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PART 2

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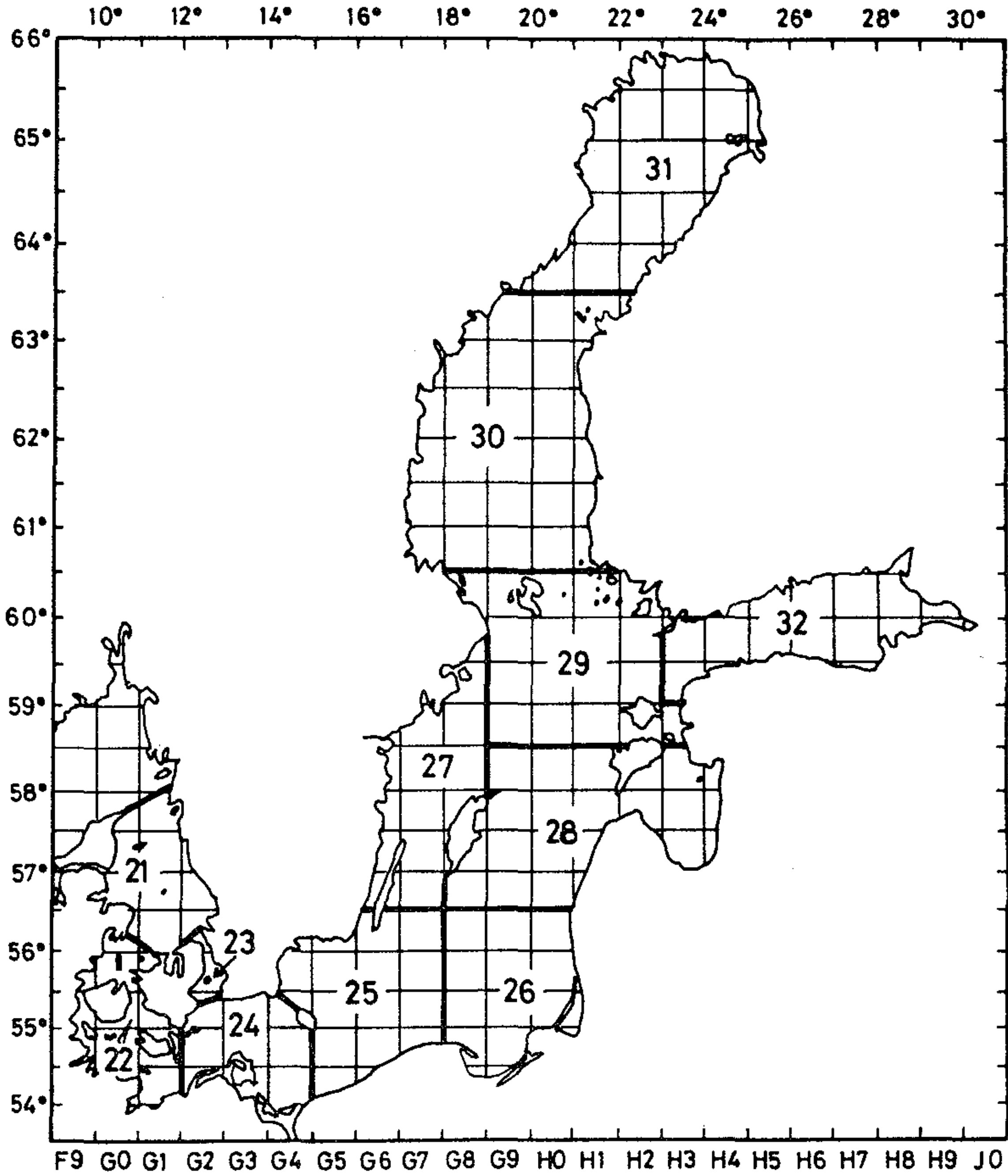
REPORT TO THE INTERNATIONAL BALTIC SEA FISHERY COMMISSION



Baltic Fishing Areas

REPORT TO THE INTERNATIONAL BALTIC SEA FISHERY COMMISSION

1. GENERAL ADVICE TO THE INTERNATIONAL BALTIC SEA FISHERY COMMISSION

1.1 Nominal Catches in the Baltic Area

Officially reported catches in the Baltic are given in Tables 1.1.1-1.1.5. 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 figures are reported by the larger Divisions IIIb,c, and d.

The trends in Tables 1.1.1-1.1.5 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 Gemany 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.

2. BALTIC PELAGIC STOCKS

Advice for 1994 and 1995

The estimated levels of exploitation (i.e. fishing mortalities) are very low for most stocks of pelagic fish in the Baltic. The results of the assessments will at these low levels of fishing mortality show a high variability more due to sampling problems than to actual changes in the stocks. To minimize the impact of this variability on management advice, ACFM gives its advice for a two-year period (1994 and 1995) for the herring stocks in Sub-divisions 25-29 and 32, and for Sub-divisions 30 and 31, as well as for the sprat stock in Sub-divisions 22-32. The stocks will, however, be monitored and any major changes evaluated at the ACFM meeting in May 1994.

The stocks mentioned above are well within safe biological limits and most of them are exploited at a level of fishing mortality below $F_{0.1}$. In the long term higher yields could be attained by increasing fishing mortality towards the $F_{0.1}$ level.

2.1 Herring

Catches of herring in 1991 and 1992 are given in Table 2.1.1.

2.1.1 Herring in Sub-divisions 22-24 and Division IIIa

(Tables 2.1.2 - 2.1.4; Figure 2.1.1)

Source of information: Report of the Working Group on Assessment of Pelagic Stocks in the Baltic, April 1993 (C.M.1993/Assess:17). Report of the Herring Assessment Working Group for the Area South of 62°N, March/April 1993 (C.M.1993/Assess:15).

Year	1986	1987	1988	1989	1990	1991	1992	1993	Max[1]	Min[1]	Mean[1]
					NORTH SEA						
CATCH											
Baltic-Div.IIIa-type spring spawners	20	14	23	20	8	8	8				
TAC					DIVISION IIIa						
Pred. catch of autumn spawners							96	153			
Recommended spring spawners	132[4]	112[4]	99[4]	84[4]	67	91	90	93-113			
Recommended mixed clupeoids		80	80	80	60	0	0	0[5]			
Agreed herring TAC (spring & autumn spawners)	46	138	138	138	120	104.5	124	165			
Agreed mixed clupeoid TAC	80	80	80	80	65	50	50	45			
CATCH											
National landings[6]	212	234	333	192	202	188	227				
Catch as used by ACFM	217	220	330	162	195	191	227				
CATCH BY FLEET/STOCK											
Autumn spawners landed for human consumption						26	47				
Autumn spawners in mixed clupeoid fishery (D)			Not available			13	23				
Autumn spawners in other ind. landings (E)						38	82				
Autumn spawners total	146	161	201	91	77[7]	77	152				
Spring spawners landed for human consumption						68	53				
Spring spawners in mixed clupeoid fishery (D)			Not available			5	2				
Spring spawners in other ind. landings (E)			Not available			40	20				
Spring spawners total	71	59	129	71	118[7]	114	75				
TAC					SUB-DIVISIONS 22-24						
Recommended TAC			97	90	64	87	80	57-68			
Agreed TAC Sub-divisions 22-29 and 32	399	399	399	399	399	402	402	560			
(Agreed TAC Sub-divisions 30 and 31	91	91	91	91	84	84	84	90)			
CATCH											
National landings	95	102	99	95	78	70	85				
Catch as used by ACFM	95	102	99	95	78	70	85				
					SUB-DIVISIONS 22-24 AND DIVISION IIIa SPRING SPAWNERS						
Total catch as used by ACFM	186	175	251	186	204[7]	192	168		261	86	172
Spawning stock size	246	204	251	248	267	291	283	232[2]	291	81	194
Recruitment, age 0	12.0	6.4	7.4	3.4	3.7	3.0[8]	4.4[8]	6.1[3]	12.0	2.5	5.9
Mean F(2-6u)	0.68	0.63	0.62	0.48	0.48	0.40	0.50		1.17	0.40	0.73

[1]Over period 1974-1992; 1974-1990 for recruitment. [2]Predicted. [3]Assumed. [4]Adult herring fishery in Division IIIa only. [5]Substantial reduction. [6]As reported by Working Group members. [7]Estimated. [8]Estimated from surveys. Weights in '000 t, recruitment in billions.

Catches: Estimated catches of this stock decreased in 1992 to the long-term average. Catches from this stock are made by four separate "fleets" (see special comments). National landings of herring (spring and autumn-spawners combined) are given in Tables 2.1.2 - 2.1.4.

Data and assessment: Stock estimates from acoustic and trawl surveys used in the assessment. Because the surveys gave unexpectedly high estimates of stock biomass in 1991 and 1992, average results for the last 5 years was given the most influence in the assessment.

Fishing mortality: Decreased from a high level (about 1.0) in the late 1970s to about 0.5 in 1991-1992 which is below the long-term average for this stock. The present level is uncertain.

Recruitment: Declining recruitment since the mid-1980s and the 1991 and 1992 year classes are among the lowest in the series from 1974-1992.

State of stock: SSB fairly stable in recent years and above the average level, but some decrease predicted in 1993. Increasing trend since the mid-1970s with a decline from a peak in 1991.

Forecast for 1994: A forecast for this stock was made for four fisheries that exploit the stock in such a way as to be consistent with the forecast for North Sea herring which are also exploited in Division IIIa. The definitions of each fishery and the assumptions made in the forecasts are given under Special Comment 2.

F(94)				Catches of spring-spawning stock in 1994						
Fisheries				Division IIIa				Sd 22-24	Total	SSB(95)
C D E	F	Over-all F_{2-6} (94)	SSB(94)	C	D	E	Total	F		
F(94) = F(93)	0.8 F(92)	0.30	213	28.5	0.8	3.9	33.2	79.7	112.9	242
"	1.0 F(92)	0.36	212	27.8	0.8	3.8	32.4	97.3	129.7	228
"	1.2 F(92)	0.42	210	27.1	0.8	3.7	31.6	114.0	145.6	215
F(94) = F(92)	0.8 F(92)	0.44	210	63.7	2.2	26.2	92.1	75.7	167.8	209
"	1.0 F(92)	0.50	209	62.2	2.1	25.6	89.9	92.4	182.3	197
"	1.2 F(92)	0.56	208	60.8	2.1	25.0	87.9	108.4	196.3	186

Weights in '000 t.

Continued fishing at current levels of fishing mortality will lead to decreased SSB due to declining recruitment.

Management advice: The stock has been increasing over the past 20 years and reached a record high level in 1991. The stock is currently considered to be within safe biological limits. The most recent year classes are poor and the spawning stock size is expected to decrease in 1993. Catches in the range of 130,000-180,000 t from the stock in 1994 will maintain the stock at its present level.

Special comments:

1) The sampling level in 1992 was generally higher than in previous years for the landings made for human consumption. There are, however, large uncertainties about the quantities and age composition of the part that goes for reduction. A major part of the Swedish landings for industrial purposes (both from the Skagerrak and the Baltic) has not been adequately sampled. This amount was about 130,000 t in 1992. This lack of sampling makes the assessment, both of the North Sea autumn spawners and of spring spawners, more uncertain.

2) The four fisheries exploiting this stock used in the forecast table are defined as follows:

C:-**A directed fishery for herring in Division IIIa** in which trawlers (with 32 mm mesh size) and purse seiners take part. Catches are landed mainly for human consumption, but a variable proportion is landed for reduction purposes.

D:-The **"Mixed clupeoid fishery" in Division IIIa** is carried out under a special "Sprat" TAC for all species caught in this fishery. Danish boats are obliged to use a 32 mm mesh (since 1 Jan. 1991). The Swedish fishery includes purse seiners fishing for sprat along the coast as well as trawlers using small-meshed gear (less than 32 mm). The Norwegian fishery is a purse seine sprat fishery for the canning industry. In the Danish mixed clupeoid fishery the proportion of herring has declined and in 1992 the proportion was 57%.

E:-Catches of herring also occur **as by-catches in other fisheries**, such as the Norway pout and sandeel fisheries. The catches in the forecast table under this "fleet" include these by-catches together with some other landings of herring made for reduction (see Fishery C).

F:-Landings from Sub-divisions 22-24

The category "Mixed clupeoids" (Fishery D) only refers to Danish landings in this fishery since it was not possible to separate the Norwegian and Swedish "Mixed" landings from other industrial landings. All Swedish landings for industrial purposes are counted under "Landings for industrial purposes" (Fishery E) whereas the Norwegian industrial landings are given under "Landings for human consumption" (Fishery A).

Attempts have been made to forecast the landings in these fisheries separately. The results are given in the forecast table.

The fisheries catching herring in Division IIIa (C, D, E) exploit both spring spawners that are indigenous to the Baltic and Division IIIa and immigrant autumn spawners from the North Sea. Any change in exploitation of herring in Division IIIa will thus affect both the spring spawners and the autumn spawners.

The assumptions made in each option in the forecast table are given in the table below.

a) For **1993** it is assumed that the values of fishing mortality in each fishery that operates in Division IIIa (ie C, D, & E) will be consistent with the fishing mortality expected on the autumn-spawning North Sea herring that form the predominant part of the catch in Division IIIa. Reductions in fishing mortality rate are expected in Division IIIa in 1993 because, in spite of an expected increase in the abundance of North Sea herring in this area, the total catch of herring is likely to be limited by capacity. The reductions in fishing mortality assumed are thus chosen to correspond to those giving equal catches of North Sea autumn-spawners in 1993 and 1992 in each of these fisheries.

The fishing mortality in the directed fishery in Sub-divisions 22-24 in 1993 is assumed to remain the same as in 1992.

b) For **1994** two sets of options are given. In one, the fishing mortalities in fisheries C, D and E are assumed to remain the same as in 1993 while in the other they are assumed to revert back to their 1992 level. Within each of these sets, fishing mortality options are given for the directed fishery in Sub-divisions 22-24. The assumptions made for fisheries C, D and E in 1994 correspond to those given in the Section on North Sea herring (Section 3.1.2 of the report to NEAFC)

c) For **1995** the assumption is made that the fishing mortality in all fisheries that exploit the stock will be at the 1992 level.

Table showing the fishing mortality options used in the forecast.

	Fisheries				Resulting fishing mortality, F(2-6)
Year	C	D	E	F	
1993	0.42 F(92)	0.36 F(92)	0.14 F(92)	1.00 F(92)	0.36
Expected catch of spring spawners in 1993	25,670 t	679 t	3,320 t	93,864 t	Total catch 123,533 t
1994	0.42 F(92)	0.36 F(92)	0.14 F(92)	0.80 F(92)	0.30
"	"	"	"	1.00 F(92)	0.36
"	"	"	"	1.20 F(92)	0.42
"	1.00 F(92)	1.00 F(92)	1.00 F(92)	0.80 F(92)	0.44
"	"	"	"	1.00 F(92)	0.50
"	"	"	"	1.20 F(92)	0.56
1995	"	"	"	1.00 F(92)	0.50

3) The fungus disease *Ichthyophonus* sp., which was identified in 1991, still occurs in the stock. The current evaluation of the additional mortality based on data only from the 1992 summer survey, indicates that the mortality could be significant. This evaluation is, however, very uncertain as the model used has not been validated and only a very limited set of data has been made available for analysis. It may, therefore, be necessary to review the present assessment at the ACFM November meeting when more data should be available.

2.1.2 Herring in Sub-divisions 25-29 (incl. Gulf of Riga) and 32

(Table 2.1.5; Figure 2.1.2)

Source of information: Report of the Working Group on the Assessment of Pelagic Stocks in the Baltic, April 1993 (C.M.1993/Assess:17).

Year	1986	1987	1988	1989	1990	1991	1992	1993	Max[1]	Min[1]	Mean[1]
Recommended TAC	-	-	-	-	-	293	343	371[4]			
Catch as used by ACFM	268	252	286	290	244	213	209	-	323	209	287
Sp. stock biomass	1004	1129	1378	1217	1363	1664	1945	2588[2]	2037	1004	1532
Recruitment (age 1)	18.7	37.5	15.1	35.3	59.1	28.0	40[3]	33[3]	59.1	15.1	37.1
Mean F(3 -8,u)	0.35	0.32	0.27	0.29	0.24	0.18	0.13	-	0.35	0.13	0.22

[1]Over period 1974-1992. [2]Predicted. [3]Estimated from catch and survey data. [4]Advice from May 1991; in 1992 ACFM advised that F could be raised towards $F_{0.1}$. Weights in '000 t, recruitment in billions.

Catches: Stable after gradual decline.

Data and assessment: Assessment using acoustic stock estimates from 1982-1991. The acoustic surveys in autumn 1992 were not used. A new assessment method caused a revision of historical trends in the stock compared with last year's assessment. The influence of cod predation on the natural mortality of herring now appears to be insignificant.

Fishing mortality: At a low level and decreasing to lowest level in series from 1974-1992.

Recruitment: The 1989 year class was the strongest on record. The 1990 and 1991 year classes are below average and average, respectively.

State of stock: At almost 2 million tonnes, close to the highest level recorded.

Forecast for 1994:
Assuming F(93) = 0.13, Basis: F(93) = F(92), Catch(93) = 267, Landings (93) = 267.

Option	Basis	F(94)	SSB(94)	Catch(94)	Lndgs(94)	SSB(95)	Consequences/implications
A	F(92)	0.13	2922	317	317	3183	SSB remains at record high level.
B	1.2 F(92)	0.16	2900	377	377	3104	
C	1.4 F(94)	0.18	2878	435	435	3028	
D	$F_{0.1}$	0.20	2867	463	463	2990	

Weights in '000 t.

Continued fishing at current levels of fishing mortality will lead to increased stock size.

Management advice: This stock is well within safe biological limits. It is being exploited at a level of fishing mortality below $F_{0.1}$ and the long-term yield could be raised by increasing fishing mortality towards that level.

2.1.3 Herring in Sub-division 30, Bothnian Sea

(Table 2.1.1; Figure 2.1.3)

Source of information: Report of the Working Group on the Assessment of Pelagic Stocks in the Baltic, April 1993 (C.M.1993/Assess:17).

Year	1986	1987	1988	1989	1990	1991	1992	1993	Max[1]	Min[1]	Mean[1]
Recommended TAC	-	-	-	-	-	32	39	39[4]			
Catch as used by ACFM	26	25	28	29	31	29	36	-	36	14	24
Sp. stock biomass	102	120	112	129	175	204	217	215[2]	217	64	111
Recruitment (age 1)	0.9	2.1	1.0	4.8	5.4	3.1	3.1	2.2[3]	5.4	0.4	2.2
Mean F(2-6,u)	0.24	0.19	0.19	0.18	0.14	0.14	0.16	-	0.26	0.13	0.19

[1]Over period 1973-1992. [2]Predicted. [3]Assumed. [4]Advice from May 1991; no advice in 1992. Weights in '000 t, recruitment in billions.

Catches: Increased to highest recorded level in 1992.

Data and assessment: Assessment tuned by effort data.

Fishing mortality: Below the long-term mean, and at a low level.

Recruitment: A series of good year classes have been observed.

State of stock: At the highest recorded level.

Forecast for 1994:
Assuming F(93) = . 0.17, Basis:F(93) = F(92), Catch(93) = 41, Landings (93) = 41.

Option	Basis	F(94)	SSB(94)	Catch(94)	Lndgs(94)	SSB(95)	Consequences/implications
A	0.8 F(92)	0.14	212	34	34	203	The SSB remains at high level.
B	$F(92)=F_{0.1}$	0.17	211	41	41	195	Slight decrease in SSB, but still high.
C	1.2 F(92)	0.20	210	49	49	185	

Weights in '000 t.

Continued fishing at current levels of fishing mortality will lead to a continued high level of SSB.

Management advice: This stock is well within safe biological limits and is currently being exploited at the $F_{0.1}$ level.

2.1.4 Herring in Sub-division 31, Bothnian Bay

(Table 2.1.1; Figure 2.1.4)

Source of information: Report of the Working Group on the Assessment of Pelagic Stocks in the Baltic, April 1993 (C.M.1993/Assess:17).

Year	1986	1987	1988	1989	1990	1991	1992	1993	Max[1]	Min[1]	Mean[1]
Recommended TAC	-[4]	9	13	≤7	9	9	8	8[5]			
Catch as used by ACFM	9.1	8.1	8.8	4.4	7.8	7.2	6.5	-	9.8	4.4	7.8
Sp. stock biomass	94	84	96	90	91	106	99	126[2]	106	38	71
Recruitment (age 1)	0.5	0.7	0.3	2.8	1.3	0.6	0.9	0.8[3]	2.8	0.1	0.8
Mean F(2-6,u)	0.09	0.08	0.09	0.05	0.06	0.05	0.05	-	0.18	0.05	0.10

[1]Over period 1974-1992. [2]Predicted. [3]Assumed. [4]Precautionary TAC based on recent catch levels. [5]Advice from May 1991; in 1992 ACFM advised that F could be raised towards $F_{0.1}$. Weights in '000 t, recruitment in billions.

Catches: Slightly below long-term average.

Data and assessment: Assessment tuned using effort data.

Fishing mortality: Very low, both in terms of the historic series and in comparison with the level of natural mortality used in the assessment.

Recruitment: Variable without marked trend.

State of stock: Stock size increasing due to good recent recruitment and low exploitation.

Forecast for 1994:

Assuming F(93) = 0.05, Basis: F(93) = F(92), Catch(93) = 7.4, Landings (93) = 7.4.

Option	Basis	F(94)	SSB(94)	Catch(94)	Lndgs(94)	SSB(95)	Consequences/implications
A	F(92)	0.05	130	7.3	7.3	132	SSB remains at high level.
B	1.5 F(92)	0.07	129	10.8	10.8	128	
C	2.0 F(92)	0.10	129	14.2	14.2	124	
D	$F_{0.1}$	0.30	125	39.0	39.0	98	

Weights in '000 t.

Continued fishing at current levels of fishing mortality will lead to slightly increased SSB and catches.

Management advice: This stock is well within safe biological limits. It is being exploited at a level of fishing mortality below $F_{0.1}$ and the long-term yield could be raised by increasing fishing mortality towards that level.

2.2 Sprat in Sub-divisions 22-32

(Tables 2.2.1-2.2.2; Figure 2.2.1)

Source of information: Report of the Working Group on the Assessment of Pelagic Stocks in the Baltic, April 1993 (C.M.1993/Assess:17).

Year	1986	1987	1988	1989	1990	1991	1992	1993	Max[1]	Min[1]	Mean[1]
Recommended TAC	-	-	-	72[4]	72[4]	150	143	154[5]			
Agreed TAC	105.0	117.2	117.2	142	150	163	201[6]	350			
Catch as used by ACFM	76	88	80	86	86	103	142	-	242	37	107
Sp. stock biomass	614	462	538	537	858	1278	1841	2335[2]	1841	216	765
Recruitment (age 1)	19.9	77.0	9.4	101.5	99.7	131.2	122.8	138.0[3]	303.0	9.4	86.5
Mean F(2-5,u)	0.15	0.16	0.16	0.14	0.09	0.06	0.06	-	0.25	0.06	0.15

[1]Over period 1974-1992. [2]Predicted. [3]Survey estimate. [4]For Sub-divisions 26-32. [5]Advice from May 1991; in 1992 ACFM advised that F could be raised towards $F_{0.1}$. [6]Revised to 290. Weights in '000 t, recruitment in 10^9.

Catches: Increasing from the level of 80,000-90,000 t in 1987-1990 to almost 150,000 t in 1992.

Data and assessment: Assessment tuned by acoustic stock estimates. Effect of cod predation on natural mortality now negligible.

Fishing mortality: At a very low level, both in terms of the historic series and in comparison with the level of natural mortality used in the assessment.

Recruitment: At present at a high level. All year classes after the 1987 year class have been estimated to be above average.

State of stock: Stock size increasing.

Forecast for 1994:
Assuming F(93) = 0.06, Basis: F(93) = F(92), Catch(93) = 180, Landings (93) = 180.

Option	Basis	F(94)	SSB(94)	Catch(94)	Lndgs(94)	SSB(95)	Consequences/implications
A	F(92)	0.06	2750	210	210	2853	
B	1.5 F(92)	0.09	2711	310	310	2729	
C	2.0 F(92)	0.12	2672	406	406	2611	SSB increases to or remains at record high level
D	3.0 F(92)	0.18	2597	589	589	2393	
E	$F_{0.1}$	0.3	2460	902	902	2037	

Weights in '000 t.

Continued fishing at current levels of fishing mortality will lead to continued increase in SSB.

Management advice: This stock is well within safe biological limits. It is being exploited at a level of fishing mortality below $F_{0.1}$ and the long-term yield could be raised by increasing fishing mortality towards that level.

3 BALTIC DEMERSAL STOCKS

3.1 Cod

3.1.1 Overview

The Baltic cod stock units

In the Baltic (i.e., the Baltic Sea area covered by the Baltic Fishery Convention) there are two main stocks of cod.

The western cod stock is distributed mainly to the west of 14°30'E in Sub-divisions 22 and 24 and it has some connections to the southern Kattegat. The border between the two Baltic cod stocks is rather blurred due to the fluctuations in the relative proportions of the stocks and to the different hydrographic situations.

From the late 1970s until the late 1980s the eastern cod stock inhabiting mainly Sub-divisions 25-30 and 32 extended its distribution area further to the north than usual (Sub-division 31), but now at the beginning of the 1990s it is found again mainly east of 14°30'E up to the southern part of the Bothnian Sea and the middle part of the Gulf of Finland.

The main spawning grounds of the western stock are found in Kiel Bay, Mecklenburg Bay, in the Arkona Deep and in the Belt Sea (Figure 3.1.1). In Kiel Bay spawning takes place at depths of 25-40 m and in the Arkona Basin at 40-50 m depth. The main spawning time is April-May in Kiel Bay and in the Arkona Basin. From time to time, part of the stock migrates to the southern Kattegat to spawn and the rate of emigration is dependent on the conditions of the spawning grounds in the Baltic.

The main spawning grounds of the eastern stock are found in the deeper part of the Baltic proper as shown in Figure 3.1.1. The most important spawning areas are the Bornholm Basin, the southern Gotland Basin, Gdansk Deep and Slupsk Furrow. If oxygen conditions permit, spawning takes place at depths greater than 60 m in the Bornholm Basin and at 70 m and deeper in the Gdansk Deep and Gotland Basin. The main spawning season is very prolonged, beginning in April in the Bornholm Basin and Gdansk Deep, in May in the Gotland Basin and ending in late August. The peak spawning is usually in May-June, but it varies from year to year and during recent years the peak spawning has been observed as late as July-August.

The feeding migration of the western cod stock does not show any clear pattern and migration seems to occur in all directions. From the Arkona region, feeding migrations of adults may reach the Belt Seas in the west and extend eastwards to the Slupsk Furrow, the Bornholm Region and, in the 1980s, even to the southern Gotland Deep area.

The feeding migration of the eastern cod stock, although without any clear pattern, has changed from that in the late 1970s and 1980s. The stock now seems to be more stationary and does not make as intensive feeding migrations as earlier. The feeding migrations of the adult stock are not very clearly directed, and they seem to be more or less random movements inside the distribution area. The rate of the feeding migration westwards from the Bornholm Basin has been observed to be very low, because of the threshold nature of the Bornholm Straits. The immigration of larvae and fry to the northern Baltic is connected to events in the Main Basin. A migration of maturing and mature cod from the northern to the southern Baltic spawning grounds has been shown.

Trends in landings

Catches of both cod stocks in the Baltic have declined steadily in recent years. Total landings were highest in 1984 at 441,000 t and decreased to 139,000 t in 1991 (Tables 3.1.1-3.1.4). The total catches decreased to 71,000 t in the whole Baltic Sea in 1992 and in the eastern and western stocks the catches are now at the record-low levels of 54,000 t and 14,000 t respectively in 1992.

The discrepancy between the catch figures used by the Working Group and the catch figures used by IBSFC is mainly due to the incomplete reporting of catches in coastal fisheries and probably double reporting of some catches which have been transferred to other parties. In the latest years, the Working Group's catch figures also include some landings which are not included in the nominal landing figures.

Environmental conditions

Low salinity and poor oxygen conditions in the eastern cod stock spawning grounds have limited spawning success in recent years. In 1991 spawning occurred only in the Bornholm Basin and practically no spawning took place in other areas. An influx of North Sea water into the Bornholm Basin was observed in March 1992 and a high influx in January 1993. This 1993 influx, which is among the highest in the period 1950-1993, has improved the environmental conditions in the Bornholm Basin as well as in the southern Gotland Deep. The environmental conditions for spawning are considered to be more favourable than in the last 16 years. The improved environment now allows the possibility of improved recruitment but does not ensure it.

Management considerations

The spawning stock biomass of the eastern stock has declined from about 818,000 t in 1980 to 79,000 t in 1992, the lowest level observed in the available time series (1970-1991). Since recruitment has been poor after 1985, and even though the 1991 year class is higher than the previous four year classes, continued fishing at the 1992 level in 1993 will reduce the spawning stock even further to 70,000 t in 1993. In 1994, however, the spawning stock biomass will increase to a level of 95,000 t due to the 1991 year class becoming partially mature in 1994.

If the agreed limitations in the cod fishery in 1993 are followed (total TAC 40,000 t for both stocks combined), the total effort is expected to decrease in 1993 by about 30-50% in the eastern area. If 25,000 t catch is taken in 1993 from the eastern stock, this will imply an increase of the spawning stock biomass to 126,000 t in 1994. This SSB level is, however, below the 1991 SSB. The SSB is still at a low level and the expected rate of recovery of SSB from such a low biomass level is uncertain. The eastern cod stock could be considered to be well below the minimum biologically acceptable level (MBAL). To rebuild the SSB to a level above MBAL, where the probability of good year class production is higher, ACFM recommends that the 1994 TAC should not exceed 25,000 t. The fishing mortality level that corresponds to this catch is about $F_{max} = 0.24$. These measures would protect the remaining biomass and allow cod to take advantage of improvements of the environmental conditions in 1994 and 1995. As stated earlier the improved environment allows the possibility of improved recruitment but does not ensure it.

The western stock has also suffered from poor recruitment. High fishing mortalities have reduced the spawning stock to the lowest level observed in the available time series. The spawning stock biomass is expected to increase in 1994 and 1995. This increase is based mainly on the 1991 year class, which will be fully recruited to the fishery in 1994. Because of the total TAC (40,000 t) level for the whole Baltic in 1993, the effort is expected to decrease in this area by about 30% in 1993. The revised prediction for 1993 in the western area shows an increase of SSB in 1994 to about 82% of the long-term average level assuming unchanged fishing mortality in 1993 compared with 1992. Assuming that a catch of 15,000 t is taken in 1993 the SSB will increase to 34,000 t in 1994. The SSB will in these circumstances be at about the long-term average level in 1994 and the SSB will increase above MBAL.

3.1.2 Cod in Sub-divisions 22 and 24

(Table 3.1.3; Figure 3.1.2)

Source of information: Report of the Working Group on the Assessment of Demersal Stocks in the Baltic, April 1993 (C.M.1993/Assess:16).

Year	1986	1987	1988	1989	1990	1991	1992	1993	Max[1]	Min[1]	Mean[1]
Recommended TAC	<24	9	16	14	8	11	-[3]	-[3]			
Agreed TAC	-	-	-	-[4]	-[4]	-[4]	-[4]	-[4]			
Discards/slipping	1	3	-	-	-	-					
Catch as used by ACFM	26	27	28	18	17	15	14		54	14	39
Sp. stock biomass	25	18	24	22	14	11	11	19[6]	50	11	34
Recruitment (age 1)	68	39	13	19	20	25	55[5]	31[2]	148	13	71
Mean F(3-7,u)	1.59	0.93	0.91	1.03	1.31	1.25	0.88	-	1.59	0.71	1.00

[1]Over period 1965-1992 for catches and 1970-1992 for assessment data. [2]Assumed. [3]Lowest possible level. [4]Included in TAC for total Baltic. [5]Survey estimate. [6]Projected. Weights in '000 t, recruitment in millions.

Catches: Stable catches until 1984. Since then decreasing gradually to 14,000 t in 1992, which is the lowest on record.

Data and assessment: Analytical assessment based on catch-at-age data and CPUE data for two Danish fleets, which were combined. There were uncertainties in the age composition data and catch figures for 1992. Recruitment estimated from survey data.

Fishing mortality: Peaked in 1985-1986 and decreased in 1987-1988. Increased again in 1989-1991. F in 1992 is 0.88, which exceeds F_{max} (= 0.29).

Recruitment: Fluctuating, but decreasing in 1986-1990. The 1991 year class estimated at 55 million in 1992, which is about 77% of the long-term mean. The 1991 year class will be the most important contributor to the catches in 1993 and 1994 and to the SSB in 1994 and 1995.

State of stock: SSB in 1992 at the lowest level on record.

Revised forecast for 1993:

Option	Basis	F(93)	SSB(93)	Catch(93)	Lndgs(93)	SSB(94)	Consequences/implications
A	0.0 F(92)	0.00	19	0	0	47	SSB increases to about half the average level in 1993 and almost to a record high in 1994.
B	0.2 F(92)	0.18		5	5	42	Increase of SSB in 1994 to above average level.
C	0.4 F(92)	0.35		10	10	38	SSB in 1994 above average level.
D	Expected catch	0.56		15	15	34	SSB in 1994 at about average level.
E	0.8 F(92)	0.71		18	18	31	Increase in SSB in 1994 but SSB remains below average.
F	1.0 F(92)	0.88		21	21	28	Increase in SSB in 1994 but SSB remains low.

Weights in '000 t.

Management advice for 1993: According to this revised prediction, there is no basis to change the recommendation given by ACFM last year for 1993, i.e. that fishing mortality in 1993 be reduced to the lowest possible level.

Forecast for 1994:

Assuming F(93) = 0.56 Basis: Expected catch(93) = 15, Landings (93) = 15.

Option	Basis	F(94)	SSB(94)	Catch(94)	Lndgs(94)	SSB(95)	Consequences/implications
A	0.0 F(93)	0.00	34	0	0	64	SSB increases to about the long term average in 1994 and record-high in 1995.
B	0.2 F(93)	0.11		5	5	59	Increase in SSB to record-high in 1995.
C	0.4 F(93)	0.23		10	10	54	Increase in SSB to record-high in 1995.
D	F(max)	0.29		13	13	52	Increase in SSB to record-high in 1995.
E	0.6 F(93)	0.33		14	14	50	Increase in SSB to record-high level in 1995.
F	0.8 F(93)	0.45		18	18	46	Increase in SSB to 135% above long-term average level.
G	1.0 F(93)	0.56		22	22	42	Increase in SSB to 124% above long-term average level.

Weights in '000 t.

In the prediction for 1994 the catch level in the western area in 1993 was assumed to be 15,000 t reflecting the catch distribution between the eastern and western stocks in recent years.

Management advice for 1994: ACFM recommends that fishing mortality rate in 1994 should not exceed the value expected for 1993 (0.56) corresponding to a TAC in 1994 no greater than 22,000 t.

ACFM reiterates its recommendation that this stock should be managed as a separate unit to ensure the recovery of the stock and to have better control of fishing effort.

Special comments: High fishing mortality rates and below-average recruitment since 1987 have reduced the spawning stock biomass in 1992 to the lowest level recorded in the available time series. If the expected catch in 1993 of 15,000 t becomes reality, the spawning stock biomass at the start of 1994 will be at about the long-term average level. At this time, it is expected that 56% of the SSB will be comprised of the 1991 year class which, although of below average abundance, is the largest since that of 1985. If the recommended management advice is applied in 1994, it is expected that the spawning stock biomass will increase in 1995 to levels above the historical average and that the 1991 year class will comprise 48% of the SSB.

However, no information exists on the abundance of the 1992 and 1993 year classes and it is not possible to predict the abundance of future year classes. Furthermore, there are other uncertainties in the assessment of this stock due to misreporting of cod landings from the Kattegat, the quality of available data on fishing effort and catch-per-unit-effort and to difficulties with data on mean weight at age. Therefore, and even though the predictions indicate that SSB is likely to increase in the near future under the recommended management measures, caution should be applied in interpretation of these results. The expected increases in catches and biomass in 1994 and 1995 are largely based on the recruitment of one below-average year class and it is far from clear that the improvement in the state of this stock will be maintained in the longer term. On this basis, it cannot yet be stated with reasonable certainty that this stock is within safe biological limits. Therefore, an increase in total effort (fishing mortality rate) in 1994 compared to that of 1993 cannot be justified.

ACFM is, therefore, of the opinion that it is prudent not to exceed in 1994 the reduced level of fishing mortality rate expected in 1993.

3.1.3 Cod in Sub-divisions 25-32

(Table 3.1.4; Figure 3.1.3)

Source of information: Report of the Working Group on the Assessment of Demersal Stocks in the Baltic, April 1993 (C.M.1993/Assess:16).

Year	1986	1987	1988	1989	1990	1991	1992	1993	Max[1]	Min[1]	Mean[1]
Recommended TAC	<232	<245	150	179	129	122	-[3]	-[5]			
Agreed TAC	-	-	-	220[4]	210.5[4]	171[4]	100[4]	40[4]			
Catch as used by ACFM	253	207	194	179	153	123	54	-	391	54	198
Sp. stock biomass	436	371	347	290	232	153	79	70[6]	818	79	487
Recruitment (age 2)	244	331	203	115	106	50	55[2]	164[2]	781	50	349
Mean F(4-7,u)	1.16	0.96	0.85	1.02	1.13	1.37	1.03	-	1.37	0.53	0.87

[1]Over period 1965-1992 for catches and 1973-1992 for assessment data. [2]Survey estimates. [3]Lowest possible level. [4]For total Baltic. [5]No fishing allowed. [6]Projected. Weights in '000 t, recruitment in millions.

Catches: Total catches very high in 1980-1984. Catches decreasing since 1985, and 1992 catches were the lowest on record in the 1965-1992 period (54,000 t).

Data and assessment: Analytical assessment based on catch-at-age data and catch and effort data from five fleets. Trawl survey data included in the assessment. Recruitment estimated from trawl survey data. The changed exploitation pattern in 1992 caused by the expanded gillnet fishery was taken into account.

Fishing mortality: Fishing mortality in 1991 was estimated to be much higher than in the previous assessment in 1992 and no simple explanation for the discrepancy is available. F in 1992 is still at a high level, which far exceeds F_{max} (= 0.24).

Recruitment: Recruitment decreasing since 1987 (Figure 3.1.3). The 1989 and 1990 year classes are the poorest on record and the 1991 year class is somewhat better, but only about half the average.

State of stock: Decreasing SSB since 1983; SSB in 1992 is the lowest on record being only 16% of the average.

Forecast for 1994:

F(93) = 0.38, Basis: Expected catch(93) = 25, Landings (93) = 25.

Option	Basis	F(94)	SSB(94)	Catch(94)	Lndgs(94)	SSB(95)	Consequences/implications
A	0.0 F(93)	0.00	126	0	0	224	SSB increases to about half the long-term average level.
B	0.2 F(93)	0.07		9	9	214	SSB increases but only to 44% of the long-term average level.
C	0.4 F(93)	0.15		18	18	203	SSB increases but only to 41% of the long-term average level.
D	Catch(94) = Catch(93)	0.22		25	25	196	SSB still at low level.
E	F(max)	0.24		27	27	193	SSB at very low level.
F	0.8 F(93)	0.30		33	33	186	
G	1.0 F(93)	0.38		41	41	177	

Weights in '000 t.

Continued fishing at reduced 1993 levels of fishing mortality will lead to a slight increase in SSB in 1995, but SSB would still be only about 36% of the long-term average. The estimated improvement in the SSB is, however, based only on the 1991 year class and the SSB is, therefore, very sensitive to high levels of fishing mortality on that year class.

Management advice: The eastern Baltic cod stock is in a depressed state and below the minimum biologically acceptable level (MBAL). To promote an increase in SSB, ACFM recommends that fishing in 1994 should be kept at the lowest possible level and that the 1994 TAC should be no higher than 25,000 t. ACFM also reiterates its recommendation that the stock should be managed as a separate unit from the western stock in order to have better control on the level and distribution of fishing effort.

Special comments: Since 1985 both spawning stock biomass and recruitment have declined steeply and SSB will be at a record-low level. Despite the 1991 year class the spawning stock biomass will remain at a low level in 1995 if fishing is continued at current levels. If a catch of 25,000 t is taken in 1993, the SSB will increase to a level of 126,000 t in 1994. The measures recommended for 1994 would protect the increasing SSB and allow cod to take advantage of improvements in the environmental conditions in 1994 and 1995.

3.1.4 By-catches of cod in the trawl fisheries for sprat and herring

In the late 1970s and early 1980s the by-catch of cod in the herring and sprat trawl fishery was at a rather high level because of the high stock level of cod and because cod stock had expanded its distribution to a much larger area than before. Information on by-catches of cod in herring and sprat trawl fisheries is scanty and proper evaluation is not possible.

3.1.5 Bottom gillnet fishery

During the 1980s the bottom trawl fishing grounds were fully exploited and there was a shift to high opening pelagic trawls and gillnets. The decline in the eastern cod stock gave very low CPUEs on the traditional fishing grounds. As a consequence a rapid expansion of the gillnet fishery was observed, and in 1992 more than 50% of the total catch in Poland and Sweden was taken by gillnets and about 30% in Denmark. The biological advice on the Baltic cod stocks has been based only on information of trawl fisheries, because the data collected up to 1991 covered mainly the trawl fisheries. Now data are also available from gillnet fisheries, but the major problem is still to improve the estimate of total gillnet fishing effort. A majority of vessels involved in gillnet fisheries are small and often not required to submit log-books.

Further investigations are necessary to make a proper evaluation of the impact of the gillnet fishery on cod stocks in the Baltic.

3.1.6 Evaluation of minimum mesh size and minimum landing size for the cod fishery in the Baltic

According to the fishery rules of IBSFC, the minimum mesh size and landing size of cod in force since 1990 are 105 mm and 33 cm, respectively, south of latitude 59°30' N. The mesh size of 105 mm also applies to the cod gillnet fishery. The main reason for the increase in mesh size in 1990 was an attempt to protect immature and maturing cod. However, 105 mm has not been shown to be an effective regulatory measure due to the poor selection of cod-ends. In the gillnet fishery the selection is better.

According to information on the pelagic trawl, bottom trawl and gillnet selectivities, an increase in mesh size from 105 mm to 110 mm would give a short-term reduction in catch per unit of effort for one year of about 15% and a long-term gain of about 8%. The corresponding L_{25} is 35 cm, which is in use in the EC fisheries. An increase of mesh size from 105 mm to 120 mm would give a short-term reduction in catch per unit of effort of about 30% and a long-term gain of about 30%. The corresponding L_{25} would be 38 cm.

Based on these analyses ACFM recommends that the minimum mesh size for trawls, gillnets and Danish seines or similar towed gears be increased to 120 mm. The minimum landing size for cod consistent with this mesh size is 38 cm.

3.1.7 Advice on implications for optimal exploitation of the cod stocks in the Baltic resulting from the transfer of fishing effort from trawling to bottom-set gillnetting

The decline of both cod stocks is due to the combined effect of excessive levels of fishing mortality, poor recruitment and unfavourable environmental conditions. In the present situation the first obvious step is to reduce fishing mortality substantially. During the late 1970s and 1980s all traditional fishing grounds were fully exploited. As a consequence of this there was a rapid shift from the trawl fishery to the gillnet fishery to exploit those numerous fishing grounds not accessible to trawling. This development started in Denmark in the late 1980s but all countries are now using gillnets in the cod fishery. There has been a tendency to increase the number of gillnets per vessel in order to compensate for decreasing CPUE and to reduce the mesh size from 105 mm towards 95 mm in order to take earlier advantage of the incoming year class. The selection factor of gillnets is much higher than that of high opening pelagic trawls or bottom trawls. The present situation of a low but slightly increasing SSB in both Baltic cod stocks favours the use of gears with better selection properties, assuming that proper control of total effort is also applied. At present the total effort in the gillnet fishery is not known and thus ACFM is not in a position to give advice on regulatory measures other than that given in Section 3.1.6.

3.2 Flatfish Stocks in the Baltic

3.2.1 Flounder

The total catches of flounder have remained stable for about twenty years, although areal changes have occurred. During recent years catches have decreased slightly (Table 3.2.1). Because of the decreasing importance of cod, there seems to be a growing interest among some Baltic countries in developing the flounder fishery.

The database of most of the flounder stocks is still in many ways incomplete. Data on discards are poor, effort and catch per unit of effort data are, in some cases, minimal, and very few indices of recruitment are available.

3.2.2 Plaice

The total catches of plaice (Table 3.2.2) were high in the 1970s and a decrease of catches was observed at the beginning of the 1980s. Since then catches has been lower and in 1992 they are the lowest on record.

3.2.3 Dab

The total catches of dab have been rather stable in the last ten years (Table 3.2.3).

3.2.4 Turbot

Turbot catches were rather insignificant in the 1960s, but catches increased in the 1980s and were the highest on record in 1992 (Table 3.2.4).

3.2.5 Brill

The revised data on landings of brill by country are given in Table 3.2.5. There are some gaps in the information and thus the total catch figures are preliminary.

3.2.6 Minimum landing sizes and minimum mesh sizes for flatfishes in the Baltic

In the flatfish fishery the minimum landing size and minimum mesh size are species- and area-dependent. According to IBSFC fishing rules they are as follows:

Sub-division	Species	Minimum landing size (cm)
22-25	Flounder	25
26-28		21
29 and 32 south of 59°30'N		18
22-25	Plaice	25
26-28		21
29 south		18
22-32	Turbot	30
22-32	Brill	30

Sub-division	Species	Minimum mesh size (cm)
22-27 28 west of 21°E, 29 south of 59°30'N and west of 21°E	All species	90
28 east of 21°E	All species	80
29 and 32 south of 59°30'N and east of 21°E	All species	70

These regulatory measures do not apply to coastal fisheries (inside 4 nm from the base line).

There is a mismatch between the minimum landing sizes (considered to represent L_{50} values) and the minimum mesh sizes for flatfish fisheries in the Baltic. According to selectivity experiments the 25 cm minimum landing size corresponds to 133 mm mesh size, 21 cm to 112 mm mesh size and 18 cm to 96 mm mesh size in trawl codends. Minimum landing size and mesh size figures for the gillnet fishery are not available, but gillnets show a better selection factor than trawls.

4 BALTIC SALMON AND TROUT STOCKS

4.1 Salmon

4.1.1 Salmon in the Main Basin and the Gulf of Bothnia (Sub-divisions 24-31)

(Table 4.1.1)

Source of information: Report of the Baltic Salmon and Trout Assessment Working Group, March/April 1993 (C.M.1993/Assess:14).

Year	1986	1987	1988	1989	1990	1991	1992	1993	Max[8]	Min[8]	Mean[8]
TACs and Landings											
Rec. TAC ('000 t)	1.7	-	<3.0	2.9	1.68	-[2]	-	-			
Rec. TAC ('000 fish)				850		-[2]	688	500[3]			
Agreed TAC ('000 t)						3.35	3.55				
Agreed TAC ('000 fish)								650			
Landings ('000 t)											
Coastal and river fisheries	0.54	0.43	0.47	0.73	1.43	1.14	1.20[1]		1.43	0.43	0.71
Offshore fisheries	2.77	3.21	2.43	3.27	3.65	3.00	2.65[1]		3.65	2.43	3.07
Total	3.30	3.64	2.90	4.00	5.07	4.15	3.85[1]		5.07	2.90	3.78
Landings ('000 fish)	885	897	791	1049	1131	776	726[1,5]		1131	776	937
Mean weights (kg/fish)	3.6	4.0	3.7	3.8	4.6	5.3	5.3				
Smolt-production to Sub-divisions 24-31 (in millions)											
Wild[6]	0.41	0.41	0.40	0.41	0.41	0.43	0.47	0.52	0.47	0.40	0.42
Reared	5.05	5.56	5.68	5.23	4.38	4.01	4.71	4.94	5.68	3.87	4.79
Total	5.46	5.97	6.08	5.64	4.80	4.52	5.18	5.45	6.08	4.34	5.20

[1]Preliminary data. [2]TAC much below present catch levels. [3]Equivalent to 2.25 - 2.70 thousand t. [4]The proportion of wild salmon is estimated to be below 10%. [5]Based on a mean weight in the catches of 5.3 kg. [6]Wild smolt production estimated annually only for rivers Tornionjoki and Simojoki, i.e. the total production is only a crude estimate. [7]Over the period 1984-1991.

Landings: Decreased in the open sea fisheries but remained at a high level in the coastal fisheries. Wild and reared salmon in the sea cannot be separated by present scale-reading techniques as these were shown to be imprecise.

Data and assessment: Progress has been made in developing area-based models based on tagging returns, catch data and recruitment estimates. CPUE and effort data available. Estimates of wild smolts are based on electrofishing and smolt traps.

Fishing mortality: At a lower level than in the late 1980s in the offshore fisheries. High in the coastal fisheries.

Recruitment: Around 90% of smolt production is based on reared smolts. Total production of smolts decreased from a high of 6.08 million in 1988 to 4.5 million in 1991 and has since then increased. No accurate estimates of wild production, but it is estimated to be around 0.47 million in 1992.

Growth: Mean weights of salmon increased during the 1980s are now the highest recorded since 1940.

State of stocks:

Wild: The wild stocks of the rivers in the Gulf of Bothnia are subject to recruitment overfishing and are below the minimum biologically acceptable level. In the Main Basin, the wild stock in the river Mörrum seems to be in a healthy state while other rivers in the Main Basin have natural smolt production much below their potential, often hampered by pollution and environmental disturbance.

Reared: The reared stocks in the Gulf of Bothnia and the Main Basin are not endangered by fishing, but the increased incidence of mortality due to M-74 (see special comments) is a reason for serious concern.

Management advice: Recognising that an increase in the escapement of wild salmon is necessary, particularly in the Gulf of Bothnia, ACFM recommends that fishing mortality should be as low as possible in 1994 and that the catch should certainly not exceed 500,000 fish which corresponds to between 2,250-2,700 t. The range is given because of uncertainties in mean weights. If reproduction and/or survival of wild smolts is shown to be seriously affected by M-74 (see Special Comments), a ban on all fishing for wild salmon may be required.

In order to safeguard wild stocks ACFM reiterates its recommendation that:

1. The summer closure in the Bothnian Sea offshore fisheries should begin on 1 May and end on 1 September. This measure reduces fishing pressure during the time when spawners enter the Gulf of Bothnia;

2. In the mouths of wild salmon rivers, areas of appropriate size should be closed to fishing during the entire season to protect spawners when they enter their home rivers.

Special comments: An aberrant cause of high mortality during the yolksac stage named M-74 ("Mystery 1974") has been observed in the Swedish and Finnish hatcheries. In 1992 the mortality ascribed to M-74 in the offspring of ascending fish of both reared and wild origin increased considerably to a level of 60-95%. In the river Torne, mortality was estimated to be 90% among the offspring of wild spawners in 1992. Experiments with accelerated hatching with females from three rivers during spring 1993 indicate similar or even higher levels of mortality caused by M-74 in 1993.

The impact of M-74 on the survival of the 1992 and 1993 parr year classes cannot be assessed until the electro-fishing results become available in autumn 1993. Any further information on the survival of these parr year classes and on M-74 that becomes available will be submitted to IBSFC in advance of its 1993 meeting.

4.1.2 Salmon in the Gulf of Finland (Sub-division 32)

(Table 4.1.1)

Source of information: Report of the Baltic Salmon and Trout Assessment Working Group, March/April 1993 (C.M.1993/Assess:14).

Year	1986	1987	1988	1989	1990	1991	1992	1993	Max[3]	Min[3]	Mean[3]
TACs and Landings											
Rec. TAC ('000 fish)								109[4]			
Agreed TAC ('000 t)						0.43	0.43				
Agreed TAC ('000 fish)								109			
Landings ('000 t)											
Coastal and river fisheries	0.08	0.06	0.11	0.15	0.40	0.42	0.32[1]		0.42	0.04	0.18
Offshore fisheries	0.32	0.29	0.16	0.25	0.18	0.19	0.11[1]		0.32	0.16	0.23
Total	0.40	0.35	0.27	0.40	0.57	0.62	0.43[1]		0.62	0.27	0.41
Landings ('000 fish)	121	141	74	106	117	122	60[1]		141	74	110
Mean weight (kg/fish)	3.3	2.5	3.6	3.8	4.9	5.0	7.2				
Smolt production - Sub-division 32 (in '000)											
Wild[2]	20	15	15	15	15	15					
Reared	544	590	569	428	530	500	415	400[1]	590	428	531
Total	564	610	584	443	545	515	430		610	443	548

[1]Preliminary data. [2]Assumed. [3]Over period 1984-1991. [4]Reared stock only; equivalent to 600 t.

Landings: Landings in weight increased up to 1991 and decreased in 1992, especially in the offshore fishery.

Data and assessment: Analytical assessment attempted but results not considered reliable. CPUE and effort data available.

Fishing mortality : At a high level in recent years. Effort has declined in the offshore fisheries.

Recruitment: Almost totally dependent on the post-smolt survival of reared smolts.

State of stocks:

Wild: Wild stocks depleted and are believed to constitute only a small fraction of the catches. The causes of depletion are unknown but could include pollution and environmental disturbance on the spawning grounds.

Reared: There are enough spawners for rearing purposes. CPUE has increased in the offshore fisheries and has remained stable in the trapnet fishery since 1990.

Management advice: Continued fishing at current levels of fishing mortality will not allow an improvement of the wild stocks. Given the decrease in recent stocking levels and assuming *status quo* fishing mortality, a catch of 65,000 fish corresponding to 400 t would be expected in 1994. The estimates are imprecise.

Special comments: Mortality due to M-74 has not been recorded in this area.

4.1.3 Utility of closed seasons at the beginning of the coastal fishery period as a means to increase escapement of wild salmon stocks

The Finnish coastal management during 1986-1991, which included closed seasons, and the general decrease in the offshore fishery seem to have had a positive effect on the northern wild stocks. It must be noted that Swedish data on coastal catches indicate a correlation between spring temperatures and migration timing, suggesting that the effects of closed periods might vary between years.

4.1.4 By-catches of fish, birds and marine mammals in the salmon drift net fishery

By-catches of sea trout and rainbow trout constitute small fractions of total drift net catches. Observations of other finfish by-catches are scarce. The quantity of birds entangled in nets is not known. Catches of seals occur occasionally.

4.1.5 Catch recording and catch control systems

The following countries collect catch statistics in terms of number of fish: Denmark, Estonia, Finland, Latvia and Sweden.

4.2 Sea trout

Naturally-reproducing sea trout stocks occur in about 250 rivers or brooks discharging into the Baltic Sea. Estimated natural smolt production is around 300,000 fish annually. The number of hatchery-reared smolts was 2.6 million in 1992. Landings have been at a level of 1,300-1,500 t per year during 1990-1992 (Table 4.2.1).

4.3 Rainbow trout

Stockings of rainbow trout have been implemented in Estonia, Latvia and Poland. In general, rainbow trout are caught in the coastal areas but a varying proportion recruit to the offshore fishery for salmon in the southern Baltic. A westward migration towards the Danish Belt Seas has been observed. Nominal landings are given in Table 4.3.1.

Table 1.1.1 Nominal fish catches in the Baltic from 1973-1992 (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	301	114	14	4.5	8	19	599
1992[1]	71	336	145	12	4.7	8	13	589

[1]Preliminary.

Table 1.1.2 Nominal catch (tonnes) of HERRING in Divisions IIIb,c,d, 1963-1992. (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	...	51,546[3]	16,022	33,270	6,468	45,991	59,176	64,426[5]	300,894[4]
1992	33,855	29,556	72,171[3]	17,746	25,965	n/a	52,864	75,907	27,979	336,043[4]

[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]Preliminary.
[5]Includes Estonia.
n/a = not available.

Table 1.1.3 Nominal catch (tonnes) of SPRAT in Divisions IIIb,c,d, 1963-1992. (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	366	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	-	10,200	1,054	14,741	112	55,050	84,265
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	51	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	...	99[2]	736	17,996	3,569	23,200	8,328	38,306[4]	114,015[3]
1992	28,210	4,140	893[2]	608	17,388	n/a	30,126	53,558	9,851	144,774[3]

[1]Including Division IIIa.
[2]Some by-catch of sprat included in herring.
[3]Preliminary.
[4]Includes Estonia.
n/a = not available.

Table 1.1.4 Nominal catch (tonnes) of COD in Divisions IIIb,c,d, 1963-1992. (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
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	...	2,992	1,662	8,637	2,627	1,849	25,748	39,552	5,008[4]	138,715[3]
1992	30,418	1,369	593	460	6,668	1,250	n/a	13,314	16,244	404	70,720[3]

[1]Including Division IIIa.
[2]Includes catches from United Kingdom (England & Wales) of 2,901 t.
[3]Preliminary.
[4]Includes Estonia.
n/a = not available.

Table 1.1.5 Nominal catch (tonnes) of FLATFISH in Divisions IIIb,c,d, 1963-1992. (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	Poland	Sweden	Russia	Total
1991	5,583	...	76	3,055	445	4,009	224	574[4]	13,966[3]
1992	4,579	164	64	2,287	624	3,906	337	75	12,036[3]

[1]Including Division IIIa.
[2]Excluding subsistence fisheries.
[3]Preliminary.
[4]Including Estonia.
n/a = not available.

Table 2.1.1 Herring catches in the Baltic Sea by country and sub-division, 1991 and 1992 (thousand t). By-catch of sprat in directed herring fisheries excluded and by-catch of herring in directed sprat fisheries included. (Data as reported to the Working Group.)

HERRING													
Year and	Total				Sub-division								
country	catch	22	23	24	25	26	27	28	29S	29	30	31	32
1991													
Denmark	33.7	14.9	1.7	10.3	6.8								
Finland	51.1						0.2	0.6		11.9	26.2	6.8	5.3
Germany	15.8	5.8		10.0									
Poland	52.7			5.7	34.5	12.6							
Sweden	61.6		2.3	19.3	13.1	0.0	21.9	1.0		0.5	3.0	0.4	
Estonia	32.7					0.1		11.7		12.1			8.7
Latvia	33.3				2.0	1.2	2.7	23.4		4.0			
Lithuania	6.5					4.8		1.7					
Russia	31.9					9.4		4.2		2.9			15.5
ex-USSR	*104.3*				*2.0*	*15.5*	*2.7*	*40.9*		*19.0*			*24.2*
Total	319.2	20.7	4.0	45.2	56.4	28.1	24.8	42.5		31.4	29.3	7.2	29.6
Year and	Total				Sub-division								
country	catch	22	23	24	25	26	27	28	29S	29	30	31	32
1992													
Denmark	37.9	9.0	2.9	17.9	8.1								
Estonia	29.7							10.9		4.5			14.2
Finland	67.9						0.1	1.0		20.8	32.8	6.2	7.0
Germany	15.6	4.6		11.0									
Latvia	25.8					0.5		25.3					
Lithuania	4.6					3.0		1.5					
Poland	54.6			15.5	22.2	17.0							
Russia	29.5					10.2		3.3					16.1
Sweden	71.0		1.7	22.3	19.5	1.2	18.1	3.3		0.8	3.7	0.4	
Total	336.7	13.5	4.5	66.7	49.8	32.0	18.2	45.4		26.1	36.5	6.5	37.4

Table 2.1.2 Landings of HERRING in '000 t by country in Sub-divisions 22 and 24.

Data provided by working Group members

Year	Denmark	Germany	Poland	Sweden	Total
1978	12.4	47.5	6.3	6.6	72.8
1979	9.7	53.4	10.3	10.2	83.5
1980	7.2	67.8	13.6	12.0	100.7
1981	8.1	62.8	13.4	7.7	91.9
1982	26.3	58.0	14.9	8.4	107.5
1983	26.6	58.6	16.7	6.5	108.5
1984	23.8	56.1	14.3	7.7	101.8
1985	15.9	54.6	16.7	11.4	98.7
1986	14.0	60.0	12.3	5.9	92.4
1987	32.5	53.1	8.0	7.8	101.3
1988	33.1	54.7	6.6	4.6	98.9
1989	21.7	56.4	8.5	6.3	93.0
1990	13.6	45.5	9.7	8.1	76.8
1991	25.2	15.8	5.6	19.3	65.9
1992	26.9	15.6	15.5	22.3	80.3

Table 2.1.3 Landings of HERRING in '000 t by country in Sub-division 23.

Data provided by working Group members

Year	Denmark	Sweden	Total
1978	4.1	1.0	5.1
1979	8.8	1.9	10.7
1980	6.3	2.4	8.7
1981	8.1	2.0	10.1
1982	7.1	2.5	9.6
1983	4.6	2.4	7.0
1984	6.9	0.8	7.7
1985	6.8	1.1	8.0
1986	1.5	1.4	2.9
1987	0.8	0.2	0.9
1988	0.1	0.1	0.2
1989	1.5	0.1	1.6
1990	1.1	0.1	1.2
1991	1.7	2.3	4.0
1992	2.9	1.7	4.5

Table 2.1.4 **HERRING in Division IIIa, 1985 – 1992.**
Landings in thousands of tonnes.
(Data provided by Working Group members 1992).

Year	1985	1986	1987	1988	1989	1990	1991	1992*
Skagerrak								
Country								
Denmark	88.2	94.0	105.0	144.4	47.4	62.3	58.7	64.7
Faroe Islands	0.5	0.5						
Germany								
Norway (Open Sea)	2.8	0.7		3.0	0.2	4.1	6.5	12.3
Norway (Fjords)	1.7	0.9	1.2	2.7	1.4	1.5	1.6	1.6
Sweden	40.3	43.0	51.2	57.2	47.9	56.5	54.7	88.0
TOTAL	133.4	139.1	157.4	207.3	96.9	124.5	121.5	166.6
Kattegat								
Country								
Denmark	69.2	37.4	46.6	76.2	57.1	32.2	29.7	33.5
Sweden	39.8	35.9	29.8	49.7	37.9	45.2	36.7	26.4
TOTAL	109.1	73.3	76.4	125.8	95.0	77.5	66.4	59.9
TOTAL Div. IIIa	242.5	212.3	233.9	333.1	191.9	201.9	187.8	226.5

* Preliminary

Table 2.1.5 Catches of HERRING, Sub-divisions 25-29 (including Gulf of Riga) and 32. Catches as reported to the Working Group ('000 t).

Country	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Denmark	11.9	13.9	19.4	10.6	14.1	15.3	10.5	6.5	7.6	3.9	4.2	10.8	7.3	4.6	6.8	8.1
Estonia															32.7	29.7
Finland	33.7	38.3	40.4	44.0	42.5	47.5	59.1	54.1	54.2	49.4	50.4	58.1	50.0	26.9	18.1	28.9
Germany															0.0	0.0
Germany, Dem. Rep.	25.2	5.6	3.5	1.0	2.1	1.0	1.3	1.1	1.7	1.9	2.6	4.0	3.6	0.0		
Germany, Fed. Rep.	0.0	0.1	0.0	0.0	1.0	1.3	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
Latvia															33.3	25.8
Lithuania															6.5	4.6
Poland	57.2	61.3	70.4	58.3	51.2	63.0	67.1	65.8	72.8	67.8	55.5	57.2	51.8	52.3	47.1	39.2
Russia															31.9	29.5
Sweden	48.7	55.4	71.3	72.5	72.9	83.8	78.6	56.9	42.5	29.7	25.4	33.4	55.4	44.2	36.5	43.0
USSR	137.0	130.6	118.1	118.0	110.2	99.2	84.6	105.6	110.8	115.7	113.8	122.8	121.8	116.2		
Total	313.7	305.2	323.1	304.4	294.0	311.1	302.0	289.9	289.5	268.3	251.9	286.3	289.9	244.2	212.8	208.8

Table 2.2.1 Sprat catches in the Baltic Sea by country and sub-division 1991 and 1992 (t). By-catch of herring in directed sprat fisheries excluded and by-catch of sprat in directed herring fisheries included. (Data as reported to the Working Group.)

Sprat catches in the Baltic Sea by country and Sub-division in 1991 (tonnes)

Country	Total catch	22	23	24	25	26	27	28	29	30	31	32
Denmark	9994	2554		7440								
Finland	1642								1236			406
Germany	744	716		28								
Poland	22501			201	10287	12013						
Sweden	8666			1463	3191	1047	832	2133				
Estonia	17893					504		8487	5132			3770
Latvia	17672					5643		12029				
Lithuania	3570					3042		528				
Russia	20542					6593		6165	3157			4627
Total	103224	3270	0	9132	13478	28842	832	29342	9525	0	0	8803

Sprat catches in the Baltic Sea by country and Sub-division in 1992(tonnes)

Country	Total catch	22	23	24	25	26	27	28	29	30	31	32
Denmark	24339	9663		3958	10718							
Finland	1764								1271	71	1	421
Germany	584	562		22								
Poland	28343			372	12432	15539						
Sweden	54200			6200	20200	7600	4400	15600	200			
Estonia	4138							146	1988			2004
Latvia	17398					6742		10656				
Lithuania	3298					3298						
Russia	8104					8104						
Total	142168	10225	0	10552	43350	41283	4400	26402	3459	71	1	2425

Table 2.2.2 Sprat catches in Sub-divisions 22-32. Data supplied by Working Group members.

Year	Sub-divisions 22-32							Total
	Denmark	Finland	German Dem. Rep.	Germany Fed. Rep.	Poland	Sweden	USSR	
1977	7,167	6,702	17,241	766	38,764	428	109,721	180,792
1978	10,815	6,052	13,710	784	24,692	800	75,521	132,382
1979	5,549	7,125	4,018	691	12,395	2,226	45,062	77,066
1980	4,738	6,191	141	541	12,735	2,834	31,359	58,089
1981	8,359	5,952	78	564	8,891	1,550	23,881	49,275
1982	6,662	4,537	1,022	632	14,209	2,750	18,866	48,678
1983	6,202	3,375	2,692	619	7,088	3,639	13,725	37,340
1984	3,179	2,400	2,761	663	9,254	8,397	25,891	52,545
1985	4,148	2,911	1,950	879	18,483	7,111	34,003	69,485
1986	5,954	3,235	2,514	473	23,653	3,469	36,484	75,782
1987	2,593	2,817	1,307	1,125	32,003	3,453	44,888	88,186
1988	1,972	3,025	1,234	330	22,236	7,345	44,181	80,323
1989	5,239	2,752	1,166	565	18,648	3,450	53,996	85,816
1990	801	2,734	518	789	13,296	7,478	60,002	85,638
1991	9,994	1,642	-	706	22,501	8,666	59,677[1]	103,186

Year	Denmark	Estonia	Finland	Germany	Latvia	Lithuania	Poland	Russia	Sweden	Total
1992	24,339	4,138	1,764	584	17,398	3,298	28,343	8,104	54,200	142,168

[1]Sum of catches by Estonia, Latvia, Lithuania and Russia.

Table 3.1.1 Total catch (t) of COD by countries in Sub-divisions 22-32 as provided by Working Group members.

Year	Denmark	Estonia	Finland	German Dem.Rep.	Germany, Fed.Rep.	Latvia	Lithuania	Poland	Russia	Sweden	USSR	Faroe Islands	Total
1965	35,313	-	23	10,680	15,713	-	-	41,498	-	21,705	22,420	-	147,352
1966	37,070	-	26	10,589	12,831	-	-	56,007	-	22,525	38,270	-	177,318
1967	39,105	-	27	21,027	12,941	-	-	56,003	-	23,363	42,980	-	196,446
1968	44,109	-	70	24,478	16,833	-	-	63,245	-	24,008	43,610	-	216,353
1969	44,061	-	58	25,979	17,432	-	-	60,749	-	22,301	41,580	-	212,160
1970	42,392	-	70	18,099	19,444	-	-	68,440	-	17,756	32,250	-	198,451
1971	46,831	-	53	10,977	16,248	-	-	54,151	-	15,670	20,910	-	164,840
1972	59,717	-	76	13,720	15,516	-	-	57,093	-	16,471	30,140	-	192,733
1973	66,050	-	95	14,408	28,706	-	-	49,790	-	18,389	20,083	-	197,521
1974	57,810	-	160	10,970	22,224	-	-	48,650	-	16,435	38,131	-	194,386
1975	62,524	-	298	14,742	24,880	-	-	69,318	-	17,965	49,289	-	239,016
1976	77,570	-	287	8,552	26,626	-	-	70,466	-	20,188	49,047	-	252,736
1977	73,505	-	310	10,967	30,806	-	-	47,702	-	18,127	29,680	-	211,097
1978	50,611	-	1,437	9,345	15,122	-	-	64,113	-	16,793	37,200	-	194,621
1979	59,704	-	2,938	8,997	19,375	-	-	79,754	-	23,093	75,034	3,850	272,745
1980	75,529	-	5,962	7,406	18,407	-	-	123,486	-	33,201	124,350	1,250	389,591
1981	92,648	-	5,681	12,936	18,281	-	-	120,901	-	44,330	87,746	2,765	385,288
1982	91,927	-	8,126	11,368	21,860	-	-	92,541	-	46,548	86,906	4,300	363,576
1983	107,624	-	8,927	10,521	25,154	-	-	76,474	-	53,740	92,248	6,065	380,753
1984	113,701	-	9,358	9,886	42,031	-	-	93,429	-	65,927	100,761	6,354	441,447
1985	107,627	-	7,224	6,593	31,798	-	-	63,260	-	54,723	78,127	5,890	355,242
1986	98,464	-	5,633	3,179	22,422	-	-	43,236	-	49,572	52,148	4,596	279,250
1987	83,844	-	3,007	5,114	18,816	-	-	32,667	-	47,429	39,203	5,567	235,647
1988	74,742	-	2,904	4,634	18,295	-	-	33,351	-	54,968	28,137	6,915	223,946
1989	65,935	-	2,254	2,147	15,342	-	-	36,855	-	55,919	14,722	4,520	197,654
1990	56,700	-	1,731	1,629[2]	7,745	-	-	32,028	-	54,474	13,461	3,558	171,326
1991	50,606	1,810	1,712	-	9,443	2,627	1,865	25,748	3,299	39,491	-	2,611	139,212
1992[1]	28,046	1,368	497	-	6,519	1,250	1,266	13,314	1,793	15,940	-	605	70,598

[1]Provisional data.
[2]Includes landings from October-December 1991 in former GDR.

Table 3.1.2 Total catch (t) of COD in Sub-divisions 22-32 by sub-division and country as providedy by Working Group members.

Year	Denmark				Faroe Islands	Finland				
	22	23	24	25-28	25-28	25-28	29	30[2]	31	32
1972	17,717	-	7,928	34,072	-	-	-	76	-	-
1973	21,400	-	9,195	35,455	-	-	-	95	-	-
1974	18,300	-	7,482	32,028	-	-	-	160	-	-
1975	15,981	-	7,500	39,043	-	-	270	8	-	20
1976	19,764	712	9,682	47,412	-	-	81	24	-	182
1977	17,726	1,166	10,213	44,400	-	-	85	26	-	199
1978	12,641	1,177	6,527	30,266	-	-	249	323	6	859
1979	16,093	2,029	7,232	34,350	3,850	-	707	518	16	1,697
1980	16,033	2,425	7,367	49,704	1,250	-	2,163	880	45	2,874
1981	15,502	1,473	7,152	68,521	2,765	-	3,036	684	11	1,950
1982	11,669	1,638	7,469	71,151	4,300	-	4,557	1,368	42	2,159
1983	14,100	1,257	7,861	84,406	6,065	-	5,322	2,013	36	1,556
1984	13,867	1,703	8,042	90,089	6,334	-	5,433	2,741	7	1,177
1985	15,563	1,076	7,461	83,527	5,890	-	4,646	1,706	7	865
1986	8,914	748	7,281	81,521	4,596	-	3,571	1,306	2	754
1987	7,990	1,503	5,470	68,881	5,567	-	1,389	1,143	2	473
1988	5,680	1,121	7,505	60,436	6,915	614	998	1,257	1	34
1989	3,422	636	4,637	57,240	4,520	392	603	1,097	1	161
1990	3,235	722	5,349	47,394	3,558	833	187	685	-	26
1991	5,536	1,431	3,847	39,792	2,611	1,061	228	404	-	18
1992[1]	6,645	2,204	2,206	16,991	605	249	48	188	-	12

Year	Federal Republic of Germany						German Democratic Republic						
	22	24	25	26	27	28	22	24	25	26	27	28	29
1972	10,531	1,782	3,193	10	-	-	4,560	5,105	1,950	2,072	-	33	-
1973	12,833	900	9,100	5,200	-	673	4,004	4,370	4,065	1,912	-	57	-
1974	9,998	395	5,242	5,769	-	820	3,028	5,431	1,469	996	-	52	-
1975	12,415	497	8,809	1,975	-	1,184	3,471	2,571	3,320	5,250	50	60	20
1976	12,312	581	7,526	4,490	-	1,717	1,292	3,290	800	3,150	10	10	-
1977	10,807	879	3,649	13,803	-	1,668	977	2,471	324	5,996	73	1,119	7
1978	9,972	880	2,178	1,793	-	299	1,619	5,466	414	1,714	1	131	-
1979	8,910	688	7,616	2,149	-	12	1,024	6,570	54	1,301	1	46	1
1980	5,968	689	10,985	673	-	92	880	4,700	5	1,818	-	3	-
1981	9,095	2,165	7,021	-	-	-	1,743	9,916	2	1,275	-	-	-
1982	7,394	666	13,069	662	-	69	1,908	8,707	-	728	-	25	-
1983	8,937	323	14,179	1,599	-	116	1,441	7,656	-	1,402	-	22	-
1984	11,340	208	21,948	7,926	-	609	1,851	6,242	-	1,793	-	-	-
1985	4,992	531	12,733	11,572	-	1,970	1,508	3,870	-	1,215	-	-	-
1986	2,236	666	10,545	8,399	-	576	825	2,173	1	180	-	-	-
1987	3,611	645	7,757	5,009	-	1,794	504	4,392	1	217	-	-	-
1988	3,670	547	11,321	2,577	-	180	330	4,302	1	1	-	-	-
1989	2,099	399	12,201	640	-	3	217	1,927	3	-	-	-	-
1990	1,997	1,057	3,232	1,427	-	32	129[5]	1,500[5]	+	-	-	-	-
1991	1,648	1,231	5,419	1,114	8	23	-	-	-	-	-	-	-
1992[1]	2,390	1,336	2,187	586	-	20	-	-	-	-	-	-	-

Table 3.1.2 (Cont'd)

Year	Poland		Sweden								
	25[4]	26	23	24	25	26	27[3]	28	29	30	31
1972	24,926	32,167	-	1,277	13,842	-	876	440	-	36	-
1973	29,010	20,780	-	1,655	15,224	-	971	485	-	54	-
1974	25,221	23,429	-	1,937	11,950	-	1,682	825	-	41	-
1975	35,373	33,945	-	1,932	12,511	-	2,052	1,367	103	-	-
1976	26,082	44,384	-	1,800	14,109	-	1,979	2,180	115	5	-
1977	18,172	29,530	550	1,516	11,775	-	2,584	1,560	120	22	-
1978	31,161	32,952	600	1,730	9,017	26	3,207	1,740	417	55	1
1979	40,146	39,608	700	1,800	13,628	50	3,458	2,665	641	145	6
1980	50,832	72,654	1,300	2,610	18,694	88	6,014	3,185	790	516	4
1981	50,698	70,203	900	5,700	24,600	260	7,200	4,450	712	500	8
1982	41,830	50,711	140	7,933	20,429	2,279	4,109	9,264	687	1,669	38
1983	35,153	41,321	120	6,910	27,630	1,810	6,490	9,200	1,260	320	-
1984	35,261	58,168	228	6,014	33,493	4,413	8,223	11,947	1,338	271	-
1985	19,332	43,928	263	4,895	22,737	8,170	7,068	9,523	1,115	929	23
1986	18,297	24,939	227	3,622	19,214	7,764	7,554	9,606	1,233	298	54
1987	12,254	20,413	137	4,314	15,173	7,833	5,708	7,507	903	5,817	37
1988	14,910	18,441	155	5,849	20,893	7,453	6,674	7,946	535	5,456	7
1989	20,819	16,036	192	4,987	28,068	6,742	7,703	6,829	440	927	31
1990	14,528	17,500	120	3,671	23,311	13,512	6,702	6,525	252	353	28
1991	9,853	15,895	232	2,768	18,413	7,034	5,096	5,548	180	207	12
1992[1]	5,449	7,865	290	1,655	7,169	2,133	2,145	2,153	93	301	1

Year	USSR						Total
	25	26	27	28	29	32	
1972	-	23,951	-	6,189	-	-	192,733
1973	-	8,768	1	11,250	50	14	197,521
1974	811	18,633	-	17,677	1,010	-	194,386
1975	946	17,884	3	28,677	1,735	44	239,016
1976	8,855	25,302	126	14,645	106	13	252,736
1977	390	17,880	4	11,304	91	11	211,097
1978	12	18,010	78	18,623	166	311	194,621
1979	13	30,776	-	39,875	1,575	2,795	272,745
1980	7	45,734	-	59,892	4,575	14,142	389,591
1981	2	44,254	-	32,195	3,733	7,562	385,288
1982	5	33,221	-	40,876	3,308	9,496	363,576
1983	-	33,600	-	39,464	6,095	13,089	380,753
1984	-	39,871	-	43,802	6,185	10,903	441,447
1985	-	32,096	-	27,137	8,822	10,072	355,242
1986	-	22,818	-	21,840	3,289	4,201	279,250
1987	-	22,652	-	11,457	1,654	3,440	235,647
1988	-	15,928	-	10,868	172	1,169	223,946
1989	-	8,440	-	6,058	121	103	197,694
1990	-	10,020	-	3,420	3	18	171,310
1991	-	-	-	-	-	-	139,212
1992[1]	-	-	-	-	-	-	70,598

Year	Estonia			Latvia			Lithuania		Russia		
	26	28	29	26	28	29	26	28	26	28	32
1991	1,537	273	-	1,190	1,432	5	1,854	11	3,034	264	1
1992[1]	1,011	352	5	380	870	-	1,266	-	1,793	-	-

[1]Provisional.[2]Finland: 1972-1974, Sub-divisions combined. [3]Sweden: 1972-1974, Sub-divisions combined. [4]Poland: some catches from Sub-division 24 included. [5]Includes landings from October-December 1990.

Table 3.1.3 Total catch (t) of COD in Sub-divisions 22, 23, and 24 as provided by Working Group members.

Year	Denmark	German Dem.Rep.	Germany, Fed.Rep.	Sweden	Total			
	22 + 24	22 + 24	22 + 24	24	22	23	24	22 + 24
1965	19,457	9,705	13,350	2,182	27,867	-	17,007	44,874
1966	20,500	8,393	11,448	2,110	27,864	-	14,587	42,451
1967	19,181	10,007	12,884	1,996	28,875	-	15,193	44,068
1968	22,593	12,360	14,815	2,113	32,911	-	18,970	51,881
1969	20,602	7,519	12,717	1,413	29,082	-	13,169	42,251
1970	20,085	7,996	14,589	1,289	31,363	-	12,596	43,959
1971	23,715	8,007	13,482	1,419	32,119	-	14,504	46,623
1972	25,645	9,665	12,313	1,277	32,808	-	16,092	48,900
1973	30,595	8,374	13,733	1,655	38,237	-	16,120	54,357
1974	25,782	8,459	10,393	1,937	31,326	-	15,245	46,571
1975	23,481	6,042	12,912	1,932	31,867	-	12,500	44,367
1976	29,446	4,582	12,893	1,800	33,368	712	15,353	48,721
1977	27,939	3,448	11,686	1,516	29,510	1,716	15,079	44,589
1978	19,168	7,085	10,852	1,730	24,232	1,777	14,603	38,835
1979	23,325	7,594	9,598	1,800	26,027	2,729	16,290	42,317
1980	23,400	5,580	6,652	2,610	22,881	3,725	15,366	38,247
1981	22,654	11,659	11,260	5,700	26,340	2,373	24,933	51,273
1982	19,138	10,615	8,060	7,933	20,971	1,778	24,775	45,746
1983	21,961	9,097	9,260	6,910	24,478	1,377	22,750	47,228
1984	21,909	8,093	11,548	6,014	27,058	1,931	20,506	47,564
1985	23,024	5,378	5,523	4,895	22,063	1,339	16,757	38,820
1986	16,195	2,998	2,902	3,622	11,975	975	13,742	25,717
1987	13,460	4,896	4,256	4,314	12,105	1,640	14,281	26,926
1988	13,185	4,632	4,217	5,849	9,680	1,276	18,203	27,883
1989	8,059	2,145	2,498	4,987	5,738	828	11,637	17,689
1990	8,584	1,629[2]	3,054	3,671	5,361	842	11,577	16,938
1991	9,383	-	2,879	2,768	7,184	1,663	7,846	15,030
1992[1]	8,851	-	3,726	1,655	9,035	2,494	5,197	14,232

[1]Provisional data.
[2]Includes landings from October-December 1990 in the former GDR.

Table 3.1.4 Total catch (t) of COD in Sub-divisions 25-32 as provided by Working Group members.

Year	Denmark	Estonia	Finland	German Dem.Rep.	Germany Fed.Rep.	Latvia	Lithuania	Poland	Russia	Sweden	USSR	Faroe Islands	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	-	-	69,319	-	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	29,577	-	-	93,429	-	59,685	100,761	6,354	391,046
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	-	2,594	2	14,078	-	-	33,351	-	48,964	28,137	6,915	194,477
1989	57,240	-	2,254	3	12,844	-	-	36,855	-	50,739	14,722	4,520	179,172
1990	47,394	-	1,731	+	4,691	-	-	32,028	-	50,683	13,461	2,882	152,870
1991	39,792	1,810	1,711	-	6,564	2,627	1,865	25,748	3,299	36,490	-	2,611	122,517
1992[1]	16,991	1,368	497	-	2,793	1,250	1,266	13,314	1,793	13,995	-	605	53,872

[1]Provisional data.

Table 3.2.1 Total catch (in tonnes) of FLOUNDER in the Baltic, by sub-divisions and country. (There are some gaps in the information. The "Total", therefore, is preliminary.)

Year	Denmark[1]			Finland			German Dem. Rep.			Germany, Fed. Rep.		Poland		Sweden[3]					
	22	23	24(25)	29	30	32	22	24	25(+26)	22	24(+25)	25(+24)	26	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	182	125	167	52[2]	1,622[2]	-	183	10	1,586	599	-	120	-	-	-	-
1991	925	-	1,497	236	82	167				246	1,814	2,008	1,926	24	31	-	88	20	-
1992	686	-	933	262	67	138				227	1,972	1,887	1,869	41	88	3	86	11	3

(cont'd)

Table 3.2.1 (cont'd)

Year	USSR				Estonia				Latvia		Lithuania	Russia		Total										
	26	28	29	32	26	28	29	32	26	28	26	26	28	22	23[4]	24	25	26	27	28	29	30	32	22-32
1973	-	2,610	-	-										2,513	-	2,014	3,598	2,070	-	2,610	-	-	-	12,805
1974	-	2,510	-	-										2,566	-	4,063	2,759	2,473	-	2,510	-	-	-	14,371
1975	-	6,455	-	-										2,624	-	3,148	2,677	2,585	-	6,455	113	22	-	17,624
1976	471	1,779	409	359										2,604	-	2,040	2,850	2,760	-	1,779	527	23	418	13,001
1977	210	1,081	321	414										2,922	-	3,101	3,583	2,299	-	1,081	436	32	470	13,924
1978	288	1,290	334	395										3,790	-	2,988	1,342	2,394	-	1,290	508	61	550	12,923
1979	158	1,170	330	1,012										2,899	-	2,917	1,545	2,018	-	1,170	522	54	1,165	12,290
1980	93	798	334	1,080										2,535	-	3,078	1,659	1,473	20	979	560	69	1,245	11,618
1981	58	742	445	1,078										2,586	-	3,165	1,181	1,599	21	936	706	56	1,213	11,463
1982	195	665	615	1,121										2,074	104	3,482	2,517	1,818	65	681	837	58	1,265	12,901
1983	209	551	497	1,114										2,412	115	4,095	1,936	1,114	212	603	687	67	1,234	12,475
1984	145	202	286	1,226										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	4,399	3,061	2,226	60	174	483	128	737	13,110
1987	1,315	203	279	397										1,393	122	3,131	2,556	3,060	57	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	1,706	1,351	-	390	326	125	308	8,403
1991	-	-	-	-	49	1	135	51	123	323	125	216	10	1,171	-	3,335	2,039	2,439	88	354	371	82	218	10,097
1992	-	-	-	-	-	47	47	46	26	664	483	146	-	913	-	2,146	1,975	2,527	86	722	312	67	184	8,932

[1]For the years 1970-1981 catches in Sub-division 23 are included in Sub-division 22.
[2]Includes landings from October-December.
[3]For the years 1973-1979 and 1990 catches in Sub-divisions 24-29 are included in Sub-division 25.
[4]For the years 1973-1981 catches in Sub-division 23 are included in Sub-division 22.

Table 3.2.2 Total catch (in tonnes) of PLAICE in the Baltic by Sub-division and country. (There are some gaps in the information. The "Total", therefore, is preliminary.)

Year	Denmark		German[1] Dem.Rep.		Federal Rep. of Germany		Poland		Sweden[2]					Total							
	22	24(+25)	22	24	22	24(+25)	25(+24)	26	24	25	27	28	29	22	24	25	26	27	28	29	22-28
1970	3,757	494	-	-	202	16	-	-	149	-	-	-	-	3,959	659	-	-	-	-	-	4,618
1971	3,435	314	-	-	160	2	-	-	107	-	-	-	-	3,595	423	-	-	-	-	-	4,018
1972	2,726	290	-	-	154	2	-	-	78	-	-	-	-	2,880	370	-	-	-	-	-	3,250
1973	2,399	203	2	44	163	1	174	30	75	-	-	-	-	2,564	323	174	-	-	-	-	3,091
1974	3,440	126	36	10	166	2	114	86	60	-	-	-	-	3,642	198	114	-	-	-	-	4,040
1975	2,814	184	11	67	302	1	158	142	45	-	-	-	-	3,127	297	158	-	-	-	-	3,724
1976	3,328	178	11	82	302	3	164	76	44	-	-	-	-	3,641	307	164	-	-	-	-	4,188
1977	3,452	221	5	36	348	2	265	26	41	-	-	-	-	3,805	300	265	-	-	-	-	4,396
1978	3,848	681	33	1,198	346	3	633	290	32	-	-	-	-	4,227	1,914	633	-	-	-	-	7,064
1979	3,554	2,027	10	1,604	195	7	555	224	113	-	-	-	-	3,759	3,751	555	-	-	-	-	8,289
1980	2,216	1,652	5	303	84	5	383	53	113	-	-	-	-	2,305	2,073	383	53	-	-	-	4,814
1981	1,193	937	6	52	74	31	239	27	118	-	-	-	-	1,273	1,138	239	27	-	-	-	2,677
1982	716	393	6	25	39	6	43	64	40	6	7	1	-	761	464	49	64	7	1	-	1,346
1983	901	297	5	12	37	14	64	12	133	20	24	2	-	943	456	84	12	24	2	-	1,521
1984	803	166	7	2	23	8	106	-	23	3	4	1	-	833	199	109	-	4	1	-	1,146
1985	648	771	68	593	26	40	119	49	25	4	5	1	-	742	1,429	119	49	5	1	-	2,345
1986	570	1,019	34	372	25	7	171	59	48	7	9	1	-	629	1,446	171	59	9	1	-	2,315
1987	414	794	4	142	14	16	188	5	68	10	12	1	-	432	1,020	198	5	12	1	-	1,668
1988	234	323	3	16	7	1	9	1	49	7	9	1	-	244	389	16	1	9	1	-	660
1989	167	149	-	5	7	-	10	-	34	5	6	1	-	174	188	15	-	6	1	-	384
1990	236	100	0	1[3]	9	1	6	0	50	-	-	-	-	245	152	6	-	-	-	-	403
1991	328	112	-	-	15	9	2	2	5	2	2	-	-	343	126	4	2	2	-	-	477
1992	304	71	-	-	11	4	2	+	3	1	1	+	+	315	78	3	+	1	+	+	397

[1]Includes 1990 also landings from October-December.
[2]For the years 1970-1981 and 1990 catches in Sub-divisions 25-28 are included in Sub-division 24.
[3]Includes landings from Oct-Dec.

Table 3.2.3 Total catch of DAB in the Baltic by sub-division and country (in tonnes). (There are some gaps in the information. The "Total", therefore, is preliminary.

Year	Denmark		German[1] Dem.Rep.		Fed.Rep. of Germany		Sweden[2]						Total							
	22	24(+25)	22	24	22	24	24	25	27	28	29	30	22	24	25	27	28	29	30	22-28
1970	845	20	11	-	74	-	+	-	-	-	-	-	930	20	-	-	-	-	-	950
1971	911	26	10	-	64	-	+	-	-	-	-	-	985	26	-	-	-	-	-	1,011
1972	1,110	30		-	63	-	23	-	-	-	-	-	1,182	53	-	-	-	-	-	1,235
1973	1,087	58	18	-	118	-	30	-	-	-	-	-	1,223	88	-	-	-	-	-	1,311
1974	1,178	51	18	-	118	-	34	-	-	-	-	-	1,314	85	-	-	-	-	-	1,399
1975	1,273	74	20	-	131	-	32	-	-	-	-	-	1,424	106	-	-	-	-	-	1,530
1976	1,238	60	17	-	114	-	27	-	-	-	-	-	1,369	87	-	-	-	-	-	1,456
1977	889	32	13	-	89	-	25	-	-	-	-	-	991	57	-	-	-	-	-	1,048
1978	928	51	19	14	128	4	-	-	-	-	-	-	1,075	69	-	-	-	-	-	1,144
1979	1,413	50	18	25	123	1	9	-	-	-	-	-	1,554	85	-	-	-	-	-	1,639
1980	1,593	21	15	25	101	+	3	-	-	-	-	-	1,709	49	-	-	-	-	-	1,758
1981	1,601	32	24	39	164	+	5	-	-	-	-	-	1,789	76	-	-	-	-	-	1,865
1982	1,863	50	46	38	182	4	6	5	8	6	-	1	2,001	98	5	8	6	-	1	2,209
1983	1,920	42	46	28	198	-	24	20	32	22	-	2	2,164	94	20	32	22	-	2	2,334
1984	1,796	65	30	47	175	2	4	3	5	4	-	1	2,001	118	3	5	4	-	1	2,132
1985	1,593	58	52	51	187	2	3	3	5	3	-	1	1,832	114	3	5	3	-	1	1,958
1986	1,655	85	36	35	185	1	1	1	1	1	-	-	1,876	122	1	1	1	-	-	2,001
1987	1,706	93	14	87	276	4	1	1	1	1	-	-	1,996	185	1	1	1	-	-	2,184
1988	1,846	75	22	91	281	1	1	1	1	1	-	-	2,149	168	1	1	1	-	-	2,320
1989	1,722	48	26	19	218	1	1	1	2	1	-	-	1,966	69	1	2	1	-	-	2,039
1990	1,743	146	14	11	252	1	8	-	-	-	-	-	2,009	166	-	-	-	-	-	2,175
1991	1,731	95			340	5	1	-	-	-	-	-	2,071	101	-	-	-	-	-	2,172
1992	1,338	78	-	-	409	6	+	1	1	+	4	-	1,747	84	1	1	+	1	+	1,834

[1]Includes 1990 also landings from Oct-Dec.
[2]For the years 1970-1981 and 1990 catches in Sub-divisions 25-30 are included in Sub-division 24.
[3]United Germany.

Table 3.2.4 Total catch of TURBOT in the Baltic, by sub-divisions and country (in tonnes). (There are some gaps in the information. The "Total", therefore, is preliminary.)

Year	Denmark		German[1] Dem.Rep.		Germany, Fed.Rep.		Poland		Sweden[2]					Russia	Total						
	22	24(+25)	24		22	24	25+(24)	26	24	25	26	27	28+(29)	26	22	24	25	26	27	28(+29)	22-28
1965	-	-	3	39	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	42
1966	16	21	5	53	-	-	-	-	-	-	-	-	-	-	21	74	-	-	-	-	95
1967	14	20	7	10	-	-	-	-	-	-	-	-	-	-	21	30	-	-	-	-	51
1968	14	18	3	67	-	-	-	-	-	-	-	-	-	-	17	85	-	-	-	-	102
1969	13	13	4	57	-	-	-	-	-	-	-	-	-	-	17	70	-	-	-	-	87
1970	11	13	5	40	-	-	-	-	2	-	-	-	-	-	16	55	-	-	-	-	71
1971	11	26	4	86	-	-	-	-	2	-	-	-	-	-	15	114	-	-	-	-	129
1972	10	26	3	100	-	-	-	-	3	-	-	-	-	-	13	129	-	-	-	-	142
1973	11	30	3	33	-	-	58	13	5	-	-	-	-	-	14	68	58	13	-	-	153
1974	14	40	2	23	-	-	34	36	6	-	-	-	-	-	16	69	54	36	-	-	155
1975	27	48	3	38	15	-	23	6	7	-	-	-	-	-	45	93	23	6	-	-	167
1976	29	24	0	52	11	-	14	12	7	-	-	-	-	-	40	83	14	12	-	-	149
1977	32	37	0	55	9	-	12	55	8	-	-	-	-	-	41	100	12	55	-	-	208
1978	33	37	2	27	9	-	7	3	10	-	-	-	-	-	44	74	7	3	-	-	128
1979	23	38	3	39	6	-	29	34	12	-	-	-	-	-	32	89	29	34	-	-	184
1980	28	38	0	30	9	-	12	20	15	-	-	-	-	-	37	83	12	20	-	-	152
1981	28	62	1	46	8	-	10	19	7	-	-	-	-	-	37	115	10	19	-	-	181
1982	31	51	1	27	7	-	2	17	3	4	-	4	3	-	39	81	6	17	4	3	150
1983	33	40	3	9	8	-	5	4	31	41	-	35	24	-	44	80	46	4	35	24	233
1984	41	45	4	8	12	-	13	2	3	4	-	3	2	-	57	56	17	2	3	2	137
1985	56	34	5	22	15	-	67	15	4	5	-	4	3	-	76	60	72	15	4	3	230
1986	99	81	6	32	25	-	32	37	6	8	-	7	5	-	130	119	40	37	7	5	338
1987	134	93	4	34	30	-	155	21	8	11	-	9	6	-	168	135	166	21	9	6	505
1988	117	117	3	28	34	-	7	10	12	16	-	14	9	-	154	157	23	10	14	9	367
1989	135	109	7	22	20	-	-	11	11	15	-	13	9	-	161	142	15	11	13	9	351
1990	178	181	4	2	26	-	23	7	14	-	-	-	-	-	208	197	23	7	-	-	435
1991	228	137	-	-	44	39	73	19	2	12	-	16		-	272	178	85	19	16	9	579
1992	267	127	-	-	55	68	74	74	12	12	+	21	36	30	322	207	86	104	21	36	776

[1]Includes 1990 also landings from October-December.
[2]For the years 1970-1981 and 1990 catches in Sub-divisions 25-29 are included in Sub-division 24.

Table 3.2.5 Total landings of BRILL (in tonnes). (There are some gaps in the information. The "Total", therefore, is preliminary.)

Year	Sub-division 22			Sub-divisions 24-28			Sub-divisions 22-28
	Denmark	Fed.Rep. of Germany	Total	Denmark	Sweden	Total	Total
1970	4	-	4	-	-	-	-
1971	3	-	3	-	-	-	-
1972	7	-	7	-	-	-	-
1973	11	-	11	2	-	2	13
1974	25	-	25	1	-	1	26
1975	38	1	39	1	+	1	40
1976	45	2	47	1	-	1	48
1977	60	5	65	2	-	2	67
1978	37	3	40	-	-	-	40
1979	30	0	30	-	-	-	30
1980	26	0	26	-	-	-	26
1981	22	1	23	-	-	-	23
1982	19	0	19	0	17	17	36
1983	13	0	13	0	42	42	55
1984	12	0	12	-	3	3	15
1985	16	0	16	0	1	1	17
1986	15	0	15	0	3	3	18
1987	12	0	12	0	3	3	15
1988	5	0	5	0	1	1	6
1989	9	0	9	0	1	1	10
1990	0	0	0	-	1	1	1
1991	15	0	0	-	-	-	15
1992	28	0	28	-	-	-	28

Table 4.1.1 Annual nominal landings in tonnes of Baltic salmon in 1972-1992. (S = Sea; C = Coastal; R = River.)

Year	Baltic Main Basin (Sub-divisions 24-29)									
	Denmark	Finland	Germany	Poland	Sweden	USSR		Total		
	S	S + C	S	S	S	S	C + R	S	C + R	GT
1972	1,034	122	117	13	277	-	107	1,563	107	1,670
1973	1,107	190	107	17	407	-	122	1,828	122	1,950
1974	1,224	282	52	20	403	21	155	2,002	155	2,157
1975	1,112	211	67	10	352	43	194	1,795	194	1,989
1976	1,372	181	58	7	332	84	123	2,034	123	2,157
1977	951	134	77	6	317	68	96	1,553	96	1,649
1978	810	191	22	4	252	90	48	1,369	48	1,417
1979	854	199	31	4	264	167	29	1,519	29	1,548
1980	886	305	40	22	325	303	16	1,881	16	1,897

Year	Baltic Main Basin (Sub-divisions 24-29)																	
	Denmark	Estonia		Finland			Germany	Latvia		Lithuania	Poland	Russia	Sweden		Total			
	S	S[1]	C	S	C	R	S	S	C	S	S	S	S	R	S	C	R	GT
1981	844	23		310	18	-	43	167	17	36	45	56	401	-	1,925	35	-	1,960
1982	604	45		184	16	-	20	143	31	30	38	57	376	-	1,496	47	-	1,543
1983	697	55		134	18	-	25	181	105	33	76	93	370	-	1,664	123	-	1,787
1984	1,145	92		208	29	-	32	275	89	43	72	81	549	-	2,497	118	-	2,615
1985	1,345	87		280	26	-	30	234	90	41	162	64	842	-	3,085	116	-	3,201
1986	848	52		306	38	-	41	279	130	57	137	46	764	-	2,530	168	-	2,698
1987	955	82		446	40	-	26	327	68	62	267	81	887	4	3,133	108	4	3,245
1988	778	60		305	30	-	41	250	96	48	93	74	710	6	2,359	126	6	2,491
1989	850	67		365	35	-	52	392	131	70	80	104	1,053	4	3,033	166	4	3,203
1990	729	68		467	46	2	36	419	188	66	195	109	949	9	3,038	234	11	3,283
1991	625	64		478	35	2	28	361	120	62	77	86	641	14	2,422	155	16	2,593
1992[1]	629	19	4	354	37	2	27	204	74	20	170	37	694	7	2,154	115	9	2,278

(cont'd)

Table 4.1.1 (cont'd)

Year	Gulf of Bothnia (Sub-divisions 30-31)											Baltic Main Basin and Gulf of Bothnia (Sub-divisions 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		143		9	126	65	163	126	65	354	1,726	298	2,024
1973	12		191		13	166	134	216	166	134	516	2,044	422	2,466
1974	0		310		15	180	155	325	180	155	660	2,327	490	2,817
1975	98		412		33	272	127	543	272	127	942	2,338	593	2,931
1976	38	271		155	22	229	80	331	384	80	795	2,365	587	2,952
1977	60	348		142	49	240	60	457	382	60	899	2,010	538	2,548
1978	0	127		145	18	212	40	145	357	40	542	1,514	445	1,959
1979	0	172		121	20	171	35	192	292	35	519	1,711	356	2,067
1980	0	162		148	23	172	35	185	320	35	540	2,066	371	2,437

Year	Gulf of Bothnia (Sub-divisions 30-31)										Main Basin and Gulf of Bothnia (Sub-divisions 24-31)			
	Finland			Sweden			Total							
	S	C	R	S	C	R	S	C	R	GT	S	C	R	GT
1981	125	157	6	26	242	35	151	399	41	591	2,076	4334	41	2,551
1982	131	111	3	-	135	30	131	246	33	410	1,627	293	33	1,953
1983	176	118	4	-	140	32	176	258	36	470	1,840	381	36	2,257
1984	401	178	5	-	140	52	401	318	57	776	2,898	436	57	3,391
1985	247	151	4	-	114	38	247	265	42	554	3,332	381	42	3,755
1986	124	176	5	11	146	41	235	322	46	603	2,765	490	46	3,301
1987	66	173	6	8	106	35	74	279	41	394	3,207	387	45	3,639
1988	74	146	6	1	141	45	75	287	51	413	2,434	413	57	2,904
1989	225	207	6	10	281	63	235	488	69	792	3,268	654	73	3,995
1990	597	680	14	12	395	93	609	1,075	107	1,791	3,647	1,309	118	5,074
1991	580	523	14	1	350	84	581	873	98	1,552	3,003	1,028	114	4,145
1992[1]	489	585	14	7	386	87	496	971	101	1,568	2,650	1,086	110	3,846

(cont'd)

Table 4.1.1 (cont'd)

Year	Gulf of Finland (Sub-division 32)					Total (Sub-divisions 24-32)		
	Finland			USSR				
	S	S + C	C	S	C + R	S	C + R	GT
1972		138				1,864	298	2,162
1973		135		-		2,179	422	2,601
1974		111		-		2,438	490	2,928
1975		74		-		2,412	593	3,005
1976	81		-	-	14	2,446	601	3,047
1977	75		-	-	13	2,085	551	2,636
1978	68		1	-	6	1,582	452	2,034
1979	63		3	-	4	1,774	363	2,137
1980	51		2	-	7	2,126	380	2,506

Year	Gulf of Finland (Sub-division 32)										(Sub-divisions 24-32) Total			
	Estonia		Finland			Russia	Total							
	S	C	S	C	R	S*	S	C	R	GT	S	C	R	GT
1981	-	2	46	1	-	5	51	3	-	54	2,127	437	41	2,605
1982	-	5	91	7	-	-	91	12	-	103	1,718	305	33	2,056
1983	-	3	163	32	-	-	163	35	-	198	2,003	416	36	2,455
1984	-	5	210	42	-	7	217	47	-	264	3,115	483	57	3,655
1985	-	4	219	34	2	20	239	38	2	279	3,571	419	44	4,034
1986	24	-	270	79	2	28	322	79	2	403	3,087	569	48	3,704
1987	10	-	257	61	2	23	290	61	2	353	3,497	448	47	3,992
1988	19	-	122	112	2	15	156	112	2	270	2,590	525	59	3,174
1989	36	-	181	145	2	37	254	145	2	401	3,522	799	75	4,396
1990	25	-	118	369	26	35	178	369	26	573	3,825	1,678	144	5,647
1991	22	-	140	398	26	30	192	398	26	616	3,195	1,426	140	4,761
1992[1]	6	3	77	273	26	28	111	296	26	433	2,761	1,382	136	4,279

[1]Preliminary data.

(cont'd)

Table 4.1.1 (cont'd)

Danish, Finnish, German, Polish and Swedish catches have been converted from gutted to ungutted weight by the factor 1.1. Estonian, Latvian, Lithuanian and Russian catches are reported ungutted.

Sea trout are included in the sea catches in the order of about 3% for Denmark (before 1983), Estonia, Germany, Latvia, Lithuania and Russia, about 5% for Poland and about 10% for Finland.

Based on an inquiry in 1990 non-professional catches in 1990, 1991 and 1992 are included in the Finnish landings from Sub-divisions 29-31 and 32 fixed to an annual quantity of 106 t and 156 t respectively.

Estonia sea catches in Sub-division 32 in 1986-1991 include an inconsiderable quantity of coastal catches.

Table 4.2.1 Annual nominal landings in tonnes of SEA TROUT in the Baltic.

Year	Baltic Main Basin								Gulf of Bothnia			Gulf of Finland		Total
	Denmark[1,4]	Estonia	Finland[2]	Germany[4]	Latvia[3]	Poland		Sweden[4,6]	Finland[2]	Sweden[6]		Estonia	Finland[2]	
	S + C	C	C	C	C	R	S + C	S + C	C	R	C	C	C	
1979	3	-	10	-	-	24	81[3]	-	6	-	-	-	73	267
1980	3	-	11	-	-	26	48[3]	-	87	-	-	-	75	250
1981	6	-	51	-	5	21	45[3]	-	131	-	-	2	128	389
1982	17	-	52	1	13	31	80	-	134	-	-	4	140	472
1983	19	-	50	-	14	25	108	-	134	-	-	3	148	501
1984	29	-	66	-	9	30	155	-	110	-	-	2	211	612
1985	40	-	62	-	9	26	140	-	103	-	-	3	203	586
1986	18	-	53	-	8	49	91	-	118	-	-	2	178	517
1987	31	-	66	-	2	37	163	13	123	-	25	-	184	644
1988	28	-	99	-	8	33	137	20	196	-	27	3	287	838
1989	39	-	156	18	10	35	149	47	215	-	51	3	295	1,018
1990	48[3]	-	189	21	7	100	388	30	318	43	40	4	334	1,522
1991[5]	48[3]	1	185	7	6	37	272	50	349	28	28	2	295	1,308
1992[5]	26[3]	1	173	-	6	60	221	129	357	37	37	8	309	1,364

[1]Additional sea trout catches are included in the salmon statistics for Denmark until 1982 (Table 5.6.1).
[2]Finnish landings include about 70% non-commercial catches.
[3]Rainbow trout included.
[4]Sea trout are also caught in the Western Baltic in Sub-divisions 22 and 23 by Denmark, Germany, and Sweden.
[5]Estimated.
[6]Catches reported by professional fishermen.

Table 4.3.1 Annual nominal landings in tonnes of Rainbow Trout in the Baltic Sea.

Year	Baltic Main Basin Sub-divisions 24-29			Gulf of Bothnia/Gulf of Finland Sub-divisions 30, 32	Total
	Finland	Latvia	Poland	Finland	
1982			44		44
1983			30		30
1984			22		22
1985			15		15
1986			20		20
1987			6		6
1988			2		2
1989		16	6		22
1990		3	10		13
1991	21	-	23	15	59
1992	31	1	22	12	66

Figure 2.1.1

FISH STOCK SUMMARY
STOCK: Herring in the Western Baltic and Kattegat
28–4–1993

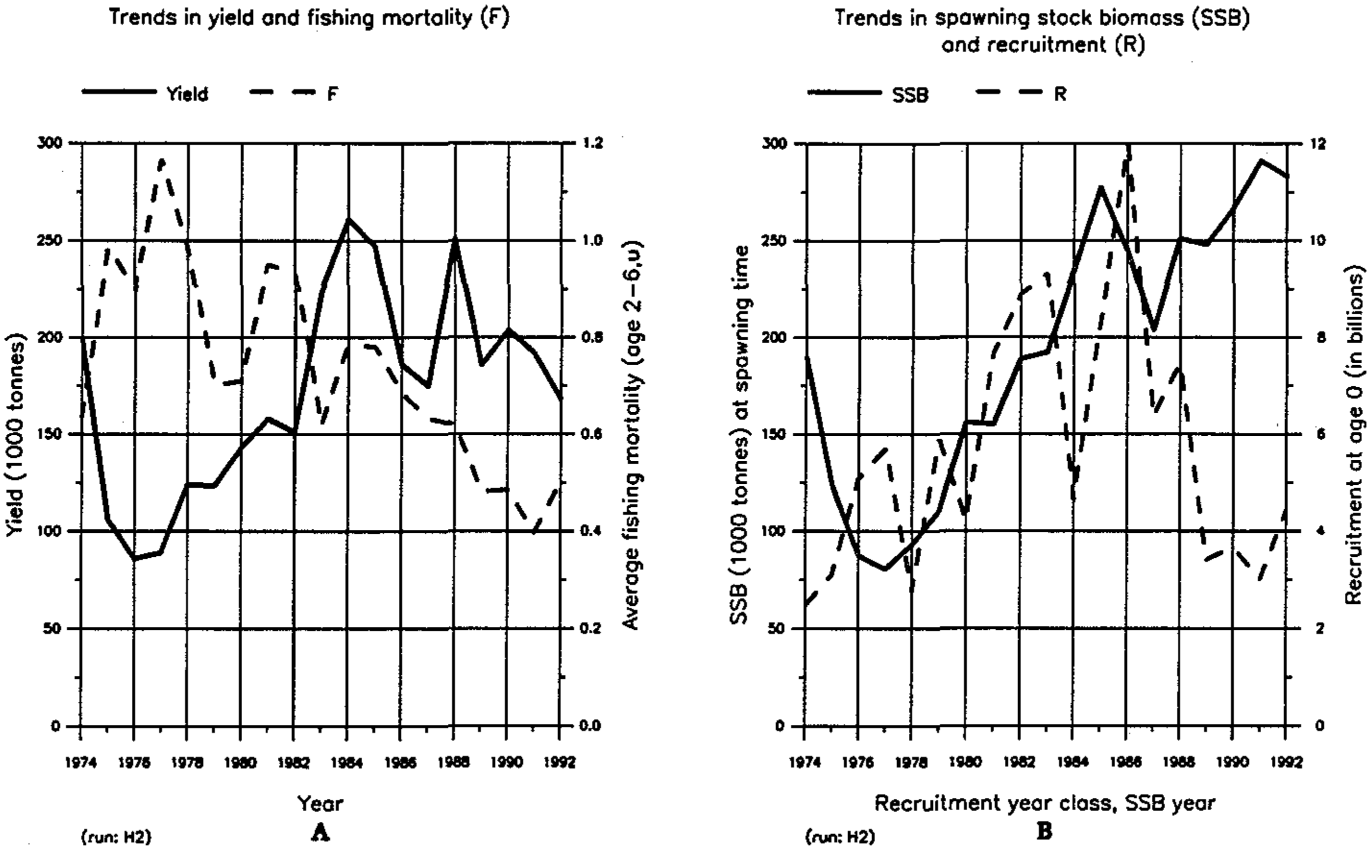


Figure 2.1.2

FISH STOCK SUMMARY

STOCK: Herring in Fishing Areas 25 to 29 and 32 plus Gulf of Riga

26-4-1993

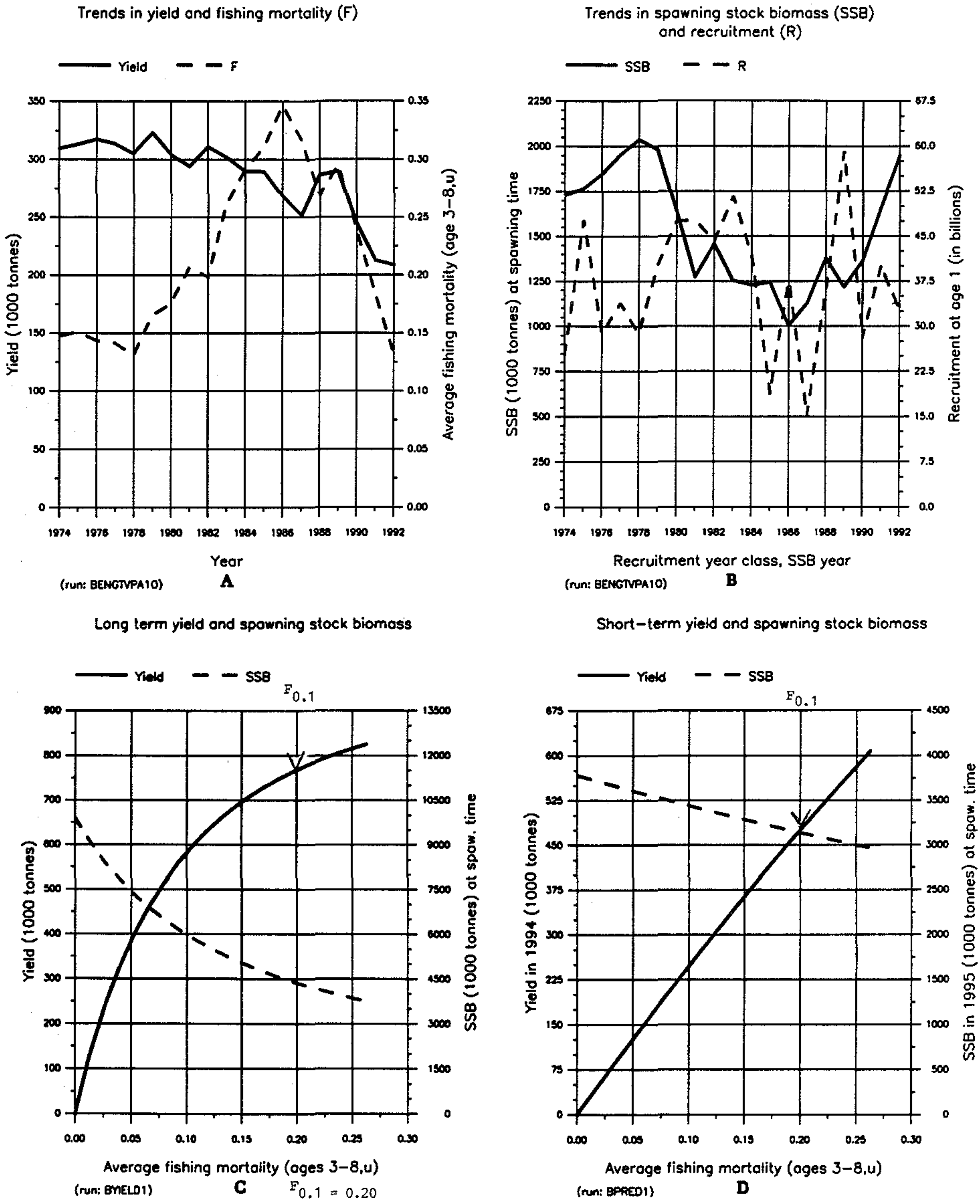


Figure 2.1.3

FISH STOCK SUMMARY
STOCK: Herring in Fishing Area 30
23–4–1993

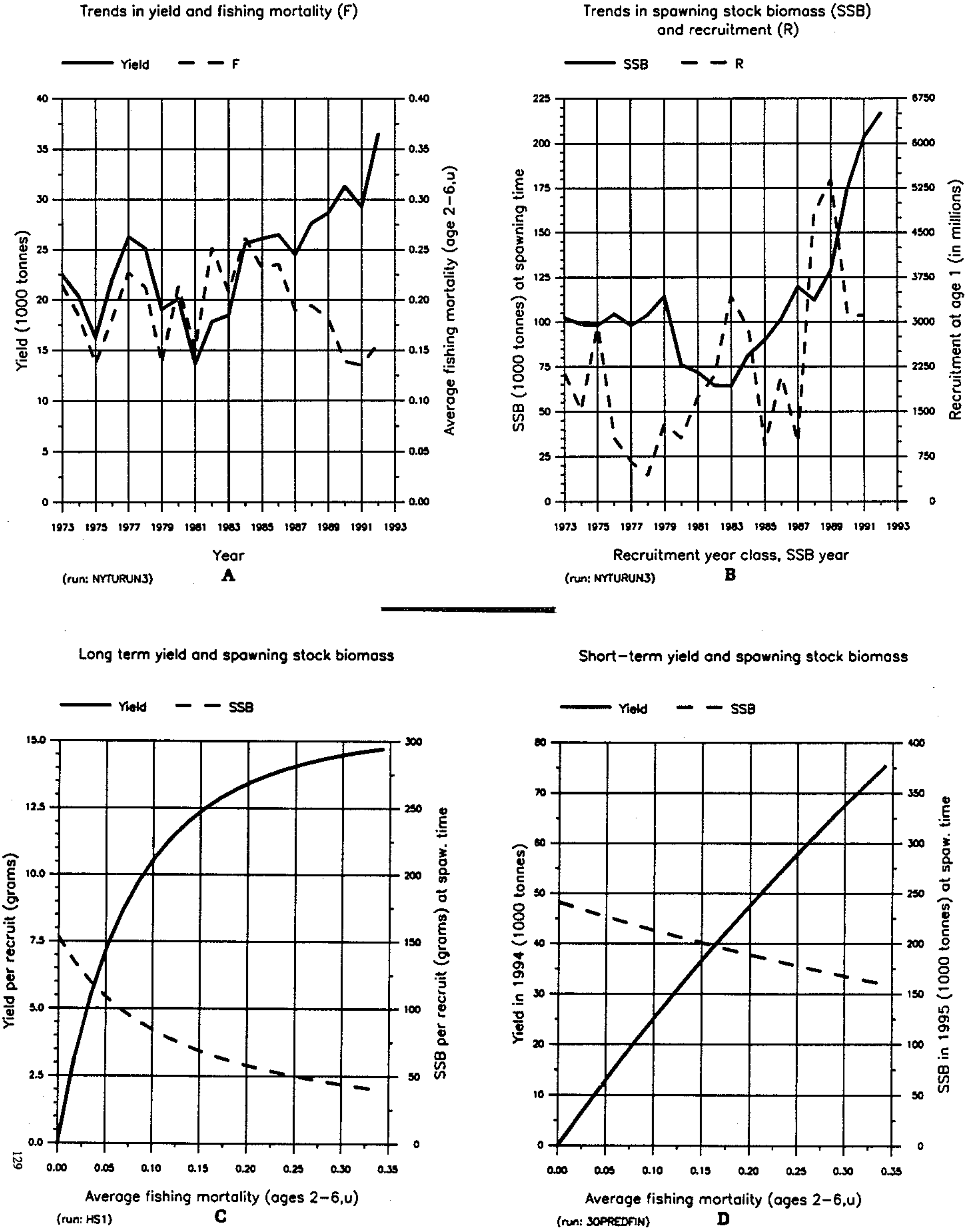


Figure 2.1.4

FISH STOCK SUMMARY
STOCK: Herring in Fishing Area 31
25–4–1993

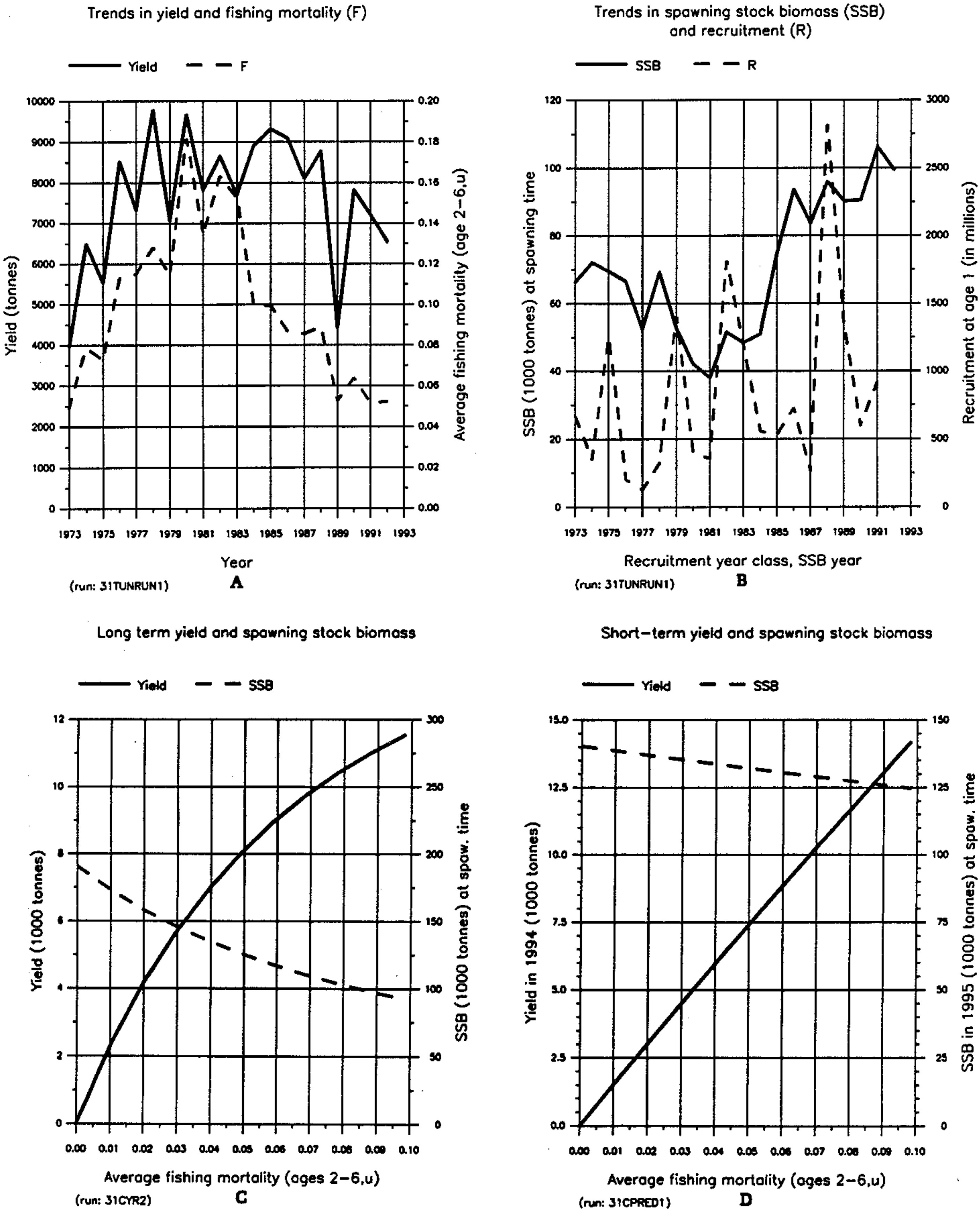
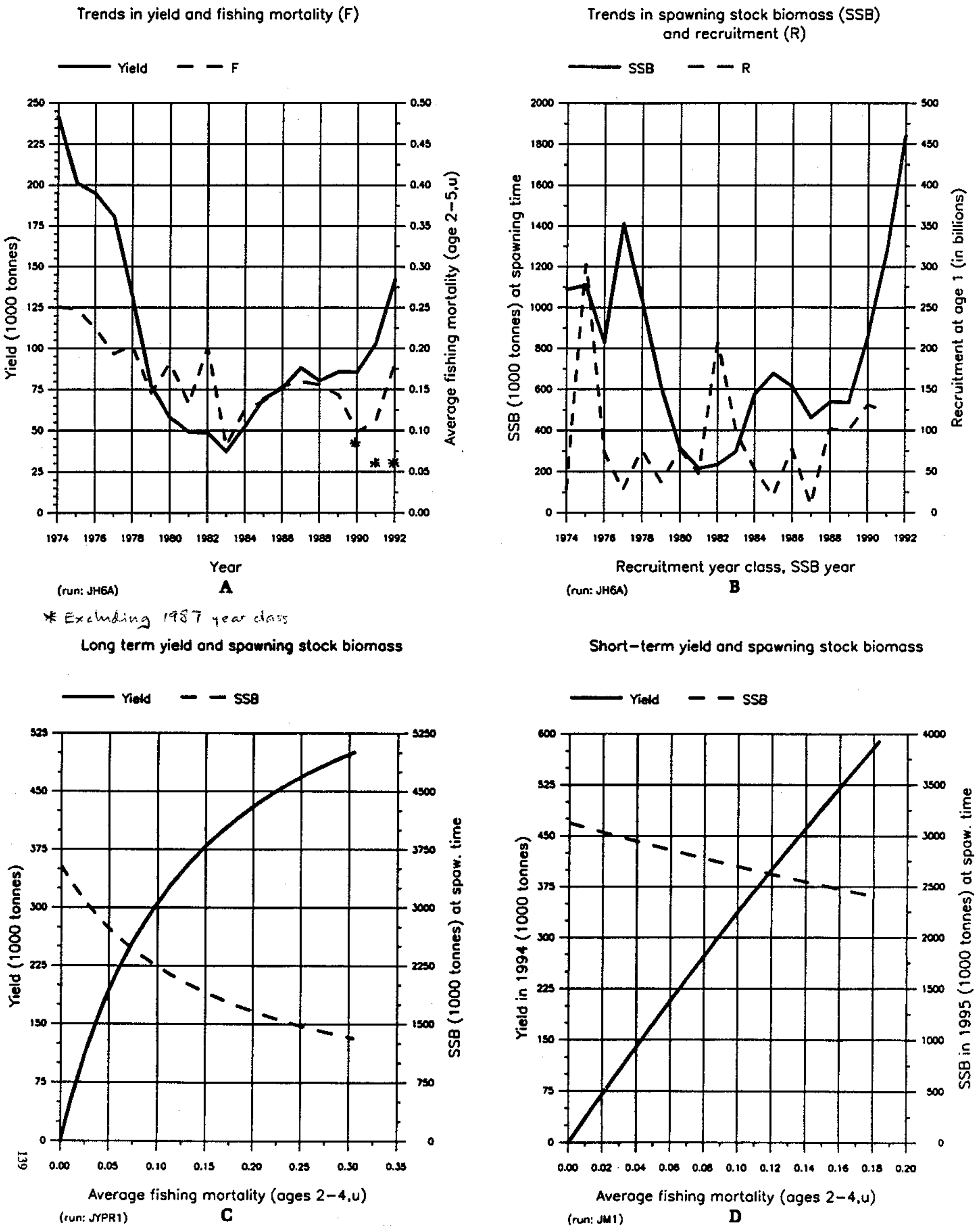


Figure 2.2.1

FISH STOCK SUMMARY
STOCK: Sprat in Fishing Areas 22 to 32
26–4–1993



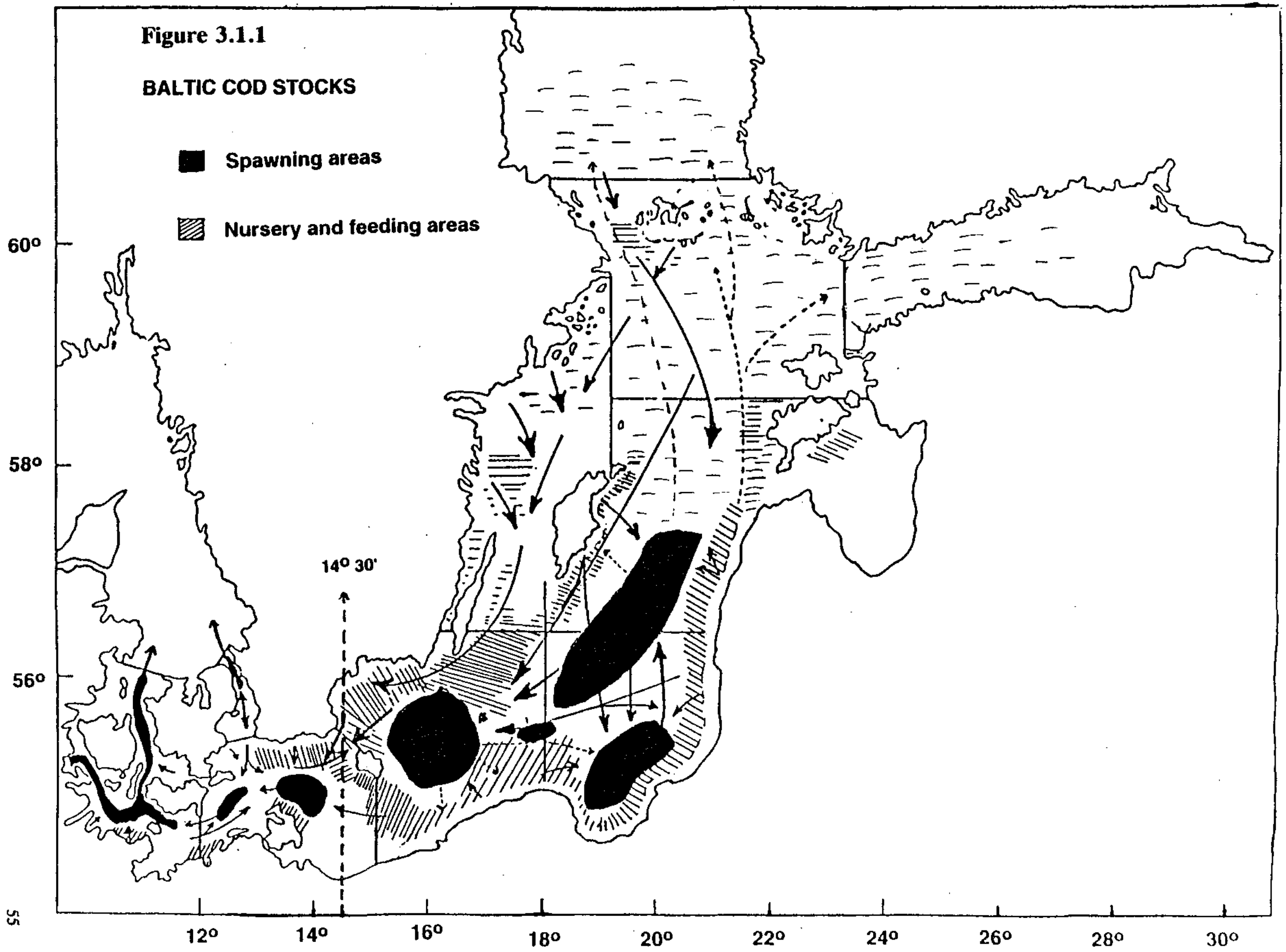


Figure 3.1.1

BALTIC COD STOCKS

Figure 3.1.2

FISH STOCK SUMMARY
STOCK: Cod in Fishing Areas 22 and 24
20–5–1993

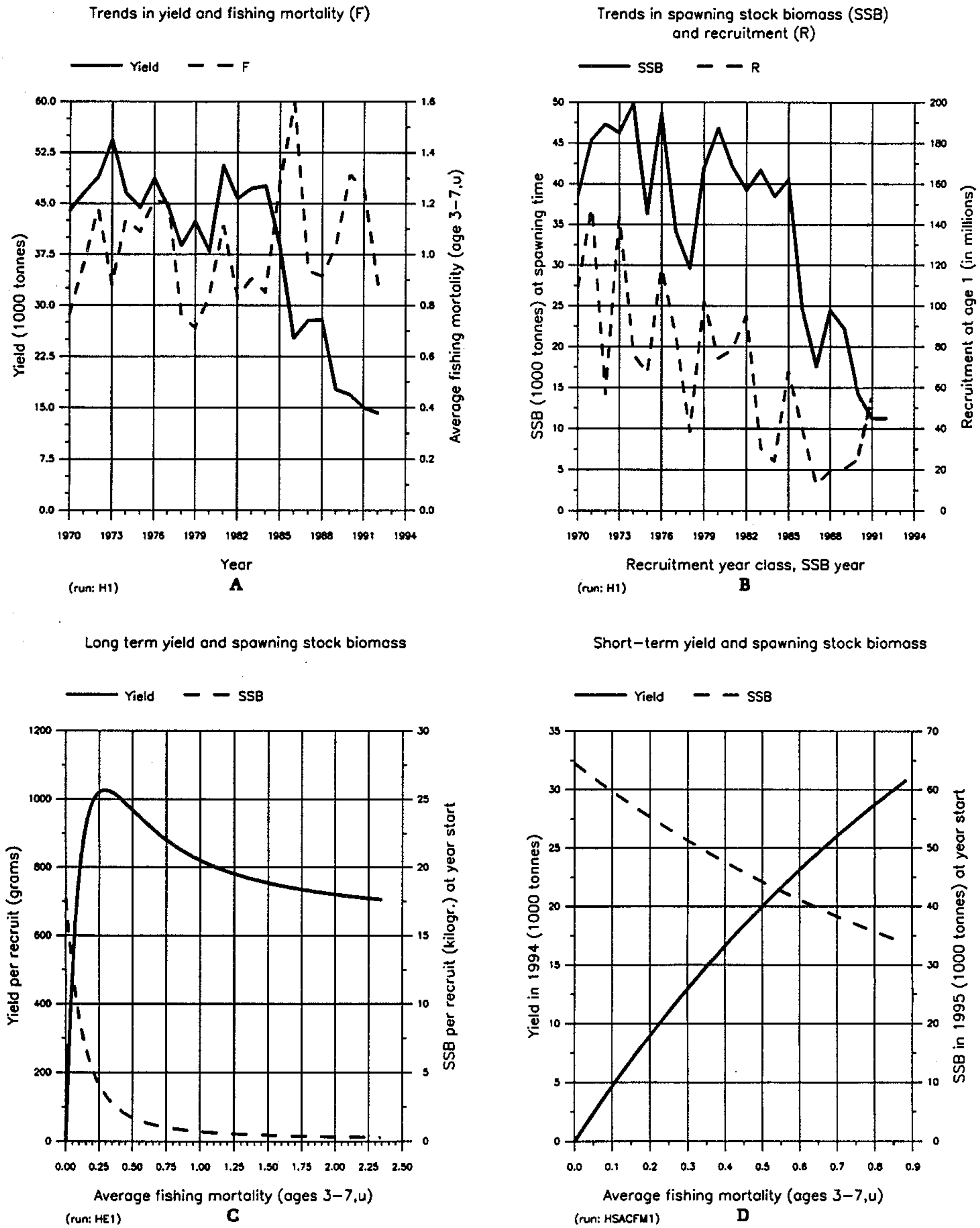
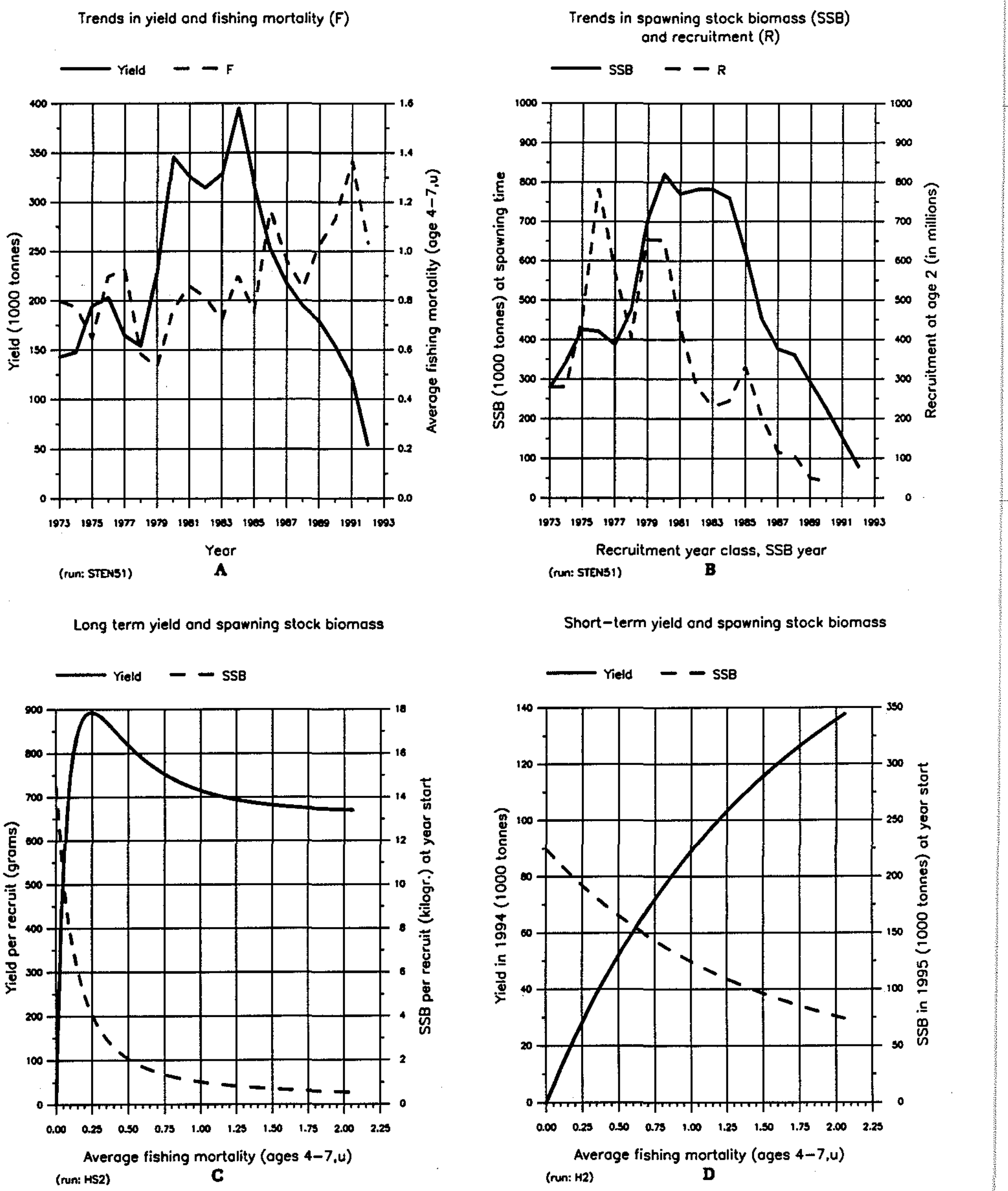


Figure 3.1.3

FISH STOCK SUMMARY
STOCK: Cod in Fishing Areas 25 to 32
22-4-1993



REPORT TO THE NORTH ATLANTIC SALMON CONSERVATION ORGANIZATION COUNCIL

Source of Information: Report of the North Atlantic Salmon Working Group, March 1993 (ICES, Doc. C.M.1993/Assess:10).

1 INFORMATION OF INTEREST TO ALL COMMISSIONS OF NASCO

1.1 Catches of North Atlantic Salmon

Total nominal catches of Atlantic salmon by country, in all fisheries 1960-1992 are given in Table 1.1.1.

The total catch reported for all fisheries (3,996 t) and for homewater fisheries (3,720 t) in 1992 are shown in the text table below. The decline in the catch of wild salmon may be greater than suggested by the total due to the inclusion of fish farm escapees and ranched fish in the North-East Atlantic. Management plans in several countries are designed to decrease catches in the sea.

Catch (t)

Year	1987	1988	1989	1990	1991	1992[1]
Total	8,142	7,716	5,893	4,937	4,124	3,996
Homewater	6,598	6,573	5,086	4,333	3,549	3,720

[1]Preliminary

The lack of information on fishing effort makes it difficult to use the catch data as an indicator of stock size.

1.2 Unreported Catches

1.2.1 Unreported catches within Commission area

Unreported catch for the North-East and North American Commission areas were 1,825 t and 137 t, respectively, in 1992.

Unreported catches (t)

Year	1987	1988	1989	1990	1991	1992
North-East	2,554	3,087	2,103	1,779	1,555	1,825
North America	234	161	174	111	127	137

1.2.2 Unreported catch in international waters

The catch during the 1991/1992 season in the area north of the Faroe Islands EEZ is believed to be between 25 and 100 t which is similar to the figure for the 1990/1991 season.

1.3 Status of Stocks

The status of Atlantic salmon stocks was evaluated over long and short time periods by examining national catch, survival, and escapement data and data from monitored rivers where available. Information on the fisheries is provided in the sections of interest to each Commission.

1.3.1 Eastern North Atlantic

Short-term stock status

Comparison of stock abundance indices for 1992 indicates some improvement relative to the previous 2 years. There is no evidence of a reduction in juvenile production in monitored rivers and adult escapement appears to have been generally higher in 1992. It must be noted, however, that the effects on juvenile production of poor 1SW adult runs in 1990 and 1991 will not be fully felt until 1993 and 1994 and even later in rivers with older smolt ages.

Examination of fishery-independent indices of abundance (marine survival to coastal waters) indicated improved 1SW survival from the 1991 wild smolt year class for most monitored stocks. This was reflected in improved return rates to freshwater. Survival of 1SW hatchery-reared fish to coastal waters was more variable than for wild fish in 1992, having increased for some strains and decreased for others relative to 1991. In general, 1SW hatchery return rates to freshwater were lower in 1992 than in 1991.

In general 2SW survival rates were poor for wild and hatchery-reared fish returning in 1992, indicating that they were probably affected by conditions which caused poor 1SW survival of the 1990 smolt year class in many areas.

The continuing presence of significant numbers of farmed fish in catches of several countries makes it difficult to assess the status of wild stocks.

Long-term stock status

There is some suggestion of positive trends in freshwater productivity over an 8 year period, though stocks known to be affected by acidification and other specific factors were not tested. Adult escapement was without trend over a 10 year period in many rivers.

Fishery-independent indices of survival of wild smolts indicated no trend in survival to coastal waters over a 5 year period; however, survival to rivers has generally increased over an 11 year period (Figure 1.3.1). In contrast, survival of hatchery smolts to homewaters showed a downwards trend (Figure 1.3.2).

Data examined by ACFM suggest that abundance and catches were much higher in the northeast Atlantic during the early 1970s and that they have declined ever since. It is likely that high natural abundance in the 1970s led to increased exploitation (including establishment of high seas fisheries). High exploitation, once established, coincided with and probably contributed to, a decline in abundance for many stocks. In response to perceived and actual lower abundances, fishing effort has declined in most fisheries, with management measures contributing to reductions in catch. At the end of the 1980s poor natural marine survival in many areas compounded the low stock situation. However, improved natural survival combined with low exploitation rates may contribute to an improved stock status.

Spawning Targets

ACFM considered that status of stocks in the North-East Atlantic could best be appraised by considering adult escapement (in terms of ova depositions) evaluated against spawning targets. Ideally, biologically based spawning targets could be set for each river system, such that the target for each would represent the number of ova required to optimise smolt and/or production from that system. This would not only provide a baseline against which annual ova depositions could be compared, but allows for the possibility that estuarine and in-river fisheries for single stocks could be managed to crop only adults in excess of the target spawning number. Targets should be set sufficiently high to allow compensation for density-independent variation.

Several significant factors need to be taken into account in setting and expressing individual river targets, such as variation in the sex ratio of spawners, changing fecundity through time and changing 1SW:MSW ratios, and the desired sea age composition of the spawning adults.

1.3.2 Western North Atlantic

Abundance

The most useful datasets for the assessment of stock status in the Northwest Atlantic now consist of estimates of returns and adult counts at fishways, and smolt survival rates for Canadian and USA rivers. The moratorium on the commercial salmon fishery in insular Newfoundland and reductions in bag limits and imposition of quotas in many of the recreational fisheries have reduced the ability to infer stock status from most of the commercial and many of the recreational catch data series. One index that is still of some utility is the catch of 2SW salmon of wild origin in Maine river which has steadily declined since 1980 (Figure 1.3.3). These data suggest that low salmon abundance was a factor in contributing to the low salmon catches in recent years.

Trends in counts of small salmon at fishways and fences and an estimate of run-size for 21 rivers in Canada for the period 1974-1992 suggest that while the abundance of small salmon was generally increasing during the period 1974-1985, that trend was reversed during the period 1985-1991. In 1992 the abundance of small salmon in some areas of insular Newfoundland increased, apparently due to the closure of the Newfoundland fishery. Trends in large salmon abundance, the important contributor to egg deposition in most mainland rivers, generally show a downward trend. However, the abundance of large salmon on the East and West Coasts of Newfoundland in 1992 appears to have increased.

The abundance of non-maturing, North American origin stocks peaked in 1975 and has been steadily declining ever since (Figure 1.3.4).

Escapement

Estimates of egg depositions in 1992 may have approximated (rivière de la Trinité and Restigouche) or exceeded (Miramichi, Margaree, Northeast, Humber, Gander, Middle and Biscay Bay) target egg requirements in nine rivers. The percent change in total egg depositions for monitored rivers in Canada during 1992 is compared to the 1987-1991 average in Figure 1.3.5. Egg depositions were above average in 10 rivers, as much as 300% in one case, while 60-75% decreases were noted in 2 rivers. The noticeable increases in egg depositions in some areas are probably the result of reductions in marine exploitation in Canada during 1992.

The abundance of North American salmon that contribute to the West Greenland fishery is estimated for the period 1974-1991. The difference between estimates of total 2SW returns in rivers and the catch of 2SW salmon in rivers provides an estimate of the spawning escapement of 2SW salmon. The estimated number of 2SW spawners to North American Rivers has shown a downward trend since 1980 (Figure 1.3.6).

Survival indices

Estimates of survival of wild smolts to 1SW returns for 5 rivers and hatchery smolts to 1SW returns for 3 rivers in Canada are shown in Figure 1.3.7. Survival of hatchery smolts released in the Penobscot River (USA) to 1SW and MSW returns to homewaters is also shown. While large annual variation in survival between years is common, many stocks continue to exhibit trends of reduced marine survival over time. While poor smolt survival years are not uniformly exhibited by all stocks, it is evident that smolt survival for many stocks is lower than in previous years.

Spawning targets

Composite estimates for 2SW spawning targets were developed for salmon rivers in the USA, and Canadian SFAs 1 to 23 and Quebec Zones Q1 to Q11. The overall target number of 2SW spawners in North America is 196,306. Most (84%) of the North American target number of spawners is required for rivers in Canada. This target of about 200,000 2SW spawners has almost certainly not been achieved since 1974 even though production of these stocks is estimated to have been as high as 650,000-950,000 over the same time period (Figure 1.3.4). A significant portion of this spawning deficit has been in US rivers which are under restoration. Canadian 2SW spawning requirements of about 165,000 fish have not been met when one considers either the minimum or midpoint of the spawner estimates although the maximum estimates exceeded the spawning target in 6 of the 19 years (Figure 1.3.6).

Summary

The status of the North American stock complex was evaluated with data on spawning escapement, adult returns, and recreational catch. The moratorium on commercial fishing on the island of Newfoundland had the expected effect of improving the runs and escapement of both small and large salmon in that region. However, these counts were exceeded in pre-moratorium years suggesting that abundance of these stocks is still low. Gulf and Quebec region stocks displayed variations in stock status with most rivers showing improvement and others suggesting low abundance relative to the previous year which was one of the worst on record. The largest river of the region, the Miramichi, is meeting or exceeding its escapement target. The stocks in the Scotia-Fundy Region continue to show low abundance. USA salmon production remains hatchery dependent. Abundance in USA stocks has not increased in spite of increased stocking, suggesting that survival is poor. The mixture of stock conditions does not give a clear depiction of the stock complexes' ability to sustain harvests. It is necessary to consider the total abundance of the North American stock complex and trends in this abundance to determine the likelihood of recruitment over-fishing.

1.3.3 West Greenland Commission

Although not measured precisely, it is believed that the most abundant European stocks in West Greenland originate from the UK and Ireland. It appears that the abundance of some of these stocks has declined in recent years. Similar declines in abundance have been noted in many North American stocks that contribute to the West Greenland fishery. The decline in catch and fishery-independent measures of abundance in North America, and the decline in catch beyond the expectation that would have resulted from effort reduction in Europe, suggest that the abundance of fish available to the West Greenland fishery remains low.

1.3.4 Causes of apparent reduced survival

Atlantic salmon population dynamics are frequently investigated in two distinct phases: freshwater and marine. Variation in freshwater survival rates is generally well documented and thought to be a major factor regulating abundance in many river systems. Atlantic salmon marine life history and, in particular, mortality during the marine phase has not been investigated nearly as thoroughly. It is, however, thought that salmon survival is highly dependent on the productivity of the marine environment and the availability of suitable prey during their marine life. Salmon, similarly to other marine fish species, are intricately woven into the ecological system of the ocean.

Estuarine and coastal effects

Estuarine/coastal mortalities are a result of factors that influence smolt survival upon passage into estuarine and nearshore marine ecosystems. Atlantic salmon smolts face a physiologically stressful osmotic challenge, temperature stress, changing predator populations, or variable feeding conditions when entering the marine environment.

Oceanic effects

It is difficult to separate mortality on Atlantic salmon populations occurring in estuarine/coastal areas from mortality occurring in the ocean. In principle, oceanic effects are those that affect Atlantic salmon over a wide geographic range or in more confined areas, where mixed stocks of salmon are feeding. Oceanic effects are difficult to study as the time and cause of mortality is very obscure, thus exploratory analyses using correlation between survival, abundance and growth with oceanographic and hydrographic factors, pelagic prey and predator abundance are commonly used.

Marine survival

Evidence of oceanic effects on survival can be obtained from observed similarities in survival among stocks. There may exist a common pattern of return rates for groups of stocks suggesting that there are common factors controlling survival (Figure 1.3.8). Coherence in the estimated survival rates of stocks spanning a wide geographical range suggests that a dominant cause of mortality acts on the stocks when they are coincident in place and time. Consequently, fall and winter become likely periods, since stocks are mixed then.

The coherence in marine survival rates observed in monitored stocks is further supported by the trends in abundance for the North American stock complex. The time series of pre-fishery abundance of 1SW non-maturing salmon for North American stocks is provided in Figure 1.3.4. Many features in this time series reflect the likely impact of changes in survival rate observed for the individual stocks that were monitored over the same time period. For example, poor survival of the 1977 smolt class followed by good survival of the 1978 smolt class would have resulted in low abundance of fish in 1978 and high abundance the following year. This is exactly what is observed in the abundance time series. In addition, both the survival rate and abundance time series show decreasing trends through the 1980s and early 1990s.

Smolt condition factor

The interplay between marine and riverine environments is exemplified in recent investigations of two Newfoundland rivers. First, the salmon stocks in two distinct river systems seem to be affected similarly by marine events resulting in low survival. Secondly, the relationship between smolt condition and marine survival suggests that growth and survival in riverine and marine environments is linked. These observations need to be confirmed by further work.

Ocean climate

Climatic and oceanographic factors seemed to exert great influence on the variability in abundance of stocks of Atlantic salmon on the northern coast of Iceland. A study demonstrated coherence in yield of salmon stocks on the north coast of Iceland, where stocks tend to fluctuate together as if controlled by a common external marine factor. Several periods of low abundance have been identified in that area, usually related to adverse marine conditions. Periods of low abundance occurred during periods of the dominance of the East Greenland current, as opposed to the Gulf stream, in northern Icelandic waters.

Marine growth

Observations in Iceland have indicated a direct relationship between the abundance of salmon and the abundance of prey species, such as capelin. It seems likely that such factors could also be related to growth of salmon.

There is an indication that reduction in marine growth may be associated with a reduction in survival. The return rate for a monitored stock in North America was significantly correlated to only the winter growth period, suggesting that annual recruitment is determined during the winter of the first year at sea. This observation is consistent with those made for other monitored North American stocks identifying the winter period as critical to survival.

The size of 1SW salmon in the West Greenland fishery has shown a declining trend from the early sixties to the present (Figure 1.3.9, similar trends noted for length). This may be indicative of reduced marine survival of those fish. Comparison of stock abundance and mean length (Figures 1.3.10 and 1.3.11) at West Greenland indicates a significant relationship between the two for European stocks which indicates that the size of fish may be related to survival and abundance.

Marine habitat

The areas of suitable post-smolt marine habitat has been declining in recent years in areas of the Atlantic Ocean. To assess the potential effects of decreasing suitable winter habitat on North American stocks, a time series of catch and the first principal component scores of habitat were compared (Figure 1.3.12). This relationship suggests that the winter period is critical to the survival and production of North American stocks. A similar comparison was made for European stocks (Figure 1.3.13).

In summary, the available evidence suggests that the size and numbers of returning adult salmon are influenced by smolt condition factor, growth during the marine phase and factors affecting the marine environment and the available habitat. The strong correlations between marine survival and the above factors do not necessarily imply cause and effect.

1.4 Production of Farmed Salmon

The reported production of farmed salmon was 220,862 t in 1992. Total farm production was more than 55 times the nominal wild catch.

	Production ('000 t)					
Year	1987	1988	1989	1990	1991	1992
Production	68	111	174	229	237	221

1.5 Compilation of Tag Releases and Fin-Clip Data for 1992

In excess of 1.84 million microtags (CWTs) and 0.33 million external tags were applied to Atlantic salmon released in 1992. In addition, 2.32 million salmon were finclipped, 2.23 million with adipose finclip only. Thus, more than 4.49 million marked fish were released.

1.6 Recommendations

1. ACFM recommends that broadly based studies should be in place on:

   Development of stock identification methodologies.

   Stock recruitment relationships, forecast models, and models to study stock complexes.

   The survival and growth patterns in stock complexes in the North Atlantic.

2. ACFM recommends that the Working Group should now focus on questions based on investigations relevant to methodologies, causal mechanisms of stock dynamics, conservation, and man-induced threats to wild salmon stocks. Examples of generic questions for which answers might be developed in the 1990s include:

   i) Advise on target and critical spawning levels for Atlantic salmon stocks of the North Atlantic.

   ii) Evaluate biological and environmental variables which provide interpretation of trends of salmon abundance in the North Atlantic.

   iii) Evaluate recent changes in the abundance of wild, farmed and ranched salmon at large and, where possible, indicate the impacts that these fish may have on the abundance of wild stocks.

   iv) Document grilsification, describe potential mechanisms and assess the impact that grilsification may have on stock abundance and future spawning requirements.

3. ACFM recommends

   i) That a study group should meet to update techniques to identify the impact of ranched fish on wild stocks and assess recent laboratory-based and behavioural research;

   ii) That a workshop be convened to consider available stock and recruit data, methodologies and, where possible, their standardization, for the development of target egg and adult spawner requirements.

2 INFORMATION OF INTEREST TO THE NORTH-EAST ATLANTIC COMMISSION

2.1 Description of the Fisheries at Faroes

2.1.1 Gear and effort

There was no commercial fishery in the Faroes during the 1991/1992 salmon season due to the by-out of the Faroes quota by various interested parties for the years 1991-1993. Only one research vessel operated during the fishing season, under the direction of the Faroes Fisheries Laboratory. The gear in use did not change in 1992. A total of 52 sets was fished by this vessel during 6 trips in the 1991/1992 season.

2.1.2 Catches and discards

No commercial fishery took place in 1991/1992. Catches for research purposes in the 1991/1992 season were 31 t and the preliminary catch for the calendar year 1992 was 23 t. A total of 8,464 fish was caught of which 782 were less than the permitted 60 cm total length. The discard rate from the catch ranged from 2.5 to 15.7%, and the overall estimate was 8.8%.

Catch (t)

Year	Catch	Season	Catch
1987	576	1986/1987	539
1988	243	1987/1988	208
1989	364	1988/1989	309
1990	315	1989/1990	364
1991	95	1990/1991	202
1992[1]	23	1991/1992	31

[1]Research vessel

2.1.3 Catch per unit effort

The CPUE on the research vessel in the first part of the season was very high and, as in 1988/1989, it remained high during February and March and dropped off in April.

2.1.4 Composition of the catch

Recent observations have shown that escaped reared fish are numerous in catches in the Faroes area. As a part of the sampling programme of Atlantic salmon in the long-line research fishery at Faroes, fish were examined in order to estimate the occurrence of reared salmon in the fishery. Recent observations are presented in the text table below:

Season	Time	N	%
1989/1990	Feb 1990	73	44
1990/1991	Dec 1990	99	42
1991/1992[1]	Dec 1991	119	36
	Feb 1992	158	48
	Mar 1992	79	25
	Apr 1992	98	28

[1]Research vessel

The methodology used to discriminate between wild and reared fish tends to underestimate the proportion of reared fish, in particular those which escaped at the freshwater stage, or at an early marine stage.

Wild fish were significantly larger and of older sea age than the reared fish. However, when compared within sea age groups, reared 1SW fish were significantly larger than wild 1SW fish, whereas among the 2SW and 3SW groups, the wild fish were larger.

2.1.5 Origin of the catch

Coded wire tags (CWT) were recovered principally from Irish salmon originating from Shannon River hatchery releases. Individual tags were also recovered from 3 rivers in UK (England and Wales) and 2 rivers in Scotland. One French origin tag was recovered; this is the first French microtag recovery although Carlin tags have been recovered in the past. The number of external tags recovered from fish tagged in Norway and Sweden was lower than in previous years.

2.1.6 Exploitation rates in the Faroes fishery

Exploitation rates in 1991/1992, after the cessation of the commercial fishery, were below 5% for all stocks. This was considerably lower than the average for the preceding five year period. The exploitation on the Norwegian Drammen and Imsa hatchery 2SW fish decreased from an average of 21 and 23% to 2 and 1% respectively.

	Exploitation					
Season	86/87	87/88	88/89	89/90	90/91	91/92
Drammen	3	6	36	45	13	2
Imsa (w)	13	5	3	5	13	4
Imsa (h)	28	21	10	15	36	1
N. Esk	6	0	0	0	2	0
Lagan	0	9	13	21	18	3

2.2 Description of Homewater Fisheries

2.2.1 Gear and effort

There were no reported changes in the fishing methods and gear used in 1992 for any countries. Long-term changes in effort were examined for selected gears. The data available from France, Norway, UK (England and Wales), UK (N. Ireland), and UK (Scotland) all indicate a decrease in the numbers of gear units used. In Norway the decrease has been particularly marked with the closure of the drift net fishery in 1989. In Ireland, effort in commercial fisheries appears to have decreased while rod licences increased. It must be emphasized that these data cannot be used to estimate CPUE and may not be comparable between countries.

2.2.2 Origin of the catch

Table 2.2.1 indicates the origin of the catch in each country based on recoveries of tags over a number of years. It must be noted that the table may reflect the relative size of the national catches and does not imply the proportion of the stock from a given country which is taken in another country's catches.

The text table at the top of page 59 shows the estimated contributions of ranched and farmed fish to national catches in 1992.

Ranching is carried out on a large scale by Iceland. Ranched fish comprised 76% of the total catch in 1991 and 70% in 1992. In addition 14 t in 1991 and 24 t in 1992 of the Swedish catch were made up of fish which had been released but were not expected to contribute to wild spawning populations.

Farmed fish make a significant contribution to the catches of Norway, Faroes and UK (Scotland). The proportion of farmed fish in Norwegian catches has remained relatively stable in the period 1989-1992. The proportion of farmed fish in freshwater catches is much lower than in catches at sea because farmed fish enter freshwater later than wild fish.

While farmed fish are present in most fisheries except Russia and France the exact contribution is not known. Levels of between 7 and 20% farmed fish have been reported from some catches in regional fisheries (coastal and estuarine) in Ireland. In most other countries, farmed fish are thought to form only a very minor (or negligible) part of the catch.

2.2.3 Exploitation rates

A comparison of exploitation rates for different stocks does not show any obvious similarities, except that hatchery stocks are often more heavily exploited than wild stocks. This is the case even when wild and reared fish originate from the same stock, as is the case for the River Bush and River Imsa stocks (see text table at bottom of page 64).

The levels of exploitation in 1992 seemed to be about average in most cases, except for the Russian River Ponoy where the exploitation was reduced. In 1991 and 1992 it was decided to reduce the exploitation rate in R. Ponoy in order to increase spawning stocks and make more fish available for the developing recreational fishery.

Estimated catch (in t round fresh weight) of wild, farmed and ranches salmon in homewater fisheries 1992

Country	Catches of salmon				
	Wild	Farmed		Ranched	Total
Faroes	20	11		0	31
Finland	77	<1		0	78
France	20	0		0	20
Iceland	176	+		412	590
Ireland	<628	+		2	630
Norway	651	26	(FW)		
		173	(Sea)		850
Russia	161	0		0	161
Sweden	24	1		24	49
UK (Engl. & Wales)	195	0		0	195
UK (N. Ireland)	147	1		3	151
UK (Scotland)	502	23		0	525

An illegal fishery of considerable magnitude occurs in many of the Russian rivers. The illegal fishery was estimated to catch 15% of the spawning stock in River Varzuga, 25% in River Pechora and 26% in River Umba. There is no clear sign that the illegal fishery is changing in size from year to year.

Preliminary 1992 homewater fishery (H/W) exploitation rates in comparison to average exploitation rates

Location	(River, H/W)	1SW	2SW	All ages
		1992 (average)	1992 (average)	1992 (average)
Iceland	(Ellidar, W)	48(41)		
Ireland	(Burrishoole, H)	68(73)		
Norway	(Drammen, H)	-(56)	51(51)	
Norway	(Imsa, W)	57(58)	76(77)	
Norway	(Imsa, H)	67(66)	91(83)	
Russia	(Ponoy, W)			11(48)
Russia	(Kola, W)			77(81)
Russia	(Tuloma, W)			45(49)
Sweden	(Lagan, H)	73(81)	100(84)	
UK (Engl. & Wales)	(Itchen, net)			9(17)
UK (Engl. & Wales)	(Itchen, rod)			27(42)
UK (Engl. & Wales)	(Test, rod)			25(31)
UK (N. Ireland)	(Bush, W)	56(68)	32(43)	
UK (N. Ireland)	(Bush, H)	74(78)	75(69)	
UK (Scotland)	(N. Esk)	28(28)	27(30)	

W = wild; H = hatchery

2.2.4 Effects of recent management measures in Norway

The impact of the recent management measures on catches in Norwegian home waters in 1989-92 is shown below.

Catch (t)

	1986	1987	1988	1989	1990	1991	1992
Drift	795	552	527	0	0	0	0
Other	497	461	314	488	514	470	427
Freshwater	306	372	235	417	416	407	423
Proportion in freshwater	.19	.27	.22	.46	.45	.46	.50

It is likely that the ban on drift netting in 1989 has resulted in a larger number of salmon being available to other marine homewater fisheries. The additional regulations in these fisheries has probably resulted in a substantial increase in freshwater escapement suggested by increased catches in freshwater despite the fact that freshwater fisheries also have been regulated by extending the annual closed time and that fishing for salmon has been totally banned in several rivers.

The frequency of net-marked salmon entering a river will also give information about changes in netting effort on the migration route. In all except one river the proportion of net-marked salmon recorded in 1990-1992 was much lower than unweighted means during the period 1978-1988. The reduced proportion of net-marked fish may be accounted for by the management measures introduced in the Norwegian homewater fishery in 1989.

The salmon fishery on the Norwegian coast intercepts stocks from Sweden, Finland and Russia on their way back to their home rivers. Exploitation in Norway on 1SW fish tagged as smolts in the River Lagan, Sweden in 1989, 1990, 1991 and 1992 was lower (average 1%) than in 1985-1988 (average 7%). It is concluded that the regulations introduced in the Norwegian homewater fishery in 1989 benefited Swedish west coast stocks. Catch per angler-season and catch per angler-day in the Tana River, Finland has shown a significant increase in the period 1989-1992 compared to 1985-1988, thus suggesting a direct benefit to Finnish stocks. The escapement into 3 Russian rivers (Kola, Ponoy and Zap.Litca) showed a significant increase during the period 1989-1992 compared to 1985-1988.

In summary, the Norwegian management measures have resulted in: **i)** a significant decrease in the homewater exploitation rates in some Norwegian index river stocks; **ii)** a significant increase in freshwater catches in Norway; **iii)** a significant increase in CPUE in Finland; **iv)** a significant decrease in interception of Swedish tagged fish; **v)** a significant increase in escapement into 3 Russian rivers.

2.3 By-catch and Mortality of Salmon in Non-directed Fisheries

The landing of salmon caught in fisheries targeting other species is illegal in most countries in the North-East Commission area except France, where it is authorized, and Sweden, where landing is allowed during the regular fishing season. In some of the countries where the by-catch cannot be landed legally, and in France where they are not consistently requested, these catches are included in the estimates of unreported catches.

By-catch in shore-based gillnets, purse seines, pelagic trawls is considered to be negligible and this is supported by information from research vessel cruises. In Iceland, the authorities are currently negotiating the closure in June and July of the fishery for male (small) lumpsuckers in order to protect salmon. In Norway, fishing experiments with mackerel gillnets showed a relatively high catch efficiency also for small salmon.

ACFM noted a report from NASCO in which information was given on the incidental catch of salmon in a pelagic trawl fishery for mackerel and horse mackerel during June to August 1991 in international waters close to the Norwegian EEZ. It was not possible with the information available to determine whether such catches are regular occurrences.

2.4 Indicators of Trends in Abundance of Salmon in the North-East Atlantic

Several biological and physical indicators can potentially be used to predict the abundance of salmon stocks in subsequent years. Most common are population estimates conducted at various points in the salmon's lifecycle, both in fresh and salt water.

Freshwater assessments

Biological indices used in freshwater include catches, run or escapement counts (spawning targets), estimates of egg, fry or parr abundance as well as smolt counts. These methods tend to be less costly than marine assessments and have thus been used to some extent in all countries bordering the north Atlantic. These methods give good estimates of the utilization of the rearing capacity in individual rivers and smolt counts can in some cases be a good indicator of grilse and salmon abundance in subsequent years.

Marine assessments

Methods used to predict salmon abundance through assessments during the marine phase include test fishing at various stages, acoustic surveys and prediction of non-maturing 1SW salmon from returning 1SW salmon in home waters. In some cases, oceanographic and meteorological factors, as well as the abundance of prey and possibly predatory species could be used to improve predictive ability. It has been noted that good salmon years in certain parts of Iceland seem to coincide with high catches in the capelin fishery.

Acoustic assessments

Acoustic methods have been used to estimate the abundance of pelagic fish for decades. Some difficulties have been encountered in estimating salmon abundance with these methods as the salmon feed close to the surface and are widely dispersed.

Forecasts of salmon abundance from 1SW returns

The abundance of 1SW fish can potentially be used as a rough predictor of the abundance of 2SW salmon in the following year. The method was first used in the Pacific to predict sockeye salmon abundance from the returns of jacks (1SW males) the previous year. Run reconstruction models have in the past indicated that age of maturity is one of the more stable biological parameters in salmon.

2.5 Effects of the NASCO Tag Return Incentive Scheme

No quantitative analyses of the effects of the scheme have been carried out. The main reasons are the small numbers of external tags used and insufficient awareness of fishermen about the NASCO lottery in most participating countries.

2.6 Effects of the Cessation of Fishing Activity at Faroes

The predicted increase in the numbers of fish returning to homewaters in 1992 as a direct result of cessation of fishing activities at Faroes would be approximately:

Wild 1SW	3,400
Wild 2SW	34,400
Farmed	22,000

These fish will probably have contributed to homewater fisheries in most salmon producing countries in the north-east Atlantic. However, it is unlikely that it will be possible to demonstrate a significant change in catches after a single year. The majority (perhaps 60-80%) of the wild fish caught at Faroes are thought to originate from Scandinavian, Finnish and Russian stocks and thus the greatest impact should be seen in the fisheries of these countries. These increased catches would, therefore, have represented the following proportions of the recorded homewater catches:

Wild	1SW	~ 1%
Wild	2SW	6 - 13%
Farmed		10 - 22%

Such small increases over the entire northeast Atlantic area, but affecting mainly Scandinavian, Finnish and Russian stocks have been within the annual variation of catches in these countries and will not represent a statistically significant increase.

The cessation of fishing would have the expected effect of reducing exploitation at Faroes to about 10% of levels in the previous three seasons. For stocks with sufficient tag returns, the exploitation observed in the 1991/92 season was significantly lower than in previous seasons.

3 INFORMATION OF INTEREST TO THE WEST GREENLAND COMMISSION

3.1 Description of the Fishery at West Greenland, 1992

In 1992, the fishery at West Greenland (NAFO Sub-area 1) was opened on 1 August and ended in November, although the official closing date was 31 December. The total nominal catch was 237 t which is 235 t less than in 1991, when the total landings were 472 t.

Quota and catch (t)

Year	1987	1988	1989	1990	1991	1992
Quota	935	-	900	924	840	-
Catch	966	893	337	274	472	237[1]

[1]Preliminary

No TAC was set for 1992, but the decision was to observe the landings after the first fourteen days of the fishery, and in the event of these being high compared to previous years, a TAC would be implemented. Because of small landings a TAC was never put into force.

The nominal landings during the first fourteen days, 1990-1992 (in tonnes)

Year	First seven days	First fourteen days	Dates
1980	260	711	01 - 14 Aug
1981	465	735	15 - 28 Aug
1982	470	766	25 Aug - 07 Sep
1983	105	192	10- 23 Aug
1984	17	58	10- 23 Aug
1985	204	361	01 - 14 Aug
1986	509	848	15 - 28 Aug
1987	439	737	25 Aug - 07 Sep
1988	219	337	25 Aug - 07 Sep
1989	131	219	18 - 31 Aug
1990	12	38	01 - 14 Aug
1991	115	208	05 - 18 Aug
1992	36	60	01 - 14 Aug

3.1.1 Composition and origin of the catch, 1992

Commercial catches in 1992 were composed of 54% North American (95% CL = 57,50), and 46% European (95% CL = 50, 43).

An alternative estimate of the overall proportion of North American and European-origin salmon for the years 1982-1992 was derived by weighting NAFO Division samples by catch in numbers. Information from the nearest NAFO Division was applied to divisions with no samples. The table below gives the results:

Year	Weighted by catch in numbers				% of all samples	
	NA		EU			
	%	Wt (t)	%	Wt (t)	NA	EU
1982	57	-	43	-	62	38
1983	40	-	60	-	40	60
1984	54	-	46	-	50	50
1985	47	-	53	-	50	50
1986	59	537	41	423	57	43
1987	59	556	41	411	59	41
1988	42	349	58	544	43	57
1989	55	179	45	158	56	44
1990	78	213	22	62	75	25
1991	63	290	37	183	65	35
1992	45	108	55	129	54	46

ACFM is concerned about the lack of a suitable test sample of scales of known origin salmon for the discriminant analysis.

In 1992, the estimated number of fish caught was 38,500 from North America and 46,800 from Europe for a total of 85,300.

An estimate of the number of Maine-origin salmon harvested at West Greenland in 1992 using the proportional harvest method was 1,950 fish.

The incidence of reared Atlantic salmon in the catches at West Greenland was examined from scales taken from salmon sampled in the 1991 fishery. Reared salmon were observed in very low frequency (1.1%). An additional 2.6% of the number of fish examined could not be accurately classified although they showed similar scale characteristics to fish which had been released as smolts from hatcheries

3.1.2 Biological characteristics of the harvest

As previously observed, North American 1SW salmon were significantly shorter and lighter than their European counterparts, both overall and on an individual NAFO Division basis. Two sea-winter salmon of North American origin were not different in length but were lighter than European-origin salmon both overall and between NAFO Divisions at the 5% level of significance.

The sea age composition in 1992 of 94.4% 1SW, 5.5% MSW, and 0.2% previous spawners indicated that there were proportionately fewer 1SW salmon and more MSW salmon than in 1991.

3.1.3 Historical data on tag returns and harvest estimates

The Carlin tag based harvest estimates of 1SW Maine-origin salmon for the 1991 fishery totalled 1,871 fish.

Carlin harvest estimate of Maine-origin salmon

Year	1986	1987	1988	1989	1990	1991
Harvest	2,035	2,087	2,309	3,797	1,525	1,871

The CWT harvest estimate for Maine-salmon in 1991 was 1,707 fish.

CWT harvest estimate of Maine-origin salmon

Year	1987	1988	1989	1990	1991
Harvest	5,571	3,882	2,857	2,037	1,707

The proportional harvest method provides estimates of harvest significantly higher than the CWT method in recent years (Figure 3.1.1). As escapees from North American aquaculture facilities could increase the estimate provided by the proportional method, ACFM recommends further investigation of the possible explanation of the discrepancy between the two methods.

3.2 Description of Homewater Fisheries

Tagging experiments have demonstrated that almost all countries listed in the national catch tables (Table 1.1.1) contribute salmon to the West Greenland fishery. However, stocks from these countries contribute to the fishery to differing extents, both because the proportion of MSW salmon in the stocks varies and because of differences in their migratory behaviour at sea.

For European salmon stocks, the relative contributions have not been estimated precisely, although MSW stocks from the UK, Ireland, and France are thought to contribute to the fishery at a higher rate than Scandinavian stocks. Additional information on fisheries in the north-east Atlantic is contained in Section 2.

For North American salmon stocks, most of the salmon that contribute to the West Greenland fishery are produced in rivers of eastern Canada, with the balance originating from a few rivers in the northeastern US. Additional information on the fisheries in the north-west Atlantic is provided in Section 4.

3.3 Stock Abundance and Exploitation at West Greenland

Stock abundance and exploitation at West Greenland was estimated using the results of tagging experiments and the run reconstruction model for the North American stock complex. The continental run reconstruction model provides a range of feasible exploitation rates and fractions of the population present in Canada and Greenland. In turn, these exploitation rates provide an estimate of the total population abundance at West Greenland prior to the fishery. Of course, the population at West Greenland consists of both North American and European stocks. It should be remembered, that the pre-fishery abundance estimator reconstructs the population by summing 2SW returns, and catches from fisheries on non-maturing 1SW salmon in Canada and Greenland, and 2SW salmon in Canada. This value represents the extant population and does not account for the fractions of the population present in a given fishery (i.e. availability).

3.3.1 Continental run reconstruction model

Exploitation rates at West Greenland have been variable, showing marked dips in 1983-84 and 1989 and peaks in 1981-82, 1987 and 1991, but overall, the time series is without trend (Figure 3.3.1). The estimates of the exploitation rate at West Greenland are sensitive to the value of FU (Fraction of population not available to either the west Greenland or Canadian fishery) used; if a higher value of FU is chosen, then a smaller proportion of the stock will be estimated to be available to the West Greenland fishery and the estimate of exploitation rate will be increased.

The estimated abundance of stocks of all origins at West Greenland has declined fairly steadily from about 1 - 1.5 million at the start of the period to only 200,000-400,000 at the end (Figure 3.3.2). The abundance of European and North American stocks have changed very much in line with each other, although European stocks were more abundant at the beginning of the period but less abundant at the end (Figure 3.3.3).

3.3.2 Exploitation of Maine (USA) stocks

The extant exploitation rates for 1SW Maine origin salmon in 1991 ranged between 61 and 78% and were the highest in the time series. The extant exploitation rate for 2SW fish was estimated to be over 90% for all combinations of parameters; it was also one of the highest recorded since 1967. The fishery area exploitation rates for US stocks in 1991 in both Canada and Greenland were among the highest estimated for any year since 1967.

The exploitation rates for the Maine stock at West Greenland and in Canada are plotted with the results of the Constraints model in Figure 3.3.4. For the Constraints model the mid-point between the minimum and maximum estimates is used. For the estimates on the Maine stock the results for P=0.1 are used, as this is the closest to the values of P (fraction of extant population available to fishery in Canada) derived from the Constraints model. There is close similarity between the estimates by the two independent methods, particularly since 1982. The results suggest that exploitation rates derived for Maine stocks do not deviate markedly from the overall magnitude and temporal pattern of exploitation rates for the aggregate North American stock complex.

3.3.3 Numerical contributions of salmon stocks to the fishery and exploitation of individual stocks

A maximum likelihood approach to estimate the relative contribution of northern and southern components of the North American stock complex to West Greenland was applied using river age data. The results suggest that the proportion of northern stocks at Greenland has declined greatly since 1974 (Figure 3.3.5). Analysis of the overall catches (Figure 3.3.6) of the stock complexes suggests that both groups have declined in abundance.

3.3.4 Relative importance to stocks of regulatory measures in the fishery and homewaters

Since the early 1970s both Canada and Greenland have imposed a variety of management measures designed to reduce fishing mortality on stocks. Greenland excluded foreign vessels in 1976 and reduced its quota in 1984 from 1,190 t to 870 t. In 1984, Canada introduced a series of reductions in fishing effort including license buy-out programs, season and regional closures, and quota restrictions. These efforts culminated in 1992 with a moratorium on commercial fisheries in insular Newfoundland, a license buy-back programme, and the imposition of quotas on recreational fisheries. In spite of these changes, population abundance of the MSW component of the stock has continued to decline.

Estimates of pre-fishery abundance, and numerous other indicators of stock status reveal that the restrictive management measures in Canada and, to a lesser extent, Greenland have coincided with a period of increasing marine mortality.

In order to assess what would have happened without such regulations, ACFM considered the following three scenarios to project the effects of regulations on returning 2SW salmon:

1. What if the quota at West Greenland had remained at 1,190 t?

2. What if Canada had not restricted fishing effort in the Newfoundland-Labrador commercial fishery?

3. What would be the combined effects of 1) and 2)?

Scenario 1. Effects of 1,190 t Greenland Quota

Projected effects of a 1,190 t Greenland quota are shown in Figure 3.3.7. As the quota was limiting on catches only in 1985-1988, the projected consequences suggest that about 50,000 North American salmon were saved per year between 1985-1988. Similar numbers of European origin salmon would also have been saved, but their subsequent fate can not be evaluated.

Scenario 2. Effects of effort reductions of the Newfoundland-Labrador Commercial Fishery in Canada

Results of this scenario (Figure 3.3.8) show that the effort reductions have saved about 50,000 salmon destined to be have been 2SW returns per year since 1985 and almost 60,000 salmon in 1992. Conversely, without effort restrictions, actual 2SW returns would have been reduced by 50,000 salmon per year.

Scenario 3. Cumulative Effect of Quotas and Effort Reduction

The penalty for a high quota and high effort (Figure 3.3.9) suggests that an additional 70,000 2SW salmon (an increase of about 20,000) salmon would have been harvested in 1985-1988. The effects of both scenarios are not additive.

Overall, the scenarios suggest that substantial savings of 2SW returns to home river areas of North America have occurred as a result of regulatory measures in the Newfoundland-Labrador commercial fishery. Additional benefits to spawning populations would also have resulted from the prohibition on retention of large salmon in most Canadian angling fisheries, season and daily baglimit reductions for angling in Quebec, Labrador and Maine, closures of the Caspé, New Brunswick, Nova Scotia and Prince Edward Island commercial fisheries and reduction in the commercial fisheries of Quebec. The benefits of the reduced quota are intermittent and related to the availability of salmon at Greenland. Substantial reductions in harvest occurred in Greenland between 1972-1976 as a result of quota regulations; this time period, however, cannot be assessed using this methodology. In years when the stocks are low, a fixed quota will result in increased exploitation.

3.3.5 Relationship between the abundance of grilse and multi-seawinter salmon in the returns to homewaters and its effect on the management of the fishery

ACFM was unsure of the intent of this question; thus, three different responses were considered. One response dealt with the utility of estimates of the population size of grilse returns to homewaters in predicting or forecasting the population size of 2SW salmon returning the following year. The second response considered the effects of changing the grilse:multi-sea-winter salmon ratio in the spawning population on production of MSW salmon. The third response considers how fisheries in homewaters can be manipulated to account for differences in relative abundances of grilse and multi-sea-winter salmon.

Application of Grilse returns to forecast 2SW salmon returns

Forecasts of 2SW salmon returns based on 1SW returns have been used with varying success throughout North America and Europe. Simple linear regression techniques have been tested for the rivers Tay and North Esk, in Scotland; used with greater success in the LaHave and the Liscomb rivers, Nova Scotia; and on various rivers in Iceland. A multiple linear regression has been adopted on the Saint John River, New Brunswick to forecast MSW returns from data on numbers and size of grilse returns. Nonparametric approaches for forecasting MSW salmon from 1SW returns are being used for the Miramichi River.

Effects of changing the grilse:multi-sea-winter salmon ratio in the spawning population on production of MSW salmon.

Sea-age at maturity is believed to be influenced by both genetics and environmental effects. There is evidence that the progeny of grilse produce proportionately more salmon that mature as grilse than progeny from 2SW salmon. It has also been demonstrated both in nature and in husbandry settings that temperature and climate can influence maturation. Selective fishing has an influence on the age of maturity of spawners which may have long-term genetic effects. ACFM was not aware of any studies that demonstrated that the increase in the number of grilse spawners in a river has resulted in a genetic shift to earlier maturation, or grilsification of the stock. However, concern was expressed that this may occur.

Manipulation of Fisheries to account for differential abundance

The abundance of grilse versus multi-sea-winter salmon in a stock may be variable. Fishery managers may consider options to adjust the harvest pressure on a particular sea-age category needing additional protection. Where these two sea-age categories are mixed in a fishery, options may include a change in gear or prohibited retention. When the grilse and MSW stocks are not mixed, fisheries can be regulated by opening and closing seasons of the fisheries to reduce exploitation on a specific sea-age. Examples of these possibilities were noted in Canada's management actions since 1984 to reduce exploitation on MSW salmon stocks.

3.4 Advice on Catch Levels at West Greenland

In previous years, ACFM was asked to propose and evaluate methods to estimate possible catch levels based upon maintaining adequate spawning biomass. The aim of advice would be to limit catch to a level that would facilitate achieving overall spawning escapement equivalent to the sum of spawning targets in individual North American and European rivers (when the latter have been defined). To achieve the desired level of exploitation for a given level of predicted abundance either a TAC could be fixed or some form of effort limitation introduced.

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 application of TACs to mixed stock fisheries are still relevant. In principle, reductions in catches in mixed stock fisheries provided via an annually adjusted TAC would reduce mortality on the population as a whole. However, benefits that might accrue to particular stocks would be difficult to demonstrate, in the same way that detriments to individual stocks are difficult to identify.

Effort limitation would, in theory, provide a greater range of options for management, such as season length restrictions, regulating number of boats or licences or closed periods in the fishery. However, it was felt that the diversity of boat types and sizes and their large numbers would make effort limitation difficult in practice, particularly because no reliable data exist on the relationship between effort and exploitation in the fishery.

The advice for any given year is dependent on obtaining a reliable predictor of the abundance of non-maturing 1SW abundance for North American stocks prior to the start of the fishery in Greenland. Prediction of this pre-fishery abundance of 1SW salmon destined to return as 2SW salmon is difficult. Such predictions have wide confidence intervals and it would be prudent to use the lower range of predicted abundance levels for management decisions.

3.4.1 Estimating the pre-fishery abundance of non-maturing 1SW salmon at the time of the fishery

The 1993 pre-fishery abundance of non-maturing 1SW salmon of North American origin (the abundance relevant to 1SW fisheries in Canada and Greenland in 1993 and the 2SW salmon fishery in Canada in 1994) was forecasted using two main methods.

The first method involved the use of a univariate time series model. The second method was a regression model in which the independent variable was an estimate of overwintering habitat in the Labrador Sea. Overwintering habitat was defined as a weighted sum of areal sea surface temperatures multiplied by average catch rates at each temperature (Figure 3.4.1). The relationship between abundance and catch rate weighted habitat in March was found to be significant (Figure 3.4.2).

Forecasts of the pre-fishery abundance for the 1993 fishery year were computed as point estimates (based on the mid-point of historical ranges) and as statistical distributions or stochastic processes utilizing information on the distribution of historical pre-fishery abundances. In addition, a provisional estimate of the 1992 pre-fishery abundance (N1*) was also developed thus allowing forecasts to be made for a single year instead of two years ahead (Figure 3.4.3).

Estimates of 1993 pre-fishery abundances are summarized in Table 3.4.1 and presented graphically in Figure 3.4.4. Regression forecasts are slightly higher than forecasts based on the univariate time series model. The inclusion of the N1* estimate has the effect of lowering both univariate and regression forecasts; this reflects both the low Greenland catch and the low habitat value for 1992. The use of stochastic forecast procedures also had the effect of lowering forecast values compared to estimates based on pre-fishery midpoints. This is due to skewed yearly distributions of pre-fishery abundance. The stochastic regression forecast utilizing N1* is the most robust forecast since it is the technique based on our best biological understanding of the recruitment process and includes information about the statistical error structure of the datasets involved.

ACFM noted the annual fluctuations in the estimates of abundance of salmon at West Greenland (Figure 3.3.2) and examined the year to year changes in these values relative to the overall mean.

	Low (i+1)	High (i+1)
Low (i)	9	1
High (i)	2	5

year in parentheses

This analysis indicated that most years when abundance was estimated to be low (i.e. below the 17 year mean) were followed by years when abundance was again low and most years when abundance was high were followed by years when abundance was again high. In 1990 and 1991, the values were the lowest in the time series of pre-fisheries abundance. Thus, some sort of qualitative assessment of the likely level of pre-fishery abundance of 1SW fish at Greenland for a current year could be obtained from knowledge of the preceding year's abundance estimate.

3.4.2 Development of a model to set catch quotas in relation to stock abundance

A worked example of a model to set catch quotas in relation to stock abundance with assessment of the probability of achieving adequate spawning biomass is described. To achieve the spawning management goal, a pool of fish must be set aside prior to fishery allocation in order to meet spawning targets and allowing for natural mortality in the intervening months between the fishery and spawning migration. ACFM identified 193,306 fish as the spawning target for the North American stock complex. Thus, 219,132 pre-fishery abundance fish must be reserved (196,306/exp*(-.01*11)) to ensure achievement of the target.

Given an agreed estimate of the total pre-fishery abundance of non-maturing North American stocks, this abundance minus the spawning reserve is the pool of fish available for harvest in all relevant fisheries (Table 3.4.2). The pre-fishery population is viewed as an extant population in this context, thus, availability is unknown and not predicted. The portion of the population in excess of the spawning reserve is divided between harvest in North America and Greenland. From the number of pre-fishery abundance fish designated for harvest in Greenland (NA1SW), the number of European origin pre-fishery abundance fish that contribute to the quota (E1SW) is estimated:

E1SW=(NA1SW/PropNA)-NA1SW

Where:

PropNA = the proportion of the total number of 1SW fish at West Greenland which is of North American origin.

The quota is then computed by:

Quota = (NA1SW*WT1SWNA+E1SW*WT1SWE)*ACF

Where:

E1SW = the Greenland allocation of pre-fishery European 1SW salmon

WT1SWNA = mean weight of North American 1SW salmon at Greenland

WT1SWE = mean weight of European 1SW salmon at Greenland

and

ACF = age correction factor to account for multi-sea-winter salmon in the catch, based on total weight of the catch divided by the weight of 1SW salmon

The data necessary to perform the quota calculations are based on the following forecasts:

Parameter	Value
PropNA	0.540
WT1SWNA	2.525
WT1SWE	2.660
ACF	1.121

The fishery allocation to North America can be harvested in 1SW fisheries in 1993 and/or in 2SW fisheries in 1994. It must be remembered that natural mortality will reduce the numbers of fish to be harvested in 2SW fisheries from the number allocated from the pre-fishery abundance.

This procedure can be expressed graphically. Allocation of extant pre-fishery abundance salmon can be determined in respect to the advice on pre-fishery abundance forecasts by selecting a forecast value of pre-fishery abundance (Figure 3.4.5). Translating vertically from this estimate level and observing where the line intersects the allocation curve pairs for various allocation schemes, the allocation can be read on the Y-axis.

Using the above formulation, Greenland allocation levels were computed for each forecast over a range of pre-fishery abundance values (Table 3.4.3) and quota options ranging from 42 to 209 tonnes. This catch advice is predicated on allocation of the predicted abundance of salmon and provides no guidance on salmon availability or fishing patterns. Yet quotas of these magnitudes will be expected to have consequences on fishing mortality. To illustrate, the exploitation at West Greenland was computed for a range of catch level using the results of the run reconstruction model to predict mean availability (availability at West Greenland=1-(mean P)-FU=0.6). These computations suggest it would be impossible to catch more than 740 t due to availability and that catch between 300 and 400 t would result in exploitation rates of approximately 45%, or levels similar to those observed in recent years of the fishery (based on results of run reconstruction model). Catch in the range of options consistent with the catch advice described above would result in exploitation rates below 30% (Figure 3.4.6).

3.4.3 Assessment of risk of not achieving management objective of adequate spawning biomass

In North America, relationships between the amount of spawning and subsequent recruits have been identified in some Atlantic salmon populations with recruitment reaching a maximum at an intermediate level of spawning. Consequently, for salmon, fisheries management practices can maximize recruitment by ensuring that an optimum number of salmon are allowed to spawn. The further the spawning escapement is below the target egg deposition (or biological level to maintain optimal production), and the longer this situation occurs, even at rates only slightly below that level, the greater the possibility exists of incurring the following risks, some of which may cause irreversible damage to the stock:

1. Accentuation of annual fluctuations in run size and reduction in the long term capability of the stock to sustain exploitation;
2. Increased susceptibility to extinction from genetic, demographic, or environmental catastrophes and consequent decreases in productivity;
3. Permanent change in demographic characteristics of the spawning population; and
4. Possible replacement in the ecosystem by other competing fish species of potentially less social and economic value.

The probability that the true stock abundance is greater or lower than the value selected (Figure 3.4.5) provides a measure of the probability of reaching escapement targets assuming fishery allocations are exactly taken. The probability levels associated with certain reference points can be classified into broad categories termed "risk neutral", "risk averse", and "risk prone". The mean estimate of the forecast represents a reference point at which there is a 50% chance that the true abundance is lower than required to achieve the spawning target. This level is termed the "risk neutral" forecast. Likewise, the forecast value at the 25th percentile, or the value with a 25% chance that the abundance is lower, is the "risk averse" forecast. The forecast value at the 75th percentile, or the value with a 75% chance that the abundance is lower, is the "risk prone" forecast.

If a risk averse approach to protecting returns to homewaters were to be adopted for 1993, no catches of potential 2SW salmon could be permitted in either Greenland or Canada. Even if the "risk neutral" scenario were to be adopted, the catch allowances would be small and would result in either very low allowable catches in Greenland or Canada or no allocation to one or other of the countries and a small permitted catch in the other. Adoption of a risk prone approach, i.e., assume the 75th percentile of the forecast of 363,000 fish, would probably mean that the numbers of 2SW salmon returning to North American homewaters in the year following the fishery would be insufficient to meet target spawning requirements (Table 3.4.2).

ACFM will employ a risk neutral approach in the formulation of its management advice. However, the current status of the stocks should be considered in management decisions.

It must also be noted that basing catch advice on estimated stock abundance of Canadian non-maturing 1SW fish may carry with it additional risks of over-exploiting particular stocks or stock complexes that are more vulnerable than the average, for example because they have lower productivity. This will have the effect of increasing the risks for certain stocks at all levels of catch, while decreasing the risks for others. The long term catch advice for the mixed stock fisheries should be based upon the stock complexes that are most vulnerable.

3.5 By-catch and Mortality of Salmon in Non-directed Fisheries

The only other fisheries likely to catch salmon in West Greenland are those where gill nets are set for arctic charr. However, these nets are set in the fjords at a time of year when salmon are either not present or in very low abundance. It is thought that by-catches of salmon are of negligible proportions.

3.6 Effects of the NASCO Tag Return Incentive Scheme

A direct estimator of reporting rate in the West Greenland fishery, based on comparison of Carlin and coded-wire tag recoveries in West Greenland for the period 1987 to 1991, was evaluated.

Reporting rates in Greenland appear to have increased appreciably in 1989 to levels 2 to 3 times higher than evident in 1987 and 1988. The low numbers of Carlin-tagged 2SW salmon returning to Maine rivers and the low numbers recovered in Greenland result in high variability in the reporting rate estimate (Figure 3.6.1).

These data suggest that the NASCO lottery scheme increased the Carlin tag reporting rates in the West Greenland fishery. The resulting estimate had wide confidence intervals; thus, the rate could not be shown to be statistically significant.

4 INFORMATION OF INTEREST TO THE NORTH AMERICAN COMMISSION

4.1 Description of the Fisheries in Canada

The following were new management measures for commercial fisheries in 1992:

1) A 5-year moratorium was implemented for the commercial fishery in insular Newfoundland. Fishing was permitted in Labrador (Salmon Fishing Areas (SFA) 1, 2 and 14B. Quotas in SFAs 2 and 14B were reduced from those of 1991 by 20 t in SFA 2 and 2 t in SFA 14B. SFA 1 had an allowance of 80 t, the same as 1990 and 1991; an allowance is an estimate of expected catch and not a limitation on allowable harvest. Monitoring of the quotas was conducted by Fisheries Officers who were in contact with buyers and fishermen on a weekly or daily basis.

   A voluntary commercial salmon license buy-back program was also implemented for fishermen in SFAs 2-14. Fishermen were allowed to apply for the buy-back until 31 December 1992.

2) In Quebec, commercial fishing quotas were reduced in area Q 7 by 52% (from 1809 to 875 fish) from 1991, commensurate with a reduction in a number of licences under a buy-back program. In Q 8 and Q 9, the quotas were reduced by 26% and 9%, respectively.

The following were new management measures for recreational fisheries in 1992:

1) The seasonal bag limit for the recreational fishery of Newfoundland-Labrador, Nova Scotia, and New Brunswick was reduced from 10 to 8 fish (SFAs 1-16, and 18-23). In Prince Edward Island (SFA 17), the seasonal and daily limits were reduced from 10 and 2 to 7 and 1, respectively. Most rivers of the inner Bay of Fundy (SFA 22 and parts of SFA 23) were not opened to recreational fishing for conservation reasons. As in previous years, large salmon could be retained as part of seasonal and daily limits only in Labrador (SFAs 1, 2, and 14B) and in Quebec.

2) Quotas for each SFA were introduced for the first time to the recreational fisheries of Newfoundland and Labrador. All rivers of each SFA were closed to retention of salmon after the quota in each SFA was reached. Some rivers of SFAs 11, 13 and 14 were managed by individual river quotas.

3) There were minor changes in angling seasons relative to previous years.

The total catch of Atlantic salmon in Canada was 470 t in 1992. Catch was distributed between recreational (42%), native (7%), and commercial (51%) fisheries. Commercial catch and quotas by SFA are shown in the text table below:

1992

SFA	Catch (t)	Quota (t)
1	20	80[1]
2	132	180
13-14	17	13
Q7-9	73	NA[2]
Q11	0	15

[1]Allowance.
[2]Not applicable.

Catches in the Newfoundland commercial fishery are given in the text table below:

Newfoundland commercial fishery

Year	1987	1988	1989	1990	1991	1992
Catch (t)	1,485	972	867	618	454	168[1]

[1]Preliminary.

4.1.1 Composition and origin of the catch, 1992

Only salmon of Canadian and USA origin were caught in Canada during 1992. Recaptures of tagged 1SW salmon of USA and Canadian origin occurred in the Newfoundland and Labrador fisheries.

4.1.2 Historical data on tag returns and harvest estimates

ACFM updated the time series of Carlin tag returns and harvest estimates of Maine-origin 1SW salmon in Newfoundland and Labrador. The total harvest of 1,425 Maine-origin salmon in the 1991 fishery was distributed primarily in SFAs 3 and 4.

Comparative harvest estimates based on CWT and Carlin tag recoveries were calculated for the communities, Statistical Sections and SFAs covered by port sampling. The ratio of harvest estimation methods (Carlin/CWT) was consistently less than 1.0 for the Statistical Sections and SFAs where harvests occurred. Previous comparisons of Carlin and coded wire tag harvest estimates generally indicated coded wire tag estimates were greater than Carlin estimates. This reversal would be consistent with the effect of Carlin tag reporting rates that are higher than the levels assumed in the Carlin harvest model.

4.2 Description of Fisheries in United States of America

Carlin harvest, Maine-origin salmon

Year	1986	1987	1988	1989	1990	1991
Harvest	552	580	393	1,722	780	1,425

The average exploitation rate (6.8%) on combined age classes in the Penobscot River for 1992 was lower than for 1991 (11.5%). The reasons for the change in 1992 were attributed to the new management measure enacted (reduction of season limit from 5 to 1) and a conscious effort by Penobscot River anglers to reduce the harvest of salmon caught early in the season. The estimated number of salmon caught and released in Maine rivers exceeded the number caught and killed by a margin of 2:1

4.3 Description of Fisheries in France (Islands of St. Pierre and Miquelon)

The catch of salmon for the islands of St. Pierre and Miquelon in 1992 was 1.3 t (Table 1.1.1). The most recent information on fishing effort is for 1989 when there were 13 professional and 37 recreational fishermen fishing for salmon. Tag returns from previous years indicate that salmon of Canadian and USA-origin have been caught in the fisheries of St. Pierre and Miquelon.

4.4 Evaluate the Effects of Quota Management Measures and Closures Taken in 1991 and 1992 in Newfoundland-Labrador Commercial Fisheries

4.4.1 Effects on Canadian stocks and fisheries

1991 Quota Management Measures

The quantities of large and small salmon affected by the early closure of the fisheries in 1991, owing to quota management measures, were evaluated by applying the closure date in each SFA in 1991 to the temporal distribution of the landings in each SFA and year, for 1984-1989. With respect to small salmon, the estimated mean tonnage of salmon not caught was 21 t (about 12,600 fish) while for large salmon it was 9 t (2,500 fish).

The estimated average numbers of small (12,600) and large (2,500) salmon not caught in 1991 are about 70% less than the estimated numbers not caught in 1990. The quota had the greatest effect in reducing numbers of small salmon caught in SFAs 10, 11 and 13, while the largest reduction in number of large salmon caught occurred in SFA 11.

1992 Commercial Salmon Fishery Moratorium

The only data available to evaluate the effects of the closure of the commercial fisheries were recreational catch statistics and the counts of salmon on several river systems.

The total recreational catch of small salmon (23,127) retained up to the date quotas were reached in each of the SFAs 3-14A in 1992 increased by 113% over 1991. There was considerable variation in changes in catches from 1992 to 1991 and 1984-1989 among SFAs which may be related to variation in: 1) commercial exploitation rates among stocks; 2) abundance of salmon among SFAs; and 3) exploitation rates in the recreational fisheries among rivers and years. The recreational quotas in 1992 had the effect of eliminating angling catches in the latter part of the season and dramatically reducing angling effort during the hook-and-release component of the fishery.

In southern Labrador (SFAs 2 and 14B), where large salmon could be retained, the early closure appeared to have resulted in the higher exploitation of large salmon over small fish due to the early entry of large salmon to the rivers.

In comparison to the 1984-1989 means, the numbers of small salmon counted in 1992 increased along the northeast and east coasts (SFAs 4-5), generally decreased along the south coast (SFAs 9 and 11) with Northeast River (SFA 10) the exception, and again increased in west coast Newfoundland (SFA 14A) (Figure 4.4.1). Except for Northeast Brook, Trepassey, counts of large salmon increased over 1991. In comparison to the 1984-1989 mean, increases occurred for all rivers except Biscay Bay River and Northeast Brook, Trepassey, and Conne River. These rivers are located along the south coast of insular Newfoundland.

If the 1992 moratorium had been in effect during 1984-1989 the estimated weight of salmon not caught per year would have been 403 t of small salmon (227,000 fish) and 314 t of large salmon (78,500 fish).

4.4.2 Effects on USA stocks

ACFM evaluated the effects of the 1991 quota regime on USA stocks harvested in the Newfoundland-Labrador fishery by determining the percentage of Maine-origin salmon that would not have been caught in previous fisheries had the closing dates observed in 1991 been in force. The small numbers of salmon harvested and the variability in the percentage of harvest foregone makes it difficult to evaluate the closure. The mean percentage of 1SW Maine-origin salmon which would not have been caught in SFAs affected by the quota during the period 1984-1989, if the 1991 closure date were in force, is 16%.

The effects of the 1992 moratorium can be estimated directly. In SFAs 1-14a, affected by the moratorium, nearly 100% (i.e. some by-catch in other gears will still occur) of the harvest would be expected to be foregone. The average harvest in these SFAs during the period 1984-1989 was 763 salmon out of an average total harvest of 1,144 fish per year. Thus, within this base period, 67% of the harvest of Maine-origin salmon would have been foregone. A similar percentage of harvests foregone would be expected for Merrimack- and Connecticut- origin salmon.

4.5 By-catch and Mortality of Salmon in Non-directed Fisheries

ACFM concluded that adult salmon appear to be caught in low frequencies in non-directed fisheries. The tonnage appears to be negligible relative to the unreported catchin salmon gear. Data were not available to estimate actual tonnage losses in by-catch fisheries. In the North American Commission area, landing of salmon by-catch is not permitted. Thus estimates of by-catch loss are partially addressed in the estimates of unreported catches, when these arise from illegal landings in non-salmon gear.

4.6 Effects of the NASCO Tag Return Incentive Scheme

Angler reporting rate in the Gulf Region, Canada

Tag recovery rates for adult salmon in the Miramichi (1971-75, 1985-91) and on the Margaree (1987-92) rivers were examined. Though slight increases in recovery rate were observed, none of the increases were statistically significant.

Reporting rates for Maine tags

Tag recoveries in distant fisheries were considered in relation to estimated counts of tag returns to Maine rivers. The results of the analysis suggest that the magnitude of the reporting rate change for tags recovered in Canada was less than the inherent variability in the historical relationship between fishery and homewaters recoveries.

Table 1.1.1 Nominal catch of SALMON by country (in tonnes round fresh weight), 1960-1992 (1992 provisional figures).

Year	Canada (5)	Den.	Faroes	Finland	France	East Grld.	West 7 Grld.	Iceland	Ireland (1, 3)	Norway (4)	Russia	St. P & M.	Sweden (WC)	UK E&W	UK Scotland	UK N.I.(1,2)	USA	Others (6)	Total
1960	1636	-	-	-	-	-	60	100	743	1659	1100	-	40	283	1443	139	1	-	7204
1961	1583	-	-	-	-	-	127	127	707	1533	790	-	27	232	1185	132	1	-	6444
1962	1719	-	-	-	-	-	244	125	1459	1935	710	-	45	318	1738	356	1	-	8650
1963	1861	-	-	-	-	-	466	145	1458	1786	480	-	23	325	1725	306	1	-	8576
1964	2069	-	-	-	-	-	1539	135	1617	2147	590	-	36	307	1907	377	1	-	10725
1965	2116	-	-	-	-	-	861	133	1457	2000	590	-	40	320	1593	281	1	-	9392
1966	2369	-	-	-	-	-	1370	106	1238	1791	570	-	36	387	1595	287	1	-	9750
1967	2863	-	-	-	-	-	1601	146	1463	1980	883	-	25	420	2117	449	1	-	11948
1968	2111	-	5	-	-	-	1127	162	1413	1514	827	-	20	282	1578	312	1	403	9755
1969	2202	-	7	-	-	-	2210	133	1730	1383	360	-	22	377	1955	267	1	893	11540
1970	2323	-	12	-	-	-	2146	195	1787	1171	448	-	20	527	1392	297	1	922	11241
1971	1992	-	-	-	-	-	2689	204	1639	1207	417	-	18	426	1421	234	1	471	10719
1972	1759	-	9	32	34	-	2113	250	1804	1568	462	-	18	442	1727	210	1	486	10915
1973	2434	-	28	50	12	-	2341	256	1930	1726	772	-	23	450	2006	182	2.7	533	12746
1974	2539	-	20	76	13	-	1917	225	2128	1633	709	-	32	383	1708	184	0.9	373	11941
1975	2485	-	28	76	25	-	2030	266	2216	1537	811	-	26	447	1621	164	1.7	475	12209
1976	2506	-	40	66	9	<1	1175	225	1561	1530	772	2.5	20	208	1019	113	0.8	289	9536
1977	2545	-	40	59	19	6	1420	230	1372	1488	497	-	10	345	1160	110	2.4	192	9495
1978	1545	-	37	37	20	8	984	291	1230	1050	476	-	10	349	1323	148	4.1	138	7650
1979	1287	-	119	26	10	<1	1395	225	1097	1831	455	-	12	261	1076	99	2.5	193	8089
1980	2680	-	536	34	30	<1	1194	249	947	1830	664	-	17	360	1134	122	5.5	277	10080
1981	2437	-	1025	44	20	<1	1264	163	685	1656	463	-	26	493	1233	101	6	313	9929
1982	1798	-	865	54	20	<1	1077	147	993	1348	354	-	25	286	1092	132	6.4	437	8634
1983	1424	-	678	57	16	<1	310	198	1656	1550	507	3	28	429	1221	187	1.3	466	8731
1984	1112	-	628	44	25	<1	297	159	829	1623	593	3	40	345	1013	78	2.2	101	6892
1985	1133	-	566	49	22	7	864	217	1595	1561	659	3	45	361	913	98	2.1	-	8095
1986	1559	-	530	38	28	19	960	310	1730	1598	608	2.5	54	430	1271	109	1.9	-	9248
1987	1784	-	576	49	27	<1	966	222	1239	1385	564	2	47	302	922	56	1.2	-	8142
1988	1311	-	243	34	32	4	893	396	1874	1076	419	2	40	395	882	114	0.9	-	7716
1989	1139	-	364	52	14	<1	337	278	1079	905	359	2	29	296	895	142	1.7	-	5893
1990	911	13	315	59	15	<1	274	426	586	930	315	2	33	338	624	94	2.4	-	4937
1991	711	3.3	95	69	13	4	472	505	404	876	215	1	38	200	462	55	0.8	-	4124
1992	470	10	23	78	20	5	237	590	630	850	161	1.3	49	195	525	151	0.7		3996
5YM	1171	-	319	53	20	2	588	365	1036	1034	374	2	37	306	757	92	1	-	6162
10YM	1288	-	486	51	21	4	645	286	1199	1285	459	2	38	338	930	107	2	-	7241

5YM - 1987-1991 Mean
10YM - 1982-1991 Mean

1. Catch on River Foyle allocated 50% Ireland and 50% N. Ireland.
2. Not including angling catch (mainly 1SW).
3. Includes only those catches sold through dealers
4. Before 1966, sea trout and sea charr included (5% of total).
5. Includes estimates of some local sales, and, prior to 1984, by-catch.
6. Includes catches in Norwegian Sea by vessels from Denmark, Sewden, Germany, Norway and Finland
7. Includes catches made in the West Greenland area by Norway, Faroes, Sweden and Denmark for the years 1965-1975.

Table 2.2.1 Origin of catches of salmon in homewater fisheries based on tag recoveries.

+ + = Principal component of catch
+ = Consistant recoveries
- = Rare tag recovery

Origin of stock	Catch by Country									
	Rus	Fin	Nor	Swe	Fr	UK E & W	UK Scot	UK N.Ire	Ire	Ice
Russia	++	-	+							
Finland	-	++	+							
Norway		+	++	+		-	-		-	
Sweden			+	++						
France					++	-	-	-	-	
UK (E & W)			-	-		++	+	+	+	
UK (Scot)						+	++	+	+	
UK (N.Ire)						-	+	++	+	
Ireland			-	-		-	+	+	++	
Iceland			-				-			++

Table 3.4.1 Summary of forecasting methods to estimate 1993 pre-fishery abundance.

Analytical Approach	Parameter	Deterministic Model	Stochastic Model
Univariate Time Series 2-year ahead forecasts based on 1974-91 estimates of pre-fishery abundance	Input Data	Mid-range of N1	200 simulated realizations
	Mean Forecast	258000	250000
	Std. Err. of Estimate	131200	137000
	Acronym	UF	SUF
Univariate Time Series 1-year ahead forecasts based on 1974-91 pre-fishery abundance and imputed value for 1992	Input Data	Mid-range of N1 plus N1*	200 simulated realizations
	Mean Forecast	238000	235000
	Std. Err. of Estimate	126400	132000
	Acronym	UFN1*	SUFN1*
Regression of pre-fishery abundance estimates (1974-91) vs marine habitat indices. Estimate for 1993 based on March 1993 habitat index.	Input Data	Mid-range of N1vs habitat	200 simulated realizations
	Mean Forecast	275000	275000
	Std. Err. of Estimate	146500	155000
	Acronym	RF	SRF
Regression of pre-fishery abundance estimates (1974-91) and imputed value for 1992 vs marine habitat indices. Estimate for 1993 based on March 1993 habitat index.	Input Data	Mid-range of N1vs habitat plus N1*	200 simulated realizations
	Mean Forecast	257000	258000
	Std. Err. of Estimate	143700	152000
	Acronym	RFN1*	SRFN1*

Table 3.4.2 Pre-fishery abundance levels from univariate and regression forecasts at probabilty levels between 25 and 75%.

Cumulative Density Function %	Forecast							
	UF	UFN1*	SUF	SUFN1*	RF	RFN1*	SRF	SRFN1*
25	153000	138000	157000	145000	170000	154000	168000	153000
30	176000	160000	174000	165000	193000	177000	192000	176000
35	198000	181000	197000	184000	215000	198000	214000	198000
40	218000	200000	215000	201000	235000	218000	235000	218000
45	238000	219000	233000	218000	255000	238000	255000	238000
50	258000	238000	250000	235000	275000	257000	275000	258000
55	277000	256000	268000	251000	294000	276000	295000	277000
60	297000	275000	285000	268000	314000	295000	316000	297000
65	318000	294000	303000	286000	335000	315000	337000	318000
70	339000	315000	323000	304000	356000	336000	359000	339000
75	363000	337000	344000	324000	380000	359000	383000	363000

Table 3.4.3 Quota (in tonnes) options at West Greenland based on univariate and regression forecasts of fishery abundance. Greenland proportion refers to fraction of harvestable surplus allocated to the Greenland fishery. Probabity level assocated with pre-fishery abundance levels derived from probabilty density function.

Greenland Proportion	Probability Level	Forecast							
		UF	UFN1*	SUF	SUFN1*	RF	RFN1*	SRF	**SRFN1***
1	25	0	0	0	0	0	0	0	0
	30	0	0	0	0	0	0	0	0
	35	0	0	0	0	0	0	0	0
	40	0	0	0	0	85	0	85	0
	45	101	0	74	0	193	101	193	101
	50	**209**	**101**	**166**	**85**	**300**	**203**	**300**	**209**
	55	311	198	262	171	402	305	407	311
	60	418	300	354	262	510	407	520	418
	65	531	402	450	359	622	515	633	531
	70	644	515	558	456	735	628	751	644
	75	773	633	671	563	864	751	880	773
0.8	25	0	0	0	0	0	0	0	0
	30	0	0	0	0	0	0	0	0
	35	0	0	0	0	0	0	0	0
	40	0	0	0	0	68	0	68	0
	45	81	0	60	0	154	81	154	81
	50	**167**	**81**	**133**	**68**	**240**	**163**	**240**	**167**
	55	249	158	210	137	322	244	326	249
	60	335	240	283	210	408	326	416	335
	65	425	322	360	287	498	412	506	425
	70	515	412	446	365	588	502	601	515
	75	618	506	536	451	691	601	704	618
0.6	25	0	0	0	0	0	0	0	0
	30	0	0	0	0	0	0	0	0
	35	0	0	0	0	0	0	0	0
	40	0	0	0	0	51	0	51	0
	45	61	0	45	0	116	61	116	61
	50	**125**	**61**	**99**	**51**	**180**	**122**	**180**	**125**
	55	186	119	157	103	241	183	244	186
	60	251	180	212	157	306	244	312	251
	65	319	241	270	215	373	309	380	319
	70	386	309	335	273	441	377	451	386
	75	464	380	402	338	518	451	528	464
0.5	25	0	0	0	0	0	0	0	0
	30	0	0	0	0	0	0	0	0
	35	0	0	0	0	0	0	0	0
	40	0	0	0	0	43	0	43	0
	45	51	0	37	0	96	51	96	51
	50	**104**	**51**	**83**	**43**	**150**	**102**	**150**	**104**
	55	155	99	131	86	201	153	204	155
	60	209	150	177	131	255	204	260	209
	65	265	201	225	180	311	257	317	265
	70	322	257	279	228	368	314	376	322
	75	386	317	335	282	432	376	440	386
0.4	25	0	0	0	0	0	0	0	0
	30	0	0	0	0	0	0	0	0
	35	0	0	0	0	0	0	0	0
	40	0	0	0	0	34	0	34	0
	45	41	0	30	0	77	41	77	41
	50	**83**	**41**	**66**	**34**	**120**	**81**	**120**	**83**
	55	124	79	105	68	161	122	163	124
	60	167	120	142	105	204	163	208	167
	65	212	161	180	144	249	206	253	212
	70	258	206	223	182	294	251	300	258
	75	309	253	268	225	346	300	352	309
0.2	25	0	0	0	0	0	0	0	0
	30	0	0	0	0	0	0	0	0
	35	0	0	0	0	0	0	0	0
	40	0	0	0	0	17	0	17	0
	45	20	0	15	0	39	20	39	20
	50	**42**	**20**	**33**	**17**	**60**	**41**	**60**	**42**
	55	62	40	52	34	80	61	81	62
	60	84	60	71	52	102	81	104	84
	65	106	80	90	72	124	103	127	106
	70	129	103	112	91	147	126	150	129
	75	155	127	134	113	173	150	176	155

Figure 1.3.1 Percent survival of wild 1SW Atlantic salmon to freshwaters for monitored European rivers.

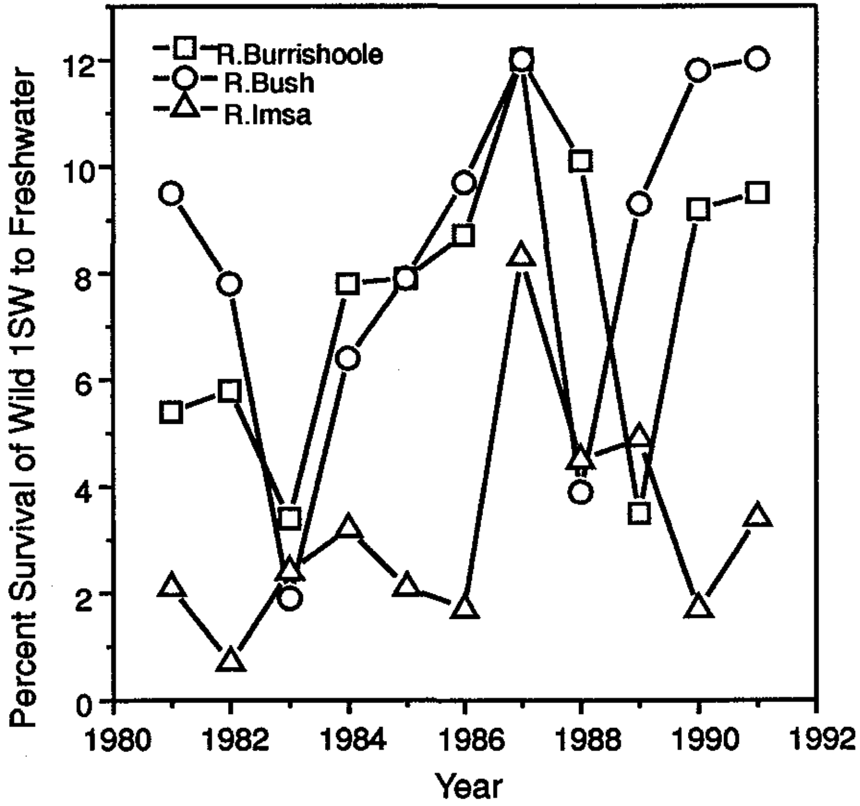


Figure 1.3.2 Percent survival of hatchery origin 1SW Atlantic salmon to homewater areas for monitored European rivers.

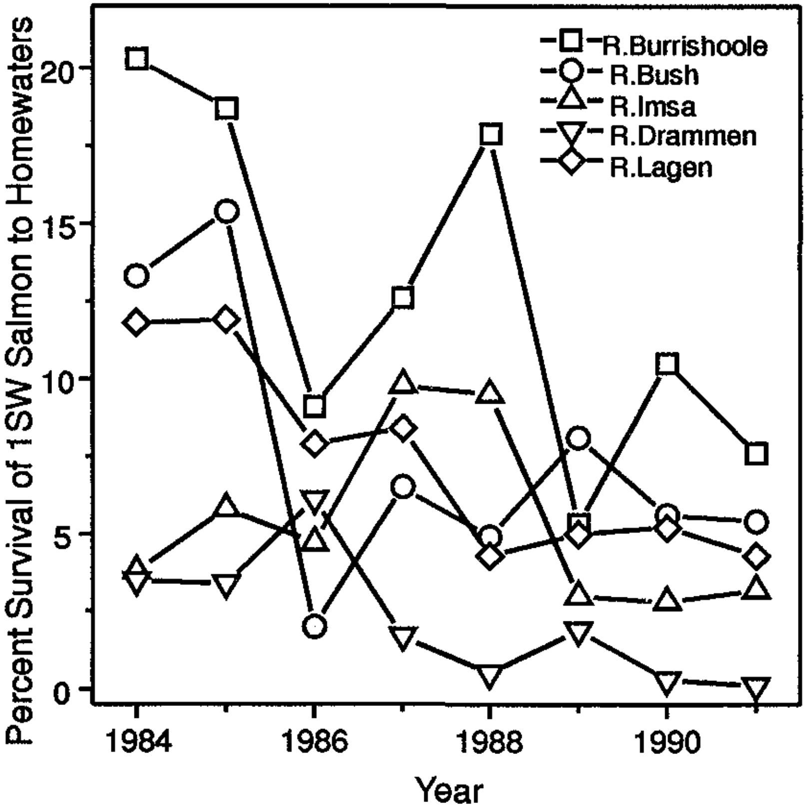


Figure 1.3.3 . Recreational harvest of wild 2SW Atlantic salmon from Maine, USA (limited to the Dennys, E. Machias, Machias, Narraguagus,and Sheepscot rivers).

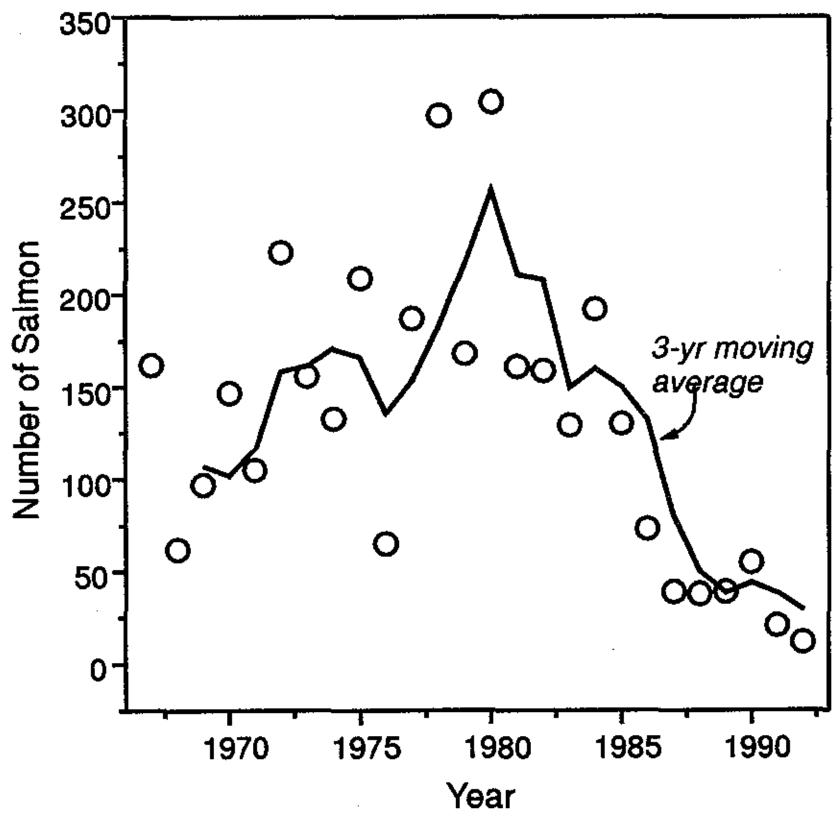


Figure 1.3.4 Estimated pre-fishery abundance of 1SW non-maturing salmon of North American origin.

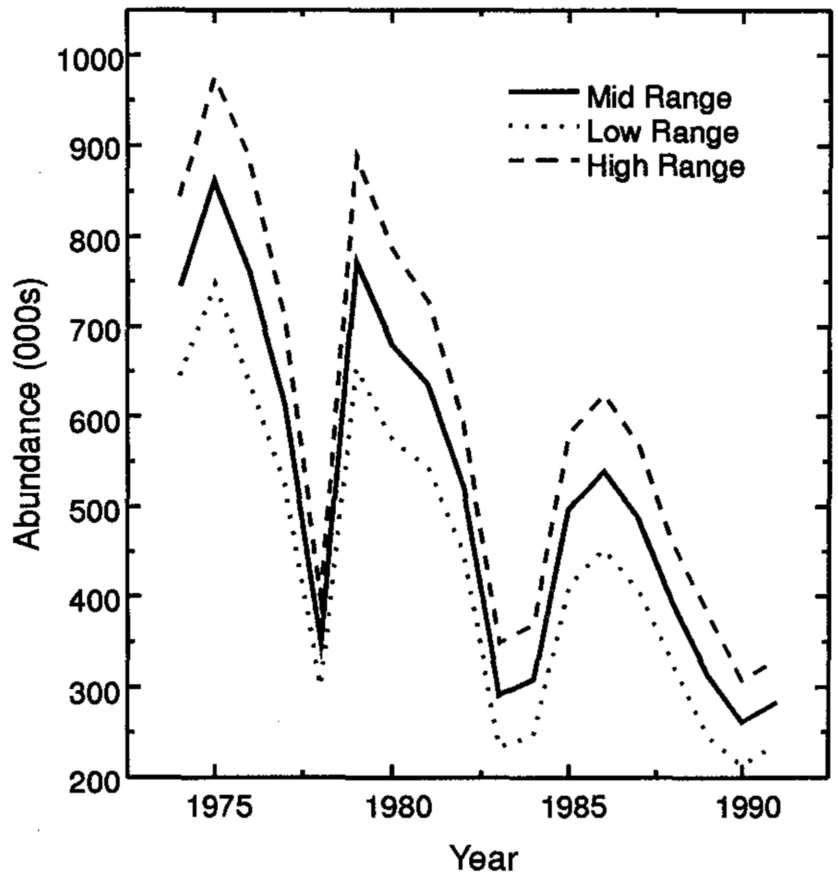


Figure 1.3.5 Percent change in 1992 egg deposition from 1987-1991 for specific rivers in Salmon Fishing Areas of Canada.

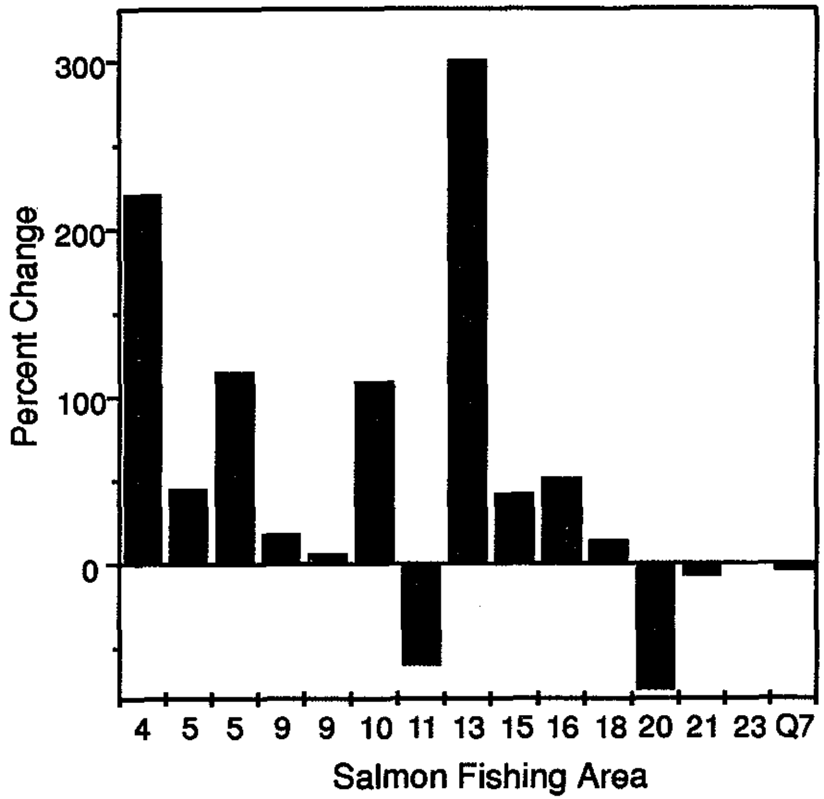


Figure 1.3.6 Estimated 2SW spawners in North America, 1974-92.

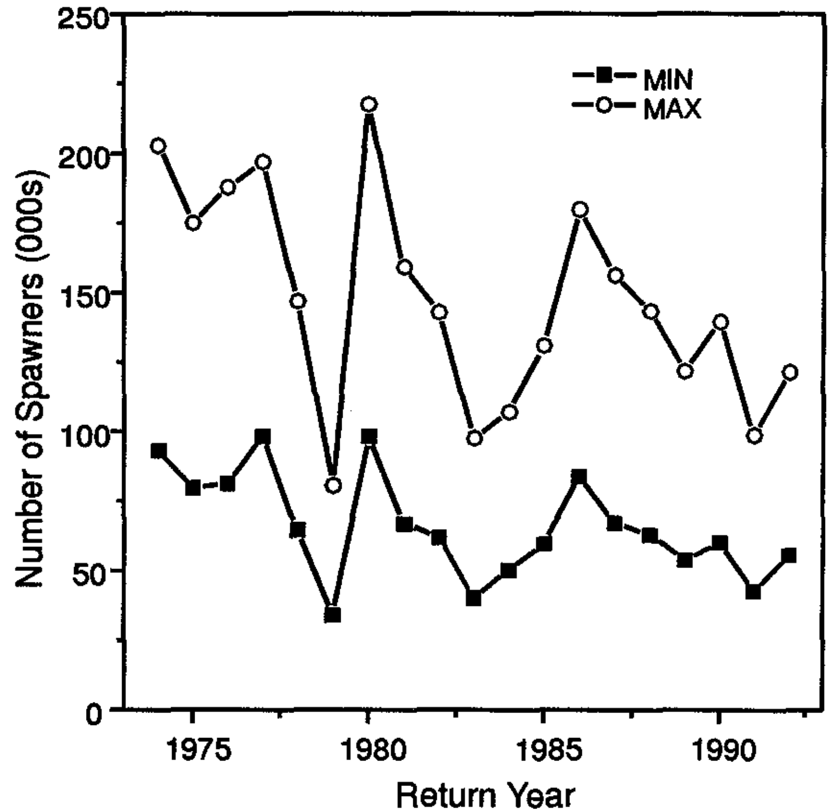


Figure 1.3.7 . Indices of smolt survival for Western North Atlantic salmon. Top: Wild smolts Canada, Middle: Hatchery smolts Canada, Bottom: Penobscot River hatchery smolts. Data smoothed by three year means.

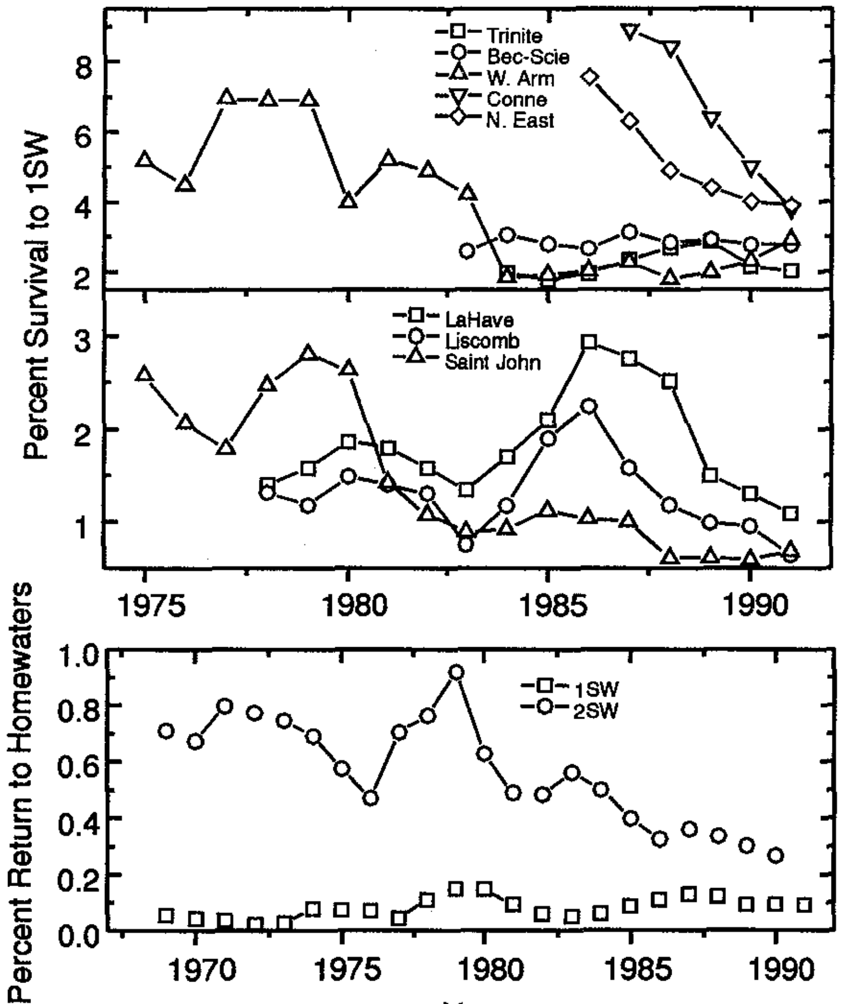


Figure 1.3.8 . Return rates for several North American stocks (A), standardized return rates for same group of stocks (B).

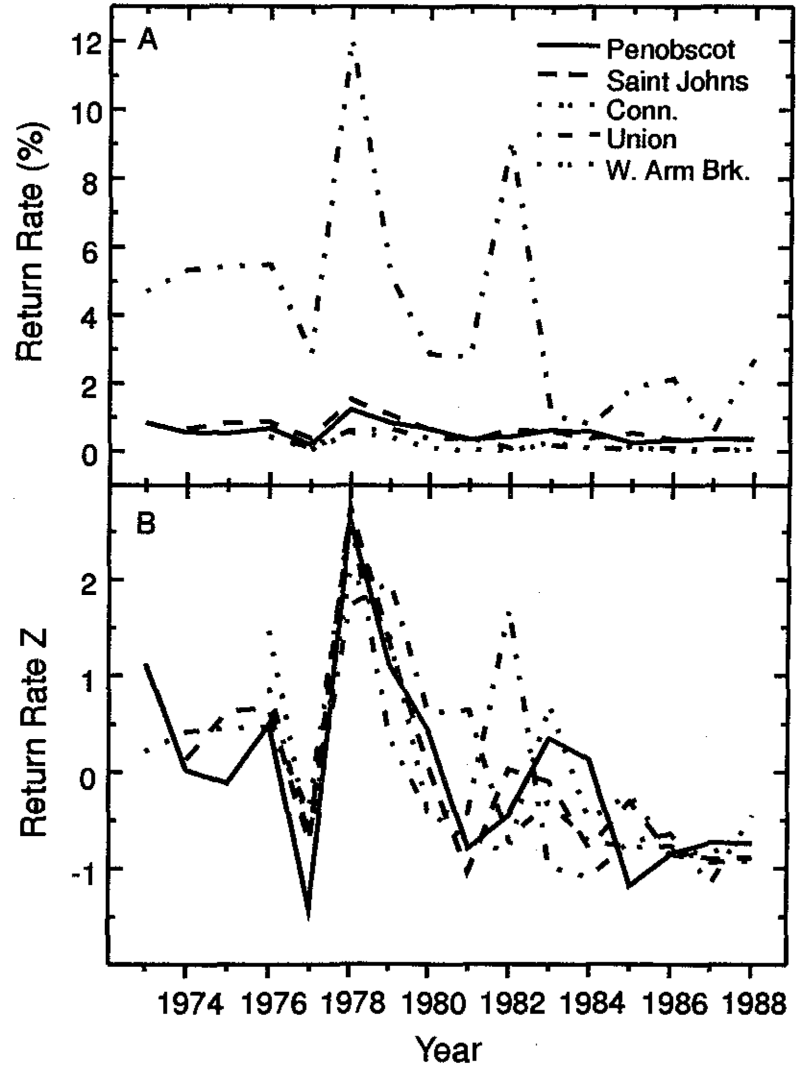


Figure 1.3.9 . Annual mean weight of Atlantic salmon caught at West Greenland, 1969-1992.

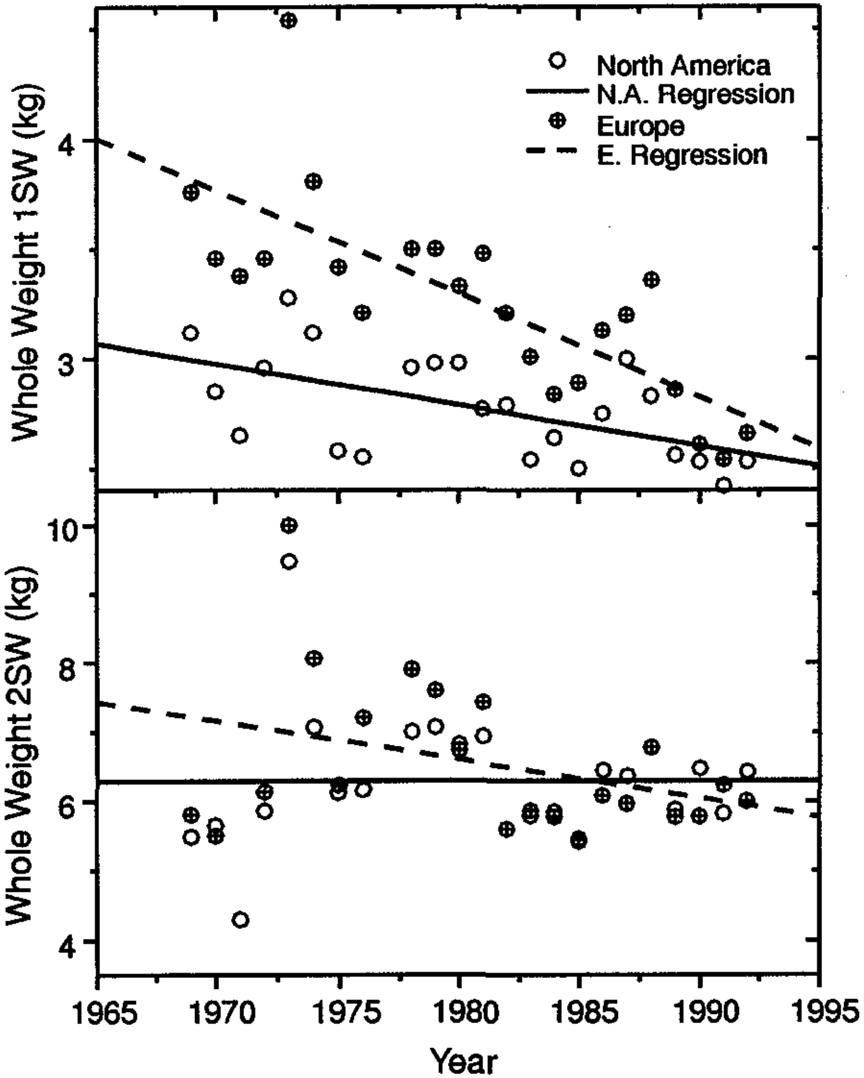


Figure 1.3.10 Relationship between estimated stock abundance and mean length of 1SW European origin salmon at West Greenland.

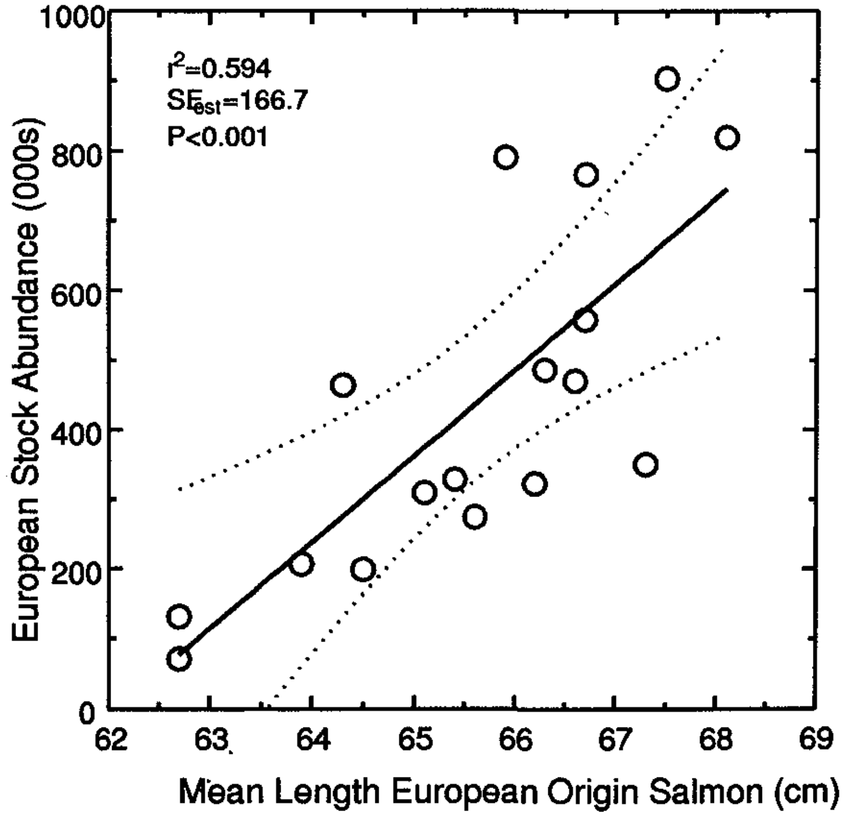


Figure 1.3.11 Relationship between estimated stock abundance and mean length of 1SW N. American origin salmon at Greenland.

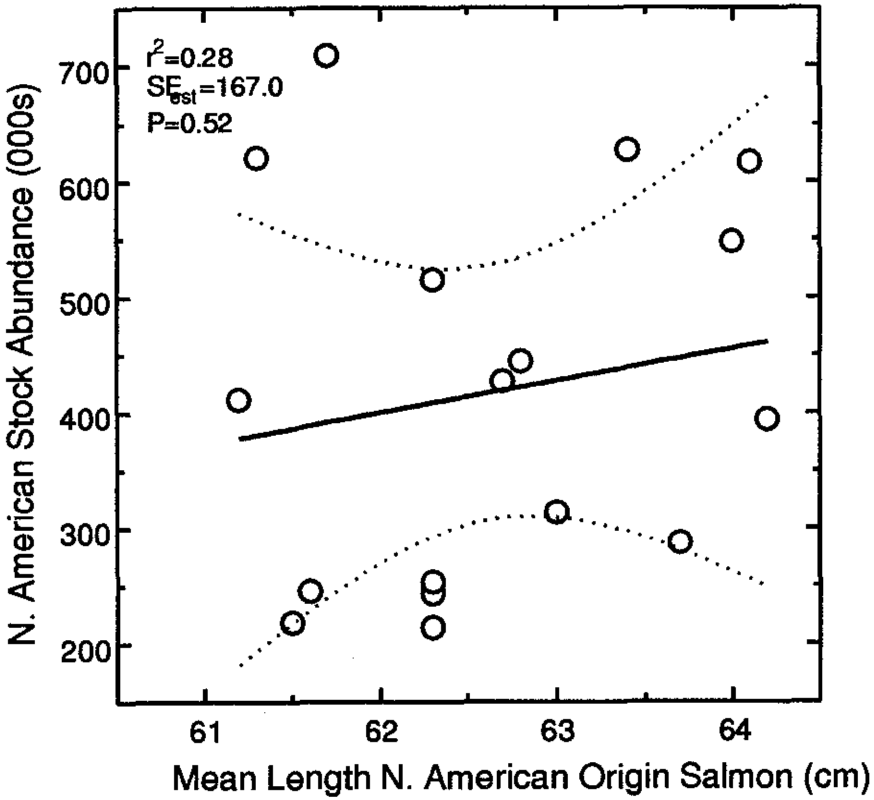


Figure 1.3.12 Estimate of catch of North American stock complex (A), standardized catch estimate, first principal component of winter habitat indices, and January index (B).

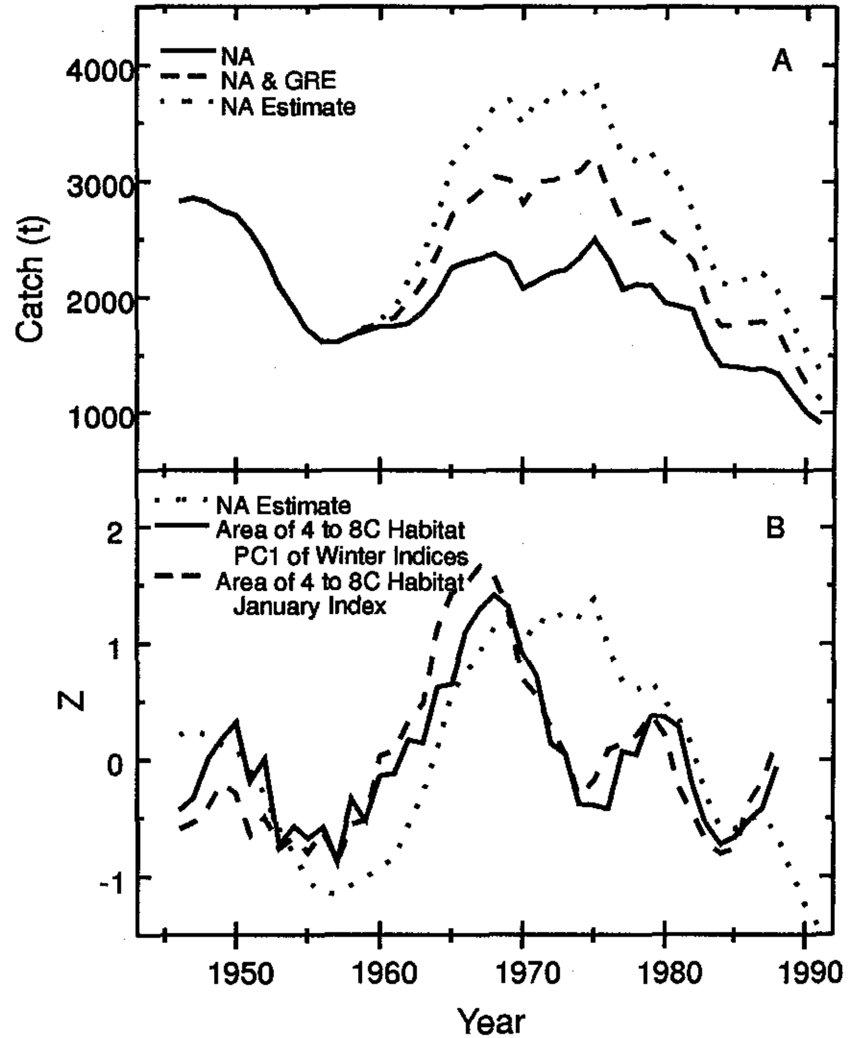


Figure 1.3.13 Estimate of catch of European stock complex (A), standardized catch estimates and first principal component of spring habitat indices (B).

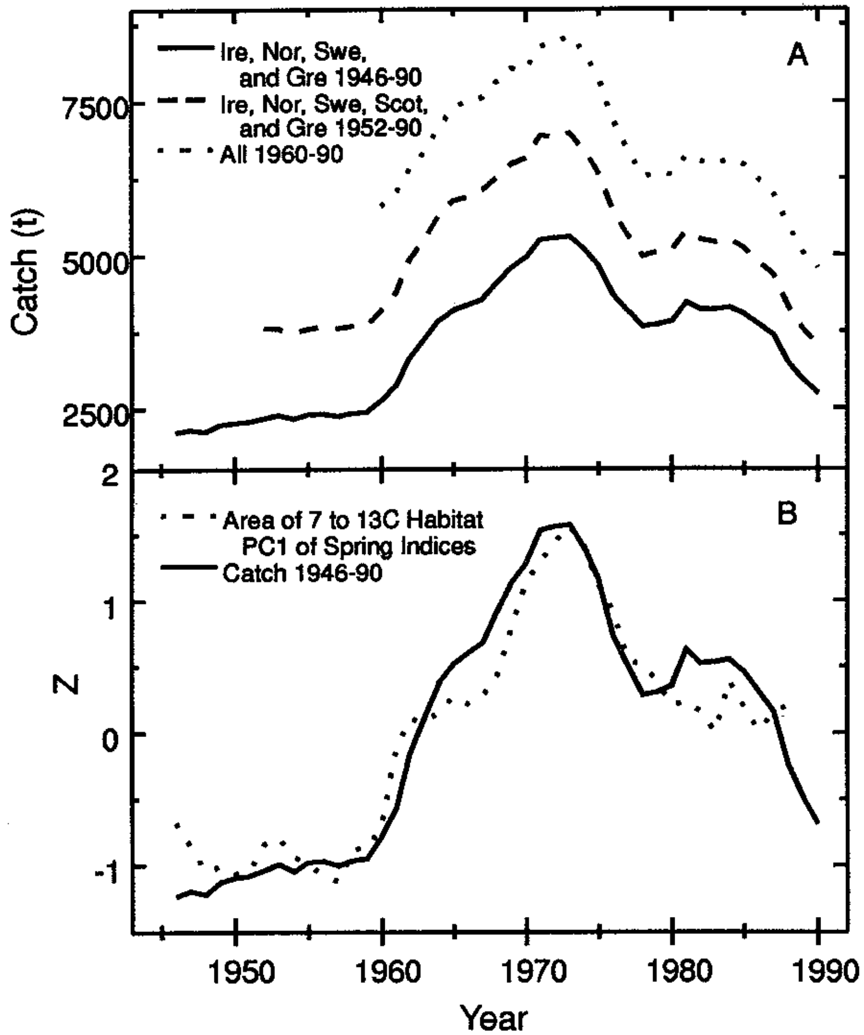


Figure 3.1.1 Comparison of harvest estimates of Maine origin salmon at West Greenland, 1987-92.

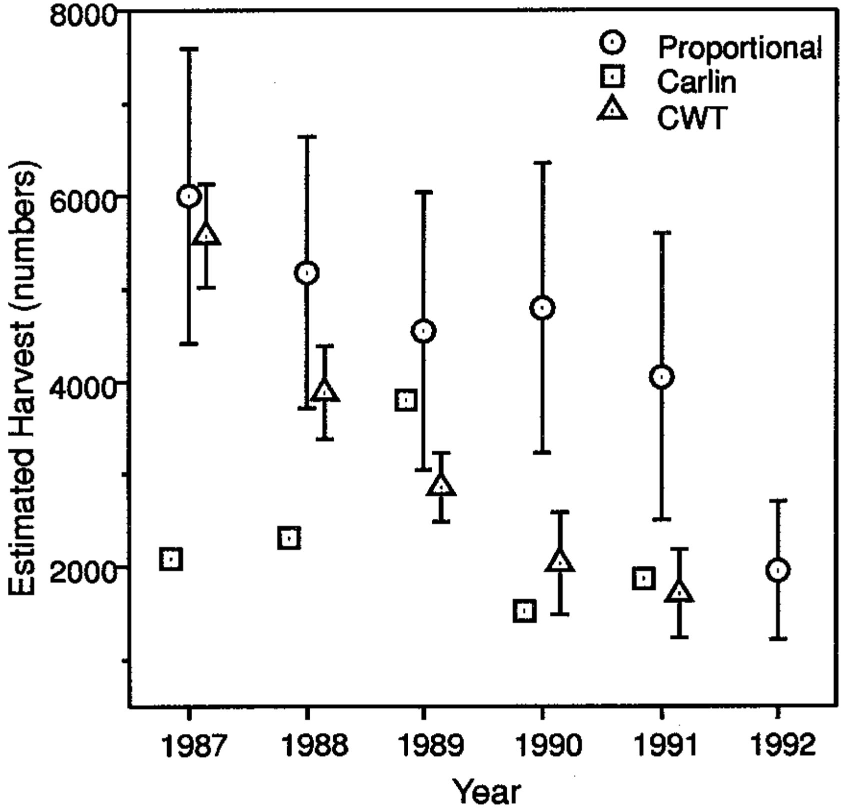


Figure 3.3.1 Minimum and maximum estimates of exploitation rates on non-maturing 1SW North American salmon at West Greenland, 1974-91.

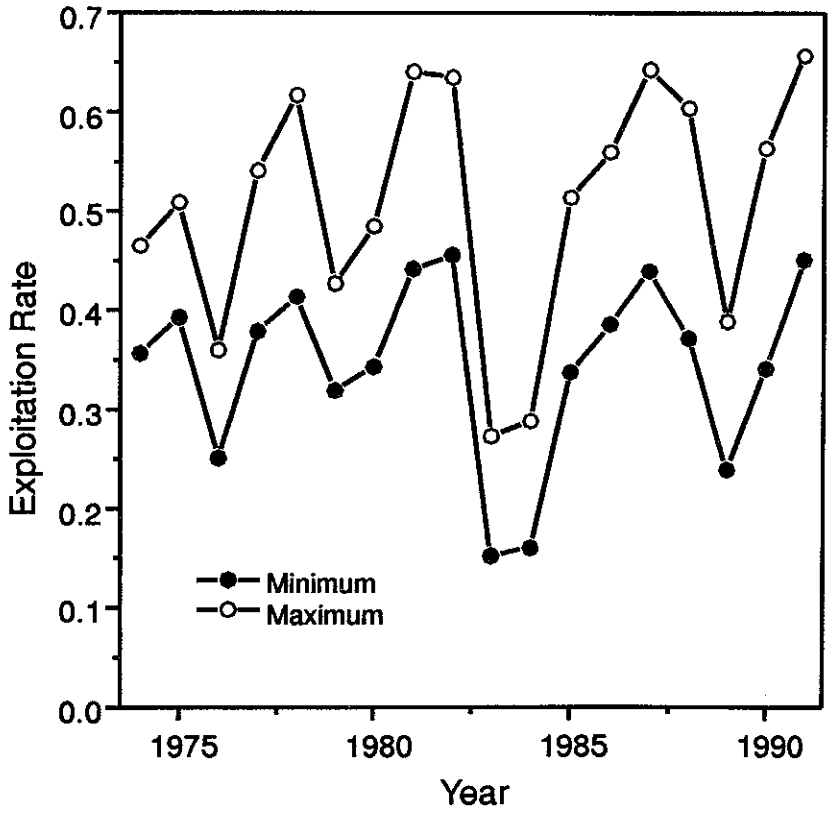


Figure 3.3.2 Minimum and maximum estimates of total stock abundance of Atlantic salmon at West Greenland, 1974-91.

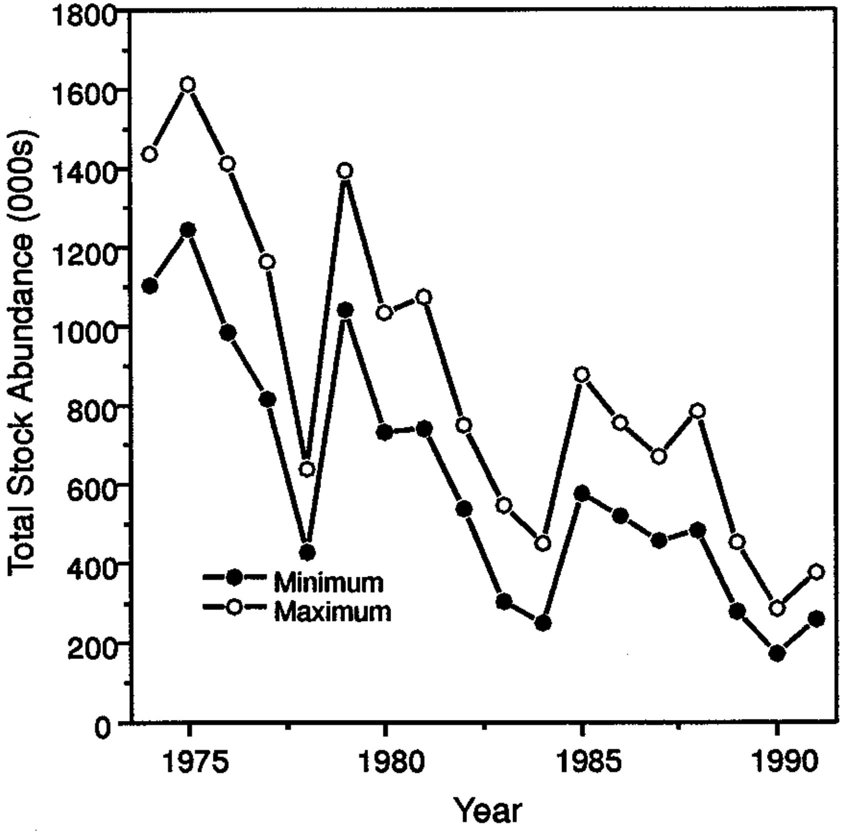


Figure 3.3.3 Minimum and maximum estimates of stock abundance of North American and European Atlantic salmon at West Greenland, 1974-91.

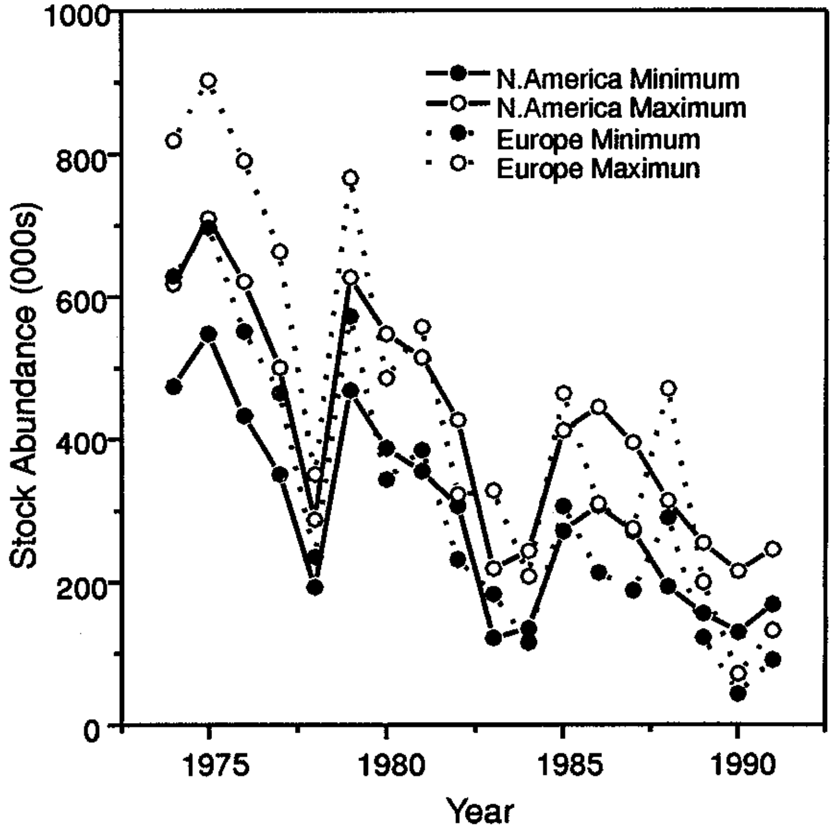


Figure 3.3.4 Comparison of exploitation rates in Canada and Greenland as determined by tagging experiments with Maine stocks (P=0.1) and by the continental run-reconstruction model.

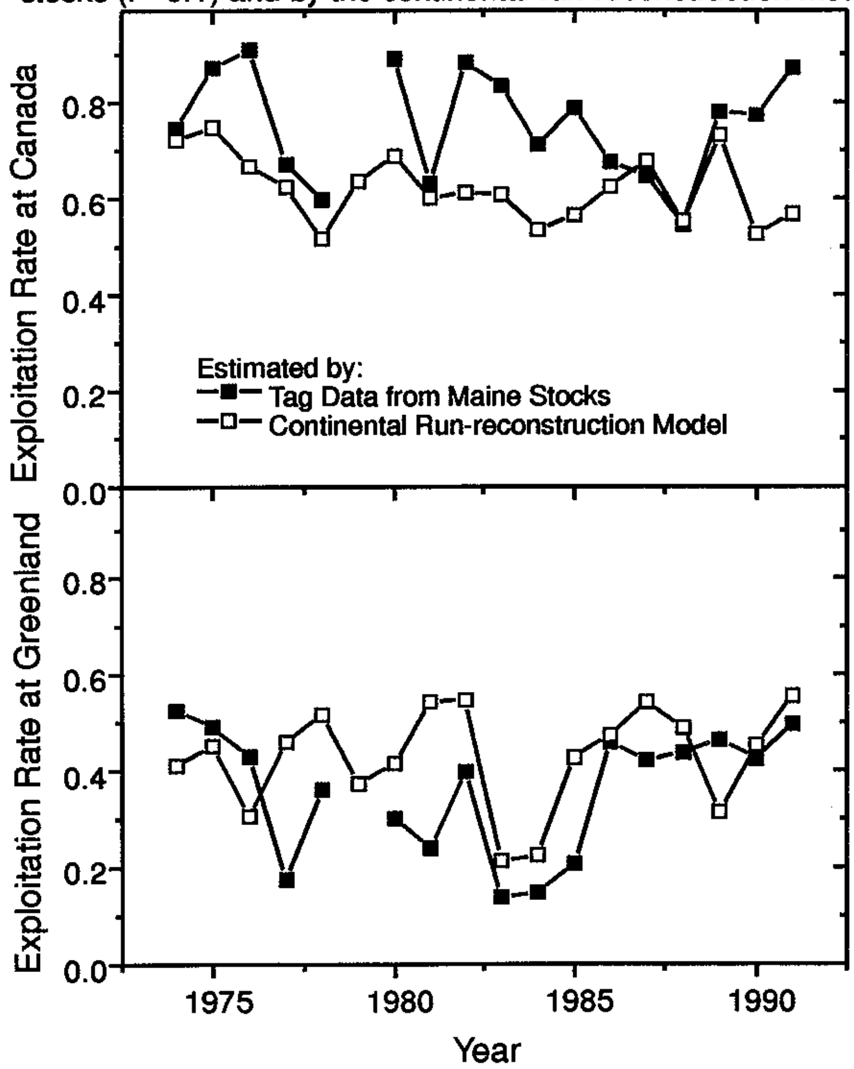


Figure 3.3.5 Proportional contribution of the northern North American stock complex to the West Greenland fishery, 1974-92.

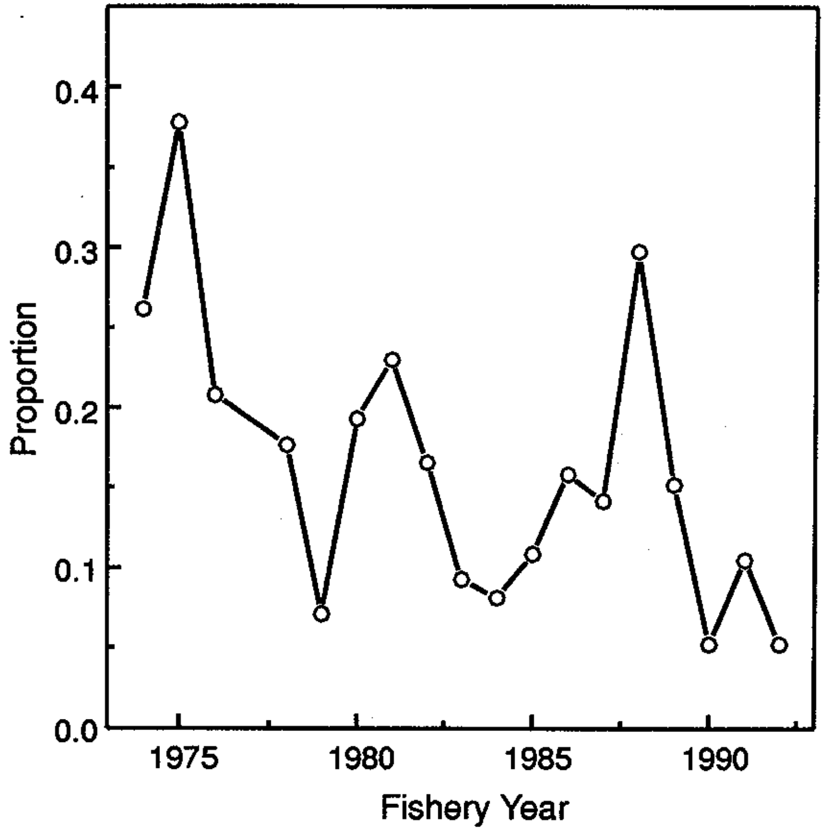


Figure 3.3.6 Estimated catches of northern and southern North American stock complexes at West Greenland, 1974-92.

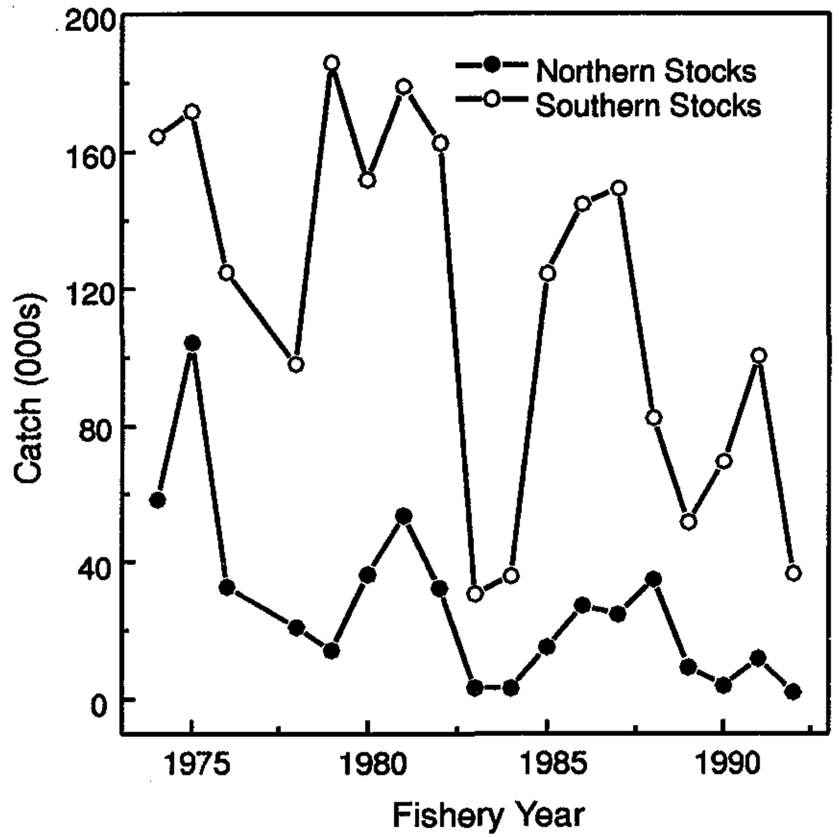


Figure 3.3.7 Comparison of observed returns of 2SW salmon to North America and projected returns assuming that the Greenland quota had not been reduced from 1190t.

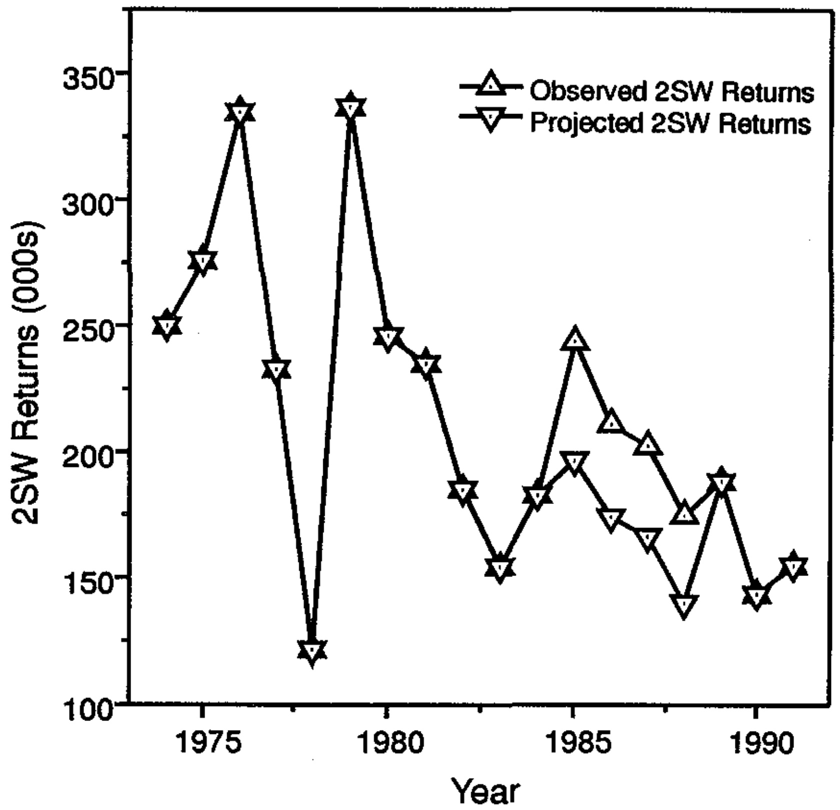


Figure 3.3.8 Comparison of observed returns of 2SW salmon to North America and projected returns assuming that Canada had not reduced fishing mortality from the average exploitation rate of 0.44 in 1974-77 in the Newfoundland-Labrador fishery.

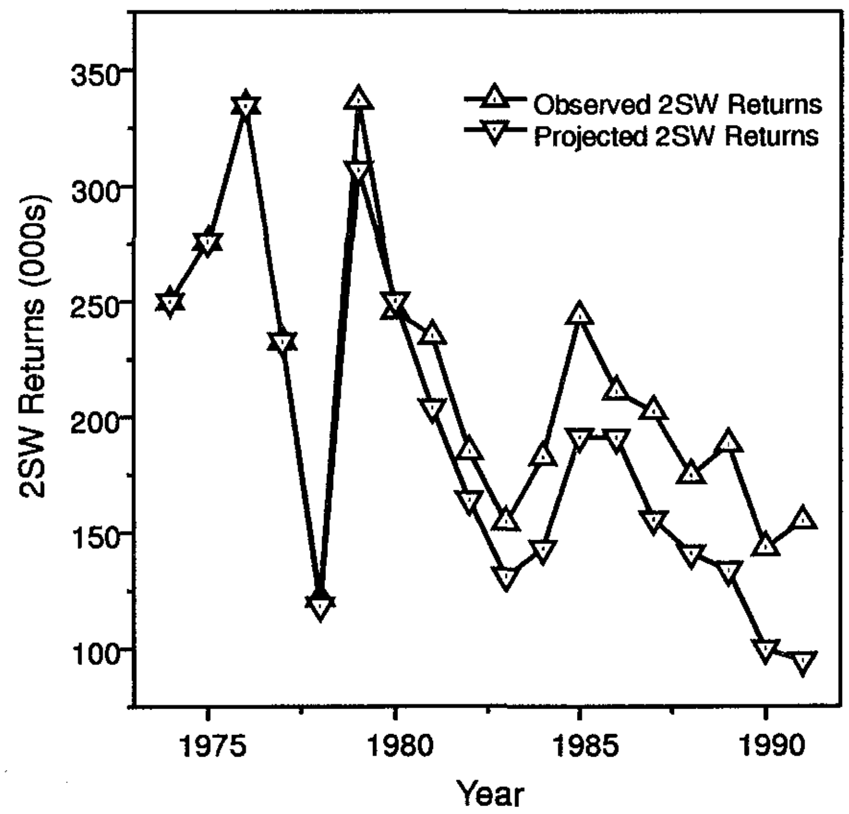


Figure 3.3.9 Comparison of observed returns of 2SW salmon to North America and projected returns based on the combined effects of 1) no reduction of the Greenland quota from 1190t and 2) no reduction in exploitation in Nfld.-Lab. from 1974-77 average of 0.44.

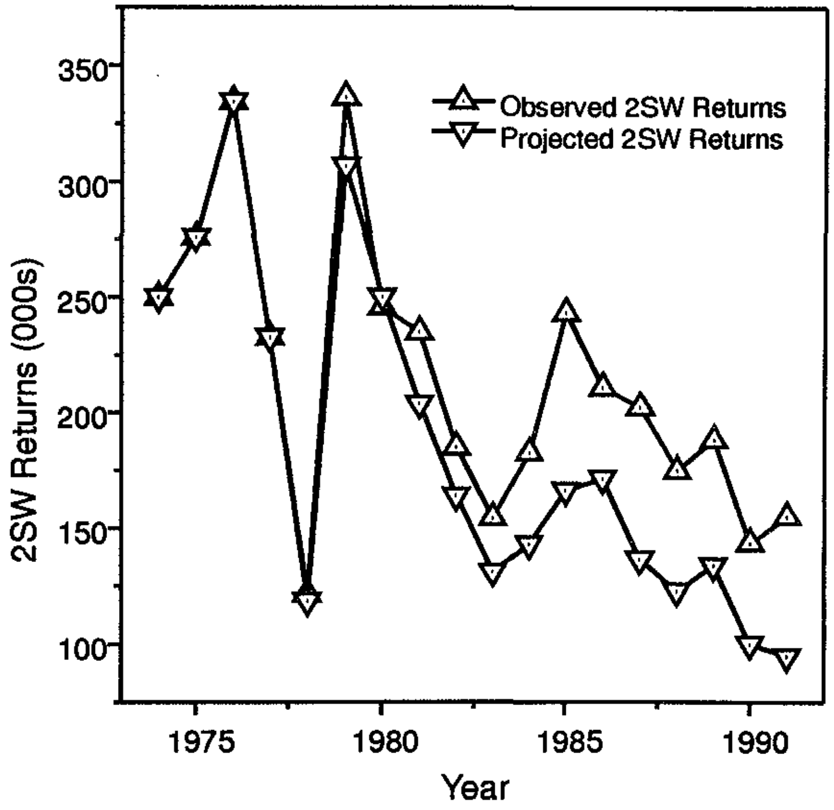


Figure 3.4.1 March index of overwintering habitat in the Labrador Sea from 1970-93.

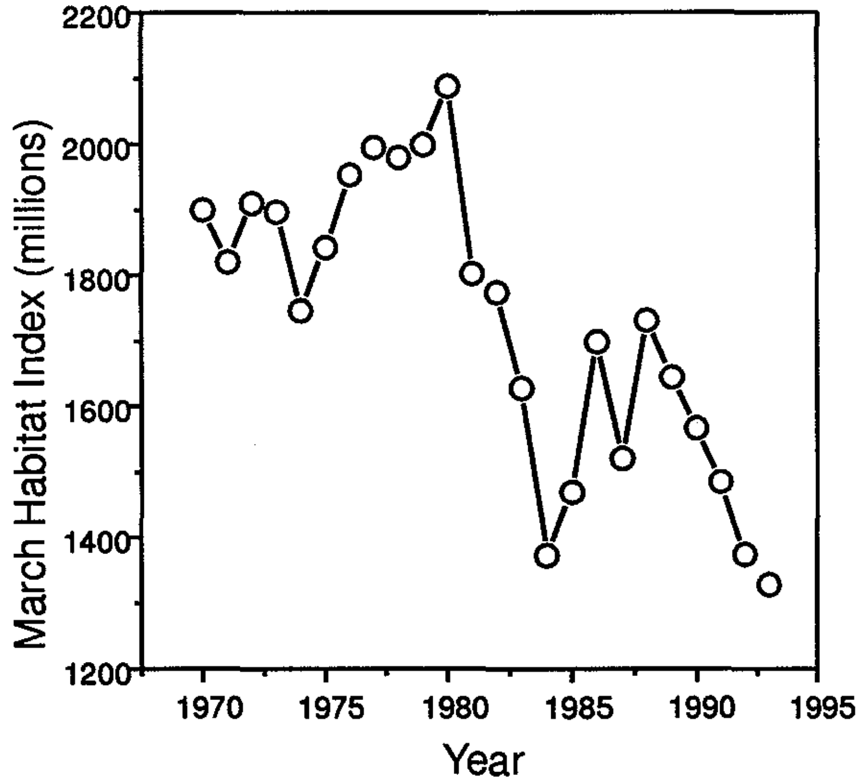


Figure 3.4.2 Pre-fishery abundance and predicted values based on habitat area in March (A). Relationship of pre-fishery abundance on weighted habitat area in March (B).

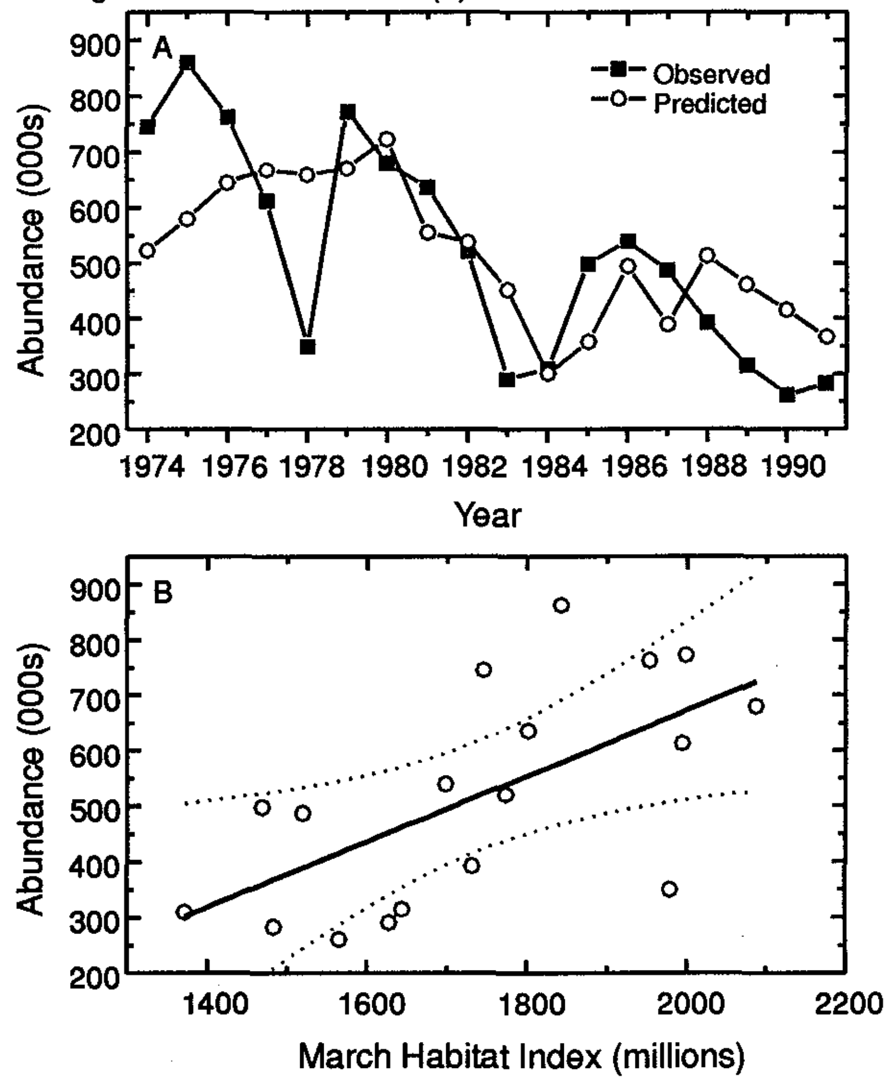


Figure 3.4.3 Estimates of pre-fishery abundance of non-maturing North American stock complex.

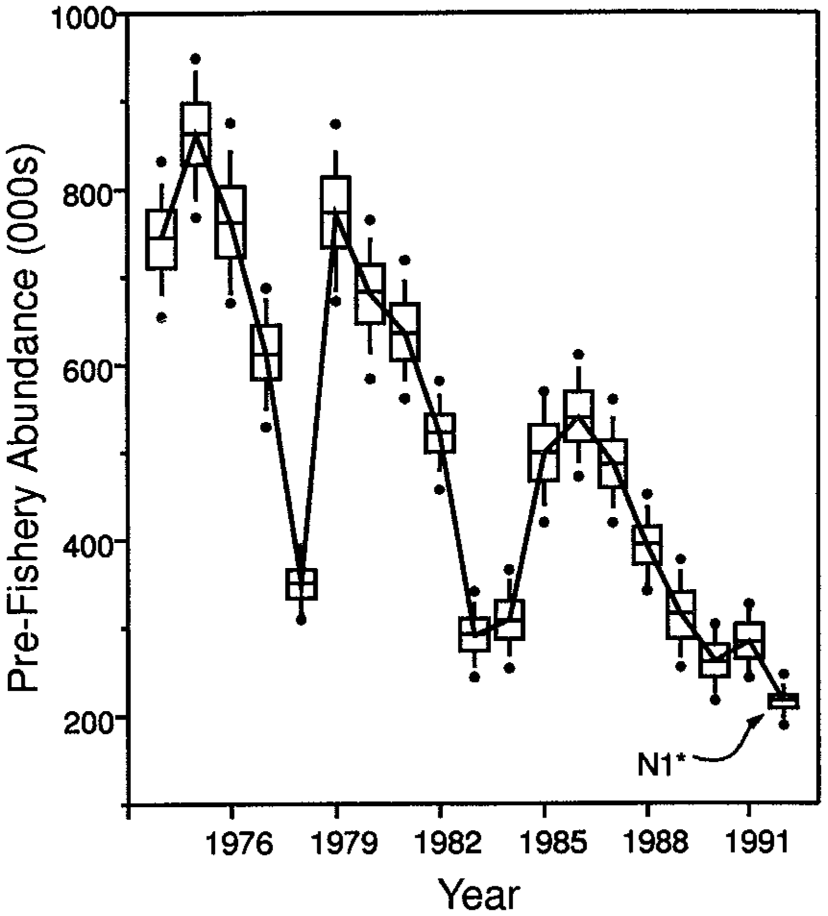


Figure 3.4.4 Univariate and regression forecasts of pre-fishery abundance in 1993. Dot centers indicate interquartile range of estimate, cross center indicates interquatile range of point estimates for stochastic forecasts only.

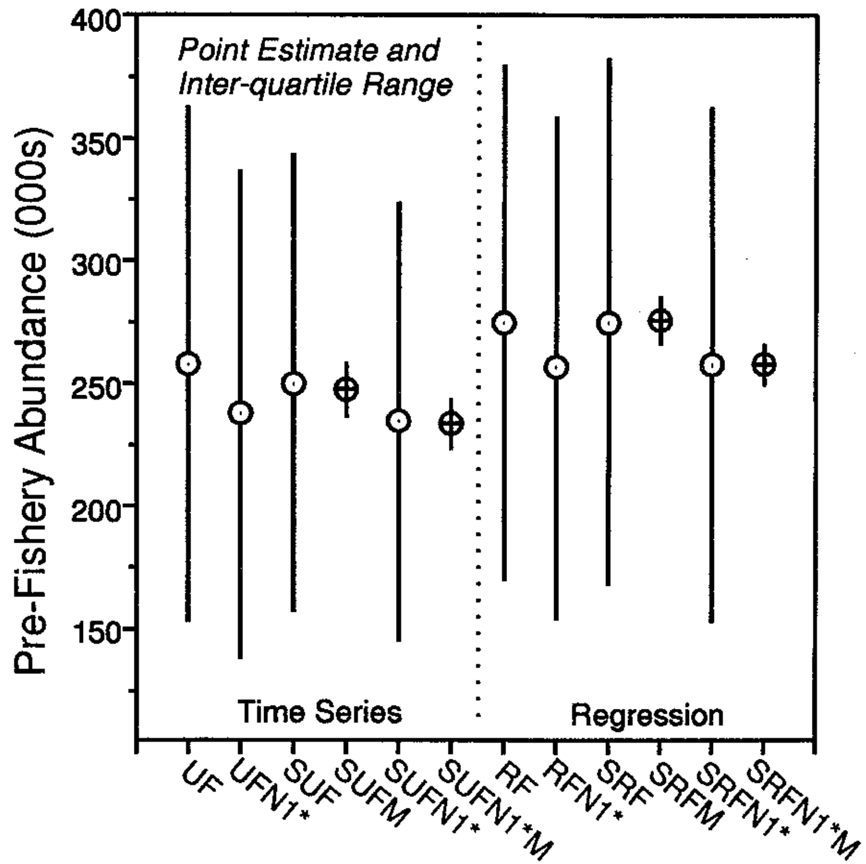


Figure 3.4.5 A probability density function of pre-fishery abundance on non-maturing stocks.

Panel C illustrates the amount of uncertainty associated with the estimate of pre-fishery abundance (PFA) in 1993. The Y-axis gives the probability (chance) that PFA is greater than any of the possible PFA values given on the X-axis. For example, there is a 75% chance that the true PFA is greater than 153,000 but only a 25% chance that the true PFA is greater than 363,000. The uncertainty in PFA implies that there will also be uncertainty in achieving the target spawning escapement level. For reference, the vertical line passing through each of the panels, gives the number of PFA fish (219,132) needed to ensure achievement of the target spawning escapement (196,306). However, the "risk" to the stock in terms of long-term productivity (or other factors) associated with not achieving this escapement is not illustrated by this figure.

In Panels A and B

The pre-fishery abundance level selected can be allocated with respect to the porportional allocation at West Greenland and North America.

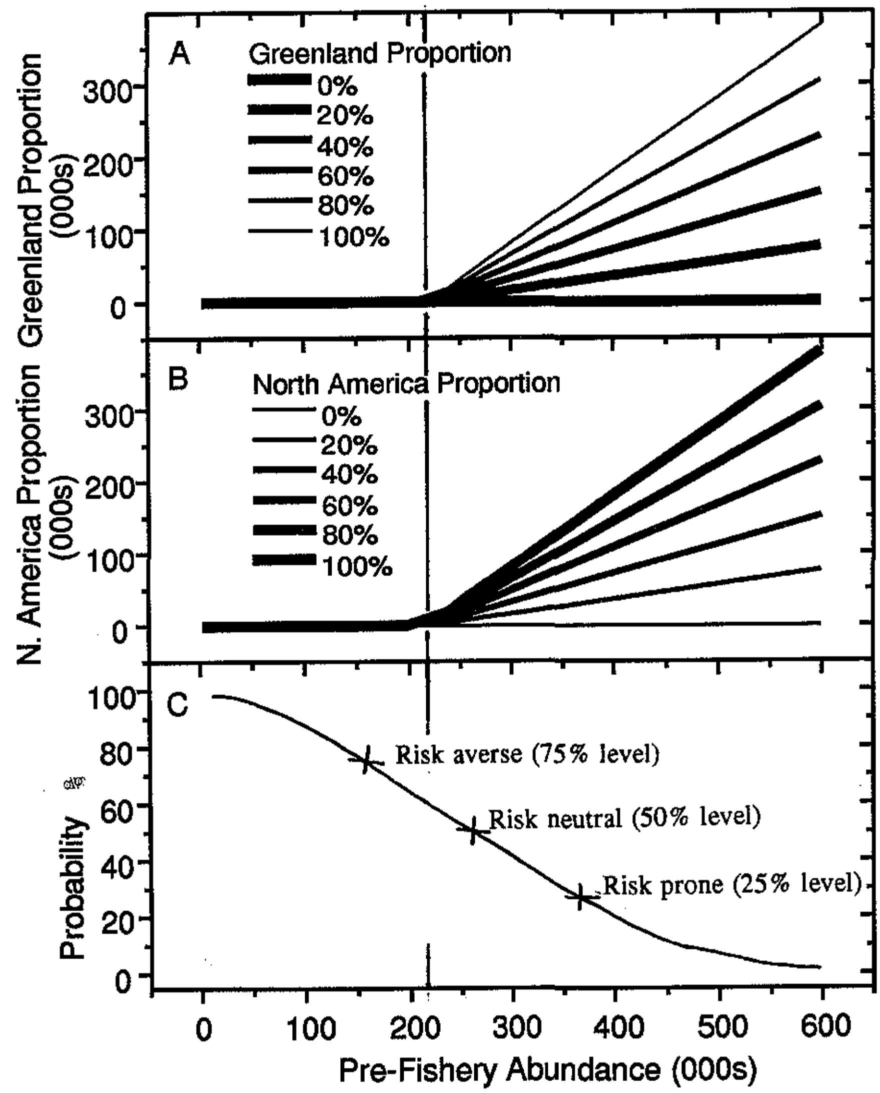


Figure 3.4.6 Predicted exploitation versus Greenland catch levels based on an assumed pre-fishery abundance level of 258,000.

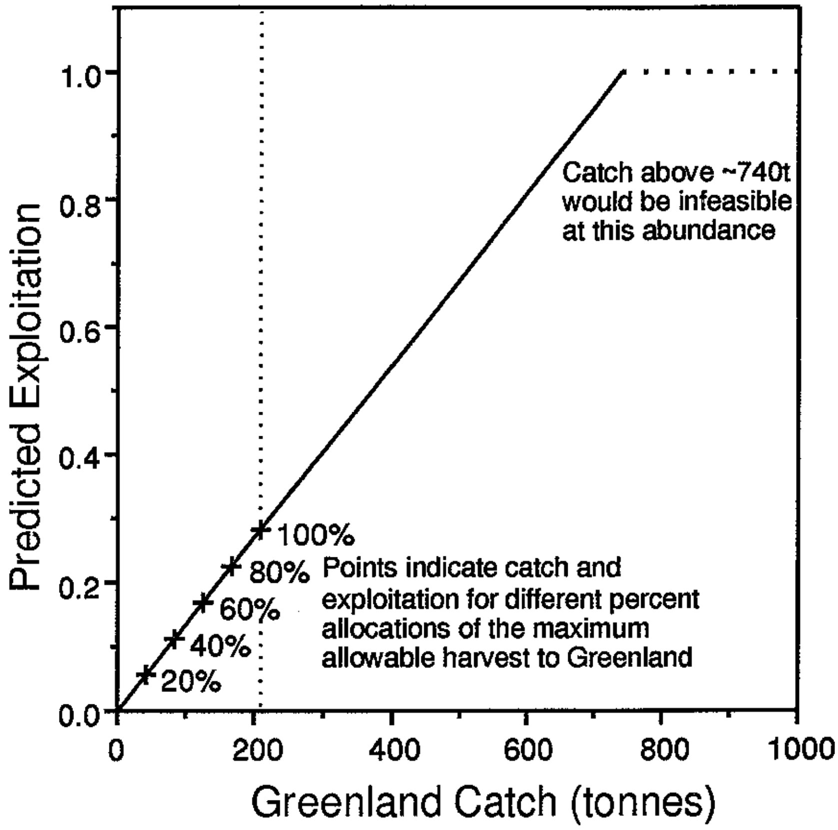


Figure 3.6.1. Reporting rate estimates at West Greenland based on comparison of Carlin and CWT recoveries.

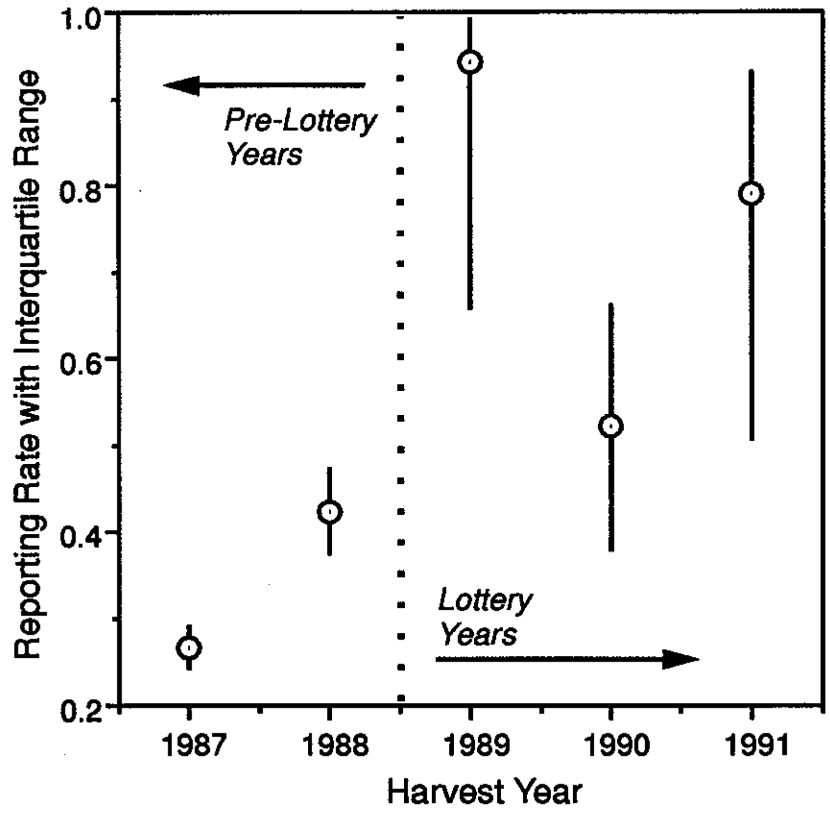
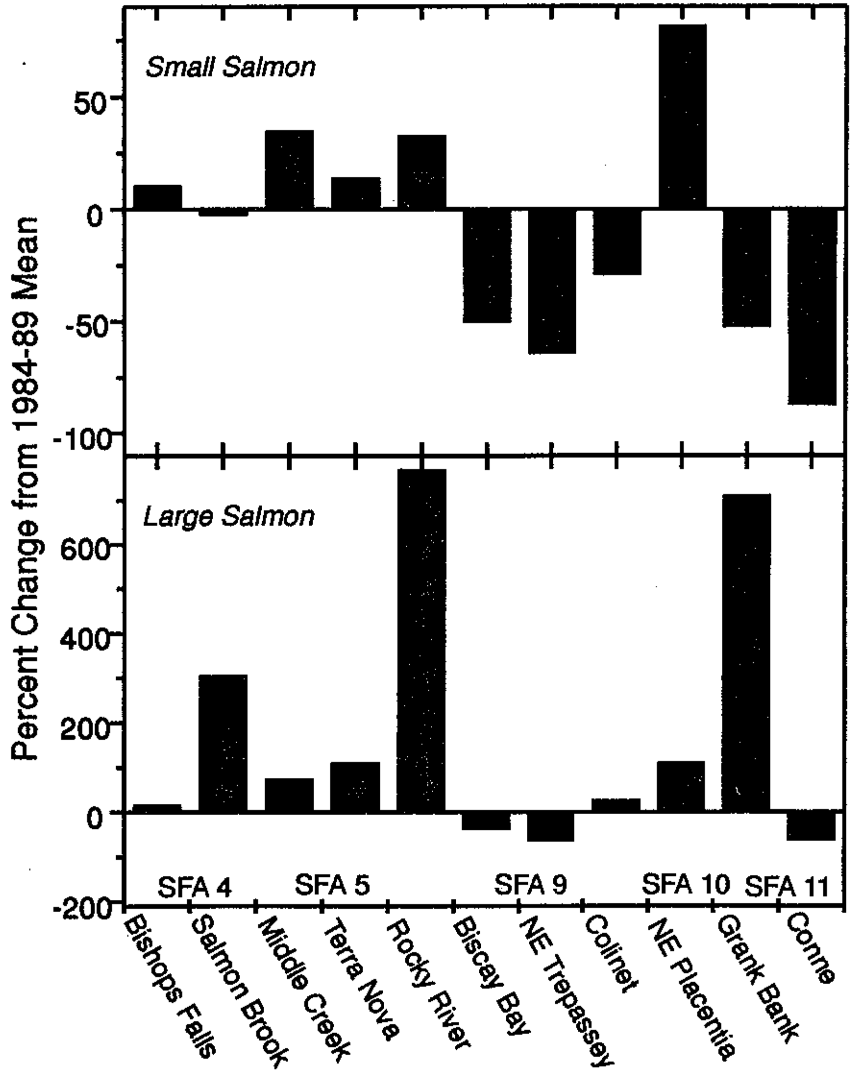


Figure 4.4.1 Counts of small and large salmon from fishways and counting fences in insular Newfoundland indicating 1992 returns as a percentage of 1984-89 mean.



REPORT TO THE GOVERNMENT OF NORWAY

HARP AND HOODED SEALS

Source of information: Report of the joint ICES/NAFO Working Group on Harp and Hooded Seals, Copenhagen, 15-21 September 1993 (C.M.1994/Assess:5)

1 HARP SEALS IN THE GREENLAND SEA (JAN MAYEN)

1.1 Catches

Catches of harp seals (*Phoca groenlandica*) in the Greenland Sea (Jan Mayen) during 1946-1993 (Table 1.1.1) have averaged about 20,000. The average for 1989-1993 is substantially lower at about 6,100.

1.2 Distribution

Tag returns indicate that harp seals from the Greenland Sea contributed to the invasion of the Norwegian coastal waters in 1986-1988. The tag returns also indicate that immature seals from this stock may share feeding grounds with seals from the Northwest Atlantic at Greenland and with White Sea harp seals in Norwegian waters. There is no evidence of mixing on the breeding grounds, however. The breeding areas and migration routes of harp seals are shown in Figure 1.2.1.

1.3 Population Size and Pup Production

The updated estimate of the 1991 pup production from mark-recapture, including recaptures in 1992 and 1993 is 57,800 pups (95% confidence limits of 46,000 and 69,000).

Visual and photographic surveys conducted in 1991 identified four whelping patches. Two patches were covered by both photographic and visual surveys. In both cases the visual estimates were higher than the photographic estimates. The results from both surveys were combined to give an estimated pup production of 55,300 (95% confidence limits of 44,500 and 68,500). This estimate is consistent with the mark-recapture estimate.

The mark-recapture pup production estimate for 1991 was used to make stock and catch projections for 1994 with the model used in the previous assessments. A value of M=0.11 was used for ages 1+ and M=0.33 was used for age 0. With these parameters, pup production in 1994 would be 59,800 and age 1+ abundance 285,800.

Three scenarios that would stabilise stock size were considered:

1) No pups, the entire catch is 1+
2) No 1+, the entire catch is pups
3) The ratio of pups to 1+ in the catch equal to the average ratio for 1979-1988

Scenario	Exploitation Rate		1994 Catches		
	Pups	1+	Pups	1+	Total
1	0	.046	0	13,100	13,100
2	0.443	0	26,500	0	26,500
3	0.225	0.025	13,500	7,100	20,600

1.4 Management Advice

ACFM considers that the catches calculated above for 1994 would stabilize stock size. The substantially decreased catches since 1983 are expected to have allowed the stock to increase and the 1991 pup production supports that expectation.

2 HOODED SEALS IN THE GREENLAND SEA (JAN MAYEN)

2.1 Catches

Catches of hooded seals (*Cystophora cristata*) in the Greenland Sea (Jan Mayen area) during 1946-1993 (Table 2.1.1) have averaged about 28,000. The average for 1989-1993 is substantially lower at 2,600.

2.2 Distribution

The known breeding and moulting areas and the supposed migration routes of hooded seals are shown in Figure 2.2.1. There is evidence of a connection between hooded seals occurring in the Newfoundland-Davis Strait area, the moulting area in the Denmark Strait, and at Greenland. Studies with satellite tracking of hooded seals in the Greenland Sea confirm previous information from traditional tagging in the same area. Recaptures in Norway and Iceland of hooded seals tagged near Jan Mayen confirm that young animals may disperse over large areas in their first year of life. Recaptures of hooded seals tagged at Newfoundland, in the Davis Strait and at the moulting patches in the Denmark Strait have been reported from both West and East Greenland. A recent recapture of a hooded seal tagged at Newfoundland and recaptured in Greenland provides evidence that hooded seals are overwintering in Greenland. For the first time, a breeding animal tagged at Jan Mayen has been recovered in Greenland.

2.3 Population Size and Pup Production

There are not enough data to assess the present state of this stock. However, considering that past catches were substantially higher than those since 1983, the population size may have increased.

2.4 Management Advice

In the absence of population size estimates, ACFM is unable to provide quantitative estimates of sustainable or replacement yield. However, ACFM does not expect that catches equal to the average catch since 1983, that is about 3,800, would cause a decrease in population size.

3 ECOLOGY OF SEALS

New information on seal feeding continues to be collected and analyzed, thus contributing considerably to the knowledge of harp and hooded seal feeding habits. However, the basic information on prey abundance, food selection, energy requirements, and distribution of seals is still not sufficient to determine the extent of possible interactions between seal stocks, other marine resources, and fisheries. ACFM notes that a more integrated approach in national laboratories between fisheries experts and marine mammal experts would help to accelerate progress in this area. Two upcoming symposia, one hosted by the Norwegian Marine Mammal Research Programme in 1994 on the Biology of Marine Mammals in the Northeast Atlantic and the other a joint ICES and NAFO Symposium on the Role of Marine Mammals in the Ecosystem in 1995 may provide an opportunity to implement such an integrated approach.

The capelin stock in the Barents Sea has apparently decreased markedly in 1993. The invasion of seals on the Norwegian coast in 1986-1988 corresponded in time to a previous period of low capelin abundance in the Barents Sea. It is not known if the same change in seal migration will occur in 1994 because other prey species could be available for seals (herring and young cod).

Table 1.1.1 Catches of **harp seals** in the Greenland Sea ("West Ice"), 1946-1993[a], incl. catches for scientific purposes.

	Norwegian catches			Soviet catches			Total catches		
Year	pups	1 year and older	total	pups	1 year and older	total	pups	1 year and older	total
1946-	26606	9464	36070	-	-	-	26606	9464	36070
1951-	30465	9125	39589	-	-	-[b]	30465	9125	39589
1956-	18887	6171	25058	1148	1217	2366[b]	20035	7388	27424
1961-	15477	3143	18620	2752	1898	4650	18229	5041	23270
1966-	16817	1641	18459	1	47	48	16818	1688	18507
1971	11149	0	11149	-	-	-	11149	0	11149
1972	15100	82	15182	-	-	-	15100	82	15182
1973	11858	0	11858	-	-	-	11858	0	11858
1974	14628	74	14702	-	-	-	14628	74	14702
1975	3742	1080	4822	239	0	239	3981	1080	5061
1976	7019	5249	12268	253	34	287	7272	5283	12555
1977	13305	1541	14846	2000	252	2252	15305	1793	17098
1978	14424	57	14481	2000	0	2000	16424	57	16481
1979	11947	889	12836	2424	0	2424	14371	889	15260
1980	2336	7647	9983	3000	539	3539	5336	8186	13522
1981	8932	2850	11782	3693	0	3693	12625	2850	15475
1982	6602	3090	9692	1961	243	2204	8563	3333	11896
1983	742	2576	3318	4263	0	4263	5005	2576	7581
1984	199	1779	1978	-	-	-	199	1779	1978
1985	532	25	557	3	6	9	535	31	566
1986	15	6	21	4490	250	4740	4505	256	4761
1987	7961	3483	11444	-	3300	3300	7561	6783	14744
1988	4493	5170	9663[c]	7000	500	7500	11493	5670	17163
1989	37	4392	4429	-	-	-	37	4392	4429
1990	26	5482	5508	0	784	784	26	6266	6292
1991	0	4867	4867	500	1328	1828	500	6195	6695
1992	0	7750	7750	590	1293	1883	590	9043	9633
1993	0	3520	3520	-	-	-	0	3520	3520

[a]) For the period 1946-1970 only 5-year averages are given.

[b]) For 1955, 1956 and 1957 Soviet reported catches of harp <u>and</u> hooded seals at 3900, 11600 and 12900, respectively (Sov. Rep. 1975). These catches are not included.

[c]) Including 1431 pups and one adult caught by a ship which was lost.

Table 2.1.1 Catches of **hooded seals** in the Greenland Sea ("West Ice"), 1946-1993[a], incl. catches for scientific purposes.

	Norwegian catches			Soviet catches			Total catches		
Year	pups	1 year and older	total	pups	1 year and older	total	pups	1 year and older	total
1946-	31152	10257	41409	-	-	-	31152	10257	41409
1951-	37207	17222	54429	-	-	-[b]	37207	17222	54429
1956-	26738	9601	36340	825	1063	1888[b]	27563	10664	38228
1961-	27793	14074	41867	2143	2794	4938	29936	16868	46805
1966-	21495	9769	31264	160	62	222	21655	9831	31486
1971	19572	10678	30250	-	-	-	19572	10678	30250
1972	16052	4164	20216	-	-	-	16052	4164	20216
1973	22455	3994	26449	-	-	-	22455	3994	26449
1974	16595	9800	26395	-	-	-	16595	9800	26395
1975	18273	7683	25956	632	607	1239	18905	8290	27195
1976	4632	2271	6903	199	194	393	4831	2465	7296
1977	11626	3744	15370	2572	891	3463	14198	4635	18833
1978	13899	2144	16043	2457	536	2993	16356	2680	19036
1979	16147	4115	20262	2064	1219	3283	18211	5334	23545
1980	8375	1393	9768	1066	399	1465	9441	1792	11233
1981	10569	1169	11738	167	169	336	10736	1338	12074
1982	11069	2382	13451	1524	862	2386	12593	3244	15837
1983	0	86	86	419	107	526	419	193	612
1984	99	483	582	-	-	-	99	483	582
1985	254	84	338	1632	149	1781	1886	233	2119
1986	2738	161	2899	1072	799	1871	3810	960	4770
1987	6221	1573	7794	2890	953	3843	9111	2526	11637
1988	4873	1276	6149[c]	2162	876	3038	7035	2152	9187
1989	34	147	181	-	-	-	34	147	181
1990	26	397	423	0	813	813	26	1210	1236
1991	0	352	352	458	1732	2190	458	2084	2542
1992	0	755	755	500	7538	8038	500	8293	8793
1993	0	384	384	-	-	-	0	384	384

[a]) For the period 1946-1970 only 5-year averages are given.

[b]) For 1955, 1956 and 1957 Soviet reported catches of harp and hooded seals at 3900, 11600 and 12900, respectively (Sov. Rep. 1975). These catches are not included.

[c]) Including 1048 pups and 435 adults caught by one ship which was lost.

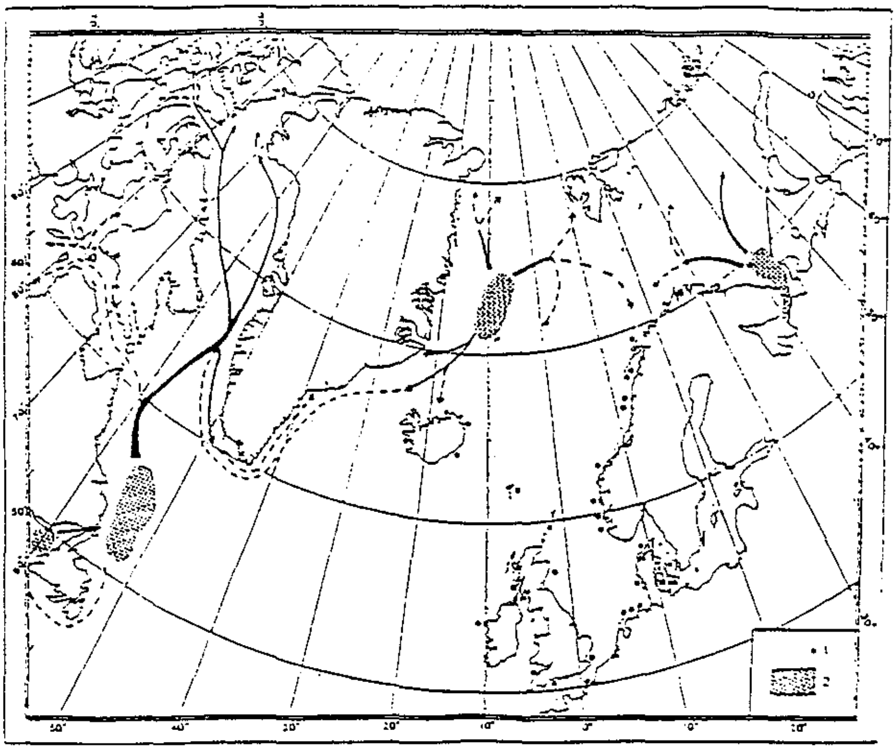


Figure 1.2.1 Breeding areas and migration routes of harp seals (<u>Phoca groenlandica</u>)

(1. extralimital observations. 2. breeding and moulting areas.)

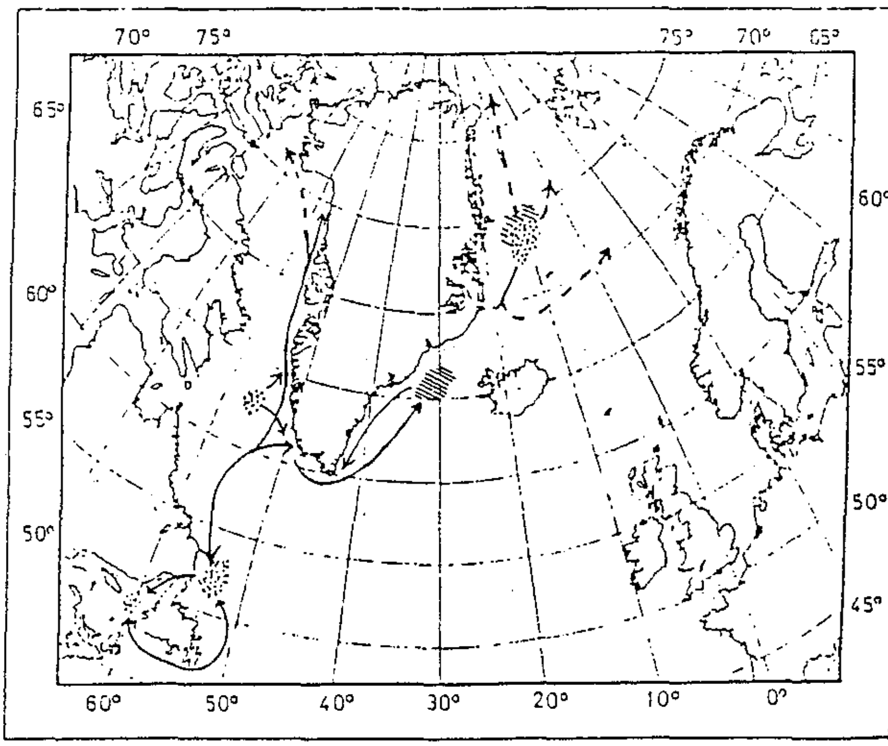


Figure 2.2.1 Breeding and moulting areas, and migration routes of hooded seals (<u>Cystophora cristata</u>)

(Dots represent breeding areas, striations represent known moulting areas.)