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the Exploration of the Sea

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REPORT ON THE ATLANTO-SCANDIAN HERRING AND CAPELIN WORKING GROUP

ICES Headquarters

29 October to 1 November 1984

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*) General Secretary
ICES
Palægade 2-4
DK-1261 Copenhagen K
DENMARK

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1. INTRODUCTION AND PARTICIPATION

1.1 Terms of Reference

The Working Group on Atlanto-Scandian Herring and Capelin met at ICES Headquarters from 29 October - 1 November 1984 to:

1. assess the state of the Atlanto-Scandian spring-spawning herring and capelin in Sub-Areas I, II, V and XIV and advise on any necessary management measures for these stocks;

2. analyse the effect of changes in the data sets of weight at age and age at first maturity on the time series of stock and spawning stock biomass.

1.2 Participants

J Carscadden	Canada
Yu V Chuksin	USSR
O Halldórsson	Iceland
J Hamre (Chairman)	Norway
J Jakobsson	Iceland
P Kanneworff	Denmark
V M Nikolaev	USSR
I Røttingen	Norway
S Tjelmeland	Norway
N G Ushakov	USSR

2. NORWEGIAN SPRING-SPAWNING HERRING

2.1 Catch Statistics

A total catch quota for the herring fishery in Norwegian coastal waters was set at 21 000 tonnes. The fishery was opened 22 August 1983, and the planned closing date was 1 March 1984. A minimum landing size of 25 cm, with allowance of 15% undersized fish, was enforced. By 31 December 1983, 13 270 tonnes of this quota were taken. In December 1983, a new total catch quota of 38 000 tonnes was set for 1984.

The winter fishery in 1984 was opened on 12 January 1984. For the first time since 1971, purse-seine vessels larger than 90 feet were allowed to participate in the herring fishery. These vessels were given a quota of 65 tonnes each. The closing date for the winter fishery was 14 April 1984; the catch was then 16 605 tonnes. Further, approximately 2 000 tonnes (mostly spring-spawning herring) were taken during a fishery at Bremanger (approximately 62°N) by the end of May 1984.

The catch of Norwegian spring spawners north of 62°N since 1972 in terms of weight and number is presented in Tables 2.1 and 2.2. As in 1983, 5 000 tonnes were added in Table 2.2 for herring of age 3 years and older to compensate for unreported catches. The Tables also include the by-catches of 0- and 1-group herring in the sprat fishery.

2.2 Recruitment

2.2.1 Larval surveys in 1984

Norway and USSR have conducted herring larval surveys in 1984. The number of herring larvae caught in these surveys was lower in 1984 compared

with 1983.

2.2.2 O-group surveys in 1983

An acoustic survey of the O-group herring distributed in the coastal areas of Norway has been conducted in November-December each year since 1975. In 1983 the survey area was extended to include the south-eastern part of the Barents Sea. The following target strength/length relationship was used to convert echo intensities to number of O-group herring:

$$TS = 19.1 \log L - 74.5$$

(L = length of O-group herring).

The results are presented in Table 2.3. Due to bad weather, the entire distribution area in the Barents Sea was not surveyed, so the number of O-group herring in the Barents Sea is underestimated.

2.2.3 O-group surveys in 1984

Figure 2.1 gives the geographical distribution of the 1984 year class of herring in the Barents Sea in August-September 1984 (Anon., 1984). With the exception of 1983, there was more O-group herring in the Barents Sea in August-September 1984 than in any other year since the present investigations started in 1965. The logarithmic O-group index for the O-group herring in the Barents Sea in 1984 was approximately 1/5 of the index in 1983 (Table 2.4).

2.2.4 Conversion factor for O-group indices

The O-group estimates obtained in November-December (Table 2.3) were regarded as representative of 1-group estimates on 1 January. Abundance estimates of 3-year-old fish on 1 January were back-calculated from the estimates of 4-year-old fish obtained by the tagging experiments and applying a mortality of 0.1. To relate the estimates of 1-group and 3-year-old fish, annual conversion factors (C Fact) were calculated for the year classes 1975-79, and an average conversion factor was calculated. The results are given in the text table below.

Year Class	1-gr. (1 January) ($N \times 10^{-6}$)	3-gr. (1 January) ($N \times 10^{-6}$)	C Fact
1975	1 075	96	.30
1976	3 775	406	.33
1977	412	313	.87
1978	1 208	353	.54
1979	3 457	560	.40
		C Fact =	.39

The values from year class 1977 were omitted from the calculations.

2.3 Adult Stock

2.3.1 Tagging

In previous years, the adult stock occurred in two separate components: a northern component overwintering in the fjords of the Lofoten area and spawning along the coast from northern Møre to Lofoten, and a southern component overwintering in the fjords of Møre and Romsdal and spawning along the southern coast of Møre. In the mid-1970s, the northern component was by far the largest and was dominated by the 1973 year class. The southern component, however, has increased in abundance faster, and is now dominated by younger age groups. This distribution pattern made it necessary to assess the stock in two separate units by allocating releases and recoveries on components according to corresponding areas.

The Norwegian tagging project as described in previous Working Group reports has been continued in 1984. In January-February a commercial catch of 2 100 tonnes of herring caught off the southern coast of Møre were screened for tags and 193 tags recovered. 430 tonnes of herring were caught experimentally in the Lofoten area in January and another experimental catch of 400 tonnes were caught on the northern coast of Møre in March yielding 60 and 51 recoveries respectively. Details of catch composition are given in Table 2.5. The catch on the southern coast of Møre is dominated by the 1979 year class whereas the catches from Lofoten and northern Møre consist of older herring.

Details of releases and recoveries by components in 1984 are shown in the text tables below:

Southern Component

Year of release	m_s	r_{ss}	r_{sn}	Σr_s	K	ln K	m_{84}
1975	5 000	5	0	5	10.0	2.30	904
1976	3 200	2	0	2	16.0	2.77	700
1977	16 044	15	2	17	9.4	2.24	4 243
1978	11 998	11	3	14	8.6	2.15	3 837
1979	5 995	9	1	10	6.0	1.79	2 319
1980	19 994	20	4	24	8.3	2.12	9 350
1981	24 967	56	6	62	4.0	1.39	14 120
1982	12 380	9	0	9	13.8	2.62	8 466
1983	15 891	50	0	50	3.2	1.16	13 141
Sum 1975 - 1983:		177	16	193			57 080
Excluding 1982:		168	16	184			48 614

$K = m_s/\Sigma r_s \cdot 10^{-2}$

m_s = number released of the southern component

r_{ss} = number recovered from m_s in catches south of $63^{\circ}N$

r_{sn} = number recovered from m_s in catches north of $63^{\circ}N$

Northern Component

Year of release	m_n	r_{nn}	r_{ns}	Σr_s	K	ln K	m_{84}
1975	20 991	7	1	8	26.2	3.27	3 171
1976	20 744	2	3	5	69.1	4.24	3 866
1977	23 989	11	0	11	21.8	3.08	5 516
1978	19 998	15	2	17	11.8	2.47	5 673
1979	20 792	9	1	10	20.7	3.03	7 276
1980	15 988	17	1	18	8.9	2.18	6 902
1981	9 977	11	0	11	9.1	2.20	5 314
1982	14 884	15	3	18	8.3	2.11	9 779
1983	10 925	13	0	13	8.4	2.13	8 856
Sum 1975 - 1983:		100	11	111			56 353
Sum 1975 - 1982		87	11	98			47 497

$K = m_n/\Sigma r_n \cdot 10^{-2}$

m_n = number released of the northern component

r_{nn} = number recovered from m_n in catches north of 63°N

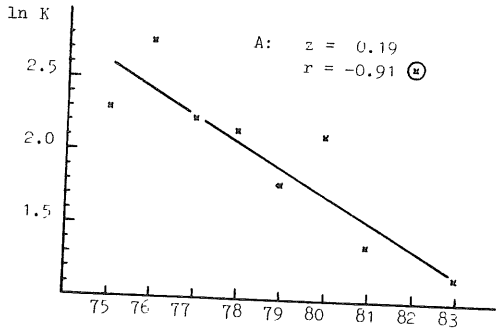
r_{ns} = number recovered from m_n in catches south of 63°N

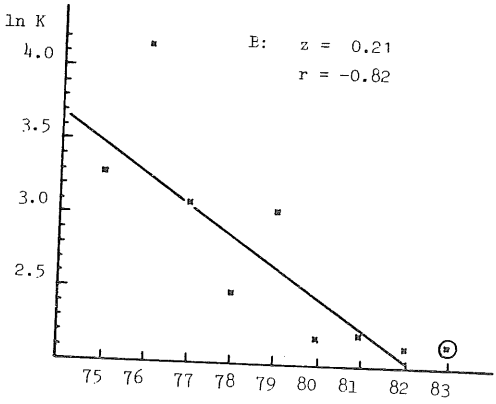
The tagged herring are released in batches of 2 000 - 10 000 herring and the allocation of the batches on components are done on the basis of the recoveries, i.e., the position of the catches from which the bulk of the recoveries are retained. The boundary between the spawning grounds of the two components runs at about 63°N.

The releases allocated to the southern component (m_s) have given 177 recoveries from catches taken in the south (r_{ss}) and 16 recoveries in the north (r_{sn}). For the northern component (m_n), the corresponding figures are 100 and 11 (r_{nn} and r_{ns}), respectively. It has been observed that the Atlanto-Scandian herring stock even mixes with a local herring stock (the stock in the Trondheimsfjord) in late spring when the tagging is executed. It is, therefore, assumed that the recoveries r_{sn} and r_{ns} reflect mixing of stock components when tagged and not when recovered.

2.3.2 Mortality estimates

The plots of ln K against time in liberty are shown in the text figure below:





A = Southern component

B = Northern component.

In calculating the regression lines, the 1982 releases of the southern component and the 1983 releases of the northern one have been omitted. The failure of recoveries may in the first case be due to a relatively high tagging mortality when the tagged herring are dominated by juveniles (1979 year class), the latter is probably due to no random mixing. The regression is calculated by weighting the points according to number of recoveries.

The total mortality rate Z is estimated at 0.19 and 0.21 for the southern and the northern components, respectively. This is slightly lower than the corresponding Z-estimates obtained in previous years (Z = 0.23 for both components). The present estimates are, however, regarded as more reliable because they are based on a longer time series and are derived from larger samples.

2.3.3 Stock abundance estimates

The calculated number of surviving tagged herring in winter 1984 by components are shown in the right-hand column of the text table above. Assuming that the r_{sn} and r_{ns} reflect mixed releases, the corresponding m_{sn} and m_{ns} can be estimated by the formulae:

$$m_{sn} = \frac{X \cdot m_n - m_s}{X \cdot Y - 1}$$

$$m_{ns} = \frac{Y \cdot m_s - m_n}{X \cdot Y - 1}$$

where $X = \frac{r_{ss}}{r_{ns}}$ and $Y = \frac{r_{nn}}{r_{sn}}$

From the text tables in Section 2.3.1 we have:

$m_s = 48\,614$ $m_n = 47\,497$, $r_{ss} = 168$, $r_{ns} = 11$, $r_{nn} = 87$, $r_{sn} = 16$.

This gives:

$X = 15.27$, $Y = 5.44$, and

$$m_{sn} = \frac{47\,497 \cdot 15.27 - 48\,614}{82.08} = 8\,244$$

$$m_{ns} = \frac{48\,614 \cdot 5.44 - 47\,497}{82.08} = 2\,643$$

Disregarding tagging mortality (assumed to be the same for all the released batches) the numbers of surviving tagged herring in 1984 and corresponding recoveries by component are as follows:

Southern Component

$m_s - m_{sn}$ = 48 614 - 8 244 =	40 370;	r_{ss} = 168
m_{ns} =	2 643;	r_{ns} = 11
Sum	43 013;	179

Northern Component

$m_n - m_{ns}$ = 47 497 - 2 643 =	44 854;	r_{nn} = 87
m_{sn} =	8 244;	r_{sn} = 16
Sum	53 098	103

The screened catches in numbers C_s and C_n are 4 992 · 10^3 and 2 479 · 10^3, respectively. Assuming 30% tagging mortality we have:

$$N_s = \frac{43\ 013 \cdot 0.7 \cdot 4\ 992 \cdot 10^3}{179} = 840 \cdot 10^6$$

$$N_n = \frac{53\ 098 \cdot 0.7 \cdot 2\ 479 \cdot 10^3}{103} = 895 \cdot 10^6$$

Distributed on year classes according to the age compositions in Table 2.5 we have (number in million individuals):

	1980	1979	1978	1977	1976	1975+	Total
N_s	2	49	14	10	14	11	100
N_n	0	7	16	14	11	52	100
N_{84}	17	475	260	208	216	559	1 735
N_{83}	100	1 100	196	122	243	589	2 350

This corresponds to a spawning stock biomass in 1984 of 640 000 tonnes.

The 1983 estimate used in last year's prognosis is included for comparison. In January 1983, tagged herring released on the coast of southern Møre in 1975-1980 were recovered in Lofoten. These recoveries, together with the observed changes in the age composition of the Lofoten catches, indicated that the older part of the southern component had mixed with the northern one. However, it had not been shown that they spawned on the same grounds because the main spawning grounds of the northern component were not sampled in 1983. Due to this mixing of stock components, the Working Group could not in 1983 assess the abundance as two separate stocks as done previously. An abundance estimate based on the tagging data obtained in 1983 was, however, obtained by separating releases and recoveries by age groups assuming random mixing of the releases within each group. Two groups were considered, the 1975

year class and older, and the 1976 year class and younger. This biased the estimate in favour of younger age groups as shown in the text table above.

The 1984 stock abundance estimate shows that the 1980 year class is very weak, which agrees with the results of the acoustic 0-group survey (Table 2.3). The 1979 year class is dominating the southern component but is not as strong as indicated by the 1983 estimate. It has not recruited to the northern component to any substantial extent, the year class being less numerous than the 1978 year class. It is also noted that this year's estimate of the 1979 year class fits better to the 0-group estimate than the estimate obtained last year.

The 1984 abundance estimate of the older ages (1975+) is estimated to be about 10% above the prognosis made last year, whereas the abundance of the younger ages is some 25% below. The age composition of the younger ages determined last year has moreover overestimated the 1979 year class, while the 1977 and 1978 year classes have been underestimated according to the 1984 estimate. However, this result is reasonable because the age samples used last year to determine the age composition of the year classes 1976-1980 were drawn from the southern stock component only. On the whole, the 1984 stock abundance estimate is about 10% below the 1983 prognosis both in number and weight of total stock biomass.

2.4 Catch and Stock Prognosis

A prognosis of catch and stock size for the period 1985-1986 has been run using the following input data:

Stock number x 10^{-6} in 1984 (1 January)	1 years 50 000 2 years 1 135 3 years 40 4+ 1984 estimate
Recruitment x 10^{-6}	1985 1 500 1986 1 500 1987 3 000
Maturation	3 years 0.10 4 years 0.80 5+ 1.00
Weight at age	in stock Table 2.6 in catch Table 2.7
Conversion factor (Section 2.2.4)	C $Fact_{1-2}$ = 0.39
Natural mortality	M_{3+} = 0.1
Fishing pattern	F_0 = 0.1 F_1 = 0.1 F_2 = 0.1 F_3 = 0.5 F_{4+} = 1.0

The input data refer to the stock at 1 January 1984. The 1-group estimate is set equal to the estimate of the 1983 year class in November-December 1983 (Table 2.3). The weight at age in the stock is set equal to the average weight at age observed in the autumn the year before, as was done in the prognosis last year. In the 1983 catch prognosis, the same weight at age in the catch as in the stock was used. This presup-

poses that the whole catch would be taken in the winter season. However, the herring catches in 1984 are more or less equally divided on autumn and winter catches, and in accordance with this fishing pattern the input of average weight at age in the catches is set equal to the mean weight at age observed in autumn in the two subsequent years. The remaining input parameters are the same as used last year. The catch prognosis was run by assuming an F in 1984 of 0.05 and the results are given in the text table below (in thousand tonnes):

1984				1985				1986			
SB	SSB	F	C	SB	SSB	F	C	SB	SSB	F	C
926	616	.05	37	1376	595	0	0	1831	734	0	0
						.03	24	1810	717	.03	41
						.05	40	1796	705	.05	67
						.10	79	1762	677	.10	129
						.15	117	1729	650	.15	186

SB = stock biomass
SSB = spawning stock biomass
C = catch

The results of this prognosis agree with the prognosis last year. The spawning stock will not change to any appreciable degree from 1984 to 1985. However, both the stock biomass and spawning stock biomass will increase between 1985 and 1986, largely because of the presence of the 1982 and 1983 year classes. As observed last year, and confirmed in this year's report, the 1983 year class is strong and in view of the greatly improved prospects for recruitment to the spawning stock, a fishing mortality on the adult component of the stock in the order of F = 0.05 will have very little effect on the long-term development of the stock.

3. BARENTS SEA CAPELIN

3.1 Regulation of the Barents Sea Capelin Fishery

Since 1979, the Barents Sea fishery has been regulated by a bilateral fishery management agreement between USSR and Norway. A TAC has been set for the winter fishery and for the autumn fishery separately. The fishery has been closed from 1 May to 15 August until 1984. In 1984, the fishery was closed from 1 May to 1 September. A minimum landing size of 11.0 cm has been enforced, and a minimum mesh size of 16 mm introduced.

In its 1983 Report ACFM recommended that:

(1) the TAC for the period 1 January to 1 May should be set at 0.5 million tonnes;

(2) the TAC for the autumn fishery (1 September to 31 December) should be set at 0.6 million tonnes.

Following a recommendation from the USSR/Norwegian Fishery Commission, the two countries agreed to set the TAC for the winter fishery at 0.6 million tonnes. The TAC for the autumn fishery was set at 0.8 million tonnes.

3.2 Catch Statistics

The international catch by countries in the years 1965-1983 is given in Table 3.1. The capelin catch (USSR and Norway combined) in numbers by age and month for the period 15 August 1983 - 30 April 1984 is given in Table 3.2. The age composition in the winter catch is about the same as in 1983. The autumn catch by the end of September is reported as 357 000 tonnes and 107 000 tonnes for Norway and USSR, respectively.

3.3 Stock Size Estimates

3.3.1 Larval and 0-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 3.3. From 1981 to 1983 the larval production was constant. The larval index for 1984 is, however, about 20% lower than this level.

No index is calculated on the basis of the International 0-Group Survey in the Barents Sea this year (Anon., 1984), but the 0-group distribution area observed in this cruise seems not to be much different from that observed in recent years (Figure 3.1).

3.3.2 Acoustic stock estimate

The 1984 acoustic survey was carried out in the period 5 - 24 September as a joint Soviet-Norwegian cruise. Four research vessels, two Norwegian and two USSR, participated in this survey. The following abundance estimate by year class was obtained:

Year class	Number . 10^{-9}	Mean weight (g)	Biomass (tonnes . 10^{-6})
1983 (1982)	145 (515)	3.7 (3.1)	0.54 (1.61)
1982 (1981)	184 (200)	7.4 (9.5)	1.37 (1.89)
1981 (1980)	48 (38)	18.2 (18.9)	0.87 (0.72)
1980 (1979)	3 (+)	27.1 (19.4)	0.09 (0.01)

The estimates of the same age groups in 1983 are shown in parantheses for comparison. The 1983 year class is nearly 4 times lower by numbers than the 1-group measured last year, while the average weight of 1-year olds is higher in 1984. These differences result in a biomass estimate which is about 3 times lower than last year.

The 1982 year class is a little lower than the 2-group estimate obtained last year but, due mainly to a considerable drop in the mean weight for this age group, the biomass is 25-30% lower compared to last year.

The 1981 year class is about 25% more abundant than the 3-group measured last year, but the mean weight is only slightly lower, resulting in a biomass estimate about 20% higher than in 1983.

The 4-group seems to be more abundant this year compared to 1983, both by number and weight. The abundance is, however, still very low, and a comparison from year to year may not be justified at this level of abundance.

The total stock biomass is estimated to be 2.9 million tonnes, compared to 4.2 million tonnes in 1983. Details of the estimate are given in Table 3.4.

The area west of Spitsbergen Island was not covered during the 1984 survey. In August, during the International 0-group survey, some capelin concentrations were detected in this area, and estimated at 130 000 tonnes, out of which about 90 000 tonnes were above 14 cm. This estimate has not been added to the stock estimate.

The text table below shows the predicted stock based on the 1983 survey and the measured stock in 1984.

Year class	Predicted 1984		Measured 1984	
	Number ($\times 10^{-9}$)	Mean weight (g)	Number ($\times 10^{-9}$)	Mean weight (g)
1982	270	9.15	184	7.37
1981	74	17.29	48	18.31
1980	2	23.98	3	27.58

The predicted growth for the 1982 year class was 1.8 g too high, and consequently, the measured stock biomass was considerably lower than that measured in 1984. This unexpectedly low 2-group growth observed in 1984 is probably caused by the great shift in distribution observed this year (Figure 3.1 and 3.3), where a larger part of the total stock was found in areas where the capelin is known to have a slow growth.

The predicted stock size in 1984, which was the basis for the calculated autumn TAC in 1984 and the preliminary winter TAC for 1985, is about 64% higher than that measured in September 1984 for age groups 2 and older.

3.4 TAC for the Winter Fishery 1985

As a guideline for TAC regulation of the fishery, a length at maturity of 14.0 cm and a monthly mortality of 0.055 has previously been used. The individual weight of the spawners has been taken as the mean weight of fish longer than 14.0 cm. The TAC was aimed at a spawning population of about 500 000 tonnes.

A capelin model parameterized for the period 1973-1980 (Hamre and Tjelmeland, 1982) yielded a value of 13.83 for the length at maturity and an optimal spawning stock of about 400 000 tonnes. In this model, age-specific weight correction factors for the mature population is used. These correction factors are based on a mean deviation between observed individual weight in the spawning population and the mean weight of fish

longer than the length at maturity, as measured in the autumn. The model is described in a paper presented at the Soviet-Norwegian Symposium on Barents Sea Capelin in 1984 (Tjelmeland, in press).

When the model is parameterized using data from the period 1973-1984, the length at maturity is increased to 13.90 cm, the natural mortality of the immature part of the stock is increased to 0.063 per month, and the optimal spawning biomass is decreased to about 300 000 tonnes. The maximum sustainable yield is decreased from above 1.6 million tonnes to about 1.3 million tonnes depending on how the catch is divided in the autumn and winter seasons.

The Working Group points out that a model based on long-term averages should be used with caution in situations of great variability in the population parameters of the stock. Since 1980, several unexpected observations have been made:

- The numbers of 2-year old capelin measured in 1982 was unreasonably high as compared to the estimate of the year class in 1983.

- The 1981 year class is unexpectedly weak considering the very high level of the spawning population in 1981.

- The 1983 year class measured as 1-year-old fish in 1984 is extremely weak.

Nevertheless, the results from the model should be taken into account when the TAC for the winter fishery is assessed. Based on the model using a natural mortality on the mature population of 0.055 in the period January-March, the following correspondence between catch and spawning biomass is obtained (thousand tonnes):

Catch	231	404	534	631
Spawning biomass	605	449	332	246

Based on these calculations and taking into consideration the present uncertainties concerning the dynamics of the stock, the Working Group advises that a cautious approach should be taken when the TAC is recommended for the winter fishery.

3.5 TAC for the Autumn Fishery in 1985

The Working Group points out, as in 1983, that the prognosis 1½ years ahead in time in order to give TAC advice on the autumn fishery involves the highly uncertain factors of growth and recruitment. Thus, a smaller fraction of the total catch should be allocated to the autumn season than to the winter season.

The Working Group finds it difficult to decide whether the extremely low value of 1-year-old capelin observed is reliable. Therefore, a prognosis for the recruiting number of 2-year-old fish in 1985 is difficult to make.

Because of the above considerations, the Working Group will not base the TAC advice on simulations. Instead, the autumn catch in 1985 should be set at a low level, compared to quotas in earlier years.

4. THE ICELANDIC CAPELIN

4.1 The Fishery

The 1983 autumn/1984 winter season opened in early November with a TAC of 375 000 tonnes. This catch quota was revised and increased to 640 000 tonnes after a new abundance estimate became available in early 1984.

The new spawning stock estimate was approximately 30% higher than the abundance predicted from the Icelandic-Norwegian survey conducted in October 1983. The observed average individual weight in the spawning stock was higher than predicted, and a larger proportion of the stock had matured to spawn than was forecast from the October data. The fishery terminated in early April with a total catch of 570 300 tonnes.

In 1984, the summer/autumn fishery began in the Jan Mayen area where Norwegian vessels caught 104 338 tonnes in August. The EEC and Faroese catch, taken in August in the same area, amounts to 14 170 tonnes.

The Icelandic 1984 autumn season started on 1 October. On 25 October, the Icelandic capelin catch amounted to about 70 000 tonnes.

The total annual and seasonal catch of capelin in the Iceland-East Greenland-Jan Mayen area since 1964 is given in Table 4.1.

4.2 Abundance of Juvenile Capelin

Abundance estimates of the 1981, 1982 and 1983 year classes as 1-group fish were obtained in acoustic surveys in August 1982, 1983 and 1984. The results are given in the following text table:

Year class	Number in 10^9
1981	119
1982	155
1983	285

The October survey in 1983 yielded an estimate of the 1981 year class as 2-group fish of 76 x 10^9 individuals. This corresponds to an estimated monthly M value of 0.032 which is somewhat lower than the assumed value of 0.04. In future assessments it is necessary to revise the value of natural mortality presently used in the stock predictions on which TAC assessments are based. At present, this is the only comparison between 1- and 2-group acoustic abundance estimates available. Further data must be evaluated before using the 1-group abundance from August surveys as a basis for setting preliminary TACs.

Information on immature capelin obtained in the autumn and winter surveys of the Icelandic capelin stock has been used for calculating preliminary TACs for the next season. Such information is at present not available since the 1984 autumn survey has not yet been carried out.

4.3 Preliminary TAC for the Autumn 1984/Winter 1985 Season

The main contributor to the 1985 spawning stock will be the 1982 year class and the proportion of the 1981 year class which did not mature in 1984.

Using data on these stock components obtained during an Icelandic acoustic survey in January/February 1984, ACFM indicated that a preliminary TAC of 300 000 tonnes could be set for the 1984/85 season. This preliminary TAC would then be re-assessed and adjusted, if necessary, when a new stock abundance estimate became available in autumn 1984.

The acoustic abundance survey usually carried out in October, has not yet taken place. However, new information on the abundance of the 1981 and 1982 year classes was obtained during the 0-group survey in the Iceland-Greenland area south of 69°N in August 1984. The resulting abundance estimate for the above year classes in number (10^9) and biomass (10^3 tonnes) is given in the following text table:

	Year classes	
	1981	1982
Number	7.2	45.5
Weight	172.3	543.8

The Working Group noted that the abundance of the 1981 and 1982 year classes estimated from the August 1984 survey are underestimated because:

(1) Experience has shown that acoustic abundance estimates obtained in the period July-September generally produce an underestimate of 2- and 3-ringed capelin in the Iceland-Greenland-Jan Mayen area.

(2) During the August 1984 cruise, a considerable fishery which took the 1981 and 1982 year classes occurred north of the survey area.

(3) Capelin shoals in near surface layers in the northernmost part of the area surveyed will lead to an underestimate of capelin there. Samples show predominance of the 1981 and 1982 year classes in this area.

The observations in August show that the growth rate of capelin is very high this year.

On this basis the Working Group calculated that the maturing stock in October 1984 would be about one million tonnes using average weights of 20 and 25 g for the 2- and 3-year old capelin, respectively.

The experience has shown that acoustic estimates derived from August surveys are underestimates and cannot be used for calculating the final TAC for this capelin stock. There are, however, strong indications that this stock is rapidly recovering, and the August survey results indicate that the preliminary TAC of 300 000 tonnes could probably be increased by 50 - 100%. Any TAC decisions taken on this basis should be reconsidered when a new stock abundance estimate becomes available later in the year or in early 1985.

4.4 A Preliminary TAC for the 1985 Autumn Season

In the absence of the results of the autumn 1984 and 1985 winter surveys the Working Group was unable to provide advice on a preliminary TAC for the 1985 autumn season. The results from the above-mentioned surveys should be made available to the May 1985 ACFM meeting when a preliminary TAC for the 1985 autumn season can be recommended.

5. EFFECT OF CHANGES IN THE DATA SETS OF WEIGHT AT AGE AND AGE AT FIRST MATURITY

The Working Group noted that for the Atlanto-Scandian herring and for the capelin stocks, weight at age and age at first maturity are measured and reported to the Working Group each year. These new data have been incorporated into the stock assessments and as a result, the time-series of stock and spawning stock biomass estimates have reflected annual changes in these parameters.

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Table 2.1 Catches north of 62°N of Norwegian spring spawning herring (tonnes) since 1972

Year	Catches of adult herring in winter	Mixed herring fishery in autumn [1]	By-catches of 0- and I-group herring in the sprat fishery
1972	0	9 895	3 266 [2]
1973	139	6 602	276
1974	906	6 093	620
1975	53	3 372	288
1976	0	247	189
1977	374	11 834	498
1978	484	9 151	189
1979	691	1 866	307
1980	878	7 634	65
1981	844	7 814	78
1982	983	10 447	225
1983	3 857	13 290	907
1984	18 605 [3]		

[1] Includes also by-catches of adult herring in other fisheries

[2] In 1972 there was also a directed herring 0-group fishery

[3] Preliminary 1 January - 30 June 1983

Table 2.2 Catch in numbers, millions, Norwegian spring spawners. Unreported catches are included for 3 years and older herring

Age	1972	1973	1974	1975	1976	1977
0	347 100	29 300	65 900	30 600	20 100	43 000
1	41 000	3 500	7 800	3 600	2 400	6 200
2	20 400	1 700	3 900	1 800	1 200	3 100
3	35 376	2 389	0 100	3 268	23 248	22 103
4	3 476	25 220	0 241	0 132	5 436	23 595
5	3 583	0 651	24 505	0 910	0 000	0 336
6	2 481	1 506	0 257	30 667	0 000	0 000
7	0 694	0 278	0 196	0 005	13 086	0 419
8	1 486	0 178	0 000	0 002	0 000	10 766
9	0 198	0 000	0 000	0 000	0 000	0 000
10	0 000	0 000	0 000	0 000	0 000	0 000
11	0 494	0 000	0 000	0 000	0 000	0 000
12	0 593	0 000	0 000	0 000	0 000	0 000
13	0 593	0 000	0 000	0 000	0 000	0 000
14	0 000	0 178	0 000	0 000	0 000	0 000

Age	1978	1979	1980	1981	1982	1983
0	20 100	32 600	6 900	8 300	22 600	127 000
1	2 400	3 800	0 800	1 100	1 100	4 679
2	1 200	1 900	0 400	11 900	0 200	1 675
3	3 019	6 352	6 407	4 166	13 817	3 183
4	12 164	1 866	15 814	4 591	7 892	21 191
5	20 315	6 865	2 278	8 596	4 507	9 521
6	0 870	11 216	8 165	2 200	6 258	6 181
7	0 000	0 326	15 838	4 512	1 960	6 823
8	0 620	0 000	0 441	8 280	5 075	1 293
9	5 027	0 000	0 008	0 345	6 047	4 598
10	0 000	2 534	0 000	0 103	0 121	7 329
11	0 000	0 000	2 688	0 114	0 037	0 143
12	0 000	0 000	0 000	0 964	0 037	0 040
13					0 037	0 143
14						0 862

Table 2.3 Norwegian spring spawners. Acoustic abundance of 0-group herring in 1975-83 (N x 10^{-6})

Year	Area				Total
	62°N-65°N	65°N-68°N	North of 68°30'	Bar.Sea	
1975	328	692	55	-	1075
1976	415	2610	750	-	3775
1977	70	305	37	-	412
1978	302	511	392	-	1205
1979	909	2260	288	-	3457
1980	12	4	218	-	234
1981	263	2	1	-	265
1982	64	571	2301	-	2936
1983	323	4543	8864	35700	49430

Table 2.4 Preliminary abundance indexes for 0-group herring in the Barents Sea 1973-84

Year	Arithmetic index	Log index
1973	1.3	0.05
1974	0.2	0.01
1975	0.0	0.00
1976	0.3	0.00
1977	0.2	0.01
1978	1.1	0.02
1979	6.7	0.09
1980	0.0	0.00
1981	0.1	0.00
1982	0.3	0.00
1983	751.8	1.77
1984	66.9	0.34

Table 2.5 Norwegian spring spawners. Age distribution of spawning stock in 1984

Year class	1980	1979	1978	1977	1976	1975	1974	1973	1972	1971	1970	1969
Southern component	2	49	14	10	14	4	5	2				
Northern component		7	16	14	11	5	17	26	1	0	1	3

Table 2.6 Average weight in stock (1 January), in grammes, Norwegian spring spawners 1975-1984

Age	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
3	181	181	181	180	178	175	170	170	155	140
4	259	259	259	294	232	283	224	204	249	204
5	342	342	342	326	359	347	336	303	304	295
6	384	384	384	371	385	402	378	355	368	338
7	409	409	409	409	420	421	387	383	404	376
8	444	444	444	461	444	465	408	395	424	395
9	461	461	461	476	505	465	397	413	437	407
10	520	520	520	520	520	520	520	453	436	413
11	543	543	543	543	551	534	543	468	493	422
12	412	412	412	500	500	500	512	512	480	459
13								500	470	449
14									500	427
15										437

Table 2.7 Average weight in catch, in grammes, Norwegian spring spawners 1974-1983

Age	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
3	259	259	259	294	232	283	224	204	249	204
4	342	342	342	326	359	347	336	303	304	250
5	384	384	384	371	385	402	378	355	368	317
6	409	409	409	409	420	421	387	383	404	356
7	444	444	444	461	444	465	408	395	424	386
8	461	461	461	476	505	465	397	413	437	401
9	520	520	520	520	520	520	520	453	436	410
10	543	543	543	543	551	534	543	468	493	418
11	412	412	412	500	500	500	512	512	480	441
12								500	470	455
13									500	438
14										432

Table 3.1 International catch of Barents Sea capelin (1 000 tonnes) in the years 1965-1983

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	1 497	812		2 309

Table 3.2 Capelin catches in the Barents Sea in August-September 1983 and in January-April 1984 in numbers

Age	Numbers x 10^{-9}								
	1983					1984			
	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
1	0.11	1.85	0.78	0.24	0.01				
2	11.48	13.17	8.50	2.27	0.72	0.04	0.01	0.01	0.09
3	9.71	8.65	4.61	1.56	1.88	2.87	2.48	2.51	0.21
4	0.24	0.19	0.61	0.12	0.14	8.36	6.13	7.04	0.03
5			0.01		+	0.79	0.59	0.72	
6+							0.02		
Sum	21.54	23.86	14.51	4.19	2.75	12.06	9.23	10.28	0.33

Table 3.3 Larval indices 1981 to 1984

Year	Area				Total
	16° - 25°	25° - 28°	28° - 31°	31° → east	
1981	5.4	2.4	1.5	0.4	9.7
1982	1.6	3.2	3.3	1.8	9.9
1983	4.4	1.8	2.3	1.4	9.9
1984	2.2	3.5	0.5	2.0	8.2

Table 3.4 Acoustic estimate autumn 1984

Total length (cm)	Age groups					Total number x 10^{-7}	Biomass tonnes x 10^{-3}	Biomass (Cumulative)
	1	2	3	4	5			
8.0 - 8.4	266	14				280	5.2	
8.5 - 8.9	998					998	20.4	
9.0 - 9.4	2 719	34				2 753	72.6	
9.5 - 9.9	3 848	391				4 239	132.9	
10.0 - 10.4	2 515	1 388				3 903	153.6	
10.5 - 10.9	2 076	2 443	25			4 544	204.8	
11.0 - 11.4	1 277	2 951	80			4 308	226.7	
11.5 - 11.9	515	3 009	114			3 638	219.5	
12.0 - 12.4	125	2 692	194			3 011	213.9	
12.5 - 12.9	139	1 742	163			2 044	171.6	
13.0 - 13.4	39	1 384	284			1 707	166.7	
13-5 - 13.9	25	739	409			1 173	134.2	
14.0 - 14.4	2	513	501			1 016	137.5	1 141.6
14.5 - 14.9		347	489			836	122.8	1 004.1
15.0 - 15.4		213	541	37		791	136.0	881.3
15.5 - 15.9		153	421	37		611	115.7	745.3
16.0 - 16.4		127	395	39		561	121.5	629.6
16.5 - 16.9		82	297	59		438	110.0	508.1
17.0 - 17.4		94	328	33		455	128.9	398.1
17.5 - 17.9		51	226	24		301	95.7	269.2
18.0 - 18.4		6	157	24		187	66.6	175.5
18.5 - 18.9		11	76	32		119	46.0	106.9
19.0 - 19.4		2	62	14		78	33.5	60.9
19.5 - 19.9			31	10		41	19.2	27.4
20.0 - 20.4			2	10		12	6.4	8.2
20.5 - 20.9				3		3	1.8	1.8
Number x 10^{-7}	14 544	18 386	4 795	322		38 047		
Number > 14.0 cm	2	1 599	3 526	322		5 449		
Biomas (tonnes x 10^{-3})	535.8	1 367.8	872.7	87.4			2 863.7	
Mean length (cm)	10.1	12.0	15.2	17.2		11.7		

Table 4.1 The total annual and seasonal catch of CAPELIN in the Iceland - East Greenland - Jan Mayen area since 1964 (in '000 tonnes)

Year	Winter season		Summer and autumn season				Total
	Iceland	Faroes	Iceland	Norway	Faroes	EEC	
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	457.6		3.1				460.7
1976	338.7		114.4				453.1
1977	549.2	25.0	259.7				833.9
1978	468.4	38.4	497.5	154.1			1 158.4
1979	521.7	17.5	441.9	126.0	2.5		1 109.6
1980	392.0		367.2	118.6	24.4	14.3	916.5
1981	156.0		484.6	91.4	16.2	20.8	769.0
1982	13.0		0.0	0.0	0.0	0.0	13.0
1983	0,0		133.3	0.0	0.0	0.0	133.3
1984	437.0			104.3	6.2	8.0	555.5

Figure 2.1 Distribution of 0-group herring in the Barents Sea in August-September 1984 (Anon., 1984)

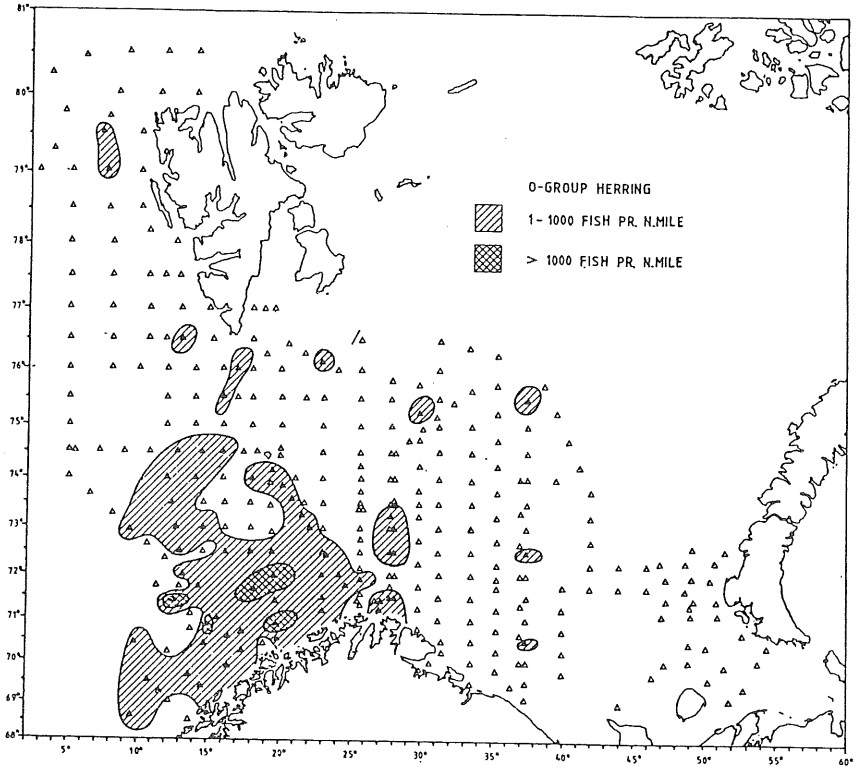

Figure 3.1 Distribution of 0-group capelin

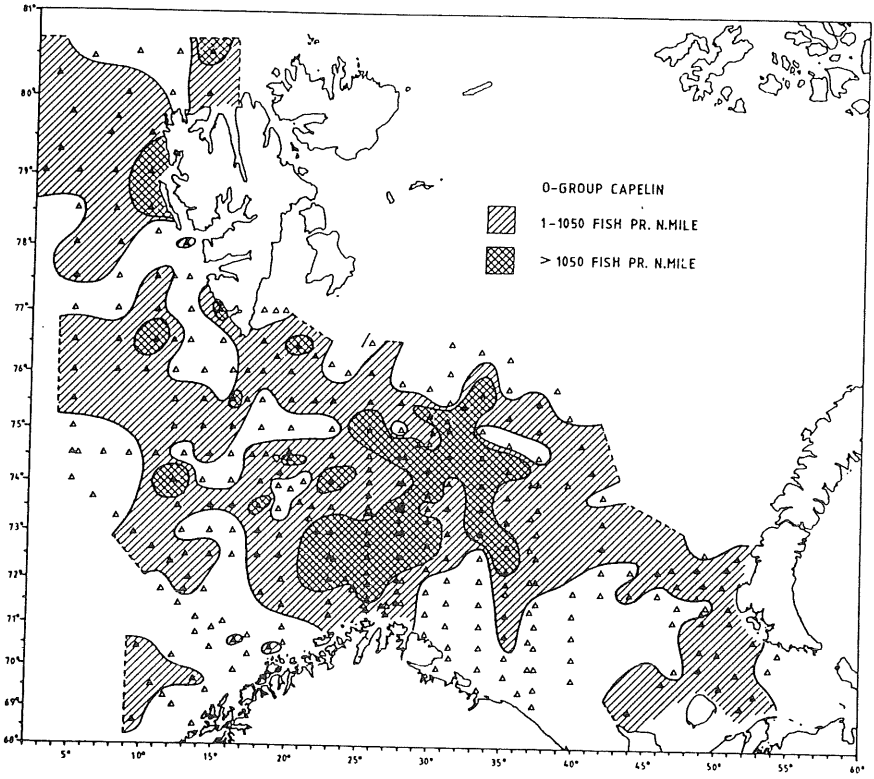

Figure 3.2 Geographical distribution of the capelin stock in 1983 (m^2 scattering cross section/n. $miles^2$ x 10)

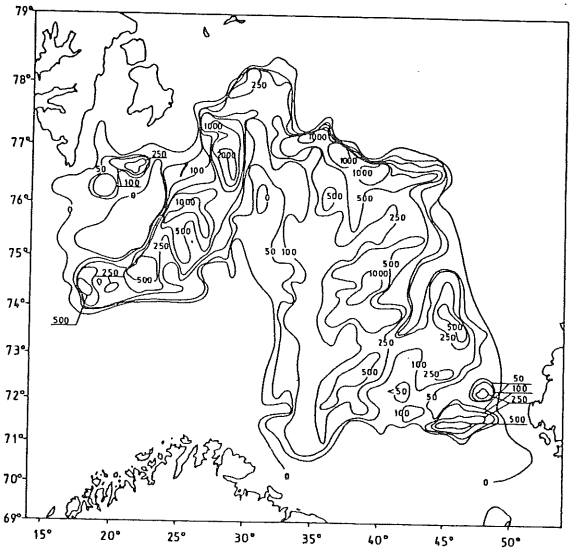

Figure 3.3 Geographical distribution of the capelin stock in 1984 (m^2 scattering cross section/n. $miles^2$ x 10)