APPENDIX 1
EXECUTIVE SUMMARY: ALBACORE (2022)

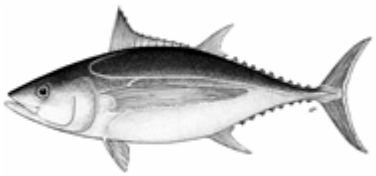

Table 1. Status of albacore (*Thunnus alalunga*) in the Indian Ocean

Area	Indicators – 2022 assessment		Status[3]
Indian Ocean[1]	Catch (2020) (t)2	41,051	
	Mean annual catch (2016-2020) (t)	39,397	
	MSY (x1,000 t) (95% CI)	45 (35-55)	
	F_{MSY} (80% CI)	0.18 (0.15-0.21)	
	SB_{MSY} (x1,000 t) (80% CI)	27 (21-33)	
	F_{2020} / F_{MSY} (80% CI)	0.68 (0.42-0.94)	
	SB_{2020} / SB_{MSY} (80% CI)	1.56 (0.89-2.24)	
	SB_{2020} / SB_0 (80% CI)	0.36 (0.26-0.45)	

[1]Stock boundaries defined as the IOTC area of competence; [2]Proportion of catch fully or partially estimated for 2020: 20.2%; [3]Status relates to the final year data are available for assessment

Table 2: Probability of stock status with respect to each of four quadrants of the Kobe plot. Percentages are calculated as the proportion of model terminal values that fall within each quadrant with model weights taken into account

	Stock overfished (SB_{2020} / SB_{MSY}<1)	Stock not overfished (SB_{2020} / SB_{MSY}≥ 1)
Stock subject to overfishing (F_{2020} / F_{MSY}≥ 1)	1%	9%
Stock not subject to overfishing (F_{2020} / F_{MSY}≤ 1)	5%	85%
Not assessed/Uncertain		

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. A new stock assessment was carried out for albacore in 2022 to update the assessment undertaken in 2019. The stock assessment was carried out using Stock Synthesis III (SS3), a fully integrated model that is currently also used to provide scientific advice for the three tropical tunas stocks in the Indian Ocean. The model used in 2022 is based on the model developed in 2019 with a series of revisions that were noted during the WPTmT data preparatory meeting held in April 2022. There are some noticeable changes compared to the previous assessment data set, mainly related to how the fisheries are structured, and how the CPUE indices and length composition data are treated within the assessment model.

The current assessment has utilised the new joint CPUE series that shows some differences compared with the last assessment. This is mainly related to changes in standardisation methodology, which were partly caused by limited operational data access for joint CPUE analysis. Compared to the last assessment, the CPUE index in the southwestern fishery (LL3) shows a somewhat flatter overall trend, the CPUE index in the northwestern fishery (LL1) also exhibited considerably larger variability. Further, the size composition data are significantly down-weighted within the assessment model, and length samples from fisheries other than longline fisheries are effectively given a zero weight. This is to reduce the bias that can be introduced by potentially unrepresentative or problematic length samples.

The final set of model options included alternative models using the northwest and southwest CPUE indices. Both sets of indices suggested a considerable difference in biomass trend between 1990 and now which highlights the uncertainty with respect to the model estimates of recent biomass trends. The two sets of indices effectively monitor different components of the albacore stock. The CPUE in the western area (LL1+3) may best represent the abundance

of albacore at this time. The western area also represents a significant proportion of the albacore biomass in the Indian Ocean. The eastern indices are affected by changes in targeting.

Trends in the northwest CPUE series suggest that the biomass vulnerable to longline has declined to around 45-50% of the levels observed in 1980-82, whereas a much smaller decline was observed in the southwest CPUE series for the same period. Prior to 1980 there were 20 years of moderate fishing, after which total catches of albacore tuna in the Indian Ocean have more than doubled (**Fig. 1**). Catches have also increased substantially since 2007 for some fleets (i.e., Indonesian and Taiwan,China longline fisheries), although there is substantial uncertainty regarding the reliability of the catch estimates. Catches in 2020 were marginally below the MSY level estimated by the SS3 model. Fishing mortality represented as F_{2020}/F_{MSY} is 0.68 (0.42–0.94). Biomass is estimated to be above the SB_{MSY} level (1.56 (0.89–2.24)) from the SS3 model (**Table 1**, **Fig. 3**). These changes in stock status since the previous assessment are mainly due to changes in the CPUE. Thus, the stock status in relation to the Commission's interim B_{MSY} and F_{MSY} target reference points indicates that the stock is **not overfished** and is not **subject to overfishing** (**Table 1**).

Outlook. The impacts of piracy in the western Indian Ocean resulted in the displacement of a substantial portion of longline fishing effort into the traditional albacore fishing areas in the southern and eastern Indian Ocean. However, in recent years the effort distribution in the Indian Ocean has been rather dynamic. Projections indicate that current catch appears to be sustainable in the short term although the projections are based on model assumptions that may be associated with high levels of uncertainty (see management advice below for more detail). It should be noted with caution that the short-term projections are more influenced by the recent low recruitment levels, whereas the long-term projections are more determined by the assumptions of average recruitment levels over the longer-term period.

Management advice. Although considerable uncertainty remains in the SS3 assessment conducted in 2022, particularly due to the conflicts in key data inputs, a precautionary approach to the management of albacore should be applied. The K2SM indicates that there is little risk of violating the target and limit reference points with current and moderate increases in catch in the short term. Current catches are just below the estimated level of MSY (41,051t for the statistical year 2020; **Table 3**).

There remains considerable uncertainty resulting from changes in the CPUE series which are not well understood, model instability in response to updated data, growth variability and poor fits to the size data. It should be noted that neither CPUE series or other model assumptions account for any change in catchability/effort creep over the time series.

The following should be noted:

- The primary sources of data that drive the assessment, total catches, CPUE and length data, are highly uncertain and should be developed further as a priority;
- The catch estimates for 2020 (41,051 t) are above the current estimated MSY levels (**Table 1**);
- A Kobe 2 Strategy matrix was calculated to quantify the risk of different future catch scenarios, using the projections from the SS3 model (**Table 3**);
- Provisional reference points: noting that the Commission in 2015 adopted Resolution 15/10 *On interim target and limit reference points and a decision framework*, the following should be noted:
  - **Fishing mortality**: current fishing mortality is considered to be below the interim target reference point of F_{MSY}, and therefore below the interim limit reference point of $1.4*F_{MSY}$ (**Fig. 3**)
  - **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. 3**)
- **Main fisheries (mean annual catch 2016-2020)**: albacore are caught using longline (87.1%), followed by line (10.3%) and purse seine (1.4%). The remaining catches taken with other gears contributed to 1.2% of the total catches in recent years (**Fig. 1**).
- **Main fleets (mean annual catch 2016-2020)**: the majority of albacore catches are attributed to vessels flagged to Taiwan,China (57.7%) followed by Indonesia (18.6%) and China (8.8%). The 28 other fleets catching albacore contributed to 14.8% of the total catch in recent years (**Fig. 2**).

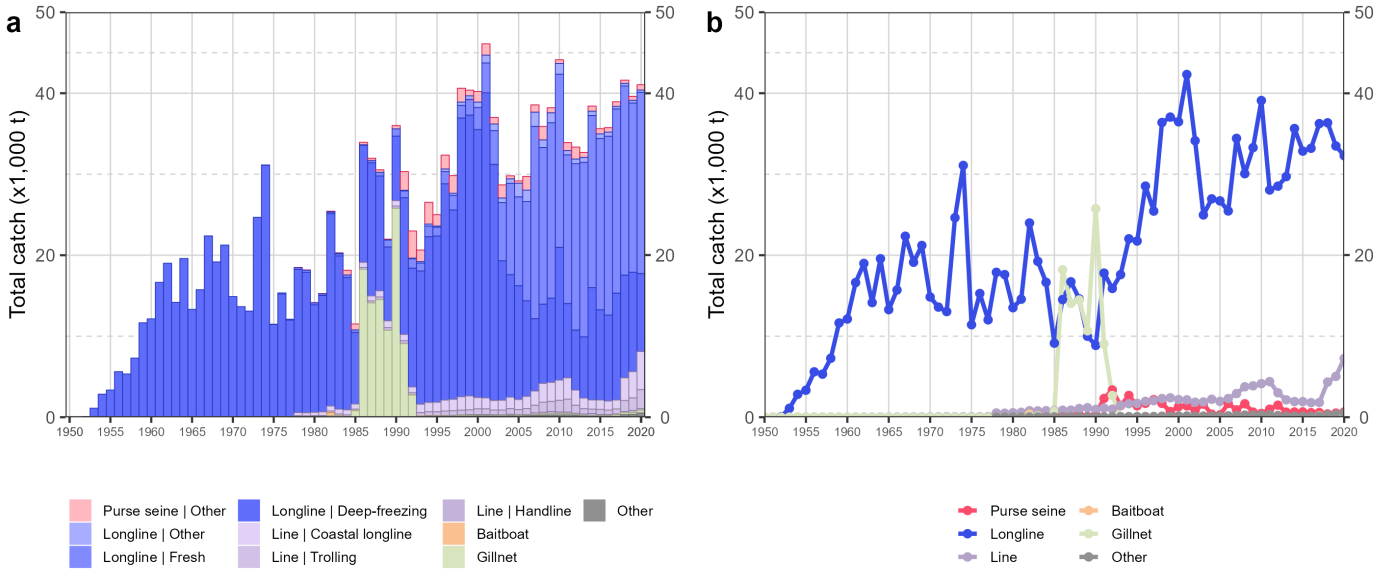

Figure 1: Annual time series of (a) cumulative nominal catches (t) by fishery and (b) individual nominal catches (t) by fishery group for albacore during 1950-2020

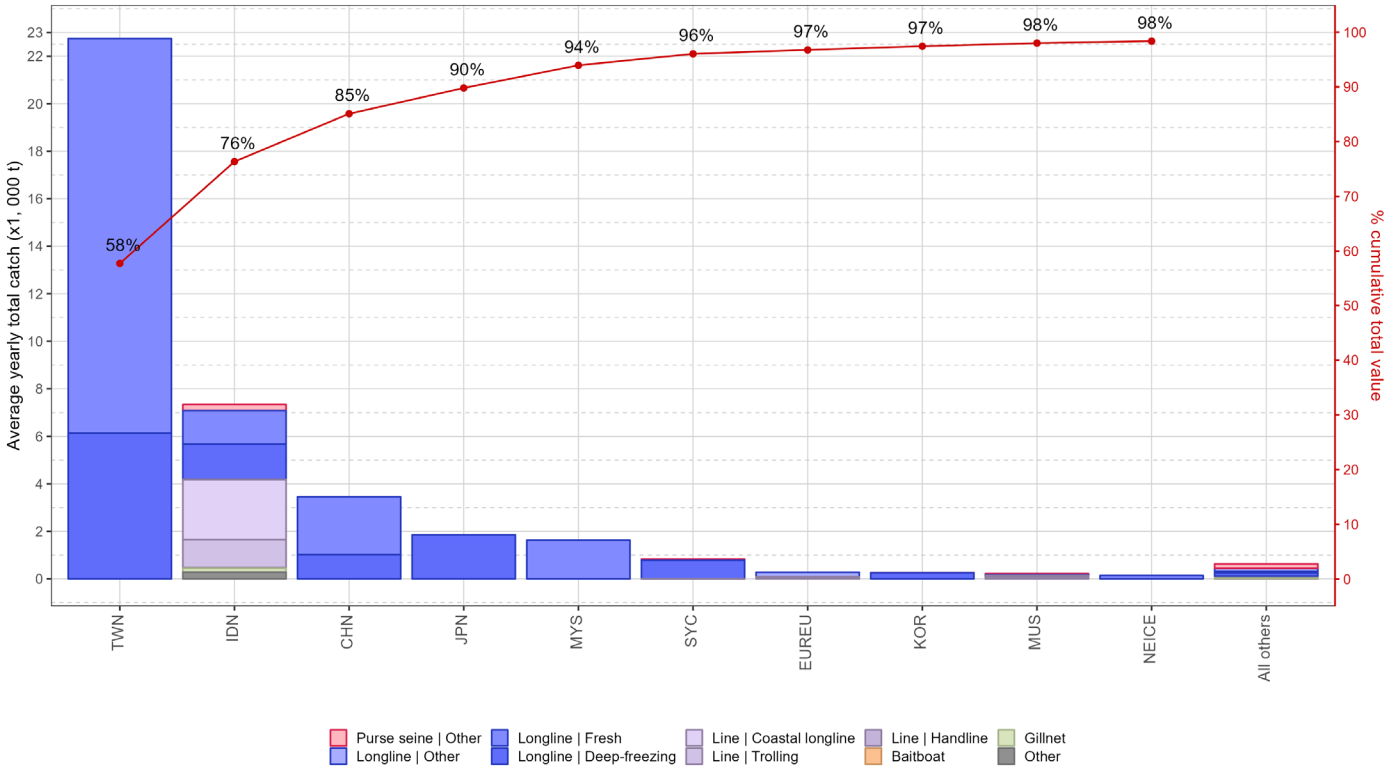

Figure 2: Mean annual catches (t) of albacore by fleet and fishery between 2016 and 2020, with indication of cumulative catches by fleet

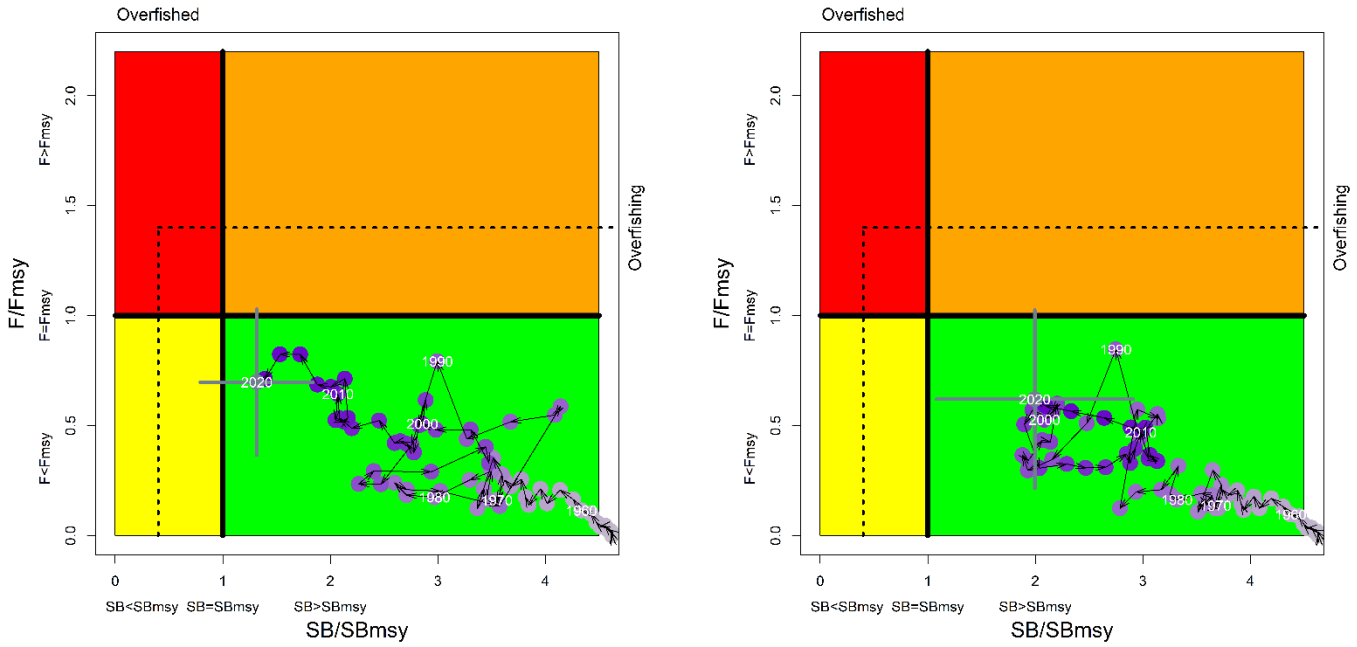

Fig. 3. Albacore: SS3 Indian Ocean assessment Kobe plot for the two model options considered: (i) Model fitted to the North-western CPUE; (ii) Model fitted to the South-western CPUE. Purple circles indicate the trajectory of the point estimates for the spawning biomass (SB) ratio and fishing mortality (F) ratio for each year 1950–2020 (the grey lines represent the 95 percentiles of the 2020 estimate). Target (F_{target} and SB_{target}) and limit (F_{lim} and SB_{lim}) reference points are shown

Table 3. Albacore: SS3 aggregated Indian Ocean assessment Kobe II Strategy Matrix based on the model options (i) Model 1 and (ii) Model 2. Probability (percentage) of violating the MSY-based target (top) and limit (bottom) reference points for constant catch projections (2020 catch level, ± 10%, ± 20%, ± 30% ± 40%) projected for 3 and 10 years

Reference point and projection timeframe	**Alternative catch projections (relative to the catch level for 2020) and probability (%) of violating MSY-based target reference points (SB_{targ} = SB_{MSY}; F_{targ} = F_{MSY})**								
	60% (24,644)	70% (28,751)	80% (32,858)	90% (36,966)	100% (41,073)	110% (45,180)	120% (49,288)	130% (53,395)	140% (57,502)
$SB_{2023} < SB_{MSY}$	0.006	0.016	0.022	0.036	0.045	0.069	0.097	0.123	0.154
$F_{2023} > F_{MSY}$	0	0	0.003	0.029	0.1	0.204	0.326	0.434	0.529
$SB_{2030} < SB_{MSY}$	0.03	0.047	0.087	0.135	0.19	0.28	0.395	0.505	0.603
$F_{2030} > F_{MSY}$	0	0	0.001	0.037	0.141	0.3	0.453	0.565	0.618
Reference point and projection timeframe	**Alternative catch projections (relative to the catch level for 2020) and probability (%) of violating MSY-based target reference points (SB_{Lim} = 0.4*SB_{MSY}; F_{Lim} = 1.4*F_{MSY})**								
	60% (24,644)	70% (28,751)	80% (32,858)	90% (36,966)	100% (41,073)	110% (45,180)	120% (49,288)	130% (53,395)	140% (57,502)
$SB_{2023} < SB_{Lim}$	0	0	0	0	0.001	0.002	0.005	0.006	0.012
$F_{2023} > F_{Lim}$	0	0	0	0	0.001	0.011	0.056	0.117	0.213
$SB_{2030} < SB_{Lim}$	0.004	0.009	0.022	0.042	0.074	0.118	0.169	0.243	0.344
$F_{2030} > F_{Lim}$	0	0	0	0	0.008	0.073	0.21	0.374	0.496