CHAPTER 2.1.8.3: LONGBILL SPEARFISH	AUTHORS: J. HOOLIHAN	LAST UPDATE: Jan. 14, 2013

2.1.8.3 Description of Longbill Spearfish (SPF)

1. Names

1.a Classification and taxonomy

Species name: *Tetrapturus pluegeri* (Robins & de Sylva, 1963)
Synonyms in use: none
ICCAT species code: SPF
ICCAT names: Longbill spearfish (English), Makaire bécune (French), Aguja picuda (Spanish)

Nakamura (1985) classified Longbill spearfish as follows:

- Phylum: Chordata
- Subphylum: Vertebrata
- Superclass: Gnathostomata
- Class: Osteichthyes
- Subclass: Actinopterygii
- Order: Perciformes
- Suborder: Xiphioidei
- Family: Istiophoridae

1.b Common names

List of vernacular names in use according to ICCAT and Fishbase (ww.fishbase.org). List is not exhaustive and may exclude some variants of local names.
Azores Islands: Longbill spearfish
Benin: Ajètè, Adjètè
Brazil: Agulhão estilete, Marlin-bicudo
Cape Verde: Espadim-bicudo, Marlin-bicudo
Cuba: Aguja
Chinese Taipei: 长吻旗鱼 (Chang wen chi yu)
Denmark: Langnæbbet spydfisk
France: Makaire bécune
Germany: Speerfisch, Langschnabliger
Japan: Kuchinagafurai
Martinique: Makaire à longue pectorale, Varé
Mexico: Marlin trompa larga
Netherland Antilles: Balau blanku
Namibia: Langschnauziger Speerfisch, Langbek-speervis
Norway: Spydfisk
Portugal: Espadim bicudo, Marlin bicudo, Espadin aguia
Russian Fed: Malyi kopénosets
South Africa: Langbek-speervis, Longbill spearfish
Spain: Aguja picuda, Romerillo, Saltón
Sweden: Långnosad spjutfisk
United Kingdom: Longbill spearfish
United States of America: Longbill spearfish
Uraguay: Marlín picudo
Venezuela: Aguja corta, Aguja-palagar, Pez lanza, Voladora

2. Identification

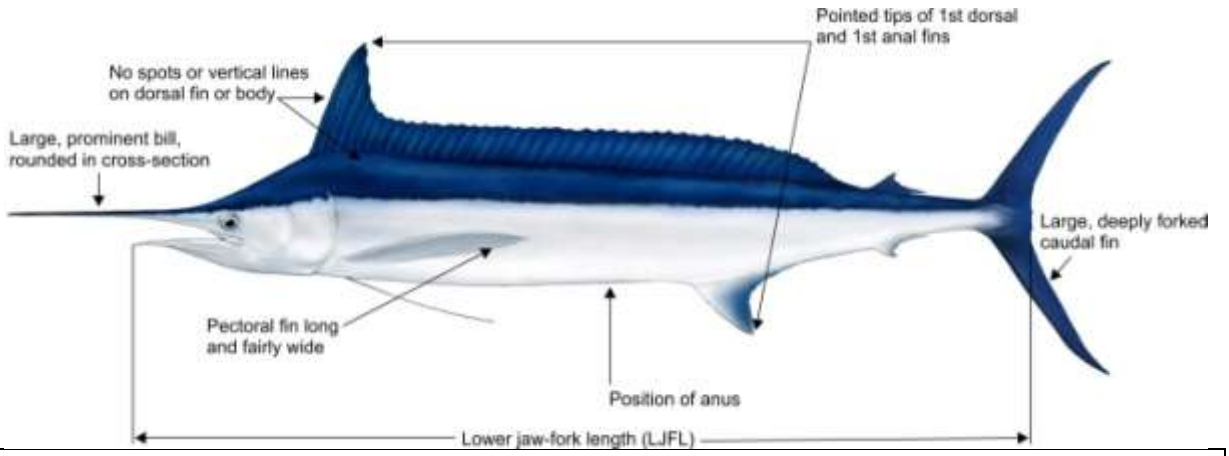

Figure 1. Drawing of adult longbill spearfish by Les Gallagher (Les Gallagher: fishpics), with annotated prominent features.

***Characteristics of* Tetrapturus pfluegeri (see Figure 1)**

Longbill spearfish is one of the small-size billfish species. Maximal size was reported by Nakamura (1985) in 200 cm total length, and 45 kg in weight. Common sizes in the western central Atlantic are 158-190 cm LJFL (Arocha *et al.*, 2007; Matsumoto and Miyabe, 2001).

Conventional tagging experiments have shown that the longest time at-large recorded for a longbill spearfish was five years (Ortiz *et al.* 2003). Over 400 anal spines have been analyzed as part of an on-going collaborative age and growth study of longbill spearfish from the western Atlantic. These specimens ranged in size from 110 to 202 cm LJFL. Preliminary results indicated that individuals can reach 7+ years based in annual ring formation (Pons, *unpublished data*).

External

- First dorsal fin rays, 44-53; second dorsal fin rays, 6-7; first anal fin rays, 13-17; ; second anal fin rays, 6-7; pectoral fin rays, 18-21; pelvic fin rays, 2; branchiostegals, 7; vertebrae, 12 precaudal, 12 caudal: gill rakers, 0; adult jaws and palatine exhibit small, file-shaped teeth.
- Body elongated, very low body depth, and very compressed.
- Head profile (nape) between preorbital region and origin of first dorsal fin nearly straight.
- Upper jaw prolonged into long stout spear (bill), rounded in cross-section.
- Long first dorsal fin, with height of anterior lobe slightly greater than body depth, then decreasing moderately posteriorly.
- Tips of first dorsal and first anal fins pointed.
- Pelvic fins slightly longer than pectoral fins.
- Caudal fin large and deeply forked.
- Caudal peduncle with double keels on each side, with a caudal notch on the dorsal and ventral surface.
- Single lateral line visible, curved above pectoral fin, then straight towards tail.
- Anal opening situated far anterior of origin of first anal fin, generally a distance equal to the height of longest anal fin ray.
- Mid-lateral scales pointed anteriorly and have multiple posterior points (**Figure 2**).

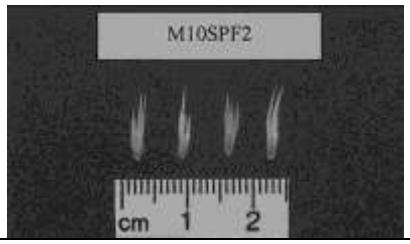

Figure 2. Examples of longbill spearfish mid-lateral scales.

Colour:

- Dark blue dorsally, silvery-white laterally and ventrally. No vertical barring or spots.
- First dorsal fin membrane bluish-black, with no spots. Remaining fins are brown to bluish-black.

Internal

- Asymmetrical gonads.
- Swimming bladder present, consisting of many small bubble-shaped chambers.

External characteristics of longbill spearfish larvae

- There is no available information on longbill spearfish larvae.

Misidentification

Gross morphology of longbill spearfish is somewhat similar to the sympatric white marlin and roundscale spearfish, often resulting in mis-identification (Arocha and Beerkircher, 2012; Shivji *et al.*, 2006). Definitive identification is available using genetic tools (Shivji *et al.*, 2006). However, close observation helps to distinguish between subtle morphological differences, which include:

- Position of the longbill spearfish anus is much further anterior from origin of first anal fin, compared to roundscale spearfish and white marlin (**Figure 3**).
- The mid-lateral scales of longbill spearfish differ from the white marlin and roundscale spearfish, being pointed anteriorly, and having multiple posterior points.

Figure 3. Comparative positions of anal opening relative to anterior origin and height of anal fin for longbill spearfish (left), roundscale spearfish (middle), and white marlin (right, *photos courtesy of* Larry Beerkircher).

3. Biology and population studies

3.a Habitat preferences

Longbill spearfish is an epipelagic and oceanic species, found in offshore waters over 100 m depth, and usually above the thermocline.

Temperature preferences for longbill spearfish have been derived from sea surface temperature recorded by scientific observers on board longline vessels. Longbill spearfish seem to associate with the epipelagic zone in water temperatures ranging from 24-29°C, although, it was also noted that longbill spearfish can be found in waters with sea surface temperatures of 22°C. Kerstetter *et al.* (2009) reported that two specimens monitored with pop-up satellite archival tags (PSATs) spent 97% and 82% of their time in water 22-26 °C. In general, the thermal preference for this species appears to be the warmest waters available in the open ocean, similar to other istiophorids.

Depth distribution seems to be similar to that of white marlin, a similar species, found within the first 25 m. However, information derived from scientific observers at sea seem to indicate that catches of roundscale spearfish overlaps with longbill spearfish, and are common when the target species is yellow fin tuna when sets are between 40-60 m in the Caribbean Basin and the Atlantic area between 12°N and 18°N. Two longbill spearfish monitored with PSATs for 11 and 45 d in the equatorial South Atlantic spent the majority of their time near the surface (<25 m), and rarely descended below 150 m (Kerstetter *et al.*, 2009).

Dissolved oxygen requirements for billfishes are poorly understood, partly due to the difficulty in maintaining these animals in a laboratory environment. However, habitat utilization, based on electronic tagging data (Prince and Goodyear, 2006; Prince *et al.*, 2010), suggests that billfishes are limited by a minimal dissolved oxygen concentration requirement of around 3.5 mL L^{-1}, similar to the high demand oxygen requirements and associated metabolic rates exhibited by tropical tunas (Brill, 1996). Studies indicate that billfishes located in the eastern tropical Atlantic oxygen minimum zone (Prince *et al.*, 2010) are restricted to a narrow surface layer of adequate oxygen. This, in turn, increases their susceptibility to capture in surface fishing gears.

3.b Growth

Longbill spearfish age determination and growth studies have not been undertaken. No growth model is available for longbill spearfish. The maximum time at large recorded for longbill spearfish was about five years (Ortiz *et al.* 2003).

3.c Length-Weight relationship

The available length-weight relationships for longbill spearfish are scarce due to the low availability of the species from commercial catches for weight measurements. The only source found, was from recreational billfish surveys conducted by the USA in the Atlantic Ocean (Witzell, 1989). Due to the small sample size (n=34), no sex specific relationships were developed. The fish collected and used for the estimation of the length-weight relationship had an average weight of 14.7 kg and average length was 151.8 cm LJFL. The length-weight relationship estimated is presented in **Table 1**.

Table 1. Available longbill spearfish length-weight relationship.

Equation	*Reference*	*N*	*Sex*	*LJFL range (cm)*
$RWT = 2.7 \times 10^{-5} LJFL^{2.6}$	Witzell (1989)	34	Combined	85-195

3.d Maturity

There is no information regarding the size or weight at which sexual maturity is reached. However, Arocha *et al.* (2007) reported that for longbill spearfish from the western central Atlantic, higher gonad index values (> 1.0) were observed in females >150 cm LJFL.

3.e Sex ratio

In a study on the distribution and reproductive biology of the longbill spearfish in the western central Atlantic (5°N - 25°N), sex ratio at size of longbill spearfish (n=117) displayed a seasonal pattern between trimesters (Arocha *et al.*, 2007). In the first trimester, the proportion of females remained above 50% for almost all sizes. During the second and fourth trimesters, the proportion of females decreased monotonically from 30% to near 0% (in the 2nd trimester) from sizes between 160 and 170 cm LJFL to sizes >190 cm LJFL, and from around 90% to 0% (in the 4th trimester). In the third trimester, the proportion of females for sizes >160 cm LJFL increased from under 20% to 100% in the larger fish. Notably, the proportion of females decreased as their size increased.

3.f Reproduction and first life stages

Similar to other istiophorids, longbill spearfish do not show apparent sexual dimorphism in color pattern or external morphological characters.

Spawning

Longbill spearfish are batch spawners, shedding batches of hydrated oocytes, in separate spawning events (deSylva and Breder, 1997), most likely directly into the sea where fertilization occurs. Spawning occurs in roughly the same offshore environments they normally inhabit. Longbill spearfish spawning areas in the Atlantic are mainly found in the tropical western areas of both hemispheres. Spawning success has been identified in the vicinity of the mid-Atlantic ridge of both hemispheres based on the occurrence of larval spearfish (deSylva and Breder, 1997). Based on the microscopic assessment of gonads, concentration of spawning females has been recorded in the Venezuelan Basin, Caribbean Sea (Arocha *et al.*, 2007).

It has been suggested that longbill spearfish spawned from November to May based on the occurrence of mature females obtained from Japanese longline data (deSylva and Breder, 1997; Robins, 1975). However, Ueyanagi *et al.* (1970) indicated that in the central South Atlantic (10°S-30°S) spawning based gonad index occurred during

the first trimester of the year (January -March). In the North Atlantic (10°N-20°N), the data was very limited and spawning seem to occur almost every trimester. In the western central Atlantic, spawning occurs from April to August, with peak spawning events occurring from June to August (Arocha *et al.*, 2007).

Eggs and larvae

Estimated batch fecundity for female fish between 150 and 175 cm LJFL was estimated in 225,000-600,000 of fully hydrated oocytes per female (Arocha *unpublished data*). Eggs are pelagic, spherical and transparent; whole hydrated oocytes are on average 1.399 mm in diameter (1.164-1.399 mm, *n*=100), and contain an oil globule measuring on average 0.400 mm (0.277-0.584 mm, *n*=100) in diameter (Arocha *unpublished data*).

Recruitment

Knowledge of the early life stages in billfishes is very scarce. It is assumed that larval period is short due to fast growth during this period (Luthy, 2004; Prince *et al.*, 1991). Young (immature) longbill spearfish first appear in the catches when they are around 100 cm LJFL. From this time on, it is easier to know their migratory movements both by observing the fisheries and by tagging experiments.

3.g Migrations

Longbill spearfish movements in the Atlantic are poorly known. Only three tagged and released fish have been recovered, and the linear displacement for these was 1924 km (Ortiz *et al.*, 2003).

3.h Diet

Longbill spearfish are apex predators that prey opportunistically on fish and squids. In the western equatorial Atlantic, the most important prey fish was the pomfret, *Brama brama*, and the snake mackerel, *Gempylus serpens*. Among the cephalopod prey, the squids, *Ornithoteuthis antillarum*, *Hyaloteuthis pelagica*, and the octopod *Tremoctopus violaceus* were the most important prey items (Júnior *et al.*, 2004). In the North and tropical Atlantic, over 75% of the diet consisted of fish prey, and the remaining were cephalopods. Among prey fish, species from the families Gempylidae, Exocotidae and Scombridae comprised over 80% of the total (Satoh *et al.*, 2004). In the southern Caribbean Sea, longbill spearfish diet is composed mainly of omastrephid squids, followed by clupeids, and *Dactylopterus volitans* (Arocha, 2006).

3.i Physiology

Billfishes, like tunas, have anatomical and physiological adaptations for continuous swimming, and cranial endothermy (brain and eyes) which facilitate foraging at different depths. Longbill spearfish, like the other billfishes, feature a thermogenic organ situated beneath the brain and close to the eyes that generates and maintains elevated temperatures in the cranial region (Block, 1986). This organ or 'brain heater' facilitates deep diving behaviour by permitting ocular and physical functions at lower temperatures.

3.j Behaviour

Longbill spearfish, like all marlins, are not schooling fish. They are considered rare and solitary species, but they are also known to occur in pairs, but sexes of the paired fish are unknown, and if caught, is usually only one of the pair (Nakamura, 1985). It has been suggested that this behaviour may be for hunting as well as for mating.

3.k Natural mortality

No reliable estimates of natural mortality rates are available. Tagging data are insufficient for that effort. Estimating M from growth parameters is limited because they have not been estimated. Natural mortality based on the estimated longevity would rand range from 0.15 to 0.30. However, based upon body size, behaviour, and physiology, estimates of adult fish would likely be fairly low (Anon., 1994; Anon., 1998).

3.l Conversion factors

There are no conversion factors available for longbill spearfish.

4. Distribution and exploitation

4.a Geographical distribution

Longbill spearfish are widely distributed in subtropical, tropical, and occasionally in Atlantic temperate waters of the Atlantic Ocean, ranging from 40 ºN to 35 ºS (**Figure 4**). In the western central Atlantic, important concentrations are present in the Venezuelan basin, and off Suriname, dispersed fish are located in the Gulf of Mexico, and off the southeastern coast of the USA. Other areas of concentration of longbill spearfish include the pelagic waters of the mid-Atlantic ridge in both hemispheres (Ueyanagi *et al.*, 1970).

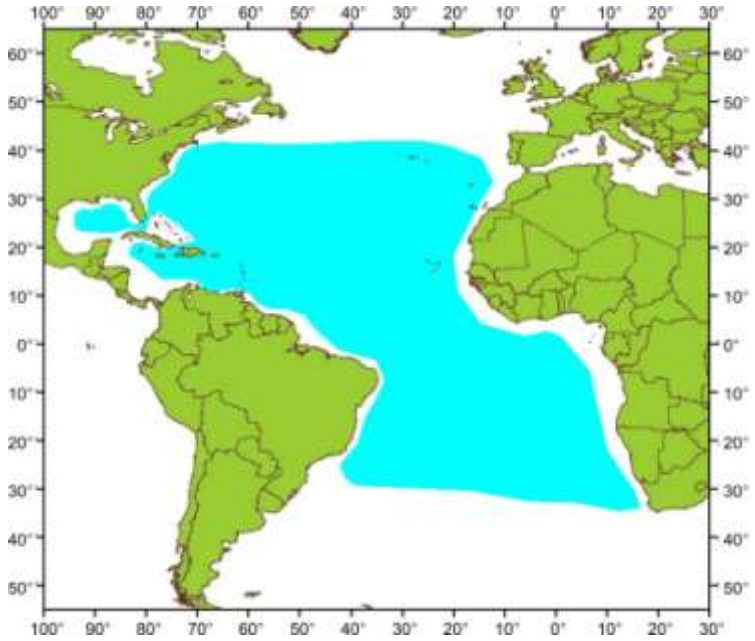

Figure 4. Geographical distribution of longbill spearfish from reported catches between 1970 and 2011 (source ICCAT).

4.b Populations/Stock structure

Landings of longbill spearfish have been traditionally combined by ICCAT with those of Atlantic sailfish and the Mediterranean spearfish, *T. belone*. Therefore, the species group sailfish+spearfish have been considered by ICCAT as a separate east and west stock for management purposes. However, in the sailfish assessment of 2001 (Anon., 2002) a procedure was developed to separate sailfish catch from that of spearfish, but without differentiating between the spearfish species caught by the fleets.

4.c Description of fisheries: Catches and effort

Longbill spearfish catches appear in the pelagic longline tuna fishery in the western Atlantic and central Atlantic. Historically, little effort was made to separate longbill spearfish from sailfish catches. Hence, ICCAT statistics classify them as sailfish+spearfish. There are no catch statistics for disaggregated longbill spearfish.

4.d Catch-at-size

There are no estimates of catch-at-age for longbill spearfish. Catch-at-size is only available from the longline fishery off the western central Atlantic for the period of 1991-2000 (Arocha, 2006) (**Figure 5**). The size distribution was based on 715 specimens, mean size observed was 166.7 cm LJFL, the median size of captured fish was 169 cm LJFL.

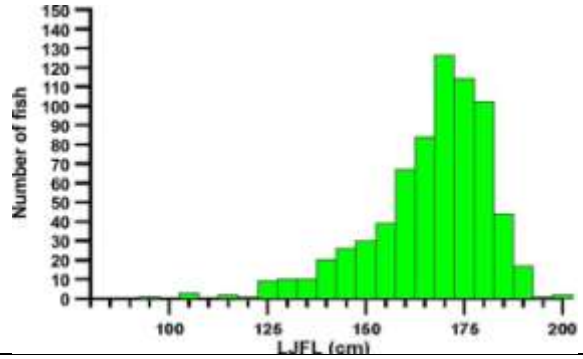

Figure 5. Size (LJFL cm) frequency distribution of longbill spearfish from the longline fishery off the western central Atlantic for the period of 1991-2000 (Arocha, 2006).

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