

Capelin in Subarea 2 + Div. 3KL

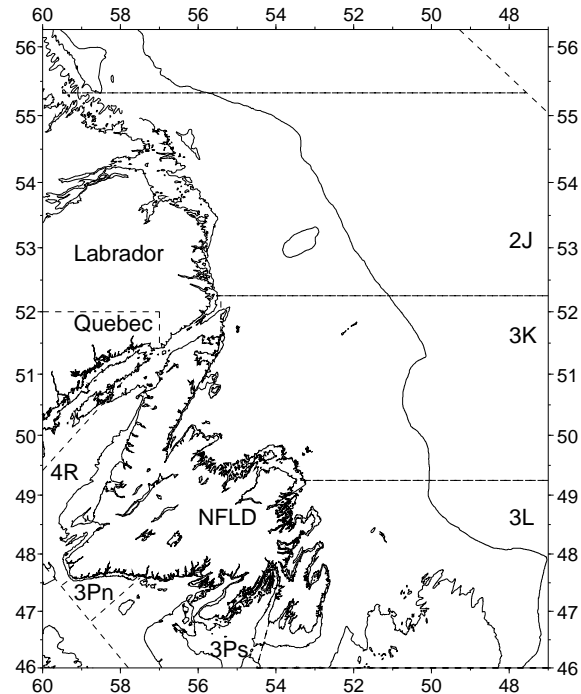
Background

Capelin (*Mallotus villosus*) is a small pelagic schooling species with major populations occurring in the Northwest Atlantic, in waters around Iceland, in the Barents Sea and in the northern Pacific. For several years, capelin in SA2 + Div. 3K and Div. 3L were treated as two stocks but, as a result of accumulated evidence, scientists recommended in 1992 that capelin in these areas be considered one stock complex.

Adult fish range in size from about 12 to 23 cm with males being larger than females. The spawning populations are composed of mainly three and four year old fish. The short life span and variable recruitment offer the potential for frequent and dramatic changes in mature biomass.

Juvenile capelin of the SA2 + Div. 3KL stock can be found both in major bays and in offshore waters although the northern Grand Bank and Northeast Newfoundland Shelf are thought to be major nursery areas. At maturity, schools of adults migrate inshore to spawn on Newfoundland beaches during June and July. After the eggs have hatched, the larvae exit the beach gravel and most are carried out of the bays rapidly by surface currents.

Capelin are eaten by many predators including seals, whales, cod, Greenland halibut, salmon and seabirds. They are considered to be a key element in the food chain. Because of this prominent position in the ecosystem a conservative approach to their management has been adopted. In the late 1970's, scientists recommended that no more than 10% of the projected mature biomass be removed annually in a commercial fishery.



Summary

- Preliminary data for 1999 indicate landings were about one-half both the 1999 TAC and 1998 landings.
- There was low fishing effort in 1999 due to low prices and lack of interest by processors.
- Many characteristics of capelin biology changed during the 1990's. Some aspects currently resemble patterns established in the 1990's while others are more reminiscent of the 1980's. Many of the changes in the 1990's were associated with below normal seawater temperatures. Water temperatures have been increasing in recent years.

- Results from a mathematical model which combines several indices indicate that most year-classes during the 1990's have been above average and slightly higher than year-classes in the 1980's.
- There is considerable uncertainty in the estimates of relative year-class strength from the mathematical model.
- The results from the mathematical model are in contrast to the opinions of capelin fixed gear fishermen who were of the opinion that capelin abundance in 1999 was lower than when they first began fishing during the 1980's.
- Discrepancies remain between offshore acoustic estimates, which dropped in the early 1990's and have remained low, and inshore indicators of abundance used in the model, which have remained constant during the 1990's.
- The 1996 to 1998 year-classes are expected to contribute to the spawning stock and the fishery in 2000. The 1997 and 1998 year-classes are about equal in strength to the long-term average while the 1996 year-class is above average.
- The mean lengths of maturing capelin in the autumn of 1999 were larger than observed during the autumn of 1998. If growth rates between late 1999 and the 2000 fishery are good, capelin should be more acceptable to the market which prefers larger capelin.

Introduction

The fishery for capelin in SA2 + Div. 3K is managed within a three-year (1999-2001) integrated plan. Up to 1999, stock status was assessed and a stock status report was produced prior to the fishery. As part of the three-year management plan, the status of the stock has again been assessed and the stock status report takes the form of an interim review.

Species biology

In this report, only updates on changes on capelin biology are reported; more detailed accounts can be found in past stock status reports.

Bycatch of capelin in autumn groundfish surveys and acoustic records collected during the summer-early autumn 0-group surveys in 1999 indicated that offshore capelin distribution was reminiscent of offshore distributions of the 1980's. These changes were first reported last year.

Capelin continued to be reported in relatively high abundance on the Eastern Scotian Shelf during the groundfish research vessel survey in March 2000. Prior to the late 1980's, capelin had appeared in this area sporadically.

The average size of mature capelin increased slightly in 1999 but was smaller than during the 1980's. Spawning time was slightly earlier than 1998 but still later than the 1980's.

Off-beach spawning, assumed to be variable from year-to-year, was likely extensive in 1999, based on results from experimental studies at Bellevue Beach and the opinions of fixed gear fishermen.

During the 1990's, capelin made up a higher portion of the gannet diets at Funk Island compared to the 1980's. This continued in 1999.

In summary, there are some elements of capelin biology which continue to reflect the patterns observed during the 1990's while others continue to change and more closely resemble patterns observed in the 1980's. The dramatic shifts in the early 1990's

appeared to be linked with below normal seawater temperature whereas reversals of some patterns now seems to be occurring with higher seawater temperatures.

The Fishery

Historically, a small domestic fishery (annual harvest estimated at about 25,000 t) for capelin on the Newfoundland spawning beaches existed to provide food, bait and fertilizer. A directed foreign offshore fishery began in the early 1970's and was closed in Div. 3L and in Div. 2J3K beginning in 1979 and 1992, respectively. During the late 1970's, an inshore fishery for roe capelin began. Throughout the 1980's, the inshore fishery usually started by mid-June in the south and finished about mid-July in the north.

Gear types in the inshore fishery are traps, purse seines and, to a lesser extent, beach seines. Since 1998, modified beach seines, called "tuck seines" have been deployed because capelin stayed in deep water and were unavailable to trap nets and beach seines.

The primary market is for frozen roe-bearing female capelin in Japan. This market is limited and the demand for quality is high. Failure to meet quality standards results in discarding. Most discarding is believed to occur after the fish are landed and since the TAC is applied to the landings, these discards are accounted for in the application of the TAC.

In 1994 and 1995, the average size of female capelin in most areas was too small to meet the management plan size criterion of 50 count/kg (sea run). As a result, the fishery either did not open or opened for only a short time and catches were low.

Beginning in 1996, the management plan has not included a size criterion and a fishery has occurred. During 1997 and 1998, fish were monitored by some sectors of the industry with the aim of opening the fishery when fish met market requirements.

Preliminary landings data indicate that landings for 1999 were about half of what was landed in 1998. The low fishing effort was attributed to low prices and lack of interest by processors. Fish sizes were larger than in recent years and generally were more in line with the market demand for larger capelin.

A summary of catches and TAC's (thousands of tons) since 1993 is given below.

	1993	1994	1995	1996	1997	1998	1999
SA2 + Div. 3K							
TAC	11.4	11.5	11.5	9.7	11.4	11.4	13.5
Nominal catch	13	< .1 ^a	< .1 ^a	8.9 ^a	9.2 ^a	11.4 ^a	7.5 ^a
Div. 3L							
TAC	21	21	22	18.3	21.7	21.7	22.0
Nominal catch	23	1 ^a	< 1 ^a	16.8 ^a	3.6 ^a	18.4 ^a	11.1 ^a
SA2 + Div. 3KL							
Total nominal catch	36	1 ^a	1 ^a	25.7 ^a	12.8 ^a	29.8 ^a	18.6 ^a

^a provisional

Industry perspective

A telephone opinion survey of capelin fixed gear fishermen has been conducted since 1994. Statistical comparisons of the responses for the time-series indicated that only 1994 (low) and 1996 (high) were different from average. The majority of respondents said that capelin abundance in the current year was lower than when they started fishing, a response that has been consistent in each year of the survey.

Resource Status

In last year's assessment, twelve indices were combined in a mathematical model to derive annual estimates of relative year-class strength. Of these indices, five, egg deposition on Bellevue Beach, the sediment larvae on Bellevue Beach, emergent larvae at Bellevue Beach, the 0-group estimate and the 1-group estimate, had additional data for 1999. Egg deposition on Bellevue Beach was the second-highest in the series. Both the sediment larval index and the emergent index were the lowest in the series, indicating that substantial mortality of eggs had occurred. The 0-group index was about the same as the index for 1997 and 1998 year-classes but lower than the 1996 index. The 1-group index in 1999 (1998 year-class) was the second highest in the series (1993-1998 year-classes) and higher than the index for the 1996 year-class.

Acoustic results from two surveys, one in May in Div. 3KL and one in August-September in Div. 2J3KLNO, indicated that offshore biomass was similar to biomasses estimated from acoustic surveys during the early 1990's but much lower than most estimates from the 1980's. These 1999 estimates were not included in the multiplicative model because they are the first such estimates available for several years and as such are not part of a time series.

In the final formulation of the mathematical model, previous acoustic survey series results from Canadian spring surveys in Div. 3L and autumn surveys in Div. 2J3K were added. In previous years, these acoustic estimates had not been used because of the divergence between them and other indices and the conclusion that the acoustic results during the 1990's did not reflect stock status. However, in the current

formulation of the model, the importance of inclusion of each indicator was determined by the amount of uncertainty in its contribution to the overall index. Since the model determined the degree of inclusion of individual indices in the final estimate of year-class strengths, the acoustic estimates were included. In the final formulation of the model, the acoustic estimates received low weight.

One index that had been used in the past, the sediment larval index at Bellevue Beach, was excluded because it was not sufficiently independent of the emergent larval index.

In the final formulation of the model, the following indices and the range of their years of availability (some indices may have missing values in some years) were included.

- 1) egg deposition index 1990-99
- 2) aerial survey index 1982-98
- 3) purse seine catch rate index 1981-96
- 4) trap catch rate index 1981-93
- 5) Russian 2J3K fall commercial catch rate index 1972-91
- 6) groundfish 2J3K fall bycatch 1985-94
- 7) groundfish 3L fall bycatch 1985-94
- 8) 0-group index 1994-99
- 9) oceanic age-1 index 1994-99
- 10) Conception Bay sediment larval abundance 1987-93
- 11) Emergent larval index 1990-99
- 12) Canadian spring 3L acoustic index 1982-96
- 13) Canadian fall 2J3K acoustic index 1981-94

According to these results, year-classes during the 1990's have been above average and slightly higher than year-classes from the 1980's. This result is somewhat different from the results of last year's

mathematical model where the 1990's were characterized as a period of relatively strong year-classes compared to the 1980's. This difference between the two formulations is the result of the exclusion of the sediment index and the inclusion of the two Canadian acoustic indices. Standard errors are large, making the relative abundance of many of the year-classes statistically indistinguishable.

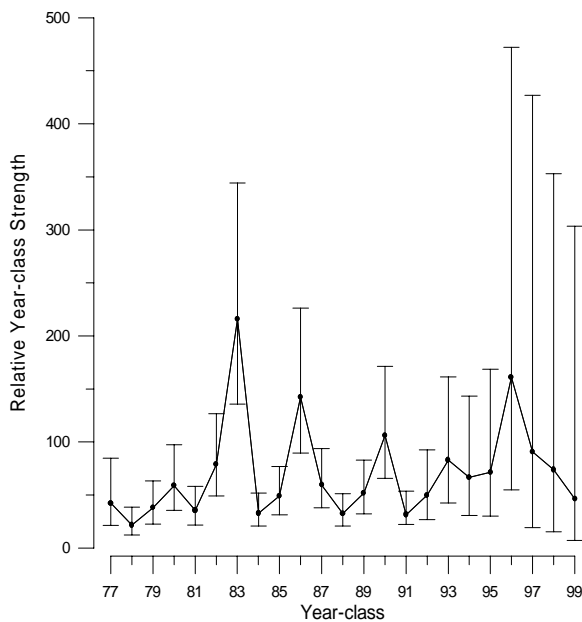


Fig. 1. Results of the multiplicative model.

Sources of uncertainty

The many uncertainties in the assessment of this capelin stock have been detailed in past stock status reports; these uncertainties remain and are not detailed in this interim review.

Unresolved differences in some indices remain even with additional data. There continues to be a divergence between the results of the mathematical model and the opinions of fixed gear fishermen, particularly the contradiction in comparison between the 1990's and earlier periods.

There is still an unreconciled difference between low acoustic estimates during the early 1990's and in 1999, and inshore indices.

Many of the changes in capelin biology and the divergence in indices occurred early in the 1990's and have persisted. This time period is also critical in the formulation of the mathematical model because some indices were discontinued and others initiated during the early 1990's. The affect of the temporal overlap of only a few indices between the 1980's and 1990's on the mathematical model is not known with confidence. Other evidence, such as reports from industry participants and acoustic explorations in 1999, neither of which is incorporated in the mathematical model, suggests that the 1990's may be calibrated too high relative to the 1980's, and if so, the present year-classes are considerably weaker.

Outlook for 2000

In the past, three- and four-year-old capelin have contributed most to the mature biomass. However, this has changed in recent years when two- and three-year-olds made the major contribution. If this pattern persists in 2000, the 1997 and 1998 year-classes will make substantial contributions to the mature biomass. The 1996 year-class has been estimated as a strong year-class and therefore there is a possibility that it, too, will appear in the mature biomass in 2000.

Both the 1997 and 1998 year-classes are about average strength. Since the 1996 year-class has probably made its strongest impact during 1998 and 1999, its contribution will be less in 2000. The overall effect will probably be a decline in

the capelin biomass in 2000 to approximately average levels.

The 1997, 1998 and 1999 year-classes are about equal strength and equal to the long-term average. When the strong 1996 year-class disappears from the population, the population abundance will be about equal to the long-term average.

The mean length of female capelin in autumn 1999 was 144 mm which is 5 mm larger than females in the autumn of 1998 and in the mid-range of mean lengths from the 1990's. If growth between late 1999 and the 2000 fishery is similar to that observed during the 1990's, there is about a 50% chance that counts will average less than 50.

For more Information

Contact: J. Carscadden
Fisheries and Oceans
P.O. Box 5667
St. John's, NF A1C 5X1
Tel: (709) 772-2093
Fax: (709) 772-4105
E-Mail: carscadden@athena.nwafc.nf.ca

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Stock Assessment Regional Office
Newfoundland Region
P.O. Box 5667
St. John's NF A1C 5X1
Phone Number (709) 772-2027/4355
Fax Number (709) 772-6100
e-mail address tillmanj@dfo-mpo.gc.ca
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