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Evaluation of CMM 2017-01 for bigeye tuna

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1. EXECUTIVE SUMMARY

The 2018 Harvest Strategy work plan, as updated by WCPFC14, requested that "SC and SPC provide advice to the Commission on the likely outcomes of the revised tropical tuna measure" (CMM 2017-01). This request specifically referred to bigeye tuna. We use an approach similar to that within recent tropical tuna CMM evaluations to:

⌡ Step 1. <u>quantify provisions of each Option</u> – i.e., translate each specified management Option into future potential levels of purse seine effort and longline catch;

⌡ Step 2. <u>evaluate potential consequences of each Option</u> over the long-term for bigeye tuna, against the aims specified in CMM 2017-01.

The CMM has not been in place for sufficient time to track the annual implementation of its provisions.

STEP 1: QUANTIFYING PROVISIONS OF THE OPTION

We repeat the detailed evaluation approach used within previous tropical tuna CMM evaluations. Assumptions are made regarding the impact that changes to the FAD closure period and/or high seas effort limits will have on FAD-related effort, and the potential future catches of longline fleets. These assumptions are consistent with those made in previous CMM evaluations, and include whether effort and catch limits specified within the CMM are taken by a flag, particularly where those limits are higher than recent fishing levels. Under these assumptions, we define three scenarios of future purse seine effort and longline catch, which are summarised as:

'Status quo': purse seine effort and longline catch levels are maintained at the average levels seen over the years 2013-2015, providing a 'baseline' for comparison.

'Optimistic': under a 3 month EEZ FAD closure, purse seine CCMs make an additional $1/8^{th}$ FAD sets relative to the average number over 2013-15, when a 4 month closure was in place (i.e. 8 months FAD fishing in those years). The <u>additional</u> 2 month high seas FAD closure (5 months in total) reduces the number of FAD sets by $1/8^{th}$ of those made on the high seas in 2013-15. CCMs with longline limits take their 2017 catch limit or 2013-2015 average level if lower.

'Pessimistic': every CCM fishes the maximum allowed under the Measure. Purse seine CCMs undertake an additional $1/8^{th}$ FAD sets relative to the average number over the period 2013-15 when a 4 month closure was in operation. The <u>additional</u> 2 month high seas FAD closure reduces the number of sets by $1/8^{th}$ of those set on the high seas in 2013-15, but where specified high seas effort limits allow additional fishing relative to 2013-15, additional FAD sets are assumed on a proportional basis. Limited longline non-SIDS CCMs and US Territories take their entire 2018 specified/2000 mt limits, 2013-2015 average level assumed for other SIDS.

The second and third scenarios assume the change in FAD closure periods under CMM 2017-01 equates to a proportional increase/decrease in FAD sets (see also Appendix 1).

We use stochastic bigeye stock projections to evaluate potential long-term consequences of resulting future fishing levels under each scenario, in comparison to status quo conditions (2013-2015 average), across the 2017 bigeye assessment grid incorporating updated growth information, weighted as defined by SC13 for management advice.

The stated aim of CMM 2017-01 for bigeye was that "the spawning biomass depletion ratio ($SB/SB_{F=0}$) … be maintained at or above the average $SB/SB_{F=0}$ for 2012-2015". The potential long-term performance of the CMM in this regard is strongly influenced by the assumed future recruitment levels (see table overleaf). If recent positive recruitments continue into the future, all scenarios examined achieve the aims of the CMM, in that median spawning biomass is projected to increase relative to recent levels, and median fishing mortality is projected to decline (the exception to the latter being the pessimistic CMM scenario, although fishing mortality remains below F_{MSY}). If less optimistic longer term recruitments continue into the future, spawning biomass depletion worsens relative to recent levels under all scenarios, and the future risk of spawning biomass falling below the limit reference point (LRP) increases to 24-40%, dependent on the scenario. In turn, all three future fishing scenarios imply notable increases in fishing mortality under those recruitment conditions, to median levels well above F_{MSY}.

We invite WCPFC-SC14 to:

⎫ review the assumptions underlying this evaluation;

In light of decisions made at SC14 on any re-weighting of the 2017 bigeye stock assessment models following incorporation of updated growth information, these analyses can be reweighted accordingly so that SC14 can:

⎫ provide advice to WCPFC15 on the potential long-term performance of CMM 2017-01 for WCPO bigeye tuna against its stated aims.

Weighted median values of reference point levels (adopted limit reference point (LRP) of 20% $SB_{F=0}$; F_{MSY}) and risk[1] of breaching reference points from the 2017 bigeye stock assessment incorporating updated growth information, and in 2045 under the three future harvest scenarios (status quo, optimistic and pessimistic) and alternative recruitment hypotheses.

Scenario		Scalars relative to 2013-2015		Median $SB_{2045}/SB_{F=0}$	Median $SB_{2045}/SB_{F=0}$ v $SB_{2012-15}/SB_{F=0}$	Median $F_{2041-2044}/F_{MSY}$	Median $F_{2041-2044}/F_{MSY}$ v $F_{2011-14}/F_{MSY}$	Risk	
Recruitment	Fishing level	Purse seine	Longline					SB_{2045} < LRP	$F>F_{MSY}$
Bigeye assessment ('recent' levels)				0.33	-	0.81	-	15%	22%
Recent	Status quo	1	1	0.40	1.21	0.78	0.96	3%	24%
	Optimistic	1.11	0.98	0.39	1.17	0.80	0.99	5%	27%
	Pessimistic	1.12	1.35	0.34	1.01	0.95	1.17	12%	43%
Long-term	Status quo	1	1	0.28	0.85	1.62	2.00	24%	95%
	Optimistic	1.11	0.98	0.27	0.82	1.65	2.03	26%	95%
	Pessimistic	1.12	1.35	0.23	0.69	1.86	2.30	40%	98%

[1] note risk within the stock assessment is calculated as the (weighted) number of models falling below the LRP (*X* / 144 weighted models, dependent upon SC weighting). Risk under a projection scenario is the number of projections across the grid that fall below the LRP (*X* / 4788 (72 models x weighting x 100 projections)).

2. QUANTIFYING THE PROVISIONS OF THE MEASURE

This evaluation of CMM 2017-01 is based upon the 2017 bigeye stock assessment where 36 models now incorporate 'updated new growth' information (Vincent et al., 2018). The abundance of the bigeye stock is projected into the future (for 30 years) under particular levels of either catch or effort within the different fisheries modelled in the stock assessment.

Therefore, the two parts of Step 1 are:
1. Estimate the levels of associated (FAD) and unassociated (free school) set purse seine effort and longline bigeye catch that would result from the provisions of the Measure. This estimation requires interpretation of the CMM text to estimate the most likely purse seine effort and longline catch levels that would result.
2. Express these levels of purse seine effort and longline bigeye catch as scalars relative to reported levels of these quantities for 2013-2015 (the last years of the assessment). This average period was selected to reduce the impact of FAD set fluctuations in individual years on evaluation results, while ensuring the FAD closure period (4 months) was consistent across those years.

Outcomes of the CMM for skipjack and yellowfin tuna are not examined in this paper.

We repeated the detailed approach used in the evaluation of CMM 2015-01 which was presented to WCPFC13 ([WCPFC13-2016-15](#)). Table 1 outlines the approach taken in relation to the relevant paragraphs of CMM 2017-01.

Table 1. Evaluation of the relevant paragraphs of CMM 2017-01.

Relevant paragraphs of CMM 2017-01	Evaluation Approach
Principles	
2	F/F_{MSY} is included as a performance indicator.
Area of application	
3 and 10	The area of application does not include archipelagic waters (AW). The evaluation will necessarily be for the WCPO (west of 150⌐W) rather than the WCPFC Convention Area because of the structure of the assessment model, which does not include catch and effort data from the overlap area. This should not significantly impact the results of the evaluation.
4	No guidance is given regarding level of any AW reductions; we assume 2013-2015 average levels of effort will continue.
Harvest strategies and interim objectives	
11	While the measure acts as a bridge to the adoption of a harvest strategy for bigeye (and other tropical tuna stocks), for the purpose of this evaluation we have examined where the stock would end up under longer-term application of this measure.
12	We use the spawning biomass depletion ratio ($SB/SB_{F=0}$) as a performance indicator, consistent with the limit reference point (LRP) formally adopted by WCPFC ($0.2SB_{F=0}$), and relate the longer-term outcome of CMM2017-01 measures (over 30 years) to the average $SB_{2012-2015}/SB_{F=0,\ 2005-2014}$.
FAD set management	
16-17	Unlike recent tropical tuna CMMs, CMM 2017-01 does not offer a choice in the application of purse seine FAD measures. CCMs therefore apply an in-zone/high seas FAD closure of 3 months in 2018 (Jul-Sept). This was modelled as (1+1/8) x average FAD sets in 2013-2015. As a four month closure (or equivalent) was in operation over those years, a 3 month closure would allow on average 1/8th more FAD sets than were seen in the remaining 8 months of the year in which FAD sets were allowed. We note this does not take into account the potentially different pattern of fishing by those CCMs that selected FAD set limits in those years, but have assumed that the impact on the number of FAD sets performed was roughly equivalent for those CCMs.

	In addition, the reduction in FAD set numbers due to the specified 2 month additional high seas FAD closure was estimated (5 months in total). The impact of CCMs choosing different two-month pairs for the closure was assumed to be negligible for this evaluation. We have assumed that **high seas FAD sets were not transferred into EEZs, but were removed from the fishery.** We based the number of high seas FAD sets on the recent average sets in the high seas by CCM over 2013-2015 (a 4 month closure), and calculated the impact of removing 1/8th of those FAD sets at the CCM level, noting the exemption for Kiribati, and for Philippines in HSP1. Two options for future conditions were examined: 　） **Optimistic**: FAD sets were limited through the 3 month FAD closure and additional 2 month high seas closure as calculated above. High seas effort was maintained at 2013-2015 average levels. 　） **Pessimistic**: FAD sets were limited through the 3 month FAD closure and additional 2 month high seas closure as calculated above. Those CCMs with high seas effort limits were assumed to fish to their day limits, and corresponding additional high seas FAD sets were estimated (see 'purse seine effort control', below), incorporating the closure; status quo was assumed for other fleets.
19-24	In the absence of information, the practical impact on the number of FAD sets made under the CMM through active instrumented buoy limits was assumed to be negligible.
Purse seine effort control	
25-30	For simplicity, we did not assume that purse seine total effort in EEZs and high seas would increase as permitted under recently nominated EEZ effort levels (e.g. Pilling and Harley, 2015). We assumed overall effort (including within archipelagic waters) would remain at 2013-2015 effort levels (with the exception of the high seas effort limits, below). This assumption means that we do not expect EEZs where purse seine effort has been less than 1500 days annually over recent years to attract additional effort. Flag-based high seas effort limits are unchanged from CMM 2016-01. Many limited CCMs would be able to increase their high seas effort marginally under the CMM. This is incorporated within the 'pessimistic' scenario detailed above. For this long-term evaluation, the potential transfer of 100 days by the US from their EEZ effort limits to the high seas (para 29 of CMM 2017-01) is assumed not to occur.
Longline fishery – bigeye catch limits	
39-44	Longline catch limits are not completely specified for all CCMs. Two options for future conditions were therefore examined: 　） **Optimistic**: Limited CCMs took their specified catch limit/2,000 mt catch limit, or their 2013-2015 average catch level whichever was <u>lower</u>, other CCMs took their 2013-2015 average catch level. 　） **Pessimistic**: Limited CCMs took their specified catch limit/2,000 mt catch limit, other CCMs took their 2013-2015 average catch level. Noting that a 2,000 mt limit has been applied to US Territories in US domestic legislation, these limits have been applied under the pessimistic scenario, consistent with the approach taken for other CCMs with a 2,000 mt limit. We have assumed that non-limited fleets (those without limits specified in CMM Attachment 1, or the upper limit of 2,000 mt) will continue to operate at 2013-2015 levels, although those fleets could legitimately increase to any level under the CMM. If this occurs, then the extent of any reduction of longline catch will be over-estimated, or any increase under-estimated. For the purposes of this long-term evaluation, the one-off transfer of 500 mt of bigeye from Japan to China (Table 3 of CMM 2017-01) is assumed not to continue into the future.
Capacity management	
45-49	Not relevant to the evaluation, assuming that total effort and catch measures are adhered to.
Other commercial fisheries	
50-51	There are neither estimates of capacity nor effort for the majority of fisheries in this category; therefore, we assume continuation of 2013-2015 average catch levels.

The interpretation of the CMM provisions detailed within Table 1 define future levels of purse seine associated effort and longline catch for each scenario ('optimistic' and 'pessimistic'). Resulting scalars (Table 2) are calculated relative to 2013-2015 average fishing levels, consistent with analyses presented to WCPFC14[2], and represent aggregate scalars across all CCMs.

Table 2. Scalars for purse seine effort and longline catch under alternative CMM 2017-01 scenarios, relative to 2013-2015 average conditions.

	Purse Seine	Longline[3]
Optimistic	1.11	0.98
Pessimistic	1.12	1.35

3. EVALUATION OF THE POTENTIAL EFFECTIVENESS OF THE MEASURE

We use the purse seine associated effort and longline catch scalars estimated in Step 1 within bigeye tuna stock projections to evaluate the outcomes in relation to the stated objectives of the CMM regarding bigeye tuna. The main indicators used are:

⌡ the spawning biomass at the end of the 30 year projection in relation to the average unfished level ($SB_{2045}/SB_{F=0}$[4]) compared to both the agreed limit reference point of 0.2 $SB_{F=0}$, and $SB_{2012-2015}/SB_{F=0}$; and

⌡ the average fishing mortality at the end of the projection period (2041-2044) in relation to the fishing mortality at maximum sustainable yield (F/F_{MSY}) and to the estimated level $F_{2011-2014}/F_{MSY}$.

Analysis of the impact of potential future purse seine associated effort and longline catch is conducted using the full uncertainty framework approach as endorsed and weighted by SC13:

⌡ Projections are conducted from 72 separate bigeye assessment models, as defined by the uncertainty grid of models selected by SC13 for management advice.

⌡ The 72 models used represent the 2017 bigeye assessment models incorporating updated growth information (Vincent et al., 2018), and hence 36 of those models reflect stock status estimated under the 'updated new growth' assumption.

⌡ For each model, 100 stochastic projections, which incorporate future recruitments randomly sampled from historical deviates, are performed for the estimated purse seine associated effort and longline catch provisions of CMM 2017-01 (scalars estimated in Step 1, applied to 2013-2015 average fishing conditions). The outputs of the projections ($SB_{2045}/SB_{F=0}$ and F/F_{MSY}) are combined across the 72 models, weighted as per the decision of SC13 (outputs from models assuming 'updated new growth' given three times the weighting of those assuming 'old growth' when calculating median stock status values and risk relative to the limit reference point).

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[2] The tables used to estimate these values are presented in Appendix 1 and are based upon data in WCPFC14-2017-IP05_rev1.

[3] If the assumption were made that all CCMs with longline limits took those limits, but that all other fleets caught at the 2013-2015 average catch level, the resulting longline scalar was 1.11 (see Appendix 1). This additional level was not analysed here, but potential outcomes can be inferred from the analysed scenarios.

[4] $SB_{F=0}$ was calculated consistent with the approach defined in CMM 2015-06, and as used within recent stock assessments, whereby the 10 year averaging period was shifted relative to the year in which the SB was evaluated; i.e. spawning biomass in future year y was related to the spawning biomass in the absence of fishing averaged over the period y-10 to y-1 (e.g. $SB_{2045}/SB_{F=0, 2035-2044}$).

) Two scenarios for future recruitment in the projection period were examined:
  - o Future recruitment was determined by randomly sampling from ONLY the <u>2005-2014</u> recruitment deviations from the stock-recruitment relationship estimated in each assessment model, consistent with previous WCPFC SC decisions for bigeye tuna. This effectively assumes that the above-average recruitment conditions of the past 10 years, in particular those in the most recent years, will continue into the future.
  - o As requested by SC12, a sensitivity analysis assuming relatively more pessimistic long-term recruitment patterns (sampled from 1962-2014) continue into the future.

We note that the use of stochastic projections in the current analysis is different to the 'deterministic projections across the 2017 bigeye uncertainty grid' approach used in SPC (2017) to provide advice to WCPFC14. The current approach better captures uncertainty in future conditions, and we note the 'long term recruitment' scenario provides comparable estimates of future stock status.

RESULTS

Table 3 summarises the median values of $SB/SB_{F=0}$ and F/F_{MSY} achieved in the long term, along with the potential risk of breaching the limit reference point (LRP) and exceeding F_{MSY}, under each of the future fishing and recruitment combinations. Figure 1 presents the corresponding distributions of long term $SB/SB_{F=0}$ and Figure 2 those for F/F_{MSY}.

Potential outcomes under status quo (2013-15 average) and CMM scenario conditions were strongly influenced by the assumed future recruitment levels.

Under the assumption that recent positive recruitments will continue into the future, spawning biomass relative to unfished levels is predicted to increase from recent levels under all examined future scenarios by 1-21% ($SB_{2045}/SB_{F=0}$ ranges from 0.34 to 0.40; Table 3, Figure 1). While future uncertainty in stock status increases due to stochastic future recruitment levels, the risk of future spawning biomass falling below the LRP falls to between 3 and 12%, due to the improved overall stock size. Fishing mortality falls slightly under both the status quo and optimistic scenarios, assuming recent recruitment. However, fishing mortality increases under the pessimistic scenario, but remains below F_{MSY} (43% risk of $F > F_{MSY}$[5]; Table 3, Figure 2).

Under the assumption that less positive long-term recruitments are experienced in the future, spawning biomass relative to unfished levels will decline under all scenarios ($SB_{2045}/SB_{F=0}$ ranges from 0.23 to 0.28). The risk of spawning biomass falling below the LRP increases to between 24 and 40% (Table 3). In all fishing scenarios, fishing mortality increases relative to recent levels (by 100-130%) and is well above F_{MSY}. Risk of fishing mortality exceeding F_{MSY} ranges from 95 to 98%.

Compared to the results from deterministic projections across the 2017 bigeye assessment uncertainty grid (SPC, 2017), the risk of falling below the LRP based upon the 2017 bigeye assessment grid incorporating updated growth information and under the current stochastic projection approach is slightly lower when recent recruitment is assumed. However, the risk of falling below the LRP is consistent with deterministic projections when longer term recruitment is assumed. We note that the 'updated growth' models indicate slightly improved

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[5] Future MSY levels are influenced by changes in the gear-specific future effort and catch defined under the optimistic and pessimistic scenarios.

overall stock status compared to McKechnie et al. (2017), and their increased emphasis under the SC13 weighting scheme contributes to reduced future risk.

3. DISCUSSION

Paragraph 12 of CMM 2017-01 states the aim that, "pending agreement on a target reference point, the spawning biomass depletion ratio ($SB/SB_{F=0}$) is to be maintained at or above the average $SB/SB_{F=0}$ for 2012-2015".

We have evaluated CMM 2017-01 using stochastic projections (incorporating variation in future recruitment), across the 2017 grid of bigeye assessment models incorporating updated growth information, with results from 'old' and 'updated new' growth models weighted consistent with decisions made at SC13. This evaluation provides an indication of whether the CMM as it currently stands will achieve the objective of paragraph 12 in the long term, to allow "the Commission at its 2018 annual session [to] review and revise the aims set out in paragraphs 12 … in light of advice from the Scientific Committee" (paragraph 15).

The potential long-term performance of CMM 2017-01 for bigeye tuna is strongly influenced by assumed future recruitment levels. If recent positive recruitments continue into the future, all scenarios examined achieve the aims of the CMM, in that spawning biomass is projected to increase relative to recent levels, and fishing mortality is projected to decline (the exception to the latter being the pessimistic CMM scenario). If less optimistic longer term recruitments continue into the future, spawning biomass depletion worsens relative to recent levels under all scenarios, and the future risk of spawning biomass falling below the LRP increases to 24-40%, dependent on the scenario. In turn, all three future fishing scenarios imply notable increases in fishing mortality under those recruitment conditions, to median levels well above F_{MSY}.

As in previous CMM evaluations (e.g. SPC, 2016), it is not possible to define precisely what levels of future fishing will result from CMM provisions. Estimating future levels for the purse seine fishery is perhaps more straightforward under CMM 2017-01 than under previous CMMs, given the removal of fleet-level choice between FAD closure months or FAD set limits in particular. However, the assumption must still be made that the number of future FAD sets performed in a year is proportional to the additional month of FAD fishing allowed, and that the choice of paired high seas FAD closure months will not affect the assumption of a proportional decrease in high seas FAD sets. We also assume that the potential increase in purse seine fishing effort permissible under recently nominated EEZ effort levels will not occur, under the logic that we do not expect EEZs where purse seine effort has been less than 1500 days annually over recent years to attract additional effort. However, those increases are theoretically permitted under the CMM. For the longline fishery, future fishing levels will depend on the degree to which those fleets recently under-fishing their defined catch limits continue to do so, and the future levels of fishing undertaken by currently unlimited fleets.

As noted, results across the 'updated new growth' and 'old growth' assessment models are weighted as defined by SC13 (those from 'updated new growth' models weighted 3 times higher than 'old growth' model results). Based upon decisions by SC14 with regards weighting of the 2017 bigeye assessment models incorporating updated growth information, the results of this CMM evaluation can be re-weighted as required, without re-running the projections.

4. REFERENCES

McKechnie, S., Pilling, G. and Hampton, J. (2017). Stock assessment of bigeye tuna in the western and central Pacific Ocean. WCPFC-SC13-2017/SA-WP-05, REV1.

Pilling, G. and Harley, S. (2015). Estimating potential tropical purse seine fleet sizes given existing effort limits and candidate target stock levels. WCPFC-SC11-2015/ MI-WP-10.

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Vincent, M. T., Pilling, G. and Hampton, J. (2018). Incorporation of updated growth information within the 2017 WCPO bigeye stock assessment grid, and examination of the sensitivity of estimates to alternative model spatial structures. WCPFC-SC14-2018/SA-WP-03.

5. TABLES

Table 3. Weighted median values of reference point levels (adopted limit reference point (LRP) of 20% $SB_{F=0}$; F_{MSY}) and risk[1] of breaching reference points from the 2017 bigeye stock assessment incorporating updated growth information, and in 2045 under the three future harvest scenarios (status quo, optimistic and pessimistic) and alternative recruitment hypotheses.

| Scenario		Scalars relative to 2013-2015		Median $SB_{2045}/SB_{F=0}$	Median $SB_{2045}/SB_{F=0}$ v $SB_{2012-15}/SB_{F=0}$	Median $F_{2041-2044}/F_{MSY}$	Median $F_{2041-2044}/F_{MSY}$ v $F_{2011-14}/F_{MSY}$	Risk	
Recruitment	Fishing level	Purse seine	Longline					SB_{2045} < LRP	$F>F_{MSY}$
Bigeye assessment ('recent' levels)				0.33	-	0.81	-	15%	22%
Recent	Status quo	1	1	0.40	1.21	0.78	0.96	3%	24%
	Optimistic	1.11	0.98	0.39	1.17	0.80	0.99	5%	27%
	Pessimistic	1.12	1.35	0.34	1.01	0.95	1.17	12%	43%
Long-term	Status quo	1	1	0.28	0.85	1.62	2.00	24%	95%
	Optimistic	1.11	0.98	0.27	0.82	1.65	2.03	26%	95%
	Pessimistic	1.12	1.35	0.23	0.69	1.86	2.30	40%	98%

[1] note risk within the stock assessment is calculated as the (weighted) number of models falling below the LRP (*X* / 144 weighted models, dependent upon SC weighting). Risk under a projection scenario is the number of projections across the grid that fall below the LRP (X / 4788 (72 models x weighting x 100 projections)).

6. FIGURES
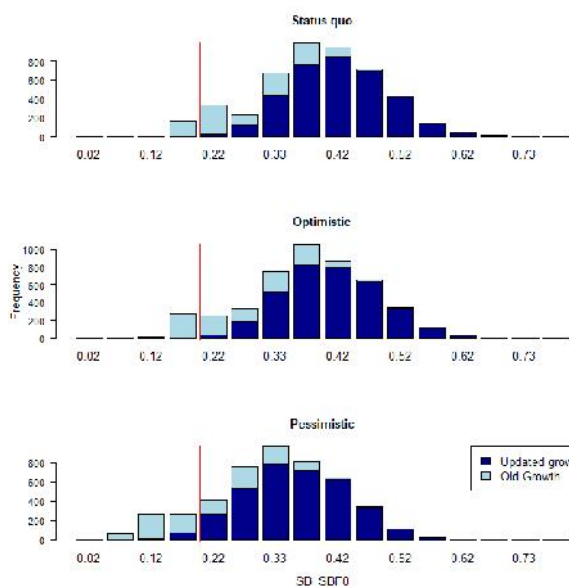
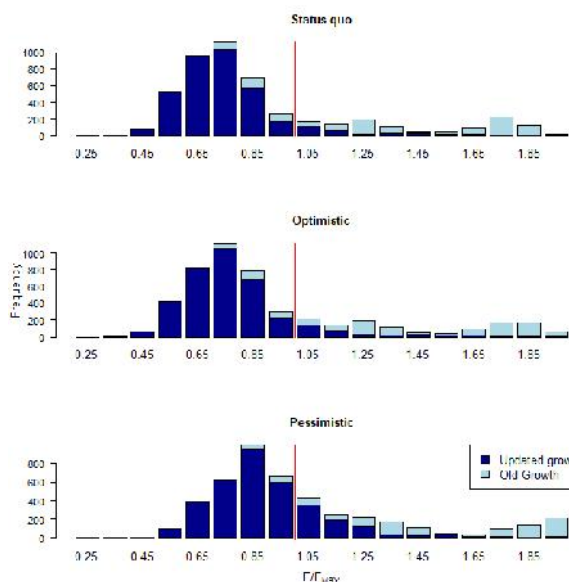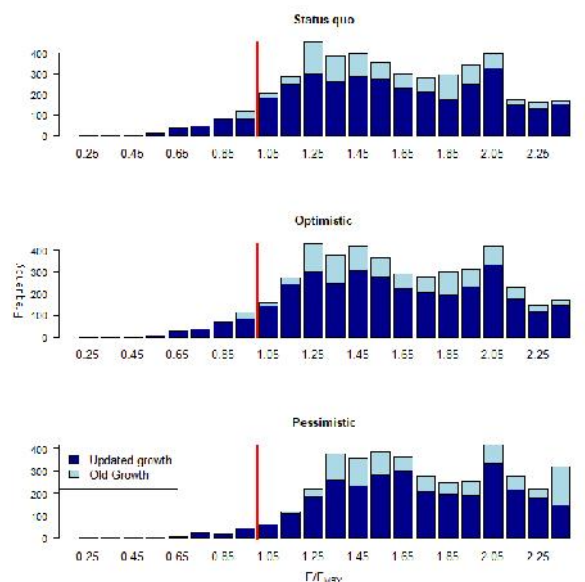Recent recruitments   Long-term recruitment
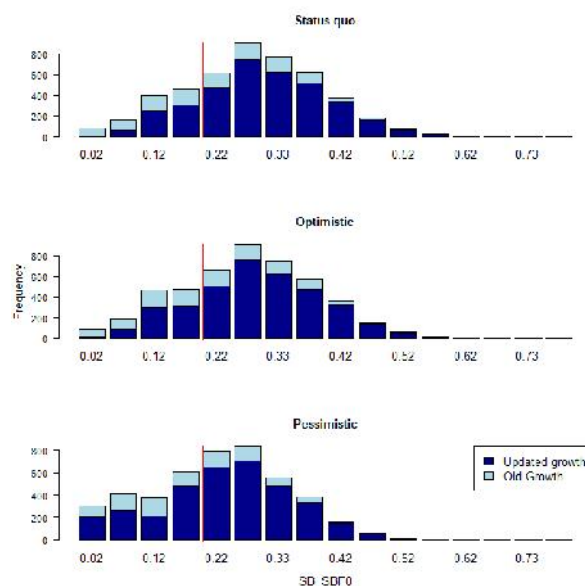
Figure 1. Distribution of $SB_{2045}/SB_{F=0}$ assuming recent and long term recruitment conditions (left and right columns, respectively), under the three future fishing scenarios: status quo (2013-15 average conditions, top row); optimistic conditions (middle row); and pessimistic conditions (bottom row). Projection results from 'updated new growth' models (3,600 projections) weighted three times higher than those from 'old growth' models (1,788 sampled projections, 4,788 projections in total).

Recent recruitments   Long-term recruitment

Figure 2. Distribution of F/F_{MSY} assuming recent and long term recruitment conditions (left and right columns, respectively), under the three future fishing scenarios: status quo (2013-15 average conditions, top row); optimistic conditions (middle row); and pessimistic conditions (bottom row). Projection results from 'updated new growth' models (3,600 projections) weighted three times higher than those from 'old growth' models (1,788 sampled projections, 4,788 projections in total).

7. APPENDIX 1. ESTIMATION OF SCENARIOS

Purse seine FAD set numbers assumed for CCMs, and corresponding scalars relative to 2013-2015 average conditions under the two scenarios.

Optimistic PS scenario

	Non-SIDS		SIDS				
	3 mth FAD closure	Additional 2mth high seas removes:	3mth FAD closure	Additional 2mth high seas removes:	Non-SIDS	SIDS	Total
CHINA	1365	0			1365		1365
ECUADOR	285	8			277		277
EL SALVADOR	292	14			279		279
FSM			661	3		658	658
JAPAN	1019	0			1019		1019
KIRIBATI			963	0		963	963
MARSHALL ISLANDS			1285	7		1278	1278
NEW ZEALAND	110	2			107		107
PAPUA NEW GUINEA			1585	7		1578	1578
PHILIPPINES (distant-water)	464	0			464		464
REPUBLIC OF KOREA	1422	4			1418		1418
SOLOMON ISLANDS			128	0		128	128
EU (SPAIN)	477	29			449		449
CHINESE TAIPEI	2591	3			2588		2588
TUVALU			61	0		61	61
USA	3330	59			3271		3271
VANUATU			230	0			230	230
					11236	**4895**	**16131**

Scalar V 2013-15 avg **1.11**

Pessimistic PS scenario: additional high seas sets under specified effort limits

	CMM HS day limit	Avg 13-15HS days	Avg HS sets/day	Additional HS sets
CN	26	15.3	0.04	0.5
ES	403	327.7	0.62	46.7
JP	121	39.3	0.08	6.9
NZ	160	59.3	0.28	28.2
KR	207	146.0	0.20	12.4
TW	95	67.3	0.36	10.0
US	1270	1279.3	0.37	0.0

Additional HS sets **105**

Longline bigeye catches assumed for CCMs, and corresponding scalars relative to 2013-15 average conditions under the two scenarios, plus intermediate analysis of consequences where CCMs limited to 2000mt take their recent average catch levels.

CCM	Pessimistic		Optimistic
	2017 CMM levels if limited, otherwise 2000mt (non sids) or 2013-2015 avg	2017 CMM levels if limited, otherwise 2013-2015 avg	2017 CMM levels or 2013-15 if lower
AMERICAN SAMOA	2,000	421	421
AUSTRALIA	2,000	588	588
BELIZE	2,000	72	72
CHINA	8,224	8,224	8,224
COOK ISLANDS	181	181	181
EU-PORTUGAL	2,000	65	65
EU-SPAIN	-	47	47
FSM	1,377	1,377	1,377
FIJI	1,300	1,300	1,300
FRENCH POLYNESIA	776	776	776
GUAM	2,000	277	277
INDONESIA	5,889	5,889	3,411
JAPAN	18,265	18,265	14,347
KIRIBATI	469	469	469
MARSHALL ISLANDS	27	27	27
NAURU	0	0	0
NEW CALEDONIA	57	57	57
NEW ZEALAND	2,000	118	118
NIUE	0	0	0
NORTHERN MARIANAS	2,000	831	831
PALAU	0	0	0
PAPUA NEW GUINEA	33	33	33
PHILIPPINES	2,000	77	77
REPUBLIC OF KOREA	13,942	13,942	12,095
SAMOA	44	44	44
SENEGAL	2,000	0	0
SOLOMON ISLANDS	2,481	2,481	2,481
TONGA	18	18	18
TUVALU	128	128	128
CHINESE TAIPEI	10,481	10,481	10,017
USA	3,554	3,554	3,554
VANUATU	3,670	3,670	3,670
WALLIS AND FUTUNA	0	0	0
Total	88,916	73,411	64,706
Scalar from 2013-15	**1.35**	**1.11**	**0.98**