THE PEMBROKE HERRING RUN
A HISTORY OF THE VALLEY AND FISHERY

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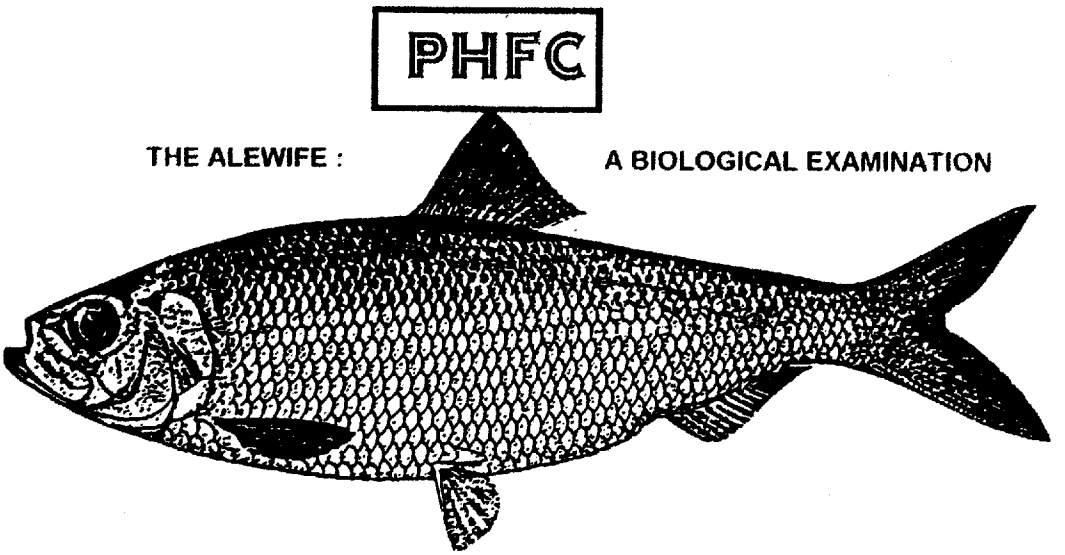


PEMBROKE HERRING RUN: A HISTORY OF THE VALLEY AND THE FISHERY

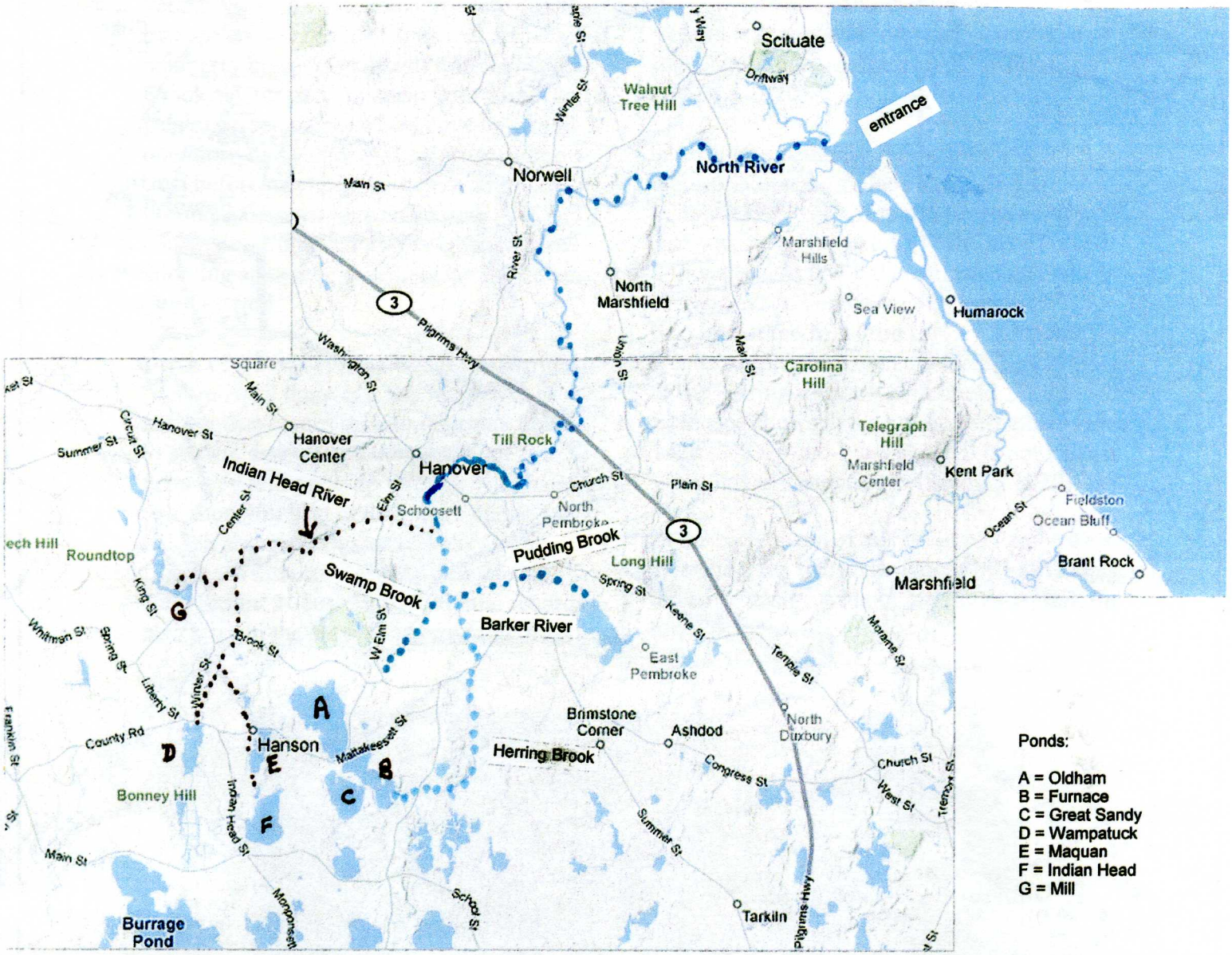
Description: The North River, formed by the junction of Indian Head River and Barker River flows northeasterly through the towns of Marshfield, Scituate, Norwell, Pembroke, and Hanover. (See figure 1). The present outlet to Massachusetts Bay was formed during the gale of 1898, 3 miles to the north of the old opening. It is here that the adult alewife begins its journey towards its spawning grounds in Furnace and Oldham Ponds.

Indian Head River receives its water from a series of ponds- Maquan, Indian Head, and Wampatuck in Hanson, and Mill Pond bordering Hanover and Rockland. Fish passage to these ponds is blocked by a series of dams, built between 1694 and 1920. Some time after 1920, a fish ladder was built at the old Clapp Rubber Factory dam located on the Pembroke-Hanover line on Elm Street. Another herring type called the shad tend to favor the still waters upstream of the dam and a small annual shad run continues to this day.

Alewives turn south along Barker River through one of the most pristine valleys in New England. The major part of the valley is bordered by West Elm Street to the west, Washington Street (Route 53) to the east, and Barker Street (Route 14) to the south, and contains an incredible variety of wildlife and fauna (See figure 2). Joining Barker River in the middle of the valley are Swamp Brook to the west, and Pudding Brook to the east. It is possible that some alewives may venture up Swamp Brook and Pudding Brook and eventually spawn in the eddies and pockets of still water in the marshes, however, there is no evidence presently to support this. It is believed that the majority of alewives continue movement towards their exact place of birth in Furnace and Oldham ponds.

Most of the valley is impenetrable by foot due to the dense growth and water laden marshes, however, there are several high ground dry land entry points that allow penetration into the valley. The Wildlands Trusts of Southeastern Massachusetts built public access trails in 1999 through Willow Brook and Fleetwood Farms that includes an observation tower and boardwalk connecting Willow Brook Farm to the Misty Meadows Conservation area. Also, a dry trail in Misty Meadows leads directly to Barker River. In 1976, the local boy scouts cut a trail along a hill off of Littles Avenue. It ends where dense marsh begins. There is a canoe landing at Curtis Crossing off of Elm Street on the Hanover side of the Indian Head River. Barker River is accessible by canoe or small boat year round up to the intersection of Swamp and Pudding Brooks, however, any further penetration south is tight and almost impossible due to overgrowth. People have been known to make it all the way by canoe to Herring Run Park off of Barker Street, but usually not in the summer months when the volume of water flow is too low.

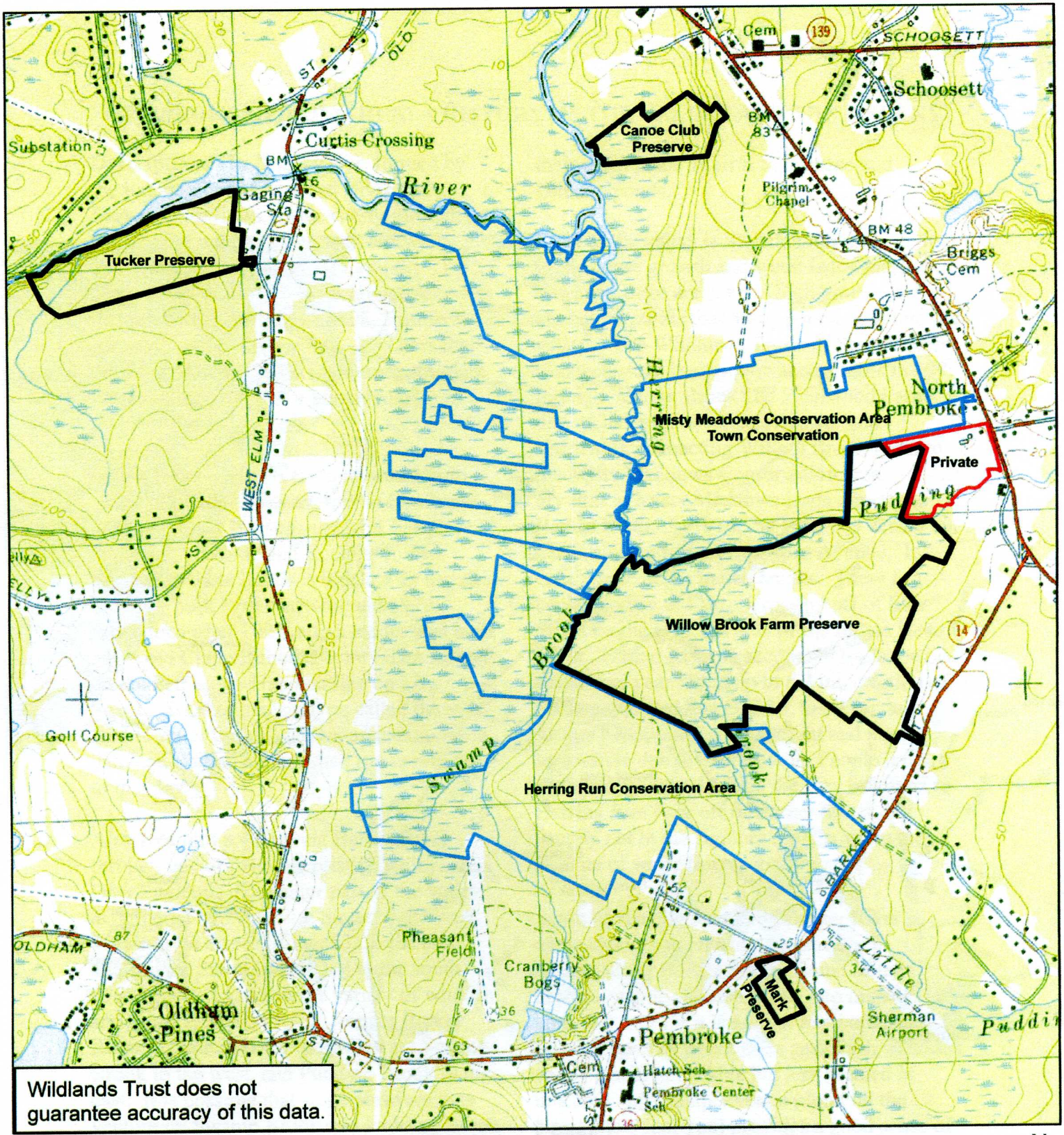
South of Herring Run Park, Barker River's name changes to Herring Brook after it crosses under Barker Street. Some of the brook along this stretch opens into marshy areas but most of it is narrow and bordered on both sides by dense trees and brush. The valley is still noticeable but less defined in this area. Mountain Avenue (don't let the street name fool you) provides a good sense of the topography of this valley with the low point at the center of Mountain Avenue. Between Mountain Avenue and Hobomock Street lies two small ponds named Upper Mill and Lower Mill Ponds both of which have a small fish



Ponds:

A = Oldham
B = Furnace
C = Great Sandy
D = Wampatuck
E = Maquan
F = Indian Head
G = Mill

Figure 1



Herring Brook Valley Open Space
Pembroke, MA

N

Legend

- Wildlands Trust
- Pembroke Open Space
- Private Property

0 0.2 0.4 0.8 Miles

WILDLANDS TRUST

Figure 2

ladder at the pond's downstream exits. Some time ago (estimated about 1958) the takes a 90 degree turn passing about 100 yards west of its old path purposely diverted by man around old Mill sites and abandoned cranberry bogs. Locals call this area Corner Brook. After passing under Mill Street and Center Street, the alewives have to ascend one more fish ladder at the Furnace Pond dam before reaching their spawning grounds. There is also a fish way connecting Furnace Pond to Oldham Pond allowing spawning to take place in Oldham Pond as well.

Birth of a Fishery: In 1616 it was written "that in April there is a fish much like a herring that comes up into the small brooks to spawn, and when the water is not knee deep they will press up through your hands, yea, thou you beat at them with cudgels, and in such abundance as incredible" (Capt. Charles Whitborne "The Travels of Capt. John Smith" 1616). Early Colonial records also refer to the alewife as providing food for the first inhabitants of New England. Fresh herring were a luxury brought to them by Spring where cured herring gave a relish, when fresh meat could not be had, the vegetable diet of summer; and constituted, together with maize their staple winter fare (Belding 1920).

The Indians name for this region was Namassakeesett, or place of much fish (Litchfield 1909). At that time, the supply of fish was greatly in excess of the needs of the population. In 1698, there existed an ancient Indian weir in Pembroke that was used throughout the first third of the Eighteenth Century, until the Town assumed a monopoly of the herring industry (Litchfield 1909). Evidence shows that a public weir existed in 1920 (see figures 4 and 8) but it is not known when it was discontinued (Belding 1920).

In the early years of the Town of Pembroke's existence, the fish were caught by individuals at their pleasure without interference from the town.

Fig. 4 Catching alewives at Barker's River, Pembroke.

PEMBROKE HERRING RUN: A HISTORY OF THE VALLEY AND THE FISHERY

Figure 8

Present Fisheries: Historically, alewives have been harvested for food, bait, and fertilizer. Offshore landings are typically by-catch of harvesting other species, and inshore and river harvests are directed specifically toward herring spawning runs. Alewives are caught commercially in weirs, traps, gill nets, and dip nets set in harbors, river mouths, or lakes up river. (See figure 3). Alewives have been marketed for human consumption, fresh, frozen, smoked, salted, and pickled. Currently, alewives have little commercial value except as bait for cod, haddock, striped bass, and lobster fisheries. In some regions, alewives are used in the production of oil and fish meal for pet food.

FIG. 3 Seining alewives, Mattakessett Creeks, Edgartown

Figure 3

PEMBROKE HERRING RUN: A HISTORY OF THE VALLEY AND THE FISHERY

The Decline: The herring populations seem to be cyclical where there were periods of time when they all but disappeared. For every major decline, prosperity seemed to follow, however, there is a trend that shows the overall population of herring to be continually decreasing. The first sign of decline was in the year 1812 where the supply was considerably below the demand (Litchfield 1909). This decline lasted until 1830 where a return of prosperity set in. It did not last for long where the stock was at a low ebb from 1837 to 1857. Periods of low fish count also existed in the early 1900's, the 1960's, and present day (Bigelow and Schroeder 1998).

Between the years 1680 and 1741, a handful of mills were established on both the Herring Brook and Indian Head Brook. The year 1742 was the first year records show the mills were required to keep their gates up during the spawning run. There is no evidence that these mills caused any problems with the alewife fishery on the Herring Brook. History shows that at one time alewives ventured into Indian Head Pond to spawn, however, since about 1845, no alewives have been seen there. Some time prior to 1920, an unsuccessful attempt was made to establish a fishery on Indian Head Brook. When the Mills stopped functioning, all the dams built on the Herring Brook were dismantled while some of the dams on the Indian Head brook remained. In 1838, shad were taken in Herring Brook for the first time. This lasted until 1896 when that was the last time shad were seen in Herring Brook (Litchfield 1909). It is unknown why they disappeared altogether from this river. At one time, Pudding Brook once led to a reservoir and had its own herring run in the early 1900's, but now overgrowth has reduced this area to a series of marshes. In 1909, Henry W. Litchfield wrote "Pembroke may waken, some fine Spring morning, to find herself left with half a manufactory, and of herrings, never a one."

SITE OF GORMAN MILL-FURNACE POND

PEMBROKE HERRING RUN: A HISTORY OF THE VALLEY AND THE FISHERY

The Le Furgey Mill, Pembroke, Mass.

In 1920, David L. Belding determined that the four causes for the herring decline are: destruction of spawning grounds, pollution of streams, over fishing, and the result of unwise regulation (see figures 5-7). The combined effects of these causes have had drastic long-term effects upon this species. Indicative of these problems is that only nine of an original 27 streams along the Gulf of Maine coast and Massachusetts that once held major river herring spawning runs still did so by 1920 (Belding 1920). Despite their concerns in 1920 regarding this downward trend, disruption of spawning habitats and increasing pollution levels associated with human activities has continued to the present day. Reflecting these trends, coast wide commercial harvests have steadily declined during the twentieth century. In 1896, the total catch for the Gulf of Maine was more than 22 million fish. By 1953, the total catch was less than half that. Of local note, Barker River's fishery was yielding 1000 barrels yearly during that time. In 1993, only 293,000 pounds were landed, which is the lowest level of recorded landings since 1946. To understand the magnitude of the loss of this potential resource, consider the following comparison. If all potential spawning areas in the State of Maine were fully developed, projected alewife landings in excess of 40 million pounds annually could be achieved in Maine waters. This level of production and harvest are estimated to potentially provide 80 percent of the total annual bait requirements for the entire Maine lobster fishery (Bigelow and Schroeder 1998).

FIG. 5. Flooded cranberry bogs, Mattapoisett River

Management: *General:* Since the colonial times, the alewife fishery's operation was conducted in one of a combination of 4 ways, (1) free; (2) town operated; (3) leased; and (4) privately owned. The first fishery law on record, known as the Plymouth Colony Fish Law, was enacted in 1623 for the protection of the alewife. Further legislation was enacted in 1682, 1709, 1727, and 1741, the latter providing that a sufficient passageway be made through or around each dam during a specific time of year. Subsequent legislation for the most part has been local in character and extremely voluminous.

FIG. 6. — Obstruction with wild rice, Herring River, Wellfleet.

The provisions of the numerous laws enacted had the following common points: Establishment of the law and responsibility, passage for alewives free of obstructions, election of a Herring Committee to manage and enforce the legislation, when and where fishing was allowed, penalties for breaking the law, pollution control, and Public rights and sale (Litchfield 1909, Belding 1920).

Recently, policy continues to be written, in part due to the prolonged depletion of river herring. In 1985, the Atlantic States Marine Fisheries Commission established a coastal management plan to regulate harvest, improve habitat quality and accessibility, and initiate stocking programs to restore population in rivers where they historically, but do not presently occur. Twentieth century efforts at restoring depleted stocks by constructing fishways and transplanting spawning adults has let to a significant recovery in Massachusetts waters. More than 100 rivers and streams of coastal Massachusetts are now the sites of river herring runs. Some streams are doing well, while others are showing marked declines in spawning fish (Bigelow and Schroeder 1998).

FIG. 7. — Neglected herring ditch, Marston's Mills Herring River.

Management: *Pembroke Specific:* Attention to the alewife was evident at one of the earliest Pembroke town meetings, and in 1717 Isaac Barker and Ephraim Nichols were empowered "to hire a man or men to go with our neighboring Indians and clear the Herring Brook," and to prosecute the author of any obstruction (Litchfield 1909). Originally all fisheries were free to the public. 1741 was the first year fishing was no longer free where it cost 1 shilling for 100 fish. It seems this is the same year for the beginning of a long and elaborate policy of herring regulation. Between 1741 and 1799 produced several changes to legislation from changing the dates for the requirement of mills to keep their gates open, to the hiring or electing of committees or overseers to regulate the fishery. In 1807, the price of alewives was set at twenty five cents per hundred fish. In 1812, the town began limiting the amount of alewives allowed per household. In the 1820's, prices rose from 33 to 50 cents per hundred, probably coinciding with the decline of alewife populations during that period. Ironically in 1920, the price of alewives was back at 25 cents per hundred (limit was 200 to each male inhabitant). During the late 1800's and early 1900's permits were sold for the privilege of catching and selling the fish.

The first evidence of a restocking program was in1782 where Nathaniel Cushing was granted leave "to take out of the Great Ponds 250 herrings, to be put into Indian River Head Pond" (Litchfield 1909). In 1865, 10,000 herring were deposited annually in Furnace Pond. For how many years this was done is unknown (Litchfield 1909, Belding 1920).

In 1974, the town petitioned the Director of Massachusetts Division of Marine Fisheries to establish local control of management. Since the early 1900's, the town employed a Superintendent and assistant to oversee the Herring Run. (See figure 9).

Figure 9

In 1998, based on citizen's concerns, and the fact that the alewife has all but disappeared from Pembroke, the Board of Selectmen appointed seven volunteer members to the newly formed Pembroke Herring Fisheries Commission, whose purpose is to study, repair and maintain the waterways in Pembroke so as to restore the river herring population to self-sustaining levels. Present agendas include: (1) physical maintenance of waterways; (2) update and repair fish ladders; (3) review procedures for water flow from Pembroke waterways by the Brocton Water Commission and the cranberry growers in the area; (4) getting listed on the Massachusetts State Stocking Program; (5) review water quality for fish habitation; and (6) establish educational programs on our resource.

Outlook: Furnace Pond was stocked with 1000 fish each year from 1995-1997, however, with the high mortality rate of the alewife, not many of those fish are expected to return. Pembroke is presently on a waiting list in the Division of Marine Fisheries restocking program where it is expected thousands of spawning fish to be stocked into Furnace Pond. Presently, it is unlawful to take herring from Pembroke waterways. During its annual town fish fry held the end of April, the town has had to purchase the herring elsewhere. The goal is to bring back the herring in plenty so that one day each Pembroke resident may reap as many fish as he wants as our colonial brethren did 300 years ago.

This report was compiled by Orlando N. Cavallo Jr. In cooperation with the Pembroke Herring Fisheries Commission (PHFC). Much of the information in this report was obtained from the following resources:

Pembroke Public Library: "Ancient Landmarks of Pembroke" Henry Wheatland Litchfield (1909)

Commonwealth of Massachusetts, Division of Fisheries and Game: "Report upon the Alewife Fisheries of Massachusetts" David L. Belding (1920)

Smithsonian Institution Press, Washington D.C.: "Fishes of the Gulf of Maine" Bigelow and Shroeder (1953); revised by Bruce B. Collette and Grace Klein-Macphee (1998)

THE ALEWIFE: A BIOLOGICAL EXAMINATION

Scientific Name: Pembroke's alewife comes from the order Clupeiformes which comprises part of the Clupeomorpha, a group of fossil and recent fishes commonly known as the herring and herring-like fishes. The scientific name of the alewife is *Alosa pseudoharengus* (Wilson 1811). Common names of this species include branch herring, sawbelly, freshwater herring, and grayback.

Description: The true herrings are soft-finned fishes wholly lacking spines, with one short dorsal (top) fin, deeply forked tails, ventral (bottom) fins situated on the abdomen far behind the pectoral (side) fins. The alewife is characterized by a grayish green back, pale silvery (sometimes iridescent) sides, fairly deep body, strong serrated abdomen, and large eyes. Colors change, to some extent, in shade from darker to paler, or vice versa, to match the bottom below, as the fish migrate upstream into shallow water. It usually has a dusky spot on either side of the body just behind the gills at eye level. A few minute teeth are present on the mandible but these disappear with age.

Size: In Massachusetts the adults range in size from 8.5 to 13 inches and average about 8 to 9 ounces in weight.

Distinctions: Seven species of herring occur in New England waters. The shad, menhaden, Atlantic herring, and round herring are easily distinguishable, but the alewife and blueback resemble one another so closely that they are often confused, even by the fishermen who handle them constantly (See Figure 10). The dorsum (back) is generally dark green in alewives and dark blue in the blueback. The alewife, blueback, and shad are generally grouped into one name called river herring.

Habitat: The alewife is a highly migratory, schooling species and is anadromous, which means it spends most of its life at sea and enters freshwater areas to spawn. Some alewife populations are landlocked in freshwater systems, including the Great lakes and some of the Finger lakes of New York (Scott and Crossman 1973). While in the ocean, the alewife undertakes seasonal migrations, possibly in conjunction with changing patterns of water temperature (Neves 1981). In the Fall, river herrings generally move offshore and southward. In the Spring, movement is generally inshore and northwards (Stone and Jessop 1992). There are some river herring that have been known to make very long journeys (1200 miles) from which they may never find their way back to their spawning grounds, but this does not seem to happen in great numbers. Catches of alewife in specific areas may be related to zooplankton abundance in these regions, although direct evidence is lacking.

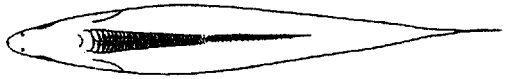
Habits: The alewife congregates in schools of thousands of individuals of similar size. Apparently a given school holds together during most of its life in saltwater. Sometimes alewives form mixed schools with Atlantic menhaden, or with Atlantic herring. For nearly its entire life, the alewife is in the sea where most its growth takes place, but upon reaching sexual maturity, the alewife enters freshwater rivers and streams to spawn. Arrival times of spawning migrants varies considerably from stream to stream, according to local conditions. Onset of spawning runs in alewife is related to water temperature, thus it varies with latitude, and it may vary annually by 3 to 4 weeks in a given locality (Loesch 1987). Alewives generally initiate spawning runs when water

HERRING FAMILY

Belly (A) is sharp-edged in cross section.

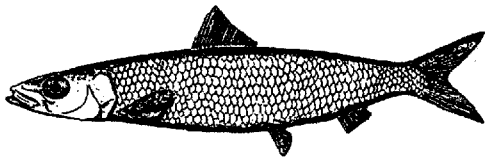
Belly (B) is more or less rounded in cross section.

Two rows of distinctive scales along middle of back between head and dorsal fin. Head (C) large, about 1/3 of body length to narrowest part of tail (D).



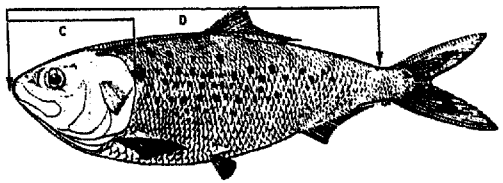
Top view of fish to show scales

No rows of distinctive scales along middle of back between head and dorsal fin. Head (C) smaller, about ¼ or less of (D).



ROUND HERRING *Etrumeus teres*
Maximum size: 10 inches
Range: Bay of Fundy to Gulf of Mexico

C = 1/3 D

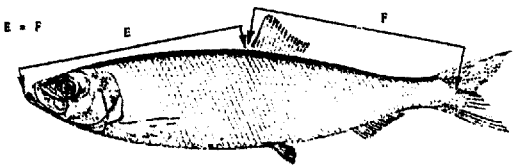


ATLANTIC MENHADEN *Brevoortia tyrannus*
(Pogy)
Maximum size: 20 inches, about 1 3/4 pounds
Range: Nova Scotia to Florida.

(E) much less than (F). Belly very sawtoothed.

Distance from tip of lower jaw to start of dorsal fin (E) equals distance from start of dorsal fin to last large scales on the middle of the tail (F). Belly slightly sawtoothed.

E = F



ATLANTIC HERRING *Clupea harengus*
(Sea herring)
Maximum size: 17 inches, about 1½ pounds
Range: Both sides of the North Atlantic. In North America, Greenland to North Carolina.

Tip of lower jaw does not extend much beyond upper jaw when mouth closed

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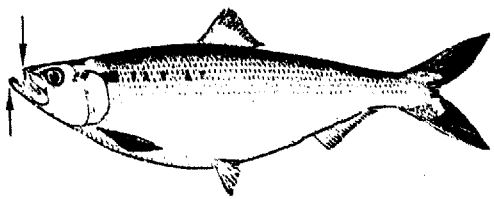
Tip of lower jaw extends beyond upper jaw when mouth is closed



HICKORY SHAD *Alosa mediocris*
Maximum size: 2 feet
Range: Bay of Fundy to Florida.

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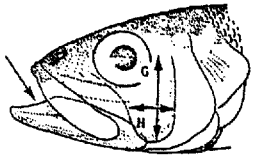
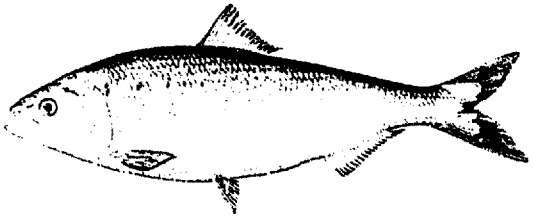
HERRING FAMILY (CONTINUED)

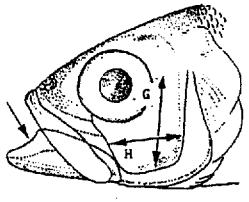


Upper outline of forward part of lower jaw nearly straight. Cheek bone much higher (G) than long (H).

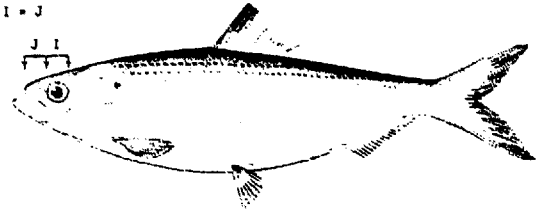


AMERICAN SHAD *Alosa sapidissima*
Maximum size: 2½ feet, 13½ pounds
Range: Newfoundland to Florida, and on the United States' Pacific coast.

Upper outline of forward part of lower jaw with pronounced angle. Cheek bone only slightly higher (G) than long (H).

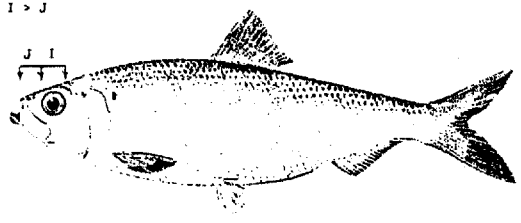


Eye width (I) equal to distance from front of eye to tip of snout (J). Lining of belly cavity black or sooty. Back is blue-green.



BLUEBACK HERRING *Alosa aestivalis*
Maximum size: 15 inches
Range: Nova Scotia to Florida.

Eye width (I) greater than distance from front of eye to tip of snout (J). Lining of belly cavity pale gray. Back is gray-green.



ALEWIFE *Alosa pseudoharengus*
(Freshwater herring)
Maximum size: 15 inches
Range: Gulf of St. Lawrence to North Carolina.

temperatures reach 41 to 50 degrees F. Shad and blueback tend to begin their runs when the water temperature is a little warmer which usually relates to about runs 3 to 4 weeks later. Alewife spawning runs start in early to mid-April in Massachusetts. Successive runs within a system follow until well into June, the later runs, going up, passing the earlier spawners moving down river. Adult alewives have been seen descending downstream as late as August 20 in some Massachusetts streams.

Food: The alewife is chiefly a particulate-feeding planktivore that consumes a wide variety of zooplankton and algae. Juvenile alewives play an important part in freshwater ecosystems by consuming large amounts of algae, insect eggs, and insect larvae. Alewives feed on zooplankton either selectively, by particulate-feeding on individual prey, or non-selectively, by filter-feeding water through their gillrakers (Janssen 1976). Choice of feeding mode depends mostly on prey density, prey size, and visibility, as well as predator size (Janssen 1978). Alewives generally feed most heavily during the day (Jessop1990). At sea, alewives consume a variety of zooplanktonic prey in addition to algae, small crustaceans and other animals and plants including Atlantic herring, eel, sand lance, cunners, their own species, and a variety of fish eggs and larvae (Edwards and Bowman 1979, Neves 1981, Vinogradov 1984, Stone and Daborn 1987). Alewives do not feed when they are migrating upstream to spawn, but when spent fish reach brackish water on their return down river, they feed ravenously on the small diatoms that abound in tidal estuaries. Similar to the alewife, shad take little or no food just prior to spawning, however, they have been known to take an artificial fly of live minnow when running upstream to spawn.

Predators and Enemies: Among the natural enemies which attack both young and adult are predacious fish, birds, disease, pollution, changes in the environment, and man. Young alewives in freshwater fall prey to a variety of predators such as eels, yellow perch and white perch (Loesch 1987). Suckers and minnows also prey on the ripe spawn. As the young alewives increase in size, they serve as food for the larger freshwater fishes such as perch, bass, and pickerel. When the alewives descend to the ocean, their arrival is often anticipated by numerous saltwater species which lie in wait at the mouths of the coastal rivers (Belding 1921). Schooling species such as the bluefish, weakfish, tuna and striped bass, in addition to sliver hake, cod, pollock, and salmon feed on young and adult alewives. Man has used the alewife as a food source since the colonial days, however, most of today's catch goes towards use as bait for commercial and recreational fishing.

Spawning Location: Alewives usually spawn in quiet waters of ponds and coves. Usually, alewives do not spawn in swift running water. The shad and alewife tend to not share the same ponds for spawning because the shad usually selects sandy or pebbly shallows for spawning grounds. During their spawning migration, alewives are much more successful than Atlantic shad in surmounting fish ways of suitable design. Generally, alewives, when on a spawning run, do not jump over obstructions, although they can negotiate white water in rapids and fish ways easily. Negotiating swift water does not apparently stress them. Most alewives are believed to return to spawn in their probable stream of origin (Loesch 1987). This theory has been supported by (1) data

gathered in various studies, (2) by the establishment or re-establishment of spawning runs by stocking fertile adults in ancestral or new systems lacking runs and (3) olfaction experiments (Belding 1921, Havey 1961, Thunberg 1971, Messieh 1977). Sense of smell appears to be the major sensory mechanism by which individuals find their natal watersheds to reproduce.

Spawning Behavior: Upstream movements onto spawning grounds are influenced by light intensity (most movement occurring during daylight hours), water flow (more movement during higher flows), and temperature (Collins 1952, Richkus 1974). Adults, when entering streams to spawn, change from salt to freshwater within a short period of time apparently without damage, and this is equally true of spent fish returning to the estuaries. However, adult alewives appear unable to endure repeated changes between saltwater and fresh, and great numbers are reported to be killed in this way under certain tidal conditions in estuaries. Several groups or waves of adult alewife arrive at the spawning sites during a spawning season. Spawning lasts only a few days for each group of fish and then spent fish emigrate rapidly downstream again after spawning so that many of them pass later migrants on their way upstream to spawning grounds. Alewife spawn during the day or night, but spawning is apparently greater at night (Graham 1956). There is considerable variation in the amount of repeat spawning that occurs in the different populations of anadromous alewives. In some populations, fish spawn only once during their lifetimes, while in other populations, spawning occurs in several years (up to 7 or 8) (Jessop 1982). During the spawning migration adult alewives may lose a substantial portion of their body weight. After spawning, alewives are noticeably thin, but they apparently recover body weight rapidly upon reaching saltwater.

Early Life History: Female alewives are prolific and may produce 60,000 to 400,000 eggs annually (Loesch 1987). The larger the fish, the more eggs it produces. Fertilized eggs are .05 inch in diameter. The eggs are slightly adhesive and tend to stick on the bottom whereas blueback eggs are somewhat buoyant in flowing water but settle to the bottom in still water. Optimum water temperature for egg incubation is 62 to 70 degrees F. Larvae form schools within about two weeks posthatching (Cooper 1961). Most juvenile alewives descend their natal rivers starting in mid-summer or early autumn. Juvenile alewives tend to emigrate from freshwater nursery areas to more brackish areas about a month earlier than do juvenile blueback herring (Kissil 1974, Loesch 1969, Schmidt 1988). The young alewives attain the approximate length of 2 to 4 inches when they descend from the breeding grounds to the ocean. Young alewives have been seen as early as late June passing downstream to the ocean but the majority do not start on the journey until early September or later. Juvenile alewives tend to remain in the shallows, or near mouths of tributary streams where they were spawned, for several weeks and then move offshore as they grow (Schmidt 1988). Decreasing water temperature and the new moon period rather than river flow have been shown to be the most important factors for down stream migration of juvenile alewives (Marcy 1976, O'Leary and Canard 1986). Seaward movement of juvenile river herring occurs predominantly at night. Several days are consumed in passing down stream, the exact period of time depending upon the length of the river.

Age and Growth: Growth rates, age at sexual maturity, and longevity vary greatly geographically. Females may grow slightly faster and live longer than males (Rounsefell and Stringer 1943, Havey 1961), and growth in both length and weight continues for most alewife population after sexual maturation, but at a rate decreasing with age. Average length is 10 inches at age 4, 11 inches at age 5, 11.6 inches at age 6, and 12 inches at age 7. Maturity for alewives is reached in 3 years in populations spawning in Massachusetts tributaries. Little data are available on age composition of sea-caught alewives.

Mortality: This species suffers high mortality throughout all phases of its life cycle (Kissil 1974). Fewer than 1% of all eggs are estimated to survive through early life stages to become juveniles that migrate to sea. In addition to natural mortality events, river alewives can also suffer high mortality due to impacts associated with power-generating facilities, pollution, and obstructions in river ways such as dams and debris. Total annual mortality of adults is also estimated to be high, with about 70% of adult members dying in a given year. Spawning mortality of adults is highly variable from area to area and from year to year within specific area. Depending on location within the geographic range, 32% to 90% of adults are estimated to die annually, during, or due to, population demographics, rigors of spawning migrations, and energetic costs associated with reproductive activities.

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Commonwealth of Massachusetts, Division of Fisheries and Game: "Report upon the Alewife Fisheries of Massachusetts" David L. Belding (1921).

National Marine Fisheries Service: "Study of Marine Resources of the North River" Fisk, Watson, and Coates (1956).

U.S. Department of Commerce, National Oceanic and Atmospheric Administration, NOAA Technical Report NMFS Circular 431, "Guide to Some Trawl-caught Marine Fishes From Maine to Cape Hatteras, North Carolina" Donald Flescher (1980).

For a copy of this report, you can write to the Pembroke Herring Fisheries Commission, Pembroke Town Hall, Pembroke, Ma. 02359

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