**BULLET TUNA**

**SUPPORTING INFORMATION**
*(Information collated from reports of the Working Party on Neritic Tunas and other sources as cited)*

### CONSERVATION AND MANAGEMENT MEASURES

Bullet tuna (*Auxis rochei*) in the Indian Ocean is currently subject to a number of Conservation and Management Measures adopted by the Commission:
- Resolution 15/01 *on the recording of catch and effort by fishing vessels in the IOTC area of competence*
- Resolution 15/02 *mandatory statistical reporting requirements for IOTC Contracting Parties and Cooperating non-Contracting Parties (CPCs)*
- Resolution 14/05 *concerning a record of licensed foreign vessels fishing for IOTC species in the IOTC area of competence and access agreement information*
- Resolution 15/11 *on the implementation of a limitation of fishing capacity of Contracting Parties and Cooperating Non-Contracting Parties*
- Resolution 10/08 *concerning a record of active vessels fishing for tunas and swordfish in the IOTC area*

### FISHERIES INDICATORS

#### Bullet tuna: General

Bullet tuna (*Auxis rochei*) is an oceanic species found in the equatorial areas of the major oceans. It is a highly migratory species with a strong schooling behaviour. Table 1 outlines some key life history parameters relevant for management.

**TABLE 1.** Bullet tuna: Biology of Indian Ocean bullet tuna (*Auxis rochei*).

| Parameter | Description |
|---|---|
| Range and stock structure | Little is known on the biology of bullet tuna in the Indian Ocean. An oceanic species found in the equatorial areas of the major oceans. It is a highly migratory species with a strong schooling behaviour. Adults are principally caught in coastal waters and around islands that have oceanic salinities. No information is available on the stock structure in Indian Ocean. Bullet tuna feed on small fishes, particularly anchovies, crustaceans (commonly crab and stomatopod larvae) and squids. Cannibalism is common. Because of their high abundance, bullet tunas are considered to be an important prey for a range of species, especially the commercial tunas. |
| Longevity | Females n.a;  Males n.a. |
| Maturity (50%) | **Age**: 2 years; females n.a. males n.a.<br>**Size:** females and males ~35 cm FL. |
| Spawning season | It is a multiple spawner with fecundity ranging between 31,000 and 103,000 eggs per spawning (according to the size of the fish). Larval studies indicate that bullet tuna spawn throughout its range. |
| Size (length and weight) | Maximum: Females and males 50 cm FL; weight n.a. |

n.a. = not available. Sources: Froese & Pauly 2009, Kahraman 2010, Widodo et al. 2012

#### Bullet tuna – Fisheries and catch trends

Bullet tuna is caught mainly by gillnet, handline, and trolling, across the broader Indian Ocean area (Table 2; Fig. 1). This species is also an important catch for coastal purse seiners. The catch estimates for bullet tuna were derived from very very little, highly aggregated information, and are therefore highly uncertain[1].

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[1] The uncertainty in the catch estimates has been assessed by the IOTC Secretariat and is based on the amount of processing required to account for the presence of conflicting catch reports, the level of aggregation of the catches by species and or gear, and the occurrence of non-reporting fisheries for which catches have been estimated.

**TABLE 2.** Bullet tuna: Best scientific estimates of the catches of bullet tuna by type of fishery for the period 1950–2016 (in metric tonnes) (data as of October 2017).

| Fishery | By decade (average) | | | | | | By year (last ten years) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1950s | 1960s | 1970s | 1980s | 1990s | 2000s | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 |
| Purse seine | - | - | 28 | 278 | 552 | 655 | 581 | 908 | 1,055 | 1,372 | 635 | 549 | 513 | 2,516 | 2,999 | 1,821 |
| Gillnet | 41 | 153 | 296 | 531 | 1,222 | 1,741 | 1,692 | 2,236 | 2,587 | 3,347 | 2,692 | 2,830 | 2,724 | 3,133 | 2,964 | 2,368 |
| Line | 113 | 193 | 325 | 393 | 780 | 1,190 | 1,141 | 1,858 | 2,182 | 2,903 | 1,162 | 1,078 | 1,054 | 1,294 | 3,281 | 3,428 |
| Other | 5 | 13 | 44 | 242 | 755 | 1,322 | 1,908 | 1,638 | 2,022 | 2,748 | 3,905 | 4,503 | 4,597 | 1,275 | 1,287 | 1,283 |
| **Total** | **159** | **360** | **693** | **1,444** | **3,309** | **4,907** | **5,323** | **6,640** | **7,847** | **10,370** | **8,394** | **8,960** | **8,888** | **8,217** | **10,530** | **8,900** |

**Definition of fisheries:** Gillnet: gillnet, including offshore gillnet; Line: coastal longline, hand line, troll line; Purse seine: coastal purse seine, purse seine, ring net; Other gears: baitboat, Danish seine, liftnet, longline, longline fresh, trawling.

The catches provided in Table 2 are based on the information available at the IOTC Secretariat and the following observations on the catches cannot currently be verified. Estimated catches of bullet tuna reached around 2,000 t in the early 1990s, increasing markedly in the following years to reach a peak in 1997, at around 4,900 t. The catches decreased slightly in the following years and remained at values of between 3,500 t and 5,500 t until the late-2000s, increasing sharply again up to the 10,000 t recorded in 2010, and in 2015 reached 15,500 t, the highest catch ever recorded for this species in the Indian Ocean (Table 2; Fig. 1).

In recent years the catches of bullet tuna estimated for the fisheries of Sri Lanka, India and Indonesia have represented over 90% of the total combined catches of this species from all fisheries in the Indian Ocean (Fig. 2).
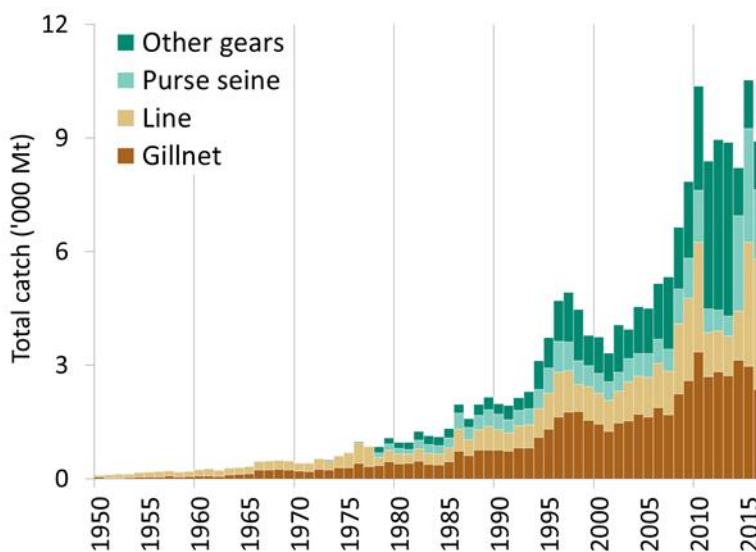


**Fig. 1.** Bullet tuna: Annual catches of bullet tuna by gear recorded in the IOTC Database (1950–2016)[2].

[2] **Definition of fisheries:** Gillnet: gillnet, including offshore gillnet; Line: coastal longline, hand line, troll line; Purse seine: coastal purse seine, purse seine, ring net; Other gears: baitboat, Danish seine, liftnet, longline, longline fresh, trawling.
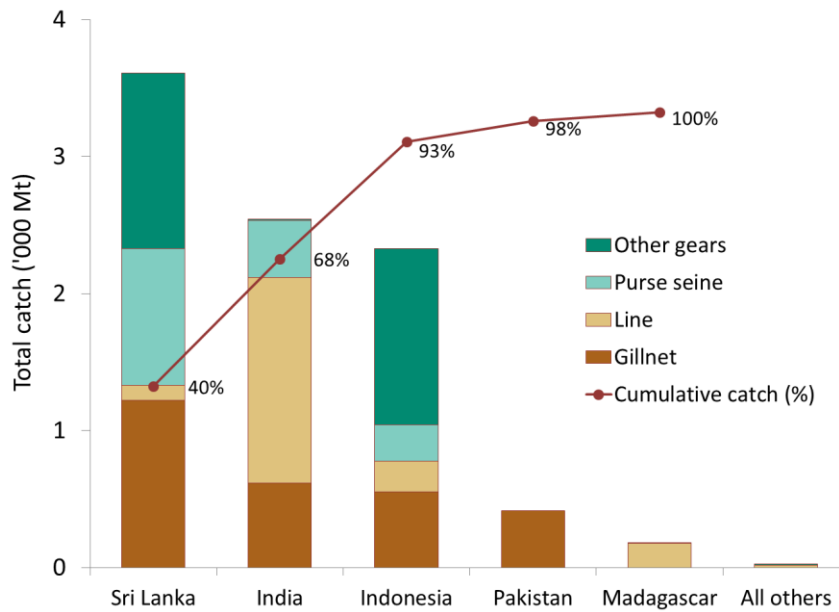
**Fig. 2.** Bullet tuna: average catches in the Indian Ocean over the period 2012–16, by country. Countries are ordered from left to right, according to the importance of catches of bullet tuna reported. The red line indicates the (cumulative) proportion of catches of bullet tuna for the countries concerned, over the total combined catches of bullet tuna reported from all countries and fisheries.

### Bullet tuna – estimation of catches: data related issues

**Retained catches** for bullet tuna were derived from incomplete information, and are therefore uncertain[3] (**Fig.3**), due to:

- Aggregation: Bullet tunas are usually not reported by species, but are instead aggregated with frigate tunas or, less frequently, other small tuna species.

- Mislabelling: Bullet tunas are usually mislabelled as frigate tuna, with their catches reported under the latter species.

- Underreporting: the catches of bullet tuna by industrial purse seiners are rarely, if ever, reported.

It is for the above reasons that the catches of bullet tunas in the IOTC database are thought to be highly uncertain and represent only a small fraction of the total catches of this species in the Indian Ocean.

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[3] The uncertainty in the catch estimates has been assessed by the Secretariat and is based on the amount of processing required to account for the presence of conflicting catch reports, the level of aggregation of the catches by species and or gear, and the occurrence of non-reporting fisheries for which catches had to be estimated.
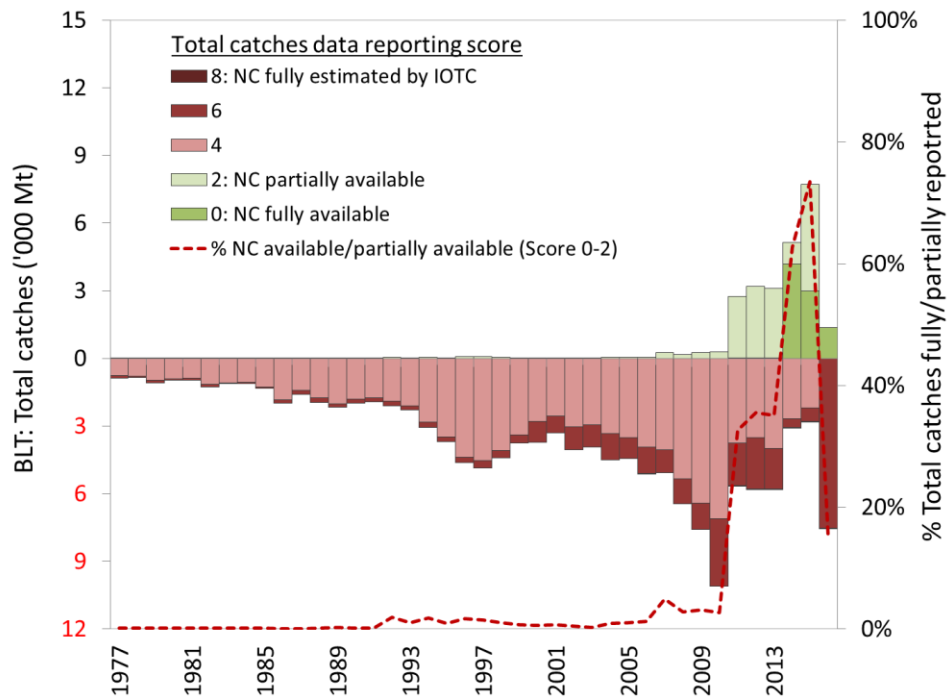
**Fig. 3.** Bullet tuna: nominal catch; uncertainty of annual catch estimates (1977–2016).

Catches are assessed against IOTC reporting standards, where a score of 0 indicates catches that are fully reported according to IOTC standards; catches assigned a score of between 2 – 6 do not report catch data fully by gear and/or species (e.g., partially adjusted by gear and species by the IOTC Secretariat; catches with a score of 8 refer to fleets that do not report catch data to the IOTC and are fully estimated by the IOTC Secretariat. The red dotted line indicates the proportion of total catches fully or partially reported to the IOTC Secretariat.

*Bullet tuna – Effort trends*

- Availability: Effort trends are unknown for bullet tuna in the Indian Ocean, due to a lack of catch-and-effort data.

*Bullet tuna – Catch-per-unit-effort (CPUE) trends*

- Availability: highly incomplete, and, when available, are considered to be of poor quality for the fisheries having reasonably long catch-and-effort data series – as is the case with the gillnet fisheries of Sri Lanka (**Table 3**).

- Main CPUE series available: Sri Lanka (gillnets) (**Fig.4**).

**TABLE. 4**.  Bullet tuna: Availability of catches and effort series, by fishery and year (1970–2016)[4]. Note that no catches and effort are available at all for 1950–78 and 2007 to present.

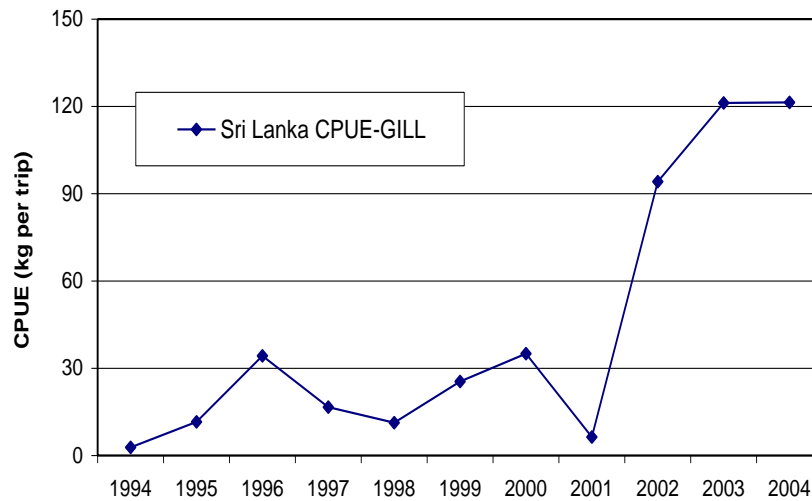| Gear-Fleet | 70 | 72 | 74 | 76 | 78 | 80 | 82 | 84 | 86 | 88 | 90 | 92 | 94 | 96 | 98 | 00 | 02 | 04 | 06 | 08 | 10 | 12 | 14 | 16 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PSS-Indonesia |  |  |  |  |  |  |  |  | ■ |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| PSS-Sri Lanka |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | ■ | ■ |
| LL-Sri Lanka |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | ■ | ■ |
| LL-Madagascar |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| GILL-Comoros |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | ■ | ■ |  |  |
| GILL-India |  |  |  |  | ■ |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| GILL-Indonesia |  |  |  |  |  |  | ■ | ■ |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| GILL-Sri Lanka |  |  |  |  |  |  |  | ■ | ■ | ■ | ■ |  | ■ | ■ | ■ | ■ |  |  |  |  | ■ |  | ■ | ■ |
| LINE-Comoros |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | ■ | ■ |  |  |
| LINE-India |  |  |  |  | ■ |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| LINE-Indonesia |  |  |  |  |  |  |  | ■ |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| LINE-Sri Lanka |  |  |  |  |  |  |  |  | ■ |  |  |  |  |  |  |  |  |  |  |  |  |  | ■ | ■ |
| LINE-Yemen |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | ■ | ■ |  |  |  |  |  |  |
| OTHR-Indonesia |  |  |  |  |  |  | ■ | ■ | ■ |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| OTHR-Sri Lanka |  |  |  |  |  |  |  |  |  |  | ■ | ■ | ■ | ■ | ■ | ■ |  |  |  |  |  |  |  |  |



**Fig. 4.** Bullet tuna: Nominal CPUE series for the gillnet fishery of Sri Lanka derived from the available catches and effort data (1994–2004).

***Bullet tunas – Fish size or age trends (e.g., by length, weight, sex and/or maturity)***

- Sizes: Fisheries catching bullet tuna in the Indian Ocean tend to catch specimens ranging between 15 and 35 cm.

- Size frequency data: highly incomplete, with data only available for selected years and/or fisheries (**Table 4**).
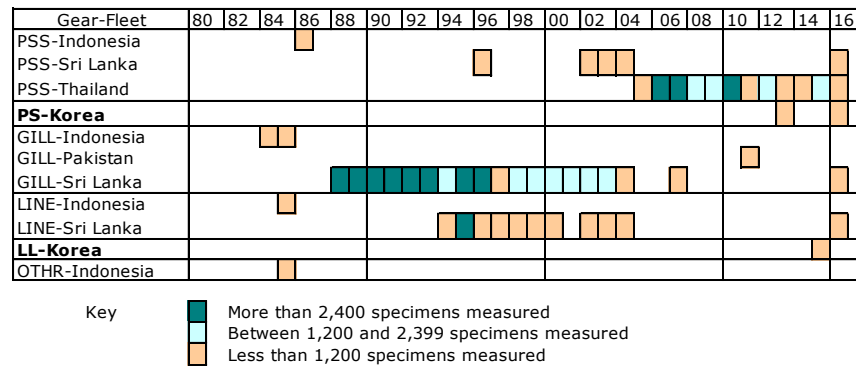
  Main sources for size samples: Sri Lanka (gillnet and trolling).

  Total numbers of samples, across all years, are also well below the minimum sampling standard of 1 fish per tonne of catch recommended by the IOTC Secretariat to reliably assess changes in average weight.

- Catch-at-Size(Age) table: Not available due to lack of size samples and uncertainty over the reliability of retained catch estimates.

- Sex ratio data: have not been provided to the Secretariat by CPCs.

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[4] Note that the above list is not exhaustive, showing only the fisheries for which catch-and-effort are available in the IOTC database.  In addition, catch-and-effort may not be available for all months for years shown in the table for each fishery.

**TABLE 4.** Bullet tuna: Availability of length frequency data, by fishery and year (1980–2016)[5]. Note that no length frequency data are available at all for 1950–83.

| Gear-Fleet | 80 | 82 | 84 | 86 | 88 | 90 | 92 | 94 | 96 | 98 | 00 | 02 | 04 | 06 | 08 | 10 | 12 | 14 | 16 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PSS-Indonesia | | | | ▨ | | | | | | | | | | | | | | | |
| PSS-Sri Lanka | | | | | | | | ▨ | | | | ▨▨▨ | | | | | | | ▨ |
| PSS-Thailand | | | | | | | | | | | | ▨▨▨▨ | ▨▨ | ▨▨▨ | ▨▨ | ▨ | | | |
| **PS-Korea** | | | | | | | | | | | | | | | | ▨ | | | ▨ |
| GILL-Indonesia | | | ▨▨ | | | | | | | | | | | | | | | | |
| GILL-Pakistan | | | | | | | | | | | | | | | | ▨ | | | |
| GILL-Sri Lanka | | | | | ▨▨▨▨▨▨ | ▨▨▨▨ | ▨▨▨ | ▨▨ | | ▨ | | ▨ | | | | | | |
| LINE-Indonesia | | | | ▨ | | | | | | | | | | | | | | | |
| LINE-Sri Lanka | | | | | | | ▨▨ | ▨▨▨ | | ▨▨▨ | | | | | | | | | ▨ |
| **LL-Korea** | | | | | | | | | | | | | | | | | ▨ | | |
| OTHR-Indonesia | | | ▨ | | | | | | | | | | | | | | | | |

Key
■ More than 2,400 specimens measured
▨ Between 1,200 and 2,399 specimens measured
▨ Less than 1,200 specimens measured

## STOCK ASSESSMENT

No quantitative stock assessment for bullet tuna in the Indian Ocean is known to exist and no such assessment has been undertaken by the IOTC Working Party on Neritic Tunas. However, a preliminary estimation of stock indicators was attempted on the catch and effort datasets from the Sri Lankan gillnet fleet (described above). However, there is considerable uncertainty about the degree to which this and other indicators represent abundance as factors such as changes in targeting practices, discarding practices, fishing grounds and management practices are likely to interact in the depicted trends. Further work must be undertaken to derive additional stock indicators for this species, because in the absence of a quantitative stock assessment, such indicators represent the only means to monitor the status of the stock and assess the impacts of fishing (**Table 5**).

**TABLE 5.** Bullet tuna (*Auxis rochei*) key management quantities.

| Management Quantity | Aggregate Indian Ocean |
|---|---|
| 2016 catch estimate | 8,900  t |
| Mean catch from 2012-2016 | 9,099 t |
| MSY (80% CI) (1,000 t) | unknown |
| Data period used in assessment | – |
| $F_{MSY}$ (80% CI) | – |
| $B_{MSY}$ (80% CI) (1,000 t) | – |
| $F_{2012}/F_{MSY}$ (80% CI) | – |
| $B_{2012}/B_{MSY}$ (80% CI) | – |
| $SB_{2012}/SB_{MSY}$ (80% CI) | – |
| $B_{2012}/B_0$ (80% CI) | – |
| $SB_{2012}/SB_0$ (80% CI) | – |
| $B_{2012}/B_{0, F=0}$ (80% CI) | – |
| $SB_{2012}/SB_{0, F=0}$ (80% CI) | – |

## LITERATURE CITED

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Kahraman A, Göktürk D, Bozkurt ER, Akayl T, Karakulak FS (2010) Some reproductive aspects of female bullet tuna, Auxis rochei (Risso), from the Turkish Mediterranean coasts. African J Biotech 9(40): 6813-6818

Widodo AA, Satria F, Barata A (2012) Catch and size distribution of bullet and frigate tuna caught by drifting gillnet in Indian Ocean based at Cilacap fishing port-Indonesia. IOTC–2012–WPNT02–12.

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[5] Note that the above list is not exhaustive, showing only the fisheries for which size data are available in the IOTC database. In addition, size data may not be available for all months for years shown in the table for each fishery.