Lessons learned from the monitoring of FOB and buoy use by French and associated purse seiners in the Indian Ocean : How to avoid data gaps ? Do we need a FAD register ?

Alexandra Maufroy A.[1], Florence Jehenne[2], Sarah Le Couls[3] and Michel Goujon[1]

Abstract

In recent years, conflicting points of views have regularly been expressed in IOTC regarding the appropriate management of Floating OBject (FOB) fisheries. Solving this issue requires high quality data on FOB fisheries, that would allow monitoring the impacts of using dFADs in purse seine (PS) and other tropical tuna fisheries, and providing appropriate scientific management recommendations. Though important efforts have been made to improve data collection and reporting, concerns about the lack of information on FOB fisheries are still regularly expressed by many stakeholders and the quality of information reported to IOTC Secretariat on FOBs and buoys is not always sufficient for scientific purposes. Therefore, alternative options such as the implementation of a FAD register has recently been proposed to improve monitoring and reporting procedures. Nevertheless, a prior assessment of data currently available for science and management is needed to evaluate if and how a FAD register could solve issues of information on FOB and buoy use in IOTC.

Here, using the data collected in the fishing/FOB logbooks and reported in IOTC 3BU form for French, Italian and Mauritian purse seiners and support vessels from January 2021 to June 2022, we examine available information on FOB and buoy use, identify potential solutions to avoid data gaps and discuss the proposed implementation of a FAD register. The results we obtain demonstrate that a large amount of information is available in fishing/FOB logbooks and 3BU forms. They also indicate that prior to introducing any additional reporting tool such as a FAD register, priority should be given to (i) the adoption of an appropriate terminology in IOTC and (ii) the improvement of existing tools for reporting on the use of FOBs and buoys to IOTC Secretariat.

[1] ORTHONGEL, 5 rue des sardiniers, 29 900 Concarneau, France. amaufroy@orthongel.fr
[2] SAPMER, 9 rue du Professeur Legendre, 29 900 Concarneau, France.
[3] CFTO, 11bis rue des sardiniers, 29 900 Concarneau, France.

Introduction

Though the use of drifting Fish Aggregating Devices (dFADs) has been limited for eight years in the IOTC area of competence and various other dFAD management options have been implemented since 2013 (IOTC, 2013, 2015), the appropriate management and monitoring of Floating OBject (FOB) fisheries remains a central issue. In recent years, conflicting points of views have regularly been expressed at the Commission level, preventing the revision of IOTC Resolution 19/02 in 2021 and 2022 (European Union, 2022; Kenya, 2022). Solving this issue requires high quality data on FOB fisheries, that would allow monitoring the impacts of using dFADs in purse seine (PS) and other tropical tuna fisheries, and providing appropriate scientific management recommendations. It also requires adopting an adapted terminology to describe FOB fisheries, preferably harmonized across RFMOs (Joint Tuna RFMO FAD Working Group, 2017), as well as developing appropriate reporting formats to IOTC Secretariat (Maufroy and Goujon, 2021).

During the last decade, important efforts have collectively been made by CPC scientists in charge of monitoring PS FOB fisheries and by PS fleets to propose an adapted terminology to monitor FOB fisheries (Gaertner *et al.*, 2016; Grande *et al.*, 2019), incorporate the recommended terminology in reporting systems such as fishing/FOB logbooks (Maufroy and Goujon, 2019a), facilitate the understanding of FOB PS fisheries by all stakeholders (ORTHONGEL, 2021) or provide scientific advice on the management of FOB fisheries through data made available to national scientists by PS fleets (e.g. Baidai *et al.*, 2021; Dupaix *et al.*, 2021; Imzilen *et al.*, 2021). Despite these efforts, concerns about the lack of information on FOB fisheries are still regularly expressed by many stakeholders (e.g. IPNLF, 2021). Yet, large datasets are available to national scientists and through reporting in various data forms to IOTC Secretariat (IOTC Secretariat, 2021) and part of this perception may be explained by the lack of adoption of the recommended scientific terminology in IOTC (Maufroy and Goujon, 2021).

Implementing a FAD register and a FAD Monitoring System (FAD-MS) has recently been proposed to improve monitoring and reporting procedures, grant data availability for research purposes and reduce dFAD contribution to marine litter, degradation of coastal habitats through stranding and mortality of sensitive species (Kenya, 2022). Since the development of such tools may be redundant with existing reporting tools (e.g. fishing / FOB logbooks, IOTC 3BU data form on operational buoys) and will require important efforts, assessing first if and how the FAD register and the FAD-MS could improve monitoring and reporting procedures is necessary. In particular, a prior assessment of data currently available for science and management is needed, to identify potential data gaps and necessary improvements to reporting procedures.

Here, using the example of the French, Italian and Mauritian purse seiners and supports vessels over January 2021 – 2022, we (i) describe the methodology used to monitor and report FOB and buoy activities in fishers logbooks, (ii) describe the methodology used to monitor and report on operational buoys in IOTC 3BU form (iii) examinate how these data could be used to improve the monitoring of the impacts of FOB fisheries, (iv) identify potential data gaps and sources of differences between available sources on information of FOBs and buoys and (v) discuss the implementation of a FAD register in IOTC.

1. What kind of information do we need on FOBs and buoys ?
2.1 Indicators for a science-based management of FOB fisheries

Relying too heavily on dFADs may impact target tropical tunas through alteration of their natural behaviour (Hallier and Gaertner, 2008; Sempo *et al.*, 2013), contribute to growth overfishing through excess fishing mortality of yellowfin and bigeye tunas (Dagorn *et al.*, 2013), increase levels of non-target catch (Amandè *et al.*, 2008, 2010; Hall and Román, 2013), contributed to ghost fishing of sharks and sea turtles when meshing elements were still in use for the construction of dFADs (Franco *et al.*, 2012; Filmalter *et al.*, 2013) and contribute to marine litter and deterioration of fragile habitats when dFADs are lost outside fishing grounds (Balderson and Martin, 2015; Maufroy *et al.*, 2015; Escalle *et al.*, 2021; Imzilen *et al.*, 2021).

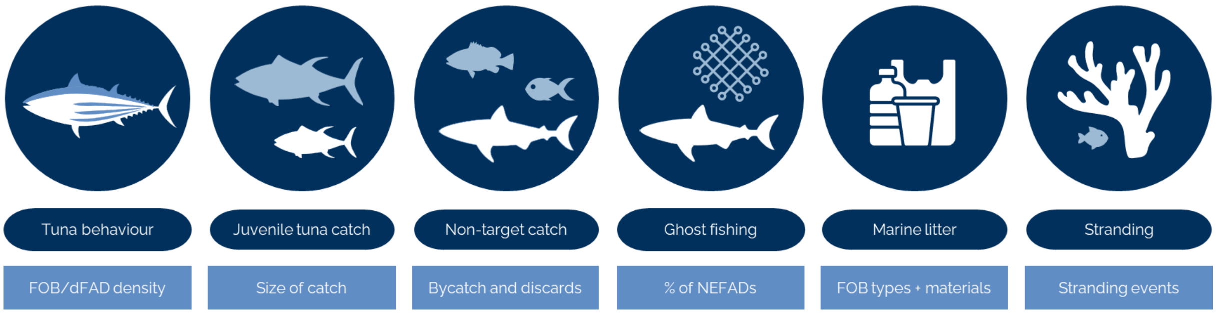

Figure 1 : main consequences (in dark blue, adapted from ORTHONGEL, 2021) and indicators to monitor the effects of dFAD use / FOB fishing (in medium blue, adapted from Capello, 2021)

The proper mitigation of dFAD impacts requires a first phase of assessment of such impacts, with appropriate science-based indicators (Capello, 2021, Figure 1), derived from robust data available to CPC scientists and reported to IOTC Secretariat. With these objectives in mind, experts of purse seine (PS) FOB fisheries (scientists, fishers and managers) have worked conjointly on appropriate definitions in the frame of various projects and collaborations (Gaertner *et al.*, 2016; Grande *et al.*, 2019; ISSF, 2019).

2.2 Glossary for a science-based management of FOB fisheries
2.2.1 Types of FOBs

At the start of PS fisheries on FOBs, scientific literature explicitly made the difference between the objects randomly found at sea (logs) and those intentionally deployed by fishers to attract tropical tunas (drifting Fish Aggregating Devices, Ariz *et al.*, 1999). For the sake of simplification, the term dFAD was progressively used to designate any type of object floating at sea.

Though this may seem like a minor issue, this actually prevents scientists from assessing the effects of adding dFADs to objects that are present at sea without the contribution of PS fleets (natural objects and debris of anthropic activities, including other fisheries than PS). This prevents, among others, assessing to what extent dFADs could act as ecological traps (Marsac *et al.*, 2000; Hallier and Gaertner, 2008) or increase plastic pollution at sea.

Acknowledging this issue, EU scientists and PS fleets proposed a set a refined definitions for the different types of objects floating at sea in the frame of the EU CECOFAD project (Gaertner *et al.*, 2016). This classification explicitly separate the Floating OBjects (FOBs) considering their origin (natural or anthropic sources) and their intentional deployment at sea to aggregate tropical tunas (dFADs vs logs, Figure 2).

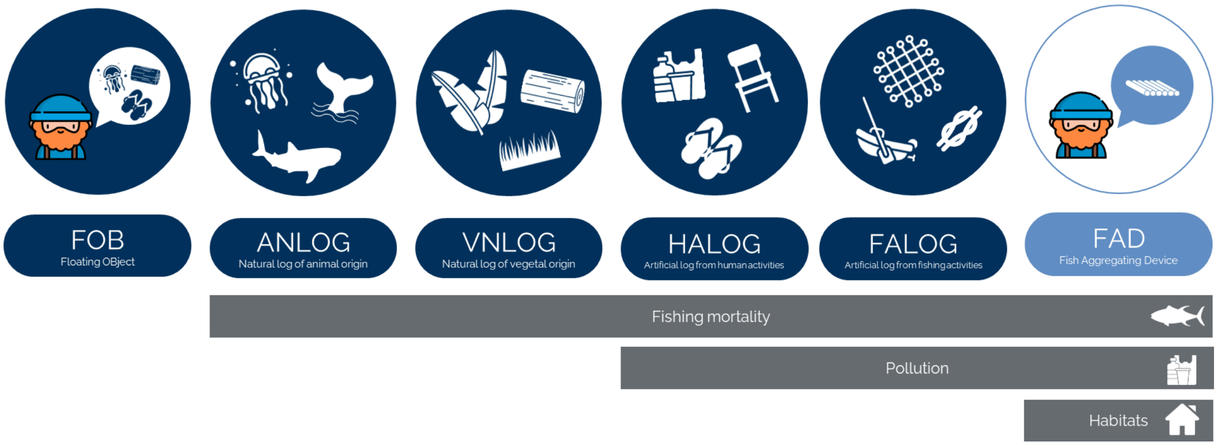

Figure 2 : **types of Floating OBjects (FOBs), adapted from Gaertner *et al.* (2016)**

These definitions are currently used to monitor EU (France, Italy, Spain), Mauritius and Seychelles flagged vessels by national scientists who can in turn build robust indicators on how dFADs modify the natural habitat of species aggregating with FOBs (Dupaix *et al.*, 2021). In 2022, some CPCs and NGOs are unfortunately still expressing their reluctancy to adopt these definitions in IOTC.

2.2.2 Non-entangling dFADs

Until the 2010s, dFADs were made of bamboo rafts covered in old pieces of purse seine netting (used to render dFADs undetectable by other vessels) and a tail made of PS net panels (used to anchor the dFAD in currents and attract fish, Dagorn *et al.*, 2013). During the early 2010s however, ghost fishing of sensitive species, through entanglements of sea turtles at the surface of dFADs (Anderson *et al.*, 2009) and of silky sharks in their tail (Filmalter *et al.*, 2013) were detected.

At the beginning of the 2010s, PS fleets started developing new designs of dFADs to reduce the risk of entanglement of sea turtles and sharks, with smaller mesh netting and designs without open curtains of nets (LER FADs, Figure 3). These designs became mandatory for the French and associated fleet in the Indian Ocean in 2012 (ORTHONGEL, 2011). In 2020, in compliance with IOTC 19/02, such LER FADs were replaced with dFADs without meshing elements (NEFADs, Figure 3).

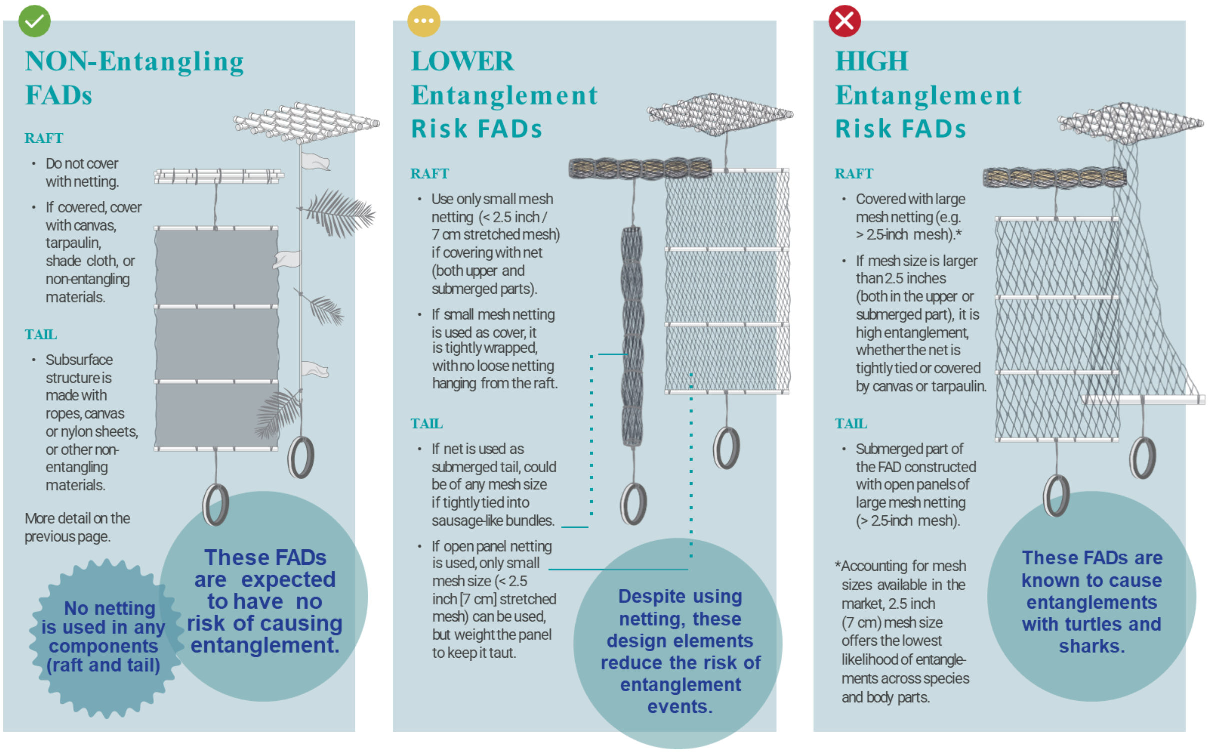

Figure 3 : **categories of dFADs per entanglement risk (ISSF, 2019)**

2.2.3 dFAD designs and materials

Though the design of dFADs may evolve rapidly, they generally consist of a surface/subsurface structure used to attract fish and a submerged structure used to anchor the dFAD in currents, and ensure the FAD drifts with the currents and not with the winds (Figure 4).

In the case of the French and associated fleet, 3 main designs are currently allowed by national FAD management plans :

(i) the *surface raft* with a raft that can be made of bamboo, metal or a mix of bamboo and metal and a tail made of a synthetic or cotton rope

(ii) the *subsurface raft*, with a raft only made of metal

(iii) the *cube dFAD*, with a cubic design that serves both as the main structure and the anchor in currents

Since other PS fleets may use slightly different designs and materials (e.g. plastic rafts) and tests of biodegradable *jelly-FADs* (Moreno *et al.*, 2021) are ongoing, Figure 4 proposed a generic classification of dFAD categories that covers most dFAD designs currently in use at sea.

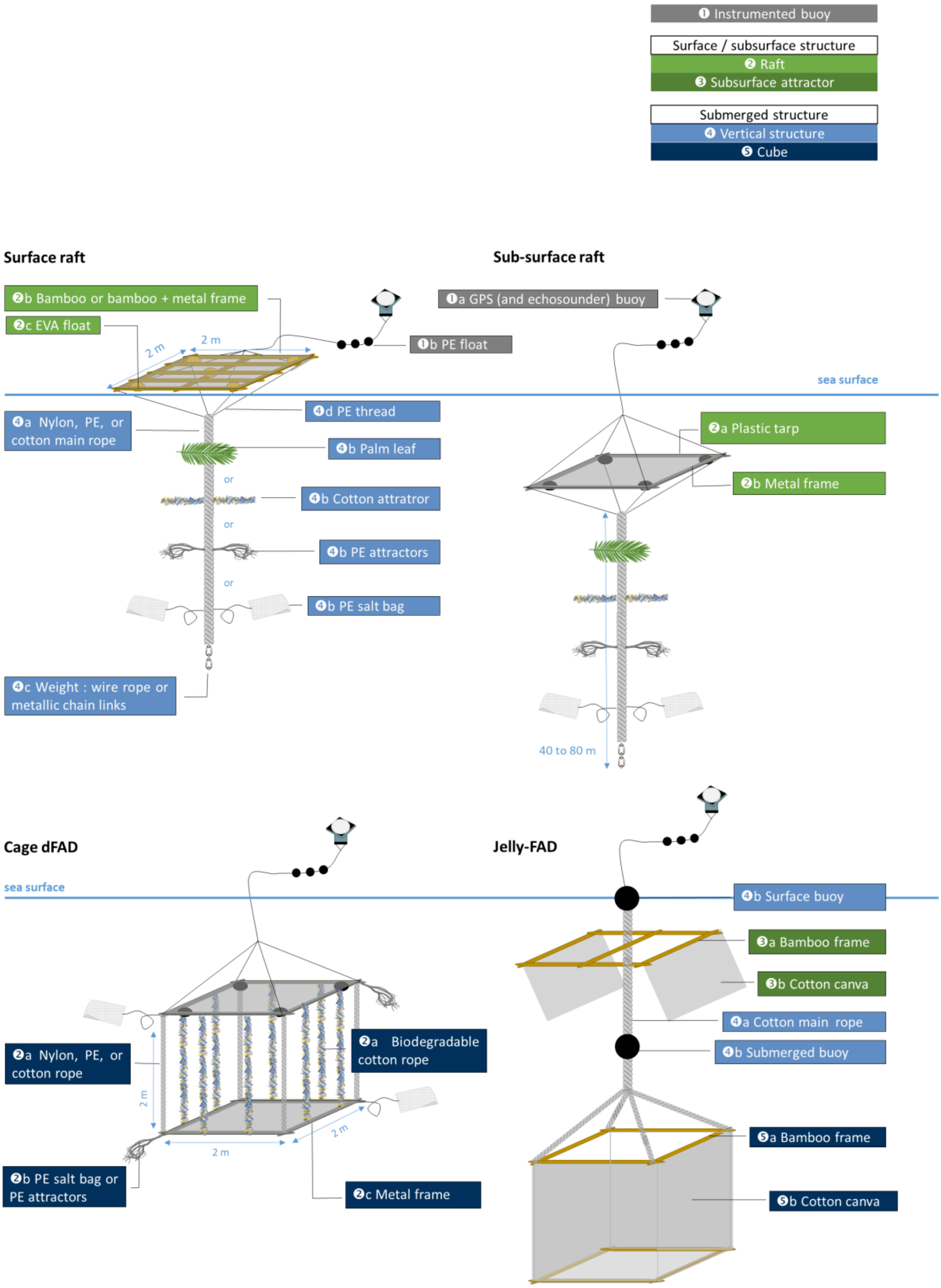

Figure 4 : **categories of dFADs per type of designs (adapted from the French FAD management plan and Moreno *et al.*, 2021).** Note that such designs should be adapted for a transition to biodegradable FADs (BIOFADs). A proposed classification of the biodegradability of dFADs can be found in (European Union, 2022)

2.2.4 Activities on FOBs and buoys

Monitoring the impacts of FOB fisheries requires monitoring separately the activities on FOBs and the activities on their tracking buoys. A classification of such operations was proposed in the frame of the EU CECOFAD project (Gaertner *et al.*, 2016) and the classification of activities with buoys was further refined in the frame of the EU RECOLAPE project (Ruiz *et al.*, 2019).

Table 1 presents an updated version the terminology recommended by scientists in the frame of the two projects, with operations from the deployment to the end of use of FOBs and buoys. In particular, the activity "loss" is better detailed, to take into account all potential reasons for the end of use of a given FOB or a given buoy, including the appropriation by another vessel (loss), the remote deactivation of a buoy of FOB drifting too far from fishing grounds to be recovered (end of use) and the stranding of the FOB/buoy.

The operation "visit" is also improved to avoid mixing information on the type of interaction with the FOB and the ownership of the FOB that can be deduced from activities on the buoy (e.g. if no buoy was present on the FOB at the time of arrival or if there is a buoy transfer, the visit was a random encounter).

Table 1: Types of activities with FOBs and buoys, adapted from Gaertner et al. 2016. Categories in italic are proposed as an addition to the so-called CECOFAD classification, to improve the monitoring of dFADs at the end of their tracking by purse seiners.

	Type of interaction	Description
FOB	Deployment	Deployment of a dFAD at sea
	Consolidation	Deployment of a FAD on a FOB (e.g. to enhance floatability)
	Visit without fishing	Visit of FOB, not followed by a fishing set
	Visit with fishing	Fishing set on the FOB
	Retrieval	Retrieval of the FOB
	End of use	*Voluntary end of use of the FOB, through remote deactivation of the buoy or by abandoning the FOB at sea without a buoy*
	Loss	*Unvoluntary end of use of the FOB, through appropriation by another vessel, sinking of the FOB or failure of the GPS signal of the buoy*
	Stranding	*Unvoluntary end of use of the FOB, due to stranding*
BUOY	Deployment	Deployment (tagging) of a buoy on a FOB already drifting at sea without buoy or deployment of a FAD equipped with a buoy
	Transfer	Replacement of the buoy owned by another vessel by a buoy of the vessel
	Retrieval	Retrieval of the buoy on a FOB drifting at sea
	End of use	*Voluntary end of use of the buoy, through remote deactivation of the buoy*
	Loss	*Unvoluntary end of use of the buoy, through appropriation by another vessel, sinking of the FOB or failure of the GPS signal of the buoy*
	Stranding	*Unvoluntary end of use of the buoy, due to stranding*

2. Where can we find the information we need for a scientific management of FOBs and buoys ?
3.1 Fishing/FOB logbook of French and associated purse seiners

Improved data collection for French and associated purse seiners of the Indian Ocean (Italy, Mauritius, Seychelles) started in 2013 with a first revision of the Excel logbook. Dedicated data fields were added to the fishing logbook to monitor the activities on FOBs and buoys and link this information with the serial number of buoys equipping FOBs (Annex 1).

At this stage, the use of an Excel format was supposed to be a temporary solution, until a fully operational *FOB module* was developed in the EU Electronic Reporting System (ERS or electronic logbook). This temporary solution was therefore not yet fully optimized for data storage, reporting and analysis purposes. For instance, the Excel format comprised various merged cells that did not allow preparing the data with an automatized tool. Though the data were reported in an electronic format in an Excel file, a long and costly manual data entry was therefore still required before storage in the dedicated database used by scientists of the French National Research Institute for Sustainable Development (IRD).

In 2019, not much progress had been made on the French version of the ERS. A *FOB module* had been added but this module was not using the recommended scientific terminology of FOB types and FOB and buoys activities. An attempt had also been made to develop a dedicated software to report on FOB and buoy use in the frame of the EU RECOLAPE project (Ruiz *et al.*, 2019) but not agreement had been found on the structure of the software. To avoid further delaying the collection of good quality data on FOBs and buoys, the French Producer Organization ORTHONGEL decided to revise the structure of the fishing/FOB logbook with three main objectives (Maufroy and Goujon, 2019a) :

(i) use the recommended scientific terminology from the EU CECOFAD project
(ii) allow an automatized preparation of the data for scientific and monitoring purposes
(iii) ensure consistency with data collected in the frame of scientific observer programs

The structure of the FOB component of the fishing/FOB logbook was therefore fully revised to improve the reporting of FOB types, activities with FOBs, risk of entanglement of FADs, identifiers of buoys and activities with buoys (Annex 1).

The proposed revised fishing/FOB logbook was presented to the IOTC WPTT and ICCAT SC-STATS to receive feedback from scientists, and make the necessary improvements, if needed (Maufroy and Goujon, 2019a, 2019b). The revised fishing FOB/logbook was then implemented at the end of 2019 both in the Atlantic and Indian Oceans, starting with fishing trips overlapping 2019 and 2020.

The implementation of the revised fishing/FOB logbook allowed collecting more detailed information on the use of FOBs and buoys by French and associated purse seiners since 2020. Of course, as with any major modification of a reporting system, fishers needed to adjust to the new format of the FOB component of the Excel logbook. To account for these necessary adjustments, the data presented in this section will only cover 2021 and the first semester of 2022.

3. What do logbook and 3BU data tell us on FOBs and buoys ?
4.1 Preparation of logbook data

The implementation of the revised fishing/FOB logbook allowed collecting more detailed information on the use of FOBs and buoys by French and associated purse seiners since 2020. Of course, as with any major modification of a reporting system, fishers needed to adjust to the new format of the FOB component of the Excel logbook. To account for these necessary adjustments, the data used in this section will only cover 2021 and the first semester of 2022.

For this period, a total of 327 Excel logbooks from 14 French, Italian and Mauritian flagged purse seiners and 3 French and Mauritian support vessels are available, representing a total of 22 467 interactions with FOBs and 24 048 interactions with tracking buoys. Information available from Seychelles-flagged purse seiners was not used in the present study, since the format of the logbook is different from other French and associated vessels. Data were corrected by fishing companies and ORTHONGEL (incorrect use of the categories of FOBs, confusions between activities on FOBs and activities with buoys, etc). The data were then used to build simple indicators that could serve a basis to manage FOB fisheries on a scientific basis (Table 2).

Table 2 : indicators for a scientific management of FOB fisheries, derived from logbook data

Type of FOB impact	Indicator
Alteration of tuna behaviour	% of random encounters with FADs vs logs Number of new dFAD deployments and location
Tuna stock status	Number and location of buoy deployments Location of fishing sets and amount of catch Size of tuna catches
Ghost fishing	Presence of meshing elements on deployed dFADs Presence of meshing elements on encountered FOBs
Marine Litter	Types of deployed dFADs Types of encountered FOBs
Stranding	Number and location of dFAD stranding events

4.2 Preparation of 3BU data

3BU data were used over the period January 2021 to May 2022 for all French, Italian and Mauritian to complement the indicators built with logbooks data (Table 3). The end of trajectories were detected as the last position available for a given buoy (last positions for the date ‘2022-05-31’ excluded as this was the last day available in 3BU data forms and not necessary the end of use of a given buoy).

Table 3 : indicators for a scientific management of FOB fisheries, derived from 3BU data

Type of FOB impact	Indicator
Tuna behaviour and stock status	Number and location of operational buoys
Marine litter and stranding	Number and location of end of transmission of buoys

4.3 Indicators of the impacts of dFADs on tuna behaviour

4.3.1 Interactions with dFADs and logs

From January 2021 to June 2022, a total of 21 131 activities with FOBs were reported by French, Italian and Mauritian purse seiners in their fishing / FOB logbook. 10 800 corresponded to random encounters of FOBs (unknown position, no buoy reported at the time of arrival of the vessel). The large majority of these random encounters of FOBs were with dFADs (86.6 %, Figure 5) with a minority of interactions with various types of logs (13.4%). Spatially, more interactions with FOBs were found in the equatorial area between 50°W and 60°W, with a slightly higher proportion of logs around 10°S – 60°W.

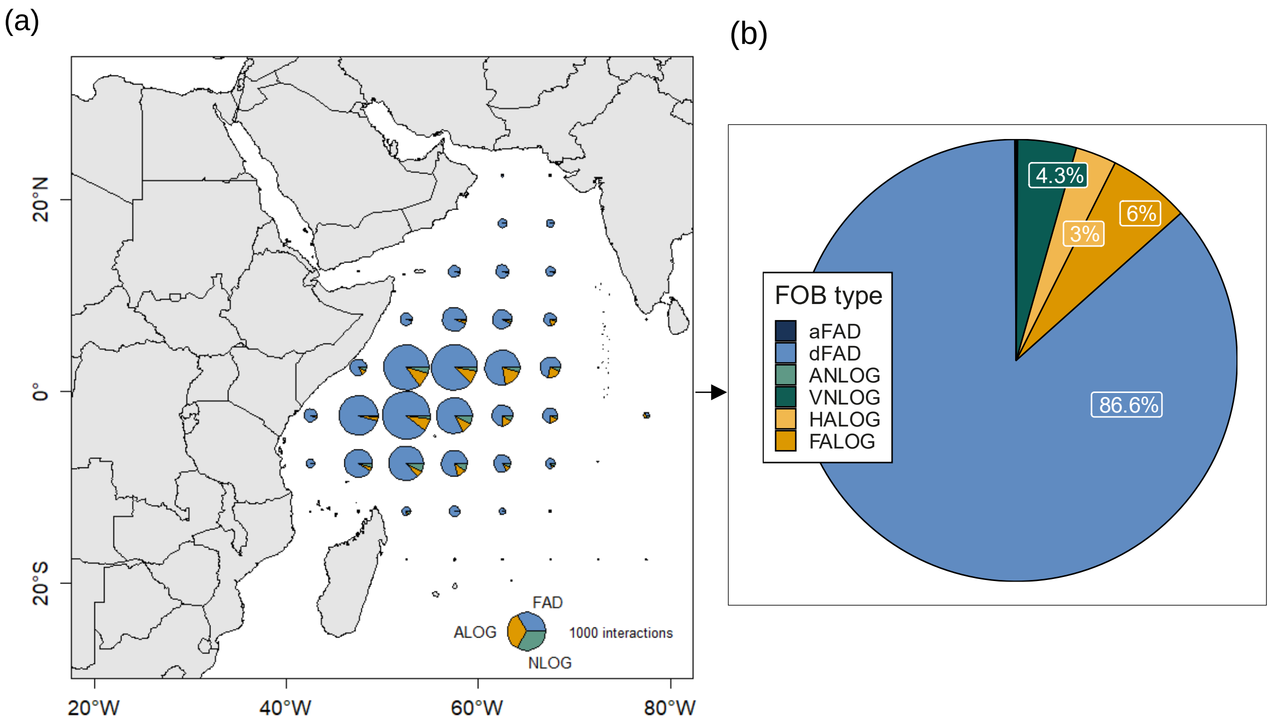

Figure 5: **Proportion of FADs (in blue) and logs of natural origin (in green) and logs of anthropic origin (in yellow) for visits to FOBs of unknown position (random encounters) by French and associated purse seiners and support vessels over January 2021 – June 2022**.

4.3.2 Deployments of new dFADs

From January 2021 to June 2022, a total of 8791 dFADs were deployed by French, Italian and Mauritian purse seiners and support vessels, representing on average 418.6 deployments of dFADs per year and per purse seiner. Purse seiners and support vessels deployed respectively 64.7 % and 35.3% of these dFADs. Among these deployments, 6.7 % corresponded to reinforcements of FOBs already floating at sea (to enhance the floatability) and 93.3% to deployments of new dFADs (Figure 6).

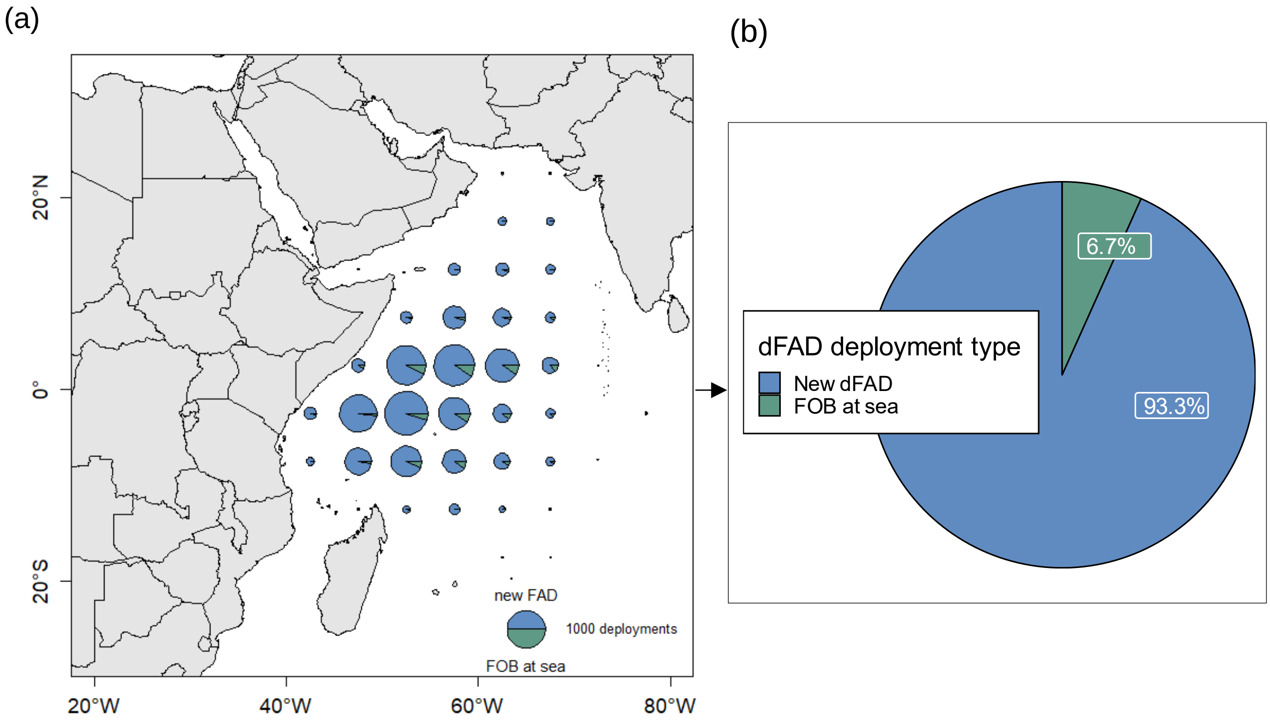

Figure 6 : **Proportion of new dFADs (in blue) and deployments of dFADs on FOBs already drifting at sea (in green) for activities reported on FOBs by French and associated purse seiners and support vessels over January 2021 – June 2022**.

4.4 Indicators of the impacts of dFADs on tuna stocks

4.4.1 Deployments of tracking buoys

From January 2021 to June 2022, a total of 24 048 activities with tracking buoys were reported by French, Italian and Mauritian purse seiners in their fishing / FOB logbook. 67.4% of these interactions corresponded to the deployment of a tracking buoy, representing on average 772.1 deployments of buoys per purse seiner and per year during this period.

Tracking buoys were deployed either on a new dFAD (49.6% of deployments, Figure 7), during the transfer of a tracking buoy already present on the FOB (42.2% of deployments) or on a FOB drifting at sea without a tracking buoy (8.2 % of deployments). Such buoy deployments occurred in similar areas as the areas of dFAD deployments (Figures 5 and 6), with a higher proportion of new dFAD deployments at the edge of FOB activity areas and a higher proportion of buoy transfers in the core of FOB activity areas.

These results indicate a relatively high rate of change of ownership of FOBs, with frequent changes of the owner of buoys tracking FOBs drifting at sea, especially at the core of purse seine fishing grounds.

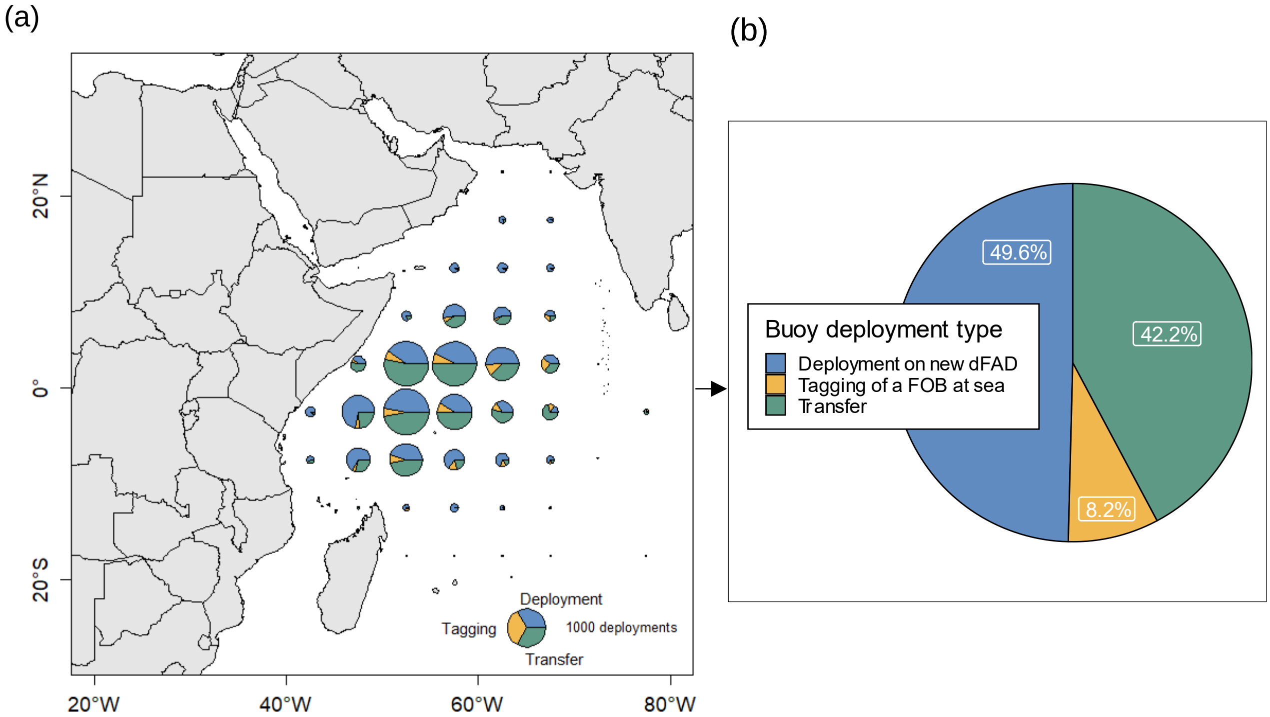

Figure 7 : **Proportion of tracking buoys deployed on new dFADs (in blue), FOBs drifting at sea without a tracking buoy (in yellow) and transfers of buoys on FOBs already equipped with a buoy (in green) reported by French and associated purse seiners and support vessels over January 2021 – June 2022**.

4.4.2 Location and number of operational buoys

A total of 14 017 different buoys were reported by French, Italian and Mauritian in 3BU forms from January 2021 to May 2022. Three main areas of higher densities were detected in the data (Figure 8): along the equator around 50°W – 60°W, around 5°S – 60°W and along the equator east of the 80°W.

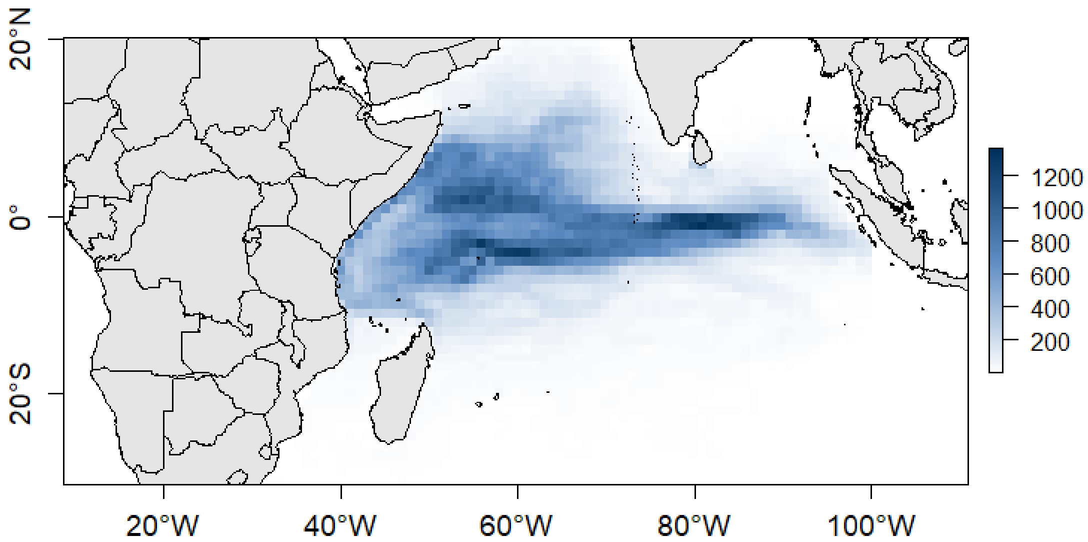

Figure 8 : **Number of operational buoys that have transited through 1° x 1° grid cells over January 2021-May 2022 for French, Italian and Mauritian purse seiners. Data reported in IOTC 3BU form.**

4.4.3 Fishing sets on FOBs

From January 2021 to June 2022, 19.8% of activities with FOBs reported by French, Italian and Mauritian purse seiners and support vessels corresponded to a fishing set (Figure 9). Once again, the main areas for activities on FOBs are consistent with previous indicators (Figure 5 - 7) with a core area along the equator between 50°W and 60°W.

A large proportion of reported interactions also corresponded to deployments of new dFADs, strengthening of FOBs already drifting at sea (36.5%) and visits without a fishing set (32.5%). This relatively high proportion of visits not followed by a fishing set indicates that the fishing effort deployed by purse seiners through the tracking of FOBs does not necessarily translate into a fishing pressure on tuna stocks through catches.

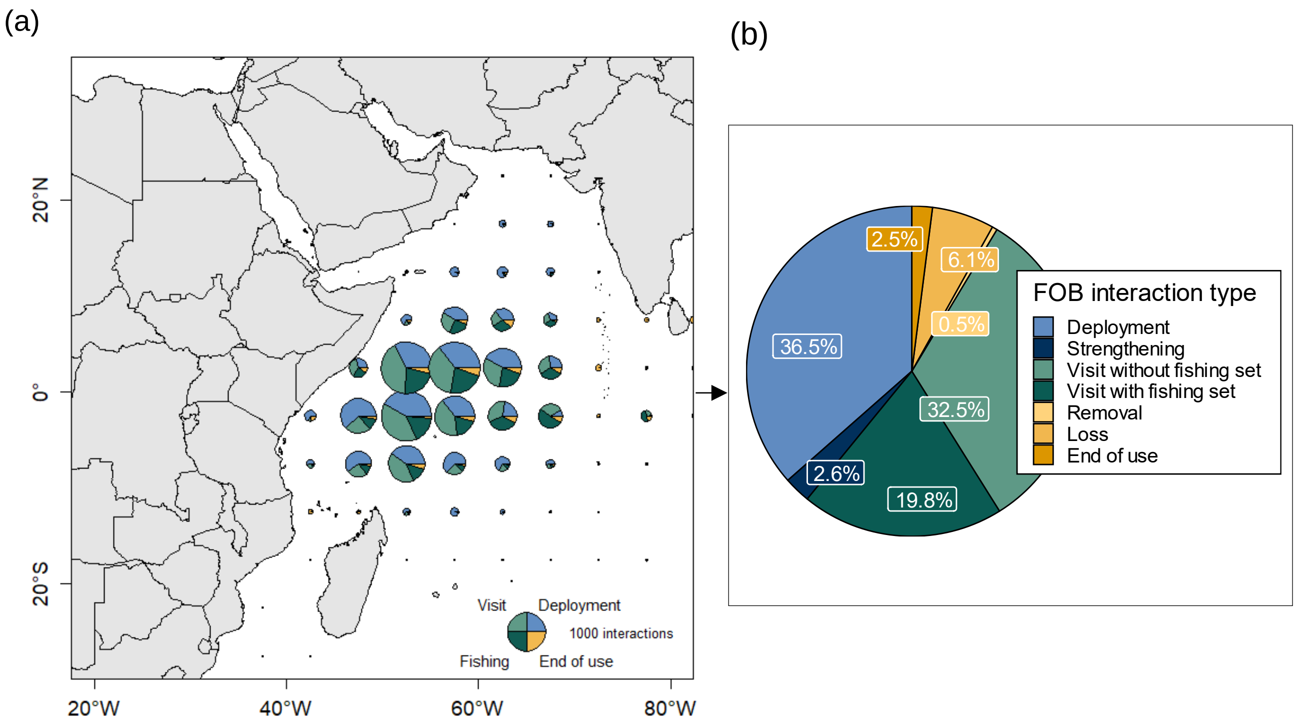

Figure 9 : **Proportion of deployments (in blue), visits without fishing (light green), visits with a fishing set (dark green) and end of use (yellow) for activities reported on FOBs by French and associated purse seiners and support vessels over January 2021 – June 2022**.

Among the 5828 fishing sets reported by purse seiners over January 2021 – June 2022, 74.1% were FOB fishing sets and 25.9% were Free Swimming School (FSC) fishing sets, with respectively 94.7% and 66.8% of positive fishing sets on FOBs and FSC (Figure 10). Most positive FOB fishing sets occurred on dFADs (92.0%, Figure 10), followed by logs of anthropic origin (5.8%) and logs of natural origin (3.6%). The patterns in FOB types were found to be consistent between random encounters with FOBs (Figure 4) and positive fishing sets on FOBs (Figure 11), suggesting that the type of FOB did not influence the presence of fish or the decision to undertake of FOB fishing set.

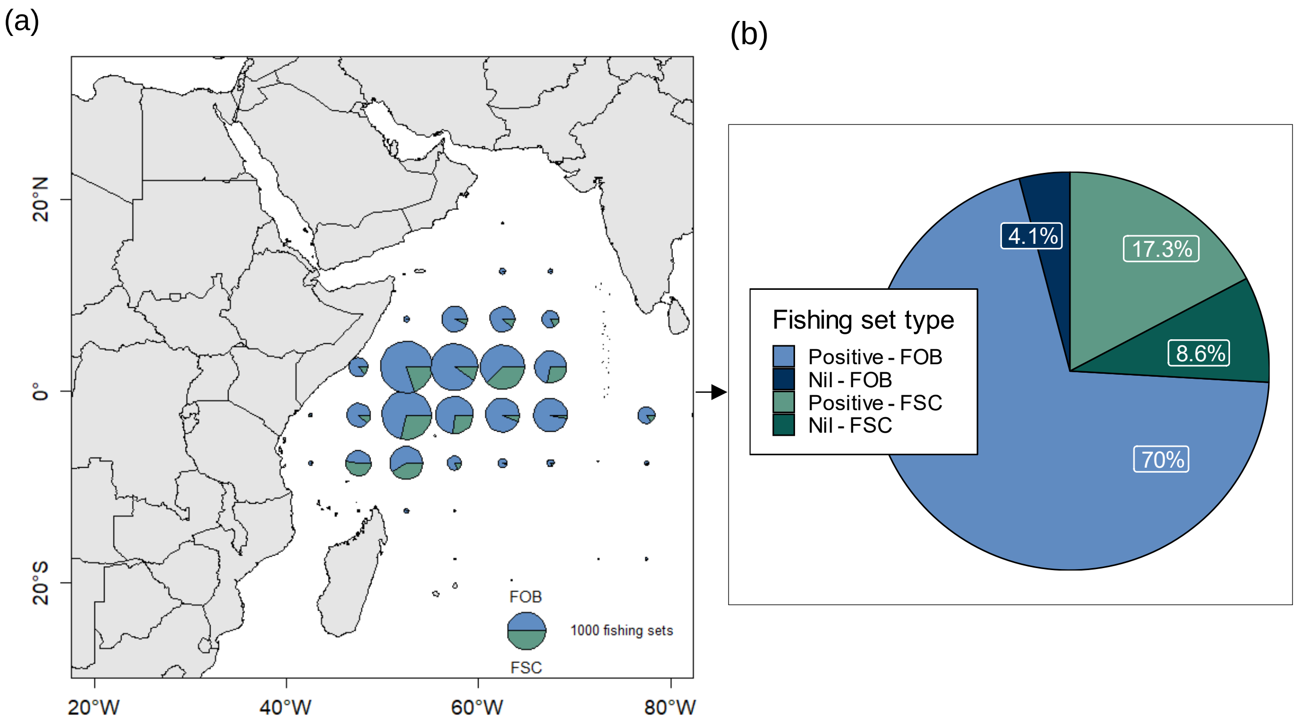

Figure 10 : **Proportion of fishing sets on FOBs (in blue) and FSC (in green) reported by French and associated purse seiners over January 2021 – June 2022**.

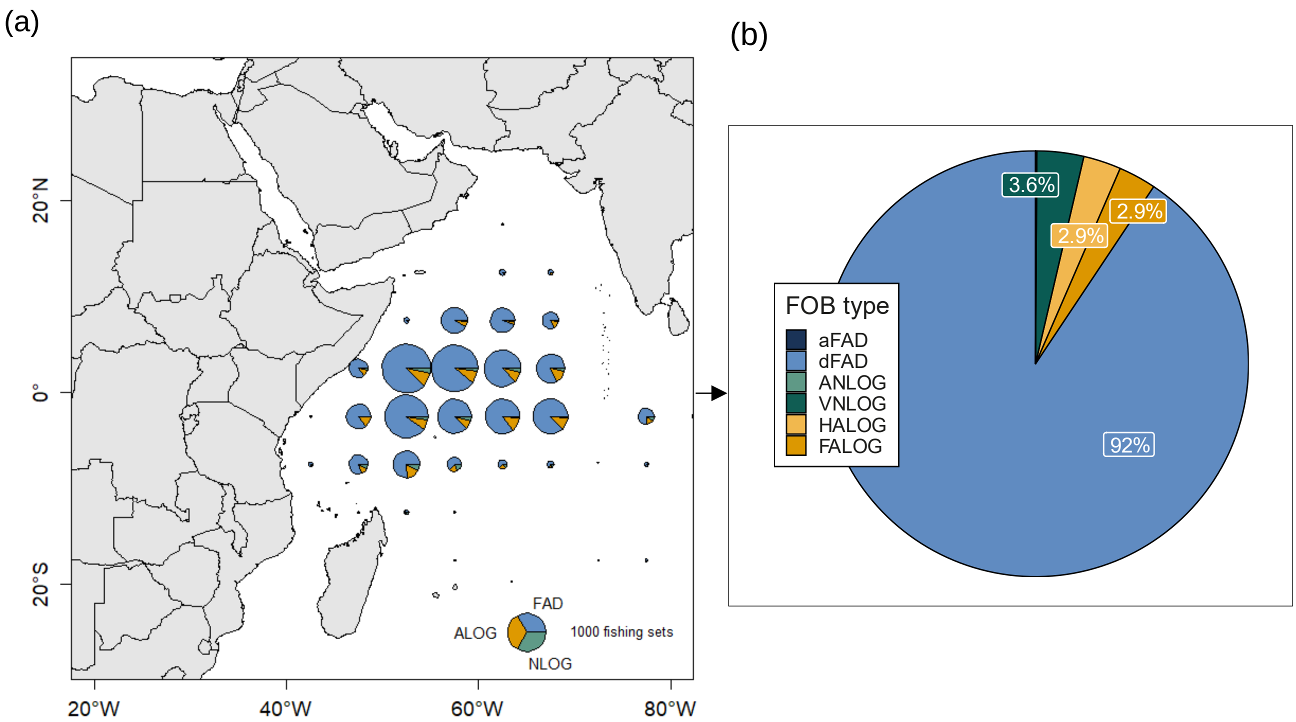

Figure 11 : **Proportion of positive FOB fishing sets on dFADs (in blue), logs of anthropic origin (in yellow) and logs of natural origin (in green) reported by French and associated purse seiners over January 2021 – June 2022**.

4.4.4 Composition of catches on FOBs

From January 2021 to June 2022, skipjack tuna (SKJ) dominated catches on FOBs with 64.0% of the catch (Figure 12), followed by yellowfin tuna (YFT, 26.1%) and bigeye tuna (BET, 7.6%). Catches of smaller fish(weight < 10 kg) dominated YFT and BET catches, with respectively 65.3% and 86.1% of catches of these two species.

Note that these estimates should not be directly compared with the composition of catches reported to IOTC Secretariat. Indeed, onboard large purse seiners, the catch composition reported in logbooks is corrected with port sampling to prepare scientific estimates (Duparc *et al.*, 2020).

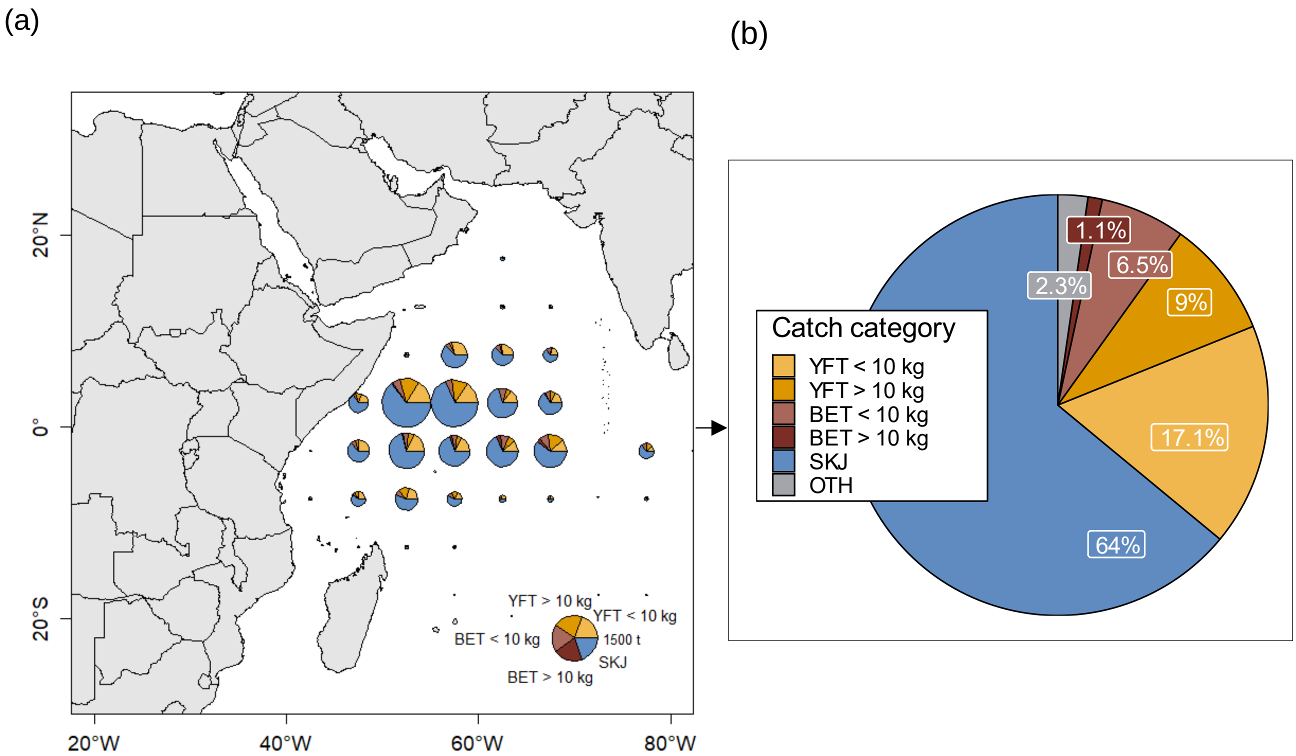

Figure 12 : **Composition of catches on FOBs reported by French and associated purse seiners over January 2021 – June 2022**.

4.5 Indicators of the contribution of dFADs to ghost fishing

4.5.1 Presence of mesh on deployed dFADs

From January 2021 to June 2022, French, Italian and Mauritian purse seiners reported a large majority of deployments of dFADs without meshing elements (Figure 13) with respectively 88.8% and 89.6% of dFADs without mesh in their surface and subsurface structure. The analysis of data collected in fishing/FOB logbooks also indicate a misunderstanding of the data structure, with some vessels reporting the type of dFAD deployed (see section 4.6.1) but not the presence/absence of mesh and one vessel reporting LERFADs though no material with small mesh was available onboard. These results underline the need to improve data reporting in the fishing/FOB logbook through continuous training of captains.

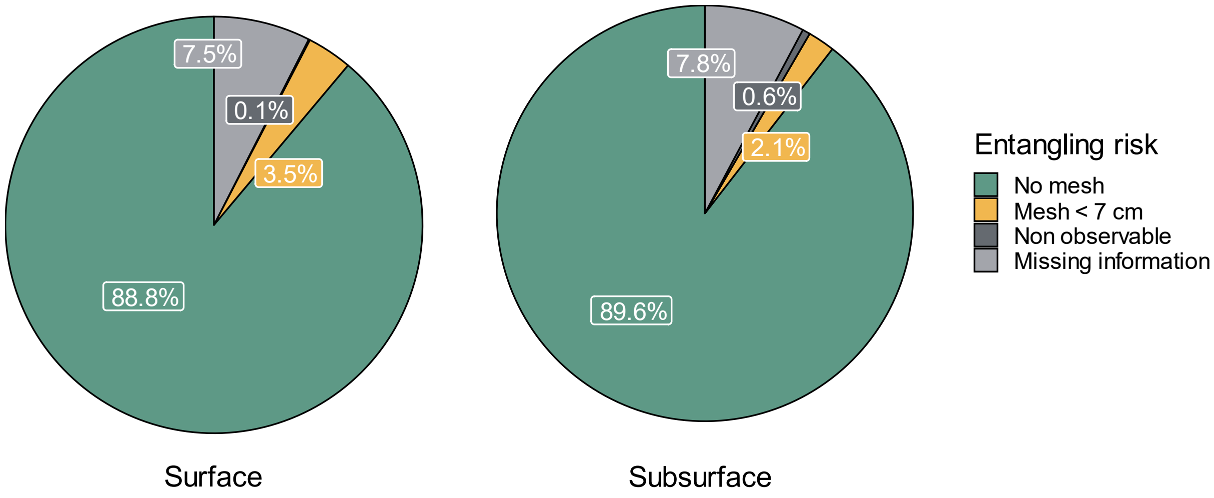

Figure 13 : Entangling risk of dFADs deployed by French and associated purse seiners and support vessels over January 2021 – June 2022.

4.5.2 Presence of mesh on visited FOBs

Over January 2021 – June 2022, the majority of visited FOBs had no meshing elements in their surface (83.9%, Figure 14) or subsurface structure (70.5%). Unlike at the time of deployment, collecting information on the structure of visited FOBs was not always feasible, especially for the subsurface structure for which observation requires lifting the FOB. Cases with missing information were also present in the data, underlining the need to improve the training of captains to the structure of the fishing/FOB logbook.

At the time of visit, the number of visits of FOBs with a moderate risk of entanglement was higher with respectively 7% and 6.8% of FOBs reported with mesh size < 7 cm. Note that these visits comprise encounters of logs originating from other fisheries (FALOGs, Figure 4), including lost fishing nets that can present a risk of entanglement for sensitive species such as sharks and sea turtles.

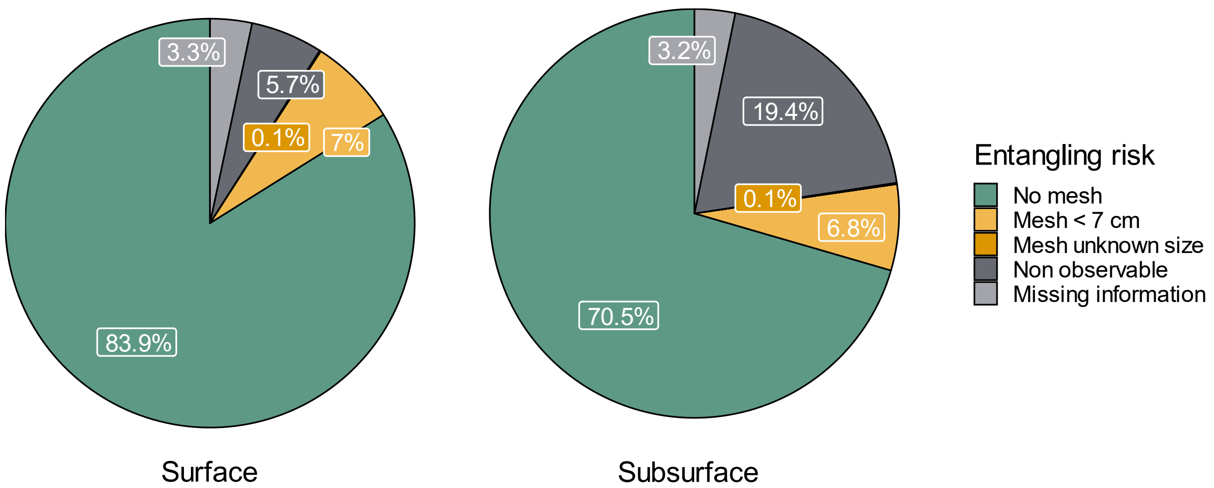

Figure 14 : Entangling risk of FOBs visited by French and associated purse seiners and support vessels over January 2021 – June 2022.

4.6 Indicators of the contribution of dFADs to marine litter

4.6.1 Types of deployed and visited dFADs

Over January 2021 – June 2022, various types of dFADs were deployed by French, Italian and Mauritian purse seiners and support vessels in the Indian Ocean (Figure 15). The main design used was the *surface raft* with 48.3% of deployments and several types of materials to build to floating structure (bamboo only, metal only or a mix of bamboo and metal). Subsurface rafts contributed to 42.9% and cage rafts to 8.2%. Once again, the analysis revealed a need to improve the training of captains to avoid the incorrect reporting of logs in the *dFAD type* data field.

The proportion of the different types of reported dFAD designs reported was different at the time of deployment and at the time of visit, where the major observed design was the *subsurface raft* with 64.7% visits to dFADs. These results may indicate differences in the types of dFADs used by the different purse seine fleets or a preference of French and associated fishers for the *subsurface raft* design to find fish.

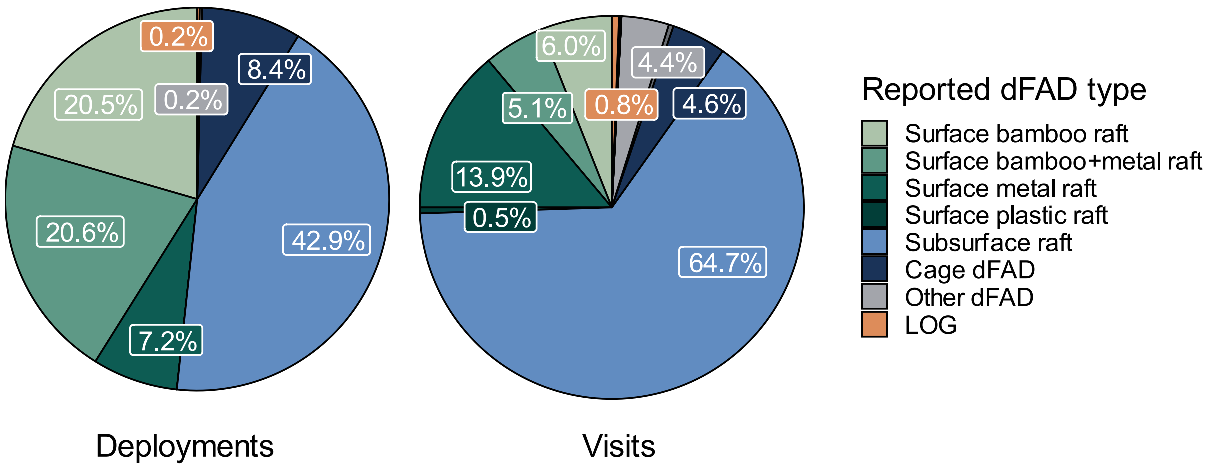

Figure 15 : Structure of dFADs deployed (left panel) and visited (right panel) by French and associated purse seiners and support vessels over January 2021 – June 2022.

4.6.2 Types of encountered FOBs

See section 4.3.1

4.7 Indicators of the contribution of dFADs to stranding

To improve the monitoring of dFADs at the end of their time at sea, purse seine and support vessel captains were recommended to report the loss and end of use of dFADs and buoys in their logbooks, in complement to data transmitted by buoy providers and reported in the IOTC 3BU form. From January 2021 to June 2022, this corresponded to 8.6% of reported interactions with FOBs (Figure 4). At this stage, information is not reported by all vessels and the location of the FOB and the buoy at the time of remote buoy deactivation was not always available in the fishing/FOB logbooks for vessels having reported the information in 2021 and 2022.

Exhaustive information from 3BU data reported to IOTC provided complementary information to fishing/FOB logbooks on the location of buoys at the end of transmission (Figure 16). Though this information may contain a mix of loss, end of use and stranding events, some clear patterns could be identified among the 10 849 buoy positions :

(i) Potential stranding events along the Eastern Coast of Africa and in the Seychelles and Maldives areas

(ii) Potential remote deactivations of buoys or appropriation of FOBs by local fishers east of 80°W (i.e. outside fishing grounds observed in fishing/FOB logbooks).

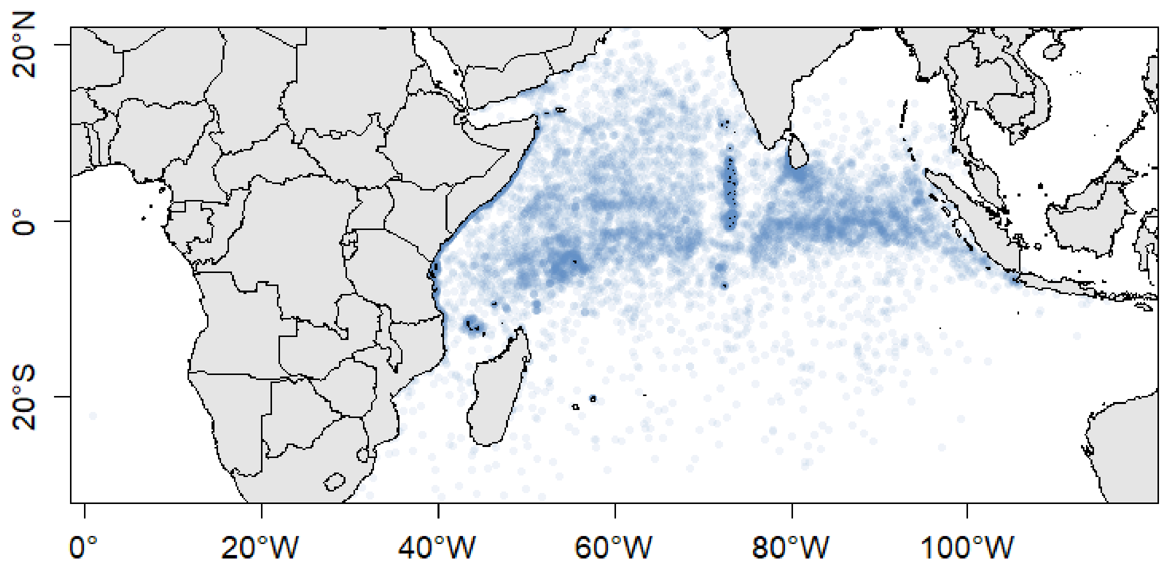

Figure 16 : Positions of buoys at the time of last transmission, derived from 3BU data reported for French, Italian and Mauritian purse seiners over January 2021 – May 2022.

5. Discussion

5.1 Lessons learned from fishing/FOB logbook and 3BU data for the French and associated PS fleet

Here, data collected in the fishing/FOB logbooks and reported in 3BU forms of French, Italian and Mauritian purse seiners were used to explore how the information available to national scientists or reported to IOTC Secretariat could be used to build simple indicators of the impacts of FOB fisheries. 12 indicators, adapted from Capello (2021) were examined to provide information on the modification of natural habitats, impacts on tuna stocks, ghost fishing, contribution to marine litter and degradation of coastal habitats. Provided that the quality of data is sufficient and that data reporting formats are appropriate, the simple indicators we built here demonstrate that a tremendous amount of information is available to provide scientific advice on FOB fisheries.

Of course, the analyses presented in this document are very simple and preliminary and the results we obtain may be influenced by the quality of data, especially in the case of fishing/FOB logbooks that contain a wide variety of data fields. Though the classification of FOB types, FOB activity types and buoy activity types had been built following interviews with fishers (Maufroy *et al.*, 2016), the experience demonstrates that these categories are not always understood onboard, with sometimes surprising confusions between data fields on FOBs and data fields on buoys. This may be explained by the high turnover of captains onboard French vessels in recent years, the need to continuously provide training on reporting requirements or the existence of duplicates in reporting requirements, with different formats (e.g. fishers report information both in their Excel logbooks and in the Electronic Reporting Systems).

Using the data collected in fishing / FOB logbooks therefore requires a sometimes long process of correction by fishing companies, that did not allow correcting all errors (e.g. logs were reported as dFAD types, Figure 15). The quality of data, as well as the limits of using an Excel tool also currently prevents IRD Ob7 from automatically transfer the data from Excel forms to the AVDTH database (Dewals *et al.*, 2017)and a manual, time consuming data entry is still necessary. These observations underline the need for a continuous training of fishers to improve the quality of reported information on FOBs and buoys. They also indicate a need to develop a unique, simple, fully-integrated and, to the extent possible, user friendly FOB reporting tool.

In the case of the information reported on operational buoys in the 3BU form, no particular issue of data quality was detected over 2021 – 2022, except for a few technical errors when buoy providers extracted the data from their servers. However, no clear guidelines are provided on how operational buoys must be reported in the 3BU form, in particular on how shared buoys must be reported, though this information is critical to build indicators of fishing effort. For French and associated purse seiners (Italy, Mauritius and Seychelles), the decision was made to provide information on a given shared buoy in 3BU forms of all sharing purse seiners (Maufroy and Goujon, 2019a). Should 3BU data become available for scientific purposes in IOTC, this will grant that 3BU data can be used to build sound indicators of the impacts of FOB fishing on tropical tuna stocks.

Despite the necessary improvements that are needed for fishing/FOB logbooks, the simple indicators we presented here are consistent with known patterns of impacts of dFAD use and PS fishing, that depict similar patterns in FOB fishing (Floch *et al.*, 2021), density of operational buoys (Floch *et al.*, 2021; Imzilen *et al.*, 2022), proportion of dFADs vs logs (Dupaix *et al.*, 2021) and end of use of FOBs/buoys (Imzilen *et al.*, 2022). If reporting formats become compatible with the recommended scientific terminology on FOB fisheries, the experience of the French and associated purse seine fleet provides an example of how routine data collection on FOBs and buoys and analyses could be done in IOTC.

5.2 How to avoid data gaps on FOB fisheries ?

The question of the appropriate vocabulary to be used to describe FOB fisheries has long been discussed in t-RFMOs. Considerable work has been done to clarify the notion of "FAD", their modalities of use and the options for FAD management (Fonteneau and Chassot, 2014; Goujon *et al.*, 2014; Gaertner *et al.*, 2016; Grande *et al.*, 2019). Among others, EU scientists and PS fleets have worked conjointly on definitions and data collection procedures that would allow evaluating separately the effects of FOB fishing in terms of fishing effort, habitat modification and pollution (Gaertner *et al.*, 2016; Grande *et al.*, 2019). Nevertheless, these definitions have not been adopted in IOTC yet and several stakeholders have expressed their reluctancy to have them adopted during the last session of IOTC Commission in 2022.

Therefore, the structure of IOTC 3FA form on activities and fishing sets on FOBs contains data fields that do not allow separating dFADs from logs (no proper assessment of the modification of natural habitats), mix information on FOBs and buoys (no proper assessment of fishing effort) and contain overlapping categories of activities with FOBs and buoys (no proper assessment of fishing effort, contribution to marine litter and stranding). This situation may cause a misinterpretation of reporting requirements in the 3FA form by CPCs and render 3FA data unusable to provide scientific advice on FOB fisheries (IOTC Ad-Hoc Working Group on FADs, 2021).

In the case of the French purse seine fleet, this may also cause the observed discrepancies in reported dFAD deployment numbers between IOTC forms 3FA and 3FD (number of dFAD deployments in 2019). Indeed, FOB activities reported in the fishing/FOB logbook are first recategorized to fit the format of the IRD AVDTH database and then recategorized a second time to fit the format of the 3FA form. In 2023, the structure of data obtained from logbooks by IRD will be updated to be compatible with recommended scientific definitions. However, unless these scientific definitions are adopted in IOTC, it is expected that discrepancies between datasets will still exist. Similarly, unless the terminology recommended by scientists is adopted in IOTC and used in all reporting requirements of tropical tuna purse seiners (logbooks, ERS, observer data, buoy data), it is unlikely that data reported to IOTC Secretariat will become of sufficient quality to be suitable for scientific analysis.

It is therefore critical that managers facilitate the work of scientists by adopting the terminology required by scientists to provide scientific advice. Further delay in the adoption of this terminology will prevent scientists from answering the questions of managers on the impacts of FOB fisheries and options for their efficient management.

5.3 Do we need a FAD register ?

Implementing a FAD register and a FAD Monitoring System (FAD-MS) has recently been proposed to improve monitoring and reporting procedures, grant data availability for research purposes and reduce dFAD contribution to marine litter, degradation of coastal habitats through stranding and mortality of sensitive species (Kenya, 2022). Though the results we obtain here confirm the need to improve monitoring and reporting procedures on FOBs and buoys, they also demonstrate that a lot of information is available but cannot be transmitted to IOTC in a format that would allow their proper scientific analysis.

Therefore, prior to introducing any additional reporting tool, priority should be given to improving existing tools for reporting on the use of FOBs and buoys in IOTC. This includes (i) revising the structure of the 3FA form and possibly of the 3BU form, (ii) ensuring that there is no misinterpretation of data reporting requirements by CPC data analysts, scientific observers and fishers (iii) avoiding the multiplication of reporting formats with inconsistent data fields across reporting tools and, if possible, (iv) developing a fully-integrated FOB reporting tool that will simplify data preparation by CPCs and data management by IOTC Secretariat. Figure 17 details the desired features of such an integrated FOB reporting tool.

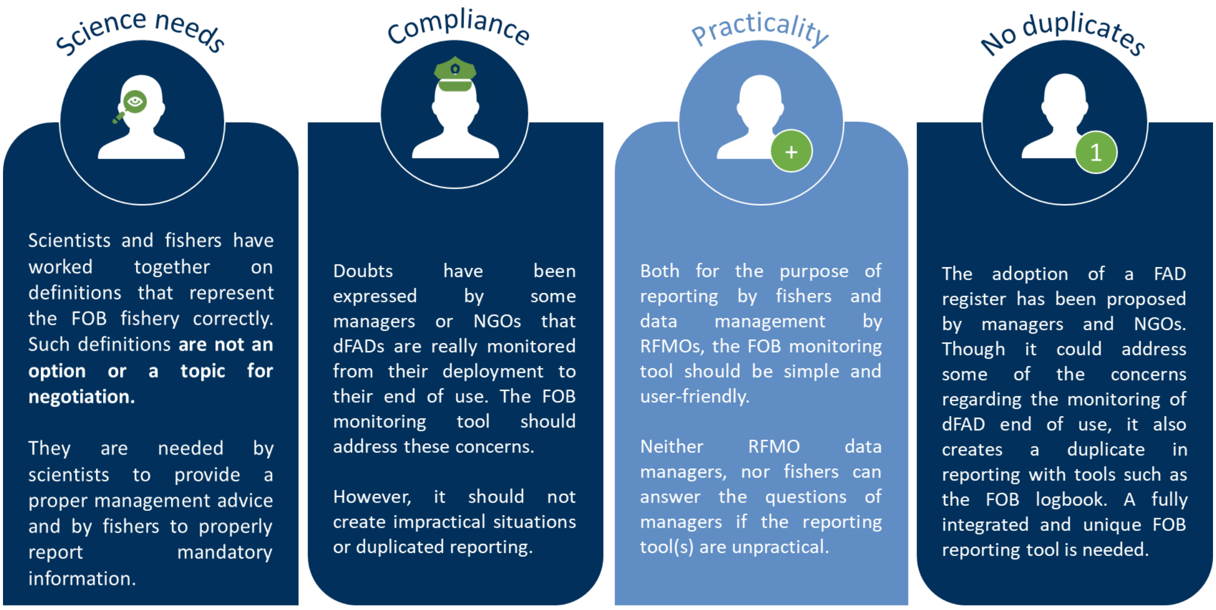

Figure 17 : Desired features for a fully-integrated FOB reporting tool

In addition, several impracticalities of the proposed FAD register (Kenya, 2022) should be highlighted, such as the request to report on an activation of a buoy two weeks in advance, the permanent marking of dFADs, or the frequent change of ownership of dFADs. Of course, a simple solution would be to reduce drastically the number of authorized buoys to facilitate the management of the FAD register and to forbid any deployment of a buoy on a log as well as buoy transfers or sharing of buoys between purse seiners. Though ensuring that reasonable numbers of dFADs are present at sea is obviously the objective, since it remains the primary solution to prevent the undesired effects of using too many dFADs, it is necessary to ensure first that management measures are applicable and do not have unwanted consequences (Maufroy and Goujon, 2021). This is true for the permanent marking of dFADs that are required at the same time to become biodegradable. It is is also true for the sharing of buoys that increases the chances that one of the sharing vessels is close enough to recover dFADs that are about to leave fishing grounds. It is also necessary to evaluate if proposed management options are really necessary before making decisions that would deeply change practices in the fishery. This is true for buoy transfers for example, that do not prevent accountability in the case of dFADs abandoned at sea or stranding on fragile coastal habitats. Indeed, there is no doubt that the vessel that appropriates the dFAD becomes responsible for any damage caused by the structure of the dFAD or its stranding.

In conclusion, the analyses we presented in this document indicate that large amounts of information are available in fishing/FOB logbooks and 3BU reporting of operational buoys. Provided that appropriate definitions are adopted in IOTC and that the structure of 3FA and 3BU forms are improved, such data could be used to provide scientific advice for the management of FOB fisheries and monitor their impacts in routine. The quality of reported data may also be improved by a continuous training of fishers and the simplification of reporting procedures, through a fully-integrated FOB reporting tool. These considerations should be taken into account before implementing an additional, potentially redundant and impractical tool such as a FAD register.

Acknowledgements

We would like to thank the Ob7 of the Institute of Research for sustainable Development (IRD), especially Philippe Sabarros and Laurent Floch for providing onboard observer and AVDTH data to validate the quality of the fishing/FOB logbook data. We also thank our member fishing companies and fishing crews for their implication in correcting fishing/FOB logbooks.

References

Amandè, J., Ariz, J., Chassot, E., Chavance, P., Delgado, M. A., Gaertner, D., Murua, H., *et al.* 2008. By-catch and discards of the European purse seine tuna fishery in the Indian Ocean. Estimation and characteristics for the 2003-2007 period. IOTC-2008-WPEB.

Amandè, M. J., Ariz, J., Chassot, E., de Molina, A. D., Gaertner, D., Murua, H., Pianet, R., *et al.* 2010. Bycatch of the European purse seine tuna fishery in the Atlantic Ocean for the 2003–2007 period. Aquatic Living Resources, 23: 353–362.

Anderson, R. C., Zahir, H., Jauharee, R., Sakamoto, T., Sakamoto, I., and Johnson, G. 2009. Entanglement of Olive Ridley Turtles Lepidochelys olivacea in ghost nets in the equatorial Indian Ocean. IOTC-2009-WPEB-07.

Ariz, J., Delgado de Molina, A., Fonteneau, A., Gonzales Costas, F., and Pallarés, P. 1999. Logs and tunas in the eastern tropical Atlantic: a review of present knowledge and uncertainties. Special Report. Inter-American Tropical Tuna Commission, 11.

Baidai, Y., Dagorn, L., Gaertner, D., Denebourg, J.-L., Duparc, A., Floch, L., and Capello, M. 2021. Associative Behavior-Based abundance Index (ABBI) for yellowfin tuna (Thunnus albacares) in the Western Indian Ocean. https://archimer.ifremer.fr/doc/00693/80507/ (Accessed 20 September 2022).

Balderson, S., and Martin, L. E. C. 2015. Environmental impacts and causation of 'beached' Drifting Fish Aggregating Devices around Seychelles Islands: a preliminary report on data collected by Island Conservation Society. IOTC WPEB.

Bard, F.-X., Stretta, J.-M., and Slepoukha, M. 1985. Les épaves artificielles comme auxiliaires de la pêche thonière en océan Atlantique : quel avenir ? Pêche Maritime: 655–659.

Capello, M. 2021. Re-thinking a science-based FAD management. IOTC-2021-WPM12-19.

Dagorn, L., Holland, K. N., Restrepo, V., and Moreno, G. 2013. Is it good or bad to fish with FADs? What are the real impacts of the use of drifting FADs on pelagic marine ecosystems? Fish and Fisheries, 14: 391–415.

Dewals, P., Damiano, A., Floch, L., and Cauquil, P. 2017. AVDTH : Acquisition Validation des Données Thon : Manuel de l'utilisateur (màj 27/07/2017): 75 p. multigr. IRD.

Dupaix, A., Capello, M., Lett, C., Andrello, M., Barrier, N., Viennois, G., and Dagorn, L. 2021. Surface habitat modification through industrial tuna fishery practices. ICES Journal of Marine Science, 78: 3075–3088.

Duparc, A., Aragno, V., Depetris, M., Floch, L., Cauquil, P., Lebranchu, J., Gaertner, D., *et al.* 2020. Assessment of the species composition of major tropical tuna s in purse seine catches: a new modelling approach for the tropical tuna treatmen t processing (case of the French fleet in Atlantic Ocean), Collect. Vol. Sci. Pap. ICCA, 76: 951–982.

Escalle, L., Hare, S. R., Vidal, T., Brownjohn, M., Hamer, P., and Pilling, G. 2021. Quantifying drifting Fish Aggregating Device use by the world's largest tuna fishery. ICES Journal of Marine Science. https://doi.org/10.1093/icesjms/fsab116 (Accessed 23 September 2021).

European Union. 2022. On management of Fish Aggregating Devices (FADs) in the IOTC area of competence. IOTC-2022-S26-PropC_Rev3.

Filmalter, J. D., Capello, M., Deneubourg, J.-L., Cowley, P. D., and Dagorn, L. 2013. Looking behind the curtain: quantifying massive shark mortality in fish aggregating devices. Frontiers in Ecology and the Environment, 11: 291–296.

Floch, L., Marsac, F., Fily, T., Depetris, M., Duparc, A., Kaplan, D. M., and Lebranchu, J. 2021. Statistics of the French purse seine fleet targeting tropical tuna in the Indian Ocean (1981-2020). IOTC-2021-WPDCS17-21.

Fonteneau, A., and Chassot, E. 2014. Managing tropical tuna purse seine fisheries through limiting the number of drifting Fish Aggregating Devices in the Indian Ocean: food for thought. IOTC-2014-WPTT16-22.

Franco, J., Moreno, G., López, J., and Sancristobal, I. 2012. TESTING NEW DESIGNS OF DRIFTING FISH AGGREGATING DEVICE (DFAD) IN THE EASTERN ATLANTIC TO REDUCE TURTLE AND SHARK MORTALITY. Collect. Vol. Sci. Pap. ICCAT, 68: 1754–1762.

Gaertner, D., Ariz, J., Bez, N., Clermidy, S., Moreno, G., Murua, H., and Soto, M. 2016. Objectives and first results of the CECOFAD project.

Goujon, M., Claude, A., Le Couls, S., and Mangalo, C. 2014. Premier bilan du plan de gestion des DCP mis en place par la France en Océan Atlantique. Collect. Vol. Sci. Pap. ICCAT, 71(1).

Grande, M., Ruiz, J., Báez, J. C., Ramos, M. L., Krug, I., Zudaire, I., Santiago, J., *et al.* 2019. Best standards for data collection and reporting requirements on FOBs: towards a science-based FOB fishery management | Bycatch Management Information System (BMIS). https://www.iccat.int/en/pubs_CVSP.html. https://www.bmis-bycatch.org/references/bdxgf688 (Accessed 23 September 2021).

Hall, M., and Román, M. 2013. Bycatches and non-tuna catches in purse seine fisheries of the world.

Hallier, J., and Gaertner, D. 2008. Drifting fish aggregation devices could act as an ecological trap for tropical tuna species. Marine Ecology Progress Series, 353: 255–264.

Imzilen, T., Lett, C., Chassot, E., and Kaplan, D. M. 2021. Spatial management can significantly reduce dFAD beachings in Indian and Atlantic Ocean tropical tuna purse seine fisheries. Biological Conservation, 254: 108939.

Imzilen, T., Lett, C., Chassot, E., Maufroy, A., Goujon, M., and Kaplan, D. M. 2022. Recovery at sea of abandoned, lost or discarded drifting fish aggregating devices. Nature Sustainability, 5: 593–602. Nature Publishing Group.

IOTC. 2013. Resolution 13/08 Procedures on a fish aggregating devices (FADs) management plan, including more detailed specification of catch reporting from FAD sets, and the development of improved FAD designs to reduce the incidence of entanglement of non-target species. https://iotc.org/cmm/resolution-1308-procedures-fish-aggregating-devices-fads-management-plan-including-more-detailed (Accessed 23 September 2021).

IOTC. 2015. Resolution 15/08 Procedures on a FADs management plan, including a limitation on the number of FADs, more detailed specs of catch reporting from FAD sets, & the development of improved FAD designs to reduce incidence of entanglement of non-target species.

IOTC Ad-Hoc Working Group on FADs. 2021. Report of the 2nd IOTC Ad-Hoc Working Group on FADs. IOTC-2021-WGFAD02-R[E].

IOTC Secretariat. 2021. Review of the statistical data on FADs. IOTC-2021-WGFAD02-03_Rev1.

IPNLF. 2021. A polluter pays principle for drifting FADs - how it could be applied. IOTC-2021-WGFAD02-08.

ISSF. 2019. Non-entangling and biodegradable FADs guide. Best Practices for fishers, RFMOs, governments and vessel owners.

Joint Tuna RFMO FAD Working Group. 2017. Report of the 1st joint Tuna RFMO FAD working group meeting. 2017_JFADS_REP_ENG.

Kenya. 2022. On management of Fish Aggregating Devices in the IOTC area of competence. IOTC-2022-S26-REF06.

Marsac, F., Fonteneau, A., and Ménard, F. 2000. Drifting FADs used in tuna fisheries: an ecological trap? *In* Pêche thonière et dispositifs de concentration de poissons, Caribbean-Martinique, 15-19 Oct 1999.

Maufroy, A., Chassot, E., Joo, R., and Kaplan, D. M. 2015. Large-Scale Examination of Spatio-Temporal Patterns of Drifting Fish Aggregating Devices (dFADs) from Tropical Tuna Fisheries of the Indian and Atlantic Oceans. PLoS ONE, 10: e0128023.

Maufroy, A., Kaplan, D. M., Bez, N., and Chassot, E. 2016. Integrating scientific and French tropical tuna purse seine skippers knowledge for a better management of dFAD fisheries in the Indian Ocean. IOTC–2016–WPTT18–36 Rev_1.

Maufroy, A., and Goujon, M. 2019a. Methodology for the monitoring of FOB and buoy use by French and Italian tropical tuna purse seiners in the Indian Ocean. IOTC-2019-WPTT21-53.

Maufroy, A., and Goujon, M. 2019b. Methodology for the monitoring of FOB and buoy use by French tropical tuna purse seiners in the Atlantic Ocean. SCRS/2019/148.

Maufroy, A., and Goujon, M. 2021. How can we efficiently mitigate the impacts of dFADs ? IOTC-2021-WGFAD02-13. 2nd ad hoc working group on FADs.

Moreno, G., Salvador, J., Murua, H., Uranga, J., Zudaire, I., Murua, J., Grande, M., *et al.* 2021. The jelly-FAD: a paradigm shift in bio-FAD design. IOTC-2021-WGFAD02-10.

ORTHONGEL. 2011. Décision n°11 du 23 novembre 2011 relative à l'utilisation de dispositifs de concentration de poissons.

ORTHONGEL. 2021. What we think you should know about Fish Aggregating Devices. IOTC-2021-WGFAD02-04.

Ruiz, J., Depetris, M., Grande, M., Tserpes, G., Carbonara, P., Bach, P., Duparc, A., *et al.* 2019. Strengthening regional cooperation in the area of large pelagic fishery data collection (RECOLAPE). Final report. Report to the European Commission in Fulfilment of Grant Award: EU MARE/2016/22.

Sempo, G., Dagorn, L., Robert, M., and Deneubourg, J.-L. 2013. Impact of increasing deployment of artificial floating objects on the spatial distribution of social fish species. Journal of Applied Ecology, 50: 1081–1092.

Stretta, J.-M., Delgado de Molina, A., Ariz, J., Domalain, G., Santana, J. C., and Le Gall, J. Y. 1998. Les espèces associées aux pêches thonières tropicales dans l'océan Indien. *In* Le thon : enjeux et stratégies pour l'océan Indien, pp. 369–386. Ed. by P. Cayré and Conférence Internationale Thonière de Maurice, Port Louis (MUS), 1996/11/27-29. ORSTOM, Paris. http://www.documentation.ird.fr/hor/fdi:010016106 (Accessed 19 May 2014).

Annexe 1 : structure of the fishing/FOB logbook used French, Italian and Mauritian purse seiners and support vessels since 2020

DATE	HEURE	LATITUDE chaque calée ou à midi	LONGITUDE chaque calée ou à midi	ZEE	T°C mer	VENT / VIENTO / WIND		CALEE / LANCE / FISHING SET		
FECHA	HORA	LATITUDE cada lance o mediada	LONGITUD cada lance o mediada	ZEE	T°C mar	Direction / Direccion / Direction Degrés / Grados / Degrees	Vitesse / Velocidad / Speed Nœuds / Nudos / Knots	Portante / Positivo / Successful	Nulle / Nullo / Nil	Type de calée / Lance typo / Fishing set type
DATE	TIME	LATITUDE each set or at midday	LONGITUD each set or at midday	EEZ	T°C sea					

CAPTURE ESTIMEE (en tonnes) / ESTIMATION DE LA CAPTURA (en toneladas) / ESTIMATED CATCH (metric tons)																	
1				2		3				4		5			6		
ALBACORE				LISTAO		PATUDO				GERMON		AUTRES ESPECES			REJETS		
RABIL				LISTADO		PATUDO				ALBACORA		OTRAS ESPECIES			DESCARTES		
YELLOWFIN				SKIPJACK		BIGEYE				ALBACORE		OTHER SPECIES			DISCARDS		
YFT +10		YFT-10		SKJ		BET +10		BET - 10		ALB		OTH			DSC		
Taille	Capture	Taille	Capture	Taille	Capture	Taille	Capture	Taille	Capture	Taille	Capture	Espèce	Taille	Capture	Espèce	Taille	Capture
Tailla	Captura	Tailla	Captura	Tailla	Captura	Tailla	Captura	Tailla	Captura	Tailla	Captura	Especie	Tailla	Captura	Especie	Tailla	Captura
Size	Catch	Size	Catch	Size	Catch	Size	Catch	Size	Catch	Size	Catch	Species	Size	Catch	Species	Size	Catch

ASSOCIATION								OBJET FLOTTANT					BOUEE INSTRUMENTEE					COMMENTAIRES
ASSOCIACION								OBJETO					BOYA					COMMENTARIOS
ASSOCIATION								FLOATING OBJECT					INSTRUMENTED BUOY					COMMENTS
Banc Libre / Banco Libre / Free School	Objet flottant / Objeto / FOB	Balise / Balisa / Beacon	Baliseur / Barco de appoyo Support vessel	Requin baleine / Tiburon ballena Whale shark	Baleine / Ballena / Whale	Oiseaux / Aves / Birds		ACTIVITE SUR L'OBJET	TYPE D'OBJET	TYPE DE DCP DERIVANT	RISQUE DE MAILLAGE		ACTIVITE SUR LA BOUEE	BOUEE DÉJÀ PRESENTE		BOUEE DEPLOYEE		Problèmes divers Détails sur les prises accessoires Taille du banc Autres associations Autres remarques
								ACTIVIDAD SOBRE EL OBJETO	TIPO DE OBJETO	TIPO DE DCP	RIESGO DE ENMALLAMIENTO		ACTIVIDAD SOBRE LA BOYA	BOYA ANTIGUA		BOYA NUEVA		
											ENTANGLING RISK			BUOY ALREADY ON THE FOB		DEPLOYED BUOY		
								FOB ACTIVITY	FOB TYPE	DFAD TYPE	En surface Parte surperficial Surface	Sous la surface Parte sumergida Underwater	BUOY ACTIVITY	TYPE	NUMERO	TYPE	NUMERO	
														TIPO	NUMERO	TIPO	NUMERO	
														TYPE	ID	TYPE	ID	