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2025 update on running the IOTC Bigeye Tuna Management Procedure for 2024

IOTC Working Party on Methods

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Contents

1 Background 2

2 Data inputs 2

2.1 Catch data 2

2.2 Longline CPUE data 2

3 Structure of the MP 4

4 Running the MP 4

5 TAC calculation 5

6 References 6

Appendix A. Data inputs for running the BET MP 7

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 tuna MP was first 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 2024 and 2025. The adopted MP schedule required the bigeye MP to be run again in 2024 to derive a recommended TAC for 2026, 2027 and 2028.

The agreed standardisation of the joint CPUE series derived from Japanese, Korean and China,Taiwan longline fisheries, a key input to the MP, was not available at the time of the 2024 working party meetings, and the MP could not be run in 2024. The joint CPUE series using the agreed standardisation approach has since become available (Kitakado pers. comm.) and 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 updated consideration of exceptional circumstances is provided in Preece and Williams (2025).

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 annual catch dataset used in running the Bigeye tuna MP for 2024 is provided in Figure 1.

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 Williams 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.

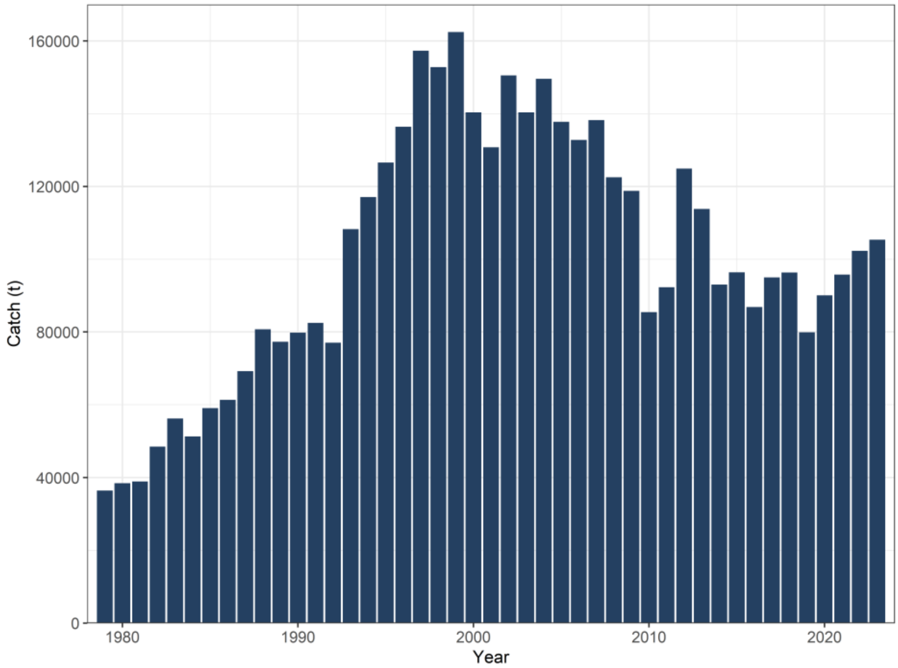

Figure 1. Annual bigeye tuna catch data (tons) used in running the bigeye tuna MP for 2024 (source https://iotc.org/WPTT/26AS/Data/03-NC).

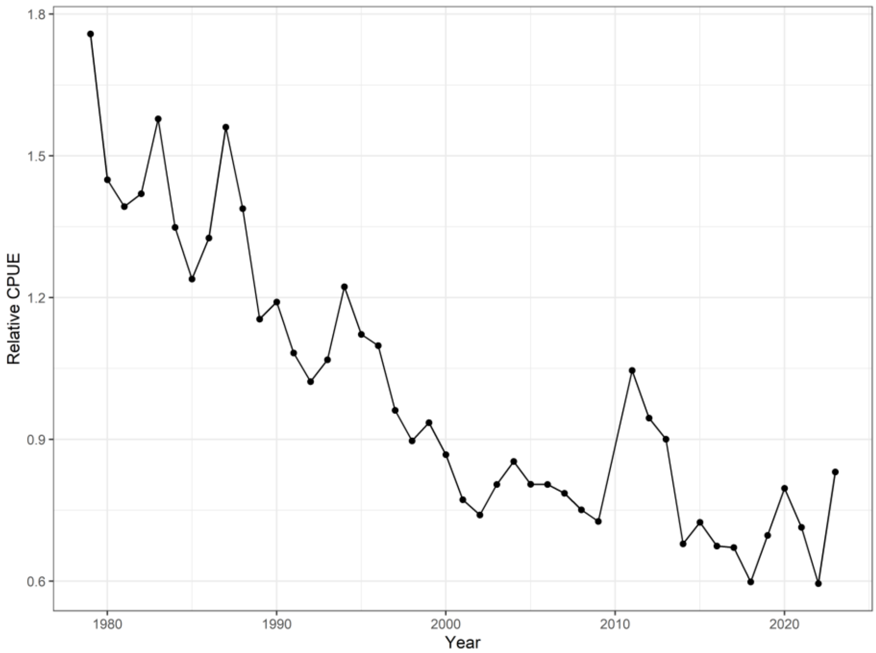

Figure 2. Standardised area-weighted longline CPUE series for bigeye tuna used as input to the bigeye tuna MP.

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 to estimate 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.

The estimated parameters from the estimation model used in the HCR are the ratio of current fishing mortality (F) to the F 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:

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

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

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

A new, unconstrained, 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 constraint on the maximum change to the TAC of 15% of the currently set TAC, such that:

$$TAC = TAC_{new} \; if \; within \; 15\% \; of \; currently \; set \; TAC, otherwise \; the \; change \; limit \; applies$$

The 15% constraint on the maximum change to the TAC for running the bigeye tuna MP in 2024 will be relative to the TAC set for 2024 and 2025 (i.e. 80,583 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).

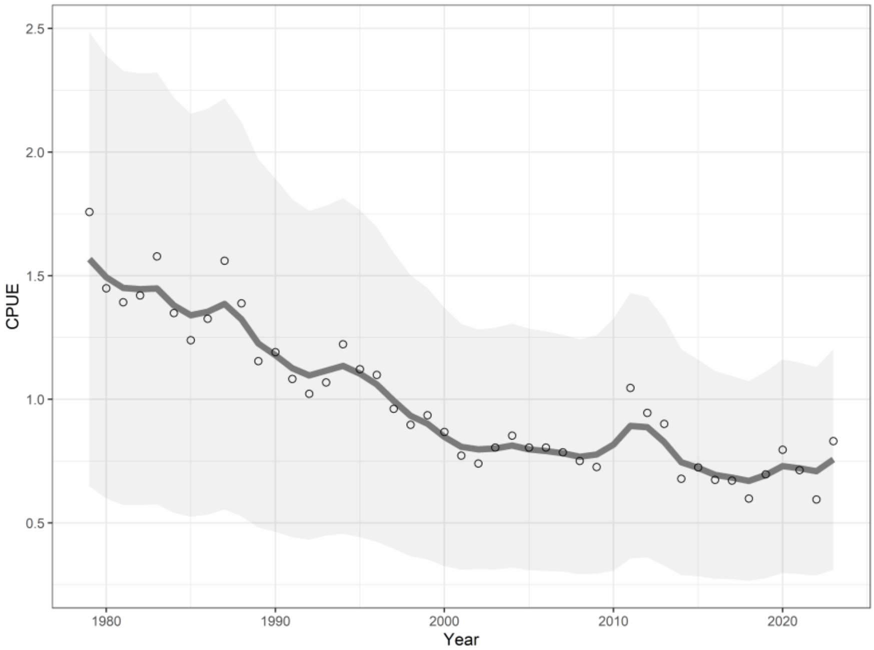

Figure 3. Model fit (line) of the Pella-Tomlinson biomass dynamics model to the standardised area-weighted longline CPUE series (points).

5 TAC calculation

Key parameters from running the MP are shown in Table 1. The ratio B_y/K = 0. 414129 (i.e. >0.4) so the value for HCR_{mult} is 1. Inputting these values into the TAC calculation generates an unconstrained estimate of a new TAC of 175,005 t, which is more than 15% higher than the TAC set for 2024 and 2025 (i.e. 80,583 t). Applying the maximum 15% change in TAC, the recommended TAC is 92,670 t.

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

Parameter/output	Abbreviation	Estimate
Fishing mortality at MSY ratio	F_{MSY} ratio	0.071447
Carrying capacity	K	1,811,442 t
Biomass estimate	B_y	750,170 t
MP Tuning parameter (fixed parameter)	F_{mult}	3.718
HCR multiplier	HCR_{mult}	1
Unconstrained TAC	TAC_{new}	175,005 t
TAC for 2024 and 2025	TAC_{2025}	80,583 t
Recommended annual TAC 2026-2028 (applying maximum 15% TAC change to 2025 TAC)	TAC	92,670 t

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.

Kolody D, Jumppanen P (2016). IOTC Yellowfin and Bigeye Tuna Management Strategy Evaluation: Phase 1 Technical Support Project Final Report. IOTC-2016-WPM07-09.

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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 2024 (source https://iotc.org/WPTT/26AS/Data/03-NC).

Year	Catch (t)	Relative CPUE
1979	36429.66	1.758278
1980	38468.31	1.449416
1981	38941.61	1.392808
1982	48497.36	1.420113
1983	56214.26	1.578397
1984	51332.16	1.348727
1985	59068.46	1.239271
1986	61347.53	1.326096
1987	69236.39	1.560774
1988	80770.18	1.388595
1989	77315.44	1.15468
1990	79801.17	1.190849
1991	82506.74	1.082794
1992	77087.28	1.022209
1993	108273.1	1.068363
1994	117087.9	1.223131
1995	126548.5	1.122129
1996	136444.6	1.098574
1997	157306.1	0.961366
1998	152804.8	0.896661
1999	162448.8	0.935328
2000	140375.1	0.867665
2001	130767.8	0.772339
2002	150535.2	0.740019
2003	140382.6	0.804569
2004	149610.2	0.853323
2005	137756.3	0.805074
2006	132781.6	0.804599
2007	138254.9	0.785922
2008	122519.9	0.750922
2009	118801.1	0.726412
2010	85472.41	NA
2011	92313.84	1.045919
2012	124901.7	0.944977
2013	113810.3	0.900316
2014	93026.17	0.6789
2015	96421.01	0.724509
2016	86874.19	0.674398
2017	94995.25	0.670971
2018	96338.35	0.598152
2019	79897.72	0.696689
2020	90067.78	0.796275
2021	95793.31	0.713883
2022	102324.5	0.594664
2023	105369.5	0.830945

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