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Recalibration of the Adopted South Pacific Albacore Interim Target Reference Point and Review of WCPFC20 Requested Options

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REV1 – calculations of vulnerable biomass were incorrect as they did not take account of the quarterly nature of seven of the modelled WCPO longline fleets within the 2024 stock assessment. This has been corrected in Tables 1 and 2, and the associated text has been adjusted accordingly.

Preliminary results have also been provided in Appendix 1 where projections are based upon catch in weight rather than catch in numbers, and where catch changes are made within WCPFC-CA fisheries only (equivalent of Table 1). Some text changes have been made accordingly, including to the final paragraph of the discussion.

Executive Summary

WCPFC20 agreed on an interim target reference point (iTRP) for South Pacific albacore but requested the iTRP be reviewed following the 2024 stock assessment. WCPFC20 also tasked SPC-OFP to evaluate a range of alternative candidate South Pacific albacore target reference points between $SB/SB_{F=0}$ 0.42 – 0.56. The current 2024 South Pacific albacore assessment model grid is used to recalibrate the iTRP and evaluate the implications of those alternative depletion values.

Using the results of the 2024 South Pacific albacore grid, the recalibrated depletion value for the iTRP for South Pacific albacore is 0.5 $SB_{F=0}$. We draw attention to the formula used to calculate that iTRP value, based upon the technical guidance provided by WCPFC20.

Long-term stochastic catch-based projections off the grid of 100 models provided to SC20 were performed for the two scenarios requested by SC17: i) catch of WCPFC-CA and EPO longline and troll fleets within the assessment model was scaled equally; ii) only WCPFC-CA longline and troll fleet catches were scaled. The baseline period was the mean across 2020-2022. Noting increases in EPO catches identified in recent years, catch of longline fisheries within the 'remainder of the EPO' (EPO excluding the overlap area) was scaled up to an equivalent of 22,500 mt, being the level reported in 2021 and 2022. Future recruitment was defined by the estimated stock recruitment relationship, with variability around it through recruitment deviation estimates from the stock assessment over the period 1973 to 2020. Fifty projections were run from each of the 100 assessment models, and future catch levels (in terms of numbers of fish) adjusted so that the long-term WCPFC-CA depletion achieved the specified level.

Based upon the current results, WCPFC-CA longline and troll average catch levels over 2020-2022 combined with EPO longline catches of approximately 22,500mt will achieve the recalibrated iTRP on average in the long term. Under those conditions, there is an 8% risk of the stock falling below the limit reference point under the current uncertainty framework. Fishing mortality on average is below F_{MSY}. Average vulnerable biomass available across the WCPFC-CA longline fishery was 26% lower than that estimated across 2017-2019, and 33% lower than that in 2013.

Under WCPFC-CA management, reductions in longline and troll catches relative to 2020-2022 levels are required to achieve less depleted stock levels than the iTRP, by up to 13% to achieve a depletion of $0.56SB_{F=0}$. If a more depleted stock were considered appropriate, WCPFC-CA catches (modelled using numbers of fish) could be increased by 18% and 25% for the two evaluated depletion levels that were lower than the iTRP, noting that risk of falling below the LRP increased, to a maximum of 19%. Where catch management was South Pacific-wide, reductions in catch to achieve less depleted stock levels are slightly less than the WCPFC-CA equivalents. Where a more depleted stock level is permissible, increases across South Pacific fisheries are lower than WCPFC-CA-only equivalents.

SC20 is invited to:

- Note the recalibrated iTRP depletion value based on the submitted 2024 stock assessment grid, for use in provision of stock status advice relative to this level.
- Consider the levels of fishing necessary to achieve the recalibrated iTRP and alternative depletion levels, and corresponding catch, catch rate and risk outcomes.
- Consider whether alternative depletion levels should be evaluated.
- Consider the implications of management action within the WCPFC Convention Area only, and those where action is taken across the South Pacific.
- Noting preliminary results in Appendix 1, provide advice on the methodology for longline catch-based projections in terms of use of catch in numbers of fish or catch weight as their basis.

Introduction

WCPFC20 agreed on an interim target reference point (iTRP) for South Pacific albacore specified as four percent below the estimated average spawning potential depletion of the stock over the period 2017-2019 (0.96 $SB_{2017\text{-}2019}/SB_{F=0}$). However, they recognised that some outstanding scientific issues remained and hence the iTRP was to be reviewed by the Commission following the 2024 stock assessment and further development of candidate management procedures. Adoption was scheduled for WCPFC21 within a Conservation and Management Measure that specified a management procedure for South Pacific albacore tuna (WCPFC20 summary report, paragraphs 238 and 241).

WCPFC20 also tasked the SPC-OFP to evaluate a range of alternative candidate South Pacific albacore target reference points between $SB/SB_{F=0}$ 0.42 – 0.56 (long-term avg $SB/SB_{F=0}$ (WCPF-CA), or preferably equivalent levels defined in terms of a reference period) to be considered in the context of the review of the adopted iTRP (WCPFC20 summary report, paragraph 242).

This paper uses the current 2024 South Pacific albacore assessment model grid (Teears et al., 2024; SC20-SA-WP-02) that is to be reviewed and agreed at SC20 to recalibrate the iTRP and evaluate the implications of alternative depletion values within the range specified by WCPFC20.

Methods

Analyses were run from the grid of 100 South Pacific albacore stock assessment models developed for SC20's consideration (SC20-SA-WP-02). We note that following SC20 discussions, re-analysis may be required to make the results consistent.

Recalibration of the iTRP

Following the development of the 2024 South Pacific albacore assessment grid there is a need to recalibrate the iTRP value, identifying the depletion value equivalent to the iTRP definition (0.96 $SB_{2017\text{-}2019}/SB_{F=0}$). Using the approach defined in the footnote to paragraph 238 of the WCPFC20 summary report[2], the depletion level consistent with the iTRP was calculated as: 0.96 x the median of [mean($SB_{2017}/SB_{F=0,2007\text{-}2016}$, $SB_{2018}/SB_{F=0,2008\text{-}2017}$, $SB_{2019}/SB_{F=0,2009\text{-}2018}$) calculated within each assessment model].

Evaluation of implications of the iTRP and requested alternative TRP levels

WCPFC20 requested evaluation of the consequences of a range of alternative depletion values. The general steps taken in this analysis were to:

i. Stochastically project the South Pacific albacore stock forward for 40 years under alternative levels ('scalars' or multipliers) of fixed future longline and troll catch. Projections therefore

[2] "Spawning potential depletion" refers to the estimated South Pacific albacore spawning potential as a percentage of the estimated spawning potential in the absence of fishing (i.e., the unfished spawning potential). The metric is dynamic and is estimated for each model time step.
The method to be used in calculating spawning potential in the absence of fishing (SBF=0) shall be
   a. $SB_{F=0,\ t1\text{-}t2}$ is the average of the estimated spawning potential in the absence of fishing for a time window of ten years based on the most recent South Pacific albacore stock assessment, where t_1=y-10 to t_2=y-1 where y is the year under consideration; and
   b. The estimation shall be based on the relevant estimates of recruitment that have been adjusted to reflect conditions without fishing according to the stock recruitment relationship.

ran from 2023 through to 2062. By the end of the projection period stock conditions had, on average, reached 'equilibrium' with the defined level of future longline and troll catch.

ii. These catch-based projections are in terms of numbers of fish for longline fisheries, and in weight for troll. Subsequent preliminary analyses evaluated the impacts of projecting based upon longline catch weight (see Appendix 1).

iii. Catchability of each fishery was assumed to remain constant in the projection period; effort creep is not considered.

iv. The stock was projected forward under alternative scenarios for future longline and troll catch. An equal multiplier was used for longline and troll fisheries within the model. The future catch level was adjusted so that the specified depletion level was achieved on average at the end of the projection period. That future catch 'scalar' was applied relative to recent 2020-2022 average longline and troll catch levels to define future levels of fishing.

v. Projections were performed for the two scenarios requested by SC17:
    a. The catch of all WCPFC-CA and EPO longline and troll fleets within the assessment model were scaled equally;
    b. Only WCPFC-CA longline and troll fleets within the assessment model were scaled.

    Noting the baseline period, and the general increases in EPO catches identified in recent years, the catch of longline fisheries within the 'remainder of the EPO' (EPO excluding the overlap area) were scaled up to an equivalent of 22,500 mt, being the level reported in 2021 and 2022. For the second scenario, where longline and troll fleet catches are unaffected by WCPFC-CA scalars, EPO catches are therefore maintained at this level. Under the first scenario, additional scalars are applied to this already adjusted future EPO catch level.

vi. For a given catch scalar, 50 stochastic projections were performed from each of the 100 assessment models presented to SC20 for consideration.

vii. Future recruitment was defined by the estimated stock recruitment relationship, with variability around it defined by recruitment deviation estimates from the stock assessment over the period 1973 to 2020, consistent with the stock assessment.

viii. For a given catch scalar, results in the year 2062 were averaged (median taken) across the 5000 projections performed.

The following results were calculated for each scenario:

i. The approximate constant catch levels in the WCPFC-CA and remaining EPO region assumed in each projection. For consistency, these are identified by applying the scalars to the catch data presented in SC20-SA-IP-07. In the 'WCPFC-CA only' scenario, catch levels in the EPO portion of the South Pacific are assumed to remain at 22,500mt.

ii. The 'equilibrium' median adult biomass depletion relative to unfished levels ($SB/SB_{F=0}$; the calculation being over the last four years of the projection, in an approach consistent with that used for the iTRP), for the stock component within the WCPFC-CA, and its level relative to the adopted iTRP ($0.96\ SB_{2017\text{-}2019}/SB_{F=0}$) and average estimated depletion over 2017-2019.

iii. The median vulnerable biomass for longline fisheries combined within the WCPFC Convention Area in 2062 (VB_{2062}; vulnerable biomass being a proxy for catch rates), relative to alternative 'baseline' levels:
    a. their mean vulnerable biomass in 2017-2019 ($VB_{2017\text{-}2019}$)
    b. their vulnerable biomass in 2013 (VB_{2013}).

iv. The median fishing mortality relative to F_{MSY} ($F_{2058\text{-}2061}/F_{MSY}$), calculated for the stock across the South Pacific (WCPFC-CA specific calculations are not available).

v. The risk of falling below the LRP ($20\%SB_{F=0}$), calculated as the proportion of runs (5000 in total) for which $SB/SB_{F=0}$ at the end of the projection period was below the LRP, for the stock component in the WCPFC-CA.

vi. The risk of fishing mortality increasing above F_{MSY} under that fishing level, at the level of the South Pacific as a whole, calculated as the percentage of the 5000 runs where $F > F_{MSY}$ in 2062.

As noted, the results in 2062 represent approximate equilibrium conditions experienced by the stock and fishery under the future constant catch level applied. They therefore represent the long-term average conditions achieved.

WCPFC20 tasked the SSP to evaluate alternative candidate South Pacific albacore target reference points between $SB/SB_{F=0}$ 0.42 – 0.56 (long-term avg $SB/SB_{F=0;}$ WCPFC-CA). As noted by WCPFC20, this would be preferably specified in terms of equivalent levels defined in terms of a reference period. Following the recalibration of the depletion level equivalent to the iTRP under the 2024 assessment, the specified depletion levels were re-framed in terms of percentages of 2017-2019 $SB_{F=0}$ for presentation within the current analysis. We note that based upon the current assessment, the recalibrated iTRP lies within this range of depletion levels. Two depletion levels both above and below the iTRP are therefore considered to illustrate the fishing levels changes required, the associated risks and impacts on vulnerable biomass.

Results

Recalibration of the iTRP

Using the results of the 2024 South Pacific albacore grid, the recalibrated depletion value for the iTRP for South Pacific albacore is 0.5 $SB_{F=0}$.

Evaluation of implications of the iTRP and requested alternative TRP levels

Table 1 presents the outcomes of changes in future catch levels relative to the 2020-2022 average levels within the WCPFC-CA longline and troll fisheries only (catch of EPO fisheries held constant). Table 2 presents the outcomes where those changes in future catch levels are applied across the South Pacific, i.e. where compatible management is undertaken by WCPFC and IATTC. Note that F_{MSY}-related metrics are evaluated as that across the South Pacific; WCPFC-CA-specific values are not available for this parameter.

Using the 100 model runs provided to SC20 within the 2024 South Pacific albacore stock assessment, WCPFC-CA longline and troll average catch levels over 2020-2022 combined with EPO catches of approximately 22,500mt will achieve the recalibrated iTRP in the long term. Under those conditions, there is an 8% risk of the stock falling below the limit reference point, under the current uncertainty grid and incorporating the historical variability in recruitments. Fishing mortality on average is below F_{MSY}, although there is a 9% risk that this level might be exceeded. Vulnerable biomass available across the WCPFC-CA longline fishery is 26% lower than that estimated across 2017-2019, and 33% lower than that in 2013.

WCPFC-CA catch changes only

To achieve less depleted stock levels, reductions in WCPFC-CA longline and troll catches relative to 2020-2022 levels are required, by up to 13% to achieve a depletion of $0.56SB_{F=0}$. Risks of falling below the LRP or exceeding F_{MSY} are reduced relative to those at the iTRP. WCPFC-CA longline average vulnerable biomass remains below that estimated across 2017-2019 and in 2013, by 18% and 26% respectively if a depletion of $0.56SB_{F=0}$ was achieved.

If a more depleted stock were considered appropriate, WCPFC-CA catches could be increased relative to the baseline. For the two specific depletion levels evaluated, these were by 18% and 25% respectively. Risk of falling below the LRP increased, to a high of 19%. The risk of exceeding F_{MSY} also increased, to up to 18%. Average vulnerable biomass in the WCPFC-CA longline fishery decreased

further relative to 2017-2019 and 2013 baselines by 41% and 47% of the level in those periods, respectively, if the stock were on average at 42%$SB_{F=0}$.

South Pacific-wide catch changes

Where catch changes were made Pacific-wide, reductions in catch to achieve less depleted stock levels were slightly less than the WCPFC-CA only equivalents. Where a more depleted stock level is permissible, increases for fisheries across the South Pacific are lower than the WCPFC-CA only equivalents as expected. Consequences in terms of LRP risk, F/F_{MSY} levels and WCPFC-CA longline vulnerable biomass are comparable, but slightly different given the shifts in the fishing patterns across the South Pacific where changes in all gears are applied compared to WCPFC-CA only.

Discussion

The recalibrated iTRP value represents the depletion level from the 2024 assessment consistent with the iTRP definition and allows assessment outcomes to be considered relative to this iTRP level.

The recalibrated iTRP was within the range of depletions specified by WCPFC20 for evaluation and hence did not require significant re-interpretation of those levels. However, we agree with WCPFC20 that it is preferable for equivalent candidate TRP levels to be defined in terms of a reference period.

The depletion levels examined, including the iTRP, imply lower vulnerable biomass levels (i.e. lower CPUE levels) than seen in the 'baseline' periods presented here (2017-2019 average and 2013). It should be noted that the calculation is averaged across fleets - given differences in estimated selectivities between fleets, some fleets perform better than others within this calculation.

Across the range of depletions examined, no risks of falling below the LRP exceeded 20%, the WCPFC-identified maximum threshold for management procedure consideration. It should be noted that this future uncertainty was based upon the current assessment uncertainty grid and incorporating the historical variability in recruitments, while projections are based on catch in number of fish.

When considering less depleted stock scenarios, the required percentage reductions in catch were similar between WCPFC-CA only and South Pacific wide analyses; differences in multipliers were at the 3rd decimal place. In contrast, when forcing the stock to lower depletion levels, greater differences were seen. It should be noted that in these catch-based projections, when assuming greater levels of fishing in the future, some projections 'failed' (insufficient biomass remaining to allow the projected catch to be taken), particularly where WCPFC-CA only management was applied (up to 5% of runs). These projection results have been set to zero for the estimation of depletion and risk, which will affect the patterns seen across depletion levels. While undertaking effort-based projections would reduce this effect, the catch-conditioned nature of the 2024 assessment does not allow these to be undertaken at present.

The current analysis has projected future catches in terms of numbers of fish. For the MSE process, longline catch within the Operating Models (OMs) has been converted from catch in numbers to catch in weight (see SC20-MI-WP-04) to be consistent with management through e.g. a TAC. A preliminary iTRP analysis projecting catch in weight is presented in Appendix 1 where that catch weight management was for fisheries within the WCPFC-CA only. Where a scalar of 1 was applied, a comparable median depletion level was achieved at the end of the time series, but LRP risk levels increased to 14% (cf 8% in Table 1). If the population declines, a smaller catch weight will result when projecting the take of a specified number of fish, but when specifying a future catch weight be taken

more fish would be needed to achieve that weight. Smaller decreases in catch weight are needed to achieve less depleted levels and smaller increases in catch weight are needed to achieve more depleted levels, while risk levels relative to the LRP are higher for all depletion levels examined.

Recommendations

SC20 is invited to:

- Note the recalibrated iTRP depletion value, based on the submitted 2024 stock assessment grid, for use in provision of stock status advice relative to this level.
- Consider the levels of fishing necessary to achieve the recalibrated iTRP and alternative depletion levels, and corresponding catch, catch rate and risk outcomes.
- Consider whether alternative depletion levels should be evaluated.
- Consider the implications of management action within the WCPFC Convention Area only, and those where action is taken across the South Pacific.
- Noting preliminary results in Appendix 1, provide advice on the methodology for longline catch-based projections in terms of use of catch in numbers of fish or catch weight as their basis.

References

SPC-OFP and the WCPFC Secretariat (2024). Trends in the South Pacific albacore longline and troll fisheries. SC20-SA-IP-07.

Teears, T., Hampton, J. et al. (2024). Stock assessment of South Pacific albacore. WCPFC-SC20-SA-WP-02.

Tables

Table 1. Outcomes under alternative future combined longline and troll fishery catch levels (scalars) applied within the WCPFC Convention Area only. Outcomes are in terms of median stock depletion level within the WCPFC-CA and depletion level relative to the adopted iTRP and that estimated over the period 2017-2019, longline vulnerable biomass relative to alternative historical periods, F/F_{MSY} (estimate available for across the South Pacific only) and risks relative to the LRP (WCPFC-CA specific) and F_{MSY} (South Pacific wide).

Catch scalar (cf 2020-2022 avg)	Approx catch (LL+TR, mt)		Depletion				Vulnerable biomass		F/F_{MSY}	
	WCPFC-CA	Remainder EPO	Long term avg $SB/SB_{F=0}$ (WCPFC-CA)	% 2017-2019 $SB_{F=0}$	Depletion relative to iTRP	Risk < LRP	$VB/VB_{2017-2019}$	VB/VB_{2013}	F/F_{MSY}	Risk $F>F_{MSY}$
0.875	53,100	22,500	0.56	1.07	1.11	3%	0.82	0.74	0.18	5%
0.935	56,750	22,500	0.53	1.01	1.05	5%	0.79	0.70	0.19	7%
1	60,700	22,500	0.50	0.96	1.00	8%	0.74	0.67	0.20	9%
1.180	71,300	22,500	0.46	0.88	0.92	16%	0.64	0.57	0.24	14%
1.250	75,900	22,500	0.42	0.80	0.84	19%	0.59	0.53	0.25	18%

Table 2. Outcomes under alternative future combined longline and troll fishery catch levels (scalars) applied across the South Pacific. Outcomes are in terms of median stock depletion level within the WCPFC-CA and depletion level relative to the adopted iTRP and that estimated over the period 2017-2019, longline vulnerable biomass relative to alternative historical periods, F/F_{MSY} (estimate available for across the South Pacific only) and risks relative to the LRP (WCPFC-CA specific) and F_{MSY} (South Pacific wide).

Catch scalar (cf 2020-2022 avg)	Approx catch (mt)		Depletion				Vulnerable biomass		F/F_{MSY}	
	WCPFC-CA	Remainder EPO	Long term avg $SB/SB_{F=0}$ (WCPFC-CA)	% 2017-2019 $SB_{F=0}$	Depletion relative to iTRP	Risk < LRP	$VB/VB_{2017-2019}$	VB/VB_{2013}	F/F_{MSY}	Risk $F>F_{MSY}$
0.880	53,400	19,800	0.56	1.07	1.11	3%	0.84	0.75	0.17	4%
0.940	57,050	21,150	0.53	1.01	1.05	5%	0.79	0.71	0.19	6%
1	60,700	22,500	0.50	0.96	1.00	8%	0.74	0.67	0.20	9%
1.100	66,800	24,750	0.46	0.88	0.92	13%	0.67	0.60	0.23	13%
1.180	71,600	26,550	0.42	0.80	0.84	17%	0.62	0.56	0.24	17%

Appendix 1. Preliminary catch weight-based projection results

Table 3. Outcomes under alternative future combined longline and troll fishery catch levels (scalars) applied in terms of catch weight within the WCPFC Convention Area only. Outcomes are in terms of median stock depletion level within the WCPFC-CA and depletion level relative to the adopted iTRP and that estimated over the period 2017-2019, longline vulnerable biomass relative to alternative historical periods, F/F_{MSY} (estimate available for across the South Pacific only) and risks relative to the LRP (WCPFC-CA specific) and F_{MSY} (South Pacific wide).

Catch scalar (cf 2020-2022 avg)	Approx catch (LL+TR, mt)		Depletion				Vulnerable biomass		F/F_{MSY}	
	WCPFC-CA	Remainder EPO	Long term avg $SB/SB_{F=0}$ (WCPFC-CA)	% 2017-2019 $SB_{F=0}$	Depletion relative to iTRP	Risk < LRP	$VB/VB_{2017-2019}$	VB/VB_{2013}	F/F_{MSY}	Risk $F>F_{MSY}$
0.85	51,600	22,500	0.56	1.07	1.11	6%	0.83	0.74	0.18	6%
0.925	56,150	22,500	0.53	1.01	1.05	10%	0.78	0.70	0.19	8%
1	60,700	22,500	0.50	0.96	1.00	14%	0.73	0.65	0.20	10%
1.075	65,250	22,500	0.46	0.88	0.92	20%	0.68	0.61	0.21	12%
1.15	69,800	22,500	0.42	0.80	0.84	26%	0.64	0.57	0.23	13%