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An Outline For A Trinidad Shark Fishery

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BY PERMISSION OF THE GOVERNMENT of Trinidad and Tobago the eighty foot motor vessel "SACHEM," owned and operated by Shark Industries Division of the Borden Company of Stuart, Florida, fished for sharks in the vicinity of Trinidad under the direction of Captain Charles Anderson for 30 days in April and May, 1949. Two sets were made within adjacent territorial waters of Venezuela by special permission through its consul at Port-of-Spain. Sets were made in the Gulf of Paria and on the north, east, and south coasts of Trinidad in depths from five to seventy-five fathoms. Each set of approximately 400 baited two and a half inch shark hooks was made with a ground line of three-eighths inch cable, about 20,000 feet long.

The catch of 750 sharks with an estimated total weight of 90 to 110 tons is not indicative of great concentration of sharks in the area. Whiteleather and Brown¹ call attention to a generally reported lower productivity of tropical waters as compared to that of higher latitudes. Sharks in the vicinity of Trinidad were found more evenly and generally distributed than in similar northern waters. Because of the apparent absence of large schools, or concentrations in limited areas, no single day's catch was very large, but the fishing results of the "SACHEM" are probably not indicative of the total shark population of the region.

Eighteen species were represented in the catch, and in addition to these, six more species are included in this report on the basis of specimens seen later, or on records in recent publications. The large number of species is unusual in so small an area, and since the range in commercial value of the various species is great, the identification of forms is important in development of shark fishery practice. This report is an attempt to provide a practical outline of the identification of species with specific suggestions for handling and utilization.

(II) SHARK PRODUCTS IN COMMERCE

Previous fishery surveys of Trinidad and Tobago and adjacent areas have carried the suggestion that a successful shark fishery might be developed if the catch in its entirety could be favorably marketed. Such a recommendation is indubitably sound and could well be extended to other fishery activities in the

1. Whiteleather, Richard T., and Brown, Herbert H., *An Experimental Fishery Survey in Trinidad, Tobago, and British Guiana*. Anglo-American Caribbean Commission. Washington, 1945: pp. 1-130.

tropics. A persistent fishery problem in any latitude is the elimination of waste; that is, waste through overfishing and exploitation of a natural resource because the value of one part of the product of fishing activity is very high, and waste because a very low market value requires the discard of other products of fishing. The liver, or rather the vitamin A in the liver, is the most valuable product of the world shark fishery, and it would be for any shark fishing operation in Trinidad and Tobago, at least under existing market conditions. The future market value of vitamin A is uncertain, not because of a probable drop in demand but because of recent success in the preparation of synthetic vitamin A. However, the effect of this is not necessarily a serious threat to the development of a successful shark fishing operation in Trinidad and Tobago.

A characteristic of the catch of the "SACHEM" was that the livers taken had a very wide range of vitamin A potency. Not only were there apparent differences in the potency range among the various species but within lots of liver segregated by species and sex. Single livers from adult sharks taken by the "SACHEM" ranged in potency from less than 500 international units to the gram of liver to more than 50,000 i.u./g liver. This condition is similar to that reported by Springer and French² for South Florida. Under such circumstances no valid conclusions concerning average liver values can be drawn. Furthermore, the catch of the "SACHEM" was made during a period of little more than a month and the effect of seasonal cycle on vitamin potency can be considerable. Oil from shark livers taken in the warm waters about Trinidad has a high stearine content and consequently is semi-solid at temperatures below 60 degrees Fahrenheit. This does not affect the usefulness of the vitamin A in it, but additional information is needed to determine the relative marketable quality of oils characteristic of the various kinds of Trinidad sharks.

Several of the larger species provide hides that have substantial value. During the rainy season there may be enough fresh water pushed into the Gulf of Paria to affect adversely the quality of shark hides taken there, but otherwise the quality should be good. Usually the presence of fresh water-damaged hides in a shipment is first detected after preliminary treatment at the tannery and may result in serious loss to the shipper. To avoid this, it is a good practice to check all hides carefully before preparation, especially those from brackish water over mud bottom. If there is a tendency for the denticles (scale-like surface covering of the hide) to slip, the hide should be discarded, or the shark should not be skinned. This slipping or looseness of the denticles is analagous to slipping in furs and indicates a spoiled spot in the hide that may render the entire hide worthless after tanning.

Although there is, at present, a greater demand in Trinidad for fresh shark meat for human consumption than is afforded by the irregular production incidental to other fishing activity, it is probable that even a small specialized shark fishery would more than satisfy it. However, distribution of fresh shark meat is restricted to the larger markets and it is recommended that an immediate objective of any Trinidad shark fishery operation be the introduction of a properly prepared, dried, salt product.

The dried fins of the larger sharks are in sufficient demand to find a ready export market, particularly since those available from Trinidad could be of better than average size and quality. It is important that fins be taken in complete sets, and for species having valuable fins it is important to include the lower tail fin.

2. Springer, Stewart and French, Price M., Vitamin A in Shark Liver Oil, *Industrial and Engineering Chemistry*: 36, 1944, p. 190.

Even with the utilization of the hides, fins, liver and meat, a considerable amount of any shark catch remains. The fins of some species, the meat of others, and the hides of small sharks are not marketable. Nearly half the weight remains after the removal of livers, fins, hides and marketable meat in most species. This residue can be made into shark meal having a protein value as high as 80 per cent. Shark meal has been shown to be satisfactory for the protein requirement of stock feed, and the supply available in Florida finds a ready market on a protein basis in competition with other sources.

There are special difficulties in grinding and drying shark waste for meal. The equipment used in the preparation of fish meal does not in all cases handle shark in a satisfactory way. There are important reasons for an attempt to find a solution to the problem of preparation of shark meal in Trinidad. The idea that shark carcasses and shark wastes spoil fishing when dumped on the fishing grounds over a long period of time is prevalent among fishermen. The problem of disposal of waste by a shore station is a serious one and can become a major operating expense. But perhaps the best reason for the preparation of shark meal in Trinidad is that the requirements for protein ingredients of stock feed now have to be met by importation and locally produced shark meal would go far to meet this demand. It is recommended that any program for a shark fishery in Trinidad include the examination of the possibilities for the preparation of shark meal using equipment adaptable to drying other available production wastes which can be used in animal feed.

(III) SHARK PRODUCTION IN TRINIDAD

Direct transfer of fully equipped fishing boats successful in other latitudes is not the only method for improving the productivity of Trinidad and Tobago marine fisheries. Increased production should follow persistent effort directed toward the correction of several conditions that now impede the progress of the fishery. One of the important bars to better production is the large degree of standardization in methods, gear, and boats. Along with this condition there is little boldness in the use of boats, in the risk of gear, or in trial of the unfamiliar. Improvement of production is to be sought by trial and error in the adaptation of knowledge about fishing and seamanship to particular local conditions. This implies instruction to fishermen but it is important that the instructor be a practical student of local fishing conditions and that the object of increasing today's production be constantly in view.

In long range, the progress of the Trinidad and Tobago fishery is held back by the standardization of small boat building to one type, by inadequate repair facilities for fishing boats of intermediate size, and by lack of protected moorings for boats too large to beach.

For the development of a shark fishery in Trinidad it is doubtful that a method such as that of the "SACHEM" is a proper aim, because the use of offshore equipment precludes the utilization of any by-products. A shark fishery similar to that of Cuba, in the employment of small rigs and wide usage of production, appears to be more adaptable to local conditions.

There is now in Trinidad an especially favorable marketing condition for shark products, and the problem of initiating production does not appear too formidable. A shark fishery offers unusual benefits to Trinidad because it would furnish an exportable surplus of vitamin A bearing liver, of fins, and of raw hides, because it could be made to meet urgent needs for low cost protein for human consumption and for animal feeds, and because its principal costs are for

labor rather than materials. On the other hand, it requires in its development a large amount of persistent and determined effort.

It is recommended that buoyed handlines, short setlines, and light weight, small set-nets be used for catching sharks. Somewhat larger boats than at present available to the average Trinidad fisherman would be desirable to get production at some distance from base, but determined men can make substantial catches close to the long coastlines of Trinidad and Tobago with boats now in use for fishing. It is probable that shark fishing close in shore would be more successful during the night.

(IV) SHARKS OF TRINIDAD

In the late spring the "SACHEM" fishing showed the bull shark to be the most valuable of the Trinidad species. At this time also the small black-tip, the great hammerhead, the South American hammerhead, and the market shark were present in the Gulf of Paria and would be the most valuable species to Trinidad fishery. It is probable that some of the other species would be found to be of relatively greater importance at other times of the year.

1. SAND-TIGER. *Carcharias taurus* Rafinesque.

This shark was not taken but is included because it has been taken both north and south of the latitude of Trinidad. It is a large (adults are 8 to 10 feet long), ugly shark and may be distinguished from other sharks of the region by the teeth, which are long, slender, and sinuous and have small hooks or toothlets at the bases of the larger ones. The hides and fins are worthless and in known examples the liver potency is very low.

2. MAKO. *Isurus oxyrinchus* Rafinesque.

This is an offshore species not taken by the "SACHEM" but included here because of a previous report of its capture off the coast of British Guiana. It may be easily distinguished from other Trinidad sharks because it has in combination, lateral keels or ridges at the base of the tail, a sharp pointed snout, long sinuous awl-like teeth without serration and without hooklets on their bases. The hides and fins have no value. The value of the liver oil is unknown. The meat of this species in other localities is considered very good.

3. NURSE SHARK. *Ginglymostoma cirratum* (Bonnaterre).

The nurse shark is radically different from other sharks, the smooth tan hide (not sandpaper-like to the touch as in other sharks), the presence of barbels, and the paved teeth set it apart from other Trinidad species. Full grown nurse sharks are 7 to 9 feet long. It appears to be generally distributed in shallow water around Trinidad but more abundant on the north and east coasts and around Tobago. It frequents rocky and coral bottom. The hide is more valuable than that of any other shark, the fins are worthless, and the liver oil is usually of very low potency. Although I am told that the meat is rejected by the Port-of-Spain market it is in my opinion superior to that of most other sharks. The nurse shark is a harmless species insofar as its armament is concerned but it is one of the most troublesome sharks to handle. Large ones should not be taken into a small boat alive. They may be killed by a knife thrust into the back of the head so as to sever the vertebral column.

4. WHALE SHARK. *Rhincodon typus* Smith

This shark has not been recorded from Trinidad but it is likely that it is occasionally present. It is a harmless plankton feeder but too large for a small boat to tackle safely. It is too rare to have any commercial value.

Regular distribution of whitish spots in rows and ridged surfaces make it resemble some riveted metal fabrication of man, and its sudden appearance alongside a small boat is alarming, if not dangerous.

5. SMOOTH HOUND. *Mustelus canis* (Mitchell).

This small three or four foot shark with blunt, paved teeth was not taken by the "SACHEM" but has been mentioned in previous reports. In other localities the species has little commercial value.

6. TIGER SHARK. *Galeocerdo cuvier*. (Lesueur).

The tiger shark is the common big shark of Trinidad and Tobago. It reaches maturity at about 9 feet 6 inches with weights of adults often in excess of 500 lbs. The largest tiger taken by the "SACHEM" was 12 feet 9 inches long and had a liver weighing 240 lbs. Tiger sharks may be recognized by the presence of strong reinforcing ridges along the sides of the base of the tail in combination with a blunt, truncate snout and wide-based large teeth, similar in the upper and lower jaws. Young tiger sharks are spotted and striped above with black or lighter ground color. As the shark gets older the spots become more diffuse and tend to form stripes. In full grown examples the stripes may disappear altogether. Four adult tiger sharks taken by the "SACHEM" off the east coast of Trinidad were representative of a black phase of biological interest. All of these sharks were a uniform shiny black above, contrasting sharply with immaculate white below. Two of them, adult males, were otherwise of normal appearance and proportion, but two, a male and a female, were much shortened in the tail region. The female, 8 feet 6 inches long, had size and proportions of head and fins approximately the same as that of the normal tiger shark 11 feet 2 inches long taken at the same time. The black phase is said to be common about Tobago. The tiger shark is common everywhere around Trinidad but not in large schools. The hides and fins are of good quality and although the liver oil potency is low, the amount of liver is usually large and the oil content is often as high as 75 per cent. The fresh meat is somewhat bitter and not marketable.

7. LEMON SHARK. *Negaprion brevirostris* (Poey).

Our specimens of this species were three adult females and two adult males 7 feet 6 inches to 8 feet 6 inches long, taken on the east coast of Trinidad. The females had pups 23 to 24 inches long and these all swam away in apparent good condition when thrown overboard after being liberated from the oviducts of the mother. The lemon shark is characterized by having a large second dorsal fin in combination with a broadly rounded blunt snout. It prefers shallow water away from mud and brackish conditions and it is likely that the species is relatively more abundant around Tobago than Trinidad. The hides, fins and meat are of good quality. The liver oil potency is generally low except in adult males.

8. BLACK-NOSED SHARK. *Carcharhinus acronotus* (Poey)

The black-nosed shark reaches an extreme length of little more than 4 feet. It may be always recognized by the presence of a black spot or indistinct smudge of black on the tip of the snout. Our specimens were from the east coast of Trinidad. Although the meat of this shark is good, the hides and fins are too small for use, and the liver oil potency is low.

9. BULL SHARK. *Carcharhinus leucas* (Müller and Henle).

This would probably be the most valuable shark of any shore-based shark fishery in Trinidad. It is a species of moderate length, the males

in the Trinidad area reaching maturity at about 6 feet 6 inches. The females are slightly larger but the maximum length of the species as represented by our Trinidad specimens is a little less than 9 feet. The bull shark is heavy for its length and specimens weighing 400 lbs. or more are not rare. The bull shark resembles other species of *Eulamia* and *Carcharhinus* in general aspect, and for identification it is necessary first to determine whether or not a ridge is present in the skin between the first and second dorsal fins. If there is no trace of a ridge and if the shark is five feet long or more and if at least a few of the teeth in the central part of the upper jaw are roughly triangular and not deeply notched on both sides, the shark is very likely a bull shark. Bull sharks are generally shallow water sharks that frequent brackish water. They were taken by the "SACHEM" all around Trinidad but in greater quantity on the south coast. The hides are good unless ruined by fresh water and the fins and meat have a good market value. Liver potencies of specimens taken in the Trinidad area were relatively high but in this there appears to be an extremely wide range of variation.

10. MARKET SHARK. *Carcharhinus porosus* Ranzani.
Common names of sharks in Spanish are applied so indiscriminately that one species may have a dozen different names in use in different localities. English common names have a somewhat wider basis. Since *Carcharhinus porosus* does not have an English common name I take the liberty of calling it market shark, an appropriate name in Trinidad at least. The species reaches a length of little more than 3 feet and is the commonest shark in the Gulf of Paria. It has no ridge between the dorsal fins and no dark markings or spots. Large numbers are sold on the Trinidad market but the hides and fins are too small to have any value. The liver oil is sometimes relatively high in vitamin A but the livers are small and the percentage of oil in them is low.
11. SMALL BLACK-TIP SHARK. *Carcharhinus limbatus* (Müller and Henle).
Males of this species become mature at a length of not much less than 4 feet 6 inches and very few individuals of either sex exceed 6 feet. The shark is well marked by black tips on many of the fins. Black-tips were taken frequently by the "SACHEM" in the Gulf of Paria and in the Serpent's Mouth. A few were collected on the north and on the east coasts. Since the small black-tip is common and easily taken it is one of the more valuable species around Trinidad. The hides are thin and not large and the fins are of much lower value than those of larger sharks but the meat is marketable and the liver in Trinidad specimens is rich in vitamin A.
12. LARGE BLACK-TIP SHARK. *Carcharhinus maculipinnis* (Poey).
One specimen was taken by the "SACHEM" off the north coast of Trinidad. Large black-tips reach a length of 8 feet or just a little more, and males become mature at not much less than 5 feet 6 inches. The teeth on the lower jaw are smooth on the edges rather than finely serrate as in the small black-tip. However, this is a characteristic that cannot always be checked unless a microscope is available. A more convenient way to distinguish between the two is to view the lower jaw teeth from the sides. In the small black-tip the cusps are somewhat sinuous and the tips curve slightly outward. In the large black-tip these teeth are neither sinuous nor recurved. A further difference, if both species are available for comparison,

is that the large black-tip has smaller teeth in spite of the greater size of the shark.

13. ————*Isogomphodon oxyrhynchus* (Müller and Henle).

This shark was described originally in 1841 from an 18 inch specimen from Surinam, and is known only from that description and a few museum specimens in poor condition. It has been twice recorded from Trinidad.^{3 4} On the first day of Trinidad fishing on the north coast one small specimen was taken but was lost before detailed examination could be made. Probably the specimen was this species because it was noticed that it had many rows of small sharp teeth. There was no fin markings. No other specimens were seen.

14. SHARP-NOSED SHARK. *Scoliodon lalandii* (Müller and Henle).

These are common small sharks rarely reaching more than 3 feet in length. The species has little value except as a market fish. Sharp-nosed sharks may be distinguished from others in Trinidad region by their size and by the presence of grooves in the skin which originate at the corners of the mouth and run along the sides of the jaw. The Trinidad form has been identified as *S. lalandii* rather than *Scoliodon terra-novae* (Richardson) because the specimens taken by the "SACHEM" appear to represent a population of smaller sharks than *terra-novae* of the Northern Caribbean and Gulf of Mexico and because embryos (at 5 inch length) of Trinidad specimens have a dense growth of long and thread-like villi on the pseudo-placental attachment tube, a phenomenon not yet observed for embryos of *terra-novae*.

The RIDGE-BACK SHARKS. *Eulamia*.

Along the east coast of the United States these are called "Ground Sharks," in Australia they are "Whaler Sharks," on the east coast of Florida they are often called "Mackerel Sharks," on the west coast of Florida they are called "Mullet Sharks," and so on. They are very common in all temperate and tropical seas and there are many species that are distinctly set off from one another by differences of habit and habitat. They generally move in schools, frequently appearing in great numbers. The ridge-back *Eulamia* were represented in the catch of the "SACHEM" by five species. These are similar to one another in general structure and are difficult to identify. Knowledge of the group is still insufficient to provide a stable classification. All of them are valuable for hides and fins, and, so far as is known, for marketable meat. The livers of Trinidad specimens taken by the "SACHEM" were relatively high in vitamin A potency except for *Eulamia altima*, a species apparently producing low potency liver throughout its range.

15. KNOPP'S SHARK. *Eulamia altima* Springer

This shark is restricted to depths of 50 to 200 fathoms, and so far as known only strays a short distance from these depths at night when it may appear at the surface or on the shallower bottoms near deep water. As would be expected, the catches of a dozen or more adults taken by the "SACHEM" came from the deep water in the Dragon's Mouth. Adults are within a length range of 7 to 9 feet and differ from other ridge-backs in having somewhat longer and thicker snouts with wider, more prominent depressed channels or nasal scoops, in having dermal denticles not over-

3. Vincent, Sea Fish, Trinidad 1910.

4. Fowler, Proc. Acad. Nat. Sci. Phila. 67 : 1916, p. 521.

lapping and about half the size of those of the closely allied *E. plumbeus* and *E. milberti*, and in having the large central teeth of the upper jaw higher and exactly triangular without lateral notches. The only notable difference of Trinidad specimens from those found off Florida was that the Dragon's Mouth sharks were very much less resistant to the knife, a phenomenon apparently associated with the characteristics and amount of mineral deposits laid down around the cartilages.

16. REEF SHARK. *Eulamia falciformis* (Müller and Henle).

Several reef sharks were collected by the "SACHEM" off the east coast of Trinidad. The species prefers the vicinity of coral reefs and the edges of oceanic banks. At times it is found at the surface in large schools. It may be expected to be relatively more common around Tobago than Trinidad. The fins of the reef shark, particularly the pectoral fins, are thinner and appreciably lighter in weight than in other ridge backs. Adults are in the size range from 5 feet 6 inches to 8 feet long and the young are relatively large at birth. Unfortunately the name *E. falciformis* as now known, probably covers two species. In Trinidad specimens, the upper jaw teeth are very strongly notched on both margins and the cusps are much narrower than in related ridge-backs.

17. DUSKY SHARK. *Eulamia obscurus* (Lesueur).

Adult dusky sharks are mature at a little more than 9 feet long and reach a length of more than 11 feet. These sharks appear to be fairly common off Trinidad in moderate depths. The only one taken by the "SACHEM" within territorial waters came from the north coast. Like the reef shark, there are apparently two forms of the dusky shark.

18. SILKY SHARK. *Eulamia floridanus* Bigelow, Schroeder and Springer.

Silky sharks are 7 to 10 feet 6 inches as adults and are generally sharks of blue water. No specimens were taken by the "SACHEM" within territorial waters of Trinidad but several were secured from off the coast of British Guiana. The silky shark is an active powerful shark with a more slender and trim appearance than other ridge-backs. The denticles are small and the hide often has a silky appearance. It is more pelagic than other ridge-backs and frequently appears at the surface although it is sometimes common in depths of more than 100 fathoms.

19. SAND-BAR SHARK. *Eulamia plumbeus* (Nardo).

Trinidad sand bar sharks differ from the sand-bar sharks of Florida, *Eulamia milberti*, in habits and in having heavier denticles set closer together. *Eulamia plumbeus* is the name properly applied to sand-bar sharks of the eastern Atlantic and Mediterranean and is tentatively used for the Trinidad form although additional information is needed to verify the identity of the Trinidad and eastern Atlantic species. The north coast of Trinidad is a nursery ground for the sand-bar shark and specimens of sizes from 30 inches up to 7 feet 6 inches long were taken. The species does not reach a length of as much as 8 feet.

20. BONNET-HEAD SHARK. *Sphyrna tiburo* (Linnaeus).

The bonnet-head shark reaches a length of about 3 feet and is very likely common in the Gulf of Paria in shallow water. Although no specimen of this kind was taken by the "SACHEM" a specimen was seen in the market and it has been reported as being common in Trinidad. It may be recognized by its spade-shaped head that has no indentation in its marginal outline at the nasal apertures, but is not regularly oval as in *S. media*.

The bonnet-head is in demand on the Port-of-Spain market but it is too small to have much value otherwise.

21. SCOOP-HEAD SHARK. *Sphyrna media* Springer.
This form is only a little larger than the preceding and probably does not greatly exceed 4 feet in length. It was described from Pacific specimens and this is the first positive record of its occurrence in the Atlantic. Two adult females were taken by the "SACHEM" in the Gulf of Paria. One of these contained eight 4 inch embryos. It is probably too small and uncommon to be of any commercial importance.
22. GREAT HAMMERHEAD. *Sphyrna tudes* (Valenciennes).
The several great hammerheads taken by the "SACHEM" ranged from 9 feet to 12 feet 6 inches long. Some specimens of this species have been taken in other localities as large as 15 feet or more. The great hammerhead has a wide but very shallow groove in the front margin of its head running from the nasal aperture toward the center of the head. In other hammerheads this groove is narrow, deep, and slit-like. The liver of the species usually produces high potency oil and the fins are valuable. The hides are valuable if in good condition but are thin and are somewhat difficult to prepare in first-class condition. The meat of all the hammerheads appears to be in demand on the Port-of-Spain market. These large hammerheads are very powerful and large individuals are too much for small boats and light gear. However, hammerheads die quickly when their free movements are restrained and if properly handled can be killed with relatively light tackle. They usually die within an hour if entangled in even a light net.
23. COMMON HAMMERHEAD. *Sphyrna diplana* Springer.
The common hammerhead *Sphyrna zygaena* (Linnaeus) frequents the higher latitudes at least to the north and in the western Atlantic. I have not been able to verify a record of its occurrence south of Salerno, Florida, where it is occasionally taken as a straggler in schools with *S. diplana*. One specimen of *diplana* was collected off the north coast of Trinidad. This species differs from other hammerheads of Trinidad in having a very low second dorsal fin with a long slender posterior lobe, its length more than twice as great as the height of the fin. *S. diplana* reaches a length of 10 feet or a little more and is not mature at less than 6 feet 6 inches.
24. SOUTH AMERICAN HAMMERHEAD. *Sphyrna bigelowi* Springer.
The second dorsal fin of this species is somewhat higher than in *S. diplana* and the form does not reach such a large size. The smallest adult male taken by the "SACHEM" was 5 feet 6 inches long and the largest 6 feet 6 inches long. However, fewer than a dozen specimens, all males were taken. Most of these were caught in the Gulf of Paria.

(V) IDENTIFICATION OUTLINE. 5

1. Sharks with expanded, flattened heads; hammerheads and shovel-nosed sharks.
 - A. Head hammer shaped, its front margin lobed or scalloped.
 - a. Groove in front margin of head shallow; second dorsal fin high *Sphyrna tudes*

5. It is suggested that identification of species be undertaken with the aid of the well illustrated "Guide to Commercial Shark Fishing," Anglo-American Caribbean Commission, Washington, 1944, or better, with "Fishes of the Western North Atlantic" vol. 1, article 3, The Sharks, by Bigelow and Schroeder, Wm. Sears Foundation for Oceanography, New Haven, 1948.

- b. Groove deep; second dorsal fin low *Sphyrna diplana*
 - c. Groove deep; second dorsal fin intermediate *Sphyrna bigelowi*
- B. Head evenly rounded or spade-shaped, not lobed or indented.
 - a. Head oval, not at all pointed in front *Sphyrna media*
 - b. Head spade-shaped *Sphyrna tiburo*
- 2. Sharks with keels along each side of the base of the tail.
 - a. Teeth large, wide, with saw-like edges *Galeocerdo cuvier*
 - b. Teeth narrow, sinuous, lance-like *Isurus oxyrinchus*
 - c. Teeth very small, enormous sharks with terminal mouths *Rhincodon typus*
- 3. Sharks with low, blunt, paved teeth.
 - a. Hide smooth when rubbed in direction toward the head *Ginglymostoma cirratum*
 - b. Hide sand-paper like when rubber toward the head .. *Mustelus canis*
- 4. Sharks not as in 1, 2, or 3, but with second dorsal fins with area as great or greater than one-half the area of the first dorsal.
 - a. Teeth not serrate, long, narrow and sinuous, with a small hook or toothlet at the base on either side; snout pointed *Carcharias taurus*
 - b. Teeth not serrate, cusps narrow, somewhat flattened, without toothlets; snout broadly rounded *Negaprion brevirostris*
 - c. Teeth serrate on cusps; snout pointed; second dorsal about half as large as first dorsal *Isogomphodon oxyrinchus*
- 5. Small sharks not as above but with two grooves on either side originating at the corners of the mouth and extending nearly parallel to the mouth for a distance about equal to the diameter of the eye *Scoliodon lalandii*
- 6. Sharks without special structures as under 1, 2, 3, 4 and 5. Typical sharks.
 - A. A ridge in the skin between the first and second dorsal fins.
 - a. Denticles not imbricate, deep water sharks, 7 to 9 feet as adults *Eulamia altima*
 - b. Denticles not imbricate, 6 to 8 feet long as adults *Eulamia plumbeus*
 - c. Denticles imbricate, 5 to 8 feet long as adults, narrow tooth cusps *Eulamia falciformis*
 - d. Denticles imbricate, 9 to 11 feet long as adults ... *Eulamia obscurus*
 - e. Denticles imbricate, 8 to 10 feet long as adults ... *Eulamia floridanus*
 - B. No trace of a ridge in the skin between the dorsal fins.
 - 1. Teeth of upper jaw with narrow cusps on broad bases.
 - a. Lower jaw teeth serrate, tips recurved outward, fins black-tipped *Carcharhinus limbatus*
 - b. Lower jaw teeth smooth, tips not recurved, fins black-tipped *Carcharhinus maculipinnus*
 - c. Fins not black-tipped *Isogomphodon oxyrinchus*
 - 2. Teeth of upper jaw flattened somewhat triangular.
 - a. Tip of nose with a black smudge, small sharks *Carcharhinus acronotus*
 - b. No black-tip on nose, small sharks, under 4 feet *Carcharhinus porosus*
 - c. Larger sharks, adults over 6 feet long *Carcharhinus leucas*