



A power winch operates the brailer or huge scoop used to take the thousands of herring from the net. Gulls hover and swoop down on the catch.

fish are unusually abundant, extensions to quotas are usually granted.

Pacific herring are almost entirely lacking in either defensive or offensive abilities, consequently, they are more preyed upon than any other species of coastal fish. Their perpetuation is dependent upon their abundance. At all stages of their life span herring form a basic food supply in the economy of the coastal waters of the north-eastern Pacific Ocean. Only one herring from 10,000 eggs is destined to return to spawn. Many fishermen think adequate stocks of herring are necessary to sustain important food fishes such as coho and spring salmon. However, available biological evidence suggests that perhaps these fish could subsist on alternative foods should herring abundance ever reach very low levels.

Herring are eaten by many creatures. Eggs are consumed by many kinds of sea birds, larvae by numerous invertebrates and older herring by

sea lions, lingcod, dogfish and salmon. It is truly astonishing that any individuals live long enough to reproduce their kind.

In turn, herring feed on flea-sized organisms, such as copepods, amphipods and the young, free-swimming stages of barnacles and crabs. This diet is supplemented in the summer months with euphausiid shrimps, known locally as red feed. Herring food forms part of the category of ocean life known as zooplankton or animal plankton. The zoo-plankton organisms rise nightly towards the sea surface and descend again at dawn to avoid the intense daylight. Because herring are zooplankton feeders they also exhibit a similar up and down movement. The fishing fleets utilize this characteristic upward, nocturnal swim to bring the herring shoals within reach of their nets

(Prepared by the Fisheries Research Board of Canada Biological Station, Nanaimo, B.C.)

July, 1966

FISHERIES FACT SHEET

PIKE

Description and Distribution

The pike (Esox lucius) is also called jackfish, and in the United States great northern pike or pickerel.

Pike are soft-rayed fish with no adipose fin, and with one dorsal fin posterior to the typical position. Pike are quite long in proportion to depth and width, and are dark green, mottled with lighter spots. Their mouths bristle with sharp, pointed teeth. They are closely related to the maskinonge (Esox masquinongy), and the uninitiated often confuse the two.



Pike
(Esox lucius)

Pike are found in lakes, ponds and quiet weedy streams throughout the northern United States and most of Canada, and their range extends across Alaska, Siberia and Europe as far west as Ireland. In some parts of Canada they are eagerly sought by anglers, but in others they are considered less highly as a game fish.

Life History

The adult fish spawn in the spring, generally after ascending streams tributary to their usual habitat. The eggs hatch in less than two weeks, and subsequent growth is rapid compared to most Canadian freshwater fish.

Pike are generally found in shallow water, and they tolerate higher temperatures, lower concentrations of oxygen and higher concentrations of carbon dioxide than many species of freshwater fish. They generally lie motionless and well camouflaged among the shallow water vegetation, waiting to pounce on anything which swims too close. Although they mostly eat fish, they also take any other animals which are small enough and which happen to swim within striking distance, such as frogs, mice, muskrats, ducks, etc. They are notorious for their ability to swallow fish almost as big as themselves.

(over)

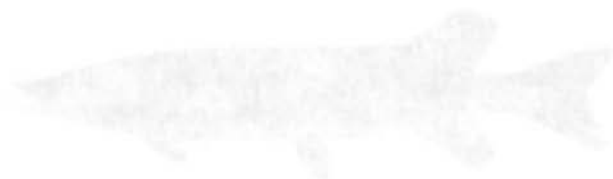
Pike (Cont'd.)

How Taken

Approximately six million pounds of pike are taken annually by commercial fishermen. Most of these are taken incidentally to other fishing operations, in gill nets, pound nets, fyke nets, and seines. Some are taken in fisheries conducted primarily for them, mainly through intercepting spawning runs with fyke nets, weirs or gill nets.

Millions of pounds of pike are taken annually for domestic use by nets, weirs, spears, angling, etc.

No. 48

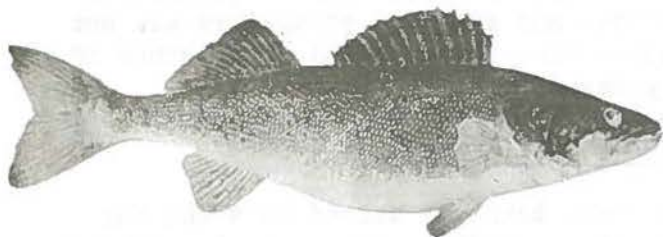


FISHERIES FACT SHEET

PIKE-PERCH OR PICKEREL

Importance and Distribution

The fish known scientifically as Stizostedion vitreum is commonly included among the pickerels. It is actually a member of the perch family, or Percidae, and not a member of Esocidae, the family to which the pikes belong. Fisheries biologists say, the fish



Pike-Perch or Pickerel
(Stizostedion vitreum)

should be known as the pike-perch, not as the pickerel. They use the hyphenated name partly because this one of the perches is somewhat pike-like and partly to distinguish the fish from the common yellow perch.

There are several species of Canadian freshwater fish, in addition to S. vitreum, which in one locality or another are called pickerel — some of them properly so — and, adding something more to the possibilities of confusion, S. vitreum itself is quite often known popularly by such names as wall-eyed pike and yellow pickerel. Among French-speaking Canadians, the name doré is ordinarily used.

Other fish often marketed as pickerel include two species of pike which, by nature, never grow very large, and the term 'pickerel' is correctly applied to them since the fish are actually little pike. Sometimes small specimens of the common pike, are also referred to as pickerel. The name sand pickerel is occasionally, though incorrectly, applied to the sauger, a member of the perch group.

Among the Canadian provinces, Manitoba is much the largest producer of pike-perch, and usually has more than half of the country's annual catch to its credit. Ontario is a big producer, and landings of substantial size are made also in Saskatchewan and Alberta. Smaller quantities are taken in several other areas. Ontario fishermen also land large quantities of a fish generally known as the blue pickerel and known to the biologists as the blue pike-perch.

The pike-perch occurs also in the Northwest Territories, the Hudson Bay region, and Labrador. In the United States it ranges from Vermont westward to the upper Mississippi Valley and southward to Alabama and Georgia. In the United States, incidentally, the fish is known by a wide variety of popular names, not only as the wall-eyed pike, for instance, but also as the jack salmon, the blowfish,

Department of Fisheries and Forestry

Ottawa

okow, and green pike.

Description

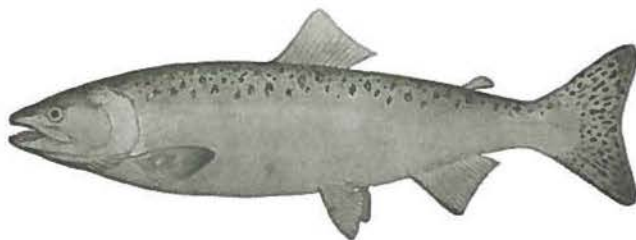
As for the pike-perch, its exterior colouration may be described as, in general, dark olive, with fine brassy mottlings forming indistinct oblique bars on the body. In maximum weight to about 20 pounds, though most specimens in the Canadian catch weigh from three to seven pounds. The pike-perch has white, firm, flaky flesh and is one of Canada's more important food fishes. Usually it frequents waters of moderate depth, and spawns in early spring, on hard or gravel bottom in shoal waters. From the very beginning of life it shows a voracious appetite, and even the youngsters are not above gobbling up their own little kin. Minnows and other kinds of small fish are staples in the pike-perch diet.

Fishing Areas and the Fishery

Pike-perch will take the hook, both the baited hook and the fly, showing considerable fight and in various areas is of considerable importance as a sport fish. Canada's commercial catch, however, is landed mainly by gill-nets set from boats or, in some localities, by stationary pound-nets. In Manitoba and Saskatchewan most of the landings are made in winter when the nets are set under the ice.

Canada's pike-perch landings are marketed in the fresh and frozen forms, with some of the fish filleted. A large part of the annual catch is exported to the United States and the remainder sold on the domestic market.

Pink Salmon



Pink Salmon (*Oncorhynchus gorbuscha*)

THE PINK SALMON, under the scientific name *Oncorhynchus gorbuscha*, makes up an important part of the annual British Columbia salmon pack. It occurs naturally around the North Pacific rim from northern California to Korea, hence it is common along the entire B. C. coast.

DESCRIPTION

The smallest of the Pacific salmon (other species are sockeye, chum, coho and spring), the pink is similar to all in shape, with an elongate body, and a conical head. The teeth are small and weak, and the scales also are small. It has a metallic blue back and silvery sides, and is covered with black blotches.

At spawning the colors of both sexes become a dark olive brown shading into white on the under surfaces. In the males, a change in shape occurs, with a pronounced hump or ridge forming on the back, and the jaw becoming elongated, with the upper jaw hooked downward at its tip. Because of this it used to be known as the "humpback salmon, although a similar change also occurs in the male sockeye. The young seldom have parrmarks. The length of the pink is usually about two feet, and the weight runs from three to five pounds, occasionally going as high as 10. The flesh is pink, hence the common name, and is highly nutritious, being first in protein content and fourth in fat content of the five B. C. salmon species.

MIGRATION AND REPRODUCTION

Its life cycle is similar to that of all Pacific salmon. The young pink goes to sea from fresh wa-

ter as fry and matures in two years, returning to the spawning ground from September to early November. In most cases there is a large spawning run of a particular population in one year and a small one in the next. Occasionally, however, the runs of successive years are of about the same size, and in a few localities there are no runs in the second year. Massett Inlet and Naden Harbour, both in British Columbia, are examples of areas having even and odd year runs of equal size in the same region.

In the southern part of B. C. the large runs are generally in the odd years while in the north they are in the even years. As is the case with all species of salmon, the ocean movements of the pink salmon are extensive and encompass thousands of square miles of area. Pink salmon usually remain near tidal water to spawn but occasionally travel long distances, for instance to the upper reaches of the Skeena River.

METHODS OF CATCHING

The pink salmon is largely taken in purse seines and gill nets. However, substantial catches are landed by fishermen using trolling gear. The latter catches are usually sold on the fresh-fish market.

Almost the entire net catch is canned and is eagerly sought in many countries. Its biggest sale is in the United States.

(Prepared by the Nanaimo Biological Station of the Fisheries Research Board of Canada).

FISHERIES FACT SHEET

Provincial Fisheries BRITISH COLUMBIA

VALUE OF THE FISHERY

The fisheries of British Columbia are of great cultural and economic importance. The history of the industry is interwoven with that of the province and the exploitation of the rich salmon and other marine resources has opened new fields for human skill and enterprise.

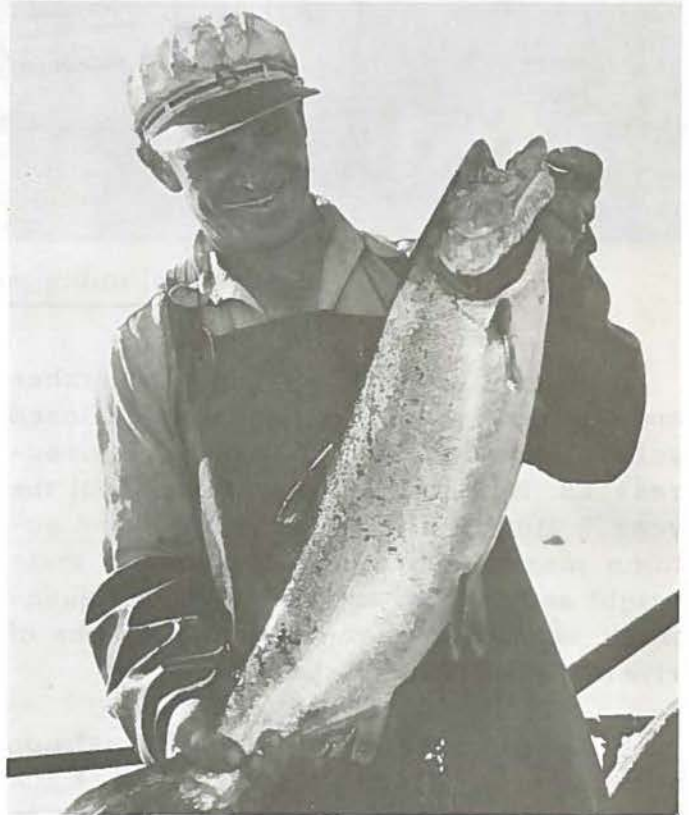
British Columbia lands about 600 million pounds of fish annually. While the volume of landings has remained relatively consistent, the value of production rose fairly steadily after 1950 and reached a peak of 98 million dollars in 1958. The average annual value of production during the period 1956-1960 was 70 million dollars. When it is considered that the total annual Canadian commercial catch is about two billion pounds, with a marketed value of about 200 million dollars, it can be seen that the commercial fisheries of British Columbia contribute significantly to the economic status of the Canadian fishing industry. British Columbia leads the other provinces in the production value of fish and fish products.

SALMON FIRST IN IMPORTANCE

Salmon stand first in importance among the species caught off the British Columbia coast and are the chief factor in placing the province in top position. Five principal species of salmon are caught: sockeye, spring, coho, pink and chum. The marketed value of the catch has been increasing steadily and averages about 50 million dollars. Most of the catch, which

averages about 150 million pounds annually, is used for canning. British Columbia canned salmon is famous all over the world. The heaviest pack on record was in 1941 when 2,248,870 cases (48-pound cases) were produced by the canneries for that year.

This record was almost reached in 1958 when 1,900,000 cases of canned salmon were produced. An increasing quantity of salmon each year finds its



A fine example of B. C. salmon.

way to the fresh and frozen markets in the United States and Canada, while smaller quantities are used for mild curing, smoking and pickling.

Department of Fisheries and Forestry

Ottawa



British Columbia purse-seiner in operation

Except for the period of December and January, which is generally a closed season, some salmon fishing is in progress in British Columbia throughout the year. But it is in the summer and autumn months that operations are at their height and the fish are taken in huge quantities as they swarm into the mouths of rivers to begin their spawning runs.

One of the most important salmon nurseries in British Columbia is the Fraser River system. The Fraser is particularly noted for its great runs of sockeye salmon which are protected by special conservation measures of the International Pacific Salmon Fisheries Commission. Since the sockeye runs pass through both Canadian and United States coastal waters in the Strait of Juan de Fuca as they approach the river mouth, these fish are shared by the fishermen of

both countries and an international treaty provides for the operation of the Commission to prevent overfishing.

OTHER SPECIES

Great quantities of herring are taken annually in the waters of British Columbia. In fact, herring accounts for about sixty per cent of all British Columbia fish landings. The bulk of the catch is processed into meal and oil and the annual value of production between 1956 and 1960 was about $7\frac{1}{2}$ million dollars. Thus herring leads other fish in total weight of landings and is about equal to halibut in monetary value of production.

British Columbia is close to one of the greatest halibut fishing grounds in the world. Some of the principal grounds

are off the west coast of Vancouver Island, some off the Queen Charlotte Islands, some in Hecate Strait, in Dixon Entrance. Others, farther away but commercially accessible to British Columbia vessels, lie off Alaska. All told these various areas yield more than 60 per cent of the world's annual halibut catch. British Columbia fishermen share this rich fishery with United States vessels and an international commission regulates operations so that the grounds are not overfished. Before the establishment of this commission under a treaty between Canada and the United States, the halibut stocks were becoming depleted as a result of uncontrolled exploitation.



Halibut fishing in Hecate Strait

Regulations of the commission have helped restore the stocks of halibut on the grounds to the point where large catches are again being made. Landings of halibut by British Columbia vessels increased sharply between 1956 and 1960, reaching a peak of nearly 35 million pounds in the latter year, with a marketed value of about 7.7 million dollars. However, about one-quarter of this total was landed direct at U. S. ports by Canadian fishermen, under the international agreement.

The trawl fishery for sole and grey and ling cod has been maintained at a fairly constant level over the past number of years and a small but efficient fleet of trawlers and draggers brings in steady supplies of soles and many other varieties of small flat fish. These species form the basis of a growing output of frozen fillets of fish.



Brailing herring

The tuna fishery, which at one time during the late part of the 1940's was a major fishery in the province, has practically disappeared as far as the troll operation off Canada's west coast is concerned, although there are indications that an off-shore seine fishery might develop. However, large quantities of imported tuna are canned in the off-season by canneries in British Columbia.

SHELLFISH

In recent years, shellfish have become of increasing importance to B.C. fishermen. Production figures show that during the period 1956-1960, the marketed value of crab and shrimp averaged 1.3



Shrimp fisherman

million dollars. Shrimp and crab are sold as shucked meat, either in the fresh or frozen state, or are canned. Most of the shrimp is taken by trawlers in the southern areas of British Columbia, while crabs are caught for the most part by traps.

Oyster production contributed between \$200,000 and \$400,000 annually to the B.C. fishing income, while clams have shown wide fluctuation in marketings, ranging in value from \$200,000 to \$600,000 each year.



Unloading salmon at Vancouver dock.

MEAL AND OIL PRODUCTION

The meal and industrial oil production in British Columbia has shown considerable variation from year to year as market prices have fluctuated and production has been affected by these returns. Until 1959 one company conducted a whaling operation off the west coast of Vancouver Island but with the declining prices of meal and oil this operation was discontinued in 1960 and 1961; it has been resumed in 1962.

FISHERIES FACT SHEET

Provincial Fisheries
NEWFOUNDLAND

The extent to which the economy and the way of life in Newfoundland are influenced by the fisheries is clearly indicated by a quick look at a map of the island. Very noticeable is the fact that the interior of the province has relatively little habitation, and that only along the railway line. On the other hand, the coastal fringes are pinpointed with upwards of 1200 settlements, large and small, practically all of which came into existence because of their proximity to good fishing grounds and most of which, to this day, are dependent on the fisheries for their existence.

The fisheries, in turn, are dominated by one great species, the cod, as they have been since the earliest days of settlement. Of historical interest in this regard is the report of the elder Cabot on his return to England from his voyage of discovery to Newfoundland in 1497. He told of a sea so teeming with fish (the cod) that they could be dipped out of the sea with baskets. In later years Sir Francis Bacon described the fisheries resources of Newfoundland as being of greater value than the tin mines of Peru.

In describing the fisheries of Newfoundland, it might be useful to consider them by three geographical areas -- the east coast, the south coast and the west coast.

CODFISHERY IMPORTANT

Along the east coast, the codfishery overrides all others in volume as in value. So dominant is this fishery, in fact, that when a Newfoundland fisherman uses the



Trawler fishing on the Grand Bank of Newfoundland.

word "fish" in the course of conversation he invariably means the cod, while, when referring to other species, he calls them by their specific names. Landings reach their peak during July and August when the cod are swarming into the bays and inlets to feed on the vast schools of small caplin which come into the beaches to spawn. The bulk of the catch is taken, as it has been for centuries past, in the close inshore waters, where the fishermen set out large traps into which the fish wander as they school along the coast. In

Department of Fisheries and Forestry

Ottawa



Hauling a codtrap in Newfoundland. Fishermen use dipnets to brail the trap into the boat.

other months, when conditions permit, fairly large catches are also made with handlines and line trawls. In bygone years a large fleet of schooners, exceeding 400 in some years, went north from Newfoundland to fish the cod along the Labrador coast but because of a decline in the demand for the salted fish produced from this operation, this fishery has fallen off considerably. Similarly there has been a great decline in the number of Newfoundland fishermen who fish from shore stations in the summertime along "the Labrador".

As against this decline a new form of fishing -- longlining -- has been introduced to the east coast largely through the efforts of the federal and provincial Fisheries Departments and the Fisheries Research Board of Canada. This method requires larger boats, to enable the fisherman to operate farther offshore than formerly; but it means that they can fish throughout a longer period and are not so dependent as were their forefathers on the summer migration of the cod.

Other species taken along the east coast include lobsters, Atlantic salmon,

mackerel, herring, seals and pothead whales as they are called by the local fishermen. The seals consisting of two species, the harps and the hoods, are taken during March and April after they have whelped on the arctic ice pushing down from the north. Part of this catch is made by sturdy motor vessels which penetrate the icefloes and search among the icebergs and growlers for the whelping patches. Quite a few are also taken by landmen who show great daring and stamina in hunting among the icefloes when the ice is to the land.

HERDING WHALES

Pothead whaling is another colourful and exciting operation. The whales, properly known as blackfish or caa'aaing whales, travel in large herds and enter the bays to feed on squid commencing in July and lasting in some years until as late as November. The fishermen in their small motor boats surround a herd of whales and drive them towards a suitable beach where the potheads become befuddled and stranded in the shallows. It is almost an exact replica of a western cattle drive, with the possible exception that at the end of a pothead round-up the



Caplin, swarming ashore, are scooped up in dipnet.

animals are slaughtered as quickly as possible. The meat is used in making feed for fur-bearing animals while the fat is rendered into oil.

Along the south coast the cod is, once again, a very important species but here greater variety is added to the catch by the many other groundfish species which teem on the offshore fishing grounds. This is the area of the fabulously rich Grand Banks and others of lesser size and renown, but justly esteemed, such as the St. Pierre Bank and Green Bank. It isn't so long ago--up to the Second World War, in fact--since cod was the only groundfish taken in this area as well as on the east coast. That was before quick-freezing came into prominence; however, as the frozen fish industry expanded, it not only became possible to utilize other species but it also became desirable in order to achieve diversification of production. Coincidental with this expansion, the salt fishing industry declined in importance and the banking schooner fleet went out of existence to be replaced by modern diesel driven otter trawlers. These ships today



Purse-seining for herring in Bonne Bay, Newfoundland.

take tremendous catches of fish that were at one time discarded, such as haddock, redfish and various flatfishes, in addition to cod.

This deep-sea fishery on the south coast is supplemented by a large inshore fishery which is carried on, in one or more areas, throughout the entire year. Other species of lesser importance but very valuable as supplementary avenues of income are lobsters, herring and salmon. An interesting point here is that the south coast of Newfoundland -- an area in Fortune Bay -- was the scene of the first Danish seine fishery in Canada. This fishery came about as the result of exploratory work by the federal and provincial Fisheries Departments and the Fisheries Research Board, and although it has attained only modest proportions yet, it has been of value to a small fishing group.

Along the west coast, the codfishery loses much of its importance and, in fact, the fishermen here are more likely to think in terms of lobsters. This is Newfoundland's best lobster fishing area, by



Squid jiggers busy on the fishing grounds, using time-honoured methods.

far, and even though the season is relatively short, lasting about $2\frac{1}{2}$ months, many fishermen make reasonably high earnings. Salmon and herring are also caught on the west coast as well as some cod and halibut, and the only scallop fishery in Newfoundland waters is also located in this area.

This has been a quick look at the more important species of fish caught by Newfoundlanders, and perhaps a word about the processing side of the industry would be in order. Here once again the cod is the most important species, but the traditional method of processing, by salting and drying the catch, has diminished considerably down through the years. This



Weighing and packaging fillets in a freezing plant.

has been occasioned by a shrinkage in the markets for this particular product brought about by world currency and trade problems and, to a not inconsiderable degree, by the growth of national fishing fleets from Europe. Offsetting this decline has been a very significant expansion of the quick freezing industry.

The years since Newfoundland became part of Canada (1949) have been a period of transition in the fisheries, of the evolution of more modern, mechanized fishing vessels and of similar advances in processing techniques. Much of the old still remains, especially in the more isolated areas, but modernization is steadily taking place.

Importance of Fisheries

The fisheries of Prince Edward Island occupy a secondary place in the economy of the island. Except in a limited number of communities the fishermen generally carry on their fishing operations on a part-time basis, farming being their major occupation. For example some fishermen migrate to Ship Wreck Point in Kings County to fish for lobsters in May and June. The houses in the village are for the most part temporary shacks. One farmer is reported to have migrated to Ship Wreck Point for the lobstering each season for the last 50 years.

The marketed value of all fishery products in Prince Edward Island is from \$3 million to \$4 million annually with the lobster fishery accounting for about \$2,000,000 of this figure. Cod are second in importance with hake, and smelts third and fourth. The catch of all fish including shellfish totals some 30 million pounds with a value to the fishermen of some \$2 million. Capital invested in the primary operations in catching and landing the fish amounts to about \$2 million while some 4,000 persons are employed in the fisheries, of which about 1,000 are engaged in the processing plants.

Landings of lobster total some 6,500,000 pounds, of which 2 million are marketed in the shell and 150,000 pounds are marketed as meat. The remainder is canned, producing some 21,000 cases. Prince County generally accounts for a large share of the landings, owing to the occurrence of both a summer and fall fishery within its boundaries.

In the other counties the May 1 to June 30 season only is allowed. As the open season for lobster lasts only two or three months in each zone, many turn to other fisheries in the off-season. The longest period of operations and the most diverse fishery probably is found in the eastern end of the island.

Cod and Hake

The joint fishery of cod and hake usually yields a catch of 12 million pounds with a landed value of nearly \$300,000. More than 50 per cent of the catch is usually taken in Kings County with fishermen operating in small boats, some of which are motor-driven. A large portion of this catch is canned as "chicken haddie" while a considerable amount is produced as wet salted fish. Very little dried fish is produced on the island and the marketing of cod in chilled, frozen or smoked forms is

(over)

Prince Edward Island (cont'd.)

negligible. Marketed value of the products from this fishery amounts to more than \$500,000.

Smelt fishing is a characteristic of the fall and winter fishing on the island. The catch, which usually amounts to more than a million pounds is marketed fresh and frozen. Value to the fishermen is about \$150,000.

Herring are fished, mainly for sale as bait. The catch annually totals some 6 million pounds. Some of the catch is marketed pickled, Scotch cured or otherwise and a few thousand cases of canned herring are produced.

Oyster Industry

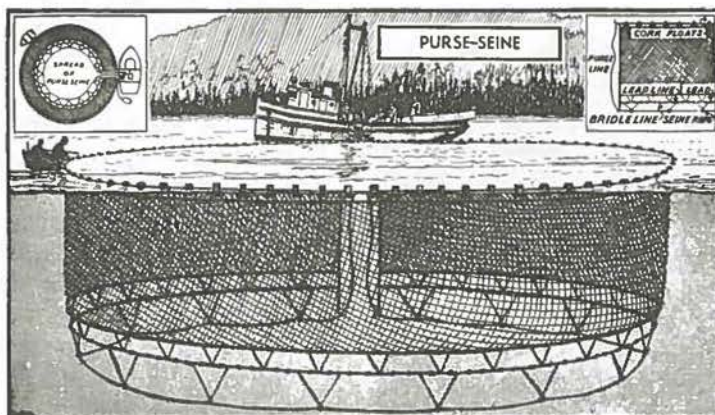
Another important fishery in Prince Edward Island is the oyster industry. The bulk of the oyster production originates in Malpeque Bay and the total yield for the province amounts to some 15,000 barrels annually. Oysters are sold in the shell, canned and shucked and contribute some \$175,000 to the overall production figure. Oyster farming is encouraged by the federal Department of Fisheries and culture techniques have been developed at Ellerslie, P.E.I., where the Fisheries Research Board of Canada operates a sub-station for this particular research.

The mackerel fishery is also of importance, some 2 million pounds being landed annually by the inshore fishermen. Mackerel are marketed in the pickled and the canned forms while a sizable amount is also used for bait. Prince Edward Island is the main producer of Irish Moss in the Atlantic Provinces. Some 3 million pounds of this sea-weed are harvested annually, bringing about \$35,000 to the fishermen and adding \$75,000 to the provincial income. Haddock, halibut, flounders, alewives, tomcod, salmon, crabs, clams, quahaugs and scallops are also taken by the island's fishermen.

FISHERIES FACT SHEET

PURSE-SEINING

Purse-seining, as the name implies, involves the use of a net which can be "pursed up" to trap a school of fish. It is particularly suitable for capturing migratory species such as salmon and herring, and is used extensively in British Columbia coastal waters.



Sketch of a purse-seine in position in the water (netting and ropes enlarged for clarity). The purse-line at the bottom is hauled in by the boat's engine until the net is closed from below — thus preventing the escape of the fish.

The net, usually of cotton webbing, may be 1,200 feet long and 70 feet in depth. When put into position around a school of fish, it stands like a fence in the water, supported at the surface by floats of cork, glass or aluminum and held down by weights along the bottom. The pursing rope is strung through large metal rings spaced every 12 feet along

the bottom of the net. When the rope is tightened, the bottom is drawn together, forming a huge purse or bag.

Method of Operation

When the boat sets out in search of fish, the net is stowed on a turntable at the stern of the boat. A small skiff is also piled on top of the net or towed astern. The seine is carefully arranged so that the floats are on one side and the weighted end is on the other. This prevents the net from becoming twisted as it is put out from the boat. The platform is power-operated and is controlled by a clutch. After a school is located the row-boat is launched with one end of the seine attached to it. The man in the boat rows a short distance from the seiner until a few fathoms of net have entered the water.

The seiner then moves in a circular direction to surround the school and the net is paid out from the table by the crew. The men are assisted by a mechanically-operated roller on the end of the turntable which helps to get the net over the end with a minimum of time and effort.

When all of the net is in the water and has taken up its vertical position both ends are brought together. The purse line around the bottom is drawn in gradually by the boat's engines until the bottom of the net is closed. The fish inside are now unable to escape. The seine is then hauled aboard until the fish are massed in a small area in the water. A dip-net or "brailer" scoops the fish from the big net and, by means of a power winch, transfers them to the hold of the vessel.

Department of Fisheries and Forestry

Ottawa

Purse-seining (Cont'd.)

The bottom of the brailer opens by means of a drawstring to drop the fish into the hold. However, fish are sometimes loaded directly into a "packer" boat for transportation to a cannery. When the fish are taken aboard the seine-boat, valuable fishing time is lost during the run to the cannery and the return to the fishing grounds.



Brailing fish from seine to packer
boat alongside purse-seiner

A salmon purse-seine can capture thousands of fish at one "set". As many as 1,200 tons of herring have been taken in one operation. Purse-seiners are among the largest vessels engaged in British Columbia's fisheries. They are stoutly-built diesel-engined craft from 60 to 80 feet in length. They carry crews of from six to eight men. The larger type of seiner will

carry about 130 tons of fish in its hold and has an engine of 240 h.p. These vessels are well-equipped with the latest mechanical devices for fishing and navigating, such as ship to shore telephones, radio, echo-depth sounders and automatic pilots, and have comfortable accommodation for the crews. Quite often through the use of the depth-sounding equipment a school of fish is trapped without a fish being sighted until the net is brought in.

This efficient catching equipment means quick profits for the crew members who work on a share basis. Most of the boats and gear are owned by the packers and are leased to the fishermen, but some are owned by the fishermen themselves. The equipment represents a considerable investment. A fully-equipped boat costs approximately \$90,000. A salmon net comes to between \$5,000 and \$7,000 while a herring net may cost up to \$15,000.

Fish predators, such as harbour seals and sharks, are often trapped in the nets along with the fish and cause extensive damage. Even one tear can mean the loss of hundreds of dollars worth of fish in addition to the cost of repairs. Much time, therefore, is spent between seasons strengthening and repairing the seines. Preservatives such as tar or tan bark are used to coat the webbing as a protection against corrosion and the attacks of marine organisms.

REDFISH

By E.J. Sandeman Fisheries Research Board of Canada

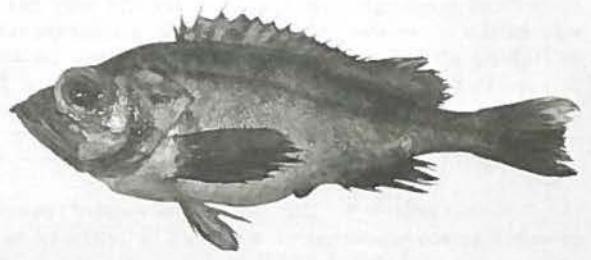
THE redfish, (*Sebastes marinus*), is also called the Ocean Perch or Rosefish.

Redfish are usually found in deep water and, although they are occasionally taken in shallow water, most of the catch comes from waters 80-250 fathoms in depth. At suitable depths and temperatures redfish are common in the Barents Sea to Spitzbergen, along the Norwegian coast, the Faroes, Iceland, Southern Greenland, and along the eastern seaboard of the North American continent from Labrador to the Gulf of Maine. Individual captures have been reported from the northeast off West Spitzbergen at Lat. $80^{\circ}06'N$ and Long. $11^{\circ}17'W$ and off West Greenland in Lat. $71^{\circ}N$. On the eastern seaboard of North America individual captures are recorded off Cape Dyer in Baffin Island to the North and at Lat. $37^{\circ}38'N$ and Long. $74^{\circ}15'W$ to the south.

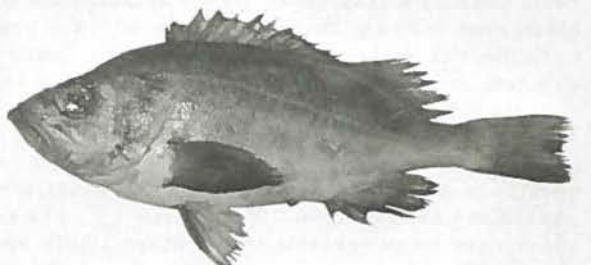
In Europe two forms of redfish (apart from a relatively insignificant inshore coastal species) are generally recognized. The one form (*Sebastes marinus marinus*) which, until recently, made up the bulk of European landings, lives in the shallower parts of the deep water, grows to a greater size and may be distinguished from its relative (*Sebastes marinus mentella*) by its usual more orange or yellowish red colour, and its relatively smaller eye and the shape of the bony protrusion on the lower jaw which is usually blunt and weakly developed. The other form (*Sebastes marinus mentella*), which prefers deeper water, is usually bright red in colour, has a relatively larger eye, and, particularly in large specimens, has a long and pointed bony protrusion on the lower jaw.

In the Western North Atlantic the common redfish resembles the *Sebastes marinus mentella* of Europe, and these *mentella*-type fish make up practically the whole of the landings in North American ports. These fish are found in commercial quantities from Southern Labrador to the Gulf of Maine including Flemish Cap and the Gulf of St. Lawrence.

Redfish had little commercial value in Canada and the United States before 1935. Taken incidentally by trawlers while fishing for cod and haddock they were usually returned to the sea except when, through scarcity of other fish, small amounts could be sold. However, the fish were not well known to the consumer. In 1935 technological advances in



Mentella-type redfish.



Marinus-type redfish.

handling fish, particularly filleting, quick freezing and the perfection of an automatic scaling machine; stimulating filleting trials in the United States. The fillets, packaged in cellophane and quick frozen, were shipped to mid-western United States where the attractive new product, offered as "Ocean Perch", was quickly accepted. Its mild flavour, similar to freshwater species, and its relatively low price made it increasingly popular. At the same time, conversion from line trawl with baited hooks to the more efficient fishing method, otter trawling, where an open-mouthed bag is towed over the ocean floor, and the subsequent increased use of the latter, made the catching of great quantities of such small-mouth fish as redfish a possibility. At first the growing trawler fleet concentrated on haddock but was soon forced to become interested in other kinds of fish. With redfish available in abundance and a growing demand for the frozen fillets, landings of redfish increased rapidly.

The total landings of redfish from the whole N.W. Atlantic area for the years 1934-1963 are shown in the table below. This table illustrates how

between the years 1935 and about 1948 a fairly gradual rise in landings occurred. This can be attributed largely to the expansion of the redfish fishery by the U.S. and Canadian fleets and the consequent exploitation of new grounds mainly along the Nova Scotian seaboard. The increase in landings shown between about 1948 and 1956 can be attributed largely to the general expansion of the area of exploitation to include the Grand Banks and Gulf of St. Lawrence. The almost explosive rise in landings which occurred about 1956, and which for the year 1959 resulted in redfish landings from the area second only to cod, was in the main due to the tremendous concentration of fishing effort exerted on the species by some European countries notably U. S. S. R., which in 1959 accounted for about 48% of the total landings.

DESCRIPTION

The redfish is like the fresh-water perch in general appearance but is actually related to the salt-water sculpins by the fact that the cheek has a characteristic bony appearance. Furthermore, the cheeks are spiny. The top of the head is concave while the mouth is large and opens to below the large black eyes which contrast vividly with the orange to flame-red colour of the body. The lower jaw projects and has a bony knob at its tip fitting into a corresponding notch on the upper. The back fin has a spiny and soft portion combined into a single long fin. The common redfish of the N. W. Atlantic occur usually to about 17½" in length. Occasional larger specimens are found to 20" or even greater but these very large specimens are more likely specimens of the much rarer (in the N. W. Atlantic) marinus-type of redfish. Fish less than about 8 inches are usually considered too small for commercial use. Fish from the coastal areas in addition to being generally smaller than those from offshore and deeper waters, are very often much darker in colour and, when taken in shallow water adjacent to the coast, may even appear to be chocolate-coloured or black.

HABITS AND MOVEMENTS

Relatively cold water is preferred by redfish although they cannot be regarded as arctic fish. Over most of the N. W. Atlantic area the temperatures at the depths where redfish are likely to occur in commercial quantities are usually between 37°F and 43°F over most of the year. When redfish are found in arctic areas they are usually in the deeper waters where the temperatures are more often than not 35°F or higher.

Very little is known of the movements of the common redfish on the western side of the Atlantic. Indirect evidence, including differences in size composition in different areas, and data on the numbers of vertebrae possessed by the fish as well as data on the numbers of fish having parasites, supports the belief that the redfish remain rather localized in particular areas and do not undertake

extensive migrations as do many other fish. Their abundance or lack of abundance at certain seasons of the year suggests that some seasonal offshore and inshore movement may be undertaken. Restricted vertical diurnal movements appear to be usual and this has resulted in the normal commercial practice of fishing for redfish only during the daylight hours when the fish are concentrated at the bottom.

In spite of the fact that redfish are usually at or very near the bottom during a great part of the day, examination of the food in redfish stomachs has shown that they are pelagic feeders and do not normally feed on bottom-living organisms.

REPRODUCTION AND GROWTH

The redfish, unlike our other common commercial fishes, bears live young, the eggs being fertilized, developed and hatched within the female. The young are retained within the female until most of the yolk of the egg is used up and they have reached one-quarter inch in length. The female redfish produces between 25,000 and 40,000 young each year. This is a very small brood compared to many of the marine egg-laying fishes (the cod lays 3,000,000 to 9,000,000 eggs). However, the protection offered by being inside the mother's body during early life gives the young a greater chance for survival.

Scientists have found that redfish grow very slowly. An increase of about one inch a year is normal during the early years, the rate decreasing with age. They found that the fish first breed and bear young at about 10 years of age. It has been estimated that many of the fish included in the catch are more than 20 years of age.

Because such slow growth and late maturity cannot keep pace with the removal of the adult stocks by the fishery, the catch in the Gulf of Maine is falling off rapidly.

The general pattern of the redfish fishery through the years has been largely based on an expansion of the area fished and the continued exploitation of new grounds where, because of the accumulated stock of old fish, the catches are very large. As these areas of virgin stocks become fewer and the accumulations of old fish are reduced the catches per unit of effort will decline. This has happened in several of the redfish areas in the Western North Atlantic notably in the Gulf of Maine and Gulf of St. Lawrence. The fishery in these areas must now depend on the balance between the supply of new fish by recruitment and growth and the rate of removal of adult fish by the fishery.

The time of year at which the female fish extrudes its larvae varies according to the area and depth at which they are living but in general in the

Newfoundland area spawning takes place in the spring and early summer (March to July). In the Gulf of Maine the time of extrusion of the larvae may be later and larval redfish may be born from about April to September. The larvae live near the surface for a time and gradually descend in the water as they grow.

Female redfish carrying young may be caught over all the fishing areas and no evidence exists of any special spawning grounds.

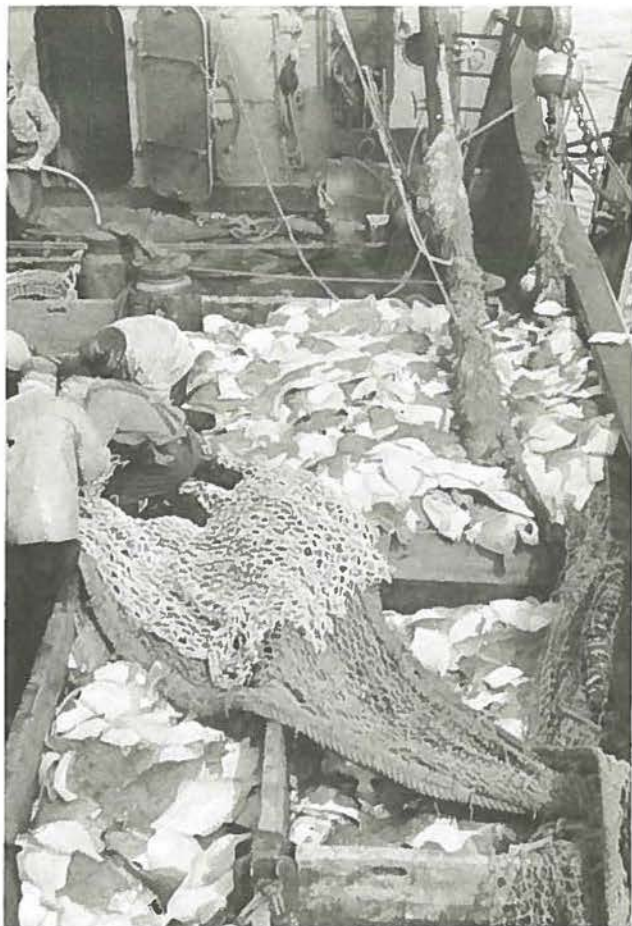
FISHING AND MARKETING

Otter trawls are responsible for the greater part of the catch. Although redfish can be caught on line trawl, only a few thousand pounds are taken each year in shallower waters near shore.

Landings (in millions of lbs.) of redfish from the North West Atlantic Area 1934-1963.

<u>Year</u>	<u>Landings</u>	<u>Year</u>	<u>Landings</u>
1934	2	1949	256
1935	17	1950	236
1936	67	1951	298
1937	58	1952	226
1938	66	1953	231
1939	78	1954	265
1940	85	1955	272
1941	155	1956	240
1942	128	1957	351
1943	115	1958	717
1944	120	1959	719
1945	132	1960	604
1946	179	1961	498
1947	151	1962	412
1948	250	1963	419

Practically all of the catch is used in the production of fillets. In 1946 only 1½ per cent of these fillets were marketed fresh, the balance being frozen. Waste from filleting is used in the production of meal and oil which has a high vitamin content.



Most of the commercial catch of redfish is taken by otter trawls. Picture shows a damaged trawl being repaired.

References:-

Templeman, W. (1959), Redfish distribution in the North Atlantic. Fisheries Research Board of Canada, Bulletin No. 120, pp. 1-173. Price \$1.75.

Rockfish of British Columbia

THERE are approximately twenty-nine species of fish in British Columbia waters belonging to the genus *Sebastes* which collectively are called "rockfish". The fishermen give them a variety of common names, some of which are rock-cod, snappers, canaries, black bass, rock salmon, and Pacific Ocean perch. Their nearest relative in the Atlantic is the redfish. The rockfish species of the Pacific coast appear to be very abundant off the British Columbia coast.

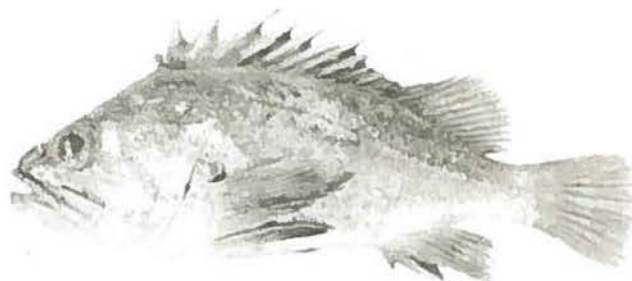
DESCRIPTION

The rockfish as a group are distinguished by their stout, heavily constructed bodies. Large broad heads, usually bearing spines and strong ridges, and heavily-spined fins are notable features. The colour patterns vary greatly among species and range from black and drab green through to brilliant orange and crimson. The colour of some species is made even more bizarre by the presence of wide red or black stripes.

HABITS

As a rule the rockfishes are found in the vicinity of reefs and rough bottom. A few species, such as the copper rockfish and the orange-spotted rockfish occur among the kelp patches in shallow water from the intertidal zone to depths of twenty fathoms. These two species are usually termed "rock-cod" by the fishermen. Other more brightly coloured species, usually termed "red-cod", such as the red snapper, orange rockfish, and "Spanish flag" occur at depths from thirty to over one hundred fathoms. The majority of the species are inhabitants of deep water off the open coast.

All of the species bear their young alive in prodigious numbers. These young fish are not much more than a quarter of an inch in length when born. During the summer months large schools of fingerling rockfish are encountered in the inlets and bays bordering the open coast. These small fish must also be very abundant in offshore waters for they are frequently found in the stomachs of the albacore tuna.



Pacific Rockfish

The food of the rockfishes consists of herring, sand lance and other small fish, crabs, shrimps and euphausiids.

AGE AND GROWTH

The study of the annulations on scales has revealed that the rockfishes as a group are much slower growing than other groundfish species. It would appear that most of the species do not reach commercial size until they are eight to ten years of age. Some specimens as old as twenty five years have been recorded.

FISHING METHODS

High-opening trawls of light web have proved to be the most effective means of capturing rockfish, since these fish do not congregate so close to the bottom as other groundfish species. Small quantities are caught incidentally in the hand-line fishery for lingcod and the long-line fishery for halibut and blackcod.

HANDLING

Rockfish caught by trawlers are landed in the round while those caught by line vessels are landed dressed with heads off. Most of the catch is filleted and packaged for freezing. A limited amount goes to the fresh fish market and to the "Fish and Chips" trade.

August, 1966



Salmon canning stands first in importance among Canadian fish canning enterprises in point of size and value of annual production. It is confined almost entirely to British Columbia although there is a small pack produced in Quebec and Nova Scotia. It is the salmon canning in British Columbia that is described here but salmon canning processes elsewhere are the same in principle.

During the summer months, great quantities of sockeye, pink, chum, coho and spring salmon are caught in the coastal waters of British Columbia. They are sped to canning plants, many of which are established up-coast in deep inlets flanked by forest-clad mountains. Generally speaking, the salmon canneries operate for about five months each year commencing in July and ending sometime in November. Some canneries operate on one species only while others operate on all five.

Like other foodstuffs, salmon is canned in order to preserve it for future use. It is shipped to countries all over the world. It goes with the explorer over the trackless tundra or through the barren desert of the Sahara. Frozen or subjected to day after day of intense heat, the fish within remains fresh and palatable, tempting and satisfying when opened.

In the canning process, the cooking sterilizes the contents of the can and as the container is airtight, the salmon remains sterile.

Upon arrival at the cannery, the salmon are unloaded from the fishing boat on to a mechanical elevator which discharges into bins located in the cannery, the different species being kept separate throughout. They are delivered mechanically from these bins into the hands of a machine which does what the fish-cleaners did by hand in the old days -- removes the head, fins, tail, entrails and washes away the blood from the backbone but does it at the rate of one fish per second.

From this machine the dressed fish is conveyed by carrier to tables where washers inspect each fish to make sure that the work of the machine has been properly performed. They remove anything that might have been missed.

Filling the Salmon Cans

Whether a salmon can is hand-filled or machine-filled, it is the raw fish that goes into the container. No preservative or colouring is used,
(over)

Salmon Canning (Cont'd.)

nor is anything added except a small amount of salt. The cut pieces are conveyed to a hopper above the machines which fill the cans. These machines have the empty cans fed to them from the floor above. They are entirely automatic and place the proper amount of cut salmon in each can at the rate of about seventy-five cans per minute. In another type of filling machine, the whole fish is fed into the machine at one end and the filled cans emerge at the other end.

An automatic weighing machine checks the weight of each can and rejects those that are underweight. These underweight cans then have added to their contents the amount required to bring them up to standard and are again placed in the production line.

While most of the salmon canned in British Columbia is filled by machines, there is a considerable quantity of the sockeye pack still filled by hand, especially the fancy-pack goods. Machine-filling does an excellent job but the cans filled by hand may have a slightly better appearance when opened although the quantity and quality of the fish which goes into the can is similar in each case.

In hand-filling, the cut pieces of salmon are conveyed to the filling tables and the filling is done mostly by women and girls who are experienced in this kind of work. The pieces of cut fish are placed in the cans, the skin side of the fish next to the inside wall of the can. Care is taken to see that not more than three pieces are placed in each can. The women filling the cans are constantly under the watchful eye of inspectors, whose business it is to see that the work is properly carried out. After the cans are filled they are conveyed back into the line and the same process is continued as though the cans were machine-filled.

Sealing the Cans

The filled cans next pass through an automatic salting-machine which places a predetermined amount of common salt on the top of the fish in each can. Cans are then conveyed to a machine known as the "clincher".

The "clincher" places the cover on each can and crimps the edge in such a way that it will not shake off, but at the same time leaves it quite loose.

Next step is the "vacuum-closing machine". This equipment is quite complicated but consists essentially of a chamber which is held under a constant vacuum by being connected to powerful vacuum pumps. When the can enters the vacuum chamber, any air in the can is drawn out. The sealing apparatus operates in this vacuum-chamber so that the cover is fastened down tightly. The vacuum produced keeps the ends of the cans concave and so reduces the strain on the sealed cans in the subsequent cooking process.

Salmon Canning (Cont'd.)

Retort Trucks and Coolers

From the closing machines, the cans are placed on slatted iron trays stacked in tiers on low trucks or cars. These trucks are rolled into a big iron retort which holds approximately 100 cases of forty-eight 1-lb cans. Cooking is done by live steam which is turned into the retort until it reaches a pressure of 15 pounds per square inch. The temperature reaches 249 degrees F. After ninety minutes at this temperature and pressure, the steam is shut off, the pressure drops, and the retort is emptied.

This sterilization is probably the most important step in the canning process. If not properly cooked, the fish will spoil. The cooking calcines the bones of the fish so that they can be eaten with the flesh and are a source of healthful lime. After the trays are removed from the retorts, the cans are tested for leaks, given a thorough washing and cooled rapidly in cold water or by blasts of cold air.

Labelling and Boxing

When thoroughly cool they are packed in standard wooden or fibre-board cases and are ready for shipment to central warehouses for storage until purchased. Labelling is done automatically. Most of the companies engaged in salmon canning have their own brands and label the packs which they distribute themselves.

Magnitude of British Columbia's salmon canning operations may be realized from the fact that as many as 2,248,000 cases -- forty-eight pounds to a case -- have been packed in a season.

Before British Columbia canned salmon can be sold, it must be inspected by Department of Fisheries' inspectors. The law requires that every can of fish be "fresh, firm and well-packed".

Government inspectors are qualified scientists who work in properly equipped laboratories where samples of all canned salmon are inspected. If the sample passes the tests imposed, a certificate of approval is issued and the end of each can is embossed with the word "Canada". If, however, the sample is below the standard set, no certificate is issued and the cans must be embossed with the word "Grade B" on the end of each can. Any goods below "Grade B" are confiscated and destroyed.

In addition to this inspection, some canning firms maintain their own laboratories where the firms' scientists keep a constant check on the quality of the product and devise new and better ways of preparing it for the trade.

FISHERIES FACT SHEET

Salmon Trolling in British Columbia

Trolling is one of the oldest methods of capturing salmon in British Columbia. However, there is a vast difference between the primitive bone hooks and twisted bark lines used by the early Indians and the modern diesel troller with steel lines hauled in by power gurdies. It is essentially a method whereby several weighted lines bearing numerous lures at different depths are dragged through the water at a slow speed. Since both spring and coho salmon readily strike at the moving lures, trolling has become one of the most sporting and extensive fisheries on the Pacific coast. Annually, between four and five thousand commercial troll licences are issued in British Columbia. In addition, there is a far greater number of ardent sport fishermen who troll each year in numerous protected bays and inlets.

The trolling method has a strong appeal for men of independent minds who are fond of the sea. It is carried on along the continental shelf usually within sight of land and extends over a long season from April to October. The troller either operates alone or with a partner. Many trollers own their own boats and live on them for long periods of the year.

Description of Boat and Gear

Modern trolling boats are 30 to 45 feet in length and are equipped with fast dependable gas or diesel engines, radio telephones, depth sounders, and various navigational aids. This allows them to travel the entire coast and to assemble at any place where fish are reported to be abundant. The troller is easily recog-

nized by the four long poles which are used to keep the six lines apart and by the cockpit in the stern from which the fishing is done.

The two main poles, set amidship, are about the length of the boat while the two bow poles are about ten feet shorter. The poles are held up-right when travelling and lowered to an angle of 45 degrees when fishing is in progress. Each bow pole carries a single line which is usually the deepest one because it bears a 30- to 40-pound weight. The main poles each carry two lines bearing 10- to 20-pound weights, the main one at the extremity and an inside one called the pig line because it is dragged clear astern by means of a floating bladder called a "pig". In recent years a stabilizing vane has been attached to each main pole to be dragged through the water in order to reduce the roll of the boat in heavy seas.

Each of the six lines is made up of strands of stainless steel wire with a lead weight attached to the end. These liners are reeled in and out on separate gurdy spools with an individually controlled clutch and brake. The power for the six gurdy spools is derived from the main engine. There is considerable variation among fishermen in the rigging of the boats and in the type and arrangement of the lures depending on the species of fish and the location of the fishery. Usually from three to seven lures are attached to each line by rubber snap-ons and strong nylon leaders. For spring salmon up to 18 lures of the large brass spoon or coloured plastic plug type are usually used. For coho salmon as many as 36 small brass spoons, the size and shape of an



Dual-purpose boat for gill-netting and trolling.

egg, are most often employed. Each lure has a single barbed hook.

In favourable years some of the larger trollers may temporarily desert the salmon fishery for a brief spell on the open Pacific where, on occasion, albacore tuna appear in great numbers. When this occurs, the fishery is short and intensive, and the trollers are soon back to the salmon fishery.

In sport fishing a much smaller boat is used and the lighter gear is operated by hand.

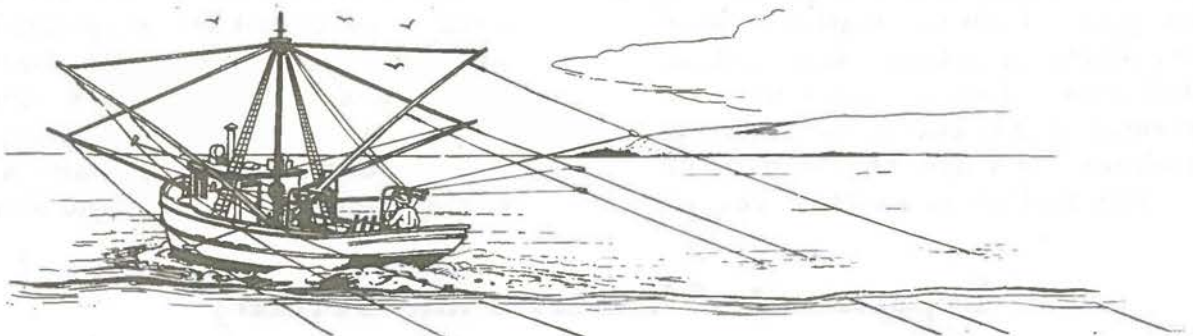
Method of Operation

Most of the small boats land their fish each day at fish camps near the fishing grounds but some of the larger boats ice their catches in the hold and remain

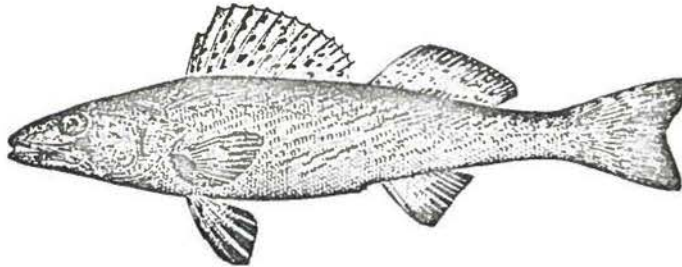


Fishermen operating salmon troller with lines out.

on the fishing grounds for a week or more. The trolling speed varies from one to three knots, faster for coho salmon than for spring salmon. The leaders and lures are attached to the lines at various depths from five to 25 fathoms. The depth is varied depending on where the fish are being caught. The spring salmon are usually taken at greater depths and closer to shore than coho salmon. When a fish strikes, the pole jerks and the line is hauled in by means of the power gurdy. The fish is landed with a gaff hook and shortly afterward is carefully cleaned. All troll-caught salmon is sold in a dressed head-on condition, usually to the fresh and frozen fish market. The best catches are usually made in the early morning. The only factor which interferes with the long hours of trolling is stormy weather. During such periods the gear is repaired and the boat is serviced.



SAUGER



(Stizostedion canadense)

The sauger is a member of the same family as the pike-perch, which is also known as "yellow walleye". It has habits quite similar and sometimes is called the sand pike. The sauger is found from the St. Lawrence westward through the Great Lakes to the lakes in Manitoba. In fact most of the Canadian commercial catch is taken in Manitoba where it ranks third in monetary importance in the freshwater fisheries. There is a considerable quantity taken also in the Great Lakes by Ontario fishermen.

DESCRIPTION

This slower growing relative of the yellow walleye is often confused with the larger species but is readily recognized by the presence of scales on the cheek. It is olive gray in colour with brassy or orange sides and dark mottlings, most distinct in the young. There are two or three rows of black dots on the first dorsal fin, and a large black blotch at the base of the pectoral fin. The average weight of the Manitoba sauger is about three-quarters of a pound and it rarely exceeds 18 inches in length. Most fish mature at about 12 inches. Due to its small average size

it does not occupy a prominent position as a game fish. It will however take a baited hook readily.

It is found close to shore in rather shallow water in spring and autumn but moves offshore in deeper water in summer.

FISHING AREAS AND THE FISHERY

The catch in Ontario in 1968 was 71,000 pounds with a value of some \$14,000. Manitoba lakes yield annually about four million pounds, valued at some \$650,000. The sauger rose to importance when the pike-perch populations in certain Manitoba lakes became depleted. The reduction of the pike-perch or yellow walleye allowed the sauger to increase to such an extent that at one period one-third of the total production of fish in Manitoba was composed of this species.

Fishermen use gill nets and pound nets to take the sauger and the catch is marketed fresh and frozen.

FISHERIES FACT SHEET

The Sea Lamprey



THE SEA LAMPREY (*Petromyzon marinus*)

THE SEA LAMPREY (*Petromyzon marinus*) belongs to a primitive family of water animals which are considered among the older links in the evolutionary chain. Lampreys are fish-like vertebrates which many scientists prefer not to classify as true fishes, because of certain distinctive characteristics. They should not be confused with eels: although bearing a superficial resemblance, lampreys are not nearly so well developed.

Together with their marine relatives, the hagfishes, lampreys are survivors of an ancient group of jawless animals that were the ancestors of fishes and modern vertebrates. They too have no jaws. They have no scales and no swim-bladder, possess only median fins, and lack the paired fins common to most fishes. In place of a solid backbone, they have only a rubber-like cartilage -- a fact which accounts for the complete disappearance of a dead lamprey's body when eaten by crayfish and other fish.

The most distinctive characteristics of the adult sea lamprey are the tooth-studded mouth with which it grasps its victims to suck out the blood on which it feeds, and the seven gill openings located on each side of the head. Fish victimized by and surviving sea lamprey attacks bear scars which clearly identify the attacker.

Five species of lamprey exist in the Great Lakes and tributary streams, but the sea lamprey is the only one which has caused serious damage to fish populations through its parasitic attacks. An extensive program to control the species in the lakes has been conducted by Canada and the United States since the lamprey's depredations upon fish stocks became known in the 1940's.

DISTRIBUTION

Sea-run forms of sea lamprey range the Atlantic ocean and penetrate well up into the St. Law-

rence River watershed. The Great Lakes are inhabited by a land-locked form which long ago established itself in Lake Ontario. Niagara Falls prevented migration of the sea lamprey above Lake Ontario until the building of the Welland Canal in 1829, but nearly a century passed before the first lamprey was discovered in Lake Erie (1921). By 1946, lampreys had advanced through Lake Huron and Lake Michigan into Lake Superior, and their population multiplied rapidly in these deeper, cooler waters.

LIFE CYCLE

Mature sea lampreys migrate from the lakes between April and July to spawn in tributary streams. Timing of the spawning runs depends upon water temperatures, and heavy runs do not begin until the stream temperature reaches 50 degrees F. Lamprey in search of suitable spawning grounds have been known to swim 50 to 60 miles upstream before being barred by dams or falls.

Male and female lamprey build a crescent-shaped gravel ridge nest in an area having a moderately strong current, flowing at the rate of about one mile per hour, and a shallow bottom of coarse sand and gravel. Spawning takes place at the upper edge of the nest.

The female releases a small proportion of her eggs at a time, and these are immediately fertilized by the male. The fertilized eggs drift into the nest where they lodge in the sand and gravel. The spawning pair moves upstream and dislodges stones so that sediment drifts down into the nest and covers the eggs. Sea lampreys spawn only once, then die.

A single female may deposit as many as 100,000 eggs; the average number is about 60,000. The eggs hatch in 10 to 12 days depending upon tem-



Lamprey larvae (ammocoetes) in varying stages of growth.

perature conditions. After hatching, the larvae drift downstream until they reach suitable silty areas where they establish residence in individual burrows at the stream bottom. Here they feed upon microscopic plants and animals carried to them by the water currents.

The lamprey larvae are known as "ammocoetes" and have a wormlike appearance throughout the prolonged period (between four and seven years) of "growing up". Remaining in their burrows at the stream bottom during the day, they often emerge at night, and are normally carried downstream by the current.

Ammocoetes undergo a dramatic change in appearance when they attain maturity. In the larval stage, the mouth is toothless. The sucking-disc mouth with its numerous horny teeth develops at the time of transformation to the adult. This takes place when the ammocoete reaches a length of about six inches. Shortly thereafter, the newly-matured lamprey descends into the lake and commences the parasitic stage of its life, preying upon fish. The major migration into the lake occurs during floods at the time of the spring break-up.

The parasitic stage in the lamprey's life is believed to continue for a period of one to one-and-a-half years. The adult grows to a length of about 18 inches, and to a weight of about eight ounces. There has been some evidence to indicate that newly-transformed lampreys migrate first to deep water where they attack lake trout, chubs and other deep-water species. As they grow larger, the lampreys move shoreward, and in the fall are found in relatively shallow water.

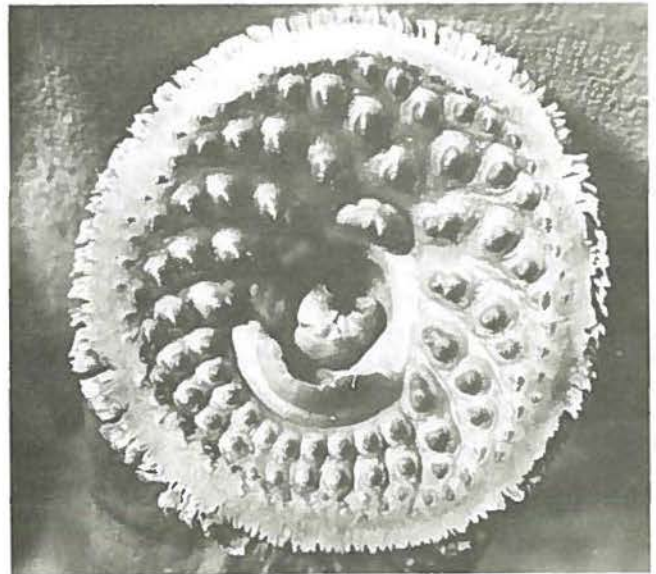
The sea lamprey attacks fish by attaching its mouth to the victim's body. With its sharp teeth, it rasps away the scales and skin and proceeds to suck the blood. The lamprey may remain attached with its suction-like hold for days or weeks, and it is very difficult for the fish to escape.

Most species of commercial fish in the Great Lakes have been known to suffer sea lamprey attacks, but the commercially valuable lake trout stocks have suffered most. As sea lampreys spread, there was a drastic reduction in the lake trout population. In Lake Huron, where the commercial catch had been 3,400,000 pounds, and in Lake Michigan, where it had been 6,600,000 pounds, there was a complete collapse of the fishery.

In Lake Superior the catch declined from 4,500,000 pounds to about 350,000 pounds by 1962. Studies showed these declines were the direct results of lamprey predation.

CONTROL PROGRAM

The lamprey control program on the Great Lakes is co-ordinated by the Great Lakes Fishery Commission, which was established by Canada and the United States in 1956. The Canadian phase of the program is carried out, under contract with the Commission, by the Resource Development Service of the federal Department of Fisheries, and extends to the Canadian segments of Lakes Superior, Huron, Erie and Ontario. Prior to 1966, the Canadian program was conducted by the Fisheries Research Board of Canada. The Bureau of Commercial Fisheries of the Fish and Wildlife Service, United States Department of the Interior, is responsible for sea lamprey control activities on the American side of these lakes and in the whole of Lake Michigan. Lamprey control headquarters for



Circular mouth of the adult sea lamprey is lined with sharp, conical teeth. The lamprey uses its rasp-like tongue to penetrate the flesh of the fish and then sucks its victim's blood.



A sea lamprey attached to a lake trout.

Canada are at Sault Ste. Marie, Ontario, and for the United States at Ann Arbor, Michigan.

Electric barriers once employed to control the sea lamprey are now used to assess the effects of chemical treatments on the lamprey population by collecting a portion of the spawning run of adult sea lamprey entering the streams in the spring.



Laboratory assistant checks the condition of ammocoetes and trout subjected in bioassay test to varying concentrations of lampricide.

Consisting of pairs of pipe electrodes which stretch across the river and are connected to an electric outlet, these devices are designed to sample the number of lamprey venturing upstream. This sample indicates the size of the lamprey population in the lake and can be compared from year to year to assess the overall effects of the control program. Fish are discouraged from entering the electrical field by wire mesh traps and fences installed below the electrodes.

CHEMICAL TREATMENTS

A selective "lampricide", a chemical which is lethal to lamprey but harmless to fish, is used on both sides of the Great Lakes to kill lamprey ammocoetes in the spawning streams. Chemical treatments begun in Lake Superior in 1958 had a dramatic effect: by 1962, the lamprey population as measured at the assessment barriers was reduced to 20% of its former level, and by 1966 it was further reduced to 10%. Treatments were also commenced on streams in Lake Michigan and Lake Huron.

The program calls for chemical treatments to be conducted in all Great Lakes tributaries that produce lampreys, and for periodic re-treatments as required. The chemical used, "3-trifluoromethyl-



East Side of Chippewa River barrier site, Lake Superior. 1965

4-nitrophenol", commonly referred to as "TFM", kills lampreys but leaves fish relatively unharmed when applied at the required concentration.

Success achieved in chemical control of sea lampreys has made possible a beginning on rehabilitation of depleted fish stocks in the Great Lakes. Natural recovery of the affected species is necessarily slow, and attention has been concentrated on large-scale plantings of hatchery fish, including lake trout, the hybrid "splake" and salmon species introduced from the Pacific coast, kokanee and coho.

No commercial lamprey fishery is carried on at present in Canada, although a small scale enterprise was in operation some years ago in Lake Huron. Limited quantities imported from Europe are sold over gourmet counters.

Scientists foresee no prospect for complete eradication of sea lampreys from the Great Lakes, but they do anticipate that effective control can be maintained to ensure that the lamprey threat will not again get out of hand.

August 1967

The Sea Scallop

Prepared by Fisheries Research Board of Canada Biological Station, St. Andrews, N.B.

SCALLOPS are widely distributed throughout the warm and temperate oceans of the world; nearly 300 species have been identified. They are among the most famous of shellfishes, rivalling even the oyster in flavour and historical interest. Today a scallop shell is the well-known trade mark for an oil company. At the time of the Crusades the shell of a European species was the symbol of holy pilgrimage and it is sometimes called the "pilgrim" or "St. James' Shell".

The sea scallop, also called the giant or smooth scallop, *Placopecten magellanicus*, is the most important commercial species of molluscan shellfish on the Canadian east coast. The Iceland scallop, *Chlamys islandicus*, is the only other scallop in our east coast waters. Like the sea scallop it is found in deep water but it is more northern in distribution, less abundant, and of no economic importance. It is very common on the Grand Bank of Newfoundland. Maritime fishermen sometimes improperly call it the Bay or Cape Cod scallop, *Aequipecten irradians*, which is commercially important in the United States and which closely resembles the emblem of the Shell Oil Company. It is doubtful if the Bay scallop has occurred in recent times on the Canadian mainland but a fossil population has been discovered on Sable Island.

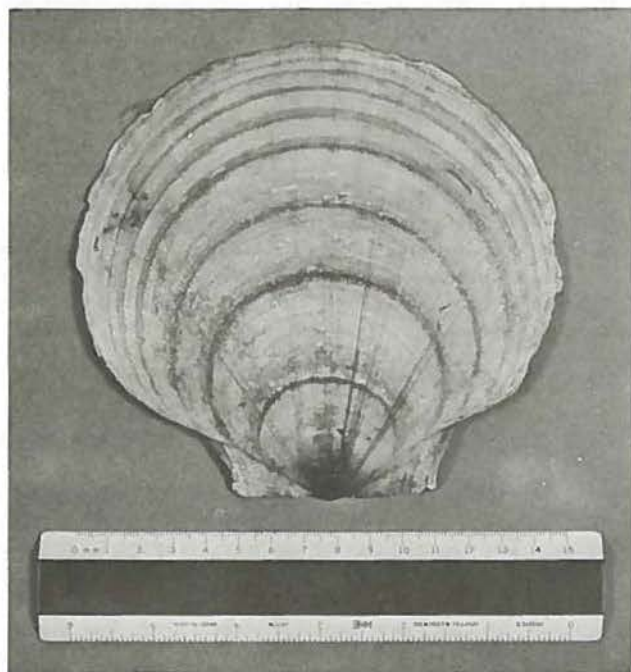


Fig. 1. - Twelve-year-old Bay of Fundy sea scallop (upper side). The shell rings which are formed in winter when growth comes to a standstill, indicate age.

DISTRIBUTION AND IMPORTANCE

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 portion of their range they occur in shallow water, less than 10 fathoms, while in the southern portion they are found in much deeper water, deeper than 30 fathoms. In the most favourable portions of the range, scallops frequently occur in dense local populations called beds which may be extensive enough to support commercial fisheries. In the last 10 years, major fisheries have occurred and in most cases continue off the Virginia Capes, Virginia, off New York City, around Block Island, Rhode Island, on Georges Bank, in Cape Cod Bay, Massachusetts, along the coast of Maine, in the Bay of Fundy (particularly off Digby, Nova Scotia), in the southern Gulf of St. Lawrence, on St. Pierre Bank, and in Port au Port Bay, Newfoundland.

The value of Canadian catches of sea scallops has increased dramatically in the last few years and since 1955 the annual landed value has been

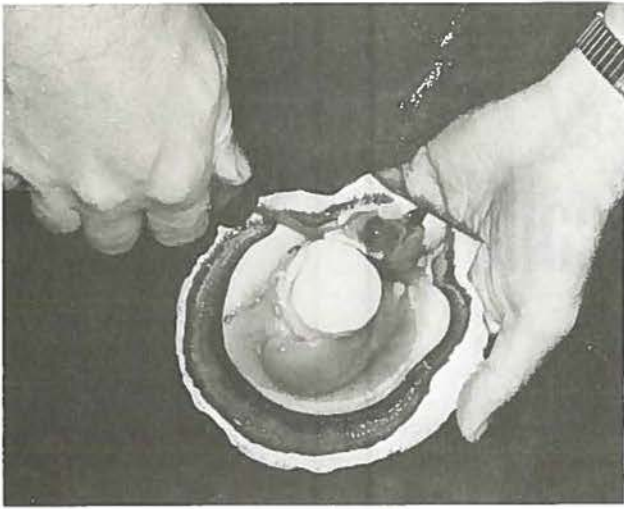


Fig. 2. - When you remove a scallop's lower shell the large circular white muscle shows in centre. This is the only part eaten in Canada. The developing kidney-shaped roe is vaguely seen immediately below the muscle.

more than the combined landed value of all other molluscs. Total scallop landings in 1964 amounted to 16.45 million pounds of meats (136.5 million pounds, whole weight) valued at 7.2 million dollars. That year the sea scallop was third in landed value of all species of fish landed on the Canadian east coast (lobster first and cod second). Of these 1964 landings, 88% came from offshore banks; 79.6% came from Georges Bank alone. The scallop fishery is primarily a Nova Scotian industry--over 95% of the catch is landed in that province.

DESCRIPTION

The sea scallop grows to a maximum diameter of seven to eight inches. It is a bivalve, i.e., it has two almost circular valves or shells which are held together by a comparatively small straight hinge formed by two "ears" or triangular projections of almost equal size. From the outside the two valves are not alike; the lower one is flat, smooth and has a white or cream color, while the upper one is arched, usually reddish in color and sometimes overgrown with barnacles or seaweeds. Young shells, in particular, frequently have delicate and attractive colors, some with beautiful pink and white radiations. The inner surfaces of both valves are smooth, pearly-white and have a satin-like lustre. The body of the scallop consists of vari-colored parts and a large centrally-located white muscle which is used to close the valves. This muscle, sometimes called the "meat" or "eye", is the only part of the sea scallop eaten in Canada.

The Iceland scallop differs from the sea scallop in that its maximum size is only four to five inches. Its two valves are almost alike and have 50 to 100 raised and radiating ribs on their outside surface. Both valves are reddish and arched, and the "ears" of the hinge are unequal in shape and size.

HABITS

Sea scallops are found on different types of ocean bottom but prefer a firm type such as gravel, shells or rock. They are mostly sedentary, lying with the flattened valve against the ocean floor. The very small ones and some of commercial size attach themselves to bottom objects by means of strong threads (byssus) like those produced by the common mussel.

Unlike most other shellfish, 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 propelling themselves forward "mouth first". As the scallop moves forward it appears to be taking great bites out of the water. From the recapture of tagged adult sea scallops it has been established that they do not move far but spend their lifetime on their native beds.

There is a most interesting association between the sea scallop and two species of fish, the sea-snail and the common hake. The young of these fish live between the valves of sea scallops. Although as many as five fish may be found in one scallop, it is apparently not disturbed or affected in any way.

FOOD

Although scallops can swim, they cannot move far. Hence scallop beds form only in areas where the food supply and other conditions are generally 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

Scallop reproduction closely resembles that of oysters, clams and mussels. The sexes are separate. Mature female sea scallop roes are a rose or coral colour and the male roes are a creamy white. The time of major spawning 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. At this time the microscopic eggs are shed into the water by the female and are fertilized there by the sperm which the male similarly releases into the water.

As in all stationary marine bivalves, the eggs develop into free-swimming larvae. This stage probably lasts at least 3 weeks and during that time

the larvae are at the mercy of currents and may be carried long distances from their parents before they settle. This aids in the distribution of the species. Settlement takes place when the larvae are about the size of a pinhead. At this time they give up their free-swimming habits, settle to the bottom of the sea and attach themselves by means of byssus to objects on the bottom. This marks the beginning of their sedentary bottom living life. By the onset of their first winter scallops are about one-fifth of an inch in diameter.

GROWTH

The growth rate of sea scallops has been carefully studied. Annual growth rings are formed on the shells each year at the time of cold water (February to April). Scallops can be aged by counting these rings and the growth rate can be determined by measuring the distance between annular rings. The rate of growth varies from area to area and from year to year, depending on the availability of food, temperature of the water and other factors. In general the growth rate is slowest in the Gulf of St. Lawrence and fastest on Georges Bank.

On Georges Bank 4-year-old scallops have a shell diameter of approximately $3\frac{1}{2}$ inches and the major part of the commercial catch is made up of 4- to 8-year-old scallops. The maximum life-span is 16 to 17 years of age, at which time the diameter of the shell may measure 8 to 9 inches.

ENEMIES

There is a high natural death-rate when scallops are in the microscopic free-swimming larval stage. At this stage they are easy prey to larger

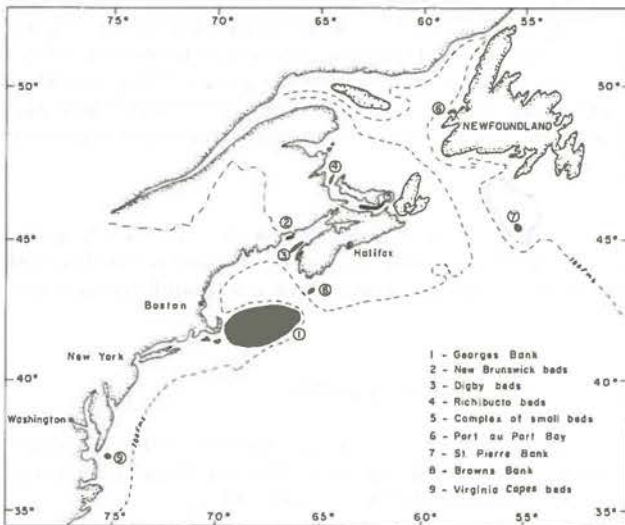


Fig. 3. - Chart of major scallop beds fished by Canadians. Georges Bank is the giant producer.

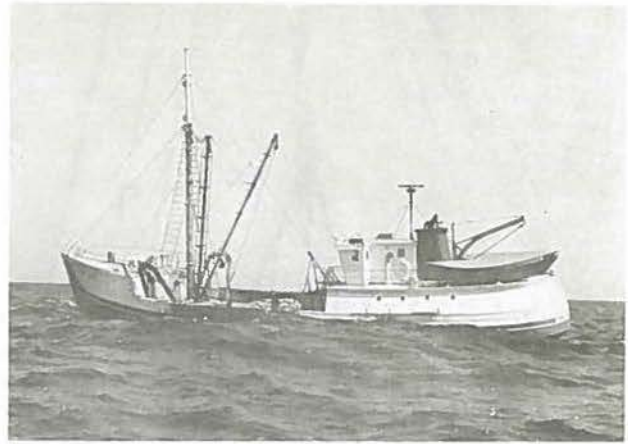


Fig. 4. - MV Stuart and Lynne, a 95-foot modern offshore scallop boat dragging Georges Bank.

animals and to unfavourable conditions in the water. After they descend to the bottom of the sea, fish such as cod, plaice and catfish feed freely on them. Flesh-eating marine snails and starfish are believed to destroy adult scallops. One enemy of older scallops is the boring sponge which perforates and honeycombs the shell. The scallop is weakened by its constant efforts to repair this shell damage and the meat becomes dark and stringy and of such poor quality that it is no longer marketable.

FISHERY

Until 1945 the Canadian scallop fishery was an inshore operation and total landings fluctuated from about $\frac{1}{2}$ to $1\frac{1}{2}$ million pounds annually. This fishery was centred mainly on scallop beds in the Bay of Fundy off Digby, Nova Scotia. Since 1945 an offshore fishery has developed and the recent dramatic increase in landings has been due entirely to the rapid development of this fishery. In the last 6 years the offshore fleet has provided over 90% of the annual Canadian scallop landings. Although this fleet has fished on several offshore banks, it has concentrated most of its effort on Georges Bank (over 85% in the last 10 years). This large bank (9,000 square nautical miles within the 50 fathom depth contour) extends eastward from Cape Cod. The northeast peak of the bank is about 90 nautical miles SSW of the southwest tip of Nova Scotia.

The offshore scallop fleet sails out of several Nova Scotian ports, the most important being Lunenburg, Riverport, Liverpool, Shelburne, Yarmouth and Saulnierville. It has grown from one small dragger in 1945 to 50 large boats in 1964. Offshore scallop draggers are sturdily built, about 95-100 feet in overall length, have a 22-24 foot beam and are powered by diesel engines of 400-800 h.p.



Fig. 5. - Bringing aboard a 12-foot offshore scallop drag after a 20-minute tow on Georges Bank. Empty drag weighs 1400 pounds, with a full catch as much as 8,000 pounds.

These boats are capable of scalloping on the offshore banks for 12 months a year and can stay at sea for as long as 15 days. Offshore scallopers tow two drags at the same time, one on each side of the boat. The standard offshore drag consists of a heavy metal frame, 10-13 feet wide, with a bag attached. Part of the back of the bag is made with rope webbing (rope back) and the remainder of the bag is knit with steel rings which have an inside diameter of 3 inches. The drags are hoisted with powerful winches because of the depth (30-50 fathoms) and great weight; a fully loaded drag may weigh upwards of 4 tons.

The two major centres of the inshore scallop fishery are the southern Gulf of St. Lawrence and the Bay of Fundy, particularly the beds off Digby, Nova Scotia. The latter region is by far the most important inshore area and at one time as many as 90 boats sailed out of Digby but in recent years the number has fluctuated around 30. Fluctuations in

the fleet size follow closely the abundance of scallops on the fishing grounds. The boats in this fleet are mostly 60-foot draggers towing a gang of up to seven rectangular-mouthed iron drags with wire meshed bags. These drags are also hoisted by winches.

There are no fishing restrictions in the offshore fishery. In the Bay of Fundy area however the beds are limited and because of the intense nature of the fishery, restrictions have been introduced to try and conserve the resources.

1. No one may fish for scallops on certain inshore grounds during the summer months.
2. The total width of scallop drags used must not exceed 18 feet.
3. The meshes of the scallop rake bags must not measure less than 3 1/4 inches inside diameter. This allows for the escape of the small scallops.

HANDLING

In both the inshore and offshore fisheries, scallops are shelled or "shucked" as soon as they are caught. The first step in this operation is to remove one shell (the flat shell) and all the soft body parts except the adductor muscle, meat or "eye" which is left attached to the other shell (see figure). This meat constitutes about one-third of the weight of the soft parts and is easily separated from the shell. The shells and remaining soft parts are discarded. The meats are iced and marketed fresh, frozen or breaded and partially fried. Most of the catch is sold in the United States but there are also good markets in Canada. Recently there has been an attempt to market the mature roes. They are also a fine delicacy and are customarily marketed along with the meats in the European and Australian scallop fisheries.

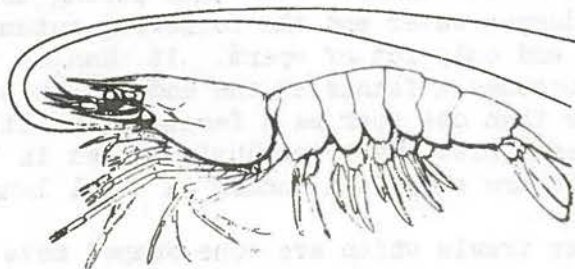
Scallop shells have been sold each year as souvenirs; the most perfectly shaped are artistically coloured, being used as ash trays and ornaments.

REFERENCES

- Bourne, N. 1964. Scallops and the offshore fishery of the Maritimes. Fisheries Research Board of Canada, Bulletin No. 145, 60 pp.
- MacPhail, J.S. 1954. The inshore scallop fishery of the Maritime Provinces. Fisheries Research Board of Canada, Atlantic Biological Station Circular, General Series, No. 22 4 pp.

Distribution and Importance

The shrimps, of which there are many species distributed from Greenland and Alaska to South America in both Atlantic and Pacific coastal waters, are in appearance very much like their close relatives the lobster and crayfish. Of the many species, one, the



Shrimp (Common)
Penaeus setiferus

Common Shrimp or Southern Prawn, Penaeus setiferus, make up 95% of North America's shrimp fishery. The fishery for this species is located along the coastline of the South Atlantic and Gulf States of the United States and is centred off Louisiana where about one-half of the 200,000,000 pounds annual catch is processed. Shrimp ranks fifth in volume and fourth in value of all the fisheries of the United States and Alaska, being exceeded in volume only by pilchard, menhaden,

salmon and sea herring, and in value by salmon, oysters and tuna.

According to present knowledge there are 29 different kinds of shrimp or shrimp-like animals in Canadian Atlantic coastal waters. Many are too small to be of commercial importance. The Pink or Red Shrimp, Pandalus borealis, provides a comparatively small fishery off the Pacific coast of the United States and Canada and off the State of Maine in the United States. Attempts have been made in recent years by the Fisheries Research Board of Canada to discover areas where commercial quantities of the Pink Shrimp might be taken in Canadian Atlantic waters.

Shrimp live on the sea floor, limited in their distribution to muddy and sandy bottom. On the Atlantic coast they are concentrated within six miles of shore. In the Gulf of Mexico, they are as far as the 30-fathom line in places 45 miles from shore.

Habits and Movements

The Common Shrimp of the South Atlantic and Gulf State waters spawns from March into September. Each female lays about half a million eggs and does not carry them as the lobster, crab or crayfish does but deposits them directly into the water. The eggs and newly-hatched young drift into the inshore waters where they settle to the bottom and feed in the numerous small bays and creeks. In general, the maximum production is from August to December in inshore waters. Here, nine-tenths of the annual catch is made. The shrimp

taken then are largely young and immature and had been spawned the preceding spring. As they become larger and more mature they move into deeper water where, since their discovery in commercial quantities in 1937, they have been providing an increasingly important offshore fishery for "Jumbo" shrimp during the months from April to July. These range from six and one-half to seven and one-half inches in total length.

The Pink or Red Shrimp, which provides a small fishery in British Columbia and Alaska waters, have an interesting life history. The young are hatched in water of about 50 fathoms. It migrates to water of 25 to 35 fathoms and there spends the first summer. Some time during the winter it joins the older shrimps in deeper water and the following autumn as a mature male produces its first and only lot of sperm. It changes its sex, unlike the Common Shrimp, and becomes a female at the end of its second winter and probably spends more than one year as a female. The life span of this shrimp is at least three years. The Pink Shrimp taken in the Gulf of Maine and Bay of Fundy waters are about six inches in total length.

Shrimp are caught by otter trawls which are cone-shaped nets varying from 30 to 100 feet in width at the mouth and are towed over the bottom by power boats.

Shrimp are marketed fresh, frozen, canned, dried, cooked and peeled. Shrimp bran, a by-product, is manufactured from dried heads and hulls and sold for animal feeds.

Source: Fisheries Research Board of Canada,
Atlantic Biological Station,
St. Andrews, N.B.

December 1949.

Shrimp Fishing in British Columbia

IN THE WATERS off the British Columbia coast six species of shrimp are found in sufficient quantities to support an enterprising minor fishery. Landings of shrimps and total marketed values for eight selected years are as follows:

YEAR	LANDINGS IN CWTs.	MARKETED VALUE
1939	831	\$ 12,246
1946	1,185	40,431
1948	3,540	84,900
1951	4,986	148,933
1955	10,880	181,000
1958	19,090	305,000
1960	16,777	299,000
1965	17,546	281,000

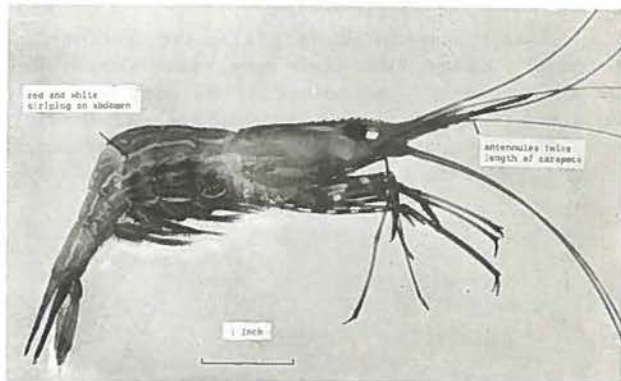
In general the six species are quite similar in appearance and size. However, there are a number of anatomical features which can be used for positive identification. In addition to distinctive anatomical features, most species possess unique colour patterns. The common names used by West Coast shrimpers are based mostly on colour characteristics. The accompanying pictures show features used in identification. Characteristic features are indicated in the photograph of each species.

The life histories of the six commercial shrimps are quite similar. The mature shrimps breed in the late autumn or early winter. The developing eggs appear on the abdomen of the female shortly after breeding, and are carried over the winter months. The young shrimps are hatched in the early spring and swim freely for about two months before settling to the bottom to begin adult life. The commercial shrimps generally mature first as males in the first or second year, depending on the species. After one or two seasons as sexually active males, these shrimps change sex and function as females for the rest of their lives.

SIDESTRIPE or GIANT RED (*Pandalopsis dispar*)

In size this shrimp is second only to the prawn. A large specimen may measure eight inches in overall length. The long antennules and striped abdomen easily distinguish this species from other commercial shrimps.

The sidestripe shrimp is found on muddy bottoms. The distribution on the Pacific coast is from



Sidestripe or Giant red shrimp (*Pandalopsis dispar*)

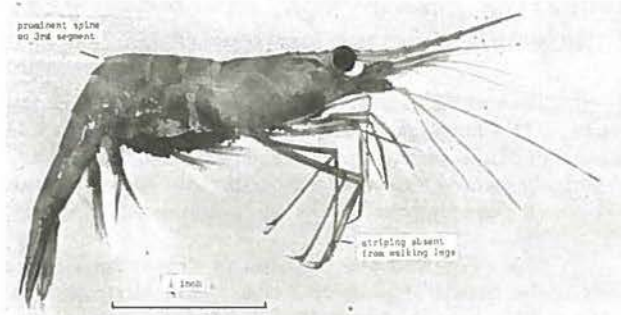
the Bering Sea to the Washington coast. In British Columbia it is fished in English Bay, Barkley Sound, and Chatham Sound.

The side stripe shrimp functions as an active male during its second year and then changes sex during the third year.

PINK SHRIMP (*Pandalus borealis*)

Generally, the length of this shrimp is three to four inches but larger individuals may reach six inches. The sharp spine or lobe pointing backward on the third abdominal segment is the most distinctive feature of this species.

The distribution of this shrimp is circumpolar, ranging from the Columbia River on the Pacific coast to Massachusetts Bay on the Atlantic coast of



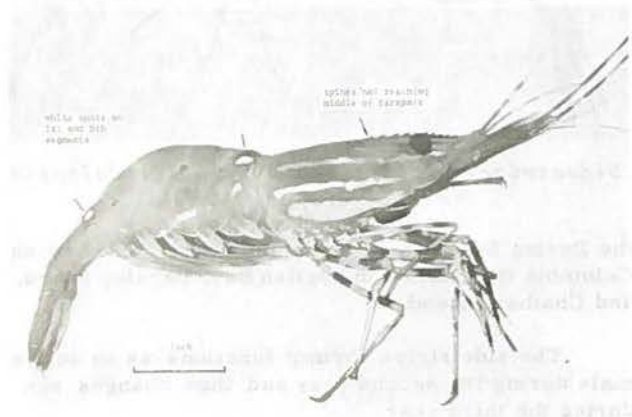
Pink Shrimp (*Pandalus borealis*)

America. It is found on muddy bottoms. Local fishing areas are Burrard Inlet, Howe Sound, and Chatham Sound.

The pink shrimp is an active male in its second year, and becomes a female during the third year. The entire life is at least three years. Some individuals mature first as females, never functioning as males.

PRAWN or SPOT SHRIMP (*Pandalus platyceros*)

This species is the largest of the commercial shrimps. Large individuals may reach almost nine inches in length. The colour of the body is usually reddish brown with distinctive white spots on the first and fifth abdominal segments, and with horizontal white bars on the carapace.



Prawn or Spot Shrimp (Pandalus platyceros)

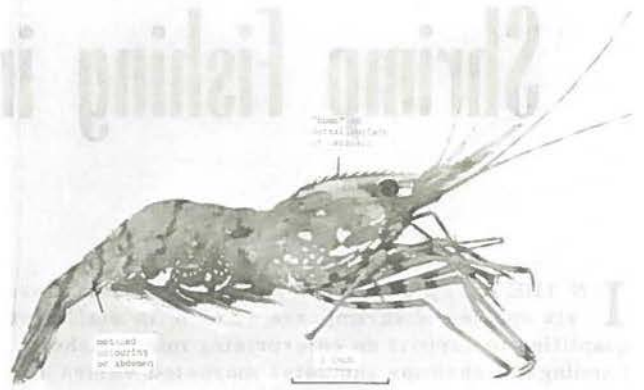
The prawn, as an adult, is generally found on rocky bottoms. The distribution on the Pacific coast is from Unalaska, Alaska, to San Diego, California. Trapping grounds are located in the Strait of Georgia, and in coastal inlets.

The prawn functions as an active male during its second year, and to a lesser extent in the third year then changes sex during the third and fourth years.

HUMPBACK or KING SHRIMP (*Pandalus hypsinotus*)

This shrimp may reach a length of six inches. The humpback shrimp is given its common name because of the arched shape of the carapace. The body is covered with a mottling of reddish brown which is conspicuous on the abdomen.

The recorded distribution is from the Bering Sea to the Strait of Juan de Fuca. This shrimp usually is found on muddy bottoms. It is of minor importance, entering trawl catches along with pink



Humpback or King Shrimp (Pandalus hypsinotus)

shrimps in such local areas as Stuart Channel and Burrard Inlet.

The Humpback shrimp is an active male in its second year, and becomes a female during the third year. Some individuals mature first as females, never functioning as males.

SMOOTH PINK (*Pandalus jordani*)

This species is very similar in size, colour, and body characters to the pink. However, the smooth pink lacks the prominent spine or lobe on the third segment of the abdomen.

The smooth pink is found on muddy bottoms. The distribution is from Unalaska to San Diego. Local trawling grounds are found in Barkley Sound and along the east coast of Vancouver Island.

This shrimp is an active male in its second year, and changes to a female in the third year. Some individuals mature first as females, never functioning as males.

COONSTRIPE SHRIMP (*Pandalus danae*)

A large coonstripe shrimp may attain the length of five inches. This shrimp derives its common name from the irregular striping of brown and red on the abdomen.

The coonstripe shrimp is found on sand or gravel bottoms, usually where a rapid tidal current exists. The distribution is from Sitka, Alaska, to San Francisco, California. The only known commercial ground in British Columbia waters is in Burrard Inlet.

This species functions as a male during the first and second years, and becomes a female in second and third years. Some individuals mature first as females, never functioning as males.

FISHING METHODS AND AREAS

The commercial shrimps are fished at moderate depths, ranging from 15 to 70 fathoms. The species generally found on muddy or sandy bottoms are caught by towing a bag-shaped net over the bottom, a method known as trawling. The trawl net is conical in shape, open at one end and tapering to an apex at the other end. As the net is towed along the bottom, shrimps are gathered in the mouth of the net and pass into the apex, or cod end.

In order to fish effectively the mouth of the net must be kept open. In the otter trawl the upper edge of the mouth of the net is supported by glass floats, and the sides of the net are attached in a special way to two vane-shaped boards, so that when the gear is towed along the bottom the resistance of the water causes the boards to spread the mouth of the net open.

The larger shrimp boats (about 40 feet in length) generally use the otter trawl, as it is gear to be handled by two men. The beam trawl is used on the smaller one-man boats (about 36 feet in length). The size of the mesh (stretched) used in shrimp nets is from 1 1/8 to 1 1/2 inches, depending on the net material. As this mesh size is smaller than allowed for the fish trawl (4 inches), any fish caught in the shrimp net must be returned to the water.

Trawls used for shrimps are designed so that the upper edge of the mouth goes first. The idea is that when the shrimps are disturbed from the bottom by the ground line, they cannot escape by swimming rapidly above the net. Shrimp trawls are towed relatively slowly. Doing so prevents the capture of too many fish and gives a catch which is reasonably free of mud.

The smaller, one-man boats used in the fishery are usually converted salmon gill-netters, and can be readily adapted to salmon fishing when that species is running. They have a drum on the stern,

which serves as a winch to reel in the tow line of the trawl net. The trawl net is similar in shape to that used on the two-men trawlers, and is kept open by a wooden beam of up to 40 feet in length. A ground line of rope weighted with chains or some other heavy material keeps the bottom of the net slightly above the sea floor, while glass floats secured to the upper part of the trawl mouth hold that part above and forward of the ground line.

The trawl or "drag", as it is sometimes called, may last from one to four hours, depending on the nature of the fishing ground.

A green manila tow rope runs from the drum through a block at the head of the vessel's mast. When the fisherman is hauling in the net, he turns the winch with a foot pedal or hand control, this winds the rope in even layers around the drum. When the mouth of the trawl reaches the surface, the beam is detached at one end and allowed to float alongside the boat. The remainder of the net is hauled up over the vessel until the cod end appears.

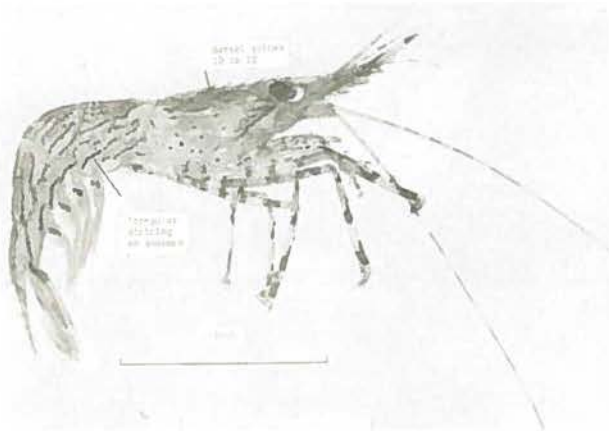
A fisherman can expect several hundred pounds of shrimp from a good drag. The cod end is doused in the sea before being brought aboard, as this helps to rid the net of mud and also makes for better quality. When the cod end is untied, the shrimp are dropped to the deck.

Prawns, which occur on rocky bottoms, are caught by means of traps. Prawn traps are generally rectangular in shape, made of a light iron frame covered with shrimp netting. At each end of the trap is a funnel-shaped opening through which the prawns enter the trap. In the fishing operation, traps are baited and set along the bottom in a line; the position of the traps is shown by means of a floating buoy. The traps are raised to the surface at regular intervals to remove the prawns and renew the bait.

Important shrimp fisheries are located in Burrard Inlet, Howe Sound, Knight Inlet, Chatham Sound, along the east coast of Vancouver Island, and Barkley Sound. The peak fishing period is in February and the low in November.

Shrimps are cooked fairly soon after capture, and the meat is removed from the shells. The shells are processed for use as fertilizer or animal feed. Until recent years a small amount of shrimp meat was canned. At the present time the entire catch is marketed fresh or frozen. Hotels and stores in Vancouver, Victoria, New Westminster, and other B. C. cities absorb the bulk of the catch, although a small proportion is shipped, frozen, to markets in the Prairie provinces; a limited supply is iced and exported to cities on the west coast of the United States.

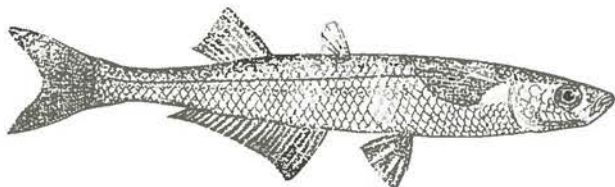
(Prepared by the Nanaimo Biological Station of the Fisheries Research Board of Canada).



Coonstripe Shrimp (*Pandalus danae*)

Distribution and Importance

The silverside is often confused with the young smelt. It is distributed along the Atlantic coast of North America from the Gulf of St. Lawrence to Delaware Bay. The southern part of the Gulf is about the northern limit of the silverside's range but it is found here in surprising abundance because of the comparatively high summer water temperatures.



Silverside
(Menidia notata)

The silverside lives in bays and harbours, frequenting the sandy and gravelly beaches within a few yards of the water's edge, and is rarely found deeper than one or two fathoms. The fish congreg-

ate in schools in the bays and harbours where they spawn during the early summer over sandy bottom and among the water plants near the low-tide level.

The small size of the silverside has restricted its commercial value. Some have been canned on Prince Edward Island and in other parts of the Gulf, and some are used for fox food. It is not used fresh as a food to any extent but is considered very tasty.

Description

It has a small mouth gaping only half-way to the eye. This along with the fact that it has no fleshy fin on the back identify it from the smelt and capelin. It has, however, a small spiny fin and a soft fin on its back. A thin line extends along the sides from head to tail.

Often wrongly called capelin in some areas, the silverside has large scales and is usually from three to five inches and not more than six inches in length. A translucent bottle-green on the back and upper sides, it has brown speckles on the latter. It has a silvery band along the middle of the side with the upper edge outlined by a fine back line. Its belly is white.

No. 4

FISHERIES FACT SHEET

Highly - Prized B.C. Species

Sockeye Salmon

THE PACIFIC sockeye salmon, with the scientific name *Oncorhynchus nerka* is the most highly prized of the five species found in British Columbia waters because its rich, red flesh coloring and the firmness of its tissues give it a greater market value. The other species of Pacific salmon are coho, pink, chum and chinook (or spring). The sockeye is found in abundance along the entire coast of British Columbia. Its complete range is from Oregon westward along the North Pacific Ocean and Bering Sea coast of North America to the northern Kuril Islands and along the northern and northeastern shores of the Sea of Okhotsk.

DESCRIPTION

The body of the sockeye is elongate, the head is conical, and the teeth are small and weak. The average life span is four years, although it sometimes goes to five or six. The length at maturity averages about two feet, and the weight runs at about five pounds. Occasionally sockeye have been caught weighing up to 15 pounds. The scales are cycloid. The color is greenish-blue on the dorsal surface, which has a silvery sheen and is marked by fine black specklings. The head is metallic-green. The body of the male turns brilliant red towards the end of its life, and that of the female dark red with green and yellow blotches, and while on its way to the spawning grounds, the characteristic hook appears above the upper jaw of the male fish. The sockeye is third among the five salmon species in protein content and second in fat content.

MIGRATION AND REPRODUCTION

After hatching in tributary streams in the interior of British Columbia, the young sockeye descends to lakes where it spends one, often two and sometimes three years before migrating to the ocean from March to July, when huge schools of small fish leave the river mouths. Some go to sea as fry, including a race of sockeye which spawns in Weaver Creek, a tributary of the Harrison River, B. C.



Sockeye Salmon (*Oncorhynchus nerka*)

In certain localities the sockeye has become "lake-locked", and spends its entire life in fresh water. In such cases it is known as kokanee, kickaninny, redfish or Kennerly's salmon.

In returning from the ocean to the inland areas where it was born, there to spawn and die, the sockeye's experience is the same as that of the other species.

METHODS OF CATCHING

The use of gillnets at the mouths of rivers is the most common method of taking sockeye, although a proportion of the annual catch is made in purse seines at the southern end of Vancouver Island. Relatively few sockeye are taken by trolling.

Nearly all the sockeye caught in British Columbia is canned, as it is best suited for this type of processing. The markets are worldwide, although the largest are on the North American continent. (A quantity of other kinds of salmon goes to the fresh and frozen fish markets, and some are mild cured, smoked, dry salted or pickled). Fishmeal and oil are made from the waste.

(Prepared by the Nanaimo Biological Station
of the Fisheries Research Board of Canada).

Soles and Flounders of the Pacific

THERE ARE nineteen species of flatfish, exclusive of halibut, which inhabit the waters of the British Columbia coast. Most of them are popularly termed "soles", although they belong not to the sole family but to the flounder and dab families. Four of the nineteen species have risen to moderate importance in the economy of British Columbia fisheries in the past two decades. Three of these, brill, lemon sole and rock sole, are in demand for the fresh and frozen fillet trade. The fourth, the turbot or arrowtooth flounder, is an important component of landings for animal food (mink food).



Brill or Petrale sole (Eopsetta jordani)

The brill or Petrale sole (*Eopsetta jordani*) inhabits the open coastal waters and has been fished extensively off the west coast of Vancouver Island, in Queen Charlotte Sound and in lower Hecate Strait. During the late 1940's the brill was the most important flatfish species landed in British Columbia and average annual production for 1946-49 was just over 3.3 million pounds. Subsequently, abundance declined largely as a result of environmental conditions. During the years 1960-65 annual production averaged one million pounds. Ages up to 25 years and lengths up to 25 inches have been recorded but the average age is about six or seven years and the average length about 16 inches. The brill spends the summer on shallow coastal banks and moves into deep water for spawning during the winter months. A major spawning ground is located in 180-200 fathoms off Esteban Point on the west coast of Vancouver Island. It is believed that the eggs are free floating and that they are carried by currents to the inshore banks where they settle

to the bottom and complete their growth to the adult form. The brill (like the turbot) has a large, strongly-toothed mouth and feeds voraciously on herring and red feed.



Lemon or English sole (Parophrys vetulus)

The lemon sole (*Parophrys vetulus*) gains its name more from its delicate lemon flavour than from any resemblance to the true lemon sole of Europe. It is sometimes referred to as the English sole and is distinguished by its slender shape and pointed head. It is most abundant in Hecate Strait, Queen Charlotte Sound and the Strait of Georgia on grounds where the bottom is composed of soft sand or mud. The average annual catch by Canadian boats during the period 1960-65 was just over 1.6 million pounds. Fish of commercial size average 14 inches in length and five or six years of age. The male grows much more slowly than the female. While the female may reach lengths over 22 inches the male seldom exceeds 16 inches. Spawning occurs during the winter months at depths between 30 and 40 fathoms. Females of average size produce about 1,000,000 eggs while very large fish will produce in excess of 2,000,000 eggs. The eggs when spawned are free-floating and are carried by currents into shallow water along sandy beaches, where within a month or two the young transform into side-swimming, bottom dwelling creatures like their parents. The lemon sole feeds almost exclusively on clams, worms and brittle stars.

The rock sole (*Lepidopsetta bilineata*) is one of the most abundant flatfish in shallow water on the British Columbia coast. It has a rough scaly

skin and inhabits hard sandy bottoms in shallow depths down to 25 or 30 fathoms. The average annual Canadian catch during the years 1960-65 was just over 3 million pounds and the main fisheries took place in Hecate Strait and Queen Charlotte Sound. Sizes and ages are very much the same as in the lemon sole, the average length being about 14 inches and the average age being about five or six years. Main spawning grounds have not been located but the adults are believed to spawn in the late winter or early spring months. The egg of the rock sole is apparently heavier than sea water and for a short while at least adheres to the bottom. Young rock sole (less than 12 inches in length) favour a diet composed mainly of sea worms while adults feed chiefly on sand lance.



Rock sole (Lepidopsetta bilineata)

The turbot or arrowtooth flounder (*Atheresthes stomias*) is the largest of the four main species.



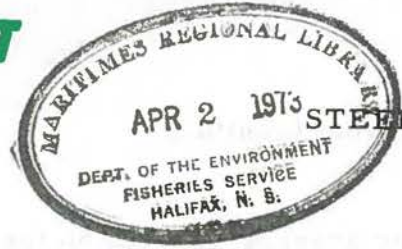
*Turbot or Arrowtooth flounder
(Atheresthes stomias)*

Like the brill it is a large-mouthed fish eater once it has grown past the juvenile stage. Individuals as large as 32 inches in length have been captured but average length in catches is considerably less and varies depending on area of capture. Nothing is known of the spawning habits but it does inhabit water deeper than the rock or lemon sole. This species is commonly encountered by trawl fishermen but appears most abundant on grounds off the lower west coast and the northern tip of Vancouver Island. The turbot is found in greatest abundance in water deeper than 50 fathoms. Annual landings which are used exclusively for animal food have reached 7 million pounds and in the period 1960-64 averaged 2.9 million pounds.

All four species are common along the British Columbia coast and range from California to Alaska.

Canadian and United States fishermen take these species with otter trawl nets at depths of 15 to 200 fathoms on sandy to muddy bottoms. (Prepared by the Nanaimo Biological Station of the Fisheries Research Board of Canada).

FISHERIES FACT SHEET



STEELHEAD TROUT

Distribution and Importance

The west coast has no native stocks of the "true" or "Atlantic" salmon and the sportsman finds no satisfactory freshwater substitute in the various species to which the name "Pacific salmon" has been given. Instead, he turns to the Steelhead (*Salmo gairdneri*) which gives him the fighting qualities of the celebrated eastern fish and which can be found in small or large numbers in nearly all of the west coast salmon streams.



Although it does not grow as large as the weightiest Atlantic salmon it is still a big fish and is often more ready to accept a lure than its eastern cousin. Moreover, steelhead fishing is especially, although not exclusively, a winter sport and provides the angler with an opportunity to practise his art at a time of year when the smaller trout are protected by a closed season.

The steelhead also contributes to the commercial catch, a few thousand cases being canned each year. This quantity of course does not compare with the landings of Pacific salmon and the fame of the species rests mainly on its sporting qualities.

Description

The steelhead very closely resembles the Atlantic salmon in structure and appearance but is usually rather more heavily spotted. It differs from the Pacific salmon in having a shorter anal fin, containing less than 12 supporting rays. When in the sea, the body is mainly silvery, with a blue back. At spawning time a band of red colour develops along each side of the body. The steelhead is a sea-going "race" or "form" of rainbow trout, the latter term being applied to fish which spend their whole lives in fresh water. Steelhead and rainbow trout can be distinguished from cutthroat trout (which occur in the same region) by the shorter head, the absence of a red dash under the lower

(over)

Steelhead trout (cont'd.)

jaw and the absence of teeth on the back of the tongue.

Mature steelheads commonly average eight or nine pounds in weight but occasionally reach 20 pounds and individuals up to 36 pounds have been recorded.

As swimmers and jumpers, steelheads are at least equal to any of the species of Pacific salmon.

Life History

Steelheads spawn in winter or spring in streams large or small. They may enter fresh water shortly before the eggs are deposited or they may arrive weeks or months ahead of the spawning act. In a given water-course the runs usually follow an established pattern from year to year. "winter runs", "spring runs", and "summer runs" can sometimes be distinguished.

After spawning, many adult fish go back to the sea and some, although usually not a high proportion, return to fresh water after recuperation, to spawn a second time (Pacific salmon do not spawn more than once). Females survive more often than males.

The young fish live for one or two (occasionally three) full years in fresh water before travelling to sea as smolts of from four to 10 inches in length. This migration takes place in spring. Usually two or more summers are spent in the ocean before the fish seek the spawning streams. Most spawning fish are four or five years old. The age of a fish, the number of years spent in fresh or salt water and the indications of any previous spawning operation can generally be found by microscopical examination of the scales.

Methods of Catching

Most of the commercially-caught steelheads are taken by gill-nets in or near the mouths of the larger rivers. Freshwater anglers get two chances during the life history of the species. Some of the young fish are of legal size before going to sea and are caught as "trout". Steelhead fishing proper concerns the large fish which have returned from salt water. These are caught by spinner, bait or fly.

The commercial catch is mainly canned. The fish caught by sportsmen cannot legally be sold.

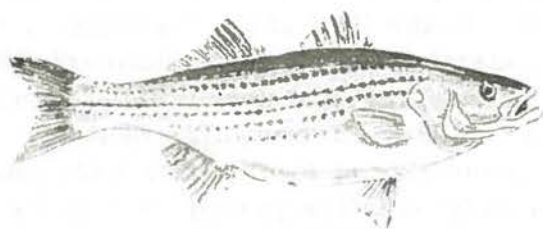


28532

Distribution and Importance

The striped bass, scientific name Roccus saxatilis, belongs to the sea bass family Serranidae, which includes the perch-like fishes found in salt water. Other common names for the striped bass are rockfish, rock or squid hound.

The striped bass has a wide range along both the Atlantic and Pacific coasts of North America and enters fresh water to spawn. On



the Atlantic coast it is distributed from the St. Lawrence River to northern Florida and in the Gulf of Mexico from Florida to Louisiana. Introduced in the Pacific Ocean in the last quarter of the 19th Century it now occurs from southern California to British Columbia. The striped bass is one of the most valuable anadromous and coastwise fishes found on the coasts of North America, especially in the areas from North Carolina to Maine.

The striped bass is important to both commercial and sporting interests. The commercial catch in Chesapeake Bay, which is the centre of the fishery along the Atlantic coast of the United States, was over 1,300,000 pounds in 1935. In these same waters it is estimated that there are 200,000 anglers each year.

Description

The general outline and colour, arrangement of the fins and their structure, are characteristic of the striped bass. Its sides are barred with seven or eight narrow, black, longitudinal stripes from which the fish takes its name.

The colour varies from dark olive-green to blue on the back, paling on the sides and silver on the belly.

(over)

Striped Bass (Cont'd.)

The fish is moderately elongate, stout, its back scarcely arched but sway-bellied, with a long head, oblique mouth gaping back to the eye and a projecting lower jaw. The two back fins are distinctly separate, the first being spiny and the second soft-rayed.

The striped bass grows to a great size; the heaviest, 125 pounds, was recorded in North Carolina in 1891. The usual run of fish range in weight from three to 70 pounds. A striped bass three feet long weighs about 18 pounds.

Occurrence in Canadian Waters

Unfortunately there is comparatively little information available on the striped bass in Canadian waters. In the Gulf of St. Lawrence, especially in the rivers, estuaries and coastal waters of Northumberland and Kent Counties, landings were as high as 123,300 pounds in 1917 but had declined to almost nothing by 1935. In Nova Scotia, Colchester, Hants, Annapolis and Digby Counties of the Bay of Fundy have had combined landings which have fluctuated widely over the period 1917 to 1951 from 48,400 pounds in 1918 to 2,200 pounds in 1920, then to a recent peak of 30,400 pounds in 1943. In this area the Shubenacadie and Annapolis River systems support a consistent though varying spawning run of this species. In 1918 Antigonish County reported a peak landing of 41,500 pounds. Catches declined steadily to nil in 1929 and no fish have been reported caught over the period 1929 to 1946.

Such violent fluctuations in abundance of striped bass suggests that there are good and bad brood years for spawning and survival. The increased numbers of the 1947 brood of striped bass in the Miramichi River of New Brunswick would seem to indicate that 1947 was a particularly good year for bass in the Miramichi area and perhaps in other parts of the Gulf of St. Lawrence and in the Bay of Fundy area.

Habits and Movements

Young striped bass wander in the rivers and in the brackish waters, feeding and growing rapidly until they are nearly two years old. Then, contrary to former belief, they tend to form large schools and may migrate over considerable distances. Tagging of fish along the Atlantic coast of the United States has indicated that there are several different stocks of striped bass which move northward and eastward from wintering areas such as Chesapeake Bay. Although

Striped Bass (Cont'd.)

there is no proof, this presents the possibility that the Bay of Fundy stocks may be joined each year by numbers which have moved in from areas to the south. In Canadian waters, striped bass are known to winter in the tidal portion of the Saint John and St. Lawrence Rivers and possibly in the Miramichi and Shubenacadie Rivers.

Movements are into the fresh and brackish waters in the spring or early summer from the coastal waters with a movement towards brackish or salt water taking place in the late summer or early fall. Striped bass do not move out to sea in winter as do herring, shad, alewives, and salmon but remain in the river mouths and estuaries, merely retreating to the deeper parts where they are often speared through the ice and netted beneath it, or, if on open coasts, to slightly deeper water. But although more or less sluggish during the cold season, it seems that they do not hibernate but feed when opportunity offer

They chiefly frequent shoal estuaries, particularly on weedy bottom, though some -- especially the large fish -- lie in the surf along sandy beaches or about rocky headlands, islets and ledges, while others again may run up rivers for long distances.

Reproduction and Growth

All male striped bass are mature when they are three years of age and 10 inches or more in length. Females are mature at four to six years of age and 17 to 18 inches in length. They gather about the river mouths in June for spawning, though there is no regular run of them comparable to the runs of salmon, alewives, or shad. They are usually described as anadromous --- that is running up into fresh water to spawn -- which is true in the sense that they always enter some stream and never spawn in the open sea. However, they often spawn in the brackish waters of estuaries and the tidal portions of rivers. Striped bass spawn late in spring and early in summer, depending on the latitude. Available evidence points to June and July as the height of the season in the Bay of Fundy.

The eggs, about one-twentieth of an inch in diameter, are semi-buoyant -- that is, they sink but are swept up from the bottom by the slightest disturbance of the water. This is so prolific a fish that a female of only 12 pounds weight has been known to yield 1,280,000 eggs, while a 75-pound fish probably would produce as many as 10,000,000. The eggs hatch in about 74 hours at a temperature of 58 degrees; in about 48 hours at 67 degrees. By autumn the young fry

Striped Bass (Cont'd.)

in our waters are from two to three inches long. In more southerly waters, where bass commence spawning earlier, the fry may grow to four and one-half inches by October. In Chesapeake Bay, where hatching is in May, fish are four inches long at the end of the first year, nine inches at the beginning of the second winter (one and one-half years of age); 12 to 14 inches at three years; and 16 to 18 inches at four years. Striped bass are certainly long lived for one kept in the New York Aquarium lived to an age of about twenty-three years. Fish from Miramichi River at one to one and one-half pounds were 12 to 15 inches long and in their third year.

Food

The bass is a very voracious fish, preying indiscriminately on small fish of all kinds -- herring, menhaden, shad, smelt and such small fish as launce, mummichogs and silversides being its chief diet in enclosed waters -- and hunting for crabs, shrimps, lobsters, squid, mussels and various other invertebrates along open shores.

Economic Importance

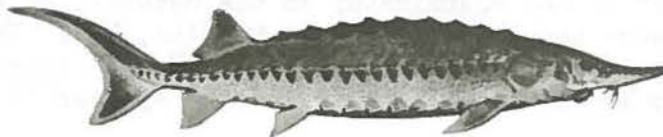
In Eastern Canada the striped bass is of little commercial value because of the small numbers available for a fishery. Bass, however, are caught in gill nets, drop nets, seines, traps and pounds, and are caught about rocks, in the surf, and in estuarine waters on hand lines and with rod and reel. The catch is mainly marketed locally in the fresh state.

FISHERIES FACT SHEET

STURGEON

Importance and Distribution

Four species of sturgeon occur in Canadian waters but only one of them, usually called the Lake sturgeon, is of any considerable commercial importance. The others in our waters are the Common sturgeon, the White



Common Sturgeon
(*Acipenser oxyrinchus*)

sturgeon and the Green. The family name of the four in the scientific registers, is Acipenseridae, and the family goes back a long way in the earth's history. The greater part of Canada's commercial catch of sturgeon comes from the fisheries of Ontario and Manitoba and the freshwater fisheries of Quebec, though a few are taken in the Atlantic sea fisheries, in New Brunswick inland waters, in Saskatchewan, and some in the Fraser River area of British Columbia. The bulk of the catch is made up of Lake sturgeon but the Atlantic landings include Common sturgeon and the British Columbia landings the White.

Sturgeon also occur in United States areas and in some parts of Europe, notably Russia.

Description

It is characteristic of the sturgeon that the body is relatively long, with no true scales but with rows of irregular bony plates (or scutes) on the sides. The snout is elongated, the mouth small and without teeth but capable of being thrust out to suck up food. In front of the mouth are four long feelers or barbels.

The Lake sturgeon is generally dark olive in exterior colouring, with paler or reddish shading on the sides, and is frequently marked by blackish spots. The Green sturgeon, true to name, is olive green, with a few olive stripes. The White is not white at all but dark gray. The Common sturgeon is grayish.

Habits and Movements

In general, sturgeons are large creatures and the Lake variety is the biggest of Canada's purely freshwater fish. On the average, Lake sturgeon weigh about 40 pounds though much heavier specimens are sometimes taken. In length the Lake sturgeon is usually less than six feet

Department of Fisheries and Forestry

Ottawa

but, there are sometimes exceptions to the rule. The White sturgeon, however, which frequents both fresh and salt water may be very much bigger than its lake cousin. For instance, a White taken in the Fraser River, British Columbia, in 1941, measured 11 feet 2 inches from the point of the nose to the tip of the tail and weighed 970 pounds. The largest specimen known weighed approximately 1,800 pounds and was reported in the "British Columbian" of New Westminster in the October 14 issue, 1897, as having been taken some years previously at Mission, B.C. The White sturgeon is undoubtedly a very slow-growing fish. Due to intensive fishing, large specimens are now rarely taken and the species is in danger of extermination.

As already noted, the Lake sturgeon is entirely a freshwater fish but the White and Common varieties are anadromous - that is, they spawn in fresh water but may also be sea-goers though it is perhaps a question whether the White does not sometimes remain permanently in freshwater and whether the Common sturgeon may not sometimes spawn in brackish water. The Green sturgeon, on the other hand, frequents the sea and seldom goes beyond the river mouth.

Fishing Areas and the Fishery

Sturgeon are taken by large-meshed nets, pound-nets and hook-and-line. Most of the landings in Canada however, are made with nets. The fish are bottom-feeders and fishing gear must be set accordingly. Their food consists largely of various bottom creatures but they also eat small fish.

All of Canada's sturgeon landings are marketed fresh or frozen, a large part of them in the United States. Roe of the female fish is used in the production of caviar. The major portion of it is packed in Ontario and the remainder in Manitoba.

28547



Description and Distribution

The common white sucker (Catostomus commersonii) is one of about 16 species of the sucker family found in Canada. This family also includes redhorse, quillback and buffalofish, and at least one member is found in all fresh waters from Labrador to British Columbia.



Sucker

(Catostomus commersonii)

the first call of spring. Most of the species of suckers are distinguished on the basis of divisions of the air-bladder, on differences in their lateral lines, lips, and other anatomical features. In the sucker family there are no spiny fin rays, adipose fins, nor teeth on the jaws.

Buffalofish, native of some waters of the western plains, have a very long dorsal fin with many rays; the quillback also has a similar dorsal fin, the first rays of which form a long point equal in length to the base of the fin. The remainder of the family have more rounded bodies and the typical sucker mouth familiar to all small boys who go fishing with

Life History and Habits

The end of winter, with melting of ice and snow and increased stream flow, is the signal for the sucker run. Crowding into rivers and creeks from the lakes below, suckers seek rapids and fast-flowing shallows and in a week of hectic activity spread their eggs by the millions. These eggs sink into crevices among the rocks, lodge in debris and vegetation, and in a few days hatch into small fry which drift down with the current. Schools of young suckers gather at stream mouths, and soon range along lake shores in search of small aquatic organisms and green algae.

Young suckers are a favorite forage fish for the larger predaceous kinds, and their numbers usually become severely decimated under attack. The survivors feed upon bottom insects, shells and vegetation sucked up from shallow, muddy places, and after about three or four years become

(over)

Sucker (Cont'd.)

mature and join in the spring spawning migration. Suckers live in nearly all types of water but thrive in warm, shallow, turbid rivers and lakes.

Commercial Importance

The commercial catch of suckers totals from two to four million pounds, but the value of this catch is low because these fish usually bring the fishermen only from one to three cents per pound. The low price is a reflection of the slack demand arising from the sucker's mediocre table qualities. Many thousands of pounds are taken annually but not listed in the statistical reports because the fish are either not shipped to market or are used locally.

Gill nets take most of the sucker catch but some are caught in dip nets, hoop nets, pound nets and seines.

The Swordfish

By S. N. Tibbo. Fisheries Research Board of Canada,

St. Andrews, N.B.

THE SWORDFISH or broadbill (*Xiphias gladius* L.) is the only member of the family Xiphiidae. It has a long upper jaw and snout forming a flat, sharp-edged sword which may be as much as one-third the total length of the fish. Although there is only one species of swordfish, it is sometimes confused with the marlins and sailfishes (family Istiophoridae) which have short cylindrical bills. The swordfish has a broader bill than the marlins or the sailfishes, and has no pelvic fins. In addition marlins and sailfishes of all sizes possess distinct scales and small teeth whereas only very small swordfish have them.

The upper surface of the swordfish varies in colour from dull blue to purple, dark brown or even black, the belly is dirty white and the flanks bronze. The eyes are deep blue.

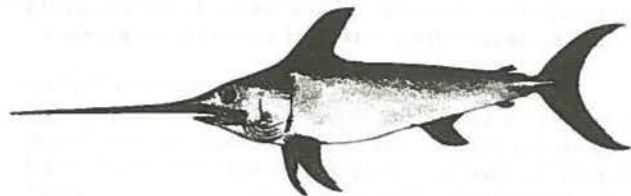
Swordfish grow to a large size. The largest one recorded by a Canadian fisherman was caught off the northern tip of Cape Breton. The dressed weight of this fish was 915 pounds. The world record for rod and reel is 1,182 pounds (live weight) taken on May 7, 1953, off the coast of Chile.

The swordfish is a powerful, fast free-swimming predatory fish of the open seas. It is a warm water fish and is most common where temperatures exceed 60°F. They tend to form schools but even when extremely plentiful individuals are usually 30 to 40 feet apart.

There are numerous records of swordfish piercing the sides and planks of ships. This is usually associated with fishing and occurs most often after a fish has been harpooned. The attack may, therefore, be accidental, as the fish rushes around wildly when it is being hauled.

DISTRIBUTION AND IMPORTANCE

The swordfish is found throughout the tropical and temperate Atlantic; in the Mediterranean; around New Zealand, Hawaii and Japan; and in the east Pacific from Chile to California. On the eastern side of the Atlantic it ranges from Cape Town, South Africa, to the Baltic, the North Sea, and along the coast of Norway to North Cape (71°N Latitude).



Swordfish or Broadbill (*Xiphias gladius* L.)

In the western Atlantic, it ranges from the West Indies to the Grand Banks.

Because of their great size, activity and power, swordfish are highly-prized by the deep sea angler in some parts of the world. However, in recent years, their commercial value has far outweighed their value as game fish. The landed value of the Canadian swordfish catch in 1964 was 3.5 million dollars.

LIFE HISTORY

Migrations: the migratory habits of the swordfish are not thoroughly understood. There are, at present, two plausible explanations for the seasonal occurrence of swordfish off the Canadian coast. One theory is that swordfish migrate to the north and east along the edge of the continental shelf during the summer and return south and west in the autumn. The other is that groups of swordfish migrate from deep water toward the continental shelf in the summer, and then move off to deep water again in the autumn.

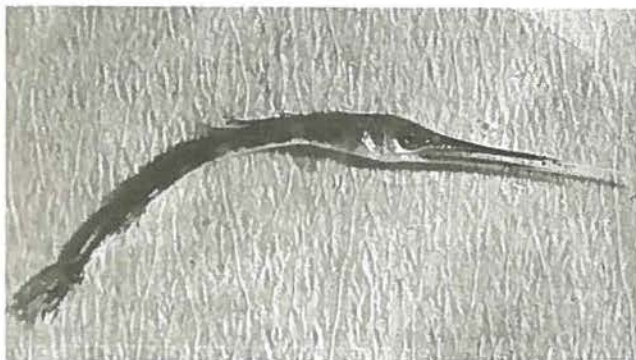
Reproduction: Swordfish spawning has been observed only in the Mediterranean Sea. However, a sufficient number of very small swordfish have been reported from the Gulf Stream off Florida and Cuba to indicate that this area is also a breeding ground. The swordfish egg is round, dimly translucent and buoyant. The mature egg is about 0.07 inch in diameter and hatches in about 2.5 days. In contrast with adults, young swordfish have teeth, scales, and a single continuous fin along the back.

Growth: No satisfactory age-determination method for swordfish has as yet been found and

hence nothing definite is known of its growth rate. In the Mediterranean where it is known best, young fish from 0.5 to 10 pounds taken in the winter and early spring are thought to have been hatched during the previous summer. This would indicate very rapid growth, but the very large size reached by swordfish could just as well be the result of a long life.

Food and feeding habits: In the Northwest Atlantic, swordfish food consists of mackerel, menhaden, silver hake, butterfish, herring, argentine and squid, which are frequently found near the surface. However, it is not unusual for swordfish stomachs to contain deep-sea fishes (redfish, barracudinas, lanternfish, etc.) of one kind or another.

Swordfish stomachs contain some fish that are in excellent condition while others have ugly gashes deep in the flesh. There can hardly be any doubt, therefore, that the swordfish uses its sword to kill some of its food. Near the surface, the swordfish's normal manner of feeding is to strike into the schools of smaller fishes, first disabling them with its sword and then picking up the victims. They do this by suddenly rising from below and sometimes even coming completely out of the water. They then fall back among the fish slashing from side to side with their sword, killing and injuring some of them.

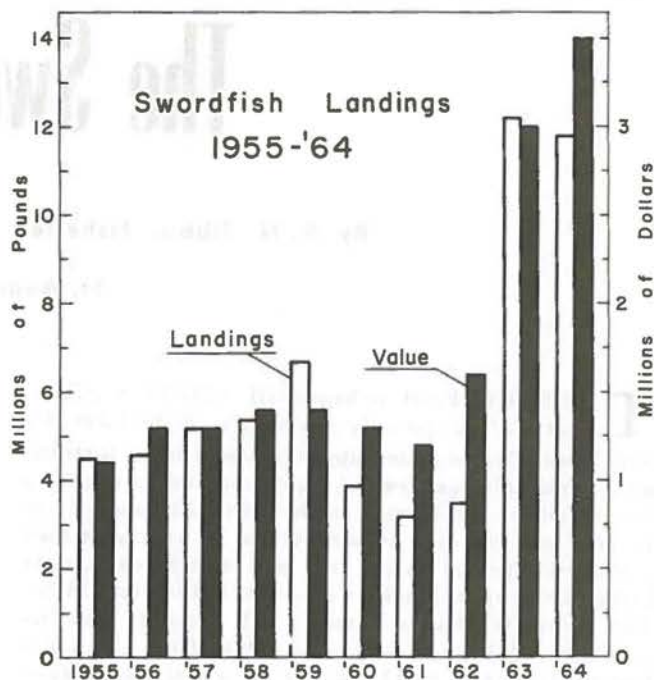


Young Swordfish

Enemies: Known swordfish predators are few. Young swordfish would presumably be preyed upon by any sufficiently large predacious fish. Sperm and killer whales, tuna and large sharks are perhaps the only species capable of making trouble for adult swordfish. Man takes an increasingly larger toll of the swordfish stocks.

THE SWORDFISH FISHERY

Swordfish usually appear in Canadian fishing areas in early June and remain until mid-September. They are captured in both inshore and offshore waters. For inshore fishermen, the main grounds are along the eastern shore of Nova Scotia,



Canadian swordfish landings and values 1955-64.

particularly off the coast of Cape Breton Island. Offshore fishermen venture as far west as Cape Hatteras and as far east as Grand Bank.

In Canada, swordfish apparently were not used for food until the beginning of the 20th century and the first official records of commercial catches date back to only 1909. The fishery developed slowly. Catches reached 2 million pounds for the first time in 1935 and remained at about that level throughout the 1940's. In recent years, there has been a sharp increase in landings. Catches increased from 2.2 million pounds in 1950 to 6.7 million pounds in 1959 and to 12.4 million pounds in 1963. Until 1962 swordfish were taken almost exclusively by harpooning. The recent expansion of the Canadian fishery is due both to the development of an offshore fleet and to the introduction of Japanese-type floating longlines.

Swordfish are not known to surface except in moderate weather. On sunny, calm days, they can be found basking in the sun, or what fishermen call "finning". It is this behaviour upon which the harpoon fishery must rely, each fish being hunted, harpooned, and retrieved as in the whaling industry. The use of the floating longline has eliminated the need for individual sightings and has greatly reduced the time involved in capturing swordfish. Some harpooning is still done during the summer months, but it now accounts for less than 15% of the total number caught.

The chief market for Canadian swordfish is in the United States. Upwards of 90% of the catch is



Boating a large swordfish on the M.V. Jean Frances.



Baiting longline gear.



Swordfish are iced below decks at the end of the day.

exported there. Most of the fish is sold in the fresh state, although some is frozen before shipment. Marketing in the United States is subject to strong competition, partly from U.S. fishermen but chiefly from the Japanese, and it is not known with what success Canadian producers will continue to meet this competition. The domestic market, however, is largely untapped and gains might be made here if an aggressive merchandising policy were developed.

REFERENCE

A much fuller account of the swordfish and an illustrated description of the harpoon fishery is available in Bulletin No. 130 of the Fisheries Research Board of Canada, entitled "The Swordfish (*Xiphias gladius* L.), its life-history and economic importance in the northwest Atlantic" by S. N. Tibbo, L. R. Day and W. F. Doucet.

February, 1966

Distribution and Importance

Steelhead, Kamloops trout and cutthroat trout provide most of the incentive for freshwater fishing in British Columbia. Other species, both native and introduced, contribute at times to the sportsman's creel.

The steelhead (Salmo gairdneri gairdneri) is dealt with in another fact sheet (No. 65).

Kamloops trout (Salmo gairdneri kamloops) occur naturally in the lakes and streams which constitute the upper portions of the Fraser and Columbia river systems, that is to say throughout most of the central and southern parts of the province, except in the coastal areas. In the latter districts the Kamloops trout is replaced by the very similar steelhead, which usually differs from its up-country relative by spending part of its life in the sea. In some coastal lakes and streams, however, there is a type of steelhead which lives permanently in fresh water and is usually called a rainbow trout. This term is sometimes applied also to the young of the sea-going steelhead and even to the Kamloops. Since no hard and fast distinction can be drawn between these three kinds of fish, there is no scientific objection to this wide use of the name. True Kamloops trout have often been introduced into coastal streams and lakes but have usually not flourished except in places where other kinds of trout are not present to compete with them. In their natural habitats, on the other hand, they are the preferred fish of the sportsman and this proud position has not been weakened by the introduction of speckled char in some places.

The cutthroat (Salmo clarki) is a common inhabitant of streams and lakes, large and small, in the coastal areas of British Columbia. Its total distribution extends from northern California to southern Alaska. Many individuals live permanently in fresh water; others spend part of their lives in estuaries or at sea. The species is in high repute among anglers. Certain small, fine-scaled types of cutthroat -- the "Yellowstone" and "Mountain" cutthroats -- provide good fishing in the south-eastern and central parts of the province, far from the habitats of their coastal relatives.

(over)

Trout and Char in British Columbia (cont'd.)

The Dolly Varden char (Salvelinus alpinus malma) is found nearly everywhere, although not always plentifully, from the Queen Charlotte Islands to the Rockies and from the southern to the northern boundaries of British Columbia. Outside these limits, its range extends from California to Alaska and Kamchatka. As a sport fish it is given a second-class rating by those anglers whose standards are based on Kamloops and cutthroat trout.

The range of the Great Lakes char, or lake trout (Cristivomer namaycush) extends from Labrador westward into central and northern British Columbia and Alaska, the preferred habitat being the deeper lakes. The species does not provide a major game fishery in this province, since its haunts are far removed from the main centres of human population and more attractive sport is provided by other fish.

Brown trout (Salmo trutta) and speckled char (Salvelinus fontinalis) have been introduced in several places. The former is established in small numbers in a few Vancouver Island streams, while the speckled char occurs both in Vancouver Island and in certain waters of the southern interior of British Columbia. In their new environment neither species has won wide esteem in comparison with native trout, although the brown does on occasion provide fishing when few native trout are available.

Identification and Size

Identification of trouts and chars is not always easy. Individual fish do not always show all the characteristics commonly used for separating the species. Also, trout and char may resemble closely Pacific salmon which sometimes live in the same waters. They may be distinguished from these by the form and structure of the anal fin, situated just behind the vent. In Pacific salmon this fin is long and is supported by 12 to 19 "rays". In trout and char the fin is shorter and contains only 8 to 12 rays. (Since some of the rays are branched, only the main stems are counted).

All the species dealt with in this sheet are of typical trout-like form and all are commonly called "trout". The "true" trouts, however, can be distinguished from the chars by the presence of black spots on the body and fins and by the distribution of teeth on the vomer, -- a bone at the front end of the roof of the mouth. In the trouts there are teeth on the head and shaft of this bone, in the chars on the head only. The spots on chars are grey, yellow, orange or red, not black.

Trout and Char in British Columbia (cont'd.)

Among the trouts, the cutthroat can usually be distinguished by a red dash along the lower jaw (whence the name) and by the presence of teeth on the back (as well as the front) of the tongue. These teeth can be felt as small prickles by an exploring finger. The species has been known to reach a weight of 17 pounds but in small bodies of water where food resources are limited mature fish may be less than one pound in weight. The largest individuals are usually lake-dwelling rather than sea-run fish.

The Kamloops and brown trouts are not likely to be confused in spite of much seasonal and local variation in appearance. The former is dark green or blue, heavily spotted on the back and upper sides, silvery on lower sides and belly, or (in breeding fish) more uniformly dark with a red band along the side. Paralleling the case of the cutthroat, there is a small, fine-scaled "mountain" version of the Kamloops trout which occurs in small lakes in the Kootenay district. It seldom grows to a length of more than 12 inches whereas the typical mature Kamloops trout may be anywhere from this size up to 36 inches in length and over 50 pounds in weight.

The brown trout has a general brown or golden-brown ground colour and some of the dark spots, including those below the lateral line, are edged with orange, pink or red. On Vancouver Island this species sometimes reaches a weight of five pounds.

Among the chars, the Dolly Varden is olive-coloured with many pale or pink spots scattered over the body. A fish weighing 32 pounds has been reported from Idaho but the species does not ordinarily approach such a size.

The speckled char is rather like the Dolly Varden in ground colour and general appearance but has dark wavy markings on the back and dorsal fin and small pale or coloured spots on the sides. In British Columbia it does not reach the large size which it is known to attain in some eastern waters.

The Great Lakes char has a prevailing body colour of grey, green or brown, with many pale (but not coloured) spots on body and fins. The tailfin is deeply forked. A large individual may weigh up to 60 pounds.

Reproduction and Habits

Except in the case of the Great Lakes char, which spawns on reefs or gravel areas of lakes, all the foregoing species usually deposit their

(over)

Trout and Char in British Columbia (cont'd.)

eggs in nests or "redds" in the gravelly bottoms of streams. The chars and brown trout spawn in the autumn, the cutthroat in late winter or early spring and the Kamloops trout in spring, -- which may be as late as June at higher altitudes. The young fish, emerging from the gravel in late spring or early summer, remain in the streams for a shorter or longer period after which, in many instances, they take up residence in a lake. The mature fish move into streams again to spawn. Those fish (that is some cutthroats and some Dolly Varden) which visit the ocean, always return upstream to lay their eggs.

Small trout and char feed largely on insects and crustaceans. With increasing size, a larger percentage of fish is included in the diet. Fish-eating habits are especially developed in Great Lakes char, cutthroats, Dolly Varden and brown trout.

Fishing

There is no significant commercial exploitation in British Columbia of the kinds of game fish discussed above (the steelhead, as recorded in another fact sheet, is fished commercially to some extent in the sea and in lower portions of the largest rivers). Angling, by fly, spoon or bait, is practised enthusiastically by residents and visitors wherever man meets fish.

FISHERIES FACT SHEET

The Trout Hatchery

IN RECENT years there has been increased interest in the development of fish hatching and rearing facilities on private properties. The establishment of such facilities is by no means a simple problem as many variable factors exist in different localities and even in one locality all experienced fish culturists might not recommend the same procedures. Several books have been written on the subject but the following summary may prove of value to the BEGINNER in this field.

WATER SUPPLY

The water should be relatively pure, well aerated, uncontaminated, dependable and neither continuously cold throughout the year nor yet reaching too high a temperature in the summer. Below 50° F. the growth made by young trout is very slow. Temperatures that stay up in the high seventies or low eighties for several days on end are usually lethal - although in this case a flow of large volume passing through the rearing troughs or ponds may materially lessen the damage.

Some commercial hatcheries filter their water supplies, some use artesian bores. Others use a river or lake water supply. Artesian bores have the advantage of a fairly constant temperature, thus enabling the hatchery operator to foretell the dates on which his eggs will be ready for shipping, hatching, etc. However they may be low in oxygen. Stream and lake waters should be used when their introduction into the plant can be obtained by gravity without too great a cost, such as might be entailed through construction of a high dam or a very long pipe line.

Careful examination for possible sources of pollution should be made of surface water (lakes and streams). The most satisfactory water supply is a combination of surface and ground water.

The summer temperature of water supplies obtained from lakes, if of good size and depth, can often be regulated by the use of two pipe lines installed at different depths, one taking water from near the surface, the other obtaining it from a lower, cooler level.

With a flow of water large enough to operate the projected plant assured, a pipe (or pipes) of the required diameter should be installed. At the intake end it should be fitted with a trash rack to keep out logs and heavy debris. Behind this a wire mesh screen should be placed to keep out finer foreign

matter. Rack and screen should be cleaned frequently, even though this entails considerable difficulty when winter ice is thick. The pipe should lie under ground below the frost line and should come up into the hatchery building near the head tank into which it should discharge through an inverted 'U'.

Gate valves should be installed near each end of the pipe line. Through the one at the intake the water may be cut off to effect repairs. The one inside the hatchery permits the regulation of the water supply without having to leave the building, clear heavy snow falls at inlet valve, etc. Wire wound wood stave pipe painted with asphaltum varnish on the outside is preferable to one of iron as it lasts well and does not clog up with rust. Recently developed plastic and other non-corrosive types of pipe are perhaps the most suitable.

The size of the pipe will depend on the available 'head' of your water supply in conjunction with the number of outlets it is intended to use. For each hatching trough, seven gallons a minute should be available, although four gallons per minute will be sufficient during the egg incubation period provided the water supply contains a high percentage of saturation of dissolved oxygen. Do not use more water than necessary especially prior to hatching for large flows often deposit silt or mud on the eggs that necessitate cleaning them, even when at their most delicate stage of development. Once hatched, a much greater flow can safely and beneficially be used. Water temperatures following hatch are usually rising. When regulating the flow it should be kept in mind that warm water contains less oxygen per unit volume at saturation than cold water. For rectangular ponds 100 feet long, 4 or 5 feet wide and 2 to 4 feet deep, 50 gallons per minute should be sufficient. Circular ponds 25 feet in diameter require about 35 gallons per minute normally.

HEAD TROUGH

The head trough is usually made of wood. Its length will depend on how many hatching troughs you have, but it should be about 12 inches wide and 14 inches deep and should be water tight. Molasses gates such as used for molasses or vinegar barrels are screwed into holes in the side of the trough. These 'gates' can be partly opened to regulate the flow into the hatching troughs. An overflow stand-pipe, removable for flushing, should be fitted into the bottom of each head tank so that it will not overflow and cause damage. Each head trough should be painted on the outside with ordinary paint and on the inside with asphaltum varnish.

Department of Fisheries and Forestry

Ottawa

HATCHING TROUGHS

The hatching troughs should be set in groups of three, four or five, side by side, on trestles, so that each trough is fed by a separate molasses gate. Troughs vary in length but a good size is 16 feet long overall, $10\frac{1}{2}$ inches wide inside and $6\frac{1}{2}$ inches deep inside. They should be installed with a pitch of about one inch to provide proper drainage. Troughs, formerly made of wood, are now frequently made of fiberglass or some other synthetic material.

HATCHING TRAYS

Zinc or tin trays with perforated bottoms and ends are fitted into these troughs and rest on strips $\frac{1}{2}$ inch x $\frac{3}{4}$ inch tacked inside along bottom of trough to hold tray off the bottom and facilitate aeration of the eggs. Each tray is $11\frac{1}{2}$ inches x $9\frac{3}{4}$ inches and $\frac{7}{8}$ inches deep and is painted with asphaltum varnish. A tray should hold roughly some 4,000 or more trout eggs. Trout eggs vary tremendously in size - roughly from 235 to 720 per ounce. Not more than one layer of the smaller nor more than $1\frac{1}{2}$ layers of the larger sizes should be laid down on a 10 x 14 tray. If more than one layer of trays is used, the trays in each successive layer should be lapped back one inch from the tray immediately under it. When troughs are loaded with more than three layers or trays, good aeration can be insured by lapping each tray about 1 inch from the tray below it and turning alternate stacks of trays thus lapped in opposite directions so far as the trough will permit. This method is generally accepted as providing better water circulation than can be obtained by placing baffles between each stack, thus forcing the water to flow upwards through one stack and downwards through the next.

CAPACITY OF TROUGH

There is really no definite number of eggs that can be carried in the egg stage but care has to be taken not to lay down too many as when the eggs hatch they have to be thinned out to prevent the fry from smothering. About 60,000 fry to the trough is enough at time of hatch but this number has to be severely reduced as the fry grow. For summer rearing 1,000 fry per trough is enough.

TROUGH FITTINGS

Bright sunlight is detrimental to eggs or fry so light opaque covers should be made to afford shade for the troughs. If fry bunch or crowd, they are easily spread by 'riffing'. To do this a thin board just long enough to clear the inner walls of the trough when held at right angles to them, is fixed to a movable crosspiece that rides the top of the walls. The board should extend to within one inch of the bottom. By moving this board or riffle with or against the current and over the crowded fish, they will be dispersed in the opposite direction without

injury. The trough should have a hole bored in the bottom at the lower end to provide for emptying. The hole can be fitted with a plug when the trough is in use. Another hole fitted with a spout should be made in the end of the trough to carry off water flowage and any dirt or mud that may find its way into the trough. Once the eggs hatch, they are turned off the trays and the fry allowed to roam at will along the bottom of the trough. Screens should be provided at the lower end to prevent fry from being drawn out by the current.

EGG PICKING

Eggs when first taken are tender and should not be disturbed any more than necessary. All dead and infertile eggs should be picked out and destroyed before they form places for growth of fungi which will spread and smother good eggs. While most dead eggs become opaque or quite white, infertile eggs may assume a glassy appearance with a well defined and complete ring showing clearly through the skin. Once the eggs become eyed, that is when the dark eye spots are visible through the shell, they are fairly hardy and can be picked freely or moved as necessary. However, avoid sudden jars and keep the eggs in circulating water if possible at all times. If the water supply fails, the trays should be removed from the trough and stacked in a cool location under a top tray covered with moss through which the stack should be watered at least twice daily. If snow is available, it may not be necessary to remove the trays from the trough. In this case the trough should be drained, the trays in each stack disposed evenly with an empty tray on top. Snow is then packed lightly around the stacks and placed on each top tray. Care must be taken to see that the eggs are never exposed to frost.

FOOT TROUGHS

Foot troughs can be made in any convenient size and are used to catch the overflow from the hatching troughs. They may also serve as salvage basins should any fry escape from the hatching troughs. They are fitted with overflows which drain off into the floor gutters.

REARING

Each fry when it hatches has attached to its under part a yolk sac on which the young fry subsists until its mouth parts are formed. When the sac is about half absorbed it is well to offer the fry a little very finely ground food. In this stage best results are generally obtained from use of finely ground raw beef liver or fine dry fish food. As the fry grow other foods can be offered such as minced beef heart, ground pork liver, melts or spleen and

coarser dry food. Dry feeds now available contain properly balanced diet but may be supplemented with ground liver.

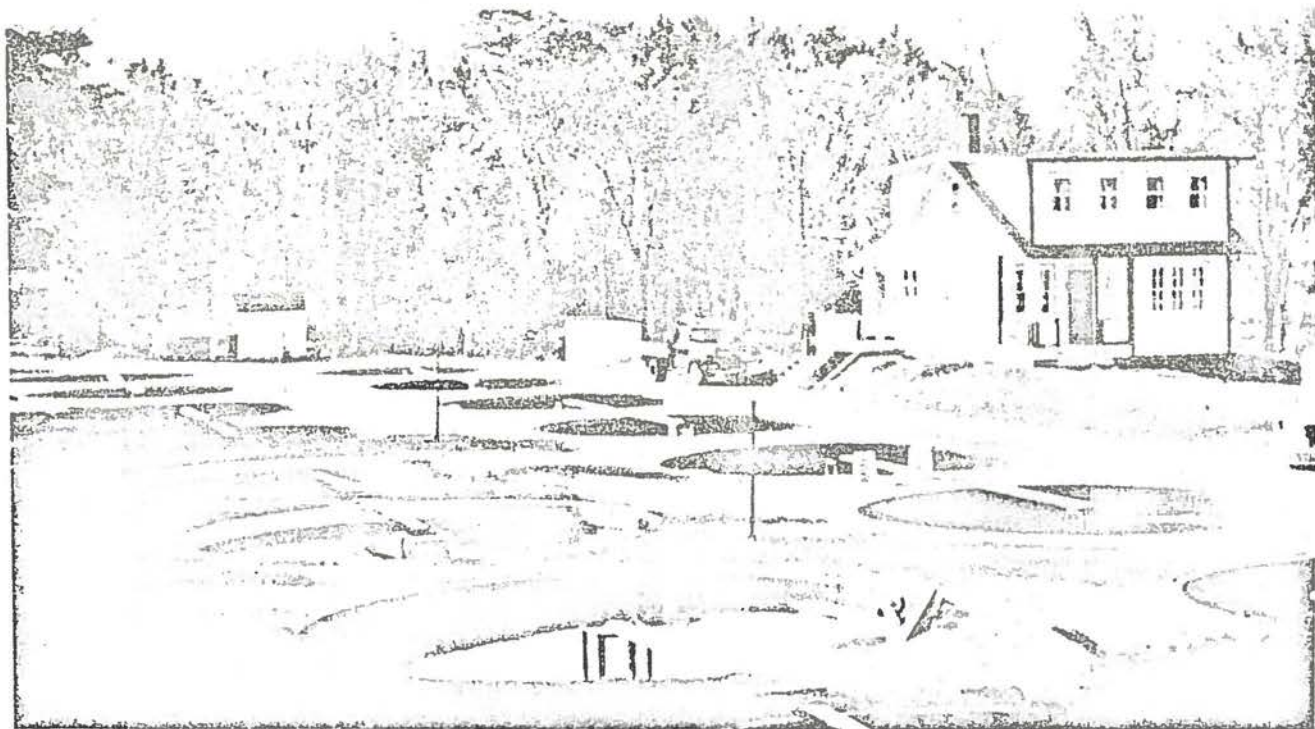
One point to keep in mind is that the food has to be ground or reduced in size sufficiently at all times so the fish will be able to take it. Later, ground fish can be fed, but do not use too much of this as the stock requires an animal meat product regularly to keep it healthy.

As mentioned above about 1,000 fry can be reared per trough as a rule, but if the water becomes very warm it may be necessary to reduce this number per trough. Better results can usually be obtained by rearing in ponds of which there are two general types: the circular and the long. Good dimensions for circular ponds are 25 feet diameter by 3 feet depth at centre sloping up to 1 foot at curb wall. These ponds usually have cement bottoms and sides. Water, controlled by a valve, enters the pond near the edge and is directed so as to establish a circular motion in the pond. It drains through an outlet at the centre of the pond. This outlet is surrounded by a framework holding screens on each of its four sides. The vertical stand pipe in the centre of the pond is usually of the sleeve type - that is it consists of two pipes that slide one inside the other. In this manner the water level in the pond can be maintained at any depth desired. About 50,000 small fingerlings can be assigned to each pond. Water flow per pond should be enough to create a definite movement of the water in a circular direction. A flow of 15 to 35 gallons per minute is

sufficient for a pond of this size. It should be regulated to suit the size, condition and number of fish carried.

The long pond is rectangular and usually built of cement. It may be 50, 100 or more feet long, 4 or 5 feet wide and 2 to 4 feet deep. The water enters one end and flows out a spillway at the other end. A wire mesh screen is needed at each end to prevent the escape of fish. A water flow of 50 gallons per minute should be sufficient under normal conditions. The long pond being slightly deeper is more suitable for keeping the fish through the winter than is the circular. The 100-foot long pond should carry 100,000 small fish. This number should be sharply reduced as the fish increase in size. Generally a 25 foot circular pond will carry as many fish as a 100 x 4 foot rectangular pond.

Feed young fry six times a day gradually reducing the number of feedings to one a day as the fish grow. Do not feed more than the fish will clean up in a 15 minute period. Excess food only sinks to bottom, fouls the water and is a direct waste. Ponds should be partly covered to provide shade and protection for the fingerlings. For the long ponds an inverted 'V' type shade is good. This consists of a framework covered with painted canvas. It is light and allows plenty of air to reach the water below. For circular ponds a shade of laths set on edge, spaced one lath apart, and nailed to a triangular section of framing is satisfactory. These shades can be made in sections to facilitate movement and are supported above the water. From 1/3 to 1/2 of



Hatching ponds at the federal Department of Fisheries' hatchery at Coldbrook, Nova Scotia.

the pond should be provided with shade.

DISEASE

The commonest remedy for trout diseases is the salt bath which consists of immersing the fish in a three per cent salt solution for a short time. Remove to fresh water again if fish show signs of distress. There are also a number of antibiotics suitable for treating the various diseases common to trout.

While fungus and certain external parasites may be removed by bathing affected fish in a 3 per cent salt solution, this treatment is valueless as a remedy for diseases caused by internal parasites and bacteria. Treatments for these are diverse and complex, but are well described in a book entitled "Culture and Diseases of Game Fishes" by H. S. Davis, and published by the University of California Press, Berkeley and Los Angeles, California, U. S. A.

HATCHERY BUILDING

The size of the hatchery building will depend on the number of troughs used. Provide a large refrigerator or some refrigerating unit to keep fish food fresh as fish do not relish food that is tainted or

partly spoiled. Provide a food grinder, and keep it and the feeding utensils clean. Speckled trout fry fed and cared for should grow 5, 6, or 7 inches by late fall.

NOTE -

For further details on the subject the reader is referred to such books as -

1. Culture and Diseases of Game Fishes - by H. S. Davis.
2. Habits and Rearing methods of Quebec Trout.
Louis-Roche Sequin.
(Quebec Department of Tourism, Hunting and Fishing)
3. Construction and Management of Ponds in Ontario
(Ontario Department of Agriculture)
4. Trout in Farm and Ranch Ponds.
Farmer's Bulletin No. 2154 U. S.
Department of Agriculture.

FISHERIES FACT SHEET

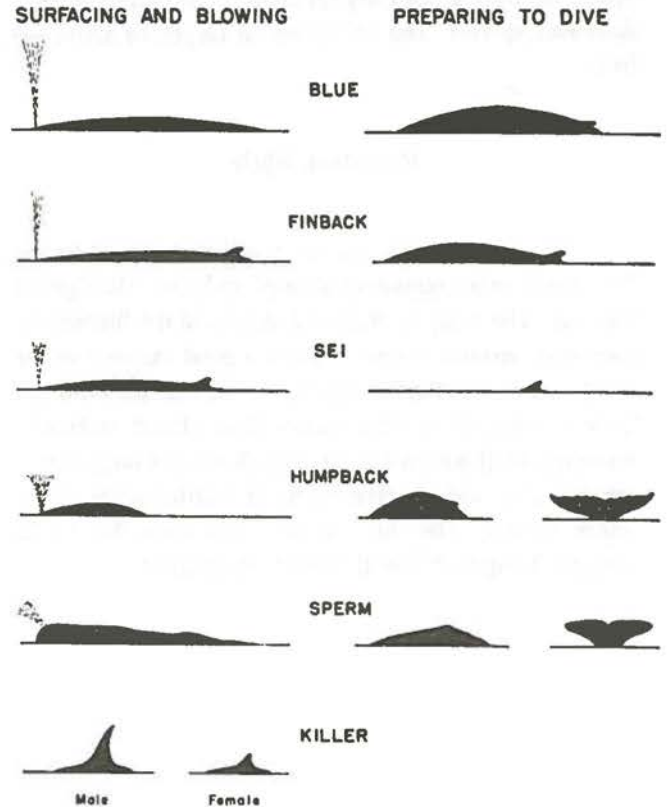
WHALES

Identification of Species on British Columbia Coast

The species most common off the British Columbia coast are the blue whale, finback, sei, humpback and sperm. The killer whale is actually a member of the dolphin family, but is often confused with these larger species. Each of these animals conforms to the habit of making a series of shallow dives followed by one of longer duration. The moisture-charged breath is ejected between the shallow dives when the animal "blows." Body form and size, duration of dive, form of the blow and attitude of the body when diving, are all useful characteristics for identification. Differences in the blow are usually difficult to detect as atmospheric conditions alter the permanency of the effect. The shape of the fin and form of the body when diving are probably the most useful identifying features. The characteristics outlined in the following descriptions and accompanying diagrams are brief and must be qualified as only representative of the many and diverse habits of these animals.

Blue Whale

The largest of all the whales, ranging in size to about 100 feet, the blue whale has a very small fin placed far back on the body. Like its close relatives the finback



and the sei, the blue has a high, narrow and vertical blow. The deep blue back is arched slightly and the small fin clearly seen when the animal commences the dive. Sometimes the flukes are thrown clear of the surface. Blue whales are not often observed close to shore and are usually seen singly or in pairs.

Finback Whale

The finback is characterized by an acutely-ridged, bluish-grey back and the distinctive fin outlined in the diagram. The flukes are not normally exposed in diving. It occurs usually many miles offshore and often in schools. The animal attains a length of 85 feet, but lengths greater than 65 feet are not common in these waters. The dive usually lasts four to 15 minutes following four to eight shallow dives.

Sei Whale

When surfacing, the snout is the first part to appear. This is followed by the bluish-black coloured back and a large distinctive falcate fin. The blow is narrower and not so high as in the two larger relatives of the sei. Before

Department of Fisheries and Forestry

Ottawa

diving, the back is not rounded up as in the two previously described species. The sei ranges in length to about 60 feet.

Humpback Whale

The humpback is the most common visitor to the B.C. coast, often remaining in bays and inlets throughout the year. The body is short and stout and the flippers are long with serrated edges. There is a great variance in the number and duration of the blows. On the last blow the back is humped and the animal dives almost vertically, throwing its flukes in the air. The flukes are large with a serrated edge and are often white or mottled white on the under surface. The dive usually lasts from five to 20 minutes. Lengths of about 50 feet are attained.

Sperm Whale

The sperm is markedly different from the other commercial species in having teeth and a single blowhole on the left side of a large box-like head. Following a dive, which may last as long as an hour, the sperm makes about 40 blows over a period of 20 to 30 minutes. The blow is distinctive in being directed obliquely forward. When about to dive, the grey coloured back is rounded to show a low dorsal hump, the tail is thrown in the air, and the animal submerges vertically. Lengths of 60 feet are attained.

Killer Whale

These animals are frequently seen in inside waters in large schools throughout the year. The bulls attain a length of about 30 feet and are distinguished from the smaller females by the distinctive high pointed fin.

Worms for Fish Bait

In Ontario there are about a dozen species of the larger, more obvious earthworms. Of these, two kinds are used commonly as fish bait. One is the dew worm (night-crawler) which is 6-10 inches long when mature. It is abundant in good well-drained turf. Since it burrows deeply in the soil when the surface becomes dry, it is available chiefly in the spring and fall after rains. The other species is the manure worm (also known by many other names including "hybrid" worm). In nature it is found in masses of rotting organic matter such as manure or compost.

The dew worm seems to be preferred by fishermen. It is obtained by collecting at night on lawns, parks and golf courses. Golf clubs in many cases will rent the worm harvesting rights. The collecting aids are simple: a bucket and a flashlight covered with a red filter. If the worms are to be held in storage for some time, the night's collection should be sorted. Injured or sickly specimens should be discarded. The further steps are listed below.

The cultivation of dew worms — As far as we know, all dew worms sold for bait in Ontario are collected since this is cheaper and less troublesome than rearing. It is, however, possible to breed them. Dew worms thrive in damp organic soil that is slightly alkaline and in the temperature range of 40° — 60°F. Those persons planning to develop this as a business enterprise should start it on a small scale, say of one or two boxes in order to master the technique before investing in it heavily.

Box: the dimensions should be approximately 20" x 14" x 6" so that the filled box may be lifted readily. Cedar or any other resistant wood may be used. Several small drainage holes should be made in the bottom and covered with plastic or aluminum fly screening.

Culture medium —	loam	3 parts
	cattle or horse manure	1 part
*	peat moss or sphagnum	6 parts
	fine sand	sprinkle

* If you live near a bog lake you should be able to obtain rotted sphagnum moss. Otherwise you can purchase

it in the form of baled peat from a nurseryman. Each of the above-mentioned materials should be air dried. After crumbling and mixing these ingredients, add water equal to 1/3 of the total weight. The pH ("acidity") should be slightly over 7: if it is too low, try adding a handful of hydrated lime and thoroughly incorporate this into the mixture.

Stocking — a box of the size described above should be filled to a depth of five inches with the culture medium and stocked with 100 healthy worms. Cover the surface with damp sacking.

Maintenance — if there are several boxes they may be stacked as long as dividers are alternated with boxes. There may be difficulty during the summer of keeping the boxes cool enough (40° — 60°F). If it is available to you, use an old-fashioned deep cool cellar or root cellar. Otherwise, use a well shaded spot if you must keep them out-of-doors. In order to feed the worms, occasionally put small pieces of air-dried manure or rotted compost on the soil surface of the boxes. Maintain the soil moisture at approximately 33% water content, that is, quite damp but not dripping wet. Every three weeks dump out the contents of the boxes on a bench, remove any diseased worms, break up any lumps of culture medium, mix again, bring to the right moisture content and replace in the boxes. At such times you may observe the presence of the egg capsules of the dew worm. They are 1/4" long, brownish-yellow and lemon shaped. Every six months, separate out the worms, discard the old medium and replace it with a new batch having the same composition as before.

Shipping and retailing — the best worms for angling are scoured. To do this keep the mature worms in damp rotten sphagnum or peat for two or three days before selling or shipping. The old method of packing was to place 50 or 100 worms in damp sphagnum moss in a small burlap-covered wooden box. Now some Ontario dealers are packing 50 worms with damp sphagnum in a plastic ice-cream carton and selling them from refrigerated vending machines. Whether the worms are going to be shipped elsewhere or held for sale locally the problem is the same. Healthy worms must be selected and kept under

cool (40° – 60°F) damp conditions.

Note: 1. To sum up: in order to rear dew worms you must control three main variables: temperature 40° – 60°F, pH, 7-8 and water content, about 33%.

2. Don't expect rapid returns. Conditions are too variable for us to estimate the average rate of increase. Remember about 5 months are required for a worm to reach maturity after hatching from the egg capsule.

3. The manure worm described above is easier to breed under artificial conditions because it can endure higher temperatures. It seems to be less favoured for angling presumably because it has a repulsive smell or taste to the fish. If you wish to rear it, follow the directions given above for the dew worm. You will, however, have more latitude in temperature. The manure worm can thrive in temperatures as high as 75°F. Other factors – soil moisture, food, etc., are the same for the manure worm.

4. Worms and soil improvement. Earthworms, as well as a host of smaller organisms, play a part in soil

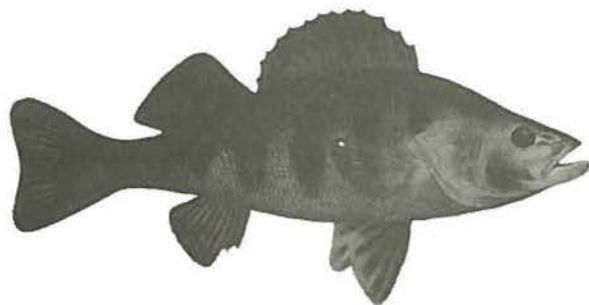
formation and, in general, large populations of worms are found only in good soils. Unfortunately there is no large scale method known of converting a poor soil into a good soil by the addition of earthworms alone. If you have a soil problem seek advice from the Agricultural Representative of your county.

5. Enchytraeid worms are whitish thread-like worms having a length of approximately one inch. They are used as food for tropical fish. They may be found in nature in damp organic soils and in the lower part of compost heaps. They may be purchased from pet shops or they may be cultured indoors. Use a box that is one foot square in area and 6" deep. In to this box place to a depth of 3 or 4 inches a mixture of peat and rotted leaf mold, that is damp but not wet. Punch some holes in the surface and into each of these introduce a few enchytraeids. Cover with a glass lid. Once a week add about a tea-spoonful of oatmeal or bread soaked in milk, or of mashed potatoes. Maintain at a temperature of 55°F – 65°F.

Dr. J.G. Oughton,
Department of Zoology,
University of Guelph,
Guelph, Ont.

Description and Distribution

Yellow perch (Perca flavescens) are typical spiny-rayed fish, with two dorsal fins -- one with spiny rays and one with soft rays. They are yellowish, with vertical bars of darker colour. Their size is relatively small, and in most places they average less than one-half pound in weight.



Yellow Perch
(Perca flavescens)

They are found in lakes, ponds and quiet streams, across the northern United States east of the Rocky Mountains, and in southern Canada from Nova Scotia through the Great Lakes basin, and northwest as far as Lesser Slave Lake.

Life History

The adults spawn in the spring. The eggs adhere in long ribbon-like masses which are generally deposited on the bottom, or occasionally on aquatic vegetation. The fry hatch in from two to three weeks. Generally they mature when too small to be useful as human food, and relatively few grow big enough to be so used. Growth rate varies with local conditions.

Their diet includes small fish, crustaceans, insect larvae and molluscs, depending, of course, on what is available.

How Taken

About three million pounds of perch are taken annually by commercial fishermen, mainly in gill nets and pound nets, although some are taken in other gear incidental to fisheries for other species. Perch are the delight of many anglers, young and old alike.

No. 46

FISHERIES PHOTOGRAPHS

CLAM FISHING
(Captions on reverse side)



50668



47831



50673



50756



50767



50744

CAPTIONS FOR CLAM PHOTOGRAPHS

- 50668 -- Clams, considered one of the very best sea foods available, are shown here in their burrows in a beach at St. Andrews, N. B.
- 47831 -- A digger seeking out the clams which, when covered by the tide, feed on microscopic plants and animals.
- 50673 -- Those who have spent some time on the sea-coast probably know the pleasure of a "clam-bake", and of clam-chowder. For a "clam-bake" the clams are usually steamed in sea-weed. Here clams, taken from the beach near St. Andrews, N. B., are being washed.
- 50756 -- A skinner and washer checks the clams which are prepared in a variety of appetizing ways.
- 50767 -- Girls shuck high quality clams which are not only shipped in the live state, but also sold as chowder and soup. The canning of clams, developed in the early part of this century, is now the most important operation in the production of this fishery.
- 50744 -- Nearly all of Canada's production of clams in the shell and as meat is sold in the United States, with the remainder being sold on the domestic market which takes most of the canned product.

FISHERIES PHOTOGRAPHS

HERRING PURSE-SEINING
(Captions on reverse side)



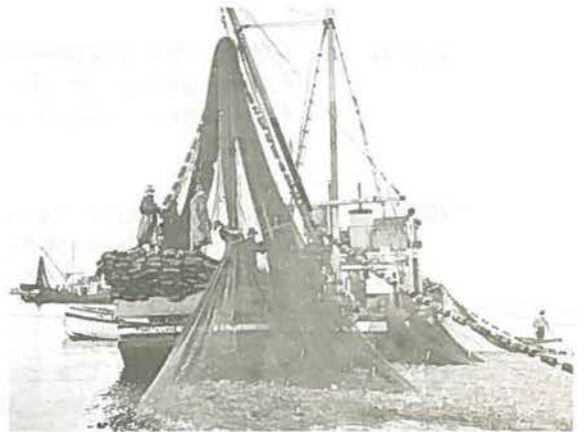
16371



WR2748



16381



16376



WR2751



WR2750

Department of Fisheries and Forestry

Ottawa

CAPTIONS FOR PHOTOGRAPHS OF HERRING PURSE-SEINING

- 16371 --- Purse-seining accounts for the greater part of Canada's Pacific Coast herring catch. Here a seiner sets out for the fishing grounds off British Columbia.
- WR2748--- This familiar scene on the British Columbia coast shows a net churning with herring as the purse-seine is drawn tighter.
- 16381 --- Sometimes the schools of herring are so large that the net of one purse-seiner is not enough to catch the fish. When this occurs, boats co-operate in laying their nets to surround the entire school.
- 16376 --- After the purse-seine strings are tightened, the net is drawn close to the boat. A derrick hoists the net out of the water, where it is refolded on a turntable.
- WR2751--- A power winch operates the brailer or huge scoop used to take the thousands of herring from the net. Gulls hover and swoop down on the catch.
- WR2750--- The last of the herring are thrown into the brimming hold of a fish packer drawn up alongside the purse-seiner. The catch is then rushed to a shore plant for processing, mainly into fish meal and oil.

FISHERIES PHOTOGRAPHS

IRISH MOSS
(Captions on reverse side)



16478



16479A



16481



41150



41156



16482

Department of Fisheries and Forestry

Ottawa

CAPTIONS FOR IRISH MOSS PHOTOGRAPHS

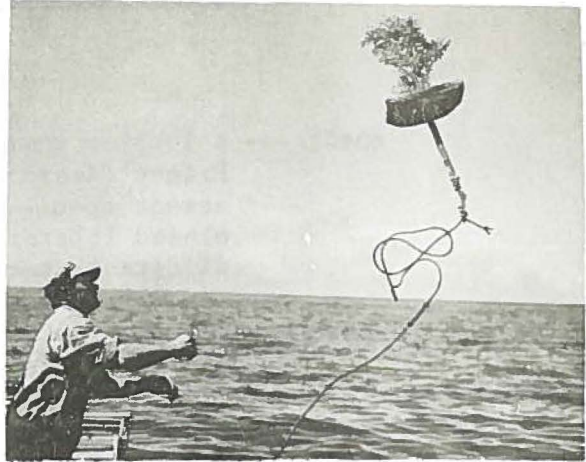
- 16478 --- Irish moss, a multi-use seaweed abundant on parts of the Canadian Atlantic Coast, is primarily used in foods as a stabilizer. In ice-cream it prevents the formation of large ice crystals during freezing and produces a smooth mixture of creamy consistency. It is used as a suspending agent in such drinks as chocolate milk, and also acts as a jellying agent in milk puddings. Irish moss, which is used also in the making of doughnuts, cakes, icings, buttermilk cream, and marshmallows, grows from near low-tide level to a depth of at least 15 feet in some places. Here a boy is raking moss along the shoreline.
- 16479A --- Rakes used for gathering moss have handles from 15 feet to 18 feet in length with teeth about six inches to eight inches long. Where it is plentiful more than 1,000 pounds of fresh moss can be gathered by one man in a day.
- 16481 --- Packing dried moss into sacks for shipment. Moss is sometimes dried on sand, canvas, grass, wire netting and on concrete. However, board surfaces are recommended.
- 41150 --- Irish moss, raked up from the sea, is spread to dry on flakes (wooden racks). Sun bleaching improves the "stabilizing" qualities and usefulness of the seaweed.
- 41156 --- Impurities being removed from Irish moss drying in the sun near Miminegash, P.E.I.
- 16482 --- Bales of compressed moss for shipment weigh from 100 pounds to 150 pounds. The moss may be ground and shipped in bags if satisfactory to the buyer.

FISHERIES PHOTOGRAPHS

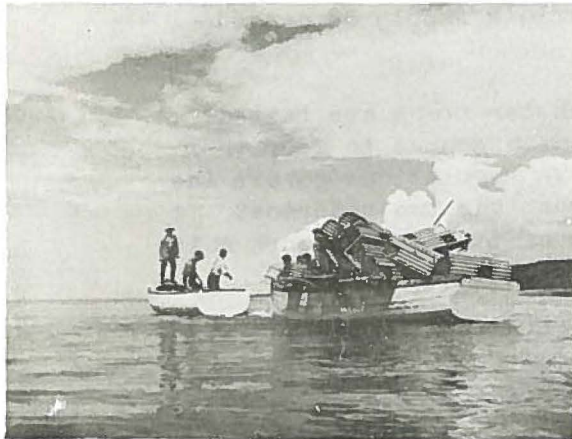
LOBSTER FISHING
(Captions on reverse side)



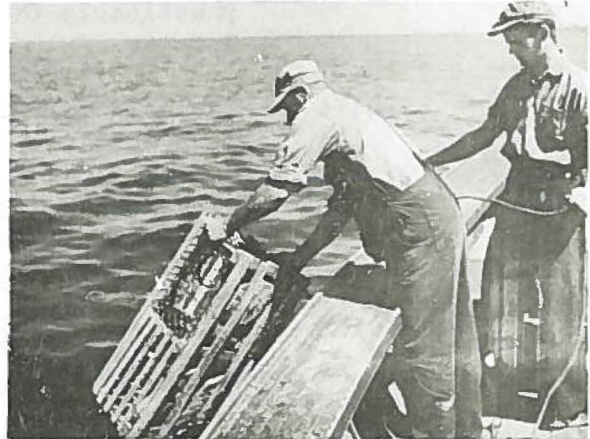
40471



40458



40472



40474



40461



40457

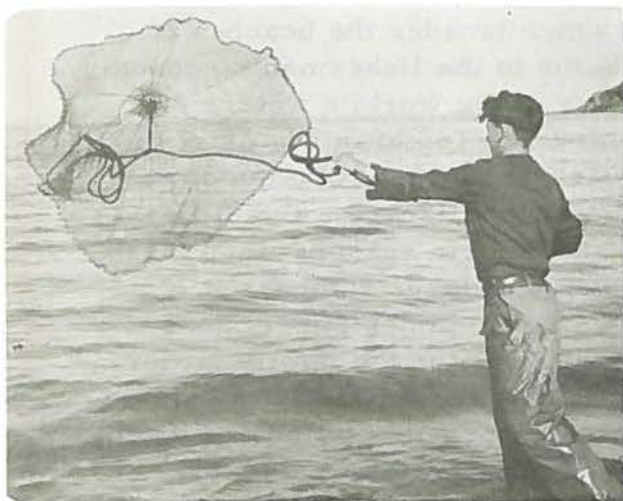
Department of Fisheries and Forestry
Ottawa

CAPTIONS FOR LOBSTER PHOTOGRAPHS

- 40471 --- A lobster boat sets out from Miminegash in Prince Edward Island as the lobster fishing season opens. The length and time of the closed lobster fishing seasons vary in different sections of Canada's East Coast.
- 40458 --- One end of the lobster trap is marked by a pine tree marker before the fisherman lays his traps.
- 40472 --- One of the many boats pursuing Canada's East Coast lobster fishery, which provides practically the world's supply of canned lobster.
- 40474 --- The oblong lath lobster traps are baited then weighed down with stones to keep them on the ocean floor. Regulations govern the size of space between the two undermost laths on each side of the trap through which small size lobsters can escape.
- 40461 --- Lobster traps are tied to a trapline then pushed free of the boat. Almost any kind of fresh or salted fish is used as bait.
- 40457 --- A delicious seafood, the lobster caught in the inshore waters of Canada's East Coast is always in high demand. With the development of air transportation and more efficient refrigeration new and more distant markets are becoming available for both the live product and the chilled meat.

FISHERIES PHOTOGRAPHS

NEWFOUNDLAND CAPLIN
(Captions on reverse side)



R 160



R 158



R 161



R 150



R 153



R 166

Department of Fisheries and Forestry
Ottawa

THE CAPLIN OF NEWFOUNDLAND

The caplin, a small, silver-sided fish which invades the beaches of Newfoundland to spawn, is an all-around contributor to the fisherman's economy in that province. Perhaps no species of fish in any of the world's waters of comparable importance is so casually accepted or taken for granted, as is the humble caplin. They are landed in enormous quantities for a profusion of purposes, the foremost being the caplin's relation to the codfishery. Quantities are frozen and held in cold storage for use by fishermen in seasons when fresh bait is not obtainable from the sea. Where it spawns in large numbers it is an important source of fertilizer for hay and potato crops. In certain sections it is lightly salted and dried to feed dogteams. As an item for the family larder it makes a worthwhile contribution to the diet of thousands of Newfoundlanders, being eaten and enjoyed fresh from the sea, frozen, "corned" (salted and dried) and smoked. The caplin also provides food for salmon, seals, whales and flatfishes as well as sea-birds

Captions for Photographs

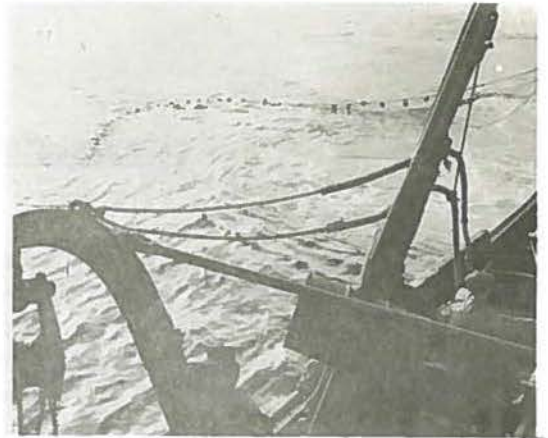
- R-160 - A fisherman throws his casting net from a Newfoundland beach to catch the tiny caplin as they roll ashore with the waves during the spawning season.
- R-158 - Catching caplin with dip nets on a Newfoundland beach. The caplin swarm ashore on waves and are captured in home made equipment.
- R-161 - The pony and cart, boat and casting net have a part in Newfoundland's caplin fishery. The net is used to cast for caplin; the boat comes in handy when the caplin are lying offshore, and the horsedrawn "box-cart" hauls the catch to a central dumping site.
- R-150 - When caplin roll in on the beaches to spawn, fisherfolk in Newfoundland catch them with dipnets at the water's edge, Photo was taken at picturesque Ferryland on the southern shore.
- R-153 - Surrounded by caplin as they swarm to the beach, a young Newfoundland fisherman scoops them up with a dipnet.
- R-166 - Caplin caught on the beaches are stockpiled in one spot for later removal to fields for use as fertilizers,

FISHERIES PHOTOGRAPHS

OTTER-TRAWLING
(Captions on reverse side)



53067



27661



53058



53114



27636



53059

Department of Fisheries and Forestry

Ottawa

CAPTIONS FOR OTTER-TRAWLING PHOTOGRAPHS

- 53067--- Launching an otter door from a fishing trawler on the Grand Bank off Canada's East Coast. Two such iron-shod wooden doors keep open a huge bag-shaped net which is dragged along the ocean floor for cod, haddock, hake and other groundfish.
- 27661--- A trawl-line is brought aboard the otter-trawler preliminary to raising the net, which has been pulled along the ocean floor scooping up the fish in its path.
- 53058--- The trawl-net is hauled aboard until only the cod-end containing the catch is in the water. Here the cod-end is being hauled aboard and the captured fish are spilled into pens on the deck.
- 53114--- Fish caught by an otter-trawler are being cleaned and sorted into pens before being stowed in ice in the hold.
- 27636--- A Nova Scotia otter-trawler hauls up the cod-end of her trawl-net during the night and spills the catch into deck pens.
- 53059--- Fishermen on an "iced-up" otter trawler, operating on the Great Bank of Newfoundland, break away some of the ice on the deck.

FISHERIES PHOTOGRAPHS

OYSTER-FARMING (Captions on reverse side)



41873



41823



41846



41803



41839



41855

CAPTIONS FOR OYSTER-FARMING PHOTOGRAPHS

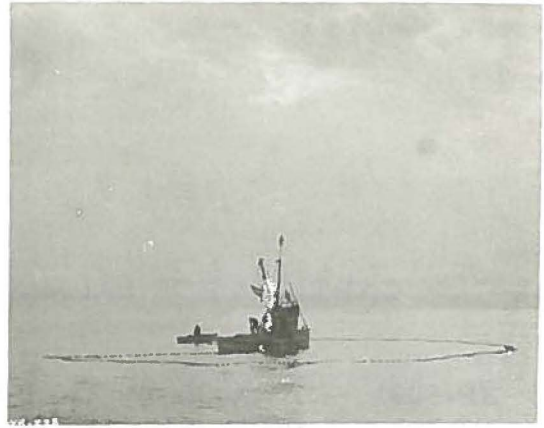
- 41873 --- The cold waters of Canada's Atlantic Coast provinces produce oysters of unexcelled quality. Oyster-farming has been encouraged by the Department of Fisheries of Canada to increase production which falls far short of the demand. Collectors made from cardboard, hardened in concrete, are used to catch the oyster larvae before it settles to the sea bottom.
- 41823 --- Taken from the collectors, the larvae which has become spat (tiny oysters) are placed in large mesh trays to grow. Here a Prince Edward Island fisherman prepares to screen the oysters for size.
- 41846 --- The larger sized oysters from the trays are planted on the oyster beds to grow to marketable size. The smaller oysters are replaced on the trays.
- 41803 --- This photograph taken in the early dawn shows oyster fishermen on their way to the Malpeque Bay oyster beds. Towed behind a motor launch they are "dropped off" over the bed they are going to fish.
- 41839 --- Rake-end, scissor-like tongs are used to bring the mature oysters to the surface. Small dredges operated from motor boats are also used.
- 41855 --- Oysters, sorted and packed for markets; are graded Fancy, Choice, Standard or Substandard by inspectors of the Federal Department of Fisheries.

FISHERIES PHOTOGRAPHS

SALMON PURSE-SEINING
(Captions on reverse side)



SP-5001



WR-228



16845



16856



16881



48136

Department of Fisheries and Forestry

Ottawa

CAPTIONS FOR SALMON PURSE-SEINING PHOTOGRAPHS

- SP-5001 -- With net and troll-line, British Columbia fishermen pursue the yearly runs of salmon. Here a purse-seiner, one of the more important types of British Columbia commercial fishing vessels, heads out to seek the schooling salmon.
- WR-228 -- As its name implies, the British Columbia purse-seiner runs a net from a turntable around the school of salmon, then "purses-up" the bottom of the net by drawing it together, preventing the downward escape of the fish.
- 16845 -- When the fish have been trapped, the net is drawn aboard until only a small portion holds the catch of salmon in the sea at the side of the boat.
- 16856 -- To empty the seine net a "brailer" is used to scoop up the salmon and deposit them in the hold of the vessel.
- 16881 -- A purse-seiner empties its catch into a cannery fish barge. The salmon are immediately iced to keep them fresh for processing.
- 48136 -- After weighing, these freshly-caught salmon are stored in a trough in a Prince Rupert (B.C.) packing plant.

FISHERIES PHOTOGRAPHS

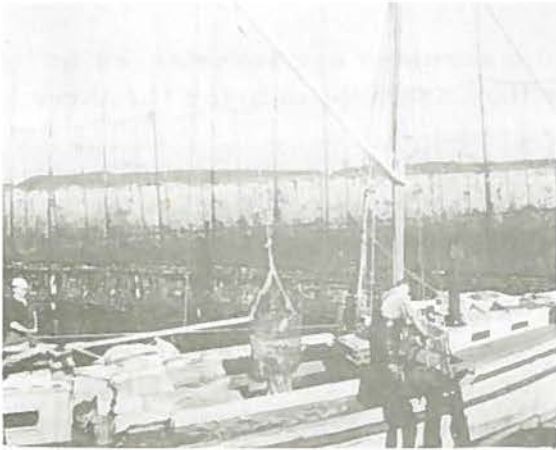
SARDINE FISHERY (Captions on reverse side)



42213



37349



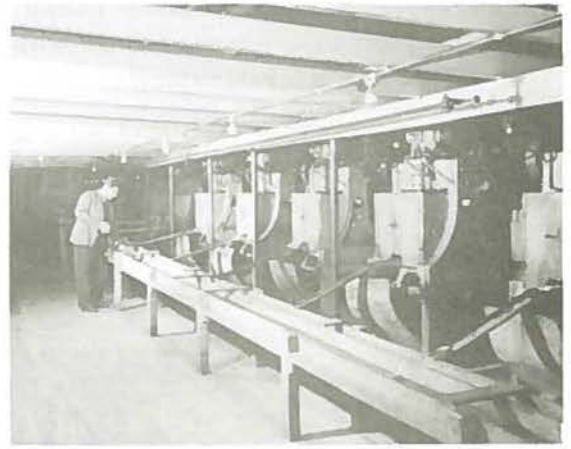
37348



42211



42212



42214

CAPTIONS FOR SARDINE FISHERY PHOTOGRAPHS

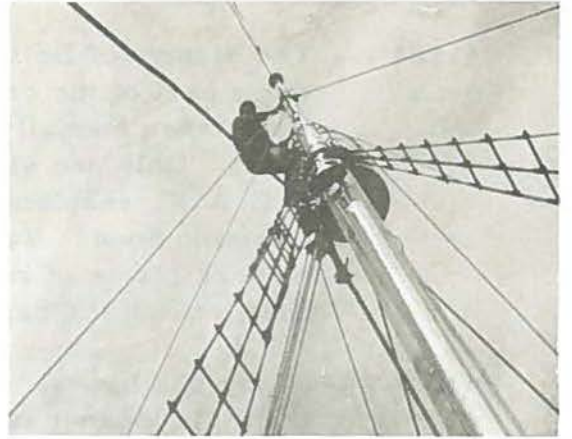
- 42213 --- Virtually all the sardines taken on the Atlantic Coast are caught by weirs and seine nets in southwestern New Brunswick waters. Here a group of sardine boats is tied up at Black's Harbour, N. B., site of the largest sardine canning factory in the British Commonwealth.
- 37349 --- "Seining the weir" is the term applied to the operation in which the sardines are concentrated into a mass in the 60-foot weir by gradually decreasing the net space.
- 37348 --- With a power-operated brailer the sardines are transferred to the hold of a carrier boat where they are held in brine for three hours.
- 42211 --- A bucket on a windlass is used to remove the catch from the hold of the carrier boat to the processing plant at dockside.
- 42212 --- Trays of tinned sardines are put into sealing machines. Main markets for Canada's canned sardines are South Africa, the United States, Trinidad, Cuba, Venezuela, The Netherlands, West Indies, Jamaica, the Leeward-Windward Islands, and the Dominican Islands.
- 42214 --- A bank of sealing machines from which the tins of sardines drop on to a carrier belt which conveys them to retorts for cooking and sterilization.

FISHERIES PHOTOGRAPHS

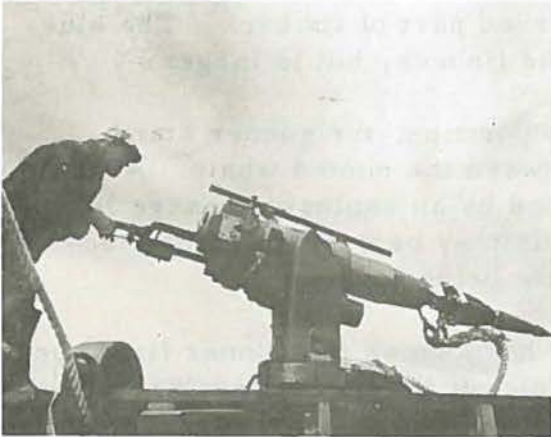
WHALING (Captions on reverse side)



41184



41207



41212



41218



41203



41190

Department of Fisheries and Forestry

Ottawa

CAPTIONS FOR WHALING PHOTOGRAPHS

- 41184 --- The history of British Columbia whaling goes back to the early part of the century when as many as 1,000 whales were taken annually by several whaling stations along the coast. Only one station is now in operation. It is a former R. C. A. F. seaplane base at Coal Harbour, at the head of Quatsino Sound, Vancouver Island, and is one of the most modern plants of its kind. This photograph shows a "killer" boat leaving the base for the whaling grounds.
- 41207 --- "Thar she blows," the age-old cry of the whaler, rings out from the lookout as he spots a "spouter". The angle of the spout is an indication of the type of whale. A sperm whale blows frequently. The finback shows a long and graceful shape barely above the surface; the humpback in the act of sounding exposes a large curved part of its back. The blue whale look very much like the finback, but is larger.
- 41414 --- As the boat manoeuvres into position, the gunner stands ready to send his harpoon toward the hunted whale. At the present time whales are killed by an explosive charge in the head of the harpoon. This may be supplanted by electrical harpoons which are now being tested.
- 41218 --- A swirl of smoke clouds the harpoon as the gunner fires the harpoon at the humpback whale off the port bow. When its whale is captured, air is pumped into the carcass to keep it afloat. The prize is marked with flagged and lighted buoys and the hunt goes on for other whales. "Catcher" boats pick the whales and tow them back to the factory.
- 41203 --- At Coal Harbour, winches haul the whales up a concrete ramp formerly used by seaplanes. Skilled workers using flensing knives strip off the blubber, the fatty outer layer of the whale. Giant calipers are used to make sure that the whale comes within the requirements of the International Whaling Commission on which Canada is represented.
- 41190 --- The blubber is cut into chunks and fed into "digesters". The whale meat is cut into pieces small enough to feed into a hashing machine. Every part of the whale is cooked until the last ounce of value has been extracted and turned into oil, meal or solubles.

FISHERIES PHOTOGRAPHS

WINTER FISHING, MANITOBA
(Captions on reverse side)



30032



30027



30051



11248



30018



11265

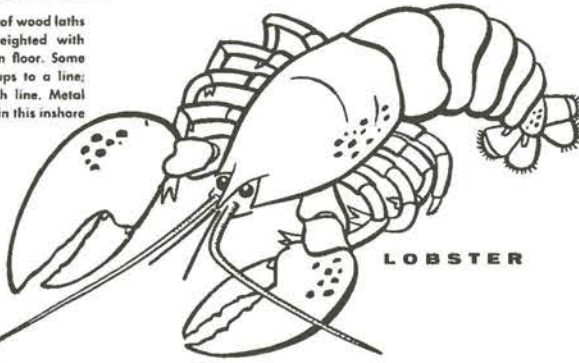
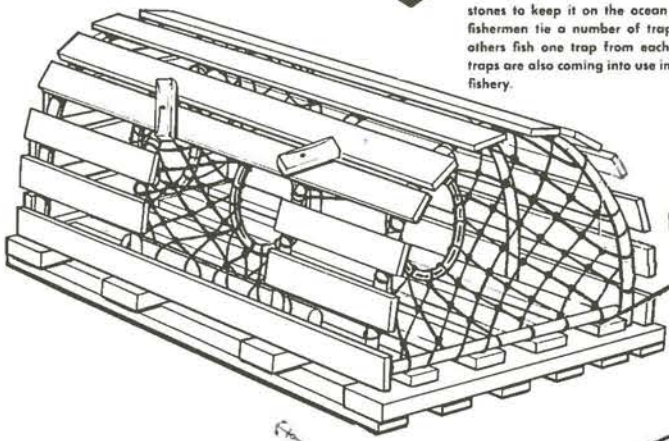
CAPTIONS FOR PHOTOGRAPHS OF WINTER FISHING MANITOBA

- 30032 --- An inland commercial fisherman sets his gill-net under the ice on Lake Winnipeg with a "jigger". After the first hole in the ice has been cut, it is possible to set 50 fathoms of net in three minutes with this ingenious yet simple device.
- 30027 --- Lifting the gill-net is cold work. Leather mitts protect the hands from the icy water.
- 30051 --- Frozen on the ice immediately they leave the water, these fish are removed from the gill-net and loaded on to the horse-drawn caboose.
- 11248 --- Stowing frozen gill-nets is a difficult job in below-zero temperatures.
- 30018 --- This tractor train covers the Dauphin Bay area of Lake Winnipeg, picking up fish and taking them to the railhead at Gypsumville, a 40-mile trip through the bush.
- 11265 --- Canada's inland winter fishing industry is a heritage from northern Indians and Eskimos. Whitefish and lake trout are the chief commercial species. Fish are packed in ice and crated for shipment, mainly to the United States.

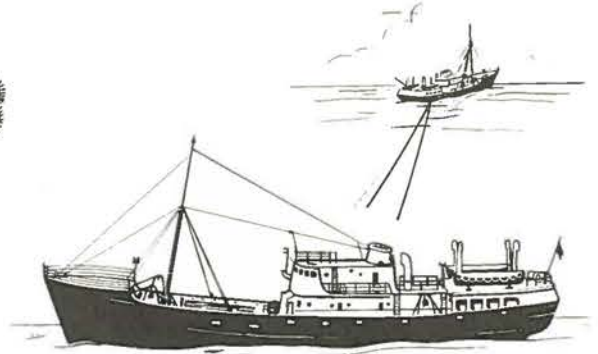
COMMERCIAL FISHING ATLANTIC

LOBSTER FISHING

The lobster trap, constructed of wood laths and twine, is baited and weighted with stones to keep it on the ocean floor. Some fishermen tie a number of traps to a line; others fish one trap from each line. Metal traps are also coming into use in this inshore fishery.



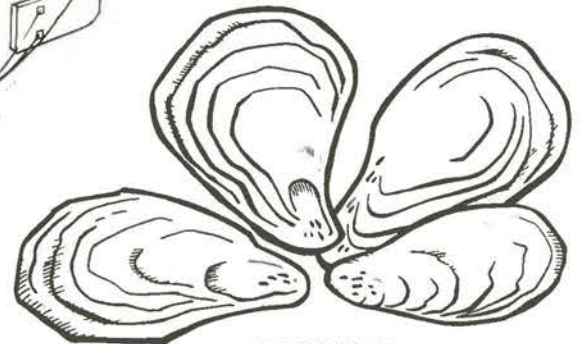
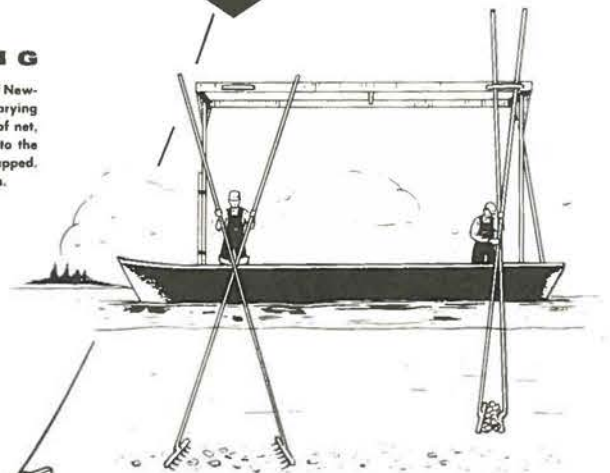
LOBSTER



OTTER TRAWLER

OYSTER FISHING

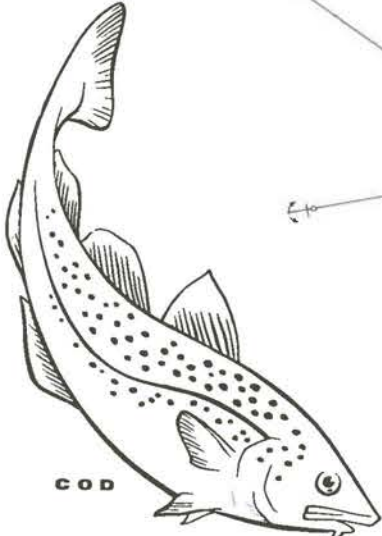
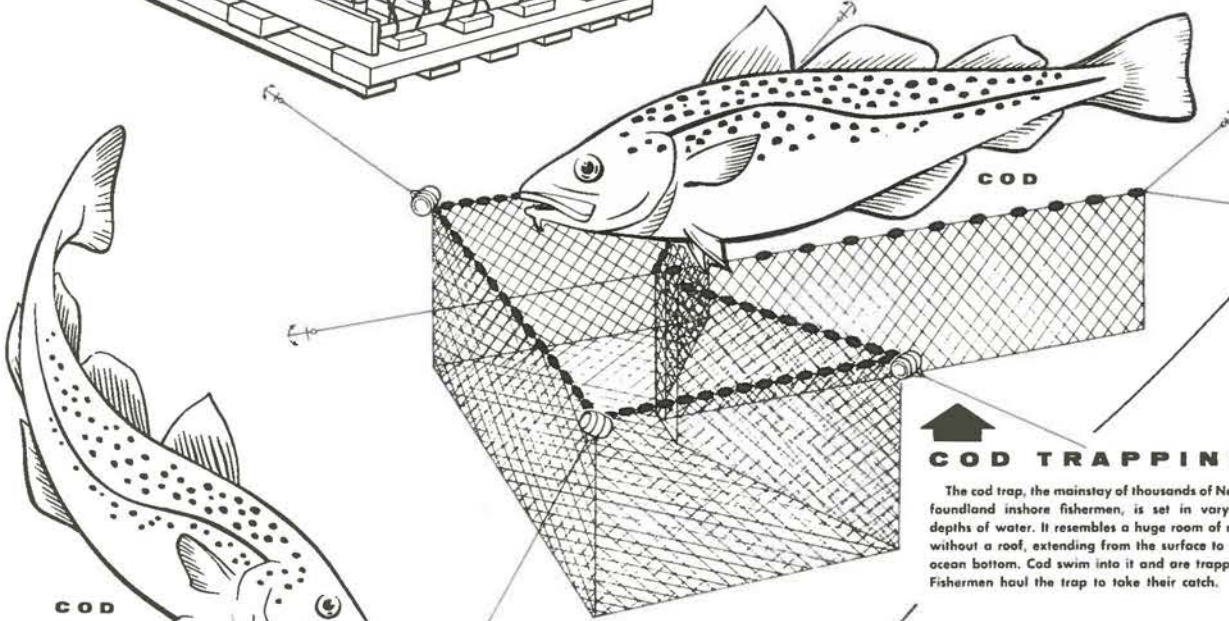
Rake-end, scissors-like tongs are most commonly used to bring oysters to the surface. Power-operated dredges towed from boats are also used.



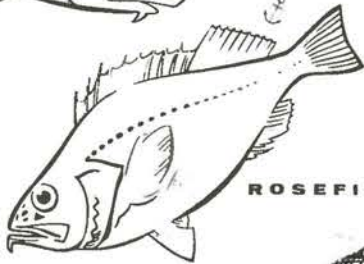
OYSTERS

COD TRAPPING

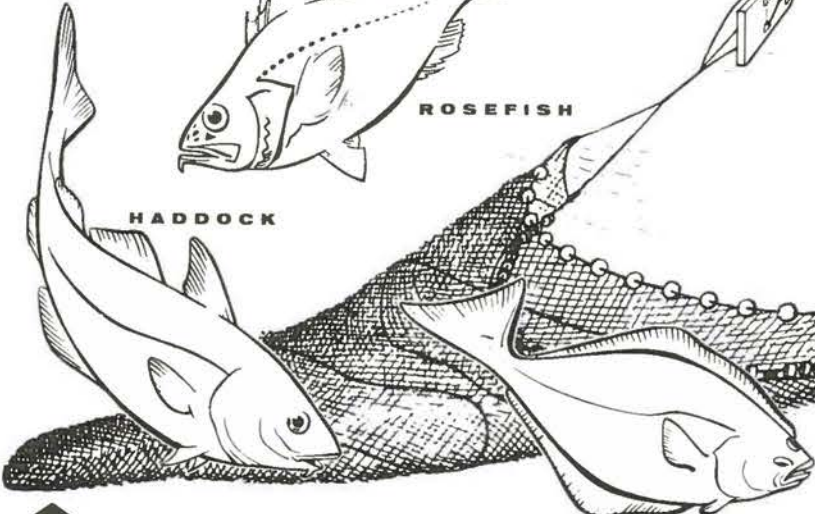
The cod trap, the mainstay of thousands of Newfoundland inshore fishermen, is set in varying depths of water. It resembles a huge room of net, without a roof, extending from the surface to the ocean bottom. Cod swim into it and are trapped. Fishermen haul the trap to take their catch.



COD



ROSEFISH



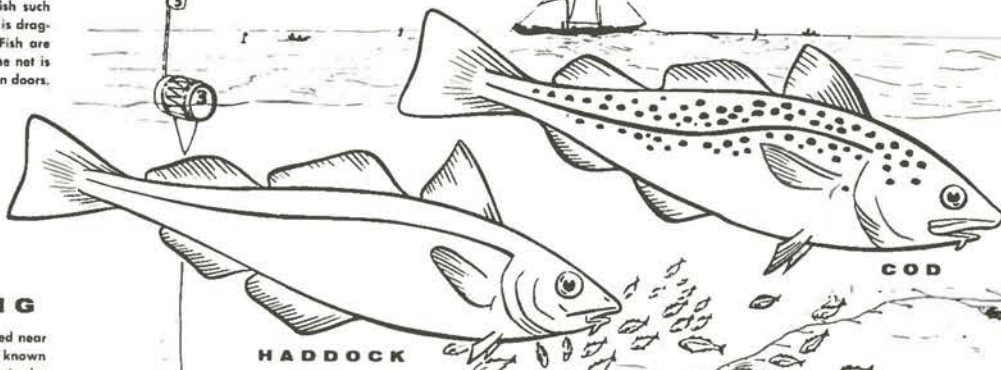
HADDOCK



FLATFISH

OTTER-TRAWLING

Otter-trawls are used to catch groundfish such as cod and haddock. The bag-shaped net, is dragged along the ocean floor by a trawler. Fish are trapped in the closed end. Cone-shaped net is kept open at its mouth by iron-shod wooden doors.

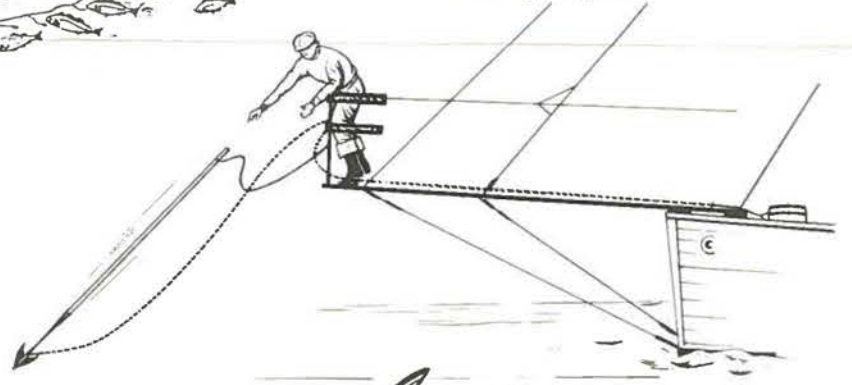


COD

HADDOCK

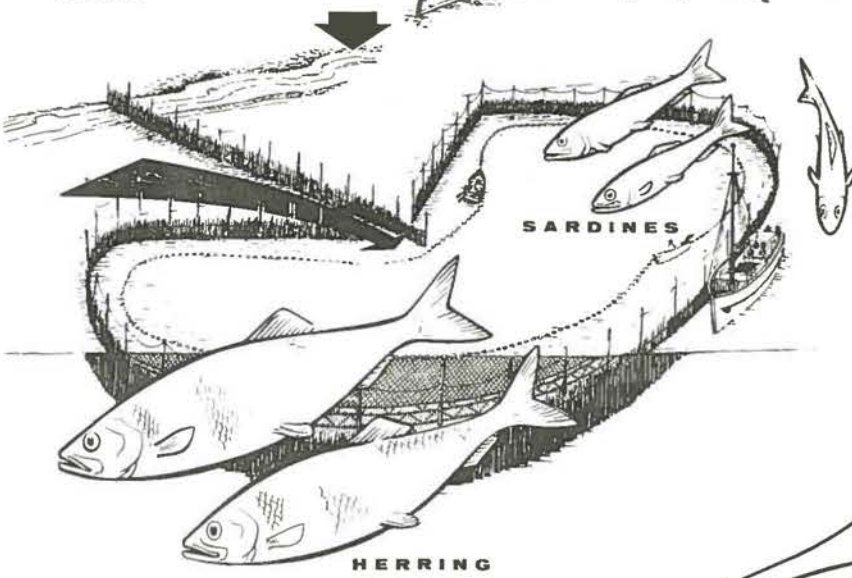
DORY FISHING

Dory fishing from large schooners is no longer practiced to any great extent on the Atlantic coast. At the present time, there are less than a dozen "Bankers" actively fishing. In this method, fishermen rowed out from the vessel in dories to set and haul in fishing lines by hand.



WEIR FISHING

Weirs, large corral-like structures, are used near shore to catch immature herring, commonly known as sardines. Fish are diverted into the weirs by fences stretching into shore; fishermen run a seine net around the inside of the weir, gathering the catch within.

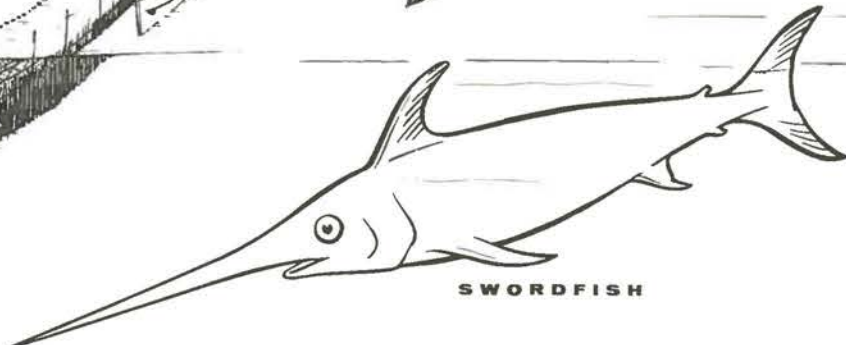


SARDINES

HERRING

SWORDFISHING

As the vessel approaches the swordfish, the "striker", standing on the "pulpit" at the bow, harpoons his target. A rope fastened to the harpoon is attached at the other end to a buoyant keg. This is thrown overboard and the fish is captured later when it becomes exhausted.

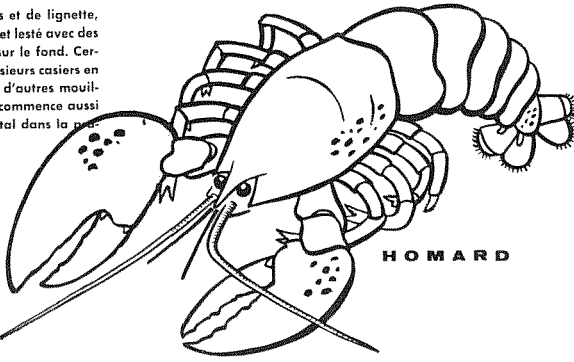
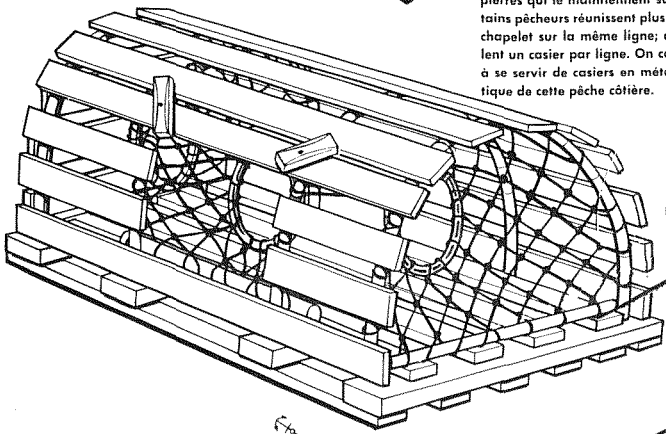


SWORDFISH

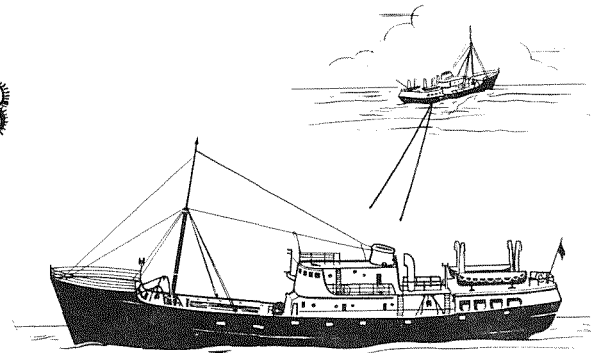
PÊCHE DE COMMERCE SUR L'ATLANTIQUE

CASIER

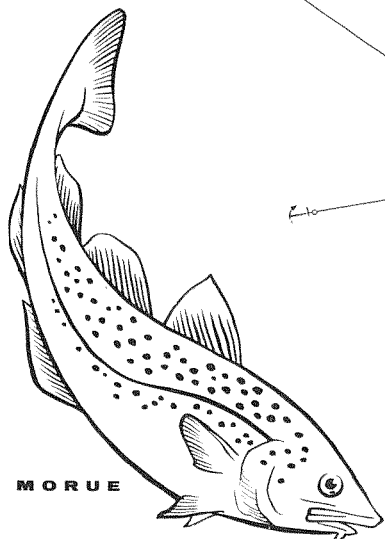
Construit de lattes de bois et de lignette, le casier à homard est boîté et lesté avec des pierres qui le maintiennent sur le fond. Certains pêcheurs réunissent plusieurs casiers en chapelet sur la même ligne; d'autres mouillent un casier par ligne. On commence aussi à se servir de casiers en métal dans la pratique de cette pêche côtière.



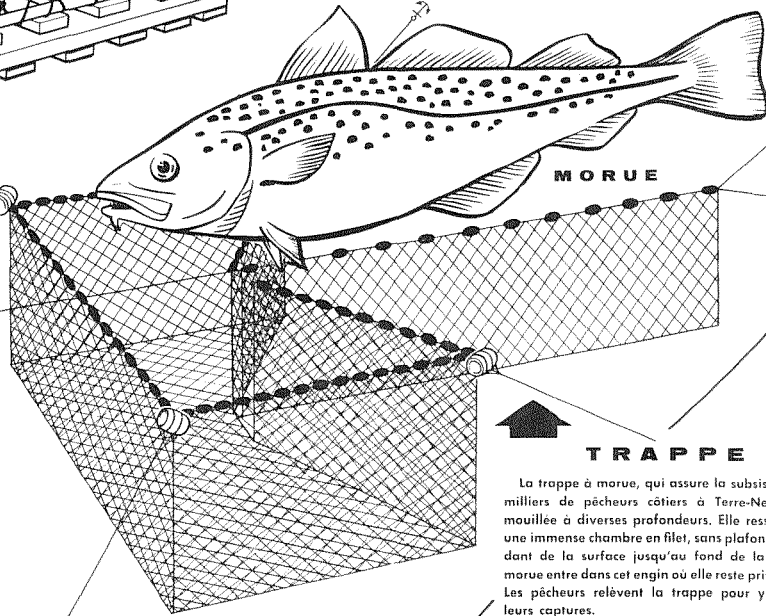
HOMARD



CHALUTIER



MORUE

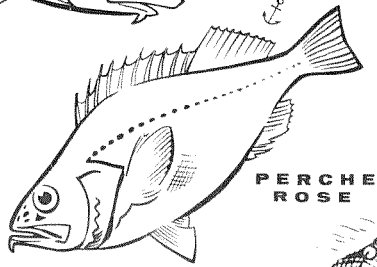
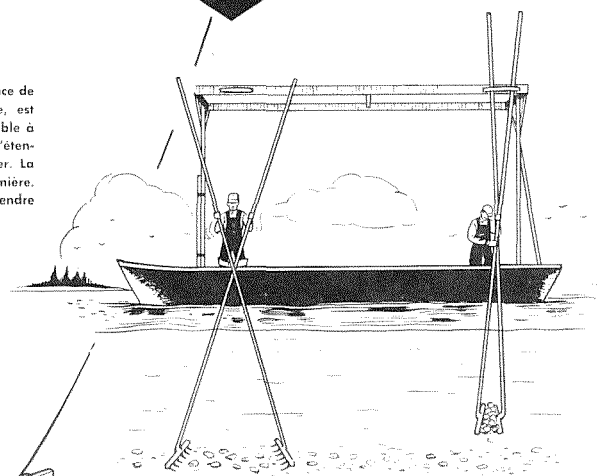


TRAPPE

La trappe à morue, qui assure la subsistance de milliers de pêcheurs côtiers à Terre-Neuve, est mouillée à diverses profondeurs. Elle ressemble à une immense chambre en filet, sans plafond, s'étendant de la surface jusqu'au fond de la mer. La morue entre dans cet engin où elle reste prisonnière. Les pêcheurs relèvent la trappe pour y prendre leurs captures.

RATEAUX

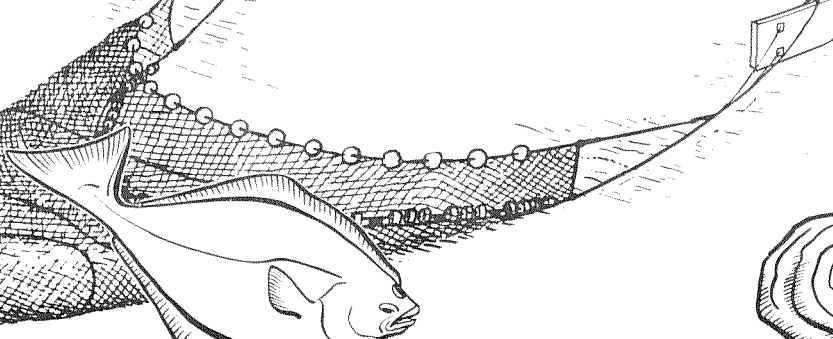
De grands rateaux réunis ensemble et fonctionnant comme des pinces sont communément employés pour ramener les huîtres à la surface. La pêche des huîtres se fait aussi au moyen de dragues mécaniques traînées par des bateaux.



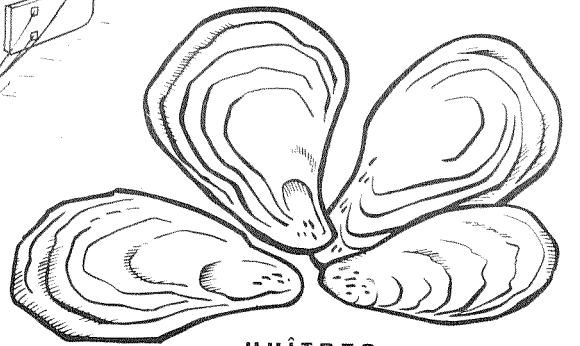
PERCHE ROSE



AIGLEFIN



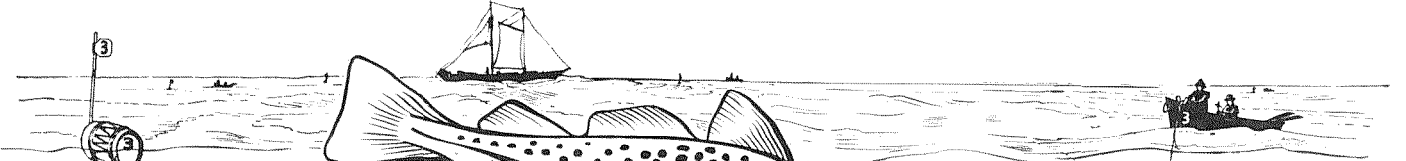
POISSONS PLATS



HUÎTRES

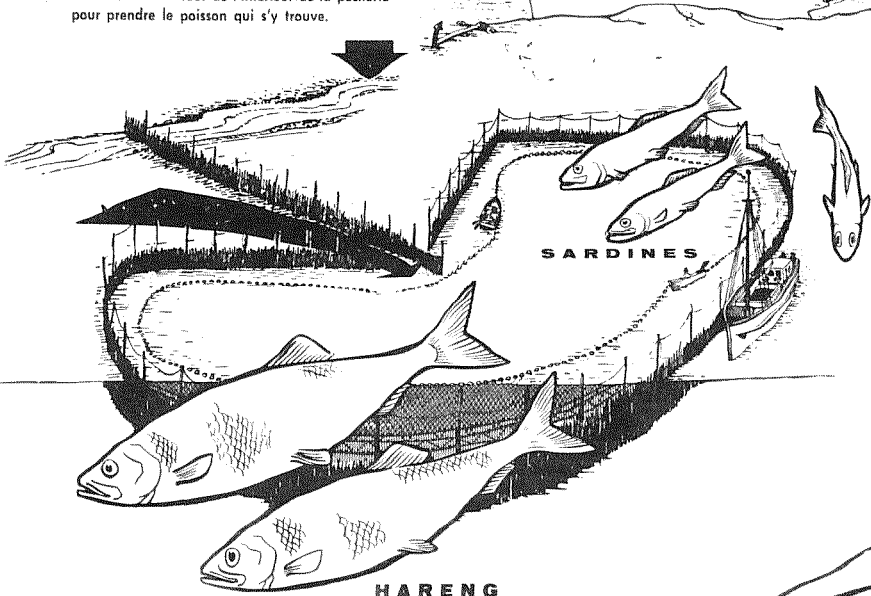
CHALUT

Le chalut sert à capturer des poissons de fond, notamment la morue et l'aiglefin. Ce filet en forme de sac est traîné sur le fond de la mer par un chalutier, et le poisson se prend dans l'extrémité fermée de l'engin. Des panneaux de bois, garnis de fer, tiennent ouverte la gueule de ce filet conique.



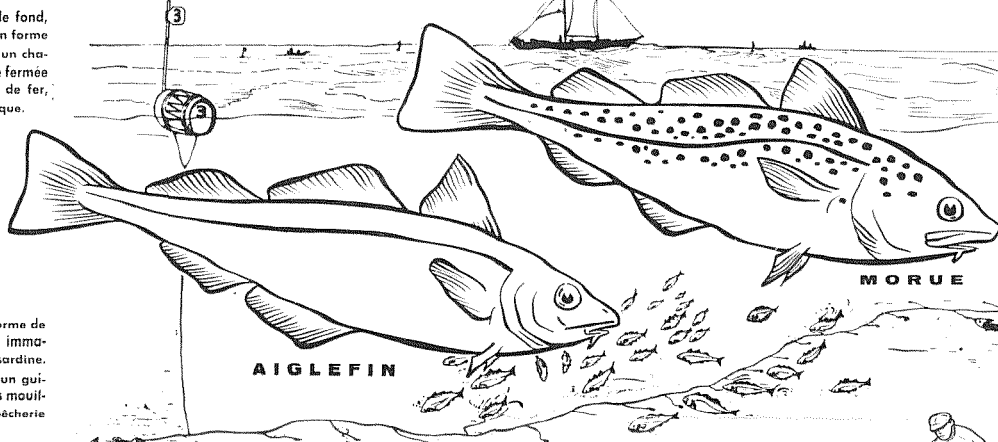
PÊCHERIE

La pêcherie est une grande structure en forme de corral, employée pour capturer du hareng immature, ordinairement connu sous le nom de sardine. Le poisson est dirigé dans la pêcherie par un guideau qui s'étend vers le rivage; les pêcheurs mouillent une seine autour de l'intérieur de la pêcherie pour prendre le poisson qui s'y trouve.



SARDINES

HARENG

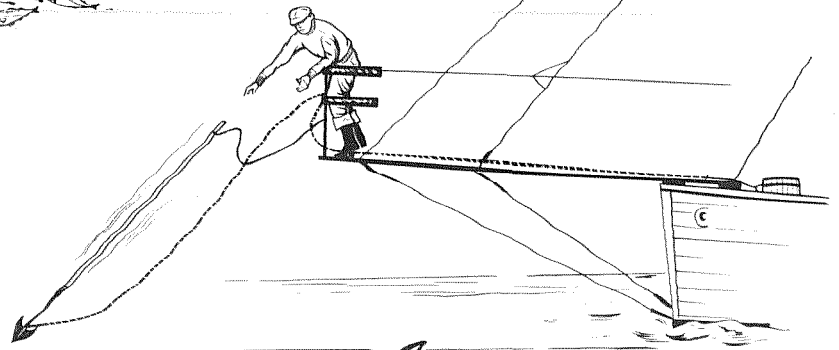


AIGLEFIN

MORUE

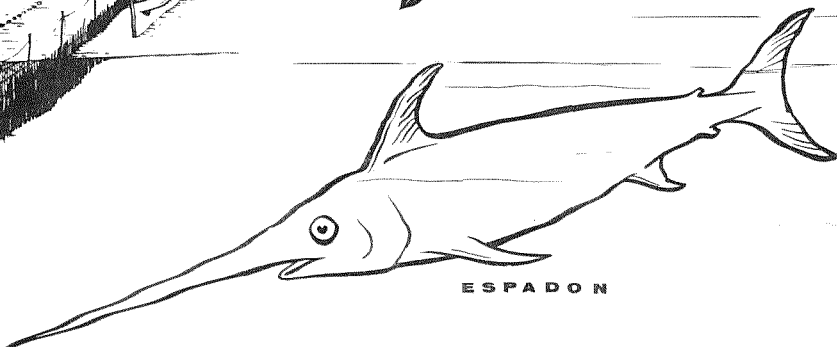
DORIS

La pêche à bord de doris transportés par de grandes goélettes ne se fait plus guère sur la côte atlantique. A l'heure actuelle, moins d'une douzaine de ces bateaux, qu'on appelait banquais, pratiquent activement la pêche. A bord de leur doris, les pêcheurs s'éloignent à la rame du vaisseau pour pêcher avec des lignes à main.



HARPON

Lorsqu'un vaisseau approche d'un espadon, le "harponneur", campé sur une petite plateforme montée devant le beaupré, lance son harpon. L'autre bout de la corde fixée au harpon est attaché à une bouée. On jette cette dernière par-dessus bord et le poisson harponné est capturé plus tard lorsqu'il devient épuisé.



ESPADON

COMMERCIAL FISHING INLAND

GREAT LAKES FISH TUG

Steel-hulled, diesel-engined fish tugs, 60 to 65 feet long, are used in the smelt, cisco, white bass, yellow perch, blue and yellow pickerel, whitefish and lake trout fisheries of the Great Lakes. Traditionally these boats use gill-nets described under "Gill-Netter". However, in recent years some of these boats have been adapted to use other gear such as mid-water and otter trawls.

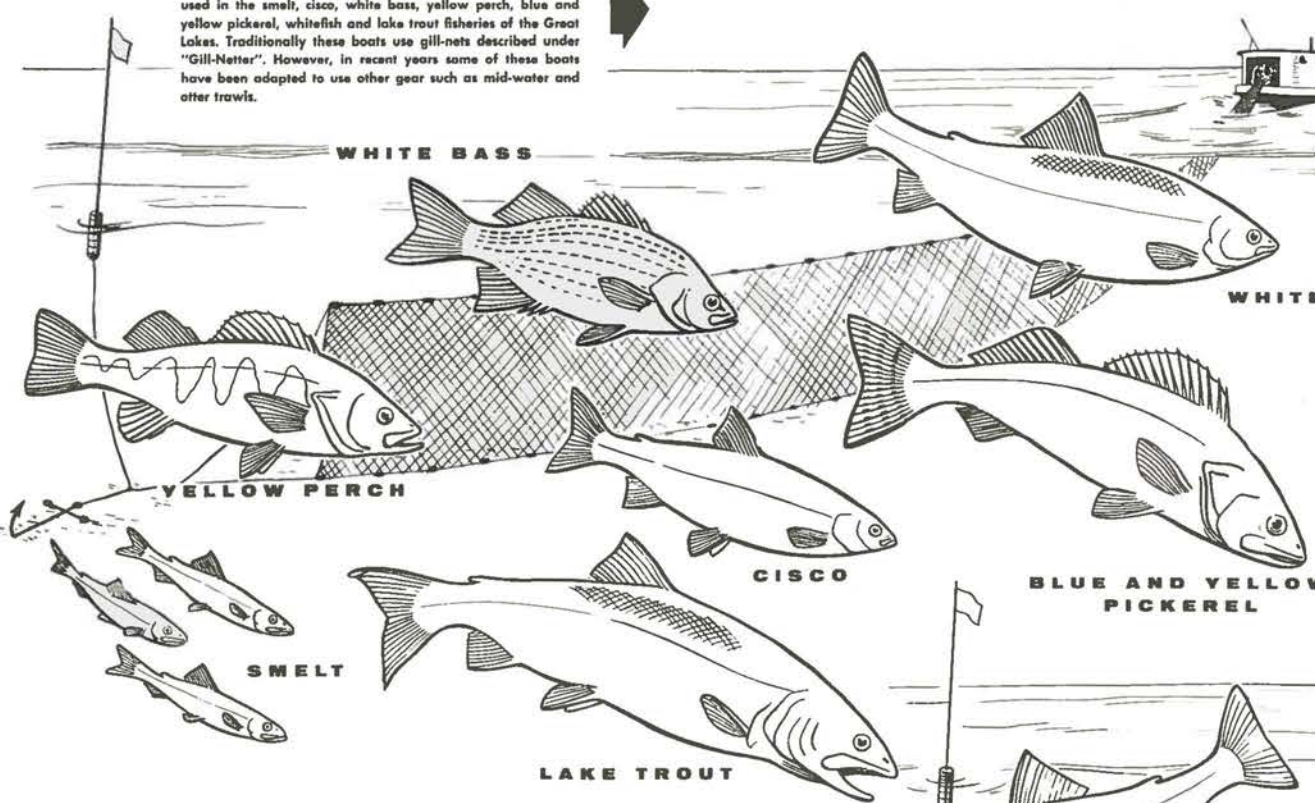


WHITE BASS

WHITEFISH

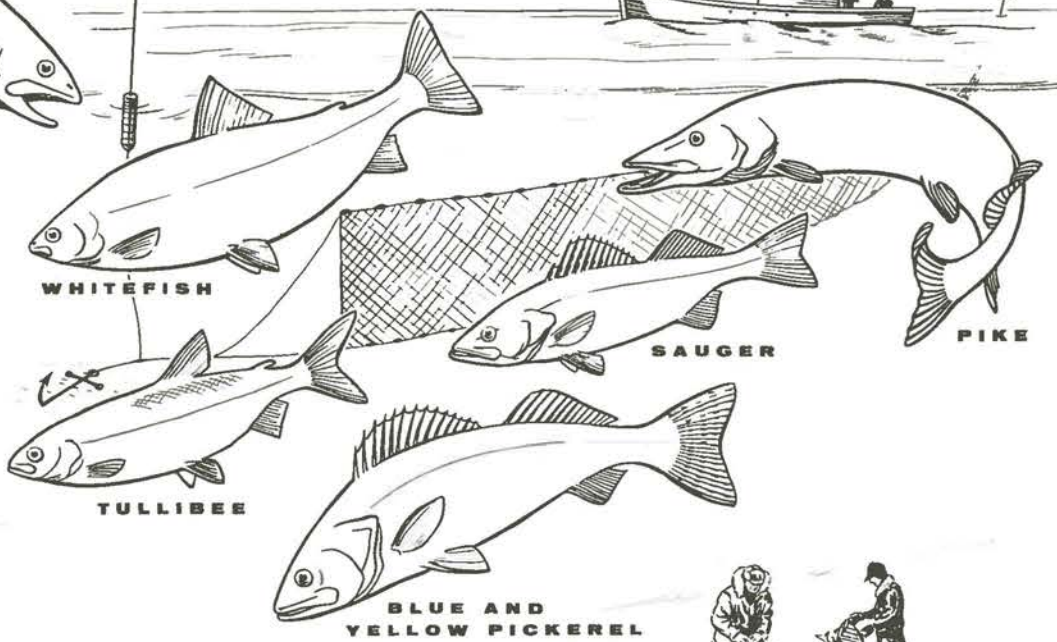
GILL-NETTER

These boats are used to catch whitefish, lake trout, tullibee, sauger, northern pike, and other freshwater species. The gill-net hangs in the water like a curtain and the fish are caught by becoming entangled when they swim into the mesh.



PRAIRIE JIGGER

Freshwater fishermen use the Prairie jigger to hang a gill-net under the ice during winter fishing. This device consists of a plank about six feet long, slotted to receive a metal lever. The jigger is thrust under a hole cut in the ice. By pulling a rope attached to the lever the fisherman makes the jigger creep along under the ice to another hole. A net is then attached to the running line and pulled into position under water.



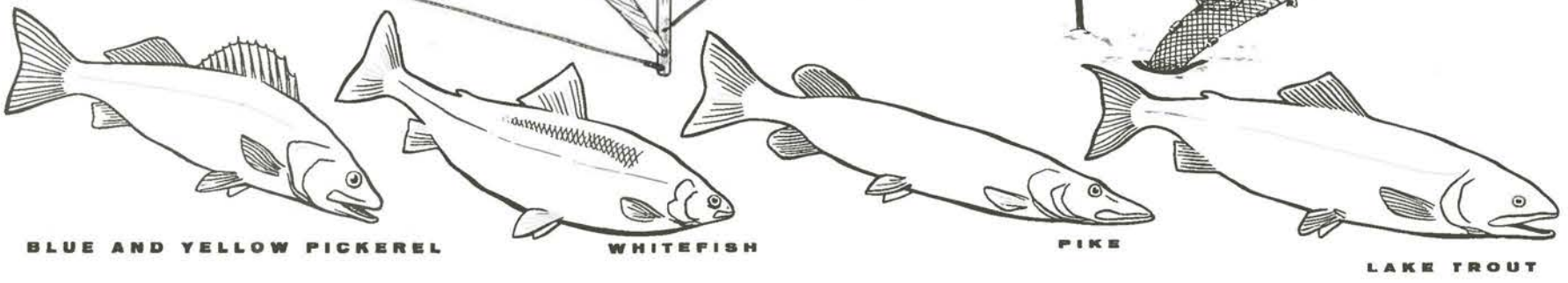
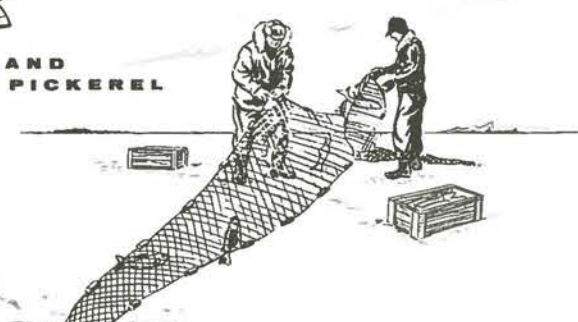
WHITEFISH

SAUGER

PIKE

TULLIBEE

BLUE AND YELLOW PICKEREL



BLUE AND YELLOW PICKEREL

WHITEFISH

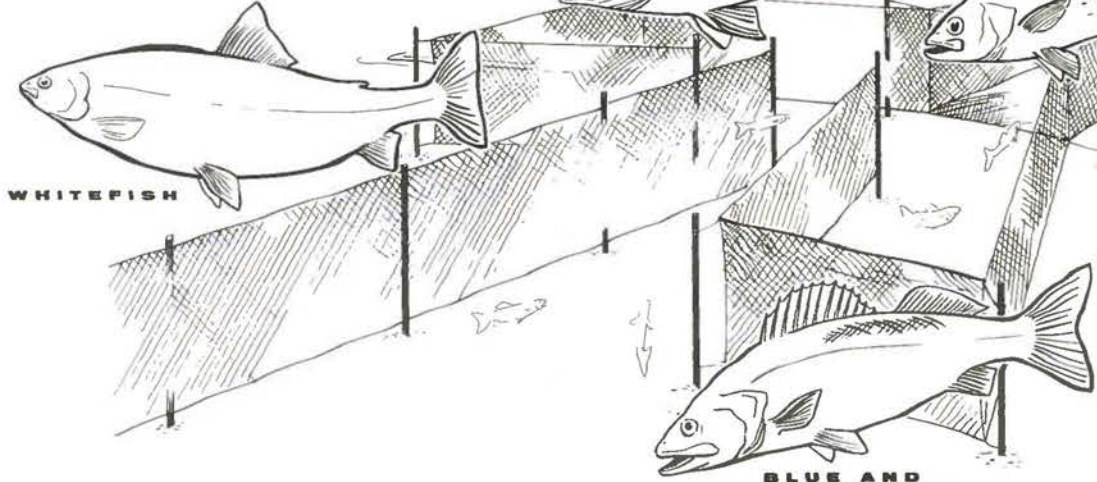
PIKE

LAKE TROUT

YELLOW PERCH

WHITE BASS

SMELT



TRAP AND POUND NET FISHING

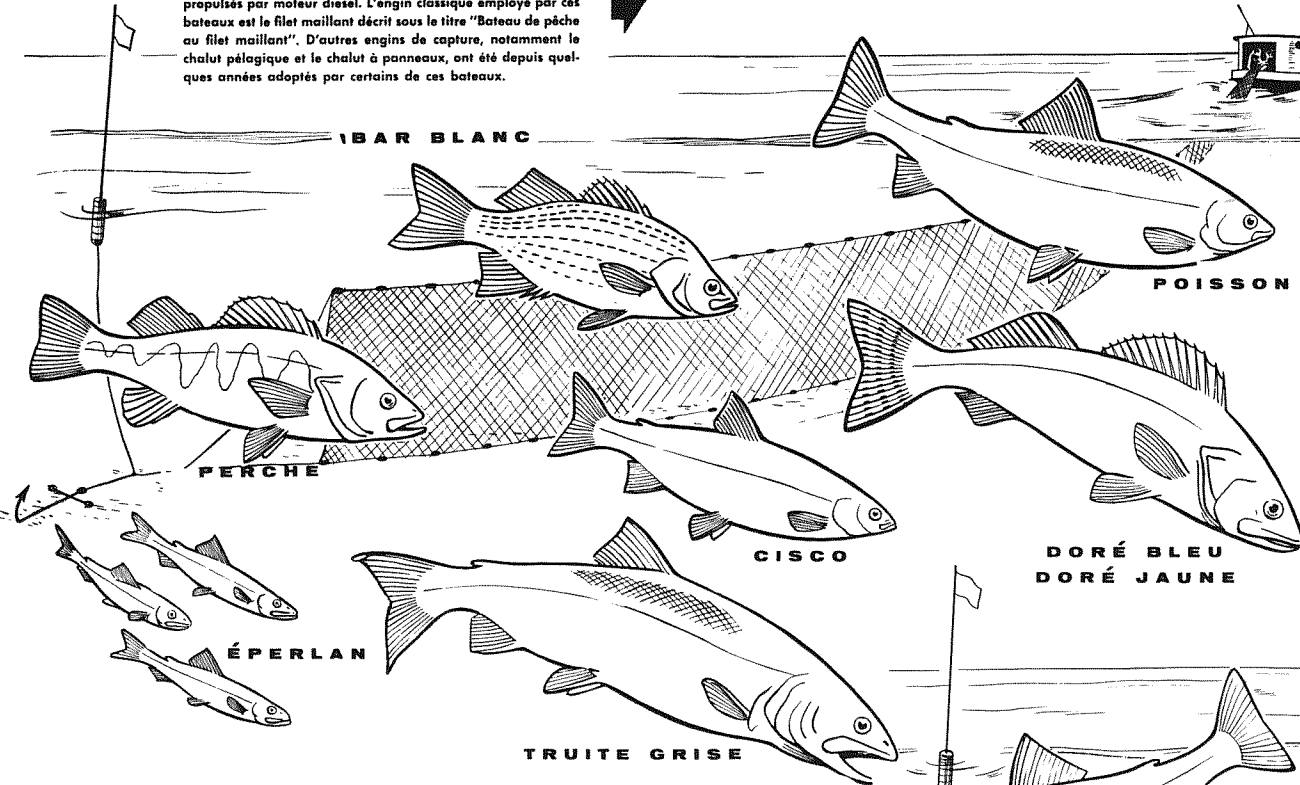
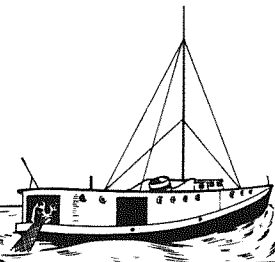
Trap and pound nets are set underwater to trap fish in shallow water close to shore. They consist of a leader which guides the fish into the "bay" from which they swim into the trap or pound. There they remain alive until fishermen arrive to lift the pocket and dip or brail the fish into their boat. Netting to form the trap is attached to stakes driven into the lake bottom.

BLUE AND YELLOW PICKEREL

PÊCHE DE COMMERCE DANS L'INTÉRIEUR

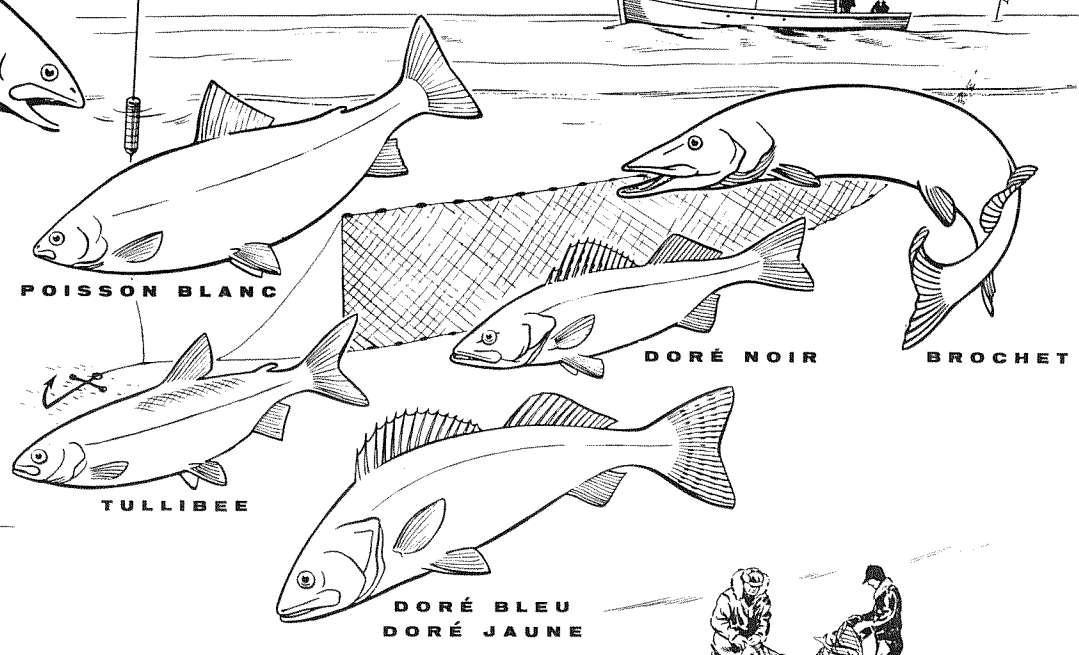
REMOREQUEUR DE PÊCHE DES GRANDS LACS

Ces bâtiments à coque d'acier, utilisés pour la pêche de l'éperlan, du cisco, du bar blanc, de la perche, du doré bleu, du doré jaune, du poisson blanc et de la truite grise dans les Grands lacs, mesurent de 60 à 65 pieds de longueur et sont propulsés par moteur diesel. L'engin classique employé par ces bateaux est le filet maillant décrit sous le titre "Bateau de pêche au filet maillant". D'autres engins de capture, notamment le chalut pélagique et le chalut à panneaux, ont été depuis quelques années adoptés par certains de ces bateaux.



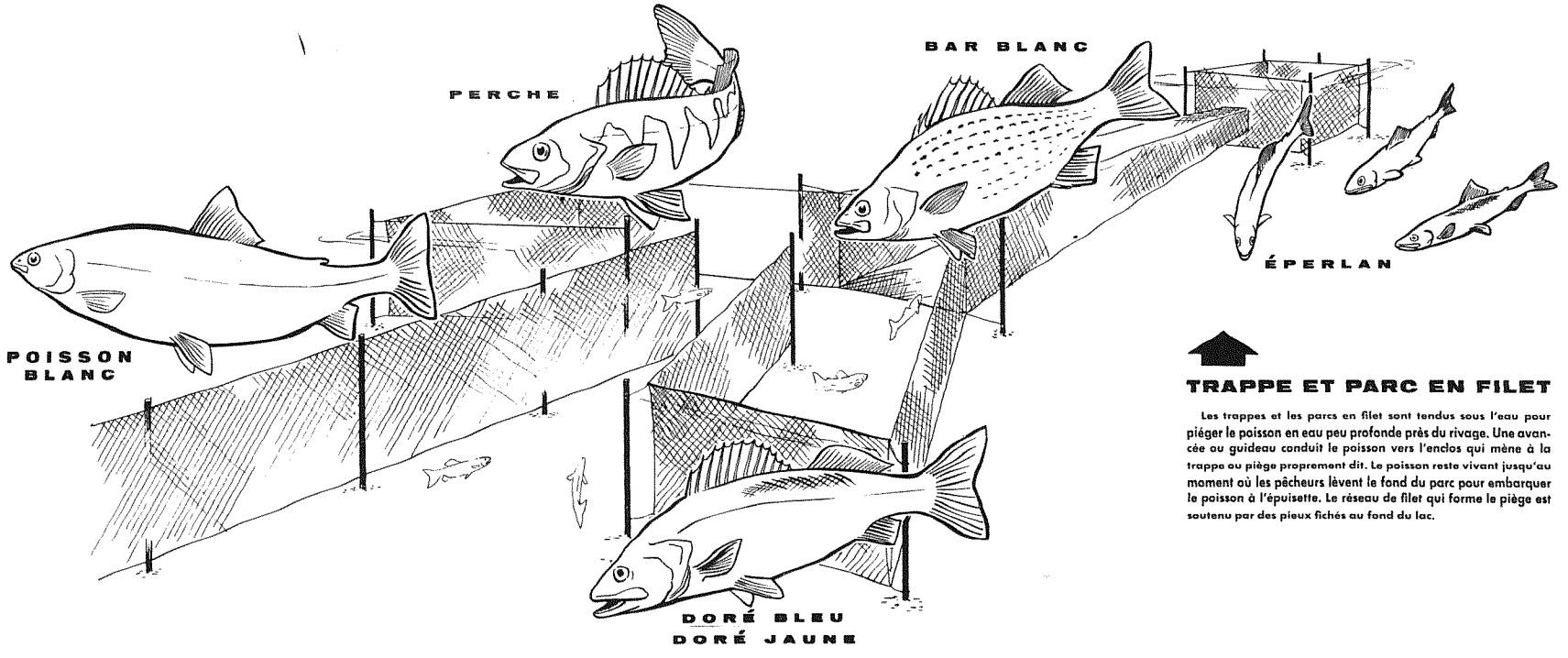
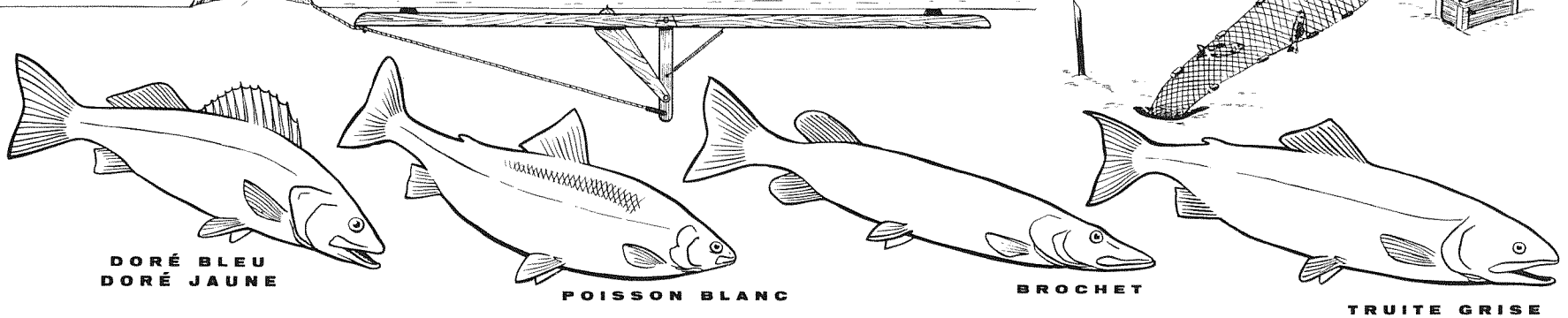
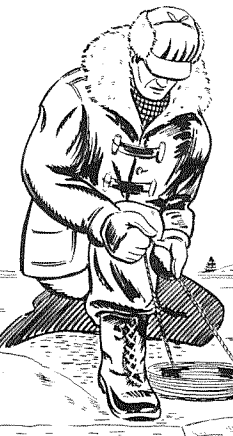
BATEAU DE PÊCHE AU FILET MAILLANT

Ces bâtiments servent à la pêche du poisson blanc, de la truite grise, du tullibee, du doré noir, du brochet et autres espèces d'eau douce. Le filet maillant est suspendu dans l'eau comme un rideau et les poissons qui tentent de le traverser s'emmêlent dans ses mailles.



"JIGGER" DES PRAIRIES

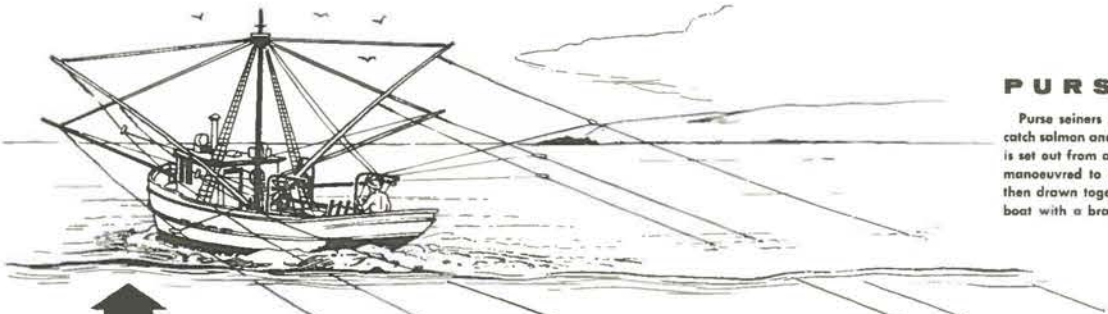
Pour tendre leurs filets maillants sous la glace des lacs en hiver, les pêcheurs en eau douce se servent d'un ingénieux machin appelé "jigger". Ce dispositif se compose d'une planche d'environ six pieds de longueur, mortaisée de manière à recevoir un levier de métal. Le pêcheur mouille son "jigger" en le passant par un trou découpé dans la glace et le fait avancer sous la glace vers un second trou en tirant sur la corde attachée au levier. Cette corde sert ensuite à tendre un filet entre les deux trous.



TRAPPE ET PARC EN FILET

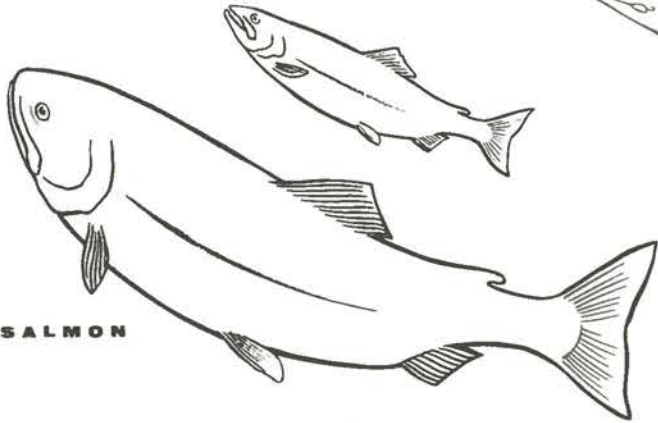
Les trappes et les parcs en filet sont tendus sous l'eau pour piéger le poisson en eau peu profonde près du rivage. Une avancée ou guideau conduit le poisson vers l'enclos qui mène à la trappe ou piège proprement dit. Le poisson reste vivant jusqu'au moment où les pêcheurs lèvent le fond du parc pour embarquer le poisson à l'épuisette. Le réseau de filet qui forme le piège est soutenu par des pieux fichés au fond du lac.

COMMERCIAL FISHING PACIFIC



TROLLING

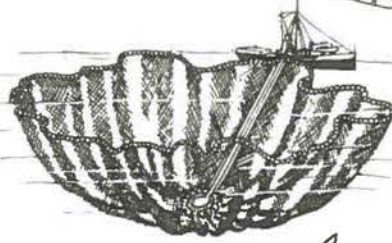
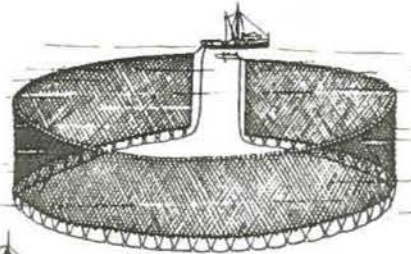
The salmon catching troller, which varies in length from 30 to 48 feet, is marked by long poles which extend over the sides of the vessel while fishing. To these poles are attached weighted lines bearing lures which are dragged through the water at a slow speed. The salmon are caught on the lures.



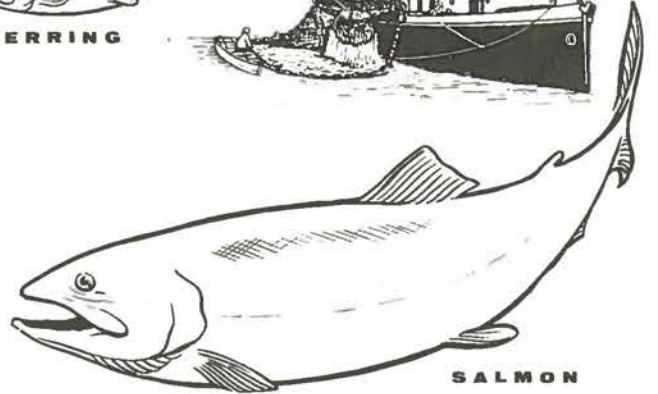
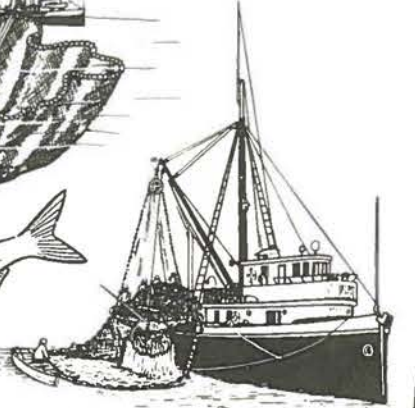
SALMON

PURSE SEINING

Purse seiners ranging in length from 60 to 80 feet catch salmon and herring. The huge net, or purse seine, is set out from a platform or table at the stern and is manoeuvred to encircle a school of fish. The seine is then drawn together and the fish are dipped into the boat with a broiler, a large dip net on a long pole.



HERRING

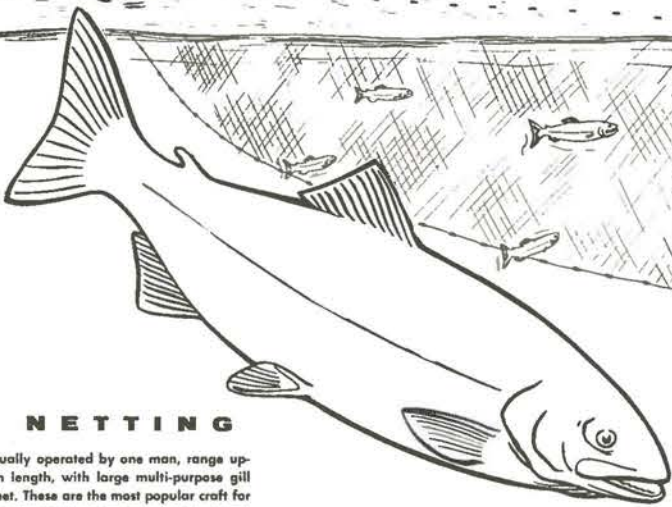


SALMON



GILL NETTING

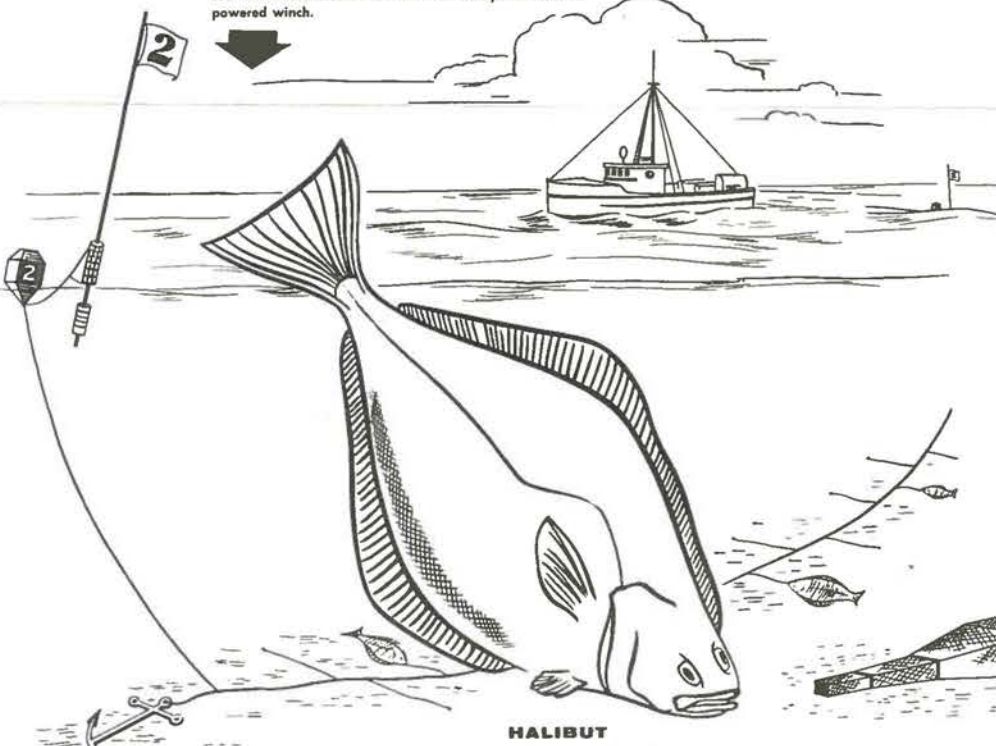
The gill netters, usually operated by one man, range upward from 28 feet in length, with large multi-purpose gill netters reaching 38 feet. These are the most popular craft for salmon fishing. From a drum at the stern the net is set out and hangs like a curtain in the water. The fish are caught by becoming entangled when they swim into the net.



SALMON

LONGLINING

The long-line is used to catch halibut and Pacific Coast cod. This fishing gear consists of a strong rope made up in lengths or skates to which are attached shorter lines with baited hooks. The long-line is set out on the bottom of the sea and is later hauled in with its catch by the aid of a powered winch.



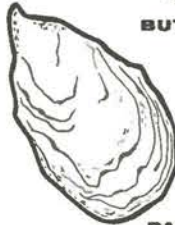
HALIBUT

SHELLFISH OPERATIONS

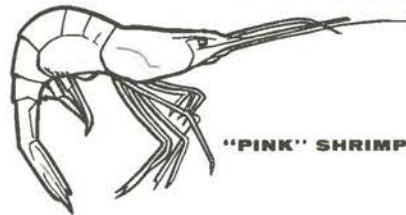
Pacific Coast fishermen land commercially important catches of crabs, shrimp, clams and oysters. The latter two are harvested in shoal water along the beaches. Crabs are caught by trap and trawl. Shrimp are taken by beam trawl and, to a lesser extent, by trap. Crab trap is shown here.



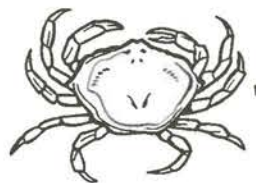
BUTTER CLAM



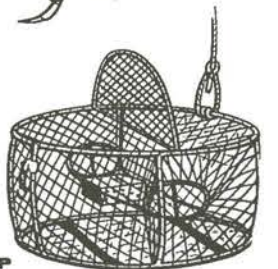
PACIFIC OYSTER



"PINK" SHRIMP



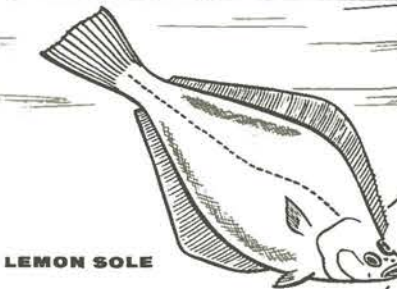
PACIFIC CRAB



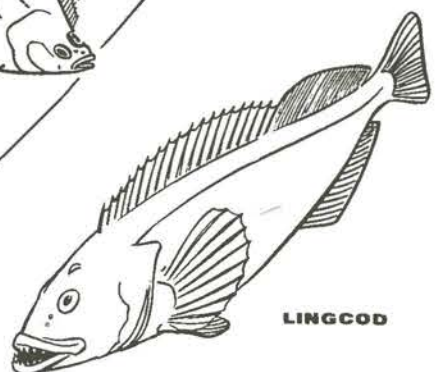
CRAB TRAP

OTTER TRAWLING

Among the Pacific groundfish are the ling, gray and black cods, ocean perch, soles and flounders. They are all caught by otter trawls. The otter trawl is a large bag-shaped net which is dragged along the ocean floor. The net is held open by planing boards called "doors".

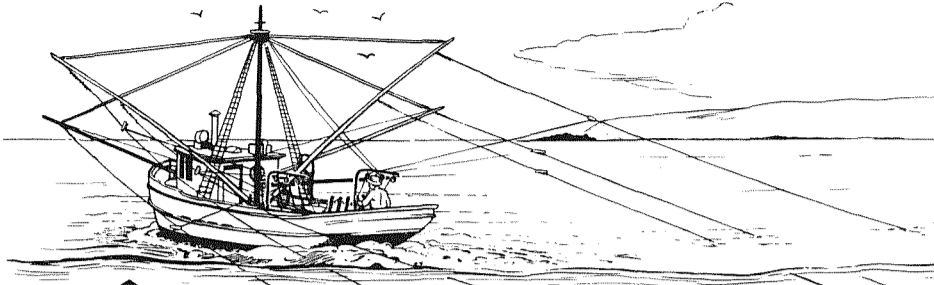


LEMON SOLE



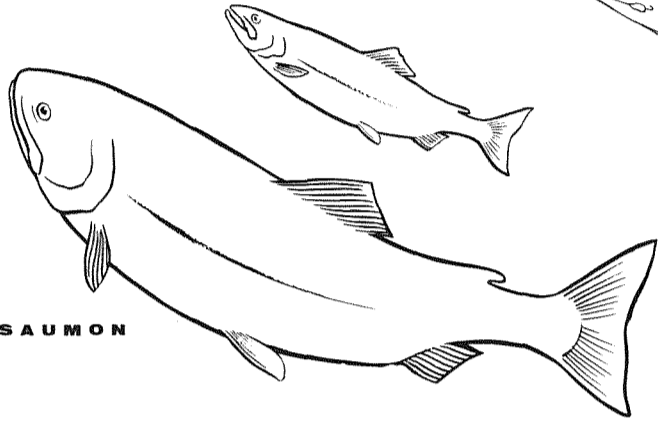
LINGCOD

PÊCHE DE COMMERCE SUR LE PACIFIQUE



PÊCHE AUX LIGNES À TRÂINER

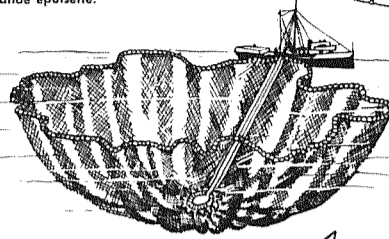
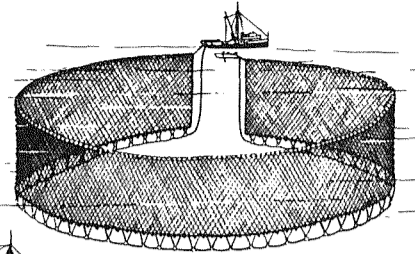
Le bateau de pêche du saumon aux lignes à traîner, dont la longueur varie de 30 à 48 pieds, se reconnaît en action de pêche à la présence de longs espars qui débordent de chaque côté du bateau. Aux extrémités de ces espars sont fixées des lignes lestées, garnies de leurres qu'on traîne lentement dans l'eau. Le saumon est capturé par ces leurres.



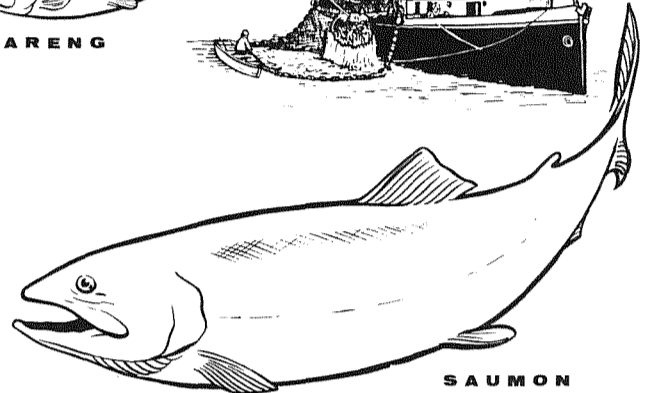
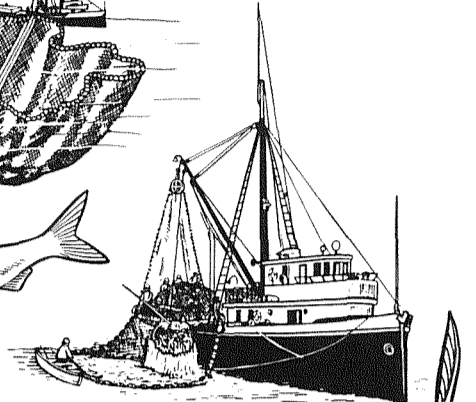
SAUMON

PÊCHE À LA SEINE À POCHE

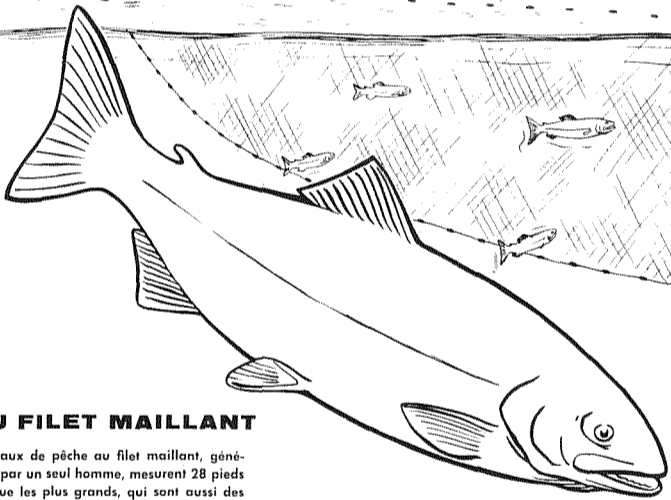
Les bateaux de pêche à la seine à poche, qui mesurent de 60 à 80 pieds de longueur, capturent du saumon et du hareng. L'immense filet coulissant ou seine à poche est mouillé d'une plateforme à l'arrière du vaisseau et manoeuvré de manière à encercler un banc de poisson. On serre ensuite la ralingue inférieure qui coulisse dans des anneaux pour fermer la poche que l'on vide avec une grande épuisette.



HARENG



SAUMON



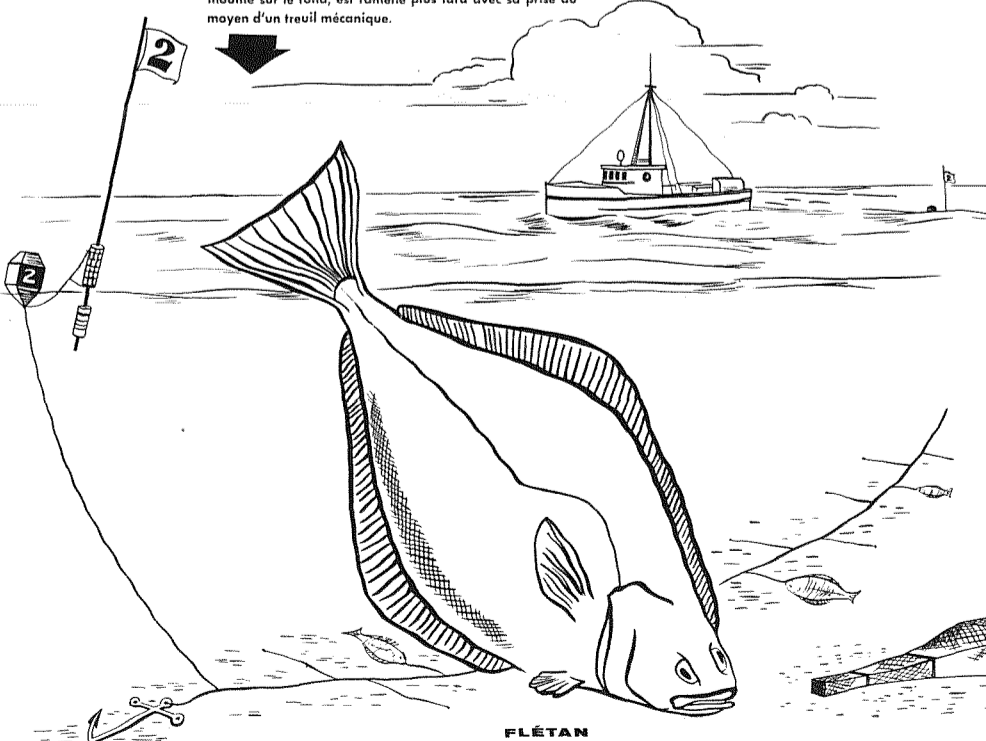
SAUMON

PÊCHE AU FILET MAILLANT

Les plus petits bateaux de pêche au filet maillant, généralement manoeuvrés par un seul homme, mesurent 28 pieds de longueur, tandis que les plus grands, qui sont aussi des bateaux à plusieurs fins, peuvent atteindre jusqu'à 38 pieds. Ce genre de bateau est le plus en vogue pour la pêche du saumon. Un tambour à l'arrière permet de mouiller le filet, qui est suspendu dans l'eau comme un rideau. Les poissons qui tentent de traverser le filet s'emmêlent dans ses mailles.

PÊCHE AUX PALANGRES

Le flétan et la morue du Pacifique se capturent à la palangre. La palangre est une forte ligne composée de plusieurs pièces ou tessures auxquelles sont fixés des avançons plus courts, garnis d'hameçons boîtés. Cet engin, qu'on mouille sur le fond, est ramené plus tard avec sa prise au moyen d'un treuil mécanique.



FLÉTAN

CRUSTACÉS ET COQUILLAGES

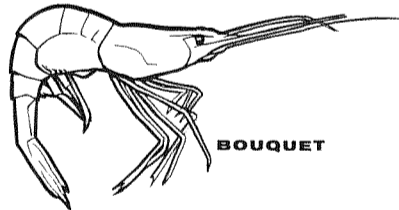
Les pêcheurs du Pacifique capturent le crabe, la crevette, les clams et les huîtres en quantités importantes. Ces deux dernières espèces se récoltent sur les hauts-fonds le long des grèves. Le crabe se pêche avec des casiers et des chaluts. La crevette se prend au moyen du chalut à perche et, dans une moindre mesure, avec des pièges. L'image représente un casier à crabes.



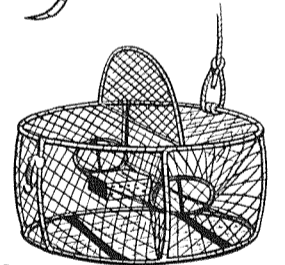
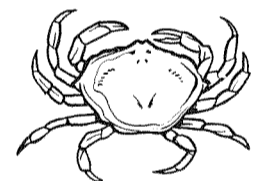
CLAM JAUNE



HUÎTRE DU PACIFIQUE



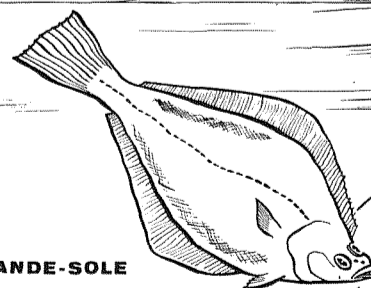
BOUQUET



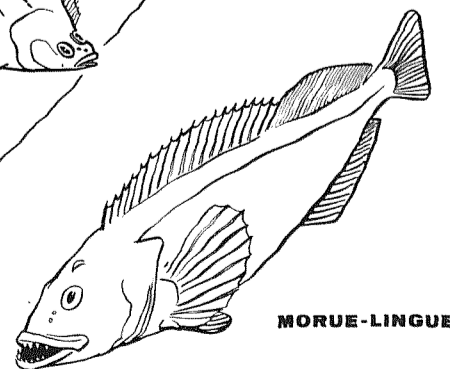
CASIER À CRABES

PÊCHE AU CHALUT

La morue lingue, la morue grise et la morue charbonnière, la perche de mer, la sole et autres poissons plats comptent parmi les poissons de fond du Pacifique. Tous se capturent au chalut qui est un immense filet conique traîné sur le fond de la mer et tenu ouvert au moyen de panneaux parfois appelés "portes".



LIMANDE-SOLE



MORUE-LINGUE