

Squirrel Hake

Urophycis chuss (Walbaum) 1792
[Jordan and Evermann, 1896-1900, p. 2555.]

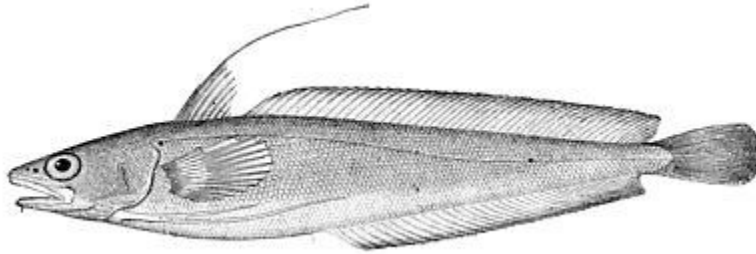


Figure 106 - Squirrel hake (*Urophycis chuss*), off Marthas Vineyard.
From Goode. Drawing by H. L. Todd.

Description

The squirrel hake resembles its larger relative, the white hake (p. 221) so closely that the one is often taken for the other. The number of scales affords the most reliable means of identification, those of the squirrel being much larger relatively than those of the white, and arranged in only about 100 to 110 oblique cross rows along the side from gill opening to base of caudal fin, and in about 9 longitudinal rows on the upper part of the sides between lateral line and dorsal fin, as against about 140 transverse rows and about 12 longitudinal rows in the white hake (p. 222). Also, the upper jaw (maxillary bone) reaches back only as far as the rear edges of the pupil in the squirrel hake, but as far as the rear edge of the eye in the white hake (p. 222), and this difference can be relied upon, even for very small fish.

The ventral fins of the squirrel hake overlap the vent as a rule, whereas those of the white hake fall short of it, but this is not invariably the case, as already remarked (p. 222), for we have seen squirrel hakes in which the ventrals, did not reach to the vent. Furthermore, the filamentous part of the third ray of the first dorsal fin is much longer (if undamaged) in the squirrel than in the white hake, i. e., three to five times as long as the rest of the fin, and the nose is blunter. The color, too, is of some value in identifying these species, for while the squirrel hake is almost always reddish brown, the white hake has a decidedly purplish lustre when fresh caught.

Color

The squirrel hake is reddish, muddy, or olive brown on sides and back, darkest above; sometimes almost black, sometimes more or less mottled, and sometimes plain, with pale lateral line. The lower part of its sides usually are washed with yellowish, and sometimes marked with dusky dots. Its belly and the lower parts of the sides, of its head are pure white, grayish, or yellowish; its dorsal, caudal, and anal fins are of the same color as the back except that the anal is pale at the base. The ventral fins are very pale pinkish or yellowish.

Size

The squirrel hake does not grow so large as the white hake, seldom reaching a greater length than 30 inches (the largest of 780 Bay of Fundy fish measured by Craigie was about 27 inches long), or a greater weight than 6 to 7 pounds, and the average of those caught will not run above 1 to 3 pounds. In fact, a fish as heavy as 5 pounds is exceptional. Females are both longer and heavier than males of the same age (p. 226).

Habits

These two hakes, [26] like many other sea fishes, spend their first months drifting at or near the surface, and fry of $\frac{1}{2}$ to 4 inches (among which both species are no doubt represented) are often taken in summer under floating eelgrass or rockweed. On calm days we have seen them darting to and fro on the surface on many occasions (p. 224). And it is evident that the duration of this pelagic stage varies, for we have towed fry as long as 4 inches on the surface although others seek the bottom while they still are only [page 224] about 2 inches long. But it is not known how far they may journey while they are at the mercy of currents. After they have taken to the bottom, they are ground fish for the remainder of their lives, only rising into the upper layers in pursuit of food. They are rather sluggish swimmers, as their body form suggests, and even a large one makes only a very feeble resistance when it is hooked.

When hake first take to bottom many of them do so in very shallow water, fry 2 to 6 inches long being common close below the tide mark among the eelgrass (*Zostera*); and fish a little larger are often caught by flounder fishermen in the harbors all around the Gulf of Maine. Others, however, seek the ground in somewhat deeper water, where they have an interesting habit of hiding within the living shells of the giant scallop (*Pecten magellanicus*). This has often been observed on the outer part of the Continental Shelf off southern New England; Nichols and Breder [27] have found little hake hiding in the mantle cavities of scallops in 20 fathoms off New York, and scallop fishermen have informed us that they often find little hake in the scallops that they dredge off the coast of Maine. Both of the common species of hake are known to use this curious refuge (they do not feed on the scallops but merely use their shells as hiding places), but most of the specimens so taken have proved to be squirrel hake. And the latter adopts this form of commensalism so commonly that Welsh records as many as 27 taken from 59 scallops in one haul of a scallop dredge, and 11 hake from 9 scallops in another haul, besides many others not counted off southern New England, New York, and New Jersey during the summer and autumn of 1913.

Slightly larger hake of both species, up to 8 to 12 inches long, are not only plentiful offshore, but are rather common close inshore in a fathom or two of water, in harbors, and even well up estuaries. The larger fish usually keep to deeper water, especially in summer, when hake of marketable sizes are most plentiful below 20 fathoms and when only a few large ones are caught in less than 10 fathoms of water. But this rule, like most others, has its exceptions. For instance, we once saw a white hake of about 8 pounds caught from a float in Northeast Harbor, Maine, in about 10 feet of water, in July (in 1922). On the other hand, hake of both the species in question are to be caught in the deepest parts of the Gulf, and white hake have been taken down to 545 fathoms at least, on the offshore slope of Georges Bank.

Both of these hake haunt soft bottom chiefly, few being caught on the gravelly or shelly grounds that are so prolific of cod and haddock, or on rocky grounds. And it has been our experience that the whites are the more strictly mud fish of the pair.

The temperatures in which hakes of different ages are found cover the entire range proper to the Gulf except perhaps the very lowest. At the one extreme many of the youngest fry that are seen swimming at the surface in the west central part of the Gulf in summer are in water as warm as 68° to 70° F., while young hake are in still higher temperatures west and south from Cape Cod if they are at the surface. And the somewhat larger fry found on our beaches a little below tide mark may be in water as warm as 60° locally. But the great majority of the hakes living deeper are in water at least as cool as 50° throughout their later lives, most of them in temperatures lower than 45° F.

At the other extreme, all of the hakes living around the inner slopes of the Gulf at depths less than 50 fathoms experience temperatures as low as 35° to 37° F. in late winter and early spring; as low as 33° to 34° locally if they are living as shoal as 20 fathoms, which many of them do. But the fact that the bottom temperatures at the particular stations on the Grand Banks (all on the southern part) where white hake have been reported by the Newfoundland Fisheries Research Commission have all been between about 42° and about 33° F. (5.5° C. and 0.6° C.), and that they were not taken on other parts of the Bank where the bottom is colder, suggests that they tend to avoid regions where the temperature is as low as 32° F. or lower. And this finds some corroboration in the report (see p. 228) that hake tend to withdraw in autumn from Passamaquoddy Bay, where the water chills at least as low as 32° at some time during some winters.

Food

Less is known of the diet of the hakes than of the cod, the haddock or the pollock. However, it is certain that they are not shell eaters to any extent, for it is seldom that their stomachs contain even the smaller univalve or [page 225] bivalve mollusks, and neither large mollusks nor echinoderms have ever been found in a hake, so far as we know. The stomach contents so far recorded [28] show that shrimps (*Pandalus*), amphipods, and other small crustacea which they find on the bottom are their chief dependence at most times and in most places. They also feed as greedily on squid as others of the cod tribe do, and a variety of small fish have been found in hake stomachs at Woods Hole [29] such as alewives, butterfish, cunners, eels, flatfishes, tautog, herring, mackerel, menhaden, launce, silversides, silver hake, sculpins, sea robins, smelt, and tomcod.

Small white hake trawled some 75 miles south of Martha's Vineyard, in 56 fathoms, January 29, 1950, by the dragger *Eugene H* had fed on small squid, crabs (*Cancer*) and small butterfish (*Poronotus*); others trawled off Chesapeake Bay (lat. 38° 13' N., long. 73° 49' W.) in 52 fathoms by the *Albatross II* , March 2, 1931, had small mackerel, flounders, crabs, and squid in their stomachs. And we have seen squirrel hake caught off northern New Jersey with their bellies distended with launce, and with launce hanging from their mouths.

Hake of both species bite on fish bait such as herring readily; in fact, most of those that are caught on long lines (p. 230) are hooked on pieces of herring. But they also take clams on the hook greedily enough. In the northeastern part of the Gulf of Maine hake feed far enough off bottom to capture the pelagic euphausiid shrimps (*Meganyctiphanes* and *Thysanoessa*) that are so plentiful there, while the general character of their diet is sufficient evidence that they do not root in the ground like haddock.

Ever since 1616, when Capt. John Smith [30] wrote "Hake you may have when the cod failes in summer, if you will fish in the night," it has been common knowledge that they bite best after dark, from which it is fair to assume they do most of their foraging between sunset and sunrise.

Herrick [31] has given an interesting account of the perceptions of squirrel hake kept in a tank at Woods Hole, where they proved to have keen sight (though less so than pollock) and usually caught bits of meat before these had sunk. But it seems that it was only while food was in motion that the fish recognized it by sight, and that they depend chiefly on the sense of touch for their livelihood. They exercised this by swimming close to bottom with the sensitive tips of the ventral fins dragging the ground. When a hake touched a fragment of clam in this way it immediately snapped it up, but not otherwise. And they paid no attention whatever to live clams in their shells, though they often brushed over them. These observations, applied to the conditions under which hake actually live, suggests that they recognize shrimps, crabs, and other foods by their ventral feelers, and that they snap up their victims as these dart ahead, when the feelers drag over them.

No doubt the eggs of the white hake are buoyant like those of the squirrel hake (p. 225), but few wholly ripe females, no eggs naturally spawned, or young larvae have been seen yet.

We were equally ignorant of the spawning and early stages of the squirrel hake up to the summer of 1912. But we trawled squirrel hake with running spawn and milt in Ipswich Bay in that July, fertilized the eggs on board the *Grampus*, and thus identified the eggs. Since then large numbers of squirrel-hake eggs have been hatched artificially at the Gloucester hatchery.

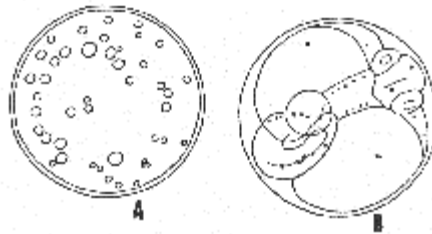


Figure 107. - Squirrel hake (*Urophycis chuss*), eggs, after 1 hour's incubation, A; and after 74 hour's incubation, B.

The eggs are buoyant, spherical, transparent, and 0.72 to 0.76 mm. in diameter. When first spawned they have variable numbers of small [page 226] colorless oil globules 0.02 to 0.07 mm. in diameter, scattered over the yolk, but most of these globules unite shortly after fertilization into one large one of 0.15 to 0.17 mm., which is sometimes single but which usually has two or three tiny ones close beside it. The embryo extends half way around the yolk sphere within two days after fertilization (at a temperature of 60° F.), and pigment has appeared, one of the most characteristic features of this species being the development of black chromatophores not only on the embryo, but over the yolk, and finally on the oil globule as well. In late stages of incubation this feature, combined with the small size of the egg and (usually) with a multiple oil globule, distinguishes eggs of the squirrel hake from all other buoyant fish eggs of known parentage that have been found in the Gulf, except for any rockling eggs that may have pigmented oil globules (p. 236). There is also some danger of confusing newly spawned eggs of the squirrel hake with those of the butterfish (of about the same diameter) for these sometimes have two oil globules (p. 364).

The newly hatched larvae have not been described. Older fry (identity established either as white hake or squirrel hake by comparison with young fry that have been reared in the hatchery by Louella E. Cable) already show the long, slender ventral fins, the short first dorsal but long second dorsal, and the tapering body form, characteristic of the adults. These little hakes, greenish blue on the back, with silvery sides, are separable from rockling fry by their more slender form, and by their scattered pigment. Older stages are separable from rocklings by their two well developed dorsal fins, while their silvery sides mark them at a glance from the dull colored fry of the cusk. [32]

Rate of growth

The rate of growth during the first few months cannot be stated until many more young fry have been measured and identified as the one species or as the other. It is probable that two year classes are represented among the fry that are caught along shore in summer. Some of the smaller ones (2 to 3 inches long) may be from the earliest spawned eggs of that same season, but other squirrel hake of 2-3/8 to 4-1/3 inches (60-110 mm.) that were seined at Provincetown, on June 26, 1925, must have been about one year old, as they were taken too early in the season to have been the product of that year's spawning. And the larger ones of 6 or 7 inches are yearlings.

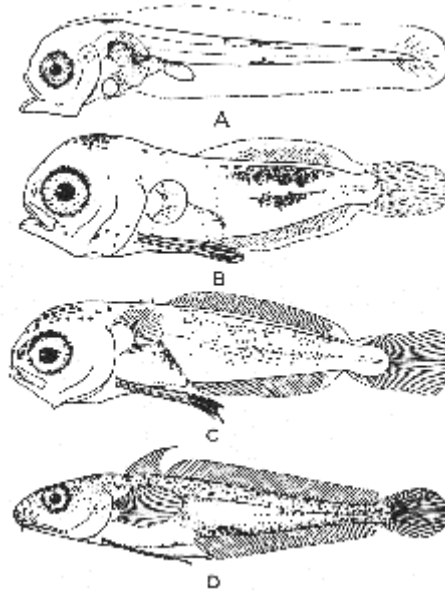


Figure 108 - Young stages of either white hake or squirrel hake.

A, larva, 2.2 mm.; B, larva, 6.2 mm.

C, larva, 9 mm.;

D, young fry, 40 mm. silvery still, and living at the surface of the water.

Specimens collected off Woods Hole.

The growth of older squirrel hake in the Bay of Fundy has been studied by Craigie; his conclusions from scale studies, [33] combined with the relative abundance of fish of different size groups, being as follows:

Age	Average length, inches	
	Male	Female
1 year old	8	8
2 years old	13	14
3 years old	16	19

The indicated rate of growth is so uniform during the first three years of life as to suggest that spawning (an event so exhausting that it [page 227] slows the growth of any fish) probably does not take place until they have passed their third birthday. Nothing definite is known of the rate of growth

of the white hake, but it is fair to assume that it grows faster than the squirrel, to attain its greater length and weight.

General range

Both the white hake and the squirrel hake are exclusively American, occurring in continental waters from the Gulf of St. Lawrence and the southern part of the Grand Bank of Newfoundland southward to the Middle Atlantic States. The squirrel, though common as far south as Chesapeake Bay, has not been reported from farther south than Virginia. But the white hake is known off North Carolina (we have seen a 30 inch specimen that was trawled off Bodie I., North Carolina, lat. 35° 52' N., long. 74° 51' W. in 70 fathoms by the *Albatross II*, Feb. 24, 1931). And very likely the "squirrel" actually ranges as far south as the "white" does. Both of them occur from near tide mark, the squirrel down to about 175 fathoms, the white down to about 545 fathoms.

Occurrence in the Gulf of Maine

Hake are very common fish in our Gulf, where the two species, white and squirrel, are caught side by side regularly. In the Bay of Fundy there are so few toward the head that stragglers are caught, or none at all, but they are plentiful enough toward the mouth where, for example, about 6,400,000 pounds were landed on the Nova Scotian side by Canadian fishermen in 1944, and about 8,200,000 pounds in 1946, while the yearly catch on the New Brunswick side is about 500,000 to 600,000 pounds. Other centers of abundance for them inshore are along the coast of Maine between Machias and Mount Desert Island, in Frenchman's Bay (formerly the site of an important hake fishery), the ground known locally as the "Grumpy" near Isle au Haut, and off Penobscot Bay.

Sundry small grounds outside the islands from Penobscot Bay to Cape Elizabeth and all along the western side of the Gulf, also yield good numbers of hakes, especially near Boon Island; the vicinity of the Isles of Shoals, a famous hake ground for small boat fishermen; Ipswich Bay; the lower slopes of Jeffreys and Stellwagen Banks; also the deeper parts of Massachusetts Bay, which yielded 750,000 pounds in 1919 when the demand for hake was better than it is now.

Hake, indeed, are so widespread on the lower slopes of all the banks and ledges in the inner parts of the Gulf, as well as on the mud floors between them, that Rich [34] listed 119 named grounds in the western side of the Gulf as good haking bottoms. Hake, with flounders, rosefish, and silver hake are practically the only commercially valuable fish one is likely to catch on the floors of the deep basins and channels of the Gulf; and a catch of 2,880 of them with 580 cusk, but no cod or haddock, by long-line fishing 15 miles southeast of Monhegan on June 24 to 25, 1913, will illustrate how completely they may monopolize suitable bottoms.

Hake are plentiful in the so-called South Channel also, and on the northwest slope of Georges Bank, whence about 2,000,000 pounds were landed in 1919, about 1,500,000 pounds in 1947. And it has long been known that there is an abundance of hake at depths greater than 60 to 70 fathoms all along the southern slope of Georges Bank. Long-line fishermen, too, have told us that while it was unusual to hook a hake on the shoaler parts of Georges, many were caught wherever the line was run off into deeper water on the northwest face of the bank; i. e., onto soft bottom. And this is borne out by the statistics of the catches, for the good trawling grounds on Georges Bank yield far fewer hake of marketable size than the inner parts of the Gulf do, if the year 1945 can be taken as representative. [35]

It has only been since 1944 that the landings of white hake and of red (i. e., squirrel) hake have been reported separately. Taken at their face value, these would point to the white hake as by far the more plentiful member of the pair throughout the inner parts of the Gulf as a whole, and on Georges Bank.

In 1945, for example, [36] the reported landings were some 14 times as great for white as for red hake, for every one of the subdivisions into which the inner part of the Gulf is divided for statistical purposes, while only a few thousand pounds of red hake were reported from off eastern or central Maine, or from the northwestern part of Georges Bank; and none from the eastern or southwestern part of the [page 228] Bank. But this would give a wholly false picture of the actual situation, because most of the red hake that are caught on these grounds are thrown overboard because they are too small to be worth gutting and icing under present market conditions.

Actually, we trawled 34 squirrel hake and only two other hake [37] in Ipswich Bay, in 22 fathoms on one occasion in July 1912; Welsh counted 5,450 squirrel hake to 652 white hake caught in otter trawling on the northwest slope of Georges Bank in June 1912; we counted 2,457 red hake to only 196 white hake from 29 trawl hauls at 22 to 150 fathoms on the southwestern part of Georges Bank and south of Nantucket Shoals on the *Albatross III*, May 11-18, 1950; and we saw 2,040 squirrel hake taken in 42 hauls by the *Eugene H* on the southwest part of Georges Bank, in late June 1951, but only 51 white hake. Reported landings also, in pounds, for 1945, were about 100 times as great for red as for white hake from the Nantucket grounds, whence all the little hake are brought in for the trash fish industry. And the discrepancy is greater still in numbers, for the white hake are much the heavier of the two, individually. Red hake also predominate over white among the hake landed in New York and to the southward, as is illustrated by the catch statistics for 1947. [38]

Landings, for 1947, to nearest 100,000 pounds:

	New York	New Jersey	Delaware
Red hake	1,200,000	5,600,000	200,000
White hake	1,000,000	200,000	100

On the other hand, inquiries of fishermen, corroborated by our own experience, point to the white hake as the more plentiful of the two in the basin of our Gulf at depths greater than 40 to 50 fathoms. The *Atlantis*, for example, trawled about 700 white hake in the deep basins off Cape Cod, west of Jeffreys Ledge and off Mount Desert, in August 1936, but only a scattering of squirrel hake. This appears to apply equally to the deeper holes in Massachusetts Bay at depths greater than 30 fathoms or so (both Storer and Goode and Bean spoke of the "white" as the more common of the two there), also to the Bay of Fundy region in general, including Passamaquoddy Bay, according to Huntsman. And nearly all of the hakes that have been listed by name from the more easterly of the Nova Scotian Banks, or from the southern part of the Grand Banks in the annual reports of the Newfoundland Department of Natural Resources, have been the white (*tenuis*). *Tenuis*, also, is the only member of the pair that was reported by Cornish [39] from Canso, but *chuss* alone is recorded from the Cape Breton shore of the Gulf of St. Lawrence by Cox, [40] who also records one from 205 fathoms on the Nova Scotian side of Cabot Strait.

The situation is made more confusing by Cornish's report of hake with 123 rows of scales from Prince Edward Island, and with 130 rows of scales from Canso, fish intermediate, that is, between *chuss* and *tenuis* in this regard, though favoring the latter. Perhaps the separation between the two species in number of scales, and also in other features, may not be so sharp toward the northern boundaries of their geographic ranges as we have found it farther south.

A more or less regular inshore movement of hakes of one or the other species, or of both of them, is said to take place in autumn, especially in the northeastern part of the Gulf, made evident by capture of considerable numbers in winter in the deeper, muddy harbors and bays east of Penobscot Bay, including St. John Harbor, and Kennebecasis Bay, which they reach by running up the St. John River, and where they are caught all winter through the ice. They also carry out corresponding movements in and offshore off southern New England, with goodly numbers appearing in shoal water at Woods Hole in autumn. But it is only in the spring and autumn that they are found close inshore off New York and off New Jersey. On the other hand, they are said to enter Passamaquoddy Bay in early summer, to withdraw in autumn.

Probably the explanation is that the adults, being cool water fish, are barred from the shallows in summer by high temperature along the coasts of Massachusetts and of west-central Maine, but that the low summer temperature of Passamaquoddy Bay allows large hake to summer there, as well as small. Their reported withdrawal from [page 229] Passamaquoddy Bay in autumn may be in avoidance of extreme winter chilling. But we should remind the reader that failure to catch fish on hook and line in the cold season of the year (it is in this way that hakes are caught in the Passamaquoddy region) does not necessarily mean that they have departed. The hake may have stopped biting, as every fisherman knows by experience. The evidence of otter trawl catches is much more reliable in this respect, for ground fishes in general.

Except for in and offshore movements, hake are resident throughout the year in the open Gulf of Maine wherever they are found, once they have taken to the bottom. And they appear to be much more stationary than either cod or haddock.

The localities where we have found eggs, provisionally identified as squirrel hake (fig. 109), show that it spawns all around the Gulf from Cape Cod to Nova Scotia. And despite its rather deepwater habitat and preference for soft bottom, most of these egg stations have been in shoal water near the coast; a haul in the eastern basin which yielded both squirrel hake and silver hake eggs (p. 178) has been the only exception. This, of course, points to a movement from the basins into shoaler water for spawning.

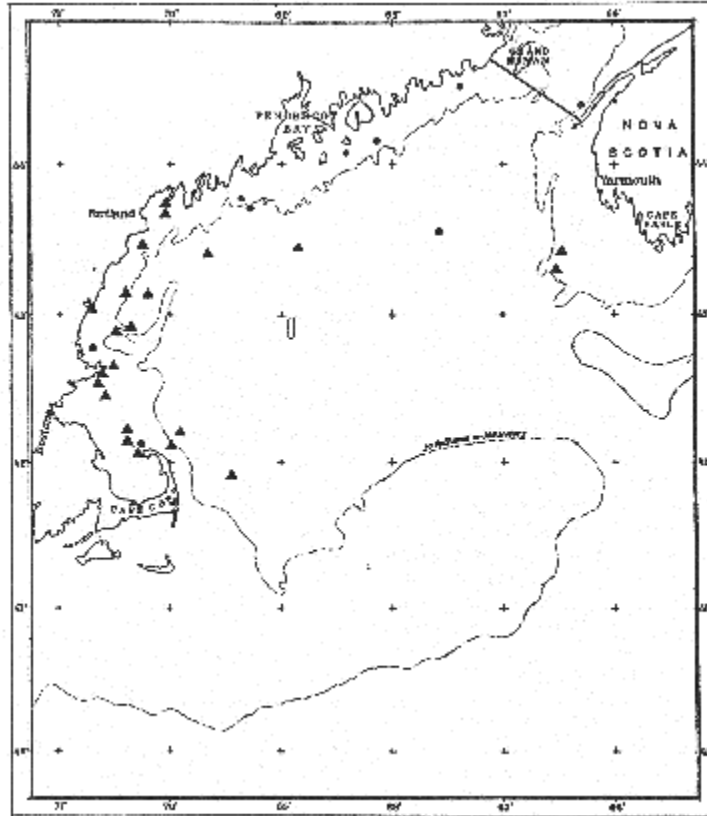


Figure 109. - Locality records for squirrel hake eggs ●, and for larvae of rockling ▲ in the Gulf of Maine.

It seems that the white hake spawns from late winter through spring to late summer, for we saw a [page 230] 30-inch female, with large roe, trawled off New Jersey (lat. 39° 23' N.) by the *Albatross II* at 88 fathoms, on February 27, 1929; Welsh saw a male with milt flowing, near Gloucester on April 22, 1913; we saw spent females, but also a male just ripening, trawled by the *Albatross III* on the southwestern part of Georges Bank on May 15, 1950; and Nichols and Breder [41] report a ripe female with ripe eggs at Woods Hole in July.

The height of the spawning season of the squirrel hake comes at least as early as June south of Cape Cod, and through early summer in the Massachusetts Bay region, judging from the size (27 to 70 mm.) of the fry mentioned above as found in scallop shells in late summer and autumn (p. 224). The extreme limits of the season are not known. But we have towed eggs of this species as early as June 10 in Petit Passage, Nova Scotia, and as late as September 20 in various parts of the Gulf, while captures of fry of 72 mm. as early as the last week in July (in Shelburne Harbor, Nova Scotia), and others as small as 36 mm. in the western part of the Gulf as late as November 1 (in 1916), point to a spawning season lasting from late spring until early autumn.

Abundance

There is nothing in the statistical picture to suggest that hake of either species fluctuate very widely in abundance in our Gulf from year to year, for the ups and downs in the amounts caught are not greater than can be charged to market conditions. Neither has any attempt been made to estimate the periodic variations in the relative abundance of different year classes. Earlier characterizations of the numbers of the two hakes in our waters have been in relative terms, ranging from "common" to "in immense numbers." [42] More precise information is that the *Atlantis* caught an average of about 32 tenuis per hour's trawling with an 82-foot trawl at 65 to 125 fathoms (120-228 meters) off Cape Cod, west of Jeffreys Ledge and off Mount Desert, in August 1936, [43] while the *Albatross III* trawled about 245 chuss and about 18 tenuis per hour's hauling on the southwestern part of Georges Bank and south of Nantucket Shoals in May 1950. And we find record of 145 tenuis taken per hour's trawling, [44] on Sable Island Bank, off outer Nova Scotia.

Importance

The hakes are soft-meated and have rather poor keeping qualities, but both the white and the squirrel hake are readily absorbed by the fish markets if they are large enough, and great numbers of small squirrel hake are now used for mink and poultry feed. A quarter of a century ago the yearly catch in the Gulf ran between 20 and 35 million pounds, and it has been much the same of late years (1941-1946), with yearly landings by Canadian and United States fishermen of between 19 and 30 million pounds. In 1946, which may serve as representative, Canadian fishermen landed about 2,100,000 pounds in outer Nova Scotian ports (Cape Sable to Cape North), about 4,800,000 pounds along the southern shore of the Gulf of St. Lawrence.

At the present time (as represented by 1946 and 1947) 4 to 5 times as much hake is marketed in Maine and Massachusetts in the form of fresh and frozen fillets as is marketed there salted, some are used for fish cakes, and a very small part [45] as smoked fillets. Hake sounds (swim bladders), especially of those that are caught off Nova Scotia in deep water, are also used to make isinglass, [46] and increasing amounts of small squirrel hake brought in from Nantucket Shoals, are utilized from year to year in the trash-fish industries. [47]

Roughly two-thirds of the poundage of hake that is landed in Maine and Massachusetts are caught in otter trawls nowadays, roughly one-fifth in gill nets, and only a little more than one-eighth on long lines. [48]

The hakes are such dull and inactive fish that they are of no special interest to the angler. But a good many fair-sized ones are caught hand-lining from party boats, for they bite readily, and small hake are caught from small boats in harbors and bays, along the Maine coast especially.

[26] the youngest stages of the two species are so much alike that in most cases we have been forced to list them simply as "hake," awaiting more critical examination than we have been able to give them.

[27] *Zoologica*, N. Y. Zool. Soc., vol. 9, 1927, p. 172.

[28] Goode, (*Fish. Ind. U. S.*, Sect. 1, 1884, p. 235); Kendall, (*Rept. U. S. Comm. Fish.*, (1896) 1898, p. 180); Linton, (*Bull. U. S. Fish Comm.*, vol. 19, 1901, p. 478); Hansen, (*Proc. U. S. Nat. Mus.*, vol. 48, 1915, p. 94); Breder (*Zoologica*, N. Y. Zool. Soc., vol. 2, No. 15, 1922, p. 350); and Vinal Edwards' notes.

[29] A large white hake taken at Woods Hole in May 1908 had a fish (*Lepophidium*) encysted in the wall of its body cavity, having no doubt penetrated the hake's stomach after it had been swallowed. (Sumner, Osburn, and Cole, Bull. U. S. Bur. of Fish., vol. 31, pt. 2, 1913, p. 768).

[30] General Historie of Virginia, New England, and the Summer Isles, 1616, ed. of 1819, vol. 2, p. 188.

[31] Bull. U. S. Fish Comm. vol. 22, 1904, p. 258.

[32] Fry figured by A. Agassiz (Proc. Amer. Acad. Arts, Sci., N. Ser., vol. 9, 1882, pl. 7, fig. 6; pl. 8, figs. 1-3), as *Motella argentata* undoubtedly were either white hake or squirrel hake. But the simple post anal pigment band, short, stocky bodies, and fan-like ventrals of the younger stages pictured by him under this same name (pl. 7, figs. 1-4) suggest that they were rockling.

[33] Contrib. Canadian Biol., (1914-1915) 1916, p. 87. Unfortunately, hake scales do not show the yearly growth zones as clearly as cod and haddock scales do.

[34] Rept. U. S. Comm., Fish. (1929) 1930, App. 3, pp. 85-86, 96.

[35] Landings of hake in 1945 were about 414,000 pounds for Georges Bank; about 12,700,000 pounds for the inner parts of the Gulf by United States fishermen and about 9,140,000 pounds by Canadian fishermen.

[36] the only year when the landings of the two have been reported by counties for Maine and Massachusetts, besides the landings at the major ports.

[37] the latter were listed by Welsh as *U. regius* , but probably they were white hake.

[38] About 13,000 pounds of white hake were reported from Maryland in 1947, about 65,000 pounds from Virginia, and about 4,000 pounds from North Carolina, with no reds. But we suspect that reds were actually included as well as whites, and spotted hake also.

[39] Contrib. Canadian Biol. (1902-1905), 1907, p. 89.

[40] Contrib. Canadian Biol. (1918-1920), 1921, p. 113.

[41] Zoologica, N. Y. Zool. Soc., vol. 9, 1927, p. 172.

[42] Huntsman, Contrib. Canadian Biol., (1921) 1922, p. 68.

[43] Bigelow and Schroeder, Biol. Bull., vol. 76, 1939, p. 308.

[44] Report, Newfoundland Fish. Res. Comm., vol. 1, No. 4, 1932, p. 109.

[45] About 39,000 pounds reported for 1946, none for 1947.

[46] For further information see Tressler, Marine Products of Commerce, 1949, pp. 489-491.

[47] Landings of red hake at New Bedford from the Nantucket Shoals region, mostly used in this way, were about 5,600,000 pounds in 1947.

[48] the amounts recorded for 1947 were:

	Pounds
Otter trawls	10,399,800
Gill nets	3,380,200
Long lines	2,097,200
Hand lines	102,200

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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