# THE MULTITUDINOUS PACIFIC HERRING



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COVER PHOTOGRAPH: A mountain of herring covers the storage bin area of the reduction plant at Imperial Cannery, Steveston, B. C., awaiting processing into fish meal and oil. Photographs by Mr. C. Morley.

# THE MULTITUDINOUS PACIFIC HERRING

## Vast Shoals of Protein-Rich Herring Rove the Temperate Coastal Waters Along Canada's Western Seabord

By Donald N. Outram



### HISTORICAL BACKGROUND

Fabulous numbers of herring (Fig. 1) are found along the sea-washed shores of Canada's most westerly province. Their migrations, their sudden abundance and their struggle to survive is an exciting study. Undoubtedly, herring were one of the first coastal fishes to be utilized by man. In northern Europe, particularly, they have been a source of food since before written history. Herring and herring roe have been an article of food or barter of the coastal Indian tribes of British Columbia for many centuries. They were not fished, however, on a commercial basis until 1877 when 75 tons were caught.

Today, in British Columbia, about 200,000 tons of herring are caught annually. While this fishery is first in landed weight and second to salmon in landed value, it is only worth about one-quarter as much as the salmon catch.

Fluctuations in the world price of fish meal and oil cause the market value at about ten million dollars to vary from year to year.

### FISHING FOR HERRING

The British Columbia herring fishery is a highly organized operation utilizing modern shore plants and efficient fishing vessels. The seventy- to eighty-foot long seine boats are equipped with the very latest electronic fish-detecting equipment, enabling the fishermen to "see" the shoals before setting the net (Fig. 2). In some areas the eighty vessel fishing fleet may use powerful blue-tinted lights to attract fish schools.

Fig. 1. HERRING PROFILES. Pacific herring (Clupea pallasi) characteristically travel in large schools. The silvery, eight-inch long adult herring shown above weigh about three ounzes, somewhat smaller than the closely related Atlantic herring (Clupea harengus). To the lower left in the photo a three-inch long, four month old juvenile herring can be seen.

Purse seining has been the dominant method of harvesting the herring crop since 1910. The 275-fathom long net encircles a school of herring and a purse line closes off the bottom like a draw string to prevent herring from escaping.

Sets average about 70 tons but catches up to 300 tons or about three million herring are not uncommon. The largest catches by a single net ever recorded were 1260 tons from Ogden Channel near Prince Rupert in 1950 and 1150 tons off Comox in 1949. The former was made by the seiner "Maple Leaf C", the latter by the seiner "Western Ranger". The captured herring are scooped two tons at a time with a giant dipnet or brailer into the hold of the fishing vessel (Fig. 3) and conveyed rapidly to the shore plants. Some herring are also caught by mid-water trawls and a few, to supply the fresh fish market, by gillnets.

DESTINY OF CAPTURED HERRING

In southern British Columbia the most prolific fishing grounds are along the Vancouver Island shoreline. On the east coast the best localities are off Campbell River, off Comox and amongst the "Gulf Islands" between Nanaimo and Victoria and on the west coast in Barkley Sound, in Nootka Sound and in Esperanza Inlet. In central British Columbia herring are caught in the channels near Bella Bella and in northern British Columbia around the islands south of Prince Rupert. Considerable catches are sometimes made along the lower east coast of the Queen Charlotte Islands.

Fish caught in southern British Columbia are generally processed at Steveston near Vancouver while those captured in central and northern British Columbia are delivered to shore plants in Prince Rupert and Namu, south of Bella Bella.

At the shore plants herring are unloaded by a giant suction hose into storage bins to await processing into fish meal and oil (Fig. 4). The herring harvest of British Columbia is not utilized directly for human consumption but rather forms a protein

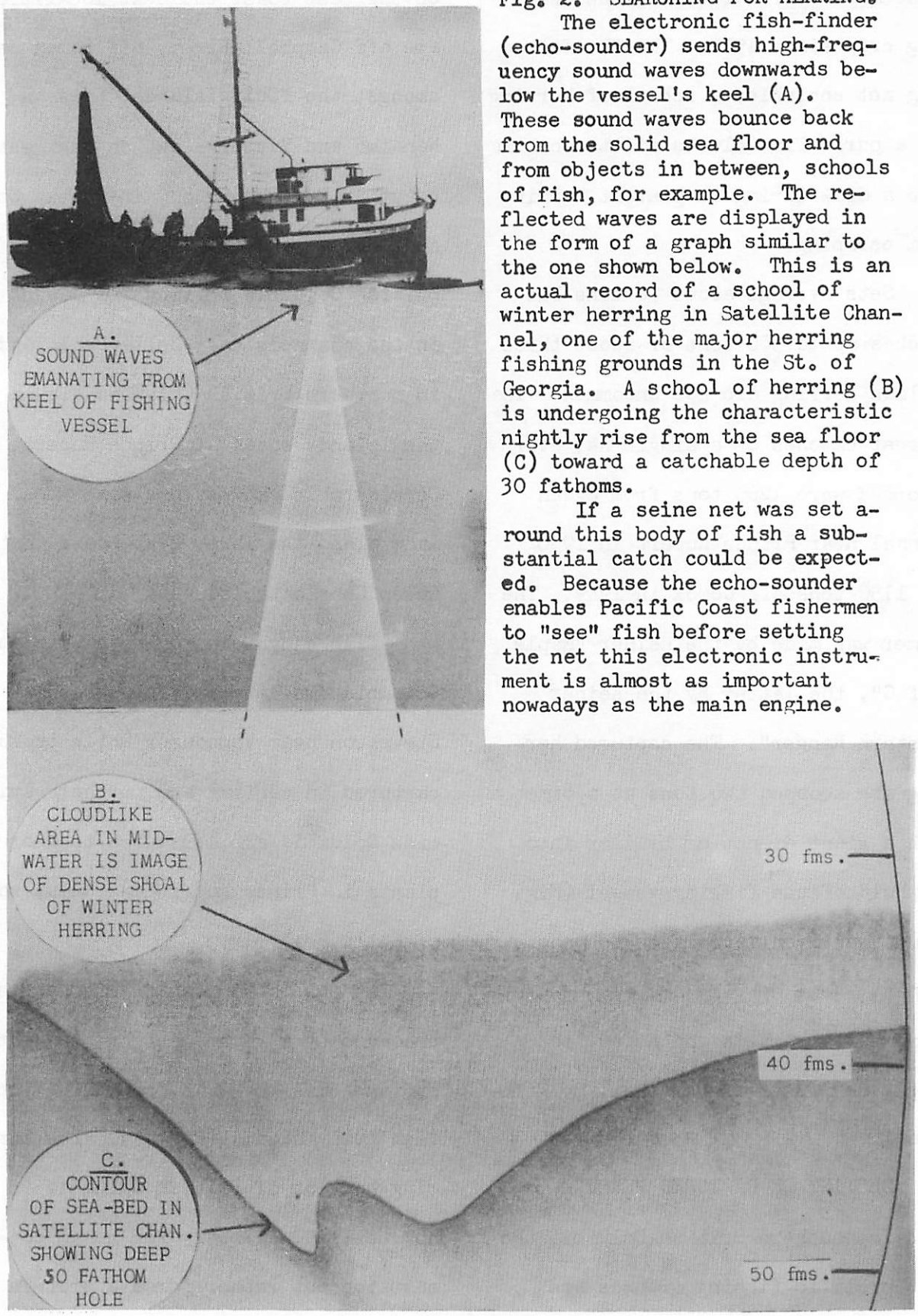


Fig. 2. SEARCHING FOR HERRING.

The electronic fish-finder (echo-sounder) sends high-frequency sound waves downwards below the vessel's keel (A). These sound waves bounce back from the solid sea floor and from objects in between, schools of fish, for example. The reflected waves are displayed in the form of a graph similar to the one shown below. This is an actual record of a school of winter herring in Satellite Channel, one of the major herring fishing grounds in the St. of Georgia. A school of herring (B) is undergoing the characteristic nightly rise from the sea floor (C) toward a catchable depth of 30 fathoms.

If a seine net was set around this body of fish a substantial catch could be expected. Because the echo-sounder enables Pacific Coast fishermen to "see" fish before setting the net this electronic instrument is almost as important nowadays as the main engine.

and mineral rich supplement in the diet of poultry, pigs and mink. The edible fish oil is shipped by rail and truck to markets in Canada and the United States for use in the manufacture of soaps, paints and cooking compounds. Only five per cent of the total herring catch is used for human sustenance either canned, salted, pickled or fresh.

## PROFILE OF A HERRING

Pacific coast herring are bony fish (Fig. 5) about nine inches long with blue-green backs shading away to silvery white on the sides. The mouth is large with a slightly projecting lower jaw; the tail is deeply forked. They are graceful but somewhat nervous swimmers, characteristically travelling in large shoals. They are grouped scientifically in the Family Clupeidae, to which also belong such other closely related Pacific coast species as the pilchard (California sardine), the shad and the anchovy.

Iridescent, loosely attached scales, about one-quarter of an inch broad, are imprinted with annual rings that can be used to tell the age of a herring (Fig. 6). In British Columbia the herring catches are composed mainly of fish that are three and four years of age. If there were no fishery some herring would grow to be quite old. The oldest herring on record, caught several years ago near Prince Rupert, was over fifteen years old.

## SPAWNING PILGRIMAGE

To fulfill the instinct to reproduce their species the herring legions undertake long spawning pilgrimages each year. In the fall, they leave the rich offshore feeding grounds above the continental shelf and migrate to inshore waters. Here, they form in dense schools awaiting the ripening of their reproductive organs. It is during this winter resting phase that the fishermen intervene to make their catches. Spawning takes place along the shore in early spring.

## UNUSUAL SPAWNING HABITS

For a few hours each spring herring leave the ocean depths and crowd

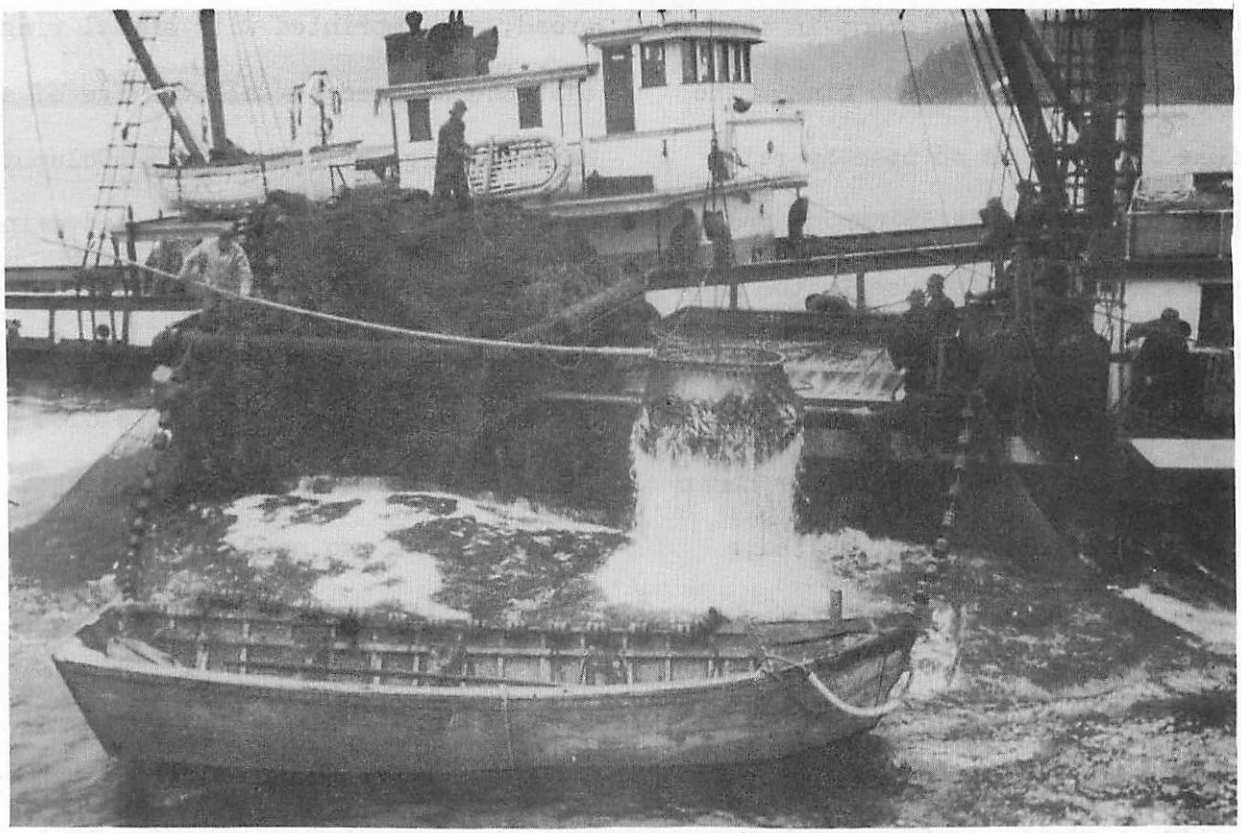

Fig. 3. HERRING HARVEST. The 70-80 foot fishing vessels may make catches of 100 tons or more. The silvery fish are transferred or brailed two tons at a time with a giant dip net into the hold of the fish boat.


Fig. 4. SACKED FISH. Herring are not utilized directly as food by man. Only five per cent of the total British Columbia catch is canned, salted, pickled or sold fresh; the remaining ninety-five per cent is processed into fish meal and fish oil. Sacks of fish meal like those in the figure are shipped by truck across the continent to markets in the United States and Canada.

onto the beaches in vast numbers to perpetuate their race. Although male and female are present in equal numbers on the spawning ground there is no "pairing off" during the spawning act. Females discharge sticky eggs on green eel grass and brown rockweed, japweed and kelp (Fig. 7). The males shed milt into the surrounding water turning it milky and opaque for miles (Fig. 8). During the 1961 spawning season, over 186 miles of spawn were deposited on 132 spawning sites along the 17,000 miles of British Columbia shoreline. After spawning, the spent fish return offshore to feed in scattered schools.

An average-sized herring deposits about 20,000 eggs each year. The transparent eggs are less than one-sixteenth of an inch in diameter and one square inch of seaweed may be covered with as many as one thousand eggs. After a sixteen-day incubation period the embryonic fish finally break out of the confining egg membranes and drift away.

During the brief period that they are fastened to moist seaweed many thousands of eggs are destroyed. Storms frequently annihilate whole spawnings. Seagulls and diving ducks are attracted in large flocks to the spawning beaches, first to feed on the spawners and then on the spawn left exposed at low tide. Mortality during the egg stage may amount to as much as 70-80 per cent.

## FRAGILE INFANT HERRING

By late April the sea lanes are populated with tremendous numbers of newly hatched, almost invisible herring larvae. These fragile, thread-like one-quarter-inch long infant herring (Fig. 9) bear as much resemblance to the adult fish as a stickleback does to a shark. They lack scales, the head and black eyes are greatly enlarged and they can barely swim. Two months later when about one and one-half inches long they will have undergone a gradual metamorphosis that changed their outward appearance into that of a miniature adult herring.

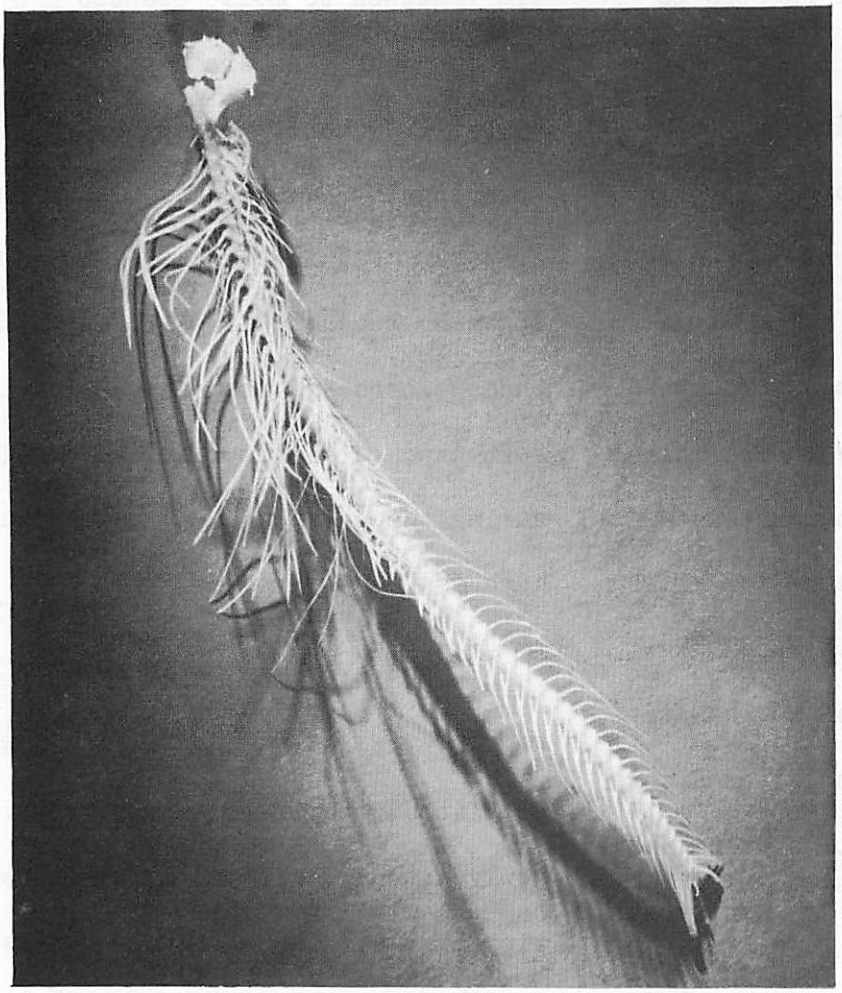

Fig. 5. HERRING BONES. The skeletal remains of a Pacific herring. The fine bone structure detracts from the appeal of herring as food on the fresh fish markets.

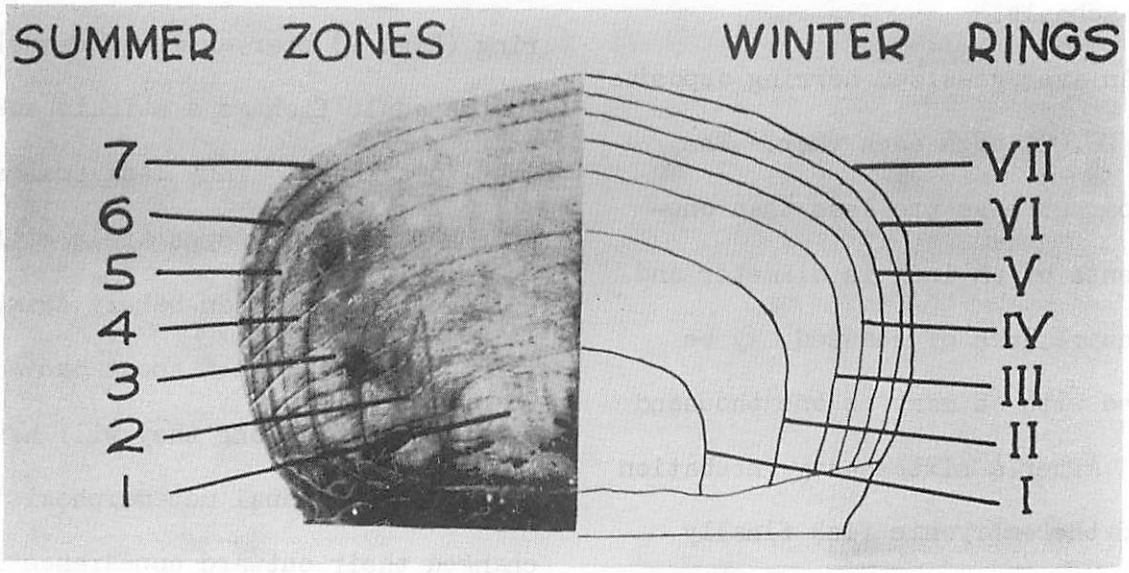


Fig. 6. HERRING REVEAL AGE. The markings or rings shown above on the enlarged half-scale from a herring indicate that this fish was seven years old when caught. In most regions of British Columbia, however, over eighty-five per cent of the fishable schools consist of herring that are three and four years of age. The oldest herring on record was a fifteen year old fish caught several years ago in Ogden Channel, thirty miles south of Prince Rupert.

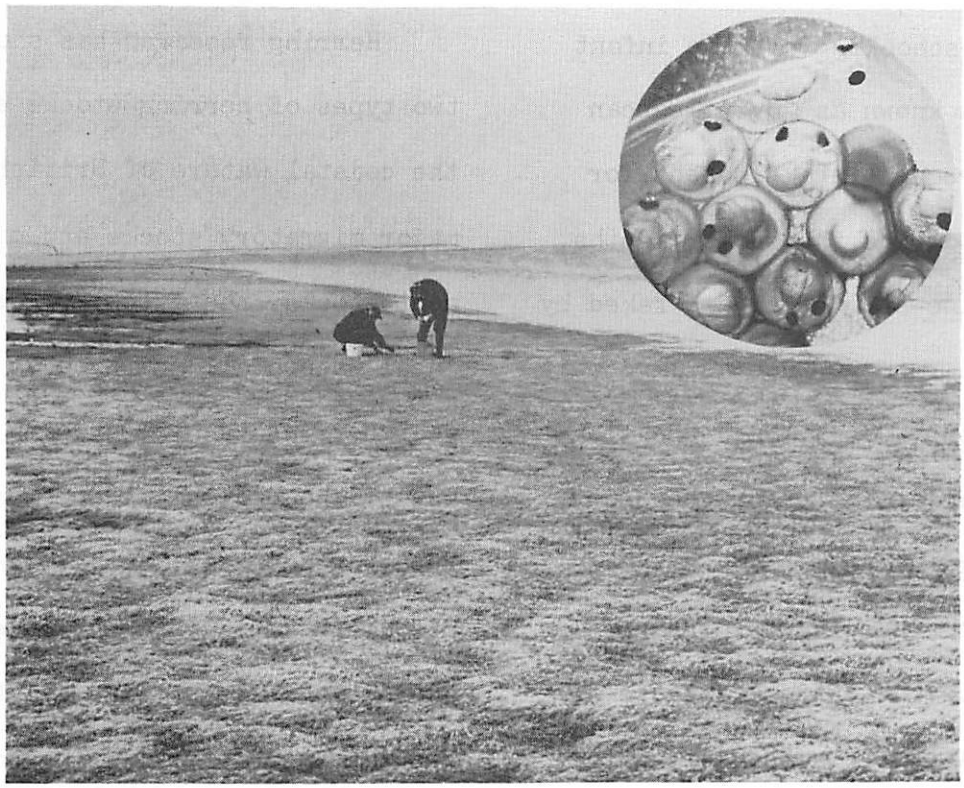

Fig. 7. EGGS UNLIMITED. Eel grass beds at Nanoose Bay covered with herring spawn for as far as the eye can see. Herring swarm onto the beaches in March, the females depositing adhesive eggs on seaweeds. The upper right-hand corner inset shows a group of transparent herring eggs (enlarged 15 times). Note the enormous black eyes of the embryos and of the newly-hatched, infant herring.

Fig. 8. WHITE WATER FROM A HERRING SPAWNING. Part of a two mile herring spawning in progress along the shore at Coffin Point near Ladysmith. Patches of water, like clouds, are turned white and opaque by the mass emission of the sperm-laden milt.

## PINT-SIZED JUVENILES

After schooling up, the infant herring now known as juveniles can be found frequenting kelp beds for protection during the summer months. These sardine-sized fish are raked by sports fishermen for use as live bait when trolling for salmon. Occasionally, a small fishery for these juveniles takes place but the schools of young herring have never been exploited to the extent of those along the Atlantic seaboard and in the Gulf of Maine.

In October, when about 4 inches long, juvenile herring normally forsake their shallow-water haunts and move seawards into deeper waters. Their survivors will return in the fishable stocks mostly as mature, three-year-old herring. They will continue to return each year in the spawning runs for the remainder of their life span. Little information exists with respect to the distribution and abundance of immature herring between the time they leave shallow water and the time they return as adult fish.

## RESEARCH AND REGULATIONS

Herring research has shown that two types of herring stocks exist in the coastal waters of British Columbia; major migratory stocks and minor resident stocks, the latter present in local waters all year round. A twenty-year herring tagging program carried out by the Biological Station, Fisheries Research Board of Canada, Nanaimo, B. C., (Fig. 10) has indicated that there are at least nine relatively separate migratory herring populations along the coast.

Present day efforts are designed to provide a scientific basis for a management program that will allow the greatest possible catch from all populations. In the continuing program emphasis is placed on compilation of catch statistics, sampling for age, length and maturity, estimating spawn abundance and echo-sounding surveys. The analysis of these data provides information on the level of abundance of each population and on the relationship between the size of the spawning stock (measured by the amount of spawn deposited) and the resulting number

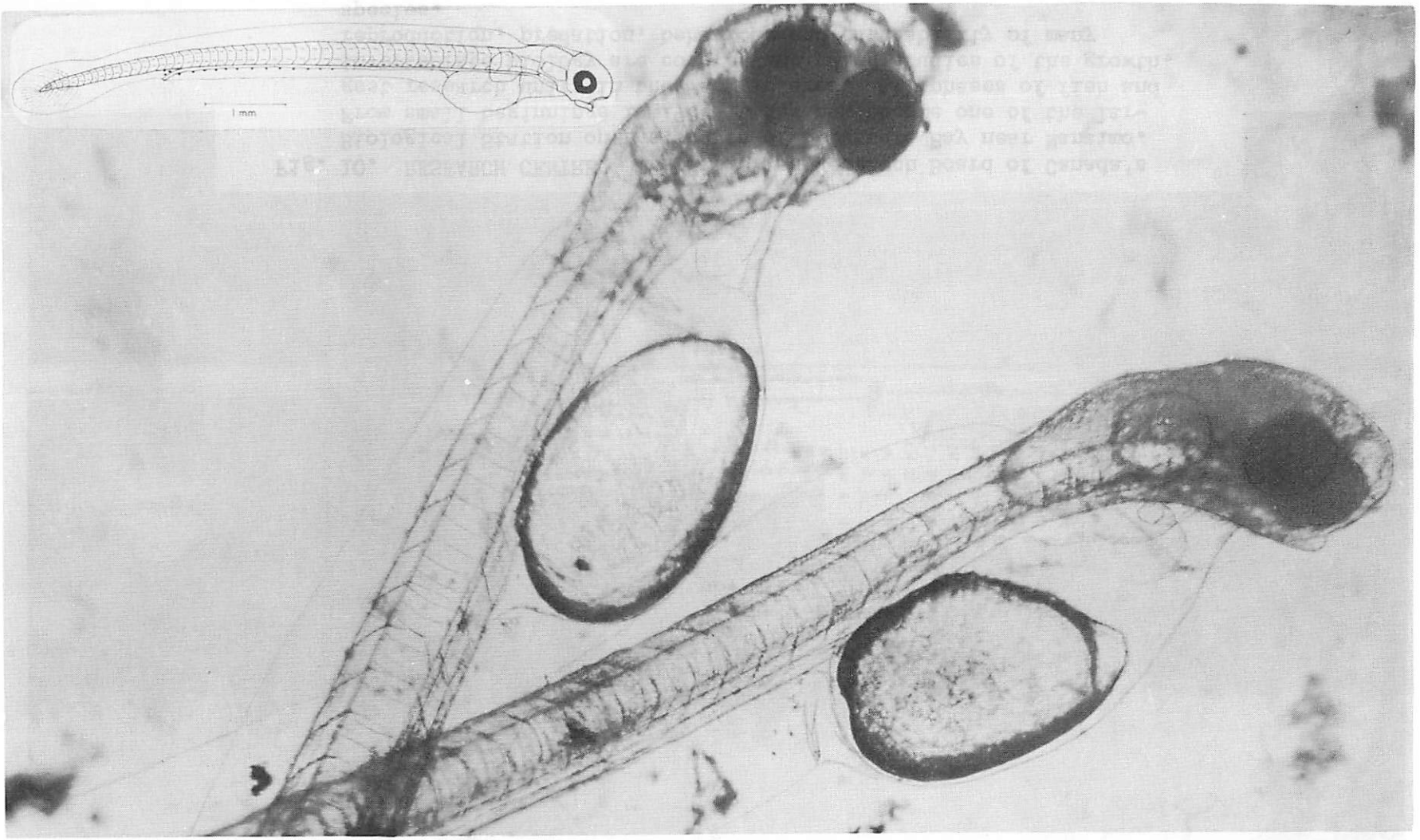


Fig. 9. INFANT HERRING. The fragile, transparent appearance of larval her- is illustrated by the two greatly enlarged young shown above. These one-quarter-inch long, infant fish with yolk sac attached lack scales and can barely swim. As ocean currents sweep them gradually away from the nursery areas they undergo awesome casualties from predation and starvation. In the upper left corner a full length sketch of a herring larva is shown.

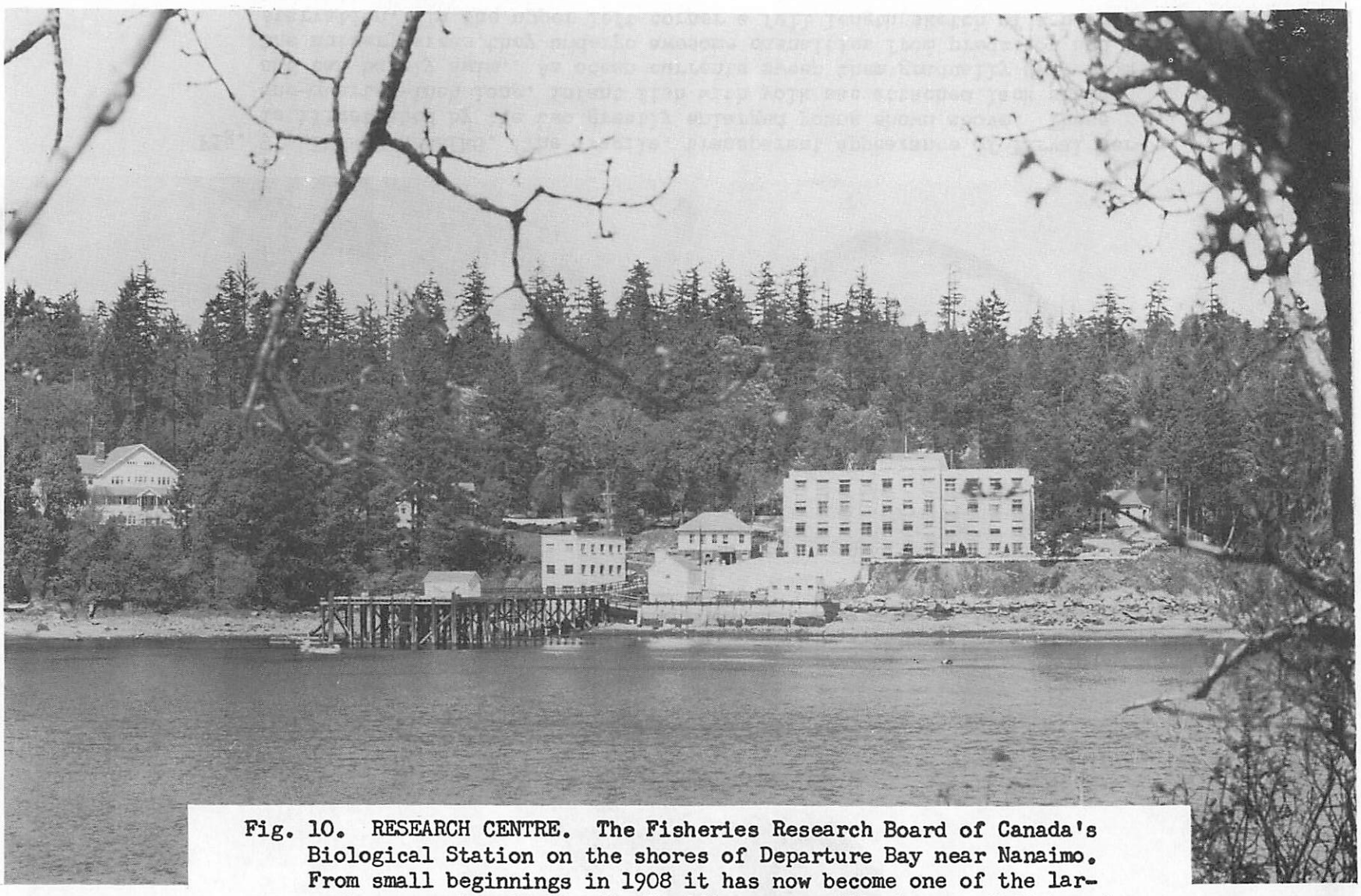

Fig. 10. RESEARCH CENTRE. The Fisheries Research Board of Canada's Biological Station on the shores of Departure Bay near Nanaimo. From small beginnings in 1908 it has now become one of the largest research units in the Pacific area. All phases of fish and invertebrate biology are covered including studies of the growth, reproduction, predation, behaviour and catchability of many species.

of recruits to the fishable schools (year-class strength).

The British Columbia herring fishery is regulated through the Federal Department of Fisheries by a combination of closed areas, closed seasons and catch quotas. The closed season extending from February 5 to May 1 in southern British Columbia is designed to protect the fish at spawning time when they are massed close to shore. By mutual agreement, a 48-hour closure period occurs each weekend as well as a 3-week shut-down over Christmas. However, control of the fishery is provided principally by a system of catch quotas applied to most of the major herring populations. Thus, 40,000 tons of herring may be taken each year from the herring population off the lower east coast of Vancouver Island. If surveys by patrol vessels of the Department of Fisheries (Fig. 11) and biological evidence indicate fish are unusually abundant, extensions to quotas are usually granted.

## HUNTER AND HUNTED

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 northeastern Pacific Ocean. 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 a whole constellation of 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.

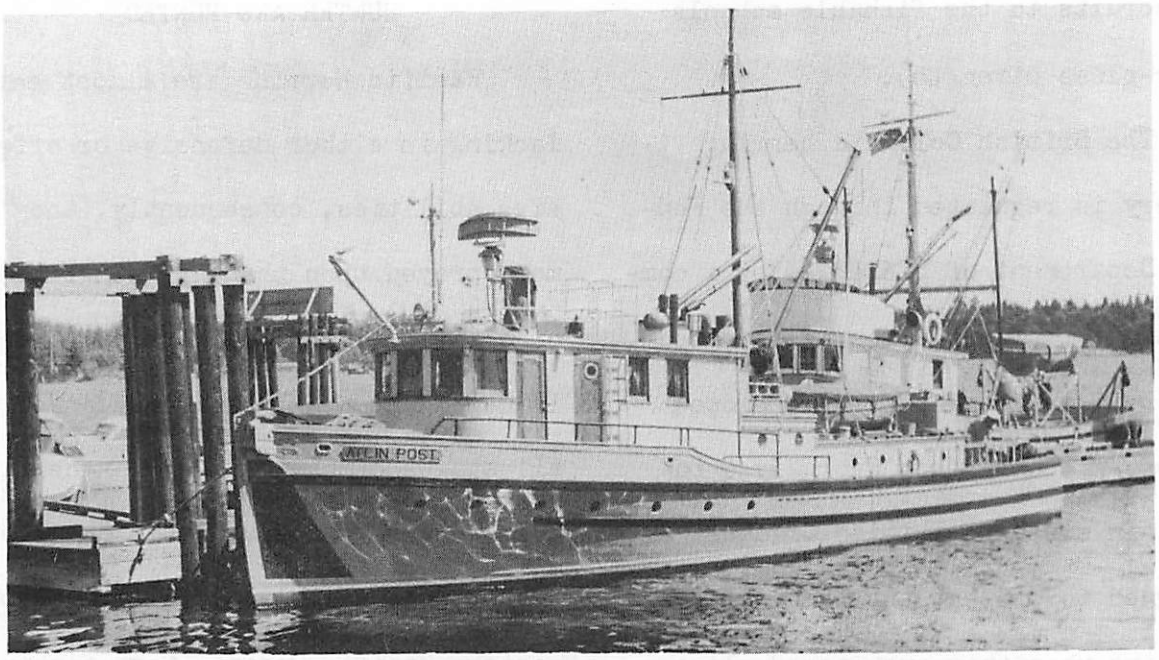


Fig. 11. FISH GUARDIAN. The fishery patrol vessel "Atlin Post" docked at Nanaimo, B.C. Vessels of this type are used to facilitate the regulation and management of renewable, marine resources like salmon, herring, cod, halibut and shellfish. Regulations pertaining to coastal fisheries are made by federal authorities. Aft the patrol vessel can be seen the fifty-four feet research trawler "Investigator No. 1".

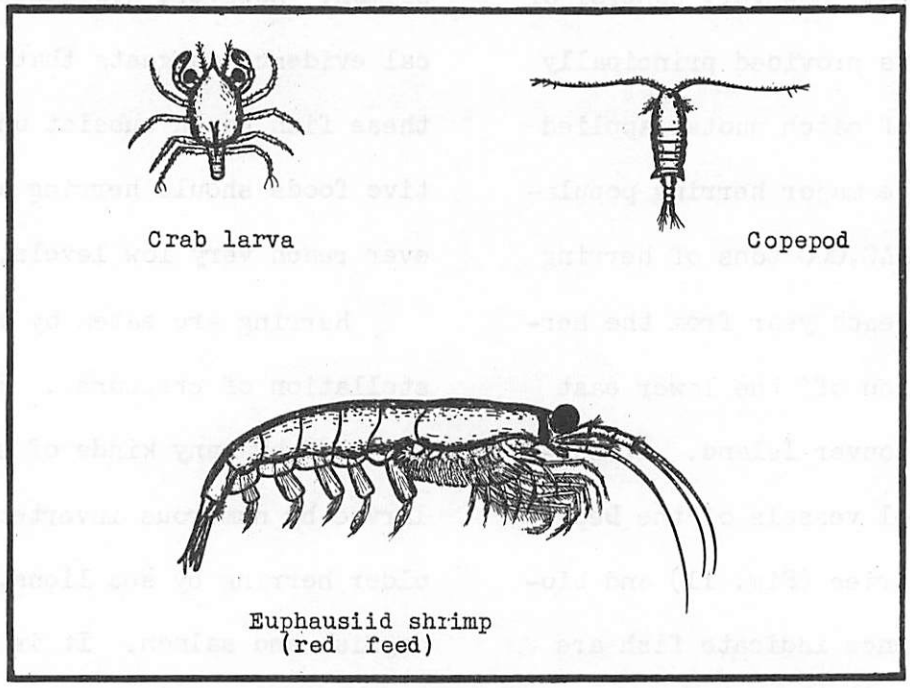


Fig. 12. PLANKTONIC FISH FOOD. Herring do not prey on other fish but feed on swarms of tiny, almost invisible sea organisms collectively called zooplankton. If the stomach contents of a Pacific herring were to be examined the chief articles of food present would undoubtedly be amphipods, copepods and shrimplike euphausiids (red feed). The latter two categories of sea life (enlarged 3 times) are pictured above together with a larval crab.

In turn, herring feed on flea-sized organisms, such as copepods, amphipods and the young, free-swimming stages of barnacles and crabs (Fig. 12). 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 zooplankton 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.

## A RENEWABLE COMMODITY

The survival of herring is a stimulating study. The natural calamities affecting the numbers of herring in the ocean are probably of much greater significance than man's effect on the stocks. Only one herring from 10,000 eggs is destined to return to spawn. In spite of this seemingly high mortality, herring exist in fabulous numbers in the temperate waters off Canada's western seaboard. This region supports a vast reservoir of minerals, proteins and vitamins that is renewable year after year with very little help from man. Herring clothe themselves, feed themselves and perpetuate themselves. Today this natural resource is utilized only to a limited extent directly for the sustenance of the shoredwellers. No doubt a time will come when Pacific coast herring stocks will prove to be an invaluable food source in a world of rapidly increasing population.

ROGER DUHAMEL, F.R.S.C.
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