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Impacts of changes to the FAD closure period on the expected performance of the WCPO skipjack tuna management procedure

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Executive Summary

For the purposes of assessment and management, purse seine fishing is broadly categorised into associated (FAD) and unassociated (free-school) set types. Within the WCPO a temporary closure of the FAD fishery has been in force since 2009. The FAD closure prohibits the deployment, servicing or setting of FADs for specified periods (those periods being different within EEZs and on the high seas). The temporal extent of the FAD closure has varied through time.

The interim skipjack management procedure was adopted in 2022 (CMM 2022-01) and first implemented in 2023. The development and testing of the skipjack MP was based on the assumption that a FAD closure of 3 months in EEZs and high seas plus an additional two months on the high seas would be in force. In 2024 the extent of the FAD closure was reduced to 1.5 months in EEZs and high seas plus an additional 1 month on the high seas.

To determine the potential impact of changes to the duration of the FAD closure on the expected performance of the skipjack MP, as requested by SC20, the MP evaluations have been re-run under 3 scenarios; a base case scenario consistent with the original assumptions; a scenario that reflects the current reduced FAD closure period and a scenario under which the FAD closure is completely removed.

The results indicate that the expected performance of the skipjack MP is largely unaffected by changes to the mix of FAD and free-school sets in the purse seine fishery.

We invite WCPFC-SC21 to:

- note that changes to the FAD closure period are expected to have very little impact on the performance of the skipjack MP.
- take the results of this analysis into account when considering the skipjack MP monitoring strategy.

1 Introduction

The WCPO skipjack tuna interim management procedure (MP) was formally adopted in 2022 (CMM 2022-01) and was first implemented in 2023 (CMM 2023-01). At the time of implementation, the conditions within the tropical purse seine fishery were consistent with the fishery dynamics assumed for simulation testing the candidate management procedures. These assumed dynamics accounted for the mix of fishery operations catching skipjack, their relative fishing effort, spatial distribution and the size selectivity of the different gear types. These assumptions included the extent of the FAD closure.

The FAD closure is a measure to prohibit the deployment, servicing or setting on FADs (fish aggregating devices) for a temporary period and has been in place since 2009 (CMMs 2008-01; 2009-02). The measure applies to the purse seine fishery in the area bounded by 20°N and 20°S with defined periods for the closure of FAD fishing specified separately for the high seas and EEZs. The temporal extent of the prohibition period has varied over time.

For the purpose of testing candidate MPs, a FAD closure period of 3 months in EEZs and high seas, plus an additional 2 months on the high seas, was assumed. This reflected the measures in force at the time of implementation and was broadly consistent with conditions in 2012 that were used as the basis for future purse seine fishery dynamics in the simulations (Scott et al., 2018). In 2024, however, the extent of the FAD closure reduced to 1.5 months in EEZs and high seas, plus an extra 1 month on the high seas (CMM 2023-01). SC20 requested an evaluation of whether the change in the FAD closure duration affected the performance of the interim MP (SC20 summary report, para 452).

Previous analyses (SPC-OFP, 2014; Hampton and Pilling, 2014) have shown that changes in the relative proportions of FAD and free-school sets can impact the quantity of bigeye tuna caught in the purse seine fishery, but that catches of skipjack and yellowfin tuna are largely insensitive to the FAD and free-school mix. It was therefore anticipated that the reduction of the FAD closure period would have little impact on the performance of the skipjack MP in terms of its ability to maintain the skipjack stock at levels consistent with the TRP. This brief report investigates the likely impact on the expected performance of the skipjack MP of recent, and alternative, changes to the extent of the FAD closure.

2 FAD closure scenarios

The analysis considers three potential scenarios for the extent of the FAD closure; scenario 0: a base scenario corresponding to the measures in force at the time of first implementation of the skipjack MP (i.e. a 3 month prohibition of FAD fishing in EEZs and high seas, plus an additional 2 months on the high seas); scenario 1: corresponding to the current measures in force (i.e. a 1.5 month prohibition of FAD fishing in EEZs and high seas, plus an additional 1 month on the high

seas); and scenario 2: in which there is no prohibition of the FAD fishery at all.

For all three scenarios the same baseline level of purse seine fishing has been assumed such that the overall level of purse seine fishing is the same but the relative proportions of FAD and free-school sets change. Therefore, for scenarios where the FAD closure periods are shorter, the number of FAD sets are assumed to increase with an equivalent decrease in the number of free-school sets.

3 Skipjack MP re-evaluation

The performance of the skipjack MP was tested under the three FAD closure scenarios using the same evaluation framework used in 2022 for the testing and adoption of the skipjack MP (Scott et al., 2022, 2023). The evaluations were run over the Centre for High Throughput Computing (CHTC) condor flock which required some modification to input formats to allow for recent updates to job submission procedures. The various FAD closure scenarios were implemented by applying additional scalars to the respective FAD and free-shcool purse seine fisheries in the tropical regions (regions 5,6,7 and 8, Figure 1) of the skipjack OM population models.

Scalars were determined using the same approach as for the recent evaluation of the tropical tuna measure (Pilling et al., 2024). Scalars were applied to the eight purse seine fisheries (fisheries 14, 15, 19, 20, 25, 26, 29 and 30, Tables 1 and 2) to increase the number of FAD sets and decrease the number of free-school sets accordingly. Similar to the approach taken for the TTM evaluations, combined scalars across all areas were calculated for FAD and free-school fishing operations (Table 2).

As for the original skipjack MP evaluations, simulations were run across the OM grid of 48 models (Table 3) with each model run for 20 iterations giving 960 sets of results for each scenario. Results are calculated for a subset of the performance indicators, specifically the expected average catch, and the resulting level of depletion ($SB/SB_{F=0}$) determined from the operating models. The performance of the MP is also reported in terms of the scalar output from the harvest control rule.

4 Impact of the FAD closure changes

Overall, the results show there is only a very small impact on the performance of the MP from reductions of the FAD closure period. Model outputs across the grid of operating models show estimated average long-term depletion (Figure 2) decreases by around 1.5% under scenario 1 (partial FAD closure reduction) and by less than 2.5% under scenario 2 (no FAD closure) from the baseline assumption (i.e long-term depletion under scenarios 1 and 2 is around 98.5% and 97.5% of the levels achieved under scenario 0). There is no discernible change in estimated average annual catches between the three scenarios (Figure 3).

Similarly, the output from the harvest control rule is largely unaffected by the changes to the extent of the FAD closure period. In the majority of cases, the outputs of the harvest control rule under

scenarios 1 and 2 are the same as those under scenario 0 (Figure 4). Where differences occur they are typically within the range ± 5% , although larger differences may occur particularly in the short-term and under scenario 2 (no FAD closure).

These results are consistent with previous analyses to investigate the potential impact on the skipjack fishery of changes to the relative proportions of FAD and free-school fishing (SPC-OFP, 2014).

We invite WCPFC-SC21 to:

- note that changes to the FAD closure period are expected to have very little impact on the performance of the skipjack MP.
- to take the results of this analysis into account when considering the skipjack MP monitoring strategy.

5 Acknowledgements

We gratefully acknowledge funding for this work from the New Zealand Ministry of Foreign Affairs and Trade (MFAT) funded project "Sustainable Pacific Fisheries". In addition we thank the Centre for High Throughput Computing (CHTC) University of Wisconsin-Madison for generously providing access to their computing resources.

6 References

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A Tables

Table 1: Skipjack fishery definitions.

Gear	number	category	Code	Flag	Region
Pole and line	1		P-ALL-1	ALL	1
Purse seine	2	combined	PS-ALL-1	ALL	1
Longline	3		LL-ALL-1	ALL	1
Pole and line	4		P-ALL-2	ALL	2
Purse seine	5	combined	PS-ALL-2	ALL	2
Longline	6		LL-ALL-2	ALL	2
Pole and line	7		P-ALL-3	ALL	3
Purse seine	8	combined	PS-ALL-3	ALL	3
Longline	9		LL-ALL-3	ALL	3
Domestic	10		Z-PH-5	PH	5
Domestic	11		Z-ID-5	ID	5
Purse seine	12	combined	S-ID-PH-5	ID-PH	5
Pole and line	13		P-ALL-5	ALL	5
Purse seine	14	associated	PS-ASS-5	DW	5
Purse seine	15	unassociated	PS-UNASS-5	DW	5
Domestic	16		Z-VN-5	VN	5
Longline	17		LL-ALL-5	ALL	5
Pole and line	18		P-ALL-6	ALL	6
Purse seine	19	associated	PS-ASS-6	ALL	6
Purse seine	20	unassociated	PS-UNASS-6	ALL	6
Longline	21		LL-ALL-6	ALL	6
Pole and line	22		P-ALL-4	ALL	4
Longline	23		LL-ALL-4	ALL	4
Pole and line	24		P-ALL-7	ALL	7
Purse seine	25	associated	PS-ASS-7	ALL	7
Purse seine	26	unassociated	PS-UNASS-7	ALL	7
Longline	27		LL-ALL-7	ALL	7
Pole and line	28		P-ALL-8	ALL	8
Purse seine	29	associated	PS-ASS-8	ALL	8
Purse seine	30	unassociated	PS-UNASS-8	ALL	8
Longline	31		LL-ALL-8	ALL	8

Table 2: Effort scalars for associated and unassociated purse seine fisheries corresponding to the 3 FAD closure scenarios (months of closure). A combined scalar sets an overall effort scalar across all four fishery groups.

	ASS			**UNA**		
	scenario 0	**scenario 1**	**scenario 2**	**scenario 0**	**scenario 1**	**scenario 2**
EEZ + HS	**3**	**1.5**	**0**	**3**	**1.5**	**0**
HS	**2**	**1**	**0**	**2**	**1**	**0**
PS-5	1.0	1.2	1.38	1.0	0.72	0.47
PS-6	1.0	1.2	1.38	1.0	0.89	0.79
PS-7	1.0	1.2	1.38	1.0	0.87	0.75
PS-8	1.0	1.2	1.38	1.0	0.90	0.81
Combined	1.0	1.2	1.38	1.0	0.89	0.78

Axis	**Levels**	**Options**		
		0	**1**	**2**
Process Error				
Recruitment Variability	**2**	**1982-2018**	**2005-2018**	
Observation Error				
Catch and effort	**1**	**20%**		
Size composition (ESS)	1	**estimated**		
Tag recaptures	**1**	**status quo**		
Model Error				
Steepness ‡	**3**	**0.8**	**0.65**	**0.95**
Mixing period (qtr) ‡	**2**	**1**	**2**	
Growth ‡	**2**		**low**	**high**
Movement	**1**	**estimated**		
DD catchability (k) ‡	**2**		**0**	**-0.5**
Implementation Error				
Effort creep	**2**		**0%**	**2%**

Table 3: Skipjack OM uncertainty grid (reference set, 96 model scenarios). ‡ denotes those scenarios for which a dedicated fit of MULTIFAN-CL is required.

B Figures

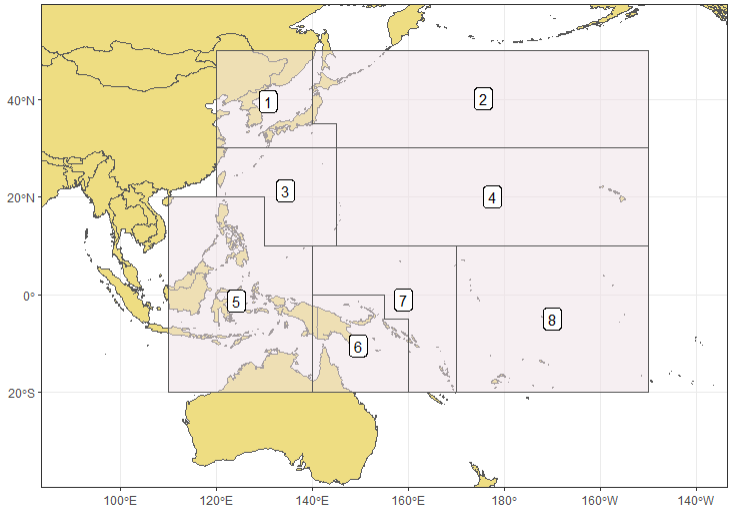

Figure 1: Spatial structure of the skipjack modelling framework.

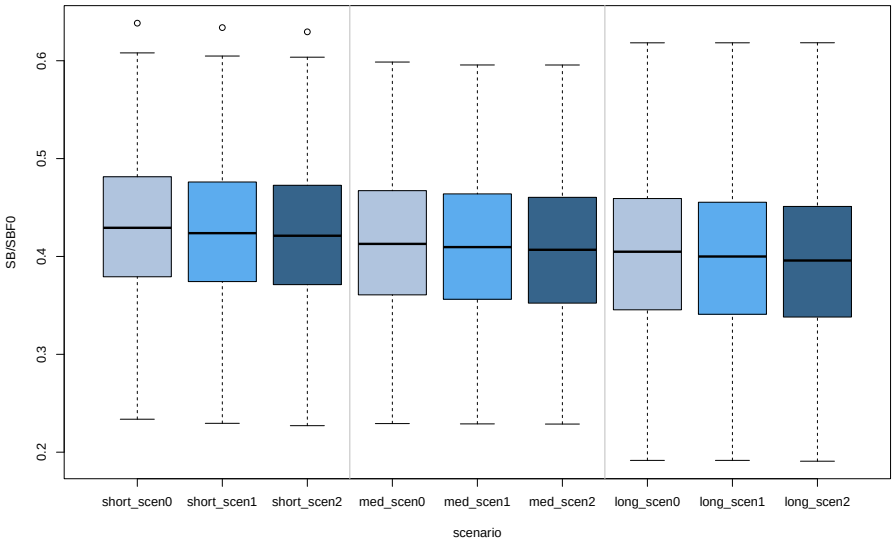

Figure 2: Average depletion (SB/SBF0) in the short- medium- and long-term under the three FAD closure scenarios (scenario 0: 3 month in zone plus 2 months high seas, scenario 1: 1.5 months in zone plus 1 month high seas, and scenario 2: no FAD closure).

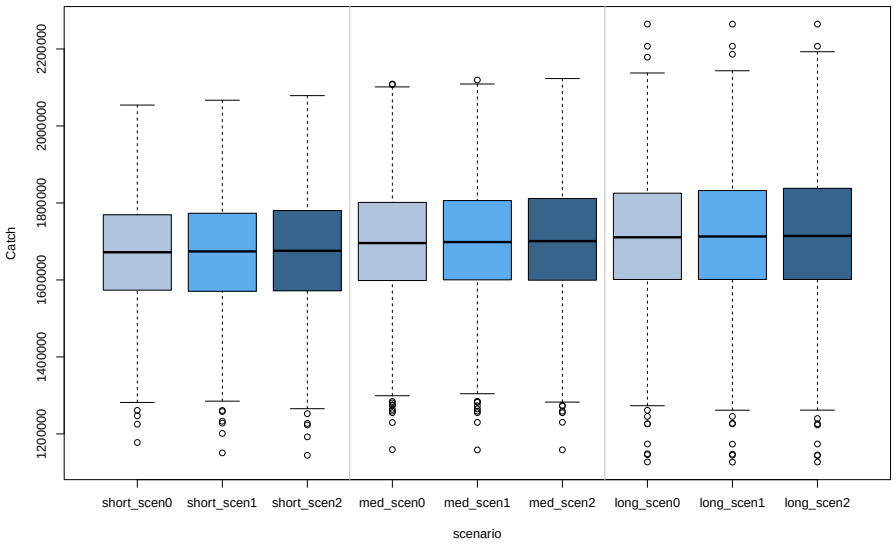

Figure 3: Average annual catch (tonnes) in the short- medium- and long-term under the three FAD closure scenarios (scenario 0: 3 month in zone plus 2 months high seas, scenario 1: 1.5 months in zone plus 1 month high seas, and scenario 2: no FAD closure).

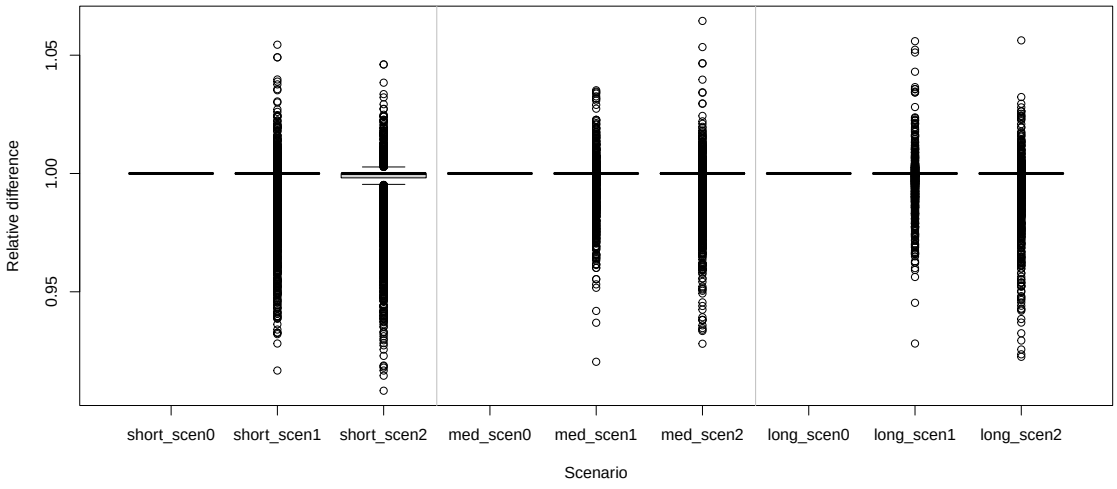

Figure 4: Relative difference in output from the harvest control rule under the 3 FAD closure scenarios in the short- medium- and long-term. A value of 1 indicates no difference from outputs under scenario 0.