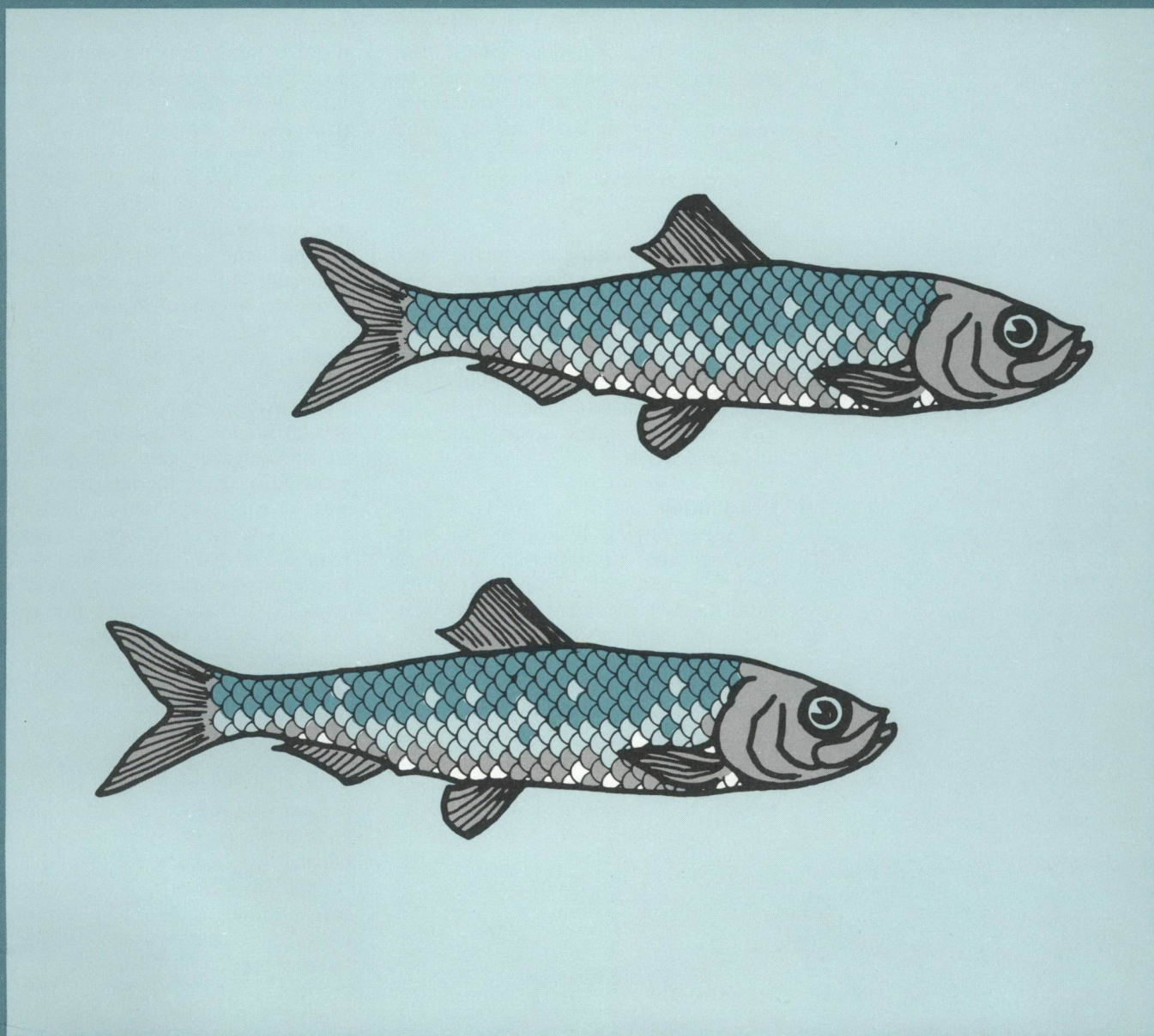




Underwater World

Pacific Herring



Pacific Herring

Captain George Vancouver, when he sailed in 1792 along the coast of what is now British Columbia, replenished his food stores by purchasing fish from the local Indians. Archibald Menzies, a naturalist who also traveled on H.M.S. *Discovery* that year, identified these fish as a form of herring. Today, the fish is called *Clupea harengus pallasii* — Pacific herring — and it is one of the most abundant of the 250 or so species of fish which inhabit the waters of Canada's west coast.

Closely related to the California sardine and the American shad, the Pacific herring ranks second only to Pacific salmon in terms of commercial value to the west coast fishery. It is prized primarily for its roe, a delicacy exported exclusively to Japan.

Description

The Pacific herring is a small, bony fish with a blue-green back shading into iridescent silver-white on the sides. Its mouth is large, with a slightly jutting lower jaw, and the tail is deeply forked. It is a slender, streamlined fish that moves fast and gracefully in the water and is almost always encountered in schools.

Distribution

Pacific herring live most of their lives in the nutrient-rich offshore feeding grounds of the western continental shelf. They range along the west coast of North America from Baja California in Mexico to the Beaufort Sea in the Arctic, and also along the coast of Asia as far south as Korea.

There are many other varieties of herring, including the slightly larger fish in the Atlantic Ocean that has been caught by European fishermen for

thousands of years. Archaeologists have found that herring were eaten in Denmark as early as 3000 B.C., and England's herring fishery is known to date back to at least 500 A.D.

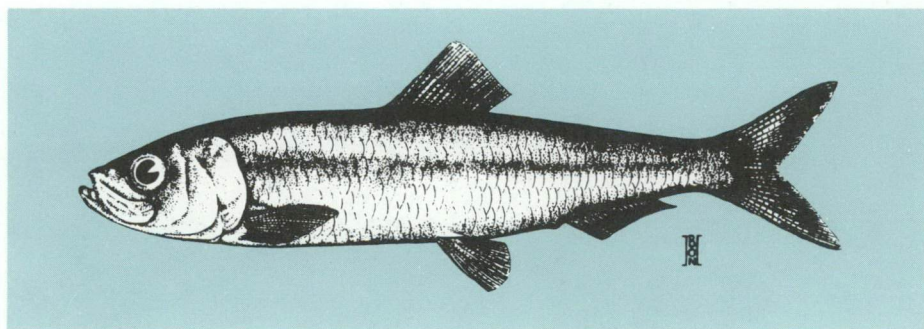
Reproduction and growth

Adult herrings mature sexually at the age of three or four years. Thereafter, for every year of their lives, they migrate from offshore summer feeding grounds into coastal waters where they spawn between February and June, with a peak in activity between late March and early April. Migrating inshore in late fall and winter, the fish move into sheltered bays where they form dense schools to wait for their reproductive organs to "ripen". As soon as they are ready to spawn, herring leave the deeper water to crowd into shallow areas, with as many as 75 per cent of the fish returning to the beaches where they themselves were spawned. This shallow-water spawning is one of the main features distinguishing the Pacific herring from its Atlantic cousin, which deposits its eggs in deep water.

An average fish will lay 20,000 to 40,000 sticky, transparent eggs that cling to eelgrass, kelp and other plants growing in or below intertidal waters, with herring eggs often exposed to the air at low tide. In some areas, the numbers of fish are so high that they spawn in successive waves, with one school after another moving toward the beaches. So thickly do the herring congregate during spawning that the eggs, each one measuring about one and a half millimetres, are laid in many layers. In fact, eggs buried under several layers are in danger of suffocation.

Though the males and females are present in more or less equal numbers at spawning, there is no individual pairing off. Males fertilize the eggs simply by releasing sperm into the surrounding waters. The sperm, or milt, can turn the ocean opaque and milky-white for miles. In 1972, a bumper year for herring, over 450 square kilometres of B.C. coastal waters were white with herring milt. That opacity serves a secondary purpose in protecting the spawning fish from the attacks of predatory seagulls.

Fig. 1 Adult herring



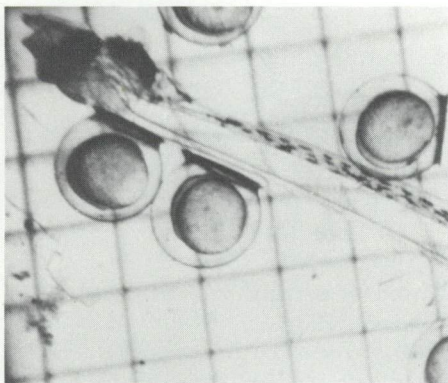


Fig. 2 Herring eggs and larva

The eggs hatch simultaneously, some 10 to 21 days after they are fertilized, depending on the water temperature. At this time, the coastal waters fill with tremendous numbers of tiny herring larvae, each measuring about nine millimetres in length. Two months pass and the fragile, transparent survivors, which by that time have grown to about 35 millimetres in length and are called *juveniles*, begin to take on an adult appearance by developing scales and colouration. Fish at the same stage of development join together in schools.

The adult Pacific herring grows to only about 25 centimetres at maximum length, with most of the growth accomplished in the first three or four years of its life — before it becomes sexually active. After that it grows slowly, and at the end of its potential lifespan — at around nine or 10 years — it is not much larger. The oldest specimen on record, taken at 15 years of age, measured 33 centimetres and weighed less than 500 grams.

Food

Herring depend to a large extent on plankton for sustenance. At twilight, plankton tends to rise towards the ocean surface, sinking again in the morning. Pacific herring follow this up-and-down movement, and herring fishermen tend to fish at night in order to exploit these "swims".

Habits

The Pacific herring live their lives in the midst of large schools. As juvenile fish, herring school in the inshore weed beds near where they hatched. These sardine-sized fish are not commercially exploited as they are on the Atlantic coast, but they are caught by sport fishermen and used as bait in the recreational salmon fishery.

At the end of the first summer of their lives, the small herring — about 10 centimetres long by then — move on to new feeding grounds, migrating sometime during October to offshore banks that lie as much as 200 kilometres from the coast. Most herring do not return inshore until they are ready to spawn. Only a few stocks remain

year-round in the coastal bays and inlets of British Columbia to form the basis of a small summer bait fishery.

Predators

At all stages of their lives, herrings are the favourite prey of many fish, birds, animals and, of course, man. From the beginning, the seagulls are their prime enemy. They, and other seabirds, swoop down on the spawning fish and feast on the roe. In fact, between the seagulls, the ducks and the crows, almost half the eggs are consumed before they have a chance to hatch.

Perch, salmon and other fish, as well as invertebrates such as the jellyfish and arrow worm, also consume great quantities of the helpless herring larvae which have such large heads that they can barely swim. In places where the herring spawn in waves, individuals in the second wave may themselves gorge on the newly-hatched larvae. This continual predation, along with the currents that sweep the larvae onto shore or away from the protected shallows, and the often limited supply of food, combine to account for an approximate one per cent survival rate among herring larvae. A 1962 herring census estimated, however, that some two trillion eggs had been laid during the previous season. So the herring manages, if man allows it, to hold its own.

Even fully grown herring are fair game. Eaten by sea lions, whales, lingcod, dogfish, salmon and seabirds, they are the target of just about everything that lives in the sea. On the average, only one of every 10,000 eggs laid is destined to become a mature herring which returns to spawn.

The Fishery

The coastal Indian tribes of British Columbia used herring and herring roe for food and trade for centuries before the Europeans arrived on the West Coast. It was not until 1877, however, that herring was fished commercially on a significant scale.

The market for herring has changed drastically in the last century. In the early 1900s, dry, salted herring was exported from British Columbia to a

Fig. 3 Seiners set their nets



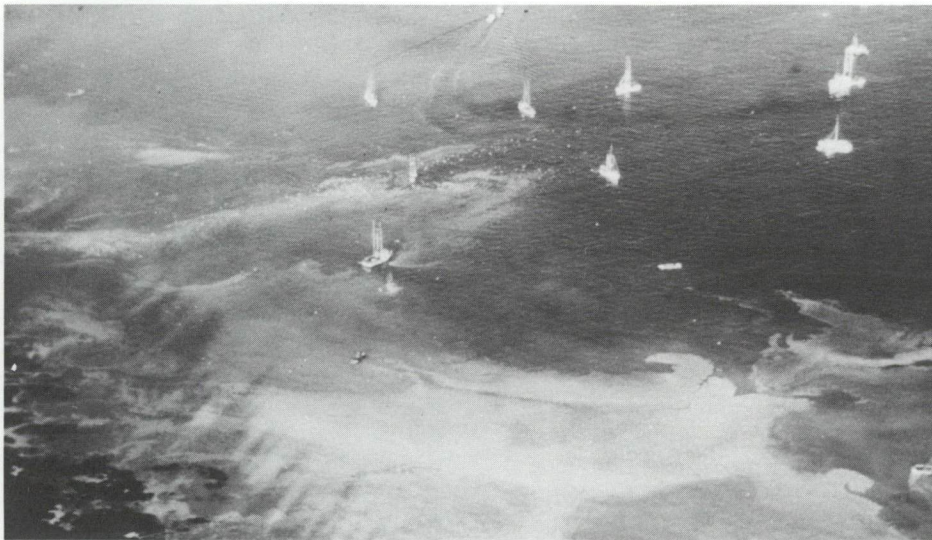


Fig. 4 Herring milt turns water opaque and milky white

large, Oriental market. Later, in 1934, when the market for food herring dropped off, fishermen began catching herring as a basis for oil and fish meal. This fishery resulted in a return of more than 140,000 tonnes annually for more than 30 years, but continuous exploitation, especially for about four years of poor year-class recruitment in the late 1960s, depleted the stocks and forced the Department of Fisheries and Oceans (DFO) to close the fishery. A reduction fishery is no longer permitted, except as a by-product of the roe fishery.

The stock recovered within a few years after the imposition of the ban. As a result fishermen were able to respond to a strong demand from Japan for herring roe, and in 1971, a new and very lucrative fishery was initiated. B.C. now produces prime quality herring roe.

Timing is the crucial element in the roe fishery, as the fish have to be taken at the right moment before they spawn. Fishery officers, biologists and technicians work with fishermen, therefore, to make sure the herring are harvested at the right point. Opening an area to herring fishing too soon would result in too much immature roe, and a greatly decreased catch value. Opening too late, however, would mean large numbers of spawned-out fish in the catch.

Roe herring are fished in two ways. Large purse seine vessels are most effective where spawning is concentrated in geographical terms and when

it lasts only a very short time. Seine nets are very efficient in such circumstances. The net is laid in a circle around a school of fish, frequently located with an echo-sounder. Then the bottom of the net is drawn inwards to form a bag. Fish are hauled in and pumped out of the net with a large pump.

Smaller vessels with gillnets are used in many cases, because their small nets can be set very close to the actual spawning grounds. That gives fishermen control over their catch and means that a large proportion of spawning herring will be taken in relation to immature or spawned-out fish. Gillnets are very effective where spawning is spread out over a long stretch of coastline and continues for several days.

At spawning time, herring carcasses are extremely lean and are of little value as food. Consequently, after the roe is removed the carcasses are made into fish meal — a common poultry feed.

An offshoot of the herring roe industry is the "spawn-on-kelp" fishery. The fish are impounded and the weed is hung in the enclosure until spawn is deposited on it. Again, Japan is the major market.

Herring is also fished for bait and for food, but only about five per cent of the catch goes for human consumption in the form of either salted, pickled, canned or fresh fish. The bait fishery concentrates on smaller fish which are frozen for use in the recreational salmon and commercial sablefish and halibut fisheries. The great advantages of herring as a bait is that it gives off a faint trace of oil as it is dragged through the water. This tends to attract larger fish.

Management

DFO closely monitors the herring fishery in British Columbia, since the roe fishery can present some very special problems. A combination of precise computing and field work is required to ensure that sufficient herring eggs are laid each year to keep the stock plentiful.

Fig. 5 Herring in gillnetter





Fig. 6 Women sort herring roe

The abundance of different herring stocks is forecast a year ahead on the basis of varied data, including catches recorded during the previous year at all fishing grounds. Sample catches are used to determine the structure of the stock (average length, age, weight and sex ratio). Surveys of spawning grounds are carried out to determine the area and density of spawn.

From this information, officials calculate the number of spawning herring that must escape the fishermen's nets in order to sustain the population. By subtracting this "escapement" from the estimated abundance of herring stocks, the total allowable catch (TAC) is decided for the next fishing season.

TAC estimates act as guidelines to help fishermen, fish processors and DFO officials plan for the season ahead, with each type of fishing gear getting a fair chance at part of the available catch. DFO Fishery Officers are responsible for the actual control of the fishery in given areas. Their purpose is to make sure that regulations are adhered to and quotas are not exceeded.

Before the fishery opens, echosounders are used to determine the number of herring present in an area, and stocks are sampled. A revised estimate of the available catch is then arrived at and previously determined TACs are adjusted, if necessary, on the basis of up-to-the-minute information.

Herring roe fisheries, because of their brevity, draw a large number of licensed fishing vessels into a concentrated area. The Fishery Officer has to estimate how many fish the vessels on the scene are capable of catching. Fishing time is accordingly adjusted so that the catch capacity of the fleet corresponds roughly to the amount of available fish. For the seine fisheries in particular, the catch capacity of the fleet is so great that an opening can be as brief as 15 minutes.

Fishery Officers must also check that fishermen and their boats are properly licensed and equipped, and that they do not take more than the allowable catch of fish. Skillful management of the roe herring fishery should prevent overfishing, yet allow fishermen to make a good living.

DFO has adopted a "best use" policy for the herring fishery, the purpose being to ensure a maximal economic return for fishermen, along with a healthy processing sector, through which the greatest possible benefit is derived from the resource without serious stock depletion. It is part of this policy that the catch should be processed in Canada, because herring products demand a higher price on world markets than unprocessed fish. The policy also stresses diversification of markets for herring products to ensure greater price stability.

Fig. 7 Gillnet fishermen pull in herring



Further Reading:

- Hart, J.L. 1973. *Pacific Fishes of Canada*. Fisheries Research Board of Canada; Bulletin 180; pp. 96-100.
- Hourston, A.S. and Haegele, C.W. 1980. *Herring on Canada's Pacific Coast*. Canadian Special Publication of Fisheries and Aquatic Science, 48, 23 p.

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