

Eel

Anguilla rostrata (LeSueur) 1817

[*Jordan and Evermann*, 1896-1900, p. 348, *A. chrysypa* Rafinesque 1817.]

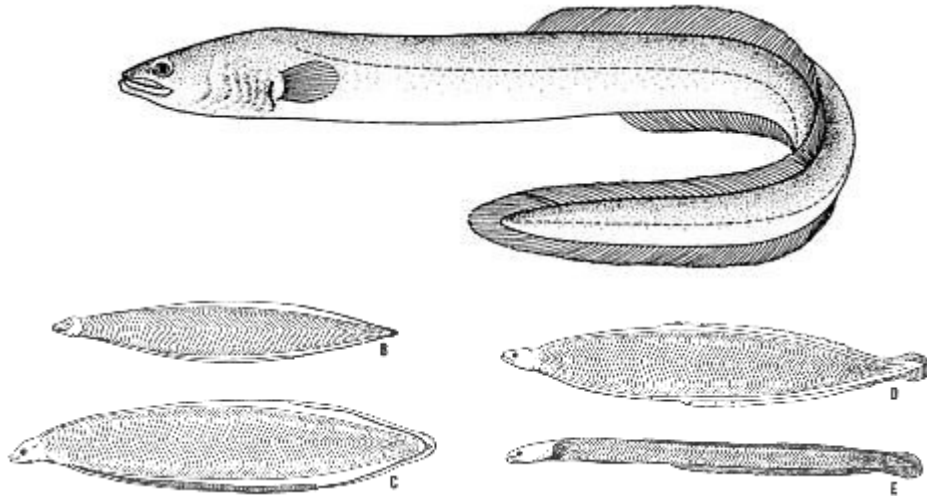


Figure 69. - Eel (*Anguilla rostrata*).

A, adult, Connecticut River, Massachusetts; from Goode, drawing by H. L. Todd;

B, "Leptocephalus" stage, 49 mm.;

C, "Leptocephalus" stage, 55 mm.;

D, "Leptocephalus" stage, 58 mm.;

E, transformational stage, 61 mm.

B-E, after Schmidt.

Description

In the common American eel the dorsal fin originates far behind the pectorals, this character is enough to distinguish it from the conger, from which it also differs in that the lower jaw projects beyond the upper or at least equals it in length, and its eyes are small and round. Furthermore, it develops scales as it grows, though these are so small that they might be overlooked. The eel, however, has a pointed snout, like the conger, a large mouth gaping back as far as the middle of the eye or past it; and its gill slits are set vertically on the sides of the neck, their upper corners abreast of the center of the base of the pectoral fin. It is very closely related to the European eel (*Anguilla vulgaris*), but has fewer vertebrae (average about 107 as compared with about 114 or 115 in the European species).

Color

The colors of eels vary widely with the bottom on which they live. As a rule they are dark muddy brown or olive-brown above, more or less tinged with yellow on the sides; the lower surface paler brown and yellower, with dirty yellowish-white belly. It is common knowledge that eels are dark if living on dark mud but much paler on pale sand. And Parker [53] has found that they can change from pale to dark in about 1½ hours and from dark to pale in a little more than 3 hours, if moved from a white background to a black or vice versa, under a strong light.

Size

Eels are said to grow to 4 feet in length and to 16½ pounds in weight. Full-grown females average only about 2 to 3½ feet, however, and males are smaller. Any eel more than 18 inches long would probably be a female, and one more than 24 inches in length would certainly be one. The smallest mature males are about 11 to 12 inches long, females about 18 inches.

Habits

The life history of the eel remained a mystery until very recently. It has been common knowledge for centuries that young elvers run up into fresh water in spring, and adults journey downstream in autumn. A host of myths grew up to explain the utter absence of ripe eels of either sex, either in fresh water or along the seacoast. But it was only a few years ago that the breeding places of the European and American eels were discovered and the history of their larvae [page 152] traced, chiefly by the persevering researches of the Danish scientist, Johannes Schmidt. [54] Now we know that the life history of the eel is just the antithesis of that of the salmon, shad, and alewife, for eels breed far out at sea, but make their growth either in estuarine situations or in fresh water.

The young elvers, averaging from 2 to 3½ inches in length, appear along our shores in spring. As yet we have few data on the exact date of their arrival on the Gulf of Maine coast. They appear as early as March at Woods Hole; by mid- or late April both in Narragansett Bay and in Passamaquoddy Bay at the mouth of the Bay of Fundy, while Welsh encountered a tremendous run in Little River, near Gloucester, on May 5, 1913, suggesting that they may be expected in the mouths of most Gulf of Maine streams during that month. And they are found ascending streams in the Bay of Fundy region during the summer. A run may last for a month or more in one stream, only for a few days in another. And there is a noticeable segregation even at this early stage, some of the elvers remaining in tidal marshes, in harbors, in bays back of barrier beaches, and in other similar situations, some even along the open coast, especially where there are beds of eel grass (*Zostera*); while others go into fresh water, some of them ascending the larger rivers for tremendous distances. [55]

It is now generally believed that most of the eels that are caught in fresh water are females. But some of the females remain in salt marshes and harbors, to judge from the large size of many of the eels that are caught there. And nothing is known as to what preference the males of the American eel may show in this respect.

It is no wonder that the ability of the elvers to surmount obstacles as they run upstream is proverbial, for they clamber over falls, dams, and other obstructions, even working their way up over damp rocks as Welsh saw them doing in Little River, where they were so plentiful on May 5 and 7, 1913, that he caught 1,500 in one scoop of a small dip net and 545 with a few grabs of his bare hand. Elvers, in equal multitudes have often been described in other streams, American as well as European. Eels can live out of water so long as to give rise to the story that they often travel overland. There is no positive evidence for this. But Sella [56] has proved, by experiments, with European eels marked so as to be recognizable if recaptured, that they can carry out journeys as long as 31 miles (50 kilometers) along underground waterways. Doubtless it is this ability that explains the presence of eels in certain ponds that have no visible outlet nor inlet, a fact often attested.

It is true in a general way that eels seek muddy bottom and still water, as has been said so commonly. But this is not always so whether in salt water or in fresh. Thus the rocky pool at the outer end of the outlet from Little Harbor, Cohasset, on the south shore of Massachusetts Bay, is a good place to catch eels; and large ones are only too common in swift flowing, sandy trout streams on Cape Cod; we have had one follow and nibble at the trout we were dragging behind us on a line. The fact is, they can live and thrive wherever food is to be had, which applies to them in estuarine situations and in fresh water.

No animal food, living or dead is refused, and the diet of the eels in any locality depends less on choice than on what is available. Small fish of many varieties, shrimps, crabs, lobsters, and smaller crustacea, together with refuse of any kind (for they are scavengers) make up the bulk of the diet in salt, estuarine, and brackish water. Being very greedy, any bait will do to catch an eel. They are chiefly nocturnal in habit, as every fisherman knows, usually lying buried in the mud by day to venture abroad by night. But eels, large and small, are so often seen swimming about, and so often bite by day that this cannot be laid down as a general rule.

Eels tolerate a wide range of temperature. But it is common knowledge that those inhabiting the salt marshes and estuaries of our Gulf, and its tributary streams, mostly lie inactive in the mud during the winter.

Eels grow slowly. Hildebrand and Schroeder [57] concluded from a series of measurements taken at different seasons in lower Chesapeake Bay that those [page 153] 2½ inches long in April are about 5 inches long a year later, or about 2 years after their transformation. The winter rings on the scales have shown that full grown adults of the European species are from 5 to 20 years old, depending on food supply, and other conditions; this is corroborated for the American species by the fact that Dr. Hugh M. Smith, former Commissioner of the United States Bureau of Fisheries, found that a female, on the way down the Potomac, was in her twelfth year.

At the approach of sexual maturity, which takes place in the fall, the eels that are in fresh water drop downstream, traveling mostly at night. They now cease feeding, as do those that have been living in the river mouths, bays, and estuaries; the color of the back changes from olive to almost black, the ventral side turns silvery, and the eyes of the males grow to twice their previous size. Both males and females then move out to sea, and it is not until after they reach salt water that the ovaries mature. In fact, no perfectly ripe female eel has ever been seen, and only one ripe male (of the European species).

So little is the life history of the eel understood by our fishermen that we again emphasize the undoubted fact that no eel ever spawns in fresh water.

The eels drop wholly out of sight when once they leave the shore; [58] no one knows how deep they swim, but they certainly journey out beyond the continental slope into the oceanic basin before depositing their eggs. Schmidt has been able to outline the chief spawning center of the American species (from the captures of its youngest larvae) as between latitudes 20° and 30° N. and between longitudes 60° and 78° W.; i. e., east of Florida and of the Bahamas south of Bermuda. But it may also spawn (always in deep water) farther north as well. [59]

The American eel spawns in midwinter, thus occupying one to two months in its journey from the coast to the spawning ground, for Schmidt found very young larvae (7 to 8 mm.) in February. Eels, like Pacific salmon, die after spawning, the evidence of this being that no spent eels have ever been seen and that large eels have never been known to run upstream again. Smith suggests that they probably "jellify" and disintegrate, as the conger does.

Eels (European) are among the most prolific fish, ordinary females averaging 5 to 10 million eggs and the largest ones certainly 15 to 20 million. It is doubtful whether eggs laid by the American eel have been seen, or of the European either, for that matter. [60] But it is generally supposed that they float in the upper or intermediate water layers until hatching. The larval, so-called "leptocephalus" stage, like that of all the true eels, is very different in appearance from the adult, being ribbon-like and perfectly transparent, with small pointed head; and it has very large teeth, though it is generally believed to take no food until the time of its metamorphosis. These leptocephali of our eel, living near the surface, have been found off our coasts as far north as the Grand Banks, but never east of longitude 50° W.

Inasmuch as the breeding areas of the American and European eels overlap, not the least interesting phase of the lives of the two is that the larvae of the American species should work so consistently to the western side of the Atlantic, and those of the European to the eastern side that no specimen of the former has ever been taken in Europe or of the latter in America.

The American eel takes only about one-third as long as the European to pass through its larval stage; i. e., hardly a year, as against 2 to 3 years. The leptocephali reach their full length of 60 to 65 mm. by December or January, when metamorphosis takes place to the "elver"; the most obvious changes being a shrinkage in the depth and length of the body but an increase in its thickness to cylindrical form, loss of the larval teeth, and total alteration in the aspect of head and jaws, while the digestive tract becomes functional.

It is not until they approach our shores, however, that the adult pigmentation develops or that the elver begins to feed, a change that is accompanied by a second decrease in size. How such feeble swimmers as the leptocephali find [page 154] their way into the neighborhood of the land remains a mystery. It seems certain, however, that all the young eels bound for the Gulf of Maine complete the major part of their metamorphosis while they still are far offshore. Thus we have never taken one in the leptocephalus stage in the Gulf of Maine in all our tow-nettings, whereas (more significant) the *Albatross* towed three young eels in the so-called "glass-eel" stage, 54 to 59 mm. long, of practically adult form but still transparent, during her spring cruise in 1920, one of them on Georges Bank, March 11; a second on Browns Bank, April 16; and one in the western basin of the Gulf off Cape Ann, February 23. Evidently they were intercepted on their way in to land. And since all three were on the surface, we may take it that glass eels, like leptocephali, keep to the uppermost water layers during their journey.

General range

Coasts and streams of West Greenland, [61] eastern Newfoundland [62] Strait of Belle Isle, and northern side of the Gulf of St. Lawrence south to the Gulf of Mexico, Panama, West Indies, and (rarely) to the northern coast of South America; also Bermuda; running up into fresh water but going out to sea to spawn p. 153.

Occurrence in the Gulf of Maine

The occurrence of the eel around the periphery of our Gulf can be described in the one word "universal." there is, we believe, no harbor, stream mouth, muddy estuary, or tidal marsh from Cape Sable on the east to the elbow of Cape Cod on the west but supports eels in some numbers, and they run up every Gulf of Maine stream, large or small, from which they eventually find their way into the ponds at the headwaters unless barred by insurmountable barriers such as very high falls. Examples of long journeys by eels upstream, in New England rivers, are to the Connecticut Lakes, New Hampshire, at the head of the Connecticut River; to the Rangeley Lakes at the head of the Androscoggin, and to Matagamon Lake, at the head of the East Branch of the Penobscot. Eels are even caught in certain ponds without outlets, as noted above (p. 152). On the other hand, we have seen a few (and some large ones) along the open coast, at Cohasset, for example, but always close in to the shore line and in only a few feet of water, where flounder fishermen catch them from time to time.

Importance

Schmidt has suggested that the American eel is not as plentiful in actual numbers as the European, arguing from the facts that its larvae have not proven so common on the high seas, and that the American catch of eels (about 2,000 tons yearly) was but a fraction as large as the European catch (about 10,000 tons annually). But it is not safe to draw any conclusions from the statistics because the American catch is limited more by the fact that eels are not much in demand, than by the available supply. And the local demand is less for them today than it was 30 years ago, as is reflected in a decrease in the reported landings from about 305,000 pounds for Maine and about 240,000 pounds for Massachusetts in 1919 to about 19,000 pounds for Maine and about 32,000 pounds for Massachusetts in 1947. The yearly landings of eels along the Canadian shore of our Gulf and from the tributary fresh waters are 30,000-40,000 pounds nowadays.

Practically the entire coastwise catch is made in salt marshes, estuaries and stream mouths; the numbers captured up stream are negligible of recent years, except in New Brunswick where 16,000 pounds were caught in the lower sections of the St. John River System in 1950. [63] In Germany, however, where the demand for eels is much greater, the yearly catch is nearly four times as great for rivers and other fresh waters as it is for the coast. And many millions of elvers were transplanted, during the 1930's, from British rivers (the Severn in particular) to landlocked bodies of water in Central Europe which the young eels could not reach naturally.

The greater part of the catch is made in nets and eelpots; and some are speared, mostly in late autumn and winter, often through the ice.

[53] Jour. of Exper. Zool., vol. 98, 1945, No. 3, pp. 211-234.

[54] the life history of the eel is presented in more detail than is possible here by Schmidt (Philos. Trans. Roy. Soc. London, Series B, vol. 211 (1922) 1923, pp. 179-208, summarized in Nature, vol. 110, 1922, p. 716), and by Cunningham (Nature, vol. 113, 1924, p. 199). See also Schmidt (Rapp. et Proc.-Verb. Cons. Perm. Internat. Explor. Mer, vol. 5, No. 4, 1906, pp. 137-204, pls. 7-13); for a popular account see Smith (Nat. Geog. Mag., vol. 24, No. 10, October 1913, p. 1140).

[55] Eels are native in Lake Ontario which they reach by way of the St. Lawrence River; and up the Mississippi drainage systems even as far as North Dakota, Wisconsin, Ohio, and western Pennsylvania.

[56] Mem. R. Comit. Talassogr. Ital., vol. 158, 1929.

[57] Bull. U. S. Bur. Fish., vol. 43, 1928, p. 114.

[58] Large eels, on their seaward journey, have occasionally been caught by otter trawlers in the western part of the British Channel, but we know of no such occurrence on this side of the Atlantic.

[59] See Schmidt (Ann. Rep. Smithsonian Inst., (1924) 1925, pp. 279-314) for a readable account of the investigations which enabled him to chart the breeding places and seasons of the American and European eels.

[60] Four eggs taken on the *Arcturus* expedition near Bermuda in 1925 were provisionally identified as those of the American eel by Fish who has pictured them and the larvae hatched from one of them

(Zoologica, New York Zool. Soc., vol. 28, 1927, pp. 290-293, figs. 103-107). But the date at which they were taken (July 15-17) makes it more likely that they belonged to some other member of the eel tribe.

[61] Jensen (Invest. of the *Dana* in West Greenland Waters, 1925, Extr. Rapp. et Proc.-Verb Cons. Internat. Expl. Mer, vol. 39, 1926, p. 101) records the American eel as one of the four fresh-water fishes known from the west coast of Greenland.

[62] Reported by Dr. G. W. Jeffers as common.

[63] Information from A. H. Leim.

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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