AN UPDATE ON BEST PRATICES ONBOARD FRENCH AND ITALIAN TROPICAL TUNA PURSE SEINERS OF THE ATLANTIC AND INDIAN OCEANS: OUTCOMES AND ONGOING PROJECTS

Wain G.[1], Maufroy A. [1] and Goujon M. [1]

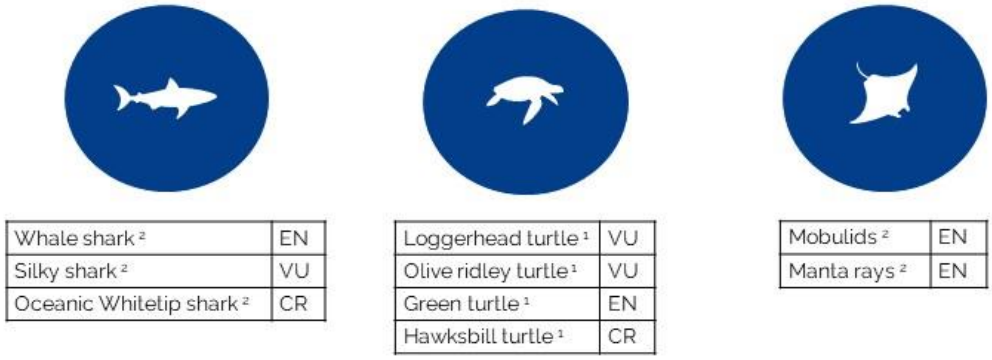
Abstract

The issue of mortality of sensitive species incidentally caught by fishing vessels has become a major concern for the sustainability of fisheries, in the last decades. In 2012, 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, 2014b). Eight years after the publication of the manual on Best Practices, a comprehensive assessment of the application of best practices on board French and associated flag purse seiners has been carried out (Maufroy et al. 2020). This study highlighted several issues. Following this, changes were made to the observation programs and new projects were set up. This paper presents the various modifications made as well as the new programs launched by ORTHONGEL and its member shipowners.

[1] ORTHONGEL, 5 rue des sardiniers, 29 900 Concarneau, France. gwain@orthongel.fr

1. Introduction

During the last decades, the issue of mortality of sensitive species incidentally caught by fishing vessels has 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, 2011), regional (European Commission 2009; ICCAT 2018; IOTC 2017) or fisheries (Goujon 2015; Grande et al. 2019; Hutchinson et al. 2015; ISSF 2016; ORTHONGEL 2011; Poisson et al. 2012) level to address these issues. In the case of tropical tuna purse seine of the Atlantic and Indian Oceans, the rates of bycatch are generally low and bycatch is dominated by teleost fish (Amandè et al. 2010, 2012). Incidental catches comprise particularly vulnerable species of sharks, rays, mobulids rays and sea turtles (Amandè et al. 2010, 2012; Ruiz et al. 2018). These species fished by tropical tuna seiners are mostly classified on the IUCN Red List (Figure 1). These species are also listed in Appendices I or II of CITES.



Whale shark [2]	EN
Silky shark [2]	VU
Oceanic Whitetip shark [2]	CR

Loggerhead turtle [1]	VU
Olive ridley turtle [1]	VU
Green turtle [1]	EN
Hawksbill turtle [1]	CR

Mobulids [2]	EN
Manta rays [2]	EN

Figure 1: Status of the species on the IUCN red list with VU: vulnerable, EN: endangered and CR: critically endangered. 1: Appendix 1 lists species that are the most endangered among CITES listed animals and plants. 2: Appendix 2 lists species that are not necessarily now threatened with extinction but that may become so unless trade is closely controlled.

Few data are available for these sensitive species, so it is difficult to be able to estimate with certainty their stock status. Several stock assessments have been made, particularly for sharks (blue shark (ICCAT 2015), shortfin mako (Bonhommeau et al. 2020; ICCAT 2019), silky shark (Cramp, Moss, and Tanna 2021)). These studies have a common conclusion that estimates are uncertain due to a lack of data.

The scientific observation of fishing vessels is an essential tool for data collection in the context of ecosystem-based fisheries management (FAO 2003) implemented by Regional Fisheries Management Organizations (RFMO). These programs can be an aid to respond to the challenges of the fishery linked to sensitive species in various ways: (i) improving the survival rate of ETP species with the implementation of safe handling and release techniques in collaboration with crews, (ii) improving the survival rate of ETP species with training of fishers and observers and (iii) collecting data with sufficient quality to support stock assessment. This document presents the project set up by ORTHONGEL and its members to meet these three objectives.

2. Improving the survival of ETP species onboard French and Italian tropical tuna purse seiners

2.1. Best Practices 1.0 (2014-2020)

In 2012, 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, 2014b). 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 countries of the Atlantic and Indian Oceans (Goujon et al. 2017a; Goujon et al. 2017b), 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, an electronic monitoring extension of the program was also implemented (Electronic Eye Optimization “OOE” Project for the Future, Briand et al. 2017). The observer coverage rate has rapidly increased in the Atlantic and Indian Oceans, offering the opportunity to monitor the application of Best Practices on most fishing trips.

Eight years after the publication of the manual on Best Practices, a comprehensive assessment of the application of best practices on board French and associated flag purse seiners has been carried out (Maufroy et al. 2020). This made it possible to highlight different issues and to consider improvements: (i) the issue of individuals arriving in the lower deck (ii) the issue of objectivity of collected data (iii) improving training to Best Practices. Based on these observations, ORTHONGEL initiated in 2021 a new *Project for the Future*, called *Best Practices 2.0* whose objectives are to further improve the monitoring of the application of Best Practices and to support fishing crews in this application as well as observers in this monitoring.

2.2. Best Practices 2.0 (since 2021)

2.1.1 Objective 1: Improving the data collection form

A dedicated observation form (F form) is routinely used since 2016 by onboard and electronic observers to monitor the application of recommended handling practices on sharks, whale sharks, sea turtles, small rays and large rays. The comprehensive assessment of Best Practices data carried out in 2020 revealed that the form required an in-depth revision to improve the objectiveness of the data collected by observers. It also highlighted the need to revise the structure of the form, so as to facilitate the routine analysis with automatized tools (Maufroy et al. 2020). The F form structure was therefore completely revised by ORTHONGEL in 2021 with the help of the OCUP coordination team, OCUP onboard and electronic observers and IRD.

Revision 1: groups of species

The handling of individuals is strongly linked to the size of the individual, the ease of handling the individual, its behaviour, the frequency of capture and the ease of detecting the individual in the net and onboard. Since these parameters are strongly

linked to the type of animal that is handled by fishing crews, it was decided to separate the F form into 4 groups of species: sharks, whale sharks, rays and turtles.

Revision 2: types of handling practices
It is essential that the types of handling practices that may be used by fishing crews are perfectly clear to facilitate data collection by onboard and electronic observers. In addition, it is critical that observers are not required to judge the work of fishing crews, since observers are not controllers and should collect information in an objective manner.

For a given group of species, the different types of handling practices were therefore organized per observation location: (i) individuals in the net (whale sharks), (ii) entangled in the net, (iii) on the upper deck and (iv) in the lower deck. This modification clarifies the structure of the form for the observer and facilitates the collection of exhaustive information.

For a given observation location, the types of handling practices were also classified either as (i) recommended practices: type of manipulations, in the strict sense, which improves the individual's chances of survival (ii) second chance practices: though the survival of individuals is lower in the lower deck compared to the upper deck (Poisson et al. 2014a), type of manipulations, used in the lower deck, which improves the individual's chances of survival when the individual could not be detected on the upper deck (iii) unsuitable practices: a type of manipulation, in the strict sense, that decreases the individual's chances of survival. This modification emphasizes the importance of releasing individuals of sensitive species from the upper deck, where their chances of survival are higher, while allowing documenting the efforts made by fishing crews in the lower deck.

Revision 3: exhaustive data collection per individual
In its previous version, the F form only allowed reporting information on handling practices for several individuals at the same time. It was therefore impossible to properly calculate the proportion of individuals which were handled with a given technique. The structure of the form has therefore been modified, so as to fill one row per individual and report the full sequence of recommended, second chance and unsuitable practices that the crew may have used to release a given individual.

Revision 4: recommended practices vs conformity
Until the revision of the F form, observers were requested to collect information on *Good* and *Bad* Practices and therefore, to judge by themselves of the work of the fishing crew. The change of terminology from good/bad to recommended/second chance/unsuitable practices address this issue. For the same reason, it was decided that the *conformity* of sequences of handling techniques should not be assessed by observers themselves, but by data analysts based on objective criteria.

Since the application of recommended practices may not be possible under certain conditions, that are independent from the fishing crew, the notion of context has therefore been added to the form. This makes it possible to put the manipulations in

the context specific to the situation at the level of the vessel (lack of appropriate handling gear, technical issue ...), the individual (dangerous, in large numbers ...) or external elements (weather ...) and to identify which unsuitable situations could or could not have been avoided by the fishing crew. This revision allows to separate *conform* sequences of handling practices from *non-conform* sequences. Any handling of an individual with at least an unsuitable practice, that cannot be related to a given context, will be classified as *non-conform* during the analysis of the data by ORTHONGEL, so as to draw recommendations to the fishing crew for next fishing trips, and to the fishing companies if improvements should be made on the configuration of the vessel or the availability of appropriate handling equipment on board.

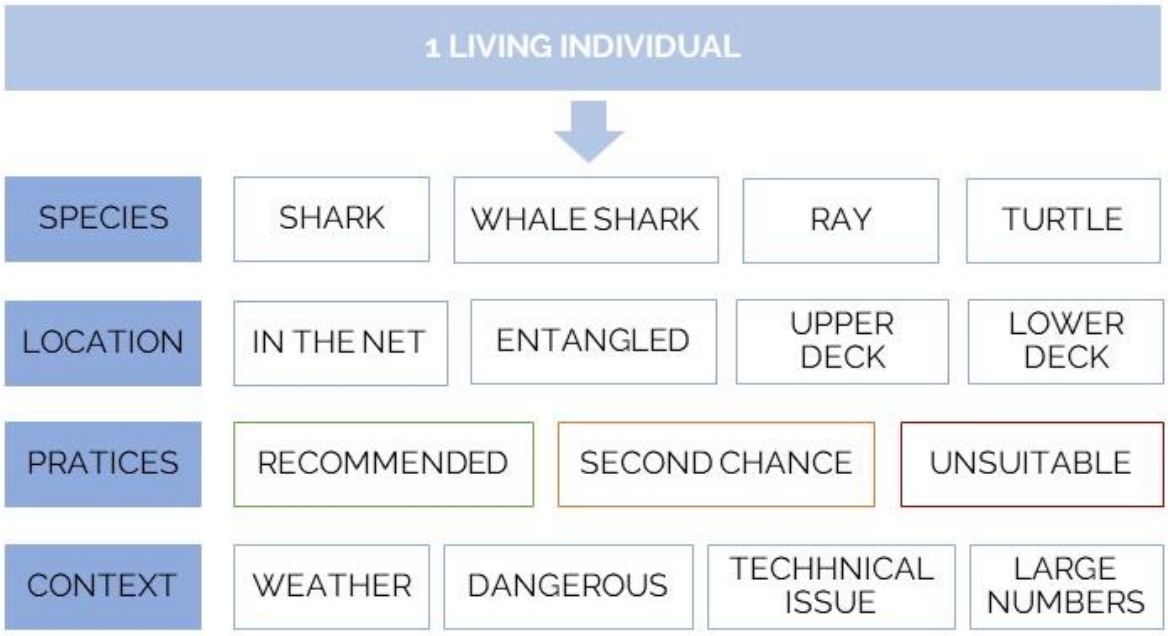


Figure 2: Structure of the F form

After a phase of test by electronic observers since July 2021 and onboard observers since April 2021, the revised F form (Appendix 1) has been deployed in January 2022 in the frame of the OCUP-program. Collected data are analysed by ORTHONGEL at the end of each fishing trip. These analyses and conclusions are shared both with fishing crews and observers in a logic of progress (respectively in their application of recommended practices or their data collection in the F form and advice to the crew during the fishing trip).

2.1.2 Objective 2: Improving data collection by observers

Of course, revising the structure of any data collection form requires training onboard and electronic observers to this new form. Onboard and electronic observers are progressively required to attend a refresher training session in the frame of the OCUP program, which includes, among others a training to the new F form. During this training session, advice is also given on the appropriate attitude that onboard observers should adopt with fishing crews (e.g., no judgement, as it is the responsibility

of ORTHONGEL and the fishing company to assess the conformity of the work done by the fishing crew).

Once onboard observers have received the initial training on the F form, a continuous training is provided by ORTHONGEL, in collaboration with the OCUP coordination team. On their return, onboard observers debrief the data collected with ORTHONGEL in order to close data gaps or correct the data if necessary. An individual follow-up of observers, with objective criteria on their use of the F form, has also been set up to assess their progress and provide adequate individualized training.

2.1.2 Objective 3: Supporting fishing crews and fishing companies

Training of fishing crews

Starting in 2022, fishing crews will attend training sessions on Best Practices, preferably onboard, so that all nationality of fishers can attend these sessions. The training, provided by ORTHONGEL, allows the crew to be shown the recommended manipulations (Poisson 2012). It also makes it possible to present the role of observers and the data collected in the framework of the OCUP project. A first training session was organized in the Atlantic Ocean (Abidjan) in April 2022, 5 purse seiners and 6 crews followed the training. Sessions will be organized onboard vessels of the Indian Ocean hopefully before the end of the year.

These trainings are also an opportunity to exchange with the crews on Best Practices. These exchanges are important to identify needs for releasing gear onboard and present projects related to Best Practices to the fishing crews.

Recommendations to fishing crews

The revision of the F form with clear and objective information allows a routine monitoring of Best Practices at the scale of the fishing crew shift, so as to provide each crew adequate and individualized training. In May 2022, ORTHONGEL started a routine analysis of the data collected in the F form by onboard and electronic observers. Based on this analysis, ORTHONGEL provides the fishing crew a follow-up report that (i) assesses the application of Best Practices during their previous fishing trip and (ii) makes recommendations for the next fishing trip.

Releasing gear and improved onboard configuration

Exchanges during training sessions and analysis of the data collected in the F form provide important feedback on the applicability of recommended handling practices. It is expected that this improved communication between fishers, fishing companies, observers and ORTHONGEL will provide new insights on the needs of fishing crews onboard, including on the development of new releasing gear, or on the improvement of vessel configuration to release sensitive species easily and safely.

These exchanges will also be important for the elasmobranch project which should be launched in 2023. Indeed, the goal of the project will be to estimate the survival rate of elasmobranch species according to the equipment used for release. The first stage of the project will therefore be to work with crews and the companies to identify the best equipment for each vessel.

3. Contributing to high quality scientific data collection

3.1. Onboard scientific observers: OCUP 2.0

In 2013, ORTHONGEL implemented the OCUP program to facilitate the boarding of scientific observers of coastal countries in collaboration with Oceanic Développement (now named Bureau Veritas Living Resources, BVLR), the French Institute for Research and Development (IRD) and 10 coastal countries of the Atlantic and Indian Oceans. Since 2013, onboard OCUP observers brought the complement of observer coverage to reach 100% of coverage of fishing sets in the Atlantic Ocean since 2015 and 62% in the Indian Ocean in 2021 (due to COVID-19 pandemic). In addition, the Electronic Monitoring System (EMS) was implemented in 2014 for purse seiners when embarking observers was not possible, covering 39% of fishing sets in the Indian Ocean in 2021 (Figure 3).

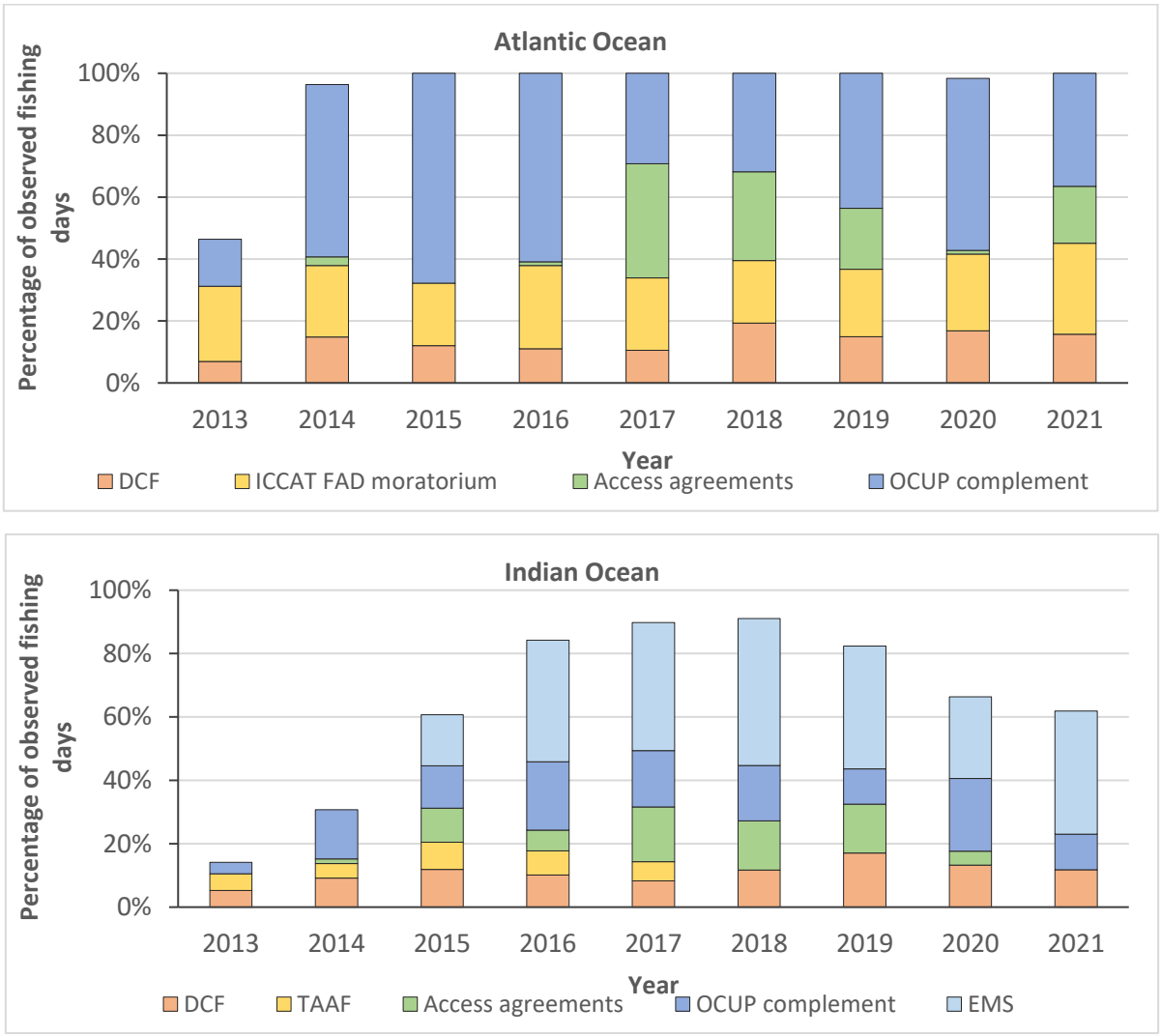


Figure 3: Observer coverage for the period 2013 – 2021 for Atlantic (top) and Indian (bottom) oceans.

This increased coverage rate has contributed to a large increase in the amount of scientific data collected on bycatch and sensitive species. These data could contribute

to a better assessment of stock status for species under t-RFMOs' mandate, provided that their quality is sufficient. However, with the increasing contribution of less-experienced observers boarding in the frame of fishing agreements and the increased volume of collected data, the amount of data corrections (e.g. errors in species identification, Figure 4) has increased.

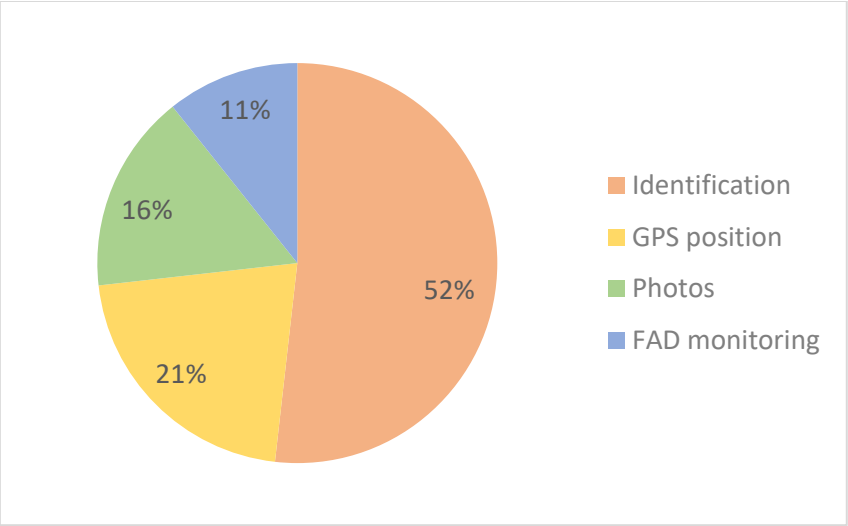


Figure 4: Errors frequently encountered in the observer's data. Errors reported by IRD in June 2020

Collaboration between partners of the OCUP program underlined the need for an improved individual follow-up of observers. In 2022, a refresher session was made for observers from Atlantic and Indian oceans (Abidjan, Seychelles). This training session made it possible to reintroduce all the data collection protocols and the Best Practices 2.0 protocol. It also reminded observers of their role, the importance of the data collected and of the appropriate attitude they should adopt onboard. This training session is completed by a continuous training provided by Bureau Veritas Living Resources and ORTHONGEL. Currently, partners of the OCUP program are working on the establishment of a follow-up report for observers. This report will permit to assess their progress and to provide them with personalized advices and recommendations. A follow-up report is already in place for the Best Practices protocol and the F form.

3.2. Electronic scientific observers

3.2.1. SIDEO project

Pilot studies carried out on tuna seiners have shown that electronic observation (EO) has various advantages, including simultaneous observation of various areas of the deck and lower deck (not feasible by the observer on board) necessary to monitor interactions with sensitive species (Briand et al. 2017; Chavance et al. 2013; Monteagudo et al. 2015; Ruiz et al. 2015). In addition, recordings that can be slowed down or viewed several times, also allow the electronic observer to conduct exhaustive counts of individuals on rejection belt and follow Best Practices (Briand et al. 2018, 2021). However, EO has some limitations due to the presence of blind spots or the distance to the camera, sometimes preventing the full observation of individuals of

sensitive species and/or their identification at the species level (Briand et al. 2017; Forget et al. 2021; Monteagudo et al. 2015; Ruiz et al. 2015).

In 2016, a first work of analysis of the recordings (Bonnieux and Relot-Stirnemann 2016) had highlighted several shortcomings of the EO in terms of data collection, including (i) the inappropriate setting of some cameras that do not allow to obtain quality data and (ii) the absence of an observation protocol and scientifically validated data collection. Since 2016, the partnership between IRD scientists, ORTHONGEL and the CFTO company has made it possible to gradually improve the configuration of the EO onboard tuna seiners equipped with this tool in the Indian Ocean. Through the Tuna Future Contract Optimization of Electronic Eye (CAT OOE – from 2016 to 2018) and the routine operation of the EO component of the OCUP programme (since 2018), initial solutions to these EO shortcomings have been proposed. However, despite improvements in EO configuration since 2016, which make this observation tool at least as effective as on-board observers in estimating discards of tuna and the most frequently caught by-species (Briand et al. 2017; Ruiz et al. 2017), a problem of underestimation and identification of incidental catches of sensitive species remains, particularly for sharks (Briand et al. 2021; Forget et al. 2021; Sieben, Gascoigne, and des Clers 2020). Difficulties in monitoring Best Practices were also noted (Maufroy et al. 2020).

The comparative analysis of EO and onboard data collected over the period 2014-2018 confirmed an underestimation of the order of 30 to 50% of the catches of silky shark (*Carcharinus falciformis*) and of the order of 75% for the catches of oceanic shark (*Carcharhinus longimanus*). The work carried out also highlighted the significant amount (17%) of sharks for which the EO does not make it possible to identify an individual at the species level with particularly important difficulties in placing the cameras on the deck (Briand et al. in prep). To compensate for this underestimation, which amounts to a total of 65% of sharks (all species combined), various recommendations have been made by Forget et al. (2021). The recommendations made by these authors include, among other things, a methodology for exhaustive shark counting by on-board observers. This methodology will be used to improve the configuration of the EO in the framework of the SIDEO project.

3.2.2. Objectives

In its current configuration, the Electronic Eye does not meet all the needs of scientists and fishermen in terms of monitoring incidental catches of sharks and their release into the water. For scientists, it does not allow the collection of sufficiently exhaustive, detailed and reliable data that would allow the provision of information to RFMOs. For fishermen, it makes it more difficult to support crews in the application of Best Practices for the release of sensitive and dangerous species such as sharks. It also reduces the chances of certification, in particular through the MSC label, whose specifications impose various obligations for the monitoring of sensitive species and participation in good fisheries management.

As part of the SIDEO project, the first approach to be explored will be to define an EO configuration optimized for shark watching, with priority given to observation on the

deck where the difficulties are currently greatest. For this, two parameters must be taken into account:

(i) the ability to observe all sharks that have been boarded and released into the water. Blind spot issues will therefore be solved, using a camera configuration to follow a wider field on the deck.

(ii) the ability to identify each of the sharks observed at the species level. Since the current distance between the cameras and shark handling areas is often too great, this problem will be solved by adding a camera closer to the main handling area on the deck.

(iii) the ability to follow shark handling practices (Best Practices) from their arrival on deck of vessels to their release into the water. In parallel with the resolution of the problems of blind spots and distance of the cameras, work will be done on the quality of the recordings.

For this first objective of the SIDEO project, an optimized installation of the EO (models and placement of cameras) will be recommended for each ship configuration group. It will be deployed on board all CFTO ships at the end of the project.

If improving the configuration of the Electronic Eye on board is an essential work step, the routine operation of this tool must also be taken into account if we want to make the most of it. The maintenance of the cameras, the working methods of the crew or the training of observers. Electronic parameters are all key parameters that can significantly improve or compromise the comprehensive monitoring of sharks and their identification at the species level.

The SIDEO project will make it possible to formulate various recommendations for an optimized use of the EO, intended for companies, crews, electronic observers as well as scientists. These recommendations will include:

(i) Best Practices for crews and companies. The Best Practices Guide drawn up jointly between ORTHONGEL and IRD and Ifremer scientists in 2012 (Poisson et al. 2012) will be updated to include recommendations for better monitoring of incidental catches of sharks and their release into the water.

(ii) recommendations to the scientific community and managers. The partners of the SIDEO project will participate, among other things, in the definition of the standard minimums dedicated to the electronic observation of sensitive species. The electronic compliance protocol will also be updated.

4. Conclusion

Continuous work is needed to improve the quality of data collected by observer in the framework of OCUP programme. Regarding onboard observation, this work focuses on several components: (i) the improvement of data collection protocols and associated forms, (ii) the establishment of regular training and the follow-up of observers, and (iii) training and follow-up of crews. For electronic observation, in addition to the training of observers, work on the configuration of equipment is necessary. Indeed, it is necessary to determine what are the best camera locations, the best configurations ...

Having robust data is important for their involvement in the assessment of stocks status for the different species fished by tropical tuna purse seiners and in particular for

sensitive species. Improvements to the Electronic Eye program will likely allow this data to be communicated to tRFMOs and used in the same way as onboard observer data.

The projects and analyses carried out by the OCUP partners in recent years show that the two types of observation, onboard and electronic, are complementary. It also shows the importance of involving all parties participating in the program: observers, crews, companies, scientists, equipment suppliers ... Observation programs are likely to continue to evolve according to tuna fisheries, regulations, science but also according to the arrival of new technologies (e.g., artificial intelligence and automatic recognition).

In addition to these improvements and projects, the efficiency of Best Practices will be studied in 2023 in the framework of the Elasmobranch project. This project will allow the tagging of silky sharks as well as large rays (mobulids and mantas) in the Indian and Atlantic Oceans with two objectives (i) to estimate post-release survival rate and (ii) to study the habitats of these species. Discussions between the different actors (observers, crews, companies …) within this project will also allow to identify the best equipment for each vessel to release large elasmobranchs.

Acknowledgements

The authors would like to thank the different partners of the OCUP program, coordinators, onboard and electronic observers, fishing companies and their crews and equipment providers for their participation in Best Practices and SIDEO projects.

References

Amandè, Monin J., Emmanuel Chassot, Pierre Chavance, Hilario Murua, Alicia Delgado de Molina, Nicolas Bez, and Delgado de Molina. 2012. "Precision in Bycatch Estimates: The Case of Tuna Purse-Seine Fisheries in the Indian Ocean." *ICES Journal of Marine Science*. doi: 10.1093/icesjms/fss106.

Amandè, Monin Justin, Javier Ariz, Emmanuel Chassot, Alicia Delgado De Molina, Daniel Gaertner, Hilario Murua, Renaud Pianet, Jon Ruiz, and Pierre Chavance. 2010. "Bycatch of the European Purse Seine Tuna Fishery in the Atlantic Ocean for the 2003-2007 Period." *Aquat. Living Resour* 23:353–62. doi: 10.1051/alr/2011003.

Bonhommeau, S., E. Chassot, J. Barde, P. de Bruyn, F. Fiorellato, L. Nelson, D. Fu, and A. E. Nieblas. 2020. *Preliminary Modelling for the Stock Assessment of Shortfin Mako Shark, Isurus Oxyrinchus Using CMSY and JABBA. IOTC-2020-WPEB16-17_Rev2.*

Bonnieux, A., and A. Relot-Stirnemann. 2016. "Exploitation et Comparaison Des Données d'une Marée Mixte Observateur Embarqué/Oeil Électronique. Marée 141 Du Torre Guilia (20/09/15 Au 14/12/15). (Rapport d'expertise Dans Le Cadre de La Mise En Oeuvre de La Composante 'Oeil Électronique' Du Programme OCUP). Oceanic Développement."

Briand, K., P. S. Sabarros, A. Maufroy, A. L. Vernet, A. Yon, A. Bonnieux, M. Goujon, and P. Bach. 2021. "On the Interest of Electronic Monitoring to Design Robust Discards Observation Protocols for Tropical Tuna Purse Seiners. IRD Sète."

Briand, Karine, A. Bonnieux, W. le Dantec, S. le Couls, P. Bach, A. Maufroy, A. Relot-Stirnemann, P. Sabarros, A. L. Vernet, F. Jehenne, and M. Goujon. 2017. *Comparing Electronic Monitoring System with Observer Data for Estimating Non-Target Species and Discards on French Tropical Tuna Purse Seine Vessels.* Vol. 74.

Briand, Karine, Philippe S. Sabarros, Alexandra Maufroy, Aude Relot-Stirnemann, Sarah le Couls, and Michel Goujon. 2018. "Improving the Sampling Protocol of Electronic and Human Observations of the Tropical Tuna Purse Seine Fishery Discards | IOTC. Presented at the Working Party on Ecosystems and Bycatch 14-18, p.19."

Chavance, P., A. Batty, H. McElderry, L. Dubroca, P. Dewals, P. Cauquil, V. Restrepo, and L. Dagorn. 2013. *Comparing Observer Data with Video Monitoring on a French Purse Seiner in the Indian Ocean (No. 09-43). IOTC, WPEB.*

Cramp, Jessica, Jordan Moss, and Akshay Tanna. 2021. *Investigation into the Effects of Catch Time Series Estimations on Stock Assessment of Silky Sharks (Carcharhinus Falciformis) in the Indian Ocean. IOTC-2021-WPEB17(AS)-18_rev1*.

European Commission. 2009. "Communication from the Commission to the European Parliament and the Council on a European Community Action Plan for the Conservation and Management of Sharks. COM/2009/0040."

FAO. 1995. "CODE OF CONDUCT FOR RESPONSIBLE FISHERIES FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS ROME, 1995."

FAO. 2003. “The Ecosystem Approach to Fisheries. (No. 4 (Suppl. 2)), FAO Technical Guidelines for Responsible Fisheries. Food and Agriculture Organization of the United Nations, Rome.”

FAO. 2011. “INTERNATIONAL GUIDELINES ON BYCATCH MANAGEMENT AND REDUCTION OF DISCARDS.”

Forget, Fabien, Jeff Muir, Melanie Hutchinson, David Itano, Igor Sancristobal, Bruno Leroy, John Filmalter, Udane Martinez, Kim Holland, Victor Restrepo, and Laurent Dagorn. 2021. “Quantifying the Accuracy of Shark Bycatch Estimations in Tuna Purse Seine Fisheries.” *Ocean & Coastal Management* 210:105637. doi: 10.1016/J.OCECOAMAN.2021.105637.

Goujon, M. 2015. “Mesures Prises Par Orthongel Pour Réduire l’incidence Des Thoniers Senneurs Sur Les Tortues Marines. Actes Du Colloque Tortues Marines. Maison Des Océans, Paris, 8-10 Septembre 2015.”

Goujon, M., A. Maufroy, A. Relot-Stirnemann, E. Moëc, M. J. Amandè, P. Cauquil, P. Sabarros, and P. Bach. 2017a. *Collecting Data on Board French and Italian Tropical Tuna Purse Seiners with Common Observers: Results of ORTHONGEL’s Voluntary Observer Program OCUP (2013-2017) in the Atlantic Ocean. SCRS/2017/212A*. Vol. 74.

Goujon M, Maufroy A, Relot-Stirnemann A, Moëc E, Bach P, Cauquil P, and Sabarros P. 2017b. “Collecting Data on Board Franch and Italian Tropical Tuna Purse Seiners with Common Observers: Results of ORTHONGEL’s Voluntary Observer Program OCUP (2013-2017). IOTC-2017-WPDCS13-22-R1.”

Grande, Maitane, Jon Ruiz, Hilario Murua, Jefferson Murua, Nicolas Goñi, Iñigo Krug, Igor Arregui, Alexander Salgado, Iker Zudaire, and Josu Santiago. 2019. *Progress on the Code of Good Pratices on the Tropical Tuna Purse Seine Fishery in the Indian Ocean. IOTC-2019-WPEB15-33.*

Hutchinson, Melanie Rhiannon, David George Itano, Jeffrey Allen Muir, and Kim Nicholas Holland. 2015. “Post-Release Survival of Juvenile Silky Sharks Captured in a Tropical Tuna Purse Seine Fishery.” *Marine Ecology Progress Series* 521:143–54. doi: 10.3354/meps11073.

ICCAT. 2015. *Report of the 2015 ICCAT Blue Shark Stock Assessment Session, Oceanario de Lisboa, Lisbon, Portugal - July 27 to 31*.

ICCAT. 2018. “Recommendation by ICCAT to Replace Recommendation 16-03 on Improvement of Compliance Review of Conservation and Management Measures Regarding Sharks Caught in Association with ICCAT Fisheries. BYC 18-06.”

ICCAT. 2019. *Report of the 2019 Shortfin Mako Shark Stock Assessment Update Meeting. Madrid, Spain 20-24 May.*

IOTC. 2017. *Resolution 17/05 on the Conservation of Sharks Caught in Association with Fisheries Managed by IOTC*.

ISSF. 2016. *Skippers’ Guidebook to Sustainable Purse Seine Fishing Practices. Third Edition.*

Maufroy, Alexandra, Adélaïde Gamon, Anne-Lise Vernet, and Michel Goujon. 2020. *8 Years of Best Practices Onboard French and Associated Flags Tropical Tuna Purse Seiners: An Overview in the Atlantic and Indian Ocean, in: Groupe de Travail Sur Les Ecosystèmes et Les Prises Accessoires (GTEPA). Presented at the IOTC-202-WPEB16-11, p. 19.*

Monteagudo, J. P., G. Legorburu, A. Justel-Rubio, and V. Restrepo. 2015. "Preliminary Study About the Suitability of an Electronic Monitoring System to Record Scientific and Other Information From the Tropical Tuna Purse Seine Fishery." *Collect. Vol. Sci. Pap. ICCAT* 440–59.

ORTHONGEL. 2011. "Décision N°12 Du 23 Novembre 2011 Relative à La Préservation Des Requins."

Poisson, F., A. L. Vernet, B. Séret, and L. Dagorn. 2012. *Good Practices to Reduce the Mortality of Sharks and Rays Caught Incidentally by Tropical Tuna Purse Seiners. EU FP7 Project #210496 MADE, Deliverable 7.2.; Convention DPMA 33246, CAT "Requins", 30p.*

Poisson, François, John David Filmalter, Anne-Lise Vernet, and Laurent Dagorn. 2014a. "Mortality Rate of Silky Sharks (Carcharhinus Falciformis) Caught in the Tropical Tuna Purse Seine Fishery in the Indian Ocean." doi: 10.1139/cjfas-2013-0561.

Poisson, François, Bernard Séret, Anne-Lise Vernet, Michel Goujon, and Laurent Dagorn. 2014b. "Collaborative Research: Development of a Manual on Elasmobranch Handling and Release Best Practices in Tropical Tuna Purse-Seine Fisheries." *Marine Policy* 44:312–20. doi: 10.1016/j.marpol.2013.09.025.

Ruiz, J. 1., I. 1. Krug, Gonzalez, G. 2. Gomez, and X. 3. Urrutia. 2015. *Electronic Eye: Electronic Monitoring Trial on a Tropical Tuna Purse Seiner in the Atlantic Ocean | Bycatch Management Information System (BMIS).* Vol. 71.

Ruiz, Jon, Francisco Abascal, Pascal Bach, José C. Baez, Pascal Cauquil, Iñigo Krug, Juliette Lucas, Hilario Murua, María L. Ramos Alonso, and Philippe S. Sabarros. 2018. "Bycatch of the European Purse Seine Tuna Fishery in the Atlantic Ocean for the Period 2008-2017. IOTC-2018-WPEB14-15." doi: 10.13140/RG.2.2.11527.24482.

Ruiz, Jon, Iñigo Krug, Ana Justel-Rubio, Víctor Restrepo, Greg Hammann, Oscar Gonzalez, Gonzalo Legorburu, Pedro José, Pascual Alayon, Pascal Bach, Paul Bannerman, and Tomás Galán. 2017. "Minmum Standards for the Implementation of Electronic Monitoring Systems for the Tropical Tuna Purse Seine Fleet." *Sci. Pap. ICCAT* 73(2):818–28.

Sieben, C., J. Gascoigne, and S. des Clers. 2020. "Marine Stewardship Council (MSC) Final Draft Report CFTO Indian Ocean Purse Seine Skipjack Fishery On Behalf of Compagnie Française Du Thon Océanique S.A.S. (CFTO). Control Union Uk Ltd, United Kingdom, p. 271."

Appendix 1: Structure of the F form.

Individual	Counts the number of individuals supported. Note from 1 to N.
B form	Note the corresponding set (B form).
INDIVIDUAL	
Specie	Note the FAO species code. If the code does not exist, note XXX.
Size	Note the measured or estimated size. Prefer the measured size.
Sex	**F**: female, **M**: male, **IN**: indeterminate or **NC**: not collected.
PRACTICES	
Recommended	See the list of recommended practices.
Second chance	See the list of second chance practices.
Unsuitable	See the list of unsuitable practices.
CONTEXT	
Indicate the reason for the context, considered particular and justifying the use of an unsuitable practice. **Breakdown**; **Bad weather**; **Dangerous individual**; **Too many individuals**.	
RELEASE MODE	
Note where the individual was released from. **From the upper deck**; **From the rejection belt or waste chute**; **Brought up from the lower deck and release from the upper deck**.	
CONDITION AT RELEASE	
Excellent: active and energetic, strong signs of life on the upper deck and when released. **Good**: active and energetic, moderate signs of life on the upper deck and when released. **Correct**: tired and slow, limited signs of life, slow or atypical swimming. **Bad**: exhausted, no signs of life, bleeding, no swimming **Very bad or moribund**: exhausted, no signs of life, excessive bleeding, no swimming.	
TIME OF RELEASE	
Note the time of release. Gives an idea of the relative time spent onboard. **Immediate**; **Delayed**; **End of set**; **Unknown**.	
ORIGIN OF INFORMATION	
Specify the origin of the source of observation. **Observed**: if observed by the observer. **Recorded** : if viewing after the set. **Reported by the crew** : if reported by the crew and not observed by the observer.	
PHOTOS / VIDEOS	
COMMENTS	