ICCAT Manual
ICCAT CICTA CICAA
INTERNATIONAL COMMISSION
FOR THE CONSERVATION OF ATLANTIC TUNAS

CHAPTER 2.1.10.2: BULLET TUNA	**AUTHORS: R. SANT'ANA (UNIVALI), R. IVANOFF (UNIVALI) AND F. LUCENA-FRÉDOU (UFRPE)**	**LAST UPDATE: 30 June 2021 Original: English**

2.1.10.2 Description of bullet tuna (BLT)

1. Names

1.a. Classification and taxonomy

Species name: *Auxis rochei* (Risso, 1810)
ICCAT species code: BLT
ICCAT names: Bullet tuna (English), Melvera (Spanish), Bonitou (French).

According to Collette and Nauen (1983), bullet tuna is classified as follows:

- Phylum: Chordata
- Subphylum: Vertebrata
- Superclass: Gnathostomata
- Class: Osteichthyes
- Subclass: Actinopterygii
- Order: Perciformes
- Suborder: Scombroidei
- Family: Scombridae
- Genus: Auxis
- Species: *Auxis rochei*
- Subspecies: *Auxis rochei rochei*

Some authors have used the name *Auxis thazard* as including *Auxis rochei* in the belief that there was only a single worldwide species of Auxis (Collette and Nauen, 1983).

In general, the distribution of *Auxis rochei* is not completely understood. As introduced by Relini *et al.* (2008), the close morpho-anatomical similarity with the congeneric cosmopolitan frigate tuna *Auxis thazard* only raises further questions. However, genetic evidence observed in the study of Relini *et al*. (2008) and more recently highlighted in Relini *et al*. (2009) indicates that *A. rochei* only inhabits the Mediterranean Sea and North Atlantic Ocean.

1.b. Common names

List of vernacular names used by different countries according to ICCAT, FAO and Fishbase (www.fishbase.org).

The list of countries is not exhaustive and some local names might not be included.

Albania: Skumri i madh.
Australia: Long corseletted frigate mackerel, Maru frigate mackerel.
Azores Islands: Bullet mackerel, Bullet tuna, Frigate mackerel, Judeu.
Barbados: Blow goat, Frigate mackerel.
Brazil: Bonito-cachorro, Cavala.
China Main: 雙鰭舵鰹.
Chinese Taipei: 花煙, 圓花鰹, 煙仔魚.
Cuba: Melva aleticorto.
Denmark: Fregatmakrel.
Ecuador: Botellita.
France: Auxide, Bonitou.

Germany: Fregattmakrele.
Greece: Τουμπαρέλι, Κοπάνι, Κοπανέλι, Βαρελάκι, Τερνέττα, Kopani, Koponi-Kopanaki.
India: ഉരുളന് ചൂര, Bullet-tuna, Eli-choorai, Kutteli-choorai, Ragondi, Urulan-choorai.
Italy: Tombarello.
Japan: Chiboh, Dainanpo, Kobukura, Kogatsuo, Kubarai, Magatsuwo, Manba, Mandara, Marugatsuwo, Marumejika, Marusöda, Marusôda, Marusödakatsuo, Mejika, Nodoguro, Rohsoku, Soda, Soku, Subo, Subota, Uzawa.
Libya: ماتسيتي, Matseti.
Madeira Island: Judeu.
Malaysia: Aya selaseh, Bakulan, Kayu, Tongkol.
Malta: Bizu, Mazzita, Pizzintun, Sgamirru, Tombitombi, Tumbreall, Tumbrell, Zgamirru.
Mexico: Bonito, Melva, Melvera.
Micronesia: Mackerel tuna, Yasiuneiu-yauma.
Mozambique: Judeu melveira.
Nicaragua: Melvera.
Norway: Auxid.
Papua New Guinea: Bullet tuna.
Peru: Barrilete negro.
Philippines: Aloy, Bodboran, Bodboron, Bonito, Buboron, Budburon, Bullet tuna, Buroboto bilog, Burot, Frigate tuna, Kuringding, Lubak-lubak, Mangko, Manko, Perit, Pidlayan, Pirit, Tangi, Tulingan, Turingan, Vahuyo.
Poland: Tazar marun.
Portugal: Judeu.
Slovenia: Trupec.
South Africa: Bullet tuna, Koeël-tuna.
Spain: Melva, Melvera.
Sri Lanka: Eli-choorai, Kutteli-choorai.
St Helena: Mackerel tuna.
Sweden: Auxid.
Türkiye: Gobene baligi, Tombik baligi.
UK: Bullet tuna, Frigate mackerel, Frigate tuna.
Uruguay: Bullet tuna, Sanguzo.
USA: Bullet mackerel, Bullet tuna.
Vietnam: Bullet tuna, Cá Ngừ o.

2. Identification

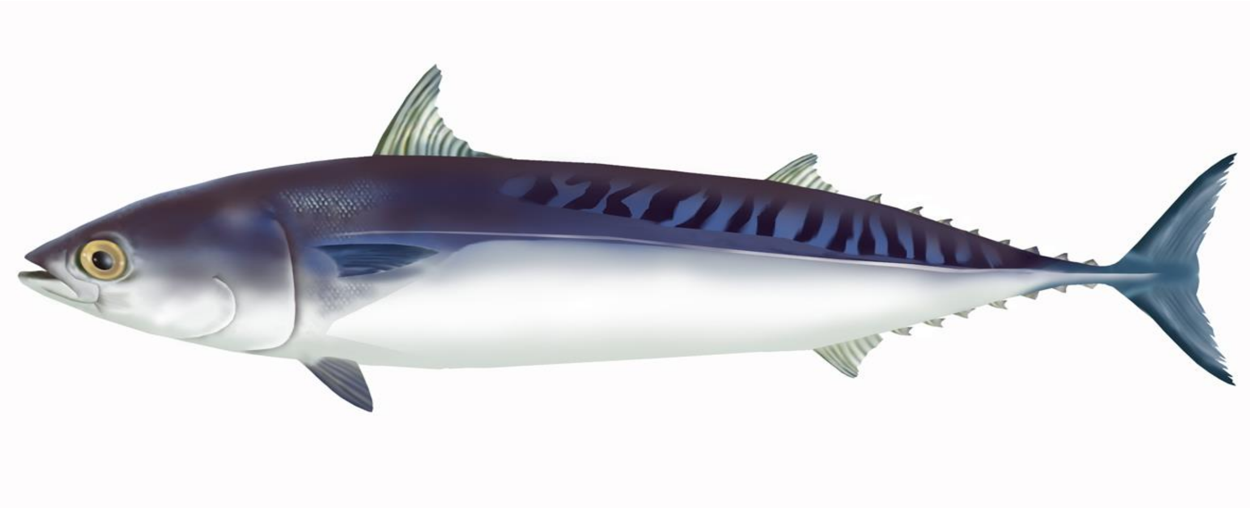

Figure 1. Drawing of an adult *Auxis rochei* (by A. López, 'Tokio').

Characteristics of *Auxis rochei* (see Figure 1 and Figure 2)

Bullet tuna is a small tuna species considered one of the smallest members of the Scombridae family (Expósito, 2015). In the eastern Atlantic, maximum size is 51 cm fork length (FL) (Santos and García, 2006). In the Strait of Gibraltar, maximum size is 47 cm FL and maximum weight is around 1.9 kg (Rodríguez-Roda, 1966). Common size is 35 cm FL (Collette and Nauen, 1983; Collette, 1986).

Colour:

- Colour bluish iridescence on dorsal parts turning to deep purple or almost black on the head.
- Pattern of 15 or more dark bars or wavy lines, oblique to nearly vertical, in the scaleless area above lateral line.
- White belly without stripes or spots.
- Pectoral and pelvic fins are purple, with black inner sides.
- Black patch at postero-ventral border of eye.

External:

- Body robust elongate and rounded.
- Body naked, except for the corselet which is well developed. Corselet wide in its posterior part (more than 6 scales wide under second dorsal fin origin, usually 10 to 15).
- Strong median keel on each side of caudal peduncle, between two smaller keels.
- Two dorsal fins separated by a large interspace (at least equal to length of first dorsal fin base). Second dorsal lower than first, followed by 8 finlets.
- Anal fin followed by 7 finlets.
- Short pectoral fin, which does not reach the beginning of scaleless area above corselet. Pectoral rays: 22-25.
- Dorsal spines: 10-12.
- Gill rakers on first arch: 38-47.
- Inter-pelvic process single and very large, equal to length of pelvic fins.

Internal:

- Swim bladder absent.
- Right lobe of liver very long, extending along the length of the body cavity and left lobe greatly reduced.
- Vertebrae: 39.
- Cutaneous artery present but divided into separate dorsal and ventral branches. The ventral branch is very poorly developed.

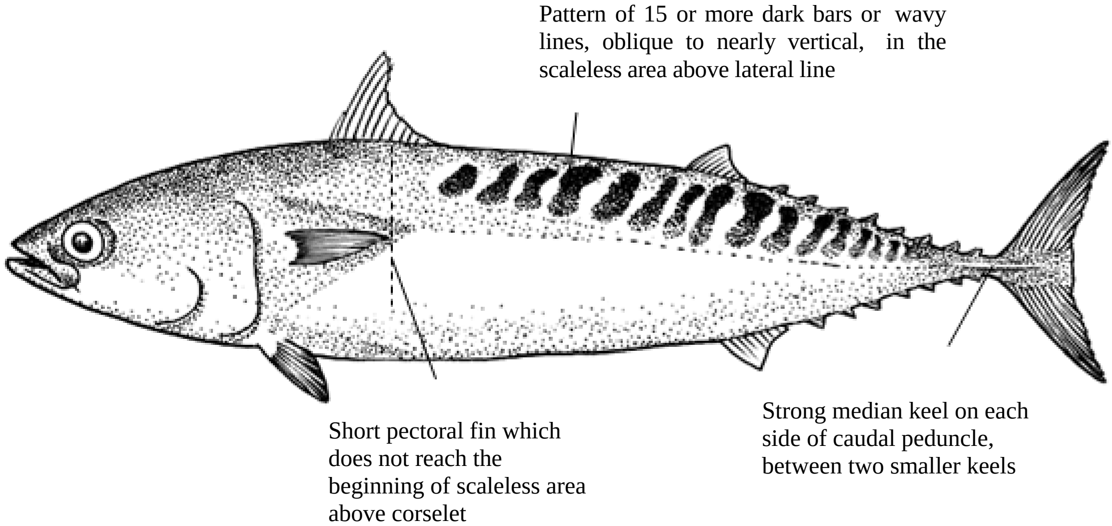

Figure 2. Synthesis of the most outstanding characteristics of *Auxis rochei* (by A. López, 'Tokio').

3. Distribution and population ecology

3.a. Geographical distribution

The genus Auxis is distributed worldwide in tropical and subtropical waters. The confusion surrounding the identification of the species of Auxis is based on reported distribution in the world's oceans. Auxis is distributed on both sides of the tropical and subtropical Atlantic Ocean, including the Mediterranean Sea, the Caribbean Sea and the Gulf of Mexico. Nevertheless, the species *Auxis rochei* is more abundant in the Strait of Gibraltar, the north coast of Africa, and on the Spanish Mediterranean coast (Kahraman *et al*., 2011; Valeiras *et al*., 2008). According to Ollé *et al*. (2019) and Collette *et al*. (2011), most specimens of the genus Auxis caught in the Mediterranean Sea might be bullet tuna (*Auxis rochei*).

General latitudinal range reported for the genus in the Atlantic is from 50º N to 50º S (Expósito, 2015; Kaschner *et al*., 2019). In the eastern Atlantic, it is reported as far north as Norway and as far south as South African waters. In the western Atlantic off the East coast of North America, it has been recorded from the Gulf of Maine (Cape Cod). Off the Atlantic coast of South America, the genus Auxis has been recorded in Mar del Plata (Argentina) (Expósito, 2015).

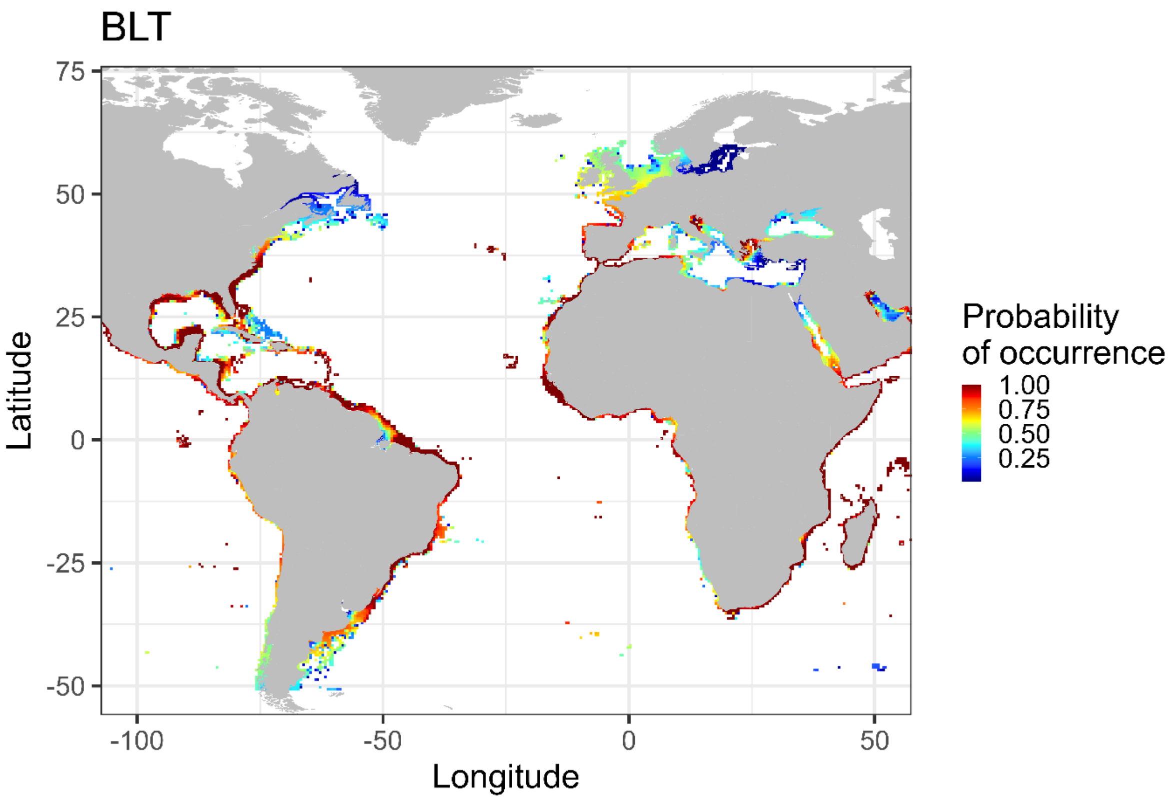

Figure 3. Native spatial distribution of bullet tuna based on data available on aquamaps.org website. Distribution colour ranges indicate probability of occurrence.

3.b. Habitat preferences

Bullet tuna is an epipelagic and neritic fish also found in oceanic areas and occurring in warm waters (Kahraman *et al*., 2011; Valeiras *et al*., 2008). Larvae have a high temperature tolerance of 21.6ºC to 30.5ºC (the widest among studied tuna species), with an optimum of 27ºC-27.9ºC. Additionally, the species has a seasonal coastal distribution in temperate and tropical areas including the Mediterranean Sea (Valeiras *et al.*, 2008). On the coast of the Algarve (Portugal), the capture of the species is reported between May and November and could be associated with the usual occurrence of warmer waters commonly related to the *Levante* wind from the Southeast (Santos and García, 2006).

3.c. Migrations

Information concerning the migration patterns of the species is scarce and fragmented (Rey and Cort, 1981). Several authors have suggested a genetic migration from the Atlantic Ocean to the spawning areas in the Mediterranean Sea through the Strait of Gibraltar (Sabatés and Recasens, 2001; Valeiras *et al*., 2008). The migratory cycle consists of a massive movement towards Mediterranean waters in the Balearic Islands and surrounding waters, followed by an exit towards the Atlantic Ocean through the Strait of Gibraltar. Both of these migrations occur close to the shore. Moreover, the species migrates locally, under a smaller scale around the spawning grounds, in neritic habitats (Reglero *et al*., 2012).

3.d. Recruitment

The early life stages of tunas are not fully understood, however, it is assumed that the larval period is short. During the first life stages, bullet tuna are not caught and juvenile life history is unknown. Immature fish first appear in fisheries from around 25 cm FL (Kahraman *et al*., 2011; Valeiras *et al*., 2008).

4. Biology and life history parameters

For the purpose of this manual, the following five stock unit areas, previously defined by ICCAT for data collection and management, were considered to summarise the results: Mediterranean Sea (MED), Northeast Atlantic (NE), Northwest Atlantic (NW), Southeast Atlantic (SE) and Southwest Atlantic (SW).

4.a. Growth

Bök and Oray (2001) studied age and growth by analysing otoliths and dorsal spines of bullet tuna and identified five age groups (0-4) for the Aegean Sea and the Eastern Mediterranean. **Table 1** shows the Von Bertalanffy growth parameters. The most recent estimates for the Mediterranean Sea are 57.4 ($L\infty$; cm) and 0.181 (k; y^{-1}) (Kahraman *et al*., 2011). Rodríguez-Roda (1983) studied vertebrae of 27 bullet tuna from the Atlantic area near the Strait of Gibraltar and identified four age groups (1-4). Valeiras *et al*. (2008) assigning ages according to spine sections and reported individuals from 2 to 5 years; 75% of males and 68% of females were 2 to 3 years old. Kahraman *et al*. (2011) estimated ages for females as ranging from 1 to +, with 3+ as the most abundant age, while for males, estimated ages ranged from 1+ to 5+ years, with 2+ as the most abundant.

Table 1. Growth parameters for bullet tuna (L∞ in cm, K in y-1, t0 in y).

Growth Parameter L∞	K	t_0	Area	Country	Reference	N	Sex	FL range (cm)	Method
45.263	0.397	-1.604	Aegean Sea and Eastern Mediterranean	Türkiye	Bök and Oray, 2001	630	Both	28.5-44.5	Dorsal spine, otoliths
45.084	0.340	-1.598	Aegean Sea and Eastern Mediterranean	Türkiye	Bök and Oray, 2001	311	Males	30.0-44.5	Dorsal spine, otoliths
47.762	0.292	-2.365	Aegean Sea and Eastern Mediterranean	Türkiye	Bök and Oray, 2001	309	Females	32.6-44.5	Dorsal spine, otoliths
41.480	0.320	-0.830	East Atlantic Ocean	Sahara	Grudtsev, 1992	1,221	Both	27.0-39.0	Dorsal rays
43.751	0.860	-0.568	Mediterranean Sea	Spain	Valeiras *et al*., 2008	109	Males	31.0-44.0	Dorsal spine
45.545	0.461	-0.821	Mediterranean Sea	Spain	Valeiras *et al*., 2008	97	Females	31.0-46.0	Dorsal spine
44.041	0.700	-0.139	Mediterranean Sea	Spain	Valeiras *et al*., 2008	206	Both	31.0-46.0	Dorsal spine
60.417	0.159	-4.311	Mediterranean Sea	Türkiye	Kahraman *et al*., 2011	81	Males	34.0-48.0	Dorsal spine
49.238	0.312	-3.011	Mediterranean Sea	Türkiye	Kahraman *et al*., 2011	69	Females	35.0-46.5	Dorsal spine
57.388	0.181	-4.155	Mediterranean Sea	Türkiye	Kahraman *et al*., 2011	150	Both	34.0-48.0	Dorsal spine

4.b. Length-weight relationship

In the scientific literature, studies on the length-weight relationship of *Auxis rochei* concentrate on the Mediterranean Sea. **Table 2** shows a summary of these scientific publications.

Table 2. Published data on the length-weight relationship of bullet tuna.

Equation	N	FL range (cm)	Sex	Area	Country	Reference
$W = 0.0076 \times FL^{3.24}$	936	28.5-44.5	All	Mediterranean Sea	Türkiye	Bök and Oray, 2001
$W = 0.000156 \times FL^{4.29}$	311	30.0-44.5	Male	Mediterranean Sea	Türkiye	Bök and Oray, 2001
$W = 0.000719 \times FL^{3.89}$	309	32.6-44.5	Female	Mediterranean Sea	Türkiye	Bök and Oray, 2001
$W = 0.00001005 \times FL^{3.130}$	744	34.0-45.0	All	Mediterranean Sea	Spain	Rodríguez-Roda, 1966
$W = 0.00559 \times FL^{3.29}$	458	25.9-47.0	All	Mediterranean Sea	Spain	Macías *et al*., 2006b
$W = 0.087 \times FL^{2.554}$	110	34.0-48.0	Male	Mediterranean Sea	Türkiye	Kahraman *et al*., 2011
$W = 0.026 \times FL^{2.885}$	106	35.0-46.5	Female	Mediterranean Sea	Türkiye	Kahraman *et al*., 2011
$W = 0.054 \times FL^{2.685}$	216	34.0-48.0	All	Mediterranean Sea	Türkiye	Kahraman *et al*., 2011
$W = 0.002 \times FL^{3.586}$	195	31.0-44.6	Male	Mediterranean Sea	Spain	Expósito, 2015
$W = 0.0019 \times FL^{3.601}$	254	28.2-46.0	Female	Mediterranean Sea	Spain	Expósito, 2015
$W = 0.0027 \times FL^{3.506}$	455	23.9-47.0	All	Mediterranean Sea	Spain	Expósito, 2015

4.c. Conversion factors

There is a lack of information on this topic.

4.d. Reproduction

- *Spawning*

This species is a multiple spawner with asynchronous oocyte development (Niiya, 2001; Macías *et al*., 2005; Kahraman *et al*., 2010).

The spawning season may vary for each region depending on the hydrographical regime. In many parts of the Mediterranean Sea and the Strait of Gibraltar, maturing fish are common from May onwards. The spawning period in the Mediterranean Sea occurs from June to September (Ehrenbaum, 1924; Piccinetti *et al*., 1996; Alemany, 1997; Macías *et al*., 2005). The spawning period of this species in the Aegean Sea and the Mediterranean Sea is from March to September (Bök and Oray, 2001). In the West African coast, spawning occurs from April to June in the Gulf of Guinea and from September-October to March off the coast of Congo and Angola (Rudomiotkina, 1984) (**Table 3**).

In large areas of the Gulf of Mexico, peaks of batch spawning are reported from March to April and from June to August, while in the coastal waters from Cape Hatteras to Cuba and in the Straits of Florida, the spawning season begins in February (Collette and Nauen, 1983) (**Table 3**).

In the Turkish Mediterranean coast, the gonad-somatic index (GSI) values calculated for females indicated that spawning generally occurs between May and September, mainly between June and August. It was also observed that the GSI values increased and the condition factor tended to decrease notably in June and August and further decrease in September, when the reproduction activity ended (Kahraman *et al*., 2010) (**Table 3**).

In the spatial context, certain areas along the coast of Greece and the Gulf of Catania, Balearic Islands, Tunisian and Algerian waters and off the eastern Mediterranean coast of Spain have been suggested as possible spawning sites of bullet tuna (Valeiras *et al*., 2008). Furthermore, larvae, mature ovaries and spawned specimens were found in June along the Turkish Mediterranean coast, suggesting that these areas are spawning sites for this species (Kahraman *et al*., 2010) (**Table 3**).

Table 3. Spawning period of bullet tuna in the Mediterranean Sea and Atlantic Ocean.

Location	J	F	M	A	M	J	J	A	S	O	N	D	Reference
Mediterranean Sea					■	■	■	■	■				Kahraman *et al*., 2010
Mediterranean Sea					■	■							Macías *et al*., 2005
Mediterranean Sea			■	■	■	■	■	■	■				Bök and Oray, 2001
Southeast Atlantic Ocean				■	■	■							Rudomiotkina, 1984
Southeast Atlantic Ocean	■	■	■						■	■	■	■	Rudomiotkina, 1984
Northwest Atlantic Ocean			■	■		■	■						Collette and Nauen, 1983
Northwest Atlantic Ocean		■											Collette and Nauen, 1983
Northwest Atlantic Ocean		■											Collette and Nauen, 1983
Mediterranean Sea					■	■	■	■	■				Plandri *et al*., 2009
Mediterranean Sea					■	■	■	■					Sabatés and Recasens, 2001

- *Maturity*

For bullet tuna, fork length at first maturity in the Strait of Gibraltar is 35 cm for females and 36.5 cm for males (Rodríguez-Roda, 1966). In the Aegean Sea and the Mediterranean Sea, *Auxis rochei* reach sexual maturity at 34.4 cm FL (Bök & Oray, 2001). In the Turkish Mediterranean coast, all 40 sexually mature females collected between May and September were over 35 cm FL (Kahraman *et al*., 2010) (**Table 4**).

Table 4. Published bullet tuna maturity studies off the Mediterranean Sea and Atlantic Ocean.

L_{50} (cm)	Size range (cm)	N	Sex	Location	Reference
35	33 – 47.5	292	female	Mediterranean Sea	Rodríguez-Roda, 1966
36.5	33 – 47.5	292	male	Mediterranean Sea	Rodríguez-Roda, 1966
35	34 - 48	216	all	Mediterranean Sea	Kahraman *et al*., 2010
32.6			female	Mediterranean Sea	Hattour, 2000
34.12			female	Mediterranean Sea	Saber *et al*., 2017
32.5	27 – 46.5	76	all	Mediterranean Sea	Plandri *et al*., 2009

- *Sex ratio*

The sex ratio for bullet tuna in the Mediterranean Sea is approximately 1:1 (Bök and Oray, 2001). However, Macías *et al*. (2005) reported a sex ratio of 1:1.7 in the western Mediterranean Sea. More recently, Kahraman *et al*. (2011) reported a sex ratio of 1:1.04 (F:M) also for the Mediterranean Sea.

- *Fecundity*

In the Mediterranean Sea, average fecundity reported for the species is 233,941 oocytes by spawning batch (Macías *et al*., 2006). The reproductive biology of *Auxis rochei* is characterised by asynchronous oocyte development (Macías *et al*., 2005; Kahraman *et al*., 2010).

4.e. First life stages

- *Eggs and larvae*

Eggs are pelagic, 0.82 mm-0.88 mm in diameter and with one oil globule (0.24-0.25 mm in diameter). The yolk is homogenous. Hatch size is 2.14 mm. The embryo presents melanophores, green chromatophores and 6-14 stellate chromatophores over oil globule. Larvae present pigmentation on midbrain, hindbrain, gut, cleithral symphysis dorsal and ventral margins of tail (Richards, 2005). The larvae of *Auxis rochei* differs from those of *A. thazard* due to the slower rate of development, larger caudal portion of body and less intense body pigmentation (Collette and Aadland, 1996).

Reglero *et al*. (2012) stated that adaptive behaviour for the spawning period may regulate other processes such as larval trophic interactions. Thus, the displacement of the spawning window of bullet tuna could be an adaptation to reduce larval trophic interactions. This strategy influences the successful production of offspring. In low-productivity environments, larval growth and survival depend on maintaining a pure zooplankton diet, which later changes to a piscivorous and cannibalistic diet (Reglero *et al*., 2011).

4.f. Diet

Food is primarily selected by the size of gill rakers. The species feeds on fish, crustaceans, cephalopods and other organisms. Fish prey largely on small pelagic fishes, particularly anchovies and other clupeoids (Etchevers, 1976). Crustaceans in the diet of bullet tuna are especially those in planktonic stage, such as megalops and stomatopod larvae.

Predators: several tuna species, pelagic sharks, billfish and large pelagic fish (*Coryphaena hippurus*, *Alepisauru sp.*, *Sphyraena sp*.). Given the abundance of bullet tuna, they are considered an important element of the food chain and serve as forage prey for other commercial species (Olson, 1982).

4.g. Physiology

There is a lack of information on this topic.

4.h. Behaviour

This species forms large schools of similarly sized individuals. It often mixes with *Auxis thazard* in the same school.

4.i. Natural mortality

There is little information available on this biological parameter. However, as a reference point for the natural mortality of the same species, *Auxis rochei,* two estimates are presented for Indian waters. Gopakumar and Ajithkumar (2005) estimated an M equal to 1.18 year^{-1} and Jasmine *et al*. (2013) estimated an M equal to 1.9 year^{-1}.

4.j. Stock structure

No clear stock boundaries were defined for bullet tuna in the Atlantic Ocean. However, the SCRS consider the following five stocks unit areas previously defined by ICCAT for data collection and management: Mediterranean Sea, Northeast Atlantic, Northwest Atlantic, Southeast Atlantic and Southwest Atlantic.

5. Description of fisheries

In the Atlantic Ocean, catches of Auxis are usually not identified at species level. Thus, in the total catch of frigate tuna, the proportion of each of the two species is unknown. However, almost all the catch of Venezuela, the Atlantic Ocean and the Mediterranean Sea is supposedly *Auxis rochei* (Collette and Nauen, 1983).

Annual catches reached 11,993 MT in 1990, which is approximately 93% of total catches for the Mediterranean Sea. Average estimated landings have four distinct phases in a time series. The first phase, observed between the years 1950 and 1960, was marked by lower catches (132 MT on average). During the second phase, from 1961 to 1980, an increase in average landings was observed (583 MT). In the third phase, from 1981 to 2015, another increase in landings was observed, totalling 931 MT on average. In the last phase, from 2016 to 2019, a slight decrease in landings of *Auxis rochei* (612 MT on average) was observed in more recent years (ICCAT Task 01 database, accessed in 2021). Unknown quantities of bullet tuna in landings are commonly recorded as frigate tuna in the Atlantic (**Figure 4**).

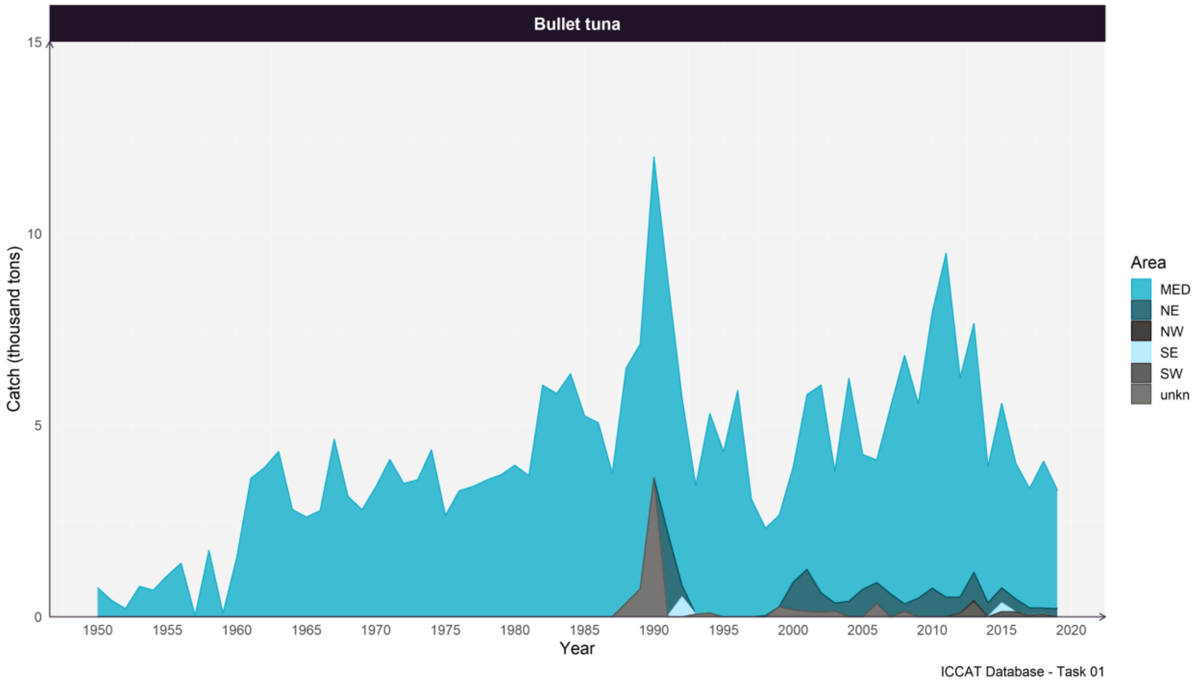

Figure 4. Catch distribution of bullet tuna in the Atlantic Ocean from 1950 to 2019 by ICCAT region (t).

Bullet tuna is exploited mainly using surface gear and by artisanal fisheries using trolling lines, handlines, small-scale longlines and a wide variety of nets, especially traps, gill or drift nets, ring nets, beach seines, otter trawls and purse seines.

In the Mediterranean Sea, most landings come from unknown fishery gear. Nonetheless, this pattern has changed in recent decades, when the most frequently reported landings were from purse seine fisheries. In contrast, for the other ICCAT regions, catches of *Auxis rochei* were commonly recorded as landings with "other fishery gear" (**Figure 5**).

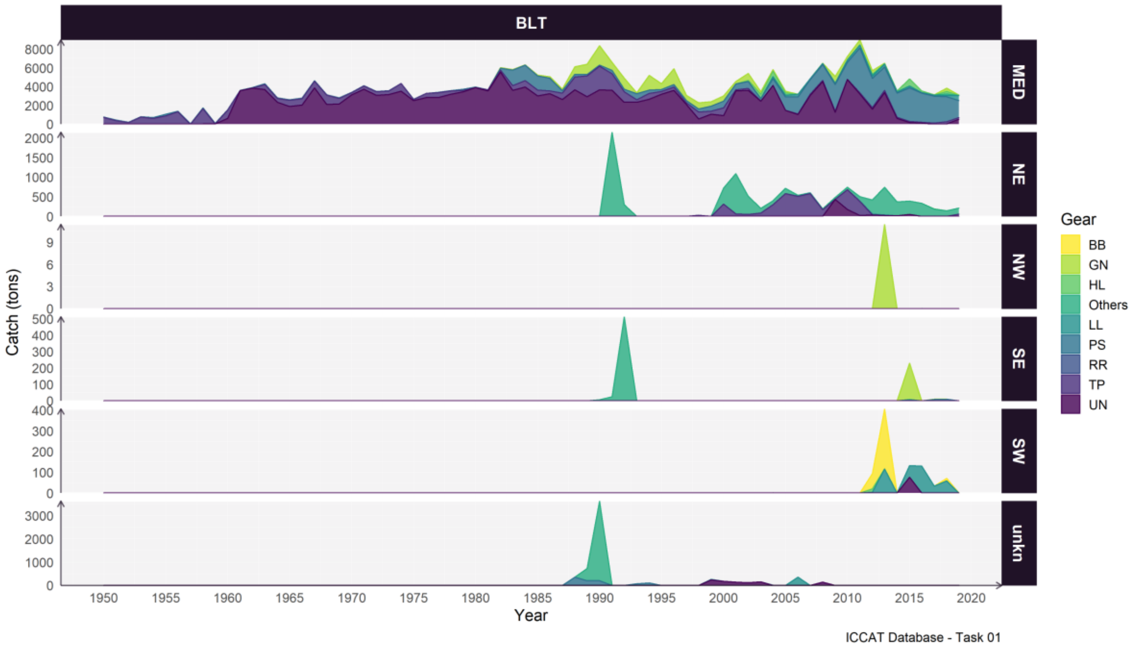

Figure 5. Catch distribution of bullet tuna in the Atlantic Ocean from 1950 to 2019 by ICCAT region and fishing gear (MT). BB: baitboats. TP: traps. RR: rod and reel. PS: purse seine. LL: longline. HL: handline. GN: gillnets. UN: unknown. Others includes: trawl (TW), trolling (TR), haul seine (HS), trammel net (TN), sport (SP), tended line (TL), and harpoon (HP).

6. Size information

There are no catch-at-size or catch-at-age estimates for bullet tuna. However, there is a considerable sample from several fisheries, ICCAT regions and temporal series available on the ICCAT Task 2 size database. The available size samples for bullet tuna are not uniformly distributed throughout the spatial distribution of the species. Specimen sizes from 35 cm to 40 cm were most frequently observed in the Mediterranean Sea and the Northeast Atlantic Ocean (**Figure 6**).

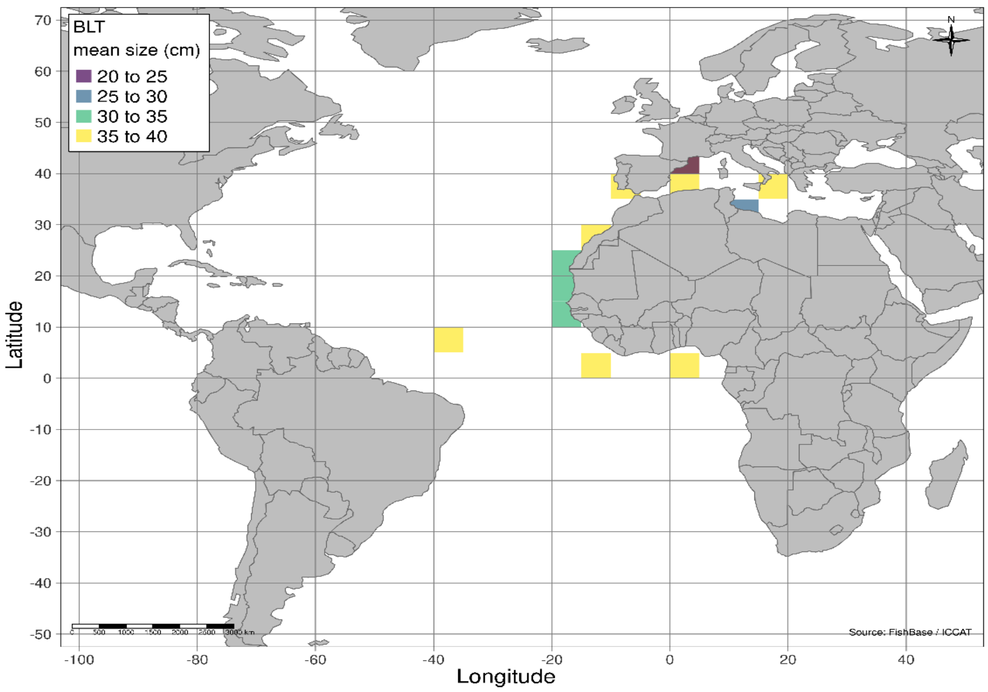

Figure 6. Spatial distribution of mean size of bullet tuna by gear type between 1992 and 2019.

The time series of size data for bullet tuna by ICCAT region are shown in **Figure 7**. For the Mediterranean Sea, from 2009 to 2019, no trend was observed in size composition. On average, sizes for the Mediterranean Sea ranged from 38.8 cm (SD = 3.99 cm) in 2009 to 38.1 cm (SD = 6.92 cm) in 2019. However, for the Northeast Atlantic Ocean, a declining trend was observed in the mean size, from 49 cm (SD = 1.86 cm) in 1995 to less than 35 cm (SD = 3.97 cm) in 2019 (**Figure 7**) (Lucena-Frédou *et al*., 2021).

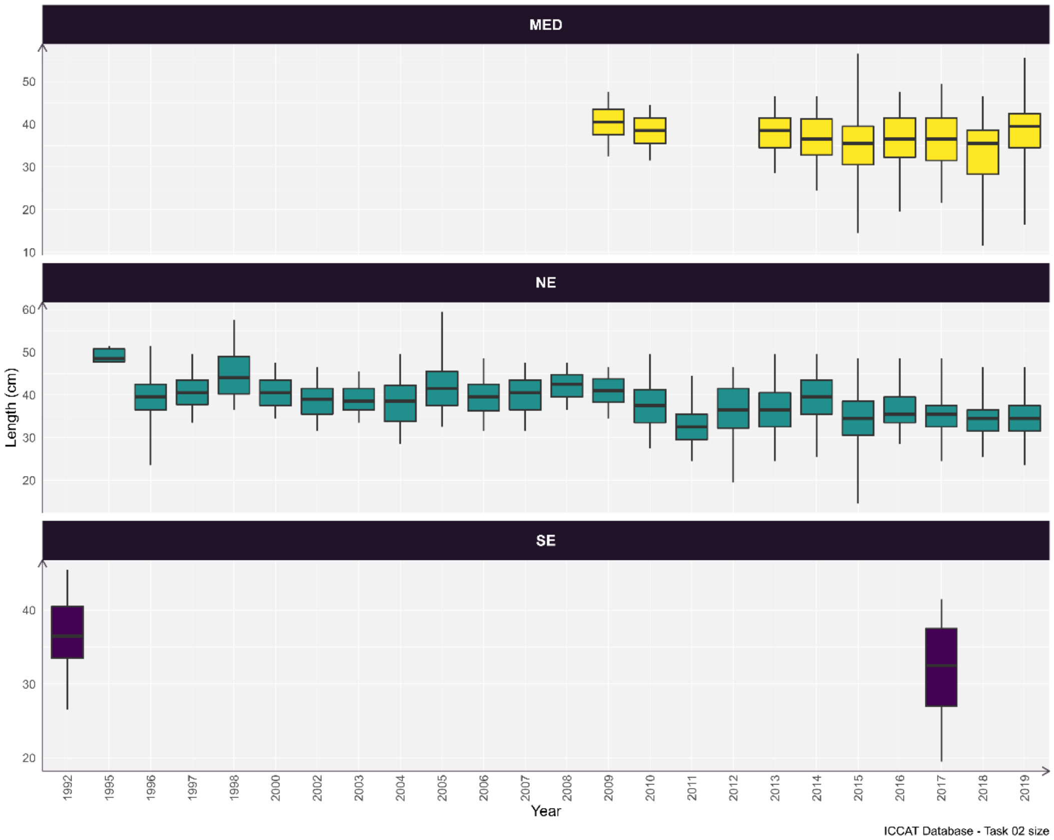

Figure 7. Length data for bullet tuna in the Atlantic Ocean between 1992 and 2019.

7. Stock assessment

Based on a semi-quantitative risk assessment (Productivity and Susceptibility Analysis, PSA), among the small tuna species, bullet fish was classified as moderate to low vulnerable for the North and South Atlantic respectively (Lucena-Frédou *et al*., 2017). No quantitative assessment is available for this species.

8. List of references

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