APPENDIX 16
EXECUTIVE SUMMARY: SWORDFISH (2022)
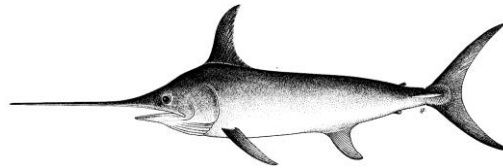

TABLE 1. Status of swordfish (*Xiphias gladius*) in the Indian Ocean.

Area[1]	Indicators		2022 stock status determination
Indian Ocean	Catch 2021[2] (t)	23,917	98%
	Average catch 2017-2021 (t)	31,157	
	MSY (1,000 t) (80% CI)	33 (27–40)	
	F_{MSY} (80% CI)	0.23 (0.15–0.31)	
	SB_{MSY} (1,000 t) (80% CI)	59 (41–77)	
	F_{2018}/F_{MSY} (80% CI)	0.60 (0.40–0.83)	
	SB_{2018}/SB_{MSY} (80% CI)	1.75 (1.28–2.35)	
	SB_{2018}/SB_{1950} (80% CI)	0.42 (0.36–0.47)	

[1] Boundaries for the Indian Ocean stock assessment are defined as the IOTC area of competence
[2] Proportion of 2020 catch estimated or partially estimated by IOTC Secretariat: 12.42%

Colour key	Stock overfished ($SB_{year}/SB_{MSY} < 1$)	Stock not overfished ($SB_{year}/SB_{MSY} \geq 1$)
Stock subject to overfishing ($F_{year}/F_{MSY} > 1$)	0.005	0.005
Stock not subject to overfishing ($F_{year}/F_{MSY} \leq 1$)	0.01	0.98
Not assessed/Uncertain		

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. An assessment was undertaken in 2020 using stock synthesis with fisheries data up to 2018. The assessment uses a spatially disaggregated, sex explicit and age structured model. The SS3 model, used for stock status advice, indicated that MSY-based reference points were not exceeded for the Indian Ocean population as a whole ($F_{2018}/F_{MSY} < 1$; $SB_{2018}/SB_{MSY} > 1$). The two alternative models (ASPIC and JABBA) applied to swordfish also indicated that the stock was above a biomass level that would produce MSY. Spawning biomass in 2018 was estimated to be 40-83% of the unfished levels. Most recent catches of 33,590 t in 2019 are approximately at the *MSY* level (33,000 t). On the weight-of-evidence available in 2020, the stock is determined to be ***not overfished*** and ***not subject to overfishing*** (**Table 1**, **Fig. 3**).

Outlook. The decrease in longline catch and effort from 2005 to 2011 lowered the pressure on the Indian Ocean stock as a whole, and despite the recent increase in total recorded catches, current fishing mortality is not expected to reduce the population to an overfished state over the next decade. There is a very low risk of exceeding MSY-based reference points by 2028 if catches are maintained at 2018 levels (<5% risk that $SB_{2028} < SB_{MSY}$, and <10% risk that $F_{2028} > F_{MSY}$) (**Table 1**). However, the Southern regions exhibit declining biomass trends which indicate higher depletion in these regions, compared to northern regions.

Management advice. The most recent catches (33,590 t in 2019 at the time of the assessment) are at approximately the MSY level (33,000 t). Under the current levels of catches, the spawning biomass is projected to remain relatively stable, with a high probability of maintaining at or above the SB_{MSY} for the longer term. Nevertheless, the Commission should consider limiting the catches so as not to exceed the 2018 catch level (30,847 t at the time of the assessment) to ensure that the probability of exceeding the SB_{MSY} target reference points in the long term remains minimal (2%). Projections indicate that an increase of 40% or more from 2018 catch levels will likely result in the biomass dropping below the SB_{MSY} level for the longer term (>75% probability). Taking into account the updated information regarding swordfish stock structure (IOTC-2020-WPB18-09), as well as the differential CPUE and biomass trends between regions, the WPB should continue to discuss the swordfish stock assessment model specifications and consider the feasibility of including a multi-stock assessment in 2023. Recognising that there is recurring evidence for localised depletion in the southern regions (particularly the South West) the WPB expresses concern and suggests this should be further monitored.

The following key points should also be noted:
- **Maximum Sustainable Yield (MSY)**: estimate for the Indian Ocean is 33,000 t.
- **Provisional reference points**: noting that the Commission in 2015 agreed to [Resolution 15/10](#) *on target and limit reference points and a decision framework*, the following should be noted:
    a. **Fishing mortality**: current fishing mortality is considered to be below the provisional target reference point of F_{MSY} and below the provisional limit reference point of $1.4*F_{MSY}$ (**Fig. 2**).
    b. **Biomass**: current spawning biomass is considered to be above the target reference point of SB_{MSY}, and therefore above the limit reference point of $0.4*SB_{MSY}$ (**Fig. 2**).
- **Main fisheries (mean annual catch 2017-2021)**: swordfish are caught using longline (53.9%), followed by line (30.2%) and gillnet (14.9%). The remaining catches taken with other gears contributed to 1% of the total catches in recent years (**Fig. 1**).
- **Main fleets (mean annual catch 2017-2021)**: the majority of swordfish catches are attributed to vessels flagged to Sri Lanka (29.2%) followed by Taiwan,China (17.9%) and EU (Spain) (6.5%). The 25 other fleets catching swordfish contributed to 46.4% of the total catch in recent years (**Fig. 2**).
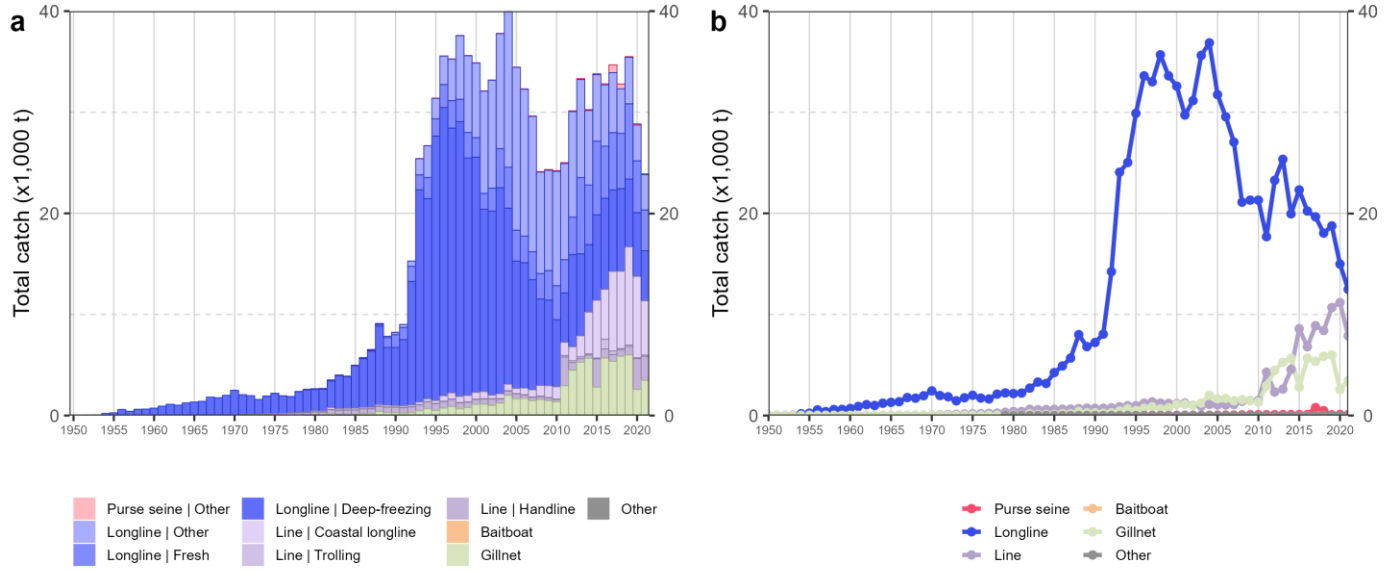
Fig. 1. Annual time series of (a) cumulative nominal catches (metric tons; t) by fishery and (b) individual nominal catches (metric tons; t) by fishery group for swordfish during 1950–2021. Longline|Other: swordfish and sharks-targeting longlines; Other: all remaining fishing gears
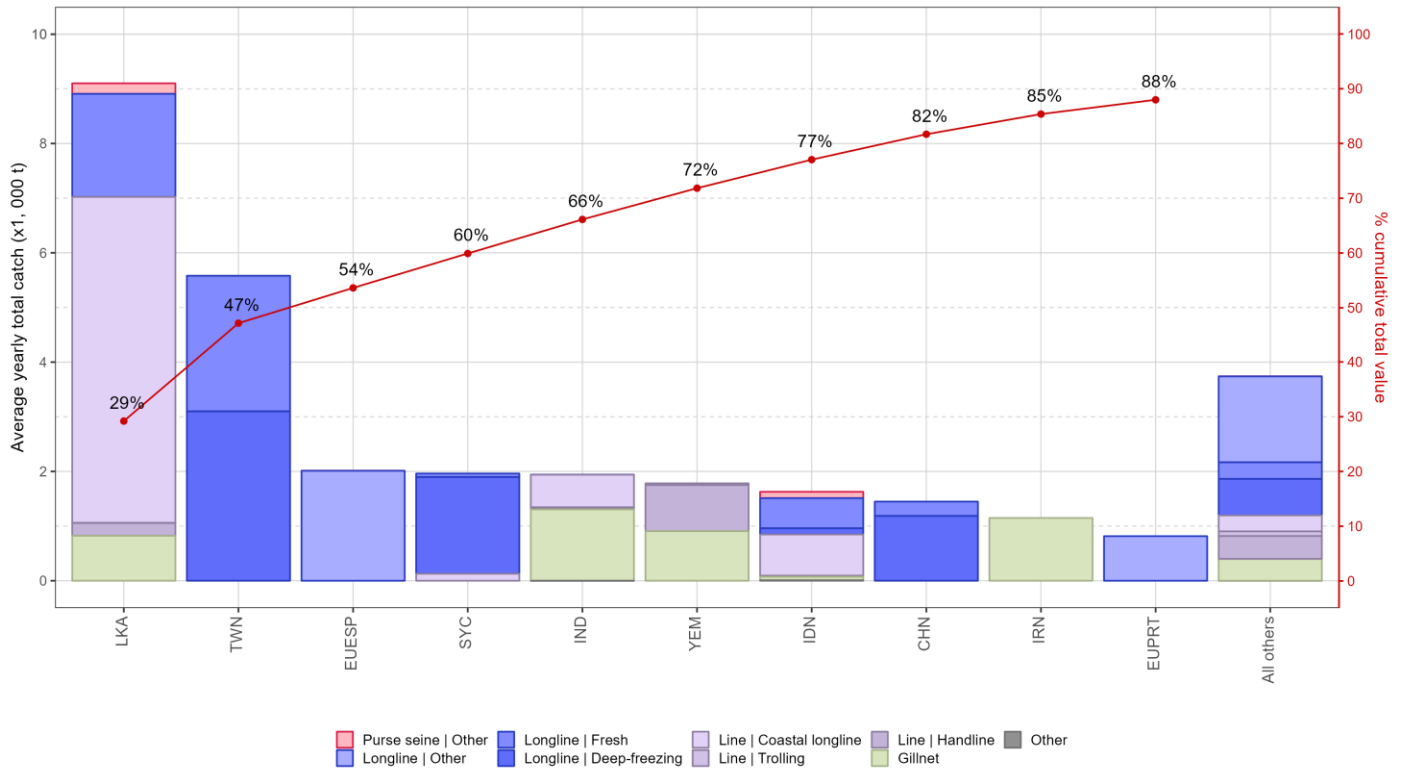

Fig. 2. Mean annual catches (metric tons; t) of swordfish by fleet and fishery between 2017 and 2021, with indication of cumulative catches by fleet. Longline | Other: swordfish and sharks-targeted longlines; Other: all remaining fishing gears
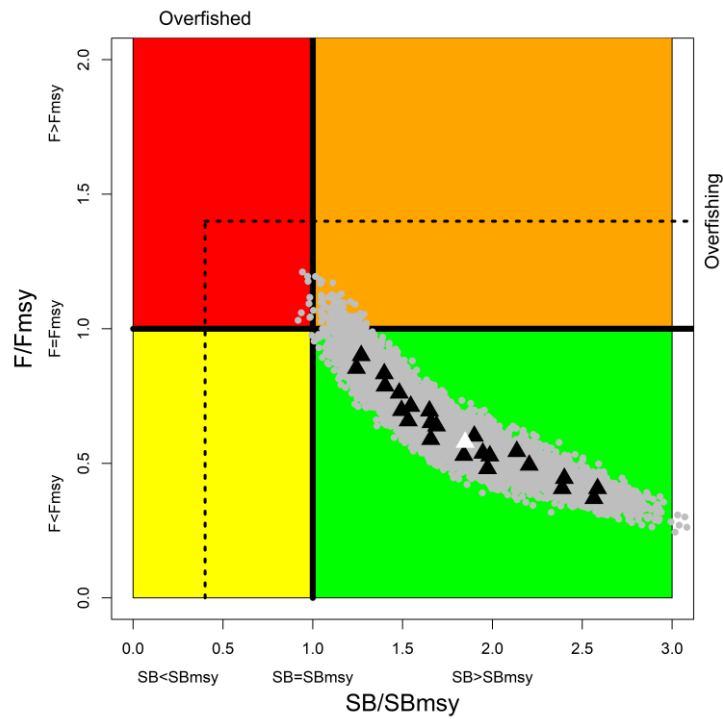
Fig. 3. Swordfish: current stock status, relative to SB_{MSY} (x-axis) and F_{MSY} (y-axis) reference points for the final model grid. Triangles represent MPD estimates from individual models (white triangle represent the estimate from the basic model). Grey dots represent uncertainty from individual models. The dashed lines represent limit reference points for Indian Ocean swordfish (SB_{lim} = 0.4 SB_{MSY} and F_{lim} = 1.4*FMSY)

Table 2. Swordfish: SS3 aggregated Indian Ocean assessment Kobe II Strategy Matrix. Probability (percentage) of exceeding the MSY-based target reference points for five constant catch projections relative to 2018* catch level (30,847 t), 0%, ± 20%, ± 40%) projected for 10 years

Pr (SB<SB$_{MSY}$)

Catch	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
60%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
80%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
100%	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.02	0.02	0.02
120%	0.00	0.00	0.01	0.02	0.03	0.06	0.08	0.11	0.13	0.18
140%	0.00	0.01	0.01	0.04	0.10	0.17	0.25	0.32	0.40	0.47

Pr (F>F$_{MSY}$)

Catch	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
60%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
80%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
100%	0.02	0.03	0.04	0.04	0.04	0.05	0.06	0.07	0.06	0.07
120%	0.10	0.13	0.18	0.21	0.26	0.30	0.32	0.35	0.38	0.42
140%	0.25	0.34	0.44	0.51	0.57	0.62	0.66	0.70	0.73	0.78

* 2018 catches, at the time of the last swordfish assessment conducted in 2020.