

# **A decade of monitoring Best Practices in tuna purse seine fisheries: implications for observer data collection**

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## **Abstract**

The tropical tuna purse seine fishery in the eastern Pacific Ocean presents, in comparison with other fishing gears, relatively low levels of bycatch in relation to target catch. Nevertheless, reducing fishing mortality of endangered, threatened, and protected (ETP) bycatch species remains a priority. In the early 2010s, the purse seine fleet associated with OPAGAC voluntarily implemented a Code of Best Practices (CBP) that includes protocols for the configuration of fish aggregating devices (FADs), species-specific handling and release procedures for ETP species, and mechanisms to monitor their implementation. This code, which is still in force, has served as a precursor to various mitigation measures later adopted by regional fisheries management organizations (RFMOs). This work presents the experience gained from collecting observer data to evaluate and improve the implementation of Best Practices, which have been progressively integrated into the fishery's data collection framework. It also proposes their application for monitoring onboard release practices of vulnerable fauna (i.e., sea turtles and elasmobranchs). The results show that incorporating additional variables into data collection, such as the condition of individuals upon release and the mode, time, and area of handling, makes it possible to estimate survival indicators. Furthermore, it provides information on onboard practices, operational difficulties depending on species or manoeuvre, and facilitates the formulation of recommendations aimed at continuous improvement. In this context, it is essential to have standardized and detailed data collection protocols that allow not only systematic monitoring of practices, but also the generation of robust indicators to estimate post-release survival and evaluate the effectiveness of these measures. Strengthening these systems will help identify areas for improvement in the handling of vulnerable species based on scientific evidence, as well as advance the implementation of the ecosystem approach to fisheries management within the framework of the IATTC.

## 1. Introduction

Most of the tropical tuna catches in the IATTC Convention Area in the eastern Pacific Ocean are made by purse seine vessels (IATTC, 2025a). Since the 1990s, sets associated with fish aggregating devices (FADs) have become the dominant set type for this fleet (Lennert-Cody et al., 2018). In this context, the purse seine fishery plays a central role both in the sustainable exploitation of the main target species (e.g., skipjack, bigeye, and yellowfin tuna) and in the identification, assessment, and mitigation of associated impacts on the marine ecosystem, in line with the ecosystem approach to fisheries management promoted by the IATTC (Hall and Román, 2013; IATTC, 2023a).

Bycatch constitutes one of the main potential impacts of fisheries on marine ecosystems, especially when it involves endangered, threatened, and protected (ETP) species (Gilman et al., 2011). In general terms, tropical tuna purse seine fisheries present relatively low levels of bycatch per ton of target species compared to other fishing gears (Hall and Román, 2013; Murua et al., 2021; IATTC, 2023b). Furthermore, when best handling and release practices are properly applied, post-release survival rates, particularly for sea turtles and whale sharks, are generally high (Poisson et al., 2014; Escalle et al., 2016; Hall et al., 2017; Onandia et al., 2021; Grande et al., 2025). In response, tuna regional fisheries management organizations (RFMOs), including the IATTC, have adopted conservation and management measures aimed at minimizing mortality of non-target species (e.g., C-15-04; C-19-04; C-19-06; C-25-08). These measures include mandatory non-entangling FADs and the establishment of specific requirements for the safe handling and release of ETP species (IATTC, 2019; Restrepo et al., 2023).

In parallel, the IATTC has been systematically collecting bycatch data for several decades through its onboard observer program for purse seine vessels (Fuller et al., 2022). Since the late 1990s, the IATTC observer program has achieved 100% coverage of trips for large-scale tuna vessels (Class 6). The main objective of this data collection has been to provide a solid scientific basis to support ecosystem-based fisheries management approaches, enabling specific analyses of bycatch species to inform managers and decision-makers about potential conservation and management issues (IATTC, 2017). In this context, recent studies have highlighted the importance of complementing this information with data from coastal fisheries, showing that shark catches, particularly of species such as silky sharks and hammerheads, can be substantial and have been historically underestimated in the region (IATTC, 2023b).

In recent years, there has also been increasing interest in improving the survival of vulnerable species in tuna fisheries through the application of Best Handling and Release Practices (Hall et al., 2017; Stewart et al., 2024; Murua et al., 2025a). This is because, although regulatory measures exist within RFMOs to mitigate impacts on ETP species, many are either outdated or still lack

clear, science-based operational guidance. In this context, IATTC scientific staff, in collaboration with the SAC and the EBWG, are updating guidelines on best handling and release practices for ETP species. These guidelines include those for sharks, initially developed in document SAC-15-11, later revised (SAC-16-10), adopted (C-24-05), and incorporated into subsequent resolutions (C-25-08), as well as those for sea turtles (C-19-04) and seabirds (Seabird Action Plan).

In line with these objectives, the Code of Best Practices (CBP) adopted by the OPAGAC fleet in 2012, and revised annually since 2014, incorporates species-specific handling and release procedures for ETP species, aiming to minimize their mortality while ensuring crew safety. These procedures are largely based on methodologies developed under the EU-funded MADE project (Poisson et al., 2012), which have since been widely adopted as best practice standards by various RFMOs. The systematic implementation of this CBP has provided not only direct benefits in terms of reducing bycatch mortality but also valuable operational experience that can contribute to strengthening observer data collection on the implementation and effectiveness of Best Handling and Release Practices. On this basis, continued collaboration between industry and the scientific community to develop improved release techniques and devices has been reflected in an updated Best Practices guide that integrates proper handling techniques and new release devices specifically designed for ETP species (Murua et al., 2025b).

This framework adopts an adaptive, continuous improvement approach, progressively refined based on available scientific evidence and the ongoing incorporation of expert knowledge from stakeholders over time. In this context, it highlights the importance of grounding these practices in the latest scientific advances, supported by robust, comparable, and systematic observational data as a key analytical component to improve onboard practices and post-release survival. Recording information on handling and release methods for ETP species is essential to understand which techniques are used onboard under real fishing conditions, as well as the circumstances in which they are applied across different vessels or fleets. Within this framework, the objective of this document is to describe the experience gained in collecting observer data directly associated with the implementation of Best Handling and Release Practices for vulnerable species under the CBP adopted by OPAGAC, and to propose it as an example to support recent IATTC initiatives aimed at updating and evaluating operationally feasible, science-based Best Practices in purse seine tuna fleets.

## **2. Code of Best Practices as mitigation measure**

The OPAGAC purse seine fleet operates in the tropical tuna fishery under the regulatory framework of the IATTC, with approximately 20 purse seine vessels in the Pacific. It also operates within the other three tuna RFMOs, with a global operational scope. In this context, more than a decade ago the association, with scientific support and in collaboration with other European

fishing associations, developed and implemented a voluntary Code of Best Practices (CBP<sup>1</sup>) aimed at reducing the environmental impacts of fishing activities and strengthening the scientific basis for ecosystem-based management. The CBP is structured around four main pillars: (i) the design, construction, and use of non-entangling and progressively biodegradable fish aggregating devices (FADs); (ii) the application of species-specific protocols for the safe handling and release of incidentally caught species, with special attention to vulnerable species such as sharks, mobulids, sea turtles, and whale sharks; (iii) the implementation of projects aimed at assessing the survival of ETP species under different release practices (through tagging), with the objective of identifying the most suitable ones for each one; and (iv) the development of data collection protocols to enable more effective monitoring of FAD-related operations and of the implementation and effectiveness of Best Practices.

Regarding vulnerable species caught incidentally, sharks constitute the most frequently encountered group in purse seine fisheries, particularly the silky shark (*Carcharhinus falciformis*) in sets associated with FADs. Nevertheless, overall bycatch levels in this fishery are low and significantly lower than those observed in other tuna fisheries, such as longline fisheries (Kelleher, 2005; IATTC, 2025b, 2026). Established best practices require the immediate and safe release of specimens, prioritizing both their welfare and crew safety, and prohibiting practices that may cause injury or increase operational risk. Scientific evidence indicates that rapid release early in the fishing operation, using appropriate tools, can contribute to increased post-release survival, with estimates suggesting survival rates of up to 40–50% under certain conditions (Onandia et al., 2021; Grande et al., 2025).

Interactions with mobulids, whale sharks, and sea turtles are infrequent in tropical purse seine fisheries. In the case of mobulids, rapid release through specific procedures is required to increase their survival (Stewart et al., 2024; Cronin et al., 2026). Encounters with whale sharks are sporadic and unintentional, as sets on this species are prohibited. When best practices are correctly applied, including releasing the animal over the corks or through an opening in the net, post-release survival is 100% (Escalle et al., 2016). Interactions with sea turtles are also uncommon, and most observed individuals are released alive when protocols such as stopping manoeuvre, proper handling, and resuscitation when necessary are strictly followed (FAO, 2011).

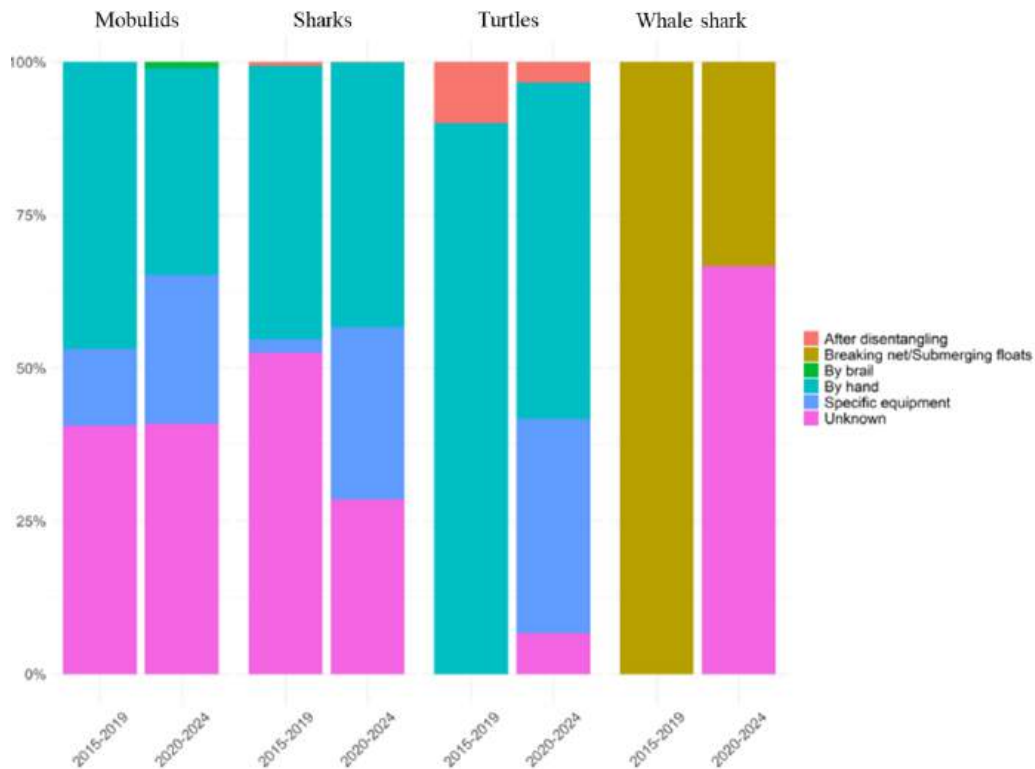
The systematic application of the CBP has proven to be an effective tool for reducing mortality associated with bycatch and has generated valuable operational experience based on comprehensive observer data collection for its evaluation (Acevedo-Iglesias et al., 2025). This accumulated knowledge constitutes a key element for improving the implementation and effectiveness of mitigation measures within this framework.

### **3. Monitoring of safe handling and release operations**

The monitoring system for safe handling and release operations is based on 100% observation coverage, supported both by in situ data collection through onboard observers and using electronic monitoring systems (EMS), which allow the recording of the implementation of Best Practices onboard vessels. In response to the need to strengthen the specific monitoring of their implementation, a form on the release of associated fauna was developed and used within the framework of the CBP (Grande et al., 2019; ANNEX I). This form is designed to record in detail the handling and release operations of vulnerable species, including sharks, mobulids, whale sharks, and sea turtles (in accordance with the guidelines explicitly stated in the AZTI onboard observer manual<sup>2</sup>). In general terms, this form (ANNEX I) collects the following information:

- (i) Biological characteristics of the individual, including species, size, and sex, whenever identification is possible.
- (ii) Release method applied.
- (iii) Release time, to assess crew response time and the time required to release each specimen.
- (iv) Handling area during the release process.
- (v) Condition of the animal at the time of release, according to the categories proposed by Hueter and Manire (1994).

The application of best practices for the rapid release of animals is always a priority, if crew safety is ensured. When the speed of the operation does not allow the observer to record all the required information, the release of the animal takes precedence over data collection. In situations with limited observation time, priority is given to recording the species and the release method, followed by the condition of the animal and, whenever possible, its individual biological characteristics (i.e., size and sex). Under no circumstances should the observer interfere with crew operations.

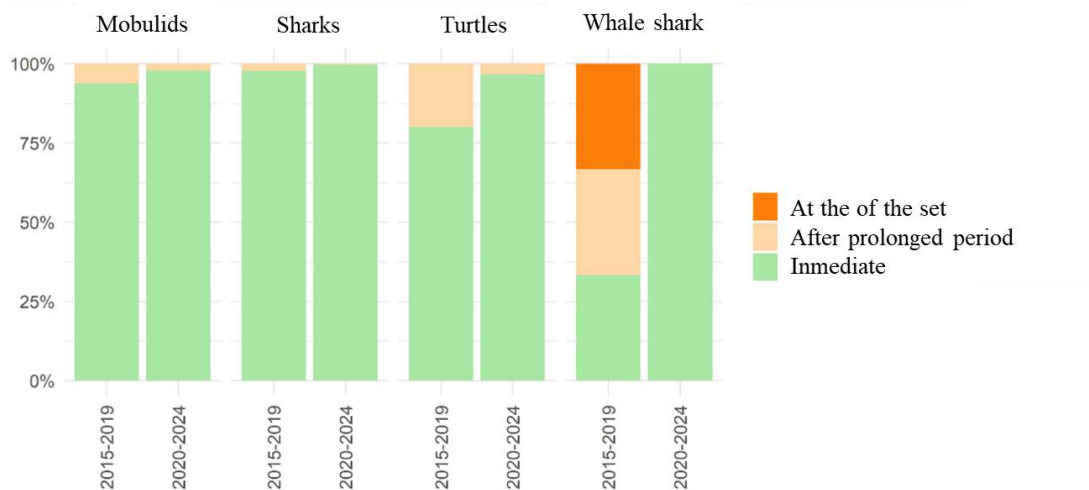


**Figure 1.** Percentage distribution of the main release methods recorded by species group and period. It should be noted that the data presented come from the EMS system; therefore, they may be subject to various limitations inherent to this monitoring system.

Based on this recording system, the information collected within the CBP framework allows for a comprehensive analysis of how the applied release methods differ both among taxonomic groups and across periods (Figure 1). In general terms, contrasting operational patterns can be observed among species groups: while manual release methods or the use of specific equipment predominates for sharks and mobulids, techniques aimed at minimizing direct handling and avoiding lifting onboard are more commonly used for sea turtles and whale sharks. Likewise, the comparison between the periods 2015–2019 and 2020–2024 suggests changes in the relative composition of the recorded release methods, particularly for sharks and sea turtles, which may reflect both the progressive incorporation of new practices and devices and improvements in observers’ recording capacity. This pattern is linked to the initiation of the design, continuous improvement, and implementation process of release tools that began in 2019.

In addition to the release method, the moment at which the animal is released during the fishing operation constitutes a key operational factor, potentially related to its level of stress and subsequent survival. Figure 2 summarizes the percentage distribution of recorded release times by species groups and period, distinguishing between immediate releases, delayed releases, and releases carried out at the end of the set. For most of the taxonomic groups analysed, particularly mobulids and sharks, immediate releases clearly predominate in both periods, which is consistent

with operational recommendations to minimize handling time. However, for sea turtles and whale sharks, greater variability is observed in the 2015–2019 period, with a noticeable proportion of releases occurring after prolonged periods or at the end of the set, whereas in the more recent period (2020–2024) the proportion of recorded immediate releases increases.



**Figure 2.** Percentage distribution of release times recorded by species group and period. It should be noted that the data presented come from the EMS system.

The variable handling area (i.e., upper deck and lower deck) is not included in a specific graphical analysis in this document, as its systematic collection has been only recently incorporated as part of a progressive improvement of the data collection protocols associated with Best Practices. Nevertheless, initial experience confirms its operational relevance, as it allows for a more precise characterization of release conditions. For this reason, its inclusion in the data collection process was decided with a view to more comprehensive analyses in future assessments.

Regarding the condition of individuals at the time of release, no quantitative results are presented, as this information primarily comes from electronic monitoring systems (EMS), whose imagery does not allow for sufficiently detailed and consistent evaluation. Despite this limitation, its inclusion remains relevant, since condition at release is a key indicator related to post-release survival and provides important context for interpreting onboard handling practices.

It is important to note that these results should be interpreted from a descriptive and aggregated perspective, as these parameters observed in individual cases may be influenced by specific operational factors, such as weather conditions (e.g., rough seas, high temperatures), catch volume (e.g., large sets exceeding 100 tons), the phase of the set (e.g., net retrieval, brailing), or the need to ensure crew safety (e.g., handling of active adult sharks). Nevertheless, the figures highlight the added value of having standardized and detailed data on handling and release operations to identify operational trends over relevant temporal scales and across different species groups,

which is not possible using conventional observation records focused solely on the final fate (e.g., released alive) of the individual.

**Table 1.** Data fields used within the CBP monitoring framework related to the handling and release of vulnerable species.

<b>Release mode</b>	Sinking the cork line
	Cutting the net
	By brailer
	After disentanglement
	By stretcher, tarpaulin, ‘sarría’ or cargo net
	Gaff, hook, or other pointed tools
	Rope noose hanging
	Rope noose pulling
	Manually by the fins or the body
	Manually hanging from the tail (sharks and rays) or fins (turtles)
	Manually by sensitive organs
	Manually dragged or pulled
	Hopper with ramp
	Ramp
Sorting grid for manta and devil rays	
Hanging from the tail with velcro	
Lower deck conveyor belt and gutter	
<b>Release time</b>	Immediate
	After a prolonged period
	At the end of the set
<b>Handling area</b>	Upper deck
	Lower deck
<b>State of the animal</b>	Excellent
	Good
	Correct
	Poor
	Very poor

To properly monitor handling and release processes and identify potential improvements, it is essential to record the release method, time, and handling area, as well as the condition of the animal at release. This information makes it possible to characterize the practice carried out and analyse its potential relationship with the subsequent survival of the individual (Onandia et al., 2021; Grande et al., 2025). In this context, Table 1 presents the options currently used for these four data fields within the CBP framework. It should be noted that the fields related to release methods have been recently modified to reflect onboard operations in greater detail (Table 1); therefore, the categories shown in Figure 1 correspond to the classification previously used.

#### **4. Detailed data collection needs**

The monitoring system for safe handling and release operations is based on full observation coverage. Consistent with this approach, in the IATTC Area the requirement for full observer coverage on purse seine tuna vessels is grounded in the Agreement on the International Dolphin Conservation Program (AIDCP), which has been in force since 1999. This requirement is implemented through the AIDCP/IATTC Observer Program, applicable to large-scale vessels classified as Class 6. Observers in this program use specific data collection forms primarily aimed at documenting the release of vulnerable species and the configuration of FADs. However, these forms do not allow for detailed monitoring of the active handling and release practices applied to ETP species during onboard operations.

Following a review of the systematic data collection forms used within the IATTC Observer Program, three main records related to the bycatch of vulnerable species were identified<sup>3</sup>. The Sea Turtle Record (RTM) compiles biological information and data on the condition of turtles observed, handled, or found dead, in order to characterize their interaction with the tropical eastern Pacific tuna fishery. The Shark Record (RDT) aims to collect biological data to better characterize sharks associated with the fishery, including species composition, size, and distribution. Finally, the Ray Record (RDR) compiles biological information to improve knowledge of rays and mantas associated with the tuna fishery. In addition to routine biological data, these records include the fate of incidentally caught individuals (i.e., human consumption, discarded, released alive, other, or unknown). In the specific case of sea turtles, the condition of the animal at the time of release is also recorded. While this information can provide a general indication of the individual's condition after release, it does not provide details on how handling and release operations were carried out, limiting the ability to monitor the effective implementation of Best Practices under the OPAGAC model.

There are also Compliance Summaries (RDC) for the applicable resolutions, used by the IATTC Compliance and Fisheries Policy Division to notify flag State authorities of potential non-compliance. These forms include some elements related to handling and release, particularly for sharks and whale sharks. Section B.1 requires the observer to indicate (i) whether live sharks were released using gaffs, hooks, or similar instruments, (ii) whether they were lifted by the tail or gill slits, (iii) whether wires, body puncturing, or similar methods were used, or (iv) whether they passed through the power block. Section B.2, related to whale shark release, records whether the individual was released using towing ropes. Although this information may be partially useful for assessing onboard practices, it is limited exclusively to the release method and does not consider other key aspects of the process. Consequently, the currently available data are fragmentary and insufficient for comprehensive monitoring of Best Practices.

Additionally, the IATTC has specific forms such as the Shark Sampling and Tagging Record (RMMT) and the Mobulid Record (RMMM), whose objective is to collect biological and operational information to assess post-release survival as well as the effects of capture-related stress. These protocols include detailed variables such as sex, detection area, key set timing, release method, and individual condition, and incorporate optional information such as tagging or lactate measurement. They also describe a wide variety of release methods and establish categories to classify animal vitality. However, these forms are applied only sporadically in scientific campaigns, limiting their temporal representativeness. Although they demonstrate the feasibility of collecting detailed information on release practices, their completion is labour-intensive and their occasional nature prevents systematic monitoring.

In this context, it is considered necessary to incorporate a specific form, or to slightly expand existing ones, to systematically record data related to release method, timing, handling area, and animal condition. This information would be key to improving the monitoring of Best Practices and facilitating subsequent analyses of their relationship with the survival of vulnerable species. The release method is critical to understanding whether the animal has suffered injuries or deterioration in health during handling. Likewise, release time is a key factor, as time spent on deck out of the water represents one of the main risks to the survival of elasmobranchs (Stewart et al., 2024), meaning that operations should be carried out as quickly as possible. Regarding the handling area, this criterion assesses whether efforts have been made to minimize the impact of handling on the upper deck, which is essential for increasing survival probability, and whether a high proportion of vulnerable species reaches the lower deck. Finally, the condition of the animal at the time of release is a key indicator of survival probability, as it reflects the combined effects of capture and handling on its physiological condition.

It is also recommended that monitoring of Best Practice manoeuvres for vulnerable species may be conducted regardless of the apparent vitality of the individual at the time of release. There are cases in which individuals displaying limited signs of vitality subsequently exhibit normal swimming behaviour after release. Furthermore, survival studies based on satellite tagging have shown that survival may occur even in individuals initially classified as being in poor condition (Onandia et al., 2021). In addition, the systematic release of all incidentally captured individuals, regardless of their condition, helps standardize onboard operational practices, reducing subjectivity in onboard decision-making and promoting a more consistent and effective implementation of Best Practices.

Finally, the continuous collection of information on the application of Best Practices allows not only for the assessment of their operational implementation but also highlights the willingness and commitment of crews to apply them correctly. While these operations are recorded at the

individual level for each interaction with vulnerable species, their analysis should be conducted at a broader temporal and operational scale, through the examination of aggregated trends, for example over complete vessel activity periods or at an annual level. This approach is necessary because the daily operation of purse seine fishing is subject to various external factors, such as adverse weather conditions, high catch volumes, time constraints, or complex operational situations, which may occasionally lead to a higher incidence of suboptimal practices. However, these isolated situations do not necessarily reflect a lack of willingness or commitment on the part of the crew, but rather exceptional limiting circumstances inherent to fishing operations. For this reason, the monitoring of Best Practices should be carried out comprehensively and based on aggregated trend indicators, to obtain a more realistic and representative picture of each vessel's operational behaviour over time. This monitoring should also follow a constructive and continuous improvement approach, identifying challenges in the application of Best Practices and proposing solutions. Viewed from this perspective, observer data not only allow evaluation of the overall level of implementation of Best Practices, but also provide valuable information on other relevant operational aspects, such as manoeuvrability during release operations, the availability, or lack, of onboard resources to handle complex releases (e.g., appropriate release devices for associated species), and possible structural limitations of the vessel that may constrain the application of certain release techniques.

## **5. Conclusions and recommendations**

The experience presented in this document shows how the consistent application of Best Handling and Release Practices in the purse seine tuna fishery can be an effective tool to mitigate impacts on vulnerable bycatch species and, at the same time, provide a solid foundation for strengthening the ecosystem approach to fisheries management within the IATTC. To this end, observation systems, both human and electronic, are essential for documenting the implementation of these practices and evaluating their performance under real operational conditions. If limitations persist in interpreting more precisely the factors influencing post-release survival, this may hinder the development of corrective solutions. In particular, the lack of systematic information on key operational variables constrains detailed analysis of the effectiveness of different handling and release practices. A comprehensive understanding of release patterns for ETP species across different vessel types is necessary to develop tailored solutions for each fleet (Murua et al., 2025a; Cronin et al., 2026).

The experience of the CBP demonstrates that it is recommendable to integrate more detailed data collection into the operational context of purse seine fishing by observers. Observers from national and regional programs in the Atlantic and Indian Ocean regions have been systematically collecting detailed information for ETP species, as well as other operational data related to fishing

vessels, for several years (Grande et al., 2019). The incorporation of specific variables related to the release process makes it possible to move towards a more complete characterization of onboard practices and opens new opportunities for comparative analyses across techniques and species groups:

- Release method: technique used to return the animal to the water (e.g., manual release by body and/or fins, using a brail), which directly influences post-release survival.
- Release time: time interval from detection to the release of the individual. Shorter times are generally associated with higher survival probabilities by reducing stress and exposure.
- Handling area: location on the vessel where handling and release take place (i.e., upper deck or lower deck), which may affect operational efficiency.
- Condition of the animal at release: status of the individual at the moment of release (e.g., excellent, good), considered a key indicator for estimating post-release survival.

Furthermore, the results highlight the importance of ensuring data consistency and comparability through standardized protocols and appropriate observer training. This is essential to guarantee data quality and its usefulness for regional-scale assessments.

Overall, strengthening data collection systems on the handling and release of ETP species represents an opportunity to improve the development of operational practices based on the best available evidence gathered by observers within the IATTC framework. The availability of more detailed and harmonized information will allow progress towards more accurate and appropriate recommendations, facilitating their implementation by fleets in the eastern Pacific and contributing to more effective management of interactions with vulnerable species, ultimately improving their survival rates.

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ANNEX I: FORM B1



Purse Seine National Programme (Tropical Tuna)  
**RELEASE OF ASSOCIATED FAUNA**

Form **B1**  
 2023 version

Fishing set No:	Date:	Fishing Trip Code
Route form No:	Route line No:	
Fauna release form No:	<b>ATTENTION:</b> note all ETPs on this form (sampled or estimated size)	

**Released fauna - sharks, rays and sea turtles** (1 line per sample, see example line 0)

Line	individual			release mode				
	(1) species	(2) size (cm)	(3) sex	(4) Handling mode	(5) Handling area	(6) Status	(7) Conformity	(8) Releasing time
0	FAL	140	2	17	1	2	NC-NC	1
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								

Notes:

- (1) write species code - see ID manual
- (2) in centimeters. It can be sampled or estimated individuals
- (3) sex - 0 undefined; 1 male; 2 female; 3 not available
- (4) Release or handling mode - **1** (brail); **2** (stretcher, tarp, sarria, cargo net); **5** (after disentanglement); **7** (sinking the floating line); **8** (cut in the net); **11** (gaff hook or other pointed tools); **12** (rope noose hanging); **13** (rope noose pulling); **14** (manually by the fins or body); **15** (manually hanging from the tail); **16** (manually by sensitive organs); **17** (manually dragged or pulled); **18** (hopper with ramp); **19** (ramp); **20** (sorting grid for manta and devil rays); **21** (shark velcros); **22** (lower deck conveyour belt and gutter/discards hatch)
- (5) Handling zone - **1** (net); **2** (main deck); **3** (below or well's deck)
- (6) Status - **E** (Excelent); **B** (Good); **C** (Correct); **M** (Poor); **I** (Unacceptable); **U** (Unknown)
- (7) Conformity - **C** (Conform); **NC-NC** (not conform-not complying: good practices are not applied although conditions allow their application); **U** (Unknown)
- (8) Releasing time - **1** (immediate release); **2** (after a prolonged period); **3** (at the end of the set)

Data verified:

if more than 25 individuals are released, continue on a new form