LONGTAIL TUNA (*THUNNUS TONGGOL*)

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Taxonomy

Longtail tuna (*Thunnus tonggol*) is a species in the Kingdom Animalia. Longtail tuna was named *Thunnus tonggol* in 1851 by Pieter Bleeker and is one of eight species part of the genus *Thunnus* which itself is one of five genera which form the tribe Thunnini (collectively known as the tunas).

Table 1. Taxonomic hierarchy and nomenclature (source: ITIS)

Kingdom	Animalia
Subkingdom	Bilateria
Infrakingdom	Deuterostomia
Phylum	Chordata
Subphylum	Vertebrata
Infraphylum	Gnathostomata
Superclass	Actinopterygii- ray-finned fishes
Class	Teleostei
Subclass	Acanthopterygii
Superorder	Perciformes - perch-like fishes
Order	Scombroidei - tunas, mackerels, bonitos, albacores, ribbonfishes
Family	Scombridae
Genus	Thunnus
Species	Thunnus tonggol

Common names: Longtail tuna [English]; Northern bluefin tuna [Australia]; thon mignon [French]; atún tongol [Spanish]; Kosinaga [Japanese]; Aya, Kayu, Tongol hitam [Malaysian]; Tongol abu abu, Fufu/Ikan asar [Indonesian]; Havoor [Iran]; Dawan, Ahur [Pakistan] (Griffiths et al. 2020)

Synonyms: (source: WoRMS, FAO)

- *Kishinoella rara* (Kishinouye 1915)
- *Kishinoella tonggol* (Bleeker 1851)
- *Noethunnus rarus* (Kishinoute 1915)
- *Noethunnus tonggol* (Bleeker 1851)
- *Thunnus nicolsoni* (Whitley 1936)
- *Thunnus rarus* (Kishinoute 1915)
- *Thunnus tonggol* (Bleeker 1851)

Distribution & habitat

Geographic range

Longtail tuna are found throughout tropical and sub-tropical neritic waters of the Indo-Pacific region between 37°N-37°S and 32°E-154°E (Froese & Pauly 2017). The species is an epipelagic, predominantly neritic species mostly found in coastal areas and rarely beyond the continental shelf making them unique compared to other *Thunnus* species (Yesaki 1994, Griffiths et al. 2020). In many parts of their distribution their geographical range can vary seasonally suggesting that the species migrates throughout its range (Yesaki 1994, Raja Bidin 2002, Griffiths et al. 2020). Longtail avoids very turbid waters and areas with reduced salinity such as estuaries and the preferred temperature range is 16-30°C with a mean of 26.5°C (Collette & Nauen 1983, Griffiths 2011, Mohri & Kajikawa 2014, Kaschner et al. 2016). Juveniles and young adults are primarily found in waters with temperatures ranging from 24-28°C in equatorial and tropical latitudes while larger adults prefer cooler subtropical waters of 18-22°C (Willette 2019).

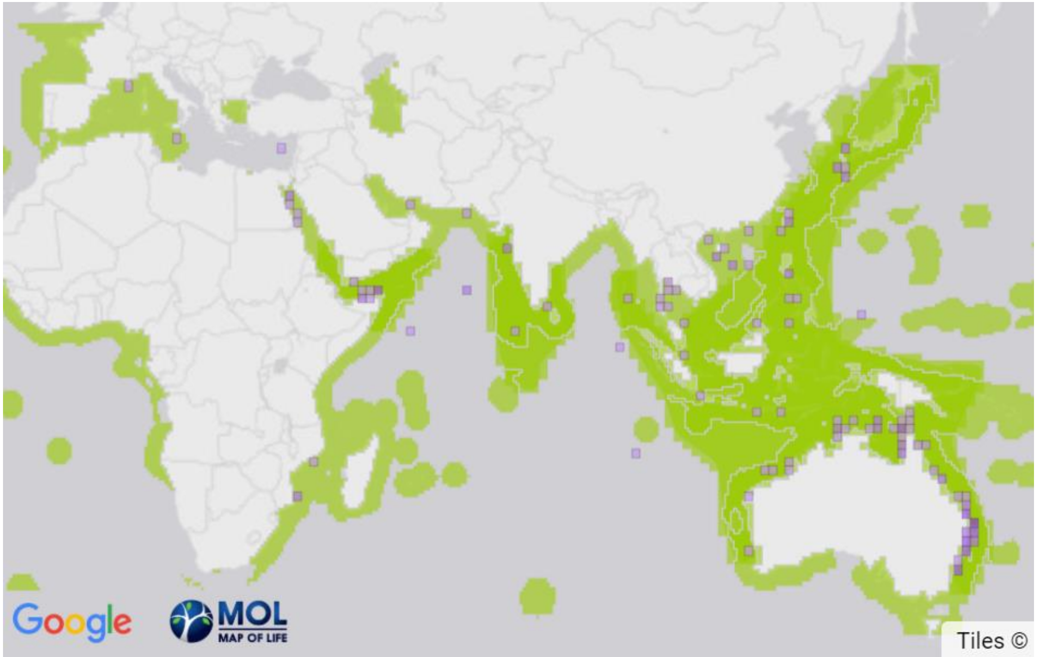

Fig. 1. Global distribution of longtail tuna according to IUCN expert range maps (green envelope) and observations (purple points) recorded in the Global Biodiversity Information Facility (purple squares). Source: www.mol.org

Movements & migrations

Tagging studies have shown that although longtail tuna mostly occupy shallow neritic waters, they have also been found to swim to depths of at least 90m (Griffiths et al. 2010). Based on this information, Griffiths (2020) determined that the distribution of longtail extends from the coast out to the 200m isobath based on the best available depth preferences.

Very little is known about the horizontal movements (i.e., migrations) of longtail tunas due to a lack of dedicated long-term tagging programmes. Small-scale tagging programmes have found individual fish to move large distances in short time periods, with the longest recorded distance of around 600km being covered in 24 days as found in a tagging programme in northeast Australia (New South Wales Department of Primary Industries (NSW DPI) 2007). Griffiths (2011) deployed miniPAT electronic tags on nine longtail tunas off the coast of east Australia and found two of the tagged fish moved 450km and 650km distances to an area that was thought to be a spawning area, but the other tagged fish moved much shorter distances and one stayed within a small area for the entire 3-month duration of the tag deployments. Data from this and some other tagging programmes have suggested an element of site fidelity or an annual visiting site during migrations for the species in certain regions (Griffiths et al. 2020).

Population structure

There is little certainty regarding the stock structure of longtail tuna throughout their range (Griffiths et al. 2020). Studies have suggested that two separate stocks may exist in Australian waters based on distinct differences between gill raker counts and size distributions of fish sampled (Serventy 1956) but further studies with larger sample sizes are required in order to test this hypothesis. A separate study found significant differences in the number of gill rakers in fish sampled from the waters off Oman compared with those from the south-eastern coast of India suggesting the presence of at least two separate stocks in this region of the Indian Ocean (Abdulhaleem 1989). However, another study which sampled in two regions in northwest Indian waters found no significant genetic differentiation which led to the conclusion that there is a single stock throughout Indian waters (Kunal et al. 2014).

Studies conducted by investigating molecular markers have been used widely in order to delineate genetic stocks of fish globally and a study by Kumar & Kocour (2015) concluded that there are likely to be at least two distinct populations of longtail tuna, one in the Indian Ocean and another in the Pacific Ocean.

Based on these studies, Griffiths et al. (2020) suggested that there may be four main punitive stocks in the Indian and Pacific Oceans as seen in Fig 2.

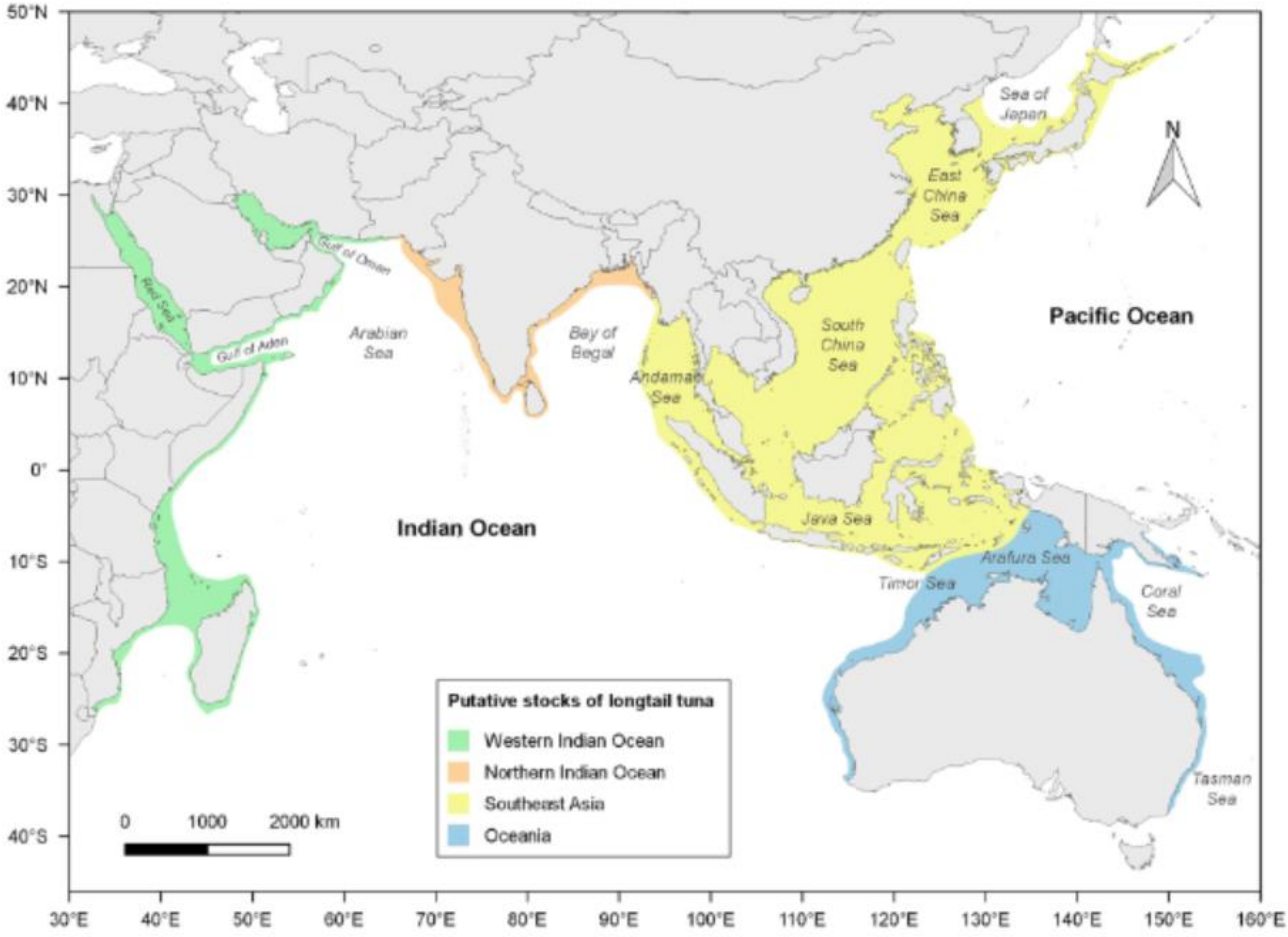

Fig. 2. Map showing the worldwide distribution of longtail tuna and the four punitive stocks based on best-available information from genetic, morphometric and tagging studies (Source: Griffiths et al. 2020)

Biology

Growth & morphometrics

Longtail tuna is the second smallest of the eight species which comprise the Thunnus genus, growing to a maximum recorded size of 145.2 cm fork length (Al-Mamari et al. 2014, Froese & Pauly 2017) and a maximum recorded weight of 35.9kg (Collette & Nauen 1983).

Length-frequency data from studies conducted throughout the range of longtail tuna show an increase in fish lengths with increasing latitude which is most pronounced in Australian waters (Serventy 1956, Wilson 1982, Stevens & Davenport 1991, Griffiths et al. 2010). Several studies have shown that fish sampled around Timor and Arafura seas in northern Australia are smaller than fish sampled towards the south coast of Australia, and this has been observed on both the west and east coasts of Australia (Griffiths et al. 2020). These findings suggest that there may be a southward ontogenetic migration of the species from a nursery ground in more northern waters (Griffiths et al. 2010). Larger fish (TL > 120cm) have also been frequently recorded in the Gulf of Oman and the Persian Gulf (Prabhakar & Dudley 1989, Kaymaram et al. 2011).

Ageing studies have found that longtail tuna grows rapidly in early life, reaching lengths of around 50 cm by age 1 year but there is large variability in length-at-age estimates after age 2 (Griffiths et al. 2010). A number of studies have been conducted to estimate growth parameters for longtail tuna (a summary of these is given in Table 2), mostly using fishery dependent length-frequency data which is not thought to be the most reliable method for estimating these parameters for use in stock assessments (Fournier et al. 1998). This is due to the limited size selectivity of fishing gears which does not allow for the proper representation in the samples through time for all cohorts of a population due to the size growth of cohorts meaning that there is a bias in the growth rates towards size classes which are more susceptible to capture in the gear (Griffiths et al. 2020). As a result, the growth parameters estimated from these studies vary widely, even when conducted in the same region.

The estimation of growth parameters using a more accurate method of quantifying growth increments in sagittal otoliths has been conducted in four studies throughout the range of the species. Only one of these studies was conducted in the Indian Ocean, in the Gulf of Oman, and this study only aged 22 fish of sizes 30-82cm leading to an estimated L_{inf} of 78.5cm (Brothers 1990). A study conducted with 26 samples (sized 45.3-110.9cm) from northern Australia to Papua New Guinea estimated an L_{inf} of 131.8cm (Wilson 1982) while from 33 samples (sized 12-49cm) from the Sea of Japan, (Itoh et al. 1999) estimated an L_{inf} of 55cm.

Longtail tuna are thought to be relatively slow-growing and long lived with an estimated maximum age ranging from around 12-19 years (Griffiths et al. 2010, Willette 2019).

Based on total length estimates for this species and the genus body shape, (Froese & Pauly 2017) estimate the length-weight for longtail tuna to be $W=0.01445L^{3.00}$ with ranges of 0.00845-0.02473 for parameter *a* and 2.85-3.15 for parameter *b* but these parameters may vary depending on the region as can be seen in Table 2.

A summary of the length-weight and growth relationships estimated by various studies can be found in **Table 2** and **Table 3.**

Table 2. Morphometric relationships for bullet tuna. Dressed weight (aka carcass weight) corresponds to headed and caudal peduncle-off weight (PD), i.e., the body without head, gills, guts, tail, and fins

Source measure	Target measure	Equation type	a	b	N	Source and location
Weight	Total length TL	$W = a \times TL^b$	$1.0\text{x}10^{-2}$	2.4606	300	Ahmed et al. 2016 Pakistan
Weight	Fork Length FL	$W = a \times FL^b$	$9.3\text{x}10^{-2}$	2.5147	2976	Ghosh et al. 2010 Veraval, India
Weight	Fork Length FL	$W = a \times FL^b$	$1.45\ \text{x}10^{-2}$	3.00		Froese & Pauly 2017 Average across various locations
Weight	Total Length TL	$W = a \times TL^b$	$3.63\ \text{x}10^{-4}$	2.472	56	Smallwood et al. 2018 Western Australia
Weight	Total Length TL	$W = a \times TL^b$	$2.28\ \text{x}10^{-4}$	2.541	50	Smallwood et al. 2018 Gascoyne Coast, Western Australia
Weight	Total Length TL	$W = a \times TL^b$	$5.5\text{x}10^{-2}$	2.636	260	Abdurahiman et al. 2004 Karnataka, India
Weight	Fork Length FL	$W = a \times FL^b$	$1.48\text{x}10^{-2}$	3.0		Abdussamad et al. 2012 India
Weight	Fork Length FL	$W = a \times FL^b$	$3.0\ \text{x}10^{-5}$	2.82	2163	Yasemi et al. 2017 Iran

Weight	Fork Length FL	$W = a \times FL^b$	2.0 x10^{-5}	2.87	331	Darvishi et al. 2018 Iran
Weight	Total Length TL	$W = a \times TL^b$	8.0 x10^{-5}	2.71		James et al. 1993 India
Weight	Fork Length FL	$W = a \times FL^b$	1.5 x10^{-3}	2.43		Khorshidian & Carrara 1993 Iran
Weight	Fork Length FL	$W = a \times FL^b$	2.0 x10^{-5}	2.83		Kaymaram et al. 2011 Iran
Weight	Fork Length FL	$W = a \times FL^b$	2x10^{-5}	2.87	331	Darvishi et al. 2019 Persian Gulf and Oman Sea
Weight	Fork Length FL	$W = a \times FL^b$	5.0 x10^{-5}	2.82		Griffiths 2010 Australia

Table 3: Summary of von Bertalanffy growth parameters, longevity and length-at-age (in cm) estimated in studies of longtail tuna where growth was characterised using otoliths or length-frequency (LF) analysis (Source: (Griffiths et al. 2020)

					von Bertalanffy growth parameters			Length-at-age			
Area	Reference	Ageing method	Length range (cm)	Sample size	L_{inf}	K (year^{-1})	t_o (year^{-1})	1	3	5	Longevity (years)
India	Silas et al. 1985	LF	-	-	93.0	0.490	-0.240	42	74	86	-
India	James et al. 1993	LF	16-92	-	94.0	0.480	-	36	72	85	-
India	Pillai et al. 2003	LF	36-100	-	108.0	0.550	-	46	87	101	-
India	Ghosh et al. 2010	LF	30-98	2976	107.4	0.180	-0.073	19	46	64	-
India	Abdussamad et al. 2012	LF	23-11 FL	-	123.5	0.510	-0.032	51	97	113	4.5
India	Kumar et al. 2017	LF	22-86	-	98.7	0.390	0.335	31	68	84	5.0
Veraval, Arabian Sea	Ghosh et al. 2010	ELEFAN	30-97.9		107.4	0.18	-0.07				
Pakistan	Ahmed et al. 2016	LF	-	300	69.9	0.934	-0.09	45	66	69	-
Persian Gulf and Oman Sea	Darvishi et al. 2019	ELEFAN	25-124	331	129.6	0.39	-0.28	50.9	76/4	93.6	
Iran	Kaymaram et al. 2011	LF	26-128	4313	133.7	0.350	-	40	87	111	-
Iran	Yasemi et al. 2017	LF	27-107	2163	111.2	0.300	-0.380	38	71	89	-
Iran	Darvishi et al. 2018	LF	25-124	4383	129.6	0.390	-0.280	51	94	113	-
Oman	Prabhakar & Dudley 1989	LF	24-118	12333	133.6	0.228	-	27	66	91	-
Oman	Brothers 1990	Otoliths	30-82	22	78.5	0.679	-0.490	50	71	77	7.0

Persian Gulf, Oman Sea	Griffiths et al. 2010	Otoliths	26-125		133.7	0.35					
Yemen	Anon 1989	LF	-	-	104.0	0.250	-	23	55	74	-
Indonesia	Wagiyo & Febrianti 2015)	LF	29-51	168	55.7	1.500	-	43	55	56	-
Indonesia	Restiangsih & Hidayat 2018	LF	18-81	168	85.0	0.400	0.046	27	59	73	-

Reproduction

Longtail tuna is a gonochoristic species which exhibits no signs of sexual dimorphism in its external morphology (Griffiths et al. 2019b). The species is thought to have a high reproductive potential and a protracted spawning period (Griffiths et al. 2007).

Little evidence of a departure from the expected male:female ratio of 1:1 has been found in nine studies considering data on sex ratios (Griffiths 2020). However, when also considering size, a study of 373 longtail tuna samples along the north-western coast of India found a male: female ratio of 1:2.1 with the proportion of males declining with increasing size (Mohammed Koya et al. 2018).

Few studies have been conducted to determine length at maturity of longtail tunas with most studies that have been conducted reporting the length at first maturity (L_m) rather than the more conservative estimate of maturity, the length at which 50% of the population is mature (L_{50}). Table 3 below provides a summary of reproduction dynamics studies conducted around the Indian Ocean on longtail tuna.

Table 4: Summary of parameters describing the reproduction dynamics of longtail tuna estimated in studies conducted around the Indian Ocean, including length-at-first-maturity (L_m), length-at-50%-maturity (L_{50}) and batch fecundity based on histological staging (HIS), macroscopic staging (MAC) or gonadosomatic index (GSI). Months defining the main spawning season in each study are shown. (Source: Griffiths et al. 2020)

Country	Author	Gonad staging	Sex ratio M:F	Length type	Female maturity L_m	Female maturity L_{50}	Batch fecundity: Fecundity range	Batch fecundity: Mean fecundity	Spawning season
Thailand (Andaman)	Hassadee et al. 2014	MAC	1:0.76	FL	41.0	44.0	44,628-240,477	123,966 (±SD 55,470)	April
Thailand (West coast)	Yesaki 1982	MAC	1:1	-	40.0	43.0	-	-	Jan-Apr and Aug-Sept
Malaysia	Raja Bidin & Rumpet 1990	GSI*	-	-	47.8	-	-	-	May-Aug
Indonesia	Hidayat & Noegroho 2018	MAC	1:0.77	FL	41.1	-	-	-	May-Aug
Indonesia	Wagiyo & Febrianti 2015	MAC	1:0.85	FL	38.9	-	-	-	Apr-May
India	Abdussamad et al. 2012	MAC	-	FL	48.0	51.1	227,364-1,092,891	-	-
India	Mohammed Koya et al. 2018	MAC	1:2.11	TL	48.0	60.7	-	-	Dec-Apr and smaller peak June-Sept
North and northeast Australia	Griffiths et al. 2019	HIS	1:1.3	FL	52.7	53.5	600,215-3,468,350	1,516,680 (±SD 743,980)	Sept-Mar

* L_m was estimated using an arbitrary GSI threshold value to define maturity without histological validation therefore these estimates may not be representative of the wider population and so should be regarded with caution.

These studies show large differences in L_m estimates for females between the northern and southern hemispheres with females maturing at larger sizes in the southern hemisphere. There are also differences in estimates between regions within each hemisphere.

The spawning timings in these studies were primarily estimated using gonadosomatic index (GSI) or macroscopic staging (MAC) of gonads and showed that spawning occurs over a period of several months during the warmest period of the year in each region (Griffiths 2020).

Off the west coast of Thailand, spawning is thought to occur between January-April and August-September which fall at the beginning and end of the monsoonal period in that region (Yesaki 1982) while spawning is thought to occur off the coast of India between January-April with a possible second smaller spawning peak in June-September (Mohammed Koya et al. 2018). In the southern hemisphere, Griffiths et al. (2019) found a spawning season of October-February in northern and eastern Australia. Spawning locations across the Indian Ocean are not well understood.

Batch fecundity estimates for longtail tuna have ranged from 44,628 - 3.5 million oocytes with a strong relationship between batch fecundity and fish length (Abdussamad et al. 2012, Hassadee et al. 2014, Griffiths et al. 2019b). Griffiths et al. (2019) estimated the fecundity of 15 mature female fish (sized 68.5-106.3cm) with ripe ovaries to have fecundities of 600,215-3.5 million oocytes (an average batch fecundity of 1.3 million oocytes) in eastern and northern Australian waters and found a strong relationship between batch fecundity and fish length. In the Andaman Sea, Hassadee et al. (2014) found fecundity estimates of 44,628-240,477 oocytes from 12 fish (sized 43.0-49.5cm) while in coastal Indian waters, Abdussamad et al. (2012) found batch fecundity estimates of 227,364-1.0 million oocytes (fish sized 53.7-79.4cm) but the number of specimens was not reported. Griffiths (unpublished histological data, in Griffiths 2010) found that the species can produce over one million eggs per spawning.

Natural Mortality

Natural mortality of longtail tuna was estimated by Abdussamad et al. (2012) to be $0.77y^{-1}$ which is in line with an estimate for the species in Indian waters of $0.8y^{-1}$ by James et al. (1993) but are higher than estimates of $0.42y^{-1}$ and $0.49y^{-1}$ estimated from Oman by Prabhakar & Dudley (1989) and Khorshidian & Carrara (1993). The mean water temperatures in each of these studies varies from 25.5-28°C so this may be a contributing factor. In north and eastern Australian waters, Griffiths (2010) considered the natural mortality-at-age for longtail tuna to be ‘U-shaped’ with mortality rates being 2-4 times higher in the first year than in subsequent years based on a modified natural mortality-at-age function for bigeye tuna in Pacific Ocean (Langley et al. 2008) as the two species have similar intrinsic growth rates and similar lifespans.

Trophic ecology

Longtail tuna is an opportunistic predator which consumes a wide range of prey types including cephalopods, crustaceans (penaeids, portunids and stomatopods) and teleost species (including *Sardinella spp., Thryssa spp., Decapturus spp., Selar spp.,* exoceotids, hemiramphids, *Megalaspis cordyla* and *Auxis spp.*) but they are thought to favour small fish where available (Collette 2001, Griffiths et al. 2007, 2020, Abdussamad et al. 2012, Mohammed Koya et al. 2018). Their diets frequently contain demersal and benthic prey as a result of their preferred habitat of shallow coastal waters. As such they provide an important trophic linkage between pelagic and demersal components of the ecosystem in a way that varies from the role of larger tuna in the trophodynamics of open ocean systems (Griffiths et al. 2020)**.**

In a study conducted in northern and eastern Australia, a distinct ontogenetic shift in feeding behaviour and diet was observed after fish grew to around 100cm (Griffiths et al. 2007). Griffiths et al. (2007) found an inverse relationship between feeding intensity and reproductive activity during a study conducted on longtail tuna sampled from north and eastern Australia. The authors suggested that this relationship indicated a possible energy investment for gonad development in the lead up to the spawning season.

Juvenile and smaller adult fish have been seen to form large schools, often at the surface of the water and this group occupies an intermediate trophic level due to its primary prey of schooling baitfishes such as *Sardinella, Stolephorous* and *Thyrssa* species as well as a variety of epipelagic crustaceans (Yesaki 1982, Griffiths et al. 2007). These schools of juveniles were often seen to be associated with other small neritic tunas including kawakawa, frigate and bullet tunas which together form an important prey source for larger predators such as Spanish mackerel, billfish species and various carcharhinid shark species (Griffiths et al. 2020). Larger longtail tuna (>100cm) are not observed in surface aggregations as frequently and are thought to feed in smaller schools or as solitary individuals (Griffiths et al. 2020). This size group had an estimated trophic level of 4.62 in Australia's Gulf of Carpentaria which is lower than the estimates found for oceanic tunas such as bigeye (4.93) and yellowfin (4.78) tunas (Okey et al. 2007, Griffiths et al. 2019a).

Other estimates of trophic level include 4.49 ±0.8 in the sea of Oman by Daghughi et al. (2011) (in Rastgoo & Navarro 2017) and 4.5 ±0.6 across the range of the species (Froese & Pauly 2017).

Markets

Longtail tuna are marketed mainly in canned, fresh and dried salted forms but are also smoked and frozen in both domestic and export markets (Frimodt 1995, Collette 2001, Griffiths et al. 2020). The fish is processed in a number of canning plants primarily in Iran, India, Indonesia and Thailand and the canned product is then exported to countries including the United States, Australia, Finland and Sweden (Asia-Pacific Fishwatch 2019). In some countries such as Japan, longtail tuna is also smoked or used for sashimi (Griffiths et al. 2020). Pakistan generally salts and dries longtail tuna for export to Sri Lanka rather than consuming it locally (Moazzam 2012).

Stock status

Stock status.

The most recent stock assessment conducted by IOTC for longtail tuna in 2020 (using data up to and including 2018) concluded that the stock is overfished and subject to overfishing with the caveat that the catch data used in the assessment models is highly uncertain.

Analysis conducted in 2020 using the Optimised Catch-Only Method (OCOM) indicated that the stock is being exploited at a rate that exceeded F_{MSY} in recent years and that the stock appears to be below B_{MSY} and above F_{MSY} (76% of plausible models runs) (Fig. 3). Catches were above MSY between 2010 and 2014, however since 2015 catches have marginally decreased and were below estimated MSY in 2018. The F_{2018}/F_{MSY} ratio is slightly higher than previous estimates. The estimate of the B_{2018} /B_{MSY} ratio (0.94) was slightly lower than in previous years, reflecting declining abundance. An assessment using a biomass dynamic model incorporating Gillnet CPUE indices was also undertaken in 2020 and results were consistent with OCOM in terms of status. Therefore, based on the weight-of-evidence currently available, the stock is considered to be both overfished and subject to overfishing (Table 5; Fig. 10).

Table 5. Longtail tuna (*Thunnus tonggol*): Key management quantities from the OCOM used in 2020.

Management Quantity	**Indian Ocean**
Most recent catch estimate (2020)	132,529 t
Mean catch over last 5 years[1] (2016-20)	133,584 t
MSY (plausible range)	128,750t (99,902t - 151,357t)
Data period used in assessment	1950-2018
F_{MSY} (plausible range)	0.32 (0.15-0.66)
B_{MSY} (plausible range)	395,460t (129,240t - 751,316t)
$F_{current}/F_{MSY}$ (plausible range)	1.52 (0.751-2.87)
$B_{current}/B_{MSY}$ (plausible range)	0.69 (0.45-1.21)

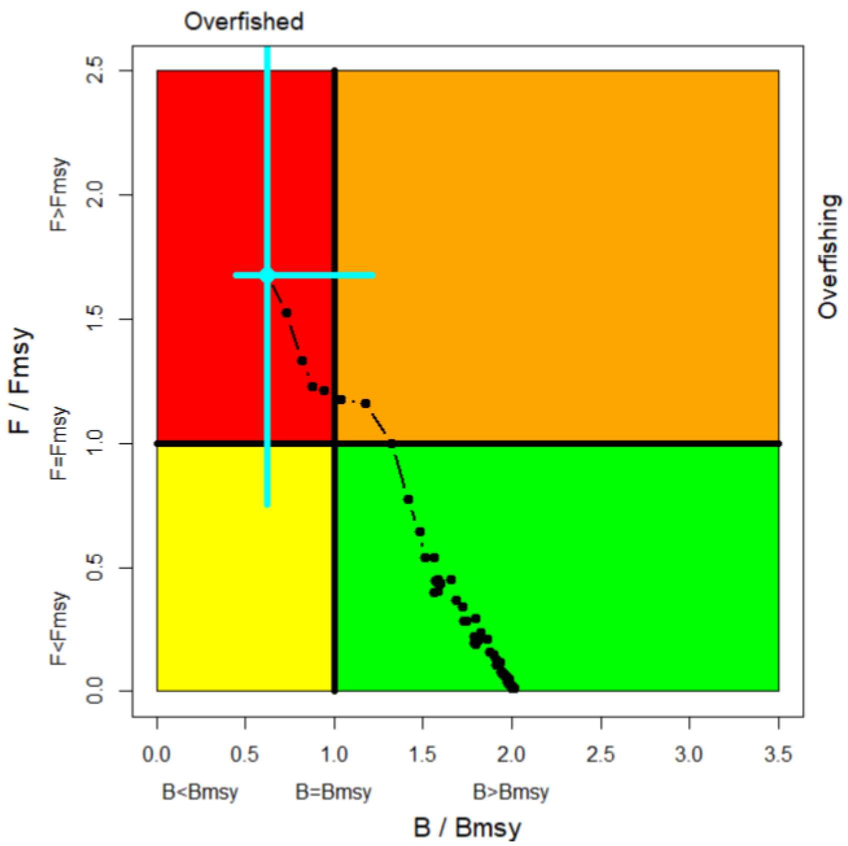

Fig. 3. Longtail tuna OCOM Indian Ocean assessment Kobe plot. The Kobe plot presents the trajectories for the range of plausible model options included in the formulation of the final management advice. The trajectory of the geometric mean of the plausible model options is also presented.

Another stock assessment conducted for Iranian waters including the Persian Gulf by Darvishi et al. (2018) estimated that the population biomass was 17.2% of the unexploited biomass and concluded that the stock in that area was therefore overfished and subject to overfishing.

Outlook

There remains considerable uncertainty about stock structure and the total catches of longtail tuna in the Indian Ocean. The increase in annual catches to a peak in 2012 increased the pressure on the longtail tuna Indian Ocean stock, although the catch trend has reversed since then. As noted in 2015, the apparent fidelity of longtail tuna to particular areas/regions is a matter for concern as overfishing in these areas can lead to localised depletion. Research emphasis should be focused on collating catch per unit effort (CPUE) time series for the main fleets, size compositions and life trait history parameters (e.g., estimates of growth, natural mortality, maturity, etc.).

Management advice

Management advice. The catch in 2018 was just below the estimated MSY but the exploitation rate has been increasing over the last few years, as a result of the declining abundance. Despite the substantial uncertainties, this suggests that the stock is very close to being fished at MSY levels and that higher catches may not be sustained. A precautionary approach to management is recommended.

The following should be also noted:

- The Maximum Sustainable Yield of around 146,000 t was exceeded between 2011 and 2014. Limits to catches are warranted to recover the stock to the B_{MSY} level.
- Limit reference points: The Commission has not adopted limit reference points for any of the neritic tunas under its mandate.
- Further work is needed to improve the reliability of the catch series. Reported catches should be verified or estimated, based on expert knowledge of the history of the various fisheries or through statistical extrapolation methods.
- Improvements in data collection and reporting are required if the stock is to be assessed using integrated stock assessment models.
- Research emphasis should be focused on collating catch per unit effort (CPUE) time series for the main fleets (I.R. Iran, Indonesia, Pakistan, Oman and India), size compositions and life trait history parameters (e.g., estimates of growth, natural mortality, maturity, etc.).
- There is limited information submitted by CPCs on total catches, catch and effort and size data for neritic tunas, despite their mandatory reporting status. In the case of 2020 catches (reference year 2018), 28% of the total catches were either fully or partially estimated by the IOTC Secretariat, which increases the uncertainty of the stock assessments using these data. Therefore, the management advice to the Commission includes the need for CPCs to comply with IOTC data requirements per Resolution 15/01 and 15/02.
- **Main fishing gear (average catches 2016-20)**: longtail tuna are caught mainly using gillnets (~70.6% of catches) and, to a lesser extent, handline and trolling (~13.5%) and coastal purse seines (9.6%) (Fig. 4). The remaining catches taken with other gears contributed to 6.4% of the total catches in recent years.
- **Main fleets (average catches 2016-20)**: about 42% of the catches of longtail in the Indian Ocean are accounted for by I.R. Iran, followed by Indonesia (~19%), Sultanate of Oman (~14%), and Pakistan (~10%).

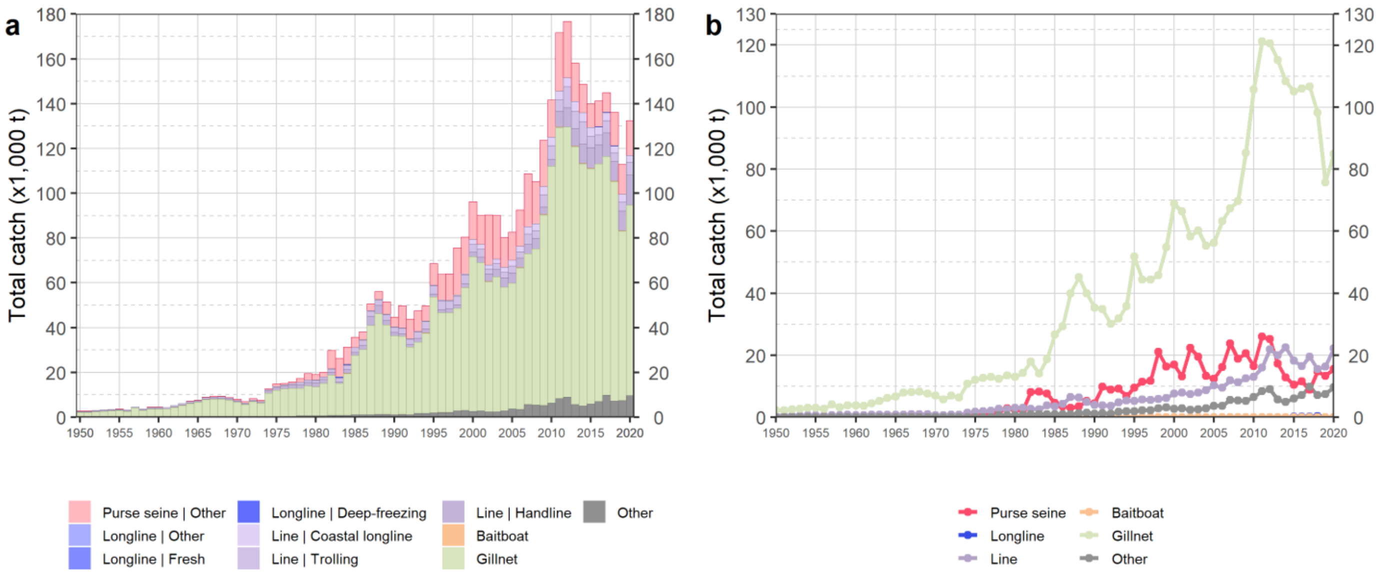

Fig. 4. Annual time series of (a) cumulative nominative catch (t) by fishery and (b) individual nominal catches (t) by fishery group for longtail tuna during 1950–2020. Longline | Other: swordfish and sharks-targeted longlines; Other: all remaining fishing gears

Management Measures

Conservation and Management Measures

Bullet tuna in the Indian Ocean are currently subject to a number of Conservation and Management Measures adopted by the Commission:

- Resolution 19/05 *On a ban on discards of bigeye tuna, skipjack tuna, yellowfin tuna and non-targeted species caught by purse seine vessels in the IOTC are of competence* states that all purse seiners must retain and land all dead non-targeted species including other tunas except when the fish are 'unfit for human consumption'
- Resolution 17/07 *On the prohibition to use large-scale driftnets in the IOTC area* prohibits the use of large-scale driftnets (>2.5km in length) in the IOTC area of competence by 2022.
- Resolution 15/01 *On the recording of catch and effort data by fishing vessels in the IOTC area of competence* sets out the minimum logbook requirements for purse seine, longline, gillnet, pole and line, handline and trolling fishing vessels over 24 metres length overall and those under 24 metres if they fish outside the EEZs of their flag States within the IOTC area of competence.
- Resolution 15/02 *Mandatory statistical reporting requirements for IOTC Contracting Parties and Cooperating Non-Contracting Parties (CPCs)* indicated that the provision are applicable to tuna and tuna-like species
- Resolution 14/05 *Concerning a record of licensed foreign vessels fishing for IOTC species in the IOTC area of competence and access agreement information* which sets out the requirements for licensing foreign vessels in the IOTC area of competence
- Resolution 10/08 *Concerning a record of active vessels fishing for tunas and swordfish in the IOTC area* which sets out the requirement for CPCs to submit a list of active vessels to the Secretariat yearly
- Resolution 11/04 *On a Regional Observer Scheme* which details the observer programme which should be implemented by CPCs to improve the collection of verified catch data and other scientific data related to fisheries for tuna and tuna-like species in the IOTC Area of Competence

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