Fisheries and Oceans
Pêches et Océans

Underwater World

Atlantic Mackerel

Canada

THE ATLANTIC MACKEREL

The Atlantic mackerel *(Scomber scombrus)* is a handsome fish — streamlined and fast swimming, with dark tiger-like striping on its blue and silvery body.

A member of the family Scombridae*, mackerel have a fatty flesh with a delicious flavour and are a favourite of some Europeans, especially the Portugese, who have fished them for centuries.

Despite these favourable qualities and a good reputation on European tables, consumer demand is relatively low in Canada. Many domestic customers do not know what they are missing.

The majority of the Scombridae are of tropical origin, but the Atlantic mackerel is found in abundance in northern waters of the Atlantic. Another member of the family, the Atlantic chub mackerel, only occasionally ventures as far north as the Maritime Provinces.

Description

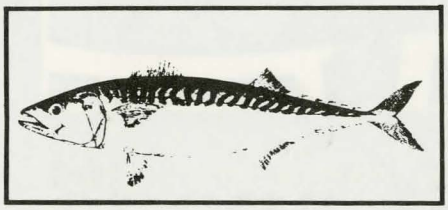
The Atlantic mackerel is shaped for swimming swiftly with a minimum of effort. Its body is slender, tapering at the tail and snout. The pectoral fins, found just behind the gill openings, are extended like hydrofoils during slow swimming; at high speeds, they are swept back and completely pressed to the body. The pelvic fins, located just below the pectorals, are extended only during turning.

The small scales of the Atlantic mackerel give the skin a velvety texture. As in many fish, the body is countershaded, dark above and light below. The steel-blue upper surface has 23 to 33 dark wavy bands extending down to the midline. The lower sides are silvery with a coppery or brassy iridescence. The belly is silvery-white.

This fish has no swim bladder (often called air bladder) and thus it must swim continuously to avoid sinking.

Most mackerel caught in the commercial fishery are from 25 to 40 cm in length, and weigh between 200 and 700 g.

Fig. 1 Atlantic mackerel



*The large, fast-swimming tunas were previously classified in the same family, but now form a distinct but closely-related family, the Thunnidae.

Distribution and migration

Atlantic mackerel are found over the continental shelf on both sides of the Atlantic Ocean. The European race extends from Norway to Spain, as well as into the Mediterranean and Black seas. In the northwest Atlantic, mackerel range from North Carolina to Labrador.

Atlantic mackerel in the northwest Atlantic comprise two populations: the southern contingent spawning between Cape May and Long Island in April and May and the northern contingent whose main spawning area is the southern Gulf of St. Lawrence in June and July. Most of the Canadian catch is taken from the northern population, although some schools belonging to the southern population may appear on the Scotian Shelf in the summer. Canadian fishermen have never fished mackerel intensively because of the lack of markets. With extension of jurisdiction and the disappearance of foreign fishing, the mackerel stocks are now rebuilding and are being lightly exploited. Recent analyses indicate catches of up to 150,000 metric tons could be safely harvested.

Mackerel prefer a water temperature between 9° and 12°C, and migrate annually, probably in response to seasonal changes in water temperature in the northwest Atlantic. The main known overwintering area is the continental shelf south and southwest of Georges Bank, at depths of 70 to 210 m. In the spring, the more local southern population moves inshore towards the American coast to spawn.

The Canadian or northern contingent migrates northward in spring from the same over-wintering ground. The migration route is not well understood but it appears that the contingent moves in a broad band covering most of the Scotian Shelf. Some large adults arrive inshore along the Nova Scotia coast in mid-May, on their way to the main spawning ground in the Gulf of St. Lawrence. Immature fish apparently migrate later, and many may spend the summer along the Atlantic coast of Nova Scotia.

Adults spawning in the Gulf of St. Lawrence usually remain there or move to the areas around Newfoundland

(including the east coast) to feed, before migrating south in October for the winter. The timing and the exact destination of these migrations are probably controlled by the duration of daylight and the water temperature. In years when the water is warmer, mackerel are abundant off the south and east coasts of Newfoundland from August to October.

Before the construction of the causeway across Canso Strait in 1954, some mackerel used that route to migrate into the Gulf of St. Lawrence. However, the mackerel population has flourished since then, and this disruption of part of the migratory path apparently has not affected the total stock.

Life history

The northern population of Atlantic mackerel contains approximately equal numbers of males and females. Some fish are mature at two years of age at a length of about 30 cm. Most are mature by four years of age.

Eggs are found only in waters over 10°C. In the main spawning area in the southwestern Gulf of St. Lawrence, the greatest numbers are found between the Magdalen Islands and the Gaspé Peninsula. Spawning takes place in open waters and near the surface in late June and early July, with a peak activity at about 12°C. The eggs and sperm are released into surface waters and must rely on normal water movement and turbulence to bring them in contact to allow fertilization of the eggs. The fertilized eggs then take about seven days to develop and hatch. It is most likely that females release the majority of their eggs at one time, rather than releasing a series of smaller batches throughout the season. The fecundity of most spawning females is quite high, between 200,000 and 500,000 eggs.

Once released into the water, these eggs suffer an estimated mortality of 50 per cent per day. Larval mortality is also very high. The specific causes of egg and larval mortality are not well known. Of course, many groundfish and pelagic fish, including mackerel and herring, feed on these drifting mackerel eggs and larvae, as well as on the eggs and larvae of many other species. It is also possible that larger larvae may prey upon smaller larvae, especially at high densities. Eggs and larvae are also very sensitive to temperature changes.

It is estimated that about 20 per cent of adult mackerel die each year from causes other than fishing. Sudden drops in temperature may kill even adult mackerel. Mass mortalities have been observed along the northeast coast of Newfoundland in the late fall. Mackerel are preyed upon by large sea animals such as whales, seals, tunas, and sharks, and also by sea birds, such as gannets. Cod and squid also feed upon small mackerel.

Fishing mortality may take place as early as one year of age, depending upon the selectivity of the gear used. In recent years, the rate of fishing mortality has varied greatly. When international fleets were heavily exploiting the over-wintering populations in the early '70s, it is estimated that 44 per cent of mackerel four years of age and over were captured each year. In 1979, with no major international fishery, the rate was about 14 per cent.

Mackerel feed on plankton (small crustaceans, fish eggs, and larvae) and on small fish (notably capelin, juvenile herring, and mackerel). They engage in both "particulate" feeding (the active pursuit of larger plankton and fish) and "filter" feeding (the gill rakers filter small food items from the water). Heaviest feeding takes place in the spring, when food availability may affect the distribution of fish, especially off Nova Scotia.

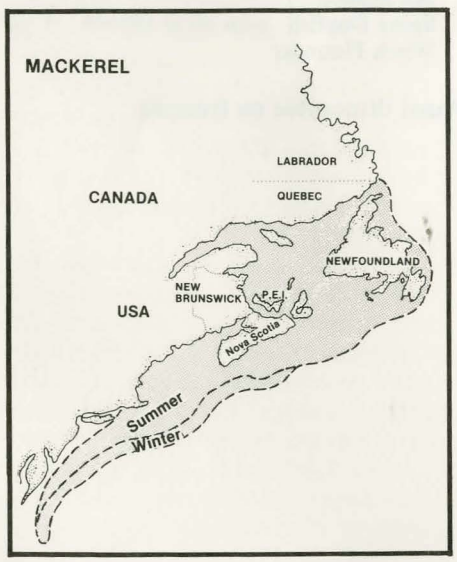
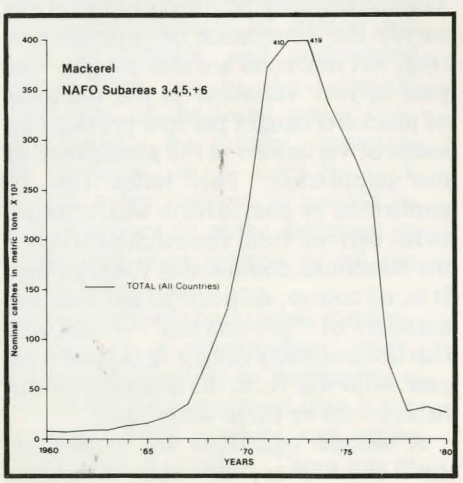


Fig. 2 General distribution of Atlantic mackerel in the Northwest Atlantic.

In the Gulf of St. Lawrence the high summer water temperature and the accompanying high food productivity permit a rapid first season growth to about 20 cm before the fall migration. The total length after one full year is between 22 and 29 cm. Second-year growth is slower, and two-year-olds are about 30 cm long by the end of the year. Few fish survive to 40 cm or longer, corresponding to an age of at least 10 years.

Fig. 3 Emptying the net

Fig. 4 Nominal catches of Atlantic mackerel from the Northwest Atlantic (NAFO Subareas 3-6).



The fishery

Northwest Atlantic mackerel have been harvested since the 17th century. Landings have been extremely variable. For example, the total catch was 8,000 metric tons (t) in 1962, but it had risen to 420,000 t in 1973. Catches have varied because of changing market conditions, new technological developments, variations in the abundance of mackerel and the development of the foreign offshore fishery. Since 1973, the fishery management policies of the Canadian and American governments have had a major impact on annual catches. Management is achieved through the licensing of vessels, and the setting of a Total Allowable Catch (TAC) and national allocations.

During the 19th century the Americans developed a large market for salted mackerel. Using hook and line gear, they followed the northern population as far north as the Gulf of St. Lawrence. During the 1870s the American fishery converted to purse seines and was successfully conducted closer to home. The total catch reached 105,700 t in 1884, but had fallen to 5,700 t by 1910.

During the early years of the 20th century, vessels converted from sail to motor power, and a fresh-fish market developed. Canadian landings exceeded 18,000 t by the late 1930s, but subsequently declined to a low of 5,459 t in 1961. American landings dropped rapidly after the Second World War due to the lack of market development. Since the mid-1950s they have fluctuated between 500 and 4,000 t, lower than any year since 1815. However American sports-fishery landings have been much higher, exceeding 33,000 t in 1969.

Mackerel catches increased dramatically during the late 1960s due to the development of a fishery on the overwintering stocks, carried out by large freezer and factory trawlers, mostly from the USSR, Poland, East Germany, and Bulgaria. This fishery was rendered possible by the exceptional abundance of the 1959 and 1967 year-classes of young mackerel. Fear of over-fishing prompted the International Commission for the Northwest Atlantic Fisheries (ICNAF) to impose an initial TAC limit in 1973 of 450,000 t. The TAC was gradually lowered as scientists gained a better understanding of the dynamics of the stocks. With a TAC of 105,000 t in 1977 and 1978, total catches were only 78,000 and 28,000 t respectively. The low catches in those two years relative to the TAC are largely due to the inability of the American fishermen to take their share of the allocations, as well as the absence of the large trawler distant water fleet in 1978. These low catch levels did not reflect a very low stock abundance and for 1979 the scientific analyses indicated that 150,000 t could be safely taken. However, market conditions were extremely limiting, and the only major effort was by Canadian inshore fishermen, who accounted for more than 90 per cent of the 33,000 t catch.

In recent years, the development of new markets for canned mackerel and the direct sale of mackerel from Canadian fishermen to foreign buyers have encouraged the expansion of the inshore fishery. The Canadian government has purchased large quantities of canned mackerel from some processors for foreign aid programs. The Department of Fisheries and Oceans in conjunction with fishermen's organizations have contracted to permit "over-the-side sales" of mackerel from Canadian inshore boats directly to foreign factory freezer vessels.

A large part of the increase in landings is also due to the unprecedented expansion of the fishery on the east coast of Newfoundland, which now accounts for 50 per cent of all Canadian landings. This fishery, which traditionally has caught about 1,000 t a year, caught 15,000 t in 1979.

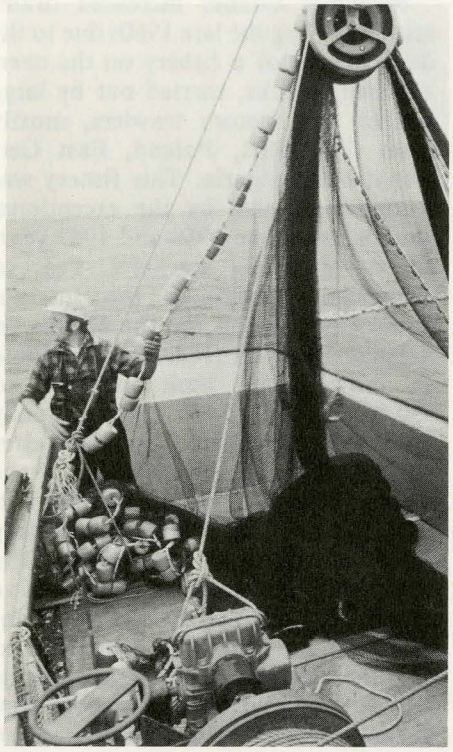


Fig. 5 Hauling in the seine

This has been made possible by the new marketing opportunities, as well as by an increased abundance of mackerel in Newfoundland waters. Higher than average autumn surface water temperatures in the Newfoundland area are possibly responsible for this major redistribution of mackerel. Market expansion has also permitted increases in landings in the traditional inshore mackerel fisheries of eastern New Brunswick, Prince Edward Island, Cape Breton Island, and the Atlantic coast of Nova Scotia.

The Canadian mackerel fishery is an inshore small-boat fishery. On the eastern shore of Newfoundland, the main gear is purse seines and bar seines. In the Gulf of St. Lawrence, gill nets have become the dominant gear in recent years, although small purse seines accounted for most of the landings throughout the 1970s. Purse seines are the major gear on Prince Edward Island, whereas in New Brunswick gill nets are the primary gear. On Cape Breton Island, mackerel are caught by handlines, trap weirs, and gill nets. The fishery along the outer coast of Nova Scotia is dominated by trap weirs, and gill nets. Most mackerel fishermen also fish other species, notably lobster, herring, and groundfish.

The economic importance of the mackerel fishery has increased greatly in recent years. The total landed value climbed from $2 million in 1976 to more than $6 million in 1979. The mackerel fishery plays an important role in the economy of the multispecies inshore fishery.

Mackerel for human consumption is sold whole or canned. Some mackerel is also sold cured or as frozen fillets. It is also a preferred bait for the snow crab and tuna fisheries. An unknown quantity of mackerel is reduced to fishmeal and oil.

Research and resource management

Fisheries research scientists are essential members of the fisheries management team. Regular scientific "assessments" of exploited fish populations provide the biological information which is necessary to the development of a management plan. Unfortunately, our biological knowledge of the Atlantic mackerel is still quite limited. Information important to the assessment, such as the rate of non-fishing mortality, or the abundance of juveniles, can be only crudely estimated at the present time.

Another long-term research problem is posed by our inability to specify what number of spawning fish is necessary to provide a given production of young. This is probably because the number of juveniles is also influenced by the temperature of the water for eggs and larvae, competition among larvae, and predation by larger fish on younger stages.

Still another management-related biological problem is the difficulty in determining when and where the mackerel are going to show up. This is especially important in the case of an inshore fishery. In recent years fish have been exceptionally abundant off eastern Newfoundland. This development was not predicted and more information about mackerel ecology is necessary before scientists will be able to predict with confidence this kind of local abundance trend.

One of the most critical pieces of information in the scientists' assessment of a fish stock is the estimation of the population. In the case of the Atlantic mackerel there are two main approaches to this problem. The first technique, used mainly by American scientists, involves the use of an index of stock size. Each spring and fall, American research vessels conduct a standard survey with a bottom trawl. These cruises are planned principally to survey the abundance of juvenile herring, but mackerel are also caught. The year-to-year variation in the numbers of mackerel caught per tow provides an index of variations in the abundance of the population. This index can be confirmed by comparison with another index derived from the catch per day of the American commercial fishing fleet. It is, of course, difficult to estimate the numbers of "pre-recruits" — juvenile fish not normally caught in commercial gear, who will form the mainstay of the fishery two or three years later.

A second technique for estimating the abundance of the mackerel

population has been introduced by Canadian scientists. In this case, an annual research survey determines the abundance of mackerel eggs in the surface waters of the Gulf of St. Lawrence during the spawning season. This information, combined with precise knowledge of the fecundity of individual fish, should permit the estimation of the total number of spawners in the Gulf. The stock abundance then may be estimated by observing the relative numbers of spawning and non-spawning fish in commercial catches.

The northern contingent of the Atlantic mackerel has a number of ecological relationships with other fish stocks, so it cannot be managed in isolation. We know, for instance, that the northern and southern mackerel contingents intermingle during the winter. But no precise information is available about the degree of intermixing or competition and thus it is difficult to predict the effect of the abundance of the northern spawning group on the southern group or vice-versa.

The northern contingent has important relationships of competition and predation with other species of fish. As well, mackerel feed on capelin in the Gulf of St. Lawrence and off Newfoundland. Both of these species are fished commercially. Further, in the Gulf of St. Lawrence, mackerel have a number of relationships with cod and herring throughout their life cycle. The fishery on any one of these fish stocks will obviously have some effect on the other related stocks.

The details of these interactions, and thus the consequences of fishing are not yet sufficiently well understood to allow their use in the scientific management of the three major fisheries involved. At present, management proceeds on a stock-by-stock basis and more research is needed to enable managers to make decisions in the best long-term interest of all the interacting fisheries.

Management of the Atlantic mackerel is still in a development stage. One of the difficulties in developing a comprehensive management plan is the uncertainty about markets and problems in product quality. There are at least three related problems which hinder the development of the Canadian mackerel fishery. Firstly, existing mackerel markets are concentrated in countries that do not offer a sufficient price to permit profitable fishing and processing in Canada. Secondly, mackerel has a high oil content and perishes rapidly. Both fishermen and processors risk the loss of their product unless they use adequate cooling facilities. Tanks with slush ice are recommended for boats and small plants, while refrigerated seawater systems are recommended for larger installations. Thirdly, there may be an oversupply of mackerel relative to the existing world market. A major component of this problem is the lack of market development in North America. If the Canadian mackerel fishery is to achieve its full potential, then considerable work must be done to promote mackerel products in the Canadian and American markets.

Further Reading

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