# BEST PRACTICES, HABITAT AND SURVIVAL RATE OF ELASMOBRANCH BYCAUGHT IN FRENCH TROPICAL TUNA PURSE SEINE FISHERIES – BEHAVE PROJECT

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*SUMMARY*

*In recent decades, the incidental mortality of sensitive species caught by fishing vessels has become a major concern for the sustainability of fisheries. In 2012, French scientists from IRD and Ifremer developed the first guidelines for the safe handling and release of sharks, whale sharks, rays and sea turtles. A decade later, in 2022, a comprehensive review assessed how these "Best Practices" were being applied onboard French and associated-flag purse seiners operating in the Atlantic and Indian oceans. This study revealed persistent challenges, particularly with the release of large or potentially dangerous animals such as sharks and large pelagic rays. To address this issue, the BEHAVE project, funded by the European Union, was launched in June 2024. Its objectives are to (i) test new release equipments for sharks and large rays, (ii) evaluate the effectiveness of these new equipments and techniques in improving post-release survival, and (iii) advance scientific knowledge on the migrations, habitat and behaviour of large rays. This document provides a detailed overview of the BEHAVE project and the progress made since its launch in June 2024.*

*KEYWORDS*

*Tropical tuna purse seiners, Indian Ocean, sensitive species, Best Practices*

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## 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 fleet level (Goujon, 2015; Grande et al., 2019; M. R. Hutchinson et al., 2015; ISSF, 2016; ORTHONGEL, 2011; Poisson et al., 2012) to address these issues.

In the case of tropical tuna purse seiners of the Indian Ocean, bycatch rates are generally low, and bycatch is dominated by teleost fish (Amandè et al., 2010). However, incidental catches comprise particularly vulnerable species of shark species and large rays (Amandè et al., 2010; Ruiz et al., 2018) including the silky shark *Carcharinus falciformis* (FAL), the giant devil ray *Mobula mobular* (RMM) and the Chilean devil ray *Mobula tarapacana* (RMT). These species are particularly vulnerable to fishing pressure due to their slow growth and low reproductive rate (Dulvy et al., 2021). The silky shark has been classified as 'vulnerable' by the IUCN, while the two Mobulas are 'endangered' (IUCN, 2023).

Even though the status of these species' populations in the Atlantic and Indian Oceans is of concern (Pacoureau et al., 2021), little information is available to confirm this assessment and propose appropriate management measures (Lezama-Ochoa et al., 2020). Reducing the impact of fisheries on these species requires, among other things, sufficient knowledge on their habitat, migrations, behaviour and mortality after incidental catches (Lezama-Ochoa et al., 2020). Currently, in the absence of such knowledge, only the status of the silky shark stock in the Indian Ocean is being assessed, but the data is considered insufficient to provide a scientific advice (Cramp et al., 2021). Reducing the impact of tropical tuna purse seine fisheries on sharks and large rays also requires avoidance measures to be proposed and, when these incidental catches cannot be avoided, effective release techniques that are safe for crews (Stewart et al., 2018; Swimmer et al., 2020). Since the 2010s, these recommendations have been the focus of Best Practices (Grande et al., 2019; M. Hutchinson et al., 2017; ISSF, 2016; Poisson et al., 2012), the effectiveness of these Best Practices is yet to be fully evaluated on the survival of sharks and large rays (Martin & Shahid, 2021; Stewart et al., 2018; Zollett & Swimmer, 2019). Providing crews with suitable release equipment is also crucial, particularly in the case of dangerous and large individuals (Maufroy et al., 2020; Wain et al., 2022; Wain & Maufroy, 2023).

Scientific observation of fishing vessels is an essential tool for collecting data as part of ecosystem-based fisheries management (FAO, 2003) implemented by Regional Fisheries Management Organisations (RFMOs), including the Indian Ocean Tuna Commission (IOTC) and the International Commission for the Conservation of Atlantic Tunas (ICCAT). Observer programmes can help addressing fishery issues related to sensitive species in different ways: (i) improving the survival rate of sensitive species by implementing release techniques in collaboration with crews, observers and scientists; (ii) monitoring the feasibility and application of these techniques on board; and (iii) collecting data of sufficient quality to enable stock assessments. However, the data collected by scientific observers is not sufficient, and the tagging of sharks and rays is necessary to supplement the information collected by observers or reported by fishermen (Martin & Shahid, 2021). While these tags are essential, their cost is not negligible. As a result, few studies using in situ tagging have been carried out, and these usually involve a small number of individuals. The studies that have already been carried out have highlighted the need to carry out new tagging campaigns to improve our knowledge of the habitats, migration and survival of elasmobranchs (Filmalter et al., 2021; Lopetegui-Eguren et al., 2022; Onandia et al., 2021). The necessity of obtaining fishery-independent information, through tagging, has also been identified as a priority within the scientific working groups of the RFMOs, to improve knowledge of the spatio-temporal movements of elasmobranchs and their survival rates after release (ICCAT, 2024; IOTC, 2022; IOTC–WPEB18, 2022).

## 2. From the development of a manual of Best Practices to BEHAVE

For more than a decade, scientists from IRD and fishermen represented by the producer organisation ORTHONGEL have been working together to monitor and reduce the mortality of sensitive species caught incidentally by French tropical tuna seiners.

As part of the European Union MADE project (2008-2012, Mitigation Adverse Ecological Impacts of open ocean fisheries) led by IRD and complemented by the *Sharks* Project for the Future (2010-2012) led by ORTHONGEL, solutions for releasing sensitive species (sharks, whale sharks, small rays, large rays and turtles) to ensure their survival and the safety of fishermen have been identified. These recommendations to crews have been described in the first manual of safe handling and releasing techniques for sharks, whale sharks, rays and sea turtles (Poisson et al., 2012), which now serves as a reference for tropical tuna seiners in all oceans (ISSF, 2016). Although tagging has been carried out to assess the survival of sharks in the absence of the application of these Best Practices (Poisson et al., 2014), the contribution of these release techniques to the survival of sharks has not been directly assessed to date. For other sensitive species, apart from whale shark (Escalle et al., 2016), the low rate of interaction between purse seiners and these species and the cost of tagging campaign have not yet made it possible to carry out this assessment.

In addition to the MADE project and the *Sharks* Project for the Future, the *Selectivity* Project for the Future has identified the equipment needed to apply Best Practices for sensitive species. Equipment for efficient and safe release was identified through working group with crews and then tested at sea (ORTHONGEL, 2014). At the end of the project, however, none of the equipment tested or considered was retained by the crews, who judged it difficult to use in real conditions.

The effects of the lack of equipment and materials adapted to this release are particularly evident today. While the release of turtles and whale sharks does not pose any particular problems on board, this is not the case for other sensitive species. For dangerous and/or large individuals (large sharks and rays), “Best Practices” cannot be applied under the correct conditions due to a lack of suitable equipment (Maufroy et al., 2020; Wain et al., 2022; Wain & Maufroy, 2023). The objectives at this stage are therefore to improve crew training in the release of sensitive species and to identify equipment adapted to the configuration of vessels (Wain et al., 2022; Wain & Maufroy, 2023). This work, which has been underway as part of the ORTHONGEL “Best Practices” 2.0 project since 2021, will involve assessing the contribution of release equipment to the survival of sharks and large rays, using tagging.

The joint experience acquired by IRD and ORTHONGEL in various projects shows that improving post-release survival is important for reducing fishing mortality of sharks and large rays, but that it is also necessary to avoid interactions to reduce mortality in these sensitive species groups. In the case of sharks, for example, a significant proportion of individuals do not survive when they arrive on board (Poisson et al., 2014) and the implementation of avoidance measures could provide a complementary response to “Best Practices”. Such strategies are being developed as part of the European INNOV-FAD project since 2018 (Mannocci et al., 2020) and similar work is underway for large rays (Guirhem et al., 2021). This work requires, among other things, improved knowledge of the habitats, migrations and fishing mortality of these species by using tags that would meet both the need to improve survival after release and to improve scientific knowledge of these species.

## 3. Objectives of the BEHAVE project

The aim of the BEHAVE project is to reduce the impact of French tropical tuna seiners on the main species of sharks and large rays bycaught in the Atlantic and Indian oceans and to improve knowledge of large rays. As part of this project, various equipment will be tested to release dangerous and / or large individuals to the water and their contribution to improving the survival of these individuals will be assessed using electronic tags. The electronic tags deployed on large rays will also improve our knowledge of the behaviour, habitat and migrations of these sensitive species. Finally, the results of the BEHAVE project and the recommendations already available in the scientific literature will be used to update the manual of safe handling and releasing techniques for sharks, whale sharks, rays and sea turtles (Poisson et al., 2012).

### *3.1. Objective 1: Improve the survival of sharks and larges rays incidentally caught by tropical tuna seiners*

Improving the survival of sharks and large rays incidentally caught by tropical tuna seiners in the Atlantic and Indian Oceans requires two types of action:

(1) Preventing the interactions with these sensitive species, using techniques that avoid their catch or allow them to be released from the net.
(2) To improve the survival of these sensitive species after release, using effective release techniques that are safe for fishermen.

Three species are included in the BEHAVE project: the silky shark *Carcharinus falciformis* (FAL), the giant devil ray *Mobula mobular* (RMM) and the Chilean devil ray *Mobula tarapacana* (RMT).

For this first objective of the BEHAVE project, an inventory of existing recommendations for avoiding the encirclement and arrival on board of sharks and large rays will be carried out. In addition, tests of equipments adapted to the release of dangerous and/or large individuals will be carried out. Three equipments have been identified and will be tested as part of the project:

(1) Flat straps used to release large rays. The straps must be placed under the individual and then lifted with the crane to the surface of the water.
(2) Tarpaulins used to release sharks and large rays. The tarpaulins are used in the same way as flat straps.
(3) A slide used to release sharks. The slide will be installed on the deck of the vessel and will connect the tank to the door on the starboard side of the vessel. The slide will reduce manual handling by the crew and should therefore improve their safety.

These tests will make it possible to compare the practicality of these equipments (feedback from crews) and the contribution to the survival of sensitive species (electronic tags). The electronic tags will be distributed in such way as to cover, for each species, the different equipments tested as well as a control level corresponding to a release without equipment (Table 1).

### *3.2. Objective 2: Improve knowledge of the habitats, migrations, behaviour and fishing mortality of large rays*

Current knowledge of the large rays in the Atlantic and Indian Oceans is insufficient to assess the status of their populations and recommend measures to avoid catching them. Better knowledge of the habitat use, migration patterns, post-release behaviour and post-release mortality rates of these sensitive species is therefore needed both for scientists (to assess the impact of fishing) and for fishermen (to improve fishing strategies).

The BEHAVE project will make it possible to obtain information on these different aspects using dedicated electronic tags (Table 1).

### *3.3. Objective 3: Update recommendations for crews*

The manual of safe handling and releasing techniques for sharks, whale sharks, rays and sea turtles (Poisson et al., 2012) was published in 2012 following work carried out between ORTHONGEL, fishing companies and French scientists from IRD and IFREMER. The experience gained over a decade applying these recommendations needs to be included in a revised version of this guide.

In addition, the BEHAVE project will make it possible to test new equipments that had not been tested in previous projects and to recommend measures for avoiding the catches of sharks and large rays. Depending on the results obtained, the new equipments and recommendations should be added to the Guide of Good Practices.

## 4. Update on the BEHAVE project

The BEHAVE project, funded by the European Union, was launched in June 2024 and will run for three years. To date, all the crews taking part in the project have been met to present them the project and the three equipment to be tested. The flat straps and tarpaulins have been sent on board and are currently being tested by the crews. At

this stage, there is no feedback to present on these two equipments. The slide is currently being installed on a vessel in the Indian Ocean and will be tested from June 2025.

Regarding tagging, protocols and forms for scientific observers are currently being designed. Scientific observers will be trained shortly. To increase the chances of tagging, some volunteer fishermen will also be trained for tagging. The tagging campaign should start before the end of 2025.

The progress and results of the BEHAVE project will be regularly presented to the dedicated ICCAT and IOTC working groups.

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**Table 1.** Distribution BEHAVE project tags by equipments, species and oceans.

| Species | Ocean | Equipment | Objective | | sPAT | miniPAT |
|---|---|---|---|---|---|---|
| | | | Survival | Ecology | | |
| FAL | Atlantic + Indian | By hand | Yes | No | 14 | 0 |
| FAL | Atlantic + Indian | Tarpaulins | Yes | No | 13 | 0 |
| FAL | Indian | Slide | Yes | No | 13 | 0 |
| RMM | Atlantic | By hand | Yes | Yes | 0 | 5 |
| RMM | Atlantic | Flat straps | Yes | Yes | 0 | 5 |
| RMM | Atlantic | Tarpaulins | Yes | Yes | 0 | 5 |
| RMM | Indian | By hand | Yes | Yes | 0 | 5 |
| RMM | Indian | Flat straps | Yes | Yes | 0 | 5 |
| RMM | Indian | Tarpaulins | Yes | Yes | 0 | 5 |
| RMT | Atlantic | By hand | Yes | Yes | 0 | 5 |
| RMT | Atlantic | Flat straps | Yes | Yes | 0 | 5 |
| RMT | Atlantic | Tarpaulins | Yes | Yes | 0 | 5 |
| RMT | Indian | By hand | Yes | Yes | 0 | 5 |
| RMT | Indian | Flat straps | Yes | Yes | 0 | 5 |
| RMT | Indian | Tarpaulins | Yes | Yes | 0 | 5 |