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Indian Ocean Tuna Commission
Commission des Thons de l'Océan Indien
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DRAFT RESOURCE STOCK STATUS SUMMARY
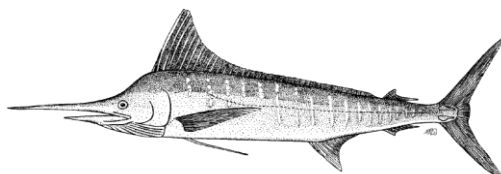
STRIPED MARLIN (*Tetrapturus audax*)

Table 1. Status of striped marlin (*Tetrapturus audax*) in the Indian Ocean

Area[1]	Indicators		2020 stock status determination
Indian Ocean	Catch 2019[2] (MT)	2,860	99.8%*
	Average catch 2015-2019 (MT)	3,455	
	MSY (1,000 MT) (JABBA)	4.73 (4.27–5.18)[3]	
	F_{MSY} (JABBA)	0.26 (0.20–0.34)	
	B_{MSY} (1,000 MT) (JABBA)	17.94 (14.21–23.13)	
	F_{2017}/F_{MSY} (JABBA)	1.99 (1.21–3.62)	
	B_{2017}/B_{MSY} (JABBA)	0.33 (0.18–0.54)	
	SB_{2017}/SB_{MSY} (SS3)[4]	0.373	
	B_{2017}/K (JABBA)	0.12 (0.07–0.20)	
	SB_{2017}/SB_{1950} (SS3)	0.13 (0.09–0.14)	

[1] Boundaries for the Indian Ocean are defined as IOTC area of competence

[2] Proportion of 2019 catch estimated or partially estimated by IOTC Secretariat: 19%

[3] JABBA estimates are the range of central values shown in Fig. 2

[4] SS3 is the only model that used SB/SB_{MSY}, all others used B/B_{MSY}

* Estimated probability that the stock is in the respective quadrant of the Kobe plot (shown below), derived from the confidence intervals associated with the current stock status

Colour key	Stock overfished ($B_{year}/B_{MSY} < 1$)	Stock not overfished ($B_{year}/B_{MSY} \geq 1$)
Stock subject to overfishing ($F_{year}/F_{MSY} > 1$)	99.8%	0.0%
Stock not subject to overfishing ($F_{year}/F_{MSY} \leq 1$)	0.2%	0.0%
Not assessed/Uncertain		

The percentages are calculated as the proportion of model terminal values that fall within each quadrant with model weights taken into account

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. No new stock assessment for striped marlin was carried out in 2020, thus, the stock status is determined on the basis of the 2018 assessment and other indicators presented in 2019. In 2018 a stock assessment was conducted based on two different models: JABBA, a Bayesian state-space production model; and SS3, an integrated length-based model. Both models were very consistent and confirmed the results from 2012, 2013, 2015 and 2017 assessments, indicating that the stock is subject to overfishing ($F > F_{MSY}$) and overfished, with the biomass for at least the past ten years below the level which would produce MSY ($B < B_{MSY}$). On the weight-of-evidence available in 2018, the stock status of striped marlin is determined to be ***overfished*** and ***subject to overfishing*** (**Table 1**; **Fig. 2**).

Outlook. The decrease in longline catches and fishing effort in the years 2009–11 reduced the pressure on the Indian Ocean stock. However, given the increase in catches reported since 2011 (mostly from coastal fisheries), combined with the results obtained from the last stock assessments conducted in 2012, 2013, 2015, 2017 and 2018, the outlook is pessimistic. As requested by IOTC Resolution 18/05, K2SM probabilities are provided with options to reduce fishing mortality with a view to recover the stocks to the green zone of the Kobe Plot with levels of probability ranging from 60% to 90% by 2026 at latest (**Table 2**).

Management advice. Current or increasing catches have a very high risk of further decline in the stock status. Current 2017 catches (**Fig. 1**) are lower than MSY (4,730 MT) but the stock has been overfished for more than two decades and is now in a highly depleted state. If the Commission wishes to recover the stock to the green quadrant of the Kobe plot with a probability ranging from 60% to 90% by 2026, it needs to provide mechanisms to ensure the maximum annual catches remain between 1,500 MT – 2,200 MT (**Table 2**).

The following key points should also be noted:

- **Maximum Sustainable Yield (MSY)**: estimates for the Indian Ocean stock are highly uncertain and estimates range between 4,270 MT – 5,180 MT. However, the current biomass is well below the B_{MSY} reference point and fishing mortality is in excess of F_{MSY} at recent catch levels.

- **Provisional reference points**: Although the Commission adopted reference points for swordfish in Resolution 15/10 *on target and limit reference points and a decision framework*, no such interim reference points have been established for striped marlin.

- **Main fishing gears (average catches 2015-19)**: Striped marlin is largely considered to be a non-target species of industrial fisheries. Gillnets account for ~47% of total catches in the Indian Ocean, followed by longlines (~43%). The remaining catches are mostly recorded under coastal longline (**Fig. 1**).

- **Main fleets (average catches 2015-19):** Around 75% of the total catches of striped marlin are accounted for by four fleets: I.R. Iran (gillnet): 26%; Pakistan (gillnet): 18%; Taiwan,China (longline): 17% and Indonesia (coastal and offshore longline): 16%.
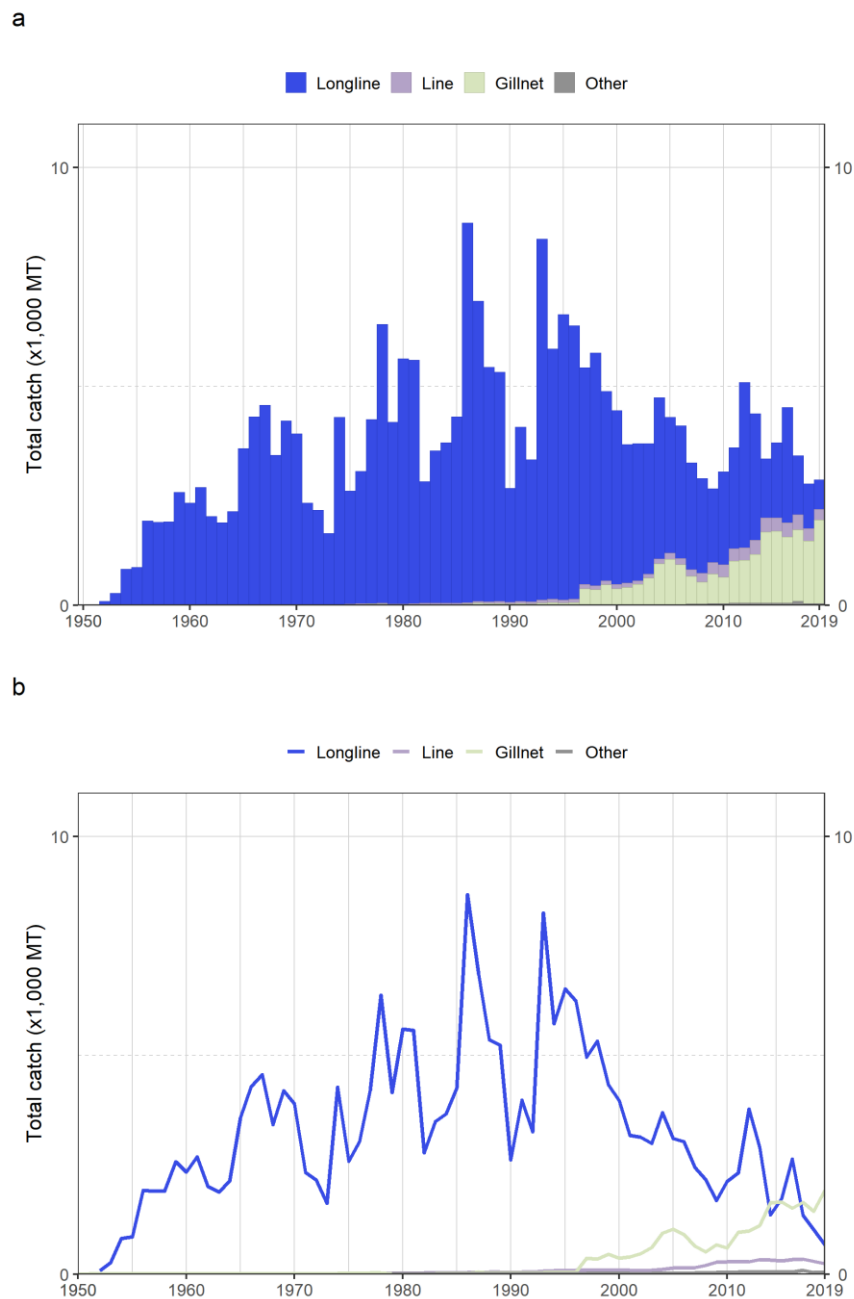
a

b

Fig. 1. Annual time series of (a) cumulative and (b) individual nominal catches (MT) by gear group for striped marlin during 1950–2019. Longline: deep-freezing and fresh longlines, swordfish and sharks-targeted longlines; Line: coastal longline, handline, troll line; Gillnet: coastal and offshore gillnets, driftnet; Other: all remaining gears
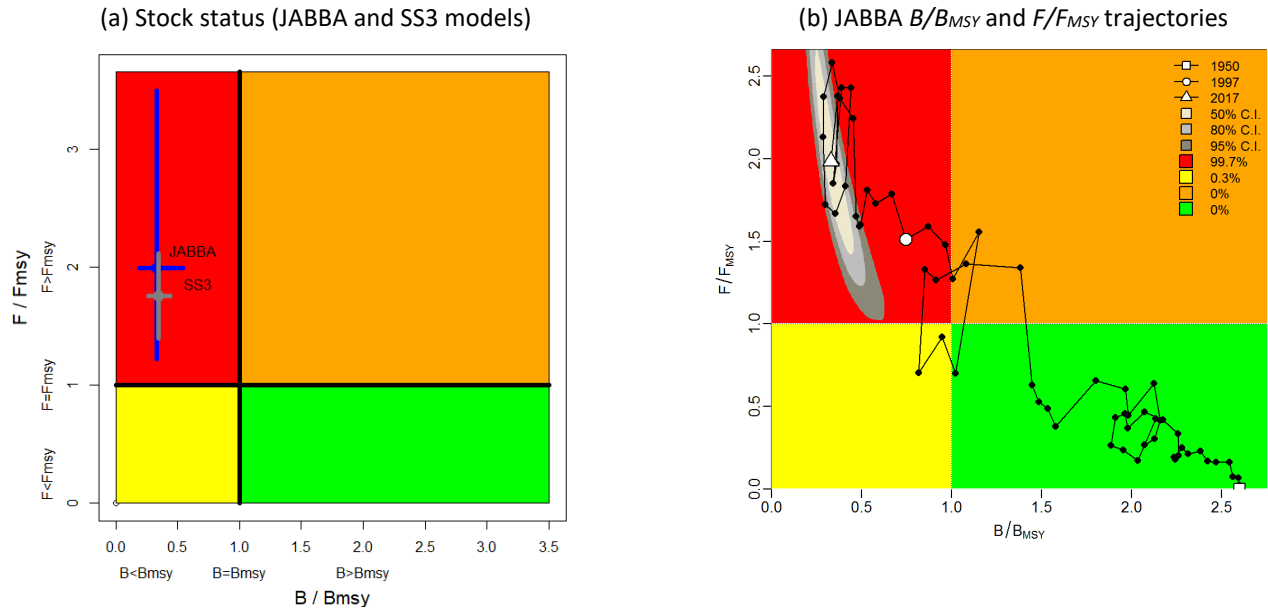
(a) Stock status (JABBA and SS3 models)

(b) JABBA B/B_{MSY} and F/F_{MSY} trajectories

Fig. 2. (a) Striped marlin: Stock status from the Indian Ocean assessment JABBA (Bayesian State Space Surplus Production Model) and SS3 models with the confidence intervals (left); (b) Trajectories (1950-2017) of B/B_{MSY} and F/F_{MSY} from the JABBA model. NB: SS3 refers to SB/SB_{MSY} while the JABBA model's output refers to B/B_{MSY}

Table 2. Striped marlin: JABBA Indian Ocean assessment Kobe II Strategy Matrix. Probability (percentage) of violating the MSY-based target reference points for nine constant catch projections relative to the average 2015-2017 catch level (3,512 MT)*, ± 10%, ± 20%, ± 30% ± 40%) projected for 3 and 10 years. Figures between brackets indicate catch levels

Reference point and projection timeframe	Alternative catch projections (relative to the average catch level from 2015-2017* (3,512 MT)) and probability (%) of violating MSY-based target reference points (Btarg = B_{MSY}; Ftarg = F_{MSY})								
	60% (2,107)	**70%** (2,459)	**80%** (2,810)	**90%** (3,161)	**100%** (3,512)	**110%** (3,864)	**120%** (4,215)	**130%** (4,566)	**140%** (4,917)
$B_{2020} < B_{MSY}$	99	100	100	100	100	100	100	100	100
$F_{2020} > F_{MSY}$	48	70	87	95	99	100	100	100	100
$B_{2027} < B_{MSY}$	25	43	64	81	92	97	99	100	100
$F_{2027} > F_{MSY}$	9	21	40	63	83	94	99	100	100

* 2015-2017 average catches, based on low catch scenario (IOTC-2018-WPB16-DATA03b).

Table 3. Striped marlin: Probability (percentage) of achieving the KOBE green quadrat from 2018-2027 for a range of constant catch projections (JABBA)

TAC | Year	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
1500	0	0	2	11	29	51	70	83	90	94
1600	0	0	2	10	25	47	66	79	87	92
1700	0	0	2	8	23	42	61	75	84	90
1800	0	0	1	7	20	38	56	71	81	87
1900	0	0	1	6	17	34	52	66	77	84
2000	0	0	1	5	15	30	48	62	73	80
2100	0	0	1	4	13	26	42	56	68	76
2200	0	0	1	4	11	23	38	52	62	71
2300	0	0	1	3	9	20	33	46	57	66
2400	0	0	1	3	8	17	29	41	52	61
2500	0	0	1	3	7	15	25	36	47	55