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Running the IOTC Bigeye Tuna Management Procedure for 2022

IOTC Working Party on Methods

Oct 2022

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IOTC-2022-WPM13

Citation

Williams AJ, Jumppanen P, Preece AL, Hillary RM (2022). Running the IOTC Bigeye Tuna Management Procedure for 2022. Working Paper prepared for the 13th IOTC Working Party on Methods, 19-21 October 2021.

Acknowledgements: This work was funded by DFAT Australia and CSIRO.

Contents

1 Background

The Indian Ocean Tuna Commission (IOTC) adopted a Management Procedure (MP) in 2022 to recommend the total allowable catch (TAC) for consideration by the Commission (IOTC Resolution 22/03). The bigeye MP is the first fully-specified MP to be adopted in the IOTC. The adopted MP schedule requires the MP to be run by the IOTC Scientific Committee in 2022, through the Working Party on Methods and Working Party on Tropical Tunas, to derive a recommended TAC for 2023 and 2024. This document describes the key data inputs to the MP and the TAC calculation given the agreed data. The full specification of the MP is provided in Williams et al. (2022), and the consideration of exceptional circumstances is provided Preece et al. (2022).

2 Data inputs

There are only two data inputs for the Bigeye tuna MP:

1. **Catch data**: the agreed aggregated annual catches of bigeye tuna compiled by the IOTC Secretariat
2. **Longline CPUE data**: the agreed standardised joint CPUE series derived from Japanese, Korean and China,Taiwan longline fisheries.

2.1 Catch data

The catch dataset to be used in the MP is the nominal catches reported to the IOTC Secretariat by Contracting Parties and Cooperating Non-Contracting Parties (CPCs) as per the IOTC Conservation and Management Measures (CMMs) and following the standards and formats defined in the IOTC reporting guidelines. The dataset to be used in the MP includes annual catches, in weight, aggregated across fleets, gears, and IOTC areas from 1979 to the most recent year of data available. The dataset used in running the Bigeye tuna MP for 2022 is provided in Figure 1 and Appendix A.

2.2 Longline CPUE data

The CPUE dataset to be used in the MP is based on the standardisation of the longline catch and effort data provided by Japan, Korea, and Taiwan,China for the years 1979 to present. A single aggregate CPUE index is used as the input data to the bigeye tuna MP, which is a weighted combination of the 4 region-specific, year-quarter CPUE series described in Kitakado et al. (2022). The weighting factors for each region are derived using the analysis by Hoyle & Langley (2020) for the period 1979 – 1994. The area weighted CPUE series is then renormalised to a value of 1 to provide a single aggregate CPUE index for input into the MP. The final CPUE index used as an input to the bigeye tuna MP is shown in Figure 2 and Appendix A.

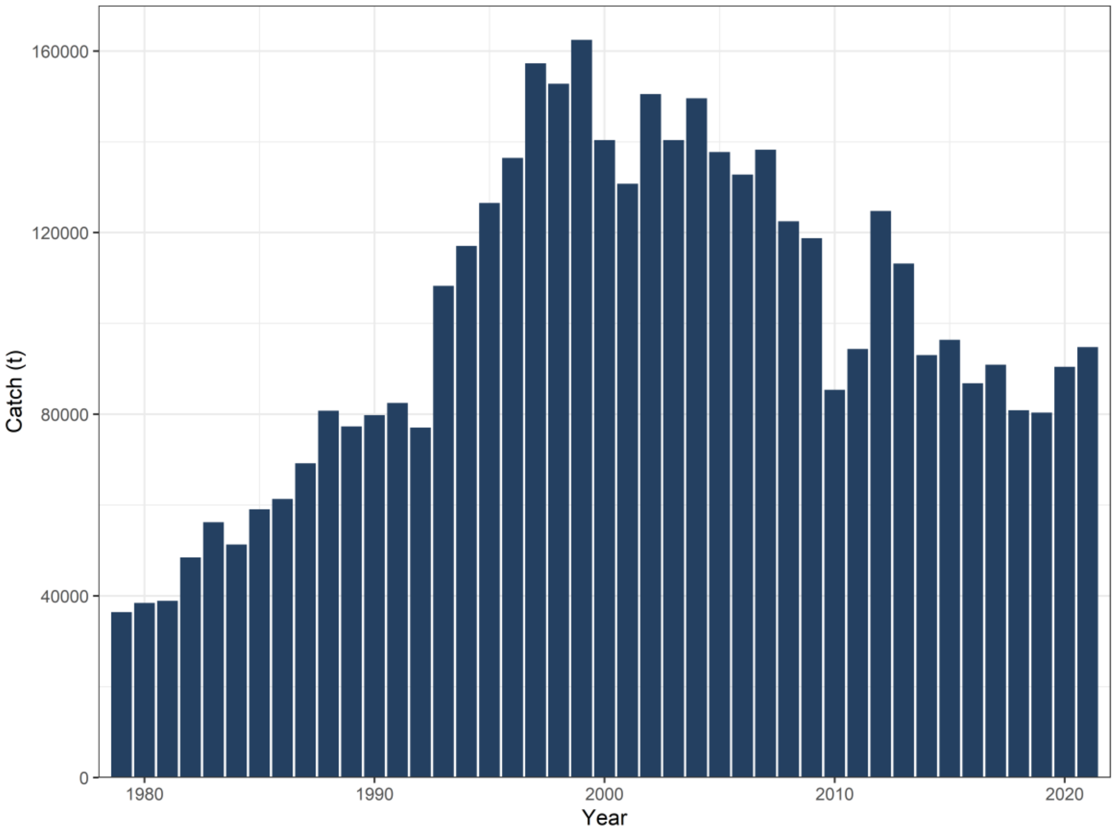

Figure 1. Annual bigeye tuna catch data used in running the bigeye tuna MP for 2022 (source https://iotc.org/WPTT/24/Data/03-NC).

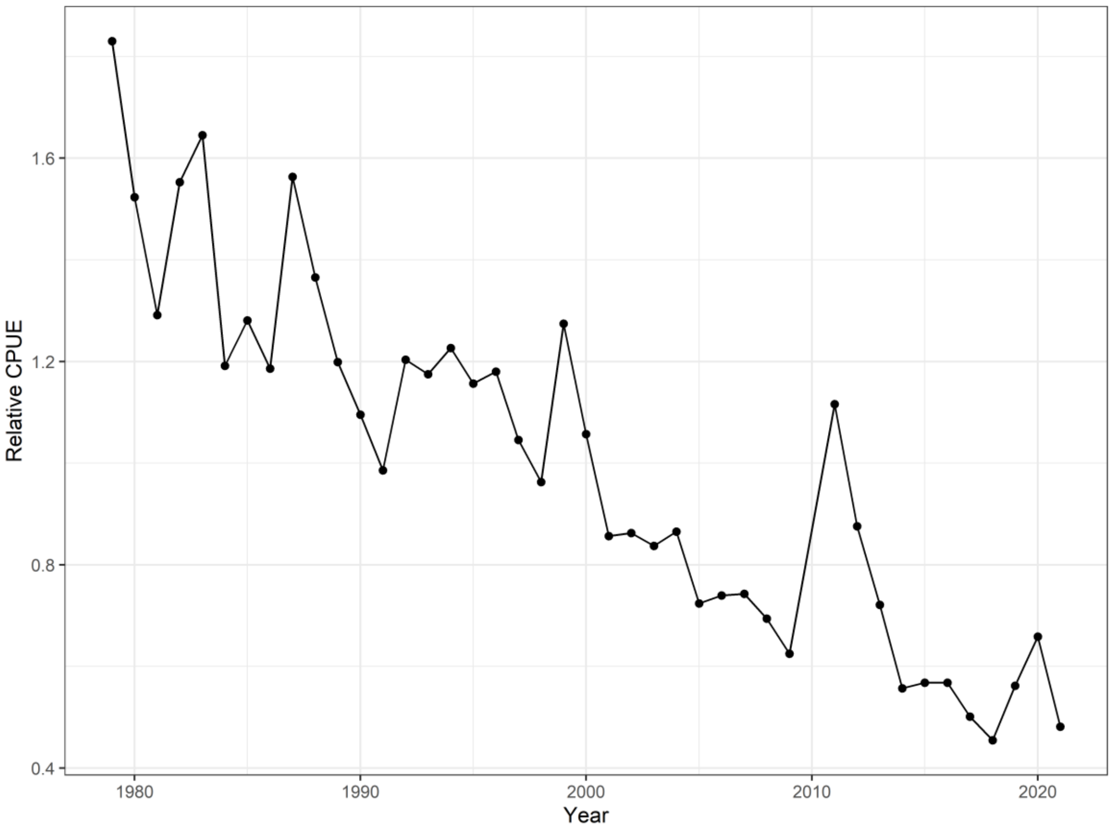

Figure 2. Standardised area-weighted longline cpue series for bigeye tuna used as input data to the bigeye tuna MP.

3 Structure of the MP

The IOTC bigeye tuna MP is a model-based MP, which uses only catch and CPUE as input data. The MP fits a simple Pella-Tomlinson biomass dynamics model (estimation model) to determine the estimated (within-MP-model) stock depletion, which is then used in a hockey stick-shaped harvest control rule (HCR) to calculate the TAC for the next 3-year cycle. In running the MP for the first time in 2022, the Commission agreed to set a 2-year TAC (2024 and 2025) to ensure that the timing of MP re-runs does not coincide with years of stock assessment updates.

The estimated parameters from the estimation model used in the HCR are the ratio fishing mortality to the value which produces MSY (F_{MSY} ratio), biomass in the most recent year (B_y), carrying capacity (K), and the relative biomass in the most recent year (B_y/K).

The HCR derives an HCR multiplier (HCR_{mult}) as follows:

$$HCR_{mult} = 1 \ if \ \frac{B_y}{K} \geq 0.4$$

$$HCR_{mult} = \frac{\frac{B_y}{K} - 0.1}{0.3} \ if \ 0.1 < \frac{B_y}{K} < 0.4$$

$$HCR_{mult} = 0.0001 \ if \ \frac{B_y}{K} \leq 0.1$$

The new TAC is then derived using:

$$TAC_{new} = B_y(1 - exp(-F_{mult} \times HCR_{mult} \times F_{MSY} \ ratio))$$

where F_{mult} is the fixed parameter (3.718) derived from tuning the MP (during the MSE process) to achieve the Commission's objective of achieving a 60% probability of being in the green zone of the Kobe plot by 2034-2038. The MP has a limit on the maximum change to the TAC of 15% of the previous TAC. The 2022 BET MP advice will be the first TAC to be implemented. Therefore, the 15% limit on the maximum change to the TAC will be relative to the total catch in 2021 (94,803 t).

4 Running the MP

The estimation model was run using the catch and CPUE data inputs as described above. It is important to note that parameter estimates from the estimation model are internally consistent within the MP and are not intended to align with those from the stock assessment (Kolody and Jumppanen, 2016), and therefore should not be directly compared. The estimation model converged and did not show any sensitivity to starting parameter values. The model provided good fits to the standardised CPUE data (Figure 3).

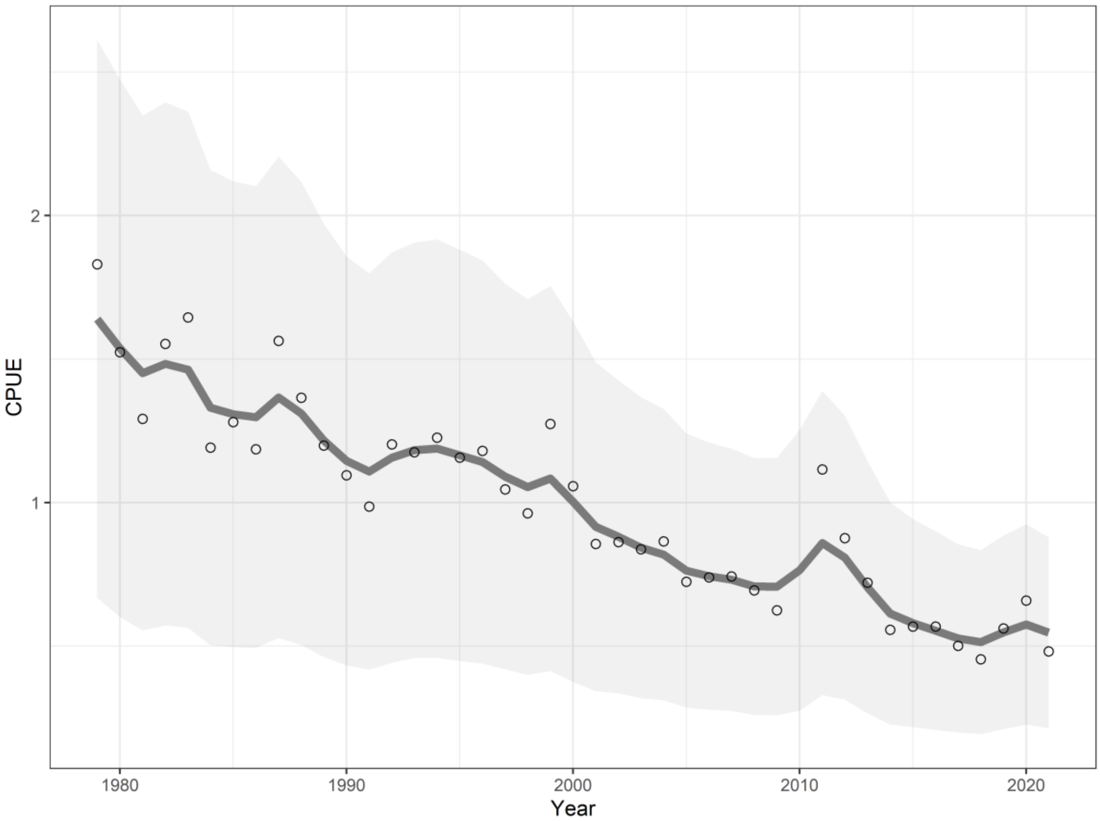

Figure 3. Model fit (line) of the Pella-Tomlinson biomass dynamics model to the standardised area-weighted longline cpue series (points).

5 TAC calculation

Key parameters from running the MP are shown in Table 1. Inputting the ratio B_y/K = 0.28 to the HCR [(B_y/K - 0.1)/0.3] provides a value for HCR_{mult} of 0.612. Inputting these values into the TAC calculation generates a new TAC of 68,404 t, which is more than 15% lower than the 2021 catch of 94,803 t. Applying the maximum 15% change in TAC, the recommended TAC is 80,583 t.

Table 1. Key parameter estimates from running the bigeye tuna MP.

Parameter/output	Abbreviation	Estimate
Fishing mortality at MSY ratio	F_{MSY} ratio	0.05
Carrying capacity	K	2,070,647 t
Biomass estimate	B_y	587,081 t
MP Tuning parameter (fixed parameter)	F_{mult}	3.718
HCR multiplier	HCR_{mult}	0.612
Calculated TAC	TAC_{new}	68,404 t
Recommended TAC (applying maximum 15% TAC change to 2021 catch[1])	TAC	80,583 t

[1] The first time the MP is run, the estimated catch for the most recent year (2021) is used as the reference level to determine whether to adjust the calculated TAC according to the maximum allowable change of 15%. In subsequent years, the most recent TAC set by the Commission will be used as the reference level.

6 References

Hoyle SD & Langley AD (2020). Scaling factors for multi-region stock assessments, with an application to Indian Ocean tropical tunas. Fisheries Research, 228, 105586.

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Appendix A. Data inputs for running the BET MP

Table A1. Annual catch and standardised area-weighted longline CPUE series data used as input to the bigeye tuna MP for 2022 (source https://iotc.org/WPTT/24/Data/03-NC).

Year	Catch (t)	Relative CPUE
1979	36430	1.830528
1980	38468	1.523529
1981	38942	1.291575
1982	48497	1.552621
1983	56214	1.645213
1984	51332	1.191679
1985	59068	1.280605
1986	61348	1.186083
1987	69236	1.563338
1988	80770	1.365293
1989	77315	1.198684
1990	79801	1.095399
1991	82507	0.985943
1992	77087	1.203251
1993	108273	1.175083
1994	117088	1.226358
1995	126549	1.156729
1996	136445	1.179919
1997	157306	1.045617
1998	152805	0.962755
1999	162449	1.274379
2000	140375	1.05698
2001	130768	0.856182
2002	150535	0.862281
2003	140383	0.837075
2004	149610	0.86508
2005	137756	0.724032
2006	132782	0.739502
2007	138255	0.742891
2008	122520	0.69395
2009	118801	0.624966
2010	85368	NA
2011	94374	1.115925
2012	124759	0.87583
2013	113193	0.720919
2014	93056	0.556949
2015	96396	0.567835
2016	86849	0.567825
2017	90905	0.501273
2018	80884	0.454371
2019	80378	0.56173
2020	90471	0.658559
2021	94803	0.481265

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