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INTRODUCTION

THE OBJECT of the present paper is to review the literature on *Makaira* and, based on the literature and on field material, to establish a stable taxonomy for the genus and its species. This constitutes a preliminary paper for the author's section on speared fishes in "Fishes of the western North Atlantic"¹ and a discussion of the species that are extralimital in that series of publications.

The study of *Makaira* and its related genera has always presented physical difficulties because of the size of these fishes and the difficulty of preserving and shipping them. Many type species have been based on photographs or on specimens hastily examined in a market; others are mounts, some of which have been greatly distorted by inexperienced taxidermists.

In localities where marlins are taken only by anglers, few specimens can be retained or even thoroughly examined by scientific workers, because the skins, head, and fins must be kept in condition for mounting. When the catch is commercial or can be eaten, the fish is often "dressed" at sea and arrives at the dock without head, fins, or viscera. Elsewhere it is impossible to keep a specimen a sufficient length of time for anything but a most superficial study, because of the danger of spoiling it as food.

No single investigator has yet been able to cover all the known *Makaira* range, and many have been able to examine only one or two specimens. Authors living in widely separated parts of the world have worked independently on the genus, often with insufficient literature at their disposal and usually with an insufficient number of specimens.

All these circumstances have contributed heavily to taxonomic errors, greatly increased by Jordan and Evermann's 1926 paper, the work most available in the past. Jordan and Evermann themselves state that "the preliminary work which makes up this paper is done almost entirely on a basis of photographs" (p. 36), and that "the measurements in this and other species [of *Makaira*] are not very exact, they having been taken in the

market, often in the midst of an auction. In Misaki, especially, the difficulties were considerable as the fishermen feared that our strange incantations might in some way injure these large and costly fishes" (p. 54).

In addition, the Jordan and Evermann paper contains a great many errors of translation and transcription, contradictory statements, and keys to which features with no apparent source have been added. However, the paper cannot be completely ignored taxonomically.

In the present paper, distribution is listed wherever it has been confirmed or constantly rumored. In most localities marlins are not commercially sought, and for this reason, and because of the general difficulty in landing and handling them, there undoubtedly remain many geographical localities, and possibly depths, in which marlins occur but which as yet have been unobserved.

I wish to express my gratitude for help in securing and handling specimens, and for other generously given cooperation, to Dr. Charles M. Breder, Jr., Dr. Vernon E. Brock, Mr. Roy W. Cann, Mme. Chiang Kai-shek, Dr. Antonio Cordeiro, Dr. Fernando de Buen, Dr. and Mrs. Roy B. Dean, Dr. William I. Follett, Mr. Gilberto Guajardo, Dr. Yoshio Hiyama, Colonel John K. Howard, Dr. Carl L. Hubbs, Mr. and Mrs. Russ Kline, Prof. T. P. Koh, Mr. and Mrs. Michael Lerner, Dr. Etienne Loppé, Dr. G. E. Maul, Dr. James Morrow, Mr. Jiro Murase, Mr. John T. Nichols, Mr. Luis R. Rivas, Dr. William F. Royce, Commander Kenneth Strickler, the Ocean City Marlin Club of Maryland, and the committees of the International Light Tackle Sailfish tournaments.

FIELD MATERIAL

The field material on which keys and other portions of the present paper are based was all examined on the grounds when freshly caught, and is as follows:

Makaira ampla: Specimens taken in 1937 off Bimini, Bahama Islands, and examined by G. M. Conrad and F. LaMonte, and on the same grounds from 1947 to 1951, examined by F. LaMonte.

¹ Sears Foundation for Marine Research, Yale University, New Haven, Connecticut.

Makaira albida: Specimens taken off Bimini in 1950 and 1951, and off Ocean City, Maryland, in 1953, examined by F. LaMonte.

Makaira mazara: Specimens taken in Australia and New Zealand in 1939, examined by Gregory and Conrad, and off Acapulco, Mexico, in 1948, 1949, and 1952, examined by F. LaMonte.

Makaira mazara tahitiensis: Taken off

Acapulco, Mexico, in 1948 and 1949, examined by F. LaMonte.

Makaira mitsukurii: Taken off Australia and New Zealand in 1939, examined by Gregory and Conrad, and off Talara, Peru, and Tocopilla and Iquique, Chile, in 1940 and examined by F. LaMonte.

In all species, fishes of comparable sizes and of both sexes were available.

SYSTEMATICS AND DESCRIPTIONS

CLASS PISCES

SUBCLASS TELEOSTEI

ORDER ACANTHOPTERYGII

SUBORDER XIPHIIFORMES¹

KEY TO THE GENERA OF THE XIPHIIFORMES

- I. No pelvic bones or pelvic fins. Neural spines not expanded or flattened; haemal spines slightly expanded distally. Air bladder simple. Adults scaleless. One keel on either side of the caudal peduncle; spear slightly crowned above, flat beneath, smooth, long, heavy *Xiphias* (swordfish)
- II. Neural and haemal spines flattened and much expanded. Pelvics present.² Air bladder sacculate. Adults scaled. Two keels on either side of the caudal peduncle. Spear cylindrical, diminishing to a point at its end, rugose.
 - A. Pectorals long or moderately long; dorsal fin comparatively high anteriorly, diminishing rapidly in height posteriorly *Makaira* (marlin)
 - AA. Pectorals short.
 - a. Dorsal fin only slightly higher anteriorly, not falcate, maintaining an even height to its end. Pectoral fins very short and set low on the sides *Tetrapturus* (spearfish)
 - aa. Dorsal fin sail-like, rising rapidly to a central height of more than double that of the body below it *Istiophorus* (sailfish)

DISCUSSION OF GENERA RELATED TO *MAKAIRA*³

FAMILY XIPHIIDAE

XIPHIAS LINNAEUS, 1758

SWORDFISH, BROADBILL, MEKAJIKI (IN JAPANESE)

Xiphias LINNAEUS, 1758, *Systema naturae*, ed. 10, p. 248; "In oceano Europae."

¹ Only recent forms are included. The fossils *Palaeorhynchus*, *Blochius*, and *Acestrus* have been assigned to the Suborder Xiphiiformes by various authors.

² The very fragile pelvic fins of marlin, sailfish, and spearfish are more often injured or missing than not by the time the fish are landed, which accounts for figures and descriptions that omit these fins, although obviously intended for the genera with pelvics.

³ Synonymy of the related genera and their species will appear in a subsequent paper. We have had no field material of *Tetrapturus*.

TYPE, AND ONLY SPECIES: *Xiphias gladius* Linnaeus, 1758.

The swordfish is easily distinguished by its flat, heavy sword, the absence of scales and pelvic fins, and the single keel on its caudal peduncle. In color it varies from bronze above and whitish below to grayish blue or black above and light below. It is widely distributed, with confirmed occurrences as follows: Japan, Korea, Formosa, Philippine Islands, Australia, New Zealand, Hawaiian Islands, from California to Peru and Chile (to slightly south of Calderá), from Newfoundland south to Cuba, Rochedos do São Paulo, Iceland, Baltic Sea, from Scandinavia to Portugal and south along the west African coast to Senegal, off the Azores and the Canary Islands, through the Strait of Gibraltar into the Mediterranean and through the Bosphorus to the Sea of Marmora and the Black Sea, from the Cape Province of Africa around the tip and north to Durban, off Madagascar, Réunion Island.

This is an important food fish and the object of large commercial fisheries.

Free eggs, larvae, and juveniles are well known off Messina, where the spawning fish swim into the large stationary tuna nets, and have been found in other localities.⁴

FAMILY ISTIOPHORIDAE

TETRAPTURUS RAFINESQUE, 1810

SPEARFISH, FURAKAJIKI (IN JAPANESE)

Tetrapturus RAFINESQUE-SCHMALTZ, 1810, *Catterati di alcuni nuovi generi e nuove specie di animali . . . della Sicilia*, pp. 54-55, pl. 1, fig. 1; Sicily.

TYPE SPECIES: *Tetrapturus belone* Rafinesque, 1810.

Tetrapturus can be distinguished from *Makaira* by its much more slender body, shorter spear, shorter pectorals, lower-lobed and evenly high dorsal, and smaller caudal span. In color, it resembles *M. albida*.

⁴ Arata (1954), Beebe (1941), Herre and Herald (1950), LaMonte (1944), LaMonte and Marcy (1941), Nakamura (1949), Sanzo (1910, 1922, 1930), Sella (1911), and Voss (1953). Nakamura (1949) refers to a paper not available to me: Nakamura, H., 1935-1936, "Larval states of shorefishes appearing in the vicinity of Ominato (parts 12, 14)." *Yoshokukai Shi* 5, pages 191-195; 6 pages. 133-139" (sic).

Nakamura (1949, p. 38) says that in this genus the gonads are asymmetrical, as opposed to those of *Makaira*, in which they are "generally symmetrically paired." Specimens of various *Makaira* species examined in the field by the present author frequently showed gonads of which one was shorter, narrower, or flatter than the other.

There seem to be two valid species of the genus: *T. belone* Rafinesque, the Sicilian fish, and *T. angustirostris* Tanaka, 1914, from Japan (pl. 8, fig. 1).

Tetrapturus is rare in most parts of its known range. Nakamura (1943) says that it occurs abundantly in offshore waters in the Kuroshio Current.

Occurrences in the following areas have been authenticated: Florida, northern France, Sicily, Hawaiian Islands, Formosa, and Japan.

Nakamura (1949, pp. 41-45) says, "in waters adjacent to Formosa it spawns around November to December in an area . . . centered 150 miles offshore in the Pacific . . . fish with ripe eggs and unripe eggs [were] taken together," but that "nothing at all is known yet about the larvae and their development."

Spartà (1953) says that *T. belone* is taken in the Straits of Messina from mid-August through September, that sexual maturity is reached by spring and summer, and that a larva hatched in the laboratory (Istituto Talassografico) is in all probability this fish. Royce reports it as fairly frequent in Hawaiian markets. Through the courtesy of Mr. Al Pflueger of Miami, I have seen two mounts of *Tetrapturus*.

Whitley (1931b, p. 148) says that "a new generic name may be required for the Japanese swordfish figured by Tanaka with its elevated spines, short snout and short pectorals." This is *Tetrapturus angustirostris* Tanaka shown in figure 1 of plate 8 of the present paper. The short snout and short pectorals are diagnostic for the genus; the "elevated spines" apply to the slightly elevated dorsal lobe. The Tanaka specimen measured 200 cm. from the tip of the spear to the tip of the upper caudal lobe.

ISTIOPHORUS LACÉPÈDE, 1803

SAILFISH, BASHOKAJIKI (IN JAPANESE)

Plate 5

L'Istiophore porte-glaive LACÉPÈDE, 1803, His-

toire naturelle des poissons, vol. 3, pp. 374-375.

Istiophorus LACÉPÈDE, 1855, Histoire naturelle de Lacépède comprenant les cétacés . . . et les poissons . . . avec des notes et la nouvelle classification de A. G. Desmarest, vol. 2, pp. 232-233.

TYPE SPECIES: *Scomber gladius* Bloch, 1801 (in Bloch and Schneider, Systema ichthyologiae, vol. 1, p. 93, genus 21, no. 1; vol. 2, p. xxix, pl. 21; "les mers des grandes Indes").

Some authors regard the sailfish as monospecific; others believe that the Atlantic and Pacific sailfishes are different species, and occasionally add a third species from the Indian Ocean.

Istiophorus is a brilliantly colored fish, the body bright blue above, silver below, and the huge dorsal brilliant blue, often spotted with dark purple or black. Even when the dorsal is furled, the fish is easy to recognize because of its slender body and long slender spear.

Occurrence has been confirmed for the following areas: Rhode Island, New York, Maryland, North Carolina, Florida, Alabama, Texas, Bermuda, northern Bahamas, Cuba, Jamaica, Puerto Rico, Venezuela, British Honduras, Brazil, Windward Islands, France, Senegambia, Gold Coast (Africa), the Mediterranean, California, Mexico, Panama, Colombia, Ecuador, Korea, Japan, Formosa, Philippine Islands, Marianas Islands, Fiji Islands, Papua, Malaya, Red Sea, Persian Gulf, Ceylon, Cape Province, Madagascar, and north along the coast of East Africa to Italian Somaliland.

Although sometimes marketed locally, *Istiophorus* is not commercially sought.

Larvae and juveniles are well known from various areas, and the developmental cycle of the sailfish is better known than that of the other speared fishes. Spawning habits, eggs, larvae, and juveniles have all been studied.¹

MAKAIRA LACÉPÈDE, 1803

MARLIN

Makaira LACÉPÈDE, 1803, Histoire naturelle des poissons, vol. 4, pp. 689-691, pl. 13, fig. 3; France.

Tetrapturus, non Rafinesque, 1810, *sed* CUVIER AND VALENCIENNES, 1831, Histoire naturelle des

¹ Beebe (1941), Günther (1873, 1874), Herre and Herald (1950), Lütken (1880), Nakamura (1949), and Voss (1953). Nakamura (1949) lists an article not available to me: Nakamura, 1940, "On the spawning habits of sailfish. Dobutsugaku Zasshi, 52."

poissons, vol. 8, p. 293 (*non* pl. 229); (*indicus*); Sumatra.

Histiophorus PHILIPPI, 1887, An. Univ. Chile, 1 secc., Mem. Cient. Lit., vol. 71, p. 568, pl. 8; (*audax*); Chile.

Marlina GREY, 1928, Nat. Hist., vol. 28, p. 47, photograph on p. 48, *nomen nudum*; (*mitsukurii*); New Zealand. HIRASAKA AND NAKAMURA, 1947, Bull. Oceanogr. Inst. Taiwan, no. 3, pp. 15-16, pl. 3, fig. 1; (*marlina*); Formosa.

Istiompax WHITLEY, 1931, Australian Zool., vol. 6, p. 321, *nomen nudum*; (*australis*); Australia. WHITLEY, 1931, Rec. Australian Mus., vol. 18, pp. 147-150; Australia.

Kajikia HIRASAKA AND NAKAMURA, 1947, Bull. Oceanogr. Inst. Taiwan, no. 3, p. 12, pl. 2, fig. 1; (*mitsukurii*); Formosa.

Eumakaira HIRASAKA AND NAKAMURA, 1947, Bull. Oceanogr. Inst. Taiwan, no. 3, p. 16, pl. 2, fig. 2; (*nigra*); Formosa.

Prov. *Pseudohistiophorus* DE BUEN, 1950, Publ. Cient. Serv. Oceanogr. y de Pesca, Montevideo, no. 5, p. 171; (*illingworthi*); Hawaii.

TYPE SPECIES: *Makaira nigricans* Lacépède, 1803.

Lacépède's description was based on a rough sketch later found among his papers by Cuvier and Valenciennes. The type specimen was washed ashore near La Rochelle, France, following a storm. Lacépède never saw the fish, which was eaten. A rough sketch of it, with notations of measurements and other characters, was sent him by a friend. Figure 3 of his plate 13 is not this original sketch, but one which Lacépède had someone redraw according to the measurements accompanying the original sketch. However, plate 13, figure 3 does not fit the original measurements as given by Lacépède, particularly differing in the length of the spear, which is much shorter in the figure than in the description.

The length given by Lacépède is "330 cm. longueur totale," and the weight, "trois cent soixante-cinq kilogrammes." If figure 3 of plate 13 is to be considered, the length would appear to have been taken from the point of the too-short spear to the mid point of the outer caudal margin, which makes comparison with standard lengths impossible. The original description does not mention lateral line, scales, or pelvic fins.

Cuvier and Valenciennes have added to the confusion by giving the weight and measurements of the specimen in the inexact "livres," "pieds," and "pouces," and conflicting state-

ments of its length ("dix pieds," "vingt pieds").

Lacépède's description of his type, *M. nigricans*, and the accompanying drawing do not warrant specific identification with any marlin at present known or found elsewhere in the literature. As far as length-weight proportions go, *M. nigricans* Lacépède appears to agree most closely with the Pacific species *M. mazara*, but *M. nigricans* was an Atlantic fish. Although the species can never be identified, the genus was adequately described. If the type is not retained, the replacement type must be designated from in or near the same locality. As there appears to be no suitable specimen available, I propose to retain the genus but to consider the species *Makaira nigricans* Lacépède unidentifiable.

One other specimen causing much confusion is a skull in the museum in La Rochelle, France, labeled "Makaira. Il de Rè, 1772." Professor Etienne Loppé of the La Rochelle Museum has kindly sent me photographs of the skull, which is that of an *Istiophorus*. Jordan and Evermann (1926, p. 58) have shown one of the same photographs, calling it *Makaira ensis* (Lacépède). They refer to the same two photographs as being of two skulls, whereas in reality they are two aspects of the same skull.

Makaira has been studied on the commercial grounds around Formosa and Japan by Koh, Hirasaka, and Nakamura. Unfortunately, because of my lack of knowledge of either Chinese or Japanese, the reports have been available to me only in part, through the kindness of Professor Koh and Mr. Jiro Murase, and in the fine translations by W. G. Van Campen. On the other hand, Western literature obviously has not been entirely available to the Chinese and Japanese authors. Owing to this fact, some of their taxonomy is not up to date, and some new genera and species are not valid, although it is evident that they know the fishes very well. It is hoped that the present paper will enable the adoption of a standard nomenclature for the *Makaira* species, so that workers in all parts of the world will be certain just what fish is under discussion.

The following description of *Makaira* is based on field material examined by the author.

The weight of the adult *Makaira* varies

from that of *M. albida*, which is considered good-sized at between 30 and 60 pounds and has a known maximum weight of only 161 pounds, to that of *M. mazara* for which there is a constantly reported weight of about 2000 pounds and a known record weight of 1560 pounds. The length of the last specimen was 14 feet 6 inches. Nakamura (1949, p. 51) indicates that there are consistent size differences in the sexes of the same fish.

The body is streamlined and fusiform, heavy at the shoulder, and tapering gradually towards the widely lunate tail. There are two keels on either side of the caudal peduncle. The dorsal outline of the head rises from the nostrils to the origin of the dorsal fin. The tip of the more or less falcate dorsal lobe, which varies in height in the different species, is the highest point of the fin; from there it descends to much lower rays which gradually decrease in height posteriorly. The anal fin is also lobed and, although its base is much shorter, similar in outline to the dorsal. Both fins can be furled into a groove, and their last few rays are usually invisible unless sought for and pulled up out of the groove. This is often quite difficult to do and accounts for some of the widely varying fin counts in the literature. There are shallower grooves for the pectorals and the pelvics. The first few rays of the dorsal are difficult to distinguish as they are fused and are covered with fairly thick skin. The second dorsal and second anal fins are much lower and shorter and differ in shape from the other fins as the photographs show (pls. 6; 7; 8, fig. 2; 9-12). The caudal lobes are long, their tips wide apart. The pectoral fins are outwardly normal in shape and differ in length depending on the species. The pelvics are very narrow, very fragile, and almost always injured. They consist of one unbranched and two fragile soft rays joined by a short, thin membrane. Only the unbranched ray continues for the full length of the fin.

The fin count varies in individuals of the same species, but insufficiently to be diagnostic. The dorsal count runs III 33-42; the anal II 10-13; the pelvic count is I 2 and does not vary.

The scales of adult *Makaira* are more or less flattened, elongate, and thorn-shaped, sometimes bifid. They are thickly and irregularly set all over the body except on the top

of the head, the belly, and the fins, which are scaleless. *Makaira albida* scales are smaller, flatter, and somewhat more regularly set than those of the other species. The lateral line is clearly visible in some species, inconspicuous or invisible in others.

The flesh is whitish, pinkish, or, towards the caudal region, reddish, and often soft and quite granular.

The spear is rugose and cylindrical, narrowing towards its pointed tip. It is often broken and very often has regenerated with some deformity. Occasionally the injury has evidently been sustained when the spear was still soft, and as a result the adult spear is bifid.

The lower jaw is comparatively fragile, pointed, and much shorter than the upper. The inside of the mouth is white or pink. The tongue is adnate except at its extreme tip. The sides of the jaws, spear, and all but the tip of the tongue are covered with tooth-like rugosities.

The triangular nostrils are single, about 19-26 mm. long, and divided by a median membranous septum.

The eyes are large, from 52 to 71 mm. in diameter, laterally placed, and supported in a bony cup.

There are four gill arches. The gills are laminated and paired, and each pair is attached at the base. There are no gill-rakers.

The air bladder is physoclastic, sacculate, and very long.

The stomach is sac-like. There is a large mass of pyloric caeca. The intestines are long. The liver is comparatively small; the spleen and the gall and urinary bladders are very small. The kidneys lie close to the vertebral column and are inconspicuous.

The gonads lie forward and ventrad in the body cavity, close to the body floor and on either side of the stomach. They are often unlike in size and vary greatly in the individual fish depending on sex and on stage of sexual activity or maturity. In one 505-pound female *M. ampla* taken off Bimini, both gonads measured 575 mm. long and 185 mm. in circumference. The vasa deferentia exit from the gonad about $3\frac{1}{4}$ inches from its free tip and converge at the anus. The anus lies approximately twice as far from the spear tip as from the base of the caudal.

The vertebral count is 24. The neural and

haemal spines are expanded and shaped like propeller blades.

The color of the *Makaira* species is discussed under the individual species, but in all *Makaira* the spear, top of the head, caudal, second dorsal and second anal fins, and the pelvics are usually dark.

These fishes seem particularly subject to injuries, especially to the fragile pelvics, but various other frequent injuries and regenerated parts were observed in field specimens. In a 482-pound *M. ampla*, one of the caudal keels was missing and the area had healed. In another, some of the rays of the first anal had been injured, had regenerated to some extent, and had become fused and overgrown with flesh which also covered part of the anal groove. In a third, the dorsal groove was overgrown with flesh for some distance, and some of the rays lay beneath the flesh. Injuries to the pelvics and the spear tip are more frequent than not.

The food of *Makaira* depends to some extent on the local supply, but squid seem to be most favored. In *M. mitsukurii* examined in Peru and Chile, we found only squid in the stomachs. We saw these squid in the water at night in great numbers from the surface to several feet down. Apparently the marlins fed on them at night, because in the fish taken in the morning the squid were less thoroughly digested than in those taken in the afternoon, and by late afternoon or evening the stomachs usually contained only the eyes and the beaks of the squid. In several blue marlin (*M. ampla*) taken off Bimini, I found small *Scomberomorus* partially digested; in one fish, the skull and bones of a small grunt; in another, some squid and a few unidentifiable fish bones; in another, an almost untouched *Caranx latus* about 15 inches long; in another, the bait (a bonefish); and in one, a bonito that weighed 5½ pounds, doubled tail to head and almost whole—the only food in the stomach. Baughman, in a letter of November 17, 1940, reports that "four marlin taken off the Texas coast had been feeding on snappers." Donald Erdman writes from Puerto Rico that during a fishing tournament off San Juan, from October 11 to 16, 1954, he examined the stomach contents of the 14 *M. ampla* caught, and found them "all more or less full with the exception of one empty stomach," and containing "pre-

dominantly many small triggerfish two to three inches long (*Xanichthys ringens*, which is an offshore species of open sea) and numerous small silvery filefish one or two inches long (*Monacanthus hispidus*) . . . and remnants of one small black-fin tuna about eight inches long."

Nelson Benedict of the Newark Star-Ledger has reported to me that on August 14, 1953, white marlin taken in a concentration 28 miles south-southeast of Beach Haven, on the 20-fathom curve, water temperature 76° F., were full of flying fishes, small bluefish, bonito, skipjack, and gulf weed.

In white marlins (*M. albida*) from Ocean City, Maryland, Wallace and Wallace (1942) report predominance of *Etrumeus sadina*.

Dr. D. G. Maitland of Sydney, Australia, writes me, "I have actually watched a pair of black marlin feeding upon *Physalia* . . . and absolutely ignoring tempting looking mackerel bait drifting in front of their noses." *Scomberesox saurus* has been reported in the stomachs of marlin taken off New Zealand. Nakamura indicates that myctophids have been found in the stomachs of "Istiophoridae."

Studies by Hubbs and Wisner (1953) suggest that *M. mitsukurii*, off California, "feeds chiefly on the saury, *Cololabis saira*," although the authors found the following fishes in 32 marlins caught near San Diego: northern anchovy, Pacific sardine, jack mackerel, Pacific mackerel, halfmoon, bonito?

Neither Hubbs and Wisner nor the present author has ever seen any evidence that the food found in the stomachs of *Makaira* had been slashed or impaled by the spear of the fish. It must be added, however, that the spear is certainly used to some extent in attack or defense (probably the same instinct in a fish), as witnessed by several instances of marlins' ramming small boats, and by an incident off Cuba, reported to us in a letter from Mr. Emilio de Mesa of Havana, and one off the Cape Province, Africa, reported by K. H. Barnard (1951, p. 265). During the last war, a German submarine sank a boatload of crude rubber near the port of Nuevitas, Cuba. Bundles of the material were picked up by fishermen and sold to dealers for repairing automobile tires. In some of the bundles of this hard stuff were found broken-off marlin spears which had penetrated into

the rubber from 3 to 5 inches. One bundle contained three such spears. Dr. Barnard reports a bale of rubber washed ashore near Kleinmond, Cape Province, pierced by two *Makaira* spears and cites another case of a piece of rubber about 12 inches thick pierced by a marlin spear.

The marlins we examined were quite free from parasites except for an occasional trematode, and *Penella*, which was most frequently attached in the cheek region. We also found, on the pelvics and on the scaleless belly, a small organism which has been mistaken in the literature for scales, but which proved to be a parasite, identified for me by Prof. Lyell Thomas as an arthropod. Dr. James Morrow has recently sent me a specimen of an orange-colored, encysted parasite which he found frequently in Peruvian *Makaira*, and which Dr. Ross Nigrelli has identified for us as a trematode, *Glomeritrema subcuticula* Yamaguti. Yamaguti (1942) described this from a *Makaira mitsukurii* taken off Naha (Nawa) on the southern tip of the Ryu-Kyu Islands. In 1881, Ramsay listed as parasitic on a New South Wales marlin, "*Echeneis*, *Caligus* and *Penella*."

The genus *Makaira* is widely distributed in the Atlantic, Pacific, and Indian oceans and is usually found in blue water in moderate depths. Detailed accounts of the migratory movements of the marlins in Japanese and adjacent waters, as well as the sex ratio of fishes examined there, can be found in Nakamura (1949).

Discussion of the very scanty knowledge of spawning, eggs, larvae, or young of *Makaira* is given under the species and under the section on possibly juvenile forms.

These fishes are the object of widespread rod and reel angling for sport, and, in a few areas, of commercial fisheries both on set lines and by harpoon. When hooked by anglers, the marlin leaps frequently and spectacularly; off Ecuador, the present author has also seen the fish leaping when free.

There is little commercial fishing for marlin off the United States where it is seldom eaten except when smoked. A commercial fishery of small size exists in Cuba, and the fish is marketed locally elsewhere. In numerous localities outside the United States it is considered good food when it happens to be taken. It is commercially caught off Formosa

and Japan, particularly in the Kuroshio (Kuroshiwo) Current, and in the South China and Philippine seas. The set lines, which Dr. Koh tells me are set at about 30 and 60 fathoms, appear to be primarily for the purpose of catching tuna.

KEY TO THE SPECIES OF *Makaira*¹

- I. Body slender, its depth less than pectoral length; dorsal height usually greater than, but occasionally equal to, body depth; spear long, slender; cross bars on sides of body
 - A. Depth in length 5.6 to 7.5; this depth 1.03 to 1.63 in the pectoral. Head in length 1.98 to 3. Dorsal lobe greater than body depth and 1.02 to 1.25 in the pectoral. Lateral line conspicuous. Body brilliantly colored, cross bars conspicuous. Average adult weight 30 to 60 pounds; maximum confirmed weight 161 pounds at a length of 8 feet 8 inches (standard or total?) *albida* (Poey), white marlin, Atlantic
 - B. Depth in length 5.4 to 6.58; this depth 1 to 1.8 in the pectoral. Head in length 2.46 to 2.72. Dorsal lobe equal to or greater than body depth and 1 to 1.3 in the pectoral. Lateral line invisible or very inconspicuous. Body color and cross bars vary greatly in intensity. Average adult weight 250 to 300 pounds. Maximum confirmed weight 692 pounds at a length of 13 feet 5 inches. *mitsukurii* (Jordan and Snyder), striped marlin, Pacific
- II. Body robust; depth usually greater than pectoral length but may run to 1.16 in it; dorsal lobe low, 1 to 1.9 in depth, never greater than depth. Spear stout. Cross bars present or not on sides of body.
 - A. Low dorsal, deep body, short, stout spear. Color usually uniform, not brilliant.
 1. Dorsal 1.34 to 1.7 in body depth and 1.3 to 1.5 in the pectoral. Head in length 2.56 to 3, spear shorter and stouter than that of *M. m. tahitiensis* or *M. ampla*. Depth in length 4.3 to 5.5; this depth greater than to 1.16 in the pectoral. Body usually uniformly dark, occasionally faintly barred. Adult weight reported up to 2000 pounds; confirmed maximum weight 1560 pounds at a length (standard or

¹ This key was made from adult, fresh specimens. Males and females of comparable sizes were available. Length is standard, taken from the spear tip unless otherwise stated. The color is that of fresh specimens.

- total?) of 14 feet 6 inches
 *mazara* (Jordan
 and Snyder), black marlin, Pacific
2. Dorsal lobe 1.39 to 1.9 in body depth,
 1.5 in pectoral. Head in length 2.56 to
 2.7; spear less short and stout than
 that of *mazara*. Depth in length 4.08
 to 5.28; this depth greater than to
 1.07 in the pectoral. Body usually
 uniformly washed with dirty white;
 head and fins usually dark; dorsal
 often has large dark spots on the
 membrane. Adult weights confirmed
 up to 755 pounds at a length (stand-
 ard or total?) of 13 feet 7½ inches . .
 *mazara tahitiensis* (Nichols
 and LaMonte), silver marlin, Pacific
- B. Dorsal lobe 1 to 1.6 in depth of body and
 1.1 to 1.59 in pectoral length. Head
 in body length 2.6 to 2.8; spear longer
 and more slender than that of *mazara* or
m. tahitiensis, but much stouter and
 more rugose than that of *albida*. Depth
 in length 4.4 to 6.3; this depth greater
 than or equal to pectoral length. Color
 brilliant blue above, silvery below; light
 bands usually visible to midline of body.
 Dorsal fin brilliant cobalt or purple-blue.
 Confirmed maximum size 742 pounds at
 a length (standard or total?) of 12 feet
 10½ inches
 *ampla* (Poey), blue marlin, Atlantic¹

Makaira albida (Poey), 1860

WHITE MARLIN

Plate 6

Tetrapturus albidus POEY, 1860, *Memorias sobre la historia natural de la Isla de Cuba*, vol. 2, pp. 237-244, 258-260; 1861, *tom. cit.*, pl. 15, fig. 1; north coast of Cuba.

Tetrapturus lessonae CANESTRINI, 1861, *Arch. Zool. Anat. Fisiol.*, Genoa, vol. 1, fasc. 1, pp. 259-261, pl. 17; Liguria.

Makaira albida (Poey) JORDAN AND EVERMANN, 1926, *Occas. Papers California Acad. Sci.*, vol. 12, pp. 66-67; "West Indies northward in Gulf Stream to Woods Hole."

Tetrapturus belone, non Rafinesque, 1810, *sed* LEGENDRE, 1928, *Bull. Soc. Zool. France*, vol. 53, pp. 391-392, fig. 1; Finistère, Brittany (male). DESBROSSES, 1938, *Bull. Soc. Zool. France*, vol. 63, pp. 48-58; west-northwest of Groix, Brittany (female).

¹ Dr. Royce, who has examined many specimens from the warmer waters of the equatorial Pacific, tells me that this species occurs there, but not off the west coast of South America where the water is colder.

Tetrapturus georgii, non Lowe, 1840, *nec* Fowler, 1936, *sed* TORTONESE, 1940, *Boll. Mus. Anat. Comp. Torino*, ser. 3, vol. 48, pp. 173-178; Genoa.

Makaira albida (Poey) is one of the two Atlantic marlins. Its outstanding characters are its slender body and spear, its conspicuous lateral line, and its high dorsal lobe. Its scales are also smaller, shorter, flatter, and more regularly arranged than those of *M. ampla*.

This fish usually shows more green in its color than do the other species of *Makaira*. The upper part of the body is brilliantly greenish blue, darker above, the color becoming lighter and more brilliant towards or just above the median body line, where it suddenly changes to bright whitish silver. The belly is whitish. The body is crossed by light blue or light lavender bars. The dorsal fin is brilliant blue, often blotched or spotted with black, purple, or, on portions of the fin nearest the base, white. The fin rays are dark.

The maximum rod and reel catch was 161 pounds; its length was given as 8 feet 8 inches. A weight of 800 pounds incorrectly reported for this species by Jordan and Evermann (1926, p. 67) is the weight given by Poey for *Makaira ampla*. The average size for this fish in North American waters is from 30 to 60 pounds. Dr. Arsenio Cordeiro of Lisbon reports several of over 80 pounds off Madeira. A fish weighing 10½ pounds thought to be this species was caught off Miami Beach, Florida, in 1939.

Occurrences of *M. albida* in the following areas have been confirmed: Nova Scotia, Massachusetts, New York, New Jersey, Maryland, North Carolina, Florida, Texas, Bermuda, northern Bahamas, Cuba, Jamaica, Puerto Rico, Venezuela, Brazil, Portugal, Azores Islands, Madeira, and the Italian Riviera. It has also been reported off British Honduras (Mather, 1952).

Its spawning habits are not known, and no free eggs, larvae, or juveniles have as yet been identified.

DISCUSSION OF SYNONYM

Tetrapturus lessonae Canestrini, 1861, Liguria: Canestrini's plate shows a fish with long, slender spear, high dorsal lobe, long pectoral fin, and long, rather slender body. The lateral line, not mentioned in the text,

TABLE 1
COMPARATIVE BODY PROPORTIONS OF *Makaira* SPECIES
(Measurements other than types are based on field material. Brackets indicate that figures or plates of the type were used, text material being lacking.)

	<i>Makaira ampla</i> (Poey)		<i>Makaira albida</i> (Poey)		<i>Makaira mitsukurii</i> (Jordan and Snyder)		<i>Makaira mazara</i> (Jordan and Snyder)		<i>Makaira mazara tahitiensis</i> (Nichols and LaMonte)	
	Range	Type	Range	Type	Range	Type	Range	Type	Range	Type
Head in standard length	2.6 -2.8	[2.6] ^a	1.98-3	[2.4]	2.46-2.72		2.56-3		2.56-2.675	[2.8]
Head from tip of lower jaw in length from tip of lower jaw	4.25-5.47	[4.7]	3.2 -5.4	[3.3]	3.5 -4.4		4.1 -5.37		4.27-4.3	[3.8]
Depth in standard length	4.4 -6.3	5	5.6 -7.5	[6.9]	5.4 -6.58	^b	4.3 -5.5		4.08-5.28	[5.2]
Dorsal height in body depth	1 -1.6	1.75	Greater		Greater than to very slightly less	Slightly greater than ^c	1.34-1.7		1.39-1.9	[1.7]
Dorsal in pectoral	1.1 -1.59	[1.3]	1.02-1.25	1	1 -1.3		1.3 -1.5	1.6	1.5	[1.5]
Depth in pectoral	greater -1	[1]	1.03-1.63	1	1 -1.8		Greater than -1.16	Greater than 1.33	Greater than -1.07	[Greater than]

^a Poey states that the size of the head depends on the sex, that of the female being larger. The type was a male fish 2453 mm. long.

^b In a second specimen without the head, 4 (Jordan and Snyder, 1901).

^c In a second specimen, 1 (Jordan and Snyder, 1901).

rises at the shoulder. The total length is given as 2240 mm.

Comparing this with a specimen of *M. albida* from Ocean City, Maryland, which measured 2220 mm., I find:

	OCEAN CITY SPECIMEN	CANESTRINI'S SPECIMEN
Depth in total length	8	8.6
Head in total length	3	3
Depth in dorsal	1.2	1.1
Pectoral in length	6	6
Lateral line	Distinct	Distinct (in the plate)

The smallest *Makaira ampla* measured in Bimini by the present author was 2520 mm. in total length. Comparing this with Canestrini's specimen, I find:

	BIMINI SPECIMEN	CANESTRINI'S SPECIMEN
Depth in total length	5.7	8.6
Head in total length	3.2	3
Depth in dorsal	Dorsal greater	1.1
Pectoral in length	5.8	6
Lateral line	Not visible	Distinct (in plate; not mentioned in text)

These figures leave little doubt that the Canestrini specimen should be synonymized with *M. albida* (Poey). We note that Jordan and Evermann's 1926 account of the Canestrini specimen contains errors both of translation and of transcription of numerals.

Tetrapturus belone of Legendre, 1928: This fish, identified by Legendre as *T. belone* Rafinesque, was taken on September 21, 1928, off the Brittany coast and brought in three days later to the Laboratoire Maritime at Concarneau, minus branchial arches, heart, and stomach. It measured 2.01 meters. Legendre's figure (fig. 1) is a poor photograph of a somewhat mutilated fish with the first dorsal flat to the ridge of the back, but showing clearly enough for one to determine that it is definitely not the dorsal lobe of *T. belone* Rafinesque. The spear also appears to be too long for that genus. The general appearance of the fish indicates *Makaira albida* (Poey).

Tetrapturus belone of Desbrosses, 1938: This fish, also taken off the Brittany coast,

200 miles west-northwest of the island of Groix, was gutted on board, the posterior portion of the opercles was cut off, and the ventral fins were removed. Measurements given in Desbrosses' account are of the gutted, mutilated specimen, but nevertheless plainly show it to be *Makaira albida*. If drawn to scale from the measurements given, the result would be a fish falling clearly into *M. albida* except for a somewhat too narrow body and too short head, two characters explicable by the gutting and the removal of part of the opercles before measurements were taken. Dorsal height, body depth, and length of spear and pectoral fin rule out its belonging to the genus *Tetrapturus*.

In 1940, Tortonese identified a mounted specimen from Genoa in the Turin Museum (N. Cat. 784) as *Tetrapturus georgii* Lowe (see p. 347 of the present paper). It is evident from the description given by Lowe, and quoted here in full, that, although the Lowe specimen was not a *Tetrapturus* and in all probability was a *Makaira*, it cannot be specifically identified. Tortonese gives, however, measurements that would place his fish in *M. albida*.

Makaira mitsukurii (Jordan and Snyder), 1901

STRIPED MARLIN, MAKAJIKI (IN JAPANESE),
PEZ AGUJA AND MARLIN (IN CHILE)

Plate 7; plate 8, figure 2

Tetrapturus mitsukurii JORDAN AND SNYDER, 1901, Jour. College Sci. Imp. Univ. Tokyo, vol. 15, p. 304, pl. 16, fig. 5; Misaki, Japan. There is apparently no type specimen.

Histiophorus audax PHILIPPI, 1887, An. Univ. Chile, 1 secc., Mem. Cient. Lit., vol. 71, p. 568, pl. 8; Iquique, Chile. Type apparently in the museum of the University of Chile, Santiago.

Makaira mitsukurii (Jordan and Snyder) JORDAN AND EVERMANN, 1926, Occas. Papers California Acad. Sci., vol. 12, p. 61, pl. 18; shores of Japan, Hawaii, and the Santa Barbara Islands.

Makaira mazara, non Jordan and Snyder, *sed* (*partim*) JORDAN AND EVERMANN, 1926, Occas. Papers California Acad. Sci., vol. 12, pl. 11, fig. 1; Hawaii.

Prov. *Makaira grammatica* JORDAN AND EVERMANN, 1926, Occas. Papers California Acad. Sci., vol. 12, p. 55, pl. 16; Hawaii.

Makaira holei JORDAN AND EVERMANN, 1926, Occas. Papers California Acad. Sci., vol. 12, pp. 63-64, pl. 19, fig. 1; California and Mexico.

Makaira zelandica JORDAN AND EVERMANN, 1926, *Occas. Papers California Acad. Sci.*, vol. 12, pp. 65-66, pl. 19, fig. 2; New Zealand.

Marlina mitsukurii GREY, 1928, *Nat. Hist.*, vol. 28, no. 1, p. 47, photograph on p. 48, *nomen nudum*; New Zealand.

Tetrapturus brevirostris, non Playfair, 1866, *sed* DERANIYAGALA, 1933, *Spolia Zeylanica*, vol. 18, p. 53; Ceylon.

?*Kajikia formosana* HIRASAKA AND NAKAMURA, 1947, *Bull. Oceanogr. Inst. Taiwan*, no. 3, pp. 13-14, fig. on p. 13; Formosa.

Kajikia mitsukurii HIRASAKA AND NAKAMURA, 1947, *Bull. Oceanogr. Inst. Taiwan*, no. 3, p. 14, pl. 2, fig. 1; Formosa.

Tetrapturus tenuirostratus DERANIYAGALA, 1951, *Spolia Zeylanica*, vol. 26, p. 139, pl. 1, fig. b; 1952, *A colored atlas of some vertebrates from Ceylon*, vol. 1, p. 105, pl. 27; Ceylon.

Since Jordan and Snyder described *Tetrapturus mitsukurii* from Misaki, Japan, in 1901, erroneously placing it in *Tetrapturus* instead of in *Makaira*, it has been known by their specific name and popularly as the striped marlin (in Japanese and Formosan waters as *makajiki*). However, in 1887, Philippi described and figured a fish from Iquique, Chile, as *Histiophorus audax* into which *M. mitsukurii* (Jordan and Snyder) fits. Philippi had both males and females. The type specimen appears to be in the museum of the University of Chile.

According to strict taxonomic observance, this fish should have been called *M. audax* (Philippi), 1887, and a few authors have so called it. But owing not only to scientific but also to angling interest in the fish, it has been very widely known by the other scientific name since 1901. In the hope that a proposal for a provision in the Règles Internationales de la Nomenclature Zoologique (see Hemming, 1953, paragraph 28, pp. 25-26), which would limit the Law of Priority, will be incorporated in the Règles, the present author here retains the specific name *mitsukurii*.

The body of this fish is slender, as is its long spear. The depth is 5.4 to 6.58 in the length and 1 to 1.8 in the pectoral fin. Further characters can be found in the key to the species of *Makaira*. Owing to the fact that *M. mitsukurii* is much less bulky at the shoulder than the other two Pacific marlins, the dorsal and ventral body outlines are characteristically smooth and streamlined,

whereas the other two fishes appear humped at the shoulder. The longer, more slender spear and higher dorsal lobe are also noticeable at once.

The striped marlin shows great variety in intensity of color and color pattern. The specimens seen in South America were fairly brilliant in the water, when fighting, and when just landed. There were a few light blue or lavender cross bars and a cobalt dorsal fin often spotted or blotched. The Australian and New Zealand specimens were startlingly cross-barred. South American and Mexican specimens were also seen in which the cross bars were very faint and the body appeared uniformly dark above and dark silvery below. This was particularly true of Mexican specimens and of the fishes of smaller size.

The largest striped marlin on record is a rod and reel catch of 692 pounds, which was 8 feet 8 inches long.

Occurrences of this fish have been confirmed from the following areas: southern California, Baja California, Gulf of California, Pacific coast of Mexico, Panama Canal Zone, Ecuador, Peru, Chile (northern), Hawaiian Islands, Fiji Islands, Korea, Japan, Formosa, Philippine Islands, and Ceylon.

Nakamura (1949, p. 44) writes that *Kajikia mitsukurii* spawning "seems to be at its peak from April to May, and in the fish taken at that season the gonads are generally well developed, ripe ova being seen frequently. At this season in Formosan waters this species is comparatively scarce in the Pacific coast waters and more abundant in the South China Sea. Consequently it is thought that spawning is carried on mainly in the South China Sea. In form the ripe ova are almost the same as those of the sailfish, and it is impossible to distinguish them merely by seeing the eggs. No data have been obtained as yet concerning the larval and juvenile forms. It is known that this species also spawns near the Ogasawara Is. in the Central Pacific around May-June."

DISCUSSION OF SYNONYMY

Histiophorus audax Philippi, 1887: Comparison of Philippi's description with *M. mitsukurii* field specimens leaves little doubt that they are the same fish.

	<i>H. audax</i>	<i>M. mitsukurii</i>
Dorsal in depth	Dorsal slightly greater	Dorsal slightly greater
Dorsal in pectoral	1.1	1-1.3 (field measurements average 1.1)
Depth in pectoral	1.14	1-1.8

The standard length in *H. audax* is given as about 2.5 in the dorsal height, which would make the standard length approximately 2544 mm. This would mean a head in length ratio of 2.6 and depth in length 5.8, as compared with head in length in *M. mitsukurii*, 2.46 to 2.72, average field measurement, 2.56, and a depth in length, 5.4 to 6.58, average field measurement, 5.7. I am therefore placing *H. audax* in *M. mitsukurii* (Jordan and Snyder).

Makaira mitsukurii (Jordan and Snyder) Jordan and Evermann, 1926: This species is correctly placed in *Makaira*. The original description is repeated, and some photographs are discussed.

Makaira mazara (Jordan and Snyder) Jordan and Evermann (*partim*) 1926: See pages 337, 338.

Makaira grammatica Jordan and Evermann, 1926: The type (Museum of the California Academy of Sciences No. 608) consists of a photograph and the dorsal fin of a specimen examined in the Honolulu market. The photograph shows a fish without its spear. The size of the specimen is not given. The dorsal, which is described as "middle part of dorsal . . . much . . . higher [than in *M. mazara*]," is shown in the photograph to resemble the dorsal of *M. mitsukurii*. It has been pulled up out of the groove for photographing. There is a possibility that this is a young fish. The measurements given are, for the most part, not the customary ones and therefore cannot be compared with those of other species. The dorsal height in the pectoral length appears to be that of *M. mitsukurii*, 1.16 (given by Jordan and Evermann as $1\frac{1}{6}$). In both *M. mazara* and *M. m. tahitiensis* the dorsal is lower than this. The photograph shows a high dorsal lobe equal to or greater than the body depth below it, although the tip of the fin is broken off, if full allowance is made for the body depth which is not clearly shown in the photograph.

Fowler (1928, p. 136) placed *M. grammatica* in *T. mitsukurii*, but later (1934, p. 400) put it questionably in *Tetrapturus mazara*. Herre (1953, p. 256) puts it in *M. mitsukurii*. It is here placed provisionally in *M. mitsukurii*, but if the size were known, it might turn out to be the juvenile form of this or some other species.

Makaira holei Jordan and Evermann, 1926: The type (Museum of the California Academy of Sciences No. 610) is a mounted specimen "taken presumably off Catalina, California, or off Lower California." The authors also had "photographs of others." The plate shown is not that of the type specimen, although presumably it represents the same species. Measurements, except for the depth, which is given as 4.5, an obvious misprint, are within those of *M. mitsukurii*. In Jordan and Evermann's key, the diagnostic characters are stated as "crossbars narrow, clear white," and "pectoral fin $1\frac{3}{4}$ in head slightly exceeding dorsal lobe which slightly exceeds depth of body and is a little less than pectoral; first anal higher."

Based on the above characters and the plate, I am placing *M. holei* in *M. mitsukurii*.

Makaira zelandica Jordan and Evermann, 1926: The type (Museum of California Academy of Sciences No. 611) is based on "a photograph received from Mr. Gilbert Archey, Curator of the Auckland Museum of a specimen taken in the Bay of Islands, New Zealand." The authors separate this species from *M. mitsukurii* on the grounds that "it appears to have a shorter spear, certainly has a lower dorsal lobe, and the color is not quite the same." The photograph, which is apparently of a mount, shows that the tip of the dorsal lobe is missing; otherwise the fish is recognizable as *M. mitsukurii*, where it is here placed.

Marlina mitsukurii Grey, 1928 (*nomen nudum*): In 1928, the late Zane Grey published an article on "Big game fishing in New Zealand seas," in *Natural History*, a popular publication of the American Museum of Natural History. The sentence in which the scientific name is used reads: "Captain Mitchell took two black marlin (*Makaira marlina*) of 685 and 976 pounds (the latter the world's record); 21 striped marlin (*Marlina mitsukurii*) ranging from 192 to

360 pounds and averaging $259\frac{1}{2}$ pounds" (The rest of the sentence concerns other fishes.) Further references to the marlins concern only their behavior on the angler's hook. There are two photographs, one captioned "R. C. Grey standing beside his 386-pound striped marlin swordfish," the other "Capt. L. D. Mitchell with his 976-pound black marlin swordfish."

The above quotation does not constitute a valid description of a genus, and the fish that is widely known as the striped marlin should remain *Makaira mitsukurii* (Jordan and Snyder).

Whitley (1931b, p. 147) says that "*Marlina* Grey, 1928, is distinguished by its striped body and reduced scales, and the Striped Marlin Swordfish of New Zealand, which has been called *Makaira mitsukurii* would be better termed *Marlina zelandica* (Jordan and Evermann) on zoogeographical grounds." I feel that the grounds in this case are purely geographical and are insufficient to justify any splitting of *Makaira mitsukurii*.

Kajikia formosana is possibly a juvenile, probably, as Hirasaka and Nakamura first thought, of *M. mitsukurii*. Their *Kajikia mitsukurii* "(Jordan and Evermann) 1901" is *Makaira mitsukurii* (Jordan and Snyder), 1901. Hirasaka and Nakamura have eliminated the genus *Makaira* on the grounds, in my opinion unjustifiable, that "the characteristics of *Makaira* [are] very indistinct," and have made a new genus from the Japanese common name for speared fishes.

Tetrapturus brevirostris (Playfair) Deraniyagala, 1933: This fish from Ceylon, which measured 8 feet 8 inches, is without doubt *M. mitsukurii*. *Tetrapturus brevirostris* of Deraniyagala (1949; in an article not available to me) was put by that author in 1951 into the synonymy of *Tetrapturus tenuirostratus* Deraniyagala. This species was based on "a fish in the British Museum labelled *Makaira indica*." The photograph given is of a Ceylon specimen, freshly caught. The dorsal fin is being held so that one cannot see the height of the lobe. Deraniyagala also puts into *T. tenuirostratus*, *Histiophorus brevirostris* Day, 1889, which is probably a juvenile. Deraniyagala's "A colored atlas of some vertebrates from Ceylon" (1952, vol. 1, pl. 27) shows a plate labeled *Tetrapturus*

acutirostratus Deraniyagala, which has been corrected on an insert slip to read *Tetrapturus tenuirostratus* Deraniyagala. This plate should not be used diagnostically. In describing the characters of this species (p. 105), he gives the length as 2640 mm. but does not say whether or not it is the length of the type. The description, not very detailed, states that "the branched rays of the first dorsal at mid length are about half the height of its anterior lobe," which eliminates this fish from the genus *Tetrapturus* and puts it definitely in *Makaira*, and, in my opinion, in all probability it is *M. mitsukurii*.

***Makaira mazara* (Jordan and Snyder), 1901**

BLACK MARLIN, PEZ-ZUNCHO (IN CHILE),
KUROKAJIKI (IN JAPANESE)

Plate 9

Tetrapturus mazara JORDAN AND SNYDER, 1901, Jour. College Sci. Imp. Univ. Tokyo, vol. 15, pp. 304-305; Misaki, Japan. Apparently there is no type specimen.

?*Tetrapturus indicus* CUVIER AND VALENCIENNES, 1831, Histoire naturelle des poissons, vol. 8, pp. 286-287¹; Sumatra. *Prov.* STEAD, 1906, Fishes of Australia, p. 170, fig. 61; New South Wales; 1908, The edible fishes of New South Wales, p. 100, pl. 68; New South Wales. McCULLOCH, 1921, Australian Zool., vol. 2, p. 106, pl. 34; New South Wales.

Tetrapturus australis WALL, 1854, Illus. Sydney News, March 11; Australia (inadmissible). WHITLEY, 1954, Australian Zool., vol. 12, p. 58; New South Wales.

Histiophorus gladius, non Bloch, 1801, *sed* RAMSAY, 1881, Proc. Linnean Soc. New South Wales, vol. 5, pp. 295-297, pl. 8; New South Wales.

Tetrapturus brevirostris, non Playfair, 1866, *nec* Day, 1878, *sed* VAN KAMPEN, 1908, Natuurkund. Tijdschr. Nederlandsch-Indië, vol. 67, pp. 120-124; Batavia.

Makaira marlina JORDAN AND HILL, 1926, *in* Jordan and Evermann, Occas. Papers California Acad. Sci., vol. 12, pp. 59-60, pl. 17; Pacific coast of Mexico.

Makaira mazara (Jordan and Snyder) JORDAN AND EVERMANN, 1926, Occas. Papers California Acad. Sci., vol. 12, pp. 53-54 (*partim*, non pl. 11, fig. 1); Pacific Ocean, Japan, and Hawaii. NAKAMURA, 1938, Rept. Fish Exp. Sta. Govt. Formosa, vol. 10, p. 20, pl. 10; Formosa. GRIFFIN, 1927,

¹ The few dimensions that are given fit either this species or *M. m. tahitiensis*.

Trans. Proc. New Zealand Inst., vol. 58, pp. 141-143, pl. 13, fig. 5; New Zealand.

Tetrapturus mitsukurii, non Jordan and Snyder, 1901, *sed* FOWLER, 1928, Mem. Bernice P. Bishop Mus., vol. 10, p. 136 (*partim*); 1934, Mem. Bernice P. Bishop Mus., vol. 11, p. 400, figs. 1, 2; Japan.

Istiompax australis WHITLEY, 1931, Australian Zool., vol. 6, p. 321; Australia; 1931, Rec. Australian Mus., vol. 18, pp. 147-150; Australia (type only).

Eumakaira nigra HIRASAKA AND NAKAMURA, 1947, Bull. Oceanogr. Inst. Taiwan, no. 3, pp. 16-18, pl. 2, fig. 2; South China Sea and Japanese Current.

Prov. *Makaira herscheli*, non Gray, 1838, Table Bay, *sed* J. L. B. SMITH, 1950, The sea fishes of southern Africa, p. 315¹; east coast of Africa.

Makaira mitsukurii HERRE, 1953, Rept. Fish and Wildlife Serv., U. S. Dept. Interior, no. 20, pp. 255-256; Philippine Islands (*partim*).

?*Istiompax howardi* WHITLEY, 1954, Australian Zool., vol. 12, pp. 58-60, pl. 3, fig. 3; New South Wales.

This species can be distinguished by the great depth of body at the shoulder and by the comparatively short spear and low dorsal lobe. The lateral line is not usually visible externally.

Gregory and Conrad (1939, pp. 453-454) in their qualitative characters give as their best criterion for identifying the black marlin, the following character: "In most fishes the adducted pectoral fin lies flat against the side of the body, that is, the plane of the upper surface of the fin is in a vertical position . . . This normal twist which brings the adducted fin (in which the upper surface is horizontal) to the snug, vertical, adducted position is noted in most marlins. In *marlina* [*M. mazara*], . . . however, the twist which streamlines the pectoral against the flank of the body is lacking and thus, when adducted, the pectoral remains in the horizontal position. This character was observed on all of the black marlins examined."

This character, it will be noted, is a movement, not an anatomical structure. It may be proved, however, that the whole pectoral complex of bones, tendons, and muscles in some way prevents the fin from being brought flat against the body. In this case, the rigid pectoral will be the chief diagnostic character for this species and very likely may go far to

prove that *M. m. tahitiensis*, in which it is also reported, does not warrant subspecific distinction.

Professor T. P. Koh of Taiwan University tells me that the rigid pectoral in Formosan marlins is characteristic of the *shirokajiki* (*M. m. tahitiensis*) and not of *M. mazara*, the *kurokajiki*. This confirms rumors that in Hawaii the fish called the silver marlin has a rigid pectoral and accounts for its frequent confusion with the black marlin. Specimens of the silver marlin seen by the author in Acapulco did not have rigid pectorals as far as could be seen. They were extremely heavy specimens and had been pulled up to the dock over a high stone wall several feet above the boats. It is possible that in the rough handling, which scarred both sides of the fishes, something had broken and the pectoral therefore lay flat. There is no question of misidentification by Dr. Koh, as the Japanese name *shirokajiki* (white speared-fish) and the Chinese name *pu-pi* (white skin) both refer to the pale tone. Dr. Yoshio Hiyama of Tokyo also reports a rigid pectoral for the *shirokajiki*, and not for the *kurokajiki*. The local name for the *shirokajiki*, Dr. Koh tells me, is *lee-tsu*, which means erect fin.

Makaira mazara is usually uniformly dark for at least three-quarters of the sides, whitish below. All the fins are dark. Occasionally dark blue forms part of the color pattern of the upper side and dorsal fin, and, infrequently, indistinct lateral bars are to be seen immediately after the fish has been fighting or immediately after death. The dorsal is frequently blotched or spotted. The eye, brown in life, is bluish after death. Further diagnostic characters are given in the key to the species. *Makaira mazara* is well known to anglers, particularly when of large size and is then easily recognizable, but is not so easily distinguished when small or of medium size. Since the establishment of an angling club in Cabo Blanco, Peru, which has facilitated fishing in a hitherto quite inaccessible area, this marlin has been taken on rod and reel in very large sizes: 1020, 1051, and 1560 pounds, the last the heaviest weight to date, although the fish is constantly reported to reach 2000 pounds. Dr. James Morrow writes me from Cabo Blanco that a black marlin seen by him weighed only 108 pounds and

¹ Plate 67, page 317, should not be used for diagnosis.

was an immature female. The 1560-pound specimen was 14 feet 6 inches long.

Occurrence of *Makaira mazara* has been confirmed for the following areas: Gulf of California, Acapulco, Panama Canal Zone (Pacific), Peru, Hawaiian Islands, Korea, Japan, Formosa, Philippine Islands, Australia, and New Zealand. There are persistent reports of the fish in the Fiji Islands, Samoa, Natal (East Africa), Kenya, and Tanganyika.

Nakamura (1949, p. 44) says that "spawning of the black marlin occurs from April to August in the waters east of Luzon and Formosa, and eggs from ripe ovaries have been collected. There is not as yet, however, any material on the larval and juvenile states. The form of the ripe ova is just like that of the sailfish and *K. mitsukurii*¹ [*Makaira mitsukurii* (Jordan and Snyder)]."

DISCUSSION OF SYNONYMY

Tetrapturus mazara Jordan and Snyder, 1901: The species was based on a specimen from Misaki, Japan, stated by Jordan and Evermann (1926) to have weighed 1080 pounds. The type description gives the length as 10 feet without the spear. While the original description is not very complete and lacks a figure, it gives dorsal count, dorsal body outline with "high back, profile rapidly rising to dorsal," dorsal in pectoral, shape of dorsal, and, in the key, mentions the "very long pectoral" and the short dorsal.² It also gives a color description, but this must have been based on information given to the authors, not on the market specimen on which the type seems to have been based and which could not have retained the color described. These authors say that the fish is known in Japan as *kurokajiki*.

Tetrapturus indicus Cuvier and Valenciennes, 1831: This species was based on a drawing sent to the authors by Sir Joseph Banks. The specimen came from Sumatra. The authors did not see the fish. It is stated to have been "9 pieds" long and to have weighed "200 livres." The snout is described

as proportionately long and a fifth of its length [standard or total?]; its ventrals only about a half. The first dorsal lobe was about three-fourths of the depth of the body beneath it, getting rapidly lower and reaching four or five times lower for the rest of its length. Although Cuvier and Valenciennes say that it is "in every way a *Tetrapturus*" and very close to that of the Mediterranean, but with a longer spear, their description of the dorsal removes it from *Tetrapturus*, and that character, with the rest of the description, puts it into *Makaira mazara* or possibly *M. m. tahitiensis*.

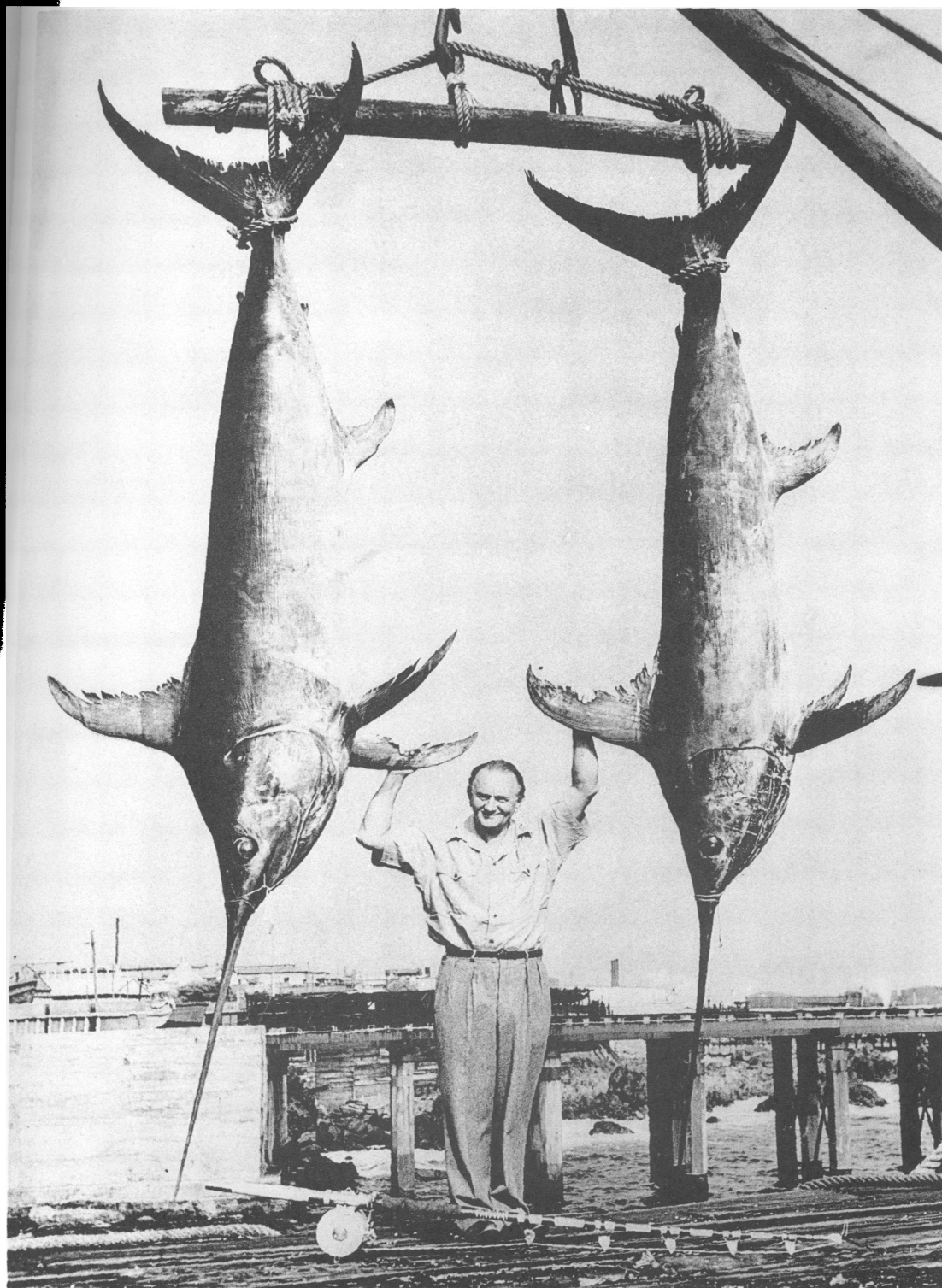
Stead (1906) shows a rather ambiguous figure, which he calls *T. indicus*. It has the comparatively low dorsal and short spear of *M. mazara*. He refers, in this popular account, to a specimen of about 12 feet long taken off Manly in 1905, and says that the photograph and spear are in the New South Wales Department of Fisheries. He refers to the fish as being the same species as that of the Wollongong specimen (Ramsay, 1881). Stead gives a photograph of the Manly specimen. It shows a laterally half-submerged fish which, although apparently a *Makaira* and probably *M. mazara*, is not more certainly identifiable. This is not the specimen from Manly referred to by Whitley (1931b, p. 149).

McCulloch (1921, p. 106), in a key, defines the genus *Tetrapturus* as having a single ventral ray and low dorsal and puts *T. indicus* Cuvier and Valenciennes and *Histiophorus gladius* of Ramsay "(nec Broussonet)" into *M. mazara*.

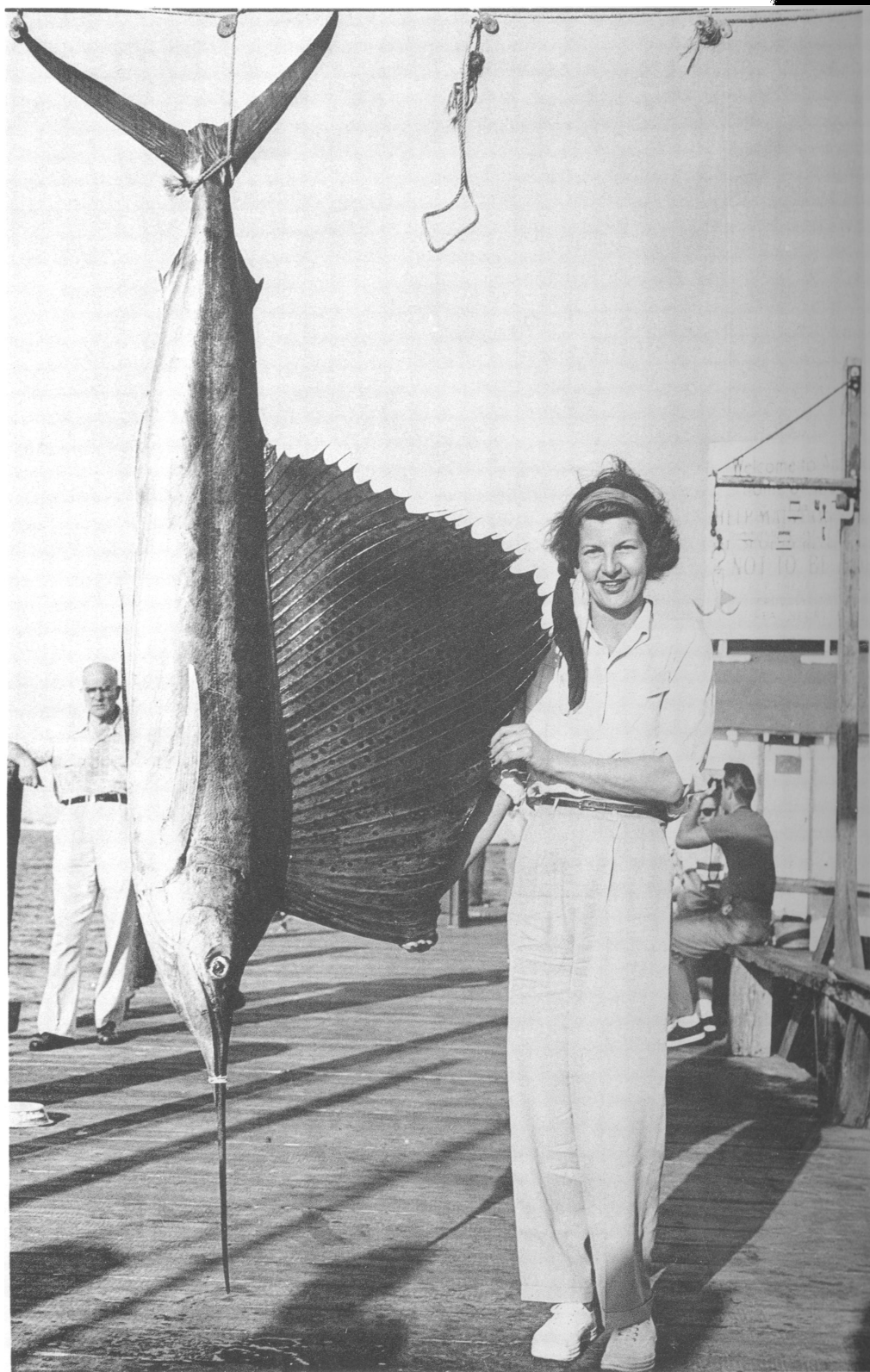
Istiompax australis Whitley, *Tetrapturus australis* Wall, *Tetrapturus australis* Macleay MS, *Histiophorus gladius* Ramsay: Whitley (1931a) named a new genus *Istiompax* and a new species, *I. australis*, in the Australian Zoologist (p. 321), stating that "The holotype of the new species, which is also the orthotype of the genus" is the specimen figured by Ramsay (1881)—*Histiophorus gladius* Ramsay. He says the specimen is mounted in the Australian Museum and that he has also examined a fresh specimen from Manly. The description is too inadequate to be valid for either genus or species. However, in the Records of the Australian Museum (1931b, pp. 148-150) Whitley describes his genus and species and gives the species synonymy.

¹ Nakamura's (1949) bibliography lists an article I have not seen: Nakamura, 1938, "On the spawning habits of the black marlin. Dobutsugaku Zasshi, 50."

² Both here and in Jordan and Evermann (1926), the dorsal height is given as " $1\frac{1}{2}$ in the length of the body without the head"; this is probably an error for $5\frac{1}{2}$.



Xiphias gladius, swordfish, caught off Tocopilla, Chile. Lerner-Peru-Chile Expedition photograph



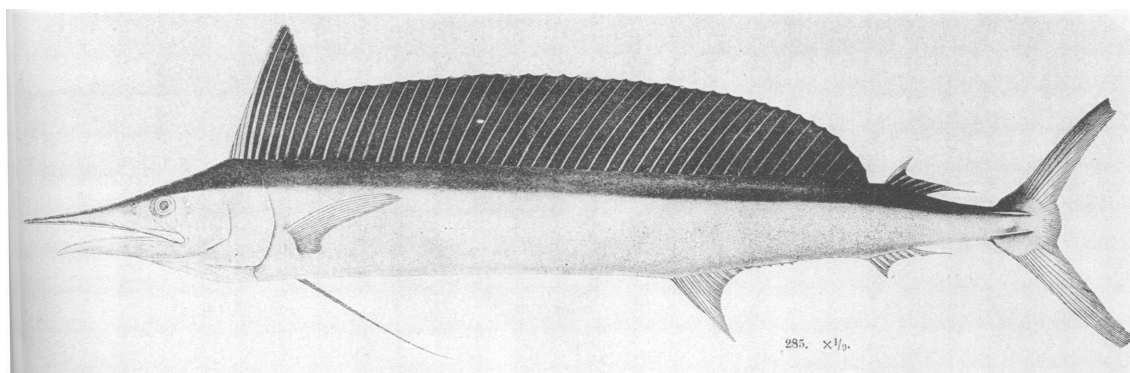
Istiophorus americanus (Cuvier and Valenciennes), sailfish, caught off Palm
Courtesy of Mrs. G. A. Bass; photograph by S. R. Quincy



Makaira albidus (Poey), white marlin, caught off Montauk, New York. Courtesy of Mrs. P. Dater; photograph by D. Edwardes



Makaira mitsukurii (Jordan and Snyder), striped marlin, caught off Tocopilla, Chile. 1.
Expedition photograph



1. *Tetrapturus angustirostris* Tanaka, spearfish, Japan. From Tanaka (1913-1915, pl. 88, fig. 285)



Istiophaga mitsukurii (Jordan and Snyder), striped marlin, caught off New Zealand. Lerner-Australia-
and Expedition photograph



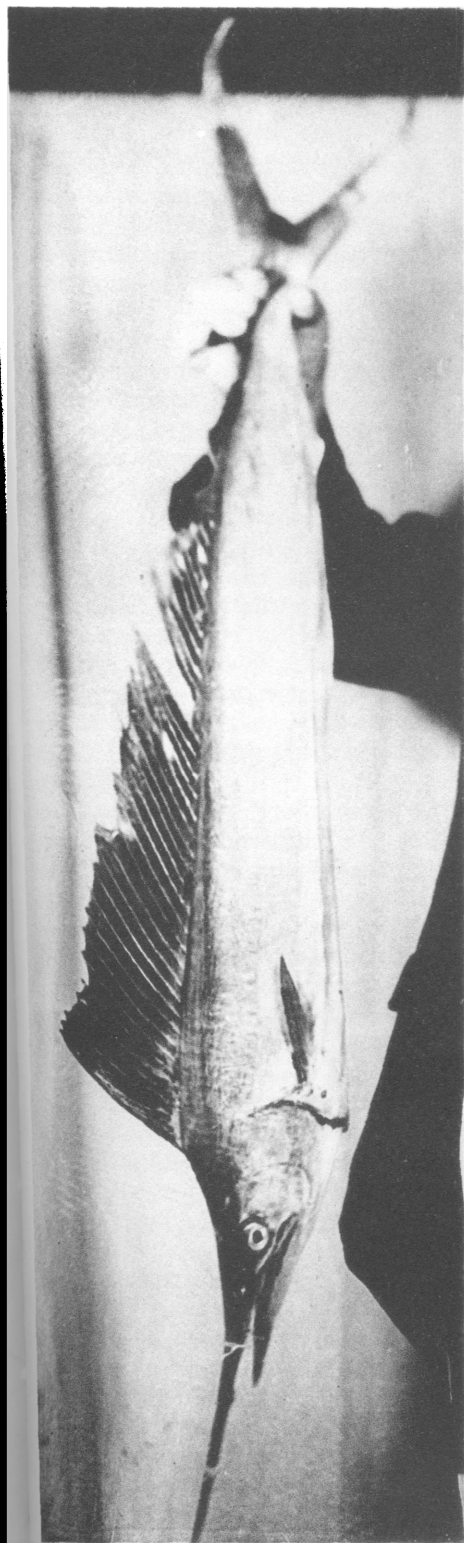
Makaira mazara (Jordan and Snyder), black marlin. Caught by Alfred C. Glassell, Jr.; photo by Richie Studio



Makaira mazara tahitiensis (Nichols and LaMonte), silver marlin, caught off the Hawaiian Islands.
Courtesy of Mrs. C. M. Cooke, III



Makaira ampla (Poey), blue marlin, caught off the Bahamas. Courtesy of Mrs. E. D. Shaffer; photograph by Carl Walden Studio



Fish from Mooloolabah, Australia, weighing 4 pounds 5½ ounces. Courtesy of Messrs. Alfred Radcliffe and J. Carrodus

Fish taken off Hawaii, weighing 97 pounds. Courtesy of Messrs. C. M. Cooke, III, and C. M. Cooke, IV

Among the synonyms of *I. australis*, he gives "*Istiompax australis* Whitley . . . [ex *Tetrapturus australis* Macleay MS]," a name, of course, invalid because of its having appeared in manuscript only. In 1954 (p. 58) he gives the synonymy of the genus *Istiompax*, again listing the invalid *Marlina* Grey, 1928, and also as orthotype of *Istiompax*, *I. australis* (Wall). The Wall references, of which I have obtained photostats, appear to be unsigned, and were published in a newspaper, the Illustrated Sydney News of March 11, 1854, and September 2, 1854. Mr. Whitley, who has been kind enough to help untangle the matter of the Wall reference, tells me that the latter article was signed, although there is no signature on the photostat. I feel that this item should be explained and should be excluded from further synonymy, as the name used in the articles, *Tetrapturus australis*, is invalid because of insufficient description and because it was published in a newspaper.

The Ramsay (1881) specimen, called by him *Histiophorus gladius*, was harpooned off Wollongong, New South Wales, and towed ashore. As this reference is not to be found in most libraries, part of his description is quoted here:

"The specimen was a male, 13' 4" to the center of the caudal fin." Its "dorsal fin was about half the height of the body . . . profile strongly curved to the snout. Height of body measured from the base of dorsal spines about $\frac{1}{2}$ total length; head from tip of snout to posterior margin of gill cover $\frac{1}{4}$ total length." The figure shows about 3.5 to a perpendicular between the tips of the caudal lobes. The plate clearly shows a lateral line, but it is not mentioned in the text. The general color is given as "a deep bluish-black (much lighter when alive) on the back and sides, above the median line, below which it is of a bright silvery hue, almost white on the belly." Although the author mentions "much lighter when alive," he did not see this fish when it was alive, as it was taken to him three days after its capture, and he writes that he received it "in quite a fresh state." The height of the body is given as 2 feet 6 inches opposite the dorsal fin; the height of the first dorsal from the base as 18 inches; the length of the pectoral, 2 feet 4 inches; the length of head with snout, 4 feet 5 inches;

the length of lower mandible to gape, 16.5 inches, to gill-cover, 21 inches. These dimensions place the fish in *Makaira mazara*.

Tetrapturus brevirostris of Van Kampen (1908) was a stuffed fish in the Buitenzorg Museum, examined by Van Kampen and identified by him as *T. brevirostris* (Playfair). He does not state whether he is dealing with the fish in a stuffed or a fresh state, but we may assume that it was fresh, as he says it was a male. His dimensions fit those of *M. mazara*, between which and the Buitenzorg specimen he himself found no important differences.

Taxonomically, confusion has been caused by Jordan and Hill's (in Jordan and Evermann, 1926) *Makaira marlina*. The general implication in the literature is that either *M. mazara* (Jordan and Snyder) or *M. marlina* Jordan and Hill is the black marlin, and that the other name is that of a different fish, the so-called silver marlin. A theory has also been advanced by anglers that the silver marlin and the black marlin are the two sexes of the same fish.

From specimens of both black and silver marlins examined off Acapulco, Mexico, I can state that the difference is not one of sexual dimorphism.

Jordan and Evermann include a photograph (pl. 11, fig. 1) which they identify as *Makaira mazara*. This photograph, of a specimen examined in the Honolulu market, shows a fish from which the spear has been cut and of which the posterior third of the body is submerged and invisible. What remains is a fairly good photograph of *M. mitsukurii*, showing the typical body depth, dorsal fin, and a clear color pattern typical of *M. mitsukurii* for some time after death, but not at all typical of *M. mazara*. On page 59 of Jordan and Evermann, Jordan and Hill describe a new species, *Makaira marlina*. All their material was photographic, and they state that they have "never seen a specimen of the Giant Black Marlin of the east Pacific." Their type is a photograph of a fish taken off Cape San Lucas, Baja California, and reproduced as their plate 17. This photograph is recognizable as the fish now universally known as the black marlin, which is *Makaira mazara* (Jordan and Snyder). Jordan and Hill differentiate it from *M. mazara* on the basis

of "deeper body, lower fins, shorter spear and plain coloration," but the photograph with which they are comparing it is the one mentioned above which is a picture of *M. mitsukurii* as far as anyone can possibly determine. The length of the pectoral is included in their description despite the fact that in the photograph the pectoral is, as often in photographs, shown to be so distorted that any measurements of it could not possibly be correct.

The diagnostic characters given in Jordan and Evermann's key, presumably with Hill's knowledge, are:

"Median dorsal spines rather high, half to one-third dorsal lobe . . . pectoral fin usually black, its length much exceeding depth of body [this statement is probably due to the fact that Jordan and Evermann are really discussing the slender-bodied *M. mitsukurii*]; dorsal lobe moderate, shorter than pectoral. Sides without pale lateral streak; pale cross-bands rather faint; median dorsal spines moderate

. *mazara* (Hawaii; Japan)
Median dorsal spines very low, 5 to 6 in dorsal lobe; pectoral fin barely equal, or not equal, to depth of body; body very robust, the depth 5 in body from tip of spear to base of caudal; dorsal lobe low, about $1\frac{1}{2}$ in pectoral; spear short (from eye), twice rest of head. Body plain steel-color with no pale cross bars and no white spots on fins . . . *marlina* (Pacific coast of Mexico)"

The characters given for *M. marlina* in the key are in some ways a better description of *M. mazara* than is the type description. It is obvious that *M. marlina*, which was described by Jordan and Hill as a different species, based on their plate 17, belongs in *M. mazara*.

Nakamura (1938) also had fishes of both sexes. In Japan and Formosa, as we have stated, one is known by a local name meaning white speared-fish, the other by a name meaning black speared-fish. Almost all authors agree that the fish called *kurokajiki* (black speared-fish) is *Makaira mazara*, but many of them call the *shirokajiki* (white speared-fish) *Makaira marlina*.

Griffin (1927, pl. 13, fig. 5) figures a typical *Makaira mazara* which he calls by that name and says was a "black marlin, inactive female." Into its synonymy he puts *H. gladius* Ramsay, 1881 "(nec Broussonet)," *Tetrapturus*

turus mazara Jordan and Snyder, *Tetrapturus indicus* of Stead and of McCulloch, and *Makaira mazara* of Jordan and Evermann. He gives a good description of *Makaira mazara* (Jordan and Snyder) which the fish undoubtedly is.

Fowler (1928, p. 136) puts *Makaira mazara* of Jordan and Evermann and *Makaira mitsukurii* from the same work, both Hawaiian specimens, into *Tetrapturus mitsukurii* Jordan and Snyder (1901), thereby retaining an incorrect genus and including in the species *mitsukurii* a fish the description of which by Jordan and Evermann is partly that of a *M. mazara* (Jordan and Snyder) and partly that of a *Makaira mitsukurii* (Jordan and Snyder) (Jordan and Evermann, 1926, pl. 11).

Fowler also puts into *Tetrapturus mitsukurii*, Jordan and Evermann's *Makaira grammatica*, here considered to be a synonym of *M. mitsukurii* (Jordan and Snyder). He does not mention Jordan and Snyder's *T. mazara* which, as we have said, only partially corresponds to Jordan and Evermann's *M. mazara*. In the same paper, Fowler retains *Tetrapturus brevirostris* (Playfair), originally *Histiophorus brevirostris* Playfair and undoubtedly a *Makaira*.

Fowler later (1934, p. 400, figs. 1, 2) changed his 1928 synonymy and retained *Tetrapturus mazara* Jordan and Snyder, including in it, questionably, *Makaira grammatica* Jordan and Evermann and *Tetrapturus mitsukurii* Fowler (1928, p. 136, *partim*; *non* Jordan and Snyder, 1901).

In making this change in 1934, Fowler entirely omitted *Tetrapturus brevirostris* (Playfair) but retained *T. illingworthi* and *T. ectenes*, although he says that they are "likely synonyms" of *mazara*, and further describes *T. ectenes* as "a doubtful nominal species described from an imperfect photograph." *Tetrapturus kraussi*, here placed with *T. illingworthi* and *T. ectenes* in unidentifiable specimens, was put questionably under *T. illingworthi* by Fowler.

As we have said above, *Tetrapturus* is a distinct genus, established by Rafinesque in 1810 on his type *T. belone* from Sicily and characterized by a low-lobed dorsal of even height, long narrow body, short spear, short pectoral, and narrow caudal span.

Istiompax: Whitley's synonymy (1931b, p. 148) for *Istiompax australis* Whitley is as follows:

"*Histiophorus gladius* Ramsay, 1881 . . . Male holotype of *Istiompax australis* Whitley, 13 ft. 4 in. long, in the Australian Museum. Off Wollongong, New South Wales; July 4, 1880. *Id.* Tenison-Woods, . . . 1882 . . . Not '*Scomber gladius* Broussonet, . . . 1786,' which according to authors, is a species of *Istiophorus*, but Mr. C. D. Sherborn states (*in lit.*) 'Pure invention, no such name occurs.' I have not seen this paper.

"*Tetrapturus indicus* Waite, . . . 1904 . . . *Id.* Stead, . . . 1906 . . . (Manley, N.S.W.) . . . *Id.* McCulloch, . . . 1921, . . . 1922 . . . Not *T. indicus* Cuv. and Val., 1831.

"*Makaira mazara* Griffin, . . . 1927 . . . *Id.* McCulloch, 1929 . . . Not *Tetrapturus mazara* Jordan and Snyder, 1901, from Japan.

"*Tetrapturus herschelii* McCulloch, . . . 1929. . . . Not *Tetrapturus herschelii* Gray, 1838, from South Africa.

"*Istiompax australis* Whitley, . . . 1931¹ . . . Off Wollongong, N.S.W. Type in Austr. Mus. [Australian Museum]. (Ex *Tetrapturus australis* Macleay MS.)"

Ramsay's specimen was a *Makaira*, incorrectly identified by him as *Histiophorus gladius* (Bloch), a sailfish incorrectly attributed by many authors to Broussonet. The Waite 1904 reference is simply a check list of New South Wales fishes. There is no way of knowing what Whitley intended by "*T. indicus* C. and V.," as he has included in it Day's plate 47, figure 3, which seems to me to be a juvenile fish, which it also appeared to be to Day. *Tetrapturus indicus* Cuvier and Valenciennes is, in my opinion, either *Makaira mazara* or its subspecies.

The Tenison-Woods reference is not available to me.

The Stead, McCulloch, Griffin, and Jordan and Snyder references are discussed in the above pages.

Whitley seems arbitrarily to have split individual specimens from Australia from the species, putting them into new species that have only geographical locality as a separating character.

In discussing *Istiompax*, Whitley gives dimensions of two other specimens assigned

by him to *Istiompax*. One of these, a specimen from Port Stephens, New South Wales, is probably a juvenile; the other, from Manly (not preserved) was a fish 13 feet 1 inch long, as compared to Ramsay's fish which was 13 feet 4 inches long (both measured to the end of the middle caudal rays). The Manly specimen fits neither *Makaira mazara* nor *Makaira mazara tahitiensis* very well, but there are some peculiar differences between it and the Ramsay specimen which was only 3 inches longer. Although so nearly the same size, the dorsal lobe of the Manly specimen is $5\frac{1}{2}$ inches lower than that of Ramsay's fish; the height of the body at the same point is $7\frac{1}{2}$ inches less; the length of the lower jaw to the gill-cover is 1 foot 3 inches greater; the tip of the snout to the pectoral fin is 2 feet 2 inches greater. Other than absolute dimensions, nothing is given about this specimen except the general color which was "light bluish grey, without vertical stripes. First dorsal fin brownish, with some dark spots between lower halves of spines; second dorsal greyish." The dorsal color would indicate that the fish had been out of water for a long time. The dimensions would indicate that it was not the same species as Ramsay's fish. Working out the fish to scale from the Manly dimensions results in a specimen of which the anterior part of the body appears in depth like that of *Makaira mitsukurii*, but in other dimensions like *M. mazara*. The body would be extremely long and narrow. I believe that this specimen should be put in unidentifiable species, as the fish has been destroyed, and I suspect that mistakes in the dimensions have gotten into print. The depth measurement could be due to the fact that the fish had been gutted or had been kept a sufficient length of time for dehydration to have caused considerable shrinkage.

I would place *Istiompax* in *Makaira* Lacépède and *I. australis* Whitley in *Makaira mazara* (Jordan and Snyder). The Manly fish described by Whitley is, in my opinion, an unidentifiable species, and the Port Stephens specimen should be put under possible juvenile *Makaira*.

Eumakaira nigra Hirasaka and Nakamura (1947, pp. 16-18, pl. 2, fig. 2): Hirasaka and Nakamura have put ?*Tetrapturus mazara* Jordan and Snyder and *Makaira mazara*

¹ This reference is to Whitley (1931a) where the new genus and species are named, based on Ramsay's specimen, but without description or figure.

Nakamura, 1938, in the synonymy of this name. In my opinion the fish should be known as *Makaira mazara* (Jordan and Snyder). Hirasaka and Nakamura's excellent plates confirm the opinion that their *Marlina marlina* is *Makaira mazara tahitiensis*, and that their *Eumakaira nigra* is *Makaira mazara*.

For a discussion of *Makaira herscheli* of J. L. B. Smith, see page 345 under *Makaira ampla* (Poey).

Herre (1953, p. 256) has put *Tetrapturus mazara* Jordan and Snyder, 1901, into *Makaira mitsukurii*, from which it is certainly distinct. As this is the only *Makaira* species listed by Herre, it would seem either that he includes all the *Makaira* of that region in one species, or that he believes *M.*

can be definitely established as a constant species character in both sexes and all growth stages, it is not a safe diagnostic character. If it should prove to be constant, *Istiompax howardi*, which otherwise fits either *M. ampla* or *M. mazara*, should be assigned to *M. ampla* because of the non-rigid pectoral. Otherwise, the character might be that of an immature fish belonging to *M. mazara*.

Since talking with Dr. Royce, I am inclined to agree with his conclusion that *M. ampla* runs in the equatorial Pacific, a region from which I have seen no specimens.

I am therefore leaving this fish in *M. mazara*, but questionably, and also placing it questionably under *M. ampla*.

	<i>Istiompax howardi</i>	<i>Makaira mazara</i>	<i>Makaira ampla</i>
Head in standard length	2.7	2.56-3	2.6-2.8
Depth in length	5.56	4.3-5.5	4.4-6.3
Dorsal in depth	1.36	1.34-1.7	1-1.6
Dorsal in pectoral	1.4	1.3-1.5	1.1-1.59

mazara to be absent from the region, a conclusion not supported by Hirasaka and Nakamura.

Istiompax howardi Whitley, 1954 (pp. 58-60, pl. 3, fig. 3): Photographs of this fish, sent to me from Bermagui, New South Wales, where it was caught, were very confusing, but Whitley has given absolute measurements, from which there seemed little doubt that this was a black marlin, *Makaira mazara*. The fish was an immature female. Whitley gives as his diagnosis: "a marlin with general characters of the black marlin, but with depressible pectoral fins and bluer colouring above, it has a narrow rostrum, a long ventral skin-groove, and the rather low anterior profile of a striped marlin . . . yet it has a deeper body than a striped marlin, without light bands, and without the elevated first dorsal fin. The first dorsal fin has large dark spots, and the posterior spines are short. Vertebrae 11+13=24. Body robust, not compressed, its depth less than one-fifth of total length. Lateral line indistinct. Spinous dorsal lobe lower than depth of body. Ventral fins much shorter than the long, low pectorals."

Until the mechanism of the rigid pectoral

Makaira mazara tahitiensis (Nichols and LaMonte), 1935

SILVER MARLIN, SHIROKAJIKI (IN JAPANESE;
WHITE SPEARED-FISH), PU-PI (IN CHINESE;
WHITE SKIN), LEE-TSU (IN CHINESE
IN FORMOSA: ERECT FIN)

Plate 10

Makaira nigricans tahitiensis NICHOLS AND LAMONTE, 1935, Amer. Mus. Novitates, no. 807, p. 1, fig. 1; Tahiti. Type specimen (A.M.N.H. No. 12449A) was a photograph sent to us by Eastham Guild.

?*Tetrapturus indicus* CUVIER AND VALENCIENNES, 1831, Histoire naturelle des poissons, vol. 8, p. 286; Sumatra.

Marlina marlina HIRASAKA AND NAKAMURA, 1947, Bull. Oceanogr. Inst. Taiwan, no. 3, p. 15, pl. 3, fig. 1; Formosa.

Istiompax dombratini WHITLEY, 1954, Australian Zool., vol. 12, p. 60; New South Wales.

Makaira nigricans tahitiensis, designated as a subspecies by Nichols and LaMonte in 1935, and which those authors now agree should be *Makaira mazara tahitiensis*, is found in Hawaii, Tahiti, Mexico, the Japan-Formosa region, and elsewhere in the Pacific. It is the fish known to English-speaking anglers as the silver marlin.

The present author feels that it is very possible that the silver marlin and the black marlin, *Makaira mazara* (Jordan and Snyder), are the same fish. It is possible that at some stage of maturity or of sexual development, the characters of *M. m. tahitiensis* appear; again it is possible that some pathological condition has resulted in the "white overwash" characteristic of *M. m. tahitiensis* and in the slight differences in body proportions. If these are a result of possible endocrine imbalance, it then remains to be determined whether such imbalance is to be considered racial or merely a pathological condition in a few individuals.

The problem of the distribution of this fish has been greatly complicated by a fact, only recently drawn to the author's attention, that on our own west coast and in Hawaii the common names "black marlin" and "silver marlin" are often used in precisely the reverse sense in which they are used in most other parts of the world. This is incomprehensible, as the names are based on the distinctive colors of the two fishes.

The question of the rigid pectoral is as yet unsolved, and this tangle of name usage has added to it. Whether the pectoral is absolutely rigid or is somehow locked in death or the struggle before death; whether it is rigid in the black marlin, the silver marlin, or both; and why it is rigid all remain to be determined.

Nakamura (1949, p. 62) states in his key that in *Marlina* "the pectoral fin forms a right angle with the side of the body and cannot be folded against the body without breaking the joint," and that in *Eumakaira* (which is the black or even possibly the blue marlin) "the pectoral fins can be readily folded back against her body." This means that the silver marlin has rigid, and the black non-rigid, pectorals! Professor Yoshio Hiyama reports the rigid pectoral in the *shirokajiki* (the silver marlin, *M. m. tahitiensis*), and the non-rigid fin in the *kurokajiki* (*M. mazara*).

Occurrences of *M. m. tahitiensis* in the following areas are authenticated: Mexico, the Hawaiian Islands, Fiji Islands, Tahiti, Formosa, Japan, and French Indo-China. In most areas it is far from abundant, but Nakamura (1943) reports it as the most abundant species throughout the fishing season in the

current area of the Kuroshio and also abundant in the South China area and the "main species" in the March to May migration "in the waters off Annam to the Hainan area."

The external characters are described in the key on page 331. At first glance, the longer, more slender spear and the whitish overwash are the outstanding characters. The color in life varies somewhat, but seems fairly consistently to be dirty white, not very silvery, over the major portion of the body. The head, fins, and sometimes the dorsal ridge and a short distance below it are dark. There is no indication of cross bars and no blue in the life color. The spear is comparatively longer and more slender than that of *M. mazara*, and the fish is more slender for its length. In all the specimens I examined, the spear was very rugose above, and the flesh of the fish was soft and quite granular.

There is as yet no published information about the spawning habits, eggs, larvae, or juveniles of this fish.

DISCUSSION OF THE SYNONYMY

Tetrapturus indicus Cuvier and Valenciennes, 1831, placed questionably in *M. m. tahitiensis*, is discussed elsewhere in the present paper (p. 338).

Hirasaka and Nakamura (1947, p. 15) base their genus *Marlina* on Jordan and Hill's (in Jordan and Evermann, 1926) description of *Makaira marlina*, a description that seems to me to belong to *Makaira mazara*, whereas Hirasaka and Nakamura's fish, as well as Nakamura's 1938 *Makaira marlina*, falls into *M. m. tahitiensis*, and does not seem to be the fish described by Jordan and Hill. The Japanese authors use the name *shirokajiki* for their fish.

Istiompax dombraini Whitley, 1954, is described as having a rigid pectoral, a not much elevated dorsal lobe, and as resembling the "black marlin, *I. australis* (Wall, 1954) [see p. 339 above] in most characters but [with] a thinner and more tapering sword." Whitley further says, "Most specimens weigh less than 150 pounds but some reach 200." No figure and no body proportions are given. The description is very scant, to which a color description fitting several species is attached. Provisionally I am placing the species in *M. m. tahitiensis*.

Makaira ampla (Poey), 1860

BLUE MARLIN

Plate 11

Tetrapturus amplus POEY, 1860, *Memorias sobre la historia natural de la Isla de Cuba*, vol. 2, pp. 237, 243, ff.; 1861, *tom. cit.*, pl. 15, fig. 2; northern coast of Cuba. Type specimen: Male, 2453 mm. long, Poey Collection No. 190.

Prov. *Tetrapturus herschelii* GRAY, 1838, *Ann. Mag. Nat. Hist.*, vol. 1, p. 313, pl. 10; Table Bay. Non *Makaira herschelii* of Smith, 1950, east coast of Africa.

Makaira ampla (Poey) JORDAN AND EVERMANN, 1926, *Occas. Papers California Acad. Sci.*, vol. 12, p. 69; West Indies.

Prov. *Makaira bermudae* MOWBRAY, 1931, *Fauna Bermudensis*, no. 1, p. 1, photograph; Castle Harbour, Bermuda. Specimen destroyed.

Makaira perezii DE BUEN, 1950, *Publ. Cient. Serv. Oceanogr. y de Pesca*, Montevideo, no. 5, pp. 171-175, figs. 1-43; Punta Carretas, Montevideo, Uruguay.

?*Istiompax howardi* WHITLEY, 1954, *Australian Zool.*, vol. 12, pp. 58-60, pl. 3, fig. 3; New South Wales.

Makaira ampla (Poey) is an Atlantic species known to anglers as the blue marlin. It is distinguished from the other Atlantic species, *Makaira albida* (Poey), by its greater body depth,¹ its lower dorsal lobe, its inconspicuous or invisible lateral line, heavier spear, and the fact that it reaches a far greater weight than does the white marlin, *M. albida*. The present rod and reel record for this fish is 742 pounds, at a length of 12 feet 10½ inches.

The dorsal fin is cobalt or purplish blue, often marked with darker spots or blotches. The upper part of the body is very dark blue, becoming brilliant towards the median line where the color suddenly changes to bright, dense silver. When the fish has just been landed, the lighter blue or lavender cross bars on the sides are strikingly powder blue, as is a spot around the pectoral base and under the fin. All the colors are intensified immediately after death, but fade quickly, the fish becoming uniformly dark.

¹ Jordan and Evermann (1926, p. 69) write, "depth of body 5 in length of head to tip of lower jaw; depth of body 5 in length from tip of spear to base of caudal." Poey gives the measurement not as the depth of the body but as the pectoral fin into the body length from the lower jaw tip.

It occurs from Georges Bank to the Windward Islands; off France; and in the equatorial Pacific.

Ripe females of the blue marlin have been taken off the northern coast of Cuba (La-Monte, 1944), but no free eggs or larval forms have as yet been recognized. Possible juveniles are discussed on page 347.

DISCUSSION OF SYNONYMY

Tetrapturus herschelii Gray, 1838, was based on a specimen taken at Table Bay, in the British Museum (Natural History) in London. The type, a stuffed specimen, was apparently described from the stuffed fish. The figure is that of the mount. Günther, who must have seen it, has added some information about the type.

Gray's plate shows a long, narrow *Makaira* in which the pectorals are on a curve so that one cannot determine their length. They seem to be short. The dorsal lobe is about 1.2 in the body depth. The spear is quite stout and appears short because it remains thick for a greater distance than is usual. Gray gives the length as "nearly 11 feet," which is very long for *M. albida*, the narrowest of the *Makaira* species for the Atlantic fauna. He gives the pectorals as 1 foot 9 inches and the pelvics as "imperfect; 9".

Günther adds, "Depth more than ½ head, and ⅓ of total" (the Gray plate agrees with this head-length ratio). Gray also gives the length of the upper jaw from the nostrils as nearly three-fourths of the length of the head.

The depth in this length corresponds to Gray's figure. According to the figure, the standard length would be about 114 inches. Therefore, the pectoral in the length would be 5.4, the depth in the pectoral 1.1. The dorsal of the figure is low and about 1.2 in the depth, as the body below it is not at all deep. The depth in the standard length would be about 6. Jordan and Evermann's (1926) statement, "... pectoral which is as long as the spear which is ¾ length of lower jaw," does not agree at all with Gray's original description. Jordan and Evermann, quoting from Günther, say "posterior part of dorsal fin much lower than the body," but what Günther actually said is "the greater portion of the dorsal fin much lower than the body."

Dr. J. L. B. Smith of Rhodes University has kindly lent me the photograph from which color plate 67, figure 875, in his "The sea fishes of Southern Africa" (1950) was made. The plate, however, does not resemble the photograph very closely. The fish, Dr. Smith says, is "a mount in our museum" and is "so far regarded as confined to the east coast of Africa—not uncommon East London—only one species in our area." The type of *M. herschelii* came from the west side of the Cape. The photograph, slightly distorted because the fish was forwardly bent, showed a short-lobed dorsal, a stout spear, and a deep body, deepest farther towards the mid portion of the body than is usual, a feature probably due to inexperienced mounting. This photograph seemed to be more like that of a fish in the *M. mazara* group than of one in the *albida-mitsukurii* group which is narrower bodied, with a longer, more slender spear than in the former group. The dorsal lobe in the plate, supposedly made from the photograph, is high; the body color is like that of a blue or a white marlin; and the spear is that of *M. mazara* or *M. m. tahitiensis*. The pectoral fin is shown on a curve, and the anal is incorrectly drawn. This seems to be more a composite figure than a figure of any single species, although it could be *M. ampla*.

Without more specimens or information *Makaira herschelii* in Smith (1950) cannot be identified. Although said to be quite common commercially off East London, I have been unable to secure any photographs of it other than the one of the mount.

Gray's *M. herschelii* agrees with *Makaira ampla*, *M. albida*, *M. mitsukurii*, and *M. mazara* in the relations of depth to pectoral; with *M. ampla* in dorsal into depth; with *M. ampla*, *M. albida*, and *M. mitsukurii* in depth in length. As the fish appears to be too large for *M. albida*, this leaves one Atlantic and one Pacific form, quite different from each other, to choose between (*ampla* and *mitsukurii*). The dorsal fin of the fish shown in Smith's plate is far lower than that in *M. mitsukurii*, which throws the fish into *M. ampla*, for which the spear is more characteristic than for *mitsukurii* and for which the geographical location is right. The possibility of a new species does not seem justified to me. I am therefore putting *Makaira herschelii* (Gray) pro-

visionally in *M. ampla*, but not including the specimen photographed and listed by J. L. B. Smith and said to occur on the other side of Africa, off East London.

Makaira bermudae: Although, in my opinion, this is *Makaira ampla* (Poey), in view of the fact that both L. L. Mowbray and L. S. Mowbray, who saw the fish, believed that it was a new species, it is in the present paper placed provisionally in *M. ampla*. The fish was destroyed before a thorough examination could be made. The photograph by Mowbray is much distorted.

Makaira perezii de Buen, 1950: This fish was towed to shore by de Buen at Mar de Solis, near Punta Carretas, Montevideo, Uruguay, on March 11, 1950. De Buen distinguishes his species by the shape and origin of its first dorsal as opposed to that of *M. marlina* of Jordan and Hill (1926); the form of the caudal fin, the pectoral length, the body, which is less robust than that of Jordan and Hill's fish, and the "uniform color without bars or spots."

Dr. de Buen kindly sent me copies of the original photographs of his specimen, and I have sent him clear photographs of the blue and the white marlins for comparison, but have not heard whether or not he finds any similarity to his species. In the meantime, comparing the measurements given for his fish with those of *Makaira ampla* taken in the field, I find that de Buen's fish is well within the limits of *Makaira ampla* (Poey).

	<i>M. perezii</i> DE BUEN	<i>M. ampla</i> (POEY)
Head in standard length	2.8	2.6-2.8
Depth in standard length	6	4.4-6.3
Dorsal in depth	1.1	1 -1.6
Depth in pectoral	1.07	1.1-1.59

In the photographs of *M. perezii*, the tip of the spear is broken off. The shape of the dorsal is that of *M. ampla*. The tail is described by de Buen as "semilunar, formada por dos ramas agudas en el ápice y destacando en el centro tres ondulaciones." This is in no way different from the caudal of *M. ampla*, in which the "three undulations" (like three scallops) sometimes show quite clearly and sometimes are not present.

De Buen describes the color as "Uniforme, sin bandas ni manchas. Más obscure el lomo,

con tonalidad azul brillante. La primera dorsal es ligeramente más pálida que al cuerpo y posee menudas manchas irregularmente distribuidas entre los radios cortos." This is a good description of *M. ampla* after death, and we gather that de Buen's specimen was dead when he towed it to shore. It is also a

perfectly possible description of a large *M. ampla* in life. The de Buen specimen measured 3820 mm. in total, and 3300 mm. in standard, length. No weight is given.

This specimen does not seem to justify specific differentiation and is here placed in *Makaira ampla* (Poey).

INCERTAE SEDIS

Tetrapturus kraussi Jordan and Evermann (1926, p. 33, pl. 9; Hawaii; Museum of the California Academy of Sciences No. 601): The type is a photograph of a specimen examined in the Honolulu market. No size is given. The description states that the spear is "a little longer than the rest of the head, $2\frac{1}{2}$ in the pectoral." The whole length of the spear cannot be seen in the photograph, and the pectoral appears to be very short. The rest of the head, than which the spear is supposedly a little longer, is shown in the photograph as 1.5 in the pectoral, which indicates that this fish may be *T. illingworthi* Jordan and Evermann (1926). The tip of the dorsal appears to be broken.

Because of the short pectoral, the slender body, and the nature of the dorsal fin, the fish may conceivably be a *Tetrapturus* or the young of a *Makaira*. Given the incomplete photograph, no size, and the confusing description, with measurements that must be incorrectly stated, it is impossible to identify the fish.

Makaira australis (Whitley) Fowler (1934,

p. 400, fig. 2; Tahiti): Here Fowler retains *Makaira australis* (Whitley), originally Whitley's type (1931a, 1931b) of a new genus, *Istiompax*, from New South Wales. The fish is figured by Fowler in his figure 2, a-d. The legend to figure 2 states, "obtained at Papeete, Tahiti, by Eastham Guild." Figure 2a is of "a fish weighing 823 pounds, collected February 6, 1932." No other weights are given. The fish shown in figure 2b, stated in the legend to have been collected July 24, 1931, appears to be the specimen, weighing 504 pounds, on the photograph of which the subspecies *Makaira mazara tahitiensis* (Nichols and LaMonte), 1935, was based. The fishes shown in figures 2c and 2d are described as "smaller fishes with longer ventrals." The fish in the outline figure 2d is similar to *M. m. tahitiensis*, but does not seem to be the species shown in figures 2a, b, and c. Because dimensions are lacking, it is impossible to determine what the fishes are, other than that they definitely belong in the genus *Makaira*.

POSSIBLE JUVENILES OF MAKAIRA

Fishes of small size that appear to have juvenile characters are placed here. None of them can be identified specifically at the present time. None was found on grounds where only one species of *Makaira* was present. None was examined internally.

If these are young *Makaira*, juvenile characters, at a length of about 3 feet to a stage just preceding that of an adult, would be a dorsal fin high throughout its length, although not always of even height, a narrow body, and, in some species, a short pectoral fin. The spear seems to be of normal *Makaira* length.

Plate 12 shows two recently taken speci-

mens of which the 97-pound fish caught off Hawaii may well be a young *Makaira mitsukurii*, as Mr. Charles M. Cooke III suspects. The spear of the Australian fish (4 pounds $5\frac{1}{2}$ ounces) is too long and the body is too deep for it to be a *Tetrapturus*, which would indicate that it, too, is a young *Makaira*. This fish was 3 feet long. Mr. Cooke also lent me a photograph of another small fish, 5 feet $3\frac{1}{2}$ inches long, which also had the characters mentioned above. On exhibit in the American Museum of Natural History is a small mounted fish originally labeled *Tetrapturus* which now seems to us to be a young *Makaira*. The mount shows a very

thin-bodied fish, hardly deeper at the shoulder than midway along its length. It is slightly over 4 feet in total length. The dorsal, of which the lobe is only very slightly higher than the rest of the fin, is twice the depth of the body below it. The spear is long, the pectorals are short, and the caudal span is wide. Its body is less deep, especially at the shoulder, than that of a young *Istiophorus* of similar size. This fish was taken in the spring of 1939, in the Gulf Stream halfway between Bimini, Bahamas, and Miami, Florida.

Kajikia formosana Hirasaka and Nakamura (1947, pp. 13-14) is said by the authors to be similar to *Tetrapturus ectenes*. Hirasaka and Nakamura state that these fishes, which "occur in the eastern sea of Formosa and are landed at Suao between February and April," were once considered as a juvenile form of *K. mitsukurii*, but "further studies made it out more reasonable to put [them] in a different species." They do not state in any publications available to me what the further studies were. The size is given as "about 150 cm. long," and the weight as "30 kg." This could be a juvenile. In 1949, the same authors state that there are no data on the spawning

habits of *K. formosana*, and that it appears to have approximately the same distribution and migrations as the short-nosed spearfish [*Tetrapturus*], but the details are not yet known. They also say, "From a consideration of certain data it appears that this species appears in the waters east of Formosa somewhat later than the short-nosed spearfish."

The genus *Kajikia*, for which no type is named, is obviously *Makaira* and is so synonymized here. *Kajikia mitsukurii* of these authors is here put into *Makaira mitsukurii* (Jordan and Snyder). It is also possible that *K. formosana* is actually, as the authors first thought, a juvenile of *Makaira mitsukurii*.

A small specimen of *Istiompax australis* Whitley, taken off Port Stephens, Australia (see p. 341), and so identified by Whitley, is here put under possible juveniles of *Makaira*. Small specimens from Madras, discussed by Day (1878) as *Histiophorus brevirostris* Playfair, are also possibly juvenile *Makaira*, although the plate illustrating one of these has every aspect of an adult fish. I am therefore also listing these Madras specimens as unidentifiable. They are further discussed on page 349.

UNIDENTIFIABLE SPECIMENS

The following names can never be positively assigned owing to loss of the type specimen or to other circumstances here discussed:

Xiphias imperator Bloch and Schneider (1801, vol. 1, p. 93; vol. 2, pl. 21; Mediterranean): Bloch and Schneider attribute three species to the genus *Xiphias*: *Xiphias velifer*, which has a large, high, semicircular first dorsal, a conspicuous lateral line, two caudal keels, and ventral fins, and which is obviously *Istiophorus*; *X. gladius*, which has one caudal keel and no ventrals and obviously is *Xiphias gladius* Linnaeus; and *X. imperator*, described as, "X. pinnis brevibus, dorso scabro, carina caudali nulla," and which, in plate 21, is shown with a small forked caudal fin and other fins resembling those of the usual central type of teleost fish. The figure shows the first and second dorsals (the first a short fin), a single anal, and ventrals. One of two errors have been made in the figure. Either the ventrals were intended to be the first

anal fin and have been placed too far forward and doubled, or the fins are a strangely distorted portrayal of pelvics, placed correctly, but otherwise unlike the blade-like pelvics of either *Istiophorus* or *Makaira*. Because, however, the authors noted the presence or absence of ventrals in their descriptions, one must assume that these fins were intended as pelvics. The short dorsal has probably resulted from failure to pull the fin up out of the groove. The very short pectoral, very forked caudal, and the type of fins portrayed seem to indicate that the artist had not seen the specimen and had misinterpreted the description. The authors have not noticed the caudal keel ("carina caudali nulla"). The specimen can never be definitely identified.

For a discussion of *Makaira nigricans* Lacépède, 1803, see page 327.

Tetrapturus georgii Lowe (1840, p. 36; Madeira; 1849, vol. 3, p. 3; Madeira; same specimen): Lowe's original description (1840)

of this fish is here quoted in full: "Having at length, through Mr. Leacock's kind exertions, obtained a fine example of the *Peito* in perfect condition I am enabled to state that it forms a new and very distinct species of *Tetrapturus* Rafin.; differing from *T. belone* Raf., as described by MM. Cuvier and Valenciennes, especially in having the pectoral fins proportionally twice as long, and the body clothed with large scales of a peculiar shape and nature. I only forbear to draw up its specific character till I have checked my notes and observations by examination of more examples; but I hope to be allowed the privilege at once of commemorating by its specific name the valuable assistance rendered to the cause of Ichthyology by Mr. George Butler Leacock of this island generally, as well as in the present instance."

In 1849, Lowe repeated this description without change or addition.

Jordan and Evermann (1926, pp. 55-56) partially quote the description and add: "This is certainly different from *Tetrapturus belone* and is doubtless a species of *Makaira*. Its long pectoral and plain colors suggest, perhaps, identity with the later described *Makaira lessonae* of Italy, but it seemed best to list both provisionally as distinct species." In their key (p. 51), although they had no specimen except the Lowe fish, as described by him, in addition to the "plain color" which was not mentioned by Lowe, they include matter for which there seems to be no source.

Dr. Maul, Director of the Funchal Museum, writes me that *peito* is a name used for all marlins. A mounted specimen of marlin seen by the present author in the Algas Aquarium, Lisbon, and labeled *T. georgii*, was taken off Tavira, Algarve, Portugal. The mount was in poor condition, but the fish appeared to be *Makaira ampla*.

Fowler (1936, p. 1277) synonymizes *T. georgii* Lowe with *Makaira nigricans* Lacépède, although questionably. He states in that paper that he regards all the nominal Atlantic forms as one. He lists this *M. nigricans* from Madeira, but his description is made from specimens from "the Gulf Stream from off New Jersey, Florida, and Cuba," and appears to be a composite of *M. ampla* and *M. albida*.

Lowe's specimen is obviously a *Makaira*, but the description is too scant for identification of the species.

Tetrapturus indicus Cuvier and Valenciennes, in Waite (1904, p. 42) is merely given in a faunal list of New South Wales fishes. There is no way of knowing what fish Waite meant.

Histiophorus brevirostris Playfair, 1866, in Playfair and Günther (1866, pp. 53-55), is described by Playfair from notes made from a fresh Zanzibar specimen. The figure was made from the same specimen, but after mounting. The mount was destroyed. The figure shows a very long, slender, rather short-speared fish, a *Makaira*, with a long pectoral fin. The description gives absolute measurements of length, depth, head, pectorals, and upper jaw from angle of mouth. It also describes the "anterior portion of the dorsal" as being "somewhat elevated but much less so than in a species hitherto described," and says that the color was "uniform." The "total length" was 10 feet 4 inches.

In 1866, the species "hitherto described" were *T. albidus* and *T. amplus* Poey, *T. lessonae* Canestrini, *T. herschelii* Gray, *T. georgii* Lowe, *M. nigricans* Lacépède, *T. indicus* Cuvier and Valenciennes, and *T. belone* Rafinesque, and the other genera were *Istiophorus* and *Xiphias*.

From the figures given, the head would be 3.4 in the length, which is given as "total" but may have been taken to the end of the middle caudal rays or the tip of the caudal lobes, a shorter head than that of any species known to us, the extreme being that of *M. albida* and of *M. mazara* in which the limit for head in length is 3. The depth in this same length would be 6.2. If 6.2 is standard length, the measurement would fit *M. ampla*, *M. albida*, and *M. mitsukurii*. However, the depth in this length, as shown in the figure, is 7.1, which fits only *M. albida*. The depth in the pectoral (1.1) fits *M. albida*, *M. mazara*, and *M. mitsukurii*. The low dorsal lobe, 1.4 in the depth, is typical of *M. mazara*, as is the uniform color.

The low dorsal, uniform color, relationship of dorsal and pectoral, and the geographical locality would indicate that the fish was probably *Makaira mazara* (Jordan and

Snyder), but the depth of the fish shown in the figure of the mount is far too slight for that species. The mount was probably badly done, and the skin may have been much stretched, increasing the length and reducing the depth, but the author presumably saw and approved the figure before it was published. If the length is total length, the fish could be *M. mazara*, but if standard, or to the outer mid-margin of the caudal, it could only be *M. mitsukurii*. As the mount has been discarded long since, and there will never be any way of determining the length measurement used by Playfair, this specimen is placed in unidentifiable specimens.

Boulenger (1887, p. 660) lists as *Tetrapturus brevirostris* two fishes taken off Muskat, but gives no characters.

Day (1878, p. 199, pl. 47, fig. 3) had several specimens from Madras which he described as possibly belonging in *H. brevirostris* Playfair. According to Day's measurements, the largest of these was only 4 feet 4 inches long and the fish on which the plate is based was "a little over 4' long." His description, he states, was based on "specimens" in the Madras Museum. From the proportions given, Day's fishes were probably small specimens of *Makaira mitsukurii* (Jordan and Snyder). Jordan and Evermann (1926) have used Day's description, but have quoted the measurements incorrectly. Owing to the fact that the length of Day's fish seems to be that of a juvenile and the plate has the appearance of an adult and the description is possibly, but not surely, that of *Makaira mitsukurii*, I am placing the Day description and plate in unidentifiable specimens with the provision that, when the developmental cycle of *Makaira* is better known, these fishes may correspond to a juvenile stage.

Tetrapturus illingworthi Jordan and Evermann (1926, p. 32, pl. 8): No one will ever know what this fish was. The type is a photograph of a fish with a broken-off spear, a dorsal from which the tip of the lobe has been broken off quite far down, and a body the lower outline of which is obscured by a paper or piece of cloth. The authors state that they examined the fish in the market in Honolulu. The dimensions of the description are at variance with the plate. For example, the

description states that the "spear from the tip of the lower jaw is $2\frac{1}{2}$ in the pectoral." The photograph shows what is left of the spear from the tip of the lower jaw as 6+ in the pectoral. The description gives, in the key, "dorsal lobe not longer than pectoral." It would be impossible to determine this from the photograph owing to the area of the dorsal lobe that is lacking. Nor could one tell what the body depth was. The two *Tetrapturus* characters shown clearly in the photograph are a rather short pectoral and a rather narrow caudal span. However, this fish was 6 feet (whether the total or standard length is not stated) long and weighed only 60 pounds; therefore it must have been very narrow-bodied. If the spear was measured in the market and was $2\frac{1}{2}$ in the pectoral (the portion of the spear beyond the tip of the lower jaw), then the spear was too long for a *Tetrapturus* and the fish is possibly a young *Makaira*. I feel that there is no way of knowing what the fish really was, and that it should be put in the list of unidentifiable specimens. Also in this category must go de Buen's genus *Pseudohistiophorus* (de Buen, 1950, p. 171) which is based on *Tetrapturus illingworthi* as its type.

Tetrapturus kraussi Jordan and Evermann 1926, p. 33, pl. 9; Hawaii): Here again is a picture of a fish with not only the spear, but also even the tip of the lower jaw, cut off. The tip of the dorsal lobe is broken off, and the ventral outline of the body is obscured. The tail lobes are cut off by the edge of the photograph. A short pectoral shows, as well as an apparently narrow body. No size is given for this fish. The type is this photograph, again of a "specimen examined in the Honolulu market." The short pectoral would indicate a *Tetrapturus*, as would the apparently very narrow body and what appears to be the beginning of a narrow caudal span. It is, however, not possible to estimate the height of the dorsal lobe or the length of the spear. The dorsal lobe is given as $1\frac{1}{2}$ in the pectoral. The photograph shows them as equal, although the dorsal tip is mutilated. The head is given as $3\frac{3}{4}$ in body to base of caudal, spear included, and the spear as $2\frac{1}{2}$ in the pectoral. I cannot discover between what points the spear was measured. However, if the head, with the complete

spear, was $3\frac{1}{4}$ in the standard length of the body, the spear was short enough to have been that of a *Tetrapturus*. As we shall never know what the dimensions of this fish really were, *T. kraussi* is put among the unidentifiable specimens.

Tetrapturus ectenes Jordan and Evermann (1926, pp. 34-35, pl. 11, fig. 2; Hawaii): It is possible that the figure numbers of plate 11 may be reversed. However, both figures of the plate are photographs of mutilated specimens "examined in the Honolulu market" by the authors. In both, the end of the spear is missing, and the posterior part of the body is submerged so that the tail does not show. Both, however, resemble fully adult fishes, and both show a very long pectoral fin and a high dorsal lobe. According to the text by Jordan and Evermann figure 1 of plate 11 is *Makaira mazara*, but in my opinion it is *M. mitsukurii*; figure 2 of plate 11 is certainly not a *Tetrapturus*, the length of the pectoral,

the shape of the dorsal, and the depth of the body ruling out that genus. The type, of which figure 2 of plate 11 purports to be a photograph, is stated in the text to have weighed only 40 pounds, although previously in the text the authors say, "the weight of the specimens examined was 72, 80 and 100 pounds respectively." The text mentions a "short pectoral." In both photographs the pectoral is considerably longer than the dorsal lobe which in one case is about 1.5 in the pectoral and in the other, 1.4. Obviously some misstatements have occurred in the text. Both figures appear to the present author to be *Makaira mitsukurii* (Jordan and Snyder), although if the specimen shown in figure 2 actually weighed only 40 pounds, it, despite its adult appearance, must have been a juvenile, certainly of *Makaira*. *Tetrapturus ectenes* Jordan and Evermann is here placed in unidentifiable specimens.

SUMMARY

THE VALID RECENT GENERA in the two families of speared fishes, Istiophoridae and Xiphiidae, are *Makaira* Lacépède, the marlin; *Istiophorus* Lacépède, the sailfish; *Tetrapturus* Rafinesque, the spearfish; and *Xiphias* Linnaeus, the swordfish, which is monospecific.

Out of the tangle of the old and recent literature on *Makaira*, there emerge two valid Atlantic species and three Pacific species with a possible subspecies of one of them: *Makaira albida* (Poey), the white marlin of the Atlantic; *Makaira ampla* (Poey), the blue marlin of the Atlantic and Pacific; *Makaira mitsukurii* (Jordan and Snyder), the striped marlin of the Pacific; *Makaira mazara* (Jordan and Snyder), the black marlin of the Pacific; and *Makaira mazara tahitiensis* (Nichols and LaMonte) a possible subspecies, the silver marlin of the Pacific.

For quick reference, the synonymy of the genus and its species is here repeated without the full bibliographic references.

MAKAIRA LACÉPÈDE, 1803

MARLIN

Type: *Makaira nigricans* Lacépède, 1803; France
Tetrapturus, non Rafinesque, 1810, *sed* Cuvier and Valenciennes, 1831; Sumatra. (*Non* pl. 229.)

Histiophorus Philippi, 1887; Chile
Marlina Grey, 1928 (*nomen nudum*); New Zealand. Hirasaka and Nakamura, 1947; Formosa
Istiompax Whitley, 1931a (*nomen nudum*); Australia. Whitley, 1931b; Australia
Kajikia Hirasaka and Nakamura, 1947; Formosa
Eumakaira Hirasaka and Nakamura, 1947; Formosa
Prov. *Pseudohistiophorus* de Buen, 1950; Hawaii

Makaira albida (Poey), 1860

WHITE MARLIN

Type: *Tetrapturus albidus* Poey, 1860; Cuba
Tetrapturus lessonae Canestrini, 1861; Italy
Makaira albida (Poey) Jordan and Evermann, 1926; West Indies northward in Gulf Stream to Woods Hole
Tetrapturus belone, non Rafinesque, 1810, *sed* Legendre, 1928; France. Desbrosses, 1938; France
Tetrapturus georgii, non Lowe, 1840, *nec* Fowler, 1936, *sed* Tortonese, 1940; Genoa

Makaira mitsukurii (Jordan and Snyder), 1901

STRIPED MARLIN

Type: *Tetrapturus mitsukurii* Jordan and Snyder, 1901; Misaki, Japan
Histiophorus audax Philippi, 1887; Iquique, Chile
Makaira mitsukurii (Jordan and Snyder) Jordan and Evermann, 1926; shores of Japan, Hawaii, and the Santa Barbara Islands
Makaira mazara, non Jordan and Snyder, 1901, *sed* (*partim*) Jordan and Evermann, 1926; Hawaii
Prov. *Makaira grammatica* Jordan and Evermann, 1926; Hawaii
Makaira holei Jordan and Evermann, 1926; California and Mexico
Makaira zelandica Jordan and Evermann, 1926; New Zealand
Marlina mitsukurii Grey, 1928 (*nomen nudum*); New Zealand
Tetrapturus brevirostris, non Playfair, 1866, *sed* Deraniyagala, 1933; Ceylon
? *Kajikia formosana* Hirasaka and Nakamura, 1947; Formosa
Kajikia mitsukurii Hirasaka and Nakamura, 1947; Formosa
Tetrapturus tenuirostratus Deraniyagala, 1951, 1952; Ceylon

Makaira mazara (Jordan and Snyder), 1901

BLACK MARLIN

Type: *Tetrapturus mazara* Jordan and Snyder, 1901; Misaki, Japan
? *Tetrapturus indicus* Cuvier and Valenciennes, 1831; Sumatra. Prov. Stead, 1906, 1908; Australia. McCulloch, 1921; Australia.
Tetrapturus australis Wall, 1854 (inadmissible); Australia. Whitley, 1954; Australia.
Histiophorus gladius, non Bloch, 1801, *sed* Ramsay, 1881; Australia
Tetrapturus brevirostris, non Playfair, 1866, *nec* Day, 1878, *sed* Van Kampen, 1908; Batavia
Makaira marlina Jordan and Hill, 1926; Pacific coast of Mexico
Makaira mazara (Jordan and Snyder) Jordan and Evermann, 1926 (*partim*, not the plate); Pacific Ocean, Japan, and Hawaii. Nakamura, 1938; Formosa. Griffin, 1927; New Zealand
Tetrapturus mitsukurii, non Jordan and Snyder, 1901, *sed* Fowler, 1928 (*partim*); Hawaii. Fowler, 1934; Japan
Istiompax australis Whitley, 1931a; Australia. Whitley, 1931b; Australia

?*Eumakaira nigra* Hirasaka and Nakamura, 1947;
 South China Sea and Japanese Current
 Prov. *Makaira herschelii*, non Gray, 1838, Table
 Bay, sed J. L. B. Smith, 1950; east coast of
 Africa
Makaira mitsukurii Herre, 1953 (*partim*); Philip-
 pine Islands
 ?*Istiompax howardi* Whitley, 1954; Australia

Makaira mazara tahitiensis
 (Nichols and LaMonte), 1935

SILVER MARLIN

Type: *Makaira nigricans tahitiensis* Nichols and
 LaMonte, 1935; Tahiti
 ?*Tetrapturus indicus* Cuvier and Valenciennes,
 1831; Sumatra
Marlina marlina Hirasaka and Nakamura, 1947;
 Formosa
Istiompax dombraini Whitley, 1954; Australia

***Makaira ampla* (Poey), 1860**

BLUE MARLIN

Type: *Tetrapturus amplus* Poey, 1860; Cuba
 Prov. *Tetrapturus herschelii* Gray, 1838; Table
 Bay. Non *Makaira herscheli* Smith, 1950; east
 coast of Africa
Makaira ampla (Poey) Jordan and Evermann,
 1926; West Indies
 Prov. *Makaira bermudae* Mowbray, 1931; Ber-
 muda
Makaira perezi de Buen, 1950; Uruguay
Istiompax howardi Whitley, 1954; Australia

INCERTAE SEDIS

Tetrapturus kraussi Jordan and Evermann, 1926;
 Hawaii
Makaira australis (Whitley) Fowler, 1934; Tahiti

POSSIBLE JUVENILES

Kajikia formosana Hirasaka and Nakamura,
 1947; Formosa
Istiompax australis Whitley, 1931; Port Stephens,
 Australia
 ?*Histiophorus brevirostris* Playfair, 1866, in Day,
 1878; Madras. (See also below.)

UNIDENTIFIABLE SPECIMENS

Xiphias imperator Bloch and Schneider, 1801;
 Mediterranean
Makaira nigricans Lacépède, 1803; France
Tetrapturus georgii Lowe, 1840; Madeira
Tetrapturus indicus Cuvier and Valenciennes, 1904,
 in Waite; Australia
Histiophorus brevirostris Playfair, 1866; Zanzibar
Tetrapturus brevirostris (Playfair) Boulenger, 1887;
 Muskat
 ?(Or juvenile) *Histiophorus brevirostris* Playfair,
 1866, in Playfair and Günther; Playfair, 1878,
 in Day; Madras.
Tetrapturus illingworthi Jordan and Evermann,
 1926; Hawaii
Pseudohistiophorus illingworthi (Jordan and Ever-
 mann) de Buen, 1950; Hawaii
Tetrapturus kraussi Jordan and Evermann, 1926;
 Hawaii
Tetrapturus ectenes Jordan and Evermann, 1926;
 Hawaii

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