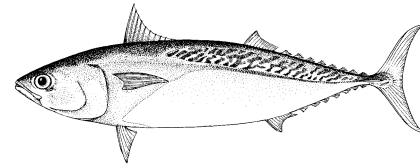


EXECUTIVE SUMMARY: FRIGATE TUNA

Status of the Indian Ocean frigate tuna (FRI: *Auxis thazard*) resourceTABLE 1. Frigate tuna: Status of frigate tuna (*Auxis thazard*) in the Indian Ocean.

Area ¹	Indicators		2015 stock status determination
Indian Ocean	Catch ² 2014:	97,980 t	
	Average catch ² 2010–2014:	97,930 t	
	MSY (1,000 t) (80% CI):	unknown	
	F _{MSY} (80% CI):	unknown	
	B _{MSY} (1,000 t) (80% CI):	unknown	
	F ₂₀₁₃ /F _{MSY} (80% CI):	unknown	
B ₂₀₃₂ /B _{MSY} (80% CI):	unknown		
	B ₂₀₁₃ /B ₀ (80% CI):	unknown	

¹Boundaries for the Indian Ocean stock assessment are defined as the IOTC area of competence.

²Nominal catches represent those estimated by the IOTC Secretariat. If these data are not reported by CPCs, the IOTC Secretariat estimates total catch from a range of sources including: partial catch and effort data; data in the FAO FishStat database; catches estimated by the IOTC from data collected through port sampling; data published through web pages or other means; data reported by other parties on the activity of vessels; and data collected through sampling at the landing place or at sea by scientific observers.

Colour key	Stock overfished (SB _{year} /SB _{MSY} < 1)	Stock not overfished (SB _{year} /SB _{MSY} ≥ 1)
Stock subject to overfishing (F _{year} /F _{MSY} > 1)		
Stock not subject to overfishing (F _{year} /F _{MSY} ≤ 1)		
Not assessed/Uncertain		

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. No quantitative stock assessment is currently available for frigate tuna in the Indian Ocean, and due to a lack of fishery data for several gears, only preliminary stock status indicators can be used. Aspects of the fisheries for frigate tuna combined with the lack of data on which to base a more formal assessment are a cause for considerable concern. Stock status in relation to the Commission's B_{MSY} and F_{MSY} target reference points remains **uncertain** (Table 1), indicating that a precautionary approach to the management of frigate tuna should be applied.

Outlook. Total annual catches for frigate tuna have increased substantially in recent years with peak catches taken in 2010 (~99,710 t) (Table 3). There is insufficient information to evaluate the effect that this level of catch, or a further increase in catch may have on the resource. Research emphasis on improving indicators and exploration of stock structure and stock assessment approaches for data poor fisheries should be considered a high priority for this species. The following should be noted:

- The Maximum Sustainable Yield estimate for the whole Indian Ocean is unknown.
- Species identification, data collection and reporting urgently need to be improved.
- Reconstruction of the catch history needs to occur before a reliable assessment can be attempted.
- Limit reference points: The Commission has not adopted limit reference points for any of the neritic tunas under its mandate.

APPENDIX I

SUPPORTING INFORMATION

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

CONSERVATION AND MANAGEMENT MEASURES

Frigate tuna (*Auxis thazard*) 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 14/05 concerning a record of licensed foreign vessels fishing for IOTC species in the IOTC area of competence and access agreement information
- Resolution 12/11 on the implementation of a limitation of fishing capacity of Contracting Parties and Cooperating Non-Contracting Parties
- Resolution 15/02 mandatory statistical reporting requirements for IOTC Contracting Parties and Cooperating non-Contracting Parties (CPCs)
- Resolution 10/08 concerning a record of active vessels fishing for tunas and swordfish in the IOTC area

FISHERIES INDICATORS

Frigate tuna: General

Frigate tuna (*Auxis thazard*) is a highly migratory species found in both coastal and oceanic waters. It is highly gregarious and often schools with other Scombrids. **Table 2** outlines some key life history parameters relevant for management.

TABLE 2. Frigate tuna: Biology of Indian Ocean frigate tuna (*Auxis thazard*).

Parameter	Description
Range and stock structure	Little is known on the biology of frigate tuna in the Indian Ocean. Highly migratory species found in both coastal and oceanic waters. It is highly gregarious and often schools with other Scombrids. Frigate tuna feeds on small fish, squids and planktonic crustaceans (e.g. decapods and stomatopods). Because of their high abundance, frigate tuna are considered to be an important prey for a range of species, especially the commercial tunas. No information is available on the stock structure of frigate tuna in Indian Ocean.
Longevity	Females n.a.; Males n.a.
Maturity (50%)	Age: n.a.; females n.a. males n.a. Size: females and males ~29–35 cm FL.
Spawning season	In the southern Indian Ocean, the spawning season extends from August to April whereas north of the equator it is from January to April. Fecundity ranges between 200,000 and 1.06 million eggs per spawning (depending on size).
Size (length and weight)	Maximum: Females and males 60 cm FL; weight n.a.

n.a. = not available. Sources: Froese & Pauly 2009

Frigate tuna – Fisheries and catch trends

Frigate tuna is taken from across the Indian Ocean area using gillnets, handlines and trolling, and pole-and-lines (**Table 3; Fig. 1**). This species is also an important bycatch for industrial purse seine vessels and is the target of some ring net fisheries (recorded as purse seine in **Table 3**). The catch estimates for frigate tuna were derived from very small amounts of information and are therefore highly uncertain¹.

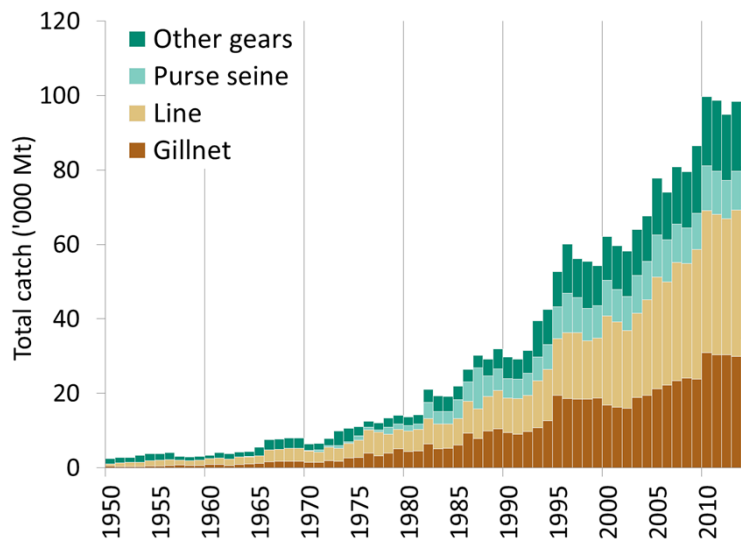
¹ The uncertainty in the catch estimates has been assessed by the IOTC Secretariat and is based on the amount of processing required to account for the presence of conflicting catch reports, the level of aggregation of the catches by species and or gear, and the occurrence of non-reporting fisheries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

TABLE 3. Frigate tuna: Best scientific estimates of the catches of frigate tuna by type of fishery for the period 1950–2014 (in metric tonnes) (data as of November 2015).

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Purse seine	-	15	824	4,664	7,550	10,021	11,384	11,320	10,337	9,501	9,663	12,044	11,636	10,362	10,400	10,383
Gillnet	485	1,239	2,837	6,948	14,519	20,190	21,189	22,190	23,322	24,082	23,750	30,908	30,361	30,342	29,849	34,633
Line	1,265	2,408	4,419	7,432	13,753	27,150	29,987	27,805	31,820	30,806	34,923	38,209	37,688	36,579	39,394	35,827
Other	1,441	2,007	2,349	3,683	9,276	13,670	15,253	12,715	15,382	15,193	18,112	18,550	18,934	17,649	18,766	17,137
Total	3,191	5,670	10,428	22,728	45,098	71,031	77,812	74,030	80,862	79,582	86,448	99,710	98,619	94,931	98,409	97,980

The catches provided in **Table 3** are based on the information available at the IOTC Secretariat and the following observations on the catches cannot currently be verified. Estimated catches have increased steadily since the late 1970's, reaching around 30,000 t in the late-1980's to between 55,000 and 60,000 t by the mid-1990's, and remaining at the same level in the following ten years. Since 2006 catches have increased, rising to nearly 100,000 t in 2010 and 2011, with current catches at around 98,000 t. The catches of frigate tuna have been higher in the east since the late 1990's, with three quarters of the catches of frigate tuna taken in the eastern Indian Ocean in recent years.

In recent years, over 90% of catches of frigate tuna have been concentrated in four countries: Indonesia (65%), Sri Lanka (9%), India (9%), and I.R. Iran (9%) (**Table 3; Fig. 2**).

**Fig. 1.** Frigate tuna: Annual catches of frigate tuna by gear recorded in the IOTC Database (1950–2014) (data as of November 2015).

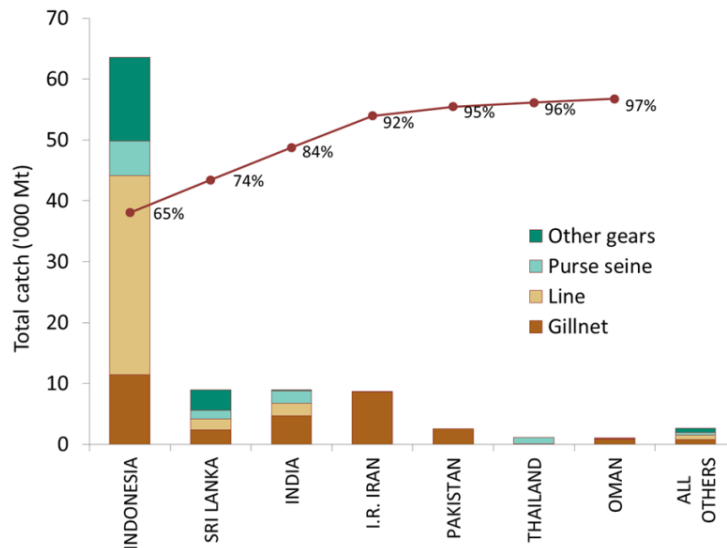


Fig. 2. Frigate tuna: average catches in the Indian Ocean over the period 2011–14, by country. Countries are ordered from left to right, according to the importance of catches of frigate tuna reported. The red line indicates the (cumulative) proportion of catches of frigate for the countries concerned, over the total combined catches of this species reported from all countries and fisheries (data as of November 2015).

Frigate tuna – uncertainty of catches

Retained catches are highly uncertain (**Fig. 3**) notably for the following fisheries:

- **Artisanal fisheries of Indonesia:** Indonesia did not report catches of frigate tuna by species or by gear for 1950–2004; catches of frigate tuna, bullet tuna and other species were reported aggregated for this period. In the past, the IOTC Secretariat used the catches reported since 2005 to break the aggregates for 1950–2004, by gear and species. However, in a recent review by the IOTC Secretariat conducted by an independent consultant in 2012 he indicated that the catches of frigate tuna had been underestimated by Indonesia. While the new catches estimated for the frigate tuna in Indonesia remain uncertain, representing around 64% of the total catches of this species in the Indian Ocean in recent years (2010–12), the new figures are considered more reliable than those existing in the past.
- **Artisanal fisheries of India and Sri Lanka:** Although these countries report catches of frigate tuna until recently the catches have not been reported by gear. The catches of both countries were also reviewed by an independent consultant in 2012 and assigned by gear on the basis of official reports and information from various other alternative sources. The new catch series was previously presented to the WPNT in 2013, in which the new catches estimated for Sri Lanka were as much as three times higher than previous estimates. In recent years, the combined catches of frigate tuna for both countries have represented 21% of the total catches of this species in the Indian Ocean.
- **Artisanal fisheries of Myanmar and Somalia:** None of these countries have ever reported catches of frigate tuna to the IOTC Secretariat. Catch levels are unknown.
- **Other artisanal fisheries:** The catches of frigate tuna and bullet tuna are seldom reported by species and, when they are reported by species, usually refer to both species (due to misidentification, with all catches assigned to the frigate tuna).
- **Industrial fisheries:** The catches of frigate tuna recorded for industrial purse seiners are thought to be a fraction of those retained on board. Due to this species being a bycatch, and its catches are seldom recorded in the logbooks, nor can they be monitored in port. The EU recently reported catch levels of frigate tuna for its purse seine fleet, for 2003–07, estimated using observer data.
- **Discard levels are moderate for industrial purse seine fisheries.** The EU recently reported discard levels of frigate tuna for its purse seine fleet, for 2003–07, estimated using observer data.
- **Changes to the catch series:** The overall catch series of frigate tuna has not changed substantially since the WPNT meeting in 2014.

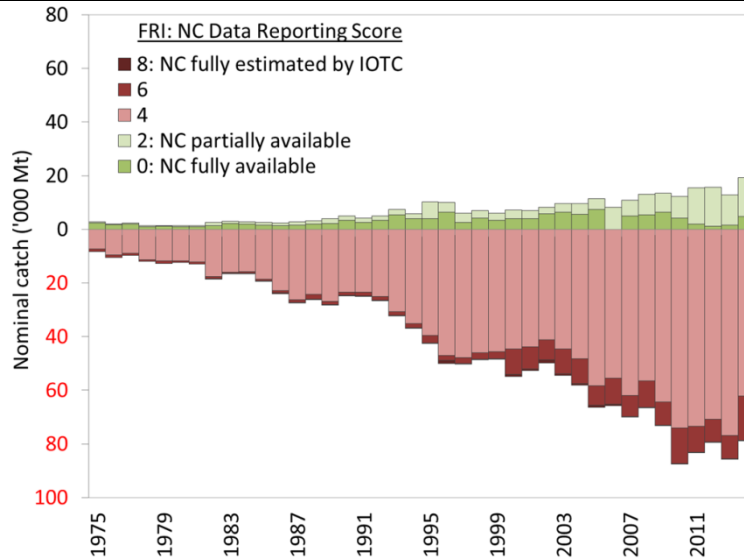


Fig. 3. Frigate tuna: nominal catch; uncertainty of annual catch estimates (1975–2014). Catches are assessed against IOTC reporting standards, where a score of 0 indicates catches that are fully reported according to IOTC standards; catches assigned a score of between 2 – 6 do not report catch data fully by gear and/or species (i.e., partially adjusted by gear and species by the IOTC Secretariat) or any of the other reasons provided in the document; catches with a score of 8 refer to fleets that do not report catch data to the IOTC (estimated by the IOTC Secretariat) (data as of November 2015).

Frigate tuna – Effort trends

Effort trends are unknown for frigate tuna in the Indian Ocean.

Frigate tuna – Catch-per-unit-effort (CPUE) trends

Catch-and-effort series are available from some fisheries but they are considered highly incomplete (**Table 4**). In most cases catch-and-effort data are only available for short periods. Reasonably long catch-and-effort series (extending for more than 10 years) are only available for Maldives baitboats and hand and troll lines (**Fig. 4**) and Sri Lanka gillnets. The catches and effort recorded for Sri Lankan gillnets are, however, thought to be inaccurate due to the dramatic changes in CPUE recorded between consecutive years.

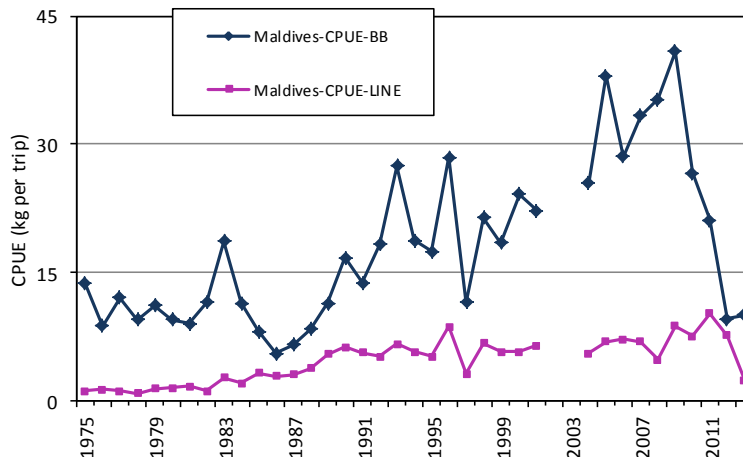


Fig. 4. Frigate tuna: Nominal CPUE series for the baitboat (BB using mechanized boats) and line (LINE, including handlines and trolling using mechanized boats) fisheries of Maldives derived from the available catches and effort data (1975–2013).

TABLE 4. Frigate tuna: Availability of catches and effort series, by fishery and year (1970–2014)². Note that no catches and effort are available at all for 1950–69.

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	
PSS-Indonesia																								
PSS-Malaysia																								
BB-Maldives																								
GILL-India																								
GILL-Indonesia																								
GILL-Iran, IR																								
GILL-Oman																								
GILL-Pakistan																								
GILL-Sri Lanka																								
LINE-India																								
LINE-Indonesia																								
LINE-Maldives																								
LINE-Oman																								
LINE-Sri Lanka																								
LINE-Yemen																								
OTHR-Indonesia																								
OTHR-Sri Lanka																								
OTHR-Maldives																								
OTHR-Malaysia																								
OTHR-Oman																								

Frigate tuna – Fish size or age trends (e.g. by length, weight, sex and/or maturity)

- The sizes of frigate tunas taken by Indian Ocean fisheries typically range between 20 – 50 cm depending on the type of gear used, season and location. Fisheries operating in the Andaman Sea (coastal purse seines and troll lines) tend to catch frigate tuna of small to medium size (15–40 cm) while the gillnet, baitboat and other fisheries operating in the Indian Ocean catch usually larger specimens (25–50 cm).
- Size data are highly incomplete, with data only available for selected years and/or fisheries (Table 5). The main sources for size samples are Sri Lanka (gillnet), and Maldives (pole-and-line).
- Length distributions derived from data available for gillnet fisheries are shown in Fig. 5. Generally speaking total numbers of samples are below the minimum sampling standard of 1 fish per tonne of catch recommended by the IOTC Secretariat to reliably assess changes in average weight – with the exception of samples recorded for Sri Lanka gillnets during the mid-1980s to early-1990 which were obtained with the support of IPTP funding.
- Catch-at-Size (age) data are 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.

TABLE 5: Frigate tuna: Availability of length frequency data, by fishery and year (1980–2014). Note that no length frequency data are available at all for 1950–82³.

Gear-Fleet	80	82	84	86	88	90	92	94	96	98	00	02	04	06	08	10	12	14
PSS-Malaysia																		
PSS-Indonesia																		
PSS-Sri Lanka																		
PSS-Thailand																		
PS-Korea																		
PS-EU-Spain																		
BB-Sri Lanka																		
BB-Maldives																		
GILL-Malaysia																		
GILL-Indonesia																		
GILL-Pakistan																		
GILL-Iran																		
GILL-Sri Lanka																		
LINE-Malaysia																		
LINE-Maldives																		
LINE-Indonesia																		
LINE-Sri Lanka																		
OTHR-Indonesia																		
OTHR-Maldives																		
OTHR-Sri Lanka																		

Key

- More than 2,400 specimens measured
- Between 1,200 and 2,399 specimens measured
- Less than 1,200 specimens measured

² 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.

³ 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.

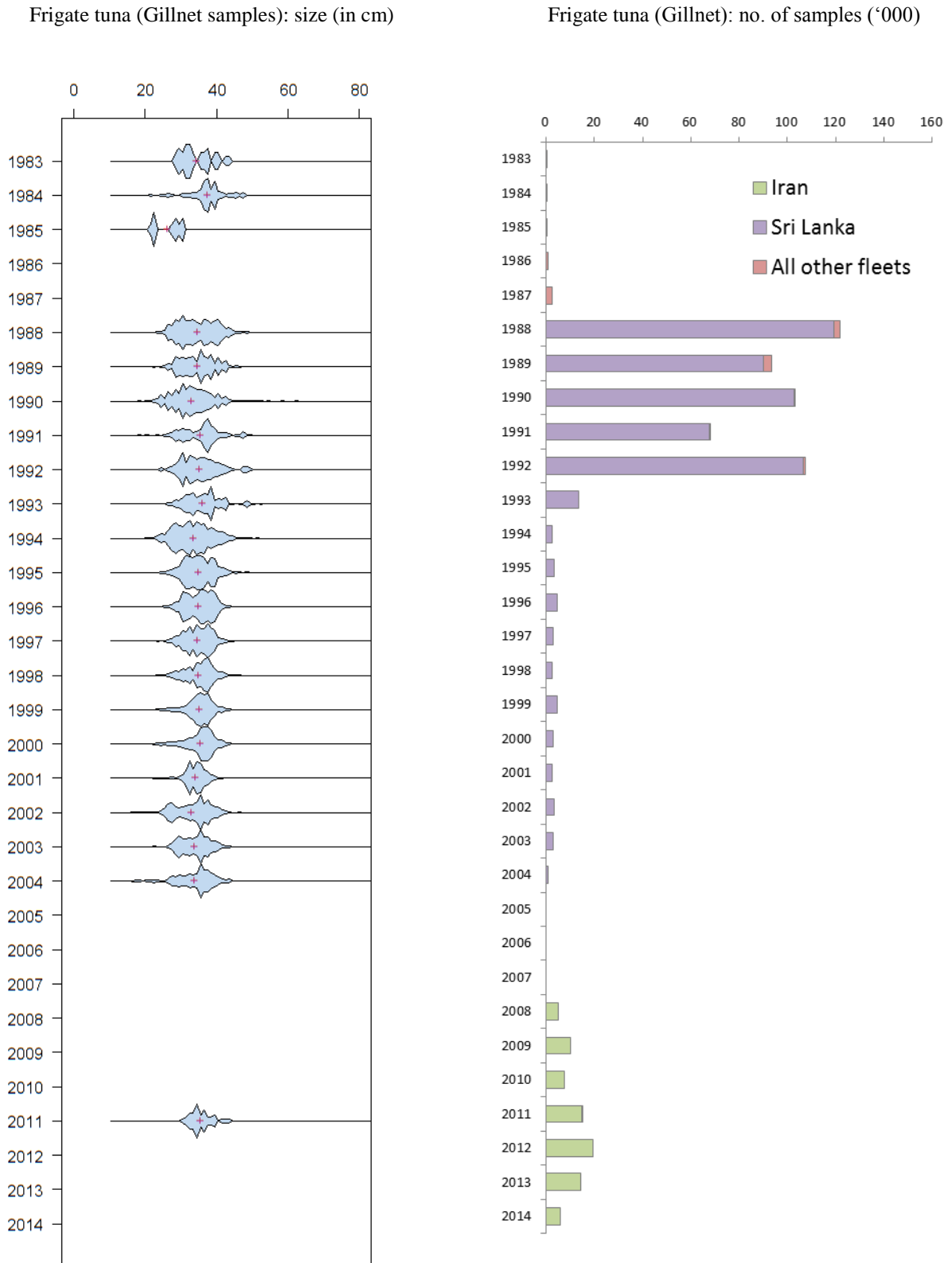


Fig. 5. Frigate tuna: Left - Frigate tuna (gillnet fisheries): Length frequency distributions (total amount of fish measured by 1cm length class) derived from data available at the IOTC Secretariat. Right - number of frigate tuna specimens (gillnet fisheries) sampled for lengths, by fleet and year.

STOCK ASSESSMENT

No quantitative stock assessment for frigate 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 Maldives baitboat and line fisheries (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 6**).

TABLE 6. Frigate tuna (*Auxis thazard*) key management quantities.

Management Quantity	Aggregate Indian Ocean
2014 catch estimate	97,924 t
Mean catch from 2010–2014	97,862 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_{2013}/F_{MSY} (80% CI)	–
B_{2013}/B_{MSY} (80% CI)	–
SB_{2013}/SB_{MSY} (80% CI)	–
B_{2013}/B_0 (80% CI)	–
SB_{2013}/SB_0 (80% CI)	–
$B_{2013}/B_{0, F=0}$ (80% CI)	–
$SB_{2013}/SB_{0, F=0}$ (80% CI)	–

LITERATURE CITED

Froese R & Pauly DE, 2009. FishBase, version 02/2009, FishBase Consortium, <www.fishbase.org>.