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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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**WCPFC21-2024-29**

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## Executive Summary

WCPFC20 agreed an interim target reference point (iTRP) for South Pacific albacore but requested it be reviewed following the 2024 stock assessment. Adoption of the confirmed or amended iTRP was scheduled for WCPFC21 within a Conservation and Management Measure that specified a management procedure for South Pacific albacore tuna (WCPFC20 summary report, paragraph 241).

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

WCPFC20 tasked SPC-OFP to evaluate a range of alternative candidate South Pacific albacore target reference points (TRPs) between  $SB/SB_{F=0}$  0.42 and 0.56. To do this, long-term stochastic catch-based stock projections based on the 2024 assessment were conducted following the SC20 recommendation that both catch numbers and catch weight be used (catch in weight being more consistent with the MP evaluations and e.g. TAC management). Two scenarios were examined: i) only WCPFC-CA longline and troll fleet catch was scaled; ii) catch of WCPFC-CA and remainder of the EPO (EPO excluding the overlap area) longline and troll fleets were scaled equally. Baseline catch was the mean across 2020-2022. Noting EPO catch increases in recent years, baseline longline catch within the remainder of the EPO was set at 22,500 mt. Fifty projections were run from each of the 100 assessment models, and future catch levels (numbers of fish/weight of fish) adjusted so that the long-term median WCPFC-CA depletion achieved the specified alternative TRP levels.

Based upon the current results, WCPFC-CA longline and troll average catch levels over 2020-2022 combined with remaining EPO longline catches of approximately 22,500 mt will achieve the recalibrated iTRP on average in the long term. Under those conditions, there is an 8% or 14% risk of the stock falling below the limit reference point (LRP,  $0.2 SB_{F=0}$ ) under the current uncertainty framework when modelled assuming catch in numbers or catch in weight, respectively. Fishing mortality at the end of the projection period is on average below  $F_{MSY}$  in both cases. Long term average WCPFC-CA longline vulnerable biomass was similar for catch in number or weight, being 26-27% lower than across 2017-2019, and 33-35% lower than in 2013.

Under 'WCPFC-CA only' 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 13-15% to achieve  $0.56 SB_{F=0}$ . If a more depleted stock was considered acceptable, WCPFC-CA catches could be increased by up to 25% or 15% for catch in numbers or weight respectively to achieve the most depleted TRP level evaluated ( $0.42 SB_{F=0}$ ). For this scenario under the current consideration of uncertainty within the analysis, risk of falling below the LRP increased, and when considering catch in weight reached the 20% WCPFC LRP risk 'threshold' at a depletion of  $0.46 SB_{F=0}$ . Where catch management was South Pacific-wide, proportional reductions in catch to achieve less depleted stock levels are slightly less than the WCPFC-CA-specific equivalents. Where a more depleted stock level is acceptable, proportional catch increases across the South Pacific are lower than the WCPFC-CA-only equivalents.

SC20 requested additional scenarios for projections where catch in the remainder of the EPO (excluding the overlap area) was fixed at lower 2017-2019 levels, and catch management applied in the WCPFC-CA only. The results are presented in Appendix 3 of this paper. Assuming lower future catches for the remainder of the EPO region allows a greater catch within the WCPFC-CA while achieving the candidate depletion levels specified. For example, the WCPFC-CA could take 10% or 5% more catch (in numbers or weight, respectively) while achieving the current iTRP depletion level.

We highlight that the modelling herein assumes a constant catch is taken into the future. Unlike within the harvest strategy MSE modelling, if that catch implies stock abundance is reduced in the future, that same catch continues to be taken. The risk of falling below the LRP and reduction in vulnerable biomass levels presented within the tables will therefore be greater than those from the MSE

modelling, where active management is taking place to react to stock status. Results here should therefore be viewed considering the MSE results now available.

**SC20:**

- recognized that WCPFC20 adopted an interim TRP for South Pacific albacore, defined as 4% below the estimated average spawning potential depletion of the stock over the period 2017-2019 ( $0.96 \text{ SB}_{2017-2019} / \text{SB}_{F=0}$ ). SC20 recommended the Commission note that the biomass depletion associated with the adopted interim TRP has been re-estimated to be 50% according to the 2024 SPA stock assessment outcomes. This biomass depletion when the interim TRP was adopted by WCPFC20 was previously estimated at 47% based on the 2021 SPA stock assessment.
- recommended the SMD and the Commission consider results from the evaluation of a range of alternative candidate South Pacific albacore target reference points provided in SC20-MI-WP-03, in reviewing the interim TRP and other scenarios recommended by SC20. [Updated in this paper]
- recommended that both catch numbers and weight be used for projections, to inform the Commission discussion on reviewing the interim TRP for South Pacific albacore noting that projections conducted in terms of weight are more consistent with the MP evaluations and management through, for example, a TAC. SC20 further recommended that SPC present trends in vulnerable biomass among specific WCPFC-CA longline fleets, and for WCPFC-CA catch levels to also be related to 2017-2019 levels. [See Tables and Appendix 2]
- recommended including more scenarios for projections by fixing EPO catch at 2017-2019 levels and using multiple catch levels in the WCPFC-CA related to 2017-2019 levels. [See Appendix 3]

**SMD02:**

- reviewed a summary of the 2024 SP-ALB stock assessment before the SSP presented WCPFC-SMD02-2024-BP-01 and noted the recent high catches of South Pacific albacore in the Eastern Pacific Ocean. SMD02 generally supported maintaining the use of both weights and numbers in the South Pacific albacore catch-based projections.

**WCPFC21 is invited to:**

- consider the results presented here when adopting the confirmed or amended iTRP within a Conservation and Management Measure that specifies a management procedure for South Pacific albacore tuna.

## 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 ( $0.96 SB_{2017-2019}/SB_{F=0}$ ). 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  $SB/SB_{F=0}$  (WCPFC-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 SC20-agreed 2024 South Pacific albacore assessment model grid (Tears et al., 2024; [SC20-SA-WP-02](#)) to recalibrate the iTRP and evaluate the implications of alternative depletion values within the range specified by WCPFC20. The methods behind the analyses can be found in Appendix 1.

The analysis of alternative depletion values uses stock projections where a set future catch is identified that results in the stock reaching the specific depletion value on average in the long term. SC20 recommended that analyses define that future catch in the longline fishery in terms of numbers of fish, which has been the approach to performing projections for stocks with a longline catch component, and in terms of a catch weight, which is consistent with both the recent South Pacific albacore MP evaluations and management through, for example, a TAC<sup>2</sup>. Future troll catch is modelled in terms of weight throughout, given the information provided by that fishery.

## Results

### *Recalibration of the iTRP*

Using the results of the 2024 South Pacific albacore stock assessment 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*

Results of the evaluation of alternative TRP levels are presented in four groups to inform Commission discussion on reviewing the interim TRP for South Pacific albacore. In each group, the SC20 recommendation that longline catch in numbers or weight be used for separate sets of projections was followed.

The first group used the results to identify the level of longline and troll catch required to achieve the recalibrated iTRP ( $0.5 SB_{F=0}$ ), based upon the evaluation results (Table 1 to Table 4).

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<sup>2</sup> The assumption within these catch-based projections is that a specific catch will be taken, regardless of the state of the underlying population. If the population declines, a smaller catch weight will result when projecting the catch of a specified number of fish, since the average size of fish in a more depleted population is smaller. In the same scenario, when specifying a future catch weight, more smaller fish would need to be caught to achieve that set weight. In a declining stock, projections based upon constant catch weight will tend to lead to more pessimistic outcomes.

The second group scaled future catch levels relative to the 2020-2022 average levels within WCPFC-CA longline and troll fisheries only to achieve the range of alternative candidate stock depletions (Table 1 and Table 2). Catch of EPO fisheries was held constant at 2020-2022 average levels.

The third group applied proportional changes in future catch levels in longline and troll fisheries across the South Pacific to achieve the range of alternative candidate stock depletions (Table 3 and Table 4). This represented compatible management undertaken by WCPFC and IATTC.

The fourth group is where, as requested by SC20, catch within the remainder of the EPO was assumed to be at lower levels consistent with that seen on average across 2017-2019 (Table 6 and Table 7 in Appendix 3). Note that the reported average catch level in the remainder of the EPO over that period is slightly lower than noted in previous evaluations (approximately 13,500 mt rather than 15,600 mt) due to data updates (catch levels in the WCPFC-CA (including the overlap area) are now slightly higher over this period). This does not affect the results in terms of e.g. stock status or vulnerable biomass, given the basis of the modelling assumptions.

$F_{MSY}$ -related metrics are evaluated across the South Pacific as WCPFC-CA-specific values are not available for this parameter.

### Achieving the recalibrated iTRP

Using the 100 model runs adopted by 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 (bold rows in Table 1 to Table 4). Under those conditions, there is an 8% risk of the stock falling below the limit reference point when projecting using catch in numbers and a 14% risk when projecting using catch in weight, under the current uncertainty grid and incorporating the historical variability in recruitments. Fishing mortality on average is below  $F_{MSY}$ , with a 9% and 10% risk for catch in numbers and weight, respectively, that this level might be exceeded. Vulnerable biomass (a proxy for CPUE) available across the WCPFC-CA longline fishery is similar for catch in numbers and weight, 26-27% lower than that estimated across 2017-2019, and 33-35% lower than that in 2013.

### WCPFC-CA catch changes only, assume a constant catch in EPO

To achieve less depleted stock levels than the iTRP (while maintaining a constant catch in the EPO), reductions in WCPFC-CA longline and troll catches relative to 2020-2022 levels are required, by up to 13%-15% to achieve a depletion of 0.56  $SB_{F=0}$  (Table 1 and Table 2). Risk 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 around 18% and 26% respectively if a depletion of 0.56  $SB_{F=0}$  was achieved.

If a more depleted stock were considered appropriate, WCPFC-CA catches could be increased relative to the 2020-2022 baseline. For the two specific depletion levels evaluated, these increases were 18% and 25% respectively when considering catch in numbers (Table 1), and a lower increase of 8% and 15% respectively when considering catch in weight (Table 2). Risk of falling below the LRP increased with increased catches, and when modelling catch in weight hit the 20% WCPFC LRP risk 'threshold' at a depletion of 0.46  $SB_{F=0}$  under the current consideration of uncertainty within the analysis and constant catch assumption. The risk of exceeding  $F_{MSY}$  also increased. 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 (36% and 43% when considering catch in weight) if the stock were on average at 0.42  $SB_{F=0}$ .

## South Pacific-wide catch changes

Where equal proportional catch changes were made in the WCPFC-CA and remainder of the EPO, reductions in catch needed to achieve less depleted stock levels were slightly less than the WCPFC-CA only equivalents (Table 3 and Table 4). Where a more depleted stock level is acceptable, proportional catch increases across both the WCPFC-CA and remainder of the EPO are overall lower than the increase in catches within only the WCPFC-CA required to achieve the equivalent depletion. Outcomes in terms of LRP risk,  $F/F_{MSY}$  levels and WCPFC-CA longline vulnerable biomass are comparable but not identical as values are influenced by the relative catch levels of the different fisheries when changes are made within the WCPFC-CA only or in both regions of the South Pacific.

## Assumption of lower future catches in the remainder of the EPO

Assuming a fixed lower future catch within the remainder of the EPO allows a larger catch to be taken within the WCPFC-CA while achieving a specific stock depletion level (Appendix 3, Table 6 and Table 7). The degree of additional catch is dependent on whether catch is modelled in numbers or in weight, with the assumption of catch in weight implying smaller catch increases. For example, to achieve the iTRP of 50%  $SB_{F=0}$ , an additional 10% or 5% catch can be taken within the WCPFC-CA, assuming catch in numbers or weight, respectively. The level of additional potential WCPFC-CA catch in comparison to the runs assuming more recent 2020-2022 average levels in the remainder of the EPO does depend upon the level of stock depletion to be achieved.

## Discussion

The iTRP – as defined by WCPFC20 - has not been changed, but the resulting iTRP depletion value has been recalibrated based upon the 2024 stock assessment. This recalibration allows assessment outcomes to be considered relative to this iTRP level.

The recalibrated iTRP value was within the range of candidate depletions specified by WCPFC20 for evaluation and hence significant re-interpretation of those levels was not required. However, as noted by WCPFC20 it is preferable for candidate TRP levels to be defined in terms of a reference period.

Based upon the 2024 stock assessment, the depletion levels examined, including the iTRP, imply lower average vulnerable biomass levels (i.e. lower CPUE levels) relative to levels estimated for the 2017-2019 and 2013 periods. The calculation is averaged across fisheries - given differences in estimated selectivities between fleet groups, some fleets perform better than others within this calculation. Results for 'DWFN' and 'PICT' fleet groups in the WCPFC-CA are shown in Table 5 (Appendix 2). The decline in combined PICT fleet vulnerable biomass relative to the historical periods is slightly greater than that estimated for DWFN fleets as a more depleted South Pacific albacore stock level is reached.

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% and 9% of model runs failed when considering catch in numbers or weight, respectively). 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 would not have allowed these to be undertaken in the time available, if they had been requested.

The differences seen in results when using catch in weight or catch in numbers are driven by the assumption that a specific catch will be taken, regardless of the state of the underlying population. If the population declines, a smaller catch weight will result when projecting the catch of a specified number of fish, since the average size of fish in the more depleted population is smaller. In the same

scenario, when specifying a future catch weight, more smaller fish would need to be caught to achieve that weight. Smaller increases in catch weight are therefore needed to achieve more depleted levels, while risk levels relative to the LRP are higher when modelling catch in weight for all depletion levels examined.

We highlight that the modelling results presented here are based upon the assumption that a constant catch is taken into the future. Unlike within the harvest strategy MSE modelling where a management procedure is being applied, if the constant catch implies the stock abundance is reduced to undesirable levels in the future, that catch is not adjusted – the catch continues to be taken. The risk of falling below the LRP and decrease in vulnerable biomass levels presented within the tables will therefore be greater than within the results of the MSE modelling, where active management is taking place to react to stock declines. Results here should be viewed considering the MSE results now available.

### SC20 outcomes

- SC20 recognized that WCPFC20 adopted an interim TRP for South Pacific albacore, defined as 4% below the estimated average spawning potential depletion of the stock over the period 2017-2019 ( $0.96 SB_{2017-2019}/SB_{F=0}$ ). SC20 recommended the Commission note that the biomass depletion associated with the adopted interim TRP has been re-estimated to be 50% according to the 2024 SPA stock assessment outcomes. This biomass depletion when the interim TRP was adopted by WCPFC20 was previously estimated at 47% based on the 2021 SPA stock assessment.
- SC20 recommended the SMD and the Commission consider results from the evaluation of a range of alternative candidate South Pacific albacore target reference points provided in SC20-MI-WP-03, in reviewing the interim TRP and other scenarios recommended by SC20.
- SC20 recommended that both catch numbers and weight be used for projections, to inform the Commission discussion on reviewing the interim TRP for South Pacific albacore noting that projections conducted in terms of weight are more consistent with the MP evaluations and management through, for example, a TAC. SC20 further recommended that SPC present trends in vulnerable biomass among specific WCPFC-CA longline fleets, and for WCPFC-CA catch levels to also be related to 2017-2019 levels.
- SC20 recommended including more scenarios for projections by fixing EPO catch at 2017-2019 levels and using multiple catch levels in the WCPFC-CA related to 2017-2019 levels.

### SMD02 outcomes

- SMD02 reviewed a summary of the 2024 SP-ALB stock assessment before the SSP presented WCPFC-SMD02-2024-BP-01 and noted the recent high catches of South Pacific albacore in the Eastern Pacific Ocean. SMD02 generally supported maintaining the use of both weights and numbers in the South Pacific albacore catch-based projections.

### WCPFC21 is invited to:

- Consider the results presented here when adopting the confirmed or amended iTRP within a Conservation and Management Measure that specifies a management procedure for South Pacific albacore tuna.

### References

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 in terms of catch in numbers 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 scalars refer to WCPFC-CA levels.**

Catch scalar		Approx catch (LL+TR, mt)		Depletion				Vulnerable biomass		$F/F_{MSY}$	
(cf 2020-2022 avg)	(cf 2017-2019 avg)	WCPFC-CA	Remainder EPO	Long term avg SB/SB <sub>F=0</sub> (WCPFC-CA)	% 2017-2019 SB <sub>F=0</sub>	Depletion relative to iTRP	Risk < LRP	VB/VB <sub>2017-2019</sub>	VB/VB <sub>2013</sub>	$F/F_{MSY}$	Risk $F > F_{MSY}$
0.875	0.72	53,100	22,500	0.56	1.07	1.11	3%	0.82	0.74	0.18	5%
0.935	0.77	56,750	22,500	0.53	1.01	1.05	5%	0.79	0.70	0.19	7%
<b>1</b>	<b>0.83</b>	<b>60,700</b>	<b>22,500</b>	<b>0.50</b>	<b>0.96</b>	<b>1.00</b>	<b>8%</b>	<b>0.74</b>	<b>0.67</b>	<b>0.20</b>	<b>9%</b>
1.18	0.97	71,300	22,500	0.46	0.88	0.92	16%	0.64	0.57	0.24	14%
1.25	1.03	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 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 scalars refer to WCPFC-CA levels.**

Catch scalar		Approx catch (LL+TR, mt)		Depletion				Vulnerable biomass		$F/F_{MSY}$	
(cf 2020-2022 avg)	(cf 2017-2019 avg)	WCPFC-CA	Remainder EPO	Long term avg SB/SB <sub>F=0</sub> (WCPFC-CA)	% 2017-2019 SB <sub>F=0</sub>	Depletion relative to iTRP	Risk < LRP	VB/VB <sub>2017-2019</sub>	VB/VB <sub>2013</sub>	$F/F_{MSY}$	Risk $F > F_{MSY}$
0.85	0.70	51,600	22,500	0.56	1.07	1.11	6%	0.83	0.74	0.18	6%
0.925	0.76	56,150	22,500	0.53	1.01	1.05	10%	0.78	0.70	0.19	8%
<b>1</b>	<b>0.83</b>	<b>60,700</b>	<b>22,500</b>	<b>0.50</b>	<b>0.96</b>	<b>1.00</b>	<b>14%</b>	<b>0.73</b>	<b>0.65</b>	<b>0.20</b>	<b>10%</b>
1.075	0.89	65,250	22,500	0.46	0.88	0.92	20%	0.68	0.61	0.21	12%
1.15	0.95	69,800	22,500	0.42	0.80	0.84	26%	0.64	0.57	0.23	13%

**Table 3. Outcomes under alternative future combined longline and troll fishery catch levels (scalars) applied in terms of catch in numbers 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 scalars refer to WCPFC-CA levels.**

Catch scalar		Approx catch (LL+TR, mt)		Depletion				Vulnerable biomass		$F/F_{MSY}$	
(cf 2020-2022 avg)	(cf 2017-2019 avg)	WCPFC-CA	Remainder EPO	Long term avg SB/SB <sub>F=0</sub> (WCPFC-CA)	% 2017-2019 SB <sub>F=0</sub>	Depletion relative to iTRP	Risk < LRP	VB/VB <sub>2017-2019</sub>	VB/VB <sub>2013</sub>	$F/F_{MSY}$	Risk $F > F_{MSY}$
0.88	0.73	53,400	19,800	0.56	1.07	1.11	3%	0.84	0.75	0.17	4%
0.94	0.76	57,050	21,150	0.53	1.01	1.05	5%	0.79	0.71	0.19	6%
<b>1</b>	<b>0.83</b>	<b>60,700</b>	<b>22,500</b>	<b>0.50</b>	<b>0.96</b>	<b>1.00</b>	<b>8%</b>	<b>0.74</b>	<b>0.67</b>	<b>0.20</b>	<b>9%</b>
1.10	0.91	66,800	24,750	0.46	0.88	0.92	13%	0.67	0.60	0.23	13%
1.18	0.97	71,600	26,550	0.42	0.80	0.84	17%	0.62	0.56	0.24	17%

**Table 4. Outcomes under alternative future combined longline and troll fishery catch levels (scalars) applied in terms of catch weight 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 scalars refer to WCPFC-CA levels.**

Catch scalar		Approx catch (LL+TR, mt)		Depletion				Vulnerable biomass		$F/F_{MSY}$	
(cf 2020-2022 avg)	(cf 2017-2019 avg)	WCPFC-CA	Remainder EPO	Long term avg SB/SB <sub>F=0</sub> (WCPFC-CA)	% 2017-2019 SB <sub>F=0</sub>	Depletion relative to iTRP	Risk < LRP	VB/VB <sub>2017-2019</sub>	VB/VB <sub>2013</sub>	$F/F_{MSY}$	Risk $F > F_{MSY}$
0.88	0.73	53,400	19,800	0.56	1.07	1.11	6%	0.83	0.74	0.17	5%
0.94	0.78	57,050	21,150	0.53	1.01	1.05	10%	0.78	0.70	0.19	7%
<b>1</b>	<b>0.83</b>	<b>60,700</b>	<b>22,500</b>	<b>0.50</b>	<b>0.96</b>	<b>1.00</b>	<b>14%</b>	<b>0.73</b>	<b>0.65</b>	<b>0.20</b>	<b>10%</b>
1.06	0.88	64,350	23,850	0.46	0.88	0.92	20%	0.68	0.61	0.23	12%
1.12	0.92	68,000	25,200	0.42	0.80	0.84	25%	0.64	0.57	0.24	14%

## Appendix 1. Methods

Analyses were based upon the grid of 100 South Pacific albacore stock assessment models adopted by SC20 (SC20-SA-WP-02).

### *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 ( $0.96 SB_{2017-2019}/SB_{F=0}$ ). Using the approach defined in the footnote to paragraph 238 of the WCPFC20 summary report<sup>3</sup>, the depletion level consistent with the iTRP was calculated as:  $0.96 \times$  the median of [mean( $SB_{2017}/SB_{F=0,2007-2016}$ ,  $SB_{2018}/SB_{F=0,2008-2017}$ ,  $SB_{2019}/SB_{F=0,2009-2018}$ ) calculated within each model in the assessment grid].

### *Evaluation of implications of the iTRP and requested alternative TRP levels*

WCPFC20 requested an 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 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. Catch-based projections are in terms of weight for troll, and following the request of SC20, in both numbers of fish and weight of fish for longline fisheries.
- 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. Catch of WCPFC-CA longline and troll fleets within the assessment model were scaled. Catches in the remainder of the EPO (excluding overlap area) were held constant.
  - b. The catch of all WCPFC-CA and EPO longline and troll fleets within the assessment model were scaled equally.

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 approximate levels reported in 2021 and

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<sup>3</sup> "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 ( $SB_{F=0}$ ) shall be

- a.  $SB_{F=0, t_1-t_2}$  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.

2022. For the first scenario, where remainder of the EPO longline and troll fleet catches are unaffected by WCPFC-CA scalars, remainder of the EPO catches were maintained at this level. Under the second scenario, additional scalars are applied to this already adjusted future remainder of the EPO catch level. In a third scenario, as requested by SC20, catches in the remainder of the EPO were held constant at the lower levels seen on average over 2017-2019 (see Appendix 3).

- 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 5,000 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 remaining EPO portion of the South Pacific are assumed to remain at the set catch level.
- 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 ( $0.96 SB_{2017-2019}/SB_{F=0}$ ) 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 ( $VB_{2017-2019}$ )
  - b. their vulnerable biomass in 2013 ( $VB_{2013}$ ).
- iv. The median fishing mortality relative to  $F_{MSY}$  ( $F_{2058-2061}/F_{MSY}$ ), calculated for the stock across the South Pacific (WCPFC-CA specific calculations are not available).
- v. The risk of falling below the LRP ( $0.2 SB_{F=0}$ ), 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 relative to 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.

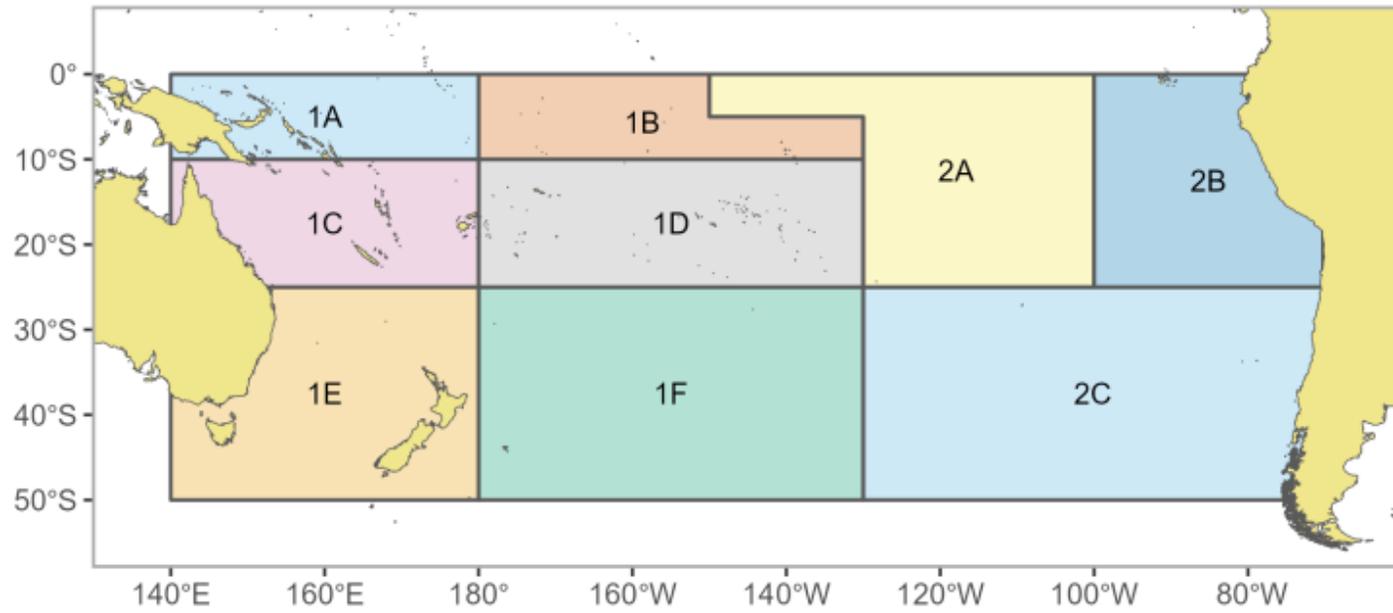
## Appendix 2. Summary of vulnerable biomass (CPUE) changes under different scenarios for ‘key’ longline fleets

Given the similarities in proportional vulnerable biomass changes between the different scenarios in Table 1 to Table 4, changes are presented here for one scenario (alternative future combined longline and troll fishery catch levels (scalars) applied in terms of catch weight within the WCPFC Convention Area only; see Table 2). Results are presented for two ‘key’ fleet groups within areas 1C and 1D of the stock assessment model (Figure 1): ‘DWFN’ (fleets 3 and 4 in the assessment model), and ‘PICT’ (fleet 6).

Given the one-region structure within the WCPFC-CA of the 2024 model, while some seasonal variability was seen due to the quarterly selectivity of specific fleets, patterns in average annual vulnerable biomass proved comparable across fleets. Impact on vulnerable biomass was generally greater for PICT fleets than DWFN fleets in that region and increased as the level of depletion increased (Table 5).

**Table 5. Average longline vulnerable biomass by fleet ‘group’ within the WCPFC-CA under each candidate TRP scenario relative to alternative historical periods, where alternative future combined longline and troll fishery catch levels (scalars) applied in terms of catch weight within the WCPFC Convention Area only.**

Long term avg SB/SB <sub>F=0</sub> (WCPFC-CA)	DWFN fleet		PICT fleet	
	VB/VB <sub>2017-2019</sub>	VB/VB <sub>2013</sub>	VB/VB <sub>2017-2019</sub>	VB/VB <sub>2013</sub>
0.56	0.83	0.75	0.82	0.74
0.53	0.77	0.71	0.75	0.68
0.50	0.72	0.66	0.68	0.62
0.46	0.67	0.61	0.61	0.56
0.42	0.62	0.57	0.56	0.50



**Figure 1. The geographical area boundaries of the nine fisheries areas used for the South Pacific-wide 2024 albacore assessment.**

Appendix 3. Outcomes of analyses where the remainder of the EPO catch is set to 2017-19 average levels

**Table 6. Outcomes under alternative future combined longline and troll fishery catch levels (scalars) applied within the WCPFC Convention Area only where the remainder of the EPO fisheries are maintained at 2017-19 levels and catch is in numbers of fish. 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 scalars refer to WCPFC-CA levels.**

Catch scalar		Approx catch (LL+TR, mt)		Depletion				Vulnerable biomass		$F/F_{MSY}$	
(cf 2020-2022 avg)	(cf 2017-2019 avg)	WCPFC-CA	Remainder EPO	Long term avg SB/SB <sub>F=0</sub> (WCPFC-CA)	% 2017-2019 SB <sub>F=0</sub>	Depletion relative to iTRP	Risk < LRP	VB/VB <sub>2017-2019</sub>	VB/VB <sub>2013</sub>	$F/F_{MSY}$	Risk $F > F_{MSY}$
0.95	0.78	57,700	13,500	0.56	1.07	1.11	4%	0.81	0.72	0.17	5%
1.025	0.85	62,200	13,500	0.53	1.01	1.05	6%	0.76	0.68	0.19	7%
<b>1.1</b>	<b>0.91</b>	<b>66,800</b>	<b>13,500</b>	<b>0.50</b>	<b>0.96</b>	<b>1.00</b>	<b>9%</b>	<b>0.71</b>	<b>0.64</b>	<b>0.21</b>	<b>9%</b>
1.2	0.99	72,850	13,500	0.46	0.88	0.92	13%	0.65	0.58	0.23	12%
1.32	1.09	80,100	13,500	0.42	0.80	0.84	19%	0.58	0.52	0.25	16%

**Table 7. Outcomes under alternative future combined longline and troll fishery catch levels (scalars) applied in terms of catch weight within the WCPFC Convention Area only where the remainder of the EPO fisheries are maintained at 2017-19 levels. 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 scalars refer to WCPFC-CA levels.**

Catch scalar		Approx catch (LL+TR, mt)		Depletion				Vulnerable biomass		$F/F_{MSY}$	
(cf 2020-2022 avg)	(cf 2017-2019 avg)	WCPFC-CA	Remainder EPO	Long term avg SB/SB <sub>F=0</sub> (WCPFC-CA)	% 2017-2019 SB <sub>F=0</sub>	Depletion relative to iTRP	Risk < LRP	VB/VB <sub>2017-2019</sub>	VB/VB <sub>2013</sub>	$F/F_{MSY}$	Risk $F > F_{MSY}$
0.925	0.76	56,150	13,500	0.56	1.07	1.11	7%	0.82	0.73	0.17	6%
0.99	0.82	60,100	13,500	0.53	1.01	1.05	10%	0.77	0.69	0.18	7%
<b>1.05</b>	<b>0.87</b>	<b>63,700</b>	<b>13,500</b>	<b>0.50</b>	<b>0.96</b>	<b>1.00</b>	<b>13%</b>	<b>0.73</b>	<b>0.65</b>	<b>0.18</b>	<b>9%</b>
1.125	0.93	68,300	13,500	0.46	0.88	0.92	19%	0.68	0.61	0.19	12%
1.2	0.99	72,850	13,500	0.42	0.80	0.84	25%	0.63	0.56	0.19	14%