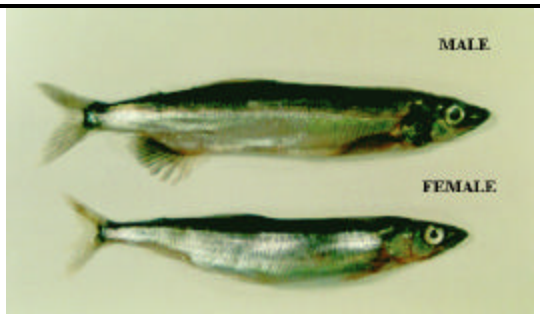

Capelin of the Estuary and Gulf of St. Lawrence

Background

In eastern North America, capelin (Mallotus villosus) occur along the coasts of Labrador and Newfoundland, on the Grand Banks and in the Estuary and Gulf of St. Lawrence (Figure 1). Capelin were abundant in the Bay of Fundy in the 1960s and have been present on the eastern Scotian Shelf since the mid-1980s. Their presence in those regions is linked to below normal water temperatures. The colder water temperatures may have affected the species' growth rate, which would explain the reduction in individual fish size observed in the early 1990s. As a result of the smaller size of the capelin, the fishing season was cut short in 1994 and the fishery was closed almost completely in 1995.

Capelin plays a key role in the food chain by transferring energy from primary and secondary producers to higher trophic levels. It is an important food resource for other fish species such as cod and salmon, as well as for certain birds and marine mammals whose migrations are linked to its presence. Preliminary estimates show that predators consume up to a million tonnes of capelin annually in the Gulf of St. Lawrence. In light of those estimates, it seems clear that the commercial fishery removes only a small portion of the total biomass.

The capelin fishery in the Estuary and Gulf of St. Lawrence developed rapidly with the emergence of a Japanese market for roe-bearing females in the late 1970s. Annual landings have risen to nearly 10 000 t from a level of less than 2 000 t back then. The bulk of catches are made by purse seiners on the west coast of Newfoundland. Capelin are also taken in a trap fishery carried out there and on Quebec's Lower North Shore, as well as in a weir fishery in the Estuary. Although we do not have a clear picture of the species' population in the Estuary and Gulf of St. Lawrence, capelin are managed based on two distinct management units, NAFO divisions 4ST and 4R (Figure 1). At present, no abundance survey is undertaken for the species in the Estuary and Gulf of St. Lawrence. General information on capelin distribution is derived from the by-catches made in two groundfish surveys, conducted in August and September in the northern and southern parts of the Gulf of St. Lawrence.

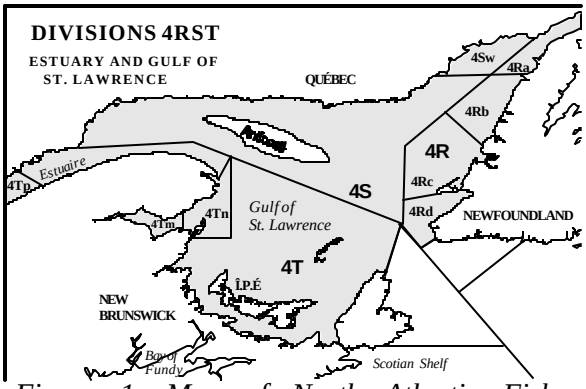

Figure 1. Map of North Atlantic Fishery Organization (NAFO) divisions and unit areas associated with the capelin fishery in the Estuary and Gulf of St. Lawrence.

Summary

- Capelin **landings** made in NAFO divisions 4RST totalled 4911 t in 1999 and 5 146 t as at February 27, 2000, a decrease of just under 5 000 t compared with the 1998 figure. The total allowable catch (TAC) is 12 425 t for the duration of the 1999-2001 management plan.
- As in past years, the **purse seine** fishery conducted on the west coast of Newfoundland accounted for most of the landings made in 1999 and 2000.
- Based on commercial samples and in comparison with 1998, the size of the fish declined in 1999 and then increased slightly in 2000. Prior to this period, that is, in the early 1990s, capelin showed a gradual decline in size, which led to a premature halt to fishing in 1994 and the nearly complete closure of the fishery in 1995.
- The increase in the **percentage of occurrence** of capelin computed from the groundfish abundance survey in the northern Gulf indicates an extension of the species' geographic range. The range extension in the southern Gulf of St. Lawrence, which has been observed

since the early 1990s, continued in 1999 and 2000.

- In view of the species' prominent role in the marine ecosystem, the sketchy knowledge of its ecology and biology in the Gulf and the absence of a separate abundance survey for the species, any increase in the catch level must be implemented **gradually**.

Biology

Capelin (*Mallotus villosus*) is a relatively small, coldwater marine fish species with a circumpolar distribution. Capelin spawn around three years of age and may live for five or six years. During the spawning period, males can be distinguished from females by their larger fins and the presence of two pairs of spawning **ridges** (four rows of elongated scales), one dorsally and the other ventrally. Spawning, which is preceded by a mass shoreward migration, occurs on beaches or in deeper water. During beach spawning, the capelin ***"roll"*** on the sand or fine gravel, whereas the second type of reproduction takes place in water up to 125 m (70 fathoms) deep. On the west coast of Newfoundland, like elsewhere in the Gulf of St. Lawrence, spawning may sometimes be sporadic due to annual fluctuations in water temperature. The beach spawning period lasts from four to six weeks, falling sometime between mid-April and July in the Estuary and Gulf of St. Lawrence, but with increasingly later starting dates as one moves from west to east. At spawning sites, the males and females gather in separate schools. Mature males reach the beaches first and await the arrival of the females, which remain a little farther offshore in fairly deep water. A large proportion of these capelin die after spawning, particularly the males, which are injured in repeated matings on the beach. Nonetheless, the survivors have the ability to spawn again over the years. Capelin eggs adhere to the beach substrate, and the incubation period and the amount of time the larvae spend on the gravely bottom vary with the water temperature. The larvae soon become pelagic, remaining near the water surface until winter arrives.

Capelin do most of their **growing** during the first two years of life. From the age of two, the males are physically larger than the females (Figure 2). Factors such as water temperature and food abundance can have a major effect on the species' growth.

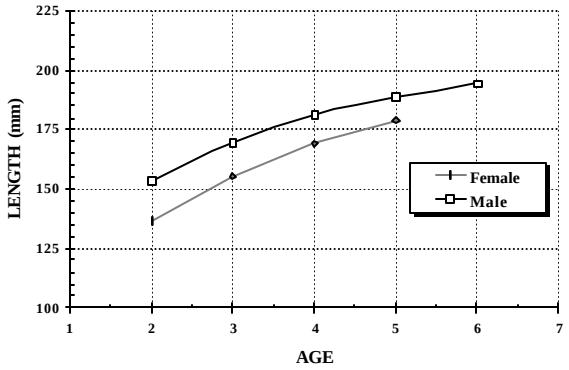

Figure 2. Length at age for the capelin of the Estuary and Gulf of St. Lawrence.

Capelin feed mainly on **plankton** (e.g. copepods, euphausiids, amphipods) but their feeding patterns vary with the seasons. For example, feeding stops almost completely during spawning, then gradually resumes.

Description of the fishery

On an international scale, the largest catches of capelin are generally made in the Barents Sea. After a halt in fishing in 1994, the fishery started up there again in 1999. The success of this fishery controls international markets, including the markets in Eastern Canada. Traditionally, in Canada, capelin has not been a major commercially sought species. The species has been used to produce farm fertilizer, food for human consumption, bait for cod fishing and, more recently, fishmeal. The emergence of a

Japanese market for roe-bearing females has attracted the attention of Canadian fishers. Japanese demand is responsible for the sharp increase in landings, which totalled about 10 000 t in 1978 and 1979 and also in 1989, 1993 and 1998 (Figure 3).

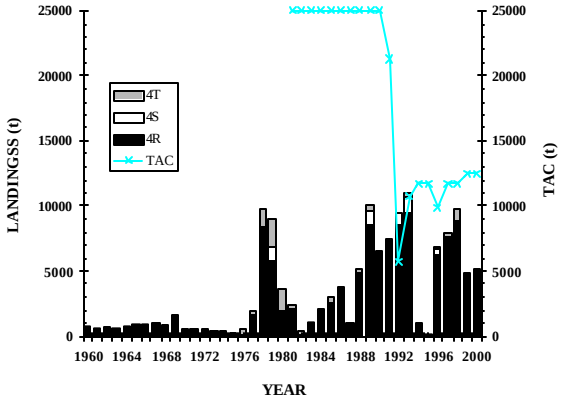

Figure 3. Capelin landings (t) and TAC (t) in NAFO 4RST divisions (2000 = preliminary data).

The fishing season is short and corresponds to the pre-spawning period, in the seine fishery, and to the spawning period, in the trap fishery. In both cases, the fishery chiefly targets mature females with the aim of meeting demand for roe capelin. The largest landings in the Gulf of St. Lawrence are nearly always made on the west coast of Newfoundland, that is, in Division 4R (Figures 1 and 3). In divisions 4R and 4S, the most intensive fishing generally takes place in June and July. By contrast, in Division 4T, the fishery sometimes begins as early as April, but the biggest landings are made in May and June. Purse seines, traps and weirs are used in most capelin catches in the Estuary and Gulf of St. Lawrence.

The total allowable catch or **TAC** for all of Eastern Canada was 50 545 t for the duration of the 1999-2001 management plan. It was set at 10 700 t for Division 4R and 1 725 t for divisions 4ST. This sharing of the TAC between the east and west coast of Newfoundland, and between the divisions within the Gulf of St. Lawrence is not based on biological factors.

The fishery in 1999 and 2000

In 1999 and 2000 (preliminary data), capelin landings in the Estuary (unit area 4Tp; Figure 1) and the Gulf of St. Lawrence (Division 4R and unit area 4Sw) totalled 4 911 t and 5 146 t respectively, down sharply from 1998, when 9 798 t of capelin was caught (Figure 3). These results are attributable to a decline in the size of the capelin (Figure 4A) and weak market demand.

An examination of median dates (MED = date on which 50 % of the year's landings had been made) of annual landings in the purse seine fishery showed that fishing activities were slower in 1986 and 1992 in unit areas 4Rb, 4Rc and 4Rd (Figure 4B). A regional pattern was also observed. Spawning tended to start in 4Rd and end in 4Rb, a trend that has been seen since 1993. The size of female and male capelin measured during commercial sampling is identical from one area to the next (Figure 4A) and a drop in size was noted in 1999, followed by a slight increase in 2000. However, the size of the fish remains smaller than that recorded in 1998. Prior to this period, that is, in the early 1990s, the size of capelin declined gradually, resulting in a shortened fishing season in 1994 and an almost complete closure in 1995.

This size pattern can also be seen in the analysis of annual length frequencies (Figure 5).

The **number of capelin per kg** shows that the size of individuals sampled in 1999 in Division 4S was higher than that in divisions 4R and 4T (Figure 6). In 2000, capelin in Division 4R were larger than those in 4T. For these two years, the numbers exceed the

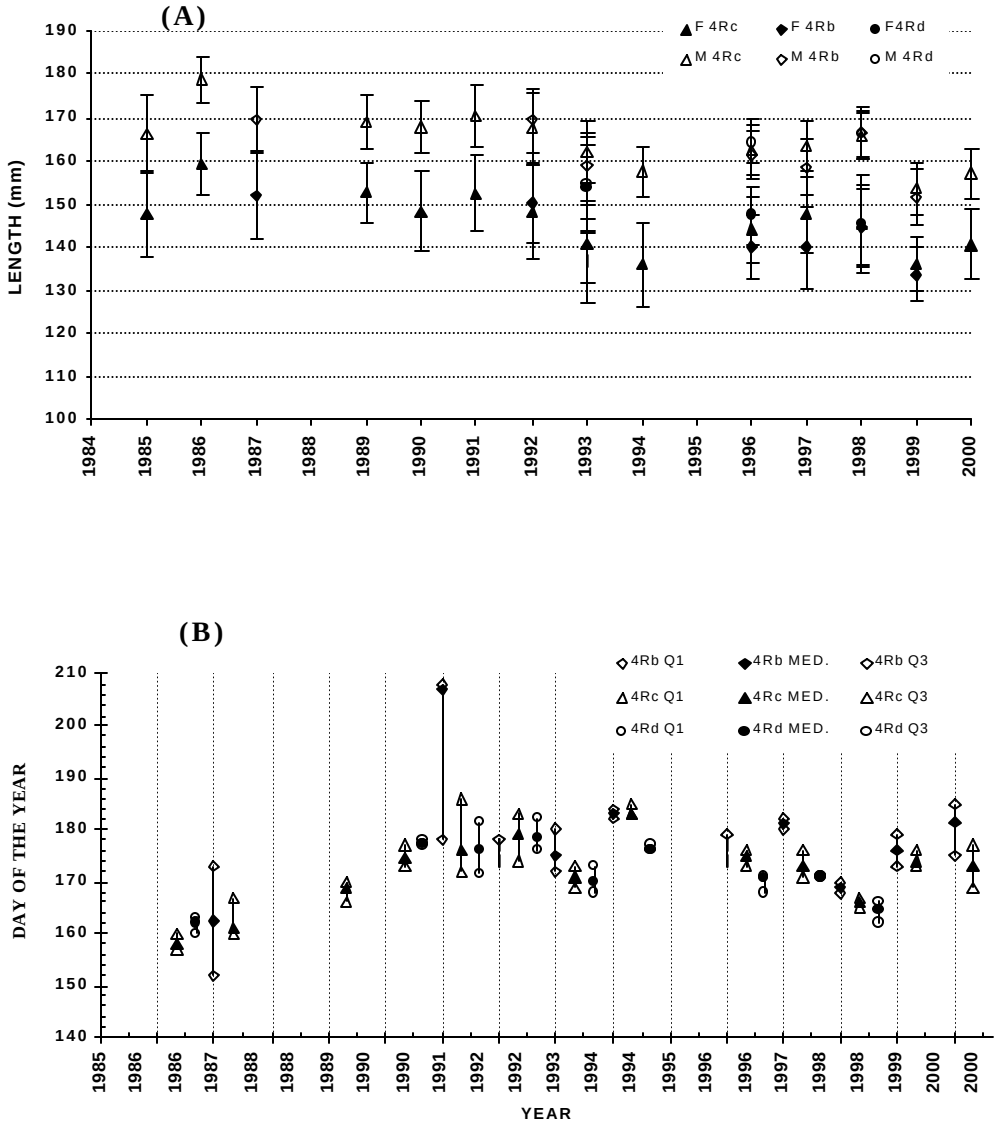

Figure 4. Mean annual lengths of female and male capelin (A) and temporal pattern (B) of the purse seine fishery in unit areas 4Rb, 4Rc and 4Rd located on the west coast of Newfoundland (point at which 25% (Q1), 50% (MED) and 75% (Q3) of total landings had been attained).

threshold of 50 capelin per kg recorded for all divisions. In Division 4R, the figures had been below this threshold since 1996, whereas in Division 4T, they have remained above it since 1993.

Capelin by-catches

Owing to the imposition of **moratoria** on cod fishing in 1994 and on redfish fishing in 1996, shrimpers have largely been responsible for the capelin by-catches of the past few years. Annual by-catches of capelin by shrimp fishers are estimated at about 600 t. Between 1990 and 2000, 6 % to 30 % of all tows with observer coverage contained capelin, except in 1997 when the percentage was 50 %. Mandatory use of the **Nordmore grate** by shrimpers, a requirement phased in as of 1993, has helped to reduce catches of capelin.

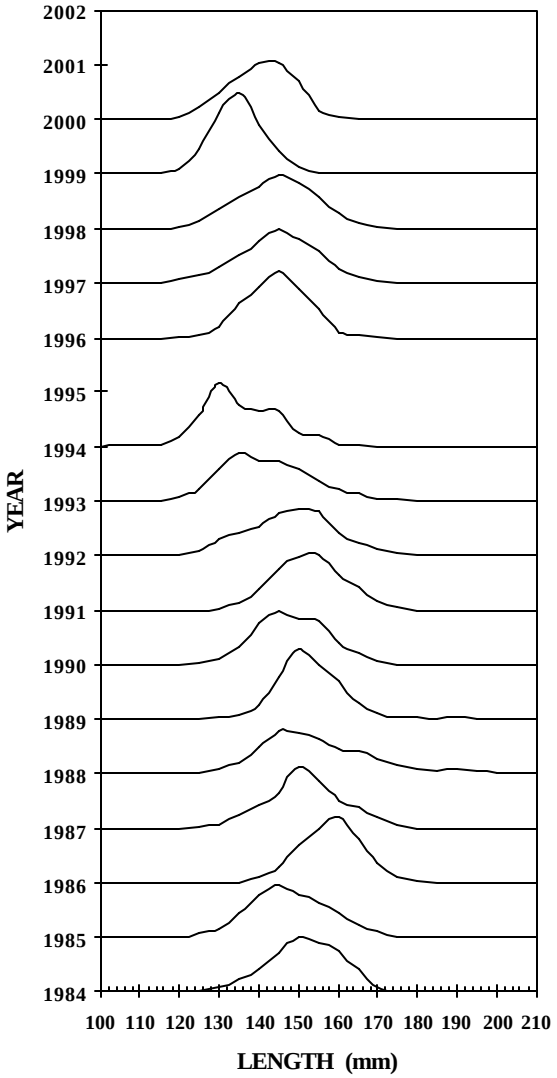

Figure 5. Size composition (expressed as a percentage) of females caught with purse seines in NAFO Division 4R (no samples were taken in 1995 due to the limited amount of fishing).

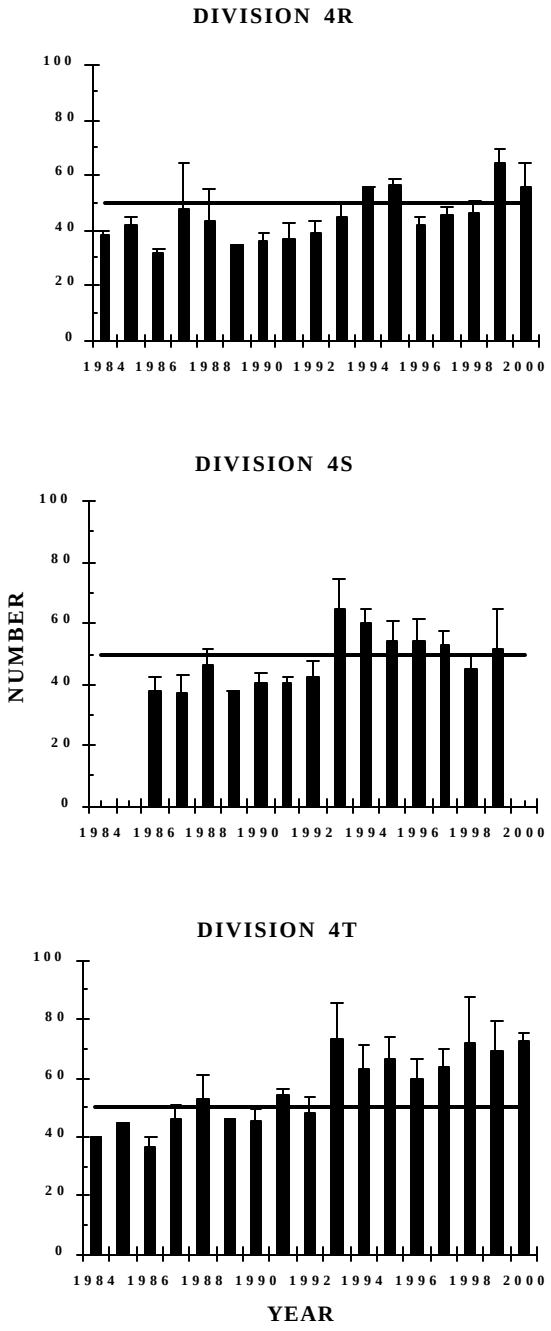

Figure 6. Mean number of capelin per kilogram (the vertical bars above the rectangles represent the standard deviation) in NAFO divisions 4RST (the horizontal line indicates the threshold of 50 capelin per kg used as a management measure).

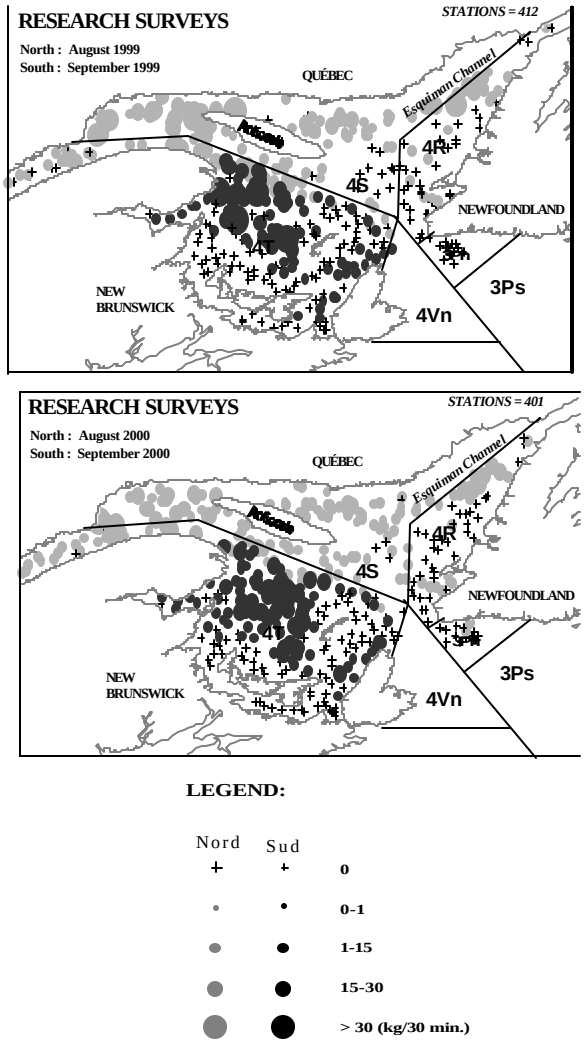

Figure 7. Maps of capelin catches made during shrimp and groundfish abundance surveys in the Gulf of St. Lawrence. These surveys used gear with different selectivity and the tows are identified using symbols of different shades.

Distribution indices

In 1999 and 2000, based on the scientific surveys conducted with bottom trawls in the northern and southern parts of the Gulf, the distribution of capelin (Figure 7) was similar to the general pattern observed during the preceding years.

The size of fish caught in recent years ranges from 80 to 160 mm (Figure 8). Given that the fish reach sexual maturity at 130 mm, this means that many of the fish taken were sexually immature.

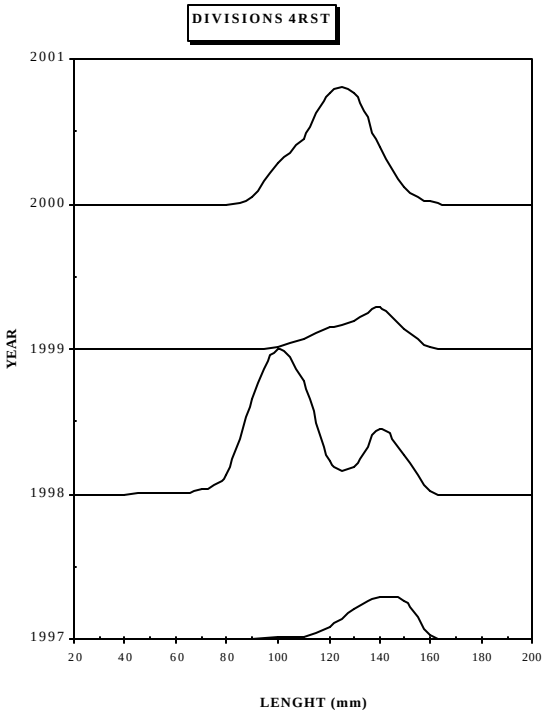

Figure 8. Capelin size distribution from the abundance surveys conducted aboard the Alfred Needler since 1997. The mean number of capelin per tow for each class length was used in deriving the curve.

Occurrence index

In the Estuary and northern Gulf, the extent of the geographic range of capelin is determined from the **occurrence index**, which corresponds to the percentage of tows in which capelin are present. Between 1990 and 2000, the index exhibited an upward trend, pointing to an extension of the species' range in the study area (Figure 9).

Assessment and outlook

Capelin is one of the most important forage species of the Estuary and Gulf of St. Lawrence. The species plays a role in transferring energy from primary and secondary producers (on which it feeds) to species at higher trophic levels (predators of capelin). Indeed, many fish, mammal and

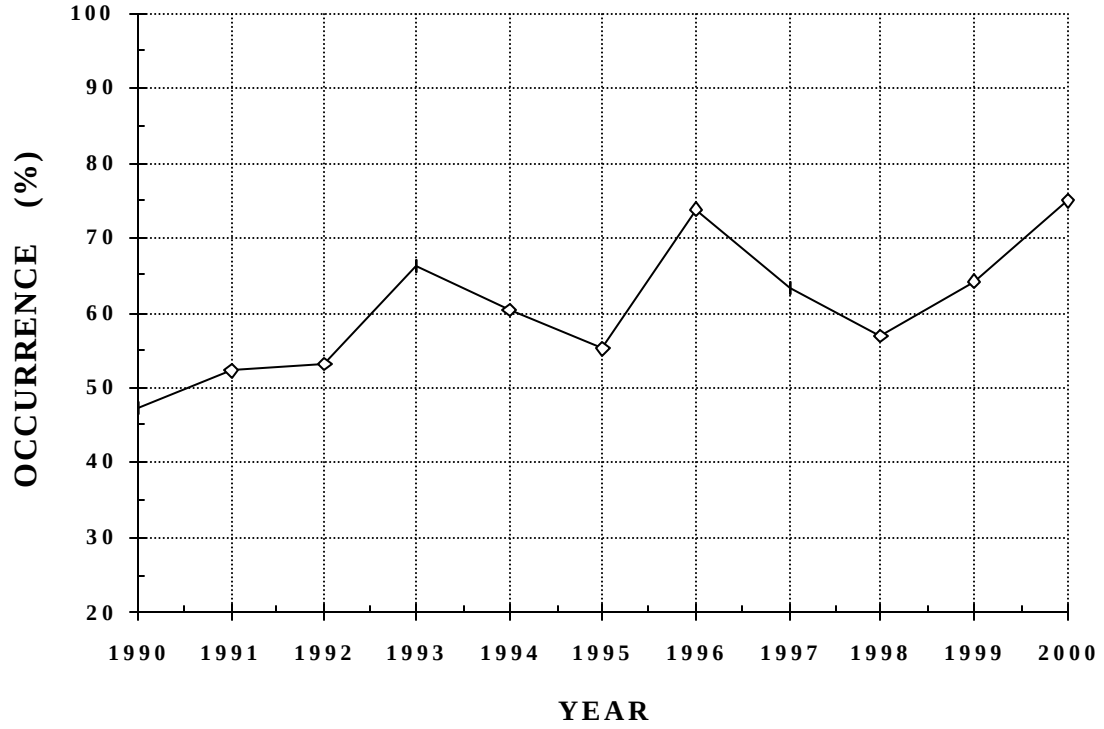

Figure 9. Capelin occurrence computed from Alfred Needler survey data since 1990.

seabird species are dependent on capelin for their survival. Analyses have already shown that **fishing mortality** is much lower than natural mortality. This is very important, in view of the level of predation and the mass mortalities that occur after spawning. Given the extent of these natural fluctuations, it is impossible to determine the contribution that the fishery makes to total mortality.

Since the early 1990s, there has been an extension of the geographic range of capelin throughout the Gulf of St. Lawrence. Climate changes observed may be the cause of this extension. Similarly, they could affect the size of the capelin that are available to the fishery, as in the early 1990s when the declining size of the fish led to a shortened fishing season in 1994 and its nearly complete closure in 1995.

The capelin fishery developed with the advent of a market for roe-bearing females. The size of capelin is a factor that can limit fishing effort. Since fishing mortality does not appear at present to have a noticeable effect on the population compared with other types of mortality, there is no clear-cut reason for holding catches to their current level. However, in view of the species' prominent position in the ecosystem, the lack of knowledge of its biology and ecology and the lack of a separate abundance survey for capelin, any increase in the total allowable catch should be made gradually.

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