COMMISSION
NINETEENTH REGULAR SESSION
Da Nang City, Vietnam
28 November to 3 December 2022

FURTHER ANALYSES TO INFORM DISCUSSIONS ON SOUTH PACIFIC ALBACORE OBJECTIVES AND THE TRP

WCPFC19-2022-15[1]
25 October 2022

SPC-OFP
Pacific Community (SPC), Noumea, New Caledonia

[1] Previously tabled as WCPFC-SC18-2022/MI-WP-04; WCPFC-SMD01-2022/IP-03

Abstract

SC17 agreed the 2021 stock assessment for South Pacific albacore and requested recalibration of the interim TRP for the WCPFC stock component and estimates of the constant catch levels that would achieve that TRP on average over the long-term. These analyses, as presented to WCPFC18 (see Appendix 1 of this paper), indicated that to achieve the objective of longline catch rates 8% higher than those in 2013, a greater catch reduction was required than previously estimated. At the Commission meeting, it was clear that those reductions were not acceptable for managers.

The South Pacific albacore Roadmap Chair requested further analyses to help inform discussion and clarify manager's objectives for the fishery. This paper presents stock and fishery outcomes of different potential future changes in longline and troll catches (WCPFC-CA or South Pacific-wide) to highlight trade-offs between objectives involved in alternative 'candidate TRP' levels.

If longline and troll fisheries catch is maintained at 2017-2019 average levels (~72,200 mt in the WCPFC Convention Area and 15,600 mt in the remaining EPO), longline vulnerable biomass - the catch rate proxy - will decline relative to all benchmarks examined here: the current management objective of 2013 vulnerable biomass levels + 8%, 2013 levels, and the 2017-2019 average level. Risk of falling below the LRP increased to 22%, and stock depletion would be around 43% of $SB_{F=0}$ in the WPCFC-CA.

To maintain or achieve future average increases in vulnerable biomass, catch reductions would be required. To achieve an increase relative to recent (2017-2019 average) vulnerable biomass levels, around a 10% reduction in longline and troll catches is needed relative to the 2017-2019 average catch within the WCPFC-CA (i.e., to ~65,000 mt, assuming EPO catches remained at 2017-2019 average levels). A smaller reduction would be required if it were taken across the South Pacific. Risk of breaching the LRP would be around 18%, while median stock depletion would be around 48% of $SB_{F=0}$.

To increase vulnerable biomass to levels consistent with that estimated in 2013, up to a 40% reduction in WCPFC-CA catch from 2017-2019 average levels would be required (i.e., to ~43,400 mt across longline and troll, if EPO catches remained at 2017-2019 average levels). If management measures were implemented across the South Pacific, this was closer to a 30% catch reduction (i.e. to ~50,600 mt within the WCPFC-CA). Risk of breaching the LRP was less than 10% and median stock depletion 63% of $SB_{F=0}$.

Increasing vulnerable biomass to levels consistent with the original management objective of 2013 levels + 8% involved a 50% reduction in WCPFC-CA catch from the 2017-2019 average (i.e., to ~36,100 mt) or a 44% reduction if across the South Pacific (i.e., to 40,500 mt; see Appendix 1). Risk of breaching the LRP was reduced to 2%, and median stock depletion would be around 68% of $SB_{F=0}$ in the WPCFC-CA.

In its discussions:

> 105. SC18 noted the implications of a potential [management procedure; MP] to be developed across the South Pacific, particularly with the areas outside of the WCPFC jurisdiction, and sought advice on how an MP that only applied to the WCPO could be developed. The Scientific Service Provider explained that this could be undertaken in a similar manner as done for skipjack tuna, where fishing in WCPO archipelagic waters is not controlled by the MP. The MP would be designed so it only applied to the WCPO, and not to the EPO.

106. Noting the request for additional catch scenarios to inform management options to clarify management objectives, several CCMs suggested a 10% and 20% reduction in catch from the 2017-2019 baseline for consideration.

107. SC18 recommended forwarding this updated working paper to WCPFC19 for its deliberations on alternative target reference points for South Pacific albacore tuna.

WCPFC19 is invited to:

- Consider acceptable objectives for the South Pacific albacore fishery that represent acceptable trade-offs in increased catch rates and corresponding reductions in catches;
- Consider additional performance indicators that may help clarify management objectives for the South Pacific albacore stock and fishery;
- Identify a tractable sub-set of additional scenarios to be evaluated, as required;
- Note the implications of management applied solely in the WCPFC-CA or across the South Pacific;
- Note the recommendation to explore implementing changes in the fishery through the application of a tested management procedure within the harvest strategy approach.

Introduction

Following agreement of the 2021 stock assessment for South Pacific albacore at SC17, that meeting requested the interim TRP for the WCPFC stock component be recalibrated for review by the Commission, in accordance with the process agreed at WCPFC15 (WCPFC15 Summary Report, para 207) and that the work also estimate the constant catch levels that would achieve that TRP on average over the long-term. The results of this analysis were presented to WCPFC18 (see Appendix 1). The new assessment indicated that to achieve the objective of longline catch rates 8% higher than those in 2013 (using longline vulnerable biomass as a proxy for catch rates), a greater reduction in catch was required than previously estimated. At the Commission meeting, it was clear that those fishery reductions were not acceptable to managers, and that achieving the specified change in CPUE is an important – but not the only – objective for managers. Ultimately the Commission 'noted the advice of the SC17 related to a recalibration of the interim TRP for the SP albacore'.

As part of the South Pacific albacore Roadmap process, the Roadmap Chair requested further analyses be undertaken to help inform discussions on the South Pacific albacore objectives. This paper presents the outcomes for the stock and fishery of different potential future reductions in WCPO longline and troll catches to highlight the trade-offs between fishery objectives. These represent specified fixed reductions in future total catches (WCPFC-CA or South Pacific-wide) rather than identifying conditions to achieve specific stock depletion levels (i.e. TRPs).

Methods

Analyses were run from the agreed 2021 South Pacific albacore stock assessment grid (Castillo-Jordan et al., 2021). The general steps taken in this analysis were to:

i. Stochastically project the South Pacific albacore stock forward for 30 years under alternative levels ('scalars') of fixed future longline and troll catch. Projections therefore ran from 2020 through to 2049. By 2049, stock conditions had, on average, reached 'equilibrium' with the defined level of longline and troll catch.

ii. Catchability of each fishery was assumed to remain constant in the projection period at the level estimated in the last year of the assessment model (2019).

iii. Project the stock forward under six alternative scenarios for future longline and troll catch, ranging from 'status quo' (scalar of 1) to a reduction by 50% (scalar of 0.5). That future catch 'scalar' was applied relative to 2017-2019 average catch levels, and applied equally to longline and troll fleets, as defined by 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 equally for the second scenario, while longline and troll fleet catches in the remainder of the EPO were maintained constant at 2017-2019 average levels into the future.

iv. For a given catch scalar, 100 stochastic projections were performed from each of the 72 assessment models used by SC17 for management advice. 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 1960 to 2018.

v. For a given catch scalar, results in the year 2049 were averaged across the 72 assessment models, incorporating the model weighting criteria specified by SC17[2].

The following results were calculated for each scenario:

i. The constant catch levels in the WCPFC-CA and remaining EPO region assumed in each projection. These use the catch scalars for longline and troll fisheries under the different scenarios (South Pacific-wide changes, and changes in the WCPFC-CA only) relative to the actual average catch levels (mt) in the fishery components over the baseline period of 2017-2019, using Annual Catch Estimates for the different ocean regions. In the 'WCPFC-CA only' scenario, catch levels in the EPO portion of the South Pacific are assumed to remain at 2017-2019 average levels.

ii. The median weighted vulnerable biomass for longline fisheries within the WCPFC Convention Area in 2049 (VB_{2049}; vulnerable biomass being a proxy for catch rates), and longline fleets within two key areas of the WCPFC-CA, relative to alternative 'baseline' levels:
   a. their median weighted vulnerable biomass in 2013 plus 8% (VB_{2013}+8%);
   b. their median weighted vulnerable biomass in 2013 (VB_{2013});
   c. their median weighted vulnerable biomass in 2017-2019 ($VB_{2017\text{-}2019}$).

iii. The median fishing mortality relative to F_{MSY} (F/F_{MSY}), calculated for the stock across the South Pacific Ocean (WCPFC-CA specific calculations are not available).

iv. The risk of fishing mortality increasing above F_{MSY} under that fishing level, calculated as the percentage of the 7,200 runs where $F > F_{MSY}$ in 2049.

v. The risk of falling below the LRP ($20\%SB_{F=0}$), calculated as the proportion of runs (7,200 in total) for which $SB_{2049}/SB_{F=0}$ was below the LRP, for the stock component in the WCPFC-CA.

vi. The 'equilibrium' median adult biomass depletion in 2049 relative to unfished levels ($SB/SB_{F=0}$; the calculation being consistent with the approach used for LRP), for the stock in the WCPFC-CA. That value represents the average depletion level for South Pacific albacore in the WCPFC-CA that would achieve the objectives (i.e. the candidate TRP).

Given the 30-year projection period, the results in 2049 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.

Results

Table 1 presents the outcomes of changes in future catch levels relative to the 2017-2019 average baseline levels within the WCPFC-CA longline and troll fisheries only (catch of EPO fisheries maintained constant). Table 2 presents the outcomes where those changes in future catch levels are applied across the South Pacific, e.g. where compatible management is undertaken by WCPFC and IATTC.

Under baseline conditions (longline and troll fisheries catch is maintained at 2017-2019 average levels, approximately 72,200 mt in the WCPFC Convention Area, 15,600 mt in the remaining EPO; Figure 1), longline vulnerable biomass (the catch rate proxy) will decline relative to all benchmarks examined here:

[2] The SC down-weighted the SEAPODYM (M2) movement hypothesis for provision of management advice, giving it half the weight of the alternative movement hypothesis (M1, model internally estimated, age-dependent).

the current management objective of 2013 levels + 8%, 2013 levels, and the level seen on average over the period 2017-2019. Risk of falling below the LRP increased to 22%, based on the current uncertainty framework. To achieve increases in vulnerable biomass in the future, catch reductions would be required.

To achieve an average increase in longline vulnerable biomass relative to recent (2017-2019 average) levels, around a 10% reduction in catches is required relative to the average over 2017-2019 within the WCPFC-CA (e.g., to approximately 65,000 mt across longline and troll, assuming EPO catches remained at 2017-2019 average levels), with a smaller reduction required if it were across the South Pacific (i.e. EPO catches also reduced). However, the risk of falling below the LRP would still be around 18%, while the median stock depletion would be around 48% of $SB_{F=0}$.

To achieve an increase in longline vulnerable biomass to levels consistent with that seen in 2013, up to a 40% reduction in WCPFC-CA catch from the average over 2017-2019 would be required (e.g., to approximately 43,400 mt across longline and troll, assuming EPO catches remained at 2017-2019 average levels). This was closer to a 30% reduction if it occurred across the South Pacific (e.g. to 50,600 mt across longline and troll within the WCPFC Convention Area). At this level, risk of falling below the LRP was less than 10%, the median stock depletion being around 63% of $SB_{F=0}$.

As noted in the original work, achieving an increase in longline vulnerable biomass to levels consistent with the original management objective of 2013 levels + 8%, reductions in WCPFC-CA catch by 50% from the average over 2017-2019 would be required (e.g., to approximately 36,100 mt across longline and troll, assuming EPO catches remained at 2017-2019 average levels) or a 44% reduction if across the South Pacific (i.e., to 40,500 mt in the WCPFC-CA. See Appendix 1). Risk of falling below the LRP was reduced to 2%. That the risk is not zero, even when the stock is at this level on average, reflects the notable uncertainty within the South Pacific albacore assessment.

To achieve the iTRP currently in place (56% of $SB_{F=0}$), a reduction in catch of between 20% and 30% in the WCPFC-CA would be required (a reduction of slightly more than 20% if that were achieved across the South Pacific). At this level, vulnerable biomass would still decline relative to 2013 levels.

Average changes in vulnerable biomass of longline fleets within Regions of the WCPFC-CA, specifically Region 1 (equator to 10°S) and Region 2 (10°S to 25°S; see Figure 2) are presented in Table 3 and Table 4. Generally, the impact of fishing in Region 1 relative to vulnerable biomass benchmarks is lower than that seen in Region 2, and Region 1 vulnerable biomass responds more 'positively' to reductions in WCPFC-CA catch than that in Region 2.

Discussion

Following discussions at WCPFC18, there is a need to clarify the relative objectives managers have for the South Pacific albacore fishery and stock. This paper uses the latest stock assessment to provide additional information to managers to allow them to consider the trade offs involved in the desire to increase albacore catch rates within the WCPFC-CA longline fishery in terms of the reductions in catch needed to achieve them. Clearly other objectives are also important when considering TRPs, but the two 'indicators' considered here (catch versus catch rates) present a recurring trade off managers must consider within both this fishery, and the harvest strategy process for WCPFC stocks as a whole.

While indicative catch levels for the WCPFC Convention Area (total longline and troll) have been provided here, the actual level that would achieve outcomes will be dependent upon the level of catch that occurs

in the remainder of the EPO. The results suggest that there are notable benefits in securing compatible management in the EPO region, particularly where greater increases in WCPFC-CA southern longline vulnerable biomass are desired by managers. Consideration is therefore needed by managers on how management of South Pacific albacore should be implemented.

If managers can identify the levels of catch reduction that they are comfortable in taking to achieve acceptable increases in catch rates, this can inform the harvest strategy process in developing management procedures that recover the stock to that desired state. This approach is a step beyond the 'stock trajectory' work previously undertaken (see for example Pilling et al., 2016) in that it better takes into account uncertainties in our knowledge of the stock and fishery. As a result, the approach is more robust, should better adjust to the natural fluctuations in stock size that occur along that recovery path, and is less impacted by changes in stock assessments given the use of a fixed 'estimation model' within the management procedure. In turn, the harvest strategy approach, through the process of Management Strategy Evaluation, provides a better representation of catch variability and the average time frames to achieve target stock levels, and allows a broader variety of alternative management procedures that achieve objectives to be considered.

In its discussions:

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WCPFC19 is invited to:

- Consider acceptable objectives for the South Pacific albacore fishery that represent acceptable trade-offs in increased catch rates and corresponding reductions in catches;
- Consider additional performance indicators that may help clarify management objectives for the South Pacific albacore stock and fishery;
- Identify a tractable sub-set of additional scenarios to be evaluated, as required;
- Note the implications of management applied solely in the WCPFC-CA or across the South Pacific;
- Note the recommendation to explore implementing changes in the fishery through the application of a tested management procedure within the harvest strategy approach.

References

Castillo-Jordan, C., Hampton, J., Ducharme-Barth, N., Xu, H., Vidal, T., Williams, P., Scott, F., Pilling, G. and Hamer, P. (2021). Stock assessment of South Pacific albacore tuna. WCPFC-SC17-2021/SA-WP-02 Rev2.

Pilling, G., Skirtun, M., Reid, C. and Hampton, J. (2016). Biological and economic consequences of alternative trajectories to achieve a candidate south pacific albacore target reference point. WCPFC13-2016-13.

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 longline vulnerable biomass relative to alternative historical periods, F/F_{MSY} (estimate available for across the South Pacific only), median (weighted) stock depletion level within the WCPFC-CA, and risks relative to the LRP (WCPFC-CA specific) and F_{MSY} (South Pacific wide).

Catch scalar (cf 2017-2019 avg)	Approx catch (mt)		Vulnerable Biomass			F/F_{MSY}		Depletion	
	WCPFC_CA	Remainder EPO	VB/VB_{2013}+8%	VB/VB_{2013}	$VB/VB_{2017-2019}$	F/F_{MSY}	Risk $F > F_{MSY}$	Risk < LRP	Long-term avg $SB/SB_{F=0}$ (WCPFC-CA)
1	72,200	15,600	-38%	-33%	-12%	0.27	11%	22%	0.43
0.9	65,000	15,600	-27%	-22%	+3%	0.23	10%	18%	0.48
0.8	57,800	15,600	-20%	-14%	+13%	0.21	9%	15%	0.53
0.7	50,600	15,600	-13%	-6%	+23%	0.17	6%	11%	0.58
0.6	43,400	15,600	-6%	+2%	+34%	0.14	3%	6%	0.63
0.5	36,100	15,600	0%	+8%	+43%	0.12	1%	2%	0.68

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

Catch scalar (cf 2017-2019 avg)	Approx catch (mt)		Vulnerable Biomass			F/F_{MSY}		Depletion	
	WCPFC_CA	Remainder EPO	VB/VB_{2013}+8%	VB/VB_{2013}	$VB/VB_{2017-2019}$	F/F_{MSY}	Risk $F > F_{MSY}$	Risk < LRP	Long-term avg $SB/SB_{F=0}$ (WCPFC-CA)
1	72,200	15,600	-38%	-33%	-12%	0.27	11%	22%	0.43
0.9	65,000	14,100	-26%	-20%	+5%	0.22	9%	14%	0.49
0.8	57,800	12,500	-18%	-11%	+16%	0.19	8%	9%	0.55
0.7	50,600	11,000	-10%	-2%	+28%	0.15	3%	5%	0.61
0.6	43,400	9,400	-2%	+6%	+39%	0.12	1%	1%	0.67
0.5	36,100	7,800	+6%	+15%	+50%	0.10	0%	0%	0.72

Table 3. Vulnerable biomass of WCPFC-CA longline fisheries in Regions 1 and 2 of the WCPFC-CA relative to alternative historical periods, where catch adjustments are applied in the WCPFC Convention Area only.

Catch scalar (cf 2017-2019 avg)	Region 1			Region 2		
	$VB/VB_{2013}+8\%$	VB/VB_{2013}	$VB/VB_{2017\text{-}2019}$	$VB/VB_{2013}+8\%$	VB/VB_{2013}	$VB/VB_{2017\text{-}2019}$
1	-36%	-28%	-10%	-39%	-34%	-14%
0.9	-22%	-20%	+5%	-28%	-23%	-1%
0.8	-14%	-9%	+16%	-21%	-16%	+11%
0.7	-9%	+1%	+25%	-15%	-8%	+22%
0.6	-2%	+6%	+35%	-8%	-1%	+32%
0.5	+4%	+12%	+45%	-1%	+7%	+42%

Table 4. Vulnerable biomass of WCPFC-CA longline fisheries in Regions 1 and 2 of the WCPFC-CA relative to alternative historical periods, where catch adjustments are applied across the South Pacific (WCPFC-CA and EPO).

Catch scalar (cf 2017-2019 avg)	Region 1			Region 2		
	$VB/VB_{2013}+8\%$	VB/VB_{2013}	$VB/VB_{2017\text{-}2019}$	$VB/VB_{2013}+8\%$	VB/VB_{2013}	$VB/VB_{2017\text{-}2019}$
1	-36%	-28%	-10%	-39%	-34%	-14%
0.9	-21%	-16%	+7%	-27%	-22%	+2%
0.8	-12%	-6%	+18%	-20%	-13%	+13%
0.7	-5%	+3%	+30%	-12%	-6%	+26%
0.6	0%	+9%	+41%	-4%	+4%	+36%
0.5	+7%	+19%	+53%	+2%	+11%	+48%

Figures

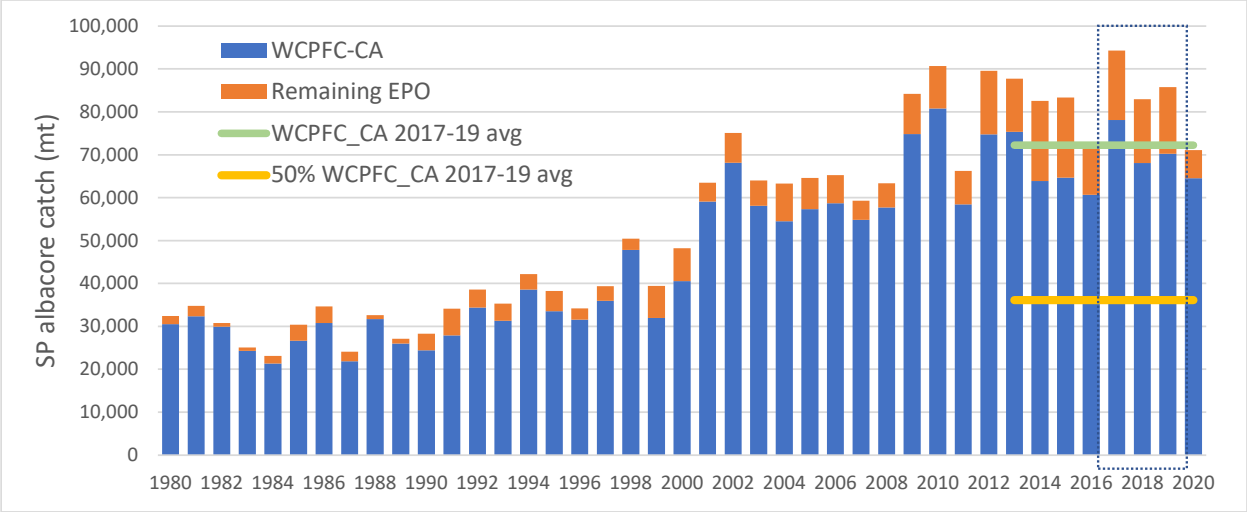

Figure 1. Pattern of WCPFC-CA and remaining EPO catches from 1980 to 2021, indicating the 2017-2019 average WCPFC-CA catch level and 50% of that level.

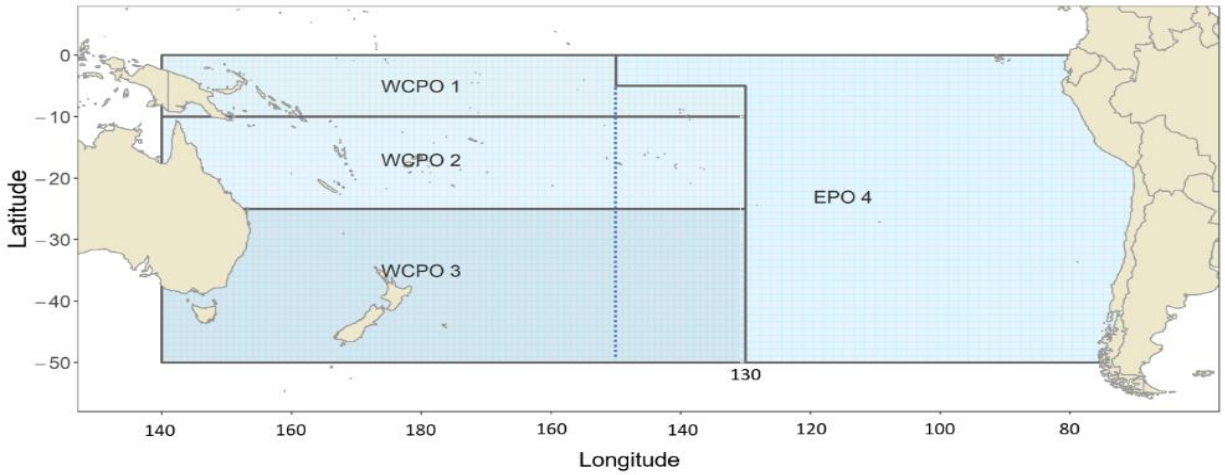

Figure 2. Regional structure within the 2021 South Pacific albacore stock assessment.

Appendix A. WCPFC18-2021-17. Recalibration of the target reference point for South Pacific albacore

COMMISSION
EIGHTEENTH REGULAR SESSION
Electronic Meeting
1-7 December 2021

RECALIBRATION OF THE TARGET REFERENCE POINT FOR SOUTH PACIFIC ALBACORE

WCPFC18-2021-17
1st November 2021

SPC-OFP
Pacific Community (SPC), Noumea, New Caledonia

Summary

At the 17th Scientific Committee (SC17), a new stock assessment for South Pacific albacore was agreed. This assessment encompassed the stock across the South Pacific Ocean (south of the equator), spanning the Convention areas of the WCPFC and IATTC. SC17 requested the SSP to:

a) recalibrate the WCPFC TRP that would on average achieve the agreed goal of an 8% increase in vulnerable biomass (CPUE proxy) for the southern longline fishery as compared to 2013 levels;
b) undertake projections to estimate the constant catch levels that would achieve that recalibrated TRP, on average, over the long-term.

The general approach used was comparable to that used to recalibrate the skipjack iTRP. Here, longline and troll fisheries were projected with their future catch level adjusted to achieve long-term WCPFC-CA longline vulnerable biomass levels specified under the TRP. SC17 requested two catch scenarios, where:

I. fishing levels within both the southern WCPFC-CA and the remainder of the eastern Pacific Ocean (EPO) were adjusted proportionally; and
II. only fishing levels within the southern WCPFC-CA were adjusted, and those in the remainder of the EPO fixed at recent catch levels.

To achieve the WCPFC-CA longline vulnerable biomass goal, the recalibrated southern WCPFC-CA albacore TRP depletion level is **68% $SB_{F=0}$**. At that average depletion level, there is a 1-2% risk of falling below the LRP. This reflects the notable uncertainty within the South Pacific albacore assessment. The recalibrated TRP implies a less depleted stock; the 2021 assessment indicates less depleted recent historical levels, influenced by the SC17 model grid weighting.

Approximate catch levels in longline and troll fisheries across the South Pacific, and within the WCPFC-CA specifically, that achieved the TRP varied according to the catch scenario:

- Under South Pacific-wide management, total (longline + troll) catch levels equated to 49,200 mt. WCPFC-CA catch was **40,500 mt**, with 8,700 mt in the remaining EPO assuming relative regional catch levels between regions remained at 2017-2019 levels.
- With management in the WCPFC-CA only (EPO catch remaining at 2017-2019 average levels), total (longline + troll) catch levels were just over 51,700 mt. **36,200 mt** of this was in the WCPFC-CA and 15,500 mt in the remaining EPO. The lower WCPFC-CA catch level reflects additional management action required to achieve the TRP if cross-Pacific management is not feasible.

Actual total and WCPFC-CA catch levels would depend upon those that occur in the EPO. The recalibrated TRP implied lower catch levels within the southern WCPFC-CA than under the 2018 assessment (which were approx. 46,700 mt in the southern WCPFC-CA). This is influenced by:

- The Pacific-wide nature of the 2021 stock assessment and the implications of fishing in the EPO component that was not previously considered;
- The different responsiveness of the 2021 assessment grid to changes in future catch.

What is consistent between 2021 and 2018 assessments is the interim TRP will not be achieved under recent catch levels in the southern WCPFC-CA. It is expected that future TRP-related catch levels will need to be adjusted in the face of increased knowledge of the South Pacific albacore stock. This will be supported through the adoption of a harvest strategy that can adapt dynamically to, for example, good or poor recruitment events, and be robust to the uncertainties inherent in the stock assessments.

Introduction

At the 17th Scientific Committee (SC17), a new stock assessment for South Pacific albacore was agreed. Unlike the 2018 assessment, which covered the WCPFC Convention Area only, the 2021 assessment encompassed the stock in the whole of the South Pacific Ocean (south of the equator), spanning the Convention areas of the Western and Central Pacific Fisheries Commission (WCPFC) and the Inter American Tropical Tuna Commission (IATTC). The SC17 noted that while the agreed assessment indicated that the stock was not overfished, nor subject to overfishing, "the spawning stock biomass has become more depleted across the model period (1960-2019), with a notable increase in depletion in the most recent years", while "the median `latest' (2019) and `recent' (2016-2019) longline vulnerable biomass for the WCPFC-CA are 56% and 76% of the 2013+8% target level that defined the interim TRP" (SC17 outcomes document paras 21 and 22).

The WCPFC indicative work plan for the adoption of harvest strategies under CMM 2014-06 (WCPFC16 report, Attachment H) called for a 'Potential update of [the South Pacific albacore] TRP following the 2021 assessment and in accordance with WCPFC15 adopted approach'. This was reflected in the tasking of the SSP by SC17 (SC17 outcomes document para 31):

SC17 noted the need to both recalibrate the TRP according to the procedure agreed at WCPFC15 (WCPFC15 Summary Report, para 207) and estimate the constant catch levels that would achieve that TRP on average over the long-term. Specifically, based upon the SC-agreed 2021 South Pacific albacore stock assessment:

a) recalibrate the WCPFC TRP (the median depletion in the WCPFC-CA, $SB/SB_{F=0}$) that would on average achieve the agreed objective of an 8% increase in vulnerable biomass (CPUE proxy) for the southern longline fishery as compared to 2013 levels.
b) undertake projections to estimate the constant catch levels that would achieve that recalibrated TRP, on average, over the long-term.
c) within that projection-based analysis, WCPFC-CA longline and troll fisheries, which includes those in the overlap area, should be modelled based upon catch, and fishing levels within the remainder of the eastern Pacific Ocean (EPO) should be adjusted in the same way as the WCPO for one scenario, and fixed in the EPO at recent catch levels for another scenario. Future recruitment should be sampled from the long-term recruitment pattern.

This paper presents the approach to deliver this analysis, and the results.

Methods

Analyses were run from the agreed 2021 South Pacific albacore stock assessment (Castillo-Jordan et al., 2021). The general steps taken in this analysis were to:

vi. Stochastically project the South Pacific albacore stock forward for 30 years under alternative levels ('scalars') of future longline and troll catch. Projections therefore ran from 2020 to 2049. By 2049, stock conditions had, on average, reached 'equilibrium' with the defined level of longline and troll catch.
vii. Catchability of each fishery was assumed to remain constant in the projection period at the level estimated in the last year of the assessment model (2019).

viii. The future catch 'scalar' was applied relative to 2017-2019 average catch levels[3], and applied equally to longline and troll fleets, as defined by the two requested scenarios:
   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 equally for the second scenario, while longline and troll fleet catches in the remainder of the EPO were maintained constant at 2017-2019 levels into the future.

ix. For a given catch scalar, 100 stochastic projections were performed from each of the 72 assessment models used by SC17 for management advice. Future recruitment was defined by the estimated stock recruitment relationship, with variability around it defined by recruitment estimates from the stock assessment over the period 1960 to 2018.

x. For a given catch scalar, results in the year 2049 were averaged across the 72 assessment models, incorporating the model weighting criteria specified by SC17[4].

xi. Outcomes in terms of the median weighted vulnerable biomass for longline fisheries within the WCPFC Convention Area in 2049 (VB_{2049}) were compared to their median weighted vulnerable biomass in 2013 plus 8% (VB_{2013}+8%). The catch scalar was then iteratively adjusted so that the WCPFC-CA longline median VB_{2049} = (VB_{2013}+8%) for each of the two catch scenarios.

Once the catch scalars that achieved a median weighted WCPFC-CA longline vulnerable biomass in 2049 equal to that in 2013 plus 8% was found, the following results were calculated for each catch scenario:

vii. The 'equilibrium' median adult biomass in 2049 relative to unfished levels ($SB/SB_{F=0}$; the calculation being consistent with the approach used for LRP), for the stock across the South Pacific Ocean, and for the WCPFC-CA specifically. That value for the WCPFC-CA represented the recalibrated TRP for South Pacific albacore.

viii. The risk of falling below the LRP ($20\%SB_{F=0}$), calculated as the proportion of runs (7,200 in total) for which $SB_{2049}/SB_{F=0}$ was below the LRP, for both the South Pacific Ocean stock and the component in the WCPFC-CA.

ix. The median fishing mortality relative to F_{MSY} (F/F_{MSY}), calculated for the stock across the South Pacific Ocean (WCPFC-CA specific calculations are not available).

x. The risk of fishing mortality increasing above F_{MSY} under that fishing level, calculated as the percentage of the 7,200 runs where $F > F_{MSY}$ in 2049.

As requested by SC17, the constant catch levels that would achieve the recalibrated TRP, on average, over the long-term are also calculated. These use the catch scalars for longline and troll fisheries under the different scenarios (South Pacific-wide changes, and changes in the WCPFC-CA only) relative to the actual average catch levels (mt) in the fishery components over the baseline period of 2017-2019, using Annual

[3] Note the different catch reference period when compared to previous South Pacific albacore TRP analyses. The impacts of this are translated into actual catch levels needed to achieve the TRP within the results.

[4] The SC down-weighted the SEAPODYM (M2) movement hypothesis for provision of management advice, giving it half the weight of the alternative movement hypothesis (M1, estimated, age-dependent).

Catch Estimates for the different ocean regions[5]. In the 'WCPFC-CA only' scenario, catch levels in the EPO portion of the South Pacific are assumed to remain at 2017-2019 average levels.

Given the 30-year projection period, the results in 2049 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, not the transition in stock and fishery to reach those conditions. That transition would be defined by the management actions taken to achieve the selected TRP (see for example Pilling et al., 2016), and as shown in that paper managers can decide to phase-in the indicated change in catch over several years.

Results

The estimated southern WCPFC-CA region stock depletion and southern WCPFC-CA longline vulnerable biomass estimates from the 2021 South Pacific-wide albacore stock assessment grid and 2018 WCPFC-CA region assessment grid are presented in Figure 3. Over the comparable time periods, there is considerable overlap in both depletion and vulnerable biomass estimate ranges from the two assessments - noting the decline in stock status in the final years of the 2021 assessment. However, the 2021 assessment grid does contain models that imply a less depleted stock and larger vulnerable biomass levels within the southern WCPFC-CA region when compared to the 2018 assessment. The decision by SC17 to down-weight particular models in the 2021 grid when providing management advice means that the median values from that assessment are generally greater than those of the 2018 assessment. This has implications when calculating the TRP value.

Table 5 presents the change in longline and troll fisheries relative to the 2017-2019 average baseline levels required to achieve the TRP conditions for South Pacific albacore, where that change is applied across the South Pacific, or within the WCPFC-CA alone. The resulting stock depletion levels in both regions – that in the WCPFC-CA representing the new TRP value – the risk of falling below the LRP, and fishing mortality relative to F_{MSY} and associated risk are also presented.

Based upon the 2021 stock assessment, to achieve the conditions defined by the interim TRP (an average vulnerable biomass level in the WCPFC-CA longline fleet that is 8% greater than that seen in 2013; Figure 3) a greater albacore stock size is required (i.e. a less depleted stock):

- The recalibrated South Pacific albacore TRP depletion level for the WCPFC-CA is 68% $SB_{F=0}$.

When the stock is at that depletion level on average, there is a low risk of falling below the depletion LRP (risk is 1-2%). That the risk is not zero, even when the stock is at the TRP on average, reflects the notable uncertainty within the South Pacific albacore assessment (Figure 4).

The recalibrated TRP value that achieves the management aim of WCPFC-CA longline vulnerable biomass 8% greater than that in 2013 therefore implies a less depleted stock than that estimated from the 2018 assessment (which was 56% $SB_{F=0}$). This is consistent with the 2021 assessment indicating a less depleted stock historically in comparison to that from the 2018 assessment. As noted, this is influenced by the SC17 weighting placed on the 2021 model grid.

[5] Note these catch values will be slightly different from those summarised in e.g. Trends in the South Pacific albacore longline and troll fisheries; SC17-SA-IP-04, but are the most accurate for the current purpose.

The approximate catch levels in longline and troll fisheries across the South Pacific, and within the WCPFC-CA specifically, are presented in Table 6.

- Where management to achieve the TRP is South Pacific-wide, total (longline + troll) catch levels across the South Pacific equate to just over 49,000 mt. Assuming relative regional catch levels are equivalent to those seen across 2017-2019, this would be 40,500 mt in the WCPFC-CA and 8,700 mt in the remainder of the EPO.

- Where management to achieve the TRP is undertaken in the WCPFC-CA only (catch in the remainder of the EPO remaining at 2017-2019 average levels), total (longline + troll) catch levels across this region equate to just over 51,700 mt. 36,200 mt of this is in the WCPFC-CA and 15,500 mt in the remainder of the EPO. The reduced catch level within the WCPFC-CA reflects the additional management action required within this region to achieve the TRP if cross-Pacific management is not feasible for the stock.

In both cases, the WCPFC-CA catch level would vary dependent upon the level of catch that occurs in the remainder of the EPO.

Catch levels within the WCPFC-CA required to achieve the new TRP level are lower than those for this region calculated under the 2018 assessment (which were approx. 46,700 mt in the southern WCPFC-CA). This is influenced by the new components of the 2021 stock assessment:

- The Pacific-wide nature of the assessment and the implications of fishing in the EPO component that was not previously considered;
- The different responsiveness of the 2021 grid to changes in future catch, influenced by biological uncertainties within the assessment. In particular, although down-weighted, the alternative 'SEAPODYM' movement model runs require greater reductions in catch to 'recover' toward larger stock sizes, and some models do not recover despite catch reductions; Figure 4.

What is consistent between 2021 and 2018 assessments is that the interim TRP will not be achieved under recent catch levels in the southern WCPFC-CA. It is expected that future TRP-related catch levels will need to be adjusted in the face of increased knowledge of the South Pacific albacore stock. This will be supported through the adoption of a harvest strategy that can adapt dynamically to, for example, good or poor recruitment events, and be robust to the uncertainties inherent in the stock assessments.

References

Castillo-Jordan, C., Hampton, J., Ducharme-Barth, N., Xu, H., Vidal, T., Williams, P., Scott, F., Pilling, G. and Hamer, P. (2021). Stock assessment of South Pacific albacore tuna. WCPFC-SC17-2021/SA-WP-02 Rev2.

Pilling, G., Skirtun, M., Reid, C. and Hampton, J. (2016). Biological and economic consequences of alternative trajectories to achieve a candidate south pacific albacore target reference point. WCPFC13-2016-13.

Table 5. Catch scalars on longline and troll fisheries applied across the South Pacific, and within the WCPFC Convention Area only, that on average achieve a WCPFC-CA median longline vulnerable biomass 8% higher than that in 2013. Results in terms of median stock depletion (in 2049, across the South Pacific and within the WCPFC-CA), F/F_{MSY} (across the South Pacific only) and risk relative to the LRP and F_{MSY} are presented.

Region where catch adjusted	Catch scalar (from 2017-19 avg)	South Pacific wide		WCPFC-CA		F/F_{MSY}	Risk $F > F_{MSY}$
		$SB_{2049}/SB_{F=0}$	Risk ($SB_{2049}/SB_{F=0}$ < LRP)	$SB_{2049}/SB_{F=0}$	Risk ($SB_{2049}/SB_{F=0}$ < LRP)		
South Pacific wide	0.56	0.68	2%	0.68	1%	0.12	1%
WCPFC-CA	0.50	0.67	2%	0.68	2%	0.12	1%

Table 6. South Pacific albacore catch levels (mt) that would on average achieve the TRP in the long term for the longline and troll fisheries across the South Pacific, and within the WCPFC-CA and the remaining EPO.

Region where catch adjusted	South Pacific region	Catch scalar (from 2017-19 avg)	Resulting catch (mt)
South Pacific wide	WCPFC-CA	0.56	40,500
	EPO (excl. overlap)	0.56	8,700
	Total		**49,200**
WCPFC-CA	WCPFC-CA	0.50	36,200
	EPO (excl. overlap)	1.00	15,500
	Total		**51,700**

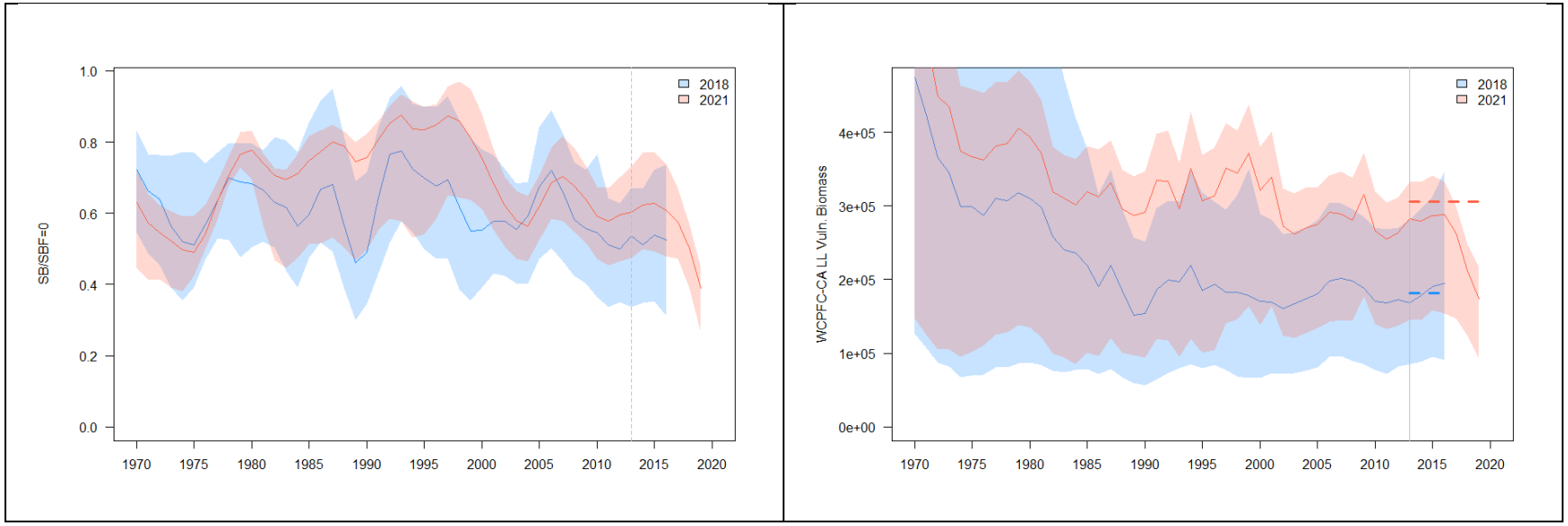

Figure 3. Comparison of WCPFC-CA region spawning biomass depletion ($SB/SB_{F=0}$; left) and WCPFC-CA longline vulnerable biomass (right) from the 2021 (red) and 2018 (blue) stock assessments. Line indicates the median across the model grid and shading indicates the 95th percentile range across the grid. SC17 weightings are applied to the 2021 assessment results. Horizontal line (plot right) indicates the vulnerable biomass consistent with the TRP (2013 levels + 8%) under the two assessments.

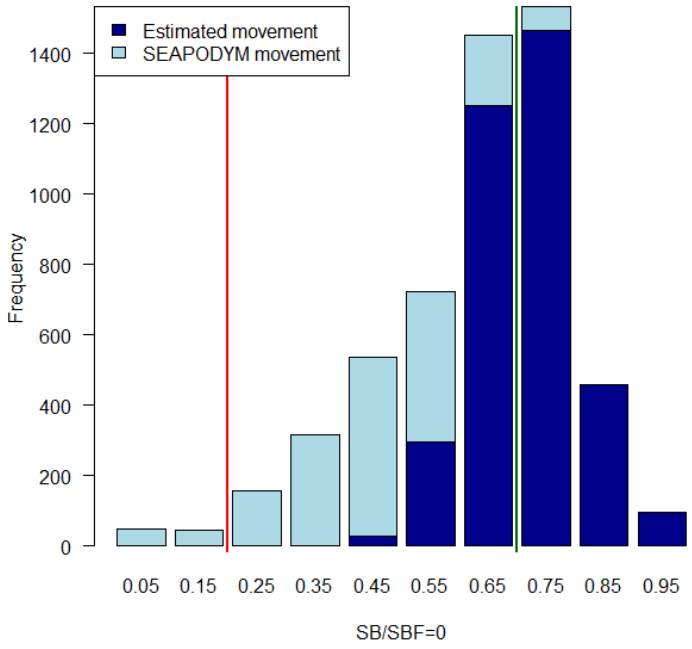

Figure 4. Distribution of $SB/SB_{F=0}$ outcomes where median depletion of the South Pacific albacore stock is at the updated TRP of 68%$SB_{F=0}$ (green line). Red line indicates the LRP (20%$SB_{F=0}$). Shading indicates the outcomes by model movement assumption.