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Reference Paper for Recommendations from the 20th Regular Session of the Scientific Committee, including 2024 Stock Status Summaries

WCPFC21-2024-09 (Rev.01)[1]
24 October 2024

Submitted by the Secretariat

Purpose

1. The purpose of this paper is to support the Commission's consideration of recommendations from the **20th Regular Session of the Scientific Committee** (SC20) that are not covered elsewhere under other Agenda Items or discussions[2], and that may require decision or action by the Commission at WCPFC21. Additional information is available in the SC20 Summary Report, which will be finalized and posted to the SC20 meeting page after 5 November 2024.

2. Recommendations are presented under the following Scientific Committee Themes and Agenda Items: Data and Statistics, Stock Assessment, and budget and administration. Additional advice from SC20 relating to Stock Status based on 2024 assessments is also presented in this paper to complement the Status of Stocks Overview provided by the Scientific Services Provider (SSP) and the International Scientific Committee (ISC) to WCPFC21.

[1] Paragraph 14 is fixed along with the SC20 Outcomes Document.
[2] Harvest strategy outcomes are contained in WCPFC21-2024-10 and climate change outcomes are contained in WCPFC21-2024-15.

SC20 Recommendations

Data and Statistics Theme

3. SC20 **recommended** that TCC and the Regular Session of the Commission consider the possible inclusion of these data (additional longline operational data fields in Table ST-01) in the "Scientific Data to be Provided by the Commission (SciData)" as voluntary reporting items, taking into account the broad implementation concerns of several CCMs with respect to the collection of these data.

Table ST-01 Proposed new voluntary additional longline operational data fields

DATA FIELD	Suggested PROTOCOL for data collection
Target species for the set	Record the primary target species, or group of species, for this set.
Number of lightsticks used in set	Record the total number of lightsticks used in the set.
Bait type used in set	Record the FAO code(s)[3] for type of bait(s) used for the set. Example types:
Mainline length	Record the mainline length (in kilometers) used in the trip or set, as appropriate.
Length of branch line	Record the average length in meters of the branch lines in the trip or set. (The total length from the mainline to the hook).
Length of float line	Record the average length in meters of the float lines in the set. (The total length from the float to the mainline).
Vessel speed during setting	Record the average speed in knots of a vessel during line setting.
Speed of the line setter	Record the speed in knots of the line setter (i.e., the line shooter speed).

FAO Code	Taxa/species categories
CLP	HERRINGS, SARDINES, NEI
DPT	DECAPTHURUS SP. - MUROAJI
MAX	MACKERELS NEI
MIL	MILKFISH
MSD	MACKEREL SCAD
PIL	EUROPEAN PILCHARD (=SARDINE)
SAP	PACIFIC SAURY
SQU	VARIOUS SQUIDS NEI
TUN	TUNAS NEI
OTHERS	Comment on bait type

4. SC20 again acknowledged the proposal for the addition of a new activity code for any day when a "transhipment at sea occurs" within the operational data submitted to the Commission (as described in SC20-ST-WP-08). SC20 **recommended** that this proposal be considered by TCC and the Commission.

5. SC20 noted the Commission tasking (WCPFC20 report, para. 754.e) to review the SciData requirements to capture turtle interactions requirements under CMM 2018-04, paragraphs 5.c.and 7.e. SC20 noted that some CCMs have different interpretations of the requirements to those paragraphs, specifically as to whether the paragraphs require reporting through submission of operational level data or in a summary form, and SC20 suggested TCC and

[3] The taxa/species list in Table ST-01 represents the common bait types reported for the longline fishery, but see https://www.fao.org/fishery/en/collection/asfis/en for a complete list of FAO species codes.

	the Commission **consider clarifying the requirements** of these paragraphs to resolve any ambiguity.
	6. SC20 **recommended** that SPC and the WCPFC Secretariat develop a paper for TCC20's and the FADMO-IWG's consideration, responding to the request to identify the needs for the FAD data fields for the work of the WCPFC (science, management and monitoring).

Stock Assessment Theme	7. SC20 **recommended** that WCPFC21 request a tractable set of projections including but not limited to the four scenarios proposed below (SWP Striped Marlin): • Status quo scenario: Projection based on recent catch levels; • Recovery scenario 1: Projection using catch levels that result to a median depletion of 20% by 2034; • Recovery scenario 2: Projection using catch levels that result to a median depletion of 30% by 2034; and • Non-retention/live release scenario: Projection using catch levels that reflect the likely outcomes under a management measure requiring release of live animals or non-retention of all animals.
	8. SC20 noted that ISC24 maintained the conservation advice of WCNPO MLS from 2023[4], which is the latest available scientific information. SC20 also noted that ISC24 provided the results of stochastic rebuilding projection based on the 2023 WCNPO MLS stock assessment. These evaluated harvesting scenarios to achieve WCNPO MLS interim rebuilding target (20%SSBF=0 with more than 60% probability) as requested by the Commission (SC20-SA-IP-15). SC20 noted the recommendations of the peer review of WCNPO MLS stock assessment (SC20-SA-WP-13) and **recommended** that these be incorporated into the future stock assessment scheduled for 2027. SC20 **recommended** the Commission to take the above information into account when **considering a possible revision** of the CMM for North Pacific striped marlin.
	9. SC20 thanked the consultants for their work on Project 113b and agreed on the need for a standardized approach to reporting stock status and management advice from stock assessments for the work of the Commission and **recommended** it as a guideline. SC20 **recommended** the Commission to review the template in **Attachment 1** and advise, if necessary.

Budget and Administration	10. SC20 **recommended** that the Secretariat work with SC Theme Convenors and the SC Chair to develop a process to submit all papers and project proposals through the WCPFC website, to further streamline the submission process and allow for greater organization and tracking of submissions, for implementation in advance of SC21.

[4] 1) It is recommended that catch should be kept at or below the recent level (2018-2020 average catch = 2,428 t); and
2) The results of deterministic projection show that when catches are 2,400 t, or less, the stock is expected to recover above SSB_{MSY} and near the 20% $SSB_{F=0}$ reference level (3,660 t) by 2040, or sooner at the lower catch levels under a low recruitment regime.

2024 Stock Status Summaries from SC20

11. The following stock status summaries are based on the 2024 assessments conducted by the SSP and ISC and reviewed by the Scientific Committee. All assessments were successful except the Southwest Pacific striped marlin assessment, which will be revisited at SC21 in 2025. The summaries are provided as further reference to support relevant decision-making by the Commission at WCPFC21. Additional details are contained in the SC20 Summary Report, which will be available after 5 November 2024.

South Pacific Albacore

12. The median depletion for the recent period ($SB_{2019\text{-}2022}/SB_{F=0}$) was 0.48 ($10^{th}$ to 90^{th} percentile of 0.36 to 0.62), which is just below the 0.5 re-estimated iTRP for SPA based on the 2024 assessment. The median ratio of $SB_{2019\text{-}2022}/SB_{F=0}$ to the iTRP was 0.952, ranging from 0.899 to 1.016, which is close to the iTRP. The South Pacific-wide albacore tuna stock spawning biomass is above the biomass LRP, and F_{recent} is below F_{MSY} for all models in the uncertainty ensemble. The stock is not overfished (0% probability $SB_{recent}/SB_{F=0}$ < LRP) and is not experiencing overfishing (100% probability $F_{recent} < F_{MSY}$).

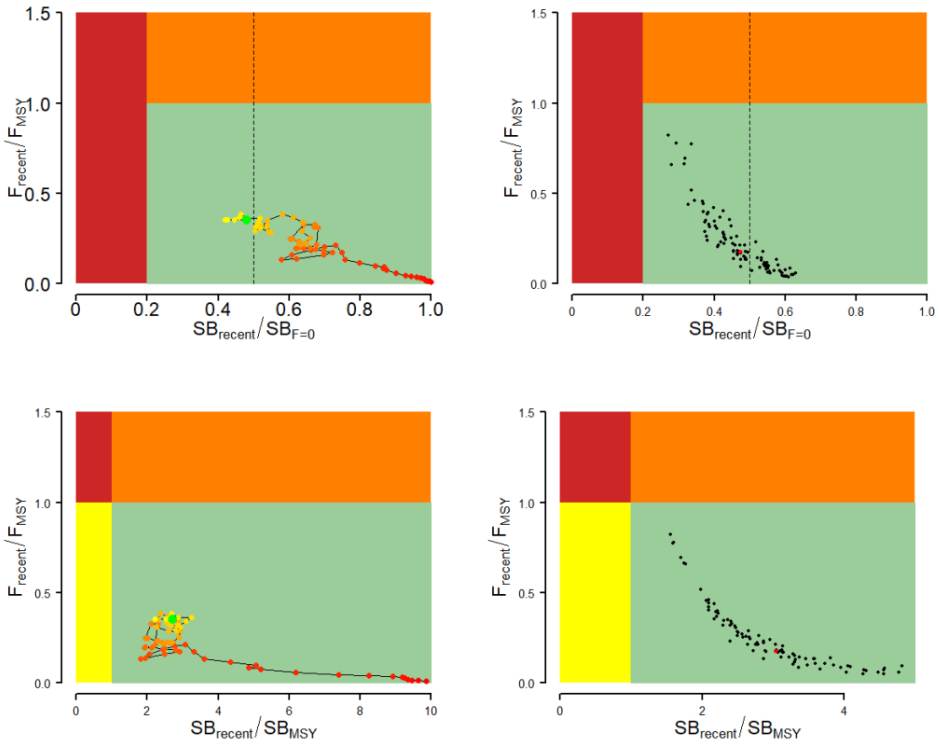

Figure 1. Majuro plots (top) and Kobe plots (bottom) summarising the results for the dynamic MSY and depletion analysis for the diagnostic case model (left) and each of the models in the model ensemble for the recent period (2019– 2022; right). Majuro plots include a dashed line at the iTRP estimate (0.5), calculated from the current assessment (Pilling et al., 2024). Colors for dynamic MSY go from red to green over time. The red point in the model ensemble represents the median.

Pacific Bluefin Tuna

13. The Pacific bluefin tuna (PBF) stock is recovering from the historically low biomass in 2010 and has exceeded the second rebuilding target of 20%SSBF=0, that is, the stock is not overfished relative to 20%SSBF=0. The recent (2020-2022) F%SPR is estimated to be 23.6% and thus the PBF stock is not subject to overfishing relative to some of F-based reference points proposed for tuna species, including F20%SPR. SPR (spawning potential ratio) is the ratio of the cumulative spawning biomass that an average recruit is expected to produce over its lifetime when the stock is fished at the current fishing level to the cumulative spawning biomass. The risk of SSB falling below 7.7%SSBF=0 (interim LRP for tropical tunas in IATTC) at least once in 10 years is negligible;

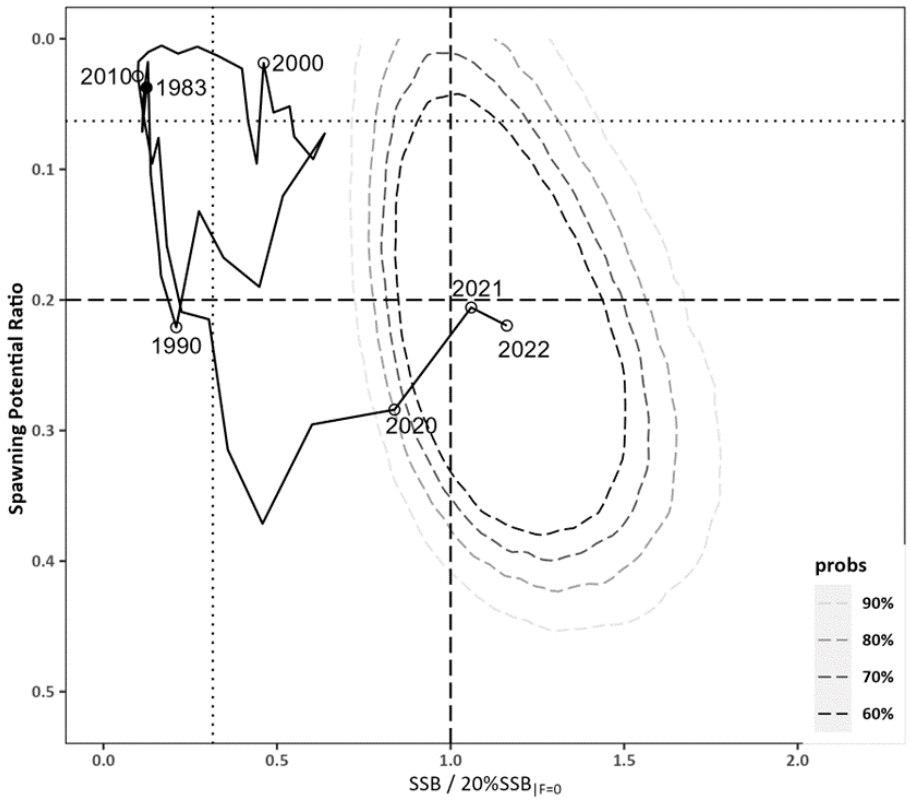

Figure 2. Kobe plot for Pacific bluefin tuna (*Thunnus orientalis*) estimated from the base-case model from 1983 to 2022. The X-axis shows the annual SSB relative to 20%$SSB_{F=0}$ and the Y-axis shows the spawning potential ratio (SPR) as a measure of fishing mortality. Vertical and horizontal dashed lines show 20%$SSB_{F=0}$ (which corresponds to the second biomass rebuilding target) and the corresponding fishing mortality that produces SPR, respectively. Vertical and horizontal dotted lines show the initial biomass rebuilding target (SSB_{MED} = 6.3%$SSB_{F=0}$) and the corresponding fishing mortality that produces SPR, respectively. SSB_{MED} is calculated as the median of estimated SSB over 1952-2014 from the 2022 assessment. The apparent increase of F in the terminal period is a result of low recruitment in this period. As noted, the recruitment estimates in recent years are more uncertain and this result needs to be interpreted with caution. Contour plots represent 60% to 90% of two probability density distributions in SSB and SPR for 2022. The method used to estimate the confidence interval was changed from bootstrapping in the previous assessments to resampling from the multi-variate log-normal distribution. The probability distribution for the area where SPR is below zero is not shown as such SPR values are not biologically possible.

Southwest Pacific striped marlin

14. SC20 recommended that a revised assessment be presented at SC21, which includes a presentation of the projection scenarios (refer to paragraph 7 above). SC20 reiterated the most recent stock status advice from SC15 (2019) that "the stock is likely overfished, and close to undergoing overfishing according to MSY-based reference points."

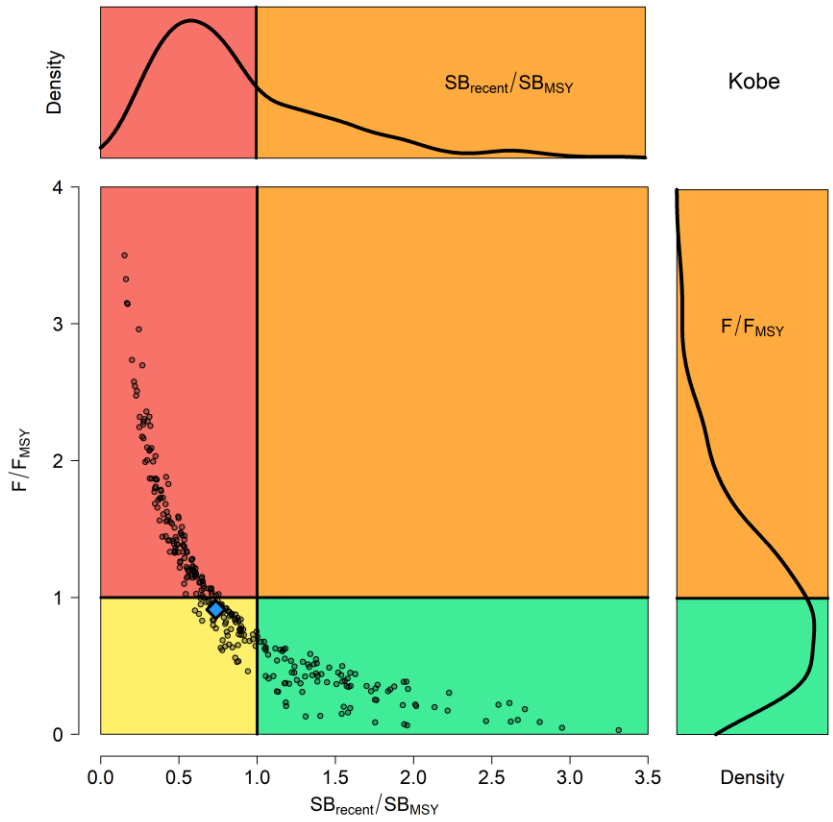

Figure 3. Kobe plot for the recent spawning biomass (2014 – 2017) summarizing the results for each of the models in the structural uncertainty grid. The plots represent estimates of stock status in terms of spawning biomass relative to the spawning biomass that produces MSY and fishing mortality, and marginal distributions of each are presented. The blue square is the median of the grid. (from SC15 Summary Report)

Silky shark

15. Recent (2019–2020) fishing mortality of silky shark was estimated to be below biological reference points (U_{recent}/U_{crash}: 0.13), that is, overfishing is very unlikely (< 10%) to be occurring relative to MSY-based reference points. However, abundance and depletion estimates were very uncertain, and SC20 considered the stock was about as likely as not (40-60 %) to be overfished relative to MSY-based reference points. SC20 recommended interpreting the results of the silky shark stock assessment with caution due to the large amount of uncertainty in catch, stock structure, life history, and other important components of the assessment, but it noted that all of the models presented resulted in a positive trend in stock status for silky sharks.

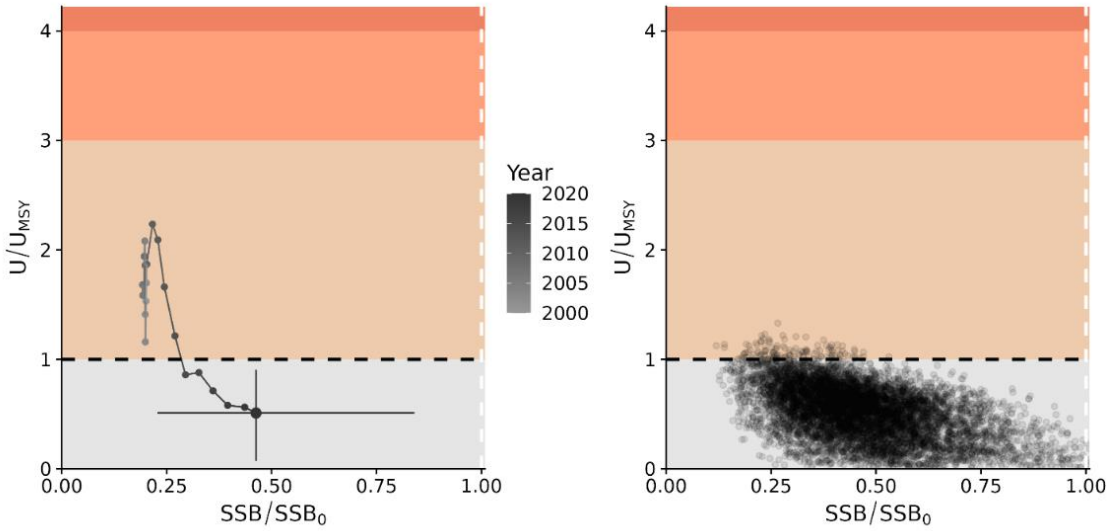

Figure 4. Majuro plots for recent (2019–2020) stock status based on the dynamic surplus production model for silky shark in the WCPFC. The top row shows the outcomes for the base (intermediate initial depletion) scenario, whereas the bottom row shows the outcomes across all three assumptions of initial depletion. Left-hand plots show the stock trajectory, with uncertainty shown for the most recent year in the analysis (2020). In contrast, the plot on the right-hand side shows individual draws from the posterior distribution(s) for recent (2019–2020) years.

North Pacific shortfin mako shark

16. The North Pacific shortfin mako shark (SMA) stock assessment used total depletion (D) and exploitation rate (U) to describe stock status. The total depletion (D) is the total number of SMA divided by the unfished total number (i.e., carrying capacity), and the exploitation rate (U) is the proportion of the SMA population that is removed by fishing relative to population carrying capacity. Recent median $D_{2019\text{-}2022}$ is 0.60 (95% CI = 0.23-1.00), which is 1.17 times D_{MSY} (95% CI = 0.46-1.92) and the stock is likely (66% probability) not in an overfished condition relative to MSY-based reference points. Recent $U_{2018\text{-}2021}$ is 0.018 (95% CI = 0.004-0.07), which is 0.34 times U_{MSY} (95% CI = 0.07-1.20), and overfishing of the stock is likely not occurring (95% probability) relative to MSY-based reference points. In summary, the model ensemble results show 65% joint probability that the North Pacific SMA stock is not in an overfished condition and that overfishing is not occurring relative to MSY-based reference points. In summary, the model ensemble results show that there is a 65% joint probability that the North Pacific. The SMA stock is not in an overfished condition and that overfishing is not occurring relative to MSY based reference points.

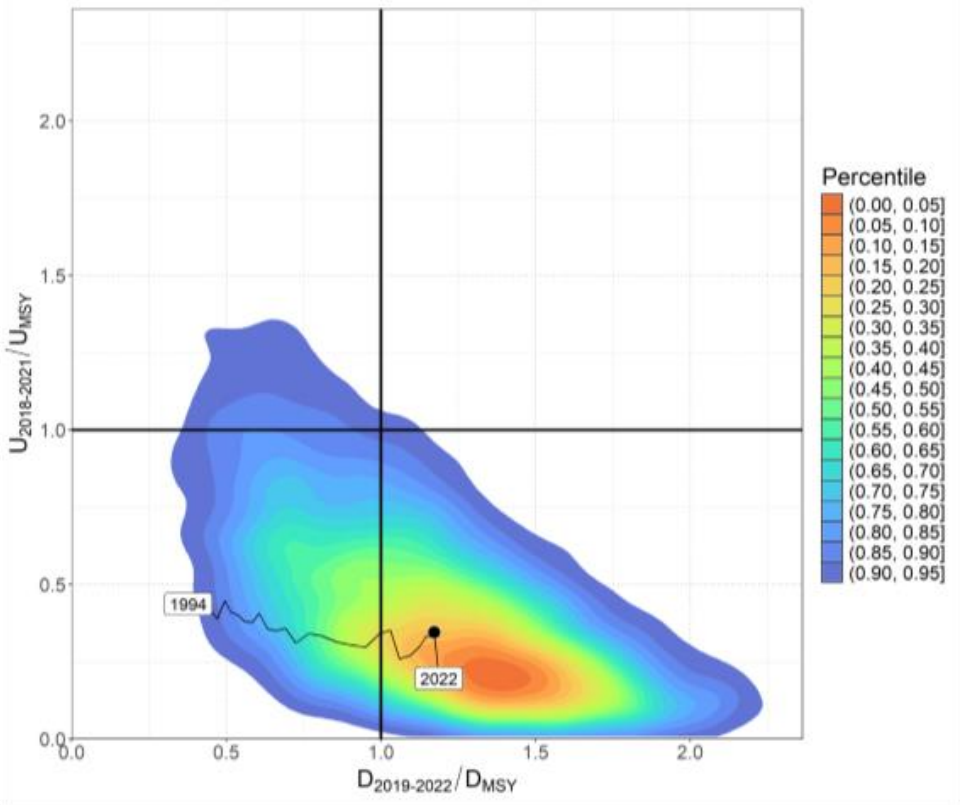

Figure 5. Kobe plot showing the bivariate distribution (shaded polygon) average recent depletion relative to the depletion at MSY ($D_{2019\text{-}2022}/D_{MSY}$) against the average recent exploitation rate relative to the exploitation rate at MSY ($U_{2018\text{-}2021}/U_{MSY}$). The median of this bivariate distribution is shown with the solid black point. The time series of annual D_t/D_{MSY} versus U_t/U_{MSY} is shown from 1994 to 2022.

Stock Status and Management Advice Template

a. Stock assessment and trends

Paragraphs (link to Figures)

1. Describe the assessment structure and rationale (Fig 1, Table 1)
2. Describe the main uncertainties considered (Table 2)
3. Describe annual catch estimates and trends (Figure 2)
4. Describe CPUE trends and other indicators of biomass trends (Figure 3)
5. Describe trends in a diagnostic model, including recruitment, spawning potential, and fishing mortality, as well as performance against diagnostics (Figures 4-6)
6. Describe the depletion of spawning stock biomass and associated uncertainty (Figure 7)
7. Describe stock assessment results compared to the previous assessment

Table 1. Assessment structure, including key fisheries and catch proportions. No defined format to accommodate alternative assessment methods.

Table 2. Summary of main sources of uncertainty in the assessment, with a degree of confidence assigned to each aspect of the assessment and potential source of uncertainty.

Figure 1. Spatial structure used in the 20XX stock assessment model

Figure 2. Time series of total annual catch (1000's mt) by fishing gear over the full assessment period

Figure 3. Time series of CPUE and/or other main abundance indices

Figure 4. Estimated annual average recruitment by model region for the diagnostic case model, including estimation uncertainty.

Figure 5. Estimated annual average spawning potential by model region for diagnostic case model, including estimation uncertainty.

Figure 6. Estimated annual average juvenile and adult fishing mortality for the diagnostic case model, including estimation uncertainty.

Figure 7. Plot showing the trajectories of spawning biomass and spawning biomass depletion (of spawning potential) by region, including uncertainty arising from estimation, structural, and intrinsic uncertainties (variability and process error).

Table 2 Example: Assessment configuration and sources of uncertainty.

Source	Type	Rationale	Uncertainty	Impact	Confidence**
Data	CPUE	Best available spatio-temporally standardised Index	Low availability of gear configuration impacting catchability	Potential hyperstability, leading to over-estimating current biomass	Medium
	Catch	Best available information	Reporting, early catch	Early catch probably less impactful now; total magnitude will impact productivity estimates	High
Model	Multifan CL	Standard tuna model in WCPFC	Low, benchmark tested	Single model used for inference	High
Spatial assumptions	9 Regions	Most parsimonious given available tags, alternative spatial configurations difficult to test	Not considered	Potentially important, not quantified, impact unknown	Low
Key parameter uncertainty	M	Estimable given trend	Estimated	Impacts estimation uncertainty	Medium
	steepness	Not estimable in present model	Grid (VALUES)	Impacts overall structural uncertainty	High
Structural uncertainties (model configurations)	Process error	Recruitment variability, time-varying selectivity	Estimated	Potential to over-fit selectivities, bias other parameter estimates	Medium
	Movement	Best estimates from tag data	Estimated, grid over assumed tag-mixing rates	Estimates driven by assumptions may not fully represent the true movement process	Low
	Time-varying selectivity	Evident in LFs	Estimated	Impacts estimation uncertainty	Medium
Estimation uncertainty	MCMC	Full Bayesian estimation integrating over key uncertainties (M)	Estimated	Estimation uncertainty replaces structural uncertainty for M	High
Other sources of uncertainty	Climate impacts	Recent recruitment may have been impacted by above-normal temperatures	Not considered	Projected biomass may be optimistic	Low

**For Table 2, use the following criteria to assign confidence in model inputs and decisions (last column in Table 1). Note that inputs

Confidence levels (diagonal across IPCC confidence table)	Description
High	Data are representative, parameters or processes well known or highly likely to be contained within prior/grid range considered
Medium	Some uncertainty about data representativeness, parameters/processes or unsure if fully captured in data/parameter scenarios/priors (e.g., single M may be used for technical reasons even though length-based M has been shown in literature)
Low	Considerable uncertainty about data/parameters/process or unlikely to be well represented in data/parameter scenarios/priors (e.g., Climate impacts, past catch unknown)

b. Stock status

8. Describe management quantities for recent and latest years related to LRP, TRP, and/or other agreed objectives with CMMs (Table 3, Figures 7 & 8)
9. Describe projections (where relevant; Figure 9)

Table 3. Stock status summary table (see examples below).

Figure 7. Majuro plot summarising the results for each of the models, including uncertainty arising from estimation, structural, and intrinsic uncertainties (variability and process error).

Figure 8. Kobe plot summarising the results for each of the models, including uncertainty arising from estimation, structural, and intrinsic uncertainties (variability and process error).

Figure 9. Plot showing projected stock status under recent fishing levels, including uncertainty arising from estimation, structural and intrinsic uncertainties (variability and process error)

c. Management advice

Describe agreed recommendations based on the results of the stock assessment (possibly more than 1 paragraph; include in Table 3 summary*)*

Table 3. Stock status table (Example only)

Summary				
Year of assessment: 2023 **Final year of assessment data: 2021**	**Biomass**	Unlikely (<33% to be above target		Stock is overfished
	Fishing mortality	Likely (>66%) to be below target		Overfishing is not occurring
	Projection	F likely (>66%) decline further		Overfishing is unlikely (<66%) to occur under current catch levels
	Recommendation	**Stock increasing towards target and F declining at current catch, no action required to reach target biomass.**		
Reference points		**Estimate [Lower–Upper]**		
Biomass	TRP ($0.4B_{F=0}$)	3,000,000 t [low – up]		
Biomass	LRP ($0.2B_{F=0}$)	1,500,000 t [low – up]		
Catch	*MSY*	250,000 t [low – up]		
Fishing Mortality	F_{MSY}	0.1 [0.08; 0.014]		
Recent estimates				**Recent trend/projection**
Biomass	*B*	1,800,000 t [low – up]		Biomass increasing
Depletion	$B_{recent}/B_{F=0}$	0.32 [0.18 – 0.43]		
Fishing Mortality	*F*	0.08 [0.06 – 0.09]		F declining
Catch	*C*	200,000		Catch stable
Status			**Likelihood**	
Biomass	B_{recent}/TRP	0.8 [0.65 – 1.07]	Unlikely (<33%) to be above target	
	B_{recent}/LRP	1.65 [0.9 – 2.65]	Unlikely (<33%) to be below limit	
Fishing mortality	F_{recent}/F_{target}	0.8 [0.6 – 1.1]	Likely (>66%) to be below target	
	F_{recent}/F_{limit}	0.8 [0.6 – 1.1]	Very likely (>99%) to be below limits	
Projections (basis[recent catch/effort/ alternative catch])				
Biomass	$B_{proj-year}^{proj-basis}/B_{MSY}$	0.42 [0.3 – 0.53]	About as Likely as Not (33 – 66%) to be below	B_{proj} increasing
Fishing mortality	$F_{proj-year}^{proj-basis}/F_{MSY}$	0.6 [0.5 – 0.7]	Likely (>66%) to be below target	F_{proj} declining

For table 3, use IPCC likelihood categories with numerical probability statements

Probability	**Description**
> 99%	Virtually Certain
> 90%	Very Likely
> 60%	Likely
40-60 %	About as Likely as Not
< 40%	Unlikely
< 10%	Very Unlikely
< 1%	Exceptionally Unlikely