# REPORT ON IOTC DATA COLLECTION AND STATISTICS

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## Introduction

The management of tuna and tuna-like species by the Indian Ocean Tuna Commission (IOTC) relies on the availability of scientific data describing the biology and ecology of these species and the activities of the fisheries that target them. Since its inception in 1996, the IOTC has implemented several Conservation and Management Measures (CMMs) that call for the collection and reporting of data by its Contracting Parties and Cooperating Non-Contracting Parties (CPCs) to support scientific analysis, assess stock status, and develop advice for the Scientific Committee. Furthermore, the IOTC data requirements have increased over time to progressively include the collection of information on non-IOTC species (i.e., bycatch species *sensu* IOTC) in order to analyse the ecosystem effects of tuna and tuna-like fisheries and contribute to the conservation of endangered, threatened, and protected (ETP) species such as sharks, rays, cetaceans, seabirds, and turtles that may be incidentally caught by fisheries directed at IOTC species (**Fig. 1**).

The IOTC Secretariat has developed standard forms to facilitate the reporting and management of IOTC data and their accompanying metadata. Mandatory data include information on fishing effort, fishing activities, and catch levels and composition and have to be reported following the standards and formats defined in the IOTC Reporting guidelines. Information on the composition and characteristics of the fishing fleets, fish sale prices, and other economic indicators can also be reported to the Secretariat on a voluntary basis. Since its implementation in 2012 (IOTC Resolution 11/04), the Regional Observer Scheme of IOTC (ROS) constitutes another source of data for both IOTC and bycatch species, including key information on discarding practices which are generally poorly reported in the logbooks and have to be sampled at sea.

The overarching objective of this document is to provide the IOTC Working Party on Data Collection and Statistics (WPDCS) with an overview of the status of data holdings in the IOTC Secretariat, in particular statistics of catch, effort, size frequency and other biological data for IOTC and bycatch species. The report covers the following areas:

1. Overview of data collection and reporting related to IOTC Resolutions
2. Timeliness and availability of IOTC catch statistics (2012-2020)
3. Overview of the status of the data reported for the reference year 2020
4. Status of the IOTC nominal catch, catch and effort, and size-frequency databases, 1980-2020
5. Status of the IOTC fishing craft statistics (FC) and active vessels (AV) databases
6. Other IOTC data holdings

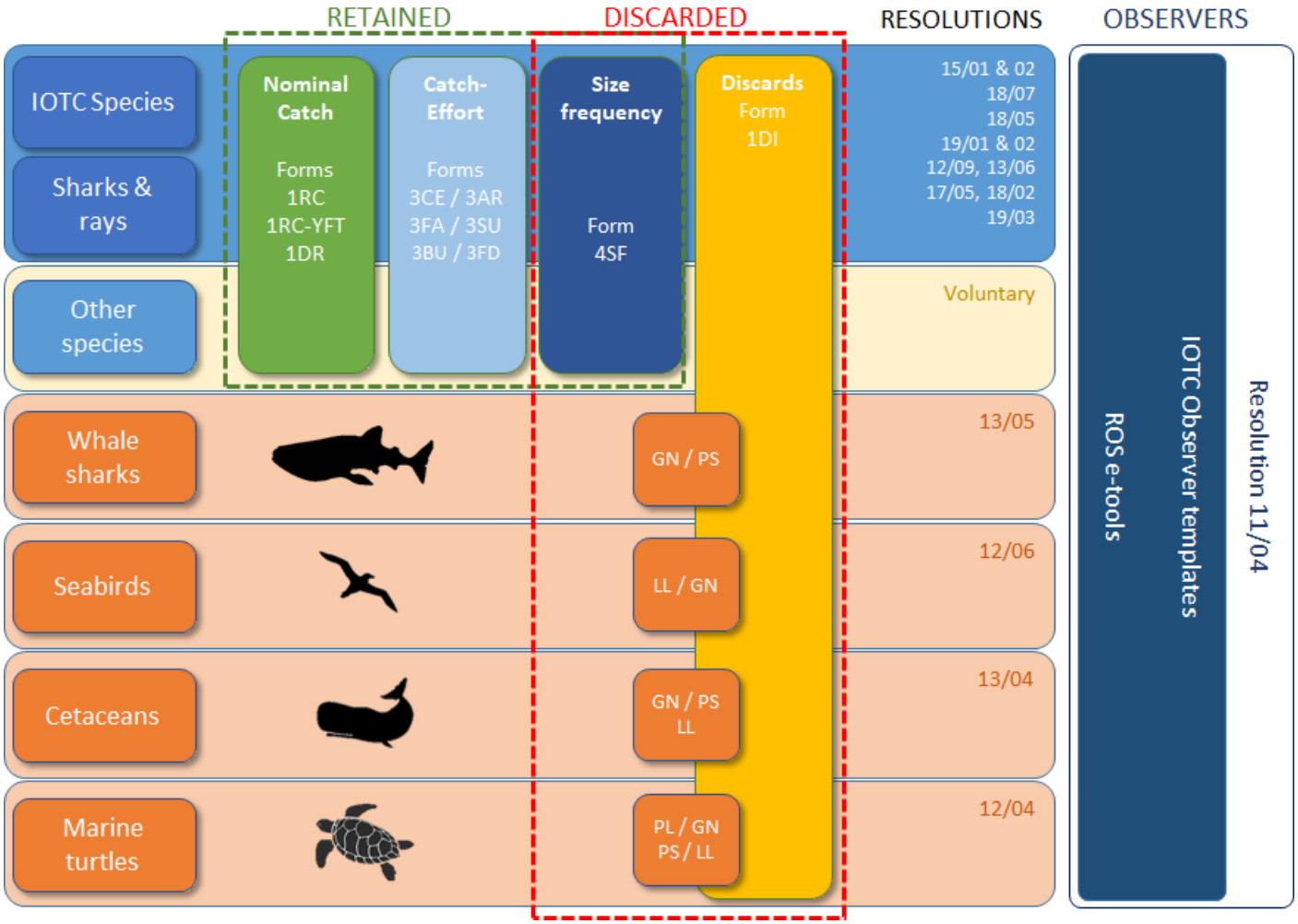


Figure 1: Overview of the data reporting requirements, including IOTC reporting forms and tools, and Resolutions for the 16 IOTC species and bycatch species caught or interacted with by fisheries for tuna and tuna-like species in the IOTC area of competence. BB = Baitboat; GN = Gillnet; LL = Longline; PS = Purse seine

## Overview of data collection and reporting related to IOTC Resolutions

The nature and resolution of data sets to be reported to the Secretariat varies according to the type of fishery operating in the IOTC area of competence. The IOTC considers two distinct categories of fisheries whose definition relies on the IOTC Record of Authorized Vessels (RAV) defined as per IOTC Resolution 19/04: (1) **authorised fishing vessels** which have to be recorded in the RAV are fishing vessels of 24 m overall length and over, and under 24 meters if they fish outside national Exclusive Economic Zones (EEZ) and (2) **coastal (or artisanal) fishing vessels** which are vessels of less than 24 m length overall that only operate within national EEZs and do not require to be recorded in the RAV.

According to IOTC Resolution 15/02, the IOTC fisheries are defined as follows:

- **Longline fisheries**: fisheries undertaken by vessels in the RAV that use longline gear;
- **Surface fisheries**: all fisheries undertaken by vessels in the RAV other than longline fisheries, in particular purse seine, pole-and-line, gillnet, handline, and trolling fisheries;
- **Coastal fisheries**: fisheries other than longline or surface, as defined above, also called **artisanal fisheries**.

Hence, the IOTC definition of artisanal fisheries differs from definitions found in the fisheries science literature (e.g., Rousseau et al. 2019).

**Table 1** provides an overview of the different data sets to be reported to the IOTC Secretariat along with the active IOTC resolutions defining the context, objectives, and data requirements (see Appendix I).

**Table 1:** Summary of IOTC Data Requirements applicable to species managed by the IOTC. M = mandatory; V = voluntary; FSA = UN Conference on Straddling Fish Stocks and Highly Migratory Fish Stocks

| Data | Resolutions | Reporting | Forms | Artisanal fisheries | Longline and surface fisheries |
|---|---|---|---|---|---|
| Nominal catch | 15/01, 15/02 | M | 1RC | Nominal catch (weight) of the 16 IOTC species and the most commonly caught elasmobranch species by major area, gear, species and year | |
| | | V | 1RC | Nominal catch (weight) of other bycatch species by major area, gear, species and year | |
| Discards | 15/01, 15/02 | M | 1DI | Discard levels of the 16 IOTC species, the most common elasmobranch species, and turtles, cetaceans, and seabirds species by major area, gear, species, and year | |
| | | V | 1DI | Discard levels of all other bycatch species by major area, gear, species, and year | |
| Fishing crafts | FSA | V | 2FC | Number of fishing crafts by fishery, boat type, and year | Individual vessel data for all vessels catching IOTC species |
| Geo-referenced catch | 15/01, 15/02 | M | 3AR, 3CE, 3FA | Catch by species, fishery, area, and period | Catch by species, fishery, school type, grid area and month strata |
| Geo-referenced effort | 15/01, 15/02 | M | 3AR, 3CE, 3SU | Effort by fishery, area, and month strata | Effort by fishery, school type, grid area and month strata, including supply vessels |
| Geo-referenced effort | 15/02, 19/02 | M | 3FA | Not applicable | Interactions with drifting floating objects by purse seiners and supply vessels, including number of sets by 1° grid area and month strata |
| | 19/02 | M | 3BU | Not applicable | Daily positions of active buoys equipping FADs and natural floating objects, by purse seine vessel |
| Geo-referenced size | 15/01, 15/02 | M | 4SF | Individual lengths of IOTC species and the most commonly caught elasmobranch species | |
| Regional Observer Scheme | 11/04 | M | ROS templates | Samples of catches landed to cover at leat 5% of vessel activities | Samples of catches at-sea to cover at leat 5% of vessel operations |
| Fish sale price | IOTC Agreement | V | 7PR | Monthly time series of fish sale price | |

## Nominal catch data

Nominal catches correspond to the total retained catches (in live weight) estimated per year, Indian Ocean major area, fleet, and gear (IOTC Res. 15/02) and can be reported through IOTC form 1RC. In addition, and in order to support the monitoring of the catch limits implemented as part of the rebuilding plan for yellowfin tuna, IOTC Res. 19/01 requests CPCs to submit their catches of yellowfin tuna, from 2019 onward, explicitly disaggregated by vessel length and area of operation (i.e., for vessel of 24 m overall length and over, and for those under 24 m if they fish outside the Exclusive Economic Zone (EEZ) of the flag state) (IOTC Form 1RC-YFT).

A series of processing steps is applied to derive the best scientific estimates of nominal catches for the 16 IOTC species (see **Appendix V** of IOTC (2014)), by implementing the following rules:

a. When nominal catches are not reported by a CPC, catch data from the previous year may be repeated or catches may be derived from a range of sources, e.g., partial catch and effort data, the FAO FishStat database, data on imports of tropical tunas from processing factories collaborating with the International Seafood Sustainability Foundation, etc.;

b. For some specific fisheries characterized by well-known, outstanding 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, i.e., fleets occurring in the same strata which are assumed to have a very similar catch composition, e.g., Moreno et al. (2012) and IOTC (2018);

c. Finally, a disaggregation process is performed to break down the catches by species and gear when they are reported as aggregates.

## Discard data

The IOTC follows the definition of discards adopted by FAO in previous reports (Alverson et al. 1994; Kelleher 2005) which considers all non-retained catch, including individuals released alive or discarded dead. Estimates of total annual discard levels in live weight (or number) by Indian Ocean major area, species and type of fishery shall be reported to the Secretariat as per IOTC Res. 15/02. The IOTC form 1DI has been designed for the reporting of discards and the data contained shall be extrapolated at the source to represent the total level of discards for the year, gear, fleet, Indian Ocean major area and species concerned, including turtles, cetaceans, and seabirds.

Nevertheless, discard data reported by CPCs to the Secretariat through IOTC Form 1DI are generally scarce, not raised, and not complying with all IOTC reporting standards. For these reasons, the most accurate information available on discards comes from the IOTC Regional Observer Scheme (IOTC Res. 11/04) that aims to collect detailed information (e.g., higher spatio-temporal resolution, fate) on discards of IOTC and bycatch species for authorized fisheries (see above).

## Fishing craft data

To complement the information on active and authorized vessels required for compliance purpose as per IOTC Resolution 10/08 and IOTC Resolution 19/04, which is limited to longline and surface fisheries, the IOTC Secretariat has developed the voluntary form 2FC for the submission of data on the annual number of fishing crafts operated by flag states by type of fishery, type of craft, and craft size. When information on vessels from longline and surface fisheries is conflicting between the active vessel list (AVL) and the form 2FC form, clarification is sought with respect to the discrepancies and preference is given to the AVL if no feedback is provided by the concerned CPC.

Following Moreno and Herrera (2013), three types of fleets are considered to better reflect the range of technical characteristics and spatial extent of the vessels fishing tuna and tuna-like species in the Indian Ocean. The fleet type is derived from the information available on vessel length, motorisation, and areas of operation (**Table 2**).

**Table 2:** Classification scheme for vessels in the Indian Ocean depending on type, size and area of operation

| Type of boat | Boat size | Area of operation | Fleet type |
|---|---|---|---|
| Non-motorised | All | Flag State EEZ only | Artisanal |
| Motorised outboard | All | Flag State EEZ only | Artisanal |
| Motorised inboard | <15 m | Flag State EEZ only | Artisanal |
| Motorised inboard | 15-24 m | Flag State EEZ only | Semi-industrial |
| Motorised inboard | <15 m | Includes other EEZ areas and/or high seas | Semi-industrial |
| Motorised inboard | 15-24 m | Includes other EEZ areas and/or high seas | Industrial |
| Motorised inboard | ≥24 m | Anywhere | Industrial |

## Catch and effort data

Catch and effort data refer to fine-scale data, usually from logbooks, reported in aggregated format and stratified per year, month, CWP[1] grid, fleet, gear, type of school, and species (IOTC Res. 15/02). The IOTC forms designed for reporting geo-referenced catch and effort data vary according to the nature of the fishing gear (e.g., surface, longline, and coastal gears). In addition, information on the use of fish aggregating devices (FADs) and activity of the support vessels that assist industrial purse seiners also has to be collected and reported to the Secretariat through IOTC forms 3FA and 3SU.

## FAD-related data

The entry in force of IOTC Res. 15/08 (September 15th 2015), combined with the new requirements expressed by IOTC Res. 15/02, called all CPCs with vessels fishing on Fish Aggregating Devices (FADs) to report to the Secretariat (in agreement with the annual statistical data submission cycle of IOTC) all data elements specific to activities on drifting and anchored FADS, possibly with the support of the recommended IOTC form 3FA.

In 2020 the IOTC Secretariat developed IOTC form 3FD to support the temporary data reporting requirements introduced by IOTC Res. 19/01, which required CPCs to provide collated geo-referenced data on the total number of FADs deployed in 2018 and 2019 by their purse seine and associated supply vessels by 1°x1° grid (see Para. 19).

## Buoy position data

As a consequence of the entry in force of IOTC Res. 19/02, IOTC CPCs with fishing vessels using drifting FOBs have now the obligation to report daily information (since January 1st 2020) on all active FADs monitored at sea with satellite-tracked buoys. The information to report to the Secretariat shall follow the structure and formats of IOTC form 3BU and contain the date, instrumented buoy ID, assigned vessel and daily position of each monitored buoy, which shall be compiled at monthly intervals, and reported to the IOTC Secretariat with a time delay of at least 60, but no longer than 90 days.

## Size frequency data

The size composition of catches may be derived from the data set of individual body lengths or weights collected at sea and during the unloading of fishing vessels. The IOTC Form 4SF provides all fields requested for reporting size frequency data to the Secretariat following a stratification by fleet, year, gear, type of school, month, CWP grid and species as required by IOTC Res. 15/02. While the great majority of size data reported through IOTC Form 4SF are for

[1] FAO Coordinating Working Party on Fishery Statistics, see also its tools and resources

retained catches, some size data on fish discarded at sea may be collected through onboard observer programs and reported to the Secretariat as part of the Regional Observer Scheme (see below).

## Socio-economic data

The IOTC Form 7PR has been designed to voluntarily report prices of fish per type of product and market for the target species of Indian Ocean tuna and tuna-like species. In addition, the IOTC encourages the reporting of information on the socio-economic dimension of tuna and tuna-like fisheries at national level, with indicators describing for instance the contribution to the Gross Domestic Product and the number of jobs in the fisheries and post-harvest sector.

## Biological data

The IOTC Secretariat is responsible for the periodical update of the morphometric relationships (i.e., length-length and length-weight equations) and conversion factors that may be required to standardize the size data submitted by the CPCs and (ii) estimate the catch in live weight equivalent when some processing occurs (e.g., gilled and gutted). In addition, information on sex-ratios, maturity, or any other biological data required for the assessments of IOTC and shark species should be made available by the CPCs for transparency and re-use of the data. The Secretariat is in the process of designing a new database aimed at hosting morphometric and other biological data collected by the CPCs in order to foster comparative analysis across fisheries and species and build regional data sets which are required to determine the factors of variability of the relationships (e.g., space, time, sex, fishing gear).

## Observer data

The IOTC definition for bycatch differs from those used in other areas and fisheries as bycatch species correspond to "all species other than the 16 IOTC listed in Annex B of the IOTC Agreement, whether caught or interacted with by fisheries for tuna and tuna-like species in the IOTC area of competence." Hence, early juveniles of tropical tunas (<1-1.5 kg) that are generally not marketable are not considered as a bycatch of tuna fisheries, although they are not targeted in most cases.

Resolution 11/04 on a *Regional Observer Scheme* (ROS) makes provision for the development and implementation of national observer schemes among the IOTC CPCs starting from July 2010 with the overarching objective of collecting *"verified catch data and other scientific data related to the fisheries for tuna and tuna-like species in the IOTC area of competence"*. The ROS aims to cover *"at least 5% of the number of operations/sets for each gear type by the fleet of each CPC while fishing in the IOTC Area of competence of 24 meters overall length and over, and under 24 meters if they fish outside their EEZs shall be covered by this observer scheme"*.

Observer data collected as part of the ROS include: (i) fishing activities and vessel positions, (ii) catch estimates with a view to identifying catch composition and monitoring discards, bycatch, and size frequency, (iii) gear type, mesh size and attachments employed by the master, and (iv) information to enable the cross-checking of entries made to the logbooks (i.e., species composition and quantities, live and processed weight and location). Observer data are in particular complementary to the nominal and catch and effort data sets as they include information on the fate of the catches (i.e. retained or discarded at sea) as well as on the condition of the discards. Furthermore, they are also the main source of spatial information on interactions between IOTC fisheries and seabirds, marine turtles, cetaceans, as well as any other bycatch species encountered.

## Tagging data

Since 2002, the Secretariat has been coordinating and supervising the Indian Ocean Tuna Tagging Programme (IOTTP). The specific objective of the programme was to reinforce the scientific knowledge of tropical tuna stocks and the rate of exploitation in the Indian Ocean by obtaining the crucial model parameters for stock assessment. The programme was implemented through a combination of a main tagging project, the Regional Tuna Tagging Project in the Indian Ocean (RTTP-IO), funded by the EU (9$^{th}$ EDF, DG-Dev), and several pilot and small-scale tuna tagging projects that took place in Maldives, India, Mayotte, and Indonesia and were funded by the DG-Fish (ex DG-Mare) and the government of Japan. In 2012, the data from past projects implemented in Maldives in the 1990s were added to the tagging database at the Secretariat. In total, 218,239 tropical tunas were tagged between 1990 and

2009 (**Table 3**). All the tagging and recapture data are hosted at IOTC Secretariat and available upon request to the Executive Secretary.

**Table 3:** Number of tropical tunas tagged throughout the Indian Ocean Tuna Tagging Programme (IOTTP). BET = bigeye tuna; SKJ = skipjack tuna; YFT = yellowfin tuna

| YEAR | BET | SKJ | YFT |
|---|---|---|---|
| 1990 | | 8,033 | 1,908 |
| 1993 | | 643 | 400 |
| 1994 | | 5,830 | 130 |
| 1995 | | | 773 |
| 2002 | 1 | 2 | 30 |
| 2003 | 18 | 70 | 974 |
| 2004 | 238 | 4,364 | 1,786 |
| 2005 | 1,892 | 17,067 | 6,399 |
| 2006 | 19,192 | 44,540 | 36,524 |
| 2007 | 14,113 | 22,580 | 13,411 |
| 2008 | 71 | 5,159 | 2,540 |
| 2009 | 474 | 7,409 | 1,668 |
| TOTAL | 35,999 | 115,697 | 66,543 |

## Data reporting quality

A scoring system has been designed to assess the reporting quality of the nominal catch, catch and effort, and size-frequency data available at the Secretariat for all IOTC and the most commonly caught shark species as defined in IOTC Resolution 15/01. The determination of the score varies according to each type of data set and aims to account for reporting coverage and compliance with IOTC reporting standards (**Table 4**). Overall, the lower the score, the better the quality. It is to note that the quality scoring does not account for sources of uncertainty affecting the nominal catches such as under-reporting and misreporting.

**Table 4:** Key to IOTC quality scoring system

| Data set | Criterion | By species | By gear |
|---|---|---|---|
| **Nominal catch** | Fully available | 0 | 0 |
| | Partially available | 2 | 2 |
| | Fully estimated | 4 | 4 |
| **Catch and effort** | Available according to standards | 0 | 0 |
| | Not available according to standards | 2 | 2 |
| | Low coverage (<30% logbooks) | 2 | |
| | Not available | 8 | |
| **Size frequency** | Available according to standards | 0 | 0 |
| | Not available according to standards | 2 | 2 |
| | Low coverage (<1 fish per ton caught) | 2 | |
| | Not available | 8 | |

# Availability and timeliness of IOTC data (2012-2021)

The deadline of submission for the nominal catch (NC), catch and effort (CE), and size frequency (SF) data is the 30th of June every year, with the possibility of submitting final versions of the data sets for longline fisheries until the 30th of December.

Failures or delays in data reporting are a major impediment to the quality of the scientific analyses performed on IOTC fisheries data sets. The timeliness of data submissions to the IOTC Secretariat is essential to provide enough time for the preparation of data sets required for the different Working Parties and Scientific Committee of the IOTC. Therefore, late reporting compromises the validation and verification of data by the IOTC Secretariat, especially when these are submitted close to, or during, Working Party meetings devoted to the stock assessment of IOTC species.

In the case of nominal catch for the 16 IOTC species, a standard procedure is used to estimate the missing data by repeating the catch data from the previous year or deriving them from a range of sources, mainly from the FAO FishStat database (see **Appendix V** of IOTC (2014)).

In general, the different types of data sets (i.e., NC, CE, and SF) are submitted by a CPC at the same date. Upon data reception, standard controls and checks are performed to ensure that the metadata and data submitted to the Secretariat are consistent and include all mandatory fields. The controls depend on each type of data set and may require the submission of revised data from CPCs if the original one is found to be inconsistent (e.g., unknown gear code) or incomplete (e.g., missing CWP spatial grid).

## Nominal catch data

### Availability

In 2021, six (6) CPCs did not report nominal catch data for 2020 to the IOTC Secretariat: Eritrea, Kenya, Somalia, Sudan, Tanzania, and Yemen. Except for Somalia, where the current status of fisheries is unknown but catches of tuna and tuna-like species from coastal fisheries are assumed to be negligible, the nominal catches of the five (5) other countries were repeated from previous year. In addition, nominal catch data had to be estimated for the following non-members of the IOTC: United Arab Emirates, Bahrain, Djibouti, Egypt, Jordan, Kuwait, Myanmar, Saudi Arabia, and Timor Leste. Overall, the part of non-reported nominal catches was small for the fishing year 2020, representing 2.3% of the total nominal catches estimated for that year.

Information collated on data submission to the IOTC Secretariat spanning the decade 2012-2021 shows sign of improvement in the levels of reporting for all IOTC species over time. Although the levels of reporting vary according to the species groups, the part of non-reported nominal catches has substantially decreased since 2012 for each species group, particularly for neritic and billfish species (**Fig. 2**). For neritic tunas, the percentage of nominal catch not reported to the Secretariat amounted to about 52% in 2012-2013 and decreased to 2.3% in 2021 (**Fig. 2**). Although less marked, the level of reporting has also much improved for tropical tunas over the last decade, decreasing from 20.2% in 2012 to 2.3% in 2021 (**Fig. 2**).

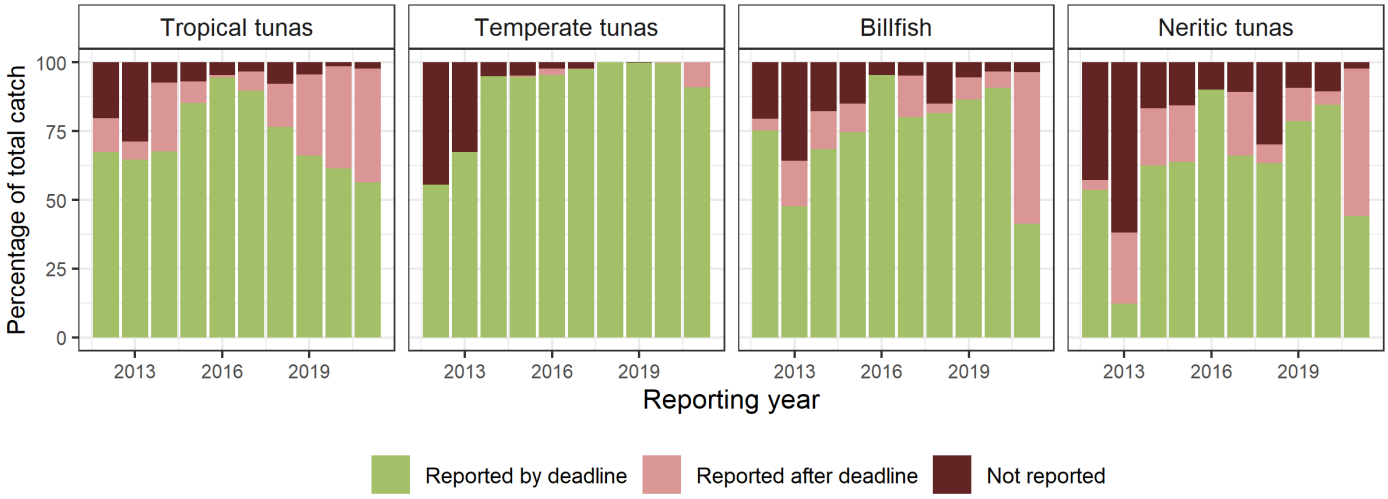


Figure 2: Annual percentage of total nominal catch of each of the IOTC species groups according to the date of submission of the nominal catch data by each fleet to the IOTC Secretariat. The submission deadline is the 30th June of each year

### Timeliness

Most of the nominal catches reported between 2014 and 2020 were received by the IOTC Secretariat by the deadline of June 30th every year (**Fig. 2**). The respect of the data submission deadline is particularly evident for temperate tunas (albacore and southern bluefin tuna) for which only 1% of the nominal catch has been reported after the 30th of June between 2012 and 2021. The amount of late submissions increases for billfish (average of 13.2% during the period 2012-2021), neritic tunas (average of 17.2% during the period 2012-2021), and is the largest for tropical tunas for which an average of 18.3% of the total catch has been submitted to the Secretariat after the deadline. The reporting year 2021 is characterized by the largest part of nominal catch reported after the deadline, i.e., 9%, 41.4%, 53.7%, and 55%, for temperate tunas, tropical tunas, neritic tunas, and billfish, respectively (**Fig. 2**). The global CoViD-19 pandemic has been indicated by some as the main cause of the delays in data reporting for 2021.

## Catch and effort data

### Availability

The amount of geo-referenced catch and effort data not reported to the IOTC Secretariat is much larger than for nominal catches (**Fig. 3**). Information is particularly limited for neritic species (i.e., neritic tunas and seerfish) for which catch and effort data were missing for the strata accounting for 63.7% of total nominal catches between 2012 and 2018. Catch and effort data are also not available in large part for billfish species, i.e., for strata accounting for more than 42% of total nominal catch of billfish species between 2012 and 2018. Nevertheless, the situation has improved for all IOTC species over the last decade as shown by the increasing percentage of nominal catch data for which catch and effort data are available (**Fig. 3**).

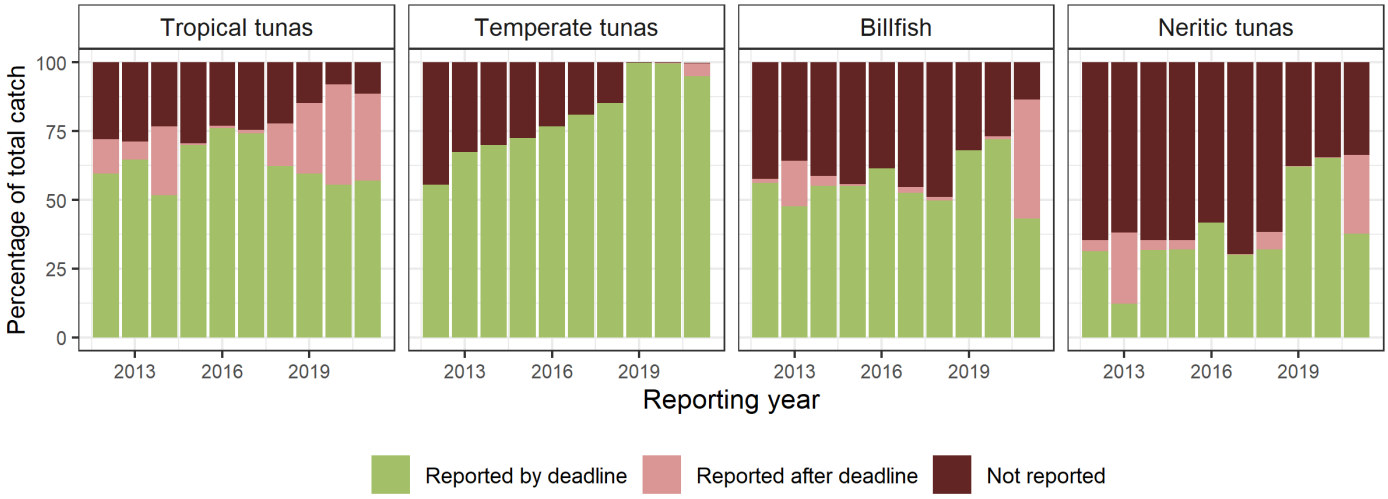


Figure 3: Annual percentage of total nominal catch of each of the IOTC species groups according to the date of submission of the geo-referenced catch and effort data by each fleet to the IOTC Secretariat. The submission deadline is the 30th June of each year

### Timeliness

Geo-referenced catch and effort data submitted to the Secretariat have been mostly reported by the deadline between 2012 and 2020 (**Fig. 3**). The reporting date of the catch and effort data has been more variable for tropical tunas, with 27.3% of the total nominal catch having their corresponding geo-referenced catch and effort data submitted after the deadline between 2018 and 2021. In 2021, a large part of the spatial information on catch and effort has been lately submitted for most IOTC species (except for temperate tunas), likely due to the CoViD-19 pandemic that disrupted some of the activities of sampling and data management.

## Size frequency data

### Availability

Very little information is available on the size composition of the nominal catches of several IOTC species. The situation is particularly concerning for all billfish and neritic tunas (including seerfish) for which size frequency data are only available for a small part of the catch. Between 2012 and 2021, 66.3% and 63.4% of the nominal catches of neritic and billfish species did not have any corresponding size frequency data, respectively (**Fig. 4**). The availability of size frequency data has increased over time for temperate and tropical tunas and was the highest in recent years, i.e., 99.1% and 84.6% for tropical and temperate tunas, respectively.

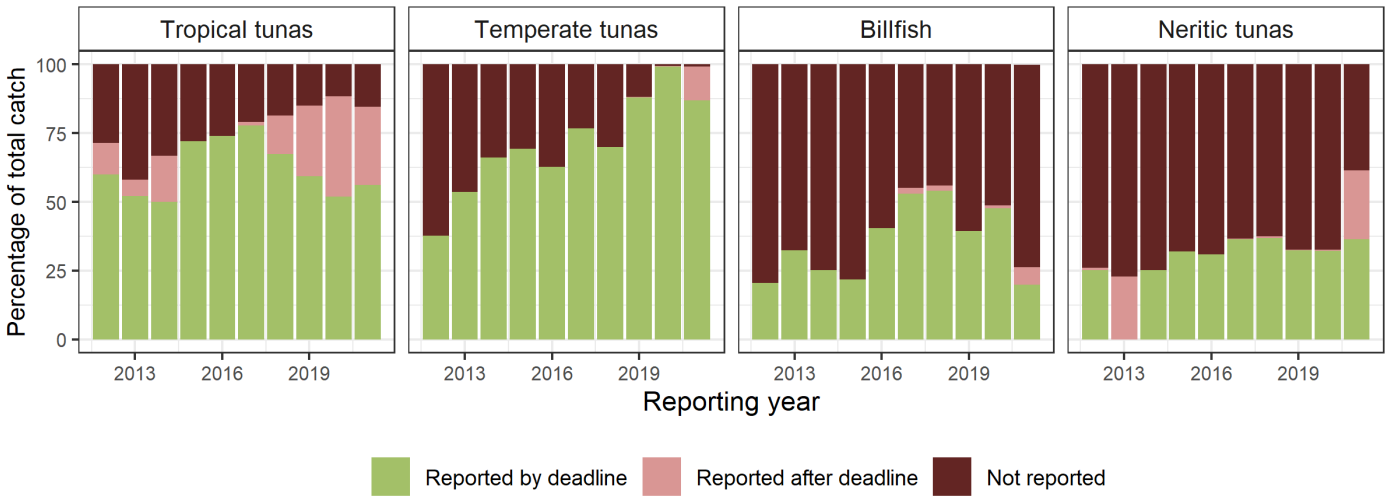


Figure 4: Annual percentage of total nominal catch of each of the IOTC species groups according to the date of submission of the size frequency data by each fleet to the IOTC Secretariat. The submission deadline is the 30th June of each year

**Timeliness**

When available, size frequency data have been mostly reported by the deadline between 2012 and 2021, with a significant part of the size data for tropical tunas reported with some delays in recent years. Between 2018 and 2021, size frequency data were submitted lately to the Secretariat for 26.1% of the nominal catches of tropical tunas on average (**Fig. 4**). As for nominal catch and catch and effort data, some increased delays have been observed in 2021 and again attributed to the CoViD-19 pandemic.

The following key points should be noted:

- Reporting coverage is highest for nominal catch, followed by catch and effort, while size data reporting levels are well below the levels reported by the other two data sets;
- Levels of timeliness and reporting coverage vary substantially between species groups, e.g., catch and effort and size data are particularly poorly reported for neritic species (i.e., between 30% to 60%, compared to around 70% for tropical tunas), mostly as the majority of neritic catches are accounted for by coastal artisanal fisheries;
- Similarly, the proportion of size frequency data available for billfish species is also very low (~20% to 55%), compared to tropical and temperate tunas;
- In recent years there have been improvements in the timeliness of reporting from some coastal CPCs, while some distant water fishing nations reported fisheries statistics either late or not in agreement with the basic IOTC data reporting requirements;
- Some delays in data submission have been observed in 2021 and attributed to the global CoViD-19 pandemic.

# Overview of the status of the data reported for 2020

## Nominal catch, catch and effort, and size frequency data

Nominal catch data and and geo-referenced catch and effort data for the reference year 2020 were reported to the IOTC Secretariat in a timely manner and according to the IOTC reporting standards for the very large majority of the industrial purse seine and longline fisheries (**Table 5**). By contrast, size frequency data were unavailable or only partially available for the main purse seine fisheries of the EU and Indonesia and the longline fisheries of Taiwan,China, China, Seychelles, Indonesia, and Korea.

The situation is more contrasted for the nominal catches of all other fisheries, with data well reported for major fishing nations such as I. R. Iran, Sri Lanka, Oman, Maldives, and Thailand, no data reported by some important coastal countries such as Yemen, Madagascar, and Tanzania, and several subsequent data submissions received from Indonesia. For the other fisheries, little information on catch and effort was available except for the fisheries of Maldives, Seychelles, and UK Overseas Territories (**Table 5**). Almost no size frequency data were made available for the other fisheries, except for Seychelles and UK Overseas Territories.

**Table 5:** Nominal catch (t) and data reporting quality of the main IOTC datasets by fishery group (industrial purse seine, industrial longline, and all other fisheries) and flag as reported in 2021 (for reference year 2020) for all IOTC species and sharks caught by tuna and tuna-like species in the Indian Ocean. NC = nominal catch; CE = catch and effort; SF = size frequency. Color key is given in **Table 4**

| Fishery group | CPC | Flag | Catch (t) | NC | CE | SF |
|---|---|---|---|---|---|---|
| Purse seine | AUS | | 3,652 | | | |
| | EU | EUESP | 144,551 | | | |
| | | EUFRA | 58,587 | | | |
| | | EUITA | 4,990 | | | |
| | IDN | | 100,054 | | | |
| | IRN | | 1,026 | | | |
| | JPN | | 620 | | | |
| | KOR | | 13,877 | | | |
| | LKA | | 3,673 | | | |
| | MUS | | 20,550 | | | |
| | SYC | | 112,016 | | | |
| Longline | AUS | | 162 | | | |
| | CHN | CHN | 12,943 | | | |
| | | TWN | 74,560 | | | |
| | EU | EUESP | 4,526 | | | |
| | | EUFRA | 1,621 | | | |
| | | EUGBR | 412 | | | |
| | | EUPRT | 1,119 | | | |
| | IDN | | 16,115 | | | |
| | IND | | 2 | | | |
| | JPN | | 12,537 | | | |
| | KOR | | 2,927 | | | |
| | LKA | | 13,324 | | | |
| | MDG | | 150 | | | |
| | MOZ | | 291 | | | |
| | MUS | | 58 | | | |
| | MYS | | 3,005 | | | |
| | OMN | | 266 | | | |
| | SYC | | 19,317 | | | |
| | TZA | | 4 | | | |
| | ZAF | | 710 | | | |
| Other | BGD | | 625 | | | |
| | COM | | 15,771 | | | |
| | EU | EUFRA | 1,870 | | | |
| | GBRT | | 2 | | | |
| | IDN | | 290,293 | | | |
| | IND | | 183,755 | | | |
| | IRN | | 188,579 | | | |
| | KEN | | 5,557 | | | |
| | LKA | | 140,211 | | | |
| | MDG | | 14,015 | | | |
| | MDV | | 35,175 | | | |
| | MOZ | | 14,338 | | | |
| | MUS | | 410 | | | |
| | MYS | | 18,859 | | | |
| | OMN | | 132,803 | | | |
| | PAK | | 56,638 | | | |
| | SYC | | 1,078 | | | |
| | THA | | 30,176 | | | |
| | TZA | | 16,778 | | | |
| | YEM | | 47,562 | | | |

## Discard data collected through the form 1DI

Estimates of discards reported to the Secretariat are derived from logbooks or observers although data on discards reported in the logbook may be collated from the latter in some cases. In 2021, a total of 14 fleets provided positive reports of discards for the reference year 2020 (**Table 6**). The comparison of discard levels between fleets and fisheries is hampered by the general lack of information provided by the CPCs on sampling coverage and absence of raising for most fisheries although IOTC Resolution 15/02 states that discards should be extrapolated to the fishery. For instance, only two leatherback turtles and one albatross have been reported caught and released alive by the longline fishery of EU,Portugal in 2020, for a fleet composed of three active longliners that caught about 500 t of fish in that year.

In addition, eight fleets submitted nil reports of discards for 2020: UK Overseas Territories, EU,Italy, India, I. R. Iran, Kenya, Madagascar, Mozambique, and Thailand. Although most of the fisheries of these CPCs are coastal and the very large majority of the bycatch (e.g., sharks) may be retained for local markets, some discarding would still be

expected to take place in some of these fisheries, as it has been shown to occur in the gillnet fishery of I. R. Iran (Shahifar et al. 2013) and observed in some swordfish-targeted longline fisheries operating in the region and similar to the semi-industrial longline fisheries of Madagascar and Kenya (Sabarros et al. 2013).

**Table 6:** Total discard levels by fleet in numbers of fish or metric tons (t) in 2020 as reported to the IOTC Secretariat

| Unit | AUS | CHN | EUESP | EUFRA | EUPRT | IDN | JPN | KOR | LKA | MUS | MYS | SYC | TWN | ZAF |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NO | 3,859 | 19,437 | 17 | 5,819 | 3 | 986 | 27 | 8,306 | 1,957 | 2,368 | 1,370 | 1,140 | 22 | 1,142 |
| t | 0 | 0 | 603 | 1,884 | 0 | 0 | 0 | 5 | 0 | 106 | 0 | 267 | 0 | 0 |

Although the information currently available on discards cannot be used to estimate the magnitude and composition of the phenomenon at regional level, it does provide some indication of the occurrence of sensitive species in some fisheries and allows for some comparisons of fisheries considered to have good-quality data. For instance, the semi-industrial longline fisheries of Australia and EU,France show a very different composition of sharks discarded at sea (**Fig. 5**). In particular, crocodile sharks (*Pseudocarcharias kamoharai*) were found to dominate the discards of Australian longliners in 2020 when the species represented a very small component of the catches of Reunion-based longliners in the same year, consistently with the major spatial differences in distribution of this shark in the Indian Ocean (Romanov et al. 2008).

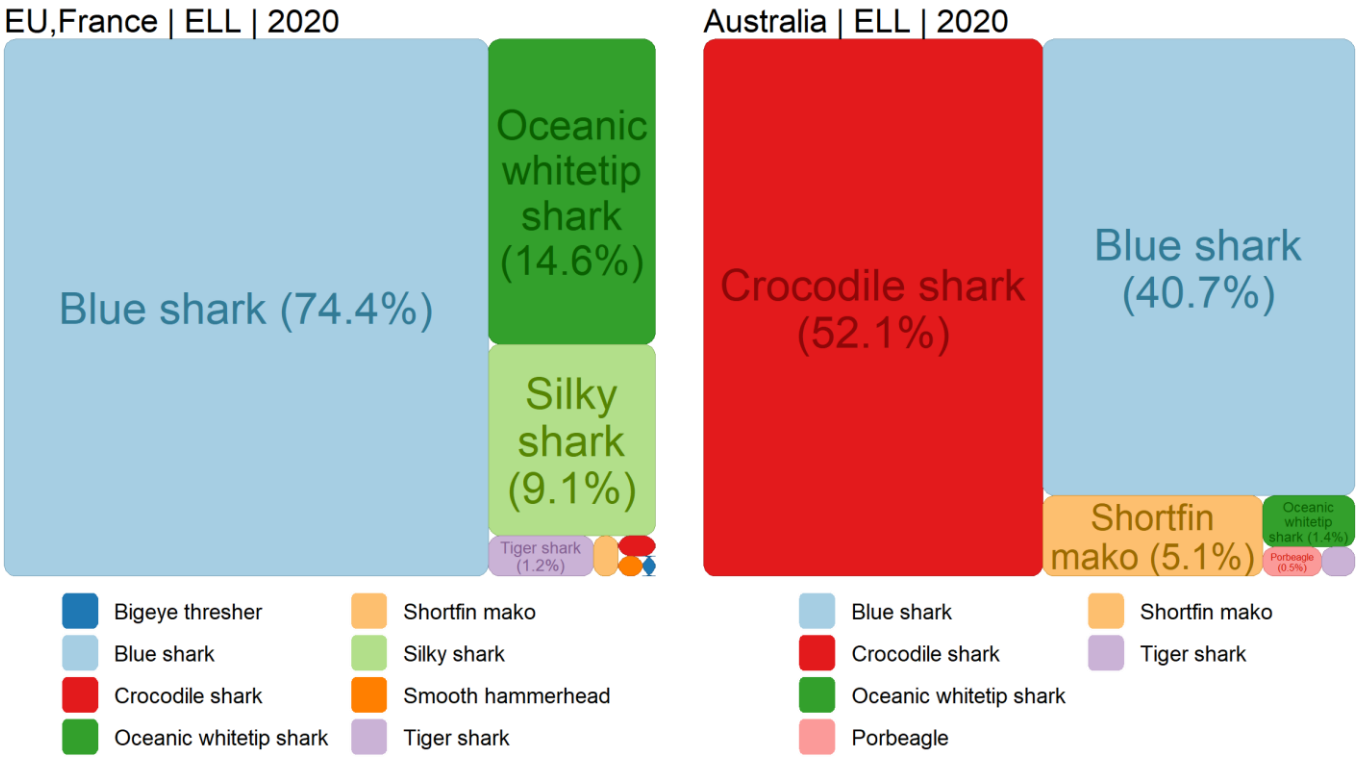


Figure 5: Composition of the catches of sharks discarded at sea in the swordfish-targeting longline fisheries of Australia and EU,France (La Réunion) in 2020 as reported to the IOTC Secretariat

Furthermore, the discard data collated from the form 1DI may be useful to highlight the absence of reported interactions of some fisheries with sensitive species when they would be expected. For instance, no interaction of purse seine on schools associated with floating objects with sharks was reported in 2020 through the form 1DI while observer data demonstrate that silky sharks are a major bycatch species in this fishery (Ruiz et al. 2018; Grande et al. 2019). Similarly, turtles have been reported as bycatch in all gears except for coastal longline while the total catch for this gear amounted to more than 110,000 t of fish in 2020, and levels of turtle bycatch are expected to be high in coastal areas where turtle nesting sites are located (Bourjea et al. 2008).

**Table 7:** Total discards (numbers) of sensitive species by fishing gear and species group in 2020 as reported to the IOTC Secretariat. ELL = swordfish-targeted longline; FLL = fresh longline; GIOF = offshore gillnets; LL = deep-freezing longline; LLCO = coastal longline; PS = purse seine; PSLS = purse seine on schools associated with drifting floating objects; RNOF = offshore ringnets

| Gear code | Cetaceans | Rays | Seabirds | Sharks | Turtles |
|---|---|---|---|---|---|
| **ELL** | 0 | 928 | 3 | 4,657 | 25 |
| **FLL** | 14 | 0 | 0 | 440 | 262 |
| **GIOF** | 26 | 0 | 0 | 14 | 1,064 |
| **LL** | 0 | 7 | 67 | 17,674 | 15 |
| **LLCO** | 0 | 48 | 2 | 107 | 0 |
| **PS** | 0 | 2 | 0 | 2,346 | 15 |
| **PSLS** | 0 | 0 | 0 | 0 | 58 |
| **RNOF** | 0 | 0 | 0 | 0 | 11 |

## FAD-related data, including the activities of supply vessels

A comprehensive description of the FAD-related data submitted to the IOTC Secretariat between 2013 and 2020 has been made at the 2nd IOTC ad hoc Working Group on FADs (WGFAD02) in October 2021, along with the release of the consolidated data sets (IOTC 2021a). The comparison of deployments at sea reported through forms 3FA and 3FD (only available for 2018-2019), as well as the numbers of sets and catches on FAD-associated schools showed major discrepancies for some purse seine fleets which mostly arose from the misinterpretation of the fields related to FAD activities (**Table 8**) and the WGFAD02 agreed that a revision of the current classification of FAD types and activities is required to improve the reporting of FAD-related data in the future. In addition, the document presented at the WGFAD02 included a review of the FAD-tracking data which are dedicated to compliance and have been submitted following IOTC reporting standard except for the purse seine fleet of the Republic of Korea and Kenya (although no information is currently available on the activities of the purse seine fleet of the latter, see also IOTC (2020)).

Effort data for supply vessels in 2020 have been fully reported to the Secretariat as the total number of days spent at sea, stratified by flag, year, month, and 1°x1° CWP grid within the IOTC area of competence (**Table 8**).

**Table 8:** Data reporting status of FAD-related and supply vessel data in 2020 as reported to the IOTC Secretariat. Color key is given in **Table 4**

| CPC code | Fleet | FAD-related activities | Supply vessels |
|---|---|---|---|
| EU | EU,France | | Fully reported |
| | EU,Italy | | |
| | EU,Spain | | Fully reported |
| JPN | Japan | | Nil report |
| KEN | Kenya | | |
| KOR | Rep. of Korea | | Fully reported |
| MUS | Mauritius | | Fully reported |
| SYC | Seychelles | | Fully reported |

# Reporting status of the IOTC nominal catch, catch and effort, and size-frequency data sets, 1980-2020

**Fig. 6** provides an overview of the reporting status of the three main IOTC data sets between 1980 and 2020. The data reporting status for each fishery group (i.e., purse seine, pole and line, gillnet, longline, and line fisheries) is given in Appendix III.

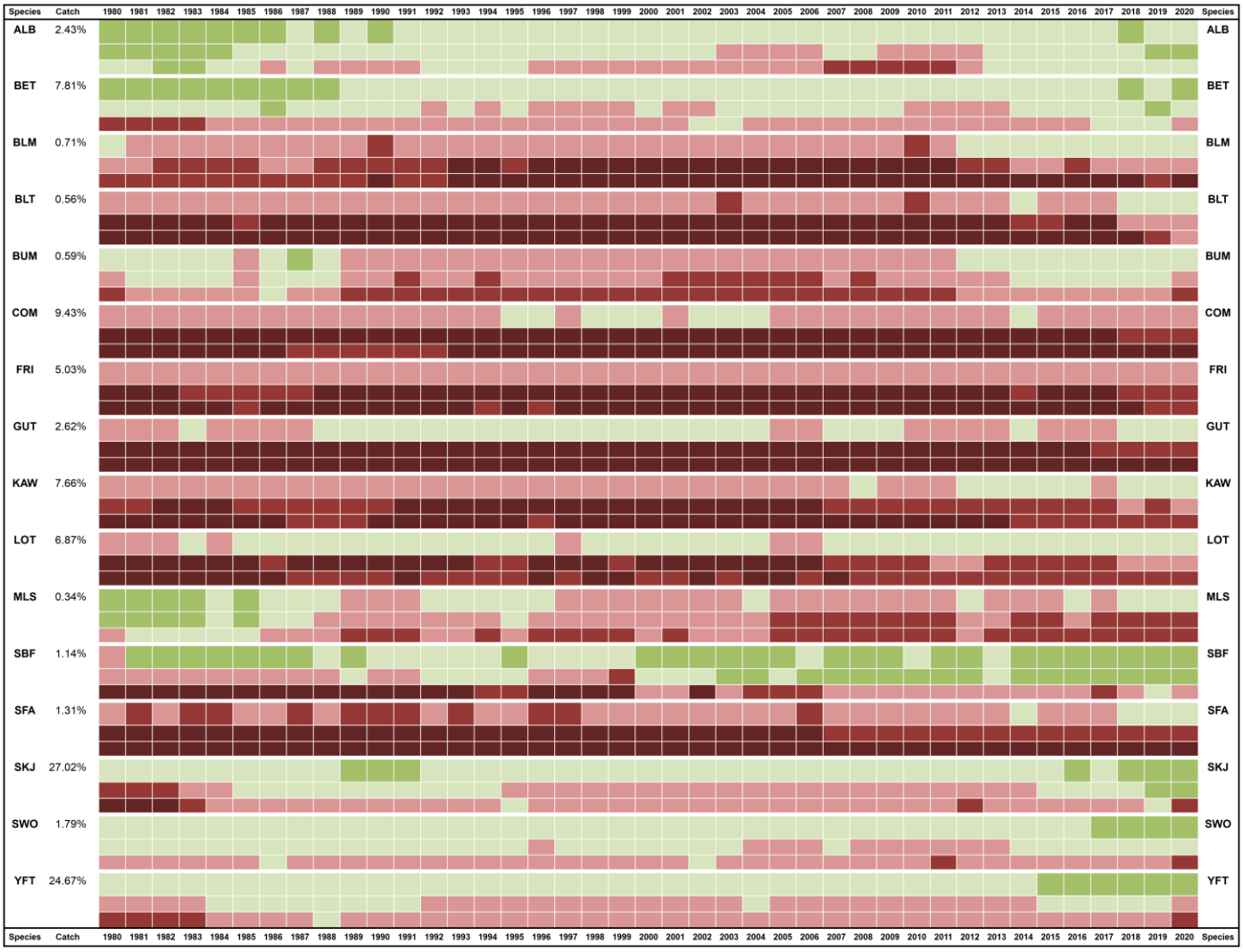


Figure 6: Reporting status of nominal catch (NC), catch and effort (CE), and size frequency (SF) data for the 16 IOTC species, by year and species (1980-2020). Percentage (%) of catch indicates the contribution of the catches of each species to the total catches of all IOTC species between 1980 and 2020. For each species, the first, second, and third rows correspond to NC, CE, and SF data, respectively. Color key is given in **Table 4**

# Status of the IOTC fishing craft statistics (FC) and active vessels (AV) databases

The number of vessels targeting IOTC species in the IOTC Area of Competence is used to:

- derive input-fishing capacity in the Indian Ocean (Moreno and Herrera 2013);
- estimate the catches of fleets that operate under the flags of countries that do not report data to the IOTC;
- assess the completeness of the catches reported by IOTC CPCs and completing those catches when the fleets concerned are not fully monitored by their flag countries.

## NEI category: numbers of vessels

The numbers of vessels operating under the flags of countries that do not report their catches to the IOTC are estimated from data reported by other countries. Those data include:

- IOTC IUU list (IOTC Resolution 11/03);
- identification, dimensions, and other attributes, by vessel, for those foreign vessels that owed fishing licenses to operate within the Economic Exclusive Zone (EEZ) of the reporting country (as specified in IOTC Resolution 14/05);
- identification and total catches unloaded, by species and vessel, for those foreign vessels using ports in the territory of the reporting country (as specified in IOTC Resolution 10/11 & 05/03);
- identification and total catches transshipped, by species and vessel, for vessels participating in the IOTC Transhipment Programme (as specified in IOTC Resolution 14/06);
- data provided by other parties, including data on the imports of tuna for canning, by species and vessel, from processors cooperating with the International Seafood Sustainability Foundation (ISSF) or other initiatives.

The catches for those fleets are estimated by using the estimated vessel numbers (obtained as above) and the catch data for vessels from other (reporting) fleets that operated in the same areas and targeted the same species (i.e., proxy fleets). The catches of this component are recorded under the NEI category.

## Partially reported fleets

In addition, the Secretariat estimates catches for countries that report only partial statistics for their fleets, i.e., catches of fleets of IOTC CPCs that are not fully monitored by their flag states. The catches reported by these countries are assumed incomplete because the average catches estimated by vessel by year are significantly lower than those estimated for similar fleets of other countries, on the assumption that both fleets have the same levels of activity.

This applies to the following fleets:

- longline fleet of India: up to 100 longliners have been operating in Indian waters in recent years, including fresh-tuna longliners and deep-freezing longliners;
- longline fleets of Indonesia: Indonesia does not monitor the catches of vessels under its flag that are unloaded in ports outside its territory;

and additional catches estimated for these CPCs are also included into the NEI category.

## Fishing craft statistics

### General findings

Data from artisanal (small-scale) fisheries are overall scarce and inconsistent in many cases. On the contrary, the statistics of large-scale and medium-scale fleets are thought to be fairly complete:

- Purse seine fisheries:
  - the number of large-scale purse seiners fishing for tropical tunas on the high seas (usually referred to as “industrial”) is well known. At present, these are flagged in countries of the European Union, Seychelles, I.R. Iran, Mauritius, Japan, and the Republic of Korea;
  - there is a large fleet of Indonesian purse seiners operating mostly in the coastal waters of Indonesia, but the industrial component of this fishery (gear code PS) is poorly known, and seems to exclude several vessels of length overall larger than 24 m that should be considered as industrial and reported as such;
  - recently, a fleet of six medium-sized purse seiners has been developed in Kenya (since 2020) but little information is available on the fishing activities of these vessels for which no data have been submitted to the Secretariat so far.
- Longline fisheries:

- there are many high seas longline fleets fishing tuna in the Indian Ocean, that include a mix of deep-freezing and fresh longline vessels. These fleets fly the flags of Taiwan,China, Seychelles, Indonesia, Sri Lanka, Japan, China, the Republic of Korea, Malaysia, the EU (France, Spain, France, Portugal, and Great Britain), South Africa, Mozambique, Oman, Australia, Madagascar, Mauritius, and Tanzania;
- there are also very important coastal longline fisheries in the Indian Ocean (which are currently considered of artisanal nature and historically classified under the *line* gear category) which caught more than 110,000 t of tuna and tuna-like species in 2020, mainly in Indonesia, Sri Lanka, I. R. Iran, India, Maldives, Kenya, and in Reunion and Mayotte (France) and Seychelles and Mozambique to a lesser extent;
- in the past, there were other longliners operating under various flags of non-reporting countries, with the total number of non-reporting longliners estimated by the Secretariat whenever new information was received from third parties (NEI category);

- High seas gillnet fisheries: the number of oceanic gillnet vessels operating in the Indian Ocean is well known for I.R. Iran and poorly known for Pakistan;
- Offshore gillnet/longline fisheries: the number of offshore gillnet/longline vessels that operate under the flag of Sri Lanka is well known;
- Pole-and-line fisheries: the number of pole-and-liners that operate under the flag of Maldives is well known.

## Vessels records for 2020

**Table 9:** Number of fishing vessels targeting tuna and tuna-like species in the Indian Ocean by CPC and fishery group as reported in the record of active vessels (industrial fleets) and fishing crafts statistics (artisanal and industrial vessels

| CPC code | Fleet code | Baitboat | Gillnet | Line | Longline | Other | Purse seine |
|---|---|---|---|---|---|---|---|
| ARE* | | | | | | | |
| AUS | | 2 | 3 | 50 | 3 | 3 | 7 |
| BGD | | | | | | | |
| BHR* | | | | | | | |
| CHN | CHN | | | | 80 | | |
| | TWN | | | | 261 | | |
| COM | | | | | | | |
| DJI* | | | | | | | |
| EGY* | | | | | | | |
| ERI | | | | | | | |
| EU | EUESP | | | | 11 | | 15 |
| | EUFRA | | | | | | 11 |
| | EUGBR | | | | 1 | | |
| | EUITA | | | | | | |
| | EUMYT | | | 94 | | | |
| | EUPRT | | | | 3 | | |
| | EUREU | | | 144 | 17 | | |
| GBRT | | | | 47 | | | |
| IDN | | | | 1 | 278 | | 103 |
| IND | | | | | | | |
| IRN | | | 4,927 | 2,221 | | | 7 |
| JOR* | | | | | | | |
| JPN | | | | | 27 | | 2 |
| KOR | | | | | 10 | | 2 |
| KWT* | | | | | | | |
| LKA | | | 2,758 | 4,348 | 23 | 46,884 | 2,184 |
| MDG | | | | | 5 | | |
| MDV | | 373 | | 14 | | | |
| MMR* | | | | | | | |
| MOZ | | | | | 14 | | |
| MUS | | | | 92 | 2 | | 3 |
| MYS | | | | | 19 | | |
| OMN | | | 25,267 | | 2 | | |
| PAK | | | | | | | |
| SAU* | | | | | | | |
| SYC | | | | | 74 | | 13 |
| THA | | | | | | | 228 |
| TMP* | | | | | | | |
| TZA | | | | | | | |
| YEM | | | | | | | |
| ZAF | | | | | 15 | | |

Information available at the IOTC Secretariat on the numbers of active vessels targeting tuna and tuna-like species in the Indian Ocean is incomplete and sometimes inconsistent between data sources, i.e., (a) the mandatory record of active vessels which covers the industrial fleets (IOTC RAV), (b) the voluntary form 2FC which covers all fleets, and (c) the national reports submitted every year for the Scientific Committee. In 2020, information on coastal fishing crafts (i.e., less than 24 m length overall and operating in EEZs) was lacking for all non-members of the IOTC as well as for several major fishing CPCs, in particular Indonesia and India (**Table 9**).

Compiling the statistics by fishery type (i.e., artisanal vs. industrial) generates some confusion when the information provided by the CPCs is not accurate. Tuna fisheries are not necessarily limited to coastal or offshore areas and the fishery type also depends on the size of the vessels and on the fishing gear. In particular, purse seine and longline vessels can operate in both coastal areas and the high seas (**Fig. 7**). Some gillnet fleets of some CPCs are also known to operate beyond the EEZ while the fishery type is also unclear for some vessels equipped with pole and line and other gears and reported as industrial, e.g., trawlers less than 24 m from Australia may only operate in coastal areas while they have been reported in the RAV.

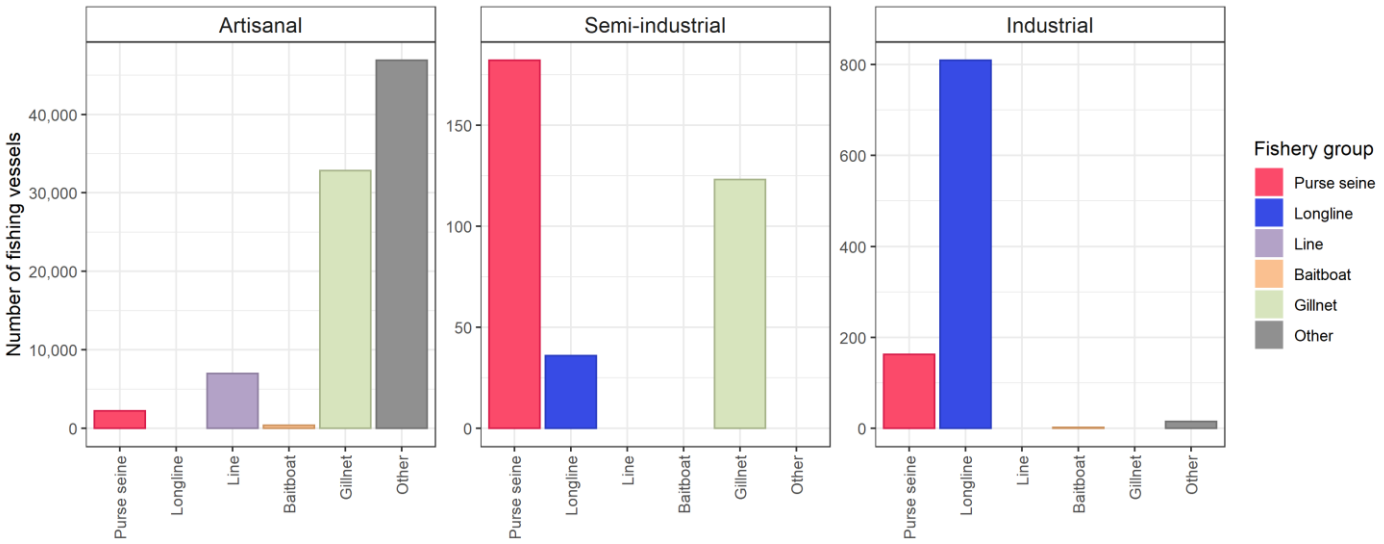


Figure 7: Number of fishing vessels by fishery group reported to the IOTC Secretariat for the year 2020 for each fishery type. ART = artisanal; IND = industrial; SEMI = semi-industrial, i.e., vessels less than 24 m length overall that may operate in the high seas

Interannual changes in fishing capacity of the artisanal fisheries of the Indian Ocean catching tuna and tuna-like species cannot be estimated from the information currently available at the Secretariat. In addition to the non-reporting of the numbers of fishing crafts by many CPCs (e.g., **Table 9** for 2020), the reporting coverage may vary from year to year for others. For instance, Malaysia did not report the form 2FC in 2020 while data reported for 2019 indicated that the gillnet fishery was composed of more than 11,400 vessels in that year.

# Other IOTC data holdings

## Socio-economic data

To date, very little information on the socio-economics of tuna and tuna-like fisheries has been reported to the Secretariat with the notable exception of time series of monthly prices by species, fishing gear, and area reported by Oman since 2005. The Secretariat has recently started to liaise with the GLOBEFISH team at FAO as well as with the Pacific Islands Forum Fisheries Agency (FFA) to access open repositories of socio-economic data, including fish sale prices, oil price, import and exports of processed tuna as well as some national economic indicators such as the Gross Domestic Product (IOTC 2021b).

## Biological data

Few biological data have been provided to the IOTC Secretariat and data available are of variable quantity and quality (IOTC 2013). In 2016, following a study by the European Union on the length-weight relationship of tropical tunas caught by the purse seine fishery, important updates to the length-weight conversion factors for tropical tuna species were included in the standard equations (Chassot et al. 2016).

## Observer data

A comprehensive description of the current status, coverage and data collected as part of the ROS has been recently presented in 2021 at the first ad-hoc Working Group on the development of Electronic Monitoring programme Standards (WGEMS01) (IOTC 2021c). To date, the ROS Regional Database contains information for a total of 1,582 commercial fishing trips (886 from purse seine vessels and 696 from longline vessels of various types) made during the period 2005-2020 from 7 fleets: Japan, EU,France and Sri Lanka for longline fisheries and EU,Spain, EU,France, Korea, Mauritius, and Seychelles for purse seine fisheries. In addition, observer reports have been submitted to the Secretariat by some CPCs (e.g., Taiwan,China) but data sets were not provided in a format suitable for data extraction at operational level as required by the ROS standards.

## Tagging data

As of November 2021, a total of 34,193 tags deployed on tropical tunas had been recovered (**Table 10**). The large range of information collected throughout the IOTTP-IO has been used to better understand the population dynamics of the three tropical tunas (i.e., growth, mortality, and movements; Murua et al. (2015)) and is routinely included in the assessment models of the three species since 2008 (e.g., Fu 2020).

**Table 10:** Number of tropical tunas recovered throughout the Indian Ocean Tuna Tagging Programme (IOTTP). BET = bigeye tuna; SKJ = skipjack tuna; YFT = yellowfin tuna

| YEAR | BET | SKJ | YFT |
|---|---|---|---|
| 1990 | | 1,287 | 100 |
| 1991 | | 85 | 18 |
| 1992 | | 1 | |
| 1993 | | 6 | 8 |
| 1994 | | 464 | 7 |
| 1995 | | 63 | 8 |
| 2003 | | | 1 |
| 2004 | | 267 | 70 |
| 2005 | 14 | 255 | 99 |

| YEAR | BET | SKJ | YFT |
|---|---|---|---|
| 2006 | 746 | 4,637 | 2,597 |
| 2007 | 3,043 | 6,567 | 4,619 |
| 2008 | 1,371 | 1,866 | 1,947 |
| 2009 | 241 | 2,154 | 904 |
| 2010 | 148 | 61 | 193 |
| 2011 | 68 | 6 | 78 |
| 2012 | 91 | 1 | 39 |
| 2013 | 14 | | 8 |
| 2014 | 12 | | 7 |
| 2015 | 15 | | 4 |
| 2016 | 2 | | |
| 2017 | 1 | | |
| TOTAL | 5,766 | 17,720 | 10,707 |

# Appendix I: Resolutions containing requirements for the collection and/or reporting of fisheries data to the IOTC

- IOTC Resolution 15/01 "*On the recording of catch and effort data by fishing vessels in the IOTC area of competence*": establishes minima data requirements for the collection of operational catch and effort data on authorized vessels, including the species for which those requirements apply. Data requirements are set for industrial purse seine, longline, drifting gillnet, pole-and-line, trolling, and handline. This Resolution also calls port states that license foreign fishing vessels to collect logbooks on fishing by those vessels within their EEZ and report this information in aggregated form to the IOTC Secretariat.
- IOTC Resolution 15/02 "*Mandatory statistical requirements for IOTC Members and Cooperating Non-Contracting Parties (CPCs)*": Defines IOTC's data reporting procedures for IOTC species, main shark species caught by IOTC fisheries, and non-target, associated and dependent species.
- IOTC Resolution 18/07 "*On measures applicable in case of non-fulfilment of reporting obligations in the IOTC*"
- IOTC Resolution 19/02 "*Procedures on a fish aggregating devices (FADs) management plan*"
- IOTC Resolution 19/03 "*On the conservation of MOBULID RAYS caught in association with fisheries in the IOTC area of competence*"
  - Paragraph 12: CPCs are encouraged to investigate at-vessel and post-release mortality in mobulids including, but not exclusively, the application of satellite tagging programs that may be provisioned primarily through the national support complementing possible funds allocation from the IOTC to investigate the effectiveness of this measure.
  - Paragraph 13: Scientific observers shall be allowed to collect biological samples of mobulid rays caught in the IOTC Area of Competence that are dead at haul-back, provided that the samples are a part of a research project approved by the IOTC Scientific Committee. In order to obtain the approval, a detailed document outlining the purpose of the work, number of samples intended to be collected and the spatio-temporal distribution of the sampling effect must be included in the proposal. Annual progress of the work and a final report on completion shall be presented to the SC.
- IOTC Resolution 17/05 "*Concerning the conservation of sharks caught in association with fisheries managed by IOTC*"
  - Paragraph 2: CPCs shall take the necessary measures to require that their fishermen fully utilise their entire catches of sharks, with the exception of species prohibited by the IOTC. Full utilisation is defined as retention by the fishing vessel of all parts of the shark excepting head, guts, and skins, to the point of first landing.
  - Paragraph 2: a) Sharks landed fresh: CPCs shall prohibit the removal of shark fins on board vessels. CPCs shall prohibit the landing, retention on-board, transhipment and carrying of shark fins which are not naturally attached to the shark carcass until the first point of landing.
  - Paragraph 2: b) Sharks landed frozen: CPCs that do not apply sub-paragraph 3 a) for all sharks shall require their vessels to not have on board fins that total more than 5% of the weight of sharks on board, up to the first point of landing. CPCs that currently do not require fins and carcasses to be offloaded together at the point of first landing shall take the necessary measures to ensure compliance with the 5 % ratio through certification, monitoring by an observer, or other appropriate measures.
- IOTC Resolution 13/06[2] "*On A Scientific and management framework on the conservation of shark species caught in association with IOTC managed fisheries*"

[2] This Resolution was objected to by India and therefore is non-binding to India

  - Paragraph 5: CPCs shall encourage their fishers to record incidental catches as well as live releases of oceanic whitetip sharks. These data shall be kept at the IOTC Secretariat.

- IOTC Resolution 12/09: "*On the conservation of thresher sharks (family Alopiidae) caught in association with fisheries in the IOTC area of competence*"
  - Paragraph 4: CPCs shall encourage their fishers to record and report incidental catches as well as live releases. These data will be then kept at the IOTC Secretariat.
  - Paragraph 8: The Contracting Parties, Cooperating Non-Contracting Parties, especially those directing fishing activities for sharks, shall submit data for sharks, as required by IOTC data reporting procedures.
- IOTC Resolution 13/05: "*On the conservation of whale sharks (Rhincodon typus)*"
  - Paragraph 3: CPCs shall require that, in the event that a whale shark is unintentionally encircled in the purse seine net, the master of the vessel shall: b. report the incident to the relevant authority of the flag State, with the following information…
  - Paragraph 4: CPCs using other gear types fishing for tuna and tuna-like species associated with a whale shark shall report all interactions with whale sharks to the relevant authority of the flag State and include all the information outlined in paragraph 3b(i–v).
  - Paragraph 7: CPCs shall report the information and data collected under paragraph 3(b) and paragraph 4 through logbooks, or when an observer is onboard through observer programs, and provide to the IOTC Secretariat by 30 June of the following year and according to the timelines specified in Resolution 10/02 (or any subsequent revision).
- IOTC Resolution 13/04: "*On the conservation of cetaceans*"
  - Paragraph 3: CPCs shall require that, in the event that a Cetacean is unintentionally encircled in the purse seine net, the master of the vessel shall: b. report the incident to the relevant authority of the flag State, with the following information…
  - Paragraph 4: CPCs using other gear types fishing for tuna and tuna-like species associated with cetaceans shall report all interactions with cetaceans to the relevant authority of the flag State and include all the information outlined in paragraph 3b(i–v).
  - Paragraph 7: CPCs shall report the information and data collected under paragraph 3(b) and paragraph 4 through logbooks, or when an observer is onboard through observer programs, and provide to the IOTC Secretariat by 30 June of the following year and according to the timelines specified in Resolution 10/02 (or any subsequent revision).
- IOTC Resolution 12/06: "*On reducing the incidental bycatch of seabirds in longline fisheries*"
  - Paragraph 1: CPCs shall record data on seabird incidental bycatch by species, notably through scientific observers in accordance with Resolution 11/04 and report these annually.
- IOTC Resolution 12/04: "*On the conservation of marine turtles*"
  - Paragraph 3: CPCs shall collect (including through logbooks and observer programs) and provide to the IOTC Secretariat no later than 30 June of the following year in accordance with Resolution 10/02 (or any subsequent revision), all data on their vessels' interactions with marine turtles. The data shall include the level of logbook or observer coverage and an estimation of total mortality of marine turtles incidentally caught in their fisheries.
- IOTC Resolution 11/04: "*On a Regional Observer Scheme*"

- Paragraph 9: CPCs shall provide to the Executive Secretary and the Scientific Committee annually a report of the number of vessels monitored and the coverage achieved by gear type in accordance with the provisions of this Resolution.
- Paragraph 11: CPCs shall send within 150 days at the latest each report, as far as continuous flow of report from observer placed on the longline fleet is ensured, which is recommended to be provided with 1°x1° format to the Executive Secretary, who shall make the report available to the Scientific Committee upon request.

# Appendix II: Availability and reporting quality of IOTC datasets for 2020

## Tropical tuna species

**Table 11:** Nominal catch (t) and availability of the main IOTC datasets by fishery group (industrial purse seine, industrial longline, and all other fisheries) and flag as reported in 2021 (for reference year 2020) for tropical tunas of the Indian Ocean. B = bigeye tuna; S = skipjack tuna; Y = yellowfin tuna. NC = nominal catch; CE = catch and effort; SF = size frequency. Color key is given in **Table 4**

| Fishery group | CPC | Flag | Catch (t) | Species | NC | CE | SF |
|---|---|---|---|---|---|---|---|
| Purse seine | EU | EUESP | 142,777 | B,S,Y | | | |
| | | EUFRA | 57,715 | B,S,Y | | | |
| | | EUITA | 4,987 | B,S,Y | | | |
| | IDN | | 74,354 | B,S,Y | | | |
| | IRN | | 610 | Y | | | |
| | JPN | | 620 | B,S,Y | | | |
| | KOR | | 13,852 | B,S,Y | | | |
| | LKA | | 781 | B,S,Y | | | |
| | MUS | | 20,406 | B,S,Y | | | |
| | SYC | | 111,880 | B,S,Y | | | |
| Longline | AUS | | 42 | B,S,Y | | | |
| | CHN | CHN | 7,293 | B,Y | | | |
| | | TWN | 24,211 | B,S,Y | | | |
| | EU | EUESP | 76 | B,Y | | | |
| | | EUFRA | 489 | B,S,Y | | | |
| | | EUGBR | 6 | Y | | | |
| | | EUPRT | 27 | B | | | |
| | IDN | | 8,404 | B,S,Y | | | |
| | IND | | 2 | B,S,Y | | | |
| | JPN | | 6,547 | B,S,Y | | | |
| | KOR | | 1,582 | B,S,Y | | | |
| | LKA | | 10,282 | B,S,Y | | | |
| | MDG | | 57 | B,Y | | | |
| | MOZ | | 132 | B,S,Y | | | |
| | MUS | | 34 | B,S,Y | | | |
| | MYS | | 633 | B,S,Y | | | |
| | OMN | | 207 | Y | | | |
| | SYC | | 12,937 | B,Y | | | |
| | TZA | | 2 | B,Y | | | |
| | ZAF | | 335 | B,Y | | | |
| Other | BGD | | 26 | B,S,Y | | | |
| | COM | | 14,680 | B,S,Y | | | |
| | EU | EUFRA | 927 | B,S,Y | | | |
| | GBRT | | 2 | S,Y | | | |
| | IDN | | 98,430 | B,S,Y | | | |
| | IND | | 49,841 | B,S,Y | | | |
| | IRN | | 36,507 | B,S,Y | | | |
| | KEN | | 3,464 | Y | | | |
| | LKA | | 66,900 | B,S,Y | | | |
| | MDG | | 1,536 | B,S,Y | | | |
| | MDV | | 35,129 | B,S,Y | | | |
| | MOZ | | 262 | B,S,Y | | | |
| | MUS | | 148 | S,Y | | | |
| | OMN | | 68,668 | S,Y | | | |
| | PAK | | 8,976 | S,Y | | | |
| | SYC | | 976 | B,Y | | | |
| | THA | | 605 | S | | | |
| | TZA | | 4,275 | S,Y | | | |
| | YEM | | 22,185 | B,S,Y | | | |

## Temperate tuna species

**Table 12:** Nominal catch (t) and data reporting quality of the main IOTC datasets by fishery group and flag as reported in 2021 (for reference year 2020) for temperate tunas of the Indian Ocean. A = albacore; S = southern bluefin tuna. NC = nominal catch; CE = catch and effort; SF = size frequency. Color key is given in **Table 4**

| Fishery group | CPC | Flag | Catch (t) | Species | NC | CE | SF |
|---|---|---|---|---|---|---|---|
| Purse seine | AUS | | 3,652 | S | | | |
| | EU | EUESP | 12 | A | | | |
| | | EUFRA | 102 | A | | | |
| | | EUITA | 2 | A | | | |
| | KOR | | 3 | A | | | |
| | LKA | | 10 | A | | | |
| | MUS | | 19 | A | | | |
| | SYC | | 8 | A | | | |
| Longline | AUS | | 23 | A,S | | | |
| | CHN | CHN | 3,763 | A | | | |
| | | TWN | 22,293 | A,S | | | |
| | EU | EUESP | 1 | A | | | |
| | | EUFRA | 208 | A | | | |
| | IDN | | 3,979 | A,S | | | |
| | JPN | | 4,983 | A,S | | | |
| | KOR | | 1,174 | A,S | | | |
| | LKA | | 94 | A | | | |
| | MDG | | 36 | A | | | |
| | MOZ | | 2 | A | | | |
| | MUS | | 18 | A | | | |
| | MYS | | 1,821 | A | | | |
| | OMN | | 54 | A | | | |
| | SYC | | 839 | A | | | |
| | ZAF | | 30 | A,S | | | |
| Other | COM | | 98 | A | | | |
| | EU | EUFRA | 97 | A | | | |
| | IDN | | 5,525 | A | | | |
| | MOZ | | 106 | A | | | |
| | MUS | | 244 | A | | | |

## Billfish species

**Table 13:** Nominal catch (t) and data reporting quality of the main IOTC datasets by fishery group and flag as reported in 2021 (for reference year 2020) for billfish species of the Indian Ocean. F = Indo-Pacific sailfish; M = marlins; P = shortbill spearfish; S = swordfish. NC = nominal catch; CE = catch and effort; SF = size frequency. Color key is given in **Table 4**

| Fishery group | CPC | Flag | Catch (t) | Species | NC | CE | SF |
|---|---|---|---|---|---|---|---|
| Purse seine | EU | EUFRA | 47 | F,M,S | | | |
| | IDN | | 279 | F,M,P,S | | | |
| | LKA | | 9 | F,M | | | |
| | MUS | | 4 | M | | | |
| Longline | AUS | | 96 | M,P,S | | | |
| | CHN | CHN | 1,747 | F,M,S | | | |
| | | TWN | 7,150 | F,M,P,S | | | |
| | EU | EUESP | 1,642 | F,M,P,S | | | |
| | | EUFRA | 870 | F,M,P,S | | | |
| | | EUGBR | 208 | F,M,S | | | |
| | | EUPRT | 468 | F,M,S | | | |
| | IDN | | 1,864 | F,M,S | | | |
| | JPN | | 627 | F,M,S | | | |
| | KOR | | 132 | F,M,S | | | |
| | LKA | | 2,764 | F,M,S | | | |
| | MDG | | 30 | F,M,S | | | |
| | MOZ | | 139 | F,M,P,S | | | |
| | MUS | | 4 | F,M,S | | | |
| | MYS | | 264 | F,M,P,S | | | |
| | OMN | | 3 | F | | | |
| | SYC | | 2,260 | F,M,P,S | | | |
| | TZA | | 1 | M,S | | | |
| | ZAF | | 174 | F,M,S | | | |
| Other | COM | | 566 | F,M,S | | | |
| | EU | EUFRA | 627 | F,M,P,S | | | |
| | IDN | | 3,969 | F,M,S | | | |
| | IND | | 10,941 | F,M,S | | | |
| | IRN | | 11,627 | F,M,S | | | |
| | KEN | | 641 | F,S | | | |
| | LKA | | 11,923 | F,M,S | | | |
| | MDG | | 842 | F | | | |
| | MDV | | 2 | F,M | | | |
| | MOZ | | 93 | F,M,S | | | |
| | OMN | | 2,978 | F,M,S | | | |
| | PAK | | 4,264 | F,M | | | |
| | SYC | | 102 | F,M,S | | | |
| | THA | | 11 | F | | | |
| | TZA | | 2,682 | F | | | |
| | YEM | | 392 | F | | | |

## Neritic species

**Table 14:** Nominal catch (t) and data reporting quality of the main IOTC datasets by fishery group and flag as reported in 2021 (for reference year 2020) for neritic tunas and seerfish of the Indian Ocean. B = bullet tuna; C = narrow-barred Spanish mackerel; F = frigate tuna; G = Indo-Pacific king mackerel; K = kawakawa; L = longtail tuna; X = seerfish. NC = nominal catch; CE = catch and effort; SF = size frequency. Color key is given in **Table 4**

| Fishery group | CPC | Flag | Catch (t) | Species | NC | CE | SF |
|---|---|---|---|---|---|---|---|
| Purse seine | EU | EUESP | 1,762 | F | | | |
| | | EUFRA | 366 | F,K,X | | | |
| | IDN | | 25,031 | B,C,F,G,K,L | | | |
| | IRN | | 416 | L | | | |
| | KOR | | 22 | K | | | |
| | LKA | | 332 | B,F,K,L | | | |
| | MUS | | 19 | F,X | | | |
| | SYC | | 66 | F,L | | | |
| Longline | CHN | TWN | 141 | B,C,F,G,K,L | | | |
| | EU | EUFRA | 3 | X | | | |
| | IDN | | 319 | B,C,L,X | | | |
| | LKA | | 13 | B,C,F,K,L,X | | | |
| | MUS | | 2 | X | | | |
| Other | BGD | | 128 | B,C,F,G,K,L | | | |
| | COM | | 348 | F,K,L,X | | | |
| | EU | EUFRA | 126 | C,K,X | | | |
| | IDN | | 163,107 | B,C,F,G,K,L | | | |
| | IND | | 103,760 | B,C,F,G,K,L,X | | | |
| | IRN | | 123,667 | C,F,G,K,L | | | |
| | LKA | | 7,177 | B,C,F,K,X | | | |
| | MDG | | 6,021 | B,C,F,G,K,L | | | |
| | MDV | | 40 | F,K,X | | | |
| | MOZ | | 10,035 | C,F,K,L | | | |
| | MUS | | 2 | X | | | |
| | MYS | | 18,857 | C,F,G,K,L | | | |
| | OMN | | 43,690 | C,F,K,L,X | | | |
| | PAK | | 29,361 | B,C,F,K,L | | | |
| | THA | | 29,560 | B,C,F,K,L | | | |
| | TZA | | 3,362 | C,F,G,K | | | |
| | YEM | | 18,032 | B,C,F,G,K,L | | | |

## Main shark species

**Table 15:** Nominal catch (t) and data reporting quality of the main IOTC datasets by fishery group and flag as reported in 2021 (for reference year 2020) for the most commonly caughts sharks of the Indian Ocean. H = hammerhead sharks; L = blue shark; M = mako sharks; O = other sharks; P = pelagic thresher; S = silky shark; W = oceanic whitetip shark. NC = nominal catch; CE = catch and effort; SF = size frequency. Color key is given in **Table 4**

| Fishery group | CPC | Flag | Catch (t) | Species | NC | CE | SF |
|---|---|---|---|---|---|---|---|
| Purse seine | LKA | | 3 | S | | | |
| | MUS | | 2 | O | | | |
| Longline | CHN | CHN | 140 | L,M | | | |
| | | TWN | 3,156 | L,O,S | | | |
| | EU | EUESP | 2,766 | L,M | | | |
| | | EUFRA | 33 | L,M | | | |
| | | EUGBR | 190 | L,M | | | |
| | | EUPRT | 611 | L,M | | | |
| | IDN | | 1,192 | L,O,S | | | |
| | JPN | | 380 | L | | | |
| | KOR | | 14 | L,M | | | |
| | LKA | | 134 | H,L,S | | | |
| | MDG | | 17 | L | | | |
| | SYC | | 740 | L,O,S | | | |
| | ZAF | | 171 | L,M | | | |
| Other | COM | | 78 | L,S,W | | | |
| | EU | EUFRA | 3 | M | | | |
| | IDN | | 12,812 | L,O | | | |
| | IRN | | 5,705 | O,S,W | | | |
| | KEN | | 57 | H,O | | | |
| | LKA | | 389 | H,L,M,S | | | |
| | MDG | | 112 | S | | | |
| | MYS | | 2 | H,O | | | |
| | OMN | | 892 | H,O | | | |
| | PAK | | 672 | M,P,S | | | |

# Appendix III: Status of the IOTC databases by fishery group

## Purse seine

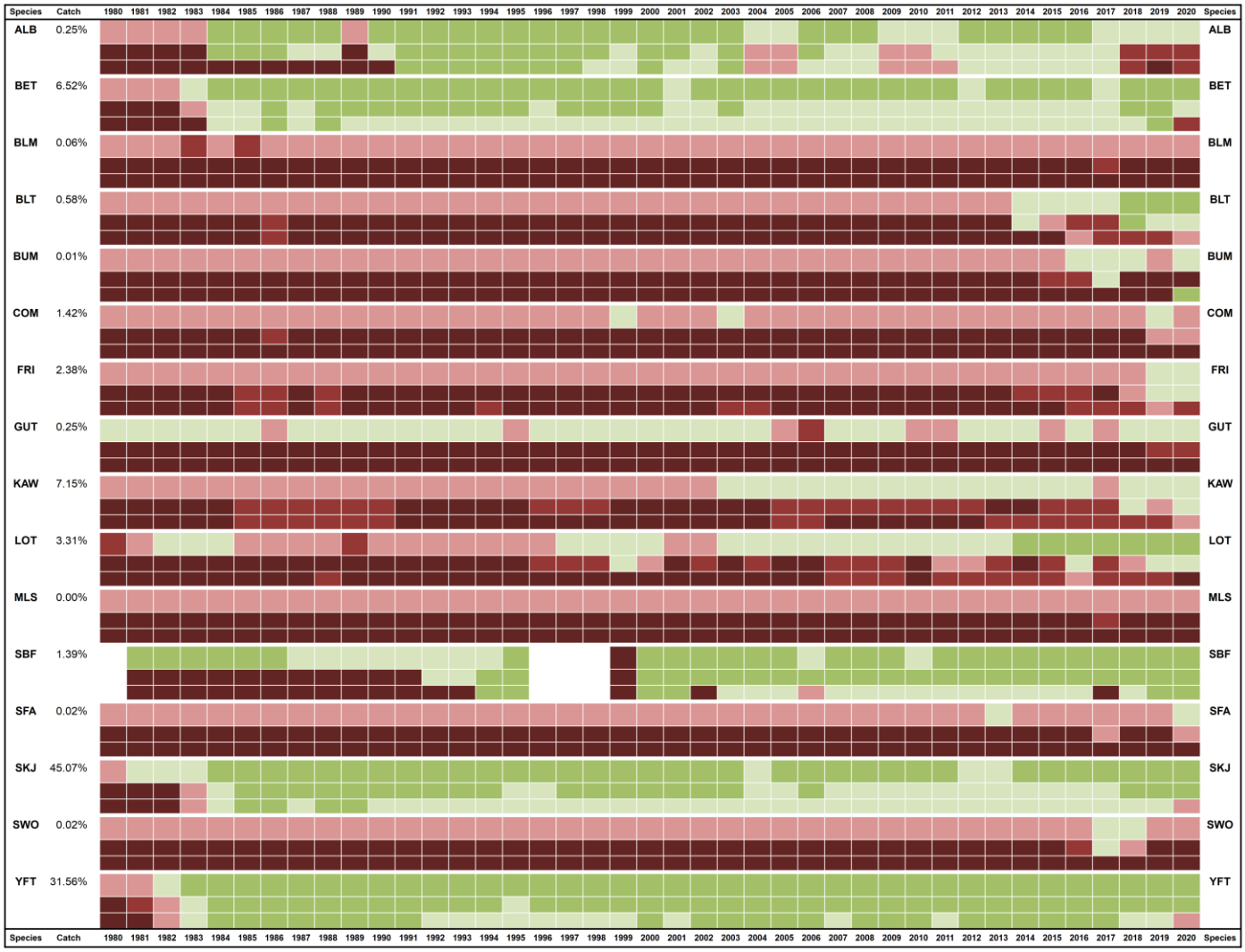


Figure 8: Reporting status of nominal catch (NC), catch and effort (CE), and size frequency (SF) data for the 16 IOTC species caught with purse seines, by year and species (1980-2020). Percentage (%) of catch indicates the contribution of the catches of each species to the total catches of all IOTC species between 1980 and 2020. For each species, the first, second, and third rows correspond to NC, CE, and SF data, respectively. Color key is given in **Table 4**

## Pole and line

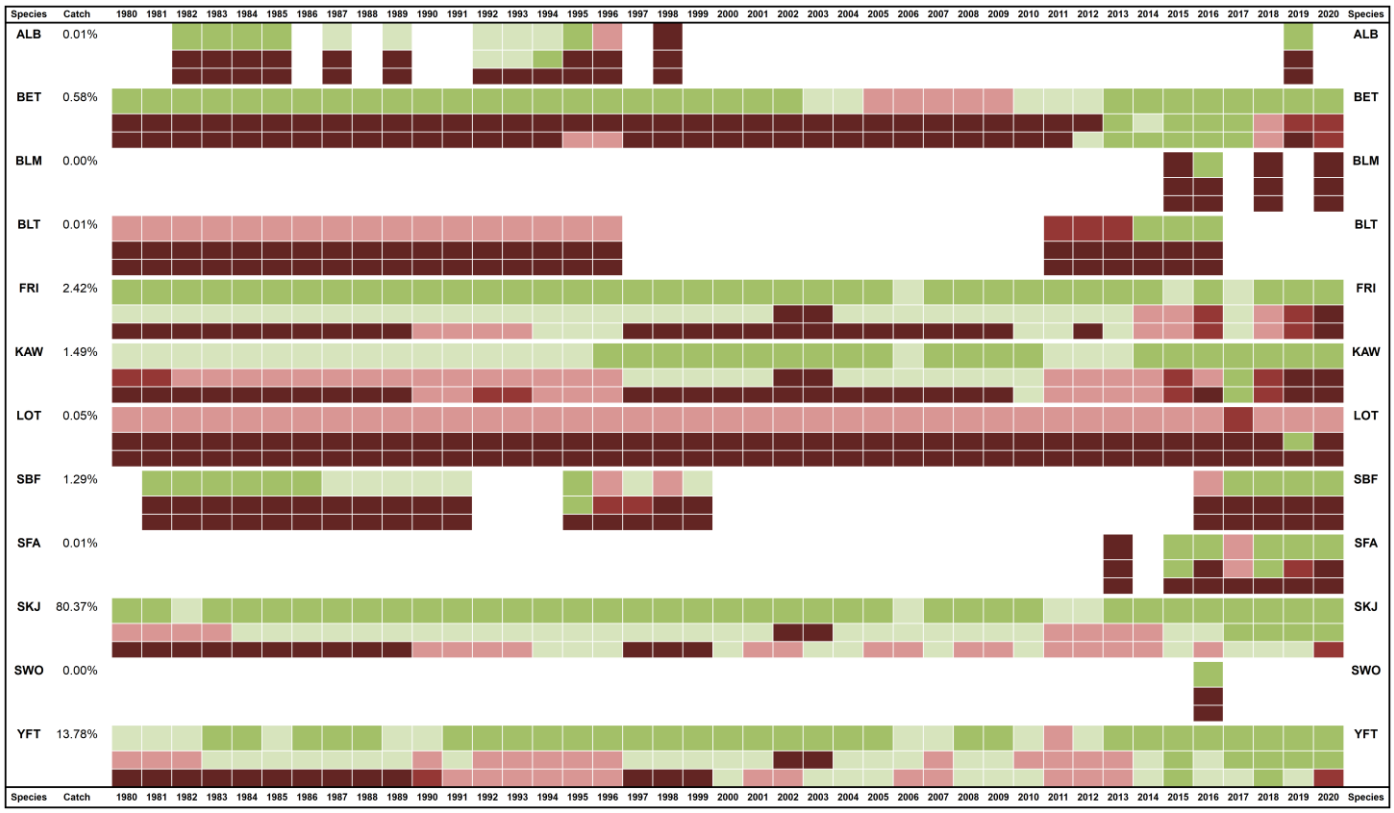


Figure 9: Reporting status of nominal catch (NC), catch and effort (CE), and size frequency (SF) data for the 16 IOTC species caught with pole and lines, by year and species (1980-2020). Percentage (%) of catch indicates the contribution of the catches of each species to the total catches of all IOTC species between 1980 and 2020. For each species, the first, second, and third rows correspond to NC, CE, and SF data, respectively. Color key is given in **Table 4**

## Gillnet

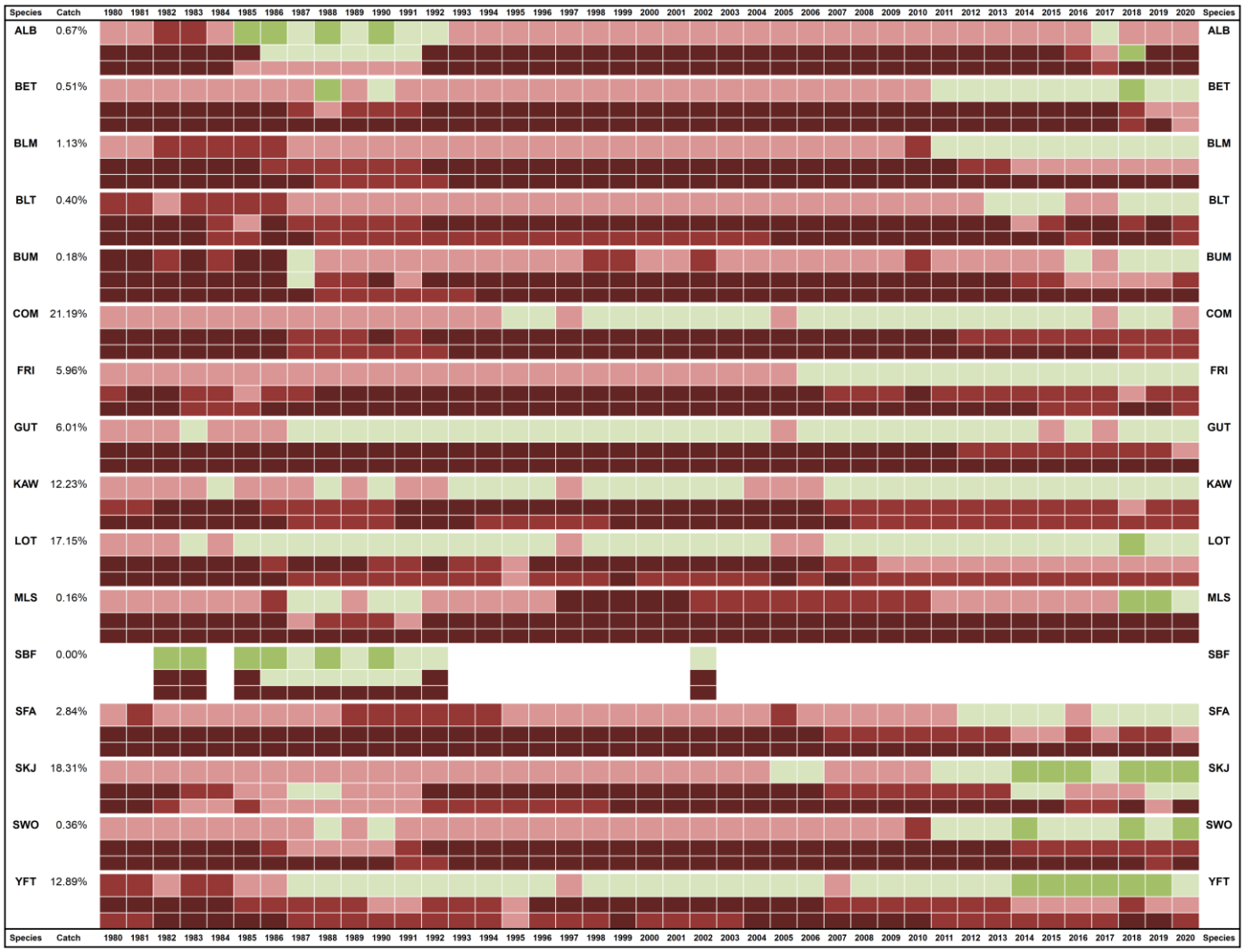


Figure 10: Reporting status of nominal catch (NC), catch and effort (CE), and size frequency (SF) data for the 16 IOTC species caught with gillnets, by year and species (1980-2020). Percentage (%) of catch indicates the contribution of the catches of each species to the total catches of all IOTC species between 1980 and 2020. For each species, the first, second, and third rows correspond to NC, CE, and SF data, respectively. Color key is given in **Table 4**

## Longline

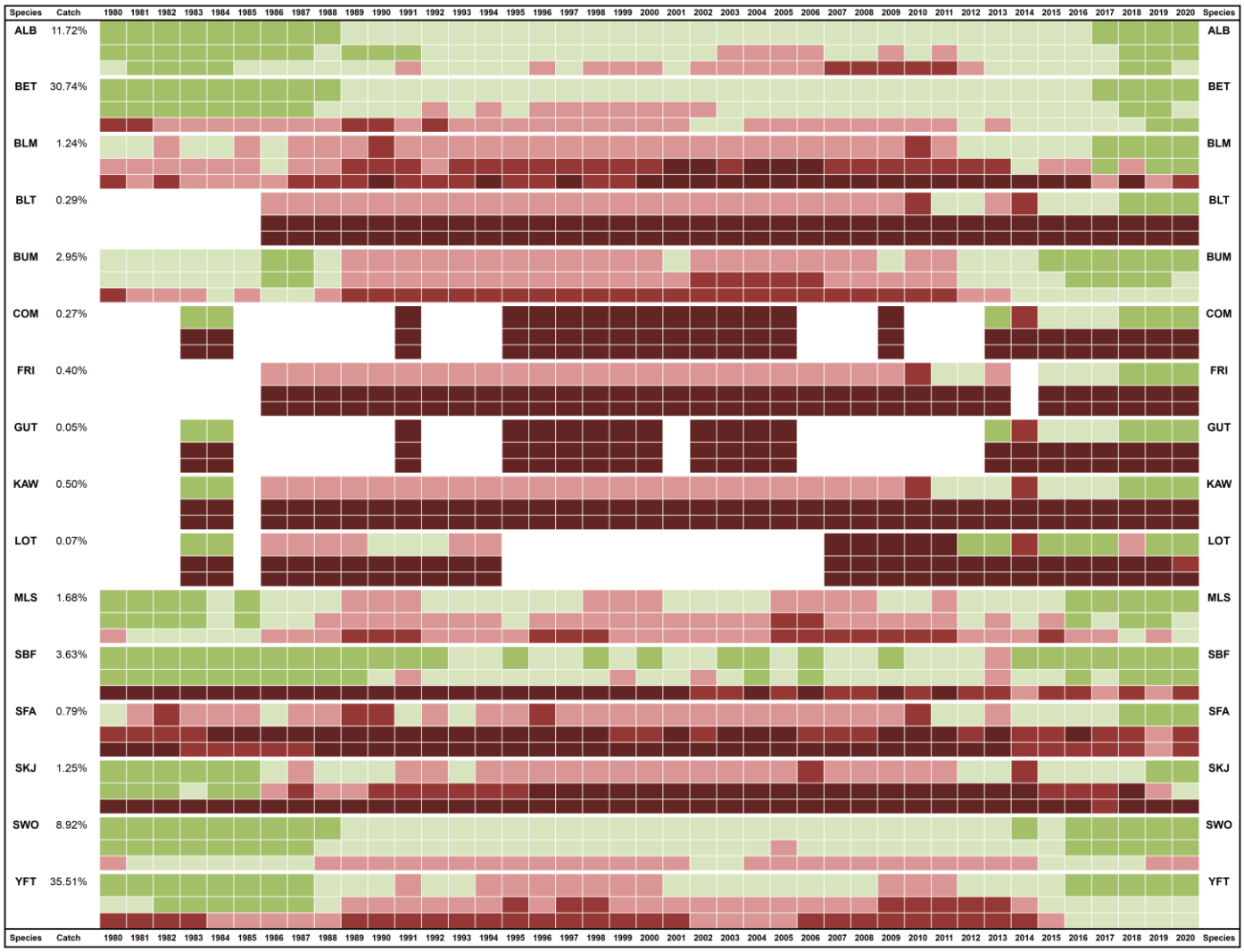


Figure 11: Reporting status of nominal catch (NC), catch and effort (CE), and size frequency (SF) data for the 16 IOTC species caught with purse seines, by year and species (1980-2020). Percentage (%) of catch indicates the contribution of the catches of each species to the total catches of all IOTC species between 1980 and 2020. For each species, the first, second, and third rows correspond to NC, CE, and SF data, respectively. Color key is given in **Table 4**. For each species, the first, second, and third rows correspond to NC, CE, and SF, respectively. Color key is given in **Table 4**

## Hand line, coastal longline, troll line, and other gears

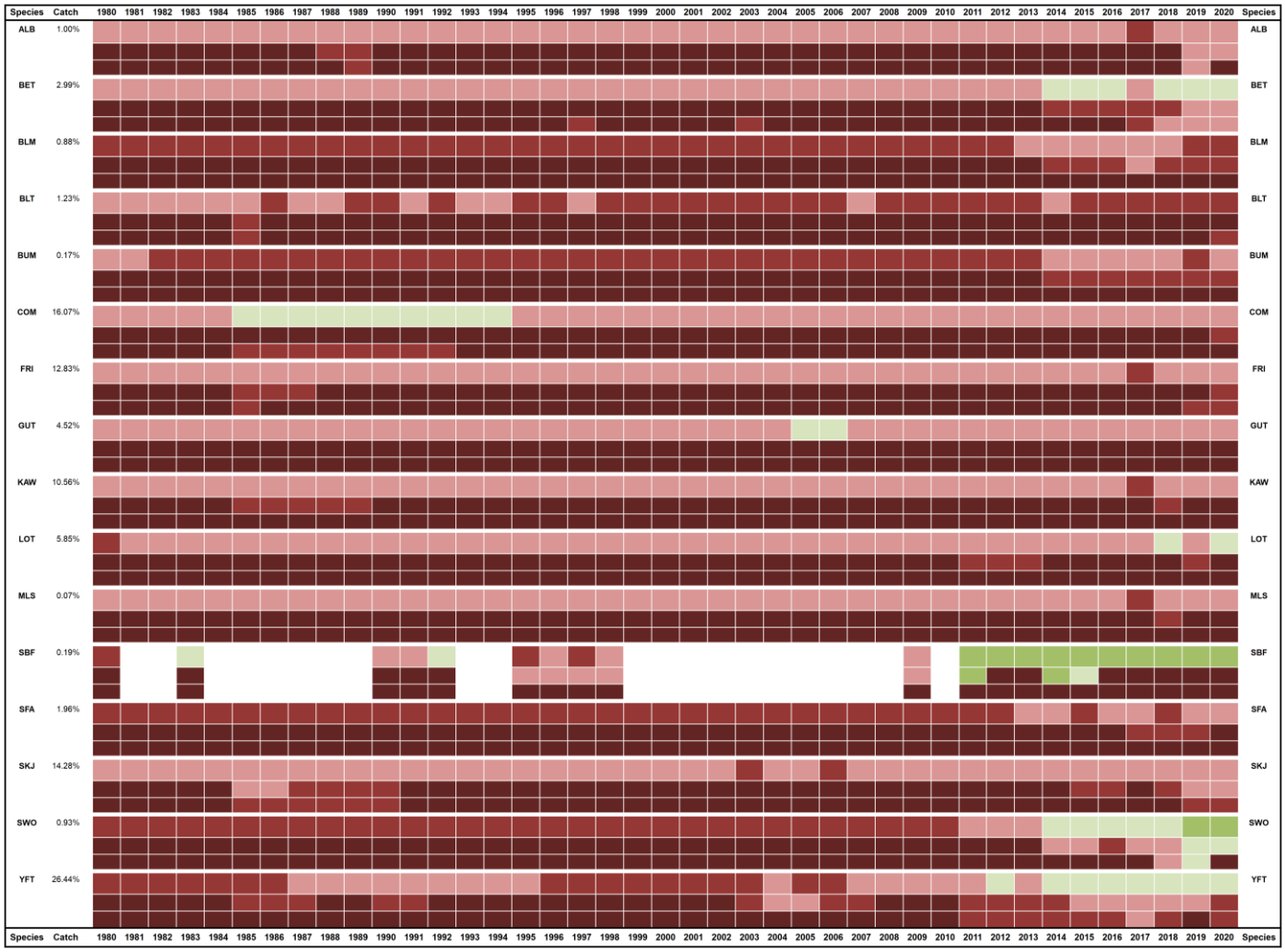


Figure 12: Reporting status of nominal catch (NC), catch and effort (CE), and size frequency (SF) data for the 16 IOTC species caught with hand lines, coastal longlines, troll lines, and other gears, by year and species (1980-2020). Percentage (%) of catch indicates the contribution of the catches of each species to the total catches of all IOTC species between 1980 and 2020. For each species, the first, second, and third rows correspond to NC, CE, and SF data, respectively. Color key is given in **Table 4**

# Appendix IV: Data issues

**Table 16:** Main data issues identified by the WPDCS and actions proposed to address them. NC = nominal catch; CE = catch and effort; SF = size frequency; ROS = Regional Observer Scheme

| Dataset | CPCs | Fisheries | Main issues | Proposed actions |
|---|---|---|---|---|
| **NC** | **India** | **Coastal fisheries** | Partial data reported in 2018 and 2019; almost no shark catch reported for 2018 | India has indicated that the IOTC shall use official figures, communicated by national authorities. Increase engagement with national scientists and stakeholders to increase the compatibility of the national data collection and reporting systems with the IOTC reporting formats |
| | **Indonesia** | | Interannual variability in official estimates of total catch and species composition, multiple data submissions every year | Continue ad hoc collaboration with institutes involved in fisheries monitoring and reporting and support for sampling of artisanal fisheries (e.g., species identification) and data management |
| | **I. R. Iran, Pakistan** | **Drifting gillnet fisheries** | Possible double-counting of catch due to vessels that may be registered in Pakistan and I. R. Iran | Liaise with fisheries administrations from Pakistan and I. R. Iran to understand and address the issue |
| | **Pakistan** | **Drifting gillnet fishery** | Additional validation of latest revised catch series | Liaise with Pakistan in terms of support for appraisal of the data |
| | **Madagascar** | **Coastal fisheries, longline fisheries** | Issues with data collection, including catch and effort and size data | Provide assistance in the sampling of artisanal fisheries upon request (dependent on staff / funds available). Liaise with FAO to assess possible options for combined interventions in the country |
| | **Somalia** | **Coastal fisheries** | Lack of national data collection systems, including catch and effort and size data | Support to national initiatives (e.g., Fisheries Data Collection Working Group) for the validation of databases and data collection programmes |
| | **Yemen** | **Handline fishery** | Nominal catches from FAO used since 2007 and repeated since 2017 | Liaise with FAO regional office and Statistics team of the Fisheries Division |
| **CE** | **All** | **Most fisheries** | Data either not submitted, or falls short of the IOTC data reporting requirements | Implement minimum data requirements for sharks (noting that those for India are different as it has objected to the logbook Resolution) |
| | | **Coastal fisheries** | Many CPCs have failed to report catches and effort per month for their coastal fisheries | As a minimum, request CPCs to report catches and fishing by species, gear, and month, in addition to the total numbers of fishing craft operated by gear, and month (or year). |
| | **Oman** | **Longline fisheries** | Data either not submitted, or falls short of the IOTC data reporting requirements | As part of the IOTC Data Compliance and Support missions, provide assistance to CPCs to understand the IOTC data requirements and processing of information and urge them to implement requirements and report data to the IOTC; for Pakistan gillnetters, appraisal of the capacity of the local crew-based data collection database to provide reliable catch and effort (as well as size-frequency) data to the Secretariat |
| | **Indonesia** | **Industrial longline fisheries** | Inconsistency between logbook and VMS | IOTC to encourage strengthening management and validation of logbook data – particularly inconsistencies with VMS data and issues of low reporting rates of submitted logbooks (<10% in recent years) |
| | **Oman** | **Handline and gillnet fisheries** | Lack of reporting due to data management | Follow-up to 2019-09 mission to finalize proper standardization of the statistical information available for handlines and gillnets, and eventually submission of catch and effort data according to Res. 15/02 |
| | **Pakistan** | **Drifting gillnet fishery** | Data either not submitted, or falls short of the IOTC data reporting requirements | As part of the IOTC Data Compliance and Support missions, provide assistance to CPCs to understand the IOTC data requirements and processing of information and urge them to implement requirements and report data to the IOTC; for Pakistan gillnetters, appraisal of the capacity of the local crew-based data collection database to provide reliable catch and effort (as well as size-frequency) data to the Secretariat |

| Dataset | CPCs | Fisheries | Main issues | Proposed actions |
|---|---|---|---|---|
| **SF** | **India, Indonesia, Malaysia, Oman, Yemen** | **Coastal fisheries** | No or very few size frequency data reported | Assist CPCs to understand data requirements, and provide support to pilot sampling and processing of fisheries data and urge them to strictly implement IOTC mandatory data reporting requirements |
| | **I. R. Iran** | **Drifting gillnet fishery** | Data not by IOTC standards | The IOTC Secretariat to continue to provide assistance to I.R. Iran to submit size data according to fishing ground (rather than landing site) based on port sampling (as logbooks are currently being piloted on a limited number of vessels) |
| | **Japan, Taiwan,China** | **Longline fisheries** | Catch-and-effort and size data conflicting over the time series | Follow-up of recommendations resulting from the consultancy conducted in 2020-2021 |
| | **Pakistan** | **Drifting gillnet fishery** | No or very few size frequency data reported | IOTC Secretariat liaising with Pakistan in terms of possible assistance for data entry, processing and submission of data via the Pakistan government |
| **ROS** | **All** | **Longline and surface fisheries** | Low levels of implementation and reporting | Organize ROS training and workshops to assist CPCs with implementation of the ROS data collection and reporting requirements, also under the activities of the ROS Pilot Project (training programme). |
| | | | Information reported in formats not suitable for data extraction | Explore ways of facilitating reporting of data using the IOTC ROS electronic tools and data reporting forms |
| | | **Coastal fisheries** | Low levels of implementation and reporting | Extension of EMS pilot project to other countries besides Sri Lanka |
| | | | | Strengthen data collection mechanisms at landing sites (in-port observers, alternative data collection mechanisms) |
| | **Sri Lanka** | **Coastal and offshore fisheries** | Partial implementation of ROS requirements | IOTC Secretariat to continue supporting the adoption of the ROS standards and tools; possible follow-up on EMS trial projects dependent on funding. Follow-up on the pilot study of EMS in Sri Lanka for coastal fisheries for which there are difficulties placing on-board observers |
| **Socio-Economic** | **All** | **All** | Limited data available, and collated within the IOTC database | Liaise with FAO Trade and Statistics Division and economic institutions to access open repositories of fish sale price, import and export data, and national indicators (e.g., Gross Domestic Product) |

# References

Alverson, D.L., Freeberg, M.H., Murawski, S.A., and Pope, J.G. 1994. A global assessment of fisheries bycatch and discards. *Edited by*FAO. Rome, Italy. Available from http://www.fao.org/3/t4890e/T4890E00.htm#TOC.

Bourjea, J., Nel, R., Jiddawi, N.S., Koonjul, M.S., and Bianchi, G. 2008. Sea turtle bycatch in the West Indian Ocean: Review, recommendations and research priorities. Western Indian Ocean Journal of Marine Science **7**(2): 137–150.

Chassot, E., Assan, C., Esparon, J., Tirant, A., Delgado de Molina, A., Dewals, P., Augustin, E., and Bodin, N. 2016. Length-weight relationships for tropical tunas caught with purse seine in the Indian Ocean: Update and lessons learned. Victoria, Seychelles, 28-30 November 2016. p. 11. Available from https://iotc.org/documents/length-weight-relationships-tropical-tunas-caught-purse-seine-indian-ocean-update-and.

Fu, D. 2020. Preliminary Indian Ocean skipjack tuna stock assessment 1950-2019 (Stock Synthesis). IOTC, Virtual meeting. p. 57. Available from https://www.iotc.org/documents/WPTT/2202/10.

Grande, M., Ruiz, J., Hilario, M., Murua, J., Goni, N., Krug, I., Arregui, I., Salgado, A., Zudaire, I., and Santiago, J. 2019. Progress on the code of good practices on the tropical tuna purse seine fishery in the Indian Ocean. IOTC, La Réunion, France, 03-07 September 2019. p. 44. Available from https://www.iotc.org/fr/documents/WPEB/15/33.

IOTC. 2013. Biological data on tuna and tuna-like species gathered at the IOTC Secretariat: Status Report. *In* Fifth session of the IOTC Working Party on Billfish. IOTC, Colombo, Sri Lanka, 27-31 March 2006. p. 23. Available from https://www.iotc.org/documents/biological-data-tuna-and-tuna-species-gathered-iotc-secretariat-status-report.

IOTC. 2014. Report of the Tenth Session of the IOTC Working Party on Data Collection and Statistics. IOTC, Eden Island, Seychelles, 2-4 December 2014. doi:10.5281/zenodo.3255691.

IOTC. 2018. Revision to the IOTC scientific estimates of Indonesia's fresh longline catches. IOTC, Mahé, Seychelles, 29 November - 01 December 2018. p. 14. Available from https://iotc.org/documents/WPDCS/14/23-IDN-FLL.

IOTC. 2020. Summary overview of buoy data submitted to the IOTC Secretariat for the period Jan-July 2020. IOTC, Virtual meeting, 30 November -03 December 2020. p. 7. Available from https://www.iotc.org/documents/WPDCS/16/17.

IOTC. 2021c. Update on the implementation of the IOTC Regional Observer Scheme. IOTC, Virtual meeting, 15-17 November 2021. p. 22. Available from https://iotc.org/documents/WGEMS/01/09.

IOTC. 2021a. Review of data on drifting Fish Aggregating Devices. IOTC, Virtual meeting. p. 52. Available from https://iotc.org/documents/WGFAD/02/03.

IOTC. 2021b. Fostering the work of the IOTC with socio-economic data sets sourced from FAO-GLOBEFISH and the Pacific Islands Forum Fisheries Agency (FFA). IOTC, Virtual meeting, 29 November - 3 December 2021. p. 5. Available from https://iotc.org/documents/fostering-work-iotc-socio-economic-data-sets-sourced-fao-globefish-and-pacific-islands.

Kelleher, K. 2005. Discards in the world's marine fisheries. An update. *Edited by*FAO. FAO, Rome, Italy. Available from http://www.fao.org/3/y5936e/y5936e00.htm.

Moreno, G., and Herrera, M. 2013. Estimation of fishing capacity by tuna fishing fleets in the Indian Ocean. IOTC, Busan, Rep. of Korea, 2-6 December 2013. p. 77. Available from https://iotc.org/documents/estimation-fishing-capacity-tuna-fishing-fleets-indian-ocean.

Moreno, G., Herrera, M., and Pierre, L. 2012. Pilot project to improve data collection for tuna, sharks and billfish from artisanal fisheries in the Indian Ocean. Part II. Revision of catch statistics for India, Indonesia and Sri Lanka (1950-2011). Assignment of species and gears to the total catch and issues on data quality. Mahé, Seychelles, 10-15 December 2012. p. 6. Available from https://www.iotc.org/sites/default/files/documents/2019/02/IOTC-2012-SC15-38E_-_Revision_of_catch_stats_0.pdf.

Murua, H., Eveson, J.P., and Marsac, F. 2015. The Indian Ocean Tuna Tagging Programme: Building better science for more sustainability. Fisheries Research **163**: 1–6. doi:10.1016/j.fishres.2014.07.001.

Romanov, E.R., Ward, P., Levesque, J.-C., and Lawrence, E. 2008. Preliminary analysis of crocodile shark (*Pseudocarcharias kamoharai*) distribution and abundance trends in pelagic longline fisheries. IOTC, Bangkok, Thailand, 20-22 October 2008. Available from https://iotc.org/documents/preliminary-analysis-crocodile-shark-pseudocarcharias-kamoharai-distribution-and-abundance.

Rousseau, Y., Watson, R.A., Blanchard, J.L., and Fulton, E.A. 2019. Defining global artisanal fisheries. Marine Policy **108**: 103634. doi:10.1016/j.marpol.2019.103634.

Ruiz, J., Abascal, F., Bach, P., Baez, J.-C., Cauquil, P., Grande, M., Krug, I., Lucas, J., Murua, H., Lourdes Alonso, M.L., and Sabarros, P.S. 2018. Bycatch of the European, and associated flag, purse seine tuna fishery in the Indian Ocean for the period 2008-2017. IOTC, Cape Town, South Africa, 10-17 September 2018. p. 15. Available from https://www.iotc.org/documents/WPEB/14/15.

Sabarros, P., Romanov, E.V., Le Foulgoc, L., Richard, E., Lamoureux, J.-P., and Bach, P. 2013. Commercial catch and discards of pelagic longline fishery of Reunion island based on the self-reporting data collection program. IOTC, La Réunion, France, 12-16 September 2013. p. 29. Available from https://www.iotc.org/documents/commercial-catch-and-discards-pelagic-longline-fishery-reunion-island-based-self-reporting.

Shahifar, R., Barghani, H.R., Noori, R.D., and Khorshidi, S. 2013. Estimation of bycatch and discard by Iranian fishing vessels (gillnets) In IOTC competence of area in 2012. IOTC, La Réunion, France, 12-16 September 2013. p. 6. Available from https://www.iotc.org/documents/estimation-bycatch-and-discard-iranian-fishing-vessels-gillnets-iotc-area-competence-2012.