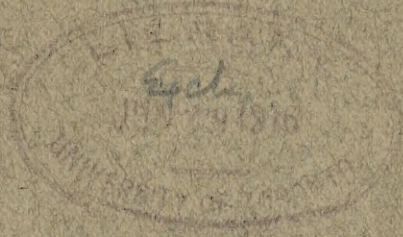


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LONG ISLAND FAUNA—IV
THE SHARKS

BY

JOHN TREADWELL NICHOLS AND ROBERT CUSHMAN MURPHY

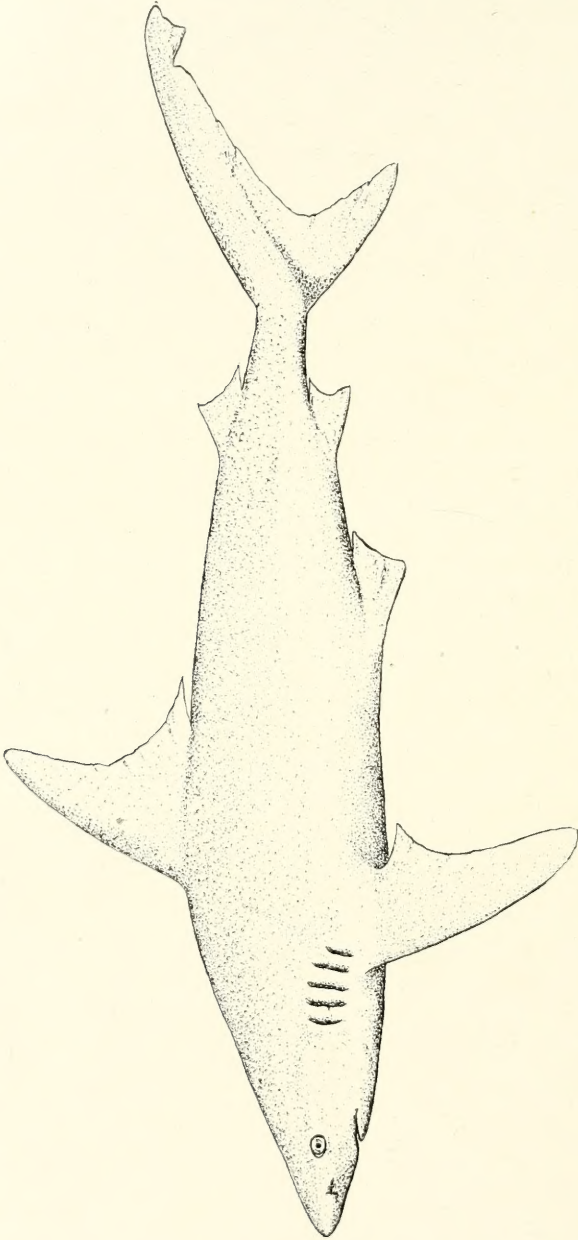
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BROWN SHARK
Carcharhinus milberti (Müller & Henle)

LONG ISLAND FAUNA¹. IV.

THE SHARKS (Order SELACHII)

BY JOHN TREADWELL NICHOLS AND ROBERT CUSHMAN MURPHY

Sharklike forms, not unlike those of to-day, were among the very earliest of fishes to be found on the earth. It is therefore natural to find the structure of the sharks simple and primitive as compared with that of other fishes. On the other hand, their mode of reproduction is highly specialized. The eggs of some kinds are hatched within the body cavity of the mother, and the young, born fully developed, are often quite sizable individuals; with others the eggs are few and large, laid singly and enclosed in a peculiarly formed capsule.

The sharklike fishes may be separated into two groups: 1, more or less cylindrical or compressed forms—the true sharks; and 2, broad, flat, depressed species, many of them specialized for lying on the bottom—the rays. In this paper the former alone are dealt with, and only such species as occur in water of twenty-five fathoms' depth or less. There is, however, an almost perfect series of connecting links between the sharks and the rays, and we have included one of them, *Squatina*, in the present discussion. This very peculiar fish might with equal propriety be placed in the other group, but that it has the gill-openings more or less lateral instead of strictly on the lower surface, as in the rays.

The sharks are generally large fishes with a curved, transverse mouth on the under side of the head, and an asymmetrical caudal fin, the upper lobe of which is the longer. They have no platelike or overlapping scales, and their more or less rough skin extends over the flipperlike fins. The latter are very different from the fins of most fishes, in which a framework of spines or rays is connected by delicate

1. Previous papers of this series were grouped under the heading "Long Island Fauna and Flora." Since the Brooklyn Botanic Garden has taken over the herbarium and botanical library, which were formerly deposited in the Museum, it is not likely that botanical publications will henceforth be issued in the Science Bulletin.—Ed.

membrane. The gill cavities open to the exterior by characteristic parallel slits on the side of the neck. The nasal apparatus is well developed, and sharks are more dependent on smell in finding their food than most fishes. As a rule, they are rather sluggish, but capable of attaining great speed when excited. Most of them have a formidable array of teeth, and eat living food, yet are ready to turn to the humble rôle of scavenger. Few authenticated cases exist of their attacking a living man in the water. Undoubtedly the true man-eater shark, which is the largest species of the mackerel-sharks—a group containing the most active, most voracious, and swiftest forms—would not hesitate to do so, but since this is everywhere a rare fish, it is a popular fallacy to call any large, fierce-looking shark a “man-eater.” From having the mouth on the lower side of the head, sharks generally turn on the side or back in taking food from the surface of the water. We have, however, seen them seize floating objects while maintaining their upright position, though in doing so the snout was pushed out of the water. Some species swim near the bottom; others are found at the surface, often with the big fin on the back, and the end of the tail, out of water.

The wanderings and migrations of sharks are of great scientific interest, and are subjects concerning which very little is known. Indeed, a comprehensive study of the life history of any fish of this interesting group, has yet to be made. It is therefore exceedingly important that advantage be taken of the opportunities offered when unfamiliar sharks wash ashore, or are captured by fishermen, for it is always possible that a new record may be made, or a new fact learned. It is highly desirable that some naturalist who is interested in fishes should have an opportunity to see any large or strange shark which may be taken in Long Island waters. The department of natural science of The Brooklyn Museum welcomes communications on such matters. In the past, members of various government Life-Saving stations have sometimes been of much service to the cause of science by notifying the proper institution or individual of their captures. The first shark in the present list, for instance, is known in the western hemisphere only from an example obtained by the Amagansett Coast Guards.

The species of sharks described in this Bulletin are representatives of nine families. The first, Pseudotriakidæ, is known from but two individuals, one of which was taken on Long Island.

The Galeidæ, or requiem-sharks, represented by the smooth dogfish, dusky shark, etc., contain the bulk of modern sharks. The species are

numerous, mostly tropical, many of them widely distributed, a few cosmopolitan. They are without strong taxonomic characteristics, the differences between some of them being slight or subtle. Usually one or more species of this family are numerous on any temperate or tropical coast. The first dorsal fin is large and placed opposite the space between the pectorals and ventrals, the second dorsal fin is usually much smaller. The head is normal in shape, the caudal fin not lunate and the peduncle without a median keel.

The Sphyrnidæ, or hammerhead sharks, contain a few species resembling in general the preceding family, but with very peculiarly formed heads.

The Alopiidæ comprise but a single species, which has an extraordinarily elongate tail, and is cosmopolitan in warm seas.

The Carchariidæ, sometimes placed with the Lamnidæ, contain a few closely related species belonging to a single genus, locally common on usually temperate shores of the world. Our only species has very sharp and white teeth, with a cusp on each side at the base. The dorsal fins are subequal in size, and there is no keel on the peduncle.

The mackerel-sharks (Lamnidæ), swift-swimming, predacious, pelagic fishes, are represented by a few warm-water species, which, as a rule, do not occur in great numbers anywhere. They have a central keel on the caudal peduncle, and a firm, lunate caudal fin.

A single species comprises the Cetorhinidæ, a huge, sluggish northern form, straggling southward to our coast, differentiated from the Lamnidæ, from which it appears to be derived, by the remarkable length of its gill-slits and by the development of its gill-rakers. The latter are probably used to strain small food from the sea-water, as is the baleen of whalebone whales.

The family Squalidæ, with several deep-water genera, is represented on the Long Island coast by a northern species without anal fin and with a spine in each of its dorsals. It is common in winter.

Finally the Squatinidæ, with a single genus and only two or three species, present a very peculiar appearance, due to their flattened circular head, narrowed neck, and a pointed, forward prolongation of the pectoral fin.

There is something peculiarly sinister in the shark's make-up. The sight of his dark, lean fin lazily cutting zigzags in the surface of some

quiet, sparkling summer sea, and then slipping out of sight not to appear again, suggests an evil spirit. His leering, chinless face, his great mouth with its rows of knifelike teeth, which he knows too well how to use on the fisherman's gear, the relentless fury with which, when his last hour has come, he thrashes on deck and snaps at his enemies; his toughness, his brutal nerveless vitality and insensibility to physical injury, fail to elicit the admiration one feels for the dashing, brilliant, destructive, gastronomic bluefish, tunny, or salmon. Probably few swimmers have actually met in him their fate, but doubtless many a poor drowned sailor has there found his final resting place.

ARTIFICIAL KEY

- I. Gill-slits more or less lateral, not strictly on the ventral surface.
- a.* Front of pectoral fin not separated from the neck by a deep notch.
- b.* First dorsal fin several times longer than high.
Pseudotriakis microdon
- b'.* First dorsal fin little, if any, longer than high.
- c.* Anal fin present. Dorsal fins without spines.
- d.* Caudal peduncle without a keel in the center of its side. Caudal fin not lunate.
- e.* Teeth without basal cusps.
- f.* Caudal fin moderate, much shorter than head and body together.
- g.* Head normal in form.
- h.* Teeth small and blunt. A small slender shark, flattened below.
Mustelus canis
- h'.* Teeth larger, sharp, more or less pointed.
- i.* Angle of mouth without a well marked groove extending along one or both jaws. Teeth erect or moderately oblique.
- j.* Teeth similar in both jaws, broad, coarsely serrate, with oblique tip and an acute notch below it. A large, usually spotted shark.
Galeocerdo tigrinus
- j'.* Teeth not as above.
- k.* Teeth with more or less serrate edges.
- l.* First dorsal fin opposite or behind the center of the space between the pectoral and ventral fins. A large slender species.
Prionace glauca
- l'.* Dorsal fin before the center of the space between pectoral and ventral fins.
- m.* Upper teeth broad, triangular, quite different from the lower, which are narrow on broader bases.
- n.* Dorsal fin high and rather pointed.
Carcharhinus milberti

n'. Dorsal fin low.

Carcharhinus obscurus

m'. Both upper and lower teeth narrow on broader bases.

Carcharhinus limbatus

k'. Teeth not serrate. Narrow, on broad bases, above and below.

Aprionodon isodon

i'. Angle of mouth with a well marked groove extending along one or both jaws; teeth oblique, not serrate.

Scoliodon terre-novic

g'. Head peculiar in form,—flattened, semicircular or hammer-shaped
Teeth very oblique.

o. Head semicircular.

Sphyrna tiburo

o'. Head hammer-shaped.

Sphyrna zygaena

f'. Caudal fin very long, not much, if any, shorter than head and body taken together.

Alopias vulpes

e'. Teeth narrow, with basal cusps. Dorsal fins subequal in size. A rather small, usually spotted shark.

Carcharias taurus

d'. Caudal peduncle with a central keel. Caudal fin more or less lunate.

p. Gill slits measuring $\frac{1}{2}$ the depth of the body, or less.

q. Teeth slender and sharp, without serrations.

r. Origin of the dorsal behind the axil of the pectorals.

Isurus dekayi

r'. Origin of the dorsal over the axil of the pectorals.

Isurus punctatus

q'. Teeth triangular, serrate. A very large, fierce species.

Carcharodon carcharias

p'. Gill slits exceedingly long, measuring much more than $\frac{1}{2}$ the depth of the body. A very large, sluggish species.

Cetorhinus maximus

c'. Anal fin absent. Dorsals each with a spine. A small species usually spotted with white.

Squalus acanthias

a'. Front of pectoral fin separated from the constricted neck by a deep notch. A peculiar flattened form.

Squatina squatina

In the descriptions which follow this key, the length given aims to be that of a well grown adult. There is, of course, much intra-specific variation in size.

Citations following the technical name of each shark refer to the following two monographic works:

Jordan, D. S., and Evermann, B. W. The Fishes of North and Middle America. Bull. 47, U. S. Nat. Mus. 1896.

Garman, S. The Plagiostomia (Sharks, Skates, and Rays). Mem. Mus. Com. Zool. XXXVI. 1913.

The drawings have been compiled from available figures, photographs, and specimens. That of *Pseudotriakis microdon* is after Jordan and Evermann. In only one instance, *Aprionodon isodon*, is the drawing based on descriptions. The frontispiece of *Carcharhinus milberti* is by Mr. Dwight Franklin.

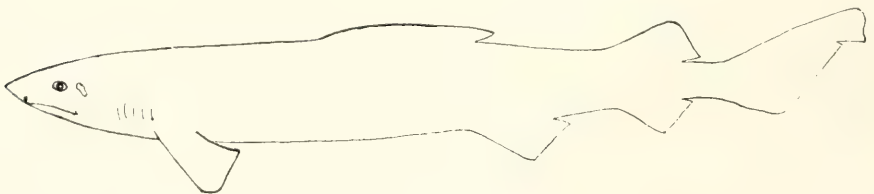
1. SMALL-TOOTHED NURSE SHARK

Pseudotriakis microdon Capello

Jordan and Evermann, p. 27.

Garman, p. 104.

First dorsal fin much (7 times) longer than high, opposite the space between pectorals and ventrals. Second dorsal somewhat larger than anal, opposite that fin. Jaws with many rows of small tricuspid teeth. Length 10 feet.



Two specimens only of this interesting large shark are known to science, one from Portugal, and another which came ashore at Amagansett, February 8, 1883, and was secured by the crew of the Life-Saving Station.

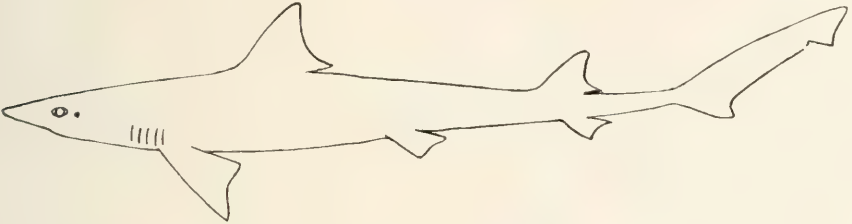
2. SMOOTH DOGFISH

Mustelus canis (Mitchill)

Jordan and Evermann, p. 29.

Galeorhinus laevis, Garman, p. 176.

First dorsal fin decidedly larger than second dorsal, opposite space between pectoral and ventral fins. Body slender, flat below. No pit at root of tail. Teeth small, blunt, and pavementlike. Light gray in color, paler below. Length 2 to 4 feet.



The smooth dogfish is found from Cape Cod to Cuba, and also along the coast of Europe. Although not gregarious, it is very abundant, and in summer is quite generally distributed throughout the salt waters of Long Island, where we have records of its occurrence from June to November. During this season, too, the young are born; they are about a foot long at birth and from four to twelve in number.²

The smooth dogfish swims near the bottom, to which habitat it is adapted by being flattened below. The latter characteristic is so marked that when the fish is placed upon a level surface out of water there is no tendency for it to fall over onto its side. It is a slender species, and all its lines are sinuous and graceful. Its teeth are small and blunt, suggesting the paved teeth of a skate, and its food consists largely of shelly, crablike animals, but to some extent of squids, clams, sand-worms, fish (menhaden, sculpins, porgies, swellfish, stickleback, etc.), and even eel-grass. It shares with man a taste for young lobsters, and doubtless the scarcity of this delicacy alone prevents its forming a considerable part of the dogfish's food.² The stomachs of ten specimens taken in nets at the mouth of the inner basin of Cold Spring Harbor, L. I., during the month of July, were examined at the Biological Laboratory and found to contain shrimps, spider crabs, hermit crabs, fiddler crabs, and remains of teleost fishes.

² 1907. Field, I. A. Rept. U. S. Bur. Fish. 1906, Doc. 622.

Since it will take any bait, by night or day, the dogfish is frequently caught by fishermen who are in pursuit of other species. It is also somewhat of a scavenger: we have found glass bottles and other rubbish in its stomach. Careful observation and experiment have shown³ that it relies chiefly on its keen sense of smell for finding food. It swims lazily along until it scents its prey, perhaps a crab lying out of sight in a tuft of waving eel-grass; then it turns, and rapidly moving the head from side to side, begins a systematic search over the bottom, circling closer and closer to the hiding crustacean, which is finally seized with a rush, shaken as a terrier shakes a rat, and quickly swallowed.

In common with other sharks, this species shows remarkable vitality and recuperative power after injury. A specimen taken in Buzzard's Bay had a large, thoroughly healed opening through the wall of its body. Into this hole a lobe of the liver had grown, forming a free plug which had served efficiently to repair a wound from which probably no higher vertebrate could have recovered.⁴

That the smooth dogfish is not more used for food in this country seems entirely due to prejudice. Its flesh is boneless, nutritious, and palatable.⁵

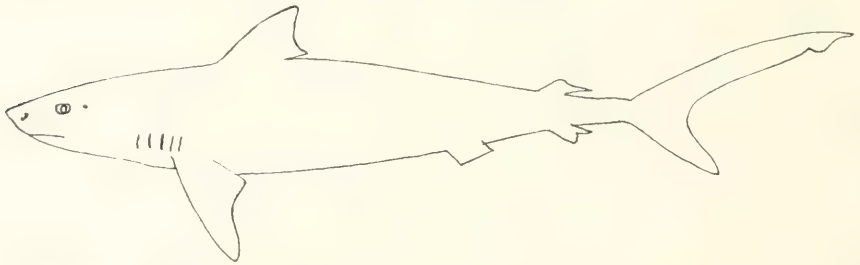
3. TIGER SHARK

Galeocerdo tigrinus Müller & Henle

Jordan and Evermann, p. 32.

Galeocerdo arcticus, Garman, p. 148.

First dorsal fin decidedly larger than second dorsal, opposite space between pectoral and ventral fins. Teeth alike in both jaws, large, coarsely-serrate, with an oblique tip and a notch below it in their outer margin. Brown, with numerous dark spots larger than the eye; adult nearly plain. Length 15 to 30 feet.



3. 1913. Parker, G. H. & Sheldon, R. E. Bull. U. S. Bur. Fish., 1912, p. 33.

4. Murphy, R. C. Science, 1912, No. 905, p. 693.

5. Field, *l. c.*

A widely distributed tropical shark, much dreaded in West Indian waters. Stragglers occur north to Cape Cod. The writers have examined the jaws and part of the head of a specimen captured in a net at Islip, on September 11, 1915, by Captain John Doxsee.

The tiger shark is present every year in variable abundance in Vineyard Sound and Buzzard's Bay, Mass., where small examples are often caught in the fish traps. Formerly it is said to have been more common than of recent years.

Its food is known to include whelks, conchs, and squids, as well as fishes (menhaden, bonito).

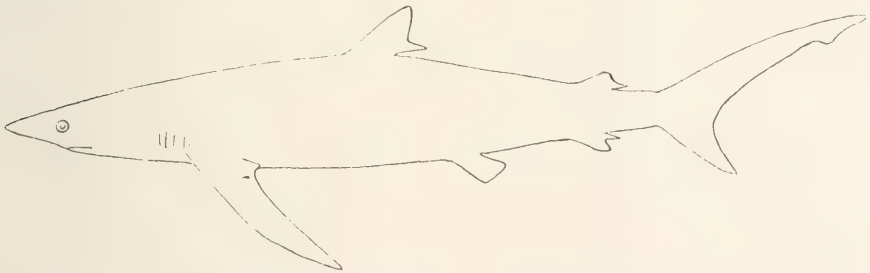
4. GREAT BLUE SHARK

Prionace glauca (Linné)

Jordan and Evermann, p. 33.

Galeus glaucus, Garman, p. 145.

First dorsal fin much larger than the second dorsal, opposite space between pectoral and ventral fins, nearer to the ventrals. Body slender, snout long. Angle of mouth without a long groove extending along one or both jaws. Teeth strongly serrate, those of the upper jaw somewhat oblique, those of the lower narrower and erect. Steel blue, light bluish, or grayish above, paler below. Length 10 feet.



The great blue shark is a large, warm-water species occasionally reaching our coast. It has been taken half a dozen times in fish traps at Woods Hole, Mass., during the months of July and August, and a large specimen captured near City Island in late October, 1911, was presented to the American Museum of Natural History by Mr. Alfred Frank of New York.

This shark belongs to the group of wide-ranging, pelagic species, concerning the life history of which relatively little is known, although most of the shark stories that we read in tales of the sea refer to one of them. In common with other pelagic sharks, the blue shark brings forth its young alive.

This species sometimes follows sailing vessels for days or even weeks in tropical and warm-temperate seas. It is quickly attracted by the smell of blood and decomposing flesh, a fact of which Florida shark fishermen take advantage by using rank meat and slaughter-house offal to entice the blue sharks within striking distance of a lily-iron. The skin of this and related species makes the toughest of all leathers, particularly suitable for the manufacture of baggage; but the commercial possibilities of shark fishing have hardly yet been realized. The color of the skin in life is a wonderfully intense blue, a hue, however, that fades and becomes leaden as the skin dries.

The teeth of the blue shark are razor-keen, and those of the upper jaw finely serrated. As in most of its relatives (*Carcharhinus*, *Carcharodon*, *Isurus*, etc.), the functional teeth stand erect on the edges of the jaws in a single, or approximately single, row. As these teeth become worn and lost, the membrane from the inner surface moves over the edge of the jaw, carrying with it fully developed teeth of a new, secondary row. The bases of these new teeth are imbedded in the membrane, and the teeth are erected by mechanical stress as the membrane draws the row abruptly over the edge of the jaw. Thus at any given time there are behind the functional row of teeth a series of reserve rows lying recumbent one below the other on the inner surface of the jaw, with their points downward or backward. The teeth of the first or uppermost reserve row are developed and ready to move into the place of their predecessors; the teeth of the lower rows are progressively smaller and less developed. These rows of incipient teeth are protected by a broad band of membrane that extends up over them from the bases of the jaws.⁶

During a cruise in the sperm whaler *Daisy* of New Bedford, one of the writers had an opportunity to see hundreds, even thousands, of blue sharks over a wide stretch of the tropical Atlantic. Whenever a whale was killed, the sharks would uncaunily begin to congregate, like hyenas round a dead lion, assembling so rapidly that the sea would be fairly alive with them by the time the whale had been towed alongside the ship. The hungry troop would then file silently and slowly along the whale's length, fondly rubbing tail fins against his black hulk, and doubtless anticipating the feast of the "cutting in." During the execution of this process, when the water for an acre around the ship was stained a ghastly

⁶ See Bridge, *Cambr. Nat. Hist., Fishes*, 1904, p. 250.



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3.

1. Embryo spined dogfish (*Squalus acanthias*) with large yolk sac. Gardiner's Island, June 12, 1911. 2. Smooth dogfish (*Mustelus canis*). Port Jefferson, September 24, 1915. 3. Sand shark (*Carcharias taurus*), about four and a half feet long. Montauk, August 11, 1915.

Photographs respectively by H. H. Cleaves, J. T. Nichols, and Francis Harper.

yellow from outpouring blood, the scrambling sharks would make the sea a living mass as each fish tried to bury its teeth in the exposed surfaces of dark red muscle. Now and then a shark would flounder right out on top of the whale, and cling there until a descending "blubber-spade" had put an end to all its ambitions. If the "cutting in" of a whale was at any time deferred several hours, owing to a continued hunt, the sharks would seemingly become impatient; they would then attack the carcass, and, thrusting their heads partly above the surface, would bite large mouthfuls out of the blubber, leaving the black sides of the whale pitted with clean white "scoops." Sometimes these bites were so numerous that they must have represented a considerable loss of blubber to the whalers.

Sharks are considered by sailors to be fair quarry upon which to practice all the barbarism of ingenious human nature; indeed it is doubtful whether there be any creature that the average human being takes more pleasure in destroying. Blue sharks are sometimes caught at sea on hooks baited with pork. They usually prove, however, rather shy and wary with regard to fishhooks, often refusing for hours to be tempted, but then, as if making a sudden resolve, rushing upon the bait and swallowing it. We have seen one hooked, shot full of lead from a repeating rifle, then harpooned, hauled on deck, and disemboweled, yet it continued alive and alert for a long while, thrashing its tail and opening and shutting its weird, expressionless eyes by moving the whitish lower lids. Fortunately sharks have little susceptibility to pain. A blue shark horribly mutilated by repeated thrusts of a whaleman's blubber spade, was seen to return immediately to the whale upon which it had been feeding and to continue ravenously until it practically died in the act, and sank slowly into the dark depths of the sea.

The food of the blue shark doubtless includes a wide variety of animals, living or dead. One of the writers once saw a wounded booby (*Sula*) engulfed within the jaws of a shark which was most likely of this species. During rough weather the blue shark takes to deep water, or, if in the vicinity of land, to the bottom, where it devours mollusks and the like. Whelks it swallows shell and all. Whether the shell is dissolved by powerful, acid digestive juices, or disgorged after the absorption of its contents, is not certainly known. The junior writer has observed, however, that captured blue sharks, as well as certain other species, have the power of everting the stomach, so that the whole organ, inside out, trails a foot or more from the mouth. Possibly this denotes

a habit of ejecting indigestible material such as most sharks frequently swallow.

During the cruise of the *Daisy*, two or three blue sharks, about seven feet long, and a smaller shark of a different kind, appeared under the vessel's stern on the day on which a sailor died. The old, old, maritime conviction that these hated brutes had come expressly for the body was breathed about the ship; but it was noted particularly that the sharks paid no attention when the dead man was consigned to the waters, and they followed uninterruptedly in our wake for several days after we had resumed our course. No doubt sharks, like certain sea birds, are apt to follow a whaler more regularly than a merchant vessel, for the former is an oleaginous craft, sometimes leaving a slight "slick" in its track, and always, if the whaling has been successful, appealing to another sense than sight and hearing. The acuteness of the olfactory sense in birds is a matter of conjecture, but in sharks it is known to be highly developed, probably replacing altogether the sense of taste.

Tropical sailors sometimes cut out the crumbly, limy otoliths of the blue shark and other species, and use them as a kind of specific in the primitive therapeutics of seafarers. They also use the vertebral disks of the shark's spine to make laminated walking sticks. Rarely the white, firm flesh is eaten, though prejudice acts against this, and the average sailor would prefer to feed on half-rancid salt meat until he died of the scurvy. In general, therefore, the sole reason for catching a blue shark is to kill it and pitch it back into its element.

We cannot close an account of the blue shark without referring to its frequent lesser companions, the remora and the pilot fish. The former clings by a sucking disk on its head, thus avoiding the effort of swimming, and subsists upon the scraps and crumbs from the shark's table. The writers have seen as many as four remoras attached to one blue shark. Sometimes they cling to the under surface or flanks of their host, sometimes they lie belly up on the dorsal side of the shark's pectoral fins, and although frequently shifting their positions, they are nevertheless so tenacious that they often may be drawn onto the deck of a ship with a captured shark.

The little striped pilot fish, of which many fanciful tales are told, accompanies the shark either singly or in small schools. The junior writer once saw the mate of the *Daisy* hook a blue shark, hoist it half out of water, and after lashing the squirming monster in that position, angle successfully for one after another of the seven pilot fish which swam

round and round it. Pilot fish exist also in an independent way, that is, dissociated from sharks, but whenever they accompany the latter, they follow their unconscious protector closely, rarely leaving it for many seconds at a time. Occasionally they dart aside for a morsel of food, but hurry back again like children afraid of losing their nurse. A favorite position with the pilots is close alongside the shark's dorsal fin, but sometimes they swim beneath their big companion.

Other fishes than the true pilots sometimes fill the same rôle with relation to sharks. One of the writers once saw a blue shark accompanied by a veritable enveloping cloud of young blue-lined runners (*Elagatis bipinnulatus*), a species which occasionally reaches the coast of Long Island.

5. DUSKY SHARK

Carcharhinus obscurus (Le Sueur)

Jordan and Evermann, p. 35.

Garman, p. 130.

First dorsal fin much larger than second dorsal and opposite space between pectoral and ventral fins, nearer to the pectorals. The fin much lower than in *milberti* and placed slightly farther back. Snout moderate, blunt. Angle of mouth with groove little developed. Teeth finely serrate; the upper broad, triangular, inclined outward, with a concave outer margin. Lower teeth narrow, erect, on broad bases. Color brownish gray above, whitish below, sometimes said to be blue. Length 6 to 10 feet.



The dusky shark is not rare on our Atlantic Coast, and is doubtless of frequent occurrence in Long Island waters. Its exact status here is not known owing to the ease with which it may be confused with *Carcharhinus milberti*. A shark eight feet nine inches long, probably of this species, was once harpooned and captured by Mr. A. H. Helme in the Sound off Miller Place.

According to Mr. H. W. Fowler, the New Jersey fishermen call the dusky shark the "Santiago," from the impression that the cannonading during the Spanish-American War had forced the species to retreat from the Tropics to our quieter coast. Bean states that the name "Spanish shark" is used on Long Island for *Carcharias taurus*. We suspect, however, that it is rather a fish of the genus *Carcharhinus* to which this name is usually applied, and we believe that such terms as both "Santiago" and "Spanish" are to be explained not upon the basis of events so recent and specific as the war of 1898, but in a general way, as follows: English maritime development and commerce superseding that of Spain, English peoples have for many years come into contact with new, more or less southern facts, associated with the Spaniards and the old Spanish domination of the Tropics. Therefore the adjective Spanish has often been loosely applied, with a meaning of strange and southern rather than that of its national significance. In this sense are Spanish oak, Spanish moss, Spanish curlew, Spanish fever. There are numerous fishes, allied to well known, familiar species, that are differentiated as "Spanish." Perhaps the best example is the Spanish mackerel (*Scomber colias* in England and in early New England, *Scomberomorus maculatus* in the middle Atlantic states and of late on all our seaboard). Another is the Spanish bream of Great Britain. There is still a tendency among fishermen to designate as "Spanish" any unfamiliar species, especially if they suspect it to be of southern origin.

The dusky shark, however, is not correctly to be associated with the Spanish main or Spanish lands, its known latitudinal range extending only from Nahant to the coast of North Carolina.

6. BROWN SHARK

Carcharhinus milberti (Müller & Henle)

Jordan and Evermann, p. 37.

Garman, p. 133.

First dorsal fin much larger than the second dorsal and opposite space between pectoral and ventral fins, nearer to the pectorals. The dorsal high and rather pointed, its anterior margin contained a little over 6 times in the total length (including caudal). Body moderately robust. Snout moderate, bluntly pointed. Angle of the mouth without a well marked groove extending along one or both jaws. Teeth finely serrate; the upper broad, triangular, inclined slightly outward, with a concave outer margin, the concavity a broad-angled notch with its apex near the base of the tooth. Lower teeth narrow, erect, on broad bases. Color brownish gray above, whitish below. Length usually 6 or 7 feet.



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1. Blue shark (*Prionace glauca*) attacking the carcass of a sperm whale during the "cutting in." Photographed in the tropical Atlantic, August 22, 1912, by R. C. Murphy.
2. Jaws of a twelve-foot white shark (*Carcharodon carcharias*) in the Brooklyn Museum. The rows of reserve teeth may be seen distinctly in the lower jaw. At the left, two teeth of this species are compared with a tooth of the extinct shark (*C. megalodon*), a species believed to have equalled in size the largest whales.
3. Brown sharks (*Carcharhinus milberti*). Photographed in the Great South Bay by Edwin Thorne.



This species is an inhabitant of the temperate Atlantic, and the commonest large shark in the latitude of New York. Its known range is from Florida to Cape Cod, and DeKay, in the *Zoology of New York* (1842), states that it had been frequently taken in local waters. He describes a specimen over seven feet long, weighing 160 pounds, captured at Brenton's Reef, R. I., in September.

Four specimens about four feet in length were taken in a fish trap at Woods Hole in August, 1873. Their stomachs contained amphipod crustaceans and remains of fishes.

Numerous females of the brown shark enter Great South Bay in midsummer to give birth to their young, and may be found there until September. They frequent the edges of the channels near Fire Island, feeding on various species of fishes, the flatfish (*Pseudopleuronectes*) predominating. Very probably they employ their sense of smell in discovering these concealingly-colored fishes as they lie on the bottom. Crabs, lobsters, skates, weakfish, young mackerel, menhaden, etc., also make up part of this shark's food.

The brown shark is in evidence about Block Island from May until November, and it is perhaps the only large shark that enters the small bays on the north shore of Long Island. During several recent summers, sharks probably of this species, accompanied by pilot fish, have been seen at Mt. Sinai Harbor, where they have created unwarranted consternation among the bathers. It is only occasionally that one catches sight of the fin and tail of the brown shark, as for instance when it crosses a bar, because it generally keeps below the surface, a characteristic of the littoral, as opposed to the pelagic, species.

For most of our local data concerning the brown shark we are indebted to Mr. Edwin Thorne of Babylon, whom the senior writer has accompanied on shark hunts. In conducting this form of fishing, one man stands on the bowsprit of a sloop, holding a long pole with a metal dart fitted loosely on its lower end, and attached by a coil of rope to a bucket. A second man, aloft, keeps a keen lookout for sharks, which may be seen from that height at some distance through the water, and instructs the third man at the helm exactly how to steer. Now the lookout sees a shark moving along the edge of the bar! With care and patience he works the sloop towards it, avoiding the shoals where she would go aground, and following the winding course of the shark. The man with the harpoon, who until now has only heard the orders from aloft to the helmsman, steadies himself as the sloop swings from one tack to the other, and with straining eyes finally begins to see an elusive shadow moving a couple of boat lengths ahead. At any moment it may turn and shoot under the bowsprit giving him a fraction of an instant to strike, or the sloop may creep up till he can launch the harpoon forward and downward upon the fish, only to see the iron graze its side and the pole stand quivering in the sand, while the shark darts away into deep water and is gone. All within the thrill of a moment, if skill and luck favor, the dart strikes home, and away goes the shark, spinning out the coil of rope and carrying the tub over the water with a rush!

The brown sharks taken by Mr. Thorne have been mostly females, and have averaged between five and seven and a half feet in total length, most of them being over six and a half. The young are usually from eight to fourteen in number, about equally males and females. Fish containing young have been recorded from June 22 to July 18. As there is more or less confusion of the closely allied species of the genus *Carcharhinus* inhabiting the eastern coast of the United States, careful measurements in feet and inches of two specimens of the brown shark from Great South Bay may be of use:

| | I | II |
|--|-------|------|
| Total length..... | 6' | 6'' |
| Length of head and body..... | 5' | 4'' |
| Distance of back fin from snout..... | 2' | 1' |
| Distance of back fin from tail..... | 4½' | 2' |
| Origin to apex of back fin..... | 1½' | 1' |
| Vertical height of back fin..... | 11'' | 9¾'' |
| Length of tail..... | 6'' | 1' |
| Length of breast fin..... | 1½'' | 1' |
| Distance of breast fin from snout..... | 8¾'' | 4'' |
| Distance of ventral fins from snout..... | 9'' | 3' |
| Circumference at root of tail..... | 10'' | 9½'' |
| Circumference at front of back fin..... | 3'' | 2' |
| Circumference of eye..... | 10½'' | 1' |
| Distance from eye to snout..... | 7'' | 6¾'' |
| Distance from mouth to snout..... | 5½'' | 5¼'' |

7. SPOTTED-FIN SHARK

Carcharhinus limbatus (Müller & Henle)

Jordan and Evermann, p. 40.

Garman, p. 127.

Allied to the dusky shark, but with teeth quite different, those of the upper jaw being narrow and much like those of the lower. The snout is somewhat pointed. The color is gray; the lower side of the pectoral fin, the second dorsal, the anal, and the lower caudal lobe usually tipped with black. Length 5 feet.



Tropical seas, north to North Carolina, casually to Long Island and Buzzard's Bay. Mr. Edwin Thorne of Babylon has the jaws of a large specimen which he took in Great South Bay in midsummer several years ago.

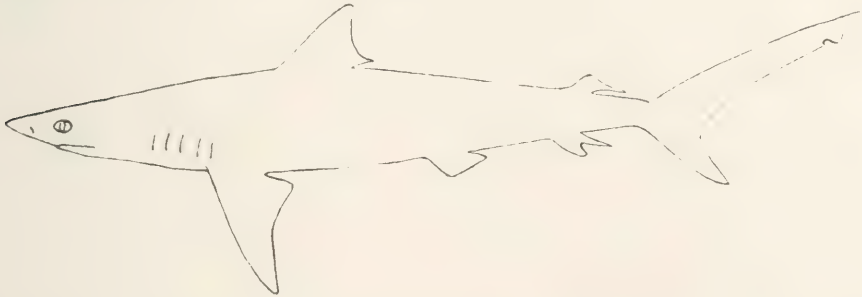
8. ROUND-NOSED SHARK

Aprionodon isodon (Müller & Henle)

Jordan and Evermann, p. 42.

Garman, p. 119.

Resembles the dusky shark in a general way, but the teeth above and below are narrow on broad bases, their edges without any serration.



A rare Atlantic species which has been recorded from New York (Müller & Henle), Virginia, and Cuba.

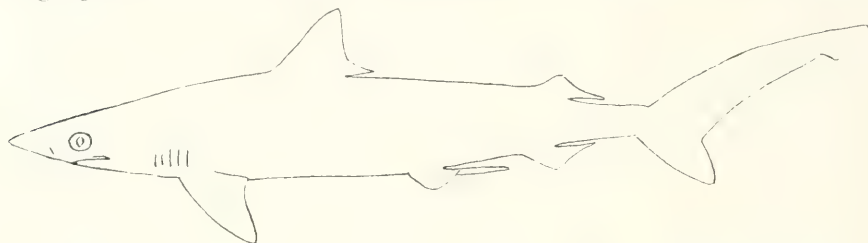
9. SHARP-NOSED SHARK

Scoliodon terra-nova (Richardson)

Jordan and Evermann, p. 43.

Garman, p. 115.

First dorsal fin much larger than the second dorsal and opposite space between pectoral and ventral fins, about midway between the two. Snout moderate, bluntly pointed. Angle of mouth with a well-marked groove extending along one or both jaws. Teeth without serrations, rather narrow, more oblique than in our species of *Carcharhinus*. Color gray, caudal fin with a conspicuous narrow blackish edge. Length 3 feet.



This species has been recorded as far north as Cape Cod. It is abundant on the south Atlantic coast of the United States, and not uncommon at Woods Hole during the summer; we know of no recent record for Long Island. It is a small shark, looking much like the species of *Carcharhinus*, but distinguishable by its entire, oblique teeth and the long grooves at the angle of the mouth.

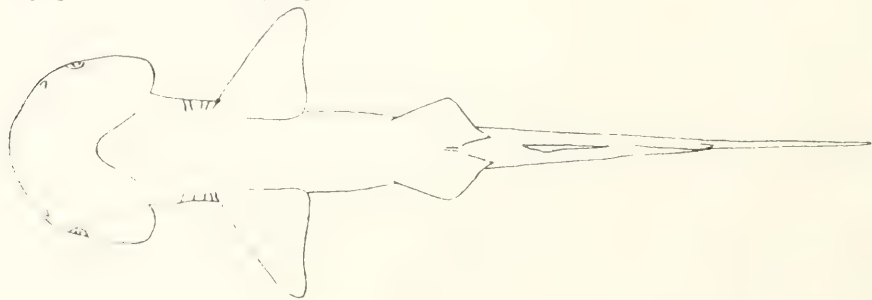
10. SHOVELHEAD SHARK

Sphyrna tiburo (Linné)

Jordan and Evermann, p. 44.

Cestracion tiburo, Garman, p. 160.

A shark having the general characters of the genus *Carcharhinus*, but the head is shovel-shaped, depressed, semicircular in front, its lateral margins continuous with the anterior, and making a strong angle with the posterior margins. Color uniform ashy, paler beneath. Length 3 to 6 feet.



The shovelhead is a rather small shark, widely distributed in warm seas, common on our south Atlantic coast and said to occur northward to Long Island, though we know of no definite records. It is readily distinguished from all our other species by the shape of its head.

Eight young have been taken from the body of a full-grown female.

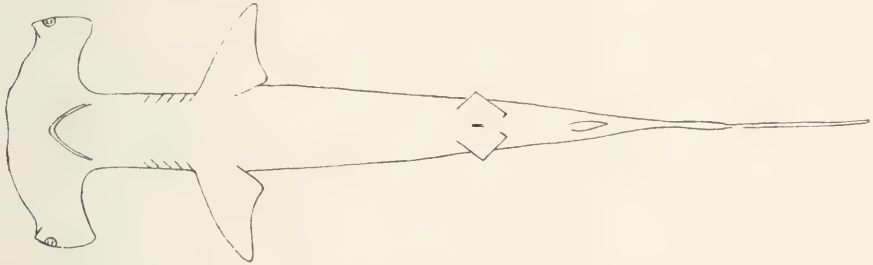
II. HAMMERHEAD SHARK

Sphyrna zygaena (Linné)

Jordan and Evermann, p. 45.

Cestracion zygaena, Garman, p. 157.

Resembles the shovelhead shark, but the head is even more eccentric in form,—truly hammer-shaped, greatly produced laterally between the mouth and end of the snout, its front and hind margins almost parallel, and perpendicular to the lengthwise axis of the body and to the short lateral margin where the eye is situated. Teeth small and very oblique. Color gray. Length 15 feet.



The hammerhead is a cosmopolitan, southern shark, not infrequent off the coast of Long Island from July to October, and most numerous during July and August. It probably breeds here, as does the brown shark, for we have seen the photograph of a very small one found on the shore, and Mr. A. H. Helme reports seeing dozens of hammerheads about two and a half feet long caught in seines near Shinnecock late in August.

Five young have been obtained from the body of a female hammerhead. The species reaches a large size, but most of the examples seen in the north are not full-grown.

Few things in the animal world are more extraordinary than the appearance of this shark, with its eyes stuck at the ends of the projections of its unearthly head. In a large specimen the crosstree may measure a yard from eye to eye. The family Sphyrnidæ contains a progressive series of forms, from those with bonnet-shaped heads to species that are even more exaggeratedly hammerheaded than *S. zygaena*. The relation of the peculiar configuration to the economy of these fishes is unknown.

South of Montauk Point on August 8, 1915, the junior writer, with Mr. Francis Harper of the Brooklyn Museum and Mr. William Parsons Jr. of Montauk, met a hammerhead about five feet in length which cleverly escaped capture. It crossed the bows of our launch, swimming lazily at the surface with its dorsal fin exposed, swishing its long tail slowly but very limberly. A swordfish harpoon was made ready, and after a few moments we followed up the shark, which had not gone far. As we approached softly at half-speed, Mr. Harper prepared to strike it from the bowsprit, but while the iron was poised the hammerhead dodged quickly, dived below with an agility which contrasted sharply with its former sluggishness, and came up astern. Thereafter it swam in small circles for a while so that we could not overtake it, finally diving and disappearing altogether.

The food of the hammerhead shark is known to include squids, barnacles, and crabs, besides menhaden and other fishes. There is a record of an eleven-foot example, taken in a net at Riverhead in the year 1805, the stomach of which contained many detached parts of a man, together with his clothing.

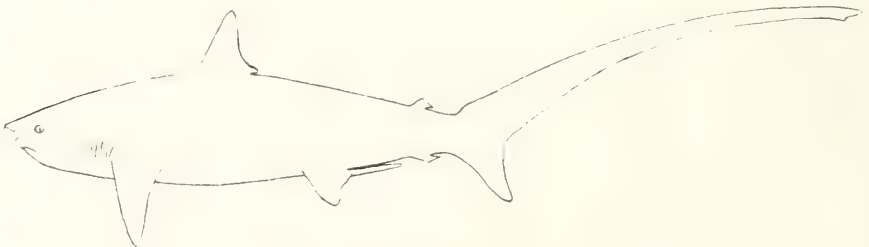
12. THRESHER SHARK; SWINGLETAIL.

Alopias vulpes (Gmelin)

Jordan and Evermann, p. 45.

Vulpecula marina, Garman, p. 130.

First dorsal fin large, situated opposite the space between the pectoral and ventral fins. Second dorsal and anal fins very small. Caudal fin remarkably long, about as long as the head and body. Snout rather short. Color blackish above, pale below. Length 15 feet.



The thresher is a warm-water species, common to both the Atlantic and the Pacific coasts of America, and on our seaboard ranging northward in summer to Maine. Around Block Island it is said to be the common-

est shark, especially after the porgy-fishing season, or during the latter part of June. It is recorded from Water Island, L. I., in May,⁷ and it remains in this latitude until very late in the autumn. Mr. A. H. Helme informs us of a "whiptail," thirteen feet five inches in length, caught off Wading River, in the Sound, in the seine of a menhaden steamer.

Strictly a surface swimmer, and readily distinguished from all other sharks by its long, slender tail, the thresher shark is unique in its feeding habits, for it uses its whiplike tail to splash the water, while it swims in narrowing circles round a school of fishes,⁸ which are thus kept crowded together until the moment of slaughter. Practically it whips its prey into its mouth. Sometimes a pair of threshers work together at this highly organized method of fishing. Formerly it was believed that they killed their prey by furious slashes of the flexible tail, but this theory has not been well borne out by observation, and it is at least improbable. Stories of threshers attacking whales are certainly untrue, the dentition of the species being relatively weak.

Thresher sharks are a great nuisance to fishermen, sometimes wrecking pound nets, and regularly destroying incredible numbers of herring, shad, mackerel, etc. According to Dr. Bean, threshers are caught by Gayhead fishermen on hooks baited with fresh herring.

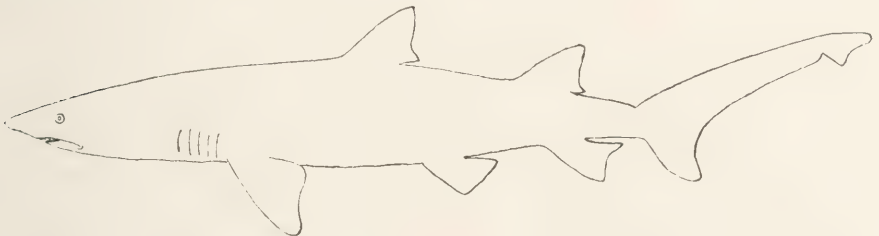
13. SAND SHARK

Carcharias taurus Rafinesque

Carcharias littoralis, Jordan and Evermann, p. 46.

Carcharias taurus, Garman, p. 25

First dorsal fin little larger than the second dorsal and situated opposite the space between the pectoral and ventral fins. Teeth long, entire-edged, narrow, pointed, mostly with small cusps at base. Color gray, with indistinct darker spots, the fins more or less black-edged. Length 5 feet.



7. 1901. Bean, T. H. Rept. N. Y. Forest, Fish and Game Comm. for 1900, p. 378.

8. 1904. Bridge. *l. c.*, p. 452.

"Sand shark" is a name more or less loosely applied by fishermen, but this common species, a somewhat heavier, clumsier fish than the smooth dogfish, is easily recognized by its white catlike teeth with cusps at their bases, its large subequal dorsal fins, and the fact that it is spotted. It is a summer resident along the coast from Cape Cod to Cape Lookout, N. C., and common in the bays and along the beaches of the south shore of Long Island from June to October, sometimes entering the mouths of streams.

Sand sharks with eggs still unripe have been taken at Woods Hole, Mass., on July 10. The species is a nuisance to fishermen because it bites a hook readily and also destroys nets. In the Great South Bay it is often seen swimming slowly near the surface. It eats lobsters, crabs, and squids, but the greater part of its food consists of fishes⁹ (flatfish, eel, weakfish, mullet, porgy, etc.).

Concerning the habits of this species at Cape Lookout, Mr. Russell J. Coles¹⁰ writes as follows:

"This shark works in a more systematic way in securing its food than any shark of which I know. On one occasion I saw a school of a hundred or more surround a school of blue-fish and force them into a solid mass in shallow water, and then at the same instant the entire school of sharks dashed in on the blue-fish. On another occasion with a large school of blue-fish in my net, a school of these sharks attacked it from all sides and ate or liberated the school of blue-fish, practically ruining the net. Again in July, 1914, on Lookout Shoals, I had a large net filled with blue-fish attacked by a school of about 200 of these vicious sharks and the net ruined. I killed about twenty of them with harpoon and lance."

14. MACKEREL SHARK

Isurus dekayi (Gill)

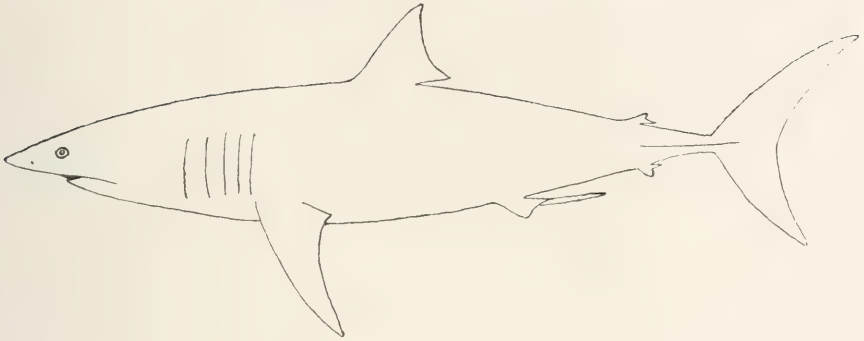
Jordan and Evermann, p. 48.

Isurus tigris, Garman, p. 36.

First dorsal fin opposite the space between the pectoral and ventral fins, about midway between the two. Second dorsal and anal fins very small. Caudal fin firm, lunate. A horizontal keel on the caudal peduncle. Gill openings measuring one half the depth of the body or less. Teeth large, slender, and sharp, without serrations or basal cusps. Dark bluish gray above, white below. Length 10 feet.

⁹ 1907. Field, *l. c.*

¹⁰ Proc. Biol. Soc. Wash. XXVIII, 1915, p. 91.



This shark ranges from the West Indies to Cape Cod, but is nowhere common. DeKay records it from the vicinity of New York Harbor. One of his specimens was taken there in October, 1840, and others have been captured in nets in Vineyard Sound, Mass., as late as December. It is a large, powerful, swift-swimming species. Mackerel and other small fishes, conger-eel, and squids have been found in its stomach. We know of no recent Long Island records for the mackerel shark.

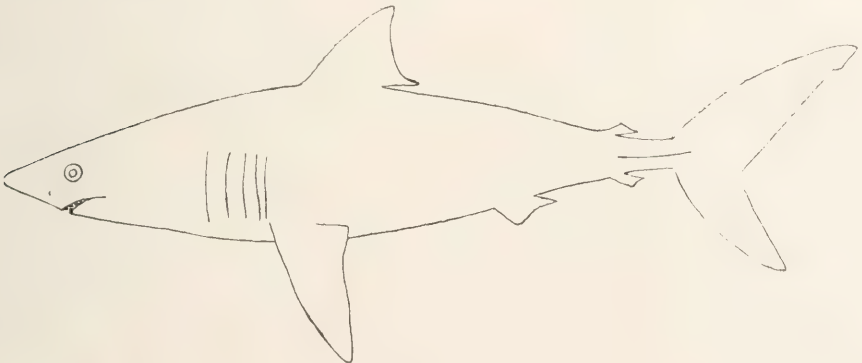
15. PORBEAGLE

Isurus punctatus (Storer)

Lamna cornubica (in part), Jordan and Evermann, p. 49.

Isurus punctatus, Garman, p. 36.

This species has the first dorsal fin placed only slightly further back than the pectorals. It resembles in general the preceding species. Bluish gray above, white below. Length 10 feet.



According to Garman, this species is abundant off the eastern coast of the United States.

A young individual, about three and a half feet long, was caught in a gill-net at Southampton in July, 1898.¹¹

The food of the porbeagle includes both cephalopods and fishes. Full-grown hakes have been found in its stomach. Its lanceolate teeth are adapted to seizing and holding prey rather than for cutting.

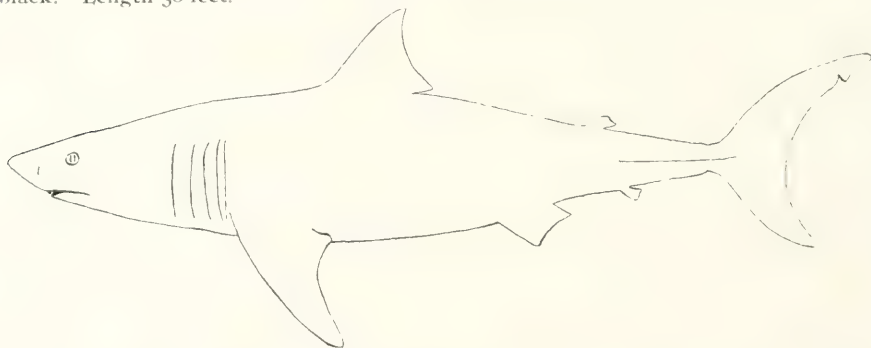
16. GREAT WHITE SHARK ; MAN-EATER

Carcharodon carcharias (Linné)

Jordan and Evermann, p. 50.

Garman, p. 32.

Closely allied to *Isurus* but with the teeth in both jaws triangular with serrated edges and without basal cusps. Color leaden gray. Tips and edges of pectorals black. Length 30 feet.



Carcharodon carcharias, or "the biter with the jagged teeth," is the largest of the mackerel shark group, and the only true man-eater shark. This, according to Linnæus, is the leviathan which swallowed Jonah. So far as we can discover, it is throughout its cosmopolitan range in warm seas, a rare fish. It is occasional on the Atlantic coast of the United States as far north as Cape Cod, but we know of no definite record for Long Island, though Bean includes it in his "Fishes of Long Island."¹² Two specimens, however, were taken in fish traps at Woods Hole in June, 1903.

¹¹ 1901. Bean, *l. c.* p. 380.

¹² *l. c.* p. 380.

In 'The Riverside Natural History,' Dr. J. S. Kingsley relates that the stomach of a white shark was once found to contain "a tin can, a number of mutton bones, the hind quarters of a pig, the head and fore quarters of a bull-dog, a quantity of horseflesh, and other and smaller things—as the auction bill says—too numerous to mention."

At the request of the writers, Dr. Frederic A. Lucas, Director of the American Museum of Natural History, has very kindly written for this bulletin the subjoined account relating to the status of sharks as man-eaters. Dr. Lucas's long experience, coupled with his repeated critical investigations of "shark stories" that arise perennially along our seacoast, eminently fit him to write with finality upon a subject so generally misapprehended.

"A question frequently asked is "what is the danger of being attacked by a shark about here?" and the answer is, that it is infinitely less than that of being struck by lightning.

"True, not a summer passes without some "maneater" being taken along the New Jersey or Long Island coast and sometimes the "monster" reaches a length of so much as 8 feet, but these "maneaters" usually resolve themselves into harmless, if ugly-looking, sand sharks.

"Sharks belonging to the two really dangerous species, the white shark and the blue shark, are occasionally taken off our coasts, but these are stragglers from tropical waters, and, so far as I am aware, there is no record of any fully grown individual *ever* having been taken within hundreds of miles of New York. Cases of shark bite do now and then occur, but there is a great difference between being attacked by a shark and being *bitten* by one, and the cases of shark bite are usually found to have been due to some one incautiously approaching a shark impounded or tangled in a net, or gasping on the shore. And, under such circumstances, almost any creature will bite.

"Some years ago, about 1890, Mr. Herman Oelrichs put the shark question to a practical test by offering, through the columns of the *New York Sun*, a reward of \$500 "for an authenticated case of a man having been attacked by a shark *in temperate waters.*" That this reward was never claimed shows that there is practically *no* danger of an attack from a shark about our coasts.

"In the summer of 1915, the subject was revived in the *Times*, but again without eliciting any *authenticated* case of such an attack, though several reports were received or published of such occurrences having happened—"quite a while ago"—at some time past.

"The subject of shark bites was also agitated in *Forest and Stream* about 1896.

"These various discussions did elicit a number of well authenticated instances of attacks, resulting in death, from sharks in tropical waters, where the real "man-eating" white shark, *Carcharodon*, is found. But remember that sharks of this species, which reach a length of forty feet and are armed with teeth an inch and a quarter to an inch and a half in length, are far different creatures from the average shark seen or taken along our coasts.

"Copies of some of these communications are appended to this chapter, in order that the reader may form his own opinion of them.

"The writer of these lines, in his boyhood, spent four years at sea, but he never met a man who had been attacked by a shark nor even one who knew of an instance of the kind having happened. Not that such attacks do not occur, especially under favorable circumstances, such as those noted later where sharks were attracted by the scent of blood or offal and accustomed to feeding on whatever they found.

"One of the commonest statements is that "the shark bit off the man's leg as though it were a carrot," an assertion that shows that the maker or writer of it had little idea of the strength of the apparatus needed to perform such an amputation. Certainly no shark recorded as having been taken in these waters could possibly perform such an act, though this might occur if a shark thirty feet or more in length happened to catch a man fairly on the knee joint where no severing of the bone was necessary. The next time the reader carves a leg of lamb, let him speculate on the power required to sever this at one stroke—and the bones of a sheep are much lighter than those of a man. Moreover, a shark, popular belief to the contrary notwithstanding, is not particularly strong in the jaws: under "blue shark" Mr. Murphy notes the difficulty of sharks in tearing meat from the carcass of a whale, and I remember my own disappointment at witnessing the efforts of a twelve-foot shark to cut a chunk out of a sea lion. The sea lion had been dead a week and was supposedly tender, but the shark tugged and thrashed and made a great to-do over each mouthful.

"But it is the part of wisdom to keep away from both ends of a captured shark, for a blow of the tail is almost as bad as a bite.

"Some of the subjoined notes appeared in the *New York Times* and some were received as personal letters.

Excerpt from *New York Times*, August 2, 1915.

***"I agitated the question of shark bites a number of years ago in the columns of *Forest and Stream* and succeeded in getting two fairly reliable references to such cases. One occurred at Bombay, where a man went bathing from a wharf whence it was customary to dump offal. The shark naturally thought all was offal that came his way, and took his leg off. Another occurred in the Hawaiian Islands, where a man started to swim for a boat that had broken adrift from a schooner. A shark came along, found that the man was harmless, and took him in out of the wet." (Signed) F. A. Lucas, Director American Museum of Natural History.

Excerpt from *New York Times*, August 20, 1915.

"If any one who doubts that sharks in temperate waters do attack human beings will visit Sydney, N. S. W., and pursue his inquiry there, his doubts will be speedily resolved. Offhand, I can remember three specific instances of death from attacks by sharks in Sydney Harbor. The first was that of a boy sitting on a wharf at Ryde, on the Paramatta River, one of the numerous arms of the harbor. His legs were dangling in the water and a shark came up, seized a foot, and disappeared with the boy, whose body was never seen again. The second was a youth of about twenty years, who was swimming across one of the bays. Halfway across he was seized by a shark, and the body was never recovered. The third instance was in Lane Cove. A youth was in swimming, but not out of his depth, when a shark seized him. By desperate efforts he managed to escape, but was so badly bitten that he died within a few hours.

Originally there were no dangerous sharks in the harbor, the generally accepted explanation of their presence being the discharge of blood and offal from the meat abattoirs at Globe Island into the harbor waters. This unsanitary system has long since been abolished and the abattoirs removed, so that the bad preëminence of Sydney harbor will, in due course, doubtless become a thing of the past." (Signed) N. S. W. East Orange, N. J.

Excerpt from *New York Times*, August 25, 1915.

"About 1870 a schooner bound from some Eastern port to New York became becalmed off Horton's Point on Long Island Sound, and while the vessel lay waiting for a breeze one of the crew went swimming from her. While he was enjoying himself at some distance from the schooner his fellow shipmates descried a shark making for him. Shouting warning to him they got out a boat for his rescue, but before they reached him the shark grabbed him by the hip. He endeavored to blind the fish, and either did, or the approaching boat frightened it off, for his shipmates took him in the boat and by rowing two miles brought him ashore, where they obtained a wagon and after a drive at least as far, obtained a doctor, who attended to the wounded man. He was taken to Greenport, where he received necessary care for several weeks and finally was able to be taken to his home. I did not see the boat, man, or shark, but heard about the case at Greenport while the sailor was there and I suppose there are some of the older Greenport people that remember about it." (Signed) B. G. Davis, Glen Cove, N. Y.

Excerpt from *New York Times*, September 8, 1915.

"Like you, I have spent many years in cruising from Maine to Florida and Nassau, looking for a man bitten by a shark," Mr. Winslow wrote to Dr. Lucas. "Last week Colonel Hunter, U. S. A., retired, told me that he saw a man at Key West who had part of his left breast bitten away while trying to kill a large shark with a hatchet. The shark was caught in the man's seine, and the owner was trying to save his net and was standing in about four feet of water when bitten."

"In a postscript Mr. Winslow adds that he 'once employed a diver who had his arm broken by a shark trying to escape from the hold of a sunken steamer. The diver had unintentionally cornered Mr. Shark.' ***"

"Perhaps the most remarkable shark story is the following, vouched for by Frank Cundall, Secretary of the Institute of Jamaica, save that the skipper was not "tried for his life," but for violation of the Navigation Laws :

"To the Editor of the *New York Times* :

I notice by the evening papers that certain documents thrown overboard from the Marina Guezada in the harbor of Pernambuco, Brazil, were later recovered from a shark's stomach, and that these papers will be used as evidence by the Government in a prosecution.

Remarkable as this seems, it is not without precedent. In the eighteenth century an American privateer was chased by a British man-of-war in the Caribbean Sea, and, finding escape impossible, the Yankee skipper threw his ship's papers overboard. The privateer was captured and taken into Port Royal, Jamaica, and the Captain was there placed on trial for his life. As there was no documentary evidence against him he was about to be discharged when another British vessel arrived in port. The Captain of this cruiser reported that when off the coast of Haiti a shark had been captured, and that when opened the privateer's papers had been found in his stomach. The papers thus marvelously recovered were taken into court, and solely upon the evidence which they afforded the Captain and crew of the privateer were condemned. The original papers were preserved and placed on exhibition in the Institute of Jamaica in Kingston, where the "shark's papers," as they were called, have always been an object of great interest." (Signed) A. Hyatt Verrill. New York, Nov. 20, 1915."

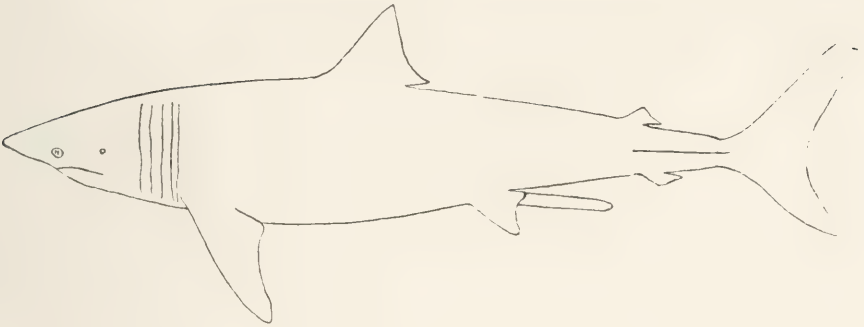
17. BASKING SHARK ; BONE SHARK

Cetorhinus maximus (Gunner)

Jordan and Evermann, p. 51.

Garman, p. 39.

Bears a general resemblance to the mackerel sharks that extends to the lunate caudal fin and keeled peduncle. Its gill-slits are much prolonged, taking in almost the entire depth of the body; eyes and teeth small. Dorsal fin midway between the pectoral and ventral fins. Not spotted or striped. Length over 30 feet.



In the basking shark we have a species which differs from nearly all of the preceding in that its range extends for a great distance northward of the latitude of Long Island. It occurs in Arctic seas, casually south to Virginia, or beyond, on our coast. The junior writer saw one in latitude 32° N., longitude 39° W., on September 1, 1912. It has been taken in the Mediterranean, near Sardinia, and sharks of the same or a closely allied species have been recorded from Australia and the west coast of South America. In 1822 an example was captured in the lower harbor of New York, and another was taken at Westhampton on June 29, 1915.

The basking shark, or bone shark as seafarers generally call it, is a sluggish, pelagic, surface-swimming species. This shark and its tropical counterpart the whale shark (*Rhinodon*), are the largest of fishes, yet among the most helpless and inoffensive so far as dental equipment is concerned. Their teeth are exceedingly minute, conical, numerous, arranged in several rows, and probably without use in feeding. The mouth, however, is of extraordinary width, and the gill-rakers, which are greatly developed, doubtless function as does the baleen of whalebone-whales in straining small fishes and other marine creatures from the water.

At certain seasons basking sharks are gregarious, shoals of them lying motionless with backs awash. Pairs also have a habit of swimming in tandem formation, one immediately behind the other. It is very likely that two such great fishes, with their high dorsal fins showing like leg-o'-mutton sails forty or fifty feet apart, have more than once given rise to tales of the sea-serpent.

Both the bone shark and the whale shark have enormous livers which yield a great quantity of marketable oil, sometimes as much as a

ton and a half. These huge species have always been hunted more or less by sperm whalers, and one New Bedford skipper is said to have taken 125 barrels of bone shark oil in two days. The bone shark is still hunted from the Iceland and Irish coasts, and about the middle of the eighteenth century, before the days of American pelagic whaling, an extensive fishery was conducted along the Massachusetts coast, when it was not unusual to obtain 400 gallons of oil from a single liver. The fishes were captured by harpooning from small boats, the iron being thrown as near the snout as possible in order to prevent the shark from diving before it could be lanced. The dangerous feature of the industry was the likelihood of the boat's destruction by the huge fish's tail. The liver oil was tried out in ordinary iron boiling pots.

According to the United States Fish Commission Report for 1902, "Shark oils are largely used in tanneries, in steel tempering, and in various compounds where it is desired to impart a low specific gravity. They are also valuable as a body for paints for out-of-door objects, as walls, fences, etc."

The bone shark recently captured at Westhampton, and referred to above, had become entangled in a bluefish net, and was hauled ashore alive. It was examined by Dr. L. Hussakof, who writes as follows:¹³

"The shark was a male, fourteen feet in length. The caudal had been cut off before I reached the scene, so that I could not verify the exact length; but from the measurements I made, the length was apparently as stated. The specimen was therefore small for this species, not even half grown.

"The color of the shark was grayish black, a little darker above than on the sides and belly. The under side was not white, as it is stated to be in textbooks; the only white about the specimen was a triangular patch on the under side of the rostrum, extending from the mouth as a base, to a point half-way to the tip of the snout. There were also two pale bands in the mid-ventral region, one on either side of the median line; they were about two inches in width, and had broken or jagged margins. They were confined to a portion of the ventral region, in front of the mixopterygia.

"The most striking feature about the shark, to one who had never seen the species in the flesh, was the extraordinary shape of the rostrum. This was the exact form of the lead end of a bullet, and so unlike that of

¹³ Copeia, 1915. No. 21, p. 25.

any other shark that it could serve as a diagnostic character equally with the enormous gill-clefts, to distinguish this species from all other sharks. It should be noted, too, that the rostrum was not short, as it is represented in textbook figures, but projected considerably in front of the mouth.

"The whole surface was covered with minute tubercles, which were rough to the touch when the shark was stroked from behind forward. The tubercles were especially large at the tip of the rostrum. On the snout, both above and below, were sensory pores distributed in groups. They were transversely elongated and very large, some of them $\frac{1}{4}$ inch in width. The long, slender gill-rakers, which are so distinctive of this species, were black in color, and looked like long, finely toothed combs attached to the gill bars. The longest rays were $2\frac{7}{8}$ inches in length. The teeth were set in the jaws in three rows, except in a few spots, where there were a few extra teeth giving the appearance of four rows.

"The alimentary canal contained a large quantity of bright red material. On examination under the microscope, this resolved itself into a vast multitude of minute Crustacea (species not yet determined), whose reddish bodies lent color to the entire mass.

"A few measurements, especially of the head region, may here be given: Rostrum, from front of eye, $10\frac{1}{4}$ in. Diameter of eye, $1\frac{1}{2}$ in. Front of eye to nostril, 3 in. Width of nostril, $1\frac{1}{4}$ in. Distance between inner margins of nostrils, $4\frac{3}{4}$ in. Mixopterygia, $7\frac{1}{4}$ in."

18. SPINED DOGFISH

Squalus acanthias Linné

Jordan and Evermann, p. 54.

Garman, p. 192.

First dorsal fin opposite the space between pectoral and ventral fins. First and second dorsal fins each with a spine in front. No anal fin. Slate color above, pale below, more or less marked with whitish spots above. Length 2 to 3 feet.



The spined dogfish is common off the ocean side of Long Island from October to June. It is abundant on the North Atlantic coast of Europe as well as America, migrating southward in winter, its range extending into the Tropics. During part of the year it inhabits deeper water than most of the sharks included within the scope of this paper, but at the times of its migrations it appears inshore and at the surface in huge, voracious schools, tremendously destructive to other fishes. These form the greater part of its food, though it also eats squid, jellyfish, etc. Unfortunate is the fisherman who gets into the schools of "thorndogs." If they do not crowd the good fish from that part of the ocean, they eat them off his line before he can get them to the surface, or fill and choke his nets, which they snarl and cut badly. Twenty thousand spined dogfish have been taken in a single haul of a seine off the British coast.

This species is the "cod shark" of New Jersey fishermen. On Long Island it is sometimes called the bonefish, from its spines. It is pestiferously abundant off the mouth of the Sound during the porgy season in May.

We have found spined dogfish numerous in late November near the bottom at the edge of the continental shelf off New York. Unlike some other fishes, they seemed little incommoded by the change in pressure in being brought from deep water to the surface, and when thrown overboard they started to swim downward again. At this season many of them contain well-developed young, three such being the number commonly observed. We have also a record of a female taken near Gardiner's Island on June 12, 1911, which gave birth to several young on the deck of a boat. Couch, in his 'Fishes of the British Islands' (1867), gives some interesting data regarding this species. He says that for nine or ten months of the year the female produces young continuously, and that the dogfish is somewhat preyed upon by other larger fishes. He also describes how the fish uses the spines on its back for defense, and states that if a finger be placed on its head, it will bend itself into a bow and strike so accurately with the posterior spine that it will prick the finger without piercing its own skin.

From year to year this species varies greatly in its abundance in certain waters, sometimes being entirely absent. The fact that it is rarely utilized for food seems to be due almost entirely to prejudice. Formerly it was used extensively in the manufacture of fertilizer or "fish guano." On treeless shores, such as Cape Cod, dried dogfish frequently serve as fuel. A liver-oil industry was at one time carried on along the New

England coast, and is still extant in Newfoundland. The dogfish livers are richest in fat during September and October, and the oil is extracted by "sun-trying" instead of by the usual boiling method, the livers being allowed to stand in open vats of water until they have macerated, when the oil is skimmed from the surface. The skin of this shark, because of its fine, hard denticles, is of value in certain crafts, such as polishing metals. The United States Government has recently investigated the various commercial possibilities of the spined dogfish. Speaking before the American Fisheries Society in 1911, Dr. George W. Field, Massachusetts state commissioner of fish and game, said: "The matter of the utilization of dogfish depends on the question of bringing them into port. Fishermen refuse to bring them in at present. We are now endeavoring to make a market by which the fishermen can bring the fish to definite places for utilization. But this is difficult, for no manufacturer will equip a plant until assured of a definite supply of dogfish."

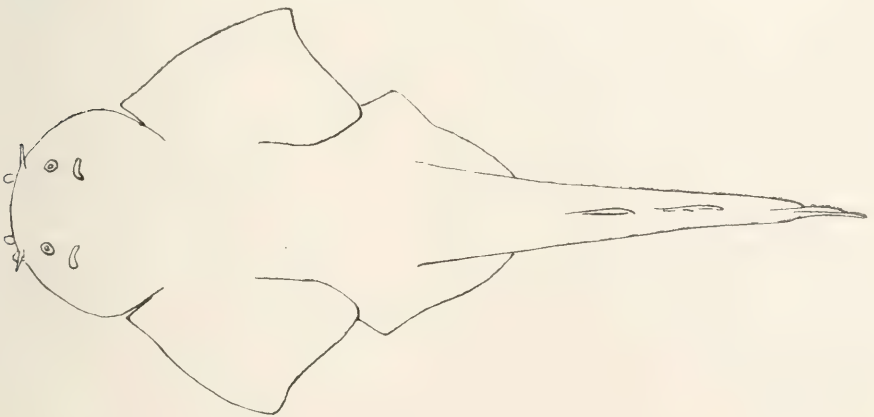
19. MONK-FISH

Squatina squatina (Linné)

Jordan and Evermann, p. 58.

Rhina dumeril, Garman, p. 252.

An extraordinary-looking fish. Both dorsal fins small, behind the ventrals. Body flat, the head circular in outline. Pectoral fins expanded in the plane of the body, broad, produced forward, separated from the neck by a deep notch. No anal fin. Ashy gray above, much blotched and speckled with olive; white below. Length 2 to 4 feet.



The monk-fish, angel-fish, fiddle-fish, or bullhead shark, all of which names are more or less appropriate, is one of the strangest in appearance of living fishes. Its circular head, constricted neck, and winglike pectoral fins are diagnostic. It is one of those forms intermediate between the normal shark and the flattened ray or skate. Its skin is said to have been much used by the ancients.

Squatina is widely distributed in warm seas, on both sides of the Atlantic and also along our Pacific shores. It occurs sparingly on our eastern coast northward to Cape Cod. Pebbles, fishes, and the opercula of whelks have been found within its stomach. It is said to produce about twenty young at a birth. It occurs occasionally in summer in the bays along the south shore of Long Island.

In a list of 'The Sharks of the Middle Atlantic States' (Copeia, No. 30, April, 1916), Mr. Henry W. Fowler uses the following technical names for species treated in this paper:

| | |
|------------------|--|
| Smooth dogfish | <i>Mustelus mustelus</i> (Linné) |
| Great blue shark | <i>Glyphis glaucus</i> (Linné) |
| Dusky shark | <i>Eulamia obscura</i> (Le Sueur) |
| Brown shark | <i>Eulamia milberti</i> (Müller & Henle) |
| Thresher shark | <i>Alopias vulpinus</i> (Bonnaterre) |

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