Fisheries and Oceans
Pêches et Océans

Underwater World

The Sea Scallop

Canada

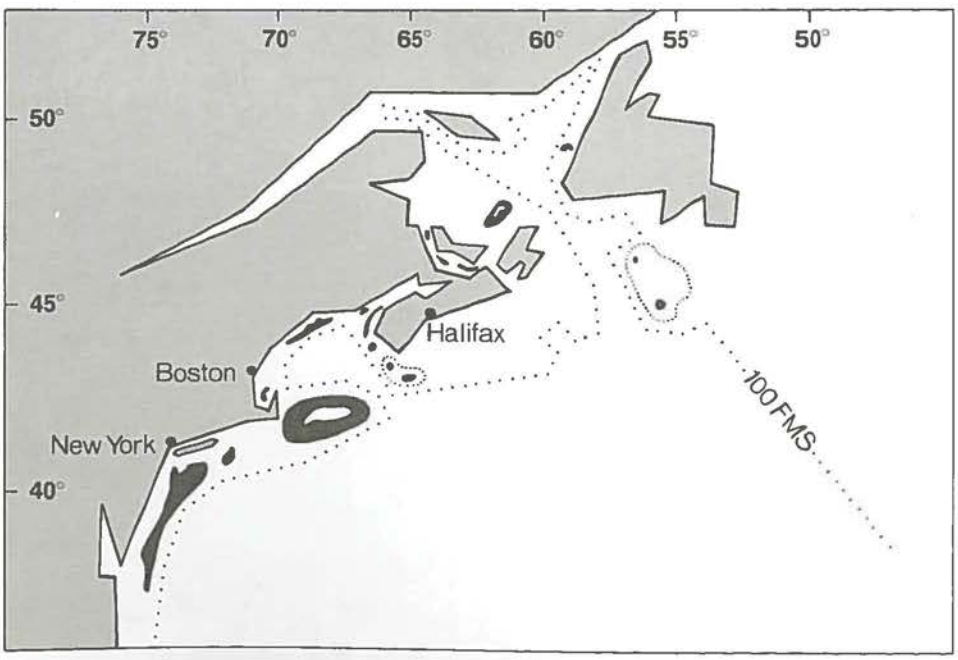
The Sea Scallop

Scallops are among the better known shellfishes and are widely distributed throughout the warm and temperate oceans of the world. Nearly 300 species have been identified to date. In flavour the scallop rivals even the oyster and is also the subject of considerable historical interest. At the time of the crusades the shell of a European species became the symbol of holy pilgrimage; even today it is sometimes called the "pilgrim" or "St. James" shell. The scallop also appears frequently in art, such as in Botticelli's painting, "The Birth of Venus", where the beautiful Venus drifts landward standing on a scallop shell. It has a prominent place in old-world heraldry too and is displayed on the coat-of-arms of two modern day Knights of the Garter, Sir Winston Churchill and Sir Anthony Eden.

The sea scallop, also called the giant or smooth scallop, *Placopecten magellanicus* (Fig. 1), is the most important commercial species of molluscan shellfish in Canada. The Iceland scallop, *Chlamys islandicus,* is the only other scallop found in east coast waters. Like the sea scallop, it prefers deep waters but it is more northern in distribution and its numbers less abundant. Those stocks commonly found in Newfoundland waters, however, are quite plentiful and contribute substantially to the commercial fishery in that region. The Iceland scallop is sometimes confused with the bay scallop, *Aequipecten irradians,* commercially important along the mid-Atlantic coast of the U.S.A., and the calico scallop, *A. gibbus,* which supports an important fishery off the southern Atlantic coast of the U.S.A. It is doubtful if the bay scallop has occurred in recent times along the Canadian coast, but fossils have been discovered near Sable Island.

Fig. 1 – Upper scallop shell of a five-year-old scallop. The rings on the shell are formed when water temperatures are low and daily shell growth is reduced.

Fig. 2 – Locations of important sea scallop fisheries on the Atlantic coast.



Distribution

Sea scallops are found in the northwest Atlantic, from the north shore of the Gulf of St. Lawrence to Cape Hatteras, North Carolina. In the northern part of their habitat range they occur in water shallower than 18 m. (10 fathoms), while in the southern portion they are confined to waters deeper than 54 m. (30 fathoms). Where conditions are favourable, scallops frequently occur in dense local populations, called beds, which may be extensive enough to support commercial fisheries. Important Canadian fisheries have occurred off Georges Bank, also in the Bay of Fundy (particularly off Digby, Nova Scotia), on the southwestern Scotian Shelf, and in the Gulf of St. Lawrence, particularly in Northumberland Strait, around the Magdalen Islands, and in Port-au-Port Bay, Newfoundland. (Fig. 2).

Whether or not a specific area has a shellfish bed appears to depend on the chance settlement and subsequent survival of a large number of scallop spat, which in turn depends on environmental factors.

Description

The sea scallop is a bivalve; that is, it has two valves or shells. Both shells are round, almost equal in diameter, and are held together by a comparatively small straight hinge. The lower valve is flatter, smooth, and white or cream in colour, while the upper one is arched and usually reddish. Young shells are frequently tinged with delicate colours which form attractive patterns such as pink and white radiations. The inner surfaces of both valves are smooth and pearly white, and have a satin-like lustre.

Between the valves are found the soft body parts which account for about 40 per cent of the animal's total weight. Figure 3 shows a large white muscle (a) in the centre, usually called the "meat," which is the only part of the sea scallop regularly eaten in North America. This muscle opens and closes the shell. Next to the meat and attached to it is the gonad (b), which in Europe is consumed along with the meat. During late spring the gonad matures and becomes bright coral red in females and creamy white in males. Along the edge of the shell is a thickened, muscular part of the mantle called the "rim" (c). It is darkly pigmented with various colours and has numerous sensory tentacles. Dozens of eyes which are sensitive to light are also found on the rim. The small black mass (d) near the hinge is the hepatopancreas, commonly referred to as the "liver".

Habits

Sea scallops are found on various types of bottom, but prefer firm gravel, shells, or rock. Scallop concentrations appear most commonly in areas of good water exchange, perhaps because of greater food and oxygen availability. They are mostly sedentary, lying with the flattened valve on the ocean floor. Small scallops often attach themselves to bottom objects by means of strong threads (byssus) similar to those produced by the common mussel. This habit gradually disappears as the scallop gets older, although scallops having a shell diameter of up to 13 cm occasionally attach with a byssus.

Unlike most other molluscs, scallops can swim. By contractions of the powerful muscle, they "clap" their shells together, forcing water out from the corners of the hinge and so jetpropel themselves foward, "mouth first". As the scallop moves forward it appears to be taking great bites out of the water. Underwater studies show that, when disturbed, scallops smaller than 10 cm can swim up to 4.5 m horizontally and up to one m off bottom, and may, in this way avoid scuba divers or scallop drags. If left undisturbed, however, scallops swim infrequently. Studies of scallops that are tagged and later captured as adults indicate that they do not move far, but spend their lifetime within a radius of a few kilometres.

Two species of fish, the sea-snail and young red hake, often found between the valves of live sea scallops, are apparently seeking protection from predators. In spite of the fact that many fish may be found there at any one time, the scallops do not appear to be adversely affected.

Food

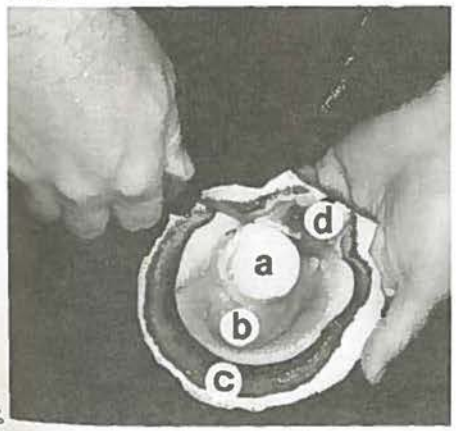
Scallop concentrations exist only in areas where food supply and other conditions are suitable. Like most other bivalves, scallops feed on minute plants and animals which they strain from the water by an elaborate filtering mechanism involving the gills.

Reproduction

Sea scallops may be either male or female, although it is possible to determine their sex only after they begin to mature in late spring. This is in contrast to the European scallop which is hermaphroditic, i.e. individuals are of both sexes simultaneously. Spawning time varies from area to area — from late August and early September in the Bay of Fundy region to late September or early October on Georges Bank. Microscopic eggs, about 0.08 mm in diameter, are released into the water by the female and are fertilized there by the male's sperm.

The fertilized eggs develop into free-swimming larvae, a stage which appears to last at least three weeks. During this time the larvae may be carried long distances by currents, accounting for the wide distribution of the species. When larvae are about the size of a pinhead, they develop a "foot" from which a byssus can be produced. At this time they settle to the bottom and attach themselves with the byssus to objects such as gravel, shells, or plants. This marks the beginning of their sedentary bottom-dwelling life. By the onset of their first winter, scallops are about five mm in diameter.

Fig. 3 – When a scallop's shell is removed, the large, circular white muscle (a) shows in the centre; the gonad (b) is seen below the muscle, the rim (c) is found around the margin of the shell, and the liver (d) is located near the hinge.



Growth

Growth rates of sea scallops have been carefully studied (Fig. 4). While the age of the scallop can be determined by counting the rings on the shell (Fig. 1), the growth rate can only be estimated by measuring the distance between rings. Growth varies from area to area and from year to year, depending on the availability of food, water temperature, and other factors. In general, winter growth is slower, and rings are therefore more pronounced in scallops from the Gulf of St. Lawrence and Bay of Fundy than those from Georges Bank.

Scallops are a relatively slow-growing, long-lived species, with an average age of exploitation of four to five years on Georges Bank and five to seven years in the Northumberland Strait. Scallops over 20 years old are frequently observed in areas of low exploitation, but annual growth of such old scallops is very slight and meat quality is often poor.

Enemies

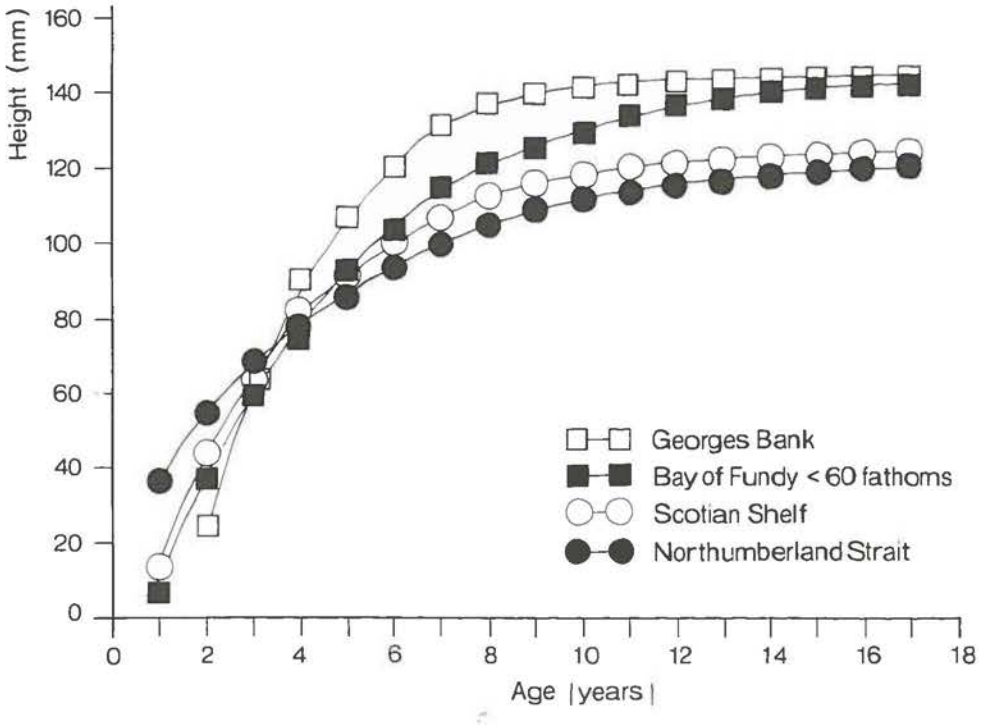
The nautral mortality rate of scallops in the free-swimming larval stage is high. During this stage they easily fall prey to larger animals and are susceptible to unfavourable environmental conditions. Once they descend to the bottom, starfish, predatory snails, crustaceans, and fish such as cod, plaice, and wolffish, feed on them. Old scallops are often attacked by boring worms and sponges, which perforate and honeycomb the shell. Since the scallop is weakened by its constant efforts to repair the shell damage, the meat may become dark and stringy and of such poor quality that it is no longer marketable.

Commercial Fishery

Until 1945, the Canadian scallop fishery was an inshore operation and total landings fluctuated from about 225 to 775 metric tons (t) annually. This fishery was centered mainly in the Bay of Fundy off Digby, Nova Scotia. An offshore fishery on Georges Bank developed after the Second World War, and since then, two peaks in landings have occurred - one in the early 1960s and the other in the late 1970s (Fig. 5). The average annual combined landings from both the Canadian and American scallop fleets fishing Georges Bank has totalled about 7-10,000 t. Recent landing figures of 18,000 t are the result of above-average spat settlement and survival in the early 1970s.

Since 1958 the annual landed value of scallops has exceeded the combined landed value of all other molluscs in Canada. Landings reached a peak in 1977, totalling more than 13,089 t in weight and worth $44 million commercially. Although landings have steadily declined since then, high market prices have maintained the landed value of sea scallops at high levels.

Fig. 4 - Average height for scallops of different ages from each of the four major Maritime scallop fisheries.



About 75 per cent of Canadian scallop landings come from Georges Bank, a large Bank extending eastward from Cape Cod and site of the largest single scallop resource in the world. In area it comprises 9,000 square nautical miles and is within the 100 m (50 fathom) depth contour. The northwest peak of the Bank is about 90 nautical miles SSW of the southwest tip of Nova Scotia.

Faced with declining catches on Georges Bank, the offshore fleet is expending considerable effort on scallop beds of the eastern Scotian Shelf and on St. Pierre Bank, south of Newfoundland. The latter area had not been exploited since the early 1970s; 1982 landings totalled more than 700 t.

Offshore scallop vessels sail out of several Nova Scotian ports, the more important ones being Lunenburg, Riverport, Liverpool, Yarmouth, and Saulnierville. The fleet has grown from one small dragger in 1945 to 50 large vessels in 1963, and since 1973 has been restricted to 77 licences.

Offshore scallop draggers are sturdily built, about 30-40 m in overall length, have a 120-440 registered tonnage, and are powered by diesel engines of 400-1800 h.p. These vessels are capable of scalloping for 12 months a year and can stay at sea for weeks.

They tow two drags at the same time, one on either side of the ship. The standard offshore drag consists of a heavy metal frame, 4-4.6 m wide, with a bag attached. (Fig. 7). Part of the top of the bag is made of rope webbing (rope back) and the remainder of the bag is knit with steel rings. A fully loaded drag may weigh upwards of 1.8 t.

The two major Maritime centres of the inshore scallop fishery are in the southern Gulf of St. Lawrence and the Bay of Fundy area off Digby, Nova Scotia. The latter region has enjoyed a long scalloping tradition, and at one time as many as 90 boats sailed out of Digby. The vessels in this fleet are mostly 15-20 m draggers, each towing a gang of up to seven drags attached to a long tow bar. However, in recent years the fleet size has fallen slightly to about 60 vessels which share an annual catch of 750 t. Such landings are above the long-term average yield; stock assessments suggest that this above-average abundance of scallops has been largely depleted and unless new fishing grounds are found, landings may be expected to decline to more traditional levels.

In recent years, both the Bay of Fundy inshore vessels and the offshore fleet have exploited scallops extensively on the southwestern Scotian Shelf, primarily from Browns, German, and Lurcher Banks. Production from this area has historically been sporadic, with the last five years producing significant landings similar to those of the Bay of Fundy.

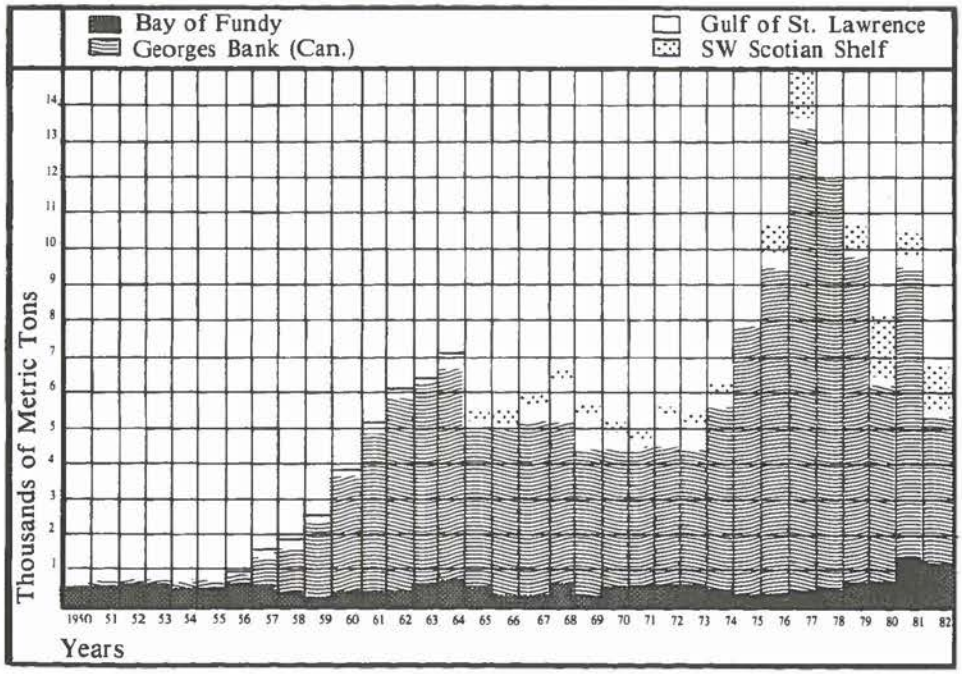


Fig. 5 – Landings of scallop meats from the four major fishing grounds in the Maritimes (Nova Scotia, New Brunswick and Prince Edward Island). Round weight values are obtained by multiplying meat landings by 8.3.

The Martimes scallop fishery in the Gulf of St. Lawrence has been concentrated in the Northumberland Strait. Major scallop fishing ports include Miminegash, Howards Cove, Borden, Wood Is., and Beach Pt., P.E.I.; Richibucto and Cape Tormentine, N.B.; and Toney River and Caribou Landing, N.S. In 1970 the fishery reached a peak, with over 1,000 t landed annually, but since then landings have declined to about 200 t. About 550 scallop fishermen are licensed to fish in Northumberland Strait, although only about 350 actively participate each year.

The vessels used in this fishery are of Cape Island design, and are often used not only for scalloping, but for finfishing, and lobstering as well, depending on the season. Two types of scallop gear are used in the Gulf – either a three or four gang, toothed, Digby-type drag for rocky bottoms or a 2.5 m sweep chain drag for smoother bottoms. This latter type of drag is similar to, but much lighter than, an offshore drag.

Fig. 6 - Bringing aboard an offshore scallop drag. Empty drag weighs 454 kg, with a full catch as much as 3 600 kg.

Recreational Fishery

Scallops in inshore locations are frequently exploited by SCUBA divers, although it is illegal for non-licensed fishermen to drag for scallops. Because the issuing of scallop licences has been restricted, recreational diving has become relatively popular. It is permitted in New Brunswick and Nova Scotia, but not around Prince Edward Island.

Divers characteristically exploit small scallop concentrations which are not self-sustaining and which result from sporadic spat settlement. Because inshore scallops are found in small numbers and because of the species' slow growth rate, a limit is set on the number that may be harvested daily. These conservation measures are designed to moderate the rate of exploitation and to encourage, in turn, the production of larger scallops. This tends to optimize overall production of meat from a population, regardless of the age distribution.

Handling the Catch

Scallops are shelled or "shucked" as soon as they are caught by removing the bottom shell and all of the soft body parts except the muscle. The meat, which is left attached to the upper shell, is then cut off and retained; shells and other tissues are discarded. Since trips by the offshore fishery to harvest the scallops last up to 12 days, the meats are iced to prevent spoilage.

Scallops landed in Canada are marketed fresh, frozen, or breaded and partially fried. The major market is in the U.S.

In North America a great deal of the scallop is wasted since neither the gonads, commonly called roe, nor the rims are eaten. Whereas in Canada these

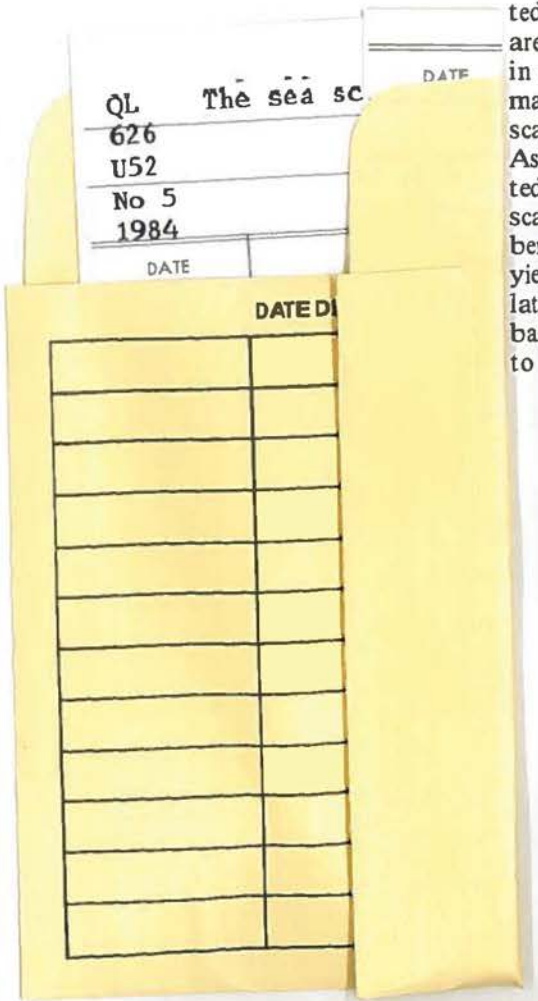
Fig. 7 - Scallop shucking at sea.

parts are currently discarded at sea, in Europe and Australia roe is normally marketed with the meats and is considered a delicacy, while the rims are often used as a tasty addition to a seafood chowder. A note of caution, however. Although the meat is never toxic, other tissues from scallops harvested in the Bay of Fundy contain paralytic shell fish poison and are highly toxic the year round. There is, however, no toxin in any part of scallops taken from Georges Bank or Northumberland Strait.

Conservation

The growing demand and the limited supply of scallops has led to a rapid rise in the price of this seafood delicacy. This in turn has resulted in the need to introduce conservation measures because of increased fishing pressure. These measures are largely of regional application and are reviewed annually to determine if they are still of optimal value.

Scallops can only be profitably fished when their numbers reach a certain density per unit area. In spite of their limited mobility they will disappear in one area, subsequently appearing elsewhere in exploitable concentrations. This has made it difficult to determine how many scallops can be fished in a given year. As a result, management has been directed towards optimizing the age at which scallops are fished rather than the number, thereby allowing the maximum yield to be achieved regardless of population size. Individual growth rate is balanced against population death rate to get a maximum overall yield.



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