CATCH DATA AVAILABILITY, ESTIMATIONS, AND GAPS RELEVANT TO THE IOTC ALLOCATION PROCESS

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Introduction

At its 14th session, the Technical Committee on Allocation Criteria (TCAC) requested *"the Secretariat to prepare an information paper that summarises any data gaps in the information reported by Contracting Parties and Cooperating Non-Contracting Parties (CPCs) to the IOTC and the level of estimation of CPCs catches over time"* (IOTC 2025). The overarching objective of this paper is to provide participants at the 15th session of the (TCAC15) with an overview of the workflow used to produce the catch data available to support the allocation process, including a summary of data gaps in CPC reporting and the extent to which CPC catches have been estimated over time.

Materials

Historical Catch Data, 1950-1996

Catch data on tuna and tuna-like fisheries for the period 1950–1996 were managed by the Indo-Pacific Tuna Development and Management Programme (IPTP), which was established in 1982 under the Food and Agriculture Organization (FAO). The IPTP aimed to assist governments in the Indo-Pacific region with the long-term management and development of tuna and tuna-like species. All data managed by the IPTP were handed over to the IOTC Secretariat upon its establishment in the Seychelles in 1998. Catch data were collated from countries involved in the IPTP through a network of national correspondents, while estimates for non-reporting countries were derived from ancillary sources of information, often using the FAO's global catch production database (IOTC Secretariat 1998). During the 1990s, the level of non-reporting increased due to: (i) the development of tuna fisheries in countries without data collection systems and (ii) the growing practice of vessel reflagging to non-member countries that did not report data to the IOTC.

Establishment of the IOTC

The IOTC was established in 1993 under Article XIV of the FAO Constitution. At its first session, held in December 1996, the Commission decided to establish the Scientific Committee (SC) as an advisory body, with one of its key functions being to recommend policies and procedures for the collection, processing, dissemination, and analysis of fishery data. In addition, the IOTC Rules of Procedure define the duties of the Secretary, including *"facilitating the collection of data necessary to accomplish the objectives of the Commission"* (IOTC 1996).

At its second session, held in September 1997, the Commission adopted the scale of contributions for IOTC Members based on the 1995 World Bank Gross National Product (GNP) classification and 1995 tuna catch data (IOTC 1997). At its third session, following discussions regarding discrepancies in catch

volumes reported by different sources, the Commission agreed that the calculation of contributions should be based on the verified catch data held by the Secretariat (IOTC 1998).

IOTC Data-Related Resolutions, from 1998

The IOTC Secretariat became fully operational in August 1998. The first fishery data request was sent to IOTC Members by email, fax, or airmail, covering the years 1997 and 1998 (IOTC Secretariat 1999). Reporting templates were developed to facilitate data submission, and the Secretariat adopted the IPTP approach of using the FAO global capture production database to estimate unreported catches by species. Gear composition was inferred from historical data and expert knowledge, as such information is not available in the FAO database.

In 1998, the 7th Expert Consultation on Indian Ocean Tunas recommended the establishment of mandatory statistical requirements for IOTC Members. These included specifications on the spatial, temporal, and technical resolution of catch, effort, and size data, as well as the timeline for data submission (Anonymous 1999). The recommendations formed the basis of the first IOTC Conservation and Management Measure (CMM) on data: Resolution 98/01. This resolution, which was superseded by Resolution 01/05 to include data on supply vessels and Fish Aggregating Devices (FADs) did not include provisions on annual nominal catch data. These were first introduced in Resolution 08/01, and subsequently carried forward and updated in Resolution 10/02 and then in Resolution 15/02.

Sources of Uncertainty

Several sources of uncertainty are associated with the data available from the Secretariat, which are used as part of the allocation process.

Catch Terminology and Discards

The concept of fisheries catch, as defined by the Coordinating Working Party on Fishery Statistics (CWP), encompasses several components that reflect the different fates of fish once taken from the water (**Fig. 1**). Resolution 15/02 calls CPCs to report *"estimates of the total catch by species and gear, separated, whenever possible, by retained catches in live weight and by discards in live weight or numbers"*. The Secretariat has developed specific reporting forms for each main catch component, i.e., retained catches (Form 1RC) and discards (Form 1DI). Nevertheless, information on discards reported to the Secretariat remains very limited, is often not raised to total estimates, and does not fully comply with all IOTC reporting standards. As most data collection systems rely on logbooks and landing monitoring, the best scientific estimates of total catch generally reflect nominal landings and exclude discards (see Section Estimates of Discards).

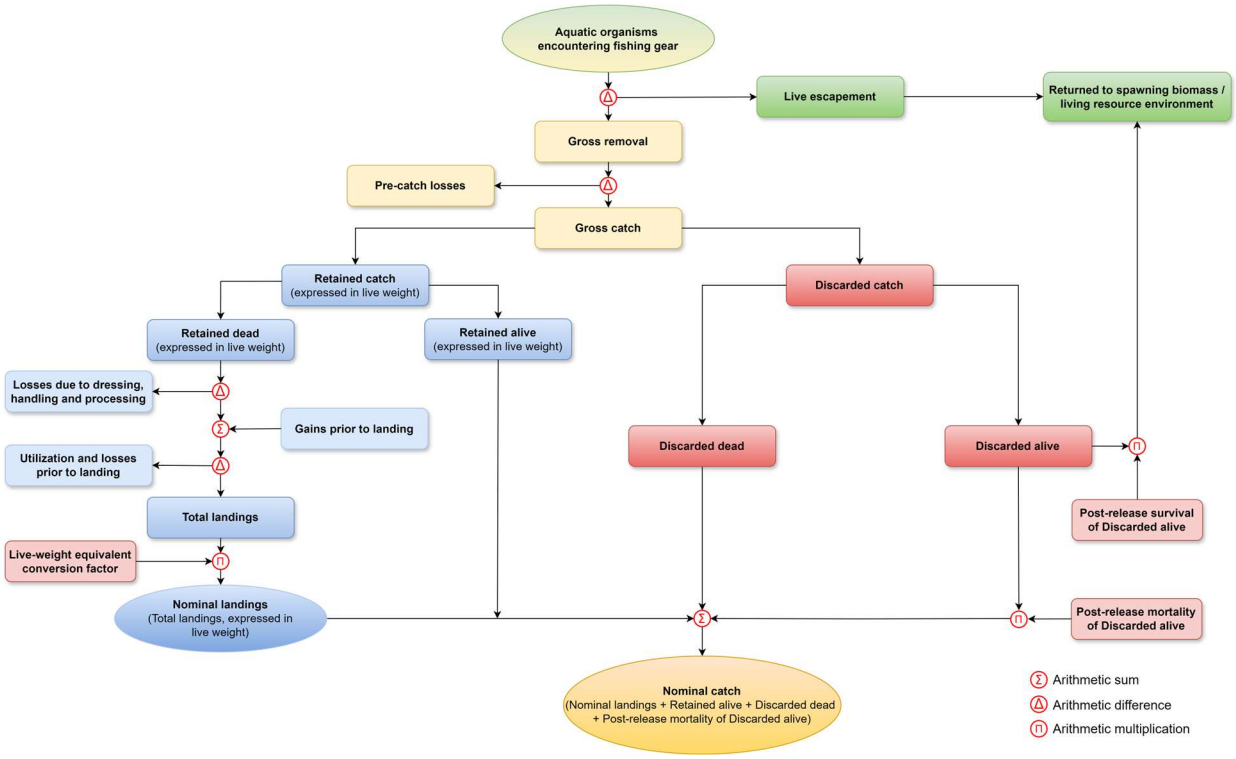

Fig. 1. Various components of the catch as defined by the Coordinating Working Party of the FAO

Monitoring and Estimation of Retained Catches

The completeness and quality of retained catch data reported to the IOTC are considered to be significantly higher for longline and surface (i.e., industrial) fisheries than for coastal (i.e., artisanal) fisheries. Catches of target species from large-scale fisheries have been monitored through logbook and landing recording systems since the development of these fisheries. By contrast, data collection in coastal fisheries is generally more challenging due to their multi-gear and multi-species nature, the typically large number of fishing vessels to monitor, and the dispersion of landing sites, which may extend over very large areas and be difficult to access. These challenges are often compounded by limited resources and staffing, irregular reporting practices, and the informal nature of many small-scale fisheries.

The data collection and management systems in place in several coastal States present a number of limitations. These include the absence of, or weaknesses in, sampling design; the lack of accurate boat frame or activity surveys to support extrapolation; and challenges in communication and data exchange between the various institutions involved in data collection. In some cases, data are not raised, and the composition and magnitude of the catch may vary considerably from year to year due to changes in sampling location or effort.

Another factor that may affect the accuracy of catch data—relevant to both coastal and large-scale fisheries-relates to challenges in the identification of small tuna species. In large-scale purse seine fisheries, processing procedures have been implemented since the 1980s to correct the species composition of catches and to better reflect the contribution of bigeye tuna (Anonymous 2010). However, the implementation of the TAC for yellowfin tuna has challenged the accuracy of the methodology used by the main fleets, which now apply different approaches (IOTC Secretariat 2019a; Báez et al. 2023; Domínguez-Bustos et al. 2025). Additionally, no corrective method has been applied for some historical and currently active purse seine fisheries, and species misidentification is considered to be frequent in driftnet and coastal fisheries targeting small tunas.

The Secretariat has conducted several actions to build the capacity of CPC enumerators and observers in species identification, including the development of species identification cards in multiple languages and organisation of training workshops. A collaborative project led by the Overseas Fishery Cooperation Foundation of Japan (OFCF) is currently underway to develop additional online materials to support the identification of tuna, billfish, and Spanish mackerel species under the IOTC mandate (see https://iotcofcf.wixsite.com/speciesid/idtool). These resources include descriptions of key distinguishing features, a photo library, and a YouTube channel.

Monitoring and Estimation of Discards

While discards of IOTC species are considered negligible in most coastal fisheries, the extent of discarding has been found to vary across gear types and fisheries (Huang and Liu 2010; Miller et al. 2017; Ruiz et al. 2018). Overall, the total amount of discards of the principal market tunas and swordfish in Indian Ocean tuna fisheries remains unknown for most gears and time periods, despite the obligation to report these data under IOTC Resolution 15/02.

Additionally, the implementation of catch limits may lead to high-grading and over-quota discarding in mixed fisheries, although the extent of such practices is difficult to assess (Batsleer et al. 2015). No information is currently available on the impact of the Total Allowable Catch (TAC) for yellowfin tuna, implemented since 2017 through Resolution 16/01 and subsequent resolutions. However, high-grading of small, low-value fish may have occurred in some fisheries. Data from the Regional Observer Scheme (ROS) may provide insights into the prevalence and scale of high-grading and over-quota discarding.

Since 2014, except in very specific circumstances – such as when the catch is deemed unfit for human consumption or when there is insufficient storage capacity following the final set of a trip – all tropical tunas caught by large-scale purse seiners must be retained on board, in accordance with IOTC Resolution 13/11. The most recent version of the resolution also recommends the retention of tropical tuna catches in high-seas fisheries using gears other than purse seines (Resolution 24/06). This measure is expected to reduce the extent of discarding in tuna and tuna-like fisheries, and its effectiveness could be evaluated using data from the ROS.

Several actions have been undertaken in recent years to improve the reporting of discard data to the IOTC, including enhanced reporting guidelines, the mandatory use of IOTC reporting forms, and the organisation of regional data workshops to strengthen CPC capacity. Some improvements have been observed, and discard data are expected to become a fully integrated component of IOTC public-domain datasets in the future.

Unreported and Uncertain Catches

Historical NEI Catch Estimates

Historically, the Secretariat produced estimates of the catches of fleets operating under the flags of non-reporting countries throughout the 1980s and 1990s. These estimates were based on assumptions regarding the number and type of fishing vessels in operation, as well as landing reports from certain ports (Herrera 2002a, 2002b; Geehan et al. 2013). These catches are highly uncertain but their estimates exceeded 150,000 t by year in 1999 and 2000, representing about 15% of the total catch of the principal market tunas and swordfish in those years (**Fig. 2**). Some illegal fishing may also occur in the Indian Ocean (e.g., Collins et al. 2021); however, it remains extremely difficult to quantify and to incorporate into the IOTC datasets.

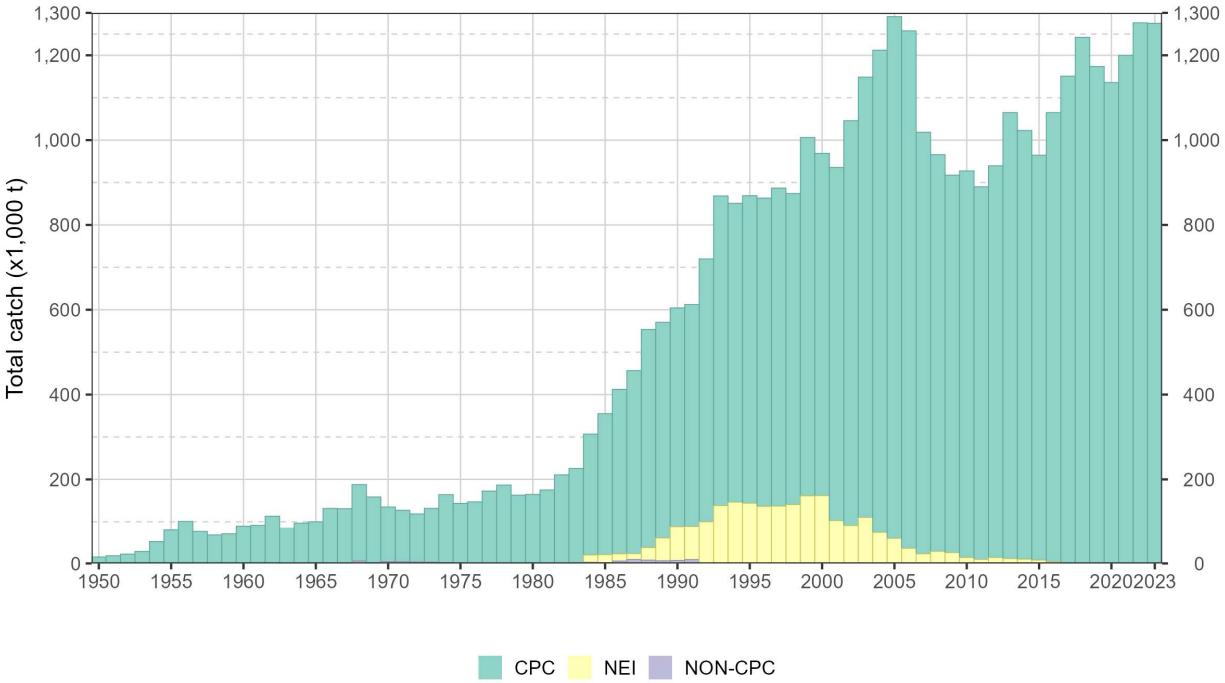

Fig. 2. Annual time series of catches (t) of albacore, bigeye tuna, skipjack tuna, and swordfish by flag attribution status, 1950–2023. CPC = Contracting Party or Cooperating Non-Contracting Party; NON-CPC = official data from non-CPCs; NEI: catch estimates from non-CPCs Not Elsewhere Included

IOTC Estimation Methodology

In 2014, the Scientific Committee endorsed a standard methodology proposed by the WPDCS to manage unreported data and to derive the best scientific estimates of catches when inconsistencies are detected (see **Appendix V** of IOTC (2014)).

When retained catches are not reported by a CPC, catch data from the previous year may be repeated, or estimates may be derived from various alternative sources, most commonly the FAO global production database. However, it is important to note that this method depends on the quality and completeness of the data submitted to FAO through the 'Fishstat NS1' questionnaire. When data are available from both workflows, discrepancies may be observed. FAO has historically given preference to the data compiled by the tuna Regional Fisheries Management Organisations (RFMOs), as some Fishstat submissions have been found to be incomplete or inaccurate for tuna and tuna-like species (Lawson and Garibaldi 2000; Garibaldi and Kebe 2006, 2006).

No catch estimates for tuna and tuna-like species have been produced for Somalia, as the country has not reported any fisheries data to FAO and no alternative sources of information are available. Somalia has recently initiated a project at six landing sites to collect fisheries data and produce estimates of domestic catches (IOTC-2024-SC27-NR23). The project is ongoing, and information on species composition and historical fishing effort may be used to estimate past catches for the country.

Similarly to non-reporting CPCs, the FAO data are used to complement catch data missing from non-CPCs. Estimates of catches for non-CPCs – such as Bahrain, Qatar, Jordan, Timor-Leste, and Egypt – have been included in the IOTC database. These catches are very small, typically ranging from a few dozen tonnes to around 1,000 tonnes over the past decade (Fig. **2**).

Finally, as part of the catch estimation methodology, a disaggregation process is applied to break down aggregated catch data by species and gear. The contribution of species aggregates to total catches is generally small and has decreased substantially over time (**Fig. 3**).

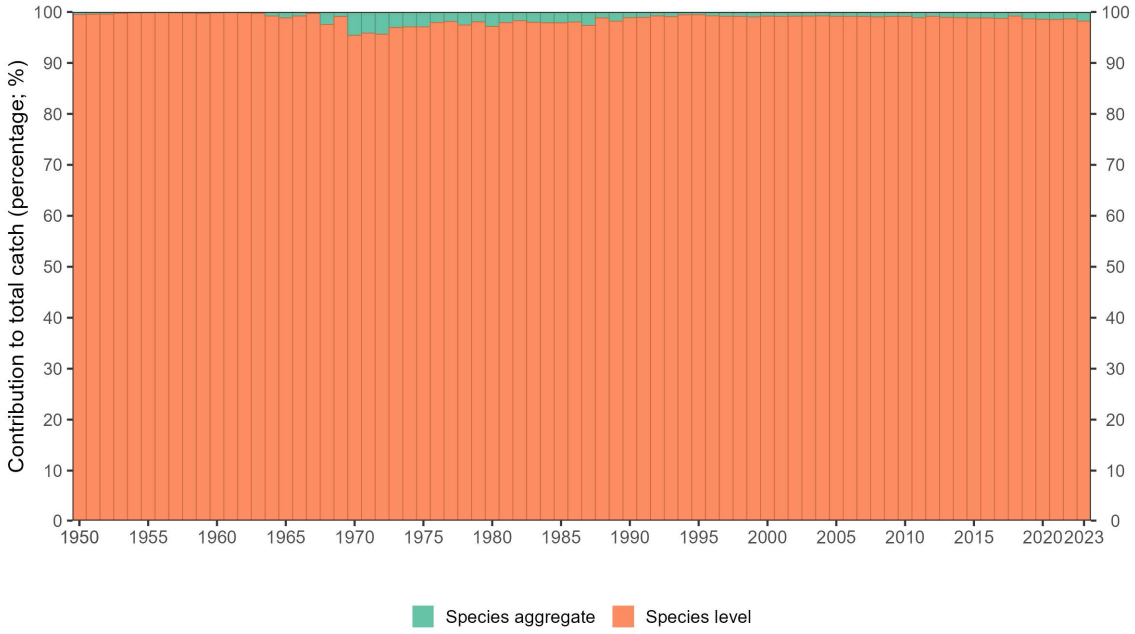

Fig. 3. Relative contribution (%) of aggregated species to the total catch of temperate tunas, tropical tunas, and billfish submitted to the IOTC, 1950–2023

Country-Specific Revisions to Catch Series

For some specific fisheries characterized by issues in terms of data quality, a process of re-estimation of species and/or gear composition may be performed based on data available from other years or areas, or by using proxy fleets, e.g., Moreno et al. (2012) and Geehan (2018). Some major revisions over long time periods may also be conducted in collaboration with CPCs, as in the case of Pakistan (IOTC Secretariat 2019b) and Indonesia (Indonesia 2024).

Data Reporting Quality

Within the IOTC framework, data collection and processing are the responsibility of the CPCs, which are expected to use the best available methods to ensure the accuracy, completeness, and consistency of the data submitted to the Commission. As early as 2010, the Secretariat developed a complex scoring system to describe the quality of the statistics held in the IOTC databases, based on information on the composition of the catch, the completeness of the estimates, sampling designs, estimation and reporting procedures for both retained catch and discard components (Herrera 2010). Due to the generally limited knowledge of the sampling designs and strategies, tools, samples collected, and data management systems used, it was very difficult to implement the procedure and assess the quality of the data submitted to the Secretariat. In addition, few ancillary sources of information are available to cross-check and validate catch data, although this is one of the primary objectives of the ROS, which primarily covers longline and surface fisheries.

Since 2015, the Secretariat has simplified the quality scoring system, which primarily reflects data availability and compliance with IOTC reporting standards, i.e., consistency with code lists and reporting at the species and gear levels (**Table 1**). Overall, a lower score indicates better data quality. It should be noted, however, that the quality scoring does not account for sources of uncertainty affecting retained catches, such as under-reporting or inaccuracies in species identification.

Tab. 1. IOTC reporting quality scores for retained catch data

Data set	Criterion	By species	By gear
Retained catch	Fully available	0	0
	Partially available	2	2
	Fully estimated	4	4

The IOTC scoring system indicates generally good reporting quality over time, with approximately 80% of the total catch for the principal market tunas and swordfish estimated to have been partially or fully reported (**Fig. 4**). For these species, the reporting quality is driven by industrial fisheries which represented about two third of the total catch in 2023. It is important to note that the reporting quality has improved substantially since the early 2010s, following enhanced submissions from key fisheries in Indonesia, Sri Lanka, and the Islamic Republic of Iran. Data from the ROS could be used to complement the assessment of reporting quality for industrial fisheries. For coastal fisheries, however, little information is available to cross-check submissions, and the Secretariat is engaged in several capacity development activities to support improvements in data collection and reporting.

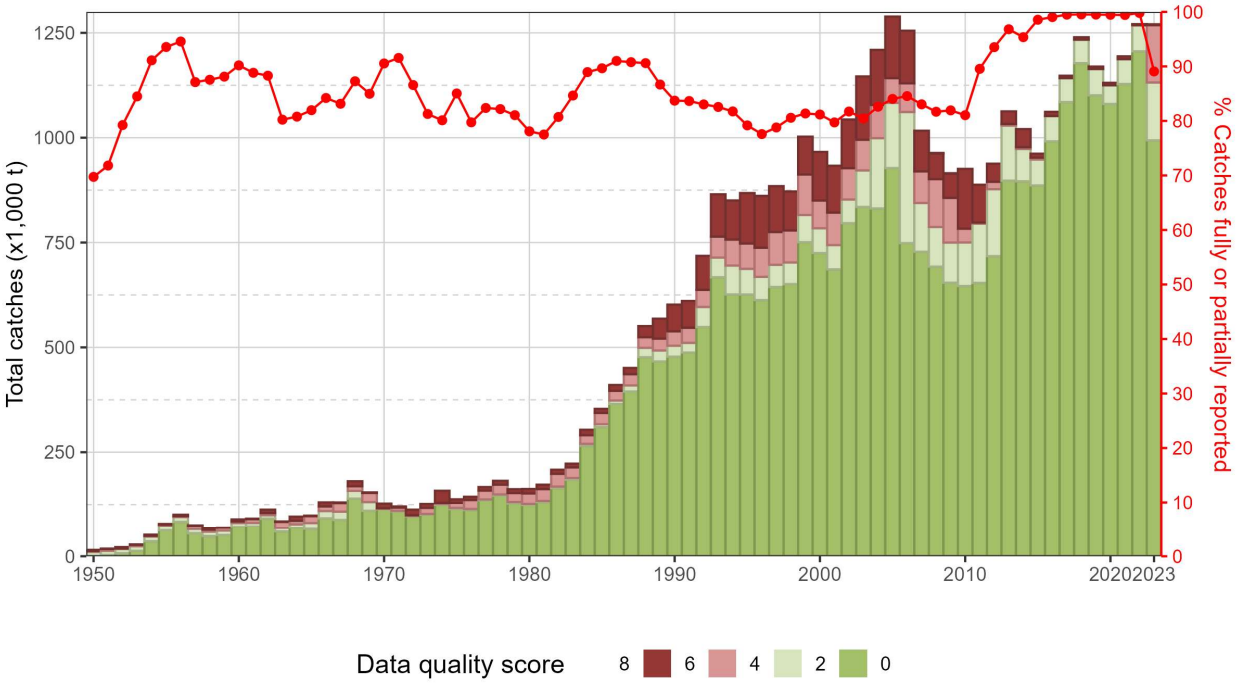

Fig. 4. Annual time series of catch (t) of albacore, bigeye tuna, skipjack tuna, swordfish, and albacore by scoring quality score, 1950-2023

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