United States Department of the Interior
Fish and Wildlife Service

Fishery Leaflet 121

Chicago 54, Ill. April 1945

OBSERVATIONS ON THE SHARK FISHERY IN THE CENTRAL PART OF THE GULF OF CALIFORNIA with RECORDS OF VITAMIN POTENCY OF LIVER OILS and with KEYS TO THE IDENTIFICATION OF COMMERCIALLY IMPORTANT SHARKS

By Lionel A. Walford*

In recent years, the fisheries for sharks on the west coast of Mexico have changed character and purpose. Whereas, formerly shark oil was utilized only locally for the manufacture of soap and for processing leather, since about 1938, it has found a new market in the United States because of its Vitamin A content. The fishery has consequently grown to large proportions. Catch figures are not available, but some notion of the volume may be obtained from the fact that 385,000 pounds of livers were produced in the Mazátlan Consular Area alone in 1942 up to July 31 (Fishery Market News, 1942, S 1).

Published knowledge is almost totally lacking as to the kinds of sharks caught, as to their geographic and seasonal distribution, and as to the magnitude of Vitamin A potencies of their livers. To arrive at such knowledge would require observations at many places, so as to sample adequately the entire geographic range of all species during all seasons.

An opportunity to make observations and collections at San Marcos Island, Lower California, was offered by Mr. J. A. McCarthy, through Mr. Otis Small of the Pacific Portland Cement Company, which in normal times utilizes the output of a gypsum mine there and encourages a local shark fishery. Accordingly, the writer spent from September 16 to October 12, 1942, of which one week was in Guaymas, the remainder at San Marcos Island, taking full advantage of the generously offered facilities of the Pacific Portland Cement Company. The following information was obtained from data collected there, and from conversations with American buyers, Mexican dealers and fishermen.

The shark fisheries of the Pacific Coast of Mexico is a peculiarly diffuse industry. There is hardly a bay or sheltering island in the Gulf of California or on the open coast that does not support one or more shark fishing camps. Though individually these are small enterprises, the sum of their effort is impressive.

Shark fishing camps are composed of several men, sometimes with their families, equipped with sailing dugouts or skiffs and necessary fishing gear. Two to several men operate one boat. Boats and gear may be owned by the fishermen themselves, or wholly or in part by investors living ashore. Fishermen put to sea daily, weather permitting, leaving early in the morning and returning in mid-afternoon with their fare of liver, flanks, and fins of sharks. These are salted, the liver stored in cans, the flanks baled, the fins piled or sacked. From time to time, the collected products are hauled by burros or sailed in canoes to various ports visited by freight boats or served by railroads. At the larger ports, like Mazátlan, Manzanillo, Topolobampo, and Guaymas are refrigeration facilities. Fishermen operating from these ports land livers fresh, which are then iced, frozen or chemically-treated for shipment to the United States.

* Aquatic Biologist, Division of Fishery Biology.

Note: This leaflet supersedes Sep. 68, a reprint from Fishery Market News, vol. 6, no. 6, June 1944, pages 2-7.

Several Mexican wholesale companies deal in shark livers; also several American companies or individuals buy livers outright or act as agents for Mexican dealers. Activity of these is in a constant state of flux, depending on the United States' demand for Vitamin A.

Over forty species of sharks occur along the west coast of Mexico. These vary greatly in potency of Vitamin A in their livers from those that are worthless in this respect to those that, at times, run up into the high potency brackets. Moreover, each species varies as to potency of liver. Large sharks are said to be more potent than smaller ones; males more potent than females; those living in deep water more potent than those living in shallow water. A considerable variety of species are caught for livers, with a wide range of potencies.

There is a great variation from place to place and from season to season in species available, in their sizes and in sex ratio. Consequently, observations made at any one locality can apply only to that locality and for the time of year the observation was made. Thus, any significant biological study of Mexican sharks should make ample provision for observations over a large area and over a considerable period of time.

In the region of San Marcos Island and Guaymas most sharks are caught with a gear called the "zimbra, which is merely a long set line. It consists of an anchor line, at San Marcos typically 600 meters long, with a buoy at its upper end, and anchor at the lower, followed by about 150 meters of additional line. To the latter length are fastened short lines at intervals of about three meters. Each of these consists of a length of rope about one meter long, followed in order by a swivel a chain about one-half meter long; and to this is attached a large hook, with a shaft about 20 centimeters long. The lines are of about one-half inch rope. The hooks are baited with fish eight to ten inches in length, the bait at San Marcos at this time being mostly Haemulids (Haemulidae--the Grunts). This gear is set for as long as three days at a time, and since the water is cold at the depths fished there is no danger of spoiling bait or catch in this interval The zimbra is hauled in by hand, old bait replaced, the catch removed and the line reset. Fishermen usually butcher the sharks in the boat, if there is room, and throw the remaining carcasses on to beaches, preferably well away from their camps.

Some additional sharks are caught with other gear Boats usually carry a spear or two, for harpooning any sharks seen near the surface. This is particularly useful for capturing hammerheads. Gill nets are used by some fishermen, but have not been markedly successful in the past being unsuitable for the very large sharks that abound in Mexico. A gill net set and pulled daily at San Marcos Island caught nothing important during the period of observation. On two occasions, it was badly torn by big fish that had escaped. Also, since it had to be set in relatively shallow, hence warm, water, fish caught tended to spoil. Since these observations were made however, it has been reported that gill nets have recently been used with some success in areas southward of Guaymas.

The biological data collected during the two and a half weeks at San Marcos Island consisted in the examination of 36 specimens. Among these, seven species were distinguished. A sample of liver was taken from each fish examined, preserved in a soda ash-formaldehyde solution, and sent to the technological laboratory of the U. S. Fish and Wildlife Service at Seattle. The assays are given in Table I. It is to be observed that three-fourths of the specimens were of the genus Eulamia, of which more than half were Eulamia lamiella. Among scores of carcasses examined on beaches, at least 90 percent seemed to be E. lamiella, the remainder mostly hammerheads (Sphyrna diplana). Thus, it appears that the most important sharks at San Marcos during the whole year are the two latter species. Fortunately, these are two of the richest in Vitamin A.

While it is impossible to judge of the abundance of sharks from observations made during this short stay at one point of the Gulf of California, fishermen and dealers uniformly expressed the opinion that the supply of Mexican sharks is exceedingly large. There seems no reason to doubt that the population is large, but to form a reliable estimate would take a vastly extensive survey.

The Mexican sharks are not very well known to science. Owing to their large size, they are poorly represented in museums, and then only by immature specimens. Many of the different species look very much alike, and are difficult to identify. Doubtless, several have yet to be described and named, as is attested by the frequency and consistency with which fishermen described sharks which they sometimes catch, and which are not familiar to the writer.

Table I--Analytical Data on Sharks and Livers--San Marcos Island, Mexico, September-October 1942

Sample No.	SHARK: Name: Local	SHARK: Name: Scientific	SHARK: Sex	SHARK: Length	LIVER: Oil	LIVER: Vitamin A: Per gram of oil	LIVER: Vitamin A: Per pound of liver
				Inches	Percent	U.S.P. Units	Millions of U.S.P.Units
20	Sardinero	Eulamia aethalorus	F	27	72	3,500	1.14
21	"	" "	M	46¼	78	4,400	1.56
22	"	" "	F	43¼	66	16,300	4.9
		Average for livers ...	-	-	72	8,070	2.6
33	Gambuso	Eulamia azureus	M	70-1/8	68	17,500	5.4
2	Injerto	Eulamia lamiella	F	64⅝	74	67,000	22.6
3	"	" "	M	68¼	75	58,000	19.8
4	"	" "	M	69-1/8	76	85,000	29.4
12	"	" "	M	38-3/8	32	48,000	7.0
16	"	" "	M	70¼	76	78,000	27.0
19	"	" "	M	62⅝	73	52,000	17.3
24	"	" "	F	57⅛	78	20,700	7.3
27	"	" "	M	65¼	75	29,500	10.0
28	"	" "	M	68	81	53,000	19.5
29	"	" "	M	68½	79	87,000	31.3
30	"	" "	M	65¾	76	51,000	17.6
31	"	" "	M	68	81	80,000	29.5
32	"	" "	M	59	74	81,000	27.2
34	"	" "	F	66½	78	69,000	24.5
35	"	" "	*	67¾	51	96,000	22.3
36	"	" "	M	59	80	21,000	7.6
		Average for livers ...	-	-	72	61,000	20.0
6	Pilota	Eulamia galapagensis	F	55-7/8	32	7,700	1.12
7	"	" "	M	62¼	54	94,000	23.1
8	"	" "	M	63	44	106,000	21.2
9	"	" "	M	54-5/8	55	73,000	18.3
		Average for livers ...	-	-	46	70,000	14.7
10	Puro	Eulamia velox	F	48-5/8	69	26,000	8.2
11	"	" "	F	45¼	72	28,000	9.2
26	"	" "	F	46-1/8	79	19,300	6.9
		Average for livers ...	-	-	73	24,400	8.0
23	Puro	Scoliodon longurio	F	35	68	51,000	15.8
1	Cornuda	Sphyrna diplana	*	49-3/8	54	52,000	12.8
5	"	" "	F	62¾	74	27,100	9.1
13	"	" "	F	71	66	46,000	13.8
14	"	" "	F	45-7/8	59	20,500	5.5
15	"	" "	F	64½	74	47,000	15.8
17	"	" "	F	66	53	145,000	35.0
18	"	" "	F	39½	62	12,500	3.5
25	"	" "	M	67-5/8	66	63,000	18.9
		Average for livers ...	-	-	63	52,000	14.9

*Sex not recorded.

NOTE: Percent oil was determined by the Stansby cold shaking method, vitamin A by the Carr-Price, antimony-trichloride method at a wavelength of 620 mmu., and a bandwidth of 15 mmu. E value was converted to vitamin A by using a factor of 732.

Virtually all the sharks taken commercially on the west coast of Mexico belong to two families, those related to the soupfin (Galeorhinidae), of which there are twelve species, and the hammerheads (Sphyrnidae), of which there are five species.

Although only seven species were identified at San Marcos, the remainder of the west coast members of these two families were examined at Stanford University Natural History Museum, and were made the basis of the following simplified keys for identification. Provided a given shark belongs to one of these two families--this may be ascertained by reading the description at the head of each key--it may be identified by reading Item 1 of the appropriate key, and following the directions given thenceforth:

A KEY TO THE SHARKS OF THE WEST COAST OF MEXICO FAMILIALY RELATED TO THE PACIFIC SOUPFIN (GALEORHINIDAE)

The fishes of this family have spindle-shaped bodies, which are not flattened, nor expanded laterally. They are not hammer-headed, have no spines in the dorsal fins or keels at the base of the tail; and their tails are of normal length, being much shorter than the rest of the body. They have five gill openings on each side of the body; have two dorsal fins, an anal fin, a pair of pectoral fins and a pair of pelvic fins. The first dorsal fin is situated in front of the pelvic fins; and the teeth are conspicuous, more or less triangular or knife-like, not plate-like or pavement-like. Although these sharks bear a family relationship, there is a wide range of value in the Vitamin A potency of their livers. Some, like the soupfin are exceedingly potent in this respect; others like the tiger shark, almost worthless.

(1) If: Spiracles (a pore situated behind the eye) are present, see Section 2.

But if: Spiracles are absent, see Section 3.

(2) If: The teeth of both jaws are deeply notched on one side, and coarsely and evenly serrate (i.e., scalloped or saw-toothed), as shown in Figure 1 the fish is a TIGER SHARK or TINTORERO (Galeocerdo arcticus).

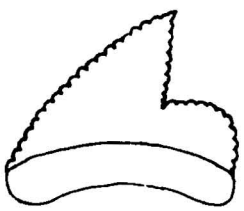


Figure 1

But if: The teeth are not as in Figure 1, those on the side of the jaw being rather minutely notched on the outer edge below the point, and the lower part of the notch is divided into two to five points, the fish is a SOUPFIN SHARK (Galeorhinus zyopterus).

(3) If. There is a conspicuous groove at the angle of the mouth, beginning on the lower jaw, and extending forward around the angle of the mouth, paralleling the upper jaw for one fourth to one third the distance from the angle to the front of the mouth, as shown in Figure 2, the fish is a PURO (Scoliodon longurio).

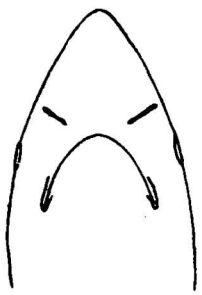


Figure 2

But if: No groove is present at the angle of the mouth, or if present, is not so extensive or conspicuous as shown in Figure 2, see Section 4.

(4) If: The middle of the base of the first dorsal fin is nearer the ventral fins than to the pectoral fins, the fish is a GREAT BLUE SHARK (Prionace glauca).

But if: The middle of the base of the first dorsal fin is nearer the base of the pectoral fins than to the base of the ventrals see Section 5.

(5) If: The second dorsal fin is very much smaller than the first, being less than half its area, see Section 6.

But if: The second dorsal fin is almost as large as the first, the fish is Aprionodon fronto.

(6) If: The snout is bluntly rounded, and the distance from the tip of the snout to the mouth is scarcely more than half the distance between the angles of the mouth, as shown in Figure 3, the fish is a GAMBUSO (Eulamia azureus).

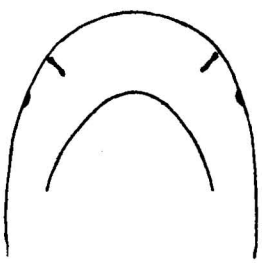


Figure 3

But if: The snout is not as shown in Figure 3, but is more or less acutely pointed, and the distance between the tip of the snout and the mouth is almost or quite as great as the distance between the angles of the mouth, or greater, see Section 7.

(7) If: The head is very narrow, so that the distance between the nostrils is hardly more than the length of a nostril, the fish is a PURO (Eulamia velox).

But if: The head is not so narrow, and the distance between the nostrils is several times the length of a nostril, see Section 8.

(8) If: The front of the second dorsal fin is opposite or behind the middle of the anal fin, the fish is Eulamia cerdale.

But if: The front of the second dorsal fin is in advance of the middle of the anal fin, see Section 9.

(9) If: The teeth of the upper jaw have broad, shoulder-like basal extensions, as shown in Figure 4, the fish is a SARDINERO (Eulamia aethalorus).

But if: The teeth of the upper jaw are without extensions to their basal portions, see Section 10.

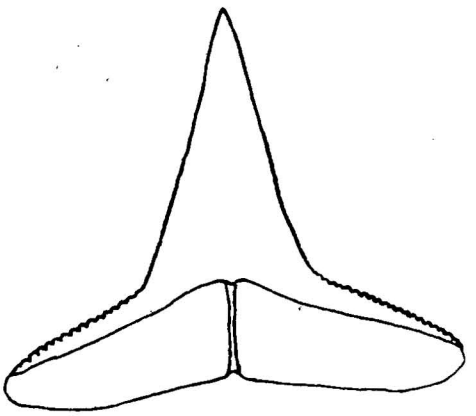


Figure 4

(10) If: The teeth of the upper jaw are deeply notched in a sharp angle, on the outer edge and rather coarsely serrate toward the basal portion, as in Figure 5a, see Section 11.

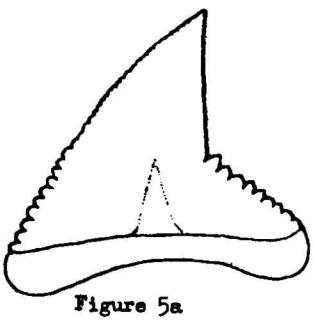


Figure 5a

But if: the teeth of the upper jaw have the outer edge deeply curved, but not sharply notched, and are very finely serrate, as in Figure 5b, the fish is an INJERTO (Eulamia lamiella).

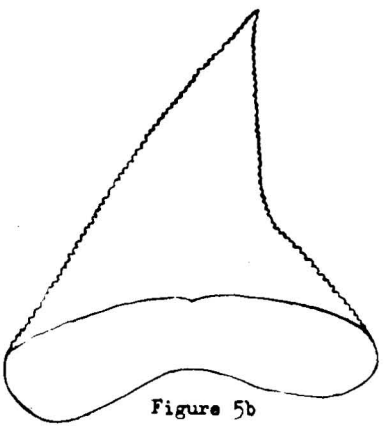


Figure 5b

(11) If: Some of the fins are tipped with white, the fish is Eulamia platyrhynchus.

But if: None of the fins are tipped with white, the fish is a PILOTA (Eulamia galapagensis).

A KEY TO THE HAMMERHEAD SHARKS OF THE WEST COAST OF MEXICO

These sharks are distinguished from all others by the peculiar shape of the head, which is expanded at the sides to become mallet-shaped or shovel-shaped. Five kinds of hammerheads have been described, as follows:

(1) If: A line drawn from the hind border of one eye to the hind border of the other passes through the mouth (i.e., both jaws), see Section 2.

But if: A line drawn from the hind border of one eye to the hind border of the other, passes in front of the mouth, or merely crosses the upper jaw, see Section 3.

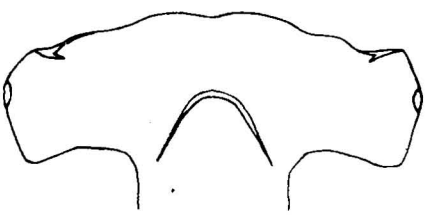


Figure 6

(2) If: The hind border of the second dorsal fin is so prolonged that when that part of the fin is lifted upward, it reaches about twice as high as the fore border of the fin; and if the distance along the hind margin of the lateral expansion of the head is at least equal to the distance between the angles of the mouth, the fish is the CORNUDA or MARTILLO (Sphyrna diplana), see Figure 6.

But if: The hind border of the second dorsal fin is not so prolonged, so that when that part of the fin is lifted upward it reaches only about as high as the

fore border of the fin; and if the distance along the hind margin of the lateral expansion of the head is only about three fourths of the distance between the angles of the mouth, the fish is Sphyrna vesperina see Figure 7.

(3) If: The fore edge of the head is lobed (i.e., more or less scalloped), as in Figures 9 or 10, see Section 4.

But if: The fore edge of the head is smooth, as in Figure 8, the fish is Sphyrna media.

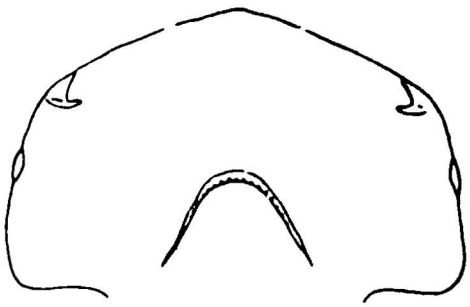
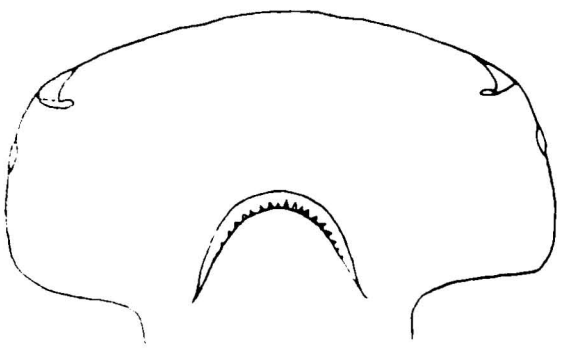


Figure 7



Figure

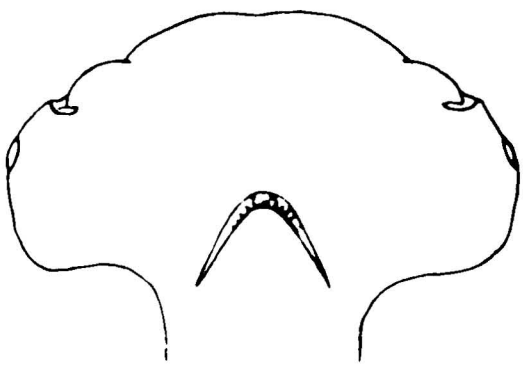


Figure 9

(4) If: The fore margin of the head is deeply rounded, as in Figure 9, and the distance from the nostril to eye is greater than the diameter of the eye, the fish is Sphyrna corona.

But if: The fore margin of the head is only slightly curved, as in Figure 10[1/], and the distance from nostril to eye is not greater than the diameter of the eye, the fish is Sphyrna tudes.

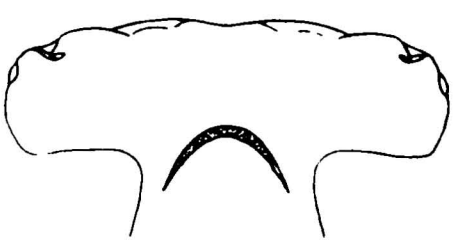


Figure 10

0-0-0

1/Figures 7 to 10 taken from "Three New Sharks of the Genus Sphyrna from the Pacific Coast of Tropical America," by Stewart Springer, Stanford Ichthyological Bulletin, Vol. 1, No. 5, pp. 161-169. By permission of Mr. Springer and the Stanford Natural History Museum.