SIMULATION TOOL FOR ALLOCATION CRITERIA: DATA, ASSUMPTIONS, AND OUTPUT

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Purpose

This document provides an overview of the data, assumptions, and outputs generated by simulating the allocation criteria described in IOTC-2024-TCAC13-REF02. It also includes a brief description of the shiny application, along with explanations of the main configuration options for setting up simulations and interpreting the resulting outputs.

Input Data

CPC and Coastal State Status

The definitions of all parameters characterising each Contracting Party and Cooperating Non-Contracting Party (CPC) in relation to the allocation criteria are provided in the Excel spreadsheet CPC_CONFIGURATIONS.xlsx file. This file contains two worksheets:

- The 'CPC' worksheet lists all current IOTC Contracting Parties (CPs), Liberia as a Cooperating Non-Contracting Party (CNCP), and Taiwan,China as a Fishing Entity (FE). It includes information on CPC status, classification as a Coastal State or Small Island Developing State (SIDS), and the presence and size of National Jurisdiction Areas (NJAs) within the IOTC Area of Competence
- The 'COASTAL_STATE_SOCIO_ECONOMIC' worksheet includes all CPCs identified as Coastal States, along with their development status and a set of socio-economic indicators aligned with the requirements of Option 1 and Option 2 under paragraph 6.6(1)(b) of IOTC-2024-TCAC13-REF02.These indicators are used to simulate allocation scenarios that incorporate development and vulnerability criteria.

Detailed descriptions of the fields included in these two worksheets are provided in Appendix 1 and Appendix 2, respectively.

Historical Catches

Historical catch data for albacore, bigeye tuna, skipjack tuna, swordfish, and yellowfin tuna are available from 1950 to 2021. These data can be downloaded from HISTORICAL_CATCH_ESTIMATES.csv and opened using spreadsheet software such as Microsoft Excel, LibreOffice Calc, or any standard text editor. Detailed description of the fields included in the file is provided in Appendix 3.

Catch data are stratified by year, fleet, gear, school type, species, and assigned area (either a National Jurisdiction Area or the high seas) to support allocation analyses. The method used to categorise

catches by area of operation was presented to the Technical Committee on Allocation Criteria at its twelfth meeting in October 2023 and endorsed by participants (IOTC-2023-TCAC12-INF02). For longline and surface fisheries operating on the high seas, catches were allocated to NJAs based on the proportion of spatial overlap between each regular grid cell and the corresponding NJA (see IOTC–2017–SC20–INF05).

The National Jurisdiction Areas (NJAs) of IOTC CPCs were sourced from the Flanders Marine Institute's Maritime Boundaries Geodatabase. These shapefiles are available for download from the IOTC Reference Data Catalogue. For historical reasons, the waters of the Chagos Archipelago were considered to be under the sovereignty of the United Kingdom of Great Britain and Northern Ireland (GBR).

Simulation Tool

The Secretariat has developed an interactive simulation tool to facilitate the exploration of various configuration options for the components of catch allocation outlined in the Draft Allocation Regime (v7), presented at the 13th session of the TCAC (IOTC-2024-TCAC13-REF02). The tool is an interactive R Shiny web application, available at https://foodandagricultureorganization.shinyapps.io/iotc-tcac-simulations/. The App is password-protected to support access control and monitoring, with login credentials provided to participating delegates. To ensure full transparency and reproducibility, all scripts and data used to generate the Shiny App are available in the iotc-tcac-simulations repository, hosted on the IOTC Secretariat's GitHub.

Total Allowable Catch Values

The App allows users to set the TAC values, which are pre-filled by default in accordance with the most recent IOTC resolutions for bigeye and skipjack tunas, and with the Maximum Sustainable Yield (MSY) values derived from stock assessments for albacore, swordfish, and yellowfin tuna:

- Albacore: 45,000 t (IOTC-2024-SC27-ES01)
- Bigeye tuna: 92,670 t (IOTC Res. 25/04
- Skipjack tuna: 628,606 t (IOTC Res. 25/03)
- Swordfish: 30,000 t IOTC-2024-SC27-ES16
- Yellowfin tuna: 421,000 t (IOTC-2024-SC27-ES04)

Baseline Allocation

The baseline allocation refers to a percentage of the TAC for a given stock that is distributed equally among all current CPCs. In the App, users can adjust the baseline weight percentage, within a range of 0–100%, using an interactive slider in the application interface.

Coastal State Allocation

Similarly to the baseline allocation, the total weight assigned to the coastal State allocation can be adjusted by users using an interactive slider in the application interface. This allocation component consists of three sub-components: (i) the equal weight, (ii) the socio-economic weight, and (iii) the Exclusive Economic Zone (EEZ) weight. The contribution of each sub-component can be adjusted using interactive sliders in the App.

While two options for the socio-economic component were defined at the 13th session of the TCAC (IOTC-2024-TCAC13-REF02), the indicators required for Option 1 are not yet fully available; therefore, only Option 2 is currently operational in the App (see Appendix 2 for details on the indicators).

The relative contributions of the three components of Option 2 – the Human Development Index, Gross National Income, and Small Island Developing States (SIDS) status – can be defined using interactive sliders, with their combined total summing to 100%.

Catch-Based Allocation

The weight assigned to the catch-based allocation corresponds to the remaining percentage once the baseline and coastal State weights have been specified. To calculate the catch-based allocation weight for each CPC, historical catch data are averaged over a user-defined time frame using one of two computational approaches:

- the annual average across the selected time period; or
- the average of the best *n* years across the selected time period, where the 'best years' are defined as those with the highest catches, within the selected period.

Transition Period for Implementation

The TCAC proposed a stepwise approach for implementing the catch allocation scheme over a period of 6 to 10 years for each stock, through annual increments during this transition period. The App follows the schedule proposed in IOTC-2024-TCAC13-REF02 whereby each annual percentage value defines the proportion of the catch taken by foreign fleets in the NJAs that is allocated to the quota.

Simulation Results

The simulation results can be downloaded as an Excel file using the **Download** button in the 'Tables' tab. The filename corresponds to the date and time the download request was issued. The file contains the following five worksheets:

1. 'CPC_REFERENCES' containing the CPC configuration parameters as in CPC_CONFIGURATIONS.xlsx
2. 'COASTAL_STATE_REFERENCES' containing the coastal states configuration parameters as in CPC_CONFIGURATIONS.xlsx
3. 'HISTORICAL_CATCHES' containing the historical catches for the selected species as extracted from HISTORICAL_CATCH_ESTIMATES.csv
4. 'SIMULATION_CONFIGURATION' containing all the configuration parameters set by the users for the specific simulation round
5. 'OUTPUT_QUOTAS' containing the outputs of the simulation expressed either as fraction of the annual TAC or as catches in metric tonnes by CPC and simulation year (depending on the chosen value of the 'output unit' parameter).

Additionally, the 'Reports' tab allows users to download outputs as Word files, either for all CPCs simultaneously or individually for each entity via a drop-down list. The reports include an initial table presenting the general scenario configuration, followed by the final results after a 10-year transition period, as well as allocation and TAC values calculated at each step of the allocation process: (i) baseline allocation, (ii) coastal State allocation including all sub-components, and (iii) catch-based allocation.

Appendices

Appendix 1: Description of the CPC dataset

Tab. A1: Description of the fields included in the CPC worksheet of the configuration file

Field name	Description	Example / Format
CODE	Mnemonic code, generally the ISO3 country code	MDV
NAME_EN	Official English name	Maldives
NAME_FR	Official French name	Maldives
STATUS_CODE	Abbreviated IOTC status: CP, CNCP, or FE	CP
STATUS	Full IOTC status: Contracting Party, Cooperating Non-Contracting Party, etc.	Contracting Party
IS_SIDS	Whether the CPC is a Small Island Developing State	true or false
IS_COASTAL	Whether the CPC is considered a coastal State	true or false
HAS_NJA_IO	Whether the CPC has a National Jurisdiction Area within the IOTC area	true or false
NJA_SIZE	Size of the NJA in km²	916,244 km2
NJA_IOTC_RELATIVE_SIZE	NJA as percentage of the IOTC Area of Competence	1.49

Appendix 2: Description of the Coastal State Dataset

The 'COASTAL_STATE_SOCIO_ECONOMIC' worksheet lists all IOTC CPCs identified as Coastal States, along with their development status and a set of socio-economic indicators aligned with the requirements of Option 1 and Option 2 under paragraph 6.6(1)(b) of IOTC-2024-TCAC13-REF02. The data are also available under the 'Coastal States Summary' tab in the TCAC Simulation App.

Tab. A2: Description of the fields included in the COASTAL_STATE_SOCIO_ECONOMIC worksheet of the configuration file. These fields define the development status and socio-economic indicators of IOTC CPCs identified as Coastal States, supporting the application of the allocation criteria specified in paragraph 6.6(1)(b) of IOTC-2024-TCAC13-REF02

Field Name	Description	Used in Option
CODE	Mnemonic code, generally the ISO3 code	-
NAME_EN	Official English Name	-
NAME_FR	Official French Name	-
DEVELOPMENT_STATUS	Development classification: Least Developed (LD), Developing (DG), Developed (DE)	-
PER_CAPITA_FISH_CONSUMPTION_KG	Per capita fish consumption (kg/person/year)	Option 1
CUV_INDEX	Commonwealth Universal Vulnerability Index	Option 1
PROP_WORKERS_EMPLOYED_SSF	Percentage of fish workers employed in small-scale and artisanal fisheries	Option 1
SIDS_STATUS	Whether the CPC is a Small Island Developing State	Both
PROP_FISHERIES_CONTRIBUTION_GDP	Percentage contribution of fisheries to Gross Domestic Product	Option 1
PROP_EXPORT_VALUE_FISHERY	Percentage of total export value contributed by fisheries	Option 1
HDI_STATUS	Human Development Index status	Option 2
GNI_STATUS	Gross National Income status	Option 2

- The Development Status was sourced from the United Nations website
- The Commonwealth Universal Vulnerability Index (CUVI) is a multidimensional metric that captures a country's vulnerability across four dimensions: economic, climate-related, socio-political, and structural, as well as its policy resilience. The CUVI values used (method #1), which refer to the year 2018, were sourced from the 2021 CUVI report. Countries are classified into four categories based on their CUVI score: (i) Extremely Vulnerable (CUVI > 1.5), Highly Vulnerable (1< CUVI $\leq$ 1.5), Vulnerable (0.5 < CUVI $\leq$ 1), and Resilient (CUVI $\leq$ 0.5). The index is not available for Australia, the European Union, and France (Overseas Territories), and the United Kingdom
- The Small Island Developing States (SIDS) status was sourced from the United Nations website

- The Human Development Index (HDI) was sourced from the UNDP website. The HDI for the EU was calculated as an average based on data from The Global Economy. As no HDI value is available for Somalia, the lowest observed value in the dataset (0.446, from Mozambique) was used
- The Gross National Income (GNI) indicator was sourced from the World Bank website
- Information on the other socio-economic indicators — including per capita fish consumption, the proportion of fish workers employed in small-scale and artisanal fisheries, the contribution of fisheries to Gross Domestic Product, and the share of fisheries in total export value — is not yet available in a standardised format suitable for inclusion in the simulations. As a result, 'Option 1' cannot currently be considered.

Appendix 3: Description of the Historical Catch Dataset

Tab. A3: Description of the fields included in the historical catch dataset (1950-2021) considered for the simulations

Field Name	Description	Example / Format
YEAR	Gregorian calendar year of the fishing activities	1995
FLAG_CODE	Flag state of the fishery vessels, combining the CPC in the case of European Union Member States and aggregating all non-CPCs as others (OTH) or not elsewhere included (NEI)	EUR.FRA
FLEET_CODE	Similar to flag code except in the case of European Union countries (EUR)	EUR
FISHERY_TYPE	Classification to define the scale of the fishing operations, separating fisheries composed of vessels less than 24 m and operating exclusively in National Jurisdiction Areas (ART = Artisanal/coastal) and surface and longline fisheries that may operate on the High Seas (IND = Industrial)	IND
FISHERY_CODE	Fishing gear used to catch the fish. GI = gillnets; HL = handlines; LL = longlines; OT = other gears; PL = pole-and-lines; PS = purse seines; TL = trolling lines	PS
SCHOOL_TYPE_CODE	Behavioural or environmental context in which fishing activity occurs, particularly in purse seine and other surface fisheries. FS = free-swimming schools; LS = schools associated with drifting floating objects	FS
ASSIGNED_AREA	Area of origin of the catch, either the high seas (HIGH_SEAS) or the national jurisdiction areas identified with the ISO 3166 alpha-3 code of the country, except for the Chagos archipelago (CHAGOS) and France Overseas territory (FRAT)	NJA_SYC
SPECIES_CODE	ASFIS alpha-3 code of the fish species	YFT
CATCH_MT	Amount of fish caught and retained in live-weight equivalent (metric tonnes)	5200