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REPORT OF THE ATLANTO-SCANDIAN HERRING AND CAPELIN WORKING GROUP

Copenhagen, 16-20 October 1989

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1 INTRODUCTION AND PARTICIPATION

1.1 Terms of Reference

The Atlanto-Scandian Herring and Capelin Working Group met at ICES Headquarters 16-20 October 1989.

The terms of reference are given in C.Res 1988/2:4:25: "The Atlanto-Scandian Herring and Capelin Working Group (Chairman: Dr V.N. Shleinik) will meet at ICES Headquarters from 16-20 October 1989 to assess the status of the Norwegian spring-spawning herring, Icelandic summer-spawning herring and capelin stocks in Sub-areas I, II, V and XIV and provide catch options within safe biological limits for the herring for 1990 and for the capelin for the winter 1989/1990 and summer-autumn 1990 seasons".

1.2 Participants

J. Carscadden J.A. Jacobsen A. Dommasnes P. Kanneworff A. Krysov V. Shleinik (Chairman) G. Stefansson	Canada Faroe Islands Norway Greenland USSR USSR Iceland
G. Stefansson	Iceland
R. Toresen	Norway

2 THE ICELANDIC SUMMER-SPAWNING HERRING

2.1 Working Paper presented

The following working paper was presented: "The Icelandic summer-spawning herring" by Jakob Jakobsson.

2.2 The Fishery in 1988

The landings of the summer-spawning herring from 1969 to 1988 are given in Table 2.1. The 1988 landings amounted to about 93 000 t. All the herring were caught in the purse-fishery which started on 8th October and finished by 20th December. About 83,000 t were taken in the fjords at east Iceland while about 10,000 t were caught in near shore areas of southeast Iceland. The text table below gives the landings and the TACs recommended during the last few years for this fishery:

Year	Landings	TACs	Recommended TACs
1984	50.3	50.0	50.0
1985	49.3	50.0	50.0
1986	65.5	65.0	65.0
1987	75.4	72.9	70.0
1988	92.8	90.0	100.01

 $^{^{1}}$ Recommended by ACFM. Weights in '000 t.

2.3 Catch in Number and Weight at Age

The catches in numbers at age for the Icelandic summer spawners for the period 1970-1988 are given in Table 2.1. In the first years after the fishery was re-opened in 1975 the 1971 year class was most abundant. During the period 1979-1982 the 1974 and 1975 year classes predominated in the catches. During the period 1983-1986 the fishery was dominated by the very strong 1979 year class. In 1987 and 1988 the fishery was on the other hand based on a number of year classes ranging from three to eleven ring herring. The weights at age for each year are given in Table 2.2.

2.4 Acoustic Surveys

The Icelandic summer-spawning herring stock has been monitored by acoustic surveys annually since 1973. Such a survey was carried out in November-December 1988.

During the period 6-19 November, the distribution and abundance of immature small herring was investigated in the fjords and bays of west and north Iceland. The main concentration of this component of the stock was located in Eyjafjordur on the north coast. During the the period 20-26 November, the distribution and the abundance of the mature component of the stock was investigated in the east coast fjords as well as in the coastal areas off southeast Iceland. The concentrations in east coast fjords were lower in abundance in 1988 than in 1987. On the other hand, a large herring overwintering school was located off south-western Iceland. At the end of November and beginning of December the area south and south-west of Iceland was surveyed. Good concentrations of one and two ringers were located south-west of Reykjanes. Due to bad weather for a long period this area could not be investigated properly. It should be noted that in 1987 considerable concentrations of the 1983 and 1984 year classes (three and two ringers respectively) were located in this area and prior to the 1988 survey fishermen reported that a component of these two year classes could be found in the south.

2.5 Stock Assessment

Results of the November-December acoustic survey together with the catch in numbers by age were used to calculate an exploitation pattern for the 1988 season. The results are given in Table 2.4. Usually it is considered that the Icelandic summerspawning herring is fully recruited as four ringers. In 1987 and 1988 it became clear however that the fishery was concentrated on the older component of the stock, that is 6 ring and older herring which were concentrated in the east coast fjords. Large quantities of younger age groups were located off the south-east coasts of Iceland in 1988 where fishing was only very limited.

Using this exploitation pattern a series of VPAs was run using a range of terminal Fs. The best one to one relation between the 12 acoustic estimates and virtual population analysis was obtained

with an input of F=0.53 on the older herring. According to this assessment the spawning stock has increased from 250,000 t in 1983 to about 300,000 t in 1985. It is estimated that in 1989 the spawning stock was just less than 400,000 t which is about 20% lower than was obtained according to the assessment made in 1988. The results of the VPA are given in Tables 2.5 and 2.6, and Figures 2.1.A and 2.1.B.

2.6 Catch and Stock Projections

Catches were calculated over a range of Fs for 1989 using the parameters given in Table 2.4. The stock in numbers data are derived from Table 2.6. Weight at age in the catch are obtained by using the relation:

$$W_{i+1} - W_{i} = -0.186 W_{i} + 80.415 (g)$$

where W_i and W_{i+1} are the mean weight of the same year class in year i and i+1, respectively, for the period 1978-1987. This relation was used to calculate the weight at age in the catch in 1988 for 1 to 8-ringed herring. For older herring the mean weight at age from 1985-87 was used.

Projections of spawning stocks biomass and catches ('000 t) based on the input data shown in Table 2.7 for a range of values of Fs are given in the text table below:

1989		199	1991		
Catch	F ₄₊	SSB at 1 July	F ₄₊	Catch	SSB at 1 July
90	0.26	430	0.22	80	560
•			0.26	90	450
			0.30	100	430

Weights in '000 t.

The details of the status $\underline{\text{quo}}$ prediction are given in Table 2.8 and Figure 2.1.D.

During the period 1982-1985 the fishing mortality varied from 0.192 to 0.319 (average, weighted by stock numbers, 4-14 rings) and was on average 0.217 or very close to the target level of fishing mortality for this stock which is $F_{0.1}=0.22$. During the period 1986 to 1988 the fishing mortality appears to have been somewhat higher.

2.7 Management Considerations

Based on this assessment it is estimated that the spawning stock in 1989 was 385,000 t which is over 20% lower than what was expected according to the 1988 assessment. Similarly it is shown in the present projection of spawning stock and catches that fishing at F $_{0.1}$ would lead to a catch of 76,000 t in 1989 and a spawning stock of 450,000 t in 1990. This is 20,000 t less catch than had been predicted in the 1988 assessment. The catch of 90,000 t

during 1989 season would result in fishing mortality of 0.26 which is somewhat above F . Despite this the spawning stock would increase from 385,000 t to 430,000 t in 1990. Taking into account that the herring stock has probably been underestimated during the 1988 acoustic survey and that the spawning stock is increasing, a TAC for the 1989 season has been set at 90,000 t. Fishing at the present fishing mortality (0.26) would result in a catch of 90,000 t in 1990. Assuming a catch of 90,000 t in 1989, fishing at $\rm F_{0.1}$ in 1990 would yield a catch of 80,000 t.

Advice on the TAC for 1990 should be deferred until after the acoustic survey in November-December 1989.

3 NORWEGIAN SPRING-SPAWNING HERRING

3.1 Working Papers Presented

The following working papers were presented: "Soviet investigations and fishery of Atlanto-Scandian herring in the Norwegian Sea in 1989" by A.I Kryssov and E.I. Seliverstova, "Norwegian spring spawning herring" by R. Toresen, and "Reappearance of Norwegian spring spawning herring on spawning grounds south of 60 N" by I. Røttingen.

3.2 Catch Statistics

The total annual catches of Norwegian spring-spawning herring during the period 1972-1989 in terms of weight and numbers are presented in Tables 3.1, 3.2 and 3.3. The estimated unreported catches have been converted to catch in numbers using Norwegian data on catch at age in the adult fisheries. Norwegian data have been applied to convert the USSR catch of 20,225 t in the winter of 1988 to catch in numbers.

3.3 Recruitment

The nursery areas of herring recruits are the fjords, the area off the Norwegian west coast, and, in some years, the southern part of the Barents Sea. The recruitment has, therefore, been assessed in two components, one coastal and one from the Barents Sea.

3.3.1 Acoustic O-group estimates in Norwegian coastal areas

An acoustic survey of 0-group herring distributed in the coastal areas of Norway has been conducted in November-December each year since 1975. The results are presented in Table 3.4.

3.3.2 The O-group index in the Barents Sea

Indices of O-group Norwegian spring-spawning herring have been estimated for the period 1965-1989 based on data from the international O-group surveys in the Barents Sea (Toresen, 1985; Anon., 1989a) (Table 3.5).

3.3.3 Acoustic O-group estimates in the Barents Sea

The acoustic estimates of O-group herring in the Barents Sea for the last six years are shown in the text table below:

Year class	Estimated number (billions)	Time of survey		
1983	35.7	Nov	1983	
1984	6.2		1984	
1985	41.5	Sep	1985	
1986	_	Sep	1986	
1987	-	Sep	1987	
1988	4.9	Nov	1988	

The Barents Sea components of the 1984 and 1985 year classes are completely depleted, most probably due to predation by cod (Mehl, 1987). In 1986 and 1987, no 0-group herring were detected in the Barents Sea. In November 1988, 0-group herring were found in the area between 34 and 41 E and to the south of 71° 30 N and an acoustic estimate was obtained. In 1989, no special survey will be conducted on 0-group herring in the Barents Sea.

3.4 The Adult Stock

As in 1988, the adult stock is assessed as one unit.

3.4.1 Acoustic estimates

In February-March 1989, an acoustic survey was carried out along the Norwegian coast to cover the spawning grounds. The conditions for measuring the biomass were favourable during the survey as the herring were not mixed with other species and were distributed in a medium-density layer at 20-100 m depth when measured at night.

The distribution area of spawning herring delineated during this survey was somewhat larger than in 1988 and is, therefore, the largest since investigations started on the spawning grounds in 1982.

Another acoustic survey was carried out in August 1989. During this period, the herring were distributed in the Lofoten area, in northern Norway. The conditions for measuring the biomass were not as favourable as in February-March because the herring were concentrated in dense schools, and often close to the bottom. The estimate of the total abundance from this survey therefore must be regarded as being too low.

In the text table below, the results from both these surveys are presented, together with the prognosis for the stock (millions) at 1 January 1989 as estimated by the Atlanto-Scandian Herring and Capelin Working Group in 1988, but adjusted at this meeting by the total catch in 1988:

Year class	1985	1984	1983	1982+	Total
Prognosis Jan (adjusted)	214	122	5,634	184	6,154
Acoustic estimate (Mar)	373	103	5,402	182	6,060
Acoustic estimate (Aug)	221	133	3,923	83	4,360

There is quite a good agreement between the prognosis and the acoustic estimate from February-March.

The year classes 1982+ are scarce, representing only about 10% by number of the spawning stock during the spring survey. This observation supports the indications from the survey made last year that these old year classes are less abundant than earlier prognoses stated. The Working Group in 1988 (Anon., 1989d) explained this feature as the effect of unreported additional mortality in the fishery through the years 1985-1987.

The 1983 year class estimate from March, representing approximately 90% of the spawning stock by number, is close to the 1988 prognosis estimate. However, when adjusted for the catch of 20,000 t in January and February in 1989 and by an annual natural mortality of 0.13 for two months, some 14,300 t are still "missing" from the 1983 year class in the acoustic estimate from March. The August estimate gave a much lower number indicating an underestimate for this year class in the Lofoten area.

The 1984 year class was measured as weaker in February-March than the prognosis predicted. This may be explained by the fact that the young, recruiting year classes do not mix well with the older fish in the spawning stock. On the contrary, they tend to concentrate in certain areas, often close to the shore. This may lead to an underestimate if the survey does not cover the area adequately.

The 1985 year class was measured as weaker in February-March than the prognosis states. This year class was concentrated in a certain area, and the sampling in this area was rather poor. This might have led to an overestimation of this year class by letting a few samples represent a large echo amount. However, the samples were judged as being representative for the age composition in the area and this estimate must be regarded as the best available. The calculated amount in August is lower, but more in agreement with the prognosis. However, due to the overall underestimation during this survey, the spring estimate of the 1985 year class is regarded as the best one.

The discrepancy between the prognosis and the acoustic estimates of the young recruits might be explained by the uncertainty in establishing the abundance of year classes not yet fully recruited to the spawning stock. It is not clear in what proportion the different year classes mature to spawn for the first time as this is very much dependent on the growth conditions of the young herring. However, at six years, even the slowest growing herring in this stock should reach the maturing size (approx. 30 cm), and at that time the relative strength of each year class in the spawning stock is set. In addition, the first spawners do not mix well with the spawning stock, leading to difficulties in estab-

lishing the relative amount of these year classes while surveying the spawning grounds. Therefore, the variation in the acoustic estimates of the youngest year classes in the spawning stock is high.

3.4.2 The state of the stock and VPA

The Working Group accepted the estimates of the different year classes from the February-March survey, except for the 1984 year class. For this year class, the Working Group accepted the August estimate which is somewhat higher than the spring estimate, indicating a better coverage in the last survey. Furthermore, the Working Group pointed to the higher probability of underestimating the youngest age groups in the spawning stock due to concentration in certain areas, often close to shore.

The Working Group adjusted the catches for the "missing" 14,300 t of the 1983 year class, adding a number of 61,111 thousand individuals. This is included in Table 3.3.

Other input data in the VPA were: Catch in number per year class (Table 3.3); Weight at age in the stock (Table 3.6); Proportions of maturity (Table 3.8); Natural mortality M (age 3 and older) 0.13.

The Working Group also decided to reduce the number of age groups in the VPA run from 14 to 10 so that the age group 12 includes this and older age groups. This was done to avoid presenting the uncertain figures of the different year classes older than 12 years. The fishing mortalities of the oldest true age group (11 years) were obtained by initially running a VPA calculating the average Fs for the age groups 11-16 years.

The fishing mortalities for the different age groups in 1988 were tuned so that the number in age groups 4 to 6 in January 1989 corresponded to the back-calculated number from the acoustic surveys in 1989 as accepted by the Working Group. The Fs of the age groups 6+ in 1988 (year classes 1982+) were set to the constant value which gave a sum corresponding to the 1989 acoustic estimate (186 million).

The results of the VPA are given in Tables 3.9 and 3.10 and Figures 3.1A and 3.B.

The estimated average Fs for the age groups 4-9 weighted and unweighted illustrate the uneven fishing pressure on the different age groups in this stock. The 1983 year class is dominating the spawning stock, but is not exploited at the same level as the other year classes in the spawning stock. This may be explained by the prices set on the different size groups of herring in Norway leading the fishermen to avoid the younger year classes (including the 1983 year class) and to target the older and bigger herring. The weighted mean F values, however, reflect the current fishing pressure on the adult stock quite well, which is also illustrated below in the results from the prognosis.

3.5 Catch and Stock Prognosis

The input data (Table 3.11) refer to the stock size on 1 January 1989. The estimate of the 1988 year class as 1-year olds was taken from the 0-group acoustic estimate in Norwegian coastal waters and the acoustic estimate of the 0-group in the Barents Sea, both in November 1988. The total number (6.17 billion individuals) was reduced by an annual natural mortality of 0.9 for two months. The number of 2- and 3-year olds (1987 and 1986 year classes) were derived from the prognosis made last year. These numbers were applied because no new estimate of these year classes exists although it is known that they are very weak. For age groups 4 and older, the acoustic estimate in February-March 1989 was used (except for the 5-year olds where the acoustic estimate in August was used). The stock size on 1 January 1989 was estimated by adjusting these estimates by the catch in the winter of 1989 and by natural mortality.

The fishing pattern level was obtained as follows. As separable VPA is not appropriate for this stock (Anon., 1989d), the current fishing mortality estimates for the year 1988 were applied, except for the age group 5 which was scaled to 0.19 by averaging the observed mortality for the 4- and 6-year-olds. Future fishing mortality is assumed to be constant on ages 6-12.

3.6 Results of Prognosis

The results of the prognosis two years ahead are given in Tables 3.12 and 3.13 and Figure 3.1D.

The 1983 year class was fully recruited to the spawning stock in 1989, resulting in a spawning stock biomass of about 1.5 million in both 1989 and 1990. There is very weak recruitment from the year classes following the 1983 year classes, and consequently the spawning stock will make up almost 85% of the total stock by 1990. The poor recruitment will lead to a decrease in spawning stock size after 1990, whether any fishing takes place or not, since losses due to natural mortality will outweigh growth. This poor recruitment will continue at least until the 1988/1989 year classes recruit in the mid-1990s. However, these year classes are strong as 0- and 1-year olds, but it is too early to predict their strength when recruiting to the spawning stock. Thus, a strong year class is needed to increase the spawning stock or even keep it at the present level if exploitation of the stock continues.

A long-term prediction for the next 5 years is illustrated in Figure 3.2. It was run based on the same recruitment as assumed for the 1989 year class and with varying levels of TAC.

3.7 Yield per Recruit

For yield-per-recruit computations, the Working Group used average catch and stock weights for the years 1984-1988 and recruitment at age 3. Otherwise the same values as in the catch and stock prognosis were used. As the fishing pattern of the oldest fish is not well known, the reference F in this year's work was

based on the unweighted average of the fishing mortalities of ages 4-9.

3.8 Management Considerations

The Norwegian spring-spawning herring is a depleted stock (Category 1) according to the criteria used by ACFM (Anon., 1989c).

The preferred level of the spawning stock, 2.5 million t, will not be reached in the near future, even without any fishing. The Working Group has no reason to assume that the problems concerning the additional mortality in the fisheries will be solved even if the control now is somewhat better than in previous years. The Working Group also noted the overfishing of the quota in the Norwegian fishery in 1988. The Working Group recommends that overfishing of the quota, unreported catches, and additional mortality be taken into account and consequently that the utmost caution be exercised in the recommendation for the coming year.

3.9 NEAFC Request

The Working Group considered the NEAFC request to "summarize all information on the present spatial and temporal distribution of the Atlanto-Scandian herring stock".

Information about the distribution of Norwegian spring spawning herring at different times of the year is scattered and derives mainly from Norwegian sources, but some information from Soviet sources is also available.

The herring presently spawns along the Norwegian coast from Sklinna in the north to Stadt in the south in February to March. In 1989 some spawning was also observed at Karmøy.

The larvae drift northwards with the coastal current and into the fjords. In some years large parts of the larval population also drift into the Barents Sea.

When the herring are 2-3 years old, at least part of the year classes congregate in the Vesterålen and Møre coastal areas of the Norwegian coast. Recruitment to the spawning stock takes place at 3-6 years of age.

The adult herring at present have their feeding areas west of the Lofoten-Vesterålen area, mainly within 200 nautical miles off the coast. They are present in this area in early June. (In July 1988, some herring were observed west of 0° by a Soviet research vessel but this has not been observed previously). By the middle of August they have congregated close to the coast in the Vesterålen-Lofoten area, and gradually move into Vestfjorden and the connecting fjord systems. They stay in deep water in this area until the middle of January, when they start migrating south to the spawning areas.

The distribution pattern in the period 1986-1989 has been summarized in Figure 3.3.

4 BARENTS SEA CAPELIN

4.1 Working Papers Presented

The following working papers were presented: "Barents Sea Capelin" by A. Dommasnes, and "Soviet Investigations of Capelin in Spring 1989" by N.G. Ushakov and E.A. Shamrai.

4.2 Regulation of the Barents Sea Capelin Fishery

Since 1979, the Barents Sea capelin fishery has been regulated by a bilateral fishery management agreement between the USSR and Norway. A TAC has been set separately for the winter fishery and for the autumn fishery. The fishery was closed from 1 May to 15 August until 1984. During the period 1984-1986, the fishery was closed from 1 May to 1 September. Since May 1986, there has been no fishing.

4.3 Catch Statistics

The international catch by country in the years 1965-1989 is given in Table 4.1.

4.4 Stock Size Estimates

4.4.1 Larval and O-group surveys

Larval surveys based on Gulf III plankton samples have been conducted in June each year since 1981. The calculated numbers by year are shown in Table 4.2. From 1981 to 1985, the index was almost constant, in the range 8.2 - 9.9. In 1986, no larvae were caught in the Norwegian larval survey, although some spawning is known to have taken place in the Varangerfjord area. In 1987 and 1988 the index was only 0.3, but in 1989 it was 7.3 - almost at the same level as in the period 1981-1985.

During the international O-group survey in the Barents Sea in August 1989 (Anon., 1989a), O-group capelin were observed over the whole of the Barents Sea north to approximately 76 N, and along the western side of Spitsbergen (Figure 4.1). Judging from the distribution area in August 1989, the strength of the 1989 year class is at about the same level as the year classes of 1983 and 1984. This confirms the impression gained from the larval index in June.

4.4.2 Acoustic stock estimates

The 1989 acoustic survey was carried out jointly by three Soviet and three Norwegian vessels during the period 12 September - 3 October (Anon., 1989b). The distribution of capelin is shown in Figure 4.2. Table 4.3 gives the estimate as numbers by age and length, and as biomass. The results are summarized in the table below. (The estimates of the same age groups in 1988 are shown in parentheses).

Year class	Number (billions)	Mean weight (g)	Biomass ('000 tonnes	
1988 (1987)	177.8 (20.0)	3.4 (3.5)	608.3 (69.6)	
1987 (1986)	18.5 (28.8)	12.4 (12.3)	229.8 (353.4)	
1986 (1985)	1.5 (0.2)	22.8 (17.1)	33.8 (4.3)	
1985 (1984)	0.01 (0.0)	21.0 (-)	0.3 (0.0)	

The estimate of the 1988 year class (1-group) is about 9 times higher than the 1-group estimate in 1988. The 1-group estimate is probably not as reliable as those from the older age groups, but it indicates that the 1988 year class is at the level of the 1983 year class and about one third the size of the 1981 and 1982 year classes. The mean weight is 3.4 g in 1989 as compared to 3.5 g in 1988, and consequently the biomass of the 1988 year class is almost 9 times larger than the 1986 year class.

The estimated number of fish in the 1987 year class (2-group) is about 64% of the size of of the 2-group measured in 1988. The biomass estimate is 65% of the estimate in 1988, as the mean weights are nearly identical.

The table below shows the number of fish in various year classes, and their survival from age 1 to age 2:

Year class:	1982	1983	1984	1985	1986	1987
Age 1 (Numbers*10E7) Age 2 (Numbers*10E7) Total mortality %	51,511 18,386 64	14,544 4,725 68	3,512 341 90		3,733 2,876 33	

As there has been practically no fishing on these age groups, the figures for total mortality constitute natural mortality only, and probably reflect the predation on capelin. As can be seen from the table, the mortality was high until 1986-1987, but then a substantial decrease occurred in 1987-1989, probably caused by diminished predation pressure from cod.

4.4.3 Management considerations

A management aim for Barents Sea capelin has been to preserve an adequate spawning stock. In the 1970s and early 1980s, the TAC recommendations were aimed at maintaining a spawning stock of about 500,000 t (see for example Anon., 1982). A paper by Hamre and Tjelmeland (1982) gave an optimal spawning stock of about 400,000 t. It is uncertain whether the stock/recruitment relations from the 1970s are valid after the recent changes in the Barents Sea ecosystem, but the Working Group is of the opinion that until other data are available, one should still aim at a spawning stock of 400,000-500,000 t.

The total stock biomass of 870,000 t in September-October 1989 is twice as high as in 1988. This increase is due to a large increase in the number of 1-year-old capelin (1988 year class), which is almost back to the level which occurred during in the first half of the 1980s. However, very few of these will spawn in 1990. The spawning stock in 1990 will consist of what is left of the 1986 year class, and part of the 1987 year class. If a maturing length of 14.0 cm is assumed, the maturing part of the stock, according to the acoustic estimate in September-October, was 180,000 t. Natural mortality will reduce the spawning stock further before spawning takes place.

Based on the available data on total stock, spawning stock, and recruitment, the Working Group recommends that no fishing should take place in 1990.

5 CAPELIN IN THE ICELAND-EAST GREENLAND-JAN MAYEN AREA

5.1 Working Papers Presented

The following working papers and documents were presented:

- "Capelin in the Iceland-Greenland-Jan Mayen Area" by S. Sveinbjörnsson.
- "Report on an Icelandic Survey of 1-group capelin in the Iceland-Greenland-Jan Mayen Area in August-September 1989" by S. Sveinbjörnsson.
- "Icelandic capelin catch statistics" by A. Dommasnes.
- "Cruise report, G.O. Sars, July-August 1989".
- "Distribution of the capelin fishery of the Greenland licensed vessels in 1986-1989 based on logbook recordings" by P. Kanneworff.

5.2 Catch Regulation

As this is a very short lived species the fishery depends to a very large extent upon the recruiting year class.

The fishery on the Iceland-East Greenland-Jan Mayen stock of capelin has been regulated by preliminary catch quotas set prior to each fishing season (July-March) based on the results of the surveys of the abundance of immature 1- and 2-group capelin carried out in August in the preceding year and/or January in the current year.

Final catch quotas for each season have then been set in accordance with the results of acoustic surveys of abundance of the maturing fishable stock carried out in the autumn (October-November) and/or winter (January-February) of that fishing season.

5.3 The Catch in the 1988/1989 Season

The total annual catch of capelin in the Iceland-East Greenland-Jan Mayen area since 1964 is shown in Table 5.1.

On the basis of an acoustic abundance estimate obtained in January 1989, a TAC of 1,065,000 t was set for the whole 1988/1989 season. The total catch amounted to 1,022,800 t leaving a spawning stock of 440,000 t. (The target spawning stock was 400,000 t.)

5.4 The Preliminary TAC for the 1989/1990 Fishery

In August 1988, an estimate of the abundance of 1 group capelin (the 1987 year class) was obtained. All other attempts to obtain reliable estimates of the abundance of immature capelin, of either the 1987 or 1986 year classes in the autumn of 1988 and winter of 1989, failed.

The abundance of 1-group capelin has been estimated annually in August since 1982. The resulting estimates can be compared to estimates of the same year classes, obtained by backcalculating their abundance as 3- and 4-group spawners to the same point in time (1 August as 1-group) taking account of the catch and the mortality rate (M). Five such pairs of estimates were available excluding the 1986 year class which, was not fully recruited to the adult stock and is underestimated due to trawl selection favouring the larger fish. The data are given in Table 5.2 and the relation between the two data sets in Figure 5.1.

Using the relationship in Figure 5.1, the August 1988 survey results correspond to 109 x 10 2-group capelin on 1 August 1989 with the assumed mortality rate (M = 0.035/month). A TAC for the 1989/1990 season was then calculated making the following assumptions:

- 1) The fishery will depend on maturing capelin only.
- About 70% of the capelin belonging to the 1987 year class and all the remainder of the 1986 year class will mature and spawn in 1990.
- 3) The 1989/1990 fishable stock and, therefore, the 1990 spawning stock, will consist of the 1987 and 1986 year classes in the ratio 80/20, this being close to the average for the 1981-1989 period excluding the abnormal 1986/1987 season (Table 5.3).
- 4) The mean weight in the fishable stock will be 17.4 g and 24.6 g for the 1987 and 1986 year classes respectively (mean weights of 2 and 3 years olds in the autumn in the 1980-1988 period (Table 5.4).
- 5) The mean weights in the 1990 spawning stock will be 19.4 g and 26.3 g for the same year classes (Table 5.4).
- 6) The natural mortality rate will be M=0.035/month (Table 5.5).

7) There will be 400,000 t left to spawn in 1990.

Calculations based on these assumptions gave a TAC of 1,065,000 t spread evenly over the period (ACFM, May 1989). In view of the short time series and other obvious uncertainties, a precautionary TAC of 900,000 t was recommended for the August-November 1989 period. The TAC for the remainder of the season (December 1989-March 1990) could then be set after the completion of the autumn 1989 survey of stock abundance, which is to take place in November.

5.5 TAC for the December 1989 - March 1990 Period

A Norwegian acoustic survey was carried out in the Jan Mayen-Iceland and E-Greenland area in July-August 1989. Very few capelin recordings were made. An Icelandic survey will not take place until November and a TAC for the period December 1989-March 1990 can, therefore, not be set until after the completion of that survey.

5.6 TAC for the Summer/Autumn 1990 Season

The fishable stock in the 1990/1991 season will consist of the 1988 year class and that part of the 1987 year class which does not mature and spawn in 1990. The abundance estimate (in numbers) of the 1988 year class was 111 x 10^9 capelin. Most of the distribution area appeared to be covered but surveying conditions were bad for part of the time. Details of the August 1989 abundance estimate are given in the survey report.

Using the relationship in Figure 5.1 and a natural mortality rate of M = 0.035/month, the August 1989 survey results correspond to 96 x 10^3 2-group capelin on 1 August 1990. A TAC for the 1990/1991 season may then be calculated using the assumptions listed in Section 5.4. This procedure gives a TAC of 965,000 t for the 1990/1991 season, spread evenly over the period.

It should be noted, however, that considerable addition to the data base could be made after the completion of an acoustic survey of the stock planned for January/February 1990. This survey will provide the addition of one more year to the data series of estimates of year class abundance as 1-group compared to adults and may provide an estimate of the abundance of the immature part of the 1987 year class, in addition to mean weights, year class ratios and maturity rates.

Advice on a TAC for the 1990 summer and autumn seasons should, therefore, be delayed until spring 1990.

5.7 Reliability of Acoustic Estimates

The ACFM has noted that "the assessment is based solely on acoustic surveys and the reliability of these results is known to be uncertain. The Working Group, therefore, should in future try to include error estimates for the acoustic results" (Vaske, 1989).

The Working Group noted that the current method of analysis does not yield useful variance estimates. Other methods of analysis are available but have not been well tested with acoustic data. It is, therefore, not known whether a change to a new method in order to obtain variance estimates would be at the cost of obtaining less useful estimates of abundance.

An ICES study group has been established to consider methods of estimating abundance based on acoustic surveys. The Working Group recommends that the results of the study group be applied to the problem of determining an appropriate method of analysis.

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Rings	1970	1971	1972	1973	1974	1975	1976
1	2.003	8.774	0.147	0.001	0.001	1.518	0.614
2	22.344	13.071	0.322	0.159	3.760	2.049	9.848
3	33.965	5.439	0.131	0.678	0.832	31.975	3.908
4	4.500	13.688	0.163	0.104	0.993	6.493	34.144
5	2.734	3.040	0.264	0.017	0.092	7.905	7.009
6	4.419	1.563	0.04/	0.013	0.046	0.863	5.481
7	1.145	3.276	0.028	0.006	0.002	0.442	1.045
8	0.531	0.748	0.024	0.006	0.001	0.345	0.438
9	0.604	0.250	0.013	0.003	0.001	0.114	0.296
10	0.195	0.103	0.009	0.003	0.001 0.001	0.004 0.001	0.134 0.092
11 12	0.103 0.076	0.120 0.001	0.003 0.001	0.001 0.001	0.001	0.001	0.092
13	0.076	0.001	0.001	0.001	0.001	0.001	0.001
14	0.051	0.001	0.003	0.001	0.001	0.001	0.001
Total	15.779	10.975	0.310	0.255	1.274	13.280	17.168
Rings	1977	1978	1979	1980	1981	1982	1983
1	0.705	2.634	0.929	3.147	2.283	0.454	1.470
2	18.853	22.551	15.098	14.347	4.629	19.187	22.422
3	24.152	50.995	47.561	20.761	16.771	28.109	151.198
4	10.404	13.846	69.735	60.728	12.126	38.280	30.181
5	46.357	8.738	16.451	65.329	36.871	16.623	21.525
6	6.735	39.492	8.003	11.541	41.917	38.308	8.637
7	5.421	7.253	26.040	9.285	7.299	43.770	14.017
8	1.395	6.354	3.050	19.442	4.863	6.813	13.666
9	0.524	1.616	1.869	1.796	13.416	6.633	3.715
10	0.362	0.926	0.494	1.464	1.032	10.457	2.373
11	0.027	0.400	0.439	0.698	0.884	2.354	
12 13	0.128 0.001	0.017 0.025	0.032	0.001 0.110	0.760 0.101	0.594 0.075	0.552 0.100
14	0.001	0.025	0.054 0.006	0.110	0.101	0.073	0.003
Total	28.924	37.333	45.072	53.269	39.544	56.528	58.665
Rings	1984	1985	1986	1987	1988		
1	0.421	0.111	0.100	0.029	0.869		
2	18.011	12.800	8.161	3.144	4.702		
3	32.237	24.521	33,893	44.590	40.855		
4	141.324	21.535	23.421	60.285	98.222		
5	17.039	84.733	20.654	20.622	68.533		
6	7.111	11.836	77.526	19.751	22.691		
7	3.915	5.708	18.228	46.240	19.899		
8 9	4.112 4.516	2.323	10.971 8.583	15.232 13.963	31.830 12.207		
10	1.828	4.339 4.030	9.662	10.179	10.132		
11	0.202	2.758	7.174	13.216	7.293		
12	0.255	0.970	3.677	6.224	7.293		
13	0.260	0.477	2.914	4.723	4.752		
14	0.003	0.578	1.786	2.280	1.935		
Total	50.293	49.092	65.413	75.439	92.828		

Table 2.2 HERRING.

Mean weight at age in grammes, Icelandic summer spawners.

Age in years is number of rings + 1.

Rings	1970	1971	1972	1973	1974	1975	1976
1	85.0	88.0	96.0	90.0	80.0	110.0	103.0
2	169.0	165.0	177.0	199.0	189.0	179.0	189.0
3 4	216.0	237,0	278.0	257.0	262.0	241.0	243.0
	263.0	273.0	332.0	278.0	297.0	291.0	243.0
5 6	312.0	301.0	358.0	337.0	340.0	319.0	305.0
7	329.0	324.0	379.0	381.0	332.0	339.0	335.0
8	338.0	346.0	410.0	380.0	379.0	365.0	351.0
9	357.0	368.0	419.0	397.0	356.0	364.0	355.0
	378.0	390.0	470.0	385.0	407.0	407.0	395.0
10	396.0	409.0	500.0	450.0	410.0	389.0	363.0
11 12	408.0	412.0	500.0	450.0	410.0	430.0	396.0
	425.0	420.0	500.0	450.0	423.0	416.0	396.0
13 14	430.0	442.0	500.0	450.0	423.0	416.0	396.0
	450.0	450.0	500.0	450.0	423.0	416.0	396.0
Rings	1977	1978	1979	1980	1981	1982	1983
1	84.0	73.0	75.3	68.9	CO 0		
2	157.0	128.0	145.3	115.3	60.8	65.0	59.3
3	217.0	196.0	182.4	202.0	140.9	141.0	131.7
4	261.0	247.0	230.9	232.5	190.5	186.1	179.7
5	285.0	295.0	284.7	268.9	245.5	217.3	218.1
6	313.0	314.0	315.7	316.7	268.6	273.7	259.9
7	326.0	339.0	333.7	351.6	297.6	293.3	308.6
8	347.0	359.0	350.4	360.4	329.8 355.7	323.0	328.7
9	364.0	360.0	366.7	379.9	368.3	353.8	356.5
10	362.0	376.0	368.3	382.9	405.4	384.6	370.2
11	358.0	380.0	370.6	392.7	381.5	388.7	406.9
12	355.0	425.0	350.0	390.0	400.0	400.4	436.6
13	400.0	425.0	350.0	390.0	400.0	393.5	458.6
14	420.0	425.0	450.0	390.0	400.0	390.3 419.5	429.9
Rings	1984	1005					471.5
		1985	1986	1987	1988	1989 ¹	
1 2	49.3	53.2	60.0	60.0	75.1	75.1	
3	131.4 188.6	146.0	139.7	167.5	157.1	157.1	
4	216.8	219.0	200.4	200.3	221.1	221,1	
5	244.9	265.8	251.6	239.8	238.6	238.6	
6	276.9	285.3	282.2	277.7	271.0	271.0	
7	314.6	314.6	297.9	303.7	298.0	298.0	
8	321.7	334.6	320.1	325.3	318.9	318.9	
9	350.7	365.0	334.4	338.8	333.6	333.6	
10	333.8	388.2 400.5	372.7	355.8	354.0	354.0	
11	361.9		379.6	377.6	351.5	351.5	
12	446.3	453.0 468.9	393.9	400.2	371.4	371.4	
13	417.4	408.9	407.8	403.6	390.4	390.4	
14	392.3	432.8	404.8	424.1	408.5	408.5	
			438.9	429.6	436.6	436.6	

¹ Estimated.

Table 2.3 Proportion of mature Icelandic summer spawners in each age group. Based on samples taken in September-December by purse seine.

Rings	1970	1971	1972	1973	1974	1975	1976
1	0.00	0.01	0.00	0.00	0.00	0.00	0.00
2	0.22	0.38	0.29	0.64	0.14	0.27	0.13
3	0.89	0.98	1.00	0.99	0.94	0.97	0.90
4	0.99	1.00	1.00	1.00	1.00	1.00	1.00
5	1.00	1.00	1.00	1.00	1.00	1.00	1.00
6	1.00	1.00	1.00	1.00	1.00	1.00	1.00
7	1.00	1.00	1.00	1.00	1.00	1.00	1.00
8	1.00	1.00	1.00	1.00	1.00	1.00	1.00
9	1.00	1.00	1.00	1.00	1.00	1.00	1.00
10	1.00	1.00	1.00	1.00	1.00	1.00	1.00
11	1.00	1.00	1.00	1.00	1.00	1.00	1.00
12	1.00	1.00	1.00	1.00	1.00	1.00	1.00
13	1.00	1.00	1.00	1.00	1.00	1.00	1.00
14	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Rings	1977	1978	1979	1980	1981	1982	1983
1	0.00	0.00	0.00	0.00	0.00	0.02	0.00
2	0.02	0.04	0.07	0.05	0.03	0.05	0.00
3	0.87	0.78	0.65	0.92	0.65	0.85	0.64
4	1,00	1.00	0.98	1.00	0.99	1.00	1.00
5	1.00	1.00	1.00	1.00	1.00	1.00	1.00
6	1.00	1.00	1.00	1.00	1.00	1.00	1.00
7	1.00	1.00	1.00	1.00	1.00	1.00	1.00
8	1.00	1.00	1.00	1.00	1.00	1.00	1,00
9	1,00	1.00	1.00	1.00	1.00	1.00	1.00
10	1.00	1.00	1.00	1.00	1.00	1.00	1.00
11	1.00	1.00	1.00	1.00	1.00	1.00	1.00
12	1.00	1.00	1.00	1.00	1.00	1.00	1.00
13	1.00	1.00	1.00	1.00	1.00	1.00	1,00
14	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Rings	1984	1985	1986	1987	1988	1989 ¹	
1	0.00	0.00	0.00	0.00	0.00	0.00	
2	0.01	0.00	0.03	0.01	0.05	0.05	
3	0.82	0.90	0.89	0.87	0.90	0.90	
4	1.00	1.00	1.00	1.00	1.00	1.00	
5	1.00	1.00	1.00	1.00	1.00	1,00	
6	1.00	1.00	1.00	1.00	1.00	1.00	
7	1.00	1.00	1.00	1.00	1.00	1.00	
8	1.00	1.00	1.00	1.00	1.00	1.00	
9	1.00	1.00	1.00	1.00	1.00	1,00	
10	1.00	1.00	1.00	1.00	1.00	1.00	
11	1.00	1.00	1.00	1.00	1.00	1.00	
12	1.00	1.00	1.00	1.00	1.00	1.00	
13	1.00	1.00	1.00	1.00	1.00	1.00	
14	1.00	1.00	1.00	1.00	1.00	1.00	
1 3	1.00	1.00					

¹ Estimated.

Table 2.4 Stock abundance and catches by age groups (millions) and fishing mortality rates for the Icelandic summer spawners. F' is the F in 1988 calculated from the Nov/Dec survey. F is the fishing pattern in 1988 calculated from the Nov/Dec survey. F is the fishing mortality in 1988 according to the method introduced in the 1986 Report of the Herring Assessment Working Group for the Area South of 62° N.

Rings 1988	Acoustic survey estimate Nov - Dec 1988	Catch 1988	F'	Fp	F ₈₈
0	441.7				
1	982.6	. 9		-	
2	236.1	4.7	.02	.036	0.010
3	319.3	40.9	. 11	. 200	0.019
4	485.6	98.2	. 17	. 309	. 106
5	216.4	68.5	. 27	.491	. 164 . 260
6	52.8	22.7	.34	.618	.328
7	29.1	19.9	.5	1	.526
8	38.0	31.8	.58	1	.53
9	20.2	12.2	. 45	1	.53
10	12.1	10.1	.58	1	.53
11	10.5	7.3	.5	1	.53
12	6.1	7.2	.73	1	.53
13	4.1	4.8	.73	1	
14	2.9	1.9	.48	1	.53 .53

Table 2.5 VIRTUAL POPULATION ANALYSIS.

SUMMER SPAWNING HERRING AT ICELAND (FISHING AREA VA)

FISHING MC	ORTALITY	COEFFICI	ENT	UNIT: Ye	ar-1	NATURAL	MORTAL	TY COEFF	ICIENT =	.10		
	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
1 2 3 4 5 5 6 7 7 8 9 10 11 12 13 14 15+	.064 .907 1.010 .636 .778 .725 .852 1.008 1.709 .655 .545 1.204 3.564 1.000	.140 .646 .508 1.491 1.084 1.346 1.999 3.116 2.280 1.908 .989 .008 .035 1.000	.002 .007 .012 .027 .093 .041 .069 .065 .730 .566 .287 .016	.000 .002 .016 .010 .003 .005 .005 .015 .008 .253 .080 .097	.000 .010 .012 .023 .009 .001 .001 .003 .003 .112 .097 .119	.008 .016 .102 .117 .238 .097 .087 .156 .123 .012 .003 .141 .119 .150	.001 .058 .034 .136 .160 .230 .147 .105 .174 .186 .367 .004 .183 .150	.002 .039 .176 .107 .246 .204 .332 .265 .159 .297 .047 1.130 .004 .250	.013 .059 .126 .130 .111 .304 .313 .710 .491 .408 .547 .034 .605 .250	.004 .087 .151 .227 .201 .126 .299 .187 .411 .242 .307 .067 .128 .250	.01.2 .064 .148 .262 .306 .190 .189 .340 .144 .579 .554 .001 .304 .250	.003 .020 .089 .108 .224 .292 .158 .128 .368 .103 .739 2.119 .107 .250 .250
(4-14)U (4-14)W	1.153 .754	1.387 1.522	.179 .051	.046	.036 .018	.113 .153	.167 .146	.276 .208	.355 .230	.222	.284 .272	.418 .220
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15+	1982 .002 .024 .148 .268 .190 .340 .496 .194 .231 .484 .321 1.651 1.6520 .300	1983 .006 .107 .239 .210 .212 .128 .179 .251 .138 .109 .255 .104 1.534 .200 .200	1984 .001 .084 .198 .327 .157 .090 .071 .066 .110 .084 .011 .024 .011 .024 .013 .040 .058 .130 .130	1985 .000 .025 .142 .176 .296 .140 .088 .050 .083 .122 .158 .060 .052 .160	1986 .000 .010 .076 .176 .228 .427 .296 .216 .232 .238 .294 .290 .228 .250 .250	1987 .000 .007 .060 .168 .207 .315 .433 .382 .414 .419 .521 .397 .648 .250 .250		.002 .060 .182 .245 .214 .175 .209 .140 .141 .200 .186 .460 .816 .197				
(4-14)U (4-14)W	,554	.302	.103 .223		.261	.378	. 264					

Table 2.6 Icelandic summer spawners.

VPA stock size in numbers (millions) and spawning stock biomass in '000 tonnes at 1 July.

Rings	1970	1971	1972	1973	1974	1975	1976
1 2 3 4 5 6 7	33,806 39.056	28 685	55 320	76.584	386.164	138.228	574.676 184.006
3 1	55.602 9.981		13.593			345.841	123,126
5	5.275		7.746 3.682	12.175 6.854		61.774	282.553
6	8.942		1.456			39.204 9.791	49.728 27.972
7	2.079	3,914	0.512	1.273	2.775	5.553	8.040
8	0.869		0.475	0.436		2.509	4.605
9 10	0.763	0.285	0.029	0.407	0.389	1.036	1.943
11	0.424 0.255	0.124 0.199	0.025 0.016	0.014		0.351	0.829
12	0.113	0.134	0.016	0.014 0.011	0.010 0.011	0.330	0.314 0.298
13	0.064	0.031	0.120	0.060		0.009	0.298
14	0.084	0.002	0.027	0.106	0.053	0.008	0.008
Spawning Stock	20.015	13.576	11.044	28.713	45.653	118.885	134.272
Rings	1977	1978	1979	1980	1981	1982	1983
1	460.871	214.127	269.326	270.647	935,851	256,960	259,663
2	519.405	416.343	191.246	242.813	241.899	844.622	232.075
4	157.136 107.694	452.057	355.291	158.701	206.072	214.479	746.006
5	223.236	119.252 87.562	360.601 94.752	276.315 260.104	123.883 192.403	170.527	167.374
5 6 7	38.340	158.004	70.929	70.119	173.392	100.574 139.101	117.983 75.223
7	20.109	28.298	105.513	56.578	52.490	117,132	89,542
8	6.282	13.055	18.727	70.774	42.379	40.564	64.539
9 10	3.750 1.477	4.361	5.806	14.049	45,605	33,727	30.237
11	0.623	2.896 0.993	2.416 1.743	3.483 1.717	11.007	28.547	24.223
12	0.197	0.538	0.520	1.161	1.766 0.893	8.979 0.762	15,928 5.892
13	0.268	0.058	0.471	0.440	1.049	0.702	0.132
14	0.005	0.242	0.028	0.375	0.294	0.853	0.017
Spawning stock	138.941	184.361	210.060	229.056	204.648	215.112	246.739
Rings	1984	1985	1986	1987	1988	1989	
1	612.132	987.592	524.666	286.061	948.083	607.000	
2	233.555 188.690	553.480	893.505	474.643	258.811	857.035	
2 3 4 5 6 7 8	531.536	194.216 140.132	488.641 152.446	800.718 409.934	426.485	229.712	
ś	122.800	346.942	106.350	115.702	682.143 313.683	347.088 523.963	
6	86.325	94.934	233.557	76.629	85.117	218.908	
7	59.861	71,353	74.659	137.877	50,606	55.501	
8 9	67.713 45.430	50.444	59.140	50.265	80.948	26.952	
10	23.831	57.362 36.817	43.436 47.780	43.099	31.044	43.112	
11	19,663	19.826	29.485	31.157 34.065	25.767 18,547	16.534 13.723	
12	11.163	17.600	15.320	19.875	18.311	9.878	
13	4.807	9.858	15,003	10.375	12.085	9.752	
14	0.026	4.102	8.467	10.810	4.921	6.436	
pawning tock	263.794	292.036	318.180	393.535	422.478	385.528	

Table 2.7

List of input variables for the ICES prediction program.

ICELANDIC SUMMER SPAWNERS

The reference F is the mean F for the age group range from 4 to 14

The number of recruits per year is as follows:

Year	Recruitment
1989	600.0
1990	400.0
1991	400.0
1992	400.0

Proportion of F (fishing mortality) effective before spawning: .0000 Proportion of M (natural mortality) effective before spawning: .5000

Data are printed in the following units:

Number of fish: millions
Weight by age group in the catch: gram
Weight by age group in the stock: gram
Stock biomass: tonnes
Catch weight: tonnes

+				natural			
i	age;	stock size	pattern	mortality;	ogive¦	the catch;	the stock:
i	1	600.0	.00	.10	.00!	60.000!	60,000!
ij	2	857.0	.15	.10	.05	135.700	135.700
1	3¦	229.7	.50	.10	.90	196.900	196.900
i	4 :	347.1			1.00¦		240.500
1	5¦	524.0			1.00¦		274.200;
1	6¦	218.8			1.00¦		304.100
ŀ	7 :	55.5			1.00¦		327.700
1	8	27.0			1.00		348.500¦
	9 !	43.1			1.00		372.300
1	10;				1.00	384.400	384.400
i	11	13.7			1.00¦		415.100
ŀ	12¦	9.9			1.00		427.900
ij	13	9.8			1.00		420.500
1	14¦	6.4	1.00	.10¦	1.00;	439,600¦	439.600;
+	+	+	+	+	+	+	+

Table 2.8 Results.

12.58.16 20 OCTOBER 1989 ICELANDIC SUMMER SPAWNERS

*Year 1989. F-factor .260 and reference F .2600 *

++	+	+		4		+ at	1 January	at spaw	ning time¦
age 	absolute¦ F¦	catch in¦ numbers¦			stock biomass	sp.stock size	sp.stock biomass	sp.stock¦ size¦	
1 1 2 1 3 4 4 4 5 5 6 6 7 7 1 1 1 1 1 1 2 1 1 3 1 1 4 1 4 1 4 1 4 1 4 1 4 1 4 1 4	.0000 .0390 .1300 .2600 .2600 .2600 .2600 .2600 .2600 .2600 .2600 .2600 .2600 .2600 .2600	.000 31.204 26.676 75.788 114.413 47.774 12.118 5.895 9.411 3.603 2.991 2.162 2.140 1.397	.0 4234.4 5252.5; 18226.9; 31372.0; 14528.0; 3971.1; 2054.5; 3503.6; 1384.9; 1241.7; 925.0; 899.8; 614.3;	857.00 229.70	116294 45227	42.85 206.73 347.10 524.00 218.80 55.50 27.00 43.10 16.50 13.70 9.90 9.80	5814 40705; 83477; 143680; 66537; 18187; 9409;	40.76 196.65 330.17 498.44 208.13 52.79 25.68	5531 38719 79406 136673 63292 17300 8950 15263 6033 5409 4029 3919 2676
Total		335.571;	88208.6	2958.50	558061	1521.38	407058	1447.18	387205

			****	* * * * :	********	***	*****	. *
	1990.	F-factor			reference		,2600	

						4	·			
+	+	+	+	+	+		at	1 January	at spaw	ning time¦
++	age¦ +	absolute¦ F¦	catch in numbers!	catch in¦ weight¦	stock; size;		sp.stock size	sp.stock biomass	sp.stock¦ size¦	sp.stock¦ biomass¦
	1; 2; 3; 4; 5; 6; 7; 8; 9; 10; 11; 12; 13; 14;	.0000 .0390 .1300 .2600 .2600 .2600 .2600 .2600 .2600 .2600 .2600 .2600 .2600 .2600 .2600	19.768 86.610 39.849 52.875; 79.823 33.331; 8.455; 4.113; 6.566 2.514; 2.087; 1.508; 1.493;	.0 2682.5 17053.6 9583.7 14498.4 24274.2 10922.5 2946.4 1531.3 2523.8 1043.4 893.0 634.2 656.3	400.00 542.90 745.79 182.50 242.16 365.58 152.65 38.72 18.84 30.07 11.51 9.56 6.91 6.84	24000 73671 146845 43892 66401 111173 50023 13494 7013 11558 4778 4089 2904 3005	27.15 671.21 182.50	3683 132160 43892 66401	25.82 638.47 173.60 230.35	3503 125715 41751
; +-	Tota		338.990¦	89243.0	2754.03	562852	1763.70;	454180	1677.68	432029

Table 2.8 (cont'd)

*	Year	1991.	F-factor	.260	and	reference	F	.2600 *
* 1	****	*****	******	***	***	******	***	*****

					+		+		+
						at	1 January¦	at spaw	ning time¦
+-	age :	absolute¦ F¦		catch in¦ weight¦					sp.stock¦ biomass¦
	1; 2; 3; 4; 5; 6; 7; 8; 9; 10; 11; 12; 13;	.0000 .0390 .1300 .2600 .2600 .2600 .2600 .2600 .2600 .2600 .2600 .2600 .2600 .2600	13.178 54.867 129.381 27.802 36.890 55.691 23.254 5.899 2.870 4.581 1.754 1.456	1788.3 10803.3 31116.0 7623.2 11218.2 18249.8 8104.0 2196.0 1103.1 1901.4 750.4 612.3	49114 93025 142508 34913 51378 83582 37115 10057 5051 8708 3436 2804	18.10 425.20 592.55; 127.33; 168.95; 255.06; 106.50; 27.01; 13.14; 20.98; 8.03; 6.67;	2455 83722 142508 34913; 51378 83582 37115; 10057; 5051; 8708; 3436; 2804;	17.21 404.47 563.65 121.12 160.71 242.62 101.31 25.70 12.50 19.96 7.64 6.34	2335; 79639; 135558; 33210; 48872; 79506; 35305; 9567; 4805; 8283; 3269; 2667;
+-	14¦ + Tota		1.052¦ + 358.673¦		 +		+		

* Year 1992. F-factor .260 and reference F .2600 *

		,			+	at .	1 January¦	at spaw	ning time¦
age	absolute;	catch in numbers	catch in weight	stock¦ size¦				sp.stock size	
1; 2; 3; 4; 5; 6; 7; 8; 9; 10; 11; 12; 13;	.2600 .2600	.000 13.178 36.578 81.962 90.266 19.397 25.737 38.854 16.224 4.115 2.002 3.196 1.223 1.016	.0 1788.3 7202.2 19711.8 24750.9 5898.5 8434.0 13540.6 6040.1 1581.9 831.0 1367.5 544.6	400.00 361.93 314.97 375.38 413.41 88.83 117.87 177.95 74.30 18.85 9.17 14.64	24000 49114 62016 90278 113356 27014 38627 62014 27663 7244 3806 6262 2356	18.10 283.47 375.38 413.41 88.83 117.87 177.95 74.30 18.85 9.17 14.64 5.60	2455 55815 90278 113356 27014 38627 62014 27663 7244 3806 6262 2356	17.21 269.64 357.07 393.25 84.50 112.12 169.27 70.68 17.93 8.72 13.92 5.33	2335; 53092; 85875; 107828; 25697; 36743; 58990; 26314; 6891; 3620; 5957; 2241;
14 ++ Tota +			92107.9	4.65; 2377.56;	2045¦ + 515801¦	4.05; + 1602.22;	+	+	

Table 3.1 Catches of Norwegian spring-spawning herring (tonnes) since 1972.

Year	A	в1	С	D	Total	Total includ. unreported catches
1972	_	9,895	3,266 ²	_	13,161	13,161
1973	139	6,602	276	-	7,017	7,017
1974	906	6,093	620	_	7,619	7,619
1975	53	3,372	288	_	3,713	13,713
1976	-	247	189	_	436	10,436
1977	374	11,834	498	_	12,706	22,706
1978	484	9,151	189	_	9,824	19,824
1979	691	1,866	307	_	2,864	12,864
1980	878	7,634	65	_	8,577	18,577
1981	844	7,814	78	_	8,736	13,736
1982	983	10,447	225	_	11,655	16,655
1983	3,857	13,290	907	_	18,054	23,054
1984	18,730	29,463	339	_	48,532	53,532
1985	29,363	37,187	197	4,300	71,047	169,8723
1986	71,122	55,507	156	-,000	126,785	225, 256
1987	62,910	49,798	181		112,899	127,306
1988	73,440	66,624	127	_	140,191	164, 491 ³
1989 ⁴	53,346	-	-	-	-	53,346

A = catches of adult herring in winter.

B = mixed herring fishery in autumn.

C = by-catches of O- and 1-group herring in the sprat fishery.

D = USSR-Norway by-catch in the capelin fishery (2-group).

¹ Includes also by-catches of adult herring in other fisheries.
2 In 1972, there was also a directed herring O-group fishery.
3 Includes mortality in addition to reported catches caused by fishing

operations.
Preliminary up to 1 October 1989.

Table 3.2 Total catch of Norwegian spring-spawning herring (tonnes) since 1972.

Year	Norway	USSR	Total
1972	13,161	_	13,161
1973	7,017	-	7,017
1974	7,619	_	7,619
1975	13,713		13,713
1976	10,436	_	10,436
1977	22,706		22,706
1978	19,824	_	19,824
1979	12,864	_	12,864
1980	18,577	_	18,577
1981	13,736	_	13,736
1982	16,655	_	16,655
1983	23,054	_	23,054
1984	53,532	_	53,532
1985	167,272	2,600	169,872
1986	225,256	_	225,256
1987	108,417	18,889	127,306
1988	144,266	20,225	164,491
1989	38,223	15,123	53,346

¹Preliminary up to 1 October.

Table 3.3 Catch in numbers ('000) of Norwegian spring spawners. Unreported catches are included for age 3 and older herring. The catches in 1985, 1986 and 1987 are adjusted for by the effects of discards and the breaking of gear, as reported by the Working Group in 1988.

Age	1972	1973	1974	1975	1976	1977	1978	1979	1980
0	347,100	29,300		30,600		43,000	20,100	32,600	6,900
1	41,000	3,500		3,600		6,200	2,400	3,800	800
2	20,400	1,700		1,800		3,100	1,200	1,900	400
3	35,376	2,389	100	3,268		22,103	3,019	6,352	6,407
4	3,476	25,220	241	132		23,595	12,164	1,866	5,814
5	3,583	651	24,505	910		336	20,315	6,865	2,278
6	2,481	1,506	257	30,667	-	-	870	11,216	8,165
7	694	278	196	5		419	_	326	15,838
8	1,486	178	-	2	_	10,766	620	_	441
9	198	-	-	-	_	-	5,027	-	8
10		-	-	-	-	-	-	2,534	_
11	494	-	-	-	-		-	-	2,688
12	593	-	_	-	_	-	_	-	-
13	593	-	-	-	-	-	-	_	-
14	-	178	-		-	-	-	_	-
15	_	-	-	-	-	-	-	_	_
16	_		-	-	-	-	-	_	-
Age	1981	1982	1983	1984	1985	1986	1987	1988	
0	8,300	22,600	127,000	33,857	28,571	13,805	13,846	15,488	
1	1,100	1,100	4,679	1,700	13,149	1,381	6,327	2,787	
2	11,900	200	1,675	2,489		3,091	35,770	10,930	
3	4,166	13,817	3,183	4,483	21,500	539,785	19,776	61,678	
4	4,591	7,892	21,191	5,388	15,500	17,594	501,393	23,904	
5	8,596	4,507	9,521	61,543	16,500	14,500	18,672	588,457	
6	2,200	6,258	6,181	18,202	130,000	15,500	3,502	8,600	
7	4,512	1,960	6,823	12,638	59,000	105,500	7,058	4,686	
8	8,280	5,075	1,293	15,608	55,000	75,000	28,000	5,664	
9	345	6,047	4,598	7,215	63,000	42,000	12,000	14,107	
10	103	121	7,329	16,338	10,000	77,000	9,500	8,550	
11	114	37	143	6,478	31,000	19,469	4,500	3,100	
12	964	37	40	-	50,000	66,000	7,834	3,645	
3	-	37	143			80,000	6,500	2,512	
4	-	-	862	_	_	-	7,000	1,538	
15	_	-	-	1,652	_	_	453	611	
6	-	-	-		2,638	2,469	733	-	

^{197,244} are from the oceanic component. 2 481,481 are from the oceanic component.

Table 3.4 Norwegian spring-spawners. Acoustic abundance of Ogroup herring in Norwegian coastal waters in 1975-1988 (number in millions).

— Tota		Area							
Total	North of 68030'	65 ⁰ N-68 ⁰ N	62 ⁰ N-65 ⁰ N	Year					
1,075	55	692	328	1975					
3,775	750	2,610	415	1976					
412	37	305	70	1977					
1,205	392	511	302	1978					
3,457	288	2,260	909	1979					
234	218	4	12	1980					
265	1	2	263	1981					
2,936	2,301	571	64	1982					
13,730	8,864	4,543	323	1983					
1,401	930	467	4	1984					
1,003	208	354	441	1985					
408	254	144	10	1986					
262	57	26	179	1987					
1,274	708	552	14	1988					

Table 3.5 Abundance indices for O-group herring in the Barents Sea, 1973-1989 (Anon., 1989a).

Year	Log index	Year	Log index
1973	0.05	1982	0.00
1974	0.01	1983	1.77
1975	0.00	1984	0.34
1976	0.00	1985	0.23
1977	0.01	1986	0.00
1978	0.02	1987	0.00
1979	0.09	1988	0.30
1980	0.00	1989	0.58
1981	0.00		

Table 3.6 Average weight (g) in stock (1 January), Norwegian spring spawners, 1976-1989.

Age	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
3	181	181	180	178	175	170	170	155	140	148	146	90	88	454
4	259	259	294	232	283	224	204	249	204	234	206	143		154
5	342	342	326	359	347	336	303	304	295	265	265		135	175
6	384	384	371	385	402	378	355	368	338	312		241	297	209
7	409	409	409	420	421	387	383	404	376		289	279	277	252
8	444	444	461	444	465	408	395	424		346	339	299	315	305
9	461	461	476	505	465	397	413		395	370	368	316	339	367
10	520	520	520	520	520	520		437	407	395	391	342	343	377
11	543	543	543	551	534		453	436	413	397	382	343	359	359
12	412	412	500			543	468	493	422	425	388	362	365	395
13	412	412	500	500	500	512	512	480	459	434	383	370	370	375
14	412	412		500	500	512	500	470	449	443	403	378	375	406
15	412		500	500	500	512	500	500	427	452	403	381	385	436
16		412	500	500	500	512	500	500	437	463	450	388	390	417
10	412	412	500	500	500	512	500	500	437	480	470	390	400	417

Table 3.7 Average weight (g) in catch, Norwegian spring spawners, 1975-1988.

Age	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1000
3 4 5 6 7 8 9 10 11 12 13 14 15 16	259 342 384 409 444 461 520 543 412 412 412 412 412	259 342 384 409 444 520 543 412 412 412 412 412	294 326 371 409 461 476 520 543 500 500 500 500 500	232 359 385 420 444 505 520 551 500 500 500 500	283 347 402 421 465 465 520 534 500 500 500 500	224 336 378 387 408 397 520 543 512 512 512 512 512 512	204 303 355 383 395 413 453 468 512 500 500 500	249 304 368 404 424 437 436 493 480 470 500 500 500	204 250 317 356 386 401 410 418 441 455 438 432 432	233 281 348 371 408 428 442 434 456 469 460 460 445 445	226 292 311 357 380 402 419 432 440 458 460 465 470 470	160 244 288 306 345 367 390 394 393 392 409 434 450 454	1987 121 169 248 287 306 321 342 346 362 371 379 380 390	1988 149 186 234 291 320 367 368 382 372 383 398 440 440

Table 3.8 VIRTUAL POPULATION ANALYSIS.

NORWEGIAN SPRING SPAWNING HERRING

PROPORTIO	NS OF MA	TURITY	t	:TIML							
	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
3	.130	.100	.250	.300	.100	.100	.100	.100	.100	.100	.100
4	.900	.620	.500	.500	.480	.500	.500	.500	.200	.300	.300
5	1.000	.950	.970	.900	.700	.690	.900	.900	.900	.900	.900
6	1.000	1.000	1.000	1.000	1.000	.710	.950	1.000	1.000	1.000	1.000
7	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
8 9	1.000 1.000	1.000 1.000	$1.000 \\ 1.000$	1.000 1.000	1.000 1.000	1.000	1.000 1.000	1.000	1.000	1.000	1.000
10	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
11	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
12+	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Table 3.9 VIRTUAL POPULATION ANALYSIS.

NORWEGIAN	SPRING	SPAWNING	HERRING
	-		

FISHING MO	RTALITY	COEFFICI	ENT	UNIT: Ye	ar-1	NATURAL	MORTALI	TY COEFF	ICIENT =	.13	
	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
3 4 5 6 7 8 9 10 11	.023 .028 .038 .042 .000 .046 .037 .023	.014 .016 .019 .025 .019 .000 .000	.021 .040 .023 .026 .041 .029 .000	.010 .017 .025 .026 .017 .026 .027 .002	.020 .022 .020 .022 .027 .022 .022 .011	.028 .037 .031 .032 .027 .021 .023 .031	.055 .055 .133 .070 .078 .075 .145 .098	.187 .252 .221 .412 .312 .514 .442 .198	.058 .212 .364 .307 .630 .751 .872 1.455 1.080	.093 .065 .336 .129 .206 .311 .230 .446	.141 .144 .095 .235 .235 .235 .235 .235
12+	.030	.027	.027	.013	.001	.015	.032	.252	1.080	.250	.235
(4- 9)U (4- 9)W	.032	.013 .020	.027	.023 .022	.022 .022	.028 .031	.093 .098	.359 .384	.523 .574	.213 .073	.196 .099

Table 3.10 VIRTUAL POPULATION ANALYSIS.

NORWEGIAN SPRING SPAWNING HERRING

STOCK SIZE IN NUMBERS UNIT: thousands

BIOMASS TOTALS UNIT: tonnes

ALL VALUES ARE GIVEN FOR 1 JANUARY

6 22311 485332 341224 90404 312766 210233 285606 409103 62330 30834 43680 55542 66566 18777 415667 291984 77324 268780 178818 233757 238036 40266 23800 303 43680 55542 68780 178918 14564 58459 16182 350171 252165 66063 229627 145195 150198 111357 28763 165 10 47 125211 10719 45067 11792 257533 185956 43130 105518 28013 43426 497 124 180 200 200 200 200 200 200 200 200 200 2		1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
79312 02134 74303 30035 251326 237022 104757 42102 402	7 8 9 10 11	463847 574364 22311 66576 14564 147953 47 36	122004 395915 485332 18777 58459 12208 125211 40	432929 105384 341224 415667 16182 51332 10719	283024 365351 90404 291984 350171 13797 45067	390384 244224 312766 77324 252165 299733 11792	628457 335406 210233 268780 66063 216674 257533	106571 532009 285606 178818 229627 56799 185956	74014 88537 409103 233757 145195 187031 43130	97963 50517 62330 238036 150198 76277 105518	8451650 69584 30834 40266 111357 62220 28013	189779 6952178 43680 23800 28763 71650 43426	0 380834 144295

TOTAL NO 1432037 1717950 1810360 1978145 2440454 2193128 1939787 171454311249188 9157512 7910592
SPS NO 1261974 1201969 1343873 1485782 1506795 1601673 1738860 1547681 1985544 3020922 6633088
TOT.BIOM 461983 551495 623369 627467 707734 739762 663807 580973 1849755 1380015 1535009
SPS BIOM 426083 453564 517812 530059 532365 590070 621194 552059 491959 513114 1336072

Table 3.11

List of input variables for the ICES prediction program.

NORWEGIAN SPRING-SPAWNING HERRING

The reference F is the mean F for the age group range from 4 to 9

The number of recruits per year is as follows:

Year	Recruitment
1989	5314000.0
1990	7000000.0
1991	7000000.0

Data are printed in the following units:

Number of fish: thousands Weight by age group in the catch: kilogram Weight by age group in the stock: kilogram Stock biomass: tonnes Catch weight: tonnes

4						+	+
1	age	stock size		natural; mortality;			
	1; 2; 3; 4; 5; 6; 7; 8; 9; 10; 11;	90000.0 60000.0 380834.0 144295.0 5554204.0 30322.0 16522.0 19967.0 49739.0 30146.0	.08 .14 .14 .19 .24 .24 .24 .24	.90 .13 .13 .13 .13 .13 .13 .13 .13 .13	.00 .10 .30 .90 1.00 1.00 1.00 1.00	.111 .154 .195 .234 .262 .291 .293 .341 .351	.100 .154 .175 .209 .252 .305 .325 .340 .359 .395
+	12+	40220.0	.24	.13¦	1.00	.361¦	.375

Table 3.12

Effects of different levels of fishing mortality on catch, stock biomass and spawning stock biomass.

NORWEGIAN SPRING-SPAWNING HERRING

Year 1989					Year 1990				Year 1991		
fac-¦ tor¦	ref.¦ F¦	stock biomass	sp.stock biomass	catch	fac- tor	ref.¦	stock¦ biomass¦	sp.stock; biomass;	catch	stock¦ biomass¦	sp.stock biomass
.3!	.06	1613	1514	100	.0 .1 .2 .3 .4 .5 .6 .7 .8	.00 .02 .04 .06 .08 .11 .13 .15 .17 .19	1812	1539	0; 34; 67; 99; 130; 161; 192; 221; 250; 278; 306;	1891 1856; 1821; 1787; 1754; 1722; 1690; 1659;	1476 1442 1409 1377 1346 1315 1285 1256 1227 1199

The data unit of the biomass and the catch is 1000 tonnes.

The spawning stock biomass is given for 1 January.

The reference F is the mean F for the age group range from 4 to 9

Table 3.13 Norwegian Spring-spawning HERRING.

*	****************	
*	Year 1989. F-factor .292 and reference F .0619	*
*		. *
*	Run depending on a TAC value	*

						4		+
							at	1 January¦
	age	absolute F	catch in numbers		stock¦ size¦		sp.stock size	sp.stock biomass
	1	.0146;	50785;	457	5314000	31884	0	0;
1	2	.0230	1354;	150	90000	9000	0	0;
ı	3 :	.0411	2268	349	60000	9240	6000	924
	4	.0420	14695	2865	380834	66645	114250	19993
Ì	5	.0554	7299	1708	144295	30157	129865	27141
1	6	.0685	345306	90470	5554204	1399659	5554204	1399659
-	7	.0685	1885	548	30322	9248	30322	9248
3	8 !	.0685	1027	300	16522	5369	16522	5369
	9	.0685	1241	423	19967	6788	19967	6788
i	10	.0685	3092	1085	49739	17856	49739	17856
1	11	.0685	1874	738	30146	11907	30146	11907
į	12+	.0685	2500	902	40220	15082	40220	15082
4	+-	+	4000001	+				
į	Total		433330¦	100000	11730250;	1612840¦	5991236	1513972

* Year 1990. F-factor .300 and reference F .0637 *

					4		+
						at	1 January
age	absolute F			stock size			sp.stock biomass
1; 2; 3; 4; 5; 6; 7; 8; 9; 10; 11;	.0237 .0423 .0432 .0570 .0705 .0705 .0705 .0705	32939 1389 2005 16670 7657 290919 1588 865 1045	3656.3 214.0 391.1 3900.8 2006.3 84657.5 465.3 295.1 367.1	2129230 35757 50562 320653 119873 4554013 24861 13546 16371	212923 5506 8848 67016 30208 1388974 8080 4605 5877	0 3575 15168 288588 119873 4554013 24861 13546 16371	0 550; 2654; 60314; 30208; 1388974; 8080; 4605; 5877;
12+							
¦ Tota	1	430165	98929.7	14363348	1811784	5134477	1539010

Table 3.13 (cont'd)

				*****	******	*********
*	Year	1991.	F-factor	.300 and	reference	F .0637 *
*	****	*****				

						+		+
4							at	1 January¦
+	age¦	absolute¦ F¦	catch in: numbers;	catch in weight	stock¦ size¦			sp.stock biomass
	1; 2; 3; 4; 5; 6; 7; 8; 9; 10; 11; 12+;	.0150 .0237 .0423 .0432 .0570 .0705 .0705 .0705 .0705 .0705 .0705	43372	4814.4 5058.8 232.8 517.3 4451.5 1823.6 69753.2 443.2 248.6 337.2	2803616 845405 30098 42521 265964 98095 3726646 20344 11085 13397	280361 130192 5267 8887 67022 29919 1211160 6917 3979 5291	0 84540 9029 38269 265964 98095 3726646 20344 11085 13397	67022 29919 1211160 6917 3979 5291
+ + +	Total	+	417754	1858.4¦ 90158.0¦	80585; 14937762;	+	+	+

Table 4.1 International catch of Barents Sea Capelin ('000 tonnes) in the years 1965-1989.

Year	Norway	USSR	Other	Total
1965	217	7	_	224
1966	380	9	-	389
1967	403	6	-	409
1968	522	15	-	537
1969	679	1	_	680
1970	1,301	13	-	1,314
1971	1,371	21	_	1,392
1972	1,556	37	-	1,593
1973	1,291	45	-	1,336
1974	987	162	-	1,149
1975	943	431	43	1,417
1976	1,949	596	-	2,545
1977	2,116	822	2	2,940
1978	1,122	747	25	1,894
1979	1,109	669	5	1,783
1980	999	641	9	1,649
1981	1,238	721	28	1,987
1982	1,158	596	5	1,759
1983	1,493	846	36	2,375
1984	811	628	42	1,481
1985	453	398	17	868
1986	72	51	_	123
1987	_	_	_	_
1988	_		_	_
1989	_	-	-	_

Table 4.2 Larval index for Barents Sea Capelin.

Year	Index
1981	9.7
1982	9.9
1983	9.9
1984	8.2
1985	8.6
1986	<u>-</u>
1987	0.3
1988	0.3
1989	7.3

Table 4.3 Acoustic estimate, autumn 1989, for Barents Sea Capelin.

Total length		Į	\ge		Total	Biomass	Biomass	
	1	1 2 3		4+	number (10E-7)	tonnes (10E-3)	(cum.)	
8.0- 8.4	1704				1704	36.7		
8.5- 8.9	2739				2739	68.4		
9.0- 9.4	3982				3982	111.5		
9.5- 9.9	3350				3350	107.7		
10.0-10.4	2501	29			2529	96.8		
10.5-10.9	1627	19			1646	70.1		
11.0-11.4	747	145			892	46.5		
11.5-11.9	512	18			530	32.5		
12.0-12.4	322	91			413	28.4		
12.5-12.9	172	102			274	23.1		
13.0-13.4	94	255			349	33.5		
13.5-13.9	14	303			317	35.8		
14.0-14.4	10	302			311	39.3	181.3	
14.5-14.9	5	205	7		216	30.8	142.0	
15.0-15.4	2	166	15		184	30.2	111.2	
15.5-15.9		87	14		101	18.4	81.0	
16.0-16.4		40	28		69	15.1	62.6	
16.5-16.9		39	45	1	84	19.2	47.5	
17.0-17.4		32	9	,	41	11,6	28.3	
17.5-17.9		12	18		29	9.0		
18.0-18.4		5	9		14	4.8	16.7	
18.5-18.9		3	4		8	2.9	7.7 2.9	
Number (10E-7)	17779	1851	148	1	19780			
Biomass (t.*10E-3)	608.3	229.8	33.8	0.3	872.2			
Mean length (cm)	9.7	13.9	16.6	16.8	10.2			
Mean volume (ml)	3.4	12.4	22.8	21.0	4.4			

Table 5.1 The total annual and seasonal catch of CAPELIN in the Iceland-East Greenland-Jan Mayen area since 1964 (in '000 t).

77	Winter	season	Summer	and aut	umn seas	ons	mata 1
Year	Iceland	Far/Nor	Iceland	Norway	Faroes	EEC	Total
1964	8.6	_	_	_	_	_	8.6
1965	49.7	-	_	_	_	_	49.7
1966	124.5	_	-	-	-	_	124.5
1967	97.2	-	_	_	-		97.2
1968	78.1	-	-	-	-	_	78.1
1969	170.6	_	-	_	_	-	170.6
1970	190.8	_		-	·	-	190.8
1971	182.9	-	_	_	-	_	182.9
1972	276.5	-	-	_	-	-	276.5
1973	440.9	_	_	_	-	_	440.9
1974	461.9		_	_	-	-	461.9
1975	457.1	_	3.1	-	_	-	460.2
1976	338.7	_	114.4	_	-	-	453.1
1977	549.2	24.3	259.7	-	_	-	833.2
1978	468.4	36.2	497.5	154.1	3.4	-	1,159.6
1979	521.7	18.2	442.0	124.0	22.0		1,127.9
1980	392.0		367.4	118.7	24.2	17.3	916.6
1981	156.0	_	484.6	91.4	16.2	20.8	769.0
1982	13.2		-	-	-	-	13.2
1983	_	_	133.4	_	_	-	133.4
1984	439.6	~	425.2	104.6	10.2	,8.5	988.1
19.85	348.5	-	644.8	193.0	65.9	16.0	1,268.3
1986	342.0	50.0	552.5	149.7	65.4	5.3	1,164.7
1987	500.6	59.9	311.3	82.1	65.2	-	1,019.1
1988	600.6	53.2	311.4	15.5	48.8	-	1,029.5
1989 ¹	609.1	52.0	-	-	-	_	-

¹Preliminary.

Year class	Estimates in August as 1-group	Calculated from estimates of 3- and 4-group spawners
1981	119	145
1982	155	147
1983	286	252
1984	31	100
1985	71	142
1986	101	1111
1987	147	-
1988	111	_
		_

The 1986 year class is not fully recruited to the surveys of the adult stock and consequently somewhat underestimated.

Table 5.3 The percentage of 4-group Capelin in the spawning stock in the years 1981-1987. (The high contribution in 1987 is due to the very rich 1983 year class and was omitted when calculating the mean.)

Year	Percentage
1981	22
1982	7
1983	12
1984	16
1985	34
1986	25
1987	63
1988	21
1989	32
Mean	21

 $\frac{\text{Table 5.4}}{\text{and winter in the seasons 1980/1981 - 1988/1989.}} \quad \text{Mean weight (g) of mature 2-3- and 3-4-years-old capelin in autumn and winter in the seasons 1980/1981 - 1988/1989.}$

Age	Season	Year class	Mean weight autumn	Mean weight winter	Year class	Mean weight autumn	Mean weight winter
1	1980/1981	1977	26.6	27.7	1978	19.3	20.7
2	1981/1982	1978	23.8	25.7	1979	19.2	19.9
3	1982/1983	1979	24.1	25.1	1980	16.5	18.7
4	1983/1984	1980	23.0	25.8	1981	15.9	19.3
5	1984/1985	1981	25.7	27.1	1982	15.8	19.1
6	1985/1986	1982	24.9	27.6	1983	18.1	20.3
7	1986/1987	1983	24.1	25.4	1984	18.1	19.6
8	1987/1988	1984	25.4	28.1	1985	17.9	19.5
9	1988/1989	1985	23.4	23.9	1986	15.6	17.8
Mean			24.6	26.3		17.4	19.4

Table 5.5 Natural mortality rates of the Icelandic capelin as calculated from successive acoustic estimates of spawning stock abundance and catch.

Estimate	Period						Mortality per month	
I	1	November	1978	_	31	January	1979	0.045
II	1	November	1979	_	31	January	1980	0.026
III	1	November	1980		31	January	1981	0.030
IV	15	November	1981	_	31	January	1982	0.048
V	1	December	1981	_	31	January	1982	0.035
VI	1	November	1982	_	31	January	1983	0.028
VII	1	November	1983		31	January	1984	0.034
VIII	15	November	1984	-	31	January	1985	0.035
Mean								0.035
Standard deviation							0.008	

FISH STOCK SUMMARY

STOCK: Herring - Va (Summer) 24-10-1989

Trends in yield and fishing mortality (F)

Trends in spawning stock biomass (SSB) and recruitment (R)

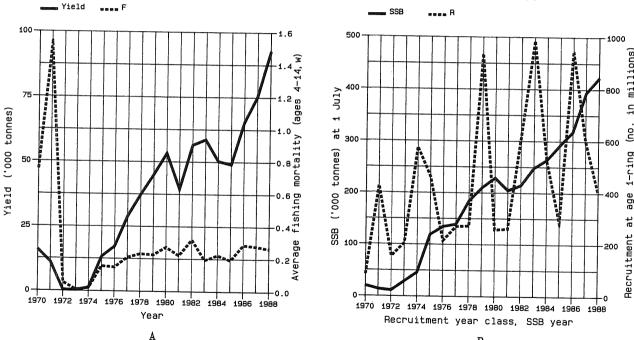
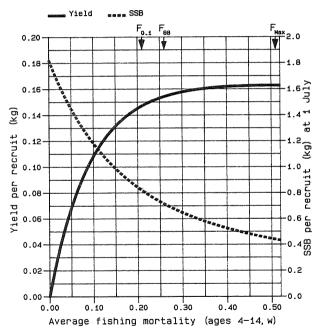


Figure 2.1 (cont'd)

FISH STOCK SUMMARY STOCK: Herring - Va (Summer) 24-10-1989

Long-term yield and spawning stock biomass

Short-term yield and spawning stock biomass



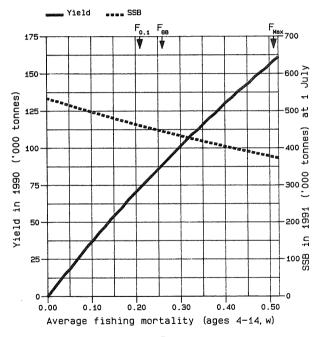
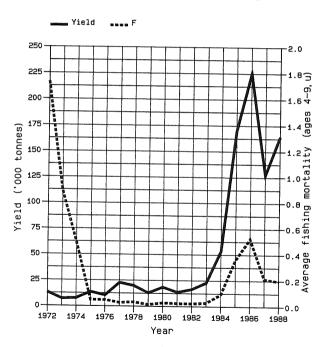


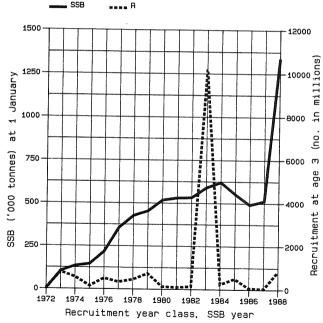
Figure 3.1

FISH STOCK SUMMARY STOCK: Norwegian Spring Spawning Herring 24-10-1989

Trends in yield and fishing mortality (F)



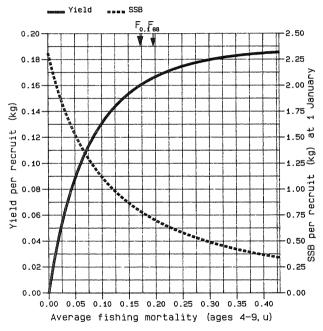
Trends in spawning stock biomass (SSB) and recruitment (R)

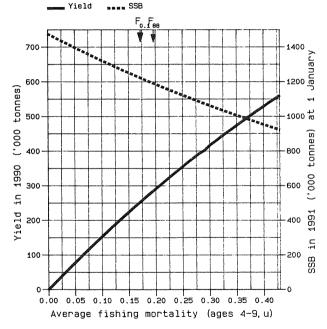


STOCK: Norwegian Spring Spawning Herring 24-10-1989

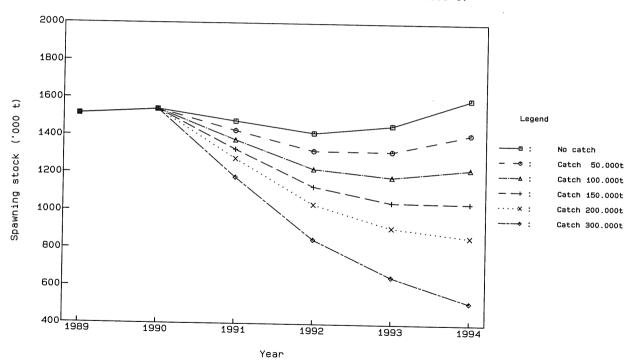
Long-term yield and spawning stock biomass

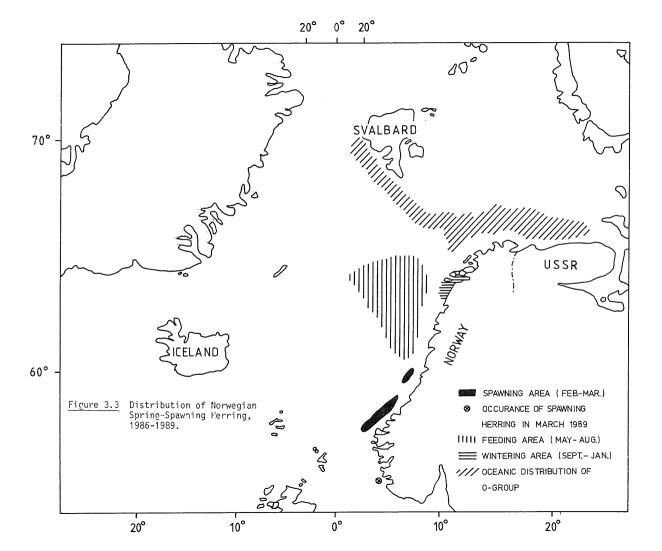
Short-term yield and spawning stock biomass





 $\frac{\text{Figure 3.2}}{\text{Norwegian spring-spawning herring. Catch in 1989: 100.000 t.}}$





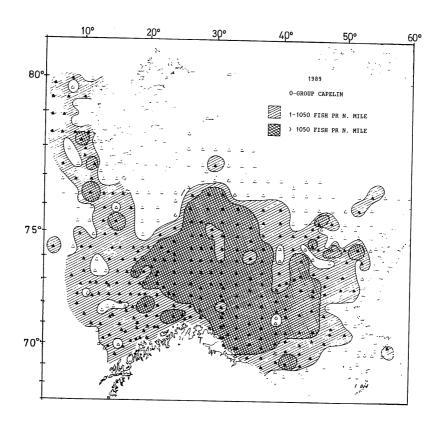


Figure 4.1 0-group distribution Barents Sea Capelin, August 1989.

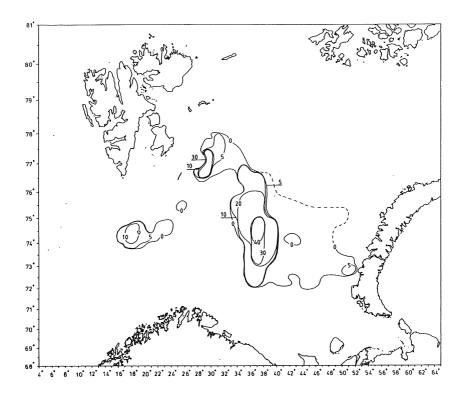


Figure 4.2 Estimated total density distribution of Barents Sea Capelin, September 1989 (tonnes per square nautical mile).

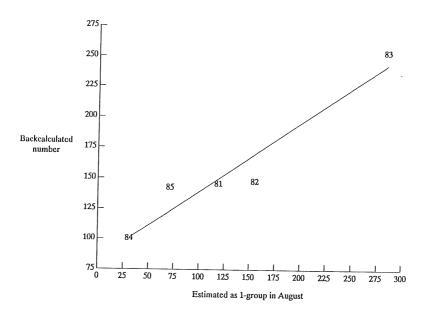


Figure 5.1 The relation between two different estimates of the abundance of the 1981-1985 year classes of capelin. $R^2 = 0.92$, a = 83.89, b = 0.55. Numbers are in 10^9 .