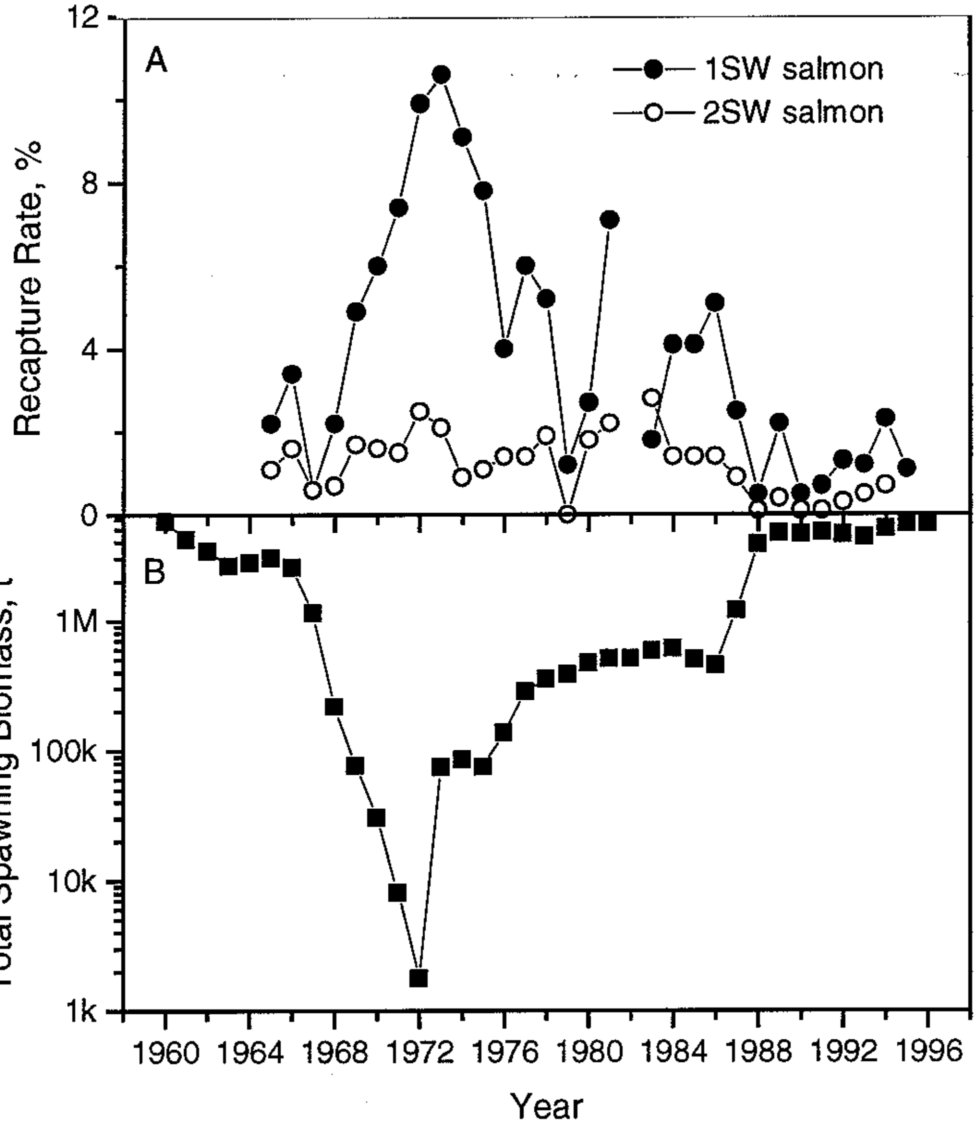


Figure 1.3.4 Recapture rates for salmon in the River Figgjo (A) and total spawning biomass for Norwegian spring spawning herring (B).



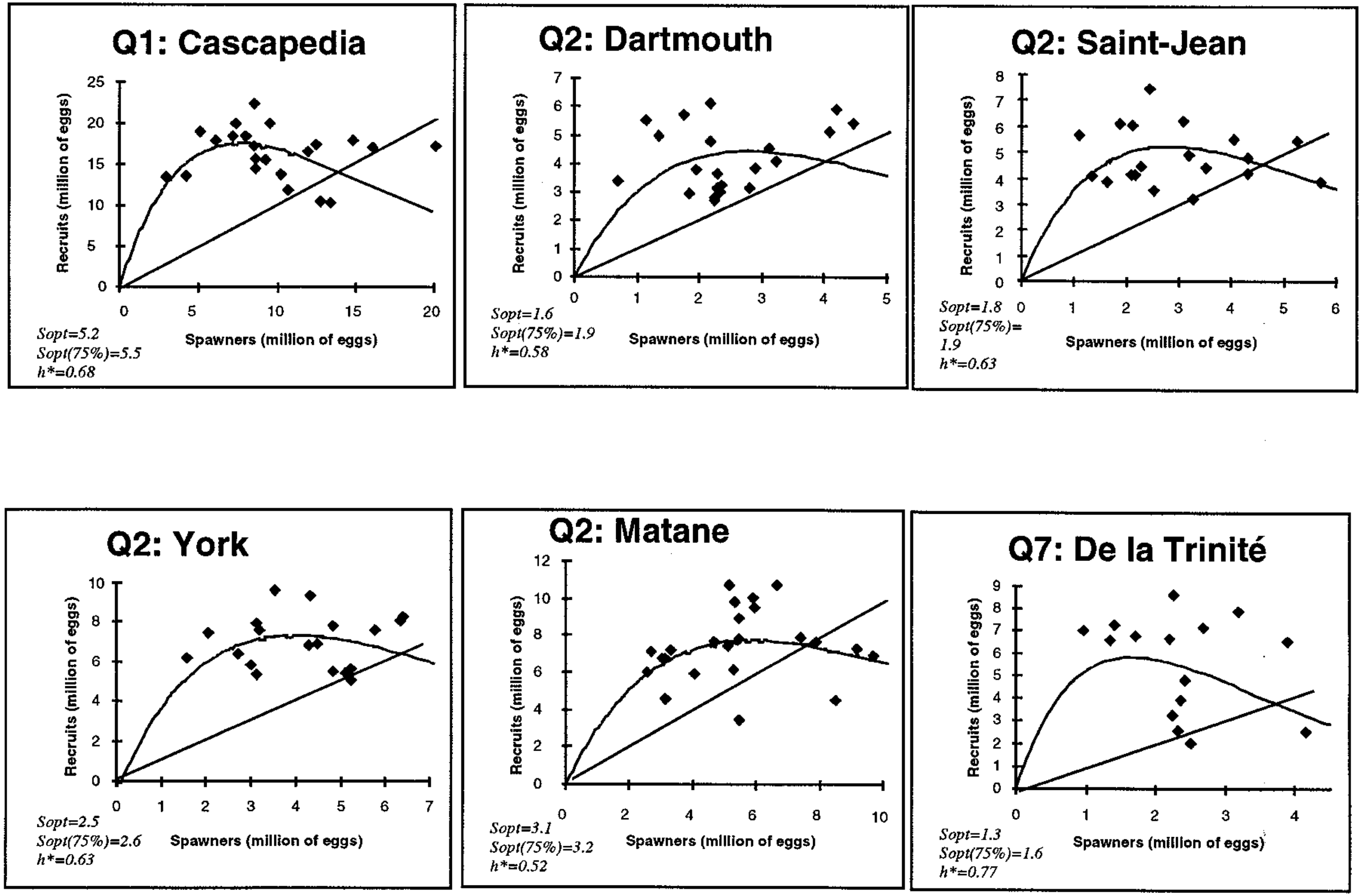
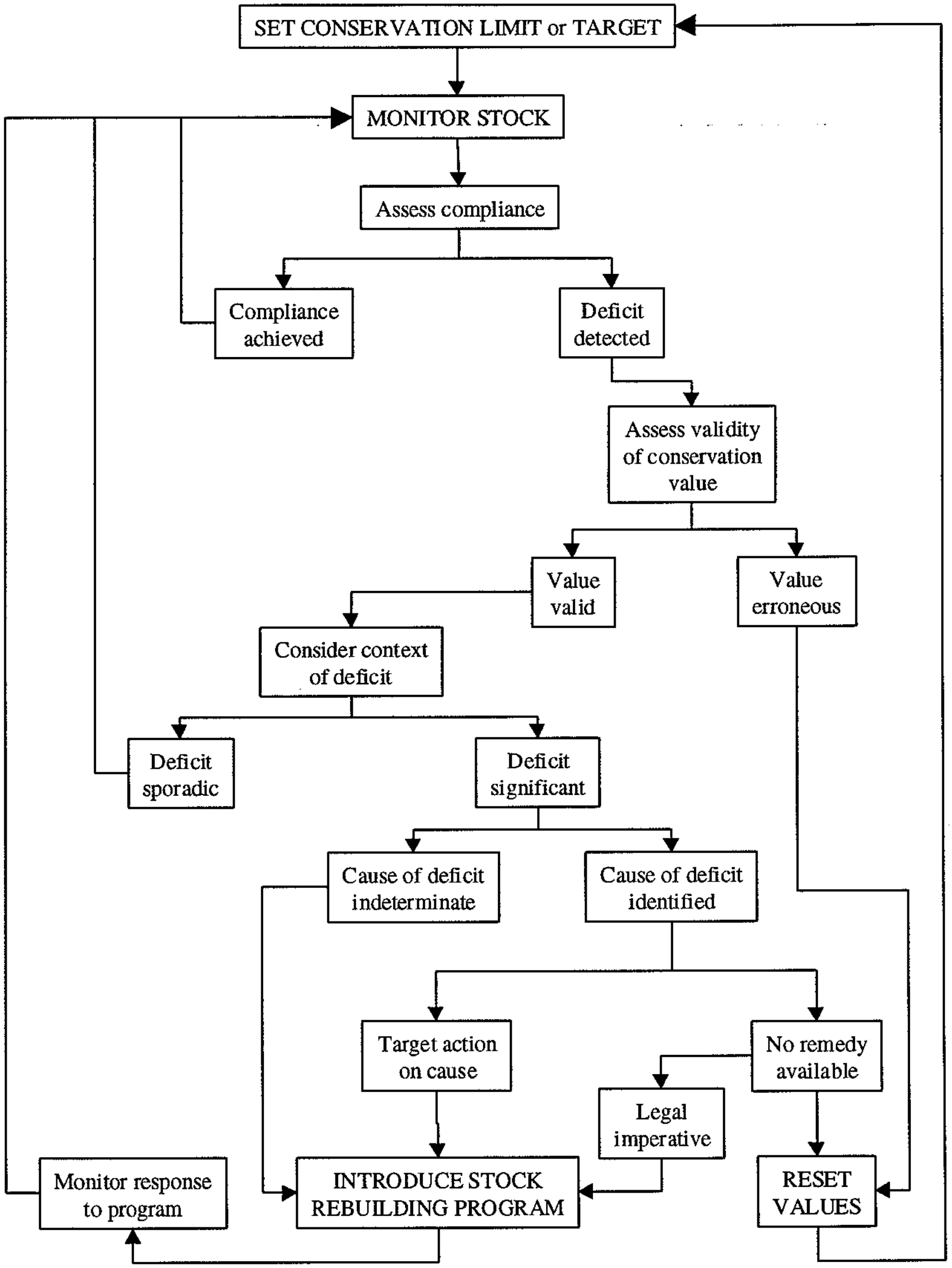
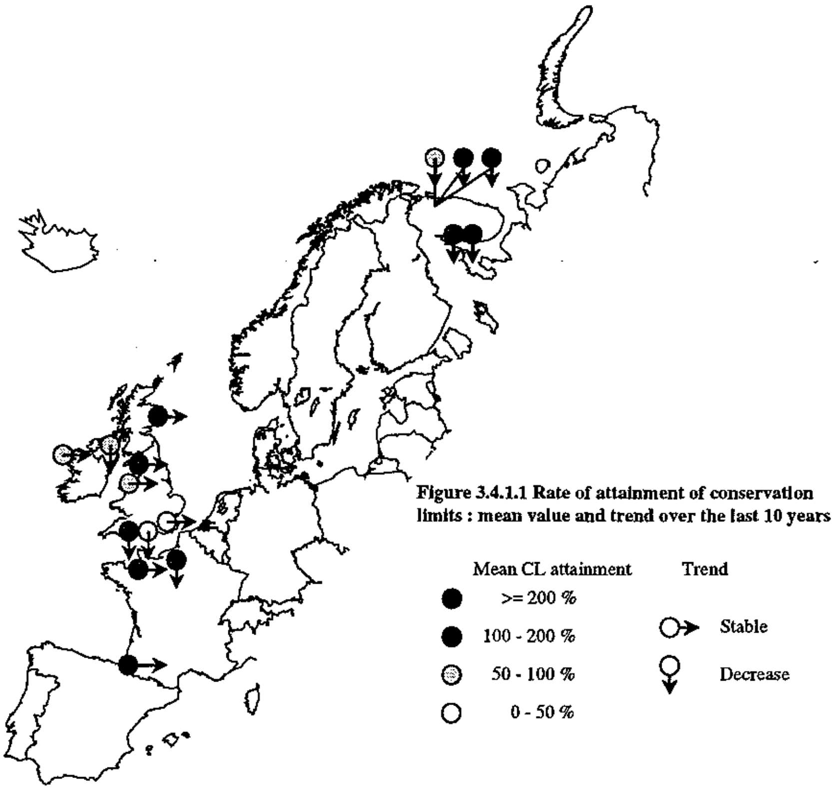


Figure 1.3.7 Stock/Recruitment relationships for the six rivers studied.

Figure 1.4.1 Flow chart for decision making in relation to compliance or non-compliance with conservation limits or targets.





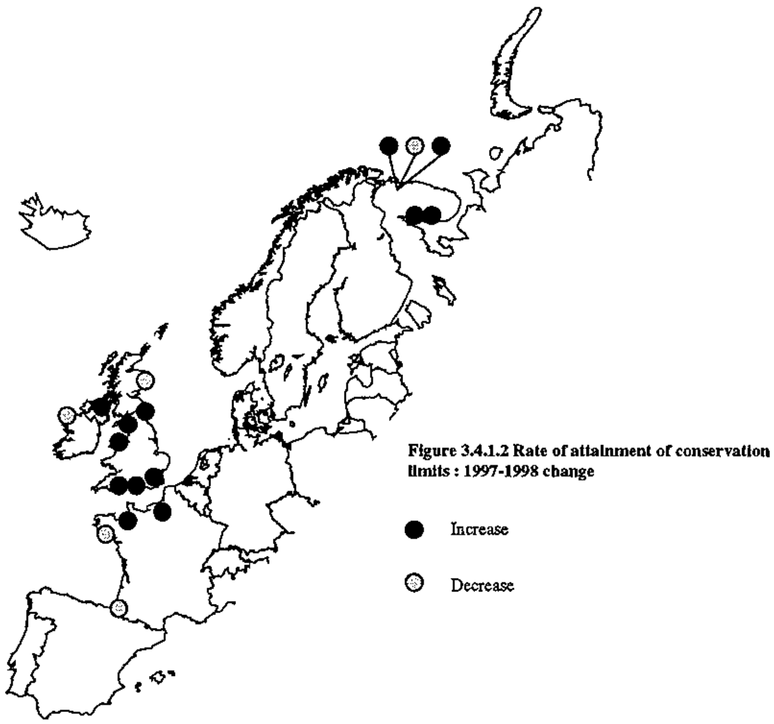
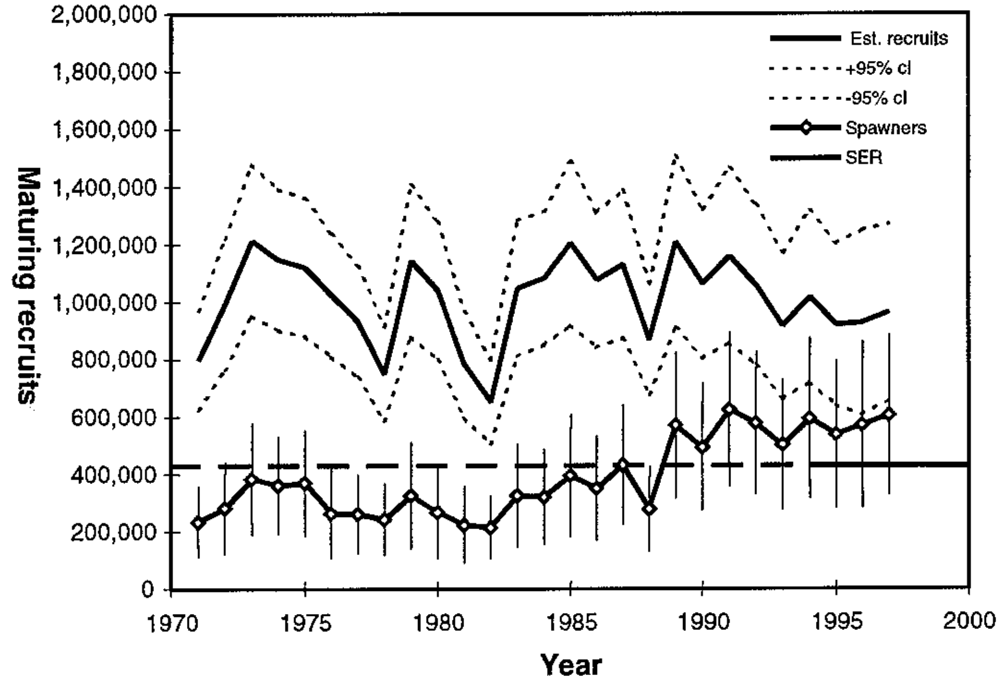


Figure 2.1.1 Rate of attainment of conservation limits. Upper panel: mean value and trend over the last 10 years; lower panel: change from 1997 to 1998.

Figure 2.3.1 Estimated PFA, spawning escapement and SER for maturing and non-maturing 1SW components of Northern European stocks, 1971–1998.

a) Maturing 1SW recruits



b) Non-maturing 1SW recruits(Recruits in Year N become spawners in Year N-

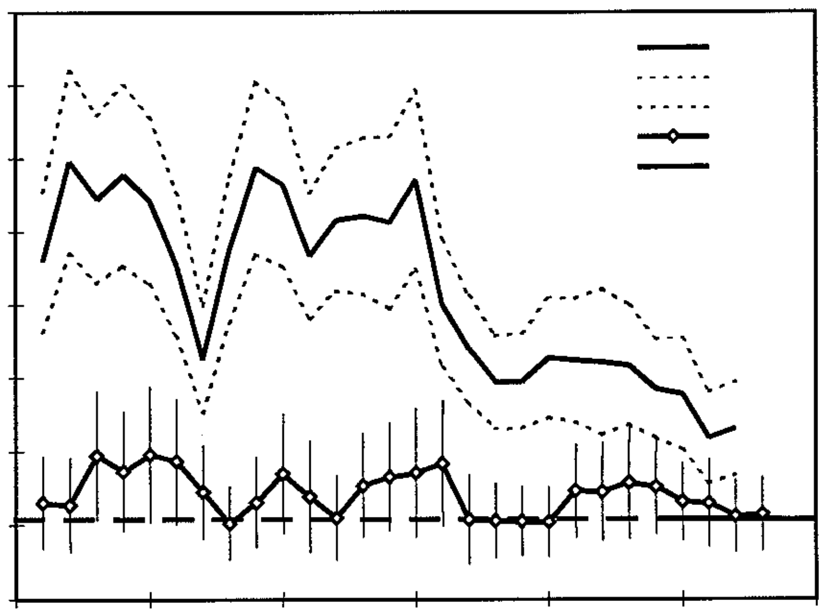
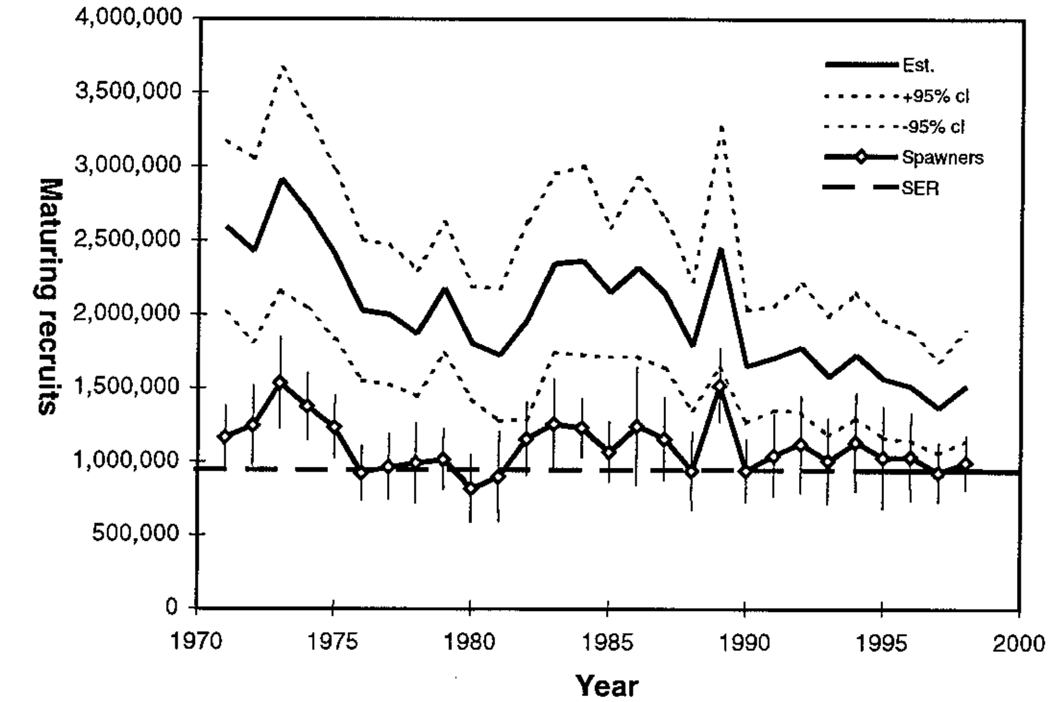


Figure 2.3.2 Estimated PFA, spawning escapement and SER for maturing and non-maturing 1SW component of Southern European stock groups, 1971–1998.

a) 1SW salmon (Southern)



b) MSW salmon (Southern) (Recruits in Year N become spawners in Year N+1)

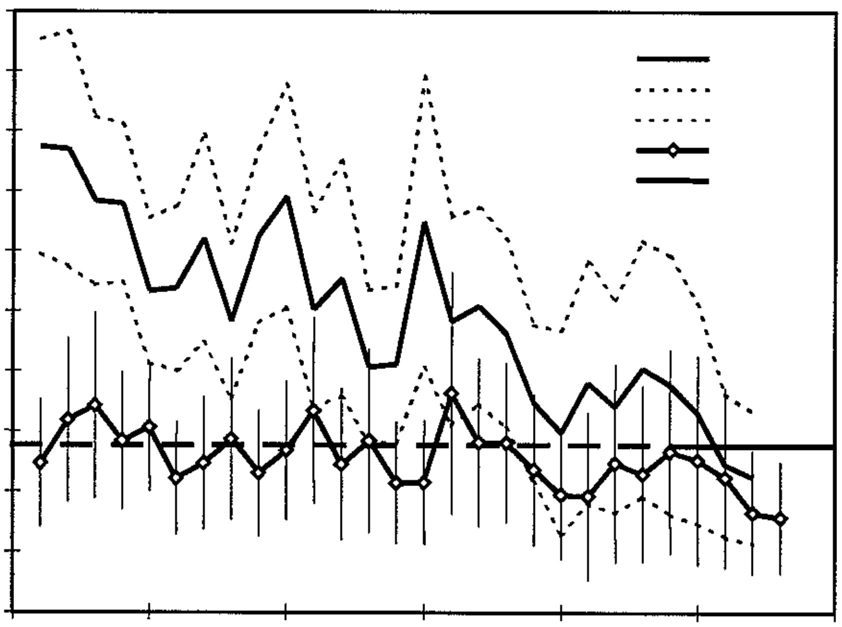
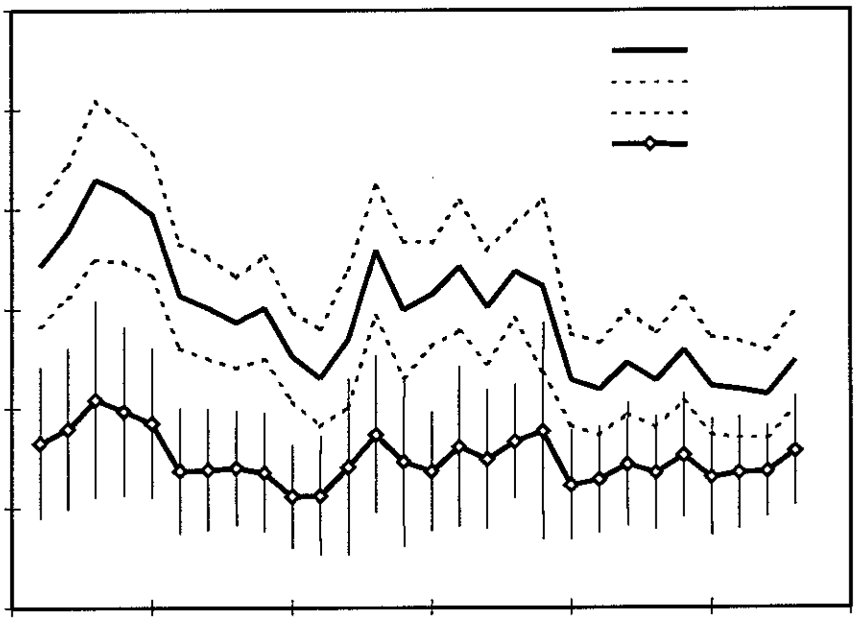


Figure 2.3.3 Estimated prefishery abundance of salmon stocks and spawning escapement in the NEAC Area, 1971–1998.

a) 1SW salmon (NEAC total)



b) MSW salmon (NEAC total) (Recruits in Year N become spawners in Year N+1)

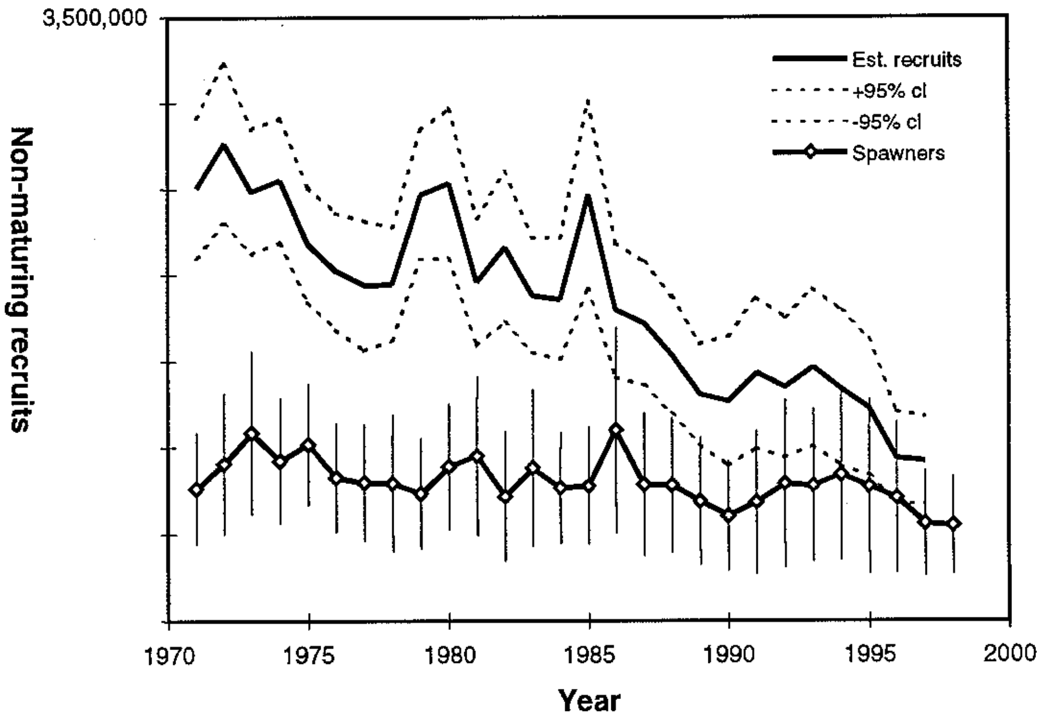


Figure 3.1.1 Map of Salmon Fishing Areas (SFAs) and Quebec Management Zones (Qs) in Canada.

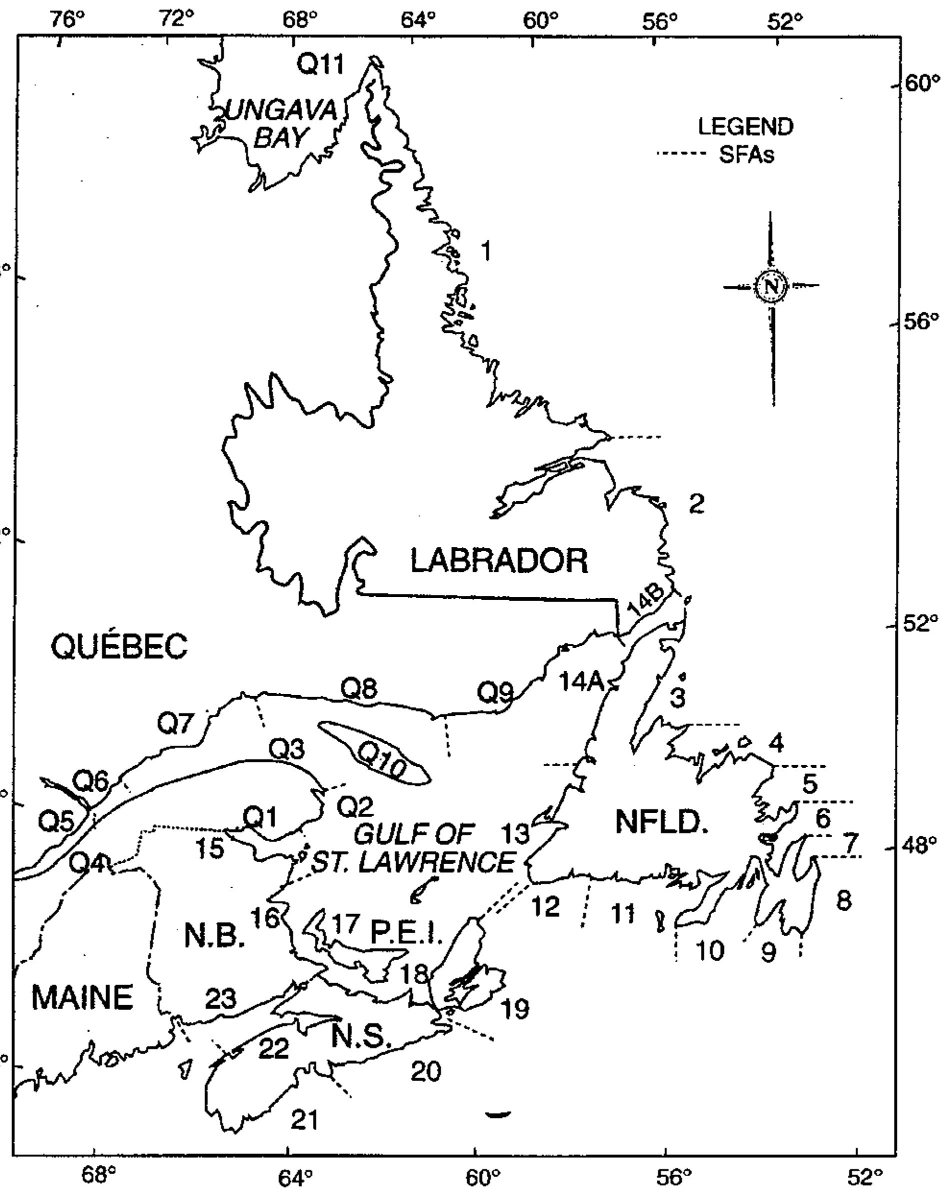


Figure 3.1.2.1 Estimated mid-points of 1SW returns (circles) to rives of Nfld. & Labrador and to SFAs of the other geographic areas, 1SW recruits of Nfld. & Labrador origin before commercial fisheries in Nfld. & Labrador (dashed lines), 1SW spawners (squares), 1971–1998. Returns and spawners for Scotia-Fundy do not include those from SFA 22 and a portion of SFA 23. Labrador data for 1998 is unavailable.

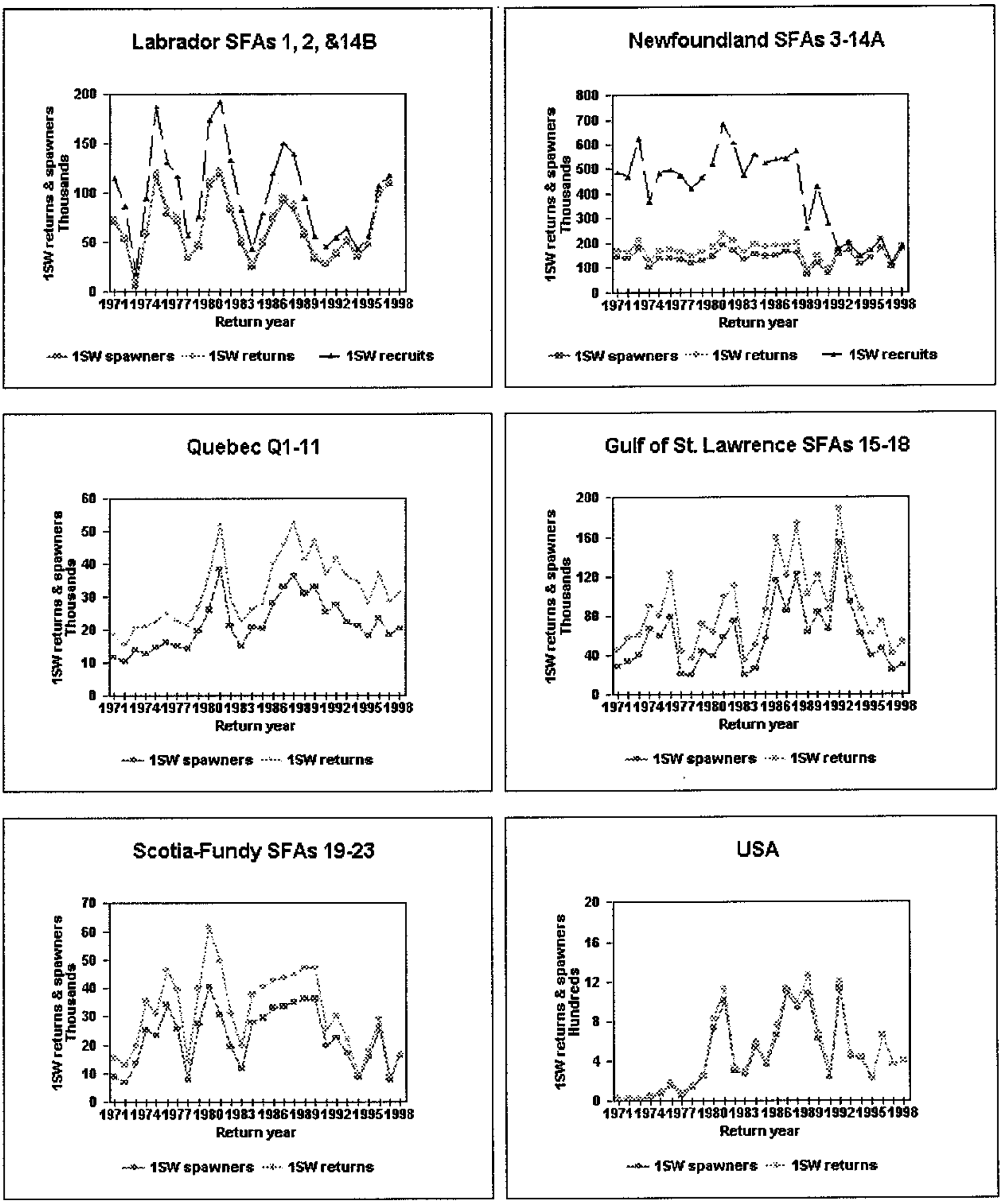


Figure 3.1.2.2 Comparison of estimated mid-points of 2SW returns (circles) to rivers of Nfld. & Labrador and to SFAs of the other geographic areas, 2SW recruits of Nfld. & Labrador origin before commercial fisheries in Nfld. & Labrador (dashed lines), 2SW spawners (squares) and 2SW conservation requirements (triangles) for 1971–1998 return years. Returns and spawners for Scotia-Fundy do not include those from SFA 22 and a portion of SFA 23. Estimates for 1998 for Labrador are unavailable.

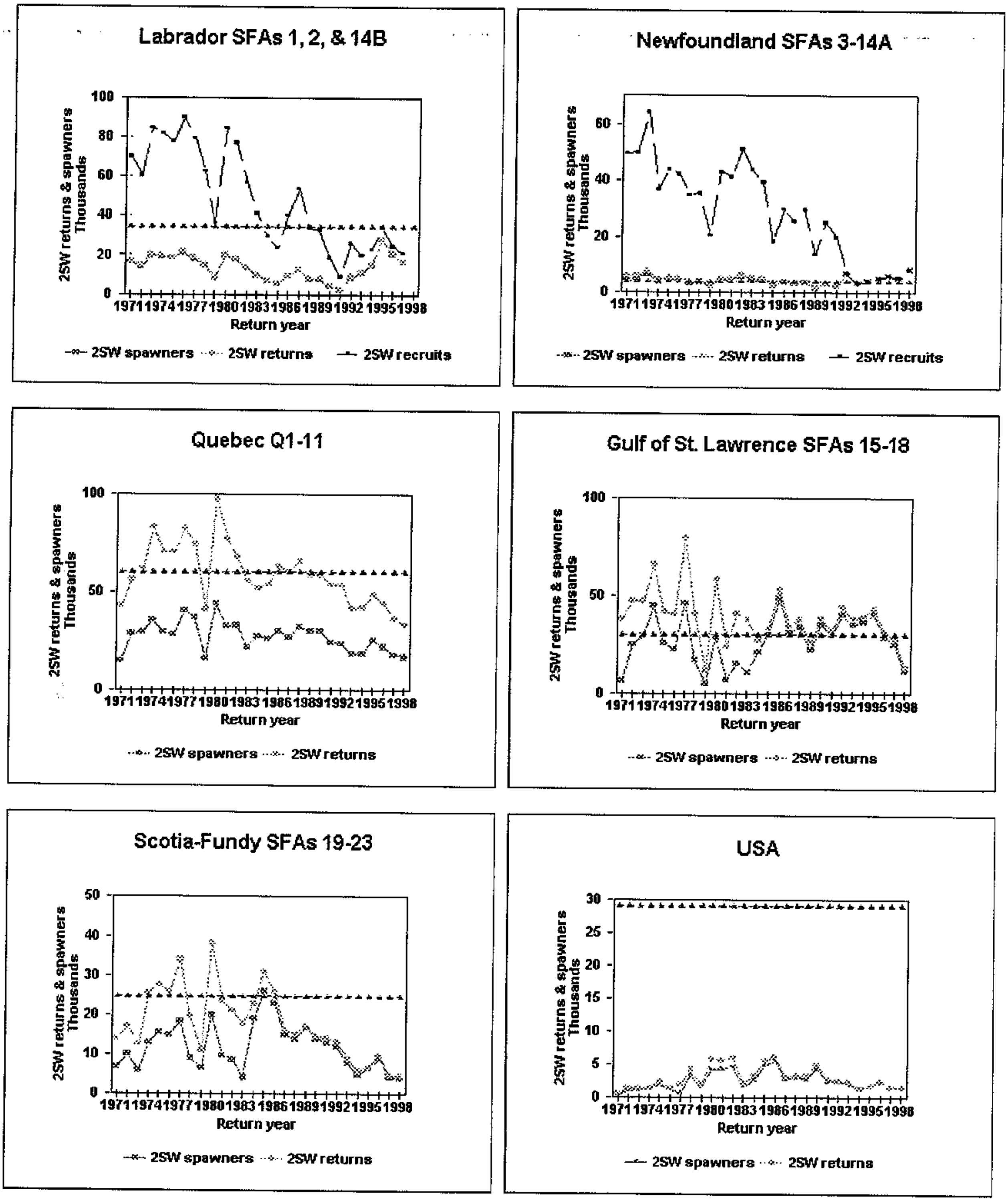
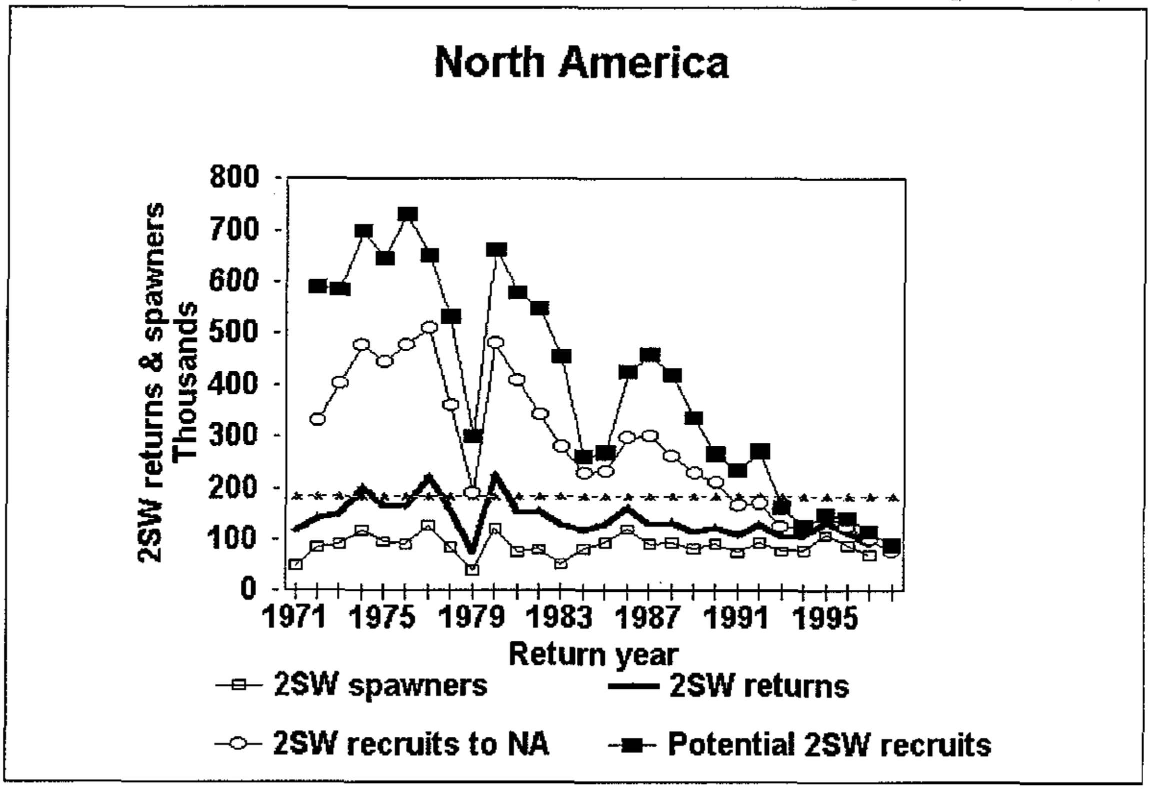


Figure 3.1.2.3 *Top panel: comparison of estimated of potential 2SW production prior to all fisheries, 2SW recruits available to North America, 1971–1998 and 2SW returns and spwners for 1971–1997, as 1998 data for Labrador are unavailable. Triangles indicate the 2SW-spawner threshold. Bottom panel: comparison of potential maturing 1SW recruits, 1971–1998 and returns and 1SW spawners for 1971–1997 return years as Labrador data for 1998 are unavailable.*



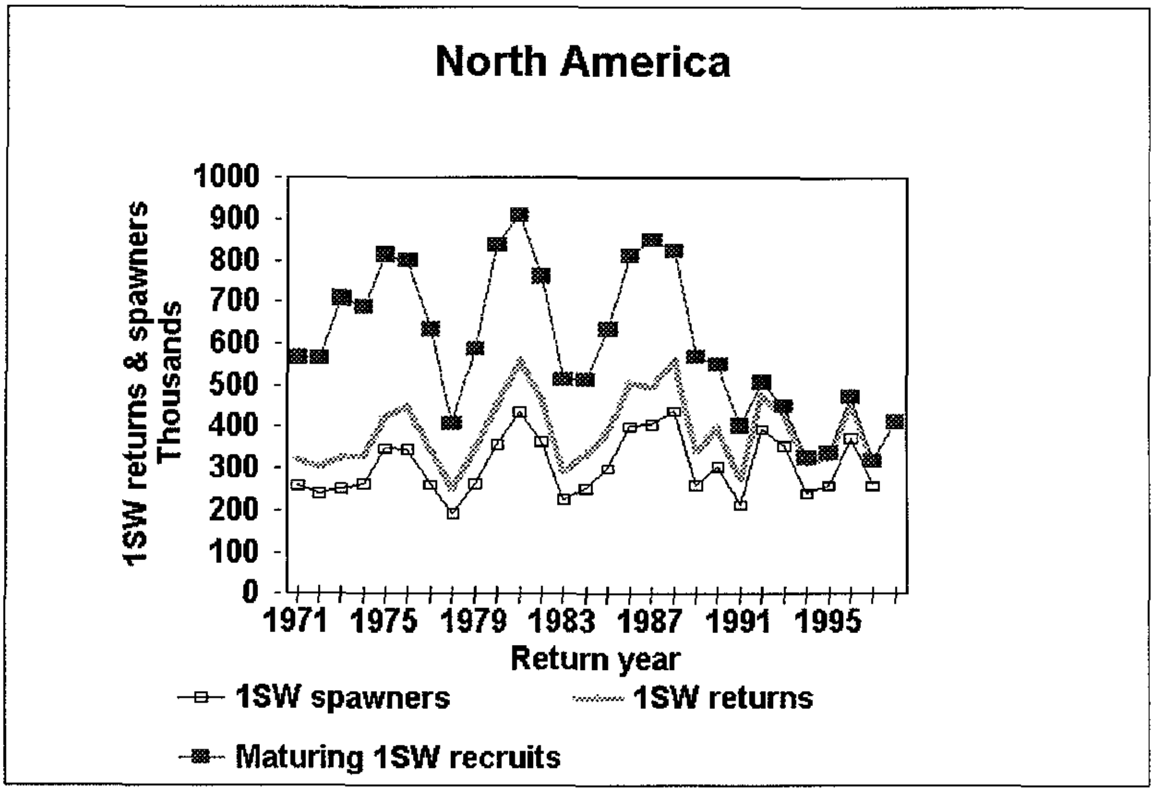


Figure 3.1.2.4 Pre-fishery abundance estimates of maturing and non-maturing salmon in North America (A) and proportion of smolt class maturing after 1SW (B).

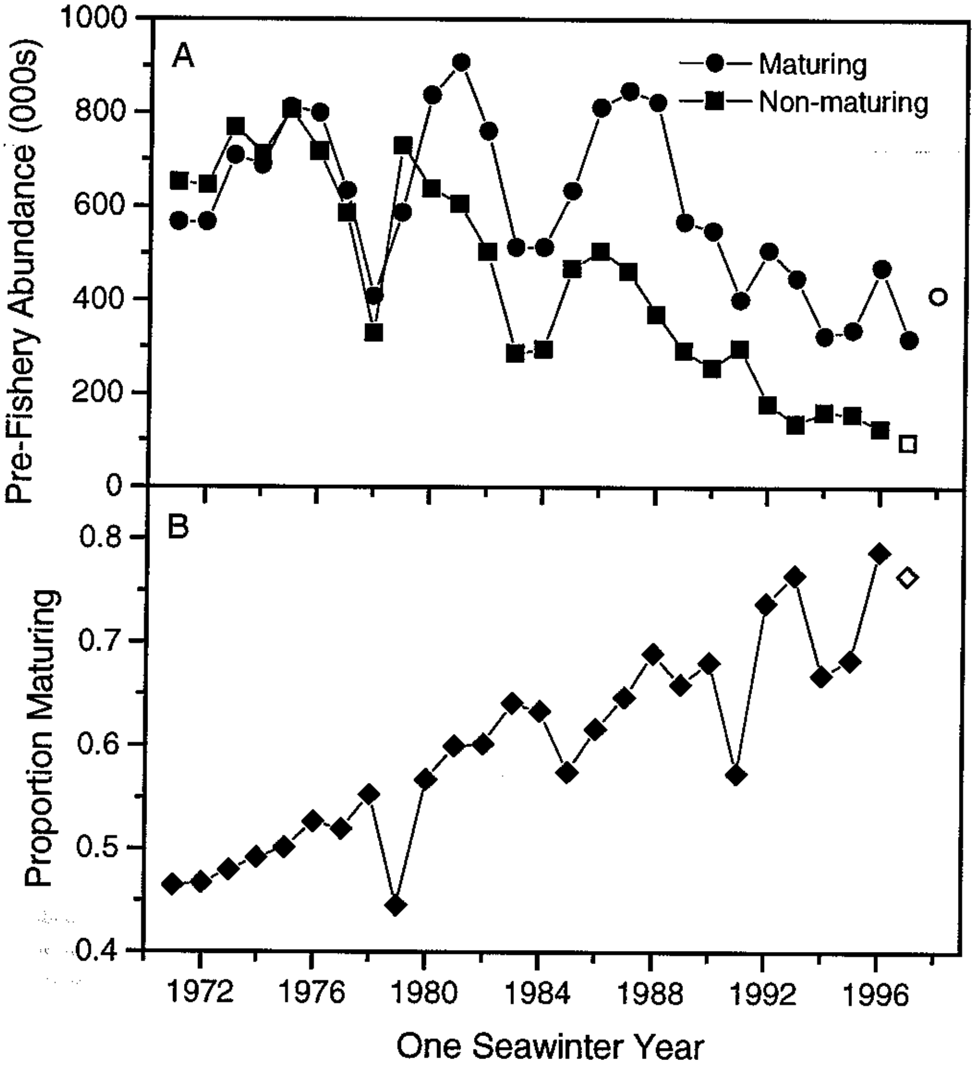


Figure 3.1.2.5 Total 1SW recruits (non-maturing and maturing) originating in North America.

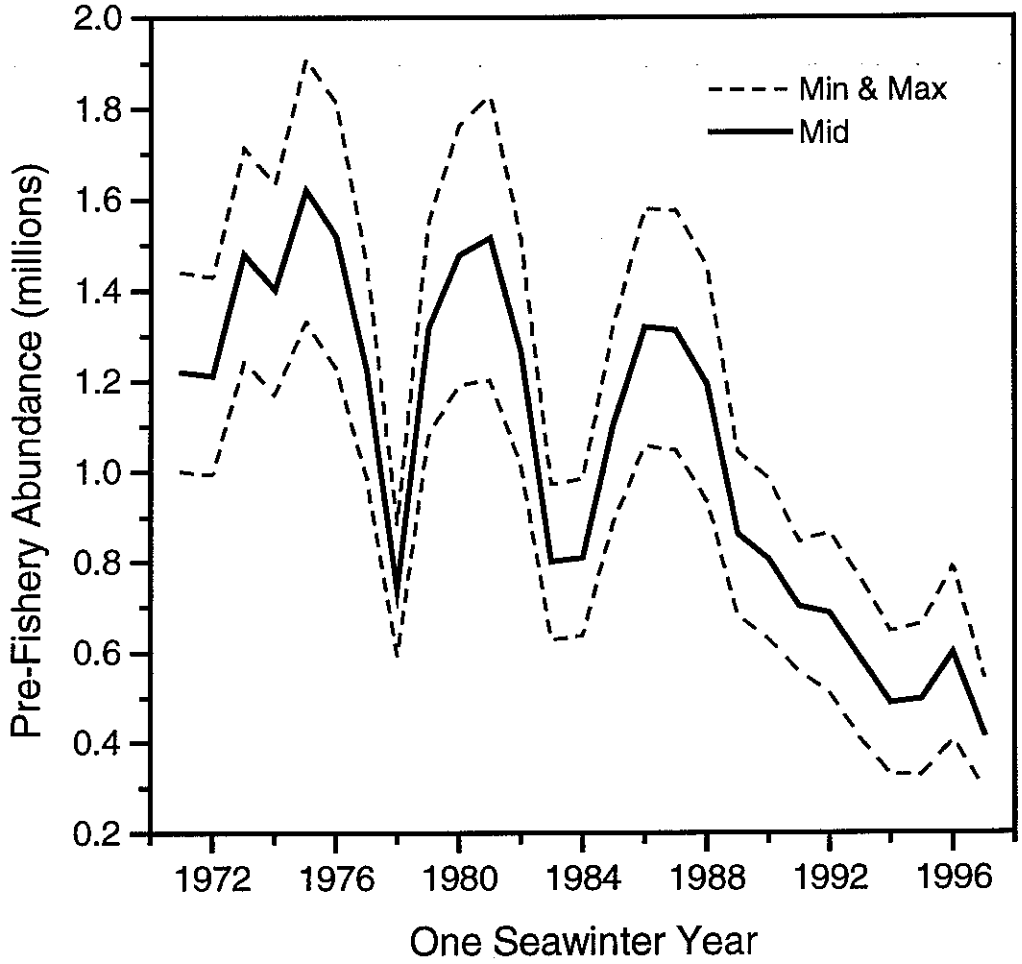
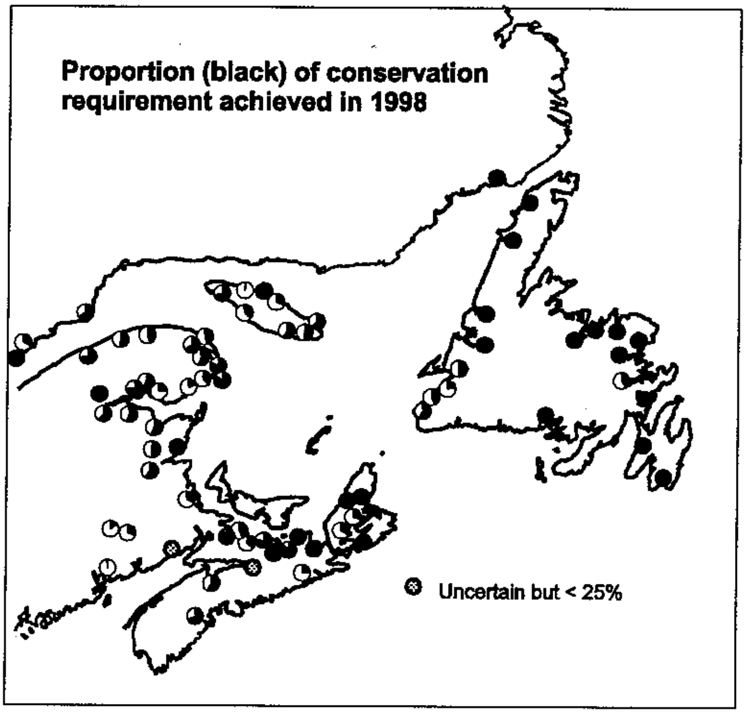


Figure 3.1.2.6 Egg depositions in 1998 relative to conservation requirements in 71 rivers (upper map) and for 19 rivers of eastern Canada and five rivers of U.S. under colonization or rehabilitation (lower map). The black slice represents the proportion of the conservation requirement achieved in 1998. A solid black circle indicates the egg deposition requirement was attained or exceeded.



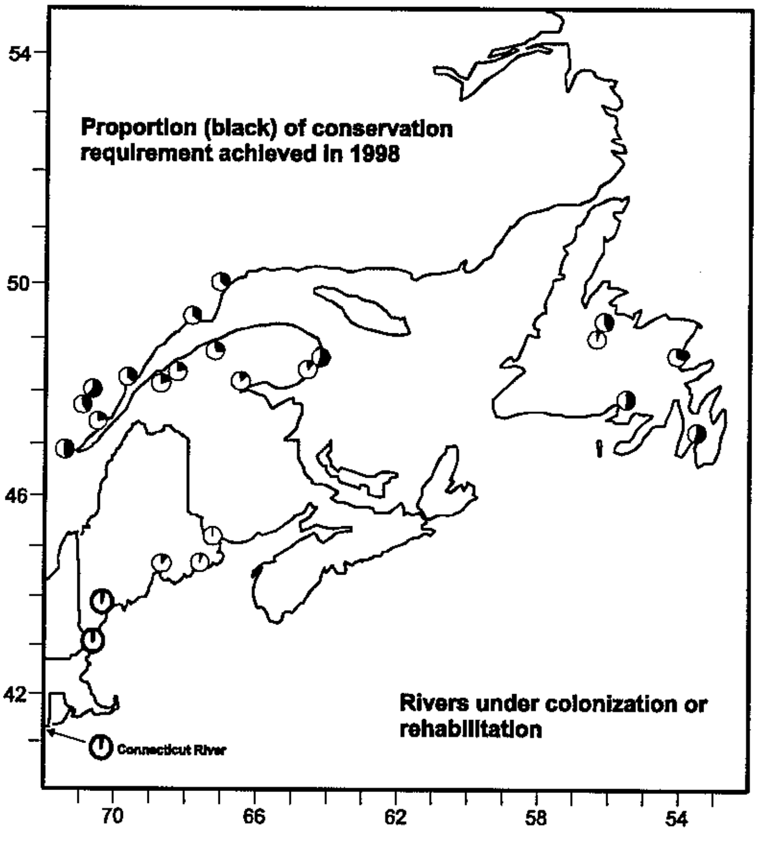


Figure 3.1.2.7 Bivariate scatter plots of variables explored in the North American Atlantic salmon survival model. Variables are: LNSURV = ln (maturing and non-maturing prefishery abundance relative to the area-weighted smolt index), FEBRUARY = index of habitat in February, SEALS98 = index of predator abundance based on harp seal population size, SMOLTS = area-weighted relative smolt index.

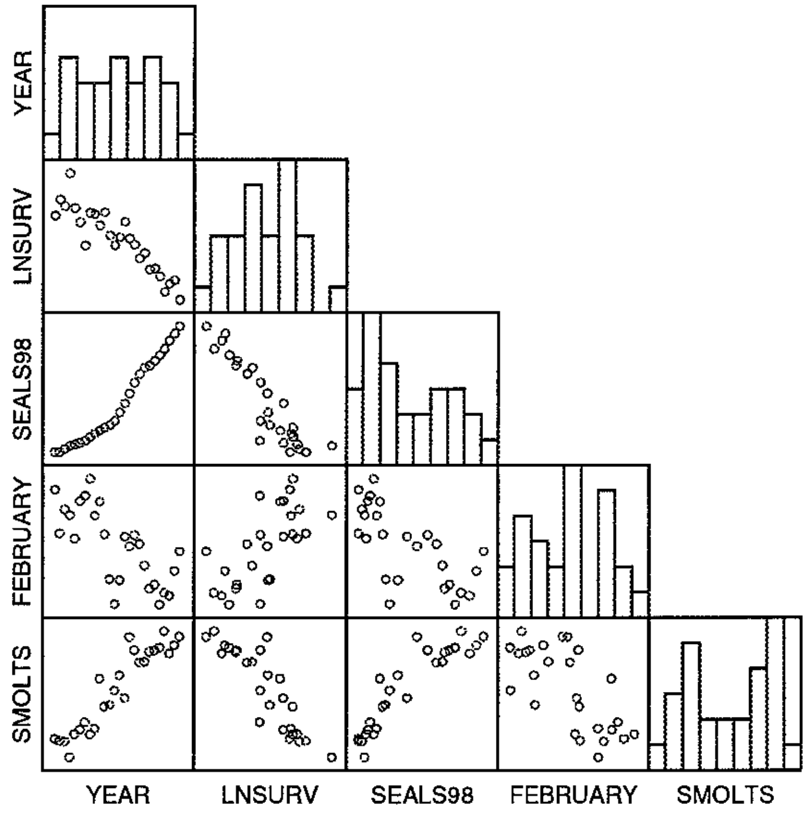
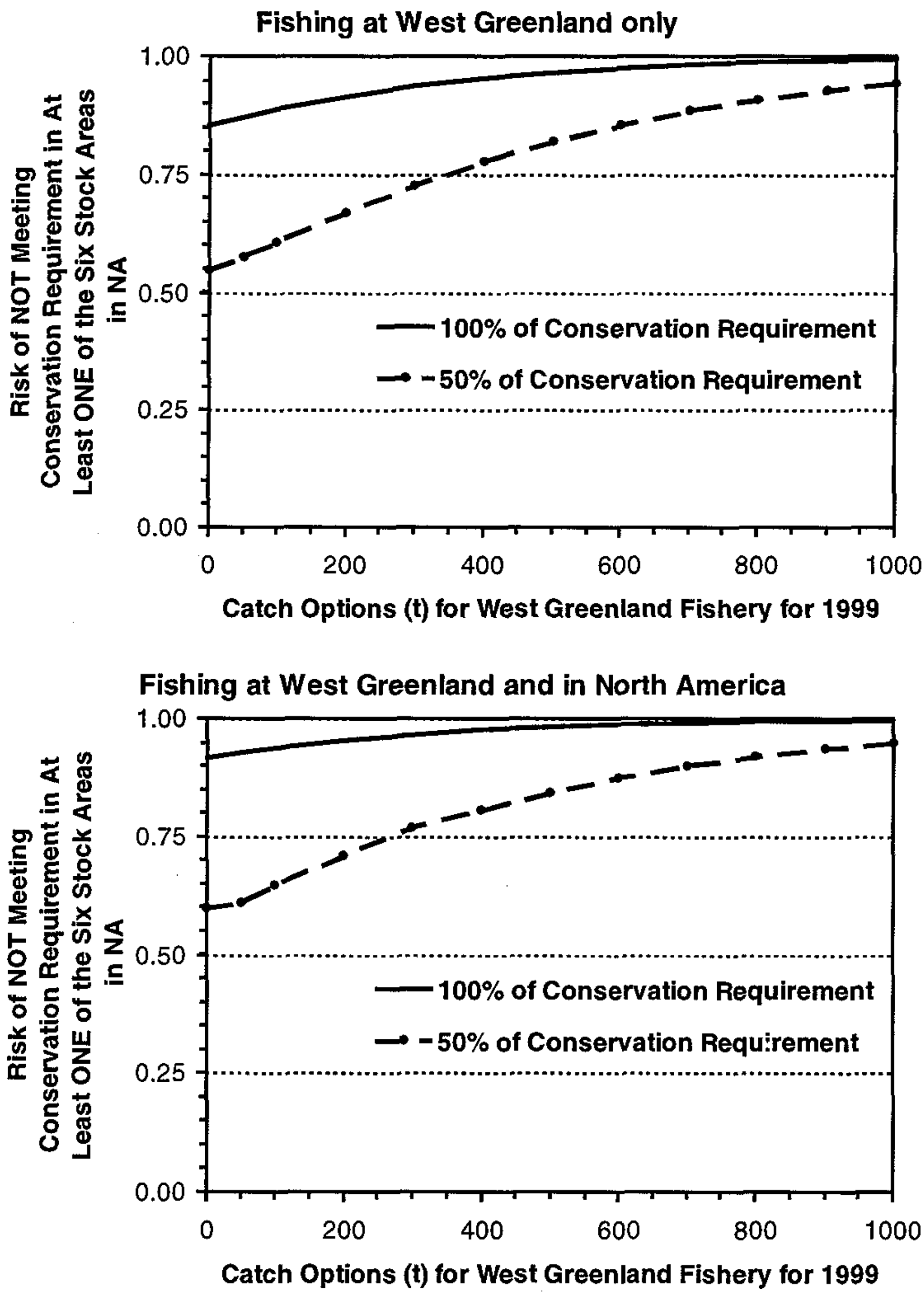


Figure 4.6.4.1 Risk analysis (probability of not meeting the conservation requirement in at least one of the six stock areas in North America) of catch options on the prefishery 1SW non-maturing salmon component in 1999. Risk is expressed relative to catch options at West Greenland in 1999 without fisheries in North America in 2000 (upper panel) and for combined fisheries at West Greenland in 1999 and North America in 2000 (lower panel). Exploitation rates in North America are based on levels varying between 0.15 and 0.25 on the returning large salmon.



Appendix 1

CNL(98)13
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 and landings, including unreported catches by stock complex and catch and release, and world-wide production of farmed and ranched salmon in 1998;
1.2 evaluate non-catch fishing mortality for all salmon gear;
1.3 report on significant developments which might assist NASCO with the management of salmon stocks;
1.4 develop a framework for stock rebuilding programmes;
1.5 provide a compilation of egg collections and juvenile releases in 1998;
1.6 provide a compilation of microtag, finclip and external tag releases by ICES member countries in 1998.

2 With respect to salmon in the North-East Atlantic Commission area:

2.1 describe the events of the 1998 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 further develop the age-specific stock conservation limits for smaller stock units in the Commission area, where possible based upon individual river-based estimates;
2.4 further develop methods to estimate the expected abundance of salmon for smaller stock units in the Commission area;
2.5 provide catch options or alternative management advice with an assessment of risks relative to the objective of exceeding stock conservation limits;
2.6 provide an estimate of the by-catch of salmon post-smolts in pelagic fisheries;
identify relevant data deficiencies, monitoring needs and research requirements.

3 With respect to Atlantic salmon in the North American Commission area:

3.1 describe the events of the 1998 fisheries and the status of the stocks;
3.2 update the evaluation of the effects on US and Canadian stocks and fisheries of management measures implemented after 1991 in the Canadian commercial salmon fisheries;
3.3 update age-specific stock conservation limits based on new information as available
3.4 provide catch options or alternative management advice with an assessment of risks relative to the objective of exceeding stock conservation limits;
3.5 identify relevant data deficiencies, monitoring needs and research requirements.

4 With respect to Atlantic salmon in the West Greenland Commission area:

4.1 describe the events of the 1998 fisheries and the status of the stocks
4.2 evaluate the effects on European and North American stocks of the Greenlandic management measures since 1993;
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 or alternative management advice with an assessment of risks relative to the objective of exceeding stock conservation limits;
4.7 identify relevant data deficiencies, monitoring needs and research requirements.

Appendix 2

Computation Of Catch Advice For West Greenland

The North American Spawning Target (SpT) for 2SW 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 Target Reserve (SpR). Thus:

Eq. 1. $SpR = SpT * \exp(11*M)$ (where $M = 0.01$)

The Maximum Allowable Harvest (MAH) may be defined as the number of non-maturing 1SW fish that are available for harvest. This number is calculated by subtracting the Spawning Target Reserve from the pre-fishery abundance (PFA).

Eq. 2. $MAH = PFA - SpR$

To provide catch advice for West Greenland it is then necessary to decide on the proportion of the MAH to be allocated to Greenland (f_{NA}). The allowable harvest of North American non-maturing 1SW salmon at West Greenland NA1SW) may then be defined as

Eq. 3. $NA1SW = f_{NA} * MAH$

The estimated number of European salmon that will be caught at West Greenland (E1SW) will depend upon the harvest of North American fish and the proportion of the fish in the West Greenland fishery that originate from North America [PropNA] [1]. Thus:

Eq. 4. $E1SW = (NA1SW / PropNA) - NA1SW$

To convert the numbers of North American and European 1SW salmon into total catch at West Greenland in metric tonnes, it is necessary to incorporate the mean weights (kg) of salmon for North America [WT1SWNA][1] and Europe [WT1SWE][1] and age correction factor for multi-sea winter salmon at Greenland based on the total weight of salmon caught divided by the weight of 1SW salmon [ACF][1] .

The quota (in tonnes) at Greenland is then estimated as

Eq. 5. $Quota = (NA1SW * WT1SWNA + E1SW * WT1SWE) * ACF/1000$

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	=	0.5844
WT1SWNA	=	2.623
WT1SWE	=	2.740
ACF	=	1.118