Sharks of North Carolina
and Adjacent Waters

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SHARKS of NORTH CAROLINA and ADJACENT WATERS

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INTRODUCTION

The sight of a triangular fin slicing through the water usually elicits immediate fear, distress, or panic in man. *Sharks — The Shadows in the Sea* (McCormick, Allen, and Young, 1963) have long been depicted as evil, sinister culprits inhabiting our oceans. While it is true that sharks have killed or attacked people throughout the world, recent findings have shown that one is less likely to be attacked by a shark in the ocean than having a serious accident at home or in a car (Baldridge, 1974; Coppleson, 1963; Schultz and Malin, 1963). Nevertheless, one should respect sharks for they are creatures remarkably well adapted to their environment. Likewise, much confusion persists concerning the sharks of the middle western Atlantic with most simply being called "sand sharks." We, therefore, intend to briefly present some aspects concerning sharks, especially those encountered in North Carolina and the adjacent western Atlantic Ocean, how to distinguish the species caught, and where to find additional information on these fishes.

What Is A Shark

Sharks and sawsharks have many features which separate them from true bony fishes (Fig. 1). True fishes have only one gill slit, a bony skelton, and cycloid or ctenoid scales or are scaleless. Elasmobranchs are fishes which include two main assemblages: sharks and sawsharks, as opposed to the skates, sawfishes, and rays. Skates, sawfishes, and rays can be readily recognized in having a flattened body, gills that open entirely on the underside of the body, pectoral fins that attach to the sides of the head anterior to the gill openings, upper margins of the orbits which are not free from the eye, and lack anal fins. The sawfish is erroneously called a shark since it possesses features described for the skates and rays, the grouping to which it is assigned. Actually one may think of the sawfish as a link between the two main assemblages of Elasmobranchs.

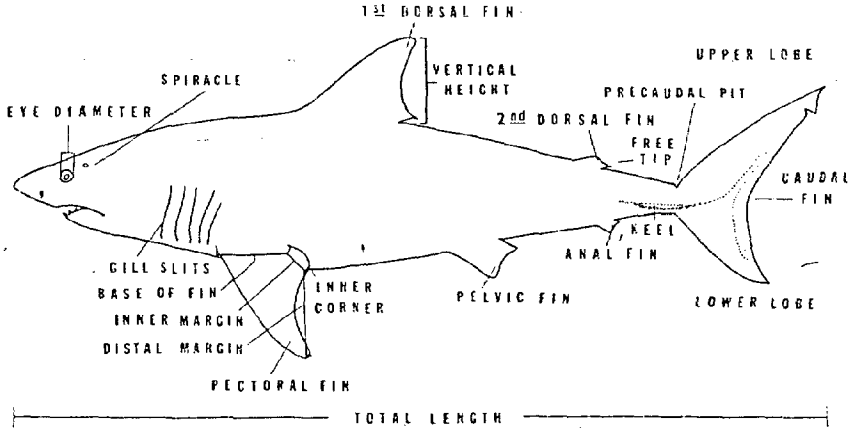

Fig. 1. Outline drawing of the mouth and body of a shark, slightly modified, to include important features mentioned in the text.

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Sharks and sawsharks are cartilaginous skeletoned fishes which have five to seven gill openings located on the sides of the head, a skin which is covered with placoid scales called denticles, the edges of the pectoral fins not attached to the sides of the head anterior to the gill openings, and the upper margins of the orbits free from the eyes. Sawsharks, which have body features and a toothed blade-like snout similar to that of a sawfish, are not included with the skates and rays since their gills are located laterally on the head. Sawsharks also lack anal fins, a feature similar to the sawfishes and squaloid sharks, and possess barbels located on the ventral surface of the toothed snout. Sawsharks have until recently been known only from Southeast Africa to Australia and the East Indies. In 1960 a sawshark, *Pristiophorus schroederi,* was discovered in 350-520 fm (640-952 m) in the Bahamas (Springer and Bullis, 1960). Further explorations of the deep ocean waters will determine whether they occur off North Carolina.

Numbers and Kinds of Sharks

Some 250 species of sharks roam the world's oceans of which less than 30 species are known to attack man, boats, or other objects (Garrick and Schultz, 1963). The majority (103) of the sharks known fall into the group referred to as the requiem sharks of the genus *Carcharhinus* (Garrick, 1967). The true number of shark species will probably be reduced from that known today with further study. Review of poor descriptions ascribed to sharks may reveal that similar appearing forms are often of the same species which may frequent more than one ocean system. For example, of the sharks of the genus *Carcharhinus* found in North Carolina and western Atlantic waters, the bignose shark (*Carcharhinus altimus*), silky (*C. falciformis*), bull (*C. leucas*), blacktip (*C. limbatus*), oceanic whitetip (*C. longimanus*), sandbar (*C. milberti*), dusky (*C. obscurus*), blacknose (*C. acronotus*), and spinner (*C. maculipinnis*), only the blacknose is restricted to the Atlantic Ocean. The spinner is found in the Indian Ocean as well as on both sides of the Atlantic, and the rest are equally at home in the Atlantic, Pacific, and Indian Oceans.

GENERAL COMMENTS ON SHARKS

Sharks are usually associated with the open oceans but some, such as the bull shark (*C. leucas*), penetrate estuaries (Schwartz, 1959, 1960) and freshwater lakes (Thorson, 1971). Sharks abound in the warmer temperate and tropical seas but also inhabit Arctic and Antarctic waters, e.g. the basking shark (*Cetorhinus maximus*) and porbeagle (*Lamna nasus*) prefer the North Atlantic waters around Newfoundland to Iceland (Leim and Scott, 1966). Sharks have been captured in shallow waters only a few meters deep (a North Carolina example is the Atlantic sharpnose shark, *Rhizoprionodon terraenovae*) to 2743 m (9000 ft) (Bigelow and Schroeder, 1948) and observed as deep as +4000 m (13,124 ft) (Grey, 1956). Deep water examples, in North Carolina, are dogfish sharks of the genus *Etmopterus*. The oceanic whitetip shark, *C. longimanus*, is an example of an open ocean inhabitant while the Atlantic angel shark, *Squatina dumerili* prefers to hug the bottom. Some sharks, such as the shortfin mako (*Isurus oxyrinchus*) are swift and powerful swimmers while others such as the basking shark and the whale shark, *Rhiniodon typus*, are slow and sluggish swimmers. Thus, sharks are found in a wide variety of conditions and niches. Most sharks bear living young but some, such as the whale and chain dogfish (*Scyliorhinus retiter*) are known to lay leathery egg cases in which the young develop. The tail of most sharks comprises one-third of the body length. Thresher sharks, which reach nearly 5 m (16.5 ft) total length, are conspicuous in having a tail of nearly half their body length. Hammerhead sharks, while typical in tail length, possess lateral expansions of the head, a condition found in no other sharks.

Although sharks are usually slate gray above to white below, they may also be brown, blue, yellow, or black in coloration. Rarely have either albinos or all white sharks been reported (Nakayama, 1973). To date, the scalloped hammerhead, *Sphyrna lewini*, has been the single Atlantic Ocean shark found exhibiting a complete albino condition (McKenzie, 1970). Spinal and cranial deformities have been noted on a few occasions for Atlantic Ocean sharks. These were in the bull shark, *C. leucas*, sandbar shark, *C. milberti*, and spiny dogfish, *Squalus acanthias* (Schwartz, 1973).

FOSSIL SHARKS

Sharks and shark-like ancestors have existed from the middle or perhaps early Devonian to the recent with few changes (Schaeffer, 1967). A more thorough discussion of fossil sharks and the early evolution of sharks is found in Compagno (1973), Miles (1971), and Zangerl (1973). The largest fossil shark tooth measures some 21 cm (8 1/4 in) high and weighs over 1 kg (2.2 lb) and has been attributed to *Carcharodon megalodon* (Case, 1967). This shark has been depicted as being 20-23 m (65-75 ft) in length; Randall (1973), however, recently showed it to have been only about 13 m (43 ft) long. A Maryland example depicted in Fig. 2a measures 12.8 cm (5.0 in) by 10.9 cm (4 1/4 in).

Since most of the eastern Atlantic seaboard has been inundated by the sea several times over the past million years (Richards, 1962) it is not sur-

prising to find dense deposits of fossil sharks teeth in the geological marine Miocene or Pleistocene deposits from Maryland to Florida (Leriche, 1942; Vokes, 1957). In North Carolina, fossil sharks teeth abound in the quarries and borrow pits near New Bern, Maysville, Cherry Point, Aurora, Bogue Banks, and Southport. One can readily find sharks teeth in the dense marine deposits at Calvert and Scientists Cliffs, Maryland and the Ashley phosphate beds of South Carolina. There one can encounter fossil teeth which belong to sharks having similar but smaller living present day representatives. These are fossils of the sand tiger *Odontaspis*, hammerhead *Sphyrna*, white *Carcharodon*, tiger *Galeocerdo*, mako *Isurus*, angel *Squatina*, *Hemipristis*, and porbeagle *Lamna* sharks, some of which are illustrated in Fig. 2b. In North Carolina most teeth seem to belong to *Carcharodon rondeleti*, *Prionodon egertoni*, and *Hemipristis serra* (Leriche, 1942).

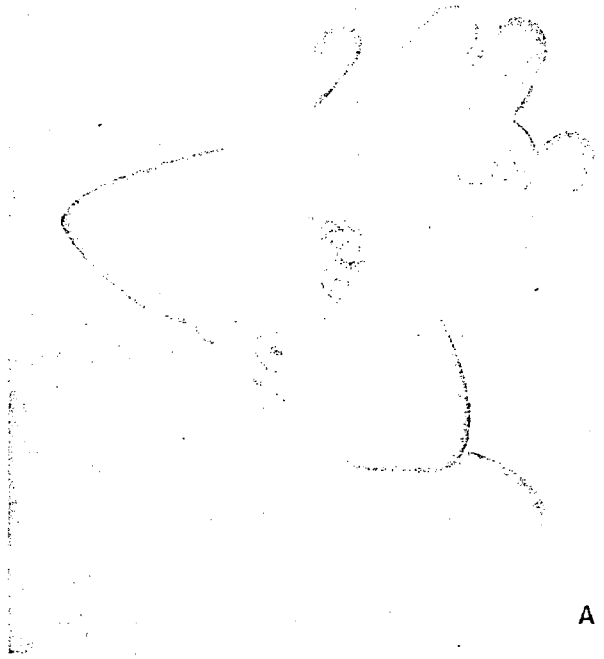


Fig. 2a. Fossil *Carcharodon megalodon* tooth from Calvert Cliffs, Maryland. 12.8 cm high by 10.9 cm wide.

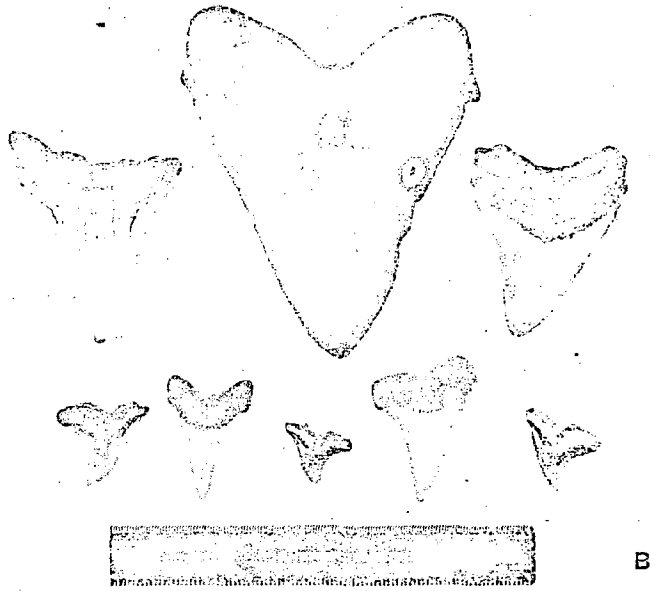


Fig. 2b. Typical fossil shark teeth of the genera *Carcharodon* (upper three), *Oxyrhina* (2 large lower), and *Hemipristis* (3 small lower) collected from Miocene cliff deposits of Maryland.

GENERAL SYSTEMATIC AND SURVEY STUDIES OF WESTERN ATLANTIC SHARKS

While man has always been preoccupied with the denizens of the sea, especially sharks, little comprehensive work on any of the various groups of sharks took place until this century. Garman's (1913) monumental work on sharks, skates, and rays set the stage for the later thorough work on sharks by Bigelow and Schroeder (1948). The latter remains the best single compilation on western Atlantic sharks. These works were followed by many excellent studies on several species and groups, including the oceanic whitetip shark (Backus, Springer, and Arnold, 1956), the genus *Carcharhinus* (Garrick, 1967a; Garrick and Schultz, 1963; Springer, 1950, 1951, 1960), squaloid sharks (Bigelow and Schroeder, 1957; Springer, 1959), hammerheads (Gilbert, C., 1967a,b), cat sharks (Springer, 1966; Springer and Sadowsky, 1970), the genus *Isurus* (Garrick, 1967b), the genera *Scoliodon, Loxodon,* and *Rhizoprionodon* (Springer, V., 1964) and the marbled cat shark, *Galeus arae* (Bullis, 1967).

Regional surveys along the entire coast of the western Atlantic have yielded much in relation to distribution, seasonality, and the biology of western Atlantic sharks. Important among these were: for the entire western Atlantic (Jordan and Evermann, 1898), Canadian waters (Leim and Scott, 1966; Templeman, 1966), Gulf of Maine (Backus, 1957; Bigelow and Schroeder, 1953; Bigelow and Welsh, 1925), New England and Middle Atlantic Bight (Casey, 1964; Mather and Gibbs, 1957), Connecticut

(Thompson, Weed, and Taruski, 1971), New Jersey (Fowler, 1905), Chesapeake Bay (Hildebrand and Schroeder, 1928). Delmarva peninsula of Delaware, Maryland, and Virginia (Schwartz, 1961, 1964). Virginia (Hoese, 1962; Richards and Castagna, 1970), North Carolina (Smith, 1896, 1907), South Carolina (Bearden, 1965a,b; Burton, 1935), Florida (Clark and von Schmidt, 1965; Heemstra, 1965), southeastern Atlantic (Bullis and Thompson, 1965; Struhsaker, 1969), the Bahamas and Caribbean (Bigelow and Schroeder, 1945; Böhlke and Chaplin, 1968; Randall, 1968), and Gulf of Mexico (Bigelow, Schroeder, and Springer, 1953). Deep water sharks were noted by Bigelow and Schroeder (1953, 1954, 1957), Bigelow, Schroeder, and Springer (1953) and Goode and Bean (1895).

For additional information on various aspects of the biology of sharks refer to Gilbert (1963), Gilbert, Mathewson, and Rall (1967), and McCormick, Allen, and Young (1963). Publications may also be found on the number of vertebrae (Springer, V. and Garrick, 1969), teeth variation (Moss, 1967; Strasburg, 1963), and dangerous nature (Halstead, 1959, 1967).

STUDIES DEALING WITH NORTH CAROLINA SHARKS

The names of Bell, Brimley, Coles, Gudger, Radcliffe, Smith, Wilson, and Yarrow dominate the shark literature of North Carolina. Not only were they important pioneers of studies on North Carolina fishes during the first quarter of this century, but their daring was often associated with the Cape Lookout-Beaufort shark fishery of the Ocean Leather Corporation which flourished during 1919-1922.

Gone are the days when Russell J. Coles (1915), the most active student of sharks at Cape Lookout, related "in 1905, while out in a small skiff, harpooning turtles, a huge shark of more than 20 feet in length appeared alongside, within reach of my hand. It apparently had no fear of us, as it struck the side of the skiff with some force. It then swam away for a distance of several hundred yards, then turned and swam rapidly toward us. I was about to fire into it as a large loggerhead turtle rose to the surface and was attacked by the shark. The shark seized the turtle in its jaws and both disappeared beneath the surface. The next day I harpooned this turtle and found the upper shell for a width of nearly 20 inches showing the mark of the shark's teeth. The edge of the shell and the right hind flipper had been torn away. In 1913 I observed three of these sharks and succeeded in harpooning them, but my tackle was too light to hold them. While I was unable to postively identify these sharks, I believe they were maneaters."

"My second adventure with the white shark occurred some years later, and although it contained an instance of close infighting, yet it was much less dangerous, for I was then trained and steadied by having won many knife fights with sharks and large rays. After trying for an hour to approach within harpooning distance of a large man-eater which was swimming in shallow water near the scene of my former encounter, I got overboard in a depth of five feet of water and had the boat retire to a distance of a hundred yards and with the coil of rope, which was attached to the

harpoon which I had with me. I also took with me a bushel of crushed and broken fish to attract the shark, which was then swimming on or near the surface, half a mile to leeward of me. Soon the shark could be seen zigzagging its course toward me, by crossing and recrossing the line of scent from the broken fish, just as a bird dog follows up the scent of quail. With harpoon poised, I crouched low, trusting that its approach would be continued in this manner, until, by a long cast, I could fasten my harpoon in its side. The scent of the broken fish, however, was so strong that they were definitely located, and the shark charged from a hundred feet away with a speed which has to be seen to be appreciated. I met the onrushing shark by hurling my harpoon clear to the socket into it near the angle of the jaw, and, as the iron entered its flesh, the shark leaped forward, catching me in the angle formed by its head and the harpoon shank, which caught me just under the right arm, bruising me badly, while my face and neck were somewhat lacerated by coming in contact with the rough hide of the side of its head. As my right arm was free, it was a great chance for using the heavy knife, with which I was armed, had my tackle been strong, but the force of the blow snapped the poorly-made harpoon at the socket and the shark escaped, although it carried its death wound. I never again employed the same blacksmith to forge my harpoon, but that poorly-made iron surely brought to a sudden ending to a most exciting situation."

Brimley, in an address delivered April 1935 to the Zoology Field Club, Woman's College, University of North Carolina, related how he and his wife were surf fishing. "She had waded out and made a cast seaward, and was standing in the water, with her back to the shore, perhaps 60 or 75 yards from the line of beach. As soon as I had rigged my tackle, I waded out in the general line she had taken when, suddenly, a fair sized shark appeared between us, crossing her line of travel. I stopped and made a quick cast in front of the swimming fish in the hope that he would see the bait and take hold, but the act failed to register. My calling down was based on the stated belief that I had stopped to try to hook and have some sport with a ferocious man-eating creature that might have eaten up my lady friend while I was simply fishing for fun. I found it awfully difficult to get my scientific explanations received in the right spirit."

The vivid exploits of Coles and Brimley furnish interesting reading and a rare insight of these men and the history of the early efforts regarding sharks in North Carolina. However, we hope modern students of sharks will not employ such reckless and dangerous methods when dealing with sharks.

Coles in a series of papers between 1910 and 1926 gave us our earliest detailed exposure to 16 species of sharks collected off Cape Lookout, North Carolina. Brimley (1935a,b) reported the earliest occurrences of the basking and whale sharks in North Carolina. Bell and Nichols (1921) and Nichols (1921) studied the food habits of some of the same sharks captured by Coles. Radcliffe (1913, 1914) noted some 20 sharks frequenting the Beaufort area. Gudger commented on tiger, hammerhead, and other sharks and expanded the list of known sharks from North Carolina in a deluge of papers published between 1907 and 1948. Jordan (1886), Jordan and Evermann (1898), Jordan and Gilbert (1879), Jenkins (1887),

Yarrow (1877), and Wilson (1900) were others who studied the sharks of North Carolina. Linton (1905) discussed the parasites found on some sharks. Hildebrand's (1941) list of sharks contained 11 species, some of which were new additions to the fauna.

SPORT AND COMMERCIAL FISHERIES FOR SHARKS IN NORTH CAROLINA

Sharks have played a role in both the sport and commercial fisheries of North Carolina. Presently sharks are occasionally sought by sport fishing fleets out of Hatteras, Ocracoke, Morehead-Beaufort, Wrightsville Beach, and Southport. Fishing for sharks is discouraged, for safety sake, by the operators of the 13 ocean piers located between Nags Head and Carolina Beach. Nevertheless, sharks contribute heavily to the catches of pier fishermen during their spring and fall movements along the coast. Sporadic hook and line and trot line sport fishermen catch dusky, Atlantic sharpnose, and hammerhead sharks in the sounds near Morehead City. Only Wrightsville Beach, North Carolina has an ordinance (since 13 October 1960) against shark fishing by sportsmen.

In 1919 a commercial shark fishery was established by the Ocean Leather Corporation of New Jersey and was situated near the present unused Camp Glen menhaden factory on Bogue Sound. The operation was directed by Captain E. Young. Originally a pier was built extending out into deep water. A skinning and dissecting platform was constructed on the pier to shield the sharks and their by-products from the hot sun. A curing, storage, and by-product building was also constructed. Later a shark liver oil plant was established complete with a narrow gauge railroad from the end of the pier to the building and processing facilities. A shark meal and fertilizer facility was added which included a steam plant, chopper, grinder, steam cooker, and long heated tunnel-dryer. Total cost was $60,000, a large sum in those days.

Three 10.7 m (35 ft) open cockpit dory-type motor driven boats equipped with mast and derrick to hold the shark nets, with a crew of four per boat, were utilized in this commercial fishery. Shark nets were 183 m (600 ft) by 10 mesh (5.2 m, 17 ft) deep and set on the bottom about 8 km (5 mi) offshore. The bottom line was weighted and anchored on both ends with 22.7 kg (50 lb) kedge anchors. The top line was fitted with 10 cm (4 in) corks. Sharks averaging 2.1 m (7 ft) were captured at a rate of 50-60 per day. Hides were skinned by a good skinner in 15 minutes, fleshed, and stored for about a week prior to shipment. The fins, 2 pectorals, 1 dorsal, and caudal were hung to dry. Livers were cut into pieces and cooked in 208 liter (55 gal) steel drums for their oil. The chopper did not work well and the quantity of carcasses was not sufficient to operate it steadily. The operation ceased in 1922. In July and August 1920, some of the Morehead City men carried on a substantial hook and line shark fishery at Nantucket, Massachusetts. The fertilizer plant was moved to Sanibel Island, Florida where it never operated. While proving unprofitable, the Morehead City-Ocean Leather Corporation venture helped develop better shark fishing and processing methods (see Moresi, 1957). This corporation founded by Mr. A. Ehrenbeich, later managed for 25 years by Mr. L. Moresi, is still in existence.

Cecil Nelson began a small shark fishery in 1936 and operated it for five years. It was reported, in one season between April and June, he caught 3000 sharks, all over 1.8 m (6 ft) long. He shipped the skins and livers to northern industries and sold the teeth for one cent each. The remainder of the shark was used as fertilizer by the local farmers or was tossed overboard (Stick, 1958). Since then landings have varied sporadically (Table 1). The catch statistics of 210,000-581,400 lb (95,254-263,713 kg) of sharks in North Carolina between 1937-1939 can apparently be attributed to Nelson's fishery.

YEAR	QUANTITY	VALUE
1936	1,100	22
1937	231,600	772
1938	581,400	1,744
1939	210,000	693
1940	----	---
1945	1,200	72
1950	5,500	550
1951	6,600	390
	No Landings 1952—1956	
1957	16,000	--
1958	4,214	210
1959	12,857	645
1960	2,309	115
1961	2,168	110
1962	2,556	152
1963	4,048	353
1964	13,891	1,389
1965	2,147	125
1966	2,507	149
1967	5,323	330
1968	5,488	357
1969	----	---
1970	2,760	113
1971	2,000	60
1972	----	---
1973	----	---

Table 1. North Carolina shark landings (in pounds) and value (in dollars) between 1936 and 1973. Data from U. S. Fish and Wildlife Service Annual Statistical Digests.

SIZES OF SHARKS IN NORTH CAROLINA AND ADJACENT WATERS

Sharks found in North Carolina waters vary in length (Fig. 3) from a few centimeters (several inches) to nearly 12.2 m (40 ft). The whale shark, a cosmopolitan species, is the largest recorded shark (Gudger, 1936). The North Carolina record was a specimen estimated at 12.2 m (40 ft) which grounded 6 June 1934 at the Quarantine Station located near the mouth of the Cape Fear River near Southport (Brimley, 1935a). To date no other whale shark has been reported in inshore waters of North Carolina. Other large sharks, observed or captured, have been basking and sixgill sharks. Basking sharks are sighted each winter along the North Carolina coast. Two were entangled in shad nets set in Stumpy Point Bay, Pamlico Sound, 23 January 1971. The largest, a male, was 4.7 m (15.3 ft) total length and estimated at 818 kg (1800 lb). Others of 5.5 m (18 ft) have been

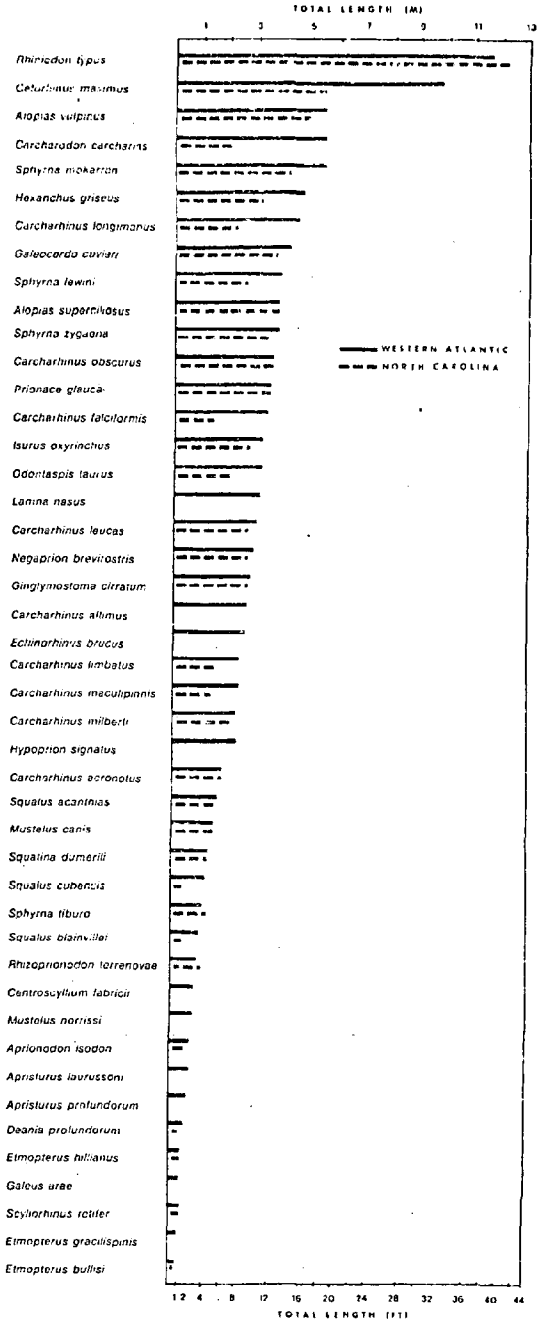


Fig. 3. Maximum recorded total lengths of sharks found in North Carolina and the western Atlantic Ocean. Note several North Carolina shark lengths exceed published lengths for the species from the western Atlantic.

seen at the surfline at Emerald Isle, Bogue Banks, in February. The only sixgill shark, *Hexanchus griseus*, known from North Carolina, 3.1 m (10 ft 2 in), was landed at Currituck Inlet life saving station in March 1886 (Smith, 1907).

While the whale, basking, and sixgill sharks are the large sharks of the area, others such as the white, thresher, and some hammerhead sharks reach lengths of 4-5 m (13-16 ft). The most abundant and common species, however, usually are 1-2 m (3-7 ft) in length. Dominating the shelf, inshore, and estuarine waters of North Carolina and adjacent areas are members of the requiem shark genus *Carcharhinus*. Their sizes vary (Fig. 3) from about 1.2-4.3 m (4-14 ft). Smaller among the sharks is the 1.1 m (3.5 ft) Atlantic sharpnose shark, which frequents inshore and estuarine areas, especially the Newport and lower Cape Fear River complexes. Our smallest sharks are the brown or black sharks of the genera *Etmopterus* (0.2-0.4 m, 8-16 in), *Deania* (0.3 m, 12 in), *Centroscyllium* (0.3 m), and *Scyliorhinus* (0.2 m) which are usually unseen by the average fishermen since they inhabit the outer continental shelf of 50 or more fathoms (92 m) and abyssal depths.

All North Carolina sharks should be respected not only for their disposition and bite, but also because their size and denticulate skin can cause harm. One is ill advised to ride or grab a shark since one quick arch of its body will place the swimmer within easy reach of the shark's mouth, regardless of size. In addition, even light contact with the abrasive skin often results in severe lacerations. Especially dangerous large sharks are the tiger, white, bull, mako, blue and hammerhead sharks. Two of the most docile local sharks are the whale and basking sharks which have short needlelike teeth. Yet, despite their docile habits, they should be given a wide berth, for their size and speed of reaction are great and a single flip of their tails could cause damage.

SHARK ATTACKS

North Carolina has had only two recorded shark attacks (Baldridge, 1974). The first, in September 1935, involved Jere Fountain who was swimming near Brown's Inlet near New River, Onslow County (34°38'N, 77°12'W). A second swimmer, Rupert Wade, was attacked 16 July 1957 while swimming well off Atlantic Beach, Carteret County (34°39'N, 77°06'W). His injuries, according to A. F. Chestnut, consisted of a large triangular portion of approximately 75 mm (3 in) wide and 50-75 mm (2-3 in) deep missing from the posterior mid-thigh region and damage to the calf musculature. The inner portion of the upper thigh had several deep lacerations. Both Fountain and Wade succumbed to their wounds. Surprisingly no other authentic attacks, other than those attributed to bluefish or barracudas, have occured despite the increased use of the seashore areas by thousands of people between March and November. The victim of the most recent attack in nearby waters was a teenager who was crabbing in four feet (1.2 m) of water near Virginia Beach, Virginia, 16 August 1973. Subsequent investigations suggested that the attack was by a blacktip shark, *Carcharhinus limbatus*. Two attacks have occured in nearby Virginia waters, while 23 are known from South Carolina waters, in the last 50-60 years (Baldridge, 1974).

SHARKS FOUND IN NORTH CAROLINA AND ADJACENT ATLANTIC OCEAN WATERS

Some 35 species of sharks are known from the estuarine, shelf, and deep ocean waters of North Carolina. With further sampling 10 others, which have been taken in the western Atlantic to the north or south of North Carolina (Delaware to northern Florida), are expected to be included as part of our fauna. The known and expected sharks from North Carolina or adjacent western Atlantic Ocean waters are listed in Table 2.

Table 2. Known and expected sharks from North Carolina and adjacent western Atlantic Ocean waters.

		STATUS	
COMMON NAME	SCIENTIFIC NAME	KNOWN FROM NC	RECORDED NEARBY
Sixgill shark	*Hexanchus griseus*	x	
Nurse shark	*Ginglymostoma cirratum*	x	
Whale shark	*Rhiniodon typus*	x	
Sand tiger	*Odontaspis taurus*	x	
Bigeye thresher	*Alopias superciliosus*	x	
Thresher shark	*Alopias vulpinus*	x	
White shark	*Carcharodon carcharias*	x	
Basking shark	*Cetorhinus maximus*	x	
Shortfin mako	*Isurus oxyrinchus*	x	
Porbeagle	*Lamna nasus*		New Jersey, So. Car.
	Apristurus laurussoni		Delaware
	Apristurus profundorum		Virginia, Caribbean
Marbled cat shark	*Galeus arae*		South Carolina
Chain dogfish	*Scyliorhinus retifer*	x	
Finetooth shark	*Aprionodon isodon*	x	
Blacknose shark	*Carcharhinus acronotus*	x	
Bignose shark	*Carcharhinus altimus*		Northern Florida
Silky shark	*Carcharhinus falciformis*	x	
Bull shark	*Carcharhinus leucas*	x	
Blacktip shark	*Carcharhinus limbatus*	x	
Oceanic whitetip shark	*Carcharhinus longimanus*	x	
Spinner shark	*Carcharhinus maculipinnis*	x	
Sandbar shark	*Carcharhinus milberti*	x	
Dusky shark	*Carcharhinus obscurus*	x	
Tiger shark	*Galeocerdo cuvieri*	x	
Night shark	*Hypoprion signatus*		South Carolina
Smooth dogfish	*Mustelus canis*	x	
Florida smoothhound	*Mustelus norrisi*		Northern Florida
Lemon shark	*Negaprion brevirostris*	x	
Blue shark	*Prionace glauca*	x	
Atlantic sharpnose shark	*Rhizoprionodon terrenovae*	x	
Scalloped hammerhead	*Sphyrna lewini*	x	
Great hammerhead	*Sphyrna mokarran*	x	
Bonnethead	*Sphyrna tiburo*	x	
Smooth hammerhead	*Sphyrna zygaena*	x	
Black dogfish	*Centroscyllium fabricii*		Virginia
	Deania profundorum	x	
Bramble shark	*Echinorhinus brucus*		Virginia
	Etmopterus bullisi	x	
	Etmopterus gracilispinis		Virginia, N. Fla.
	Etmopterus hillianus	x	
Spiny dogfish	*Squalus acanthias*	x	
Blainville's dogfish	*Squalus blainvillei*	x	
Cuban dogfish	*Squalus cubensis*	x	
Atlantic angel shark	*Squatina dumerili*	x	

HOW TO USE THE KEYS

Two methods are presented to help the reader identify a shark: a rapid pictorial distinguishing method and a lenghtier dictomous key, which contains more finite features.

Pictorial method: Western Atlantic Ocean sharks can be grouped into several natural groupings based on important obvious features. These are: flattened body, six gills versus five, barbels, no anal fin and usually with spines in dorsal fins, head expanded laterally, first dorsal fin positioned behind midpoint of body, tail half or more of body length; well developed lateral keels on caudal peduncle or tail, ridge present between dorsal fins, and no ridge present between dorsal fins. Follow this sequence, noting which characters the shark possesses, to arrive at the section that deals with similar appearing sharks. Remember, as one proceeds, that several species may have more than one of these important characteristics. Turn to the appropriate section and identify the shark by a process of elimination, utilizing a combination of the distinguishing features and line drawing.

Dicotomous Key Method: A dicotomous key is a series of couplets in which one selects between two alternatives. Eventual identification is achieved by following through the key in a step-by-step manner. For example, a tiger shark can be determined by following the choices in couplets 1b, 2b, 3b, 12a, 13b, 14b, 15a, and 16a.

We purposely refrained from using tooth count and/or shape (which is specific for each species) as primary characters in the dictomous key since one usually does not have time or the ability to check the teeth of a thrashing shark. Only stable color patterns have been noted since body colors often vary within individuals of a given species and usually change as the fish struggles in capture or upon death. We caution not to place too much attention to the presence of dusky or black tips on the pectoral fins, since many sharks may have this characteristic.

FIELD KEY TO NORTH CAROLINA SHARKS

1a. Body flattened dorso-ventrally ..... p. 18, *Squatina dumerili*, Atlantic angel shark

1b. Body round in cross section 2

2a. Six gill openings ..... p. 18, *Hexanchus griseus*, Sixgill shark

2b. Five gill openings 3

3a. Anal fin absent 4

3b. Anal fin present 12

4a. No spines on dorsal fins ..... p. 20, *Echinorhinus brucus*, Bramble shark

4b. Both dorsal fins with spines 5

5a. Midbases of pelvic fins located approximately halfway between rear base of first dorsal fin and origin of second dorsal fin 6

5b. Midbases of pelvic fins located much nearer to the origin of second dorsal fin than to rear base of first dorsal fin 8

6a. First dorsal spine over or posterior to inner corners of pectoral fins; midpoints of bases of pelvic fins much nearer to origin of second dorsal fin than rear base of first dorsal fin ..... p. 24, *Squalus acanthias*, Spiny dogfish

6b. First dorsal spine about over midpoints of inner margins of pectoral fins; midpoints of bases of pelvic fins about midway between rear base of first dorsal fin and origin of second dorsal fin 7

7a. Inner margins of pectoral fins deeply concave, inner corners acutely pointed ..... p. 24, *Squalus cubensis*, Cuban dogfish

7b. Inner margins of pectoral fins weakly concave, inner corners at approximately right angles ..... p. 24, *Squalus blainvillei*, Blainville's dogfish

8a. A noticeable flap of skin located medially between pelvic fins and lower caudal lobe ..... p. 20, *Deania profundorum*

8b. Dermal flap absent 9

9a. Rear bases of pelvic fins lie nearly even with midbase of second dorsal fin; prominent mucous pores absent on lower surface of snout ..... p. 20, *Centroscyllium fabricii*, Black dogfish

9b. Rear bases of pelvic fins lie even with or in advance of origin of second dorsal fin; prominent mucous pores present on lower surface of snout 10

10a. Distance between rear base of first dorsal fin and origin of second dorsal fin is as long as the distance from tip of snout to origin of pelvic fins ..... p. 22, *Etmopterus hillianus*

10b. Distance between rear base of first dorsal fin and origin of second dorsal fin is much shorter than distance from tip of snout to first gill opening 11

11a. Distal margins of pectoral fins lie even with origin of first dorsal fin; body flank markings long and narrow ... p. 22, *Etmopterus bullisi*

11b. Distal margins of pectoral fins fail to reach origin of first dorsal fin; body flank markings are broad and wing-shaped ..... p. 22, *Etmopterus gracilispinis*

12a. Caudal peduncle with one or more keels or ridges 13

12b. Caudal peduncle without keels or ridges 19

13a. Two keels on caudal peduncle .. p. 36, *Lamna nasus*, Porbeagle

13b. One keel or ridge on caudal peduncle 14

14a. Mouth on tip of snout; coloration a series of round spots and narrow transverse stripes; three to four large ridges along back and sides p. 35, *Rhiniodon typus*, Whale shark

14b. Mouth inferior; color not as above; no such ridges along back and sides 15

15a. Keel on caudal peduncle a weakly developed ridge 16

15b. Keel on caudal peduncle well developed 17

16a. First dorsal fin originates even with rear bases of pectoral fins; coloration irregular bands or elongated spots .....
p. 32, *Galeocerdo cuvieri*, Tiger shark

16b. First dorsal fin originates well past rear bases of pectoral fins; coloration uniformly deep blue .....
p. 30, *Prionace glauca*, Blue shark

17a. Gill slits long, extending almost full height of head .....
p. 34, *Cetorhinus maximus*, Basking shark

17b. Gill slits shorter, not extending full height of head 18

18a. Origin of anal fin placed well behind rear base of second dorsal fin; black spot usually present in axils of pectoral fins; teeth strongly serrated ..... p. 36, *Carcharodon carcharias*, White shark

18b. Origin of anal fin placed at the base of the second dorsal fin; black axil spot always lacking; teeth smooth .....
p. 36, *Isurus oxyrinchus*, Shortfin mako

19a. Head flattened dorso-ventrally and expanded laterally 20

19b. Head not flattened and expanded 23

20a. Head shovel shaped ..... p. 26, *Sphyrna tiburo*, Bonnethead

20b. Head hammer shaped 21

21a. Front margin of head not notched at midline .....
p. 26, *Sphyrna zygaena*, Smooth hammerhead

21b. Front margin of head notched at midline 22

22a. Free rear tip of second dorsal fin longer than vertical height of fin; mouth symphyses in advance of rear margin of head .....
p. 26, *Sphyrna lewini*, Scalloped hammerhead

22b. Free rear tip of second dorsal fin shorter than vertical height of fin; mouth symphyses even with rear margin of head .....
p. 26, *Sphyrna mokarran*, Great hammerhead

23a. Dorsal lobe of caudal fin greatly elongated, being nearly as long as the distance from tip of snout to precaudal pit 24

23b. Dorsal lobe of caudal fin not elongated, being much shorter than the distance from tip to snout to precaudal pit 25

24a. Eye large, horizontal diameter is less than vertical diameter; teeth 10-11 on a side .... p. 32, *Alopias superciliosus*, Bigeye thresher

24b. Eye smaller, horizontal diameter is approximately equal to vertical diameter; teeth 20 on a side ... p. 32, *Alopias vulpinus*, Thresher

25a. Origin of first dorsal fin lies behind origins of pelvic fins 26

25b. Origin of first dorsal fin lies even with or in advance of pelvic fins origins 29

26a. Origin of first dorsal fin lies posterior to rear bases of pelvic fins; sides with series of chain-like markings .....
p. 30, *Scyliorhinus retifer*, Chain dogfish

26b. Origin of first dorsal fin lies anterior to rear bases of pelvic fins; no chain-like markings present 27

27a. Lateral body coloration is rows of blotches and spots .....
p. 30, *Galeus arae*, Marbled catshark

27b. Coloration uniformly black or dark brown 28

28a. Denticles on and near upper margin of dorsal lobe of caudal fin closely packed, forming a crest; denticles on the lateral surfaces of caudal fin widely spaced ..... p. 28, *Apristurus profundorum*

28b. Denticles on upper margin and lateral surfaces of caudal fin nearly identical in shape, size, and density ..... p. 28, *Apristurus laurussoni*

29a. Two dorsal fins of almost equal size 30

29b. Two dorsal fins unequal in size 34

30a. Low dermal ridge on midline of dorsal surface between first and second dorsal fins 31

30b. No dorsal ridge present 32

31a. Corner of lower lobe of caudal fin pointed and directed rearward; distal margin of pectoral fin deeply concave ..... p. 38, *Mustelus norrisi,* Florida smoothhound

31b. Corner of lower lobe of caudal fin broadly rounded; distal margin of pectoral fin nearly straight ..... p. 38, *Mustelus canis,* smooth dogfish

32a. Head pointed; large pointed teeth protrude from mouth ..... p. 42, *Odontaspis taurus,* Sand tiger

32b. Head blunt; teeth pointed but not protruding 33

33a. Barbel on margin of each nostril ..... p. 18, *Ginglymostoma cirratum,* Nurse shark

33b. No such barbels present ..... p. 28, *Negaprion brevirostris,* Lemon shark

34a. Dorsal, pectoral, and caudal fins tipped with white; first dorsal fin broadly rounded; pectoral fins large with rounded tips ..... p. 40, *Carcharhinus longimanus,* Oceanic whitetip shark

34b. Fins not white tipped 35

35a. Anal fin origin in advance of second dorsal fin origin ..... p. 42, *Rhizoprionodon terraenovae,* Atlantic sharpnose shark

35b. Anal fin origin behind or even with second dorsal origin 36

36a. Low ridge present between first and second dorsal fins 37

36b. Low ridge absent between first and second dorsal fins 41

37a. First dorsal fin large, vertical height greater than 10% of total length ..... p. 40, *Carcharhinus milberti,* Sandbar shark

37b. First dorsal fin smaller, vertical height less than 10% of total length 38

38a. Length of free rear tip of second dorsal fin more than two times the vertical height of the fin; first dorsal fin rounded ..... p. 40, *Carcharhinus falciformis,* Silky shark

38b. Length of free rear tip of second dorsal fin two times or less than the vertical height of the fin; first dorsal fin not rounded 39

39a. Snout moderately long, distance from mouth to tip of snout less than the width of the mouth ..... p. 40, *Carcharhinus obscurus,* Dusky shark

39b. Snout long, distance from mouth to tip of snout equal or longer than mouth width 40

40a. Diameter of eye is one-half height of first gill opening; cusps of upper jaw teeth serrated .....
p. 38, *Carcharhinus altimus*, Bignose shark

40b. Diameter of eye is equal to height of first gill opening; cusps of upper jaw teeth smooth ..... p. 38, *Hypoprion signatus*, Night shark

41a. Snout short and broadly rounded, distance from tip of snout to line connecting nostrils not more than 1/2 the distance between inner ends of nostrils ..... p. 44, *Carcharhinus leucas*, Bull shark

41b. Snout longer, distance from tip of snout to line connecting nostrils at least 2/3 the distance between inner ends of nostrils 42

42a. No black or dusky tips on fins; teeth erect, symmetrical, and smooth
p. 42, *Aprionodon isodon*, Finetooth shark

42b. Black or dusky tips on fins; teeth definitely serrated 43

43a. Black or dusky spot on tip of snout .....
p. 44, *Carcharhinus acronotus*, Blacknose shark

43b. No such spot on tip of snout 44

44a. Snout long, vertical height of first dorsal fin approximately equal to distance between tip of snout and eye; eye small, horizontal diameter is 1/4 or less than the length of the first gill opening ..
p. 44, *Carcharhinus maculipinnis*, Spinner shark

44b. Snout shorter, vertical height of first dorsal fin much greater than distance between tip of snout and eye; eye larger, horizontal diameter is 1/3 or greater than the length of the first gill opening
p. 44, *Carcharhinus limbatus*, Blacktip shark

BODY FLATTENED DORSO-VENTRALLY

Atlantic angel shark — *Squatina dumerili* Lesueur

Distinguishing features: Only shark flattened dorso-ventrally like skate, from which it differs in having gill slits positioned partially on side of head; pectoral fins separate from head and pelvic fins; protrusible jaws; no anal fin.
Occurrence: A common coastal inshore winter transient (December to April). Large September catches in 73 m (40 fm) suggest abundance in offshore waters during other seasons. Nowhere abundant in North Carolina. Best catches in January-March near Cape Lookout and Beaufort Inlet while trawling for weakfish (gray trout), *Cynoscion regalis*.

SIX GILLS

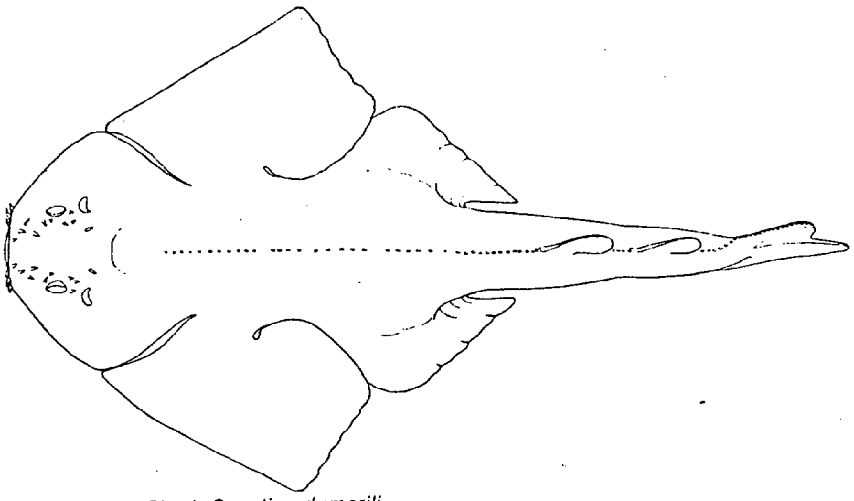
Sixgill shark — *Hexanchus griseus* (Bonnaterre)

Distinguishing features: Six gill slits; single dorsal fin.
Occurrence: A worldwide and South Atlantic deep water species known in North Carolina from a single specimen captured March 1886.

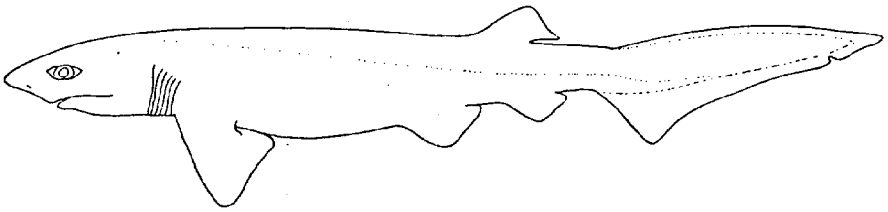
BARBELS PRESENT ON NOSTRILS

Nurse shark — *Ginglymostoma cirratum* (Bonnaterre)

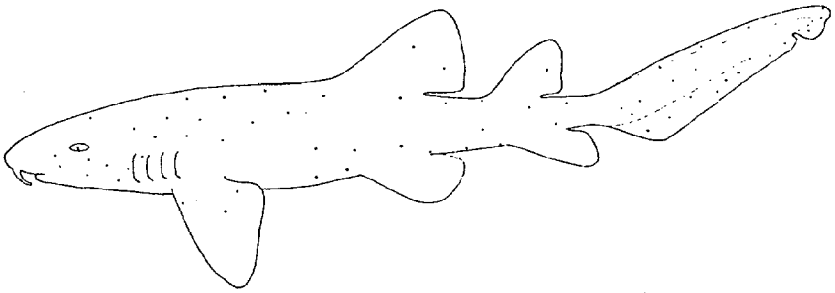
Distinguishing features: Ventral pair of barbels found on anterior margin of each nostril; groove connects each nostril with mouth. Dorsal fins far back on body and nearly equal in size. Long upper, no lower caudal fin lobe. Color yellow or brown; young with small black spots, adults often with two dark spots high on sides anterior to dorsal fin.
Occurrence: Known in western Atlantic from Rhode Island to Brazil. Most abundant in tropical waters but a sporadic summer visitor in inshore waters or inlets south of Cape Hatteras, North Carolina.



Atlantic Angel Shark *Squatina dumerili*



Sixgill Shark *Hexanchus griseus*



Nurse Shark *Ginglymostoma cirratum*

NO ANAL FIN AND USUALLY WITH SPINES IN DORSAL FINS

(pages 20-25)

Bramble shark — *Echinorhinus brucus* (Bonnaterre)

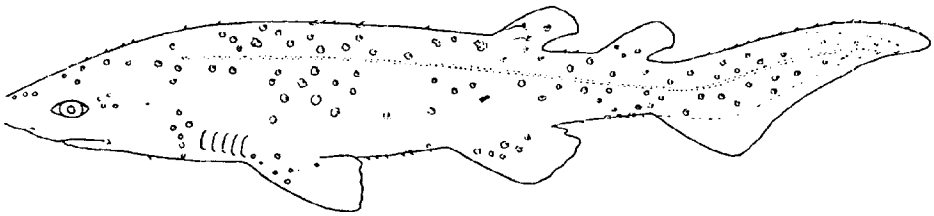
Distinguishing features: No anal fin; no spines at front of dorsal fins; heavy buckler-like denticles giving warty appearance to body.
Occurrence: Cape Cod, Brazil, and 78.2 kg (173 lb), 2.2 m (7.2 ft) specimen captured 20 January 1968 at 37°38'N, 74°15'W in 187 m (102 fm) off Virginia (Musick and McEachran, 1969); none from North Carolina.

Deania profundorum (Smith and Radcliffe)

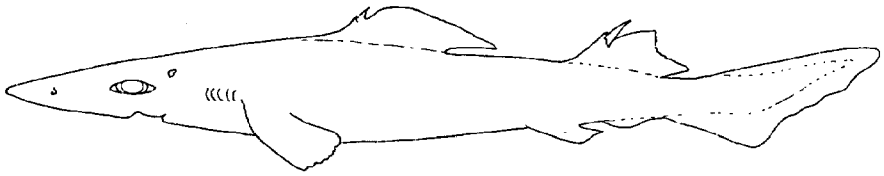
Distinguishing features: Spine with lateral grooves on each side; lower lobe of caudal fin with subterminal notch; dorsal fin located over pectoral fin. Ridge present between pelvic and caudal fin. Color black.
Occurrence: Only North Carolina collection, as *Deania elegans* (Springer, 1959), at 34°40'N, 75°32'N in about 366 m (200 fm) 23 February 1958.

Black dogfish - *Centroscyllium fabricii* (Reinhardt)

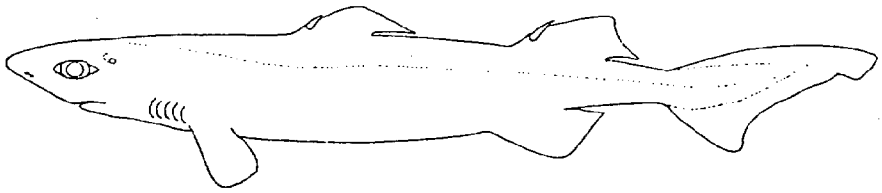
Distinguishing features: Spines with two lateral grooves on each side; subterminal caudal fin notch. No lateral ridge between pelvic and caudal fins. Color brown to black.
Occurrence: Grand Banks to Virginia. No North Carolina specimens but expected in deep waters near edge of continental shelf.



Bramble Shark *Echinorhinus brucus*



Deania profundorum



Black Dogfish *Centroscyllium fabricii*

Etmopterus bullisi Bigelow and Schroeder

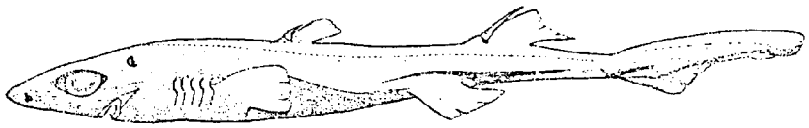
Distinguishing features: Dorsal fin spines with lateral grooves. Interspace between dorsal fins less than distance from tip of snout to first gill slit. Distinct elongate flank markings. Pectoral fin reaches level first dorsal fin origin. No ridge on caudal peduncle.
Occurrence: Western Atlantic from North Carolina to the Caribbean. Only North Carolina specimens taken in February in 366 m (200 fm).

Etmopterus gracilispinis Krefft

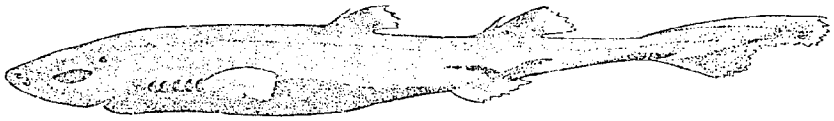
Distinguishing features: Dorsal fin spines with lateral grooves. Interspace between dorsal fins less than distance from snout to first gill slit. Distinct wing-like flank markings. Pectoral fin ends far short of dorsal fin origin. No ridge on caudal peduncle.
Occurrence: In western Atlantic known from Virginia, off Jacksonville, Florida, and in the south Atlantic. None from North Carolina, expected in deep water.

Etmopterus hillianus (Poey)

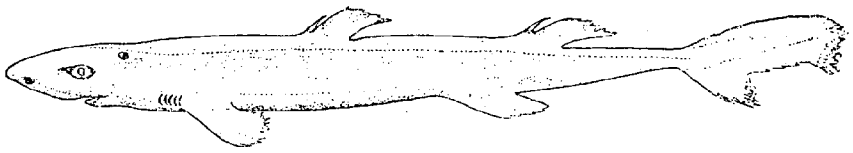
Distinguishing features: Dorsal fin spines with lateral grooves. Interspace between dorsal fins more than distance snout to first gill slit. Slight or ill-defined flank markings. Pectoral fin ends far forward of dorsal fin origin. No ridge on caudal peduncle.
Occurrence: Virginia to the Caribbean. Found year round in deep water 110 m (150 fm) or more.



Etmopterus bullisi



Etmopterus gracilispicis



Etmopterus hillianus

Spiny dogfish — *Squalus acanthias* Linnaeus

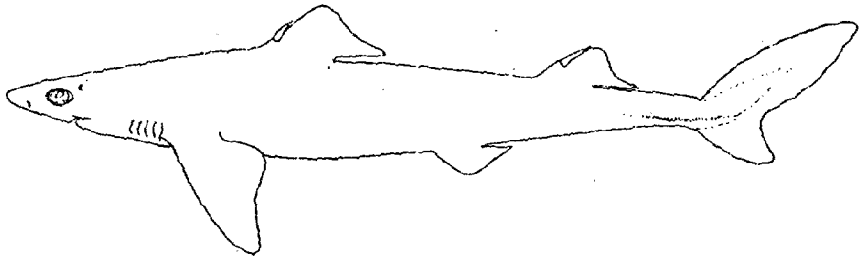
Distinguishing features: Often confused with *S. cubensis* and *S. blainvillei*. No anal fin; caudal peduncle with lateral ridge; dorsal fins positioned well behind pectoral and pelvic fins; distance from fifth gill slit to first dorsal spine about equal to distance from front of eye to fifth gill slit. No lateral grooves in fin spines. Pectorals concave. Anterior nostril flap single. Gray with white spots often on body or along lateral line.
Occurrence: Labrador to South Carolina. Occurs in North Carolina coastal and deep waters November to April or until water temperatures reach 12°C (54°F).

Blainville's dogfish — *Squalus blainvillei* Risso

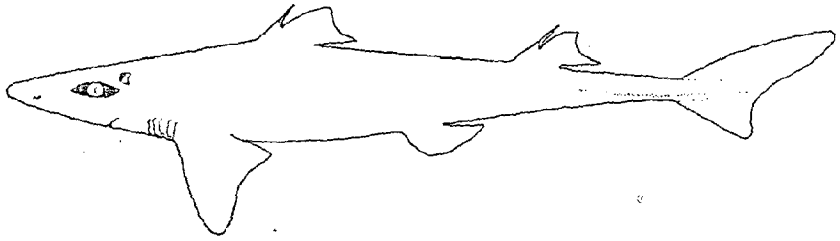
Distinguishing features: Confused with *S. acanthias* and *S. cubensis* and previously included in sharks referred to as *S. suckleyi mandinus*. No anal fin; caudal peduncle with lateral ridge; first dorsal fin positioned over pectoral fin; distance from fifth gill slit to first dorsal fin spine equal to distance from eye to second gill slit. No lateral grooves on dorsal fin spines. Pectorals moderately concave. Anterior nostril flap double or bilobed. Dusky on caudal and first dorsal fin, no spots on body, brown or gray body.
Occurrence: Found cosmotropically. North Carolina specimens taken only in June in 330-366 m (180-200 fm).

Cuban dogfish — *Squalus cubensis* Howell-Rivero

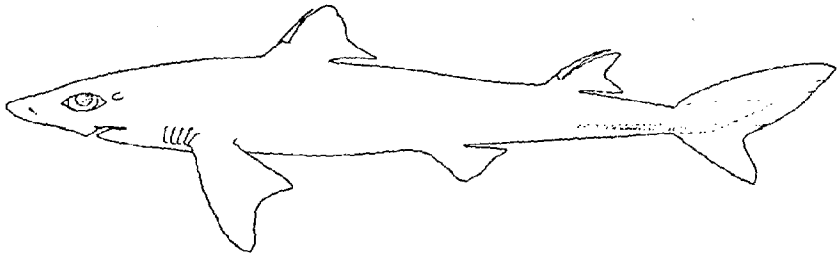
Distinguishing features: Confused with *S. acanthias* and *S. blainvillei*. No anal fin, caudal peduncle with lateral ridge; first dorsal fin positioned over pectoral fin; distance from fifth gill slit to first dorsal fin spine less than distance from eye to first gill slit. No lateral grooves in dorsal fin spines. Pectorals concave. Anterior nostril flap double. Dorsal and caudal fins may be black, no spots on brown body.
Occurrence: North Carolina to Cuba in western Atlantic. Known occasionally in April-November in North Carolina in 311-457 m (170-250 fm).



Spiny Dogfish *Squalus acanthias*



Blainville's Dogfish *Squalus blainvillei*



Cuban Dogfish *Squalus cubensis*

HEAD EXPANDED LATERALLY

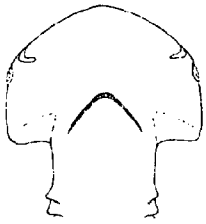
Scalloped hammerhead — *Sphyrna lewini* (Griffith and Smith)

Distinguishing features: Center anterior margin of hammer shaped head notched. Outer lateral rear edges of head, viewed ventrally, end on level behind corner of mouth (see figure). Distal margins of pectoral fins straight.
Occurrence: In western Atlantic, New Jersey to Brazil. Year round in Gulf Stream off North Carolina, inshore in March-November. Exhibit inshore-offshore seasonal movement patterns. Most common hammerhead in North Carolina.

Great hammerhead — *Sphyrna mokarran* (Ruppell)

Distinguishing features: Head hammer shaped; anterior margin straight but with notch. Outer lateral rear edges of head, viewed ventrally, end on level of mouth symphysis (see figure). Distal margins of pectoral fins falcate.
Occurrence: North Carolina to Brazil. Uncommon; found in all North Carolina waters June-August.

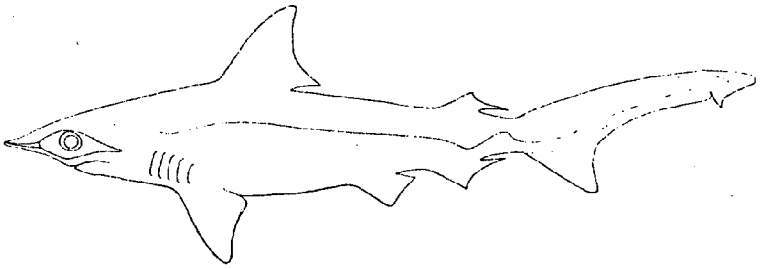
Bonnethead — *Sphyrna tiburo* (Linnaeus)



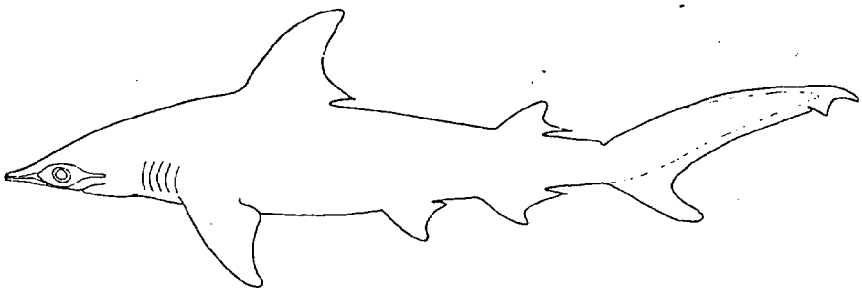
Distinguishing features: Head round and spade shaped, about as wide as long. Distal margins of pectoral fins straight.
Occurrence: Massachusetts to southern Brazil. Occasional in inshore and estuarine waters June-November, not known from deep waters.

Smooth hammerhead — *Sphyrna zygaena* (Linnaeus)

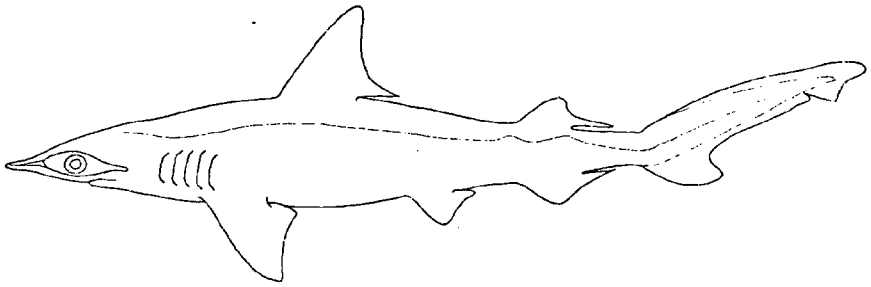
Distinguishing features: No notch to front margin of head. Outer lateral rear edges of head, viewed ventrally, end behind level of mouth symphysis (see figure). Distal margins of pectoral fins straight.
Occurrence: Nova Scotia to northern Argentina. Uncommon in June-October in shallow inshore North Carolina waters, year round resident in warm open ocean waters.



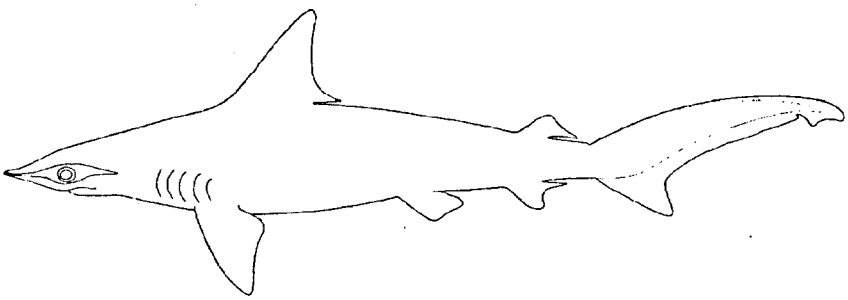
Scalloped hammerhead *Sphyrna lewini*



Great hammerhead *Sphyrna mokarran*



Bonnethead *Sphyrna tiburo*



Smooth hammerhead *Sphyrna zygaena*

FIRST DORSAL FIN BEHIND MIDPOINT OF BODY

(pages 28-31)

Lemon shark — *Negaprion brevirostris* (Poey)

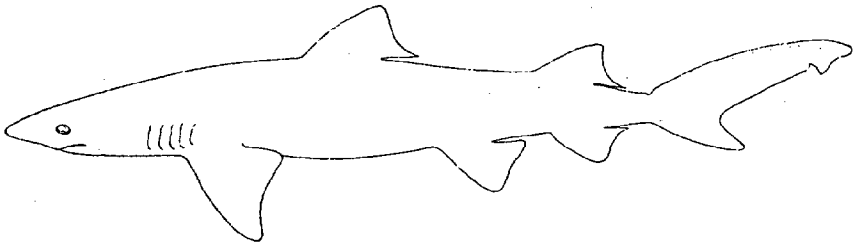
Distinguishing features: Two large dorsal fins of nearly equal size; head blunt and wide. No mid-dorsal ridge; dorsal precaudal pit present, absent ventrally. Color brown or yellow.
Occurrence: New Jersey to northern Brazil primarily in warm tropical waters. A summer straggler to North Carolina inshore waters in July-September.

Apristurus laurussoni (Saemundsson)

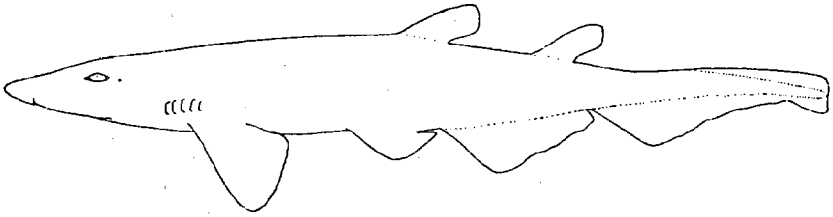
Distinguishing features: No space between second dorsal and caudal fins. Spiracle present. Denticles on dorsal edge of caudal fin not conspicuous as crest. Nostril flap present. Gill filaments often exposed in gill slits.
Occurrence: A deep water shark, Iceland, Massachusetts to Delaware, and Gulf of Mexico. So far no North Carolina records, expected.

Aspristurus profundorum (Goode and Bean)

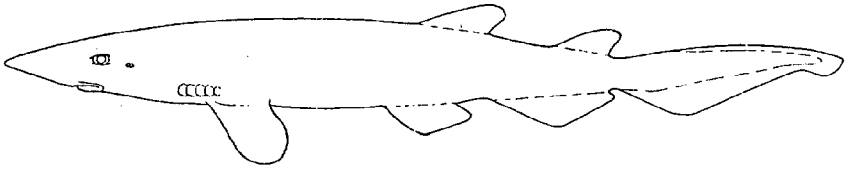
Distinguishing features: No space between second dorsal and caudal fin. Spiracle present. Denticles on dorsal edge of caudal fin conspicuous as a crest. Nostril flap present. Gill filaments often exposed in gill slits.
Occurrence: Nova Scotia to Delaware and Caribbean. A deep water shark. No North Carolina records as yet, expected.



Lemon Shark *Negaprion brevirostris*



Apristurus laurussoni



Apristurus profundorum

Marbled cat shark — *Galeus arae* (Nichols)

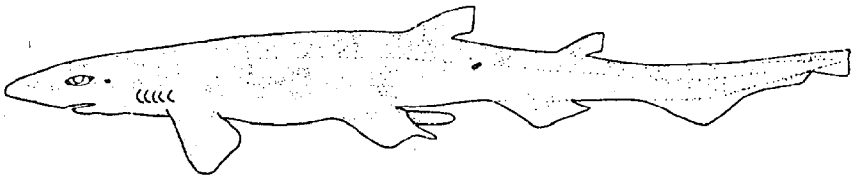
Distinguishing features: Distance from tip snout to cloaca greater than remainder of body and tail length. Caudal crest of denticles evident; spiracle present. Space exists between second dorsal and caudal fin. Body yellow-brown, sides, back, dorsal fins, and upper caudal lobe marked with brown blotches and spots; dark streak present from snout to eye.
Occurrence: South Carolina to Columbia and Gulf of Mexico. Expected in deep water off North Carolina.

Chain dogfish — *Scyliorhinus retifer* (Garman)

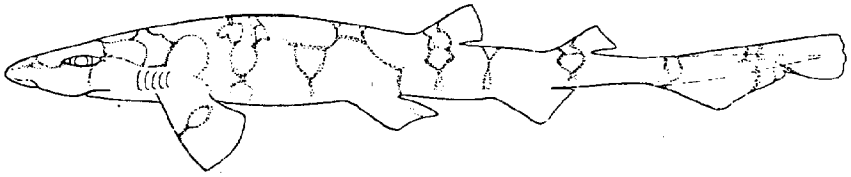
Distinguishing features: Distance from tip snout to cloaca equals remainder of body and tail length. No enlarged denticles forming crest on upper lobe of caudal fin. Spiracle present. Space exists between second dorsal and caudal fin. Body light colored with brown chain-like markings.
Occurrence: George's Bank to Caribbean. Year round resident of deep water 90 m (49 fm) or more in North Carolina.

Blue shark — *Prionace glauca* (Linnaeus)

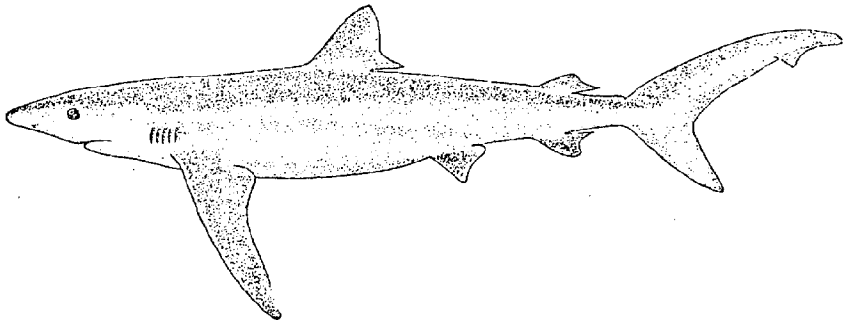
Distinguishing features: Long snout; long falcate pectoral fins; dorsal and ventral precaudal pits present; no mid-dorsal ridge between dorsal fins. Deep blue body color. Weakly developed lateral ridge on caudal peduncle.
Occurrence: Newfoundland to Brazil. Pelagic off North Carolina year round.



Marbled Cat Shark *Galeus arae*



Chain Dogfish Shark *Scyliorhinus retifer*



Blue Shark *Prionace glauca*

TAIL LONG AND POINTED, ONE-THIRD TO ONE-HALF OR MORE BODY LENGTH

Tiger shark — *Galeocerdo cuvieri* (Peron and Lesueur)

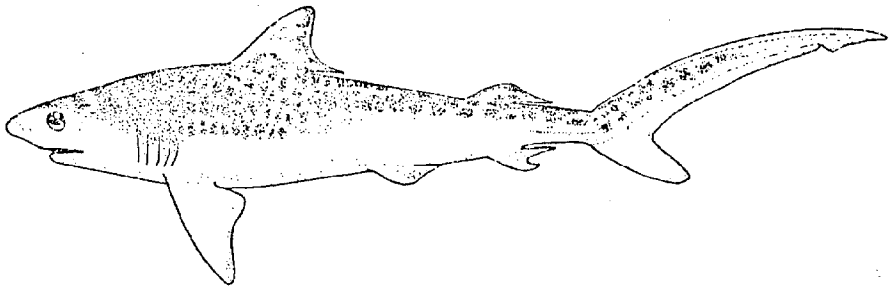
Distinguishing features: Low ill-defined ridge and furrow between dorsal fins; slight keel on caudal peduncle; upper lobe of caudal fin long, pointed, one-third of body length. Snout short and broadly rounded, head flattened above. Body spotted in young and barred in adults.
Occurrence: Massachusetts to Uruguay. Inshore in North Carolina April-December, year round offshore.

Bigeye thresher — *Alopias superciliosus* (Lowe)

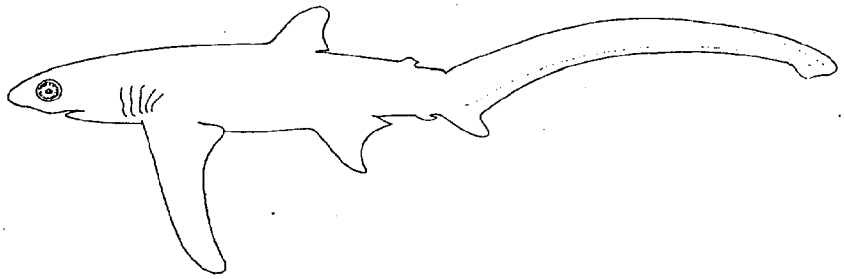
Distinguishing features: Eye large, ovate, higher than long. Head in adults grooved, giving helmet appearance (see figure). Position of dorsal fin in relation to pelvic fins variable but closer to pelvics than pectorals. No ridges on body or tail. Upper lobe caudal fin nearly half body length. Body not spotted.
Occurrence: Known from New Jersey to Cuba. North Carolina specimen collected off Cape Hatteras 35°39'N, 74°27'W on 26-27 February 1963 (Fitch and Craig, 1964).

Thresher shark — *Alopias vulpinus* (Bonnaterre)

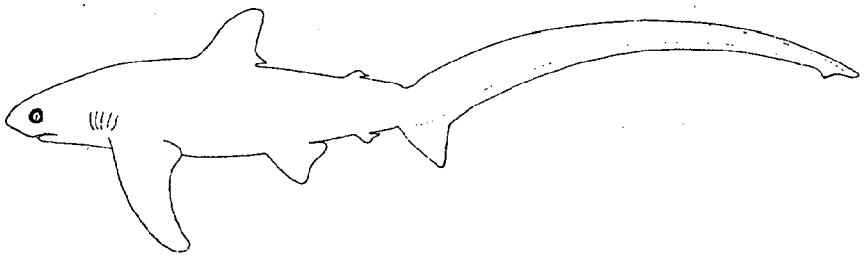
Distinguishing features: Eye smaller than in bigeye thresher and nearly round. No grooves on head in adult. Dorsal fin closer to pectoral fin than pelvic fin but character variable. No ridges on body or tail. Upper lobe of caudal fin more than half body length. Body not spotted.
Occurrence: Gulf of St. Lawrence to Argentina. A July-August continental shelf inhabitant in North Carolina waters; a year round resident in offshore oceanic waters.



Tiger Shark *Galeocardo cuvieri*



Bigeye Thresher *Alopias supercilosus*



Thresher Shark *Alopias vulpinus*

WELL DEVELOPED LATERAL KEELS ON CAUDAL PEDUNCLE

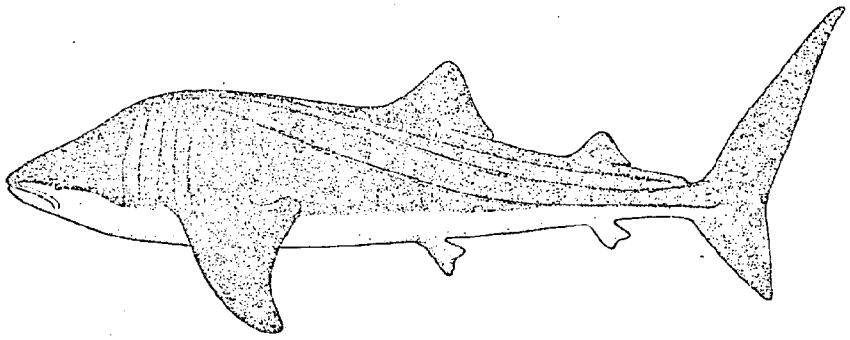
(pages 34-37)

Whale shark — *Rhiniodon typus* Mihi

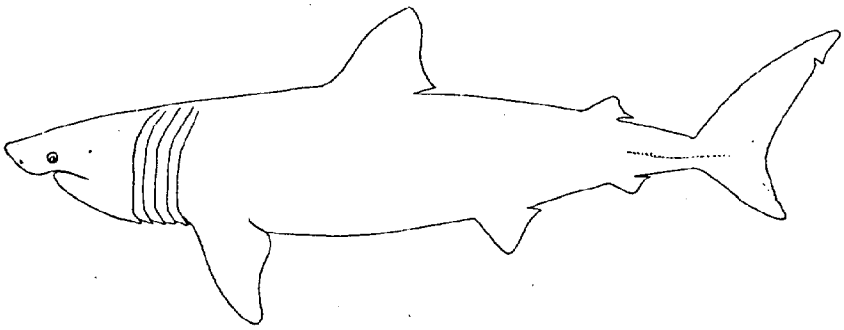
Distinguishing features: Size large. Mouth at tip of snout on horizontal plane. Head blunt. Distinct keel on caudal peduncle. Three of more lateral ridges on body. Body spotted.
Occurrence: Cosmopolitan; in western Atlantic from New York to Brazil. Known in North Carolina from a specimen washed ashore 6 June 1934. Name corrected from *Rhincodon* to *Rhiniodon* by Penrith (1972).

Basking shark — *Cetorhinus maximus* (Gunnerus)

Distinguishing features: Size large. Enormous gills extend from top of head to throat. Head pointed. Teeth minute and needle-like. Body black, interior of mouth snowy white.
Occurrence: A northern species found from Newfoundland to Gulf of Mexico. Found offshore in deep waters off North Carolina in December, move south and onshore, often into the surf, until February or March, and retreat northward as waters warm above 10°C (50°F).



Whale Shark *Rhiniodon typus*



Basking Shark *Cetorhinus maximus*

White shark — *Carcharodon carcharias* (Linnaeus)

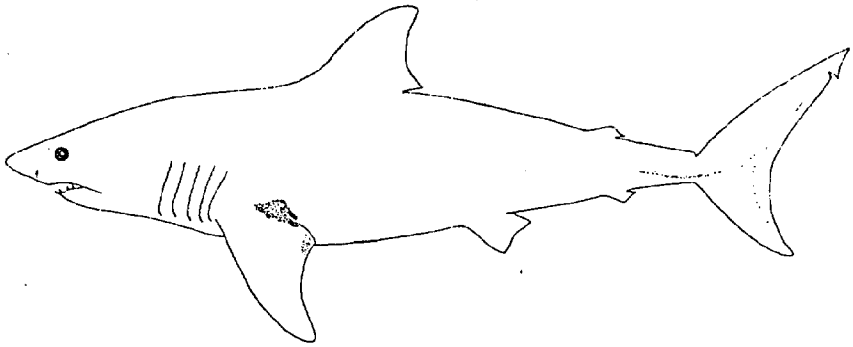
Distinguishing features: Usually a black spot in axil of pectoral fin which may fade with increase in body size. Strong single keel on caudal peduncle. Second dorsal fin in advance of anal fin.Caudal fin equally lobed and nearly lunate.
Occurrence: Pelagic. Frequents inshore waters of one meter (3 ft) or more in April and possibly all summer.

Shortfin mako — *Isurus oxyrinchus* (Rafinesque)

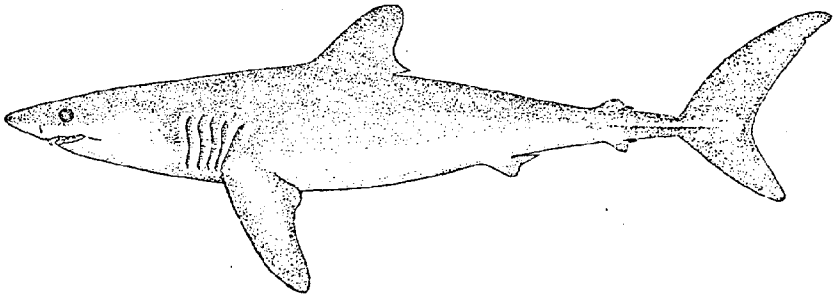
Distinguishing features: Broad keel on caudal peduncle. Tail falcate and equally lobed. Snout short and sharply pointed; teeth often protrude. Second dorsal fin positioned halfway over anal fin. Color blue or gray.
Occurrence: George's Bank to Caribbean. A summer visitor to North Carolina in all offshore waters south of Cape Hatteras, July-September.

Porbeagle — *Lamna nasus* (Bonnaterre)

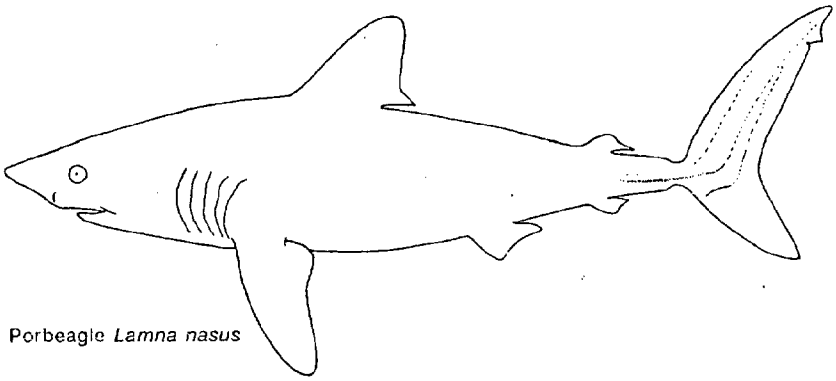
Distinguishing features: Two keels on caudal fin, one on caudal peduncle. Caudal nearly equally lobed, but not as falcate as in mako and white sharks. Second dorsal fin over anal fin.
Occurrence: Europe and Gulf of St. Lawrence to New Jersey, and possibly South Carolina. No North Carolina records.



Great White Shark *Carcharodon carcharias*



Shortfin Mako *Isurus oxyrinchus*



Porbeagle *Lamna nasus*

RIDGE BETWEEN DORSAL FINS

(pages 38-41)

Smooth dogfish — *Mustelus canis* (Mitchill)

Distinguishing features: Both dorsals nearly equal in size. Second dorsal fin ahead of anal fin. Lower lobe of caudal fin does not project acutely rearward.
Occurrence: New Brunswick, Canada to Uruguay. Off North Carolina in less than 274 m (150 fm) from October to July, sometimes in large schools south of Hatteras while migrating seasonally north or south.

Florida smoothhound — *Mustelus norrisi* Springer

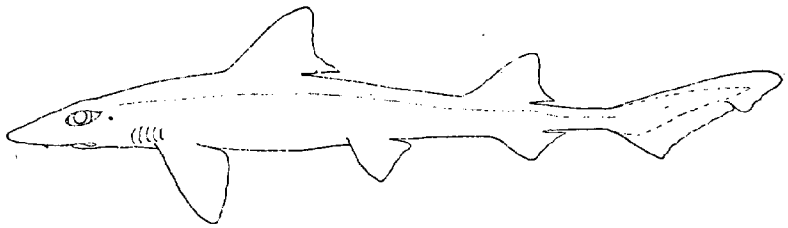
Distinguishing features: Similar to *M. canis* but rear tip of lower caudal fin lobe projects sharply rearward. Second dorsal situated ahead of anal fin.
Occurrence: Known from northern Florida southward but expected in North Carolinian waters of moderate depths during spring.

Night shark — *Hypoprion signatus* Poey

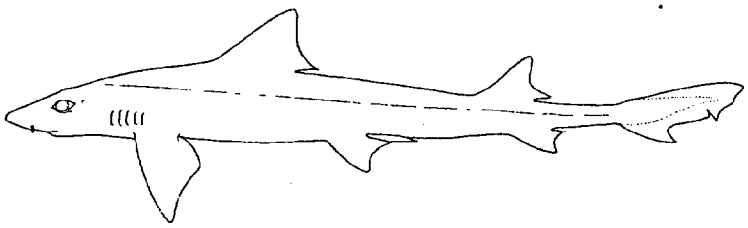
Distinguishing features: Second dorsal fin positioned over anal fin. Head long, pointed, one-third of body length. Snout equal to or greater than mouth width. Eye bright green, when alive, and larger than in *C. altimus*.
Occurrence: South Carolina to Caribbean. Expected in North Carolina waters over 183 m (100 fm).

Bignose shark — *Carcharhinus altimus* (Springer)

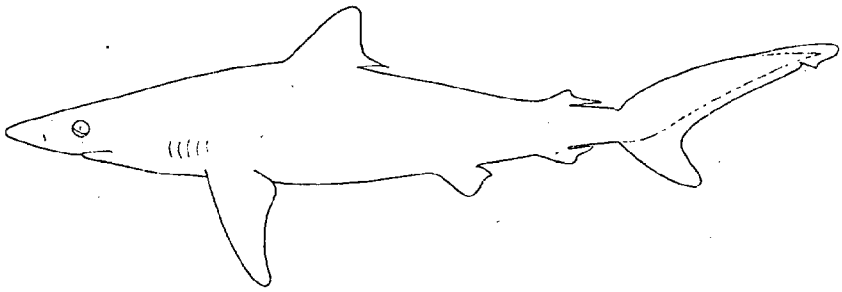
Distinguishing features: Snout long, equals or is greater than mouth width; prominent nasal channels. First dorsal fin set behind axil of pectoral fin, whereas is over axil in *C. milberti*.
Occurrence: Known from northern Florida southward, but expected in deep waters off North Carolina.



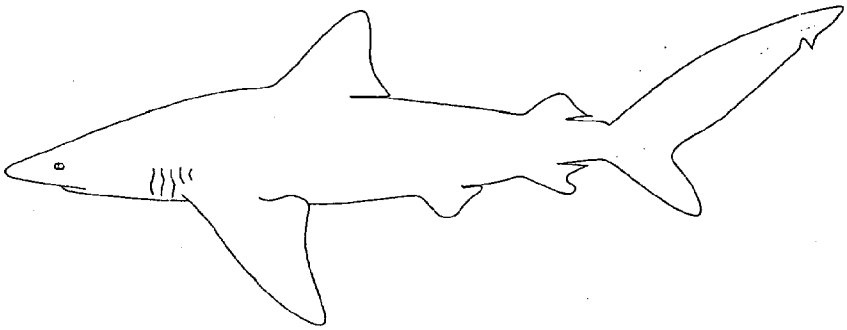
Smooth Dogfish *Mustelus canis*



Florida Smoothhound *Mustelus norrisi*



Night Shark *Hypoprion signatus*



Bignose Shark *Carcharhinus altimus*

Silky shark — *Carcharhinus falciformis* (Bibron)

Distinguishing features: First dorsal fin leading edge curved and tip rounded. Second dorsal fin over anal fin; free rear tips of both long. Snout length approximately equal to mouth width.
Occurrence: New England to Brazil. A May to October inhabitant of all waters 183 m (100 fm) or less south of Cape Hatteras. A year round resident offshore.

Oceanic whitetip shark — *Carcharhinus longimanus* (Poey)

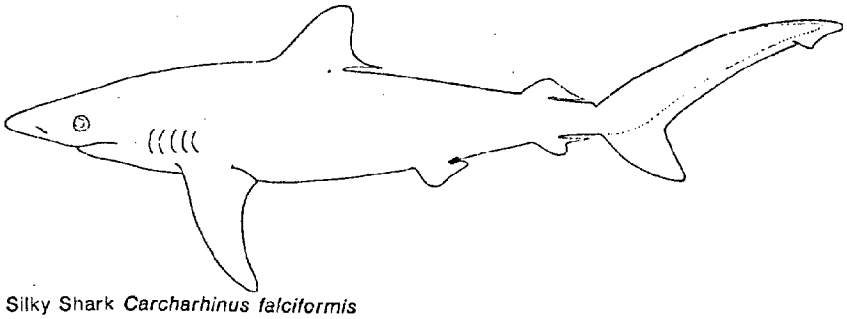
Distinguishing features: Broad rounded first dorsal fin. Some adults may be ridgeless between dorsal fins. Dorsal, pectoral, and caudal fins tipped with white. Pectoral fins large, tips rounded.
Occurrence: George's Bank to Uruguay. Year round in North Carolina in waters deeper than 183 m (100 fm).

Sandbar shark — *Carcharhinus milberti* (Valenciennes)

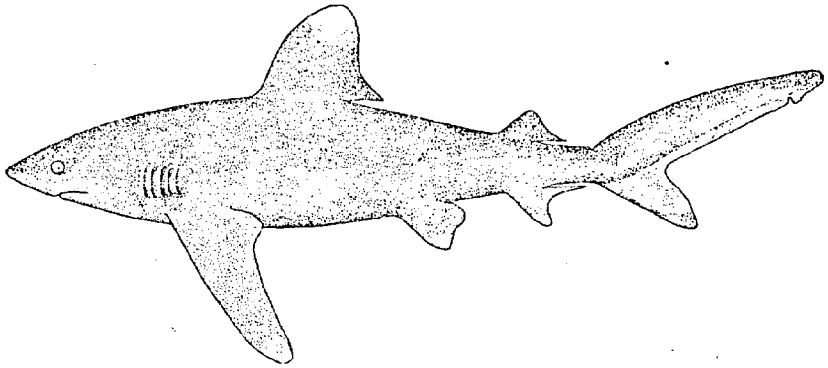
Distinguishing features: First dorsal fin high, triangular, and situated over axil of pectoral fin. Second dorsal fin over anal. Snout length less than mouth width. Deep bodied.
Occurrence: New England to southern Brazil. A common inshore shark in North Carolina south of Cape Hatteras from June to September.

Dusky shark — *Carcharhinus obscurus* (Lesueur)

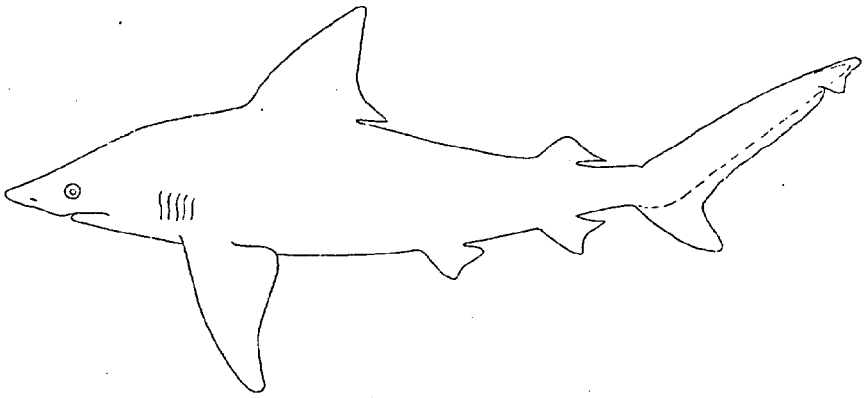
Distinguishing features: Similar to *C. falciformis* but first dorsal fin clearly triangular. Snout to mouth distance less than mouth width.
Occurrence: George's Bank to southern Brazil. One of the most abundant sharks in North Carolina south of Hatteras, April to November; moving north or south with lower winter water temperatures. Penetrates estuaries and tolerates salinities as low as 10 0/00.



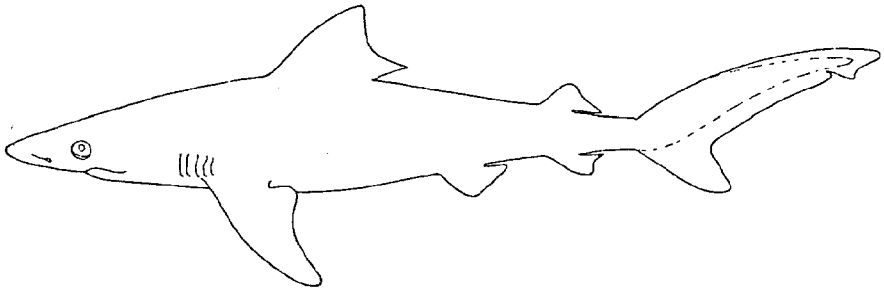
Silky Shark *Carcharhinus falciformis*



Oceanic Whitetip Shark *Carcharhinus longimanus*



Sandbar Shark *Carcharhinus milberti*



Dusky Shark *Carcharhinus obscurus*

NO RIDGE BETWEEN DORSAL FINS, DORSAL FIN AT OR BEFORE MIDPOINT OF BODY

(pages 42-45)

Finetooth shark — *Aprionodon isodon* (Valenciennes)

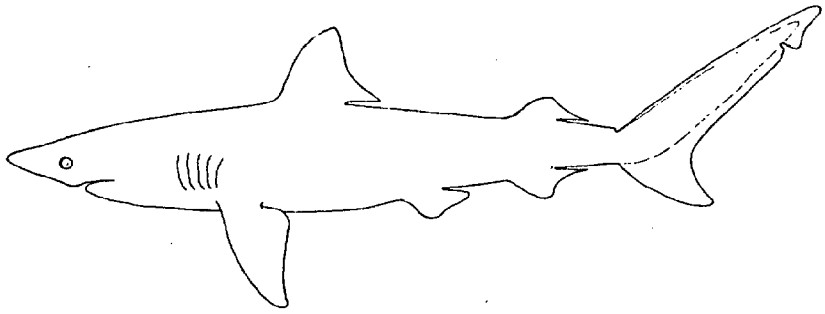
Distinguishing features: Length of pectoral fin half head length. Gill slits long, equal to 2/3 of snout to mouth distance. Precaudal pits present. Body slender.
Occurrence: New York, South Carolina to Cuba; rare, found inshore in April near Beaufort, North Carolina.

Sand tiger — *Odontaspis taurus* (Rafinesque)

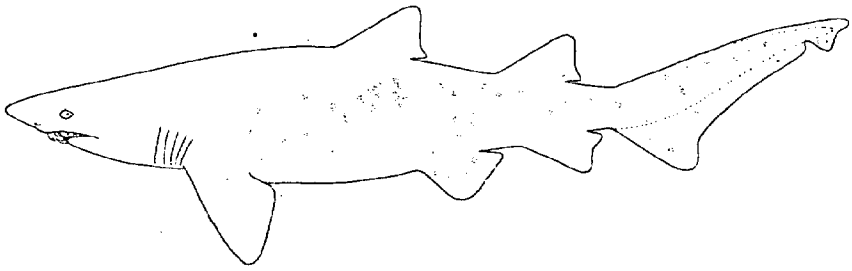
Distinguishing features: Dorsal fins large, equal in size. Dorsal precaudal pit present, absent ventrally. Teeth protrude from jaws. Usually gray, may be tinged with yellow. Light spots on body between pectoral and anal fins and occasionally on fins.
Occurrence: Gulf of Maine to southern Brazil. A summer North Carolina inshore visitor June-September. Occurs offshore in deeper waters July-August.

Atlantic sharpnose shark — *Rhizoprionodon terraenovae* (Richardson)

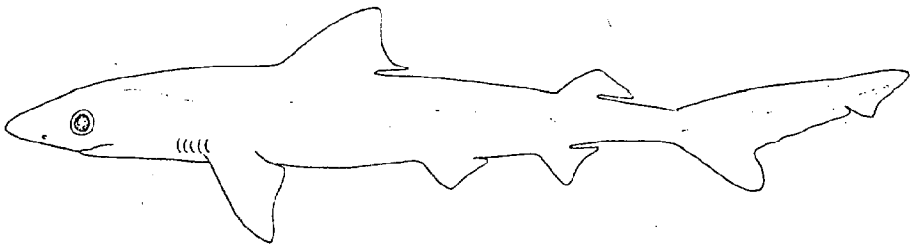
Distinguishing features: Second dorsal fin behind anal fin. Snout pointed. Rear margin of pectoral fins often white.
Occurrence: Bay of Fundy to Yucatan. Found in North Carolina year round in continental shelf waters, in estuaries October-May. One of the most abundant North Carolina sharks.



Finetooth Shark *Aprionodon isodon*



Sand Tiger *Odontaspis taurus*



Sharpnose Shark *Rhizoprionodon terraenovae*

Blacknose shark — *Carcharhinus acronotus* (Poey)

Distinguishing features: A distinct black mustache on tip of snout. Fresh coloration usually yellow-olive; fins dusky. Second dorsal fin over anal fin. Snout long. Eye diameter 2/3 of first gill slit length.
Occurrence: North Carolina to Brazil. Rare north of Cape Hatteras, North Carolina, a summer inshore transient from June to August south of Cape Hatteras.

Bull shark — *Carcharhinus leucas* (Valenciennes)

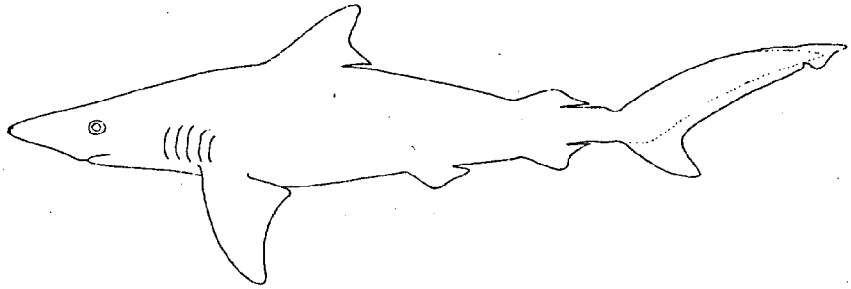
Distinguishing features: Short, stocky body. High triangular first dorsal fin. Pectoral fins nearly as long as length from tip of snout to origin of pectoral fins. Broad "U" shaped snout.
Occurrence: New York to Brazil, primarily tropical. In North Carolina, frequents shallow inshore waters July to September, offshore July to August.

Blacktip shark — *Carcharhinus limbatus* (Valenciennes)

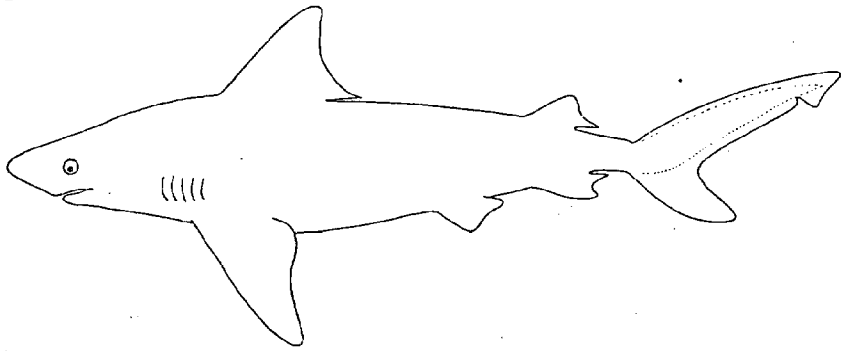
Distinguishing features: Often confused with *C. maculipinnis.* Black or dusky tips usually on all fins; sides of fresh specimens may be olive-bronze with a white elongate "Z" coloration originating at the pelvics and projecting forward toward the pectoral fins. Eye more than 1/5 first gill slit length.
Occurrence: Massachusetts to southern Brazil. A common summer, June to September, transient in North Carolina offshore as well as inshore waters.

Spinner shark — *Carcharhinus maculipinnis* (Poey)

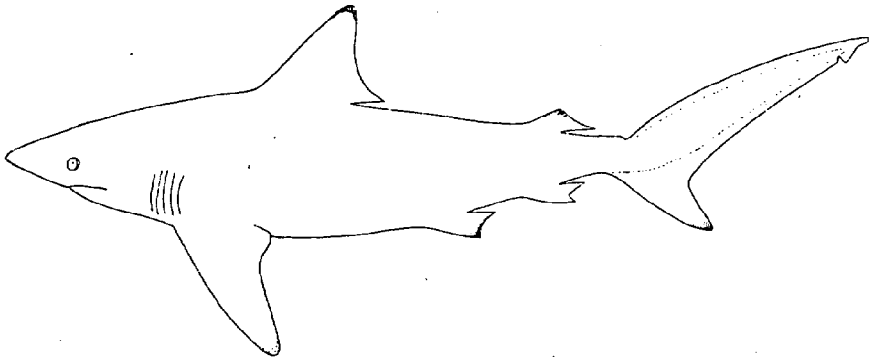
Distinguishing features: Similar to *C. limbatus.* Prominent black tips usually on all fins. Fresh specimens may be bronze with a white elongate "Z" coloration originating at the pelvics and projecting forward, on the sides, toward the pectoral fins. Snout long, sharp, pointed. Eye small, less than 1/5 first gill slit length.
Occurrence: North Carolina to Cuba and Puerto Rico. Rare to Cape Hatteras, common from Cape Lookout, North Carolina southward on the continental shelf. Common inhabitant of inshore North Carolina waters June-September.



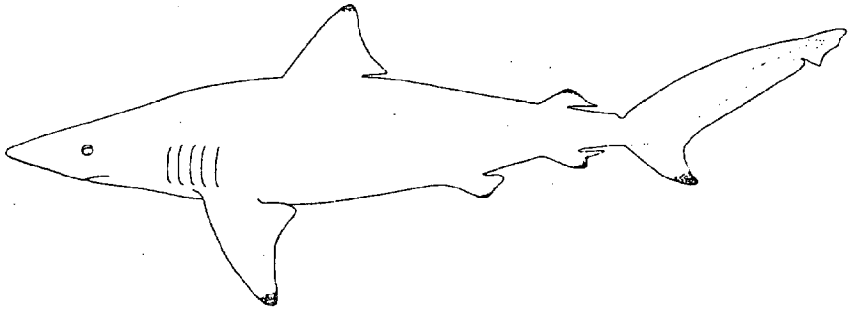
Blacknose Shark *Carcharhinus acronotus*



Bull Shark *Carcharhinus leucas*



Blacktip Shark *Carcharhinus limbatus*



Spinner Shark *Carcharhinus maculipinnis*

GLOSSARY

Abyssal — Areas at great depths below the ocean surface.

Axil — The "armpit" of fishes, the inner base of the pectoral fins.

Barbel — A fleshy process attached to the nostrils or lower jaws of fishes.

Body Length — Distance from tip of snout to precaudal pit.

Buckler — Shield shaped.

Caudal Peduncle — The body area lying between the posterior end of the anal fin and caudal fin base.

Chondrichthyes — Class of fishes including the sharks, skates, and rays.

Cloaca — Common exit in sharks for reproductive, excretory, and digestive systems.

Continental Shelf — The shallow terrace that surrounds most continents and is terminated seaward by a relatively sharp increase in depth.

Cosmopolitan — Distributed world-wide.

Cosmotropically — Distributed in tropical areas throughout the world.

Cranial — Referring to the dorsal region of the head.

Ctenoid Scale — Thin disc-like in shape with obvious teeth (called ctenii) on exposed margin.

Cycloid Scale — Smooth thin disc-like in shape without teeth on exposed margin.

Denticulate — See placoid scale.

Denticle — See placoid scale.

Devonian — Geologic period about 345-395 million years ago.

Dorsal Ridge — The raised portion of skin between the first and second dorsal fins.

Estuarine — Referring to an estuary, an area where seawater is measurably diluted by fresh water influx and is subject to tidal fluctuations.

Falcate — Sickle-shaped, deeply concave with short middle rays and long exterior rays.

Ganoid Scale — Hard, plate-like scales found in gars, sturgeons, and paddlefishes.

Inshore — Landward waters less than approximately 20 fathoms.

Interorbital — Distance between eyes on top of the head.

Keel — A lateral raised ridge on caudal peduncle or caudal lobe.

Landward — Towards the land.

Leeward — Situated away from the wind.

Midbase — The midpoint of the base of a fin.

Offshore — Seaward waters of greater than approximately 20 fathoms.

Orbit — The eye socket.

Pelagic — Free swimming in the open sea.

Placoid Scale — Also called dermal denticle, tooth-like in appearance with disc-like basal plate and projecting cusp, found in Chondrichthyes.

Precaudal Pit — The notch found on dorsal and sometimes ventral surfaces of the caudal peduncle of sharks.

Protrusible Jaws — Jaws that are capable of being projected outwards.

Seaward — Towards the sea.

Serrated — Rough or saw-like.

Shagreen — The prepared rough hide of sharks and rays with scales in place.

Spiracle — Opening usually located posterior to the eye which serves to supplement the gill openings.

Symphysis — Meeting point of upper and lower jaws at corner of mouth.

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FISH DRAWINGS

Most sharks figured are based on fresh or preserved material catalogued in the Institute of Marine Sciences collection (UNC). The remainder are modified from the *Fishes of Western North Atlantic* (FWNA) Vol. 1, pt. 1 or as noted.

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Squatina dummerili, UNC 7890, 284 mm TL.
Hexanchus griseus, FWNA, (p. 80), 830 mm TL.
Ginglymostoma cirratum, UNC 7315, 365 mm TL.

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Echinorhinus brucus, FWNA (p. 527), 915 mm TL.
Deania profundorum, Springer, S., Copeia 1959 (1):31, 315 mm TL.
Centroscyllium fabricii, FWNA (p. 482), 640 mm TL.

Page 23
Etmopterus bullisi, UNC 4030, 200 mm TL.
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Page 25
Squalus acanthias, UNC 5230, 515 mm TL.
Squalus blainvillei, UNC 4060, 285 mm TL.
Squalus cubensis, FWNA (p. 473), 672 mm TL.

Page 27
Sphyrna lewini, UNC 3466, 385 mm TL.
Sphyrna mokarran, Gilbert, C., Proc. U.S. Nat. Mus. 119(3539):27. 673 mm TL.
Sphyrna tiburo, UNC 2803, 530 mm TL.
Sphyrna zygaena, Gilbert, C., Proc. U.S. Nat. Mus. 119(3539):32, 687 mm TL.

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Negaprion brevirostris, UNC 4281, 635 mm TL.
Apristurus laurussoni, Springer, S., Fish. Bull. 65(3):614, 540 mm TL.
Apristurus profundorum, FWNA (p. 222), 510 mm TL.

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Galeus arae, FWNA (p. 216), 324 mm TL.
Scyliorhinus retifer, UNC 305, 204 mm TL.
Prionace glauca, FWNA (p. 282), 2175 mm TL.

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Galeocerdo cuvieri, UNC 8230, 878 mm TL.
Alopias superciliosus, FWNA (p. 163), 1296 mm TL.
Alopias vulpinus, UNC 4964, 1332 mm TL.

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Rhiniodon typus, FWNA (p. 189), 5285 mm TL.
Cetorhinus maximus, UNC 4978, 4685 mm TL.

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Carcharodon carcharias, UNC 9302, 1967 mm TL.
Isurus oxyrinchus, UNC 7953, 800 mm TL.
Lamna nasus, FWNA (p. 112), 935 mm TL.

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Mustelus canis, UNC 6455, 300 mm TL.
Mustelus norrisi, FWNA (p. 257), 643 mm TL.
Hypoprion signatus, FWNA (p. 316), 935 mm TL.
Carcharhinus altimus, Kato, Springer, and Wagner, U.S. Fish Wildl. Serv. Circ. 271:13, 1579 mm TL.

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Carcharhinus falciformis, UNC 4969, 720 mm TL.
Carcharhinus longimanus, FWNA (p. 354), 2060 mm TL.
Carcharhinus milberti, UNC 6373, 655 mm TL.
Carcharhinus obscurus, UNC 6013, 512 TL.

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Aprionodon isodon, FWNA (p. 303), 504 mm TL.
Odontaspis taurus, UNC 4275, 1500 mm TL.
Rhizoprionodon terraenovae, UNC 3387, 324 mm TL.

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Carcharhinus acronotus, UNC 2535, 400 mm TL.
Carcharhinus leucas, UNC 9443, 2335 mm TL.
Carcharhinus limbatus, UNC 4715, 1260 mm TL.
Carcharhinus maculipinnis, UNC 8596, 1000 mm TL.

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