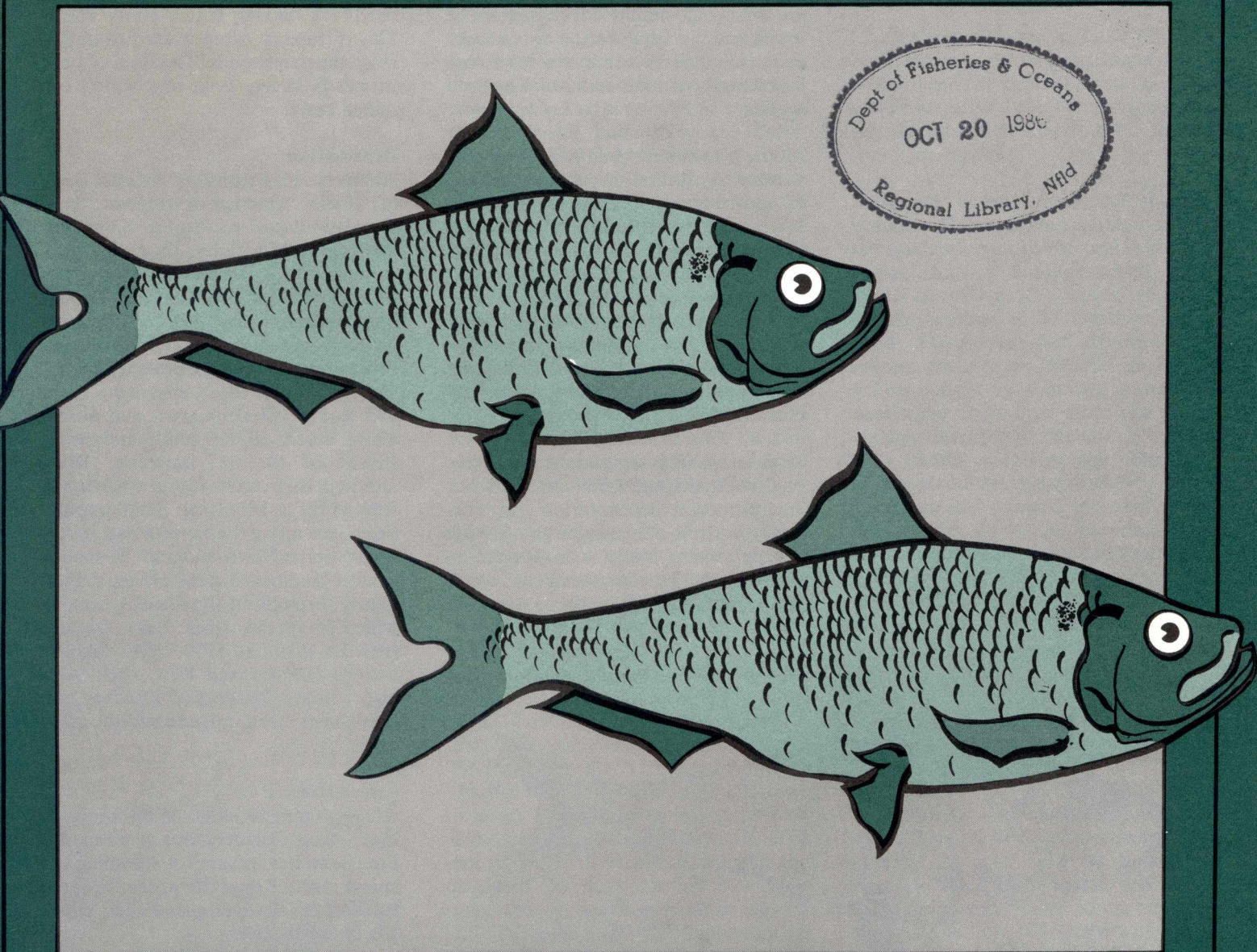


Underwater World

Alewife



The Alewife

Since colonial times, the alewife has been an important factor in the economy of the Maritime provinces. These fish are found in almost every Maritime stream and river, and are used for local subsistence and export.

The alewife (*Alosa pseudoharengus*) and a closely related species, the blueback herring (*A. aestivalis*), are commonly referred to as gaspereau in Atlantic Canada and as river herring along the Atlantic coast of the United States. To avoid confusion, the term "alewife" will be used to represent both species because their appearance and biology are somewhat similar. Fishermen make no distinction between the two species and commercial catch statistics are based on the combined harvest of both species.

As the Maritimes developed, there was a marked decline in the abundance of gaspereau. As early as the mid 1800s, one concerned official wrote that "... the gaspereau fishery has been considered of so much importance that various Acts of Assembly have, from time to time, been passed for its regulation and protection. But these laws have either been neglected, or not properly enforced, and this fishery is rapidly declining."

Modern fishery regulations are more comprehensive and better enforced, but environmental deterioration has worsened with the expansion of human population and industry, and pollution such as acid rain threatens stock abundance.

Description

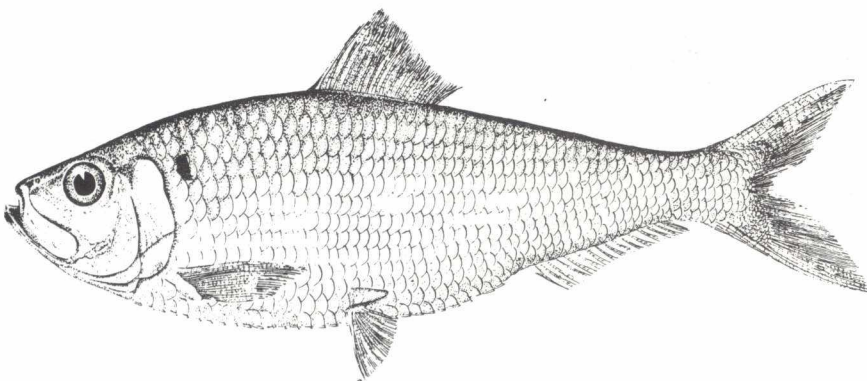
As the name river herring suggests, the alewife somewhat resembles the marine herring. It is small, usually less than 30 cm long and 400 g in weight, laterally compressed and has a deep keel edged with saw-like keel scutes. It has silvery, iridescent sides, a greyish-green back and a single black spot on its shoulder immediately behind the gill cover at the level of the large eye. Sea-run fish may have a golden or brassy sheen. There may be several variegated dark stripes along the sides above the midline. The lining of the alewife body cavity is pale grey to pinkish white, whereas in blueback herring it is a sooty black. This difference often is used to distinguish the two species. The flesh of both species is sweet, firm, and white, but rather bony.

Distribution

Alewives range along the Atlantic coast of North America southward from Newfoundland to South Carolina. Within the Maritimes, they are abundant in large rivers such as the Miramichi, Margree, LaHave, Tusket, Shubenacadie and Saint John and proportionately less abundant in most small streams. They are present but relatively scarce in the Restigouche River and Bay of Chaleur area, and absent along much of the south and north shores of the St. Lawrence River although they can be found upstream at least as far as Montreal. Small populations exist along the western and southern coasts of Newfoundland. The much smaller landlocked alewife occurs abundantly throughout the Great Lakes, to which it spread from Lake Ontario between 1930 and 1950. Other lakes in eastern Ontario and New York State also contain landlocked alewives and they have been introduced to other areas.

Life History

Alewives may be either anadromous or landlocked. Anadromous alewives utilize freshwater streams for spawning but spend most of their life at sea, whereas landlocked alewives spend their entire life in freshwater.





The transition between salt and freshwater by anadromous fish is readily accomplished but does require certain physiological adjustments to maintain the water-salt balance of the body. Thus, on entering freshwater a fish tends to absorb water through the body surface and gut and must excrete an increased amount of urine while retaining and even absorbing necessary body salts which are scarce in freshwater. When at sea, the fish must reduce its urine output and increase the excretion of salts, which are available to excess in the sea. Much of the salt absorption in freshwater and excretion in saltwater is done by special cells in the gills and membranes of the mouth while the kidney is responsible for the level of urine excretion and the retention of salts.

The timing of the spawning migration of anadromous alewives is related to water temperature and thus begins earlier at southern than at northern latitudes. In South Carolina, river entry occurs in March and April when water temperatures are near 8°C. In New Brunswick streams tributary to the Gulf of St. Lawrence, river entry occurs in May and June. Maturing alewives can be found in the harbour and lower reaches of the Saint John River in late January but upriver migration, which occurs primarily during daylight, does not begin until April. It is generally accepted that alewives home to their natal stream, much as Atlantic salmon do, although some fish inevitably go astray. Smell plays an important role in the homing process. In large rivers,

some fish may run upstream as much as several hundred kilometers. They can negotiate small rapids but rarely leap over obstructions.

Immature alewives, mostly age 2 and 13 to 15 cm long, often migrate into the lakes of the lower Saint John River during the latter part of the spawning run (mid-to-late June) where they are known locally as "flippers" because of their activity when caught. An unusual occurrence was the appearance one year of large numbers of one-year-old alewives at Mactaquac Dam, located about 150 km upstream from the river mouth.

Landlocked alewives in Lake Ontario begin moving inshore from deeper water in April but the peak of spawning may not occur until June. Water temperatures must reach about 10°C before spawning begins.

Spawning occurs along the shallow beaches of lakes, in sluggish stretches of streams and even in the ponds behind coastal barrier beaches which have access to the sea. In southern regions, swampy sections of the river may be utilized. Female sea-run alewives may release 60,000 to 200,000 or more yellow-orange eggs during spawning, depending upon their size. The much smaller landlocked alewife produces only 10,000 to 12,000 eggs. The randomly broadcast eggs are slightly adhesive when first released and tend to settle and stick to bottom materials for a short time. When water hardened, the eggs are about 1 mm in diameter. For each group of fish, spawning lasts only a few days. Hatching requires 3 to 6 days at water temperatures between 15° and 22°C.

Larval alewives are about 4 mm long when hatched but by late August they have reached lengths of 50 to 70 mm in Maritime streams. Factors such as water temperature, food availability and predation level are believed to influence the survival of larval alewives during the first few weeks of life and largely determine the abundance of young alewives that year. In turn, the numbers of young alewives produced is related positively to the number of returning adults four

to five years later. Although downstream migration by young alewives may begin in late July, most migrate during August and September and some may remain as late as November. Some evidence indicates that a high abundance of juveniles may initiate early migration by small fish from the nursery area. Adults return to the sea shortly after spawning; most have departed the river by mid July. Adult landlocked alewives migrate to deeper water after spawning as do young fish as they grow.

Once at sea, young alewives typically remain there four to five years before maturing and beginning the reproductive cycle anew. Although adult mortality following spawning may be high (40 to 60 per cent), the surviving adults may return to spawn annually for several years. Ten-year-old fish that are believed to have spawned up to five times are known, but most spawn only two to three times before being caught in a fishery or dying naturally. The ability of alewives to spawn more than once helps to stabilize their numbers by protecting against the occurrence of years when the survival of young fish is poor.

The movements of alewives at sea are poorly known. Fish of similar size congregate in large schools but some may be found mixed with schools of Atlantic herring and menhaden. There is evidence that young alewives may remain in inshore waters for one or two years in northern regions. Older fish, however, have been found during summer in abundance in the upper Bay of Fundy and up to 100 km offshore in areas such as Georges Bank and Emerald Bank and at depths of more than 100 m. They may undertake extensive seasonal migrations, much as American shad are known to do, moving south from their natal areas as winter approaches and north during spring. More evidence is required for firm conclusions but alewives can apparently migrate long distances as shown by two fish that were tagged and released in the Saint John River in the spring of one year and caught in late winter of the next year by a fisherman in North Carolina.

Female alewives tend to be larger than males, to mature later and to live several years longer. For example, in the Saint John River, females often exceed males of the same age by about 10 mm in length and mature at age five rather than four. Differences of one or two years in the age at maturation of alewives may occur between river systems but no latitudinal gradient is evident. The size and growth rate of northern stocks, however, tend to exceed that of southern stocks. Landlocked female alewives, on the other hand, mature at age three with males maturing at age two. Growth is most rapid in the years preceding maturity because, with maturity, much energy is devoted to developing sexual products rather than to growth.

It has been suggested that the freshwater environment somehow hastens sexual maturity. That may be so, but it is clear that the freshwater environment of the Great Lakes places great stress on landlocked alewives which results in massive die-offs, particularly in the spring and summer. Dead and dying fish may wash ashore in such numbers as to constitute a health hazard to nearby communities. The cause of these die-offs is uncertain but appears related to the alewife's inability to acclimatize to rapidly rising or fluctuating water temperatures and to certain physiological changes associated with stress.

Alewives are opportunistic feeders, foraging primarily on zooplankton (small crustaceans) at the surface, yet under certain conditions consuming items such as bottom-dwelling insect larvae, adult insects, fish eggs and larval fish. They also can effectively filter-feed by swimming with their mouth agape and non-selectively straining the water with their gill rakers (comb-like projections from the gill arch). Young alewives in freshwater feed most actively at night, then the schools of fish tend to rise from deeper water to near the surface and to disperse, as do their prey. The behaviour of adults at sea is presumably similar. Adult alewives feed little, if at all, during their spawning migration.

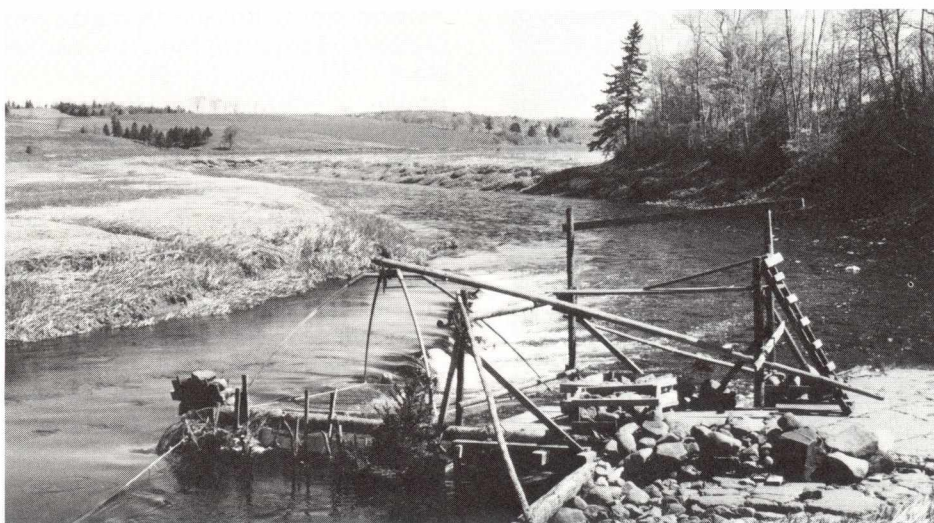
The nutrients added to the stream environment from alewives that die after

spawning contribute to the spring bloom of zooplankton that in turn is fed on by young alewives. This effect, of course, is most pronounced when large numbers of spawners enter small streams. Large numbers of young alewives may graze the available stock of zooplankton sufficiently to reduce it greatly.

Little is known about the marine predators of alewives. Freshwater alewives are preyed upon by large piscivorous fishes such as bass, perch and trout of several types, and the Pacific salmon introduced into the Great Lakes consume large quantities of landlocked alewives. When such forage is abundant, the growth rates of resident game fishes are improved.

The Fishery and Utilization

The harvest of sea-run alewives by present day commercial fisheries is much lower than it was in colonial times. Nonetheless, important fisheries exist in most of the Atlantic coastal regions of the United States and in the Maritime Provinces, particularly New Brunswick and Nova Scotia (Table 1). These figures are minimal harvest estimates because they do not include the often substantial quantities that are taken by dip-net fishermen. Historically, alewives have been used both as food, either fresh or salted, and as bait; uses that reflect their high volume and relatively low dollar value, (now less than 5 cents per kg for food use and about 25 cents for fish as bait). The value of the 1983 Maritime harvest was about \$940,000.



Catches have undergone large fluctuation over time in response to environmental changes (mostly man-made) and market demand. Thus, an observer in the mid 1800s reported that "very slight obstructions suffice to prevent the gaspereaux from ascending streams to their old haunts; the dams for mills, or for driving timber, have shut them out in numerous instances from their best spawning grounds, and the greatest injury has in this way been inflicted on the fishery." Prior to the introduction of refrigeration, alewives were prized as food fish because they were salted easily for shipping to distant markets. With the advent of refrigeration and the availability of other foods, tastes changed and their use as human food declined. However, salt fish are still shipped from the Maritimes to the Caribbean and Middle East. During the late 1970s, canned filets and a marinated product were also produced. They also have been used for pet food and for reduction to fish meal, but these uses have declined recently. It seems that the existence of a market may influence the magnitude of landings more than does price and thus reported landings may be an unreliable indicator of the status of alewife stocks.

Alewives are widely used as bait in the lobster and crab fisheries along the Atlantic coast and once were used as bait for species such as cod, haddock, pollock and mackerel. The bait was thrown overboard from fishing vessels to attract the mackerel which were then caught in nets. An 1868 report to the Minister of Marine and Fisheries noted that one of the causes of the recent failure of the mackerel fishery along the Atlantic shores of Nova Scotia "may be found in the diminishing supply of bait afforded by our rivers and streams, the sad havoc caused among the gaspereaux and other fish which formerly resorted in such vast quantities to our shores, by the erection of mill dams across so many of our best rivers, without sufficient fish passages . . ."

A variety of gears are employed to catch alewives as they migrate upriver. For example, trapnets are used in the lakes of the lower Saint John River and in the

Year	Nova Scotia	New Brunswick	Prince Edward Island	Grand Total
1970	1,097	2,136	48	3,281
1971	1,660	9,267	13	10,940
1972	2,124	5,640	21	7,786
1973	3,392	4,990	63	8,445
1974	4,203	4,564	47	8,814
1975	3,393	2,925	81	6,399
1976	3,319	4,081	165	7,565
1977	4,204	5,818	97	10,119
1978	4,283	5,457	104	9,844
1979	4,142	6,091	404	10,637
1980	4,207	5,791	254	10,252
1981	2,530	4,103	259	6,892
1982	2,375	3,191	133	5,699
1983	1,222	2,867	36	4,125

Table 1. Commercial landings (t) of alewives in the Maritime provinces, 1970-83

estuary of the Miramichi River; gillnets are used in lakes, estuaries and quiet stretches of river; dipnets are used in rivers at the foot of rapids or other obstructions; weirs are used in rivers such as the Margaree River; squarenets (a large, pole-mounted dipnet braced on a pivot) are used in the Gaspereau River. Brush and netting weirs are used along the coast of Minas Basin in the upper Bay of Fundy to catch fish at sea. During the late 1960s and early 1970s, foreign high seas fishing fleets heavily exploited alewives on the continental shelf, particularly off the mid-Atlantic states and are blamed for a reduction in the return of alewives to this area. Mari-

time alewife stocks were less affected and regulation changes imposed with recognition of the 200-mile economic zone have virtually eliminated the problem.

The very high reproductive potential of alewives means that stable and sustained yields can be achieved from runs which experience high (70 to 90 per cent) fishing mortality rates. There is, however, a relationship between the number of fish spawning and the abundance of fish returning in subsequent years so that larger escapements result in higher future returns.

Fisheries Management

Perhaps the most significant act taken to restore depleted runs of alewives was the provision and enforcement of a requirement for adequate fish passage at obstructions to fish migration such as mill and hydroelectric dams. Changing patterns in industry also have resulted in the removal of many mill and logging dams on smaller streams. Fishery control mechanisms such as the creation of fishing seasons, weekly closed periods and fishing gear regulations, help the maintenance of established alewife stocks. The recent attention paid to reducing the level of agricultural, municipal and industrial water pollution has also been beneficial. Alewife runs have even been reestablished in suitable streams by the release of transplanted adult fish, particularly in the New England states.

Alewife stocks are insufficiently well understood to permit the use of annual stock assessment to determine the amount of fish that should be caught by the commercial fishery. One inadequacy is the lack of accurate and comprehensive records of fishing harvest and effort. Nonetheless, biologists are making progress towards better management of the resource. Trends in commercial landings and fishing effort, when coupled with biological information on the age and size composition of the run, provide a basic understanding of the status of the stock. Other studies are attempting to link indices of juvenile abundance with future adult returns and to refine the link between adult indi-





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ces of abundance and future returns. Such studies require information over many years before conclusions can be drawn.

Further Reading

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