

Winter Flounder

Pseudopleuronectes americanus (Walbaum) 1792
[Jordan and Evermann, 1896-1900, p. 2647.]

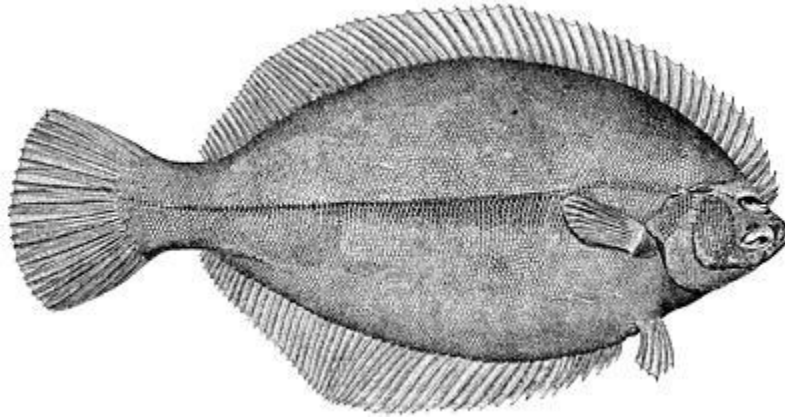


Figure 140 - Winter flounder (*Pseudopleuronectes americanus*)
From Goode. Drawing by H. L. Todd.

Description

This is a small-mouthed, right-handed species (eyes on the right side and viscera on the right). But it is easily separable from the yellowtail, which is similarly characterized, by the fact that its lateral line is nearly straight (at most only slightly bowed abreast the pectoral fin); that the dorsal profile of its head is less concave; that its nose is blunter; that its eyes are farther apart; that it has fewer fin rays; and that its fins are less tapering in outline. The most obvious differences between the winter flounder and the smooth flounder (p. 283) is that the former is rough scaled between the eyes, the latter smooth there, and that the winter flounder has the larger number of anal fin rays. On the other hand, it has only about two-thirds as many dorsal rays as the witch (p. 285); it lacks the mucous pits that are conspicuous on the left (lower) side of the head of the witch, and its tail is much larger proportionately than that of the witch. It is oval in outline, about two and one-fourth times as long to the base of the caudal fin as it is wide, thick-bodied, and with proportionately broader caudal peduncle and tail than any of our other small flatfishes.

Its dorsal fin (60 to 76 rays) originates opposite the forward edge of the eye, and is of nearly equal height throughout its length. Its anal fin (45 to 58 rays)[40] is highest about midway, and it is preceded by a short, sharp spine. Its ventral fins are alike on the two sides of the body, and both of them are separated from the long anal fin by a considerable gap. The mouth is small, not gaping back to the eye, and the lips are thick and fleshy like those of the yellowtail. The left (under) half of each jaw is armed with one series of close-set incisor-like teeth, but the right (upper) side has only a few teeth, or it may even be toothless. The scales are rough on the eyed side, including the space between the eyes, but they are smooth to the touch on the blind (white) side.

Color

The winter flounder, like other flatfishes, varies in hue according to the bottom on which it lies, but it is the darkest of Gulf of Maine flatfishes as a rule. Large ones are usually of some shade of muddy or slightly reddish brown, olive green, or dark slate above, sometimes almost black. And they vary from plain or more or less mottled to definitely marked with smaller or larger spots of a darker shade of the general ground tone. There usually is a wide variation in this respect, among any lot of flounders. And fish caught on Georges Bank average more reddish in [page 277] hue than those caught inshore. But this rule does not always hold (see p. 277).

The blind side is white, more or less translucent toward the edge, where it is often faintly tinged with bluish, and the lower side of the caudal peduncle is yellowish on some specimens, but is pure white on others. The long fins usually are tinged with pinkish, reddish, or are yellowish on the eyed side; the ventrals and pectorals of the eyed side are of the general ground tone, but their mates on the blind side are pure white. Small fish average paler and more blotched or mottled than large ones.

Various color abnormalities have been recorded (fish, for example, that are partially white on the eyed as well as on the blind side, or with the blind side yellow-edged) and it is not uncommon to see specimens with dark blotches on the blind side. In fact, one-third of the fish caught near Providence, R. I., during the winter of 1897-98 were these "black bellies," as fishermen call them, but the commissioners of fisheries of that State estimated them as forming only 4 percent of the catch in 1900. And none (or at most only an occasional fish) has been seen since. In 1898, some fry that had been hatched artificially from eggs of black-bellied flounders were released in Waquoit Bay, southern Massachusetts, where this race had been unknown previously, and several "black bellies" 7 to 8 inches long (hence probably two years old) were taken there in 1900, probably the offspring of this planted stock.[41]

Winter flounders change color to some extent to suit their surroundings, usually being very dark on mud, and pale on bright sand bottoms. But field experience suggests that they have less control over shade and pattern than the summer flounder has.

Size

The largest winter flounder on record caught inshore was one 22³/₄ inches long mentioned by Scattergood;[42] Nichols and Breder[43] report one 20 inches long, weighing 5 pounds; and Welsh saw three of about 19¹/₂ inches, weighing 3¹/₄, 3³/₄, and 4 pounds, respectively, that were caught near Boon Island in April 1913. But fish longer than 18 inches or heavier than 3 pounds are unusual inshore, the general run of adults caught there being from 12 to 15 inches in length and 1¹/₂ to 2 pounds in weight. Flounders grow larger on Georges Bank, where many of 4-6 pounds are taken, and where they often are caught up to 7-8 pounds; we have handled one Georges Bank fish of 25 inches, weighing 8 pounds.

Remarks

The winter flounder shows some tendency to break up into local races in the number of its fin rays,[44] in the size to which they grow, and perhaps in other characteristics.

The most interesting of these races, from the fisheries standpoint, is the population on Georges Bank, for the flounders tend to grow larger there than they do anywhere inshore. This fact was first brought to scientific attention in 1912, when some of these large flounders from Georges were received by the Bureau of Fisheries, to be made the basis of a new species, *Pseudopleuronectes dignabilis*, by Kendall.[45] Since that time this Georges Bank flounder has been accepted provisionally as a separate species, supposedly characterized by rather more numerous fin rays, by reddish color, and by a caudal peduncle yellow on the under side, as well as by large size. But our own comparison of specimens of the winter flounder group of various sizes, from Georges Bank, with others from the No Mans Land ground, from Nantucket Shoals, and from many localities, inshore, from Labrador to New York, leads us to conclude that it is simply a large, more rusty-brownish, local race of the winter flounder, for we find no definite regional discontinuity in the number of fin rays or of gill rakers, in the teeth, or in color (p. 277). The names "blackback" and "lemon sole," as used by fishermen, have no bearing on the case, for their choice of the one or of the other is based solely on the size of the fish in question (p. 282).[46]

Habits

Tide mark, high or low according to the stage of the tide, is the upper limit for this flounder. It runs up into brackish water in river mouths, and we have even caught them in the Susquehanna River, tributary to Chesapeake Bay, where the water was fresh enough to drink.[47]

Its lower limit cannot be stated definitely. It is plentiful certainly at 10 to 20 fathoms in Cape [page 278] Cod Bay and on Stellwagen Bank, while the gillnetters sometimes take very large ones at about this same depth about Boon Island. According to general report, however, few, if any, are caught deeper than this in the inner parts of the Gulf except in the Bay of Fundy, where they are to be taken in winter on soft bottoms down to 30 to 50 fathoms. On Georges Bank they are taken mostly between 25 fathoms and 45 fathoms; 70 fathoms is the deepest definite record for them there of which we know. Usually the smaller fish live the shoalest and the larger ones deeper. But we have seen large flounders caught so often in only a few feet of water that no general rule can be laid down. The young fry are found chiefly in the shallows.

Most of those that are caught inshore are on muddy sand, especially where this is broken by patches of eel grass. But winter flounders are common enough there on cleaner sand, on clay, and even on pebbly and gravelly ground. And the populations on the offshore banks are on hard bottom of one type or another. When they are on soft bottom they usually lie buried, all but the eyes, working themselves down into the mud almost instantly when they settle from swimming. And flounders that live on the flats usually lie motionless over the low tide to become more active on the flood, when they scatter in search of food. They keep near the bottom, and we have never heard of them coming up to the surface as the summer flounder so often does (p. 269). But though they spend most of their time lying motionless, they can dash for a few yards with astonishing rapidity, to snap up any luckless shrimp or other victim that comes within reach, or to snatch a bait, as any one may see, who will take the trouble to watch them on the flats on a calm day. It is in this manner that they usually feed, not by rooting in the sand. But flounders can sometimes be attracted by stirring the bottom with an oar when they are not biting, or by dragging anchor to bring up small animals from the mud, an old trick.

How close inshore they may come (how shoal) in any particular locality at any particular time depends largely on local conditions of temperature. Generally speaking, the summer temperature is low enough for their comfort close in to shore and up to within a few feet of the surface all around the open coast line of the Gulf, and among the island passages, but the winter temperatures may be uncomfortably low for them in enclosed situations locally. In Passamaquoddy Bay, for instance, where the temperature of the water falls close to the freezing point in winter, those that are closest inshore in summer work out in winter unless the year is a very mild one. Others, however, that are living at 15 fathoms or so remain there the year around, while it is only in winter that they are known to descend as deep as 30 to 50 fathoms in the Bay of Fundy.[49]

In shallow enclosed bays, however, or harbors, where extensive flats are heated by the sun at low tide in summer but are exposed to very severe chilling in winter, the flounders tend to desert the flats for the deeper channels during the heat of summer, work back again into shoal water in autumn, desert the ice-bound flats once more in winter, and then work up again in spring. Duxbury Bay is a case in point, also Barnstable Harbor, where we have speared many of them in spring, while wading on the flats.

A migration of flounders out into deeper water in the summer and back to shoal for the winter is generally characteristic south of New York, where the coastal waters are warmer, hence the common name "winter flounder." they are very scarce, for instance, in the bays of southern New Jersey in summer, but very plentiful there in winter. And many are caught in Chesapeake Bay from November to the first of June, but none are taken in shoal water there in summer or early autumn.

It has long been believed that the winter flounder is one of the most stationary of our fishes, apart from seasonal movements of the sorts just mentioned, and apart from a general tendency (recently emphasized by Perlmutter)[50] for the fry that are produced in bays and estuaries to work offshore as they grow older. This essentially stationary nature has been demonstrated recently by extensive marking experiments that have been carried out in Long Island Sound, along southern New England, and on the coast of Maine, for about 94 percent of the recaptures were made in the general areas where the fish had been tagged. Thus the population consists "of many independent localized stocks inhabiting the bays and estuaries along the coast" as Perlmutter words it, [page 279] with the fish merely tending to scatter "from population centers, a characteristic phenomenon with nonmigratory animals." [51] But some of them may stray for considerable distances. Thus winter flounders tagged at Waquoit Bay, near Woods Hole, in 1931 were recovered off Chatham, on the outer coast of Cape Cod, and on Nantucket Shoals. The case of one that was tagged near Block Island on April 17, 1941, and was recaptured on the central part of Georges Bank (lat. 41° 45' N., long. 67° 06' W.) on August 27, 1945, is especially interesting,[52] as showing that some interchange does take place between the inshore and offshore populations of adult fish.

The normal distribution of the winter flounder covers a wide range of temperature at one season or another, from a minimum close to the freezing point of salt water around Newfoundland, in Nova Scotian waters, in the Gulf of St. Lawrence, and in the shoaler parts of the Gulf of Maine in late winter, to a maximum of about 64°-66° F. in shallow water in the southwestern part of the Gulf in summer, and of perhaps about 68°-70° in the southern part of its range.

They sometimes perish by the thousands in very hot spells of summer weather, if they are trapped in shallow enclosed bays, as happened in Moriches Bay, Long Island, N. Y., in 1917, between July 29 and August 4, when the air temperature rose to 82°-89°, and the temperature of the water on the very shallow flats nearly as high, probably.[53] But we have never heard of this happening in the Gulf of Maine where cooler water is always close to hand. On the other hand, they may succumb to anchor ice in winter if they are overtaken in very shoal water in a severe freeze, for dead "flounders" of one sort or another are sometimes reported in such locations after unusually severe weather. And observations at Woods Hole have shown that freezing temperatures (say 30° to 29°) drive them down into slightly warmer water.

Experience at the Boothbay and Woods Hole hatcheries, combined with the results of the trawl fishery (p. 283), proves that those living a few fathoms down are as active in winter as they are in summer, both north and south of Cape Cod. Bean, it is true, has described the winter flounder as going into "partial hibernation in the mud in winter,[54] but (as Breder[55] has pointed out) the reason the hook-and-line fishermen cannot take them in late winter or early spring may simply be that they will not bite then, this being the spawning period when winter flounders fast, as so many other fishes do.

According to Sullivan[56] diatoms are the first food taken after the yolk of the larval flounder is absorbed. A little later they begin preying on the smaller Crustacea, and Sullivan invariably found isopods in the stomachs of fry that had just passed their metamorphosis. A series of young flounders 1 to 4½ inches long from Casco Bay were found by Welsh to have fed chiefly on isopod crustaceans, with lesser amounts of copepods, amphipods, crabs, and shrimps, which together formed 36 percent of the stomach contents; worms (39 percent); mollusks (2 percent); and various unidentifiable material (22 percent). Linton[57] who examined about 398 young flounders of various sizes at Woods Hole, likewise found them feeding chiefly on amphipods and on other small Crustacea, together with annelid worms. And his tables of stomach contents show an increase in the ratio of mollusks to Crustacea as the fish grow. The adult winter flounder, like the yellowtail (p. 271), is limited by its small mouth to a diet of the smaller invertebrates and of fish fry. Sometimes they are full of shrimps, amphipods, small crabs, or other crustaceans; sometimes of ascidians, sea worms (Nereis), or other annelids; or of bivalve or univalve mollusks. Three hundred "seed" clams, for example, were found in an 11-inch flounder at St. Andrews, New Brunswick.[58] And it seems that they often bite off clam siphons that protrude from the sand. They also eat squid, holothurians, and hydroids; occasionally they capture small fish; and they sometimes take bits of seaweed. Examination of the stomachs of adults taken at Woods Hole in February 1921 by Breder showed that they cease feeding when they are about to spawn.

In spite of its small mouth the winter flounder bites very readily on clams, pieces of sea worm, or [page 280] almost any other bait for that matter, provided the hook is small enough.

Breeding habits

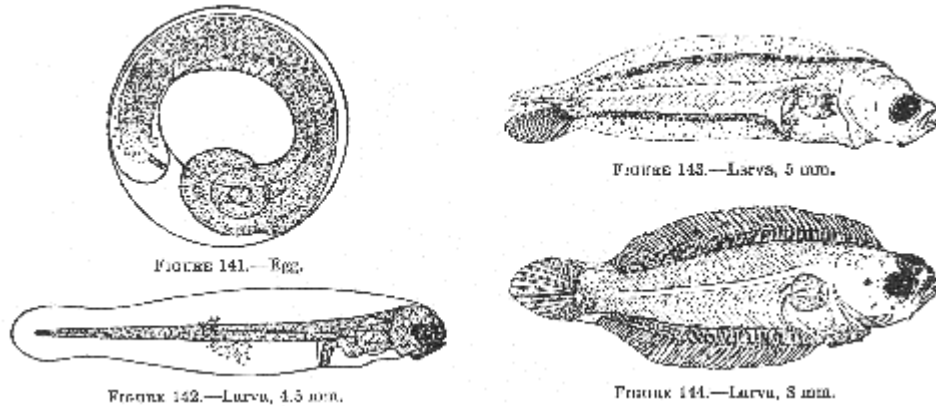
The winter flounder is a winter and early spring breeder, spawning from January to May (inclusive) in New England. The season is at its height during February and March south of Cape Cod and in the Massachusetts Bay region,[59] but it is somewhat later along the coast of Maine; near Boothbay spawning commences about March 1 and continues until about May 10 or 15 with the chief production of eggs usually taking place from March 30 to April 20, according to information supplied by Capt. E. E. Hahn, former superintendent of the Boothbay hatchery. Local differences of this sort in the spawning season are probably due to variations in the temperature of the water. After the severe winter of 1922-23, for example, when the vernal warming of the coastwise waters was slower than usual, Captain Hahn wrote us from Boothbay that "the fish were 10 to 15 days later in spawning than in any previous year, the first eggs being taken on March 24." On Georges Bank spawning fish have been reported in April and into May.

Thus spawning is well under way inshore while the water is still near its coldest for the year; i. e., about 32° to 35° F. in the Woods Hole region, about 32° to 37° near Gloucester, and about 31° to 35° near Boothbay, according to precise locality and depth. And the major production of eggs takes place there before the water has warmed above about 38°, with about 40° to 42° as perhaps the maximum for any extensive spawning in the inner parts of our Gulf. The picture is not so clear for Georges Bank, for we do not yet know how early in the season flounders commence spawning there. Those that spawn on the Bank in April may do so in temperatures ranging from about 38° to perhaps 42°, depending on the year, on the precise date, and on the locality.

Winter flounders spawn on sandy bottom, often in water as shoal as 1 to 3 fathoms, but as deep as 25 to 40 fathoms on George Bank, and they do so throughout the range of the fish, including the Bay of Fundy, where Huntsman found its larvae common near the mouths of estuaries. Most of the eggs are produced in salinities from about 31 to 32.3 per mille in the inner parts of the Gulf, to somewhere between 32.7 and 33 per mille on Nantucket Shoals and on Georges Bank. But those that spawn in estuaries are known to do so in brackish water, in salinities as low as 11.4 per mille near Woods Hole, for instance.

Individual females produce an average of about 500,000 eggs annually, and nearly 1,500,000 have been taken from a large one of 33/8 pounds. They spawn at night, at least those did that were kept in the tanks at Woods Hole, where they seemed indifferent to the electric lights overhead. And Breder[60] describes the fish of both sexes as swimming in a circle, about one foot in diameter, clockwise so that the vent is outward, with the eggs from the females flowing back along the upper side of the anal fin and along the tail. After about 10 seconds of activity, they sink motionless to the bottom.

This species is peculiar among our local flatfishes in that its eggs are not buoyant but sink to the bottom, where they stick together in clusters, usually so closely massed that the individual eggs are forced into irregular outlines. They are 0.74 to 0.85 mm. in diameter, and newly shed eggs have no oil globule, but some of them (if not all) develop one as incubation proceeds.[61] Incubation occupies 15 to 18 days at a temperature of 37° to 38° F., which is about what they encounter in nature. The young larvae, which are 3 to 3.5 mm. long at hatching, are marked by a broad vertical band of pigment cells that subdivides the post anal part of the body, a characteristic feature; and the end of the gut also is heavily pigmented. In water of about 39° the larva grows to 5 mm. in length, and the yolk is absorbed (fig. 142) in 12 to 14 days. The vertical fin rays begin to appear in 5 to 6 weeks after hatching, at a length of about 7 mm., and the left eye has moved upward by then until about half of it is visible above the dorsal outline of the head, while the whole left eye shows from the right side and the fins are fully formed in larvae of 8 mm. Metamorphosis continues rapidly.[62] the left eye moves from this position to the right side of the head; the pigment fades from the blind side; the eyed side becomes uniformly pigmented; and the little fish now lies and swims with the blind side down, its metamorphosis complete when it is only 8 to 9 mm. long.



Winter flounder (*Pseudopleuronectes americanus*).

- Figure 141. - Egg
- Figure 142. - Larva, 4.5 mm
- Figure 143. - Larva, 5 mm
- Figure 144. - Larva, 8 mm

The youngest larval stages are made identifiable as winter flounders by the pigment bar just mentioned. After the fin rays appear their small mouth separates them from any of the large-mouthed flounders; their short, deep body, combined with the small number of fin rays, separates them from the witch; and the number of fin rays marks them off from the yellowtail (p. 273). The winter flounder also completes its metamorphosis at a smaller size than either of these other small mouthed flatfishes (pp. 287 and 273).

The rate of development of the larvae is governed by temperature, occupying from about 2½ to about 3½ months, according to the data available, and the larvae that are hatched later may catch up with the earlier hatched ones before their metamorphosis takes place. Larvae in their later stages have been taken in abundance in the tow nets at Woods Hole. But their habits in aquaria suggest that they are less at the mercy of the tide and current than our other flatfishes are, for they have been described as alternately swimming upward and then sinking, to lie for a time on the bottom instead of remaining constantly adrift near the surface, as the larvae of most of the flatfishes do at a corresponding stage in their development. At any rate, we have not taken any in our tows in the open Gulf[63] that were certainly identifiable as winter flounder.

Judging from a large series from Casco Bay, measured by Welsh, and from others seen by us off near Boothbay Harbor and at Mount Desert, the fry of the previous winter grow to an average length of 1½ to ¾ inches by August, with an occasional specimen as long as 4 inches; they are 2 to 4 inches long by the end of September; and 4 to 6 inches long off southern New England in January and February, when nearing 1 year old, which probably applies north of Cape Cod as well. They may grow somewhat faster in more southern (warmer) waters, as in Chesapeake Bay, where fish of the year are 4¼ to 7 inches long in January and February.[64]

Welsh also concluded, from measurements gathered from various sources, that the winter flounders are 5 to 7½ inches in length at 2 years of age, 7½ to 9½ inches at 3 years, and 9½ to 10 inches long when 4 years old, which accords with 8 to 10 inches at 2 to 3 years in New York waters as reported by Lobell[65] and by Perlmutter.[66] Probably they mature sexually at 3 years, for most of the spawners are upwards of 8 inches long. Our only information as to the rate of growth of older fish is that one tagged near Block Island, April 17, 1941, when it was 107/8 inches long, was 17 inches long when it was recaptured on Georges Bank, 4 years and 4 months later.

General range

Atlantic coast of North America from the coast line out to the offshore fishing banks; common from the Strait of Belle Isle,[67] the north shore of the Gulf of St. Lawrence where it has been characterized as "all along the coast,"[68] and southern and southeastern Newfoundland to Chesapeake Bay; recorded from the southern part of the Grand Banks,[69] and as far north as Ungava Bay, northern Labrador;[70] and from as far south as North Carolina and Georgia.[71]

Occurrence in the Gulf of Maine

This is the commonest shoal water flounder, and perhaps the most familiar of all the ground fishes of the Gulf of Maine. There is no bay or harbor from Cape Cod to Cape Sable, no inter-island passage, and no stretch of open coast where it is not to be caught, unless the bottom be too smooth and hard, except, perhaps in the very turbid waters at the head of the Bay of Fundy.

As one looks down at low tide from some pier where the water is clear enough, or from a boat, drifting over the flats, one is almost sure to see a flounder here and there, lying partly buried in the sand or mud. And they often come into water so shallow that it is easy to spear them. A flounder spear used to be almost as familiar an instrument along our coasts as an eel spear.

With most of the flounder population of the inner parts of the Gulf living shoaler than 30 fathoms (20 fathoms is the deepest we have caught one there, close in to Little Duck Island, off Mount Desert), the zone occupied by them around the coast north of the elbow of Cape Cod is hardly as much as 8 to 10 miles wide, measured from the outer headlands or islands, except for Stellwagen Bank which lies a few miles farther out, and off Cape Sable, where their outer-depth limit lies something like 15 miles offshore. But their range extends out along the offshore rim of the Gulf, in somewhat deeper water, to include the Nantucket Shoals region as a whole (they must be plentiful to account for the 2 to 4 million pounds of blackbacks and lemon soles that are brought in from there yearly) and from the shoaler parts of Georges Bank.

The flounders on Georges run so much larger than they ordinarily do in-shore that they have been described as a separate species (p. 277). During the summer of 1913 these soles (as they are called now, if they weigh more than 3 pounds) constituted about 4 percent by number of all the fish of all kinds that were caught on Georges by the several otter trawlers that carried investigators from the Bureau of Fisheries. Nowadays most every otter trawling trip brings in anywhere from a few hundred to several thousand of them according to depth and precise location on the bank. About 4 million pounds of lemon soles (larger than 3 pounds) and blackbacks (smaller than 3 pounds) were brought in from Georges Bank as a whole in 1947.

They seem not to be so plentiful on Browns Bank, to judge from a catch of about 23,000 pounds of large sole and smaller blackbacks there by United States vessels in that same year. But, much larger numbers are landed in the fishing ports along the outer coasts of Nova Scotia; about 420,000 pounds of flounders and soles combined, in 1946, the most recent year for which we have seen the Canadian Fisheries statistics.

Fluctuations in abundance

Declining catches in the fyke nets that were used to take brood fish for the Boothbay (Maine) hatchery leave no doubt that winter flounders were decidedly less abundant in that vicinity from 1934 to 1940 than they had been from 1925 to 1933. And some decrease in their abundance during the same period is indicated for the southern Cape Cod shore by the catch records of the Woods Hole hatchery; also along Connecticut and near New York, by the evidence of fishermen's logbooks.[72]

Importance

The winter flounder, whether blackbacks or lemon soles, is the thickest and meatiest of all the flatfishes smaller than the halibut that are common on our coasts eastward and northward from the elbow of Cape Cod.

In 1946 (most recent year when statistics are available for the Canadian catch as well as for the United States catch), the inner parts of the Gulf, from the tip of Cape Cod around to Cape Sable, [page 283] yielded not far from 4 million pounds of flounders smaller than 3 pounds (blackbacks) to New England fishermen,[73] and about 49,000 pounds of fish heavier than 3 pounds (lemon sole). Nantucket Shoals, and the neighboring side of the so-called South Channel yielded about 5 million pounds of blackbacks and 1 million of soles; Georges Bank[74] about 3 million pounds of the larger soles and about 600,000 pounds of the smaller blackbacks.

In addition to all this, Canadian fishermen caught some 4,400 pounds of flounders at the mouth of the Bay of Fundy on the New Brunswick side, 16,200 pounds of "flounders and soles" on the Nova Scotian side of the Bay, and 82,000 pounds off the west coast of Nova Scotia.

Our Gulf as a whole thus yielded something like 14 million pounds of winter flounders, large and small, in the year in question, which seems to have been a representative one.

Most of the commercial catch is made today by the otter trawlers, a small part on hook and line, or in nets of one sort or another. Years ago numbers were speared on the flats; as lately as 1919, about 7,000 pounds were reported as taken in this way on Cape Cod. But flounder spearing has gone out of fashion so completely of late that no flounders, only eels, are listed under the heading "spears" in the Massachusetts landings by gear for 1945 or for 1946.[75]

Flounder fishing, too, for amusement and for home use goes on in harbors, estuaries, and other sheltered situations all around the shores of the Gulf, from bridges, piers, and small boats. And the number taken in this way must be very large in the aggregate for flounders are easy to catch (as well as very toothsome) provided the hook is not too large (Nos. 4 to 8 are best) and the bait is on bottom. Pieces of clam, of large snails, of sea worms (Nereis) or of squid, shrimp, and mussels, all are good. And they will take angle worms.

[40] Perlmutter (Bull., Bingham Oceanogr. Coll., vol. 11, Art. 2, 1947, pp. 19, 20) gives a detailed tabulation, and graph of the number of dorsal and anal fin rays from upwards of 1,100 specimens including both the smaller inshore form and the larger Georges Bank form.

[41] Bull., U. S. Fish Comm., vol. 19, 1901, pp. 305-306.

[42] Copeia 1952, p. 206.

- [43] Zoologica, New York Zool. Soc., vol. 9, 1927, p. 180.
- [44] See Bumpus (American Naturalist, vol. 32, 1898, pp. 407-412) and especially Perlmutter (Bull. Bingham Oceanographic Coll., vol. 11, Art. 2, 1947, pp. 18-23) in this connection.
- [45] Bull. U. S. Bur. Fish., vol. 30, 1912, p. 391, pl. 57.
- [46] Perlmutter has already emphasized this point in his detailed study of the blackback (Bull. Bingham Oceanogr. Coll., vol. 11, Art. 2, 1947, p. 18).
- [47] Hildebrand and Schroeder, Bull. U. S. Bur. Fish., vol. 43, Pt. 1, 1928, p. 170.
- [49] As proved by captures in shrimp trawls, as reported by Huntsman.
- [50] Bull. Bingham Oceanogr. Coll., vol. 11, Art. 2, 1947, p. 17.
- [51] Perlmutter, Bull. Bingham Oceanogr. Coll., vol. 11, Art. 2, 1947, pp. 26, 27.
- [52] This specimen is on display at the Laboratory of the U.S. Fish and Wildlife Service at Woods Hole.
- [53] This occurrence is described by Nichols (Copeia, No. 55, 1918, pp. 37-39), also by Nichols and Breder, Zoologica, N. Y. Zool. Soc., vol. 9, 1927, p. 79.
- [54] Bull. 60, New York State Mus., Zool., 9, 1903, p. 778.
- [55] Bull. U. S. Bur. Fish., vol. 38, 1923, p. 311.
- [56] Trans. Amer. Fisheries Soc., vol. 44, 1914-15, No. 1, p. 135.
- [57] App. 4, Report U. S. Comm. Fish. (1921) 1922, pp. 3-14.
- [58] Fisheries Research Board of Canada, Progress Reports of the Atlantic Coast Stations, No. 52, January 1952, p. 3.
- [59] This species was propagated artificially at the Woods Hole, Gloucester, and Boothbay hatcheries in large numbers.
- [60] Copeia, No. 102, 1922, pp. 3-4.
- [61] Breder, Bull. U. S. Bur. Fish., vol. 38, 1923, fig. 274g.
- [62] Williams, Bull. Mus. Comp. Zool., vol. 40, 1902, No. 1, pp. 1-58, pls. 1-5. See also Sullivan (Trans. Amer. Fish. Soc., vol. 44, 1914-15, pp. 125-136, figs. 1-4) and Breder (Bull. U. S. Bur. Fish. vol. 38, 1923, p. 311).
- [63] Three larvae taken in the Gulf in July 1912, were provisionally identified by Welsh as this species.
- [64] Hildebrand and Schroeder, Bull. U. S. Bur. Fish., vol. 43, Pt. 1, 1928, p. 169.

[65] 28th Rept., New York Conserv. Dept. 1939, Sup., Pt. 1, p. 86.

[66] Bull. Bingham Oceanogr. Coll., vol. 11, Art. 2, 1947, p. 17.

[67] Jeffers (Contrib. Canadian Biol., N. ser., vol. 7, No. 16, ser. A, General, No. 13, 1932, p. 210) reports it as not uncommon at Raleigh, on the Newfoundland side of the Strait.

[68] Stearns, Proc. U. S. Nat. Mus., vol. 6, 1883, p. 125.

[69] At 2 stations, see Rept. Newfoundland Fish. Res. Lab., vol. 2, No. 3, 1938, p. 79.

[70] Reported from Fort Chimo, Labrador by Kendall (Proc. Portland Soc. Nat. Hist., vol. 2, Pt. 8, 1909, pp. 225, 233); specimen in U. S. Nat. Museum, collected in 1882 or 1883 by L. M. Turner and identified by T. H. Bean.

[71] Reported from Beaufort, N. C. (by Yarrow, Proc. Acad. Nat. Sci., Philadelphia, vol. 29, 1877, p. 205); from the Neuse River, near New Bern, N. C. (by Smith, North Carolina Geol. and Econ. Surv., vol. 2, 1907, p. 390); and from Georgia (by Hildebrand and Schroeder, Bull. U. S. Bur. Fish., vol. 43, Pt. 1, 1928, p. 170).

[72] For details, see Perlmutter, Bull. Bingham Oceanogr. Coll., vol. 11, Art. 2, 1947, pp. 6-13, who has made a special study of the blackback.

[73] the amount cannot be stated any more precisely because of uncertainty as to how much of the 21/3 million pounds of black backs reported that year from Cape Cod was caught off the Gulf of Maine coasts of the Cape, and how much off the south shore of Massachusetts.

[74] Including the statistical area classed as Eastern Side South Channel.

[75] "Spears" are not included for 1947; only "harpoons," for larger game.

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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