REVIEW OF DATA ON DRIFTING FISH AGGREGATING DEVICES

Prepared by IOTC Secretariat[1]

Introduction

IOTC Resolution 15/09 was adopted in 2015 to create a scientific forum aiming at assessing the consequences of the increasing number and technological developments of fish aggregating devices (FADs) in tuna fisheries and their ecosystems, in order to inform and advise on future FAD-related management options. A first session of the IOTC *ad hoc* Working Group on FADs (WGFAD01) was held in Madrid, Spain on 18 April 2017 (IOTC 2017).

The overarching objective of this paper is to provide participants to the 2nd Working Group on FADs (WGFAD02) with a review of the data and information on FADs and FAD-related fisheries as available in the IOTC databases as of October 2021. The document summarises data on fishing capacity, fishing effort, and catches for the species caught with purse seine in association with drifting floating objects for the period 1950-2020, as well as data sets providing information on FAD-related activities (e.g., deployments, retrievals, etc.) and spatio-temporal distribution of floating objects across the Indian Ocean.

Materials

Several data sets shall be reported to the IOTC Secretariat by the Contracting Parties and Cooperating Non-Contracting Parties (CPCs) as per all relevant IOTC Conservation and Management Measures (CMMs) and following the standards and formats listed in the IOTC Reporting guidelines. Although not mandatory, the use of the IOTC forms is recommended to report the data to the Secretariat as they facilitate data curation and management.

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.

Changes in the IOTC consolidated data sets of nominal catches (i.e., raw and best scientific estimates) may be required as a result of:

i. Updates, received by December 30th each year, of the preliminary data for longline fleets submitted by June 30th of the same year (IOTC Res. 15.02);

ii. Revisions of historical data by CPCs following corrections of errors, addition of missing data, changes in data processing, etc.

iii. Changes in the estimation process performed by the Secretariat based on evidence of improved methods and/or assumptions (e.g., selection of proxy fleets, updated morphometric relationships) and upon endorsement by the Scientific Committee.

Geo-referenced catch and effort data

Catch and effort data refer to fine-scale data, usually from logbooks, reported in aggregated format and stratified by year, month, 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 effort exerted by support

[1] IOTC-Statistics@fao.org

vessels that assist industrial purse seiners shall also be collected and reported to the Secretariat through IOTC forms 3FA and 3SU.

Discard data

The IOTC follows the definition of "discards" adopted by FAO in previous reports, and considers all non-retained catch as discarded catch, including individuals released alive or discarded dead (Alverson et al. 1994; Kelleher 2005). 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 to the Secretariat with 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 industrial fisheries (see below).

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, grid and species as required by IOTC Res. 15/02. While the great majority of size data reported with 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 ROS.

FOB-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 floating objects (FOBs) 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 FOBs, possibly with the support of the recommended IOTC form 3FA.

In particular, drifting FOBs shall be categorized according to the IOTC classification that combines the nature of the floating object, the type of tracking system, and the presence of net webbing hanging underneath (**Fig. 1 & Table 21**). The activities to be recorded shall always refer to the corresponding number of floating objects affected by the activity itself, and include events such as: deploying or encountering a FOB at sea, retrieving a FOB from the water, and recording a FOB as no longer remotely monitored when the GPS signal is lost (**Table 22**). Furthermore, the numbers of sets made on schools associated with drifting floating objects must also be reported for each time-area stratum, along with the corresponding species-specific catches.

At-sea deployments (IOTC form 3FD and 3FA)

In 2020 the IOTC Secretariat developed IOTC form 3FD to support the temporary data reporting requirements introduced by IOTC Res. 19/01, which require 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). Beside serving the original purposes of IOTC Res. 19/01, the information received through this additional form can also be used to cross-verify the data on deployments of floating objects submitted through IOTC Form 3FA for the years 2018-2019, and identify potential inconsistencies with the latter.

In fact, information on the deployments of FOBs was submitted by CPCs to the Secretariat using both IOTC form 3FA and IOTC form 3FD. Data from IOTC forms 3FA are stratified by fleet, year, month, vessel type (purse seiners or supply vessels) and 1°x1° grid, and cover to various degrees the years between 2013 and 2020, while data from IOTC forms 3FD are stratified by fleet, year, vessel type (purse seiners or supply vessels) and 1°x1° grid, and cover only the years 2018 and 2019.

While IOTC form 3FD is specifically dedicated to the reporting of FOB deployments, in IOTC form 3FA this same information is available only through the records associated to the FOB activity type '*DD*' ('*Deployment of drifting FAD*,' see **Table 22**), and the number of FOBs deployed should be inferred from the *NUM_FOBS* column in the collated dataset (or from the *EFFORT* column in the original IOTC form 3FA submissions).

Sets on FOBs (IOTC form 3CE and 3FA)

Information on the number and location of sets on FOBs was submitted by CPCs to the Secretariat using both IOTC form 3FA and IOTC form 3CE. Data from IOTC forms 3FA and data from IOTC forms 3CE are both stratified by fleet, year, month, and 1°x1° grid. While the former (available through the column *NUM_SETS_ON_FOB* within the corresponding data set) is expressed in number of sets by default, the latter (available through the column *EFFORT* within the corresponding source data set) might appear with different unit of measures, and for this reason only records where the effort unit is indicated as *SETS* (and the school type as *LS* - *Log-associated schools*) are considered here. This is a limiting factor when selecting the strata for which the information from both sourcescan be compared, due to the use of non-standard effort units from many purse seine fleets and for several years in the catch-and-effort data for purse seine fisheries.

Catches on FOBs (IOTC form 3CE and 3FA)

Information on the location and magnitude of catches on FOBs was submitted by CPCs to the Secretariat using both IOTC form 3FA and IOTC form 3CE. Catch data from IOTC forms 3FA and catch data from IOTC forms 3CE are both stratified by fleet, year, month, 1°x1° grid, and species. The former is available through the columns *ALB*, *BET*, *SKJ* and *YFT* within the corresponding data set (and is expressed in metric tons by default), while the latter is available through the columns *ALB-LS*, *BET-LS*, *SKJ-LS* and *YFT-LS* within the corresponding data set, and might potentially appear with different catch units according to the reference unit stored under the *CatchUnit* column.

For the purpose of the analysis within this document, only catches of tropical tunas (bigeye tuna, skipjack tuna and yellowfin tuna) will be considered from both data sets.

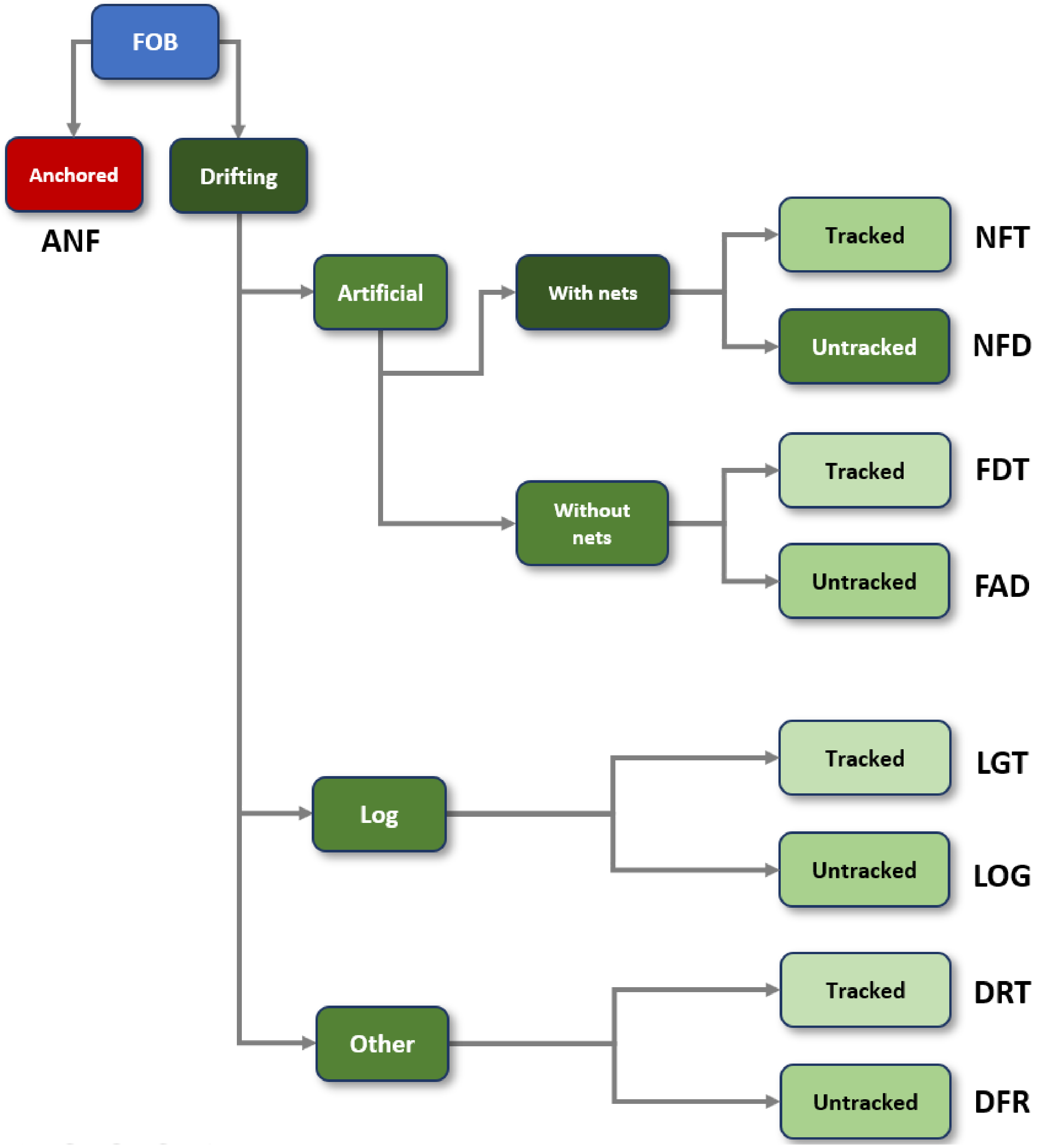

Figure 1: Classification of types of floating objects in use at the IOTC Secretariat. See Appendix I for description of each code

FOB-tracking 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 FOBs 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.

According to paragraph 24 of IOTC Res. 19/02, the information thus collected shall be used "*to support the monitoring of compliance with the limitation established in Paragraph 4, while protecting business confidential data*

(…).” A preliminary attempt at using this data for scientific purposes, after aggregating all sensitive details in order to not disclose activities of any single vessel, was made for the first time during this scientific forum, and after receiving explicit acknowledgement from all concerned CPCs.

This global data set covers the period from January 2020 to May 2021, and does not include data for the buoys monitored by the Republic of Korea, which have not yet been submitted to the Secretariat. Also, no information is available from the active purse seiners of I.R. Iran, due to the country being subject to an embargo restricting access to standard satellite communication, while additional information is required from Kenya to clarify if their recently developed purse seine fishery (comprising six vessels of around 50 m LOA and 493 GT) is actively fishing on floating objects and therefore subject to this requirement.

Regional Observer Scheme

Fisheries observer data collected as part of the Regional Observer Scheme (ROS; Resolution 11/04) include information on: (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). Furthermore, observers deployed on large-scale purse seiners of the EU, Mauritius, and Seychelles collect a large range of information on FAD-related activities (e.g., deployments, retrievals), design and components of the FADs, and handling practices for the safe release of sensitive bycatch species such as sharks, rays, and turtles (Goujon et al. 2017; Grande et al. 2019).

However, due to changes in data reporting formats for some fleets, fisheries, and years, and the temporary use of a non-comprehensive format of exchange of the ROS data with the Secretariat, data collected on FADs by observers at sea on industrial purse seiners are not yet available for scientific analysis and therefore are not included in the present report, nor in any of its accompanying public data sets.

Methods

The release of the curated public-domain data sets is done following some checking and processing data steps which are briefly summarized below. First, standard controls and checks are performed to all data sets received at the Secretariat to ensure that the metadata and data are consistent and include all mandatory fields (e.g., dimensions of the strata, etc.). The controls depend on each data set and may require the submission of revised data from CPCs if the original one is found to be incomplete.

Nominal catch data

For the nominal catch data, a series of processing steps is applied to derive the best scientific estimates 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 (IOTC 2016). Briefly, the process estimates the catch proportion of each IOTC species of an aggregate in a given stratum from past reports of catches where the species and gears were reported separately, following a substitution scheme.

Geo-referenced catch data

For albacore, bigeye tuna, skipjack tuna, yellowfin tuna, and swordfish, geo-referenced catches were raised to the best scientific estimates of nominal catches using available information and by either leveraging data from proxy fleets or adopting substitution schemes when the spatio-temporal information is not available for a given stratum. For this reason, the raised data sets represent the best scientific estimates of the geo-referenced catches given the information available to the Secretariat and the well-known issues with data availability and data quality affecting several fisheries.

The resulting data set is comprised of catches in weight and number and stratified by year, month, fleet, gear, school type (when available) and 5°x5° grid, and covers the entire time series for which nominal catches of each species are available. The species-specific average weight in the catch can be computed directly from the raised weights and numbers for each fishery, with the accuracy of the results being directly proportional to the availability and quality of geo-referenced catch and size-frequency data for the stratum. From the raised geo-referenced catch data sets, information on the type of school association becomes available for the nominal catches of the three tropical tuna species caught with purse seine.

Geo-referenced effort data

Fishing vessels

Until recently, effort information for vessels fishing on floating objects was not strictly standardized, and therefore data were provided by CPCs to the IOTC Secretariat using a variety of different effort units, that included fishing hours, fishing days, days at sea as well as number of sets. For this reason, the Scientific Committee of IOTC, at its 22nd session in 2019 recommended that "*(…) all purse seine fleets reporting effort as fishing hours or fishing days begin to submit this information as 'number of sets' instead, in particular when fulfilling the reporting requirements of Resolution 15/02 (…)*" (IOTC 2019a).

Several concerned CPCs are currently transitioning towards the implementation of this requirement, and actively liaising with the IOTC Secretariat to ensure that the provision of revised historical effort information (expressed as number of sets) can be progressively incorporated within the IOTC databases.

In the ad-interim period, until this transition is fully completed, no conversion is applied by the IOTC Secretariat to effort data provided by purse seine fleets using non-standard units (e.g., fishing days or fishing hours), and this limits the comparative analysis that could be performed in combination with more specific information available through the dedicated data reporting forms for FOB-related activities.

Supply vessels

Effort data for supply vessels has been exclusively reported to the Secretariat as the total number of days spent at sea, stratified by flag, year, month and 1°x1° grid within the IOTC area of competence. CPCs were requested to report this information following the entry in force of IOTC Res. 15/02 in 2015, and since then the level of implementation of this requirement has been extremely variable, with full reporting (from all concerned CPCs) available only in 2018 and 2019, with some CPCs also providing historical data covering statistical years prior to 2015 (albeit partially).

In agreement with the data confidentiality requirements expressed by IOTC Res. 12/02, and in light of the fact that for several years only a single supply vessel was known to be active for some CPCs, the information is currently disseminated in aggregated format, i.e. without indication of the vessel flag. Furthermore, and in order to support the analysis of total yearly effort for all combined fleets, this dataset includes records that either completely lack spatial / temporal information (and are therefore aggregated annually) or refer to grid codes that fall outside of Indian Ocean waters (when not on the mainland).

Size data

Filtering and conversions are applied to the size data of all 16 IOTC species plus the most common shark species in order to harmonize their format and structure and remove data which are non compliant with IOTC standards, such as those provided with size bins exceeding the maximum width considered meaningful for the species (IOTC 2020).

The standard length measurements considered vary with the species and size samples collected using other types of measurements are converted into the standard measurements using the IOTC conversion equations, considering different size ranges and intervals according to the species. If no IOTC-endorsed equations exist to convert from a given length measurement for a species to the standard size measurements, the original size data are not disseminated but kept within the IOTC databases for future reference.

FOB-related activity data

Notwithstanding the fact that - although with varying levels of accuracy - CPCs have been submitting data on FOB-related activities to the IOTC Secretariat since the statistical year 2015 (following the entry in force of IOTC Res. 15/08) this information was not publicly disseminated until today, due to well-known issues with the corresponding data collection and reporting requirements, concerning in particular the interpretation of the FOB activity types, their underlying business logic as well as the expected mechanism to report the number of interacted FOBs as well as the positive sets on FOBs and their associated catches by species.

This lack of clarity, together with the difficulties found by some CPCs in mapping IOTC FOB types and FOB activity types to the standard classifications adopted at national level (e.g., Gaertner et al. (2016)) resulted in a combined dataset that is not fully accurate and representative of the information it is supposed to describe.

In particular, and as already indicated earlier in the case of effort data reported for supply vessels, several records were identified that refer to grid codes that are either plain wrong or fall outside of Indian Ocean waters (when not on the mainland), while in other cases evidences were found in the original records of of positive sets (i.e., sets with non-NIL catches) reported for FOB activities that are not supposed to be followed by setting / hauling (e.g., deployment or loss of FOBs) (Fiorellato et al. 2017).

In order to provide a minimum level of support to future analysis requested by this scientific forum, and with the aim of fostering further discussions on the current limitations of these sources of information, the IOTC Secretariat has collated and made available the data provided so far by all concerned CPCs through IOTC form 3FA, although for the reasons indicated above this specific data set is provided *as is*, i.e., with only a minimum level of standardization applied to the original data and the reference codes within it.

The level of availability of explicit FOB deployment data (IOTC form 3FD), as well as of geo-referenced catch and effort data for sets on log-associated schools (IOTC form 3CE), are adequate enough to support basic cross-verification tasks with the data collated from IOTC form 3FA, and to identify potential issues with over / under reporting of efforts and catches, as well as seasonal patterns emerging from the information contained within.

Although historical FOB activity data are also available for some CPCs for years preceding the entry in force of IOTC Res. 15/08 (2013 and 2014, in particular), the information here presented will mostly focus on the years 2015-2020.

FOB tracking data

Data sets recording positions and ancillary data of instrumented operational buoys were received by the IOTC Secretariat on a regular basis and mostly in compliance with the requirements and structure of the IOTC Form 3BU.

First, duplicates were removed from the original data sets and vessels and flags were formatted to comply with IOTC reference code lists. As part of the fishing strategy of the purse seine companies, some buoys may be monitored by several vessels at the same time but this information on buoys shared among purse seiners is not available for all fleets. Following the methodology defined to deal with the reporting of buoys shared between purse seiners in some fleets (Maufroy and Goujon 2019), an individual weight of 1/(number of sharing purse seiners) was assigned to each daily buoy position.

While the individual daily buoy position data sets are devoted to compliance purpose, all CPCs with active purse seiners fishing on FOBs have agreed to release in the public domain the buoy position data sets in aggregated format, i.e. stratified by CPC, year, month, and 1°x1° grid. For each CPC and all CPCs combined, the summary statistics (minimum, first quartile, median, mean, third quartile and maximum) of the daily total number of active buoys were computed for each 1°x1° grid and month covering the period from January 2020 to May 2021.

Results

Historical catch trends

World oceans

The global purse seine catch of the main tropical tunas has steadily increased over the last seven decades and is largely dominated by catches from the Western-Central Pacific Ocean which have been driving the increasing trend since the early 1980s (**Fig. 2**). In 2019, the global purse seine catch reached a maximum close to 4 million metric tons of tropical tuna, with the Indian Ocean contributing to about 12% of the total catches through its industrial purse seine component.

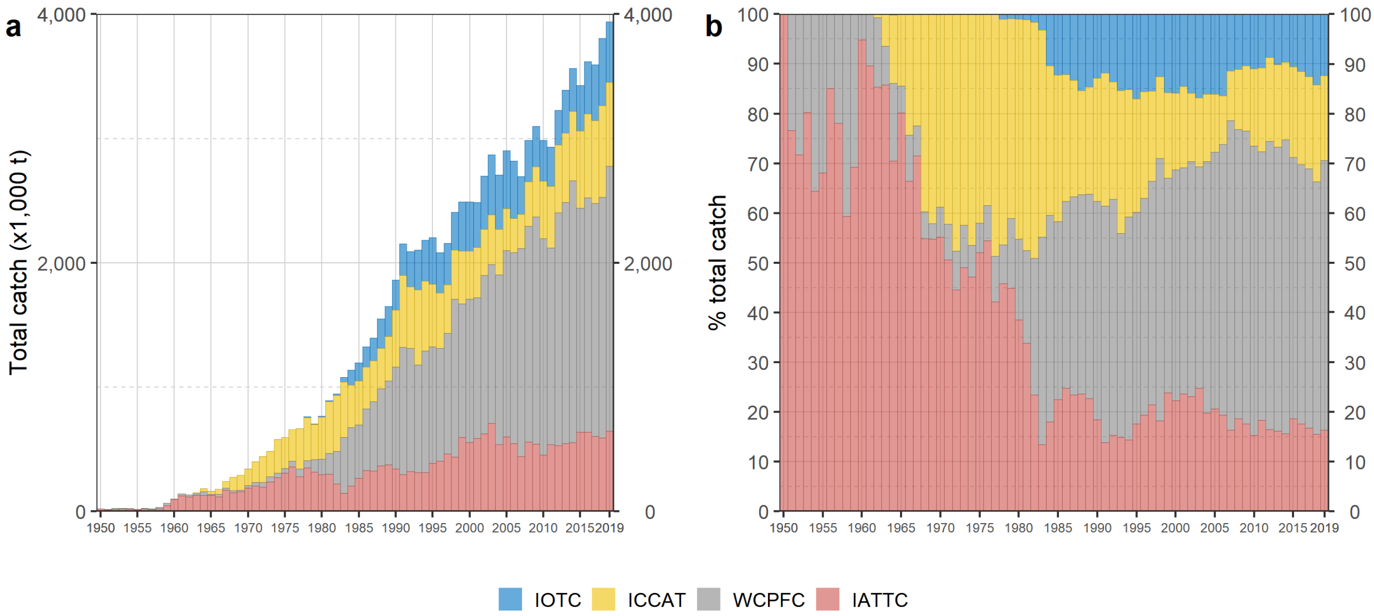

Figure 2: Annual time series of cumulative nominal absolute (a) and relative (b) global purse seine catches (t) of the three principal market tropical tunas (bigeye tuna, skipjack tuna, and yellowfin tuna) by tuna RFMO for the period 1950-2019. Source: FIRMS Global Tuna Atlas

At global scale, the volume of tropical tuna caught in association with drifting floating objects has steadily increased since the mid-1970s and has exceeded 2 million metric tons since 2016 (**Fig. 3a**). The contribution of this school type to the total purse seine catch of tropical tuna increased from about 30% in the early 1980s to about 50% in the 1990s, and about 55% in the 2000s-2010s (**Fig. 3b**). The relative stability of the proportion of catches of tuna associated with drifting floating objects over the last two decades is explained by the concurrent increase of catches of free-swimming schools while catches in dolphin-associated schools have remained fairly constant over time.

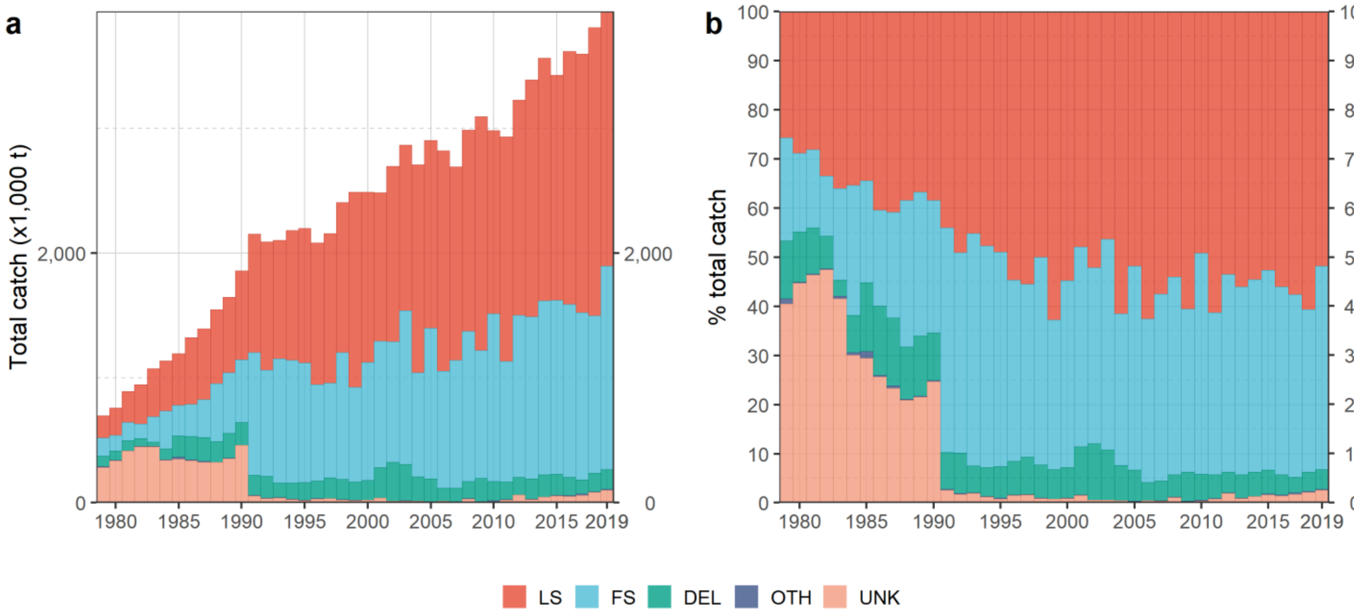

Figure 3: Annual time series of cumulative nominal absolute (a) and relative (b) global purse seine catches (t) of the three principal market tropical tunas (bigeye tuna, skipjack tuna, and yellowfin tuna) by type of school association for the period 1979-2019. LS = floating object-associated school; FS = free-swimming school; DEL = dolphin-associated school; OTH = other; UNK = unknown. Source: FIRMS Global Tuna Atlas

Purse seine catches on floating objects in each ocean basin show a general increasing trend over time, although with some variability between RFMOs (**Fig. 4a**). Following the development of the purse seine fisheries in the early 1980s, the contribution of the Indian Ocean to the global purse seine catches taken on schools associated with floating objects has varied between 11% and 24% over the last 35 years. The contribution decreased from an average of about 20% during 1985-2003 to about 15% during 2004-2017, but showed an increasing trend since 2012 and reached more than 20% in 2018-2019 (**Fig. 4b**).

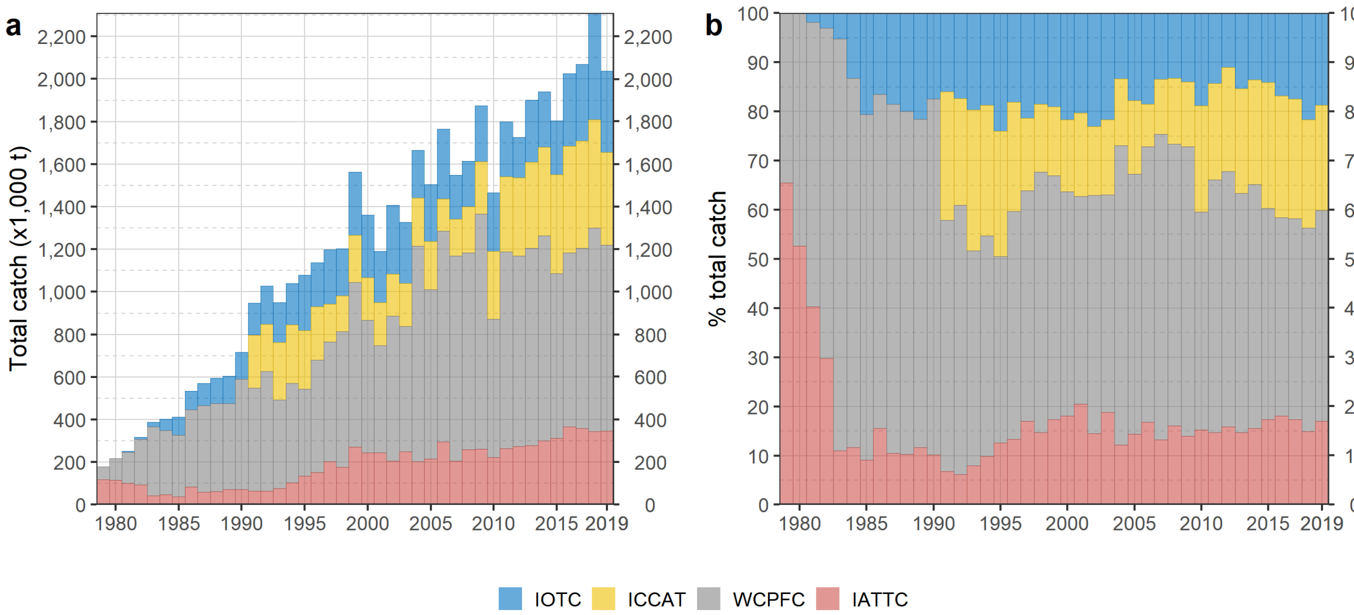

Figure 4: Annual time series of cumulative nominal absolute (a) and relative (b) global purse seine catches (t) of the three principal market tropical tunas (bigeye tuna, skipjack tuna, and yellowfin tuna) caught on schools associated with drifting floating objects for the period 1979-2019. Source: FIRMS Global Tuna Atlas

Indian Ocean

Catches of tuna schools associated with drifting floating objects have always dominated the total catches of the purse seine fishery of the Indian Ocean (**Fig. 5**). As early as in the 1980s, a large part of the purse seine catches was taken on tuna schools that were mainly composed of natural objects at that time (Hallier et al. 1992). Catches on both school types showed an increase during the period from the fishery development to its expansion until the mid-

1990s. Therafter, catches on free swimming schools showed an overall decrease over the years, with the notable exception of the "golden years" 2003-2005, to reach a minimum of less than 30,000 t in 2018 and about 40,000 t in 2020 (**Fig. 5a**). In the meantime, the FAD fishery developed substantially, showing a sharp increase from 2015 and reaching a maximum of about 466,000 t in 2018. In 2020, the total reported catches for the Indian Ocean purse seine fishery on associated schools was about 388,000 t, representing 90.6% of the total purse seine catch (**Fig. 5b**).

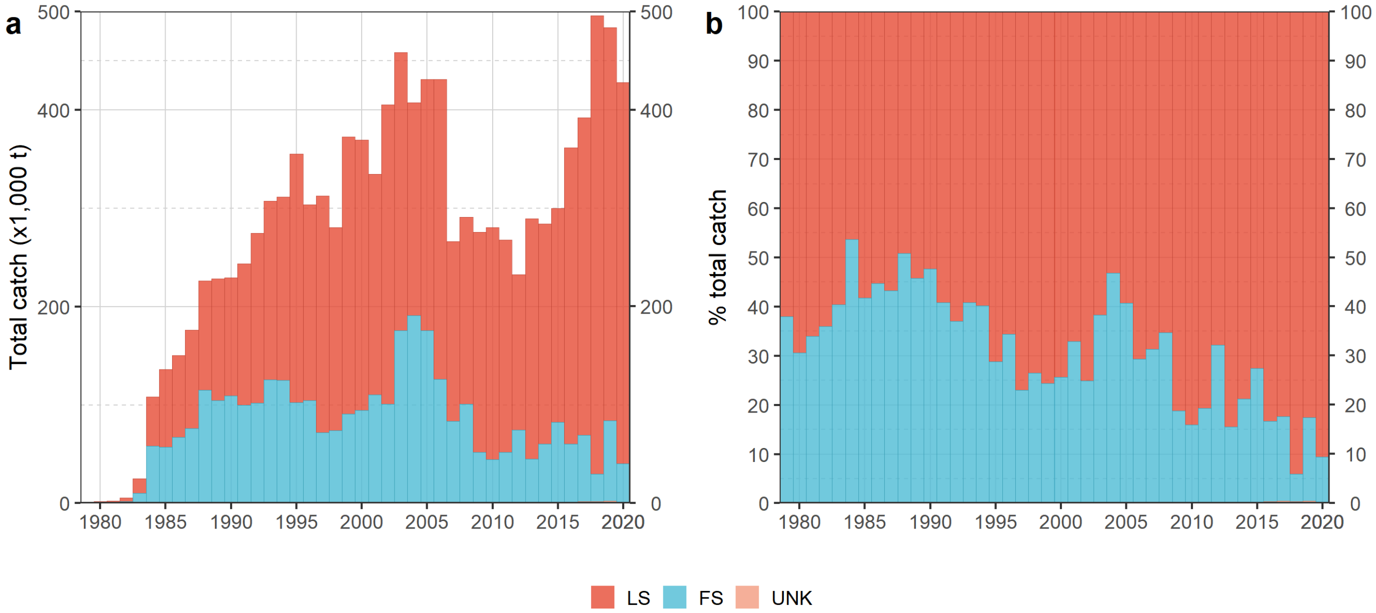

Figure 5: Annual time series of cumulative nominal absolute (a) and relative (b) purse seine catches (t) of the three principal market tropical tunas (bigeye tuna, skipjack tuna, and yellowfin tuna) by school type in the Indian Ocean for the period 1979-2020. LS = floating object-associated school; FS = free-swimming school; UNK = unknown. Source: raised IOTC geo-referenced catches

All purse seine fleets of the Indian Ocean show an overall increasing trend of the proportion of catch taken on FAD/log-associated schools over the last four decades, although with some interannual variability (**Fig. 6**). While the three main purse seine fleets show similar patterns over time, the fleet of EU,France has been characterized by a significantly lower proportion of catch on associated schools than the other main fleets over time, ranging between 6% and 24% lower than EU,Spain over the period 2001-2020. In 2020, about 90% of the total purse seine catch was taken on associated schools, with Seychelles, EU,Spain, and EU,France catching 97.5%, 89.7%, and 77.8% of their purse seine catches on tropical tuna associated with drifting floating objects (**Fig. 6**).

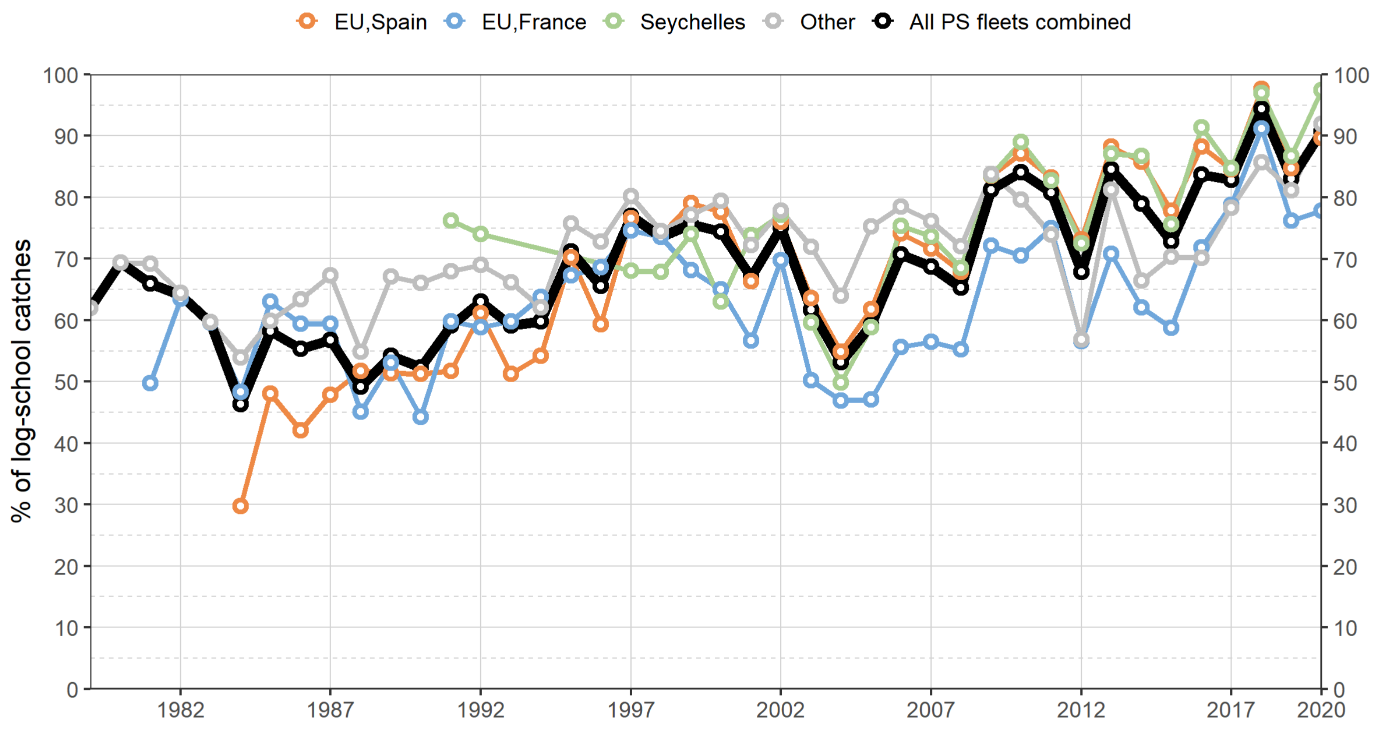

Figure 6: Annual time series of percentage of purse seine catches of the three principal market tropical tunas (bigeye tuna, skipjack tuna, and yellowfin tuna) caught on floating object-associated schools in the Indian Ocean by fleet for the period 1979-2020. Source: raised IOTC geo-referenced catches

Spatial distribution

Decadal view, 1980-2019

Decadal maps of the distribution of purse seine catches in the Indian Ocean since the inception of the fishery in the early 1980s show that purse seine fishing grounds are essentially located in the western Indian Ocean (**Fig. 7**). Except for the Mozambique Channel, almost no purse seine catches have been reported south of 10°S, i.e., within the Indian Ocean gyre located south of the South Equatorial Current (Schott et al. 2009). The fishery expanded rapidly between the 1980s and the 1990s towards the south of the Mozambique Channel and in the areas beyond national jurisdiction of the north-western Indian Ocean (**Fig. 7a-b**). Catch levels increased in the 2000s and some important catches on free-swimming schools were reported between 10°S and the equator during the decade 2000-2009 (**Fig. 7c**). In the last decade, catches on schools associated with drifting floating objects have dominated in all grid areas of the whole purse seine fishing grounds, with an increasing gradient from 10°S to the north of the equator (**Fig. 7d**).

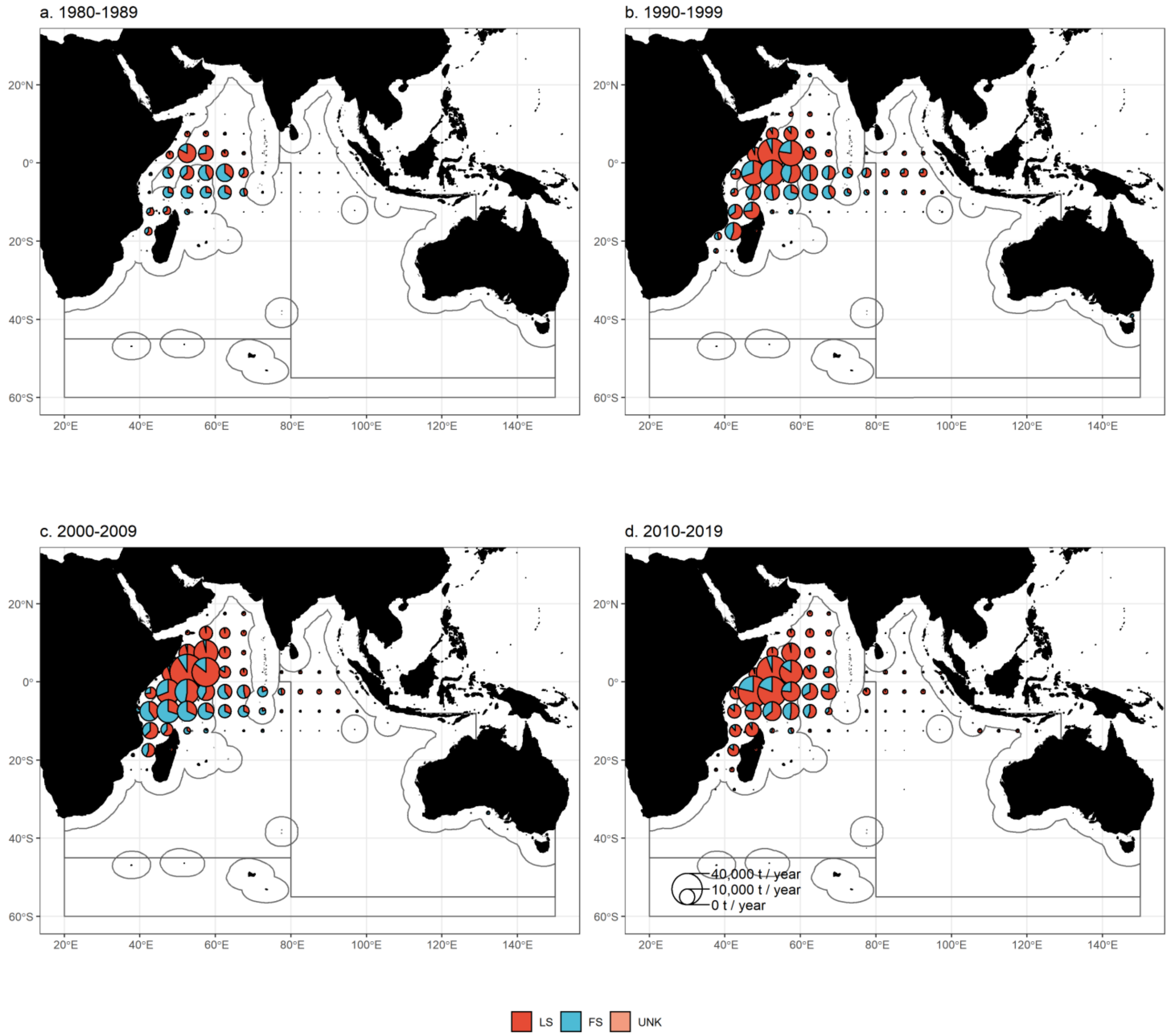

Figure 7: Mean annual time-area purse seine catches (in metric tons) of tropical tunas for the period 1980-2019, by decade and type of school association. LS = floating object-associated school; FS = free-swimming school; UNK = unknown. Source: raised IOTC geo-referenced catches

Seasonal patterns, 2016-2020

The spatial distribution of the purse seine catches does not show a marked seasonal variability over recent years, with the mean annual distribution of the catches per quarter between 2016 and 2020 indicating a major concentration of the purse seine fishing grounds around the Seychelles archipelago all over the year (**Fig. 8**). Catches appeared to be more stretched along the equator during the months of January to March, with some fishing also occurring in the Mozambique Channel down to 25°S (**Fig. 8a**). During April-June, the fishery extended towards the north of the western Indian Ocean up to 20°N (**Fig. 8b**). Catches were more concentrated around the core fishing grounds around the equator in July-September before the purse seine fleet moved north of the equator off the coasts of Somalia to almost exclusively fish on FADs between October and December (**Fig. 8c-d**).

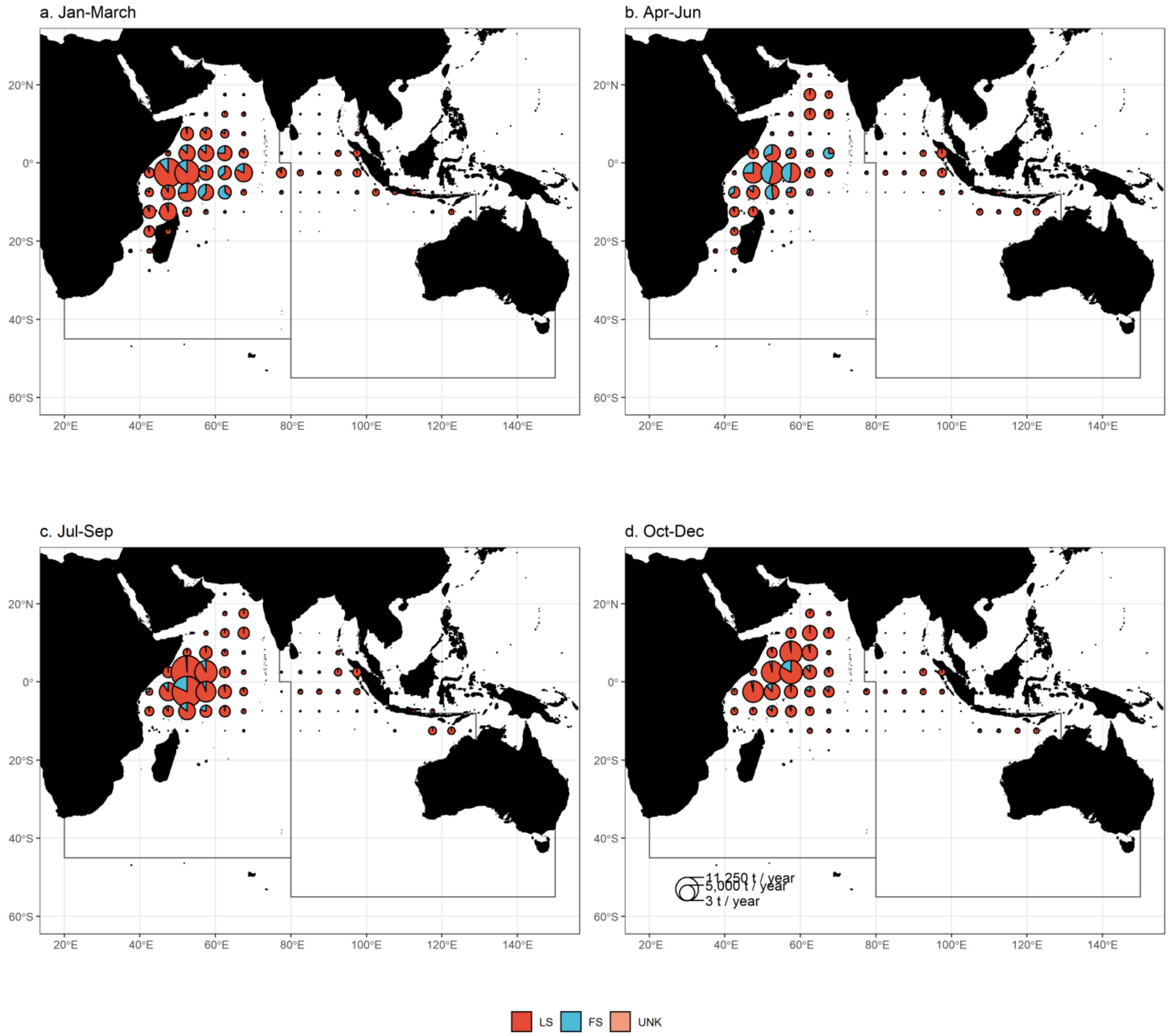

Figure 8: Mean annual time-area purse seine catches (in metric tons) of tropical tunas for the period 2016-2020, by quarter and type of school association. LS = floating object-associated school; FS = free-swimming school; UNK = unknown. Source: raised IOTC geo-referenced catches

Composition of the catch

Species composition

Purse seine catches on schools associated with drifting floating objects are dominated by skipjack tuna, followed by yellowfin tuna, while bigeye tuna represent a small component of the catch and are not specifically targeted in the large-scale purse seine fishery. After an initial period of increase, the catches of skipjack on FOB-associated schools reached annual catch levels of around 175,000 t during 1999-2006, before showing a decrease to around 124,000 t between 2007 and 2015 (**Fig. 9a**). From 2016, the catches of skipjack showed a sharp increase, reaching a maximum of 302,000 t in 2018, and an average annual catch of 280,000 t during the period 2018-2020. Purse seine catches of yellowfin tuna on associated schools also showed an increase between the late 1970s and the mid-1990s, reaching a level of around 70,000 t between 1996 and 2006. Since 2008, the catches have shown an increasing trend from 42,000 t to around 103,000 t in 2020 (**Fig. 9a**). Catches of bigeye tuna have remained fairly constant over the last two decades at around 20,000 t, except for an abnormal high value in 2018 which is due to the reporting of around 25,000 t of bigeye tuna by EU,Spain in that year (IOTC 2019b).

The contribution of skipjack tuna to the total catches showed large interannual fluctuations over the last decades. Following the initial period of exploration and fishery development until 1984, the percentage of skipjack tuna in the total purse seine FOB-school catches has varied between a minimum of 49% in 2013 and a maximum of 73% in 1991 (**Fig. 9b**). In recent years (2016-2020), skipjack tuna contributed to around 65.3% of the total purse seine catches on associated schools. Since 2000, the proportion of yellowfin tuna in the FOB-associated catches has varied between a minimum of 20.3% to a maximum of 42% in 2012-2013, with a mean value of 28.16% in recent years (**Fig. 9b**).

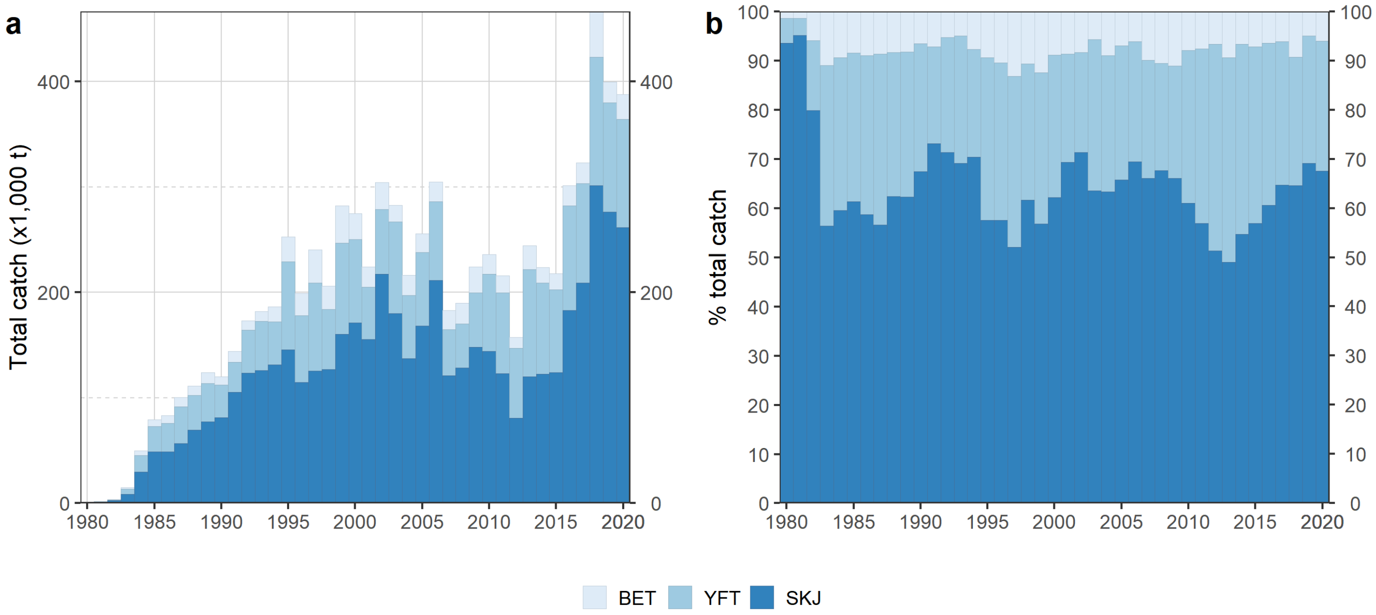

Figure 9: Annual time series of cumulative nominal absolute (a) and relative (b) purse seine catches (t) of the three principal market tropical tunas (bigeye tuna, skipjack tuna, and yellowfin tuna) caught in schools associated with drifting floating objects in the Indian Ocean for the period 1980-2020. Source: raised IOTC geo-referenced catches

Size structure

The very large majority of the tropical tunas caught in association with drifting floating objects are fish smaller than 60 cm fork length (FL), i.e., juveniles in the case of yellowfin and bigeye tuna (**Fig. 10**). While some yellowfin tuna larger than 90 cm in FL are reported in the catches, adult bigeye tuna almost never occur in association with floating objects at the surface of the Indian ocean. For the sizes smaller than 90 cm FL, the three species show a very similar size range with most fish caught between 45 and 55 cm, skipjack showing a median fork length (44.5 cm) in the catch smaller than bigeye tuna (49 cm) and yellowfin tuna (51 cm). The distributions of fork length measurements for the three species over the last two decades show some interannual variability in the catch composition with no clear trend in the time series of the fork length median values (**Fig. 10**).

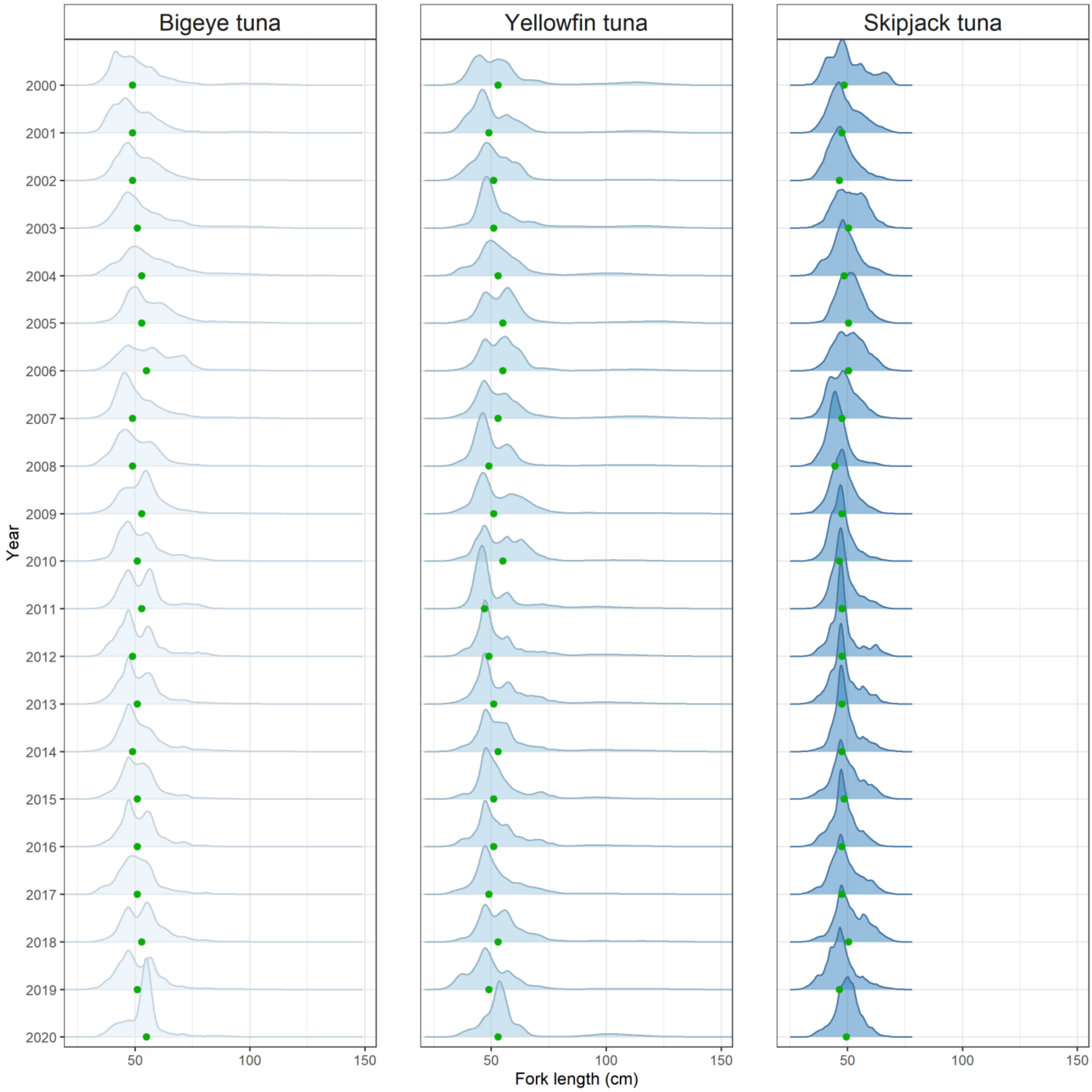

Figure 10: Annual size frequency distributions of the three principal market tropical tunas (bigeye tuna, skipjack tuna, and yellowfin tuna) caught in schools associated with drifting floating objects in the Indian Ocean for the period 2000-2020. Green dots indicate the median value. Source: raised IOTC geo-referenced catches

The average weight of the three tropical tunas caught in association with drifting floating objects has decreased over the last four decades. Information on size data in the purse seine fishery was sparse and incomplete prior to the 1990s, so the values of average weights estimated during the 1980s should be considered with care (Pianet 1999). Despite some major interannual variability, the estimated weights of both yellowfin and bigeye tuna show a decreasing trend between the 1990s and the late 2010s with a significant correlation between the two time series (**Fig. 11**). Bigeye tuna caught on associated schools in the early 1990s were described by an average weight of around 5 kg while their average weight was estimated to be around 3.8 kg in recent years (2016-2020). Yellowfin tuna shows the most marked decline with an average weight having decreased from about 8.2 kg during the period 1984-1995 to around 5.6 kg between 1996 and 2007, and 4.7 kg since 2008. In 2020, the average weight of yellowfin tuna in purse seine catches on drifting floating objects was estimated to be 4.1 kg (**Fig. 11**).

The average weight of skipjack tuna in the purse seine catches on FOBs shows a more complex pattern, with an initial decrease from more than 3.2 kg in the late 1980s-early 1990s to about 3 kg in the 2000s before reaching very small values between 2008 and 2011 (2.2-2.6 kg). Since then, the weight of skipjack has increased and estimated at a mean value of 2.9 kg between 2016 and 2020 (**Fig. 11**).

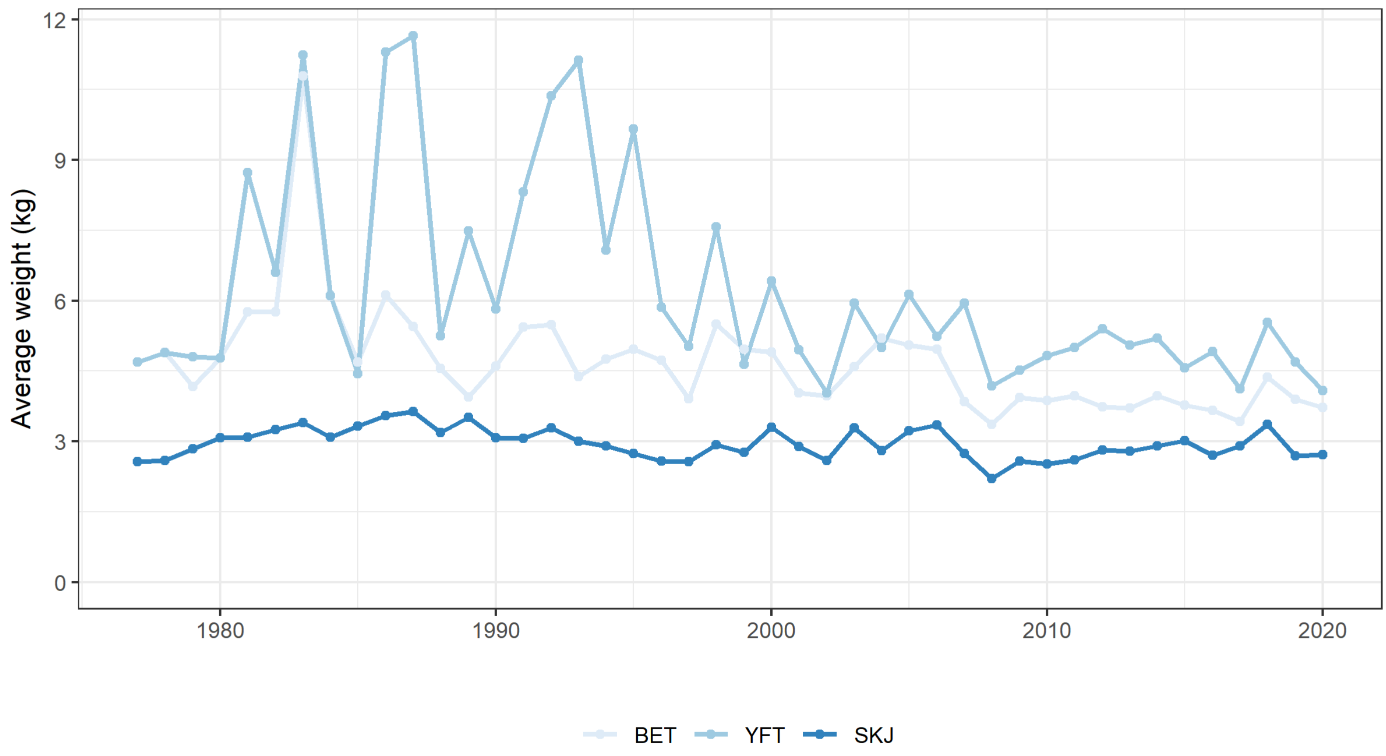

Figure 11: Annual time series of the mean annual weight (kg) of the three principal market tropical tunas (bigeye tuna, skipjack tuna, and yellowfin tuna) in the catch of purse seine on schools associated with drifting floating objects in the Indian Ocean for the period 1977-2020. Source: raised IOTC geo-referenced catches

The recent distribution of tuna average weights in the FOB-associated catches of the purse seine fishery shows strong spatial patterns across the Indian Ocean. Overall, tropical tunas caught in coastal waters at the periphery of the distribution areas and in the eastern part of the Indian Ocean between 2016 and 2020 appeared to be generally smaller than their counterparts taken in deeper waters of the western Indian Ocean (**Fig. 12**). Bigeye tuna and skipjack tuna showed overall similar spatial patterns between 2016 and 2020. The grids described by the highest average weights for both species were found in the regions located at the southeast and east of the Seychelles archipelago and around the Chagos archipelago (**Fig. 12a-b**). The highest weights (>4 kg) of yellowfin tuna in the recent FOB-associated catches were located in the western Indian Ocean, while average weights of less than 2-3 kg were estimated along the coasts of Indonesia, off the coasts of Sri Lanka, and in the Arabian Sea. It is to note that few size data have been reported by the industrial purse seine fisheries of Indonesia, Sri Lanka, and I.R. Iran, resulting in some large uncertainties on the tuna weights estimated in their fishing grounds.

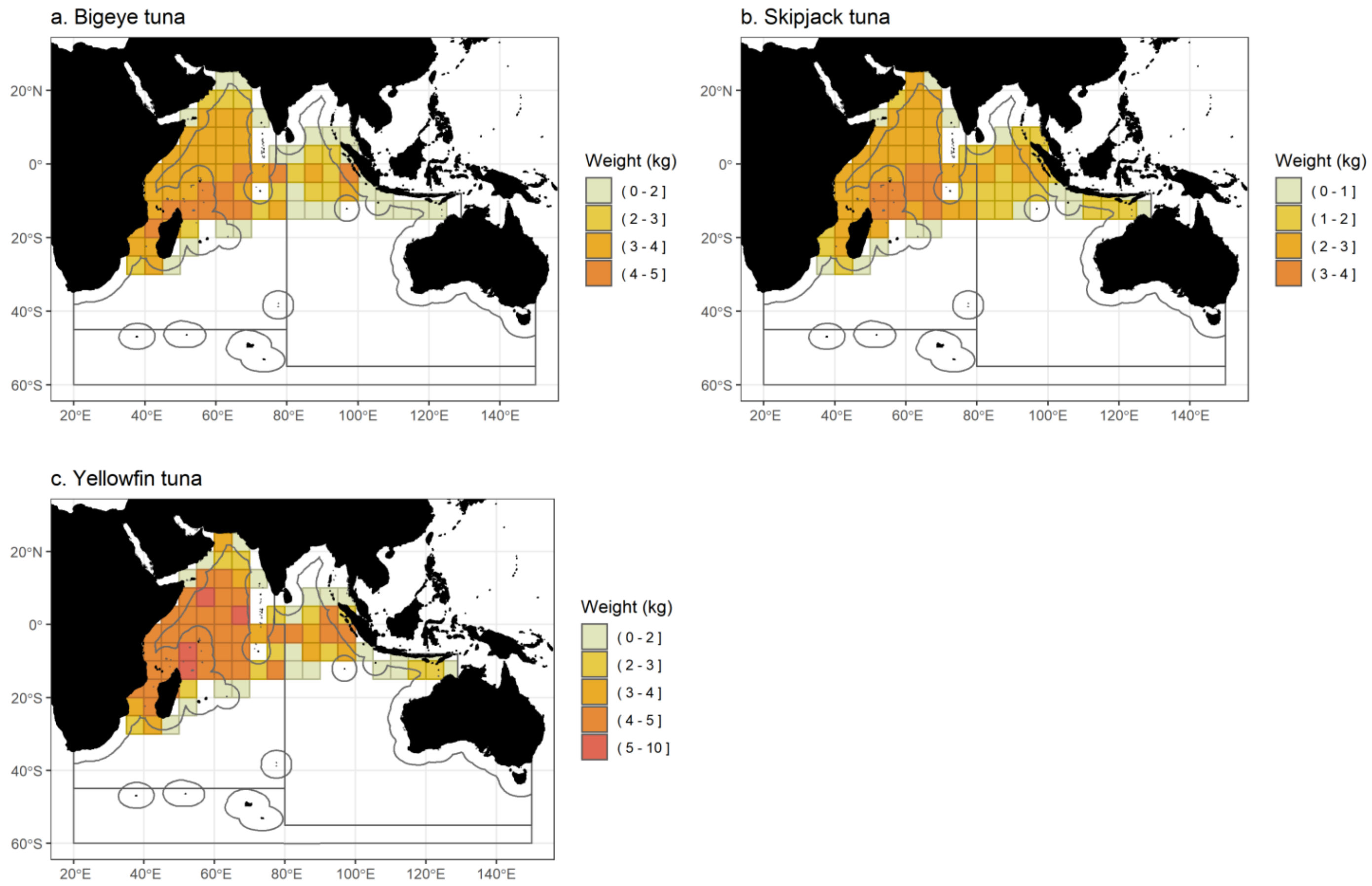

Figure 12: Estimates of average weight per fish (kg) of the three principal market tropical tunas (bigeye tuna, skipjack tuna, and yellowfin tuna) in the catch of purse seine on schools associated with drifting floating objects in the Indian Ocean for the period 2016-2020.

Analysis of FOB-related data

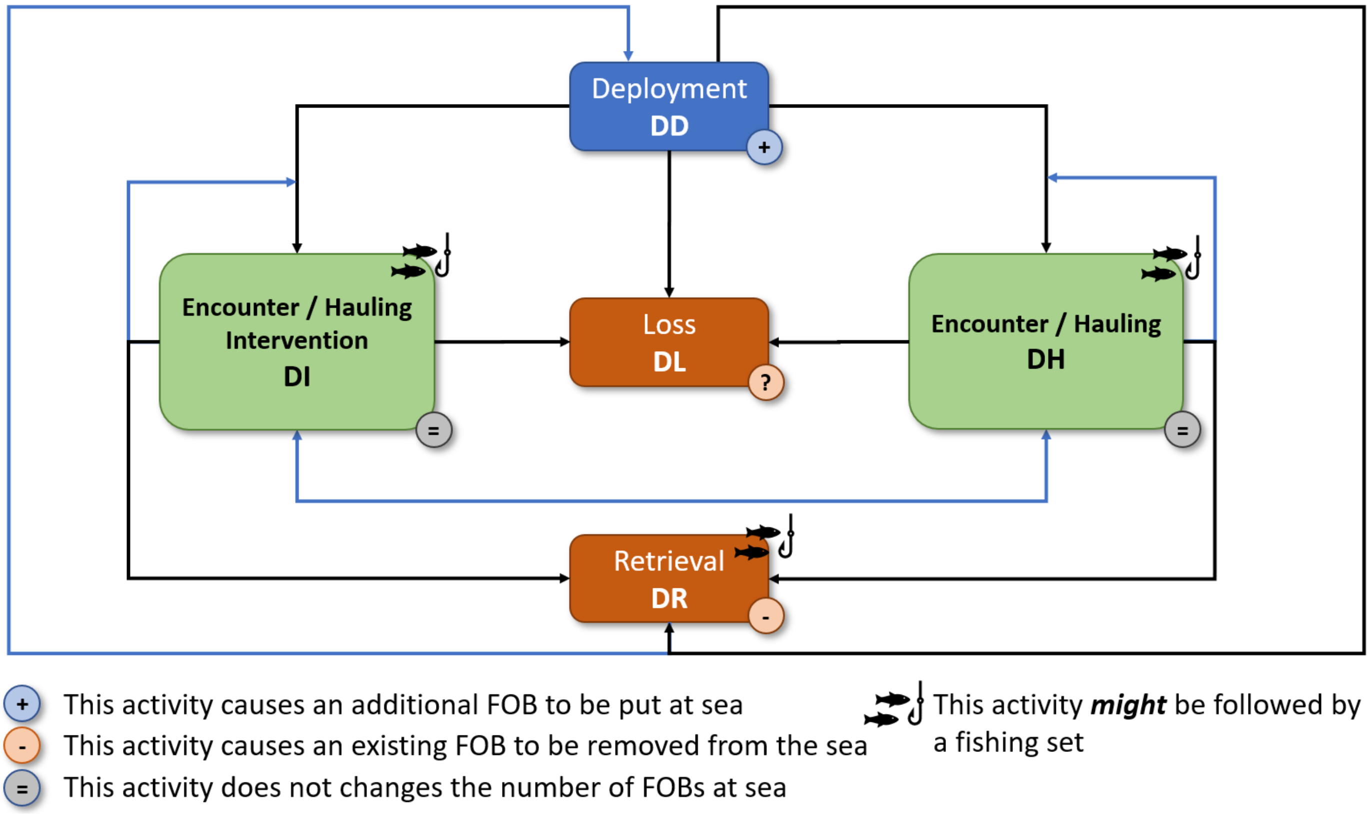

Figure 13: Classification of types of FOB activities in use at the IOTC Secretariat and their state-transition diagram. See Appendix II for descrption of each code

At-sea deployments

Tables 1-6 summarize the information available for all concerned CPCs across the years for which data were submitted to the IOTC Secretariat via IOTC form 3FA and IOTC form 3FD.

The meaning of each column in these tables is as follows:

- **FLAG**: the flag of the fleet that reported the information;
- **YEAR**: the statistical year;
- **FD**: the number of FOBs (of whatever nature) deployed in the year by the reporting fleet, regardless of the type of vessel, derived from IOTC form 3FD (available only for 2018 and 2019, as per IOTC Res. 19/01);
- **FA**: the number of FOBs (of whatever nature) deployed in the year by the reporting fleet, regardless of the type of vessel, derived from IOTC form 3FA (records with activity type set to *DD*);
- **DIFF**: the arithmetic difference between **FD** and **FA**;
- **FD_PS**: the number of FOBs (of whatever nature) deployed in the year by purse seine vessels from the reporting fleet, derived from IOTC form 3FD (available only for 2018 and 2019, as per IOTC Res. 19/01);
- **FA_PS**: the number of FOBs (of whatever nature) deployed in the year by purse seine vessels from the reporting fleet, derived from IOTC form 3FA (records with activity type set to *DD*);
- **DIFF_PS**: the arithmetic difference between **FD_PS** and **FA_PS**;
- **FD_SU**: the number of FOBs (of whatever nature) deployed in the year by supply vessels from the reporting fleet, derived from IOTC form 3FD (available only for 2018 and 2019, as per IOTC Res. 19/01);

- **FA_SU**: the number of FOBs (of whatever nature) deployed in the year by supply vessels from the reporting fleet, derived from IOTC form 3FA (records with activity type set to *DD*);
- **DIFF_SU**: the arithmetic difference between **FD_SU** and **FA_SU**.

FD cells for years other than 2018 and 2019 should always be blank, as there was no requirement to report this data outside those two years. Grayed-out cells correspond to strata for which there is no information available.

For each stratum, the following identities are always valid:

- **FD** = **FD_PS** + **FD_SU**
- **FA** = **FA_PS** + **FA_SU**

Summary by fleet

Table 1: Summary of total number of FOBs deployed by the Spanish component of the European Union purse seine fleet, as reported through IOTC form 3FD and IOTC form 3FA for the period 2015-2020

FLAG	YEAR	FD	FA	DIFF	FD_PS	FA_PS	DIFF_PS	FD_SU	FA_SU	DIFF_SU
EU,ESP	2015		17,176			17,176				
EU,ESP	2016		19,058			19,058				
EU,ESP	2018	10,181	10,167	14	5,979	10,167	-4,188	4,202		
EU,ESP	2019	8,176	8,365	-189	4,845	8,365	-3,520	3,331		
EU,ESP	2020		7,902			7,902				

Data on deployments by Spanish-flagged vessels of the Eropean Union fleet are in relatively good agreement overall between IOTC form 3FD and IOTC form 3FA (see the *DIFF* column in **Table 1**). When considering the breakdown of all deployments by vessel type, though, it is evident how the deployment data reported through IOTC form 3FA are erroneously accounted for exclusively by purse seine vessels (see the *FA_PS* column in **Table 1**), while the data from IOTC form 3FD indicates an almost even split between FOBs deployed by purse seines and supply vessels in 2018 and 2019 (see the *FD_PS* and *FD_SU* columns in **Table 1**). Regardless of the vessel type, the deployments of FOBs show a negative trend from 2016 onward, after reaching a peak of almost 19,000 FOBs deployed by the Spanish fleet during that year.

Table 2: Summary of total number of FOBs deployed by the French component of the European Union purse seine fleet, as reported through IOTC form 3FD and IOTC form 3FA for the period 2015-2020

FLAG	YEAR	FD	FA	DIFF	FD_PS	FA_PS	DIFF_PS	FD_SU	FA_SU	DIFF_SU
EU,FRA	2015		97			97				
EU,FRA	2016		3,518			3,518				
EU,FRA	2017		548			548				
EU,FRA	2018	4,464	624	3,840	3,296	624	2,672	1,168		
EU,FRA	2019	3,404	820	2,584	2,433	820	1,613	971		
EU,FRA	2020		3,138			3,138				

Data on deployments by French-flagged vessels from the European Union fleet are not in agreement between IOTC form 3FD and IOTC form 3FA. In particular, for the years 2018 and 2019 (when information is available from both sources) the deployments recorded through IOTC form 3FA appear to be severely under-reported (see the *DIFF* column in **Table 2**). The trend in total number of FOBs deployed according to IOTC form 3FA is extremely variable and seems to be on the levels comparable to those reported through IOTC form 3FD only in 2016 and 2020.

Table 3: Summary of total number of FOBs deployed by the Japanese purse seine fleet, as reported through IOTC form 3FD and IOTC form 3FA for the period 2013-2020

FLAG	YEAR	FD	FA	DIFF	FD_PS	FA_PS	DIFF_PS	FD_SU	FA_SU	DIFF_SU
JPN	2013		93			93				
JPN	2014		183			183				
JPN	2015		227			227				
JPN	2016		224			224				
JPN	2017		251			251				
JPN	2018	331			301			30		
JPN	2019	119	69	50	69	69	0	50		
JPN	2020		33			33				

Deployment data for the Japanese fleet are available from both IOTC form 3FA and IOTC form 3FD only in 2019, where they show a perfect agreement when limited to deployments from purse seine vessels only (see the *DIFF_PS* column in **Table 4**). The trends in deployed FOBs derived from either IOTC form 3FD or IOTC form 3FA are in agreement with the evolution of the Japanese purse seiners fleet, which has been dramatically reducing operations in the Indian Ocean in recent years.

Table 4: Summary of total number of FOBs deployed by the Korean purse seine fleet, as reported through IOTC form 3FD and IOTC form 3FA for the period 2014-2020

FLAG	YEAR	FD	FA	DIFF	FD_PS	FA_PS	DIFF_PS	FD_SU	FA_SU	DIFF_SU
KOR	2014		1,618			1,618				
KOR	2015		1,940			1,940				
KOR	2016		1,749			1,749				
KOR	2017		1,445			1,445				
KOR	2018		489			489				
KOR	2019		412			412				
KOR	2020		399			399				

FOBs deployment data for the Korean fleet are exclusively available through IOTC form 3FA and therefore it is not possible to substantiate their accuracy with the help of data from IOTC form 3FD: in any case, the total annual number of FOBs deployed shows a trend similar to what already observed for EU,ESP, decreasing systematically from a peak level of 1,940 FOBs in 2015 to 399 FOBs (absolute minimum for the fleet) in 2020.

Table 5: Summary of total number of FOBs deployed by the Mauritian purse seine fleet, as reported through IOTC form 3FD and IOTC form 3FA for the period 2013-2020

FLAG	YEAR	FD	FA	DIFF	FD_PS	FA_PS	DIFF_PS	FD_SU	FA_SU	DIFF_SU
MUS	2013									
MUS	2016		1			1				
MUS	2017		929			346			583	
MUS	2018	600	718	-118	141	141	0	459	577	-118
MUS	2019	893	848	45	252	199	53	641	649	-8
MUS	2020		408			273			135	

The information on FOBs deployed by Mauritius as provided through IOTC form 3FA shows a generally decreasing trend from a peak of 929 FOBs deployed in 2017 to 408 deployed in 2020. The comparison of data from IOTC form 3FA and IOTC form 3FD for the years 2018 and 2019 shows a perfect agreement in deployments reported by purse seine vessels in 2018, with a mild under-reporting in 2019 (evidence of 53 more FOBs deployed by Mauritian purse seiners in IOTC form 3FD, see the *DIFF_PS* column in **Table 5**). The situation is inverted when considering deployments from supply vessels, in which case, there's a slight over-reporting for 2019 and a more marked over-reporting for 2018 (see the *DIFF_SU* column in **Table 5**).

Additionally, Mauritius reported a single record corresponding to a FOB deployment event through IOTC form 3FA in 2013, but this record actually indicated zero FOBs being deployed (therefore explaining the blank row for 2013 in **Table 5**), and furthermore was followed by a non-NIL value of the number of sets on FOBs: this suggests a potential issue with the provision (through IOTC form 3FA) of both the number of FOBs and the number of sets on FOB for the year and flag concerned.

Table 6: Summary of total number of FOBs deployed by the Seychellois purse seine fleet, as reported through IOTC form 3FD and IOTC form 3FA for the period 2013-2020

FLAG	YEAR	FD	FA	DIFF	FD_PS	FA_PS	DIFF_PS	FD_SU	FA_SU	DIFF_SU
SYC	2013		1,354						1,354	
SYC	2014		4,103						4,103	
SYC	2015									
SYC	2016									
SYC	2017									
SYC	2018									
SYC	2019	1,465						1,465		

Information on FOB deployments for Seychelles is sparse and often inaccurate: data from IOTC form 3FA is available for the years between 2013 and 2019, but for 2015, 2016, 2017 and 2019 all the records related to FOB deployment activities (*DD*) explicitly indicate zero deployed FOBs, while on the contrary reporting a positive number of sets on FOBs (without corresponding catches). Similarly to what detected for Mauritius, this situation might indicate a potential issue with the provision (through IOTC form 3FA) of the number of FOBs and the number of sets on FOB for the years and flag concerned.

Furthermore, data from IOTC form 3FD for Seychelles are only available for 2019, and indicate all FOBs as exclusively being deployed by Seychellois supply vessels, with no explicit deployment attributed to purse seiners.

Geo-referenced annual FOB deployments

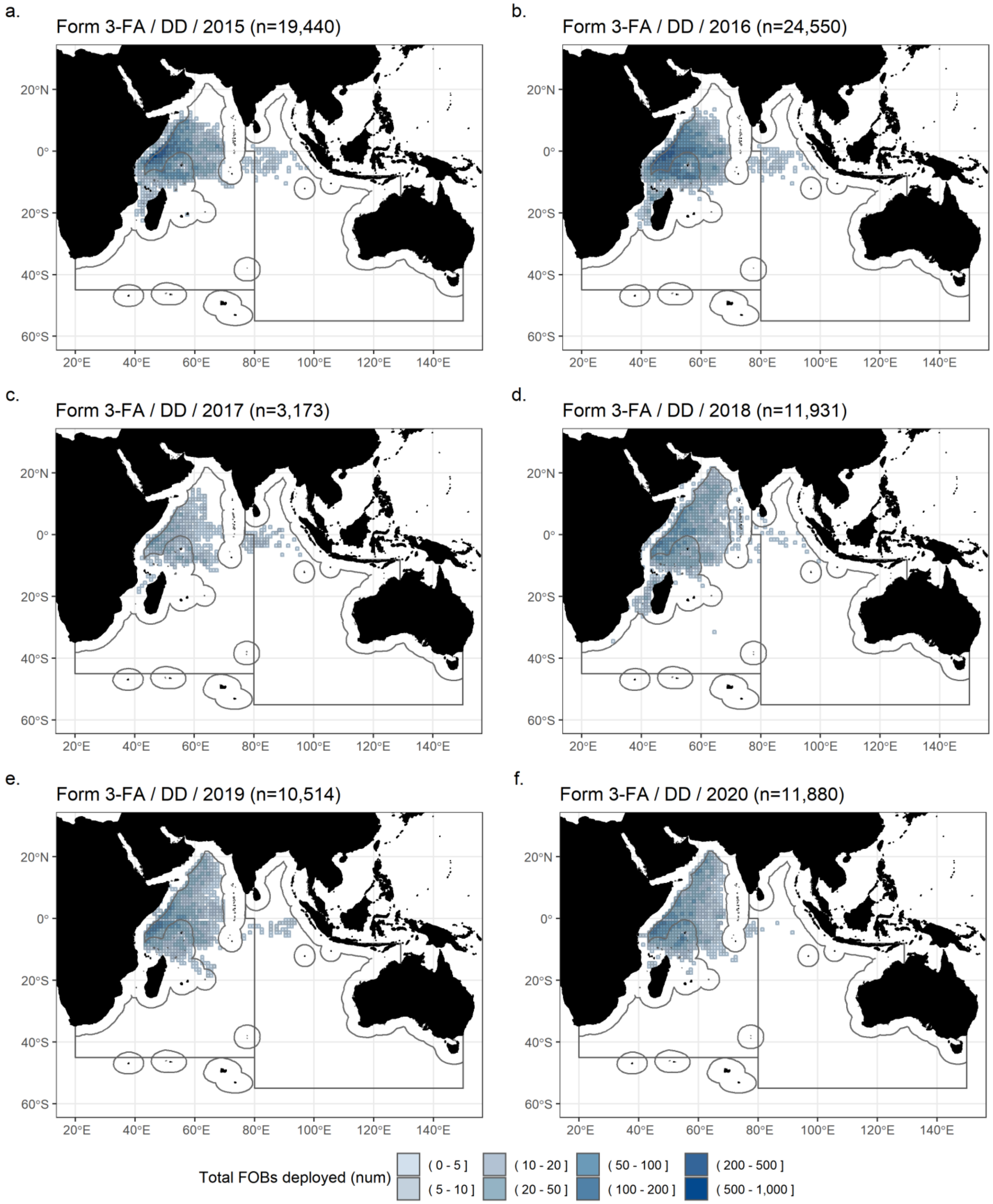

Figure 14: Total number of FOBs deployed by year and grid, as reported through IOTC form 3FA (activity type = DD) for all fleets and FOB types, for the period 2015-2020. Source: IOTC collated FOB activity data

Geo-referenced quarterly FOB deployments

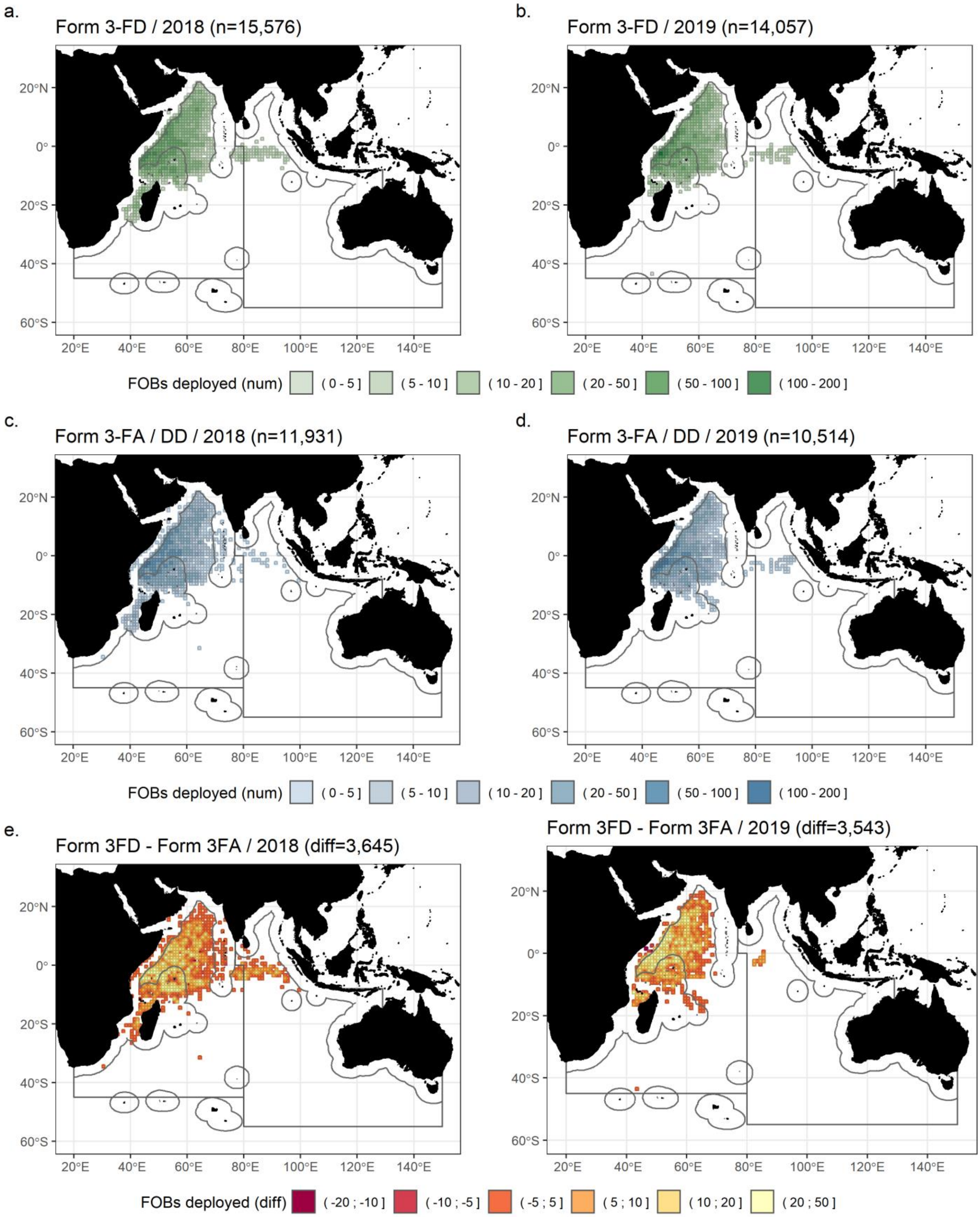

Figure 15: Average annual number of FOBs deployed by quarter, as reported through IOTC form 3FA (activity type = DD) for all fleets and FOB types, for the period 2015-2020. Source: IOTC collated FOB activity data

Aggregated quarterly FOB deployments data from IOTC form 3FA (2015-2020) show how deployments in the Southwest Indian Ocean / Mozambique Channel are apparently more frequent during the first and fourth quarters of the year (**Fig. 15.a** and **15.d**), with less deployments reported on average in the area during the second quarter (**Fig. 15.b**) and close to zero during the third quarter (**Fig. 15.c**).

Geo-referenced annual FOB deployments for 2018 and 2019

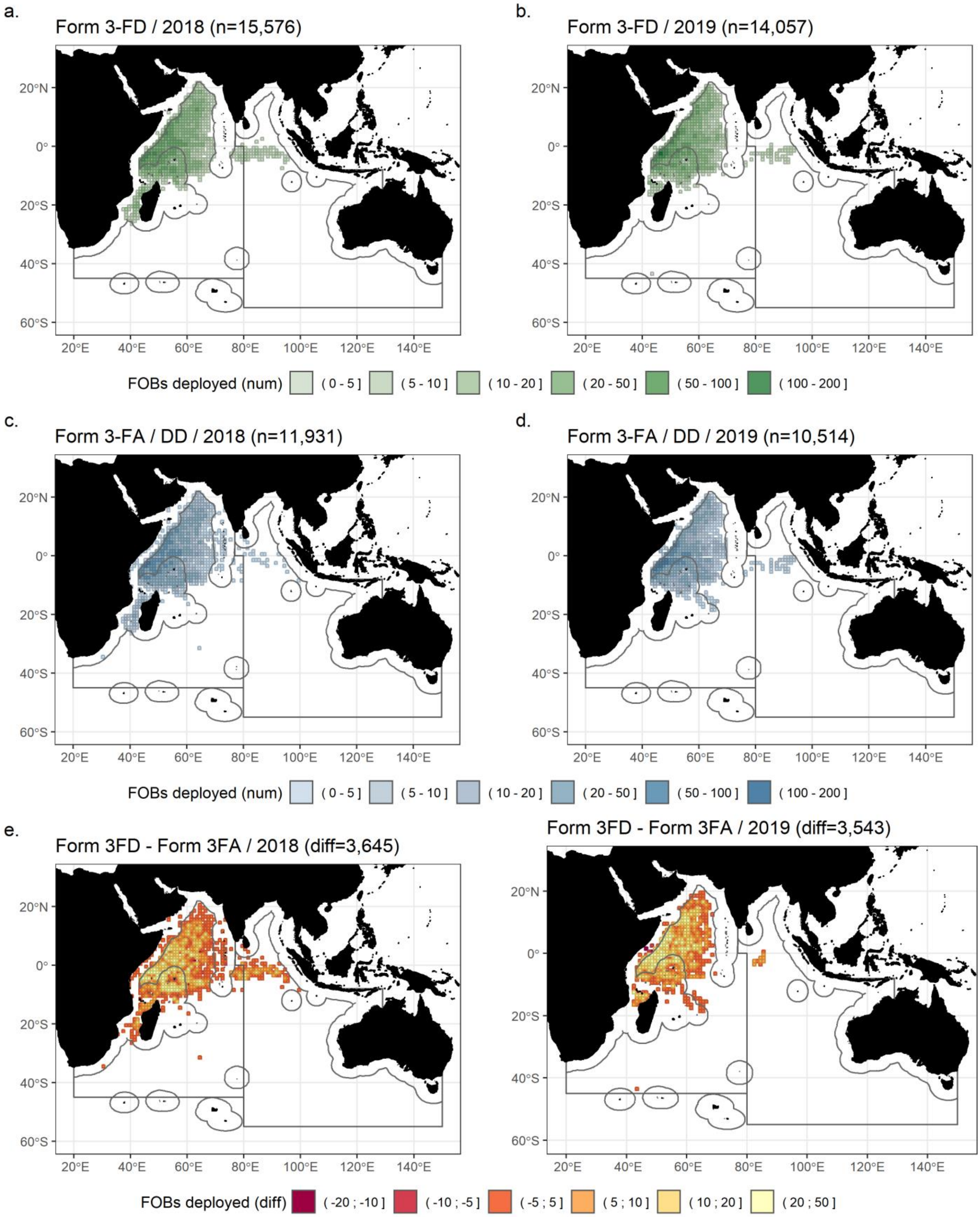

Figure 16: Comparison of annual number of FOBs deployed, as reported through IOTC form 3FD and IOTC form 3FA (activity type = DD) for all fleets and FOB types, for the years 2018 (a, c, e) and 2019 (b, d, f). Source: IOTC FAD deployment data (2018-2019) and IOTC collated FOB activity data

A comparison between the information (total number of FOBs deployed by year and grid) as reported through IOTC form 3FD and IOTC form 3FA for the years concerned shows relatively good agreement in terms of spatial distribution between the two datasets, with minor differences in the areas covered evident only in the Eastern Indian Ocean in 2018 (see **Fig. 16.a** and **Fig. 16.c**).

Overall, data received through IOTC form 3FA (records with activity type set to *DD*) appear to under-report the total number of FOBs deployed in comparison to the same data provided through form 3FD, with a total of around 3,500 more FOBs reported as deployed by the latter source in each of the two years considered.

The reasons for these differences are manyfold, and include (but might not be limited to):

a) non-reporting of IOTC form 3FD for the years considered (SYC 2018, KOR 2018 and 2019),

b) non-reporting of FOB deployment activities (*DD*) through IOTC form 3FA for the years considered (JPN 2018, SYC 2018 and 2019),

c) errors in the interpretation of the reporting requirements of IOTC form 3FA, with the number of FOBs deployed potentially reported in place of the number of positive sets on FOBs (SYC 2019) or data only reported for purse seine vessels (EU,FRA 2018 and 2019).

In light of the considerations above, great caution should be exercised when analysing FOB deployment data provided to the IOTC Secretariat through IOTC form 3FA: the quality of this information appears to be higher when provided through IOTC form 3FD, although severely limited by the temporal coverage and resolution of the dataset (annual, limited to 2018 and 2019 only and lacking any information on the type of FOB deployed).

Sets on FOBs

Tables from **Table 7** to **12** summarize the information available for all concerned CPCs across the years for which data was submitted to the IOTC Secretariat via IOTC form 3CE and IOTC form 3FA.

The meaning of each column in these tables is as follows:

- **FLAG**: the flag of the fleet that reported the information;
- **YEAR**: the statistical year;
- **EF_LS**: the number of sets on FOBs (of whatever nature) recorded in the year by the reporting fleet, as derived from IOTC form 3CE;
- **FA**: the number of sets on FOBs (of whatever nature) recorded in the year by the reporting fleet, derived from IOTC form 3FA (records with *NUM_SETS_ON_FOB* greater than zero);
- **DIFF**: the arithmetic difference between **EF_LS** and **FA**;

Grayed-out cells correspond to strata for which there is no information available.

Summary by fleet

Table 7: Summary of total number of FOB sets recorded by the Spanish component of the European Union purse seine fleet, as reported through IOTC form 3CE and IOTC form 3FA for the period 2015-2020

FLAG	YEAR	EF_LS	FA	DIFF
EU,ESP	2015		2,829	
EU,ESP	2016		3,931	
EU,ESP	2018		4,439	
EU,ESP	2019		4,051	
EU,ESP	2020		4,092	

No effort information as *number of sets* is available for the Spanish component of the European Union purse seine fleet through IOTC form 3CE, and for this reason it is not possible to analyze how this compares to the same data reported through IOTC form 3FA. Nevertheless, information from the latter shows (for years between 2016 and 2020, with data for 2017 not currently available) that the number of sets on FOBs remains stable at around 4,000 sets per year.

Table 8: Summary of total number of FOB sets recorded by the French component of the EUropean Union purse seine fleet, as reported through IOTC form 3CE and IOTC form 3FA for the period 2015-2020

FLAG	YEAR	EF_LS	FA	DIFF
EU,FRA	2015		2,165	
EU,FRA	2016			
EU,FRA	2017		3,710	
EU,FRA	2018		4,152	
EU,FRA	2019	1,918	5,594	-3,676
EU,FRA	2020	1,898	2,779	-881

Effort information as *number of sets* from the French component of the European Union purse seine fleet is only available through IOTC form 3CE for the years 2019 and 2020, with French institutions responsible for the collation of these data currently liaising with the IOTC secretariat to discuss how to best report historical effort information as number of sets for all available years.

When data on FOB sets is available from IOTC form 3CE and 3FA (i.e., for the statistical years 2019 and 2020) they show a tendency at over-estimating the number of sets reported through IOTC form 3FA, although the differences between the two data seem to have reduced over time (from 3,676 to 881 sets of difference in 2019 and 2020 respectively, see the *DIFF* column in **Table 8**).

While the total number of sets on FOBs provided through IOTC form 3CE is stable at around 1,900 sets / year (data originating from logbooks), the same data recovered from IOTC form 3FA shows a higher magnitude and a greater variability over time, although remaining at levels constantly higher than 2,000 sets / year.

When comparing efforts reported through IOTC form 3FA for the Spanish and French component of the European Union purse seine fleet, it appears that the latter has exerted comparable efforts to the former (when not higher, as in the case of 2019). This is partially in contradiction with the known differences in the number of active vessels and the mode of operation of the two fleets (with Spanish-flagged purse seiners remaining more at sea during the year, and performing more sets per day on average) which would suggest the contrary.

The reasons for these differences are unclear, and might potentially depend on national institutions interpreting the FOB sets reporting mechanisms differently from what originally intended for IOTC form 3FA.

Table 9: Summary of total number of FOB sets recorded by the Japanese purse seine fleet, as reported through IOTC form 3CE and IOTC form 3FA for the period 2013-2020

FLAG	YEAR	EF_LS	FA	DIFF
JPN	2013			
JPN	2014	44	44	0
JPN	2015	142	137	5
JPN	2016	139	124	15
JPN	2017	196	104	92
JPN	2018	146		
JPN	2019	9	7	2
JPN	2020	34	32	2

The Japanese purse seine fleet operating in the Indian Ocean has been regularly providing effort information as number of sets from 2014 onward: when comparing data from IOTC form 3CE with the same data from IOTC form 3FA, the differences are minor (when not negligible) for several years - namely 2014, 2015, 2019 and 2020 - and range between 0 and 5 sets of difference detected each year (see the *DIFF* column in **Table 9**). Conversely, data from IOTC form 3FA for 2015 and 2017 appear to underestimate the annual effort by as much as 50% of the total FOB sets reported by Japan through IOTC form 3CE for the same years.

The number of sets on FOBs reported since 2019 by Japan through both IOTC form 3CE and 3FA are in agreement with each other as well as with the available information on the operations of the fleet in the Indian Ocean, which has reduced greatly in comparison to previous years.

Table 10: Summary of total number of FOB sets recorded by the Korean purse seine fleet, as reported through IOTC form 3CE and IOTC form 3FA for the period 2013-2020

FLAG	YEAR	EF_LS	FA	DIFF
KOR	2013	704		
KOR	2014	538		
KOR	2015	731		
KOR	2016	935		
KOR	2017	521		
KOR	2018	415		
KOR	2019	451		
KOR	2020	529		

The Korean purse seine fleet operating in the Indian Ocean has been regularly providing effort information as number of sets from 2013 onward. Unfortunately, there is no corresponding effort information available for the fleet through IOTC form 3FA, and therefore a comparative analysis of the two data sources cannot be performed

When considering effort information from IOTC form 3CE only, the number of annual sets on FOBs shows a stable trend from 2017 onward, with values fluctuating between 415 and 521 FOB sets per year, which follows an all-time peak (in the period considered) of 935 FOB sets reported by the fleet for the statistical year 2016.

Table 11: Summary of total number of FOB sets recorded by the Mauritian purse seine fleet, as reported through IOTC form 3CE and IOTC form 3FA for the period 2013-2020

FLAG	YEAR	EF_LS	FA	DIFF
MUS	2013		44	
MUS	2014	351		
MUS	2015	273		
MUS	2016	262	271	-9
MUS	2017	496	510	-14
MUS	2018	452	464	-12
MUS	2019	421	1,070	-649
MUS	2020	452	1,356	-904

Mauritius has been regularly reporting efforts from its purse seiner fleet as number of sets since 2014, with official data from IOTC form 3CE showing a relatively stable trend in total annual sets on FOBs, whose values fluctuate between 421 and 496 sets each year from 2017 onward.

Data from IOTC form 3FA for the fleet are available for 2013 and from 2016 onward, and show variable levels of agreement across time. In particular, effort information from both sources is consistent from 2016 to 2018 (included), with slightly higher number of sets on FOBs reported through IOTC form 3FA for these three years.

Conversely, in 2019 and 2020 data from IOTC form 3FA reported a much higher number of sets on FOBs than what available from IOTC form 3CE for the corresponding years. The actual reasons of these discrepancies are still unclear, but are likely to be attributed to issues in the interpretation (or reporting) of effort information through IOTC form 3FA.

Table 12: Summary of total number of FOB sets recorded by the Seychellois purse seine fleet, as reported through IOTC form 3CE and IOTC form 3FA for the period 2013-2020

FLAG	YEAR	EF_LS	FA	DIFF
SYC	2013		1,534	
SYC	2014			
SYC	2015		2,186	
SYC	2016		3,264	
SYC	2017		2,981	
SYC	2018		2,784	
SYC	2019		2,878	
SYC	2020		3,265	

The Seychellois purse seine fleet has never provided effort information as number of sets through IOTC form 3CE. In fact, this information is only available through IOTC form 3FA (since 2013, with the exception of 2014) and shows a relatively stable trend at around 3,000 sets on FOBs per year since 2016, with limited fluctuations that do not seem to suggest a marked decrease in fishing operations from the fleet.

Geo-referenced annual efforts

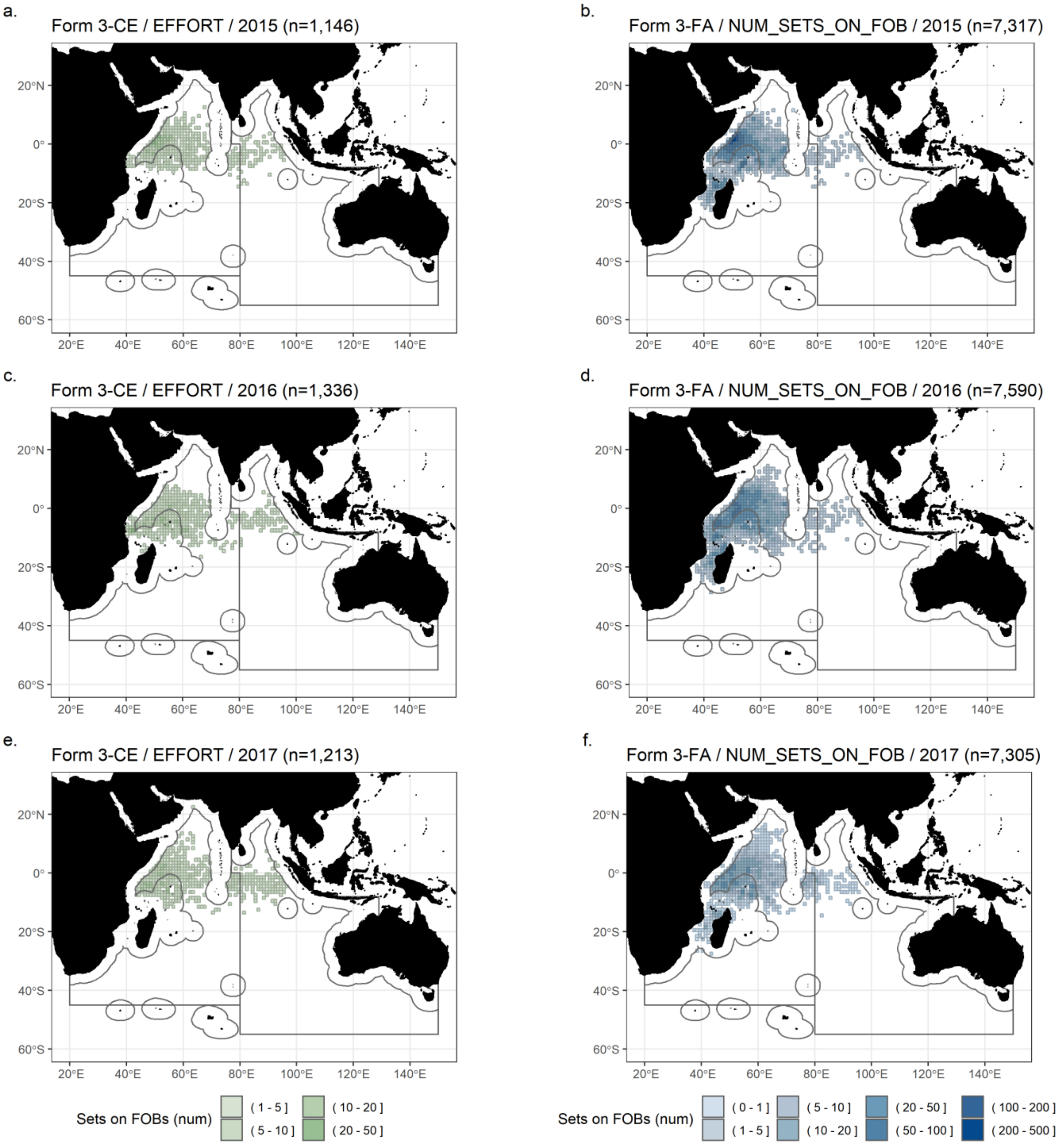

Figure 17: Comparison of total annual number of sets on FOBs for the years 2015-2017, as reported through IOTC form 3CE (a, c, e) and through IOTC form 3FA (b, d, f). Source: IOTC catch-and-effort data for surface fisheries and IOTC collated FOB activity data

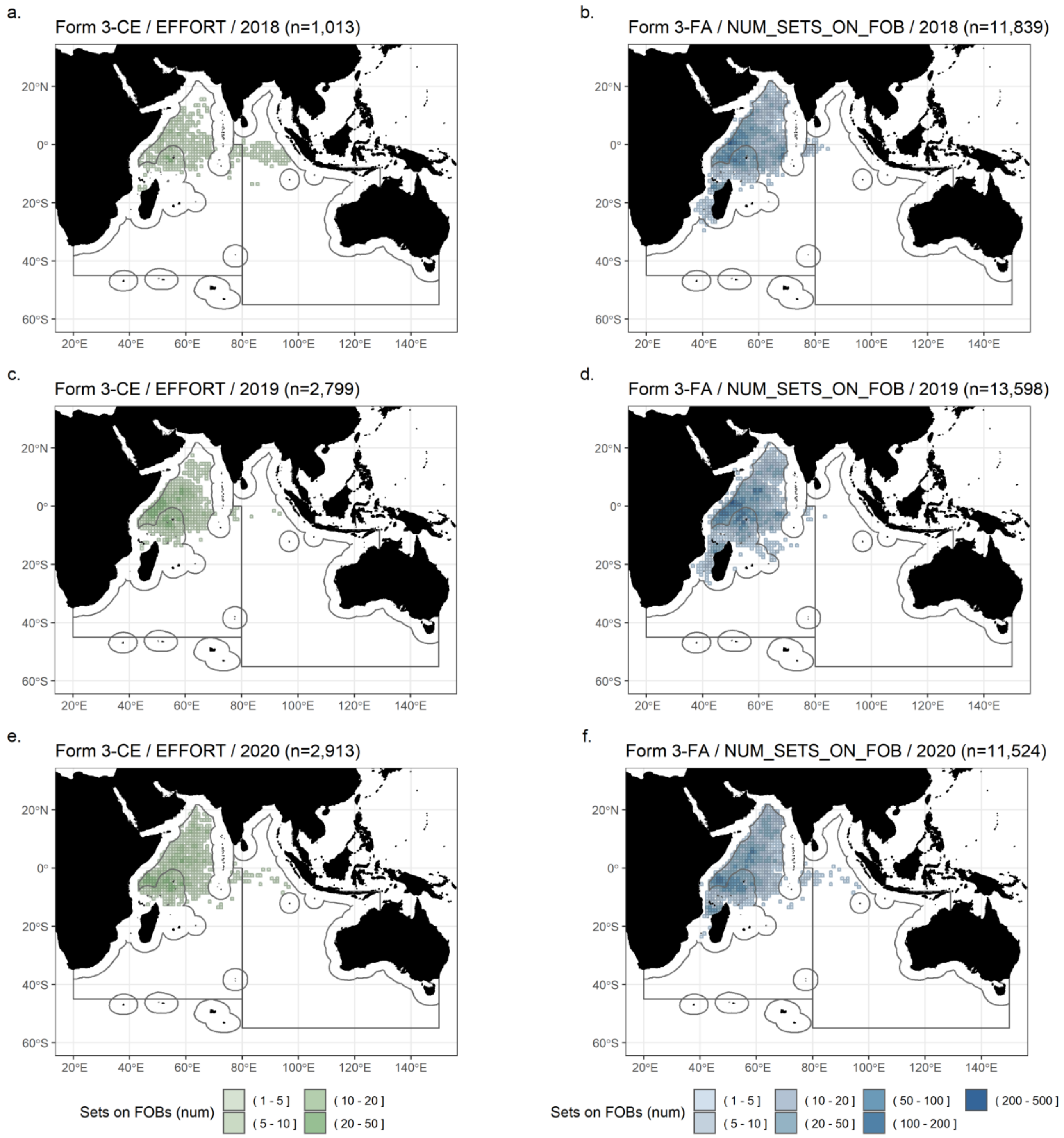

Figure 18: Comparison of total annual number of sets on FOBs for the years 2015-2017, as reported through IOTC form 3CE (a, c, e) and through IOTC form 3FA (b, d, f). Source: [IOTC catch-and-effort data for surface fisheries] and [IOTC collated FOB activity data]

Geo-referenced quarterly efforts

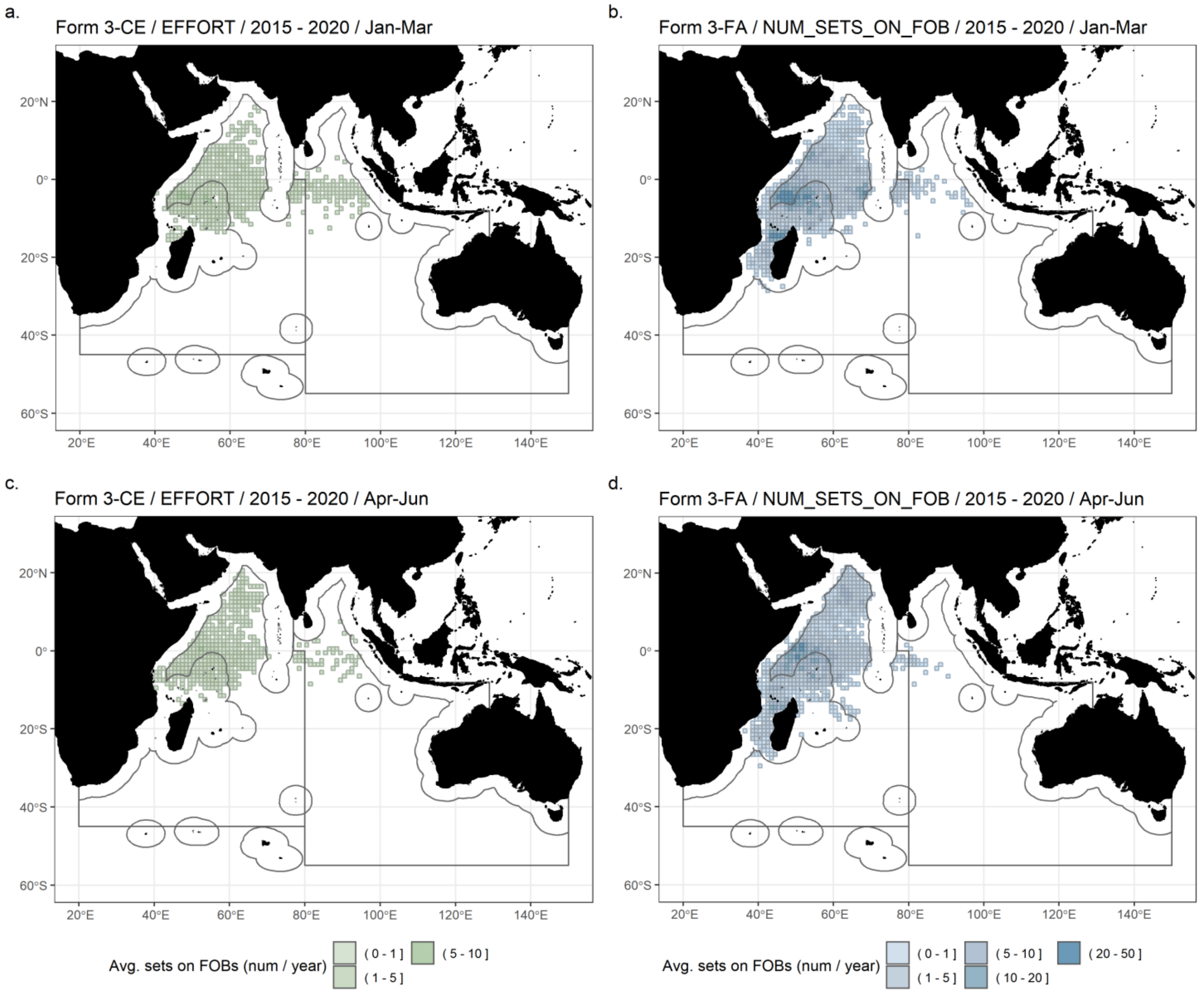

Figure 19: Comparison of average annual number of sets on FOBs for the 1st and 2nd quarter of the years 2015-2020, as reported through IOTC form 3CE (a, c) and through IOTC form 3FA (b, d). Source: IOTC catch-and-effort data for surface fisheries and IOTC collated FOB activity data

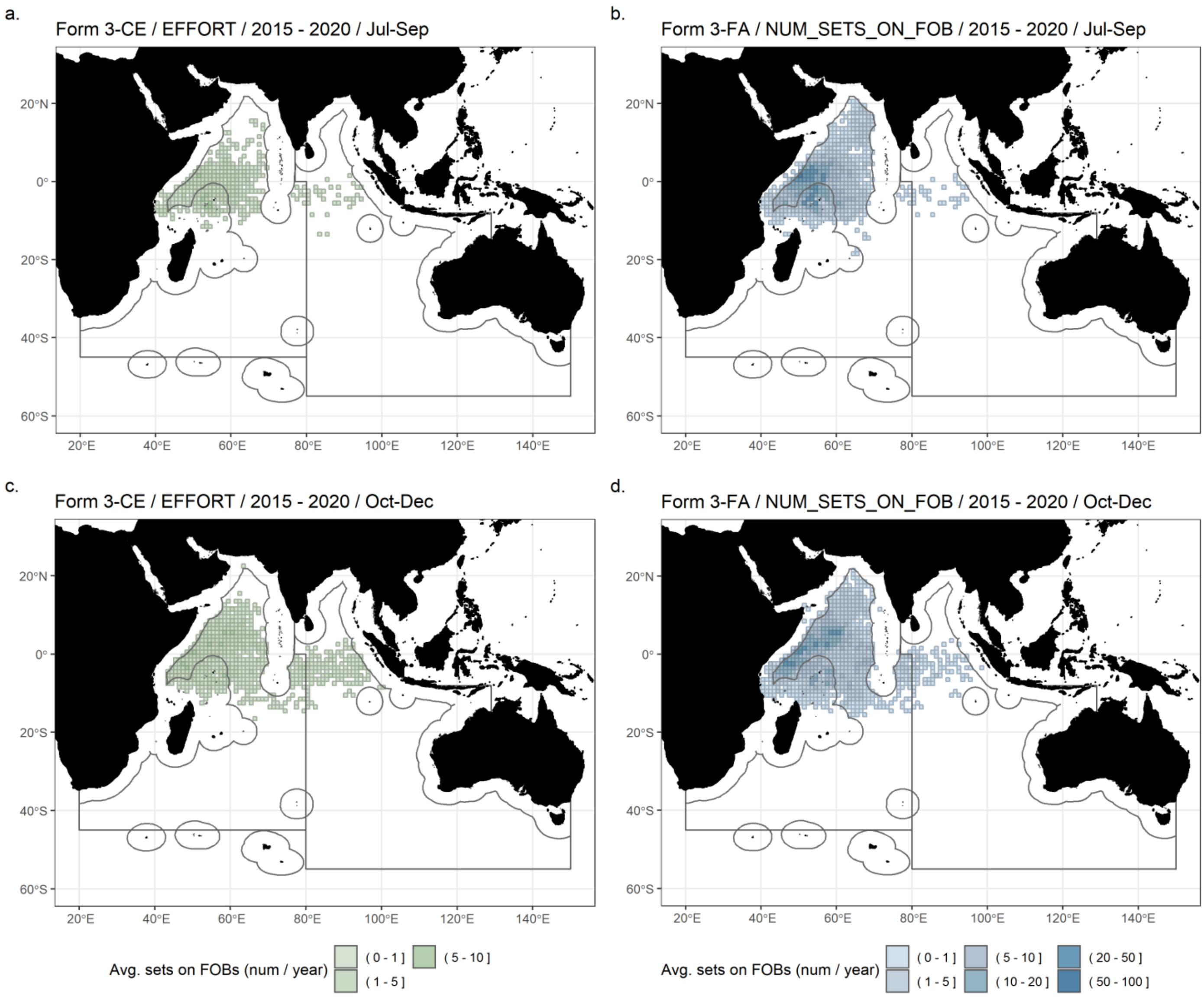

Figure 20: Comparison of average annual number of sets on FOBs for the 3rd and 4th quarter of the years 2015-2020, as reported through IOTC form 3CE (a, c) and through IOTC form 3FA (b, d). Source: IOTC catch-and-effort data for surface fisheries and IOTC collated FOB activity data

Catches on FOBs

Tables from **Table 13** to **18** summarize the information available for all concerned CPCs across the years for which geo-referenced catch data was submitted to the IOTC Secretariat via IOTC form 3CE and IOTC form 3FA.

The meaning of each column in these tables is as follows:

- **FLAG**: the flag of the fleet that reported the information;
- **YEAR**: the statistical year;
- **B_CA_LS**: total bigeye tuna catches (in metric tons) recorded in the year by the reporting fleet of purse seiners on schools associated with drifting FOBs, as derived from IOTC form 3CE;
- **B_FA**: total bigeye tuna catches (in metric tons) recorded in the year by the reporting fleet of purse seiners on schools associated with drifting FOBs, as derived from IOTC form 3FA (records with *NUMBER_OF_SETS_ON_FOB* greater than zero);
- **B_DIFF**: the arithmetic difference between **B_CA_LS** and **B_FA**;
- **S_CA_LS**: total skipjack tuna catches (in metric tons) recorded in the year by the reporting fleet of purse seiners on schools associated with drifting FOBs, as derived from IOTC form 3CE;
- **S_FA**: total skipjack tuna catches (in metric tons) recorded in the year by the reporting fleet of purse seiners on schools associated with drifting FOBs, as derived from IOTC form 3FA (records with *NUMBER_OF_SETS_ON_FOB* greater than zero);
- **S_DIFF**: the arithmetic difference between **S_CA_LS** and **S_FA**;
- **Y_CA_LS**: total yellowfin tuna catches (in metric tons) recorded in the year by the reporting fleet of purse seiners on schools associated with drifting FOBs, as derived from IOTC form 3CE;
- **Y_FA**: total yellowfin tuna catches (in metric tons) recorded in the year by the reporting fleet of purse seiners on schools associated with drifting FOBs, as derived from IOTC form 3FA (records with *NUMBER_OF_SETS_ON_FOB* greater than zero);
- **Y_DIFF**: the arithmetic difference between **Y_CA_LS** and **Y_FA**;

Grayed-out cells correspond to strata for which there is no information available.

Summary by fleet

Table 13: Summary of total tropical tuna catches (in metric tons) recorded by the Spanish component of the European Union purse seine fleet fishing on schools associated with drifting FOBs, as reported through IOTC form 3CE and IOTC form 3FA for the period 2013-2020

FLAG	YEAR	B_CA_LS	B_FA	B_DIFF	S_CA_LS	S_FA	S_DIFF	Y_CA_LS	Y_FA	Y_DIFF
EU,ESP	2013	12,430.60			61,364.06			55,757.81		
EU,ESP	2014	7,557.81			63,453.87			43,478.30		
EU,ESP	2015	6,694.50	6,665.43	29.07	55,289.66	55,100.50	189.16	31,948.32	31,936.34	11.98
EU,ESP	2016	8,461.29	8,507.31	-46.02	72,972.39	73,373.85	-401.46	38,662.11	38,873.62	-211.51
EU,ESP	2017	7,926.00			83,426.19			36,583.47		
EU,ESP	2018	24,507.31	24,508.10	-0.79	132,078.76	129,059.27	3,019.49	43,652.48	43,705.91	-53.43
EU,ESP	2019	7,732.59	6.70	7,725.89	104,965.74	33,553.08	71,412.66	33,575.79	453.00	33,122.79
EU,ESP	2020	10,659.48	10,659.20	0.28	80,749.57	80,749.94	-0.37	36,652.63	36,650.58	2.05

Overall catch data on log-associated schools for the three tropical tuna species are in relatively good agreement between IOTC form 3CE and 3FA for the Spanish component of the European Union purse seine fleet, with the exception of data for the statistical year 2019, when information from IOTC form 3FA seems to severely under-report catches for all three species when compared to data recorded through logbooks.

Potential over-reporting is detected for 2016, 2018 and 2020, when catches from IOTC form 3FA are marginally higher than those from logbooks for the same species and year, but these might be considered by all means negligible when compared to the magnitude of catches reported for each species during the years concerned.

Table 14: Summary of total tropical tuna catches (in metric tons) recorded by the French component of the European Union purse seine fleet fishing on schools associated with drifting FOBs, as reported through IOTC form 3CE and IOTC form 3FA for the period 2013-2020

FLAG	YEAR	B_CA_LS	B_FA	B_DIFF	S_CA_LS	S_FA	S_DIFF	Y_CA_LS	Y_FA	Y_DIFF
EU,FRA	2013	2,777.96			12,954.06			12,329.31		
EU,FRA	2014	2,333.77			18,540.50			15,180.00		
EU,FRA	2015	2,105.03	2,357.02	-251.99	17,499.98	19,913.96	-2,413.98	12,216.21	13,912.60	-1,696.39
EU,FRA	2016	2,775.31			28,750.32			17,360.32		
EU,FRA	2017	2,909.76	5,639.38	-2,729.62	31,399.86	61,687.33	-30,287.47	18,279.50	36,805.61	-18,526.11
EU,FRA	2018	4,305.45	8,668.44	-4,362.99	46,835.46	95,174.56	-48,339.10	25,892.92	52,831.31	-26,938.39
EU,FRA	2019	2,698.09			33,006.97			17,948.68		
EU,FRA	2020	2,017.23	13,958.41	-11,941.18	28,767.85	197,117.93	-168,350.08	14,134.86	101,618.80	-87,483.94

The information provided by the French component of the European Union purse seine fleet indicates, for the years in which data is available both from IOTC form 3CE and 3FA, a systematical (and severe) over-reporting of catches through the latter, with figures that exceeds the total reported by logbooks by several thousands tons.

This is a clear indication of issues in data reporting through IOTC form 3FA, with catch data potentially repeated multiple times for those strata where fishing on FOBs is accompanied also by other activities on floating objects.

Table 15: Summary of total tropical tuna catches (in metric tons) recorded by the Japanese purse seine fleet fishing on schools associated with drifting FOBs, as reported through IOTC form 3CE and IOTC form 3FA for the period 2013-2020

FLAG	YEAR	B_CA_LS	B_FA	B_DIFF	S_CA_LS	S_FA	S_DIFF	Y_CA_LS	Y_FA	Y_DIFF
JPN	2013	197.00	197.00	0.00	861.00	861.00	0.00	95.00	95.00	0.00
JPN	2014	97.00	98.00	-1.00	495.00	495.00	0.00	144.00	144.00	0.00
JPN	2015	280.00	297.30	-17.30	2,083.00	2,061.70	21.30	278.00	258.00	20.00
JPN	2016	256.00	297.30	-41.30	2,357.00	2,061.70	295.30	419.00	258.00	161.00
JPN	2017	369.00	208.00	161.00	3,121.10	1,304.00	1,817.10	570.10	238.00	332.10
JPN	2018	287.00			2,076.00			407.00		
JPN	2019	24.00	24.00	0.00	187.00	187.00	0.00	24.00	24.00	0.00
JPN	2020	68.00	66.00	2.00	494.00	483.00	11.00	58.00	56.00	2.00

Catch levels reported by Japan are quite comparable across most of the years and species for the two data sources, with the notable exceptions of 2016 and 2017 when generalized under-reporting of catches of bigeye, skipjack and yellowfin tuna appear in the data from IOTC form 3FA.

For several other years (e.g., 2013, 2014, 2019) catch levels are in perfect accordance between the two data sources.

Table 16: Summary of total tropical tuna catches (in metric tons) recorded by the Korean purse seine fleet fishing on schools associated with drifting FOBs, as reported through IOTC form 3CE and IOTC form 3FA for the period 2013-2020

FLAG	YEAR	B_CA_LS	B_FA	B_DIFF	S_CA_LS	S_FA	S_DIFF	Y_CA_LS	Y_FA	Y_DIFF
KOR	2013	1,193.50			8,565.00			2,107.50		
KOR	2014	664.00			6,198.00			4,264.00		
KOR	2015	972.00			5,588.00			5,538.00		
KOR	2016	513.00			12,893.15			4,925.08		
KOR	2017	712.00	712.00	0.00	10,822.00	10,822.00	0.00	2,910.00	2,910.00	0.00
KOR	2018	1,058.00			12,412.00			2,828.00		
KOR	2019	855.00			8,464.00			1,881.00		
KOR	2020	632.00			10,627.00			1,313.00		

The Republic of Korea only reported explicit catches of tropical tunas through IOTC form 3FA for the statistical year 2017: in that case, the information provided was in full accordance with the logbook-source data for the same statistical year.

Table 17: Summary of total tropical tuna catches (in metric tons) recorded by the Mauritian purse seine fleet fishing on schools associated with drifting FOBs, as reported through IOTC form 3CE and IOTC form 3FA for the period 2013-2020

FLAG	YEAR	B_CA_LS	B_FA	B_DIFF	S_CA_LS	S_FA	S_DIFF	Y_CA_LS	Y_FA	Y_DIFF
MUS	2014	253.09			2,406.52			1,748.38		
MUS	2015	489.00			2,650.00			2,116.50		
MUS	2016	357.91	357.91	0.00	3,496.74	3,496.78	-0.04	2,189.78	2,187.85	1.93
MUS	2017	722.23	722.23	0.00	8,135.71	8,135.71	0.00	4,402.51	4,402.51	0.00
MUS	2018	1,437.97	1,437.97	0.00	8,817.55	8,817.55	0.00	6,086.32	6,086.32	0.00
MUS	2019	1,332.97	1,332.97	0.00	10,059.37	10,059.37	0.00	3,876.76	3,876.76	0.00
MUS	2020	1,165.63	1,165.63	0.00	8,418.31	8,418.31	0.00	4,748.44	4,748.44	0.00

Catch data of tropical tuna species from Mauritian-flagged vessels is only available, through IOTC form 3FA, for the years from 2016 onward. In those years, the data is in almost perfect accordance with the information received from logbooks, and the negligible differences in catch levels detected in 2016 for skipjack and yellowfin tuna can be *de facto* considered as mere rounding errors.

Table 18: Summary of total tropical tuna catches (in metric tons) recorded by the Seychellois purse seine fleet fishing on schools associated with drifting FOBs, as reported through IOTC form 3CE and IOTC form 3FA for the period 2013-2020

FLAG	YEAR	B_CA_LS	B_FA	B_DIFF	S_CA_LS	S_FA	S_DIFF	Y_CA_LS	Y_FA	Y_DIFF
SYC	2013	4,376.34	4,355.65	20.69	24,748.57	24,675.56	73.01	20,754.99	20,632.37	122.62
SYC	2014	3,870.30			30,672.99			17,656.60		
SYC	2015	4,724.86	4,763.10	-38.24	39,257.57	39,101.08	156.49	23,112.40	23,038.38	74.02
SYC	2016	6,785.64	6,068.20	717.44	59,430.03	54,889.24	4,540.79	32,501.95	29,556.51	2,945.44
SYC	2017	6,771.15	6,777.09	-5.94	66,317.36	66,345.93	-28.57	29,740.20	29,757.30	-17.10
SYC	2018	5,999.61	5,999.61	0.00	80,410.15	80,410.15	0.00	32,748.12	32,748.12	0.00
SYC	2019	5,730.91	5,730.91	0.00	63,457.23	63,457.23	0.00	28,328.53	28,328.53	0.00
SYC	2020	5,709.56	5,670.91	38.65	74,729.31	74,401.96	327.35	28,596.36	28,374.61	221.75

The overall differences in catch levels of tropical tuna species detected between IOTC form 3CE and 3FA for Seychelles are somehow half way between what detected for EU,Spain and Mauritius: for some years (namely 2018 and 2019) there is perfect accordance in the information provided by the two data sources. For other years (2013, 2015, 2017 and 2020) the differences are relatively minor, and mostly consisting in under-estimation of catch levels reported through IOTC form 3FA. Only in 2016 the two data sources seem to diverge, with catches from IOTC form 3FA systematically lower (by around 10%) of the corresponding catches by species reported by logbooks.

Overall, data from Seychelles can be considered in good agreement if not for 2016 and 2014 (when no information was shared through IOTC form 3FA).

Geo-referenced annual catches

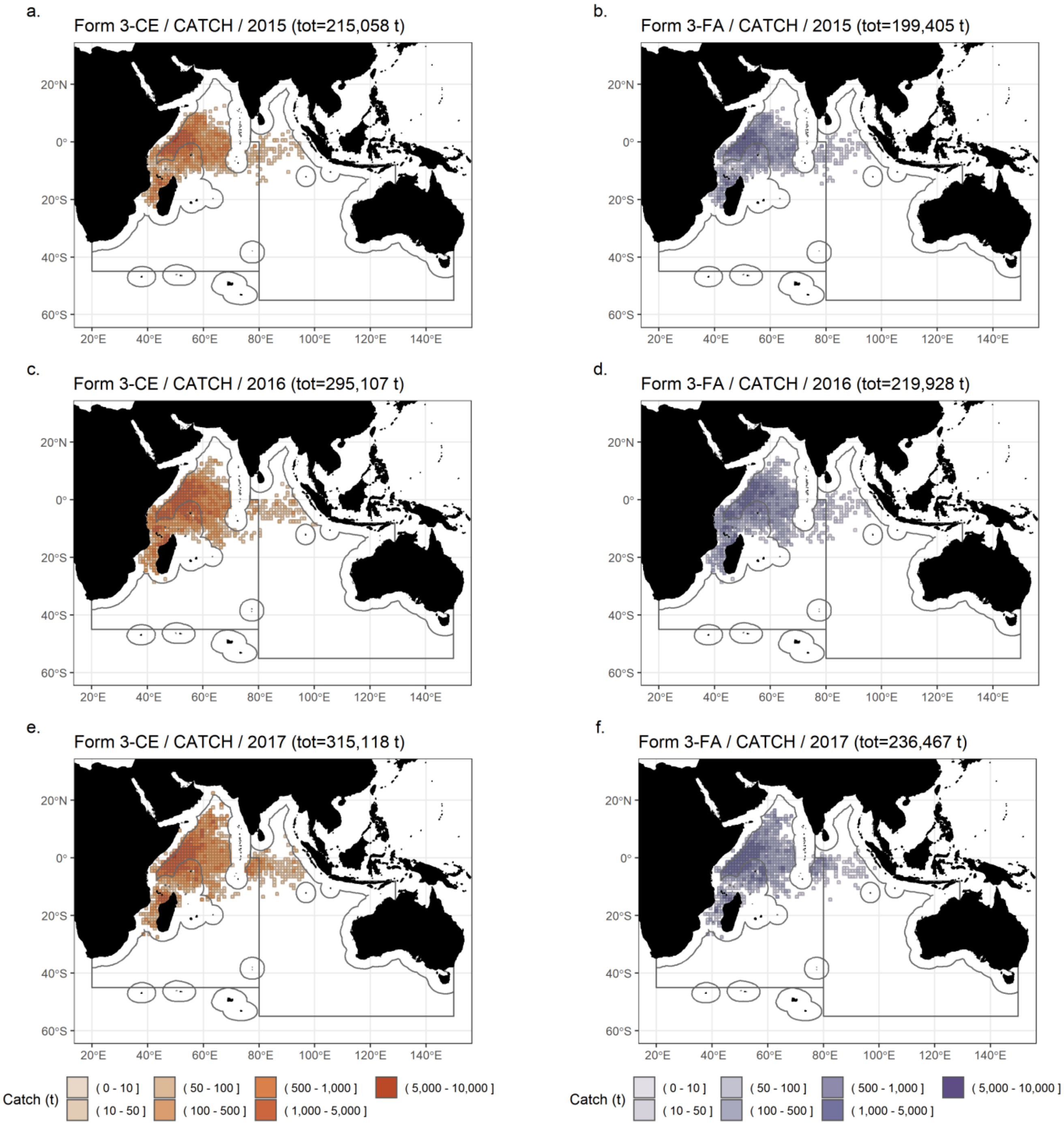

Figure 21: Comparison of total annual catches on FOBs for the years 2015-2017, as reported through IOTC form 3CE (a, c, e) and through IOTC form 3FA (b, d, f). Source: IOTC catch-and-effort data for surface fisheries and IOTC collated FOB activity data

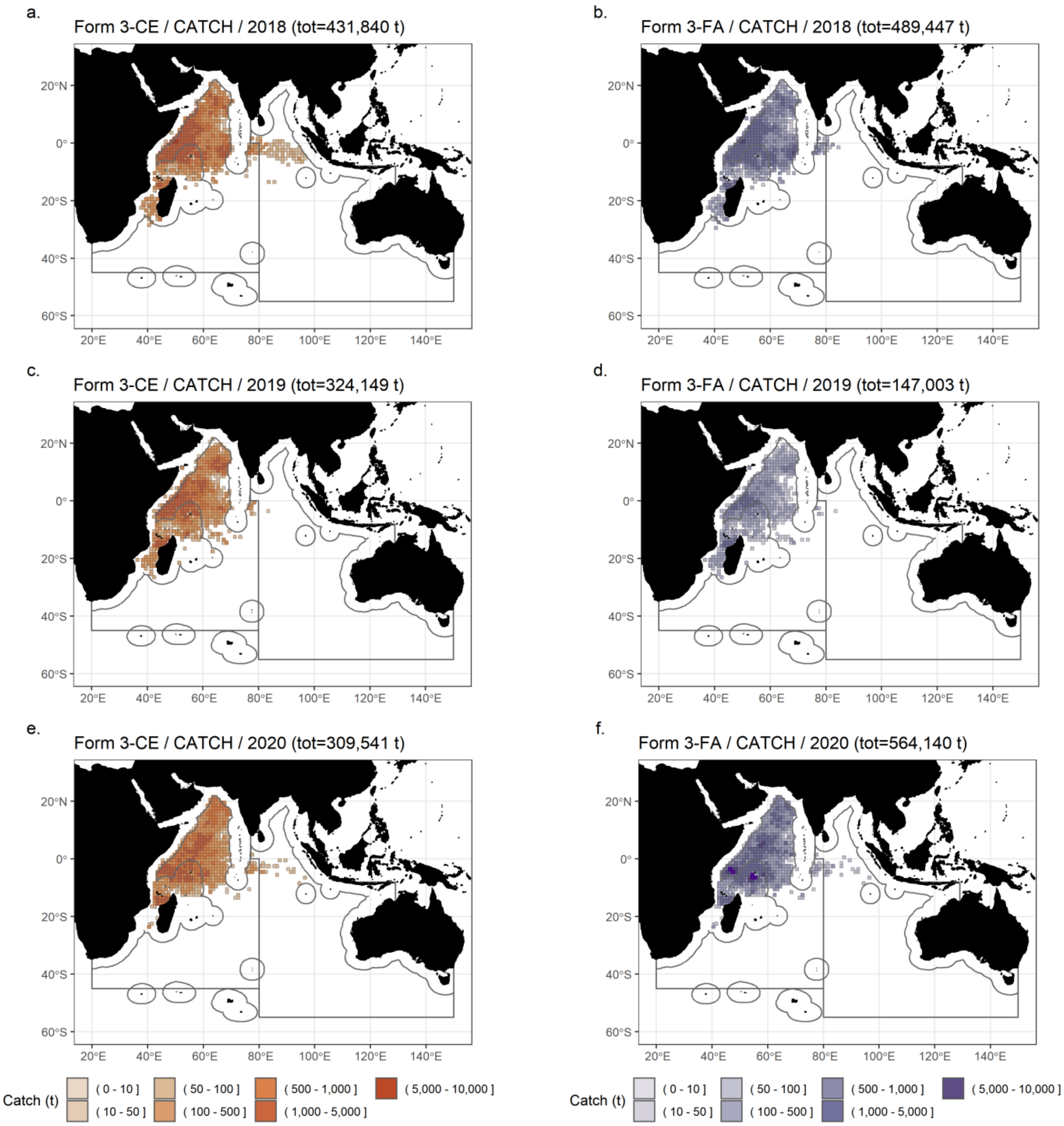

Figure 22: Comparison of total annual catches on FOBs for the years 2018-2020, as reported through IOTC form 3CE (a, c, e) and through IOTC form 3FA (b, d, f). Source: IOTC catch-and-effort data for surface fisheries and IOTC collated FOB activity data

Geospatial information on the distribution of annual catches for all three tropical tuna species shows a good agreement between the two data source across all years considered, with some minor problems in spatial coverage mostly in the Eastern Indian Ocean due to the lack of data for some years from the purse seine fleets operating in the area.

Overall, data from IOTC form 3FA provides an acceptable indication of the hot-spots for tropical tuna catches (on log-associated schools) and their general distribution by the main purse seine fleets operating in the Indian Ocean. The main differences between the two sources of data being in catch magnitudes, in particularly for 2019 and 2020, due to either lack of data from IOTC form 3FA for some fleets / years, or by severe over-reporting such as in the case of EU,France.

Geo-referenced quarterly catches

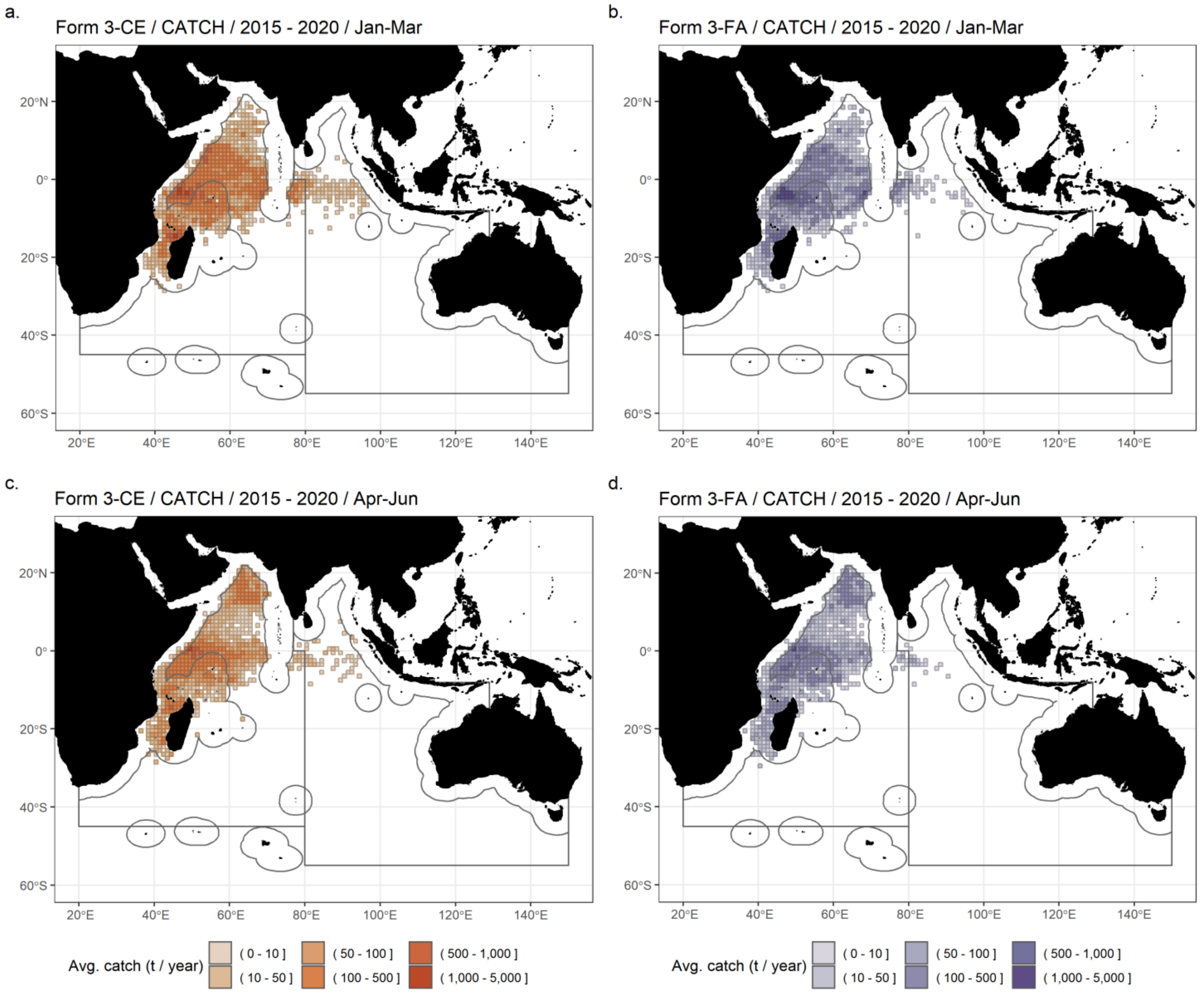

Figure 23: Comparison of average annual catches on FOBs for the 1st and 2nd quarter of the years 2015-2020, as reported through IOTC form 3CE (a, c) and through IOTC form 3FA (b, d). Source: IOTC catch-and-effort data for surface fisheries and IOTC collated FOB activity data

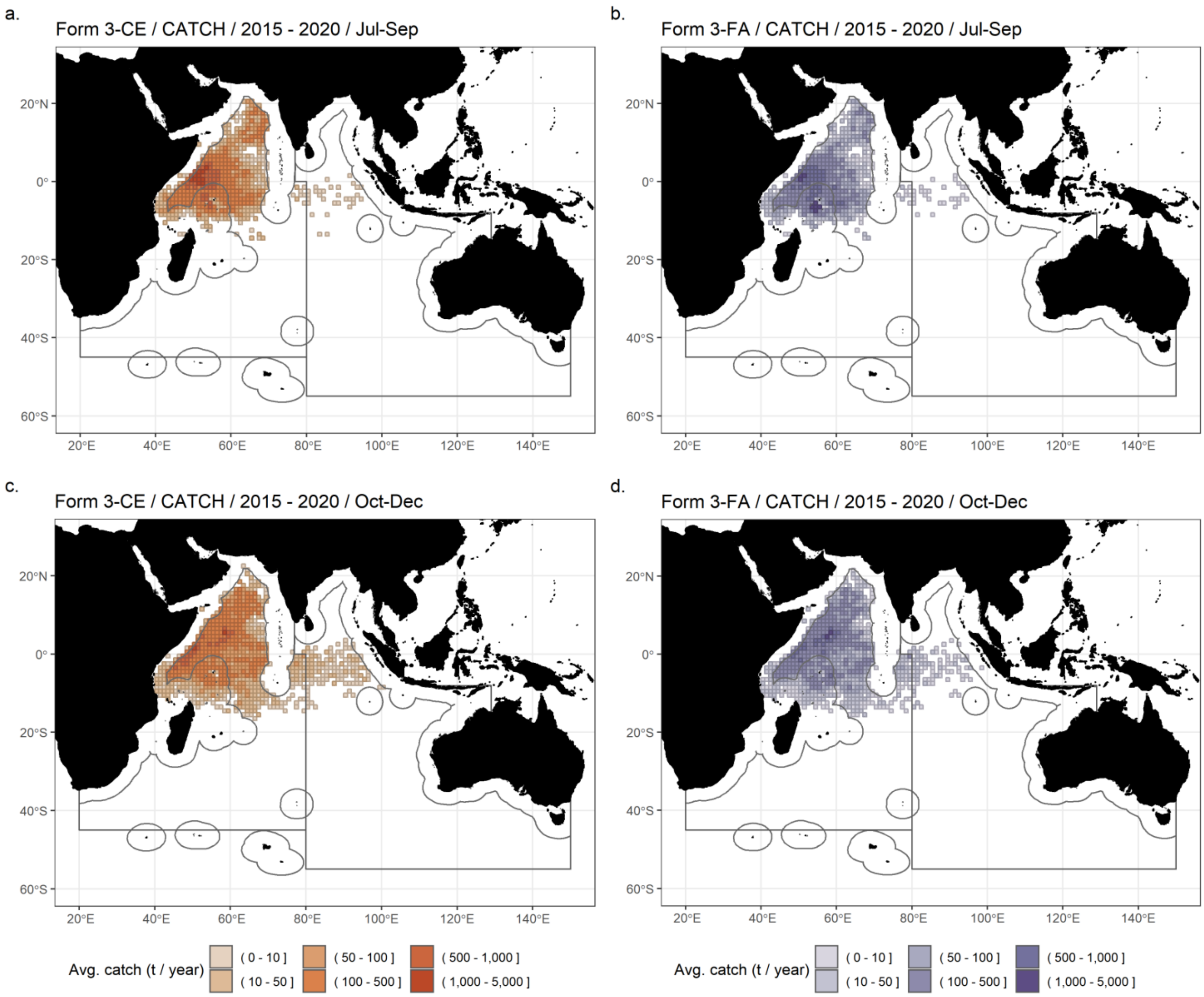

Figure 24: Comparison of average annual catches on FOBs for the 3rd and 4th quarter of the years 2015-2020, as reported through IOTC form 3CE (a, c) and through IOTC form 3FA (b, d). Source: IOTC catch-and-effort data for surface fisheries and IOTC collated FOB activity data

Supply vessels

Table 19 summarizes the information on the effort (number of days at sea) exerted by supply vessels as reported by all concerned CPCs for the years for which data was submitted to the IOTC Secretariat via IOTC form 3SU.

The meaning of each column in the table is as follows:

- **FLAG**: the flag of the fleet that reported the information. *Total* corresponds to the accumulation of data across each flag for a given year;
- ***YEAR***: the statistical year for which information is collated, with the cell content corresponding to the total number of days at sea reported for the supply vessels of each fleet during the year concerned.

Blank cells correspond to strata for which there is no information available.

Summary by fleet

Data on the effort exerted by supply vessels begun to be regularly received by the Secretariat from the statistical year 2017 onward (**Table 19**), even though IOTC Resolution 15/02 called for its provision starting with the statistical year 2015 (data available for 2014 is the result of submission of historical information from the CPCs concerned).

All information on efforts from supply vessels should be cross-verified with the Active Vessels' List of IOTC (AVL), that provides data on the active vessels operating in the Indian Ocean by year, flag and vessel type, to understand whether the complete lack of effort for some strata is a consequence of non-reporting, or rather of the absence of active supply vessels for the flags and years concerned.

Table 19: Summary of total number of days at sea spent by supply vessels flagged by the major fleets with purse seiners operating, as reported through IOTC form 3SU

FLAG	2014	2015	2016	2017	2018	2019	2020
EU,ESP	1,172.05			2,633.00	2,028.53	2,016.00	1,755.00
EU,FRA					383.00	1,328.59	1,247.67
JPN		20.00	19.00	17.00	20.00	27.00	
KOR				304.00	307.00	298.00	294.00
MUS				382.00	397.00	405.00	425.00
SYC			1,099.00		982.00	863.00	2,550.00
Total	1,172.05	20.00	1,118.00	3,336.00	4,117.53	4,937.59	6,271.67

In the case of Japan, for instance, the Active Vessels' List (AVL) of the IOTC indicates no supply vessel from the same fleet as actively operating during 2020, and therefore the lack of effort data for the year is indeed a confirmation of this situation.

For what concerns Mauritius, data in the AVL indicates no Mauritian supply vessel as actively operating in the Indian Ocean since 2014, which is in contradiction with the non-NIL number of days at sea reported by the flag state since 2017. Indeed, information provided by Mauritius through their National Reports indicates the presence of active supply vessels since 2017, although the reported number of days at sea (for each year) is roughly half of what reported through IOTC form 3SU.

A similar situation can be also highlighted in the case of EU,France, with the AVL indicating no active supply vessels for the flag state until 2020 (when 2 of them were then reported as active) although data from IOTC form 3SU shows non negligible activities since 2018; and Seychelles, with the AVL indicating no active supply vessel in 2020 although data from IOTC form 3SU shows a peak in effort reported by the flag state during the year.

Overall, the information collated from the submitted IOTC form 3SU is far from being considered complete or accurate, although it has the merit of providing rough figures on the total yearly effort as well as the fishing grounds where the activity from these vessels appears to be more concentrated.

Future analysis shall be attempted to cross-verify the effort information from IOTC form 3SU with data on activities by supply vessels (mostly deployments of FOBs) as reported through IOTC form 3FA, although with all the caveats required by the inherent inconsistency of the latter.

Geo-referenced annual efforts

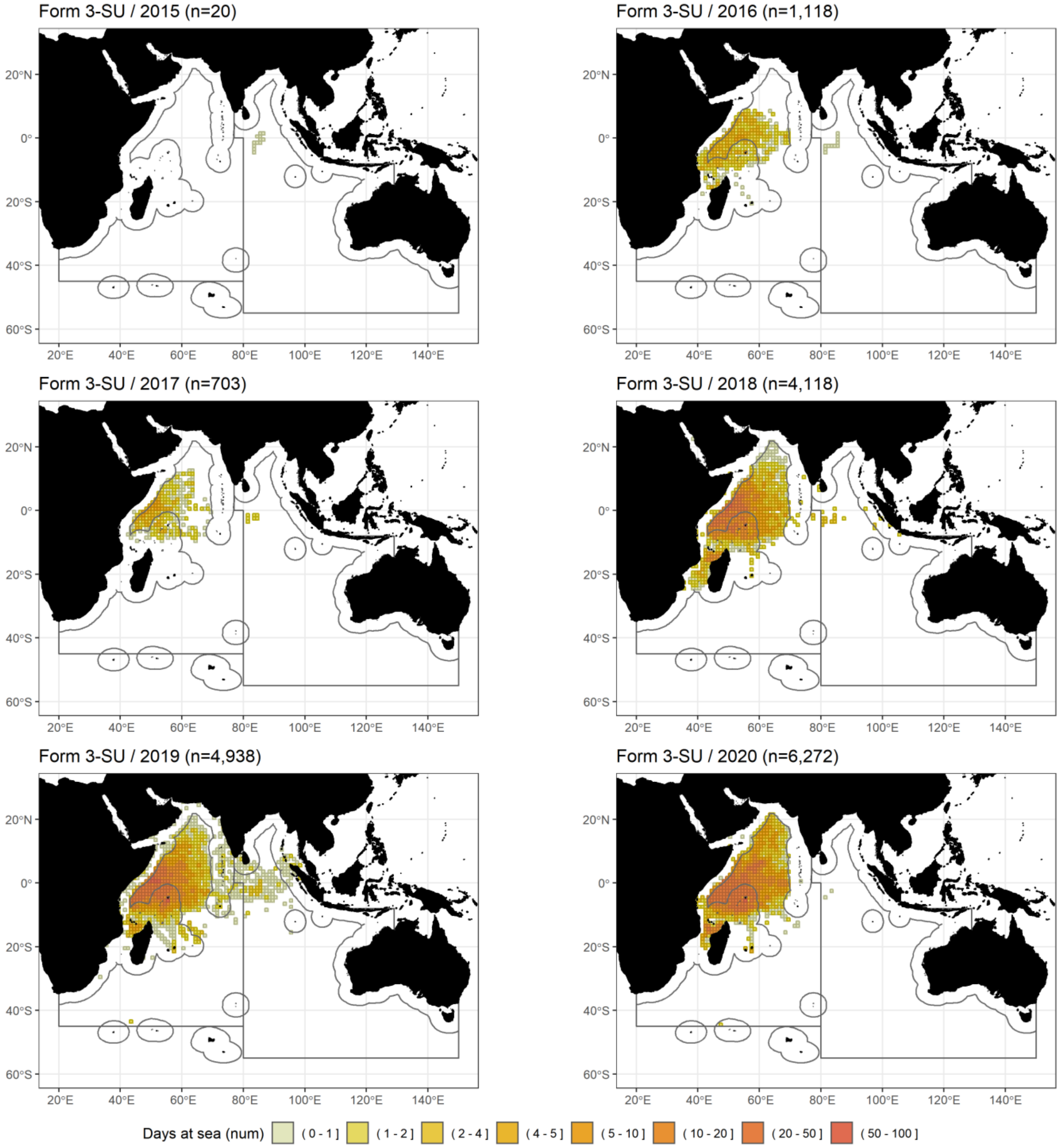

Figure 25: Total annual number of days at sea spent by supply vessels flagged by the major fleets with purse seiners operating in the Indian Ocean, as reported through IOTC form 3SU. Source: Effort data for supply vessels (2014-2020)

Geo-referenced quarterly efforts

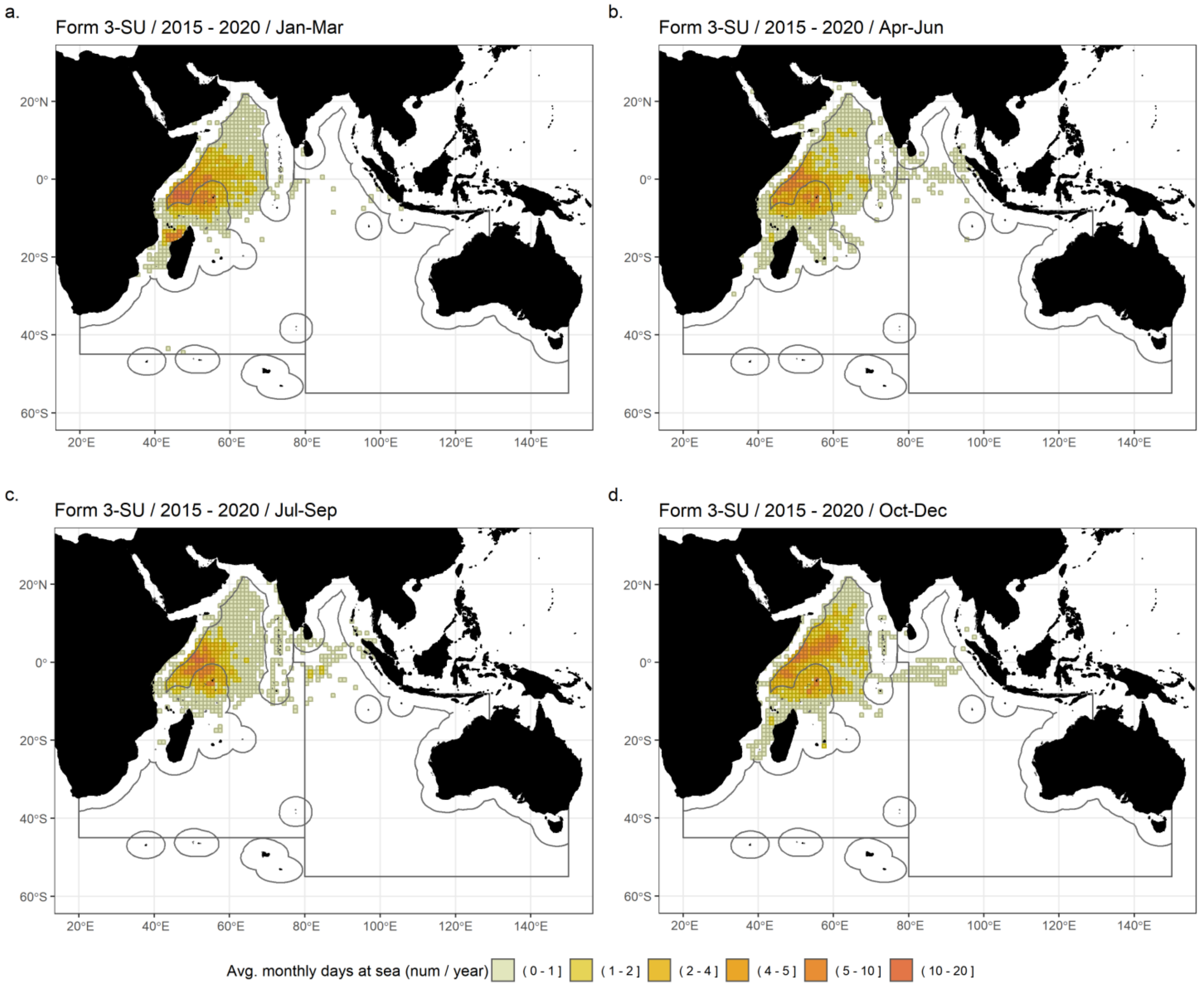

Figure 26: Average annual number of days at sea spent (by quarter) by supply vessels flagged by the major fleets with purse seiners operating in the Indian Ocean. Source: Effort data for supply vessels (2014-2020)

Quarterly effort trends from supply vessels show spatio-temporal patterns similar to those reported through IOTC form 3FA for purse seine vessels (and expressed as number of sets on FOBs), with little to no activity on average in the Southwest Indian Ocean / Mozambique Channel during the 3rd and 4th quarter of each year.

The areas with recorded peaks in total effort from supply vessels are also geographically close to the areas with recorded peaks in total effort from purse seine vessels reported through IOTC form 3FA (see **Fig. 19** and **20**) and this might be a direct consequence of the way in which purse seine and supply vessels operate.

FOB-tracking data

The current FOB-tracking database of the IOTC Secretariat hosts a total of distinct 9,789,402 daily positions transmitted through satellite communication from 48,185 buoys that were monitored at sea by 45 purse seiners between January 2020 and May 2021. The position data are of highly dynamic nature due to the high turn-over of the buoys at sea where deployments of new FADs and transfers of buoys on FOBs encountered at sea constantly compensate for the buoys stopping transmission (see Section At-sea deployments). **Table 20** provides a summary of the buoys' positions data set available for the period covering January 2020 to May 2021.

Table 20: Summary table of the IOTC daily position dataset of instrumented buoys equipping floating objects drifting at sea between January 2020 and May 2021. Buoys may be duplicated between national purse seine fisheries when information on buoys is shared among fleets and reported to the Secretariat

YEAR	CPC	FLAG	PS	DAYS	POSITIONS	BUOYS
2020	EU	EU,ESP	15	366	1,459,581	14,242
2020	EU	EU,FRA	11	366	3,086,904	8,546
2020	EU	EU,ITA	1	366	226,579	2,504
2020	JPN	JPN	2	88	4,353	109
2020	MUS	MUS	3	366	515,353	2,788
2020	SYC	SYC	13	366	1,406,849	13,394
2021	EU	EU,ESP	15	151	576,103	9,328
2021	EU	EU,FRA	10	151	1,298,863	5,855
2021	EU	EU,ITA	1	151	120,665	1,967
2021	MUS	MUS	3	151	413,197	2,301
2021	SYC	SYC	13	151	680,955	9,134

The daiy number of buoys transmitting the position of FOBs drifting at sea in the Indian Ocean varies between CPCs and between the purse seiners of a same CPC (**Fig. 27**). The variability is particularly marked for the EU for which some purse seiners permanently monitor a number of buoys close to the limit of 300 when others monitor less than 200 buoys at sea in some time periods. The daily number of buoys followed by the EU-flagged purse seiners show an overall declining trend between January 2020 and December 2020 followed by an increasing trend since then. Purse seiners from Mauritius show a median range of monitored buoys from less than 200 in November 2020 to around 280 in May 2021. Seychelles purse seiners monitor more buoys at sea than Mauritius-flagged purse seiners and show a certain homogeneity between vessels, as well as a relative stability in the numbers of buoys providing FOB locations over the year (**Fig. 27**).

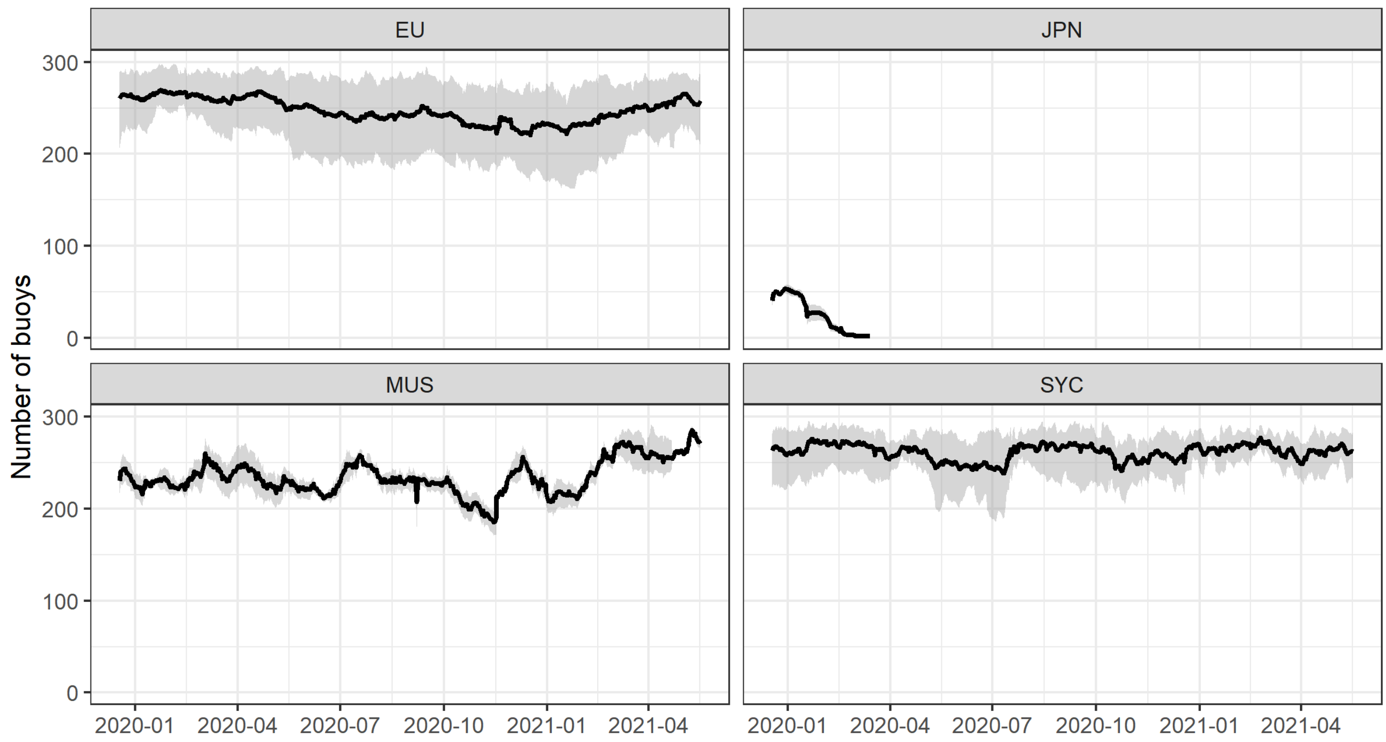

Figure 27: Mean daily number (solid black line) of operational buoys in the Indian Ocean monitored by each purse seiner between January 2020 and May 2021 for the CPCs having reported data to the Secretariat. The grey area indicates the 80% confidence interval computed from the purse seiners of each CPC

The spatial extent of the distribution of satellite-tracked buoys shows that the FADs used in the purse seine fishery occur across a large part of the Indian Ocean (**Fig. 28**). While buoys are to be found in higher densities within the fishing grounds of the western Indian Ocean, surface currents carry them towards the north where they cover the whole Arabian Sea, towards the east until the northern coasts of Indonesia, and towards the south and east of Madagascar. The distributions of the buoys appear overall very similar between quarters although the seasonal variability in ocean circulation may modify the FOBs spatial patterns as shown for instance by the west-east flow along the equator (from Mozambique to Indonesia) observed in the first quarter of 2021 (**Fig. 28**). Also, the seasonality in the purse seine fishing grounds may explain some spatial features such as the higher density of monitored FOBs in the Mozambique Channel in April-June 2020 (**Fig. 28**).

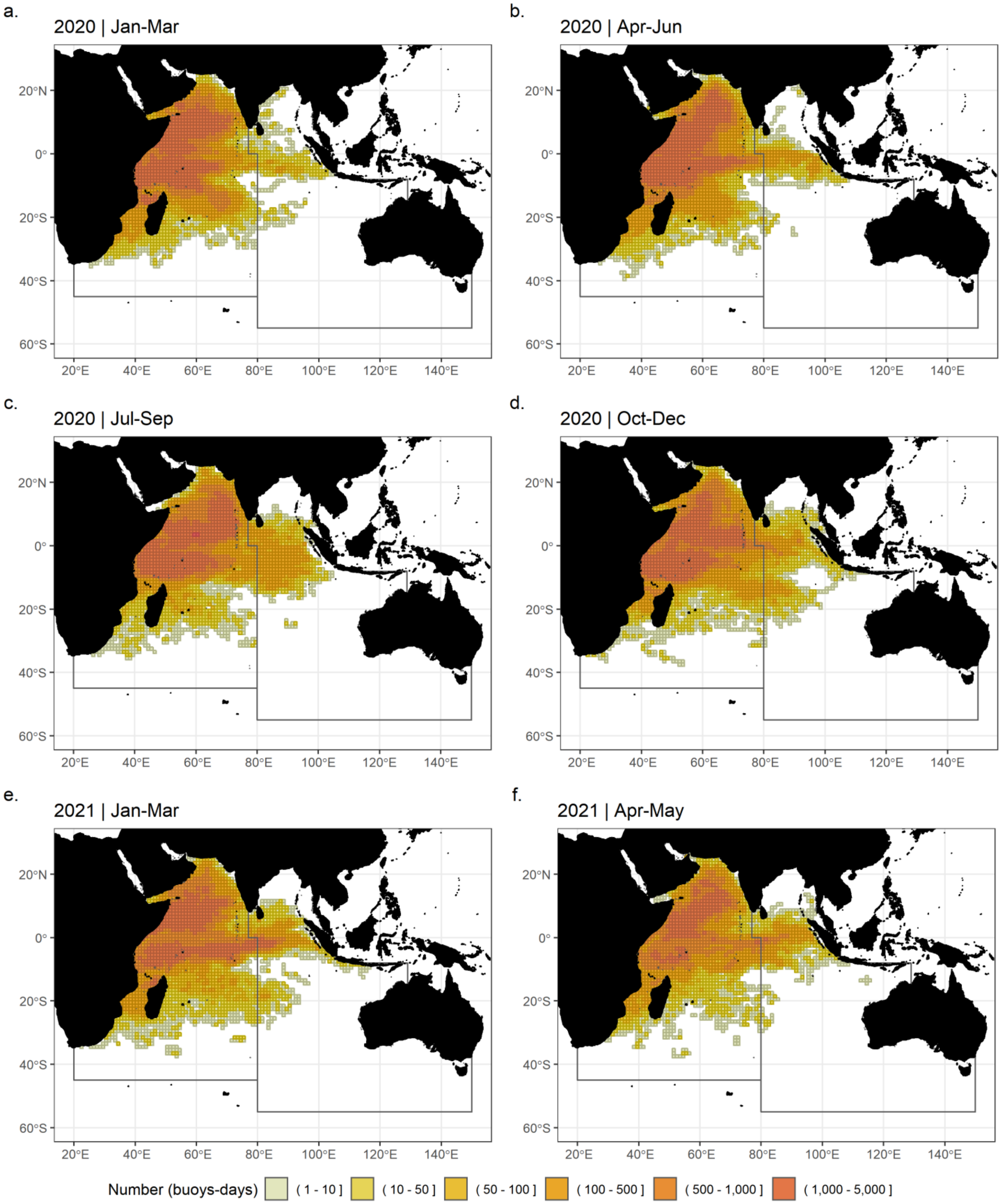

Figure 28: Quarterly density of operational buoys (buoys-days) in the Indian Ocean monitored by the Indian Ocean purse seine fishery between January 2020 and May 2021 for the CPCs having reported data to the Secretariat

Appendix I: Code lists in IOTC databases for FOB-related activities

Table 21: Classification of types of drifting floating objects in use at the IOTC Secretariat

Code	Description
DFR	Other drifting objects NOT located using a tracking system (radio or satellite transmission) (e.g. dead animal, etc.)
DRT	Other drifting objects located using a tracking system (radio or satellite transmission) (e.g. dead animal, etc)
FAD	Drifting raft or FAD without a net NOT located using a tracking system (radio or satellite transmission)
FDT	Drifting raft or FAD without a net located using a tracking system (radio or satellite transmission)
LGT	Drifting log or debris located using a tracking system (radio or satellite transmission)
LOG	Drifting log or debris NOT located using a tracking system (radio or satellite transmission)
NFD	Drifting raft or FAD with a net NOT located using a tracking system (radio or satellite transmission)
NFT	Drifting raft or FAD with a net located using a tracking system (radio or satellite transmission)

Appendix II: Classification of FOB-related activities in use at the IOTC

Table 22: Classification of activities related to drifting floating objects in use at the IOTC Secretariat

Code	Description
DD	Deployment of drifting FAD
DH	Retrieval/encounter and hauling of drifting FAD
DI	Retrieval/encounter, hauling, and intervention on electronic equipment of drifting FAD
DL	Loss of drifting FAD (tracking signal lost)
DR	Retrieval of drifting FAD

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