

Bigeye tuna management procedure design considerations

WCPFC-SC21-2025/MI-WP-06

SCIENTIFIC COMMITTEE
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Introduction

A management procedure (MP) comprises three components:

- data collection,
- estimation method (EM), and
- harvest control rule (HCR).

All three components should be considered as a whole when designing, evaluating and implementing an MP.

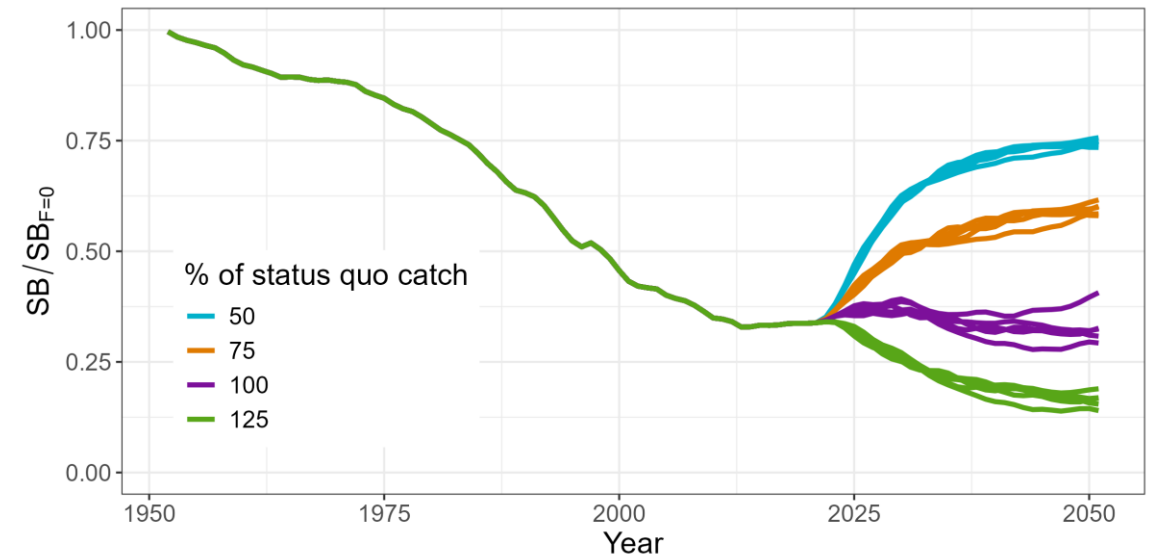
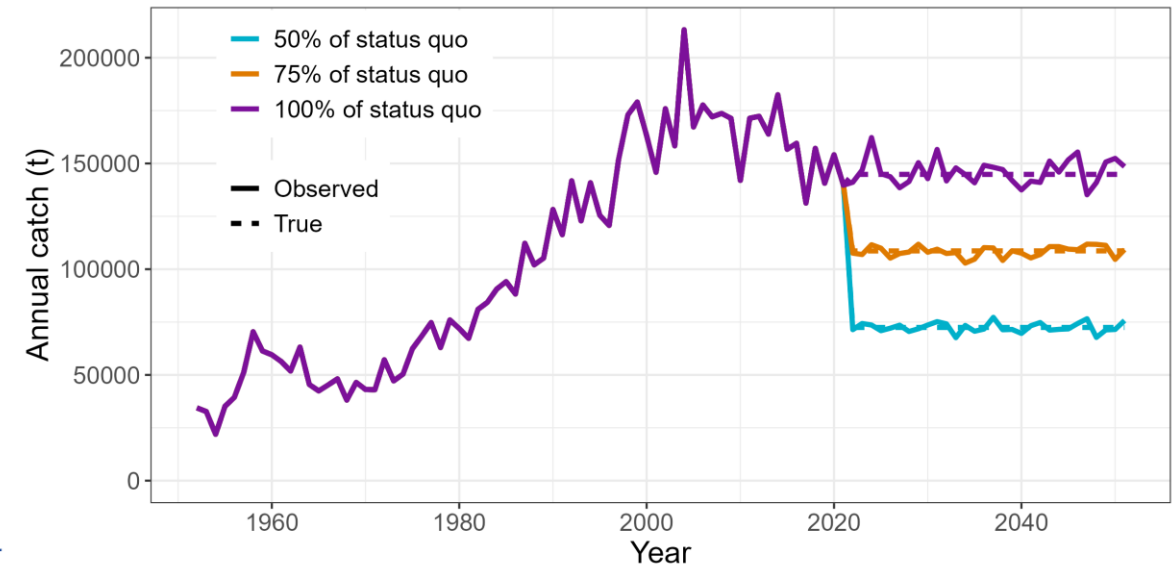
A significant portion of the report was dedicated to the EM, which is the most complex component of MP design. Other design considerations for candidate bigeye MPs were also presented.

Generation of test data

Test data was generated from stochastic projections.

Used to evaluate whether the EM could accurately estimate stock status.

Type	Axis	Levels	Options
Model error	Steepness	3	0.65, 0.8 and 0.95
	Tag mixing period	2	1 quarter and 2 quarters
Process Error	Recruitment period	2	long term and short term
Implementation Error	Effort creep	2	0% and 2% PS, 1% for LL
Observation Error	Catch variance	1	20%
Future scenario	Catch target	4	50%, 75%, 100% and 125% of SQ
	Terminal year	5	2011, 2021, 2031, 2041, 2051



EM performance

Two models were investigated: an age-structured production model implemented in Stock Synthesis 3 (SS3) and a surplus production model implemented in SPiCT.

EM performance was judged by comparing the 'true' terminal stock status from simulated data to the estimated terminal stock status from the EM.

Four metrics of terminal stock status were considered:

- $SB/SB_{F=0}$
- $SB/SB_{Initial}$
- SB/SB_{2012}
- SB/SB_{2017}

SPiCT

SPiCT is a simple biomass model with growth, natural mortality and recruitment all contained in a single productivity parameter.

The population scaling parameter (carrying capacity) was estimated due to the strong correlation with depletion. The productivity parameter was also estimated.

Preliminary results from SPiCT revealed that changes in stock status were not estimated with sufficient accuracy for SPiCT to be considered a plausible EM.

Structure

No. areas	1
No. extraction fisheries	1
No. index fisheries	9

Parameters

Productivity	Estimated
Carrying capacity	Estimated
Recruitment deviations	NA
Growth	NA
Maturity	NA
Natural mortality	NA
Steepness	NA
Movement	NA
Recruitment distribution	NA
Selectivity	NA

SS3

SS3 was run on an annual timestep with four seasons.

‘Consensus’ index combined indices from the 9 SA regions.

The population scaling parameter (initial recruitment) and annual deviations from the stock recruitment relationship were estimated.

Other parameters fixed to values from the diagnostic model of the most recent stock assessment.

Structure

No. areas	1
No. extraction fisheries	32
No. index fisheries	1

Parameters

Growth	Fixed
Maturity	Fixed
Natural mortality	Fixed
Steepness	Fixed
Initial recruitment	Estimated
Recruitment deviations	Estimated
Movement	NA
Recruitment distribution	NA
Selectivity	Fixed

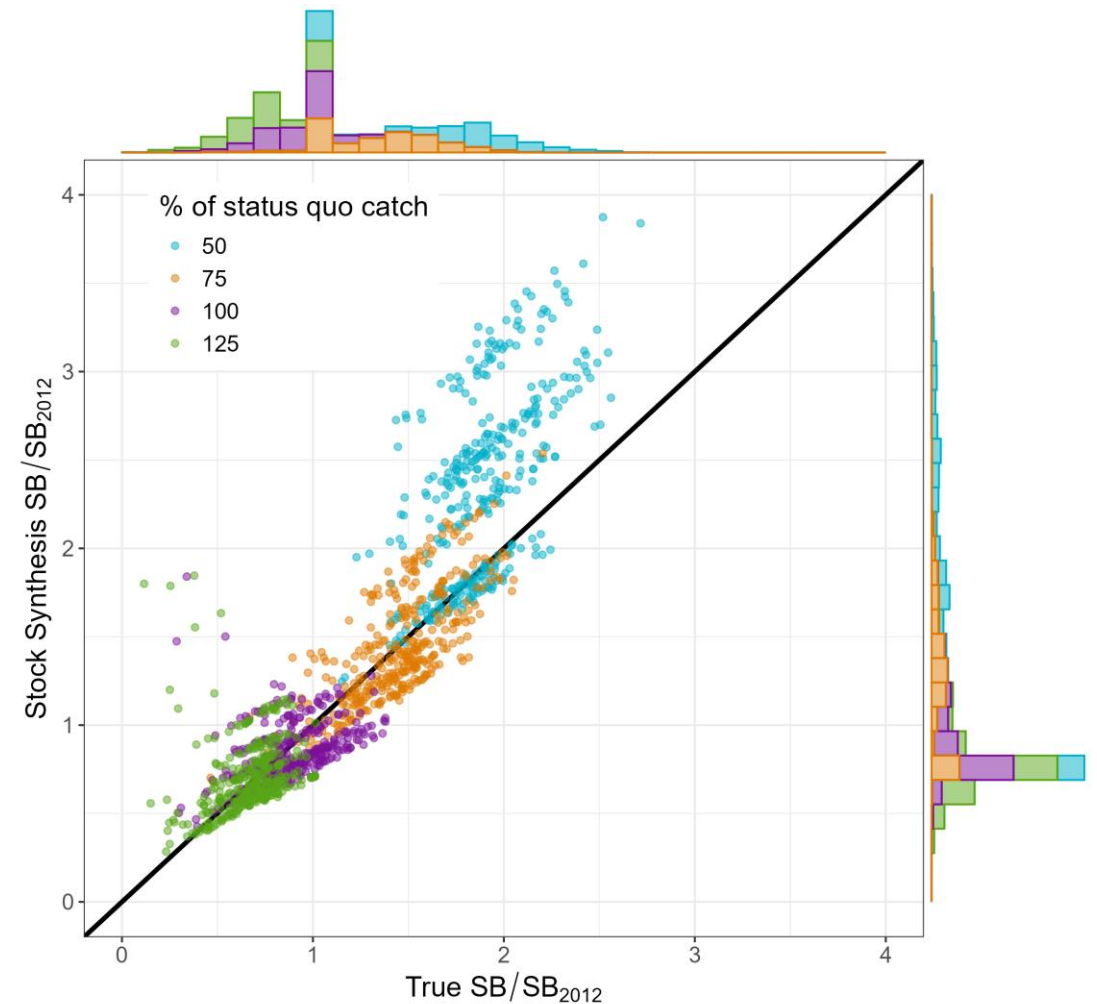
SS3 results

The relationship between the estimate of stock status and the 'true' stock status should be linear.

The best performing metric was SB/SB_{2012} .

SB/SB_{2012} is $SB/SB_{F=0}$ in the terminal year relative to the average $SB/SB_{F=0}$ in the reference period from 2012 to 2015.

Output	Intercept	Slope	R^2
$SB/SB_{Initial}$	0	0.51	0.72
$SB/SB_{F=0}$	-0.04	0.4	0.62
SB/SB_{2012}	-0.34	1.31	0.78
SB/SB_{2017}	-0.38	1.53	0.78



Operational considerations

- The proposed EM requires future data collection to obtain:
 - annual catch totals by weight for the WCPFC convention area, and
 - longline catch and effort data for the 9 BET regions suitable for CPUE standardisation.
- The revised harvest strategy schedule proposes a three-year cycle for the bigeye MP.
- Under the mixed-fishery framework, longline fisheries operating between 20N and 10S will be managed through the bigeye MP.
- The HCR should ensure the stock has a high probability of avoiding the limit reference point and demonstrate a high likelihood that management objectives are achieved.
- The HCR may be supplemented with meta-rules that impose a maximum percentage change in catch or effort for each year the MP is run.
- Fishery management advice may be catch- or effort-based, with conversions used to translate between the two.

Next steps

Further developments may investigate:

- The preparation of CPUE time series,
- Alternative ways to calculate stock status from EM output,
- Sensitivity to initial conditions.

There may be a need to re-evaluate the performance of the EM following any significant developments with the operating models.

Recommendations

SC21 is invited to:

- Consider the results of the estimation method trials for the bigeye tuna management procedure,
- Endorse the continued development of an estimation method implemented in SS3 for the bigeye tuna MP, and
- Provide guidance on the operational considerations of MP design, including the harvest control rule, meta-rules and output type (catch- or effort-based).

Acknowledgement

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Other results

