Fisheries and Oceans
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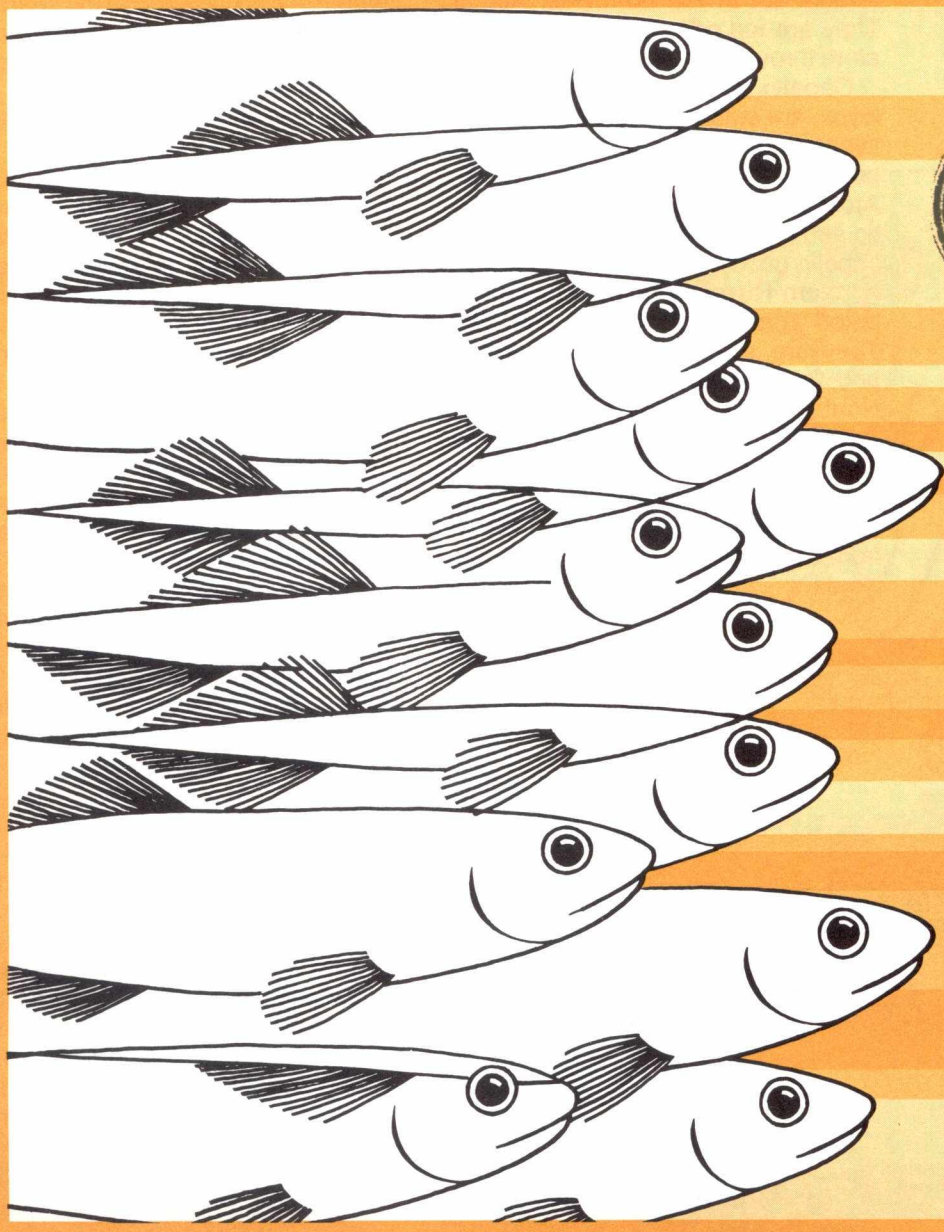
Underwater World 10

Capelin



Canada

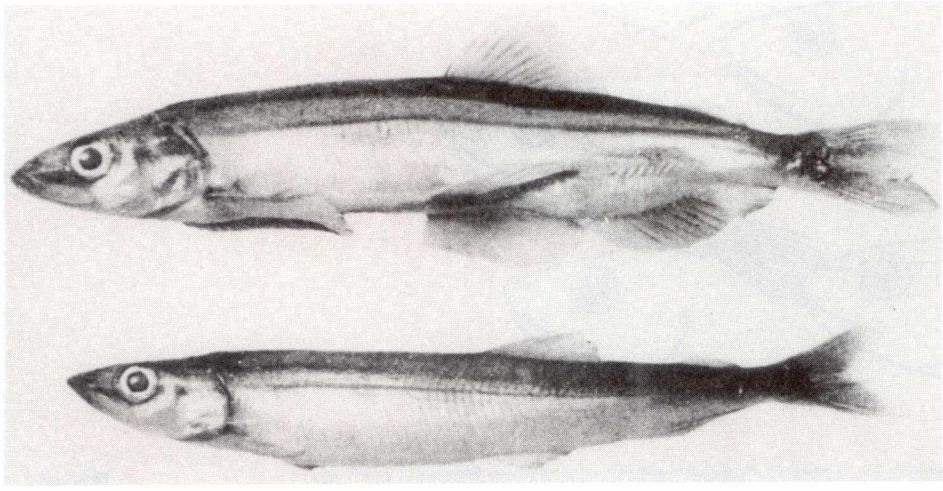
Capelin

Each year during June and July the waters around the sandy beaches in Newfoundland are invaded by a strange mixture of predators — cod, whales, seabirds and humans, including both adults and children.

This is the time the "capelin scull" takes place — when these small, smelt-like fishes move onto the sandy beaches to spawn, attracting predators for an easy meal. It is a dangerous period in the life cycle of the capelin, conceded to be the most important forage fish in the northwest Atlantic. They are fed on heavily by their predators throughout their spawning stage.

Capelin (or caplin), *Mallotus villosus*, are small silvery fish, close relatives of smelt. They are a cold water, pelagic, schooling species inhabiting Arctic and sub-Arctic seas in the Atlantic and Pacific. In the eastern Atlantic, capelin occur from western Norway to northern Russia and are widely distributed throughout the Barents Sea. They are also found around Iceland and Greenland. On the east coast of North America, capelin appear from Hudson Bay to Nova Scotia but are most abundant around Newfoundland and Labrador. In the Pacific, they occur from Alaska to Juan de Fuca Strait and from the Sea of Chukotsh to Japan and Korea.

Figure 1 — Male (top) and female (bottom) capelin. This photo illustrates the larger size, enlarged fins and spawning ridges of the male in relation to the female.



Description

Once thought to be different species, the Atlantic and Pacific capelin are now considered to be the same species, *Mallotus villosus*. The specific name comes from the Latin, "hairy", and it is interesting to note that the common name of capelin in Norway is "lodde" from the word lodden, meaning hairy. This name may have derived from the spawning ridges of the male. During spawning, two pairs of ridges develop, a prominent dorsal pair running the length of the body above the lateral line and a smaller ventral pair extending from the pectoral fin back to the pelvic fin. These ridges are formed from elongation of scales that project outward to form soft (hairy) ridges.

Besides the spawning ridges, the males also have larger fins which project from the body at this time. Males are larger than females at sexual maturity and this, with the larger fins and spawning ridges, gives the males a distinctly more robust appearance (Fig. 1). These external sexual characteristics in the males begin to develop at least four to five weeks before the spawning season. During the rest of the year the sexes are almost indistinguishable. Mature specimens are relatively small, approximately 13-20 cm. The colour ranges from olive to bottle green above the lateral line and silver below. The fish are elongate and slender and there are two fins on the back, a larger dorsal fin in the middle and a smaller adipose fin just in front of the tail.

Distribution

Most capelin spend the bulk of their lives offshore, moving inshore only to spawn. However, exceptions to this occur, since there are apparently stocks of capelin resident in Newfoundland bays year-round and there is one major stock that spawns offshore. While the distribution of young capelin is not well defined, the distribution and migration patterns of adults are better known and spawning stocks of capelin have been identified.

There are five major stocks of capelin in the Newfoundland area; (a) Labrador-Northeast Newfoundland stock; (b) Northern Grand Bank-Avalon stock; (c) South Grand Bank (Southeast Shoal) stock; (d) St. Pierre-Green Bank stock; (e) Gulf of St. Lawrence stock (Fig. 2). Some of these major stocks (e.g. Labrador-Northeast Newfoundland stock and Gulf of St. Lawrence) may in fact be composed of a number of sub-stocks.

Notre Dame Bay is known to be an overwintering area for part of the Labrador-Northeast Newfoundland stock. Other parts of this stock are also

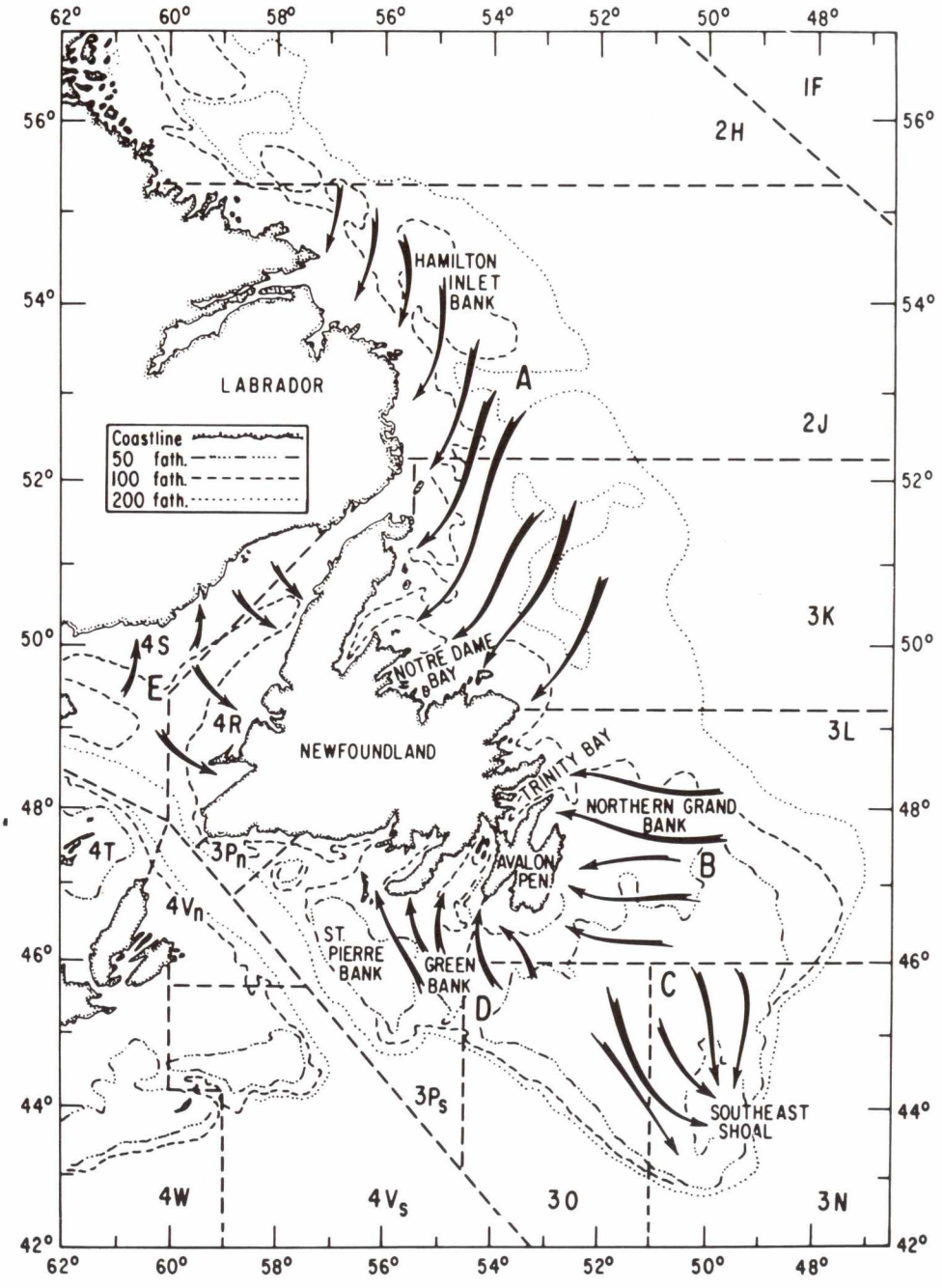


Figure 2 — This photo shows the major stocks of capelin (labelled A-E) and their probable migration routes during the spawning migration. Other alpha-numeric designations (e.g., 2H, 3L, 4Vs, etc.) are Northwest Atlantic Fisheries Organization (NAFO) statistical divisions.

thought to overwinter off Labrador, although the exact limits of distribution are not well known at this time of year. During June and July, mature capelin move inshore to spawn on beaches in northeastern Newfoundland and Labrador.

After spawning most fish die. The few spawning survivors move offshore in late summer and join immature fish to form feeding schools. Feeding is heavy from August to November and large schools are found in offshore waters from Labrador to northeast Newfoundland. There is a gradual southward movement during the autumn feeding period from the Hamilton Bank area to the overwintering area in Notre Dame Bay.

The northern Grand Bank-Avalon and Southeast Shoal stocks mix and overwinter on the northern part of the Grand Bank. During late winter and early spring the fish become active and form feeding schools. In the spring there is a slow migration to their spawning grounds. The northern Grand Bank-Avalon stock moves inshore to spawn on Newfoundland beaches. The Southeast Shoal stock moves south over the Grand Bank to spawn on sandy bottom on the Southeast Shoal. Spawning in both areas occurs during June and July and mortality is high at this time. Spawning survivors are believed to move to the Northern Grand Banks area for feeding and overwintering.

Less is known of seasonal distribution and migration patterns of the Gulf of St. Lawrence stock. Six substocks have been tentatively identified in this area. Spawning occurs on the west coast of Newfoundland, the Quebec coast, northern New Brunswick and sporadically on beaches of Cape Breton Island. The seasonal patterns of offshore feeding and movement inshore for spawning appear to be similar to capelin stocks in other parts of the Northwest Atlantic.

Spawning

There are differences in the timing of spawning in different areas. In the Gulf of St. Lawrence and its estuary, spawning may occur in April in the estuary and is progressively later downstream, so that spawning on the North Shore occurs in June. Spawning on the west and south coasts of Newfoundland usually begins in late May and is progressively later to the North. Spawning in Labrador may not occur until August. On the Southeast Shoal, the only known offshore spawning area for capelin, spawning occurs in June and July.

Environmental conditions necessary for spawning have been characterized. Capelin spawning inshore in Newfoundland and Labrador prefer water temperatures of 5.5-8.5°C. They also prefer pebbles ranging in size from 0.5-2.5 cm in diameter. Spawning normally occurs at night or on dull cloudy days although there are exceptions. On the Southeast Shoal, spawning occurs in water ranging in depth from 30-60 m where bottom temperatures are 2-4°C.

Inshore spawning normally occurs from four to six weeks; most spawning takes place on the beaches but if water temperatures on the beach become too high, the fish will spawn in deeper water adjacent to the beaches. Deepwater spawning is more common on the west coast of Newfoundland because the cold Labrador current has less influence and water temperatures rise more rapidly than on the east coast.

During the spawning season, the sexes are segregated, with males in schools near the beach and females in schools in deeper water. As the females ripen they move towards the beach to join the males. Then both sexes move onto the beach, mate and are washed back on the next wave (Fig. 3). Often two males will mate with one female. It is believed that the larger size of the male, the larger fins and the spawning ridges help to hold the female during mating. Females usually release all their eggs at one time while males may mate more than once. Although most capelin die after spawning, a greater proportion of females survive. This may be because males undergo more physical damage during their extended stay in the turbulent water near the beach.

Capelin eggs stay on the bottom where they stick to the sand and gravel. Hatching time varies according to water temperature but most eggs spawned on the beach probably begin hatching in about 15-20 days. Eggs may occur at depths as great as 10 cm in the gravel. Mortality of eggs appears to be influenced by depth of eggs in the gravel as well as position in the tidal zone. After hatching, the larvae remain in the gravel until they are washed into the water, usually by wave action generated by onshore winds.

Newly-hatched larvae range in size from three to six mm and by the beginning of the first winter, they range in size from three to four cm. Capelin mature at three or four years of age with faster growing fish maturing at an earlier age. In the spawning population three and four year-olds usually predominate, although there are occasionally two year-olds and fish as old as seven years sometimes appear.

Importance

In addition to being an important commercial species, capelin are also the most important forage fish in the Northwest Atlantic. Capelin have been documented as a food for many commercially important species and probably are eaten by many other species as well. For instance, capelin are eaten by codfish, haddock, winter flounder, Atlantic salmon, Atlantic herring, minke whales, humpback whales and harp seals.

It has been estimated that during the 1970s, when predator stocks were at low levels, the average annual consumption of capelin by cod was three million tons (t), by harp seals 300 000 t, by fin whales 250 000 t and by minke whales 35 000 t. It should be noted that these estimates are very crude averages, but keeping in mind that there are also other important predators of capelin, the estimates do illustrate the importance of capelin as a forage food.

Traditionally, capelin were fished in Newfoundland and Labrador when they were near or on the spawning beaches. It has been estimated that 25 000-50 000 t of capelin were taken each year to be used for bait, human food, dog food and fertilizer. However, these catches declined in the 1950s and 1960s probably due to the decline in the number of gardens and the use of dog teams.

Figure 3 — A typical scene on a capelin spawning beach in Newfoundland during June. Quite often, the capelin spawn at night or during foggy, dull weather but as this photo illustrates, capelin beach spawning also occurs during fine weather.

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Offshore Catches

In 1972, the first substantial offshore catches of about 70 000 t occurred. These catches increased rapidly, peaking in 1976 at about 370 000 t and declining since then. The catches were taken by large Soviet midwater trawlers plus some Norwegian purse seiners. The fishery usually started in March or April on fish that were beginning to form feeding schools on the Northern Grand Banks. Thus, fish from two stocks, the Northern Grand Bank-Avalon stock and the Southeast Shoal stock, were fished at this time. The fishery fleet followed the capelin as they moved to their spawning grounds; however, because the foreign vessels were not allowed in Canadian waters, they followed the Southeast Shoal capelin stock to its spawning grounds where the fishery on spawning capelin continued into July.

When the capelin spawning season was over, the fishery ended and capelin fishing did not start again until late August or early September. At this time the fishery began off Labrador and northern Newfoundland and concentrated on feeding capelin that would mature and spawn the following summer. This fishery was carried on by USSR midwater trawlers and continued until November or December.

Capelin first came under quota regulation in 1974 when a quota of 250 000 t was established. This was increased in 1975 to 500 000 t of which 200 000 t could be taken in the spring and summer fishery in the south and 300 000 t in the fall fishery in the north. In 1979, evidence of poor recruitment in the capelin stocks resulted in a reduction in the quota to 10 000 t in the south and 75 000 t in the north. At about the same time that quotas were reduced in the offshore area, inshore fishermen in Newfoundland began catching capelin during the spawning run to meet Japanese demands for roe capelin. Consequently the quota of 10 000 t was taken inshore. Interest in capelin by Newfoundland fishermen continued in 1980 and that year a quota of 16 000 t was imposed on stocks on the east coast of Newfoundland. Because the stocks were still low in 1980, no offshore fishery was allowed.

Canadian fishermen operating in the Gulf of St. Lawrence have also begun catching capelin for the Japanese roe market. Catches of less than 10 000 t have been reported and a quota of 30 000 t for the Gulf was imposed in 1979 and 1980.

Management

The management of capelin stocks is complex. Because of the importance of capelin as a forage fish, many people believe that capelin should not be fished commercially at all. Not only are capelin important as a forage fish but the annual inshore spawning migration of capelin apparently influences the inshore trap fishery for cod. Cod follow capelin inshore and then become available to the traps. Although not statistically proven, there is considerable anecdotal evidence to suggest that if capelin are not abundant during their spawning migration, then cod trap catches are also lower. Since the inshore cod trap fishery is important to thousands of Newfoundland fishermen, any change in capelin stocks could have a serious impact on the inshore cod migration and the cod fishery.

The biology of capelin makes their management difficult. Since there are only a few year-classes that dominate in the mature portion of the population, the total biomass of the stock can undergo large annual fluctuations. This in turn means that annual yields will also fluctuate in response to the changes in biomass. Since capelin are relatively young when they mature, the detection of strong or weak year-classes before they mature and become fishable usually occurs just prior to the fishery, making long-range planning difficult.

Federal fisheries scientists are conducting research in monitoring the adult population and investigating distribution and abundance of juvenile capelin. The biomass of the adult stock is estimated by analytical methods using a combination of fisheries and biological data and by acoustic and aerial surveys. Juvenile surveys provide relative estimates of abundance of young capelin before they enter the adult portion of the stock.

A school of capelin photographed at a depth of approximately 50 metres on the Southeast Shoal, June, 1979.

Dr. J. Carscadden

Further reading:

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