

## 8 YEARS OF BEST PRACTICES ONBOARD FRENCH AND ASSOCIATED FLAGS TROPICAL TUNA PURSE SEINERS: AN OVERVIEW IN THE ATLANTIC AND INDIAN OCEANS

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### Abstract

In 2012, the first manual for the safe handling of sensitive species onboard tropical tuna purse seiners was released. This *Code of Best Practices*, developed in collaboration between French associated flags tropical purse seiners and French scientists of IRD and Ifremer, provides a set of recommendations and techniques to improve the survival of sensitive species incidentally caught by tropical tuna purse seiners, while taking into consideration crew safety. Following the release of the *Guide of Best Practices*, purse seine crews have been trained to *Best Practices*, vessels have been equipped with adequate *Best Practices handling gear*, and the methodology for the monitoring of *Best and Unsuitable Practices* has gradually improved.

This document presents the evolution of the methodology used for this monitoring since 2015, describes the data collected by onboard and electronic observers in the frame of the OCUP program and proposes further improvements in the monitoring methodology. The analysis of the data collected from April 2016 to March 2020 indicates that Best Practices are more easily applied for sea turtles and whale sharks than for undetectable small sharks and rays, dangerous sharks, or large sharks and mobulid rays that cannot be easily handled with Best Practices. Our results also suggest differences in the exhaustivity and objectivity of the data collected by onboard and electronic observers. The results we obtain are used to draw recommendations for future work, such as a better consideration of the effect of vessel configuration or individualized training of crews and observers to Best Practices.

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## 1. Introduction

During the last decades, the problems of bycatch, discards and survival of sensitive species incidentally caught by fishing vessels have become a major concern for the sustainability of fisheries. Over time, numerous guidelines, Codes for Responsible Fisheries, Conservation and Management Measures (CMMs) and Action Plans have been adopted worldwide at the global (FAO 1995, FAO 2011), regional (European Commission 2009, IOTC 2017, ICCAT 2018) or fisheries (Poisson et al. 2012, Goujon 2015, ORTHONGEL 2011c, ISSF 2016, Hutchinson et al. 2017, Grande et al. 2019) level to address these issues.

In the case of tropical tuna purse seine fisheries of the Atlantic and Indian Oceans, though the rates of bycatch are generally low and bycatch is dominated by teleost fish (Amandè et al. 2010, 2012, Hall and Roman 2013), incidental catches comprise particularly vulnerable species of sharks, rays, mobulid rays and sea turtles (Amandè et al. 2010, 2012, Escalle et al. 2015, Ruiz et al. 2018). In addition, the inappropriate use of old pieces of netting in the structure of Fish Aggregating Devices (FADs) has been shown to cause important ghost mortalities of sharks and sea turtles (Filmlalter et al. 2013) and degradation of the habitats of some of these vulnerable species group could occur due to important numbers of lost drifting FADs (Balderson et al. 2015, Maufroy et al. 2015).

In 2012, due to raising concerns regarding the increasing of Fish Aggregating Devices (FADs) and their negative consequences (Dagorn et al. 2012a, Fonteneau et al. 2013), a voluntary limitation of the number of tracking buoys used by French (21 vessels) and Italian (1 vessel) purse seiners (PS) on Floating Objects (FOBs) was implemented for the first time in the Atlantic and Indian oceans (ORTHONGEL 2011a). In parallel, the French and associated purse seine fleets worked in collaboration with scientists to develop non-entangling FADs (NEFADs) who became mandatory for these fleets in 2012 in the Indian Ocean and 2013 in the Atlantic Ocean (ORTHONGEL 2011b). Such initial Best Practices of the French and associated flags purse seine fleet have been turned into mandatory bycatch mitigation techniques in ICCAT and IOTC CMMs since 2015 (ICCAT 2019, IOTC 2019), they will therefore not be discussed in the present document.

At the same time, the collaboration with French scientists of the French Institute for Research and Development (IRD) and Ifremer resulted in the first manual of safe handling and releasing techniques for sharks, whale sharks, rays and sea turtles (Poisson et al. 2012, Poisson et al. 2014a). These so-called *Best Practices* could improve the survival of sharks incidentally caught by tropical tuna purse seiners by up to 20% (Poisson et al. 2014b, Hutchinson et al. 2015, Eddy et al. 2016) and address the requirements of ICCAT and IOTC CMMs who encourage the live release of various sensitive species (Grande et al. 2019). Eight years after the release of the manual on Best Practices, the present study aims at making a comprehensive assessment of the application of Best Practices onboard French and associated flags purse seiners, so as to build on experience and lessons learnt so far for further improvements.

This document therefore (i) presents the evolution of the methodology used for the monitoring of Best Practices onboard French and associated flags purse seiners since 2016, (ii) describes the data collected by onboard and electronic observers in the frame of the OCUP program and (iii) proposes further improvements in the monitoring methodology.

## 2. Material and methods

### 2.1 From the development of a manual of Best Practices to the training of crews

#### *Sharks Project for the Future (2010 – 2012)*

In 1999, FAO adopted an International Action Plan for the Conservation and Management of Sharks (FAO, 1999) that was followed in 2009 by the implementation of a similar Action Plan at the scale of the European Union (European Commission, 2009). Among others, the objectives of these action plans were to ensure that sharks are sustainably managed and that their bycatches are properly regulated. The implementation of the EU Action Plan for Sharks encouraged French and associated tropical tuna purse seine fleets to develop efficient and adapted techniques to release sharks alive.

From 2010 to 2012, ORTHONGEL and its member fishing companies worked in collaboration with scientists of the IRD and Ifremer in the frame of the *Sharks Project for the Future* and the European Union *MADE* project (Mitigation Adverse Ecological Impacts of open ocean fisheries). As a result of this collaboration, the first manual of safe handling and releasing techniques for sharks, whale sharks, rays and sea turtles was published in 2012 (Poisson et al. 2012, [http://www.orthongel.fr/docs/publications/GoodpracticesGuide\\_LDef.pdf](http://www.orthongel.fr/docs/publications/GoodpracticesGuide_LDef.pdf)). The manual contains a set of recommendations to safely release specimens of sensitive species, while enhancing their survival. These recommendations have been adapted to the case of other tropical tuna purse seine fleets (e.g. Grande et al. 2019) and are currently used by the International Sustainable Seafood Foundation (ISSF) to inform skippers on Best Practices (ISSF 2016).

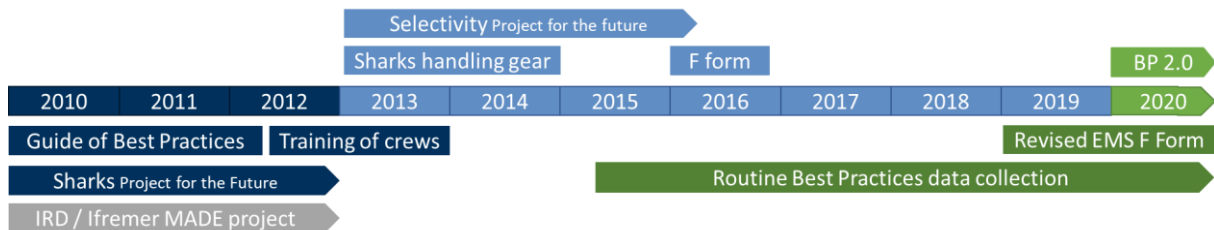
Following the release of the manual of safe handling and releasing techniques, training sessions were organized at port from June 2012 to July 2013 onboard each purse seiner operating in the Atlantic or the Indian Ocean. Interviews with purse seine crews, discussions during training sessions and analyses of the configuration of purse seiners had highlighted the need for adapted Best Practices equipment, that would both improve the survival of specimens of sensitive species and the security of the crews. A set of potential solutions was therefore proposed as a complement to the manual of Best Practices.

#### *Selectivity Project for the Future (2013 – 2015)*

In 2013, ORTHONGEL implemented the *Selectivity Project for the Future* to test the solutions proposed by fishers and scientists in the frame of the *Sharks Project for the Future*, better inform purse seine and support vessel crews on ORTHONGEL's various *Projects for the Future* (i.e. projects to improve the sustainability of the fishery), and develop practical solutions for non-entangling and biodegradable FADs and issues of bycatch reduction and utilization.

From April 2013 to May 2015, specific sharks and rays handling equipment were selected with fishing companies and tested onboard by purse seine crews. Unfortunately, none of the proposed solutions received the full support of crews, as they were often too difficult to use in real fishing conditions. In addition, ORTHONGEL and its member fishing companies were dedicating considerable energy to other projects developed at the same time (e.g. OCUP, see 2.2), which slowed down the progress made in the frame of the Selectivity project. Nevertheless, summary sheets on Best Practices, non-entangling FADs (NEFADs) and programs of scientific observation were prepared and data collection on Best Practices started during the *Shark Project for the Future*. In addition, since 2015, ISSF skipper's

workshops have been organized each year in France to inform captains, second captains, bosuns, fleet managers and fleet representatives on the latest developments regarding Best Practices.



**Figure 1:** Best Practices projects implemented by ORTHONGEL and its member fishing companies since 2010. Results of the “Sharks Project for the Future” were obtained in collaboration with IRD and Ifremer scientists in the frame of the EU MADE project.

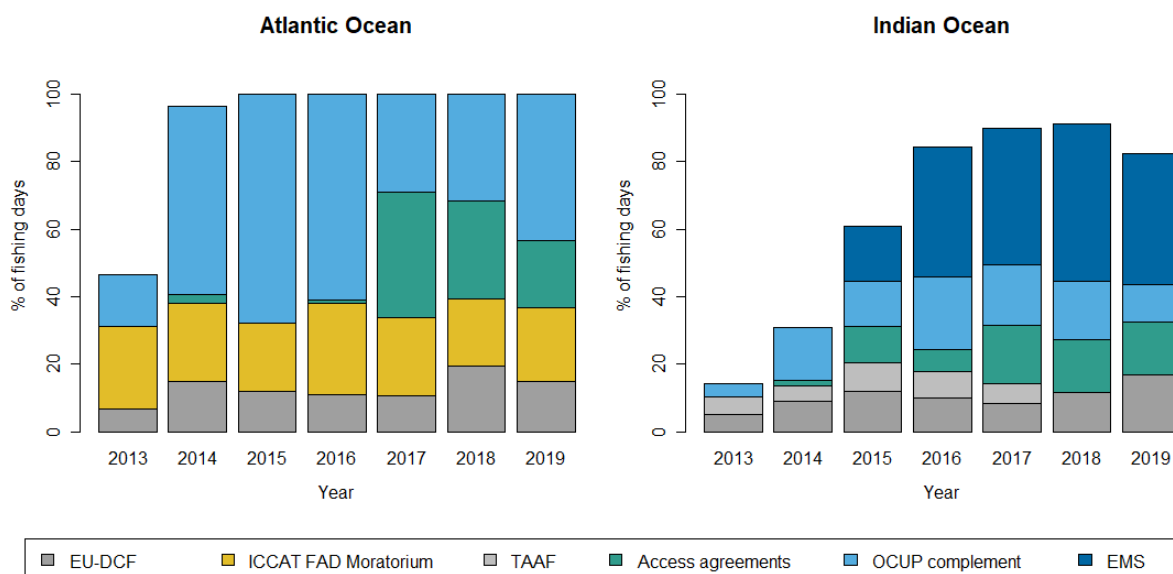
## 2.2 Monitoring Best Practices onboard French and Italian tropical tuna purse seiners (2015 – 2020)

### 2.2.1 Observer programs

In 2013, ORTHONGEL implemented the *OCUP program* to facilitate the boarding of scientific observers of coastal countries in collaboration with Oceanic Développement (OD), IRD and 10 coastal countries of the Atlantic and Indian Oceans (Goujon et al. 2017a-b), with the aim of reaching an exhaustive observer coverage of its member fishing vessels. In 2014, as smaller vessels of the Indian Ocean could not carry observers due the lack of space onboard (piracy-protection teams are embarked since 2010), an electronic monitoring extension of the program was also implemented (Electronic Eye Optimization “*OEE*” *Project for the Future*, Briand et al. 2017).

Since 2013, onboard OCUP observers have brought the complement to the mandatory 5-10% observer coverage (EU *DCF program*) to reach 100% of fishing days in the Atlantic Ocean since 2015 and 49.0% of fishing days in the Indian Ocean in 2019. The Electronic Monitoring System (EMS) implemented in 2014 covered the remaining 39.7% of fishing days in the Indian Ocean in 2019 (Figure 2). In parallel to the *Selectivity Project for the Future*, the observer coverage rate has therefore rapidly increased in the Atlantic and Indian Oceans, offering the opportunity to monitor the application of Best Practices on most fishing trips.

Though monitoring the survival of sharks, whale sharks, rays and sea turtles after an interaction with a purse seiner is obviously of great importance to assess the fishing mortality for these species, the monitoring of the application of Best Practices is a matter of compliance with fleet specific procedures and commitments made in the frame of certification processes (e.g. ISSF, Marine Stewardship Council). Since it is not the role of scientists to participate in the verification of compliance or to support the certification of fishing fleets, it was agreed with IRD that ORTHONGEL and its member fishing companies would be responsible for the application of Best Practices onboard French and associated purse seiners. Best Practices are therefore not monitored in the frame of the EU-DCF program (managed by IRD) and data collection respectively concerned the remaining 82.0% and 71.0% of fishing days in the Atlantic and Indian Oceans in 2019.



**Figure 2:** observer coverage per type of scientific observation program. Best Practices are monitored in the frame of the ICCAT FAD moratorium and by national, OCUP and EMS observers. The proportions presented here do not indicate that data was available for all fishing trips covered by these programs, as Best Practices data were missing or partially available for some Access agreement and OCUP fishing trips. The undergoing revision of the F form will allow an easier calculation of such coverage.

### 2.2.2 Best Practices observation form and data preparation

From 2012 to 2015, as the various *Projects for the Future* were still ongoing, observers only filled a simple questionnaire to report on their perception of the application of Best Practices onboard French and associated purse seiners. They could also suggest improvements based on their own observations or on discussions with purse seine crews.

A dedicated observation form (F form) was then implemented and is routinely used since 2016 by onboard and electronic observers. For each fishing set and each species, information on *Good* and *Unsuitable* practices are collected using the classification presented in Table 2. Observers also report on individuals that could not be manipulated using Best Practices for security reasons.

**Table 2:** categories of Good and Unsuitable Practices in the F form

Species group	Good Practices	Unsuitable Practices
<b>Sharks</b>	Handled manually (dorsal or pectoral fin + tail)	Arrived in the lower deck
	Use of a plastic tarp + shark <i>lasso</i>	Suspended by the tail
	Disentangled from the net	Handled by the gill slits
<b>Rays</b>	Handled manually (by the side of the wings)	see <i>All</i>
<b>Whale sharks</b>	Rolled above the float line	see <i>All</i>
	Released by cutting the net	
<b>Sea turtles</b>	Held by the side of the shell (longitudinal axis)	see <i>All</i>
<b>All</b>	Use of a hose (delayed release sharks or turtles)	Left on the upper deck
	Use of pieces of netting (sharks, mobulid rays)	Injured by a pointed object
	Other technique	Other unsuitable technique

As sharks are the main group of species incidentally caught by tropical tuna purse seiners, some categories of unsuitable practices had only been designed to collect information on sharks when implementing the first version of form F in 2016. A revised version of the F form was implemented for EMS observers in 2019 to extend these categories to other species. This revised version of the F form has not been tested with onboard observers so far. When possible, data collected by onboard observers were modified to use these improved categories of *Good* and *Unsuitable* practices.

Yet, some onboard observers had already decided on their own to extend the categories initially only designed for sharks to other groups of species (e.g. the category “suspended by the tail” was also used for sharks not handled with both hands or manta rays not handled by the side of the wings) without always providing comments to check the validity of collected data. Comments were also often missing for techniques categorized “other” *Good* or *Unsuitable* practices for fishing trips by onboard observers.

Finally, some categories of *Unsuitable* practices such as a category *dragged on the upper deck, thrown on the upper deck or not observed / observable* were clearly missing in the F form where they were often reported by electronic observers in their comments. These categories have been added when preparing for analysis of the data.

## **2.3 Assessment of the application of Best Practices**

### **2.3.1 Number of individuals handled with *Good* and *Unsuitable* Practices**

The 2016 version of the F form does not allow collecting information separately for each individual of a sensitive species (Annex 2). Observers report a total number of individuals handled with *Good* practices along with a list of categories of *Good* practices, without detailed information on the proportion on individuals handled per category of *Good* practice. They also report the number of individuals handled with each category of *Unsuitable* practice, with some individuals counted several times if several *Unsuitable* practices were used for the same animal. The revised version of the F form implemented in 2019 allows solving this issue, but data collected with the 2016 form F could not be translated into this improved format. Therefore, the following assumptions were made when preparing the data for analysis:

*for Good practices*, the total number of individuals handled by *Good* practices reported by the observer was used. The number of individuals handled with each *Good* Practice was calculated as the ratio between the total number of individuals handled by *Good* practices and the number of categories of *Good* practices reported on the same row of the F form.

*for Unsuitable practices*, the total number of individuals handled with *Unsuitable* practices was calculated as the sum of individuals reported for each category of *Unsuitable* practice. The number of individuals handled with each *Unsuitable* practice were those reported by the observer.

### 2.3.2 Proportions and types of *Good* and *Unsuitable* practices

The application of Best Practices was assessed for the period April 2016 – March 2020 using the relative proportions of *good practices*, *unsuitable practices*, *dangerous specimens* and *unobserved / unobservable specimens*. These proportions were calculated:

(i) *per species group* (sharks, whale sharks, small rays, mobulid rays and sea turtles) so as to detect differences due to the size or the dangerousness of handled specimens

(ii) *per year* so as to detect changes in the behavior of purse seine crews over time

(iii) *per ocean and type of observer* so as to detect differences between onboard or electronic observers. Indeed, the two types of observation may provide different results as EMS simultaneously record operations on the upper and the lower decks, while onboard observers must at the same time collect information on discards in lower deck and report on Best Practices in two different locations of the vessel (Briand et al. 2017, Ruiz et al. 2017). In addition, the physical presence of an observer may encourage fishing crews to better apply Best Practices while cameras are easily forgotten.

In addition, the proportion of each handling techniques were calculated for *Good* and *Unsuitable* Practices to understand which techniques are most often used onboard French and associate purse seiners. Results were separated per observation program and ocean.

## 3. Results

### 3.1 Species reported in Best Practices data

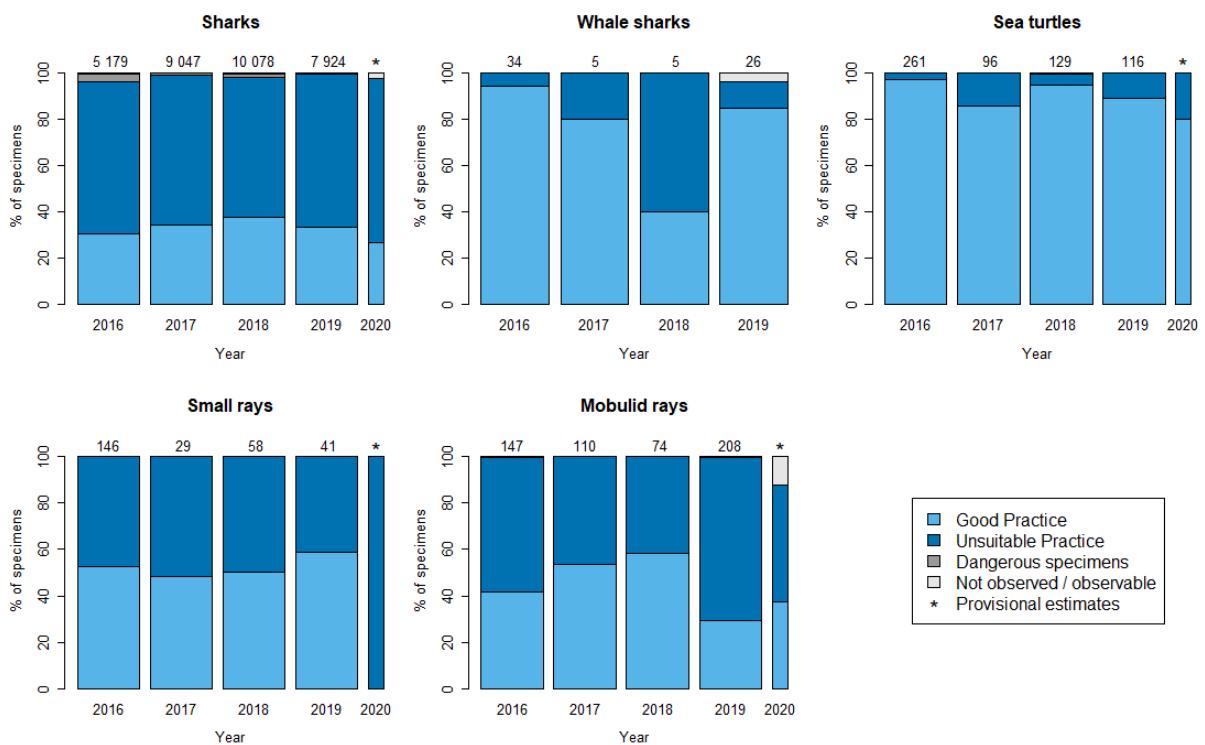
During 2016 – 2020, sharks were the main group of species incidentally caught by French and associated flags purse seiners with 95.6% of the 34 897 individuals reported in Best Practices data. Silky sharks (*Carcharhinus falciformis*) largely dominated the number of incidentally caught sharks with 88.1% of individuals, followed by Carcharhinidae (8.7%) that could not be identified at the species level.

Less interactions were reported for whale sharks that represented 0.2% of individuals in Best Practices data, small rays with 0.8% of individuals, mobulid rays with 1.6% of individuals and sea turtles with 1.8% of individuals. The main species observed for these groups were the *Pteroplatytrygon violacea* (92.5% of observed small rays), *Mobula mobular* (43.4% of mobulid rays), *Mobula japanica* (25.1% of mobulid rays), and *Lepidochelys olivacea* (61.2% of sea turtles).

### 3.2 Proportion of *Good* and *Unsuitable* handling practices

Safe handling techniques were more often applied for sea turtles (94.0% of individuals handled with *Good* practices, figure 3) and whale sharks (85.7% of *Good* practices) than for small rays (52.3% of *Good* practices), mobulid rays (46.0% of *Good* practices) and sharks (34.6% of *Good* practices). All types of observation programs combined, these patterns remained relatively stable over time, fluctuations being often related to the variability in the number of reported individuals.

These results tend to indicate that the techniques considered as *Good* practices are less easily applicable for large individuals (mobulid rays and large sharks), dangerous individuals (large sharks) and less detectable individuals (small rays and small sharks).

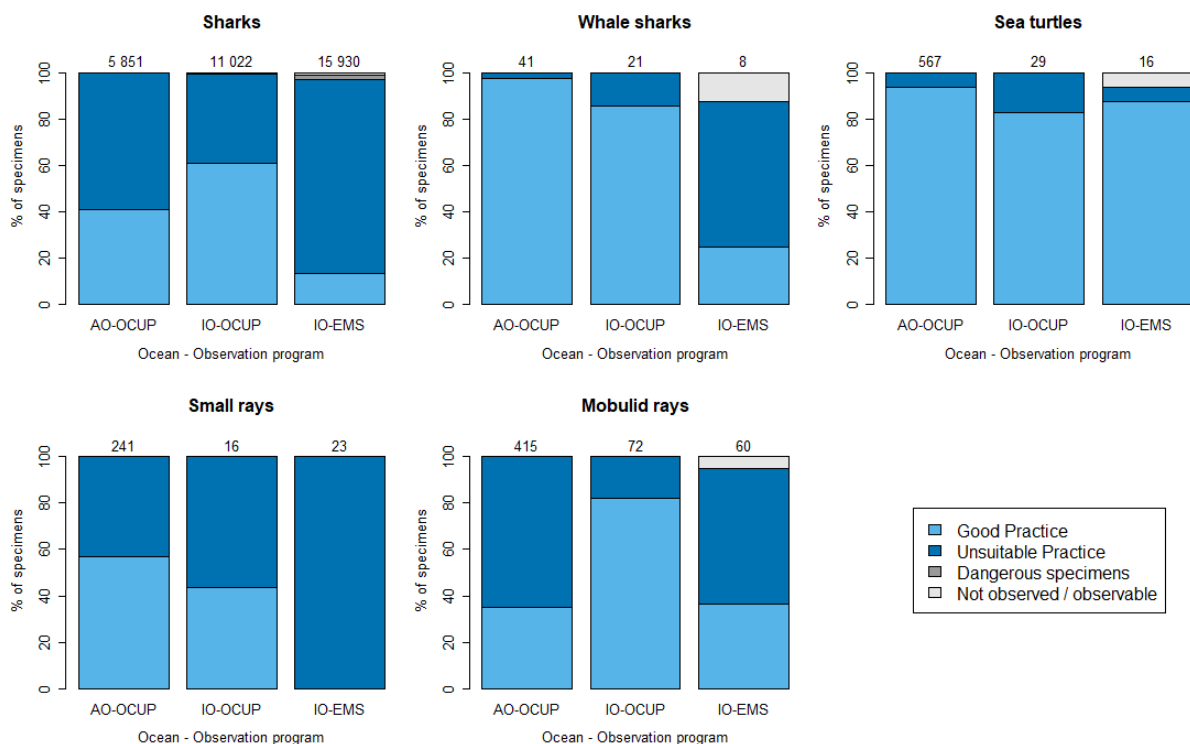


**Figure 3:** proportion of *Good* and *Unsuitable* handling practices per species group and year (April 2016 to March 2020). Numbers of observed specimens are presented on the top of histograms.



The comparison of data collected in the frame on onboard or electronic monitoring programs reveals differences among these two types of observation, as the proportion of reported *Good* practices is generally lower for fishing trips covered with EMS (figure 4). For sharks for example, onboard observers report a proportion of 55.5% of *Good* practices while electronic observers report a proportion of 13.2%. Similar differences are obtained for whale sharks (93.5% vs 25.0%) and small rays (57.1% vs 0%) while no clear difference can be noted between the two types of observation for mobulid rays and sea turtles.

These results indicate that the data collected by onboard and electronic observers are not perfectly equivalent, potentially due to (i) differences in their training to data collection, (ii) their sensitivity to the question of Best Practices and their rigor when collecting the data, (iii) the difficult simultaneous collection of data on discards and Best Practices for onboard observers, (iv) or the positive effect of the physical presence of an observer onboard on the efforts made by fishing crews to release individuals of sensitive species.

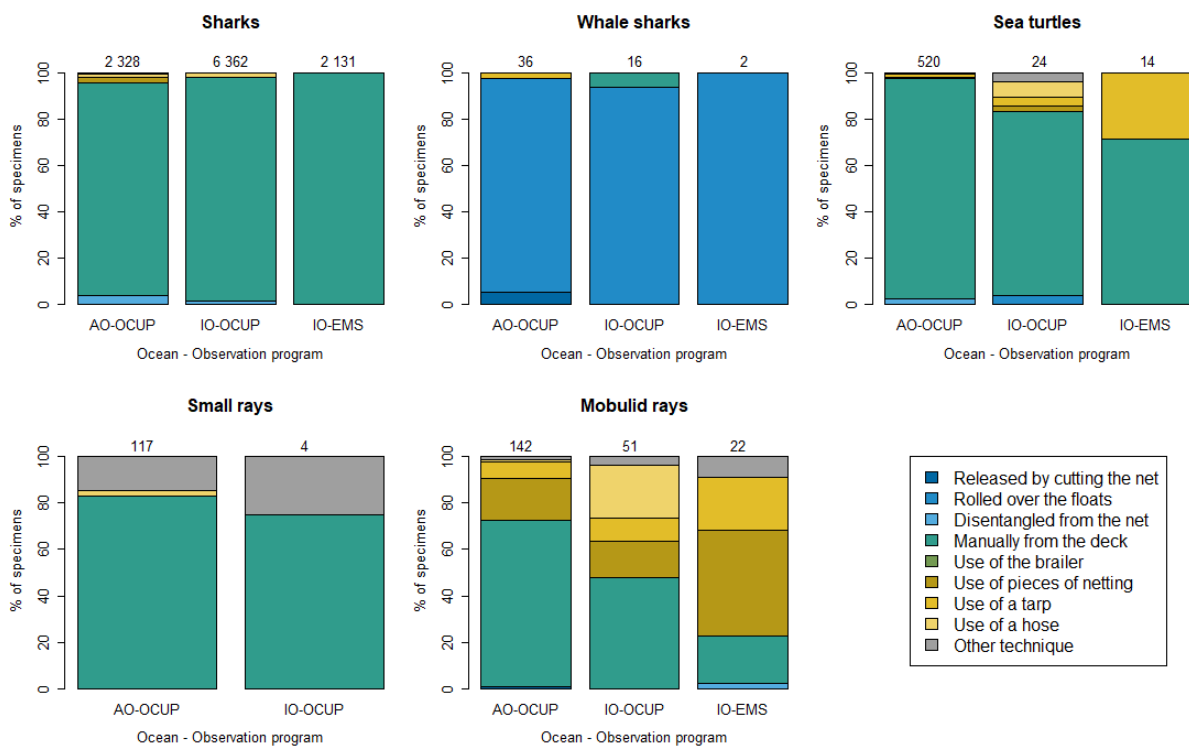


**Figure 4:** proportion of Good and Unsuitable handling practices per species, per type of observer program (OCUP: Onboard Observation, EMS: Electronic Observation) and per ocean (AO: Atlantic Ocean, IO: Indian Oceans) reported from April 2016 to March 2020. Numbers of observed specimens are presented on the top of histograms.

### 3.3 Types of *Good* and *Unsuitable* handling practices

From 2016 to 2020, when released with *Good* practices, whale sharks were most often rolled over the floats (92.6% of correctly released whale sharks) while other species were most often handled manually (figure 5). The use of specific equipment was less frequent except for mobulid rays for which pieces of netting were used in 20.3% of the cases of correctly released mobulids and plastic tarps were used in 9.3% of the cases.

No notable change in the types of Best Practices used by purse seiners over time and no notable differences were observed among types of observers. These results suggest that the recommended Best Practices have been well understood by fishing crews, even with the high turnover in fishing crew members. Small differences in the techniques used for sea turtles and mobulid rays were reported among oceans and types of observations. However, these differences may be an artefact of the smaller numbers of individuals reported in Best Practices data in the Indian Ocean.



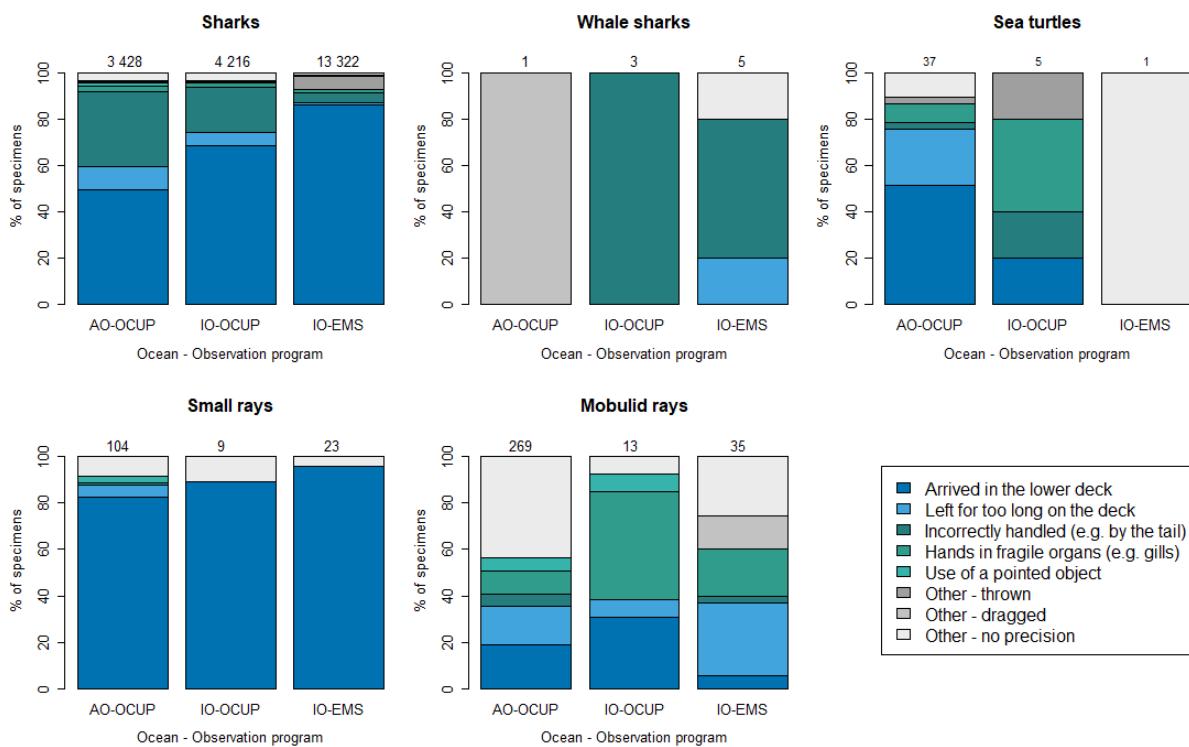
**Figure 5:** types of *Good* handling practices per species, per type of observer program (OCUP: Onboard Observation, EMS: Electronic Observation) and per ocean (AO: Atlantic Ocean, IO: Indian Oceans) reported from April 2016 to March 2020. Numbers of observed specimens are presented on the top of histograms.

For individuals released with *Unsuitable* practices, the category “arrived in the lower deck” was the most frequently reported by all types of observers for sharks and small rays (figure 6) with respectively 79.1% and 88.5% of individuals. Though information on the size of such individuals was not available

for the present study, this result tends to indicate that small sharks and small rays are not easily detected when the brailer is transferred into the hopper.

Other issues detected by observers were the incorrect handling of sharks (12.5% of the incorrectly handled sharks suspended by the tail), manta rays left for too long on the upper deck (21.4% of the incorrectly handled manta rays), manta rays handled by the cephalic fins or gill slits (15.3% of the incorrectly handled manta rays), hands inserted under the shell of sea turtles (14.7% of the incorrectly handled sea turtles). Though these observations were made for only a fraction of individuals of sensitive species arrived onboard, they provide useful information for a future individualized training of purse seine crews.

Finally, differences were observed among types of observers as electronic observers tended to be more rigorous in their appreciation of *Unsuitable* practices. Indeed, electronic observers reported numerous of sharks being thrown on the upper deck in their comments (5.6% of incorrectly handled sharks, figure 6) and a far larger proportion of sharks arrived in the lower deck compared to estimates made by onboard observers (86.0% for EMS fishing trips in the Indian Ocean, 68.6% for onboard observation in the Indian Ocean and 49.7% for onboard observers in the Atlantic Ocean).



**Figure 6:** types of unsuitable handling practices per species, per type of observer program (OCUP: Onboard Observation, EMS: Electronic Observation) and per ocean (AO: Atlantic Ocean, IO: Indian Oceans) reported from April 2016 to March 2020. Numbers of observed specimens are presented on the top of histograms.

## 4. Discussion

### 4.1 Monitoring Best Practices: is it that simple?

#### *The issue of individuals arriving in the lower deck*

The analysis of the data collected from 2016 to 2020 revealed that a large proportion of sharks and small rays arrive in the lower deck of French and associated fleets purse seiners. Though size data was not available for the present study, part of the sharks arriving in the lower deck may be small size individuals, that are not easily detected when brailers are transferred into the hopper for a fast presorting of the catch, before being transferred in the lower deck trough the loading hatch. In that case, one may consider that since it is not easy to prevent small sharks from arriving in the lower deck, such cases should not be considered as an *Unsuitable* practice but as “residual unavoidable mortality” (Grande et al. 2019).

Also, most French and associated purse seiners are equipped with a discard belt which allow a fast release of sharks arrived in the lower deck (Briand et al. *in preparation*). For these vessels equipped with a discard belt, the chances of survival of small sharks may be increased compared to other vessels where fishing crews need to stop sorting the catch in the lower deck, cross the conveyor belt and bring the shark back on the upper deck for a manual release (Poisson et al. 2014). All these steps are obviously impractical in real fishing conditions and discard belts represent a real improvement of vessel configuration though they were initially designed for the fast discard of small individuals of bycatch species.

However, the chances of survival of sharks arrived in the lower decreases compared with individuals released from the upper deck. Indeed, during 3 fishing trips in 2011 and 2012, Poisson et al. (2014b) estimated that 40% of sharks detected on the upper deck were already dead against 73% in the lower deck. Passing through the loading hatch can easily cause trauma to sharks internal organs, that are not protected by a rigid skeleton. In addition, it is not possible to release large sharks using the discard belt in the lower deck, since the width of waste chute is not large enough. For large sharks, even for vessels equipped with a discard belt, there is therefore a non-negligible risk of delayed release once detected in the lower deck.

For all these reasons, the release of sensitive species from the lower deck should either not be considered fully as a *Good* or as an *Unsuitable* practice. The configuration of purse seiners and fishing sets should be taken into account to correctly assess the efforts made by purse seine crews and provide them adequate guidance to safely release sensitive individuals (see 4.2).

#### *The issue of the differences between onboard and electronic monitoring*

The results we obtain when analyzing Best Practices data also clearly indicate differences among types of observers, electronic observers being more rigorous in their appreciation of the efforts made by fishing crews. These differences may be related to the ability of EMS to record simultaneously all operations on the upper deck and in the lower deck (Ruiz et al. 2017) as cameras are placed in these two locations (Briand et al. 2017). Also, contrary to onboard observers, electronic observers can separate the task of collecting data on discards from the task of collecting data on Best Practices. They also have the possibility to analyze EMS records as many times as necessary to collect these data. Therefore, onboard observers may miss part of the individuals handled on the upper deck when they

are busy collecting data on discards in the lower deck, which should remain their primary task as scientific observers. Yet, our results suggest that onboard observers would greatly benefit from cameras installed onboard to better collect data on Best Practices. A combined onboard and electronic observation would probably also be useful to both types of observers when collecting data for scientific purposes, to ensure that all individuals of sensitive species have been detected (Briand et al. *in prep*).

On the other hand, differences between onboard and electronic observers could also be the result of differences in their sensitivity to the question of Best Practices. Electronic observers are often former observers of the EU-DCF program, with a strong background in biology, that have been working for several years as full-time observers. As part of the OCUP program, some observers, boarding in the frame of fishing agreements (Goujon et al. 2017a-b), are only present onboard for a few fishing trips and may consider the collection of information on Best Practices as a secondary task. Several years of experience in the frame of the OCUP program have underlined the need for an individualized and continuous training of observers to improve data collection on discards (Maufroy and Herrera 2019), our results indicate that this training should also cover the collection of data on Best Practices.

#### *The issue of the objectivity of collected data*

Another potential issue detected when analyzing the data collected onboard French and associated purse seiners is that it is extremely difficult to grant the objectivity of both data collection and analysis when it comes to a subject as sensitive as Best Practices. Of course, when it comes to sharks, small and mobulid rays, the data collected since 2016 indicate that the application of Best Practices remains difficult for large, dangerous or undetectable individuals of sensitive species. However, our results also indicate that the need for *Best Practices* has been well understood by French and associated purse seine crews. The transparent results presented in this document provide the framework for future improvements in the training and the information of both purse seine crews and scientific observers.

They also provide the framework for an improvement of data collection on Best Practices in the F form. Among others, preparatory work to the analyses presented in this document has revealed the need to carefully design Best Practices data collection, so as to ensure that collected data really achieve the objectives of Best Practices programs. Such data should provide information on the potential survival of sharks, whale sharks, rays, mantas rays and sea turtles incidentally caught by tropical tuna purse seiners, though this survival can only be fully assessed through the tagging of released individuals. They should also provide all the necessary information to assist purse seine crews and fishing companies in this task.

The question of sharks being transferred in the lower deck is a good example of the questions raised by the analysis of Best Practices data. As stated previously, this example illustrates the difficult classification of some handling techniques as fully *Good* or *Unsuitable*. It also suggests that the terminology used so far may need to be refined to separate *Good* (techniques that enhance the survival of individuals) from *Conform* handling techniques (combination of a *Good* technique and information on the configuration of the vessel, the behavior and the size of the individual, etc). This change of terminology would not only grant the objectivity of collected data but would also be useful to provide adapted support to purse seine crews in their efforts to safely release individuals of sensitive species.

## 4.2 The future for Best Practices onboard French and associated flags purse seiners

### *Should we update the Guide of Best Practices released in 2012?*

One of the questions raised over the years is *what should be considered as a Best Practice?* And in particular, should we consider that all efforts made to decrease the environmental impacts of tropical tuna purse seine fleets are *Best Practices* and update the manual of Best Practices published in 2012 (Poisson et al. 2012) to cover all potential topics? Due to their impacts in terms ghost fishing of sharks and sea turtles or habitat degradation of some of these sensitive species, recommendations on the use of non-entangling and biodegradable Fish Aggregating Devices (FADs) could be included in the manual of Best Practices. However, to avoid confusion for purse seine crews between suitable (Best Practices) and mandatory techniques (measures adopted by IOTC and ICCAT) the decision was made not to include non-entangling (NEFADs) and biodegradable (BIOFADs) FADs in future updates of the manual of Best Practices. This does not prevent French and associated fleets to report on their use of NEFADs in their fishing/FAD logbooks as provided for by IOTC and ICCAT CMMs and national FAD management plans (ICCAT 2019, IOTC 2019, Maufroy et al. 2019).

Nevertheless, the manual of safe handling practices of sensitive species released in 2012 was a snapshot of the best available techniques recommended at that time. Almost a decade later, additional recommendations have been made by scientists and could be considered as new material for the manual. This includes for example reducing the proportion of fishing sets on Floating OBjects (FOBs), targeting larger FOB schools or releasing sharks from the net rather than from the upper deck (Dagorn 2012b, ISSF 2016). Other recommendations, based on techniques developed by some purse seine crews may also be considered when revising the manual. To do so, collecting feedback from purse seine crews and observers would be necessary.

### *Improving data collection and training to Best Practices*

The last eight years of Best Practices have been highly instructive and the results presented in study, combined with the feedback provided by observers, purse seine crews and ORTHONGEL member fishing companies provide useful information for the future of Best Practices onboard French and associated flags purse seiners. In a new project, started in 2020, the F form will be fully redesigned to ensure that Best Practices data are fully objective. The new form, will be designed to monitor as precisely as possible the sequences of handling techniques used by the crew on each individual of a sensitive species, while taking into account the factors that affect the applicability of the most suitable handling techniques (vessel configuration, dangerousness and detectability of individuals, etc).

The information collected during this first phase of the project will also serve as a basis to improve the training of fishing crews and observers. Solutions to be tested include more frequent training sessions, not only in France where only a fraction of the crew can be trained by also in the main landing ports, and potentially with observers so that everyone present onboard receives the same information. This individualized and continuous training could be based on the continuous analysis of the data collected by observers using the simple metrics presented in this document.

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**ANNEX 1:** content of French manual of Best Practices (Poisson et al. 2012)

<b>Group or species</b>	<b>Recommended Best Practices</b>
Small pelagic sharks	Handle with both hands Release as fast as possible from the deck or the lower deck Do not hold the animal by the tail or the head Do not insert hands in gill slits Do not expose the animal to the sun Do not expose the animal to physical trauma Be cautious and avoid the jaws for safety reasons
Medium pelagic sharks	Handle the shark with two persons Release as fast as possible from the deck Do not hold the animal by the tail or the head Do not insert pointed objects in the body or the gills Do not expose the animal to the sun Do not expose the animal to physical trauma Be cautious and avoid the jaws for safety reasons
Small and medium rays	Handle small mobulids by the side of the wings with 2-3 persons Do not carry the ray by its tail for safety reasons Do not drag or hold the animal by its cephalic lobes Do not insert hands in gill slits Do not insert pointed objects in the body Do not expose the animal to the sun
Large animals	Use the brailer, a piece of net or another device to release the animal from the deck Do not bind wire tightly around the animal's body Do not insert wire into the skin
Whale sharks	Release from the net (rolling above the float line)
Sea turtles	Hold by the side of the shell Return the turtle gently to the sea from the deck Keep the skin and eyes moist Do not place the animal upside down Do not expose the animal to the sun Do not lift the animal by the flippers
Entangled animals	Reduce the speed of the net reel before releasing the animal safely from the net Avoid tugging or yanking the net strongly

## ANNEX 2: F form for the monitoring of Best Practices (2016 version)



### Programme d'Observation OCUP

Formulaire F

#### Mise en œuvre des bonnes pratiques Raies - Requins - Tortues

(à remplir uniquement pour les individus arrivés vivants à bord et observés par l'observateur)

Ligne	Formulaire B	Code espèce	Mise en œuvre BP		Autres pratiques utilisées (nombre d'individus)						Individus dangereux impossibles à manipuler pour des raisons de sécurité	Bonnes pratiques non observables	Commentaires : description des bonnes pratiques mises en œuvre si identifiées comme nouvelles blessures et soins éventuellement apportés aux individus
			Nombre d'individus bien manipulés	Type de bonnes pratiques mises en œuvre (code voir tableau)	Individus laissés sur le pont	Individus suspendus par la queue	Individus pris par les ouïes	Individus Blessés par un crochet	Individus piégés dans le faux pont	Autres mauvaises pratiques			
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Commentaires généraux sur la mise en œuvre des bonnes pratiques : description / avis / solutions à tester