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, georreferenced catch and 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 (2012-2021)
3. Overview of the status of the data reported for the reference year 2021
4. Status of the IOTC nominal catch, catch and effort, and size-frequency databases, 1981-2021
5. Status of the IOTC fishing craft statistics (FC) and active vessels (AV) databases
6. Other IOTC data holdings

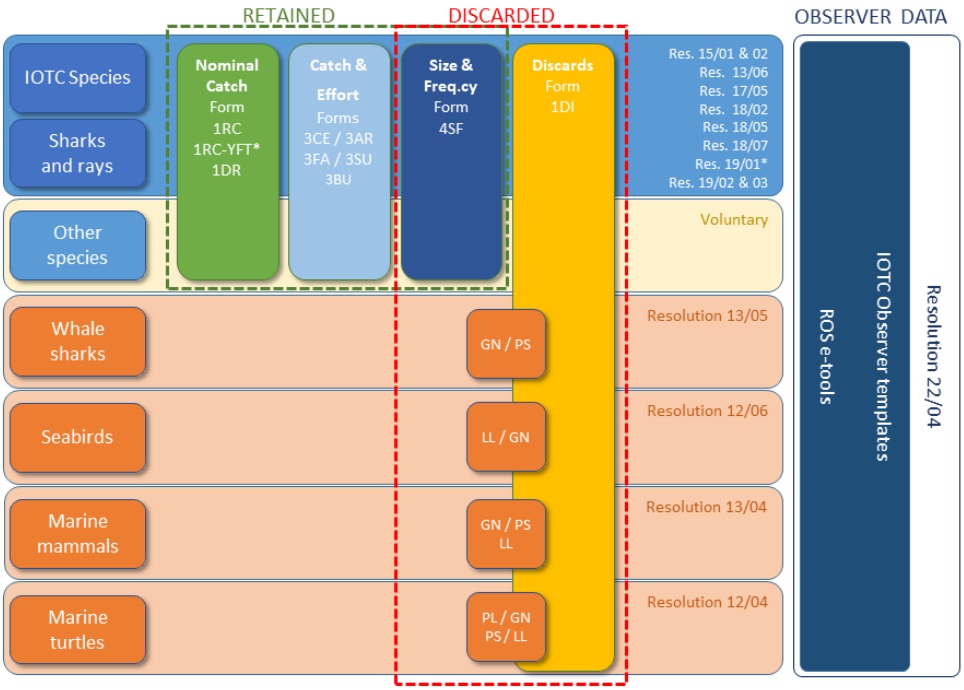

Figure 1: Overview of the data reporting requirements, including IOTC reporting forms and tools, and Resolutions for the 16 IOTC species and bycatch species caught or interacted with by fisheries for tuna and tuna-like species in the IOTC area of competence. BB = Baitboat; GN = Gillnet; LL = Longline; 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).To shade some light of the classification and definition on coastal fisheries, FAO introduced a pilot testing of the Small Scale fisheries Matrix (Funge-Smith (2019)), with the aim of providing statistical definition of the small fisheries.

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	22/04	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, which applies to CPCs who objected the superseded resolution 21/01, 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). Notwithstanding the low coverage currently recorded from fisheries with scientific observer on-board, besides the none coverage from several fisheries (Secretariat (2021)).

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. Furthermore, the fishing craft statistics database is a repository for number of smaller crafts which are not registered in IOTC vessel record.

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). However, this classification could still be improved considering that:

- Smaller vessels can fall into two or more categories. Based on the vessel size, operating areas, either within EEZ or ABNJ or both, and furthermore, the type of market or purpose of the catch, are factors which will determine the vessel categories;
- Changes in fisheries operational activities make the classification redundant for many countries. Development in fisheries allow vessels of different sizes to operate beyond its coastline. Although vessel are below 15m, they could provide catches for commercial purposes for export;
- For better annotations, need broader classification. With the above two points on characteristics and fisheries development, there is a need to reclassify the fisheries categories, for countries to have wider explicit choices.

Table 2: Current 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	RAV
Non-motorised	All	Flag State EEZ only	Artisanal	No
Motorised outboard	All	Flag State EEZ only	Artisanal	No
Motorised inboard	<15 m	Flag State EEZ only	Artisanal	No
Motorised inboard	15-24 m	Flag State EEZ only	Semi-industrial	No
Motorised inboard	<15 m	Includes other EEZ areas and/or high seas	Semi-industrial	Yes
Motorised inboard	15-24 m	Includes other EEZ areas and/or high seas	Industrial	Yes
Motorised inboard	≥24 m	Anywhere	Industrial	Yes

Catch and effort data

Catch and effort data refer to finer-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).

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

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 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 (9th 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 (2012-2022)

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 by 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 2022, eight (8) CPCs did not report nominal catch data for 2021: Australia, Eritrea, EU-Italy, Pakistan, 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 seven (7) other countries were repeated from previous year. Besides these non-reporting CPCs, one (1) CPC, Kenya, submitted repeated catch of 2020. In addition, nominal catch data had to be estimated for the following non-members of the IOTC: Bahrain, Djibouti, Egypt, Jordan, Kuwait, Myanmar, Saudi Arabia, and Timor Leste. United Arab Emirates, on the other hand, directly responded to the Secretariat with revised catches by species from 2012 to 2021, based on a recent national revision of their catch data. Overall, the fraction of non-reported nominal catches increased from 3% in 2021 to 8% in 2022.

Information collated on data submission to the IOTC Secretariat spanning the decade 2012-2022 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 fraction 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 7.5% in 2022 (**Fig. 2**). Although less marked, the level of reporting for tropical tunas has also over the last decade, with estimated nominal catches decreasing from 20.2% in 2012 to 2.3% in 2021 (**Fig. 2**).

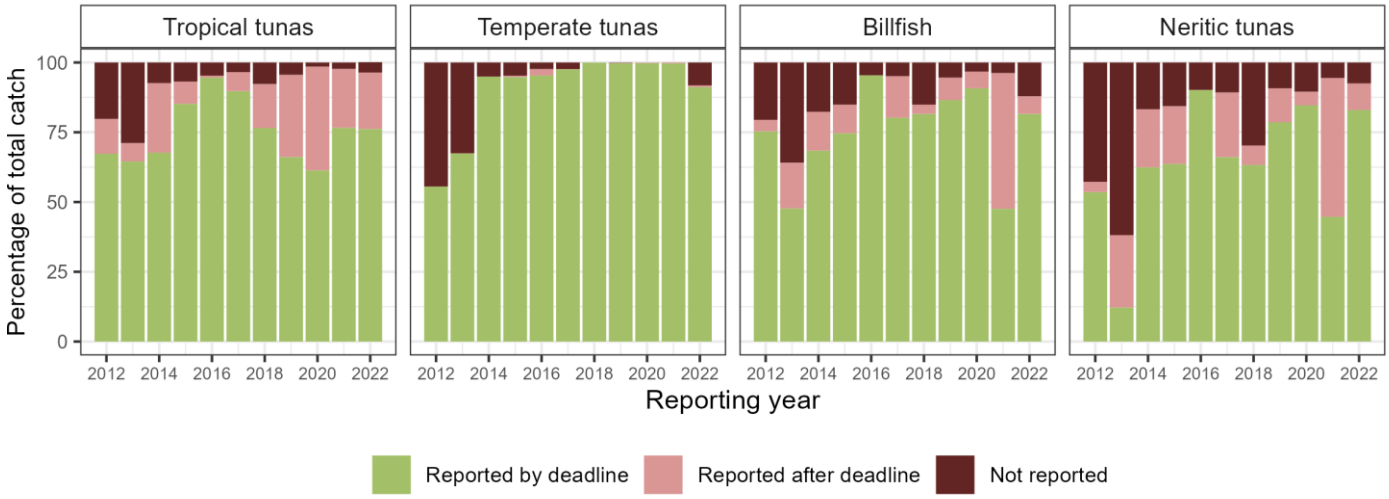

Figure 2: Annual percentage of total nominal catch of each of the IOTC species groups according to the date of submission of the nominal catch data by each fleet to the IOTC Secretariat. The submission deadline is the 30th June of each year

Timeliness

Most of the nominal catches reported between 2012 and 2022 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 basically all nominal catches have has been reported by the 30th of June in the years between 2018 and 2021. However, reporting of temperate tunas catches in 2022 was slightly incomplete, as only 91% of catches were available by the 30th of June. Apropos billfish species, although the late submissions decrease, from 49% in 2021 to 6% in 2022, the level of non-reporting increased to 12%. Late submissions of catches of neritic tunas decreased to the same level as billfish (where average was 16.1% during the period 2012-2022), while for tropical tunas, an average of 16.6% of the total catch has been submitted to the Secretariat after the deadline. The reporting year 2022 shows an improvement in the timely report of nominal catches of about 0.6%, 20.2%, 9.5%, and 6.3%, for temperate tunas, tropical tunas, neritic tunas, and billfish, respectively (**Fig. 2**). These improvements, follow the slowdown in all fishing activities affected the reporting of data in 2021 due to the global CoViD-19 pandemic.

Catch and effort data

Availability

The amount of geo-referenced catch and effort data not reported to the IOTC Secretariat is 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 strata accounting for 63.7% of total nominal catches between 2012 and 2018. Besides neritic tunas, billfish species also present particularly low levels of geo-referenced data, which only cover strata accounting for around 42% of total nominal catches between 2012 and 2018. Nevertheless, the situation has improved for all IOTC species over the last five years, with the exception of significant late reporting 2021, and as shown by the increasing percentage of nominal catch data for which catch and effort data are available (**Fig. 3**).

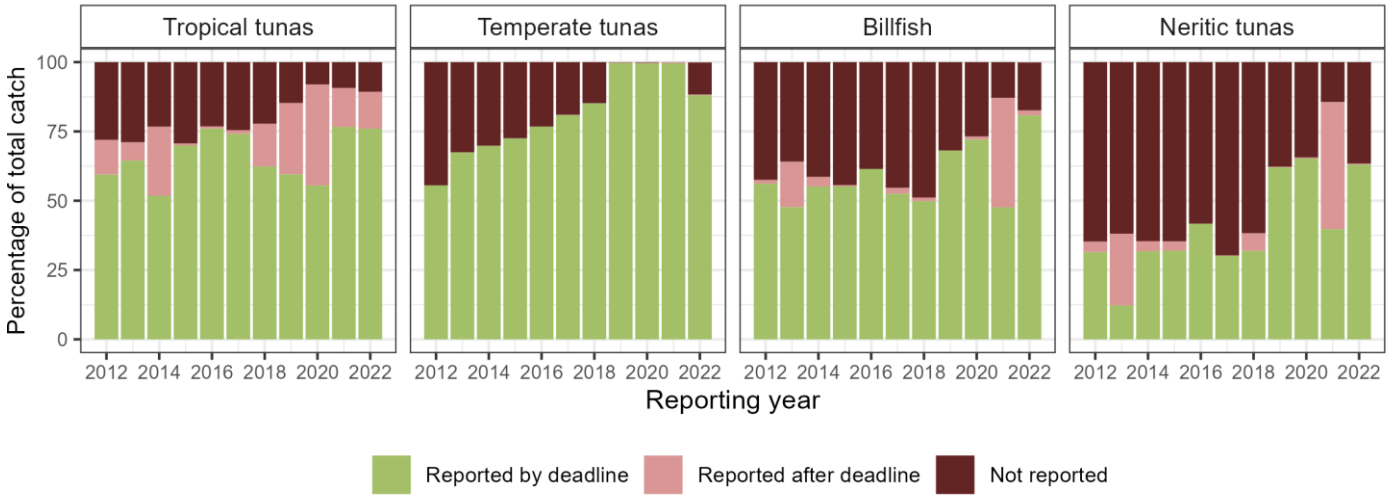

Figure 3: Annual percentage of total nominal catch of each of the IOTC species groups according to the date of submission of the geo-referenced catch and effort data by each fleet to the IOTC Secretariat. The submission deadline is the 30th June of each year

Timeliness

Considerable amount of geo-referenced catch and effort data for tropical and temperate tunas submitted to the Secretariat have been mostly reported by the deadline of June 30^th between 2012 and 2022 (**Fig. 3**), withthe possible exception of tropical tunas, for which 21% of the total nominal catches have their corresponding geo-referenced catch and effort data submitted after the deadline for the years between 2018 and 2021. Late submission of geo-referenced catch and effort data for most species improved from 24.9% in 2021 to 3.9% in 2022, following the substantial amounts of late submissions received in 2021, due to the CoViD-19 pandemic affecting the sampling and data management activities of CPCs.

Size frequency data

Availability

Limited information is available on the size composition of the nominal catches of several IOTC species. Although a large proportion of billfish catches are from industrial fisheries, limited size frequency data continued to be received for the species. On the contrary, there are marked improvement in the submission of size frequency data for neritic tunas in recent years, considering that 66.1% of neritic tunas nominal catches did not have any corresponding size frequency data between 2012 and 2021, while in 2022 this fraction improved to 36.7%. Concerning billfish, on average 60.1% of the nominal catches beween 2012 and 2021 did not have any corresponding size frequency data, and the performance worsened in 2022 when this value reached 68.5% (**Fig. 4**). The availability of size frequency data for temperate and tropical tunas hs increased over time and recorded the highest values in recent years. however, size frequency of temperate tunas reached 99.3415299.55829% of availability in 2020 and 2021, before declining 75.7% in 2022. On the contrary, the level of coverage of tropical tunas size frequency remained approximately the same in recent years, reaching 84.4% in 2022.

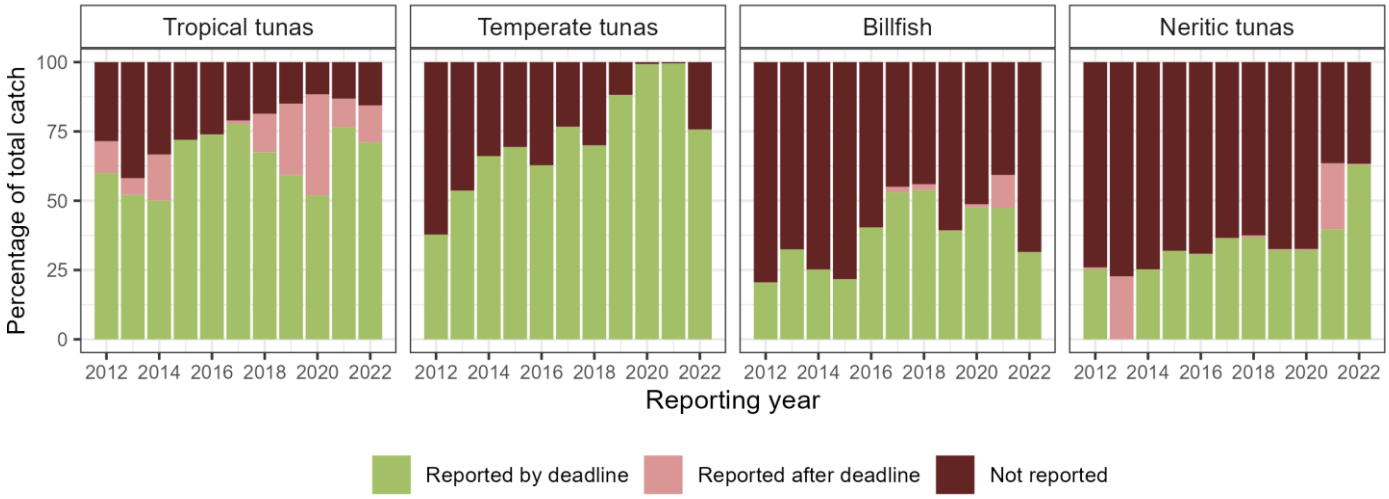

Figure 4: Annual percentage of total nominal catch of each of the IOTC species groups according to the date of submission of the size frequency data by each fleet to the IOTC Secretariat. The submission deadline is the 30th June of each year

Timeliness

When available, size frequency data between 2012 and 2022 have been mostly reported by the deadline, with a significant fraction of the size data for tropical tunas reported with some delays in recent years. Between 2018 and 2022, size frequency data were submitted lately to the Secretariat for 19.9% of the nominal catches of tropical tunas on average (**Fig. 4**). Although there were delays in reporting nominal catch and catch and effort data in 2021, again attributed to the CoViD-19 pandemic, in 2022 the overall reporting increased, although the timeliness of size-frequency reported declined further.

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 reached 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 40.1% for catch and effort, and 32.2% for size frequency), compared to tropical tunas (i.e., between 66% for catch and effort, and 64.7% for size frequency) 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 (37.6%), 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;
- Although data reporting in 2022 shows sign of recovery from the CoViD-19 pandemic in reporting in 2022, some major fisheries (both industrial and coastal), were still late in reporting.

Overview of the status of the data reported for 2021

Nominal catch, catch and effort, and size frequency data

Nominal catch data, geo-referenced catch and effort data, and size frequency data for the reference year 2021 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, and for some coastal fisheries (**Table 5**). Nevertheless, there are still some important fleets that have not reported the three main datasets to date.

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, Comoros, Sri Lanka and UK (**Table 5**), and almost no size frequency data were made available for these fisheries, except for Comoros, and some fisheries of Indonesia and Iran.

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 2022 (for reference year 2021) 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	EU	EUESP	156,445			
		EUFRA	78,474			
	IDN		62,187			
	IRN		531			
	KOR		21,702			
	MUS		25,803			
	SYC		122,885			
Longline	AUS		162			
	CHN	CHN	11,743			
		TWN	63,241			
	EU	EUESP	4,150			
		EUFRA	1,663			
		EUPRT	1,345			
	IDN		10,283			
	IND		5			
	JPN		10,609			
	KEN		1,025			
	KOR		1,016			
	LKA		10,837			
	MDG		127			
	MOZ		389			
	MYS		2,523			
	SYC		15,317			
	ZAF		1,001			
Other	BGD		30,358			
	COM		14,583			
	IDN		358,921			
	IRN		307,699			
	LKA		156,130			
	MDV		143,550			
	OMN		173,538			
	PAK		47,827			
	SYC		3,417			
	THA		20,365			
	TZA		16,778			
	YEM		37,857			

Discard data collected through form 1DI

Estimates of discards reported to the Secretariat are derived from logbooks or observers although data on discards reported in the logbook may also be collated from the latter in some cases. In 2022, a total of 11 fleets provided positive reports of discards for the reference year 2021 (**Table 6**). The comparison of discards levels between fleets and fisheries is hampered by the great heterogeneity of the information provided by CPCs, particularly in the levels of sampling coverage and absence of raising for most of the fisheries. Although IOTC Resolution 15/02 states that discards should be extrapolated to the fishery, the level of discarded catch reported by CPCs are low and in number based mostly on observation, which do not give any indication of extrapolation.

Other issues regarding the nature of discards data reporting includes email notifications which are focused on specific resolutions requirements (Res. 13/05, Res.12/06, Res.13/04, Res 12/04, Res. 17/05 and Res.19/03). Therefore, the information received is fragmented, and does not comply with the IOTC standards included in form 1 DI in accordance to Res 15/02. In 2022 five fleets submitted nil reports of discards, compareD to eight fleets 2021: UK, India, I. R. Iran, Madagascar, 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, 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: Discarded data by fleet in 2021 as reported to the IOTC Secretariat

Unit	CHINA	EU.SPAIN	EU.FRANCE	INDONESIA	KOREA	SRI LANKA	MOZAMBIQUE	MAURITIUS	MALAYSIA	SEYCHELLES	TAIWAN,CHINA	SOUTH AFRICA
NO	103	1,028,257	4,136	381	3,746	1,807	7	5,093	529	2,079	7,266	1,069
t	0	0	1,663	0	0	0	0	34	0	1	0	0

The availability of discarded catches by fisheries, indicate that most tunas and tuna-like species are discarded from purse seine fisheries fishing on log associated school and for sensitive species, substantial sharks discarded from longline fisheries (**Table 7 and 8**).

Table 7: Total discard levels in numbers of IOTCSP by Gear in 2021 as reported to the IOTC Secretariat

Gear	BILLFISH	NERITIC TUNAS	TEMPERATE TUNAS	TROPICAL TUNAS
Fresh longline	127	0	14	239
Longline	84	0	451	5,878
Purse seine associated-school	230	629,862	0	365,615
Purse seine free-school	0	31,783	0	558
Purse seine others	15	3,773	0	569
Swordfish longline	640	0	87	300

Table 8: Total discards (numbers) of sensitive species by fishing gear and species group in 2021 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	Cetaceans	Rays	Seabirds	Sharks	Turtles
Coastal longline	3	240	0	243	155
Fresh longline	7	16	12	788	71
Gillnet	3	0	0	14	1,265
Longline	0	48	222	7,071	5
Purse seine associated-school	0	0	0	224	99
Purse seine free-school	0	0	0	27	0
Purse seine others	0	1	0	735	0
Purse seine ringnet	0	0	0	0	36
Swordfish longline	0	1,180	0	1,767	17

Although the scarcity of the data most fleets record the fate of the species on discards, indicating a high level of species discarded alive. The fates of the species discarded were analysed by main industrial fisheries by species group (**Fig. 5 and 6**) , species discarded alive by fisheries (**Fig. 8**), and species discarded dead by fisheries (**Fig. 7**) In summary the charts indicate:

- Limited rays reported from purse seine fisheries, whereas most rays from longline fisheries are discarded alive
- More turtles interacted with purse seine fisheries. Most of the turtles from both purse seine and longline discarded alive
- Large proportion of seabirds interacted in longline are discarded dead
- Tuna and tuna-like species from both longline and purse seine are discarded dead minimal number release alive from longline fisheries

Notwithstanding, that the information currently available on discards cannot be used to estimate the magnitude and composition of the phenomenon at regional level. However, it does provide some indication of the occurrence of sensitive species in some fisheries and gaps that need to be considered to improve the quality of the data for further analysis.

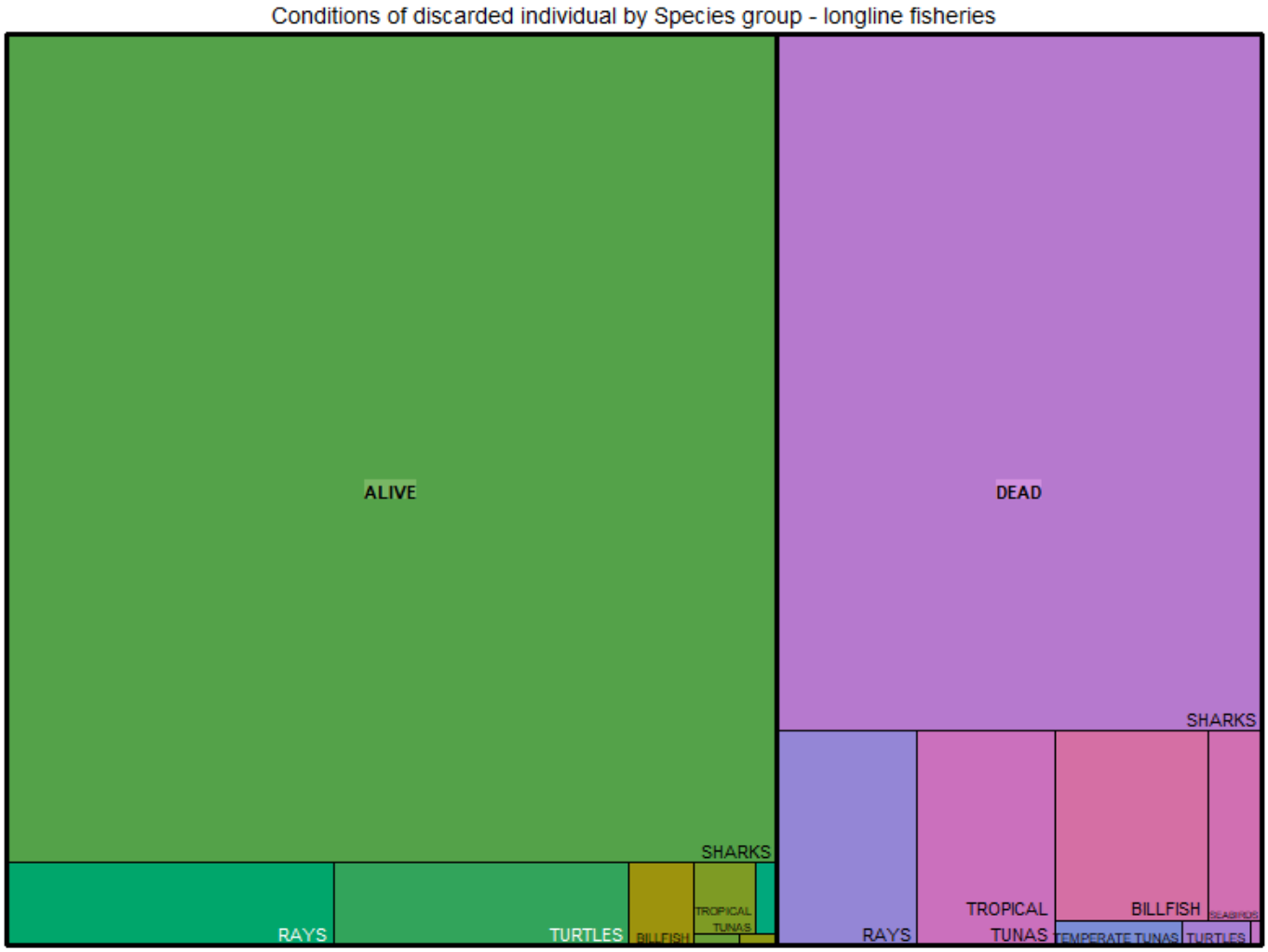

Figure 5: Total discards by fate and species group from longline 2021 reported in form 1DI

Figure 6: Total discards by fate and species group fro purse seine fisheries in 2021 reported in form 1DI

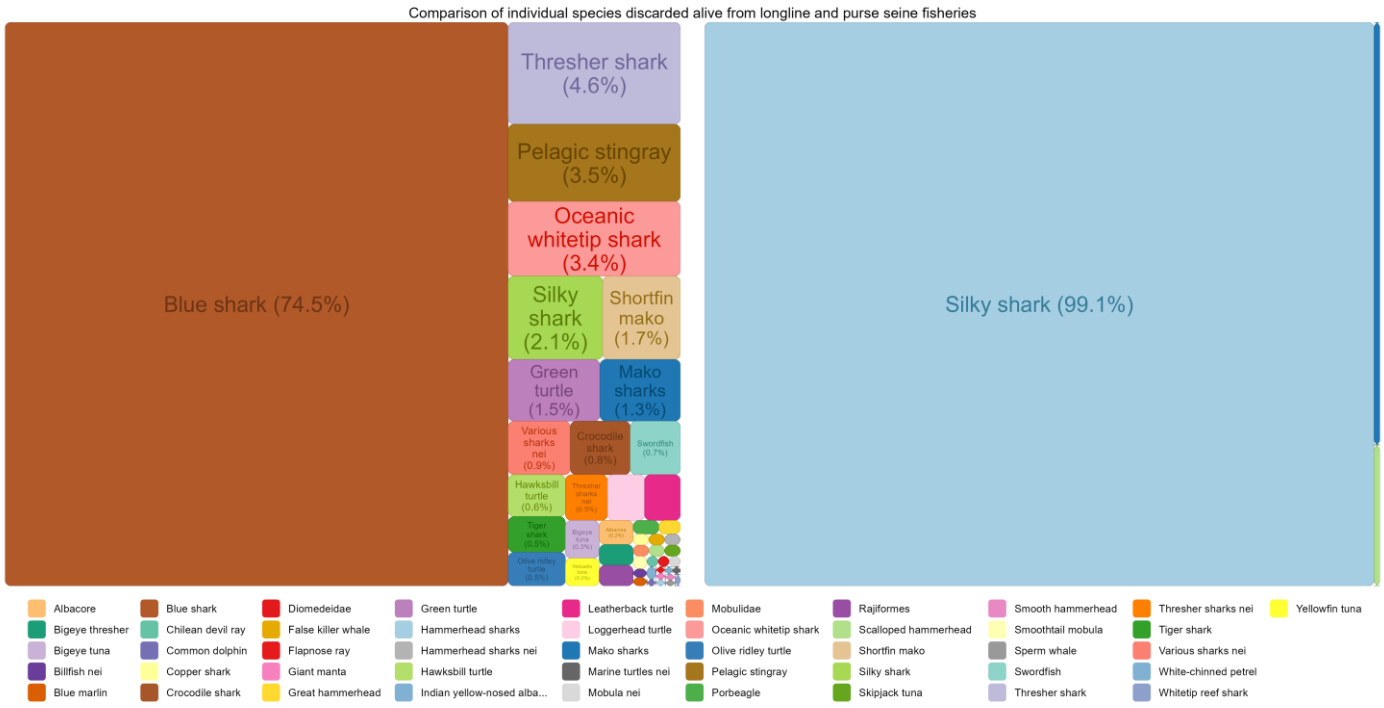

Figure 7: Species discarded alive from longline and purse seine fisheries in 2021 reported in form 1DI

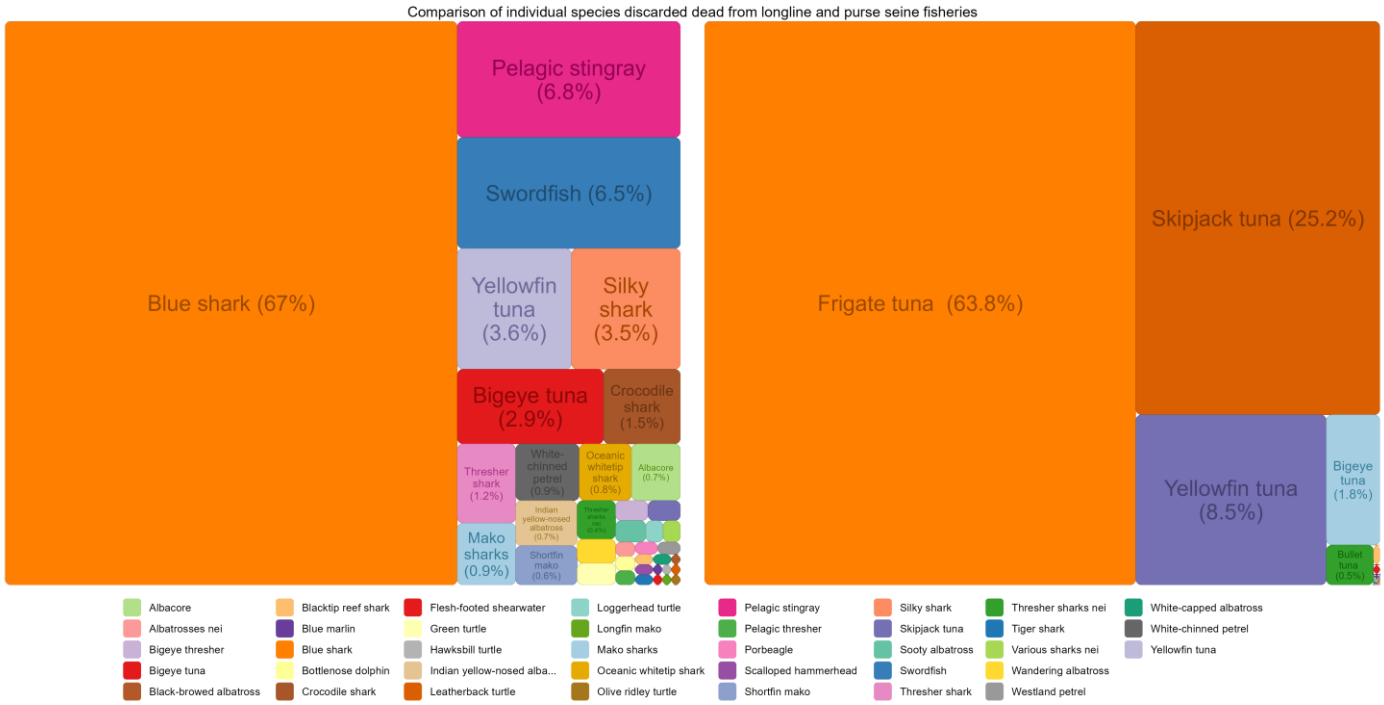

Figure 8: Species discarded dead from longline and purse seine fisheries in 2021 reported in form 1DI

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 2021 has been made at the 3nd IOTC ad hoc Working Group on FADs (WGFAD03) in October 2022, along with the release of the consolidated data sets (IOTC-WGFAD-03 2022). Although with some improvement compared the previous year, still some issues are found in the data reported for some purse seine fleets mostly due to misinterpretation of the data reporting requirements related to FAD activities (**Table 9**). The WGFAD03 endorsed the creation of a small Working Group to discuss methods to facilitate FAD data submissions (revise existing data submission forms) as well as harmonise definitions and classifications related to FAD fisheries.

Effort data for supply vessels in 2021 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 9**).

Table 9: Data reporting status of FAD-related and supply vessel data in 2021 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, 1981-2021

Fig. 9 provides an overview of the reporting status of the three main IOTC data sets between 1981 and 2021. 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.

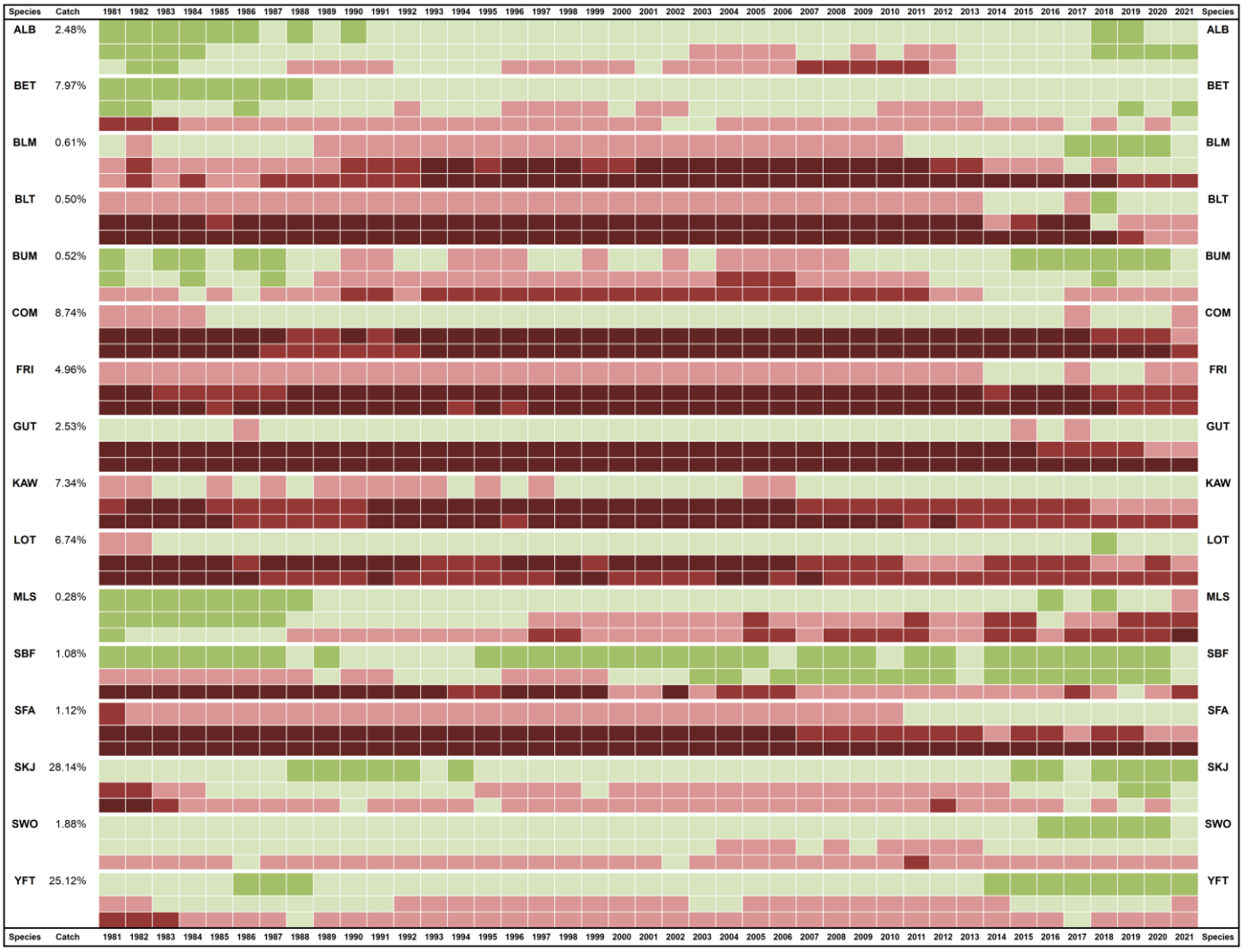

Figure 9: Reporting status of nominal catch (NC), catch and effort (CE), and size frequency (SF) data for the 16 IOTC species, by year and species (1981-2021). Percentage (%) of catch indicates the contribution of the catches of each species to the total catches of all IOTC species between 1981 and 2021. 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 2021

Table 10: 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 through form 2FC. Red: FC not available; Grey: not applicable or do not have the fisheries

CPC code	Fleet code	Baitboat	Gillnet	Line	Longline	Other	Purse seine
ARE*							
AUS							
BGD							
BHR*							
CHN	CHN				78		
	TWN				260		
COM							
DJI*							
EGY*							
ERI							
EU	EUESP				8		21
	EUFRA						13
	EUITA						
	EUMYT			87			
	EUPRT				2		
	EUREU			130	19		
IDN		5,445	120,780	107,451	86	21,281	5,502
IND					4		
IRN			3,787	2,122			6
JOR*							
JPN					53		
KEN							
KOR					5		3
KWT*							
LKA			2,636	4,648	718	46,835	2,088
MDG					5		
MDV							
MMR*							
MOZ					6		
MUS				149			4
MYS			10,463	113	20	2,416	420
OMN			26,102		4		
PAK							
QAT*							
SAU*							
SDN							
SYC					82		16
THA							227
TMP*							
TZA							
YEM							
ZAF					12		

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 2022, information on fishing crafts was only provided by twelve fishing CPCs, (**Table 10**).

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. 10**). 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.

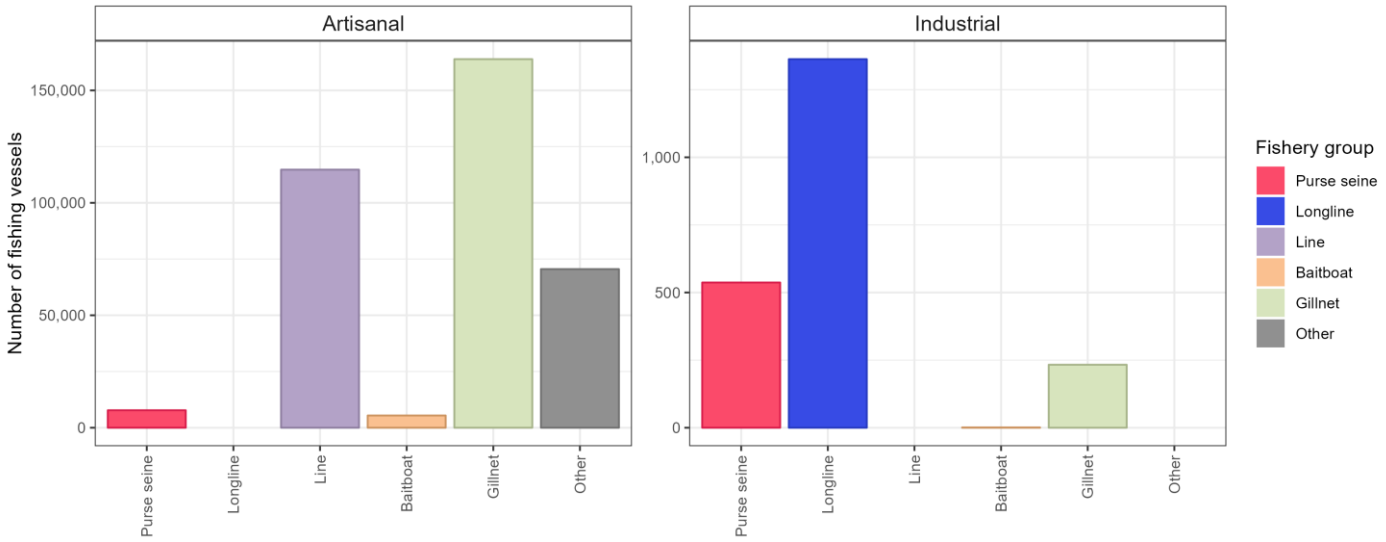

Figure 10: Number of fishing vessels by fishery group reported to the IOTC Secretariat for the year 2021 for each fishery type. ART = artisanal; IND = industrial; SEMI = semi-industrial, i.e., vessels less than 24 m length overall that may operate in the high seas

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 10** for 2021), the reporting coverage may vary from year to year for others.

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 2021).

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

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.

A more complete overview of the status of ROS data reporting is available in document IOTC-2022-WPDCS18-10.

Tagging data

As of November 2022, a total of 34,193 tags deployed on tropical tunas had been recovered (**Table 11**). 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 11: 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
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 2022

Tropical tuna species

Table 12: 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 2022 (for reference year 2021) 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	154,702	B,S,Y			
		EUFRA	78,123	B,S,Y			
	IDN		60,334	B,S,Y			
	IRN		305	S,Y			
	KOR		21,698	B,S,Y			
	MUS		25,705	B,S,Y			
	SYC		122,027	B,S,Y			
Longline	AUS		42	B,S,Y			
	CHN	CHN	7,334	B,Y			
		TWN	24,270	B,S,Y			
	EU	EUESP	84	B,S,Y			
		EUFRA	471	B,S,Y			
		EUPRT	41	B			
	IDN		5,225	B,S,Y			
	IND		1	S,Y			
	JPN		4,273	B,S,Y			
	KEN		293	B,Y			
	KOR		641	B,S,Y			
	LKA		8,248	B,S,Y			
	MDG		58	B,Y			
	MOZ		212	B,S,Y			
	MYS		695	B,S,Y			
	SYC		9,628	B,Y			
	ZAF		574	B,Y			
Other	COM		11,904	B,S,Y			
	IDN		125,314	B,S,Y			
	IRN		112,703	B,S,Y			
	LKA		62,755	B,S,Y			
	MDV		143,455	B,S,Y			
	OMN		75,127	S,Y			
	PAK		5,952	S,Y			
	SYC		918	B,Y			
	THA		3,998	S,Y			
	TZA		4,275	S,Y			
	YEM		20,160	S,Y			

Temperate tuna 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 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	EU	EUESP	108	A			
		EUFRA	61	A			
	IDN		131	A			
	KOR		4	A			
	MUS		10	A			
	SYC		29	A			
Longline	AUS		23	A,S			
	CHN	CHN	2,360	A			
		TWN	19,554	A,S			
	EU	EUESP	1	A			
		EUFRA	231	A			
		EUPRT	1	A			
	IDN		3,354	A,S			
	JPN		5,532	A,S			
	KOR		295	A,S			
	LKA		112	A			
	MDG		23	A			
	MOZ		6	A			
	MYS		1,277	A			
	SYC		1,185	A			
	ZAF		95	A,S			
Other	COM		18	A			
	IDN		6,534	A			

Billfish species

Table 14: Nominal catch (t) and data reporting quality of the main IOTC datasets by fishery group and flag as reported in 2022 (for reference year 2021) 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	EUESP	38	F,M			
		EUFRA	26	F,M			
	IDN		10	F,M,S			
	SYC		8	M			
Longline	AUS		96	M,P,S			
	CHN	CHN	1,855	F,M,S			
		TWN	5,559	F,M,P,S			
	EU	EUESP	1,523	F,M,P,S			
		EUFRA	908	F,M,P,S			
		EUPRT	461	M,S			
	IDN		708	F,M,S			
	IND		1	F,S			
	JPN		470	F,M,S			
	KEN		554	F,M,S			
	KOR		41	F,M,S			
	LKA		2,244	F,M,S			
	MDG		24	F,M,S			
	MOZ		152	F,M,P,S			
	MYS		325	F,M,S			
	SYC		1,630	F,M,P,S			
	ZAF		288	M,S			
Other	COM		334	F,M,S			
	IDN		4,597	F,M,S			
	IRN		26,530	F,M,S			
	LKA		7,993	F,M,S			
	OMN		2,438	F,M,S			
	PAK		4,264	F,M			
	SYC		78	F,M,P,S			
	THA		17	F			
	TZA		2,682	F			
	YEM		1,982	F,S			

Neritic species

Table 15: Nominal catch (t) and data reporting quality of the main IOTC datasets by fishery group and flag as reported in 2022 (for reference year 2021) 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	1,597	F			
		EUFRA	72	K,X			
	IDN		1,502	B,C,F,K,L			
	IRN		220	L			
	MUS		12	F,X			
	SYC		5	X			
Longline	CHN	TWN	100	B,C,F,G,K,L			
	EU	EUFRA	2	X			
	IDN		230	C,F			
	LKA		2	B,F,L,X			
Other	COM		239	C,K,L,X			
	IDN		197,379	B,C,F,G,K,L			
	IRN		135,010	C,F,G,K,L			
	LKA		4,609	B,C,F,K,L,X			
	MDV		80	F,K,X			
	OMN		51,825	C,F,K,L,X			
	PAK		23,537	B,C,F,K,L			
	THA		16,350	B,C,F,K,L			
	TZA		3,362	C,F,G,K			
	YEM		9,067	C,F,G,K,L			

Main shark species

Table 16: Nominal catch (t) and data reporting quality of the main IOTC datasets by fishery group and flag as reported in 2022 (for reference year 2021) 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	MUS		2	O			
Longline	CHN	CHN	170	L,M,W			
		TWN	2,964	L,S			
	EU	EUESP	2,515	L,M			
		EUFRA	33	L,M			
		EUPRT	832	L,M			
	IDN		745	L			
	JPN		333	L,M			
	KEN		157	L,M,S			
	LKA		202	H,L,S			
	MDG		12	L			
	SYC		515	L,O,S,W			
	ZAF		43	L,M			
Other	COM		93	L,O,S,W			
	IDN		23,732	L,O			
	IRN		4,112	O,S,W			
	LKA		1,025	H,L,M,S			
	OMN		4,522	O			
	PAK		937	M,P,S			

Appendix III: Status of the IOTC databases by fishery group

Purse seine

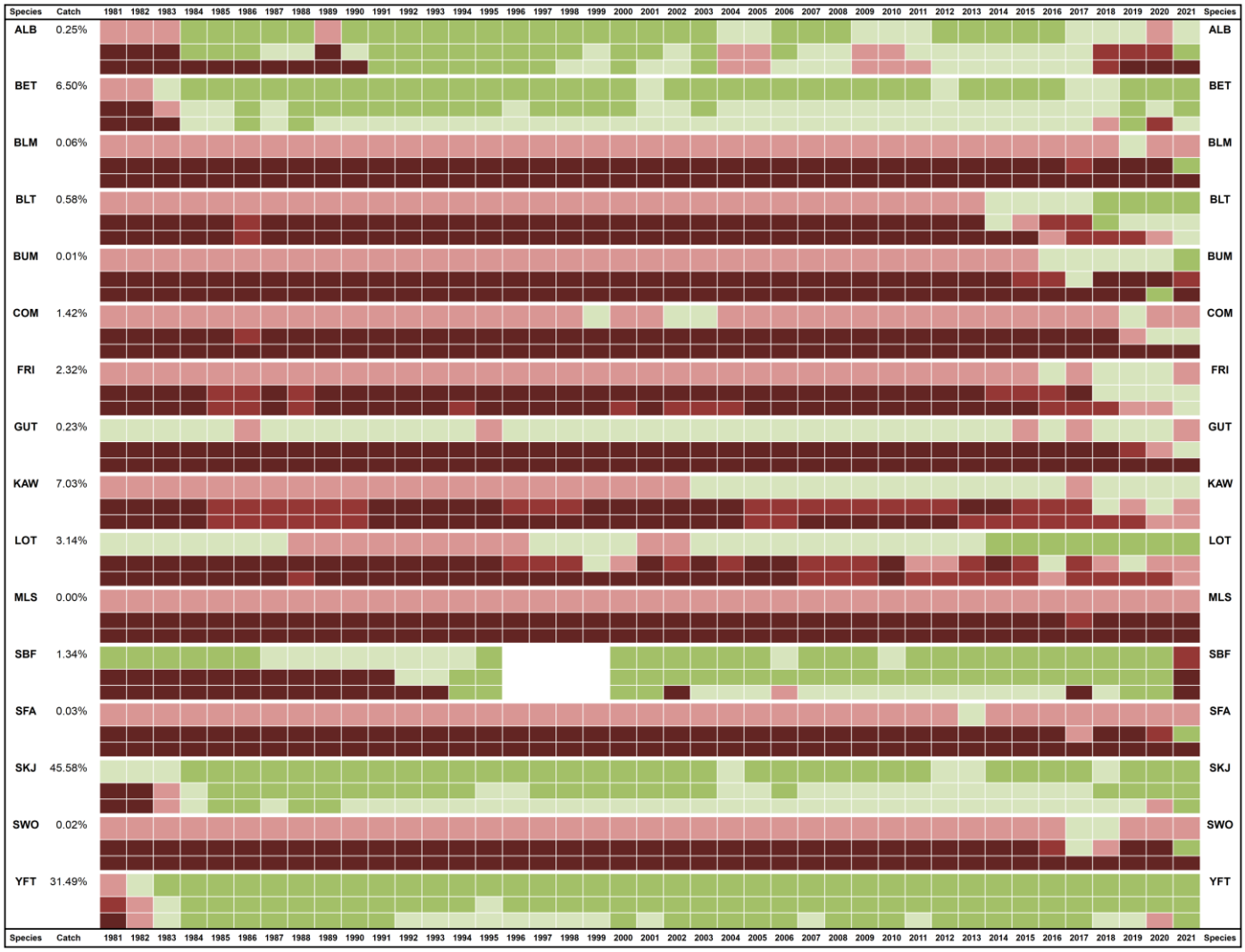

Figure 11: Reporting status of nominal catch (NC), catch and effort (CE), and size frequency (SF) data for the 16 IOTC species caught with purse seines, by year and species (1981-2021). Percentage (%) of catch indicates the contribution of the catches of each species to the total catches of all IOTC species between 1981 and 2021. 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

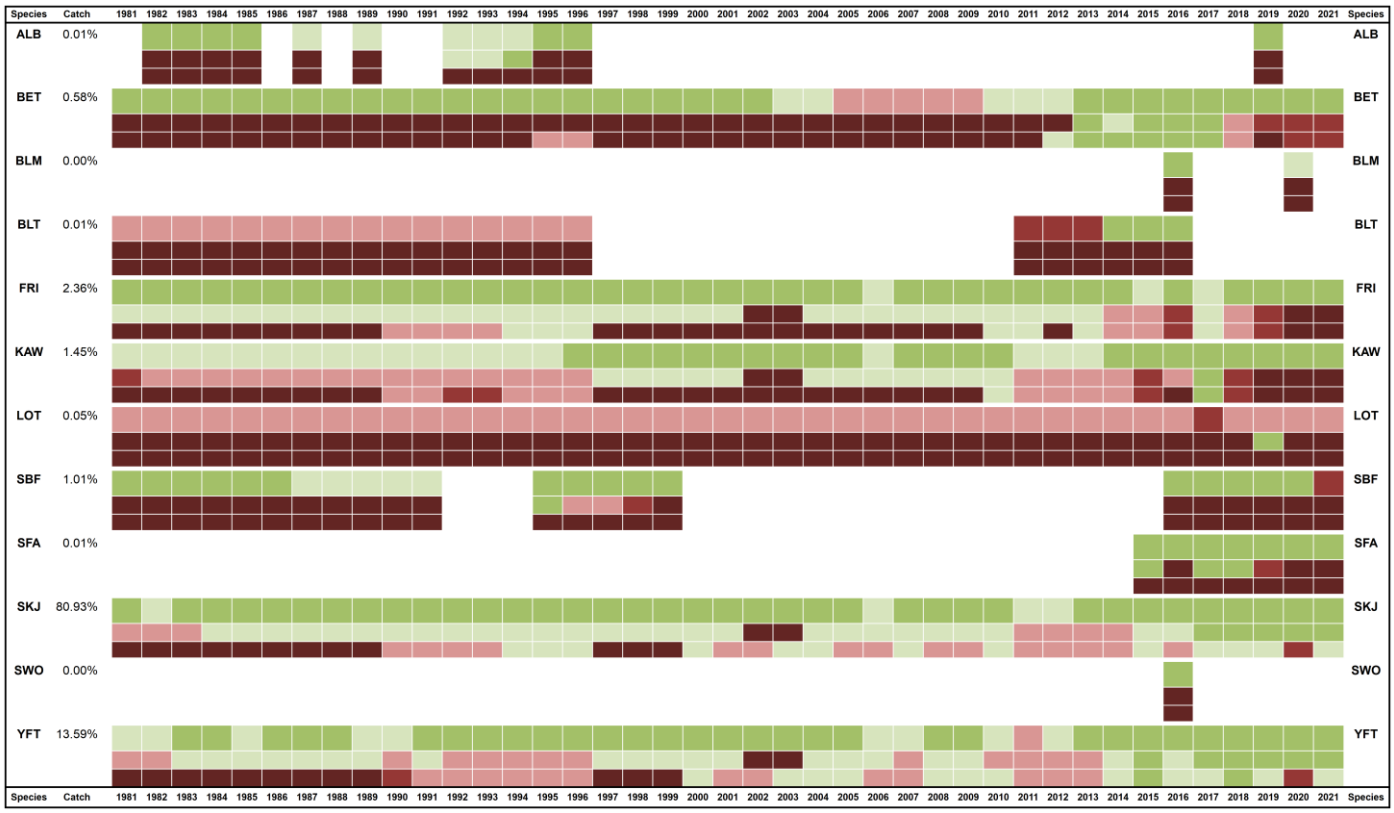

Figure 12: Reporting status of nominal catch (NC), catch and effort (CE), and size frequency (SF) data for the 16 IOTC species caught with pole and lines, by year and species (1981-2021). Percentage (%) of catch indicates the contribution of the catches of each species to the total catches of all IOTC species between 1981 and 2021. 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

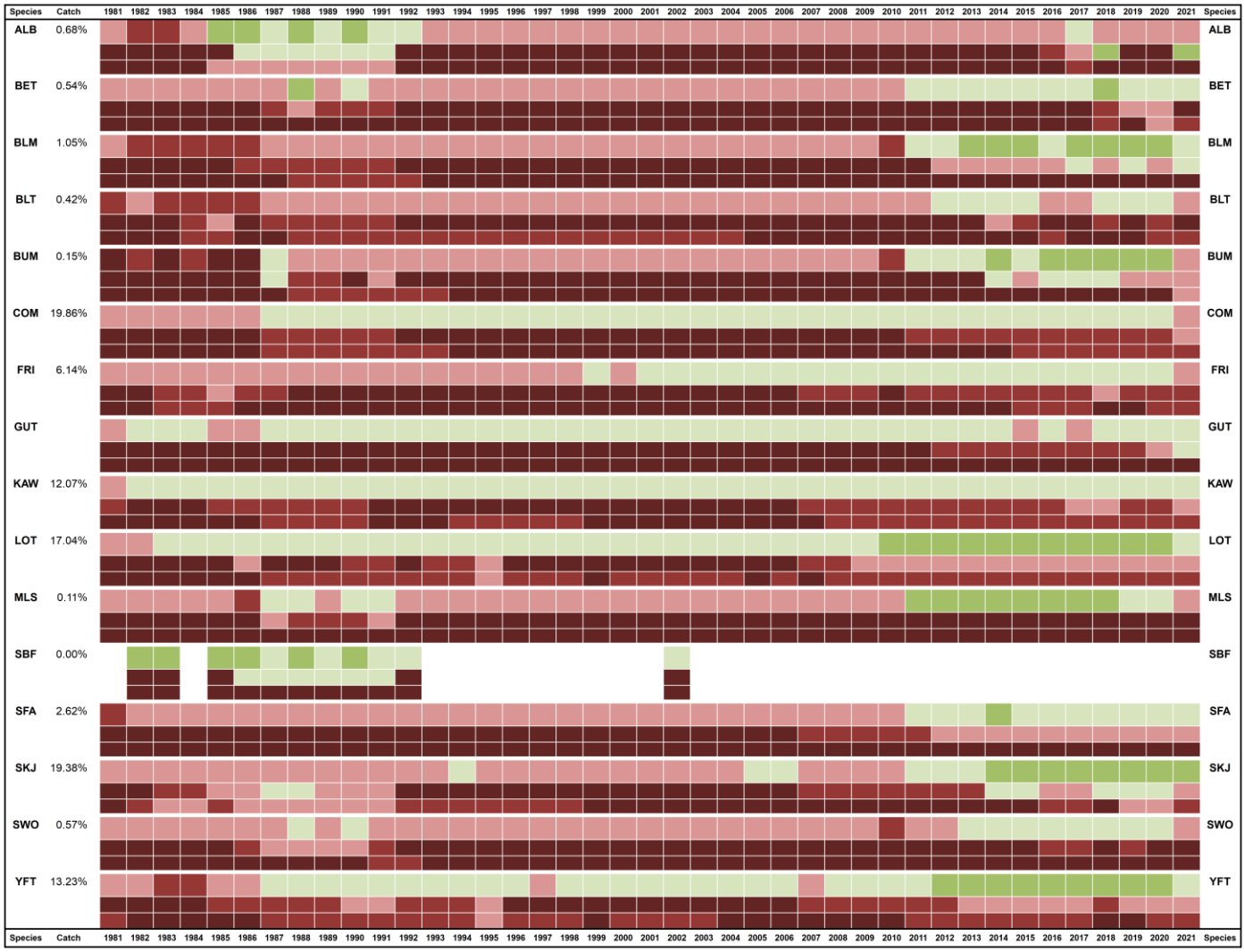

Figure 13: Reporting status of nominal catch (NC), catch and effort (CE), and size frequency (SF) data for the 16 IOTC species caught with gillnets, by year and species (1981-2021). Percentage (%) of catch indicates the contribution of the catches of each species to the total catches of all IOTC species between 1981 and 2021. 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

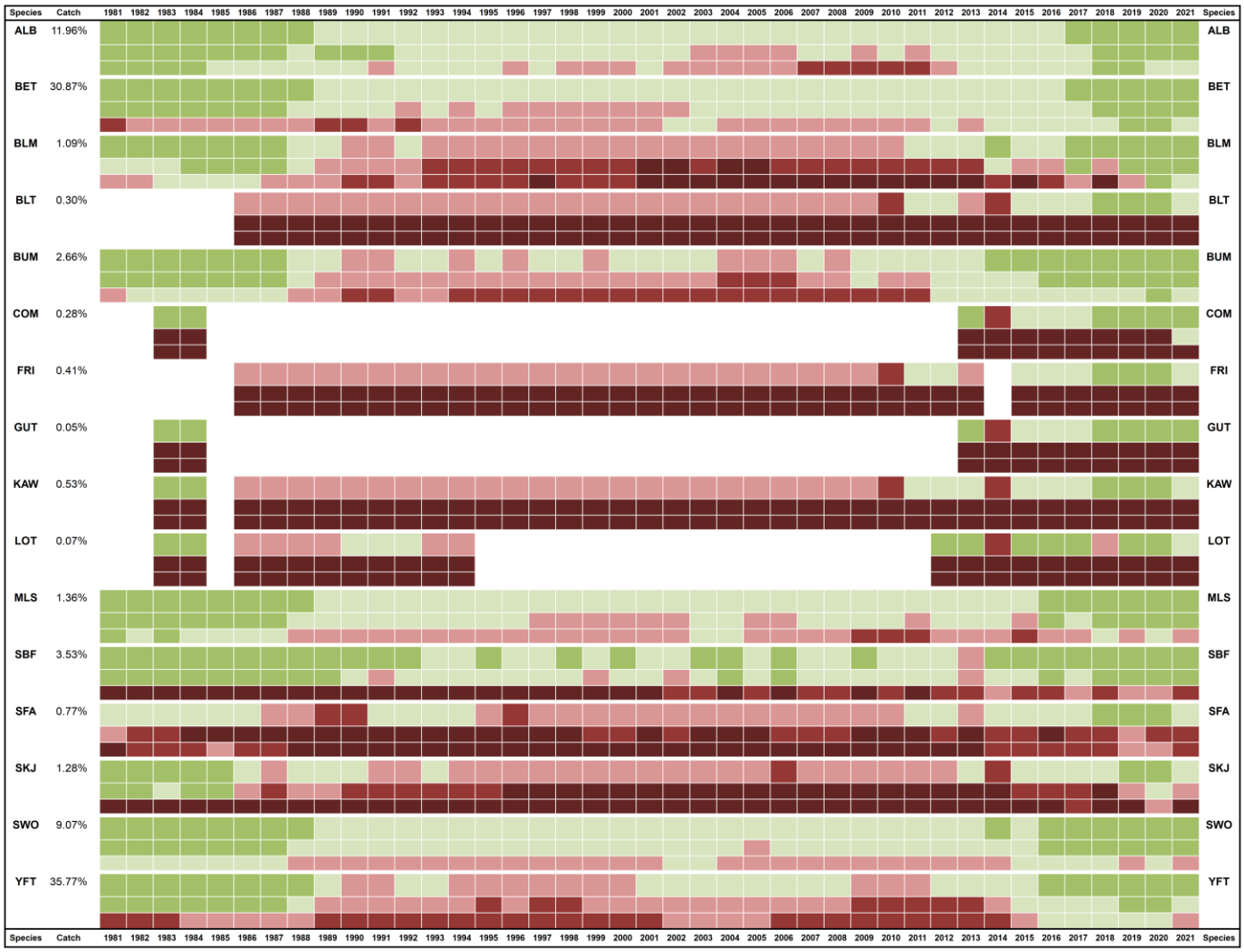

Figure 14: Reporting status of nominal catch (NC), catch and effort (CE), and size frequency (SF) data for the 16 IOTC species caught with purse seines, by year and species (1981-2021). Percentage (%) of catch indicates the contribution of the catches of each species to the total catches of all IOTC species between 1981 and 2021. 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

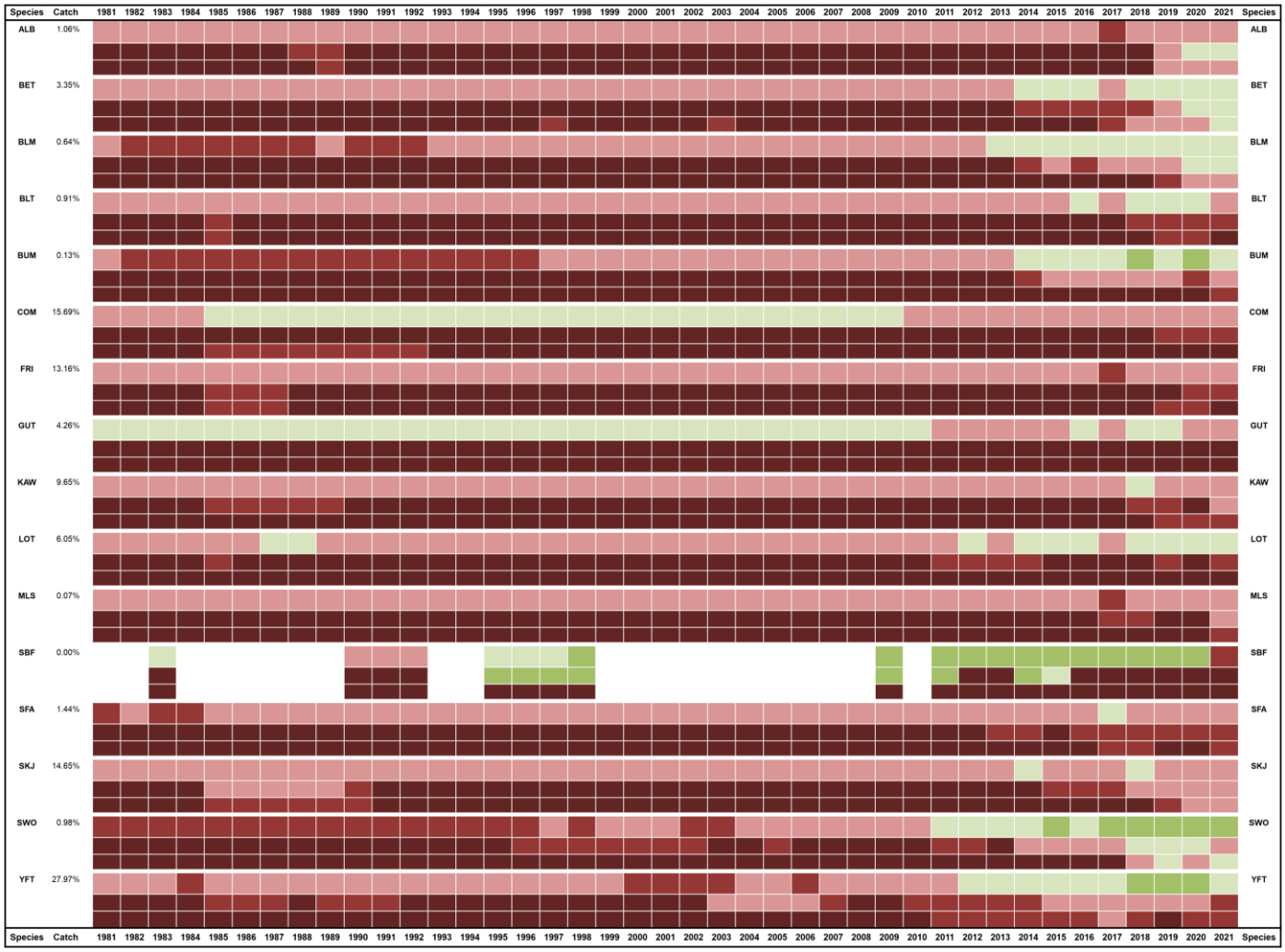

Figure 15: Reporting status of nominal catch (NC), catch and effort (CE), and size frequency (SF) data for the 16 IOTC species caught with hand lines, coastal longlines, troll lines, and other gears, by year and species (1981-2021). Percentage (%) of catch indicates the contribution of the catches of each species to the total catches of all IOTC species between 1981 and 2021. 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 17: 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**	Catches are reported for various regions by fisheries, rather than aggregated by main IOTC areas, as required for NC. Aggregated catches of shark species.	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
	Kenya	**Coastal fisheries, Industrial fisheries**	Lack of knowledge on industrial fisheries activities. Issues with data collection, including catch and effort and size data for coastal fisheries	Liaise with Kenya, with the assistance of Compliance expert to help Kenya to implement the requirement of resolutions 15/01 and 15/02. (Compliance mission?)
	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 which have recently updated, which include changes in catches of some IOTC species	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
	Indonesia	**Industrial longline fisheries**	Inconsistency between logbook and VMS; Low logbook coverage, particularly for small scale fisheries. Irregularities in fisheries catch	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)

Dataset	CPCs	Fisheries	Main issues	Proposed actions
	Oman	**Handline and gillnet fisheries**	Lack of reporting due to data management	Follow-up to previous mission (2019-09) to support the standardization of statistical information available for handlines and gillnets, and establish proper submission of catch and effort data according to Res. 15/02 and identify the reasons for the recent remarkable increases in the catches of yellowfin tuna. Oman formally declined the offer of the Secretariat to deliver this missio, although it was explicitly requested by the Commission in May 2022.
	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
	Madagascar	**Coastal fisheries**	Issues with data collection, incomsistency and not fully covering all areas	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
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 providing assistance to I.R. Iran to submit size data by fishing ground (rather than landing site) based on port sampling as logbooks are currently being fully implemented 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). Encourage CPCs to report information of fish prices (local sale, export, import prices)

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