

Shad

Alosa sapidissima (Wilson) 1811 [Approximate date]
[Jordan and Evermann, 1896-1900, p. 427.]

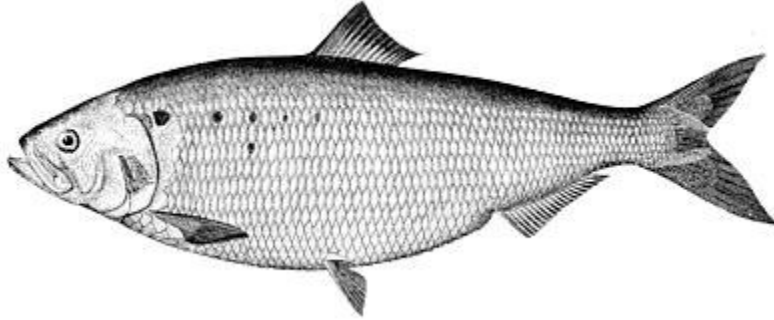


Figure 48 - Shad (*Alosa sapidissima*), Chesapeake Bay specimen.
From Goode. Drawing by H. L. Todd.

Description

The shad is a typical member of the herring tribe in all respects with soft-rayed dorsal and anal fins of moderate size, the former situated above the ventrals and well forward of the middle of the body. It has a deeply forked tail and large scales that are loosened easily. Unlike the sea herring, the shad has no teeth on the roof of the mouth; adults have no teeth at all, although young shad have small ones in the jaws which may persist until the fish is a foot or so long. The shad agrees with the hickory shad, alewife, and blueback, in its deep body and sharp saw-edged belly. But it differs rather noticeably from the hickory shad in its longer mouth, with upper jaw reaching to below the rear edge of the eye, and in the fact that the tip of its lower jaw is entirely enclosed within the tip of the upper when its mouth is closed. The most clear cut character distinguishing shad from alewife and blueback is that the upper outline of the shad's lower jaw is very slightly concave, without a sharp angle, the outline of theirs deeply concave with a pronounced angle. Furthermore the lining of the shad's belly is very pale.

Color

Dark bluish or greenish above, white and silvery low on sides and on belly, with a dusky spot close behind the rear edge of the gill cover, and usually with one or two longitudinal rows of indistinct dusky spots behind it.

Size

The shad is the largest of the herrings that regularly visit our Gulf, growing to a length of 2½ feet. In the Bay of Fundy, according to Leim[96] shad weigh about 1/5 pound at 8 inches; about 3/5 pound at 12 inches; about 11/3 pounds at 15 to 16 inches; about 2½ pounds at about 20 inches; and about 4½ pounds at 23 to 24 inches, though with variations according to their condition. Adult males weigh from 1½ to 6 pounds; females from 3½ to 8 pounds. Shad are occasionally reported to 12 pounds, and the older writers mention shad of 14 pounds, but none so large has been credibly reported in the Gulf of late years.

Habits

The shad, like the alewife, spends most of its life at sea, and makes most of its growth there, but runs up into fresh rivers to spawn, the spent fish soon returning to salt water, and its fry soon running down also. During their stay in the sea shad are schooling fish, often in thousands, and they never reenter fresh water until they return to spawn, though they sometimes do appear in brackish estuaries. Schools of shad are often seen at the surface in spring, summer, and autumn. In winter they disappear from sight. Probably the shad of the year winter near the mouths of their parent streams; the larger sizes somewhat farther out and deeper. The most direct evidence as to the depths to which they may descend is that shad have been trawled at about 50 fathoms off Nova Scotia in March (see footnote 22, p. 112), and at 26 to 68 fathoms off southern New England in May (footnote 23, p. 112).

Food

The shad, like other herrings, is primarily a plankton feeder. We have found shad taken in the Gulf of Maine in summer full of copepods (chiefly *Calanus*), and the stomach contents [page 109] of fish from the Nova Scotia Coast of the Bay of Fundy examined by Willey[97] consisted chiefly of the copepod genera *Arcatia* and *Temora* with other smaller ones, of mysid shrimps and of the larval stages of barnacles; while Leim[98] found that the shad in the open Bay of Fundy feed chiefly on copepods and mysids. Shad are also known to feed as greedily on the pelagic euphausiid shrimps as herring do, on fish eggs, and even on bottom dwelling amphipods, showing that they forage near the ground at times.

Occasionally they eat small fish, but these are only a minor item in their general diet.[99] Shad, it appears, take little or no food just prior to spawning. But they will often take an artificial fly, or a live minnow when running upstream to spawn.[1] During the past few years, crowds of anglers have caught many on flies in the Connecticut River, and doubtless could in the few Gulf of Maine streams to which shad still repair (p. 110).

Reproduction and growth [2]

The sexually mature fish enter the streams in spring or early summer when the river water has warmed to 50° to 55°. Consequently the shad run correspondingly later in the year passing from south to north along the coast, commencing in Georgia in January; in March in the waters tributary to Pamlico and Albemarle Sounds; in April in the Potomac; and in May and June in northern streams generally from the Delaware to Canada. In the Kennebec, according to Atkins,[3] the first shad appear (or did) late in April, with the main run in May and June; the first ripe females are caught the last week in May and they begin to spawn about June 1, most of them doing so during that month, a few in July, and possibly an occasional fish as late as August. Probably these dates applied equally to the Merrimac in the good old days when shad were plentiful there, but the season is somewhat later in the St. John, also in the Shubenacadie as might be expected; i.e., from mid-May until the end of June.[4]

In large rivers they run far upstream. In the St. John River, New Brunswick, they ascend about 200 miles to the grand falls even today according to Leim, and they still run up 300 miles (or did recently) in the Altamaha in Georgia; for 375 miles in the St. Johns River, Florida. But they could run up only about 35 miles at present in the Penobscot, where they formerly ascended some 90 miles, or 44 miles (to Augusta) in the Kennebec, which they formerly ascended 108 miles (to Carratunk Falls), though none enter either of these rivers now, so far as we know. And the dams at Lawrence, only 20-odd miles upstream, now stop any stray shad that may still enter the Merrimac, which they formerly ascended for 125 miles to Lake Winnepesaukee.[5]

In the Shubenacadie, shad spawn mostly in temperatures higher than about 54°, and spawning is interrupted if the water chills below that, temporarily.

The fish select sandy or pebbly shallows for spawning grounds, and deposit their eggs mostly between sundown and midnight. Females produce about 30,000 eggs on the average, though as many as 156,000 have been estimated in very large fish. The spent fish, now very emaciated, begin their return journey to the sea immediately after spawning. In the Kennebec they were first seen on their way down about June 20 and constantly thereafter throughout July; in the St. John spent fish are running down in July and August. According to Atkins they begin feeding before reaching salt water and recover a good deal of fat before moving out to sea.

The eggs are transparent, pale pink or amber, and being semi-buoyant and not sticky like those of other river herrings they roll about on the bottom with the current. The eggs hatch in 12 to 15 days at 52° (12° C.), in 6 to 8 days at 63° (17° C.), which covers the range characteristic of Maine and Bay of Fundy rivers during the season of incubation. And Leim has made the interesting discovery that larval development is more successful in brackish than in pure fresh water, with about 7.5 parts of salt per thousand as about the most favorable salinity.

The larvae are about 9 to 10 mm. long at the time of hatching, growing to about 20 mm., at 21 [page 110] to 28 days. Shad larvae resemble alewife larvae, being extremely slender with the vent almost as far back as the base of the tail.[6] the young shad remain in the rivers until fall, when they move down to salt water; they are now 1½ to 4½ inches long, resembling their parents in appearance.

According to Leim's investigation, based on scale studies and length frequencies, shad in the upper Bay of Fundy, average about 5 to 6 inches long when one year old; 9 to 10 inches long at 2 years; 13 to 14 inches at 3 years; 15 to 16 inches at 4 years; and 18 to 19 inches at 5 years. The two largest he examined, about 24¼ inches (62 cm. and 63 cm.) long, appeared to be 7 and 6 years old, respectively. They may grow somewhat faster in the open Gulf of Maine, to judge from the greater abundance of pelagic crustaceans on which they feed (p. 109). Most of the spawning fish are 5 years old in the Shubenacadie, and presumably in other Gulf of Maine rivers; the oldest 8 or 9 years old.

General range

Atlantic coast of North America from the southeastern coast of Newfoundland,[7] which shad have been known to reach as strays, and the estuary of the St. Lawrence River, where there is a considerable population of them,[8] to the St. Johns River in Florida; also represented in the Gulf of Mexico by a closely related species. The shad has been successfully introduced on the Pacific coast of the United States. It runs up rivers into fresh water to spawn.

Occurrence in the Gulf of Maine

When the first settlers arrived in New England they found seemingly inexhaustible multitudes of shad annually running up all the larger rivers and many of the smaller streams, with the tributaries of the Gulf of Maine hardly less productive than the Hudson or Delaware. But one stream after another was rendered impassable by the construction of dams near the mouth, for shad cannot or will not run up through fishways that are readily used by alewives. Indeed, they have been practically wiped out in the Merrimac River, as appears from the following compilation:[9]

| Year | Number of shad caught, reported, or estimated | Year | Number of shad caught, reported, or estimated |
|-----------|---|-----------|---|
| 1789 | 830,000 | 1888 | None |
| 1805 | 540,000 | 1889 | 18 |
| 1835 | 365,000 | 1890-1892 | None |
| 1865 | 50,000 | 1893 | 2,020 |
| 1871-1873 | (average) 1,942 | 1894 | 2,750 |
| 1880 | 2,139 | 1895 | 94 |
| 1885 | 130 | 1896 | 7 |

The Gulf of Maine rivers to which shad are known to resort regularly today are the Annapolis, Petit Codiac, Shubenecadie, and St. John, tributary to the Bay of Fundy; perhaps the St. Croix;[10] the only Maine rivers that see regular runs of a few shad are the Nonesuch and the Sheepscot.[11]

A few shad may enter other Gulf of Maine streams in some years if not yearly, and bright spots in the shad picture are that a considerable number of adult shad ran up the South River in Marshfield, Massachusetts, on the southern shore of Massachusetts Bay in 1950, and that there has been a run of something like 2,000 shad yearly in Mill Creek, Sandwich, Mass., for the past four years.[12] How successfully they may have spawned in either of these streams is not known.

It appears that most of the shad hatched in the rivers tributary to the Bay of Fundy, and the spent fish from there, remain in or near the estuaries where they take to salt water; and that most of the adults that survive the strain of spawning return to the parent stream to spawn again. Thus it is only in St. Marys Bay, in Annapolis Basin, in Cobequid Bay and Minas Basin, in Chignecto Bay and at the mouth of the St. John as well as for a few miles westward, that large Fundian shad are caught in any numbers.[13] the fact, on which Leim[13a] comments that "there is not a single record of a shad ever having been taken" at Grand Manan island, although this "lies almost directly in the path of any body of [page 111] fish going in or out of the Bay of Fundy," is especially significant as emphasizing the localization of the St. John shad near the parent river.

The behavior of the St. John river shad raises an interesting question, as to the source of the young fish that sometimes congregate in the Bays and among the islands along the coast of Maine (Casco Bay especially), for there seem to be too many of them, in some years, to be credited to the small runs that still frequent the rivers of Maine (unless runs may have been overlooked of late in other rivers there).

Immature shad, up to 2 to 2½ pounds in weight are observed more or less commonly in Cape Cod Bay near Provincetown in summer or autumn and in the inner parts of Massachusetts Bay (sometimes taken in the traps at Beverly or Manchester), and off Cape Ann.[14] Spent shad up to 10 pounds in weight (averaging about 5 pounds), are sometimes reported by fishermen off the coast of Maine west of Penobscot Bay; near the Isles of Shoals; off York Beach, and off Cape Ann, in summer, autumn, and even in December.[15]

The few mature shad with ripening sexual organs that are picked up by the haddock netters between Cape Ann and Portland in April and May, most often about the Isles of Shoals and Boon Island,[16] probably are headed for the rivers of Maine.

Larger numbers of fish are seined in September and October, in the neighborhood of Mount Desert Island, where they have been the object of a frozen fish industry in some years.[17] these, like the green fish mentioned above, seem far too numerous to be accounted for by the small production that still takes place in the rivers of Maine. Some few of them, it seems, are Bay of Fundy fish, for one of a batch tagged near Mount Desert Rock in August 1947, was recaptured in Kings County, New Brunswick (St. John River system) the following June, and a second in the Petitcodiac River that July, while a third, tagged farther west on the coast of Maine in August or September 1948 was recaptured in the St. John River in May 1950. But it seems established that most of the medium sized shad and larger now found in our Gulf are immigrants from the south, growing and fattening on the rich supply of plankton they find there, but returning to the rivers west and south of Cape Cod to spawn.

Direct evidence of this is that one tagged in Chesapeake Bay was recaptured at Race Point, at the tip of Cape Cod, 39 days later;[18] one also was recaptured near Gloucester and another near Portland that had been tagged in the Hudson River, while 3 out of 1,380 tagged in New York Bay were recaptured in the Bay of Fundy after 37 days, 75 days, and 85 days, respectively, and one tagged off Fire Island, N. Y., was recaptured at St. John, New Brunswick, after 39 days.[19] On the other hand, 18 shad, from a batch of 236 that were tagged near Mount Desert Rock in August 1947 were recaptured the next spring scattered along in different stream systems from the Connecticut to the Altamaha in Georgia. Others, from this same batch, were recaptured in the Connecticut, in the Hudson, on the coast of New Jersey, and in the Pamlico River, N. C., during the next two springs. And three others, from a batch of 431 tagged farther west along the coast of Maine in the summer and autumn of 1948, were recaptured in the Hudson River; three in Chesapeake Bay, and one in the Pamlico River, N. C.[20]

The shad that take part in this intermigration must winter somewhere between their northern feeding grounds whence they have vanished wholly by mid-autumn, and their southern breeding streams near which they do not appear until spring. But it is not yet known where they pass the cold months, how deep down they go, how far offshore, or how active they are then.

Still other shad are known to make very long journeys that can hardly be fitted into any regular migratory pattern, and from which they may never find their way back. Thus one that was tagged in the lower St. Lawrence River was recaptured on Brown's Bank 258 days later; a second, from that same batch, was recaptured in Cumberland basin, near Amherst, Nova Scotia, at the head of the Bay of Fundy after 322 days; a third at Provincetown [page 112] at the tip of Cape Cod, some 1,200 miles away from where it had been tagged 444 days previous.[21] And one, from a batch of weir-caught fish tagged on the coast of Maine, August-September, 1948, was recaptured in the Medway River, outer coast of Nova Scotia, a second, in the Miramichi River, tributary to the southern side of the Gulf of St. Lawrence in 1950, and a third, off Tor Bay, eastern Nova Scotia in 1951.

To what extent the seasonal journeys of the shad are passive with the dominant circulatory movements of the water, and to what extent (if any) they are self-directed is perhaps the most interesting question that now faces us in our studies of the shad of the Gulf of Maine.

Shad have been trawled 50 to 60 miles out, off eastern Nova Scotia;[22] have often been reported 40 to 50 miles out off the coast of Maine; also 25 to 90 miles out, off southern New England,[23] and we saw one trawled by the Eugene H in late June, 1951, on the southern part of Georges Bank (lat. 40° 52' N., long. 67° 40' W.), about 110 miles from the nearest land. Evidently they may wander as far offshore as alewives do; perhaps even as far as herring.

Shad reared in different regions may, perhaps, prove to differ enough in racial characters for recognition when taken at sea, but this is a question for the future.[24]

Abundance

The stock of shad in the Gulf is but a shadow in comparison with that of colonial days.

In 1896, the only year for which detailed information is available as to the numbers taken in different streams, 290,122 shad were reported as caught in the Kennebec system, 9,000 in the Pleasant River, about 3,000 in the Harrington River, only 114 in the Penobscot and 12 in the St. Croix; 100 in the Piscataqua and 7 in the Merrimac.[25] In that same year the catch was about 1,059,000 pounds for the Nova Scotia shore of the open Gulf and for the Bay of Fundy;[26] 1,404,477 pounds for the rivers and coast of Maine; about 122,932 pounds (32,782 fish) for the Gulf of Maine coast of Massachusetts, or a total of about 2,586,400 pounds for the Gulf as a whole. With shad averaging about $3\frac{3}{4}$ pounds in weight,[27] this corresponds to about 690,000 fish.

But the yearly catch was only about one-third as great for the period 1916-1919 as it had been in 1896, whether for the United States shores of the Gulf or for the Canadian.[28] And it was of about that same order of magnitude in 1931, i. e., 677,540 pounds for the Gulf as a whole (157,763 pounds for Maine, 147,277 pounds for Massachusetts, 237,200 pounds for the Bay of Fundy and West Nova Scotia region). Since that time, the catches have ranged between 10,400 pounds and 306,000 pounds for the Massachusetts coast of the Gulf and between 9,300 pounds and 1,106,800 pounds for Maine, a fluctuation so extreme (no regional correlation appearing) as to suggest that market conditions were the chief governing factor. On the other hand the catches for the Canadian shores of the Gulf increased rather consistently from 1931 to a total of 1,287,600 pounds in 1939 then declined to around 780,000 pounds for 1944 and 1946, a rise and fall regular enough to suggest a corresponding fluctuation in the actual abundance of the shad. The average yearly catch for the period 1944-1946 combined, was about 20,000 pounds for Massachusetts, about 224,050 pounds for Maine, and about 780,000 pounds for the Bay of Fundy and western Nova Scotia.

[96] Contrib. Canad. Biol., N. Ser., vol. 2, 1924, p. 245, fig. 41.

[97] Contrib. Canad. Biol., N. Ser., vol. 1, 1923, p. 316.

[98] Contrib. Canad. Biol., N. Ser., vol. 2, 1924, p. 231.

[99] Leidy (Proc. Acad. Nat. Sci. Philadelphia, Ser., 2, 1868, p. 228) found 30 small sand eels (Ammodytes) in the stomach of a shad, probably caught in Delaware Bay.

[1] Bean (Bull. 60, Zool., vol. 9, New York State Mus., 1903, p. 207) commented on this long ago.

[2] Accounts of the breeding habits of the shad have been given by Ryder, Rept. U. S. Comm. Fish. (1885) 1887, p. 523; by Prince, Supp. 6, Rept. Dept. Marine Fish. Canada, Fish. Branch. 1907, pp. 95-110; in the Manual of Fish Culture, published by the U. S. Bur. of Fish., 1887; and more recently by Leim (Contrib. Canadian Biol. N. Ser. vol. 2, 1924, pp. 184-202).

[3] Fish. Ind. U. S., Sect. 5, vol. 1, 1887, pp. 683-694.

[4] Leim, Contrib. Canad. Biol., N. Ser., vol. 2, No. 11, 1924, p. 182.

[5] Stevenson (Rept. U. S. Comm. Fish., (1898) 1899, p. 111) has given a table of the distances to which shad ascended various rivers then, and formerly from the Penobscot in Maine to the St. Johns in Florida.

[6] Leim (Contr. Canad. Biol., N. Ser., vol. 2, No. 11, 1924, p. 195) gives a detailed comparison of shad with alewife larvae.

[7] the most northerly record of a shad, on which we have chanced, is one taken in Bull's Bay, near St. Johns, Newfoundland.

[8] See Vladykov (Contr. Dept. Fish., Quebec, No. 30, 1950, pp. 121-135, and Natural. Canad., vol. 77, 1950, pp. 121-135) for a study of the movements of the shad in the St. Lawrence estuary.

[9] From Stevenson, Rept. U. S. Comm. Fish. (1898) 1899, p. 262.

[10] the St. Croix once had a large run of shad. None were seen there for 8 or 9 years prior to 1915, but they were there in some numbers in 1915 and 1916, according to investigations by H. F. Taylor of the U. S. Bureau of Fisheries; their present status there is not known. They have been entirely extirpated from the Saco, where they were abundant formerly, probably from the Penobscot and Kennebec, and certainly from the Merrimac, as noted above.

[11] Information from Dr. C. E. Atkinson, U. S. Fish and Wildlife Service.

[12] Reported to us by John B. Burns of the Massachusetts Division of Fisheries and Game.

[13] Leim (Contr. Canad. Biol. N. Ser., vol. 2, No. 11, 1924, fig. 2) gives a chart showing the location of shad catches for the Bay of Fundy.

[13a] Contr. Canad. Biol. N. Ser., vol. 2, No. 11, 1924 p. 173.

[14] 502 barrels (about 100,400 lb.) were taken in one set of mackerel pounds at Provincetown in June 1910; the traps picked up numbers of shad of about 14 inches from June 20 to July 6, 1921, at Magnolia and Beverly, where the catch was 10,300 pounds in 1945; and 14 shad 11 to 15¾ inches long were taken in one set of traps at Barnstable, on Cape Cod Bay, October 3, 1950.

[15] 135,000 pounds of these large spent fish were caught near Gloucester in the autumn of 1915; 125 barrels of 2- to 5-pound shad, some spent, near Seguin Island, July 19, 1925.

[16] A series of shad from that region, examined by the late W. W. Welsh in April and May 1913, averaged 5 pounds, all with well-developed sex organs.

[17] About 250,000 pounds were brought in to the local freezers yearly in 1913, 1914. and 1915.

[18] Vladykov, Trans. Amer. Fish. Soc., vol. 67, 1938. p. 64.

[19] Information supplied by C. E. Atkinson, U. S. Fish and Wildlife Service.

[20] Information supplied by E. H. Hollis of the U. S. Fish and Wildlife Service.

[21] See Vladykov, Nat. Canad., vol. 77, 1950, p. 121, for a detailed account of his tagging experiments on St. Lawrence River shad.

[22] Vladykov, Copeia, 1936, No. 2, p. 168, reports between 25 and 30 shad of 4-6 pounds, taken per haul, by otter trawlers in March, 1935, southwest of Middle Ground, about lat. 44° 25' N., long. 61° 05' W., at about 50 fathoms.

[23] Two shad were trawled by Albatross III on the eastern part of Nantucket Shoals at 68 fathoms, and 46 others at 9 stations distributed thence westward to the offing to Montauk Point (long. 71° 52' W.) at 26-64 fathoms, May 11-18, 1950.

[24] Vladykov and Wallace (Trans. Amer. Fish. Soc., vol. 67, 1937-1938, pp. 52-66) believe that Shubenacadie, Delaware River and Chesapeake Bay shad differ significantly in average number of vertebrae, of mid ventral scales and of pectoral fin rays. But Warfel and Olsen (Copeia, 1947, pp. 177-183) doubt whether any distinction can be drawn between shad in various streams along our North Atlantic coast, at least as far as average number of vertebrae goes.

[25] Stevenson, Rept. U. S. Comm. Fish (1898) 1899 pp. 265-269.

[26] these catches were reported as "barrels" presumably of 200 pounds each.

[27] Stevenson, Rept. U. S. Comm. Fish (1898) 1899, p. 121.

[28] About 460,000 pounds for the United States coast of the Gulf and about 374,000 pounds for the Bay of Fundy and in western Nova Scotia combined in 1916-17.

Fishes of the Gulf of Maine by Bigelow & Schroeder is the seminal work on North Atlantic fishes. It was originally published in 1925 with William Welsh, a Bureau of Fisheries scientist who often accompanied Henry Bigelow on his research cruises. In the late 1920's, Bigelow began a long association with William C. Schroeder, publishing a number of papers and reports on fishes of the North Atlantic, including the first revision of *Fishes of the Gulf of Maine*. This excerpt is from that 1953 edition.

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