

STATUS OF CAPELIN STOCKS. SA2+3K. DIV. 3L SUBDIVISION 3Ps. AND DIV. 4RST

Capelin in SA2 + Div. 3K

Catch Trends

The capelin fishery in NAFO Subarea 2 and Div. 3K was, until 1972, limited to inshore catches during the spawning season. In 1972, substantial catches were taken offshore by vessels from several countries. Catches peaked in 1976 at 212,000 t before declining in the late 1970s to 11,000 t in 1979 (Figure 1).

Offshore catches during the 1980s were restricted by quota and ranged between 5,000 to 31,000 t. The offshore fishery has generally been conducted during August-December with peak catches occurring in September- November. A total of 57,000 t were caught in the offshore fishery in 1990, but only 500 t were caught in 1991. There was no offshore fishery during 1992.

During the 1980s, an inshore directed roe fishery during June and July has occurred, primarily in Div. 3K. Beginning in 1988, landings increased because of an increased share of the market for Canadian capelin with the closure of the Barents Sea capelin fishery. TACs generally reflect market demand and the increase of the TACs during the late 1980s can be attributed to the larger market share. These have however, remained below the 10% of total spawning biomass that has been set as the biological criteria for setting the TAC.

The 1992 preliminary inshore catch of 16,000 t was lower than the 1991 catch and approximately equal to the TAC. The capelin arrived later in 1992 than observed in the 1980s but not as late as in 1991.

The offshore fishery first came under quota regulation in 1974 and the inshore fishery in 1982. Catches and TACs since 1986 are shown below:

	1986	1987	1988	1989	1990	1991	1992
Offshore							
TAC	17	31	17	20	71	57	0
Catch	17	31	17	22	57	0.5 ¹	0
Inshore							
TAC	19	9	21.5	24.1	29	29	17
Catch	12	11	27	28	33	20 ¹	16 ¹
1 Provisional							

Age Compositions and Mean Lengths in the 1992 Commercial Fishery

The 1989 year-class with 77% and the 1988 year-classes with 13% by numbers dominated the inshore catch in 1992. This is the second highest percentage contribution by age 3 capelin in the 1982-92 series. The proportions of age 2 capelin (9%), was the highest in the series and substantially higher than the mean of 1.3% for the period 1982-91. Age 2 also contributed a relatively high proportion (4.7%) in 1991.

Mean lengths and weights declined between 1990 and 1992. The decline was greater in Div. 3K than in Div. 3L.

Abundance Indices

Catch rates from traps and purse seines for the inshore and acoustic estimates by Canada and Russia for the offshore have traditionally been used as abundance indices (Figure 2).

Catch rate estimates from a research logbook program for the inshore fishery were available for purse seines (1981-91) and traps (1983-91).

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Traps t/day ¹			3.3	4.1	3.2	5.8	10.5	5.9	5.8	10.7	4.6	6.6
PS t/day	9.2	15.5	12.0	14.1	16.5	18.0	15.3	18.5	16.7	21.8	5.4 ²	19.2
1 Landings and discards. Discards include dead fish and those released alive												
2 Only 1 purse seiner												

The fishery in 1992 was again somewhat different from historical patterns. Most of the catch was taken in White Bay and the western side of Notre Dame Bay. Many trap fishermen did not fish in 1992 because of the late arrival of capelin, small females in some areas, and the moratorium on northern cod. Opening and closing dates varied considerably in 1992 due to a monitoring program to assess the quality of the product.

An acoustic survey for capelin in Div. 2J3K was conducted during October 1992. The area surveyed was similar to 1990 and earlier years; the 1991 survey area had been changed during the survey to investigate reports of large quantities of capelin outside the planned survey area. The 1992 survey design was a uniform parallel transect design. This is different from the design used during 1989-91 because it was felt that uniform spacing would provide more adequate coverage during periods of low stock abundance such as was anticipated in the 1992 survey.

The total biomass estimate was 31,900 1. Although a few individual capelin were caught in midwater trawl sets in Div. 2J, the catches were so low that the Div. 2J portion of the biomass estimate was zero. The biomass estimate for 2 + 3K is the third consecutive low estimate (1991 = 43,000 t, 1990 = 96,000 t) and is much lower than the 1989 estimate of 1,744,000 1. The 1992 estimate is about 5% of the mean. Capelin were found in a few scattered concentrations and one large school. All capelin detected acoustically were near the bottom. This distribution pattern is different from other years when capelin were from bottom to midwater during the daytime and dispersed at the surface during the night. The location of capelin concentrations within the Canadian acoustic survey area agreed with the concentrations detected during the Canadian groundfish survey (November-December) and the Russian acoustic survey (early November). The vertical distribution patterns of capelin also agree with the Russian observations.

The age compositions of capelin in the fishing sets made during the survey were dominated by the 1990 year-class (86%). While the predominance of a single age group is not unusual, this is the highest proportion in the series.

A trip summary of a Russian survey conducted in early November 1992 indicated a biomass of 9,500 t, detected in the same area as the Canadian survey. The overall survey area was less than the area surveyed during the Canadian survey. No ageing data were available but the length frequencies were similar to the Canadian results.

The distribution of incidental catches of capelin in the annual bottom trawl surveys conducted by Canada during November and December 1978-92 was examined. During the period 1980-89, there was a geographical break between moderate to good catches in northwestern Div. 2J3K and catches of similar magnitude in northern Div. 3L. In many years there were numerous and often large catches on Hamilton Bank and on the coastal shelf off southern Labrador whereas in other years (eg. 1986, 1987) the capelin were further to the south. In 1987, 1990, 1991, and 1992 capelin were caught further to the southeast than in any other year. These were also the years in which the capelin acoustic biomass estimates were low. During 1992, there was no distinct break between catches in southern Div. 3K and northern Div. 3L.

Most of the large incidental catches in Div. 2J3K in 1992 occurred within the area covered by the acoustic survey, although several on northeastern and southeastern Funk Island Bank were taken very close to the boundary of the survey. The area of high frequency of occurrence in southeastern part of Div. 3K was not included in the acoustic survey.

Capelin were recorded at 49% of fishing stations made at depths shallower than 750 m, equal to the 1987 value, the highest frequency of occurrence observed during 1978-92. For capelin, the results of the 1992 groundfish survey may not be directly comparable to surveys prior to 1991 because of a change in survey design. Many catches of capelin occurred in strata which received much higher intensity of fishing. The impact of this change of the allocation of fishing sets is not presently known.

The distribution of capelin from mean cod stomach fullness indices indicates a similar pattern to that observed in the incidental catch of capelin during the groundfish surveys (aggregated for 1980-89). Specifically there are capelin in Div. 2J and western 3K and in northern and northeastern Div. 3L. The data for individual years reveal that the capelin tend to be either on Hamilton Bank and along the coastal shelf off southern Labrador and northeastern Newfoundland or more aggregated on the central northeast Newfoundland Shelf (e.g. in 1986, 1987). It appears that in 1990 capelin were further to the east than in previous years and that in 1991 they were aggregated in the southeast.

Data from 1991 and 1992 were available from studies of spawning success on seven Newfoundland beaches. Age compositions of spawning capelin were different from those reported from the commercial catches. In this study, there was a lower proportion of two- and three-year-olds than in the commercial samples. These differences are thought to be due to different interpretations by the different age readers. A preliminary analysis of combined egg deposition data indicated similar egg deposition densities in 1991 and 1992. In most areas, greater numbers of larval capelin emerged from the gravel during 1992 than during 1991.

Status of the Stock in 1992 and Prognosis for 1993

Several data sources were examined to evaluate the status of the stock during 1992. Trap catch rates in 1992 were about equal to the average for the period covered and higher than 1991. Based on consecutive (1990 and 1991) low biomass estimates from both Canadian and Russian surveys and a poor offshore fishery, CAFSAC in 1992 was pessimistic regarding the outlook for the spawning stock and a fishery during 1992. In spite of this, catches of 16,000 tons and average trap catch rates were reported. In addition, catch rates at ages two and three (1990 and 1989 year-classes) in the Div. 3K trap fishery were the highest on record. However, the interpretation of this observation in terms of relative year-class strength is uncertain. Individual fish were smaller-at-age than in 1991 and substantially smaller than during the 1980s. Although there are apparent discrepancies in the age determination by different readers, both sets of age compositions show higher proportions of two-year-old fish in the mature portion of the stock than has been observed previously.

Observations in Div. 3L are consistent with these observations regarding inshore abundance indices. The fishery in Div. 3L was poor because fish were small and it was rapidly closed for this reason. Consequently, there is no valid trap catch rate available. However the aerial survey index in 1992 was above average. Data from Conception Bay beaches indicate egg abundances above the 1987-92 average. The egg abundance data have not been used as an index of adult abundance but rather to indicate the occurrence of spawning at levels comparable to the previous five years. Mean length of mature capelin in Div. 3L was also much smaller during 1992 and two-year-olds constituted a much higher proportion of the stock than had previously been recorded.

Offshore in Div. 2J3K, acoustic estimates by Canada indicate a very low biomass for the third consecutive year. Russian estimates have been low for the last two years. Estimates of year-class strength at age 2 from the Canadian acoustic surveys indicate that the 1989 and 1990 year-classes were the lowest on record. Similar estimates (1981-88 year-classes) have been positively correlated with trap catch rates at age (ages 3+4). Biomass estimates from Canadian offshore acoustic survey in Div. 3L have also been low during 1991 and 1992. The distribution of capelin in research groundfish survey bycatches in Div. 2J3K is consistent with distribution from acoustic surveys. There is no indication from these groundfish surveys that capelin were distributed widely enough outside the acoustic survey area to account for the decrease in biomass observed between 1989 and 1992. The research groundfish survey bycatches are not considered to represent a quantitative indicator of capelin abundance, but the frequency of occurrence has been above average since 1988. The distribution of capelin as described by acoustic surveys, groundfish bycatch, and occurrence in cod stomachs has changed markedly in recent years.

There have been virtually no cape/in detected in acoustic surveys in Div. 2J during 1991 and 1992; most capelin have been detected in the southeast area of Div. 3K. This shift in capelin distribution is similar to that exhibited by other finfish, notably cod, during the same time period from research groundfish surveys. Cod biomass estimates have also declined.

A similar situation has occurred in recent years for both SA2 + Div. 3K and Div. 3L capelin. Offshore biomass estimates have been extremely low and these were expected to result in low spawning stock biomasses inshore. However inshore abundance indices and egg concentrations have been near average. This paradox has not been resolved.

However, as in the past two years, it was not possible to identify reasons to discount the results of the fall acoustic survey. Consequently, the fall survey was used as a basis for projection, but with different mean weights-at-age than used in the past. It was noted that the year-classes (1989 and 1990) expected to be most important in the mature stock in 1993 would have encountered the poor environmental conditions documented since 1990. Furthermore, the individual lengths of cape/in encountered during the acoustic surveys were at the smaller end of the observed length range. Consequently, average mean weights from the 1990-92 period were used in the projections.

The following parameters were used in the projections:

Age	Proportion Mature	Mean ¹ Weights (g)
3	.22	24.6 (29.9)
4	.64	28.8 (37.3)
5	.77	27.5 (35.1)
6	.89	33.0 (36.7)
1 Mean for 1990-92. Weights used previously in parenthesis		

The estimates of the numbers of each age group from the survey were projected forward to take into account natural mortality (assumed to equal 0.3) between November 1 and July 1 and the number of mature fish estimated using the proportions mature-at-age. The results of the projection are given below:

AGE	Billions of Fish Nov. 1, 1992	Billions of Fish July 1, 1992
2	1.9	1.58
3	0.2	0.18
4	0.4	0.03
5	0	0
6	0	0
Mature Biomass (t)		12,400 (15,400) ¹
1 Using old mean weights		

The unreconcilable and contrasting differences in abundance indices is cause for concern. Three consecutive Canadian offshore surveys have indicated a severe decline in biomass. In contrast, inshore catch rates remained at an average level.

Given the potential large variances around all of the abundance indices and the conflicting evidence about the status of the stock, catches in 1993 should be kept to the lowest possible level. Given the likelihood of relatively small fish in the population, the possibility of excessive discarding is cause for concern.

CAFSAC advice for 1992 to maintain the catch at the lowest possible level resulted in a catch of 16,000 t. It was not possible to assess the impact of such catch on the stock in 1992 and it is unlikely that it will be possible to do it in 1993.

Capelin in Div. 3L

Introduction

The assessment of the Div. 3L capelin stock completed by NAFO in June 1992 was reviewed in light of new data available from the 1992 inshore fishery and spawning season and from groundfish trawl surveys conducted in 1992.

Catch Trends

Catches in NAFO Div. 3L were less than 4,000 t, increased to a peak of 58,000 t in 1974, and declined to 12,000 t in 1979. The offshore fishery was closed in 1979. During the 1980s an inshore roe fishery employing purse seines, capelin traps, and beach seines has occurred during June and July. In recent years, TACs have reflected market demand and have been less than the TACs advised on a biological basis. The 1992 preliminary inshore catch of 1,921 t was substantially lower than catches in recent years and lower than the 1992 TAC. The fishery opened in different areas on June 5, 15, and 22 and closed on July 8, reopened on July 31, and closed again on August 1. The trap fishery was closed in the third week of July, during the main spawning period because capelin were small.

	1986	1987	1988	1989	1990	1991	1992
TAC (t)	55	25	45	46	56	56	19.3
Catch (t)	48	19	53	52	48 ¹	48 ¹	2 ¹
1 Provisional							

The inshore catch was dominated by the 1989 year-class as age 3 (61%) and the 1990 year-class as age 2 (33%). The proportion of two-year-olds was the highest observed and the proportion of four-year-olds the lowest.

For all ages and sexes combined the mean length has varied between 170 and 179 mm between 1981 and 1990, however, the mean length declined to 163 mm in 1991 and to 150 mm in 1992. The smaller mean lengths in recent years substantiates concerns by the industry about the presence of small females in the catches.

Abundance Indices

Several abundance indices were examined. Commercial catch rate estimates from a research logbook program for the inshore fishery were available for purse seines (1981-92) and traps (1981-92). The 1992 trap estimate was derived from only five traps compared to an average of 77 traps in the period 1981-91.

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Trap t/day	2.9	3.1	3.4	2.0	4.6	4.6	8.8	6.2	6.7	8.6	7.3	0.9
PS t/day	9.4	16.4	18.8	14.3	16.4	19.0	18.1	20.7	24.3	21.4	16.2	17.0
Includes landings and discards. Discards include dead fish as well as those released alive												

As In 1991, the pattern of the trap fishery was different to that seen in the 1980s:

- capelin were approximately three weeks late in arriving, although they arrived one week earlier than in 1991;
- the trap fishery was closed during the main spawning period;
- the number of logbook fishermen who fished capelin in 1992 decreased and;
- the total numbers of traps fished also decreased.

The reduced effort was partly due to the closure of the fishery on July 8, the late arrival of capelin inshore, and the preponderance of small fish observed in monitoring programs in different bays. These effects and the small sample size make unreliable the estimate of the trap catch rate in 1992.

An acoustic survey during 6-26 May 1992 covered a wider geographical area than previous surveys. Strata between 47° N and 48° N were extended 160 km east to the 500 m depth contour, because of indications from groundfish surveys that capelin regularly occurred in the area. One of the planned transects in the northern stratum could not be surveyed because of ice. It was noted that the highest biomass estimate was in that stratum suggesting that more capelin occurred to the north of the surveyed area. The 1992 biomass estimate of 206,000 t was approximately double the 1991 estimate of 116,000 t but much lower than estimates between 1985 and 1990 which ranged from 2.6 million tons in 1987 to 7.0 million tons in 1990 (NAFO Scientific Council Report 1992).

The distribution of incidental capelin catches in the annual bottom trawl surveys conducted by Canada in November 1985-92 were considered. In 1992 the frequency of occurrence of capelin was 37%, the third highest in the series. Capelin were observed in northern and northeastern Div. 3L and in the Avalon Channel. Capelin were found in only a few catches on the plateau of the Grand Bank.

The distribution of capelin in Div. 3LNO was inferred from the bycatch of capelin in bottom trawl surveys and the occurrence of capelin in stomachs of cod caught during spring surveys in May. In 1992 capelin were caught at several stations in northern and eastern Div. 3L and at several stations near the shelf break in southern Div. 3NO. Percent occurrence and distribution of capelin bycatches were similar to 1991 and different from earlier years by the near absence of capelin catches in southwestern Div. 3L and northwestern Div. 3O. Examination of stomachs of cod in 1992 was affected by poor cod catches in many stations in Div. 3LNO. Generally the pattern of capelin in cod stomachs was similar to that observed for capelin bycatches in the bottom trawl survey, however most of the cod stomach data came from fishing sets near to the shelf edge.

Aerial surveys of capelin in Trinity and Conception bays were conducted in June and July during 1982-92. The 1992 survey was conducted between June 21 and July 14 using the Compact Airborne Spectrographic Imager (CASI). Total surface area of schools provided an index of abundance. Unlike 1991, when the survey ended early before the capelin had arrived, the 1992 survey occurred when capelin had arrived in the survey area to spawn. The 1992 estimate of total school surface area of 491,783 m² was the third highest in the series. However, this estimate is preliminary and should be considered a minimum value. The digital imagery is still being assessed prior to its presentation to NAFO in June 1993 and the 1992 estimate provided at this stage include only those schools which have been positively identified as capelin.

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Surface Area ('000M ²)	220	349	173	308	260	718	402	539	359	186'	492
1 STACFIS concluded that this was not representative of stock status because the survey ended before schools has arrived inshore.											

The aerial survey index was significantly ($P = 0.05$) correlated with the trap catch rate series (1982-90) and the projections of mature biomass from previous assessments (1982-90, 1992).

Since 1987, capelin egg deposition has been estimated from the mid-tide zone of 15 capelin spawning beaches in Conception Bay. The estimates of egg deposition represent an index rather than total abundance because this study concentrates on eggs released during the peak spawning period, eggs in high-tide and low-tide zones are not counted, and spawning may occur subtidally. Total egg abundance for all 15 beaches summed together indicated that the 1992 estimate was higher than 1991 and is similar to the 1990 estimate. The 1992 egg abundance for these 15 beaches was higher than the average egg abundance for the period 1987-91.

	1987	1988	1989	1990	1991	1992
Index	68.4	126.7	46.2	108.3	73.4	103.3

Summary

Similar to the situation in Div. 3K, it was not possible to resolve the difference between the offshore and inshore indices. It was not possible either to evaluate the most recent assessment of this stock by NAFO In June 1992 and consequently it was not possible to modify their advice.

Stock Structure of Capelin

Beginning in the mid-1970s capelin were assessed and managed as “northern” (NAFO SA2 + Div. 3K) and “southern” (NAFO Div. 3LNOPs) components. The “southern” stocks were further subdivided during the late 1970s and early 1980s such that separate management units in Div. 3L, 3NO, and 3Ps were identified. All stocks were originally assessed under the aegis of ICNAF (now NAFO) but starting in 1984, SA2 and Div. 3K and Div. 3Ps capelin were assessed in CAFSAC.

The original stock designations in the early 1970s were based on tenuous and circumstantial evidence from research vessel surveys. During the 1970s and 1980s there were meristic, morphometric, parasite, isoenzyme, mitochondrial DNA, and tagging studies of capelin stock structure. Only the meristic studies provided weak evidence to support the present stock designations. The tagging studies indicated substantial migration of mature capelin biomass between Div. 3L and 3K.

A review of the stock structure of capelin during 1990 suggested there was good evidence to combine these stocks. However, this was not formally recommended at that time pending further tagging studies. These studies have not been conducted. However, given the strong evidence from the earlier tagging studies, the similarities in age structure and year-class strength of these stocks, it is now concluded that these stocks should be considered as one stock complex.

Current management practice of allocating quotas by bays should be continued. Tagging studies indicate extensive migration during the pre-spawning period and allocation by area should reduce the probability of interception of large quantities of capelin destined to spawn in other areas.

Subdivision 3Ps Capelin

The provisional catch of 127 t in 1992 was low and similar to the low catch in 1991 (Figure 3), probably because of the late arrival of capelin and the presence of small females which present a quality problem for the Japanese market. The capelin fishery opened on June 5 and closed on July 8 for all gear types. A fixed gear fishery in a small area of Placentia Bay was reopened on July 10 and closed on July 18. Recent catches (t) and TACs (t) were as follows:

	1986	1987	1988	1989	1990	1991	1992
TAC	2000	1300	3400	3100	3600	3600	2090
Catch	2395	392	3183	2350	1236 ¹	79 ¹	12 ¹
1 Provisional							

The age composition of the catch was dominated by the 1990 year-class as age 2 (73%) and the 1989 year-class as age 3 (26%). From 1986-90, catches were dominated by three- and four-year-old fish.

Research logbook data from one fisherman were available in 1992. The CPUE of 8.5 t/day was less than the CPUEs for 1989 and 1990, however, this index was not considered as a measure of abundance because the sample size was small.

Because no biomass estimates or relative year-class strength data were available for this stock, there are no data on which to base an assessment. Because catches are low for this stock and it is unlikely that biomass estimates will be available, it is inappropriate to review annually the status of the Subdivision

3Ps capelin stock. This should be undertaken every three to five years depending on data availability and developments in the fishery.

Capelin in Divisions 4RST

No new research information was available for capelin in the Gulf of St. Lawrence and it is therefore not possible to provide more definitive advice on recommended catches from this resource than has been provided in the past. However, it is believed that past recommendations to avoid large catches from localized concentrations remains valid and may prevent over-exploitation.

Figure 1. Inshore and offshore capelin catch in SA2+3K.

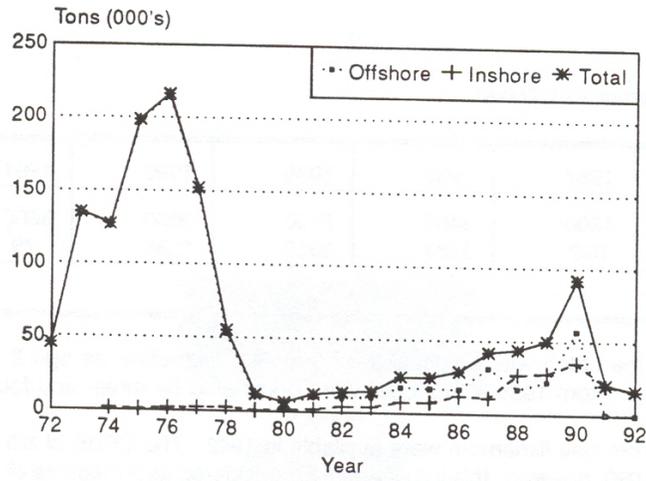


Figure 2. Indices of abundance, standardized to the mean, for SA2+3K capelin

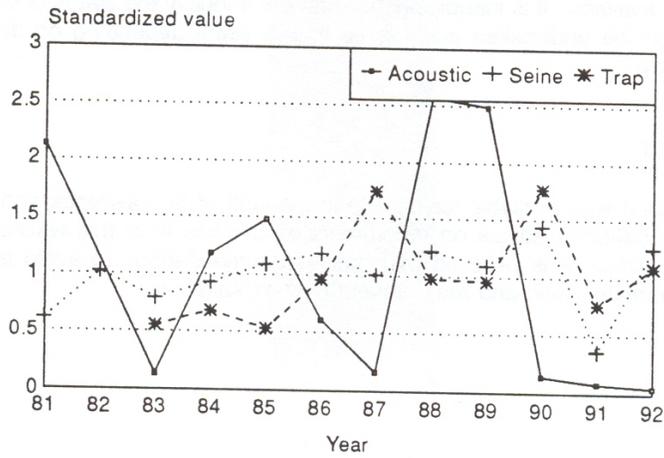


Figure 3. Inshore capelin catch in Div 3Ps

