Literature : Nakamura (1937, 1938); Royce (1957); Ueyanagi (1962); Watanabe & Ueyanagi (1963); Howard & Ueyanagi (1965); Koga (1967); Merrett (1970, 1971); Howard & Starck (1975); Kikawa (1975).

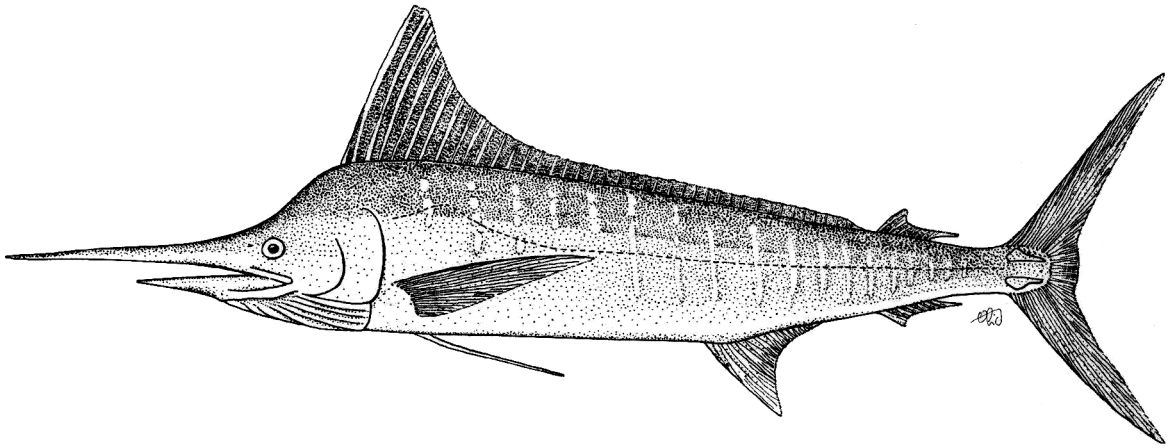
Tetrapturus audax (Philippi, 1887)

ISTIO Tetra 5

Histiophorus audax Philippi, 1887, Anal.Univ.Chile, 71:35-8, p1.8 (figs 2 to 3) (Iquique, Chile).

Synonymy : Istiophorus audax-Abbott, 1899; Tetrapturus mitsukurii Jordan & Snyder, 1901; Tetrapturus ectenes Jordan & Evermann, 1926; Makaira grammatica Jordan & Evermann, 1926; Makaira holei Jordan & Evermann, 1926; Makaira zelandica Jordan & Evermann, 1926; Makaira audax-Jordan & Evermann, 1926; Marlina mitsukurii-Grey, 1928; Marlina zelandica-Whitley, 1937; Kajikia mitsukurii-Hirasaka & Nakamura, 1947; Kajikia formosana Hiraska & Nakamura, 1947; Tetrapturus tenuirostratus Deraniyagala, 1951; Tetrapturus acutirostratus Deraniyagara, 1952; Makaira formosana-Matsubara, 1955; Marlina audax-Smith, 1956; Tetrapturus audax-Robins & de Sylva, 1961; Makaira audax zelandica-Whitley, 1962.

FAO Names : En - Striped marlin; Fr - Marlin rayé; Sp - Marlin rayado.



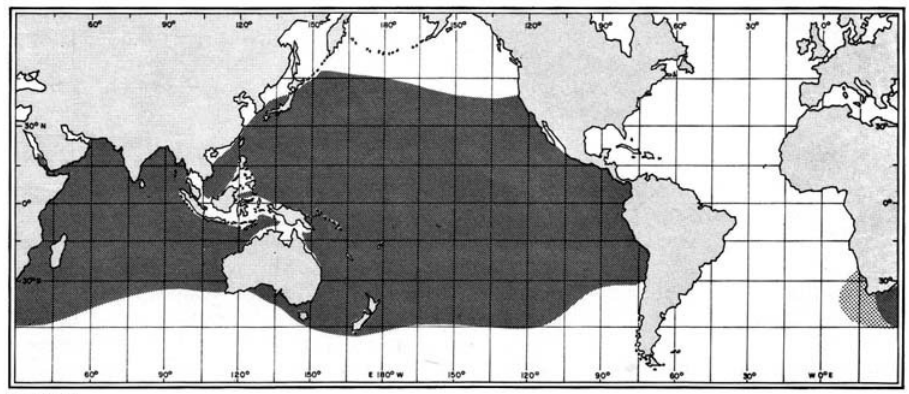
Field Marks : Anterior lobe of first dorsal fin pointed and higher than remainder of the fin, the height decreasing gradually backward; anus situated near origin of first anal fin, the distance between them smaller than half of anal fin height; tips of pectoral and first anal fins pointed.

Diagnostic Features : Body elongate and fairly compressed. Bill stout and long,round in cross section; nape fairly elevated; right and left branchiostegal membranes completely united to each other, but free from isthmus; no gillrakers; both jaws and palatines (roof of mouth) with small, file-like teeth. Two dorsal fins, the first with 37 to 42 rays, usually with a pointed anterior lobe, higher than (or occasionally equal to) body depth anteriorly, the fin then abruptly decreasing in height to about the 10th dorsal fin ray and gently decreasing further backward; first dorsal fin base long, extending from above posterior margin of preopercle to just in front of second dorsal fin origin; second dorsal fin with 5 or 6 rays, its position slightly backward in respect to the second anal fin; two anal fins, the first with 13 to 18 rays, the second with 5 or 6 rays and very similar in size and shape to the second dorsal; pectoral fins long and narrow, with pointed tips, adpressible against sides of body and with 18 to 22 rays; pelvic fins slender and almost equal to, or slightly shorter than the pectorals in large specimens, and slightly longer than pectorals in smaller individuals. Caudal peduncle well compressed (laterally) and slightly depressed (dorsoventrally), with a pair of keels on each side and a shallow notch on both, the dorsal and ventral surfaces; anus situated just in front of first anal fin origin. Lateral line single and obvious, curving above base of pectoral fin and then continuing in a straight line toward the caudal fin base. Body densely covered with elongate bony scales, each with 1 or 2 posterior points. Vertebrae 24 (12 precaudal and 12 caudal). Colour: body blue-black dorsally and silvery white ventrally, with about 15 rows of cobalt-coloured stripes, each consisting of round dots and/or narrow bands. First dorsal fin dark blue; other fins usually dark brown, sometimes tinged with dark blue; bases of first and second anal fins tinged with silvery white.

ca. 12 cm body lengh | ca.100 cm. body length | ca.180 cm. body length

Schematic drawings of scales (not same size)

Geographical Distribution : T. audax occurs mainly in the tropical, subtropical and temperate waters of the Pacific and Indian oceans. Japanese longline catch data collected over many years show that the distribution pattern of this species within the Pacific Ocean is horseshoe-shaped, with the base of the horseshoe located along the Central American coast. T. audax is occasionally found on the Atlantic side of the Cape of Good Hope (Talbot & Penrith, 1962) and one individual was caught off Angola, West Africa in October 1976, having probably strayed from the Indian Ocean as in a few cases of Tetrapturus angustirostris and Makaira indica. The latitudinal range limits of T. audax, based on data from the commercial longline fishery, extend from about 45°N in the North Pacific to 30° S in the eastern South Pacific and to 45°S in the western South Pacific, as far south as 45°S in the southwestern Indian Ocean and 35°S in the southeastern Indian Ocean.



Area of occasional distribution, or invasion, (no spawning)

Habitat and Biology : This is an epipelagic and oceanic species, usually swimming above the thermocline. Parin (1968) included it among the holoepipelagic species which inhabit the isothermic, surface-pelagic layer of the ocean at all stages of their life cycle, and are usually confined to tropical and subtropical waters where permanent thermoclines exist, but penetrate higher latitudes in the local warm seasons. However, the striped marlin has a somewhat atypical distribution as compared to most other billfishes and tunas, and seems to prefer more temperate waters. In the Pacific, its distribution resembles that of the albacore (Thunnus alalunga) and the bluefin tuna (Thunnus thynnus), in contrast to that of the other billfishes and tunas. In the Indian Ocean, however, it is found in warmer waters. The total distributional range of this species, is generally bounded by the 20° and 25°C isotherms, at least in the western Pacific Ocean. This is the most dominant and widely distributed of all billfishes, especially in the eastern and northcentral Pacific, where it is much more abundant than in the western Pacific. In the Indian Ocean, the striped marlin is abundant in the western Arabian Sea.

Larvae of striped marlin have been recorded from the western North Pacific (west of 180° long.) between 10° to 30°N, and from the central South Pacific (west of 13O°W) between 10° and 30°S. They are most abundant in the respective local early summers, with peak occurrences during May through June in the western North Pacific, and in November and December in the central South Pacific. The seasonal occurrence of mature females coincides with that of the larvae. While the distribution of larvae for the eastern Pacific (east of 12O°W) is not known, mature fish are reported to occur there between 5° and 20°N, largely in May and June. Larvae have also been reported to occur in the Banda and Timor seas in January and February,in the eastern Indian Ocean in October and November between 6°N and 6°S, and in the western Indian Ocean between 10°S and 18°S in December and January. Mature females are found in March and May in the Bay of Bengal, although larval occurrence is not yet known there. The lower temperature limit in the distribution of larvae is approximately 24°C, both in the Indian and Pacific oceans. However, larval distributions in the two oceans differ in that, in the Pacific, the larvae of this species are scarcely found in equatorial waters. It has been noted that larvae of T. audax are not likely to appear in the Kuroshio Current area, while those of the Indo-Pacific sailfish, Istiophorus platypterus occur there extensively. Two juveniles of striped marlin (12.2 and 14.5 cm body length) were found in stomachs of a yellowfin tuna (Thunnus albacares), and of a dolphinfish (Coryphaena hippurus) taken by longlines on 13 January 1955 at 23°52'S/175°49'W and on 21 December 1964 at 17°5'S/67°29'E. These two occurrences coincide with larval distributions of the species in the South Pacific and Indian oceans, respectively.

The ovarian eggs of striped marlin from New Zealand average about 0.85 mm in diameter shortly before spawning. The size of ovulated eggs is presumed to exceed 1 mm in diameter, considering that the mean diameter of the eggs of the shortbill spearfish (Tetrapturus angustirostris) is 1.442 mm and that the eggs of the Indo-Pacific sailfish (Istiophorus platypterus), measure 1.304 mm in diameter.

T. audax, like the other marlins, does not form dense schools like the tunas, and the individuals are usually dispersed at considerably wide distances. Several fish, however, are often seen together, sometimes following one another, especially during the spawning season. Surfacing is apparently more common with strong wind and high waves. When wind and current are moving in the same direction, the water surface is rather smooth, but when the wind runs against the current, high waves develop and this is when striped marlin are most often seen at the surface around Taiwan Island, usually swimming in the direction of the wind. When surfaced, striped marlins usually swim very slowly, with the upper caudal fin lobe above the surface and the dorsal fin retracted and not showing, a characteristic which reportedly distinguishes them from swordfishes which are unable to depress the dorsal fin and show both the dorsal and caudal fins when surfaced. Striped marlins swim faster and are less easily approached when surfaced than the swordfish. Like other billfishes and tunas, they tend to school by size. For example, in the eastern Pacific, fish on the southern spawning grounds (forming a single size mode at 180 to 200 cm eye-fork length = 83.9 to 86.1% of body length) are larger than those on the northern spawning grounds

(two size modes, one at 140 cm and one at 180 cm). Smaller striped marlins occur in equatorial waters of the Pacific, but these small fish are absent between 5° and 16°S; in midlatitudes (15° to 30°S) of the central South Pacific, a longitudinal stratification is apparent, the larger fish (over 180 cm eye-fork length) occurring in the western Pacific; harpooned fish tend to be larger than longlined fish in the East China Sea, and the harpooned fish are also fatter at a given length.

Dolphinfishes (Coryphaena spp.), wahoo (Acanthocybium solandri) and the pelagic large sharks (Prionace, Isurus, Lamna, Carcharhinus and Alopias) feed on many of the same forage organisms as the striped marlin. Its closest competitors for food are possibly the other billfishes and larger tunas. The striped marlin, however, tends to feed more on epipelagic organisms and less on mesopelagic ones than the swordfish and the oceanic tunas. Food habits do not appear to vary significantly with sex or size, at least in adults. Considerable variation in species composition of the diet occurs, however, with seasons and geographic localities. T. audax, like other billfishes and tunas, is thought to be carnivorous and a non-selective feeder. Some of its reported major forage species by localities are: Fistularia sp., Auxis, sp., squid (East Africa); Scomberoesox saurus, Arripis trutta, Loligo sp., Omnastrephes sloani, Caranx lutescens, Scomber japonicus (New Zealand); Alespisauridae, Clupeidae (Tasman Sea; Gempylus serpens, Cololabis saida, Engraulis mordax, Sardinops caerulea, Trachurus symmetricus (California); Etrumeus teres, Fistularia sp., Argonauta sp., squid (Mazatlan, Mexico); Etrumeus teres, Scomber japonicus, Fistularia sp., squid (Baja California, Mexico); Auxis spp., Bramidae, Gempylidae, squid (eastern North Pacific) Alepisaurus spp., squid (eastern South Pacific); squid (Peru-Chile); Engraulis ringens, Trachurus symmetricus, squid (Chile).

Predators of adults of this species are probably extremely rare or almost inexistent, the only likely candidates being some of the large pelagic sharks and the toothed whales, although there are many predators to the earlier life-stages of the striped marlin.

Size : The maximum size attained by this species exceeds 350 cm in total length and 200 kg in weight. The all tackle angling record is a fish caught off the Cavalli Islands, New Zealand, on 14 January 1977, weighing 189.37 kg (417 lb 8 oz). Other records of large specimens (over 180 kg) are the following: 183.47 kg (404 lb 8 oz), Bay of Islands, New Zealand, on 12 March 1980; 181.89 kg (401 lb), Cavalli Islands, New Zealand, 24 February 1970; 180.53 kg (398 lb), Mayor Island, New Zealand, 30 December 1974 (IGFA, 1981). All world records for both men and women recognized by IGFA are from New Zealand, except a record from Botany Bay, Sydney, on 24 October 1976 (161.93 kg=357 lb for men's 30 lb line class).

Size at first capture (longline fisheries) of T. audax is approximately 80 cm eye-fork length (=83.9 to 86.1% of body length). Around Taiwan Island, size at first maturity generally estimated between 140 cm and 160 cm eye-fork length, and the biological minimum size of males at about 137 cm eye-fork length. The maximum size in commercial fisheries is probably about 290 cm eye-fork length or 258.6 kg (570 lb). The sizes of fish taken by commercial longliners range mainly from 205 to 225 cm body length in the northern part of the western North Pacific, between 145 and 185 cm body length in the southern part of the western North Pacific, between 235 and 255 cm body length in the central North Pacific, and about 280 cm body length in the western South Pacific.

Interest to Fisheries: In the period from 1978 to 1982, catches of T. audax have been reported from seven FAO Fishing Areas (51, 57, 61, 71, 77, 81 and 87), mostly by Japan and the Republic of Korea. The total world catch was 15 426 t in 1978, 15 988 t in 1979, 18 429 t in 1980, 15 664 t in 1981 and 15 460 t in 1982. Only 13.6% (2 132 t) of the 1981 total catch was taken in the Indian Ocean, and 86.4% (13 532 t) in the Pacific Ocean, particularly in Fishing Area 61 (northwest Pacific) with 7 229 t predominantly by Japan, in Fishing Area 77 (eastern central Pacific), with 2 414 t predominantly by Japan, and in Fishing Area 87 (southeast Pacific) with 2 217 t by Japan and the Republic of Korea (FAO, 1983); of the 1982 catch, 12.6% (1 949 t) was taken in the Indian Ocean and 87.6% (13 511 t) in the Pacific Ocean, predominantly by Japan, China (Taiwan Province) and the Republic of Korea (FAO, 1984).

The commercial catch of T. audax is taken mostly by surface longlining, while harpooning may be responsible for less than 1% of the total catch in recent years. The longliners aim chiefly at tunas and marlins which are frequently swimming at depths between 100 and 150 m. Longline gear consists of a mainline, float lines, branch lines, hooks, bouys including several radio-bouys, and flags. Several hundred of these units (each unit is referred to as a "basket") are joined in a series to make up a set of longline. The longline is retrieved with a line hauler. Japanese longliners in the eastern Pacific use about 2 000 hooks (about 400 baskets) per set. Due to recent manpower problems, considerable effort has been directed toward developing labour-saving devices in longlining. The reel-type and the tub-type of longlining are two examples of this development. In the reel-type the mainline (usually wire) is continuous and reeled onto a large drum, while in the tub-type, the retrieved line is coiled into a large tub. In harpooning, the electric harpoon has been recently introduced in Japanese fisheries to speed up the killing of the fish.

The quality of the flesh is the best among billfishes for sashimi and sushi. It is marketed mostly frozen, sometimes fresh.

Local Names : AUSTRALIA: Striped marlin; CHILE: Pez aguja;CHINA: Chi zuo fo yii, Hung ju chi yii, Hung ju ting pan; JAPAN: Achinoiyo, Achinoiyu, Achinuigu, Akinoio, Akinoiyo, Amenashi, Bai, Boke, Chiruguwa, Dainanbo, Haihage, Hainouo, Haise, Mage, Maka, Makajiki, Masashi, Masasu, Naeragi, Naidonbo, Nairage, Nairagi, Nairanbo, Neeranbo, Nooragi, Nouragi, Oiragi, Oiraki, Okajiki, Sashi, Sasu, Shitore, Shiutome, Tenguzawara,

Tsukinbo, Unjiachi; KENYA: Nduaro; MEXICO: Agujón, Marlin, Marlin rayado, Pez puerco; NEW CALEDONIA: Empéreur, Marlin rayé, Empéreux; NEW ZEALAND: New Zealand marlin, Striped marlin; PHILIPPINES: Dugso, Liplipan, Marasugi, Spearfish; REPUBLIC OF KOREA: Cheong-sae-chi; SRI LANKA: Haura; USA: Barred marlin, Pacific striped marlin, Spearfish, Spikefish, Striped marlin, Striped swordfish; USSR: Polosatii marlin; VIET NAM: Cá cò mitsukurii.

Literature : Nakamura, H. (1938); Ueyanagi (1959, 1964); Jones & Kumaran (1964); Howard & Ueyanagi (1965); Nakamura, I. (1968); Parin (1968); Kume & Joseph (1969, 1969a); Ueyanagi & Wares (1975); and Silas & Pillai (1982).

Remarks : Honma & Kamimura (1958) and Kamimura & Honma (1958) advanced the hypothesis that North and South Pacific populations of this species, being quite separate from each other, may represent different species, based on differences in pectoral fin length, and ecology. Further study is needed on this problem.

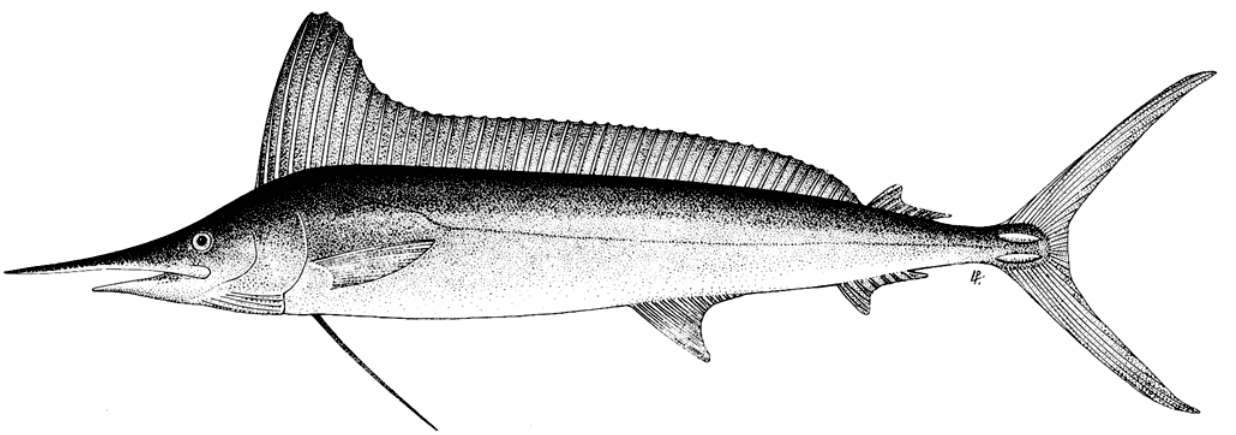
Tetrapturus belone Rafinesque, 1810

ISTIO Tetra 6

Tetrapturus belone Rafinesque, 1810, Caratteri di alcuni nuovi generi e nuove specie di animali e piante della Sicilia, con varie osservazioni sopri i messimi. Palermo, 1810, 105 pp., 20pl. (ref.p. 54-5, p1.1, fig. 1).

Synonymy : Skeponopodus typus Nardo, 1833; Tetrapterurus belone-Bonaparte, 1841; Tetrapterus belone-Agassiz, 1843; Tetraplurus belone-Verany, 1847; Histiophorus belone Günther 1860; Scheponopodus prototypus Canestrini, 1872; Histiophorus (Tetrapturus) belone-Lütken, 11376; Makaira belone-Tortonese, 1958.

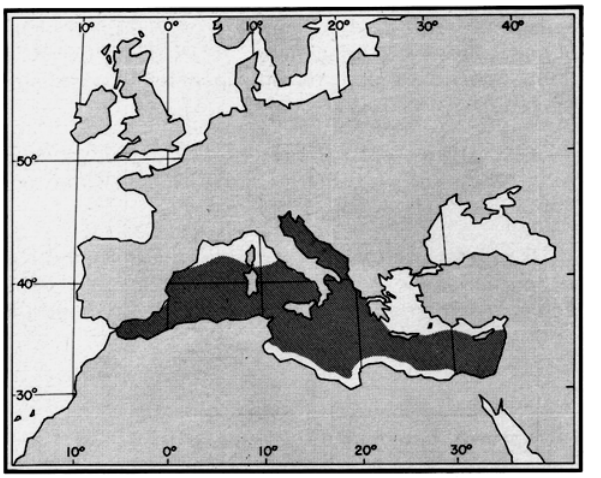
FA0 Names : En - Mediterranean spearfish; Fr - Marlin de la Méditerranée; Sp - Marlin de1 Mediterráneo.



Field Marks : Bill very short, about 18% of body length; pectoral fins narrow and short, less than 15% of body length; distance between anus and anal fin origin nearly equal to anal fin height.

scales

Diagnostic Features : Body elongate and fairly compressed. Bill rather short and slender, round in cross section; nape almost straight; right and left branchiostegal membranes completely united to each other, but free from isthmus; no gillrakers; both jaws and palatines (roof of mouth) with small, file-like teeth. Two dorsal fins, the first with 39 to 46 rays and a rounded anterior lobe higher than body depth anteriorly, the fin then abruptly decreasing to about the 10th dorsal fin ray and keeping the same height further backward; first dorsal fin base long, extending from above posterior margin of preopercle to just in front of second dorsal fin origin; second dorsal fin with 5 to 7 rays, its position backward with respect to the second anal fin by half the length of the anal fin base; two anal fins, the first with 11 to 15, rays, the second with 6 or 7 rays and very similar in size and shape to the second dorsal; pectoral fins short (10 to 13% of body length), adpressible against sides of body, their upper margins curved, lower margins nearly straight and tips pointed, with 16 to 20 rays; pelvic fins long and slender, slightly shorter than twice the pectoral fin length and depressible into deep ventral grooves. Caudal peduncle well compressed (laterally) and slightly depressed (dorsoventrally), with strong double keels on each side and a shallow notch on both, the dorsal and ventral surfaces; anus situated far anterior to first anal fin origin. Lateral line single and obvious, its arch ending between midpoint and tip of pectoral fin. Body densely covered with elongate bony scales, each with 3 to 5 posterior points. Vertebrae 24 (12 precaudal and 12 caudal). Colour: body dark bluish grey to nearly black dorsally and silvery white ventrally; usually no blotches or marks on body or fins.



Geographical Distribution : T. belone is limited in its distribution to the Mediterranean Sea, being considerably abundant around Italy. Its eastern distributional limits have not been clearly defined and there have been no records of its occurrence in the Black or the Aegean seas. Although juveniles are known from off Lebanon and Haifa, Israel, no adults have been reported east of the Ionean Sea. T. belone is the most common istiophorid in the central basin of the Mediterranean and its life cycle is completed inside this sea as far as is known to date. Reliable literature records of this species are from around Sicily, the Straits of Messina, Palermo, Taranto, the Gulf of Naples, Venice, the Ligurian Sea, Malta, Mallorca, the Adriatic Sea, and Split, Yugoslavia (adults); Haifa and Lebanon (juveniles); the Straits of Messina (larvae).

Habitat and Biology : Like other billfishes, this species probably swims in the upper 200 m water layer (epipelagic), generally above or within the thermocline. It is frequently reported to travel in pairs, this being known to occur in other istiophorids, possibly corresponding to a feeding behaviour. In the Straits of Messina, the area of most heavy fishing, adults occur in August and September, and occasionally in October and November. They seem to prefer the upper water layers of the Straits, a fact that may well be associated with upwelling and the consequent concentration of food in these waters.

Winter or spring might not be an unreasonable hypothesis for the spawning season of this species. Its pelagic eggs have been found in plankton collections from the Straits of Messina; they average 1.48 mm in diameter and the oil globule is yellow-green; the eggs are incubated for several days and their development has been described (Sparta, 1953, 1961).

T. belone probably feeds on pelagic fishes, such as sardines (Clupeidae), flyingfishes (Exocoetidae), carangidis, scombridis, dolphinfishes (Coryphaenidae) and others. Around Sicily, it pursues dolphinfishes, Atlantic sauries, sardine-like fishes, needlefish (Belone belone) and pilotfish (Naucrates ductor).

T. belone is ecologically similar to Xiphias gladius, Tetrapturus albidus, Thunnus thynnus and some large sharks, with which it competes for food. Because of its relatively large size, it is probabily not preyed upon extensively in the adult phase, although the larval and juvenile stages are taken by large pelagic fishes.

Size : The maximum size reached by this species exceeds 240 cm in body length and 70 kg in weight. The usual size composition in commercial catches ranges from 10 to 30 kg (mostly 14 to 18 kg) and averages about 200 cm in body length.

Interest to Fisheries: T. belone is usually taken at the surface by harpoons, longlines, driftnets and setnets. In the Gulf of Castellammare, Sicily, and near the towns of Torretta, Granitola and Marinetta, a few individuals are taken by tuna traps. It is also occasionally caught by flag lines and drifting handlines.

The fishery of this species is incidental to those for swordfish (Xiphias gladius), bluefin tuna (Thunnus thynnus) and albacore (Thunnus alalunga). In the Straits of Messina, the gear most often used is the harpoon (fiocine) although this species is also occasionally caught by nets (revastina) normally used for the Atlantic saury, locally called “costardella”, on which T. belone feeds. To the south of the Straits of Messina, T. belone is taken at night with vertical nets (palamideras) normally used to catch albacore.

No quantitative data are available on the annual or seasonal catch.

Local Names : ALGERIA: Auggia imbriale; FRANCE: Marlin, Poisson-pique; ITALY: Acura ‘mperiale (regional variations of spelling and pronounciation based on Aguglia imperiale), Aguggha imperiali, Agugghia ‘mpiriale, Aguglia imperiale, Aguglia pelerana, Ugghia ‘mpriali, Ugulia imperiali; JAPAN: Chichukaifuurai, Nishifuuraikajiki (even though this species does not occur around Japan, the Japanese have a keen interest to have names for all billfishes); MALTA: Pastardella; MONACO: Aguglia imperiale; MOROCCO: Bumkhiat; SPAIN: Marlin; USA: Mediterranean shortbill spearfish, Mediterranean spearfish; YUGOSLAVIA: Iglan, Igloklјun.

Literature : Sparta (1953, 1961); Robins & de SyIva (1960, 1963); Cavaliere (1962); Rodriguez-Roda & Howard (1962); de Sylva (1973, 1975).

Remarks : Because of difficulties in identification of juvenile and adult billfish, it is possible that this species is more widely distributed in the Mediterranean Sea than has been reported in the literature, and that Mediterranean spearfish may have been identified by sports- and commercial fishermen as white marlin, Tetrapturus albidus, a species which also occurs in the western and central Mediterranean Sea.

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