Collect. Vol. Sci. Pap. ICCAT, 76(9): 193-234 (2020)

PROGRESS ON THE CODE OF GOOD PRACTICES ON THE TROPICAL TUNA PURSE SEINE FISHERY IN THE ATLANTIC OCEAN

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SUMMARY

The two Spanish tuna purse seiner associations, ANABAC and OPAGAC, established a voluntary agreement for the application of good practices to minimize the ecosystem impacts of purse seine fishing, by reducing mortality of incidental catch of sensitive species and the use of non-entangling FADs. This paper presents results on the use of FADs and sensitive fauna release for the period 2015 and 2017 in the Atlantic Ocean. More than 600 trips were monitored in 28 purse seiners and 8 support vessels by human observers onboard or by electronic monitoring system. Results show that the percentage of entangling FADs is nowadays a residual component, being the 81.3% of the FADs left at sea non-entangling FADs. Overall, 37,468 vulnerable specimens were registered with a predominance of sharks (88% of the interactions). Sensitive species are mainly released by hand from the deck. For mantas specific releasing tools are also used. Bycatch release time has been reduced since 2015, which is an indicator of the increased commitment of the crew and could contribute to higher post-release survival rates.

RÉSUMÉ

Les deux associations espagnoles de thoniers senneurs, ANABAC et OPAGAC, ont conclu un accord volontaire pour l'application de bonnes pratiques afin de minimiser les impacts sur l'écosystème de la pêche à la senne, en réduisant la mortalité des prises accidentelles d'espèces sensibles et l'utilisation de DCP non emmêlants. Ce document présente les résultats de l'utilisation des DCP et des rejets de faune sensible couvrant la période 2015 et 2017 dans l'océan Atlantique. Plus de 600 sorties ont été suivies à bord de 28 senneurs et 8 navires d'appui par des observateurs humains à bord ou par un système de surveillance électronique. Les résultats montrent que le pourcentage de DCP emmêlants est de nos jours une composante résiduelle, 81,3% des DCP déployés en mer étant non emmêlants. Au total, 37.468 spécimens vulnérables ont été enregistrés avec une prédominance de requins (88% des interactions). Les espèces sensibles sont principalement remises à l'eau manuellement depuis le pont. En ce qui concerne les raies mantas, des outils de remise à l'eau spécifiques sont également utilisés. Le temps de remise à l'eau des prises accessoires a été réduit depuis 2015, ce qui est un indicateur de l'engagement accru de l'équipage et pourrait contribuer à améliorer les taux de survie suivant la remise à l'eau.

RESUMEN

Las dos asociaciones españolas de atuneros cerqueros, ANABAC y OPAGAC, establecieron un acuerdo voluntario para la aplicación de buenas prácticas a fin de reducir al mínimo los efectos de la pesca con redes de cerco en el ecosistema, mediante la reducción de la mortalidad de las capturas fortuitas de especies sensibles y el uso de DCP no enmallantes. En este documento se presentan resultados sobre el uso de los DCP y la liberación de fauna sensible para el período de 2015 y 2017 en el océano Atlántico. Se hizo un seguimiento de más de 600 mareas en 28 cerqueros y 8 buques de apoyo mediante observadores humanos a bordo o mediante un sistema de seguimiento electrónico. Los resultados muestran que el porcentaje de DCP enmallantes es hoy en día un componente residual, siendo el 81,3 % de los DCP colocados en el mar DCP no enmallantes. En total, se registraron 37.468 especímenes vulnerables con predominio de tiburones (88 % de las interacciones). Las especies sensibles se liberan principalmente manualmente desde la cubierta. Para las mantas también se utilizan herramientas de liberación específicas. El tiempo de liberación de la captura fortuita se ha reducido desde 2015, lo que es un indicador del aumento del compromiso de la tripulación y podría contribuir a aumentar las tasas de supervivencia después de la liberación.

KEYWORDS

Purse seining, tuna fisheries, FADs, by-catch, mitigation measures, Atlantic Ocean

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1. Introduction

The use of man-made drifting fish aggregating devices (FADs) in tropical tuna (i.e. skipjack tuna, *Katsuwonus pelamis*; yellowfin tuna, *Thunnus albacares*, and bigeye tuna, *Thunnus obesus*) purse seine (PS) fisheries has been significantly increasing since their introduction in the early 90s, improving fishing efficiency, reducing searching time and increasing successful catch rates (Dagorn *et al.*, 2012; Fonteneau *et al.*, 2013) and becoming the principal fishing mode for the purse seine fleet in all oceans. Nowadays, over half of the tropical tuna caught worldwide is fished by PS on FADs (Fonteneau *et al.*, 2013; Scott and Lopez 2014, ISSF, 2019). For example, tuna catches associated to FADs by the Spanish tropical purse seine fleet have accounted on average for 60% of the yearly catches in the Atlantic for Spanish tropical tuna purse seine fishery.

The increasing use of FADs in the past decades [i.e., about 100,000 FADs are estimated to be deployed annually worldwide (Scott and Lopez 2014)], and their impact on the marine ecosystem, have received much attention (Dagorn *et al.* 2012). The main concerns over FAD fishing are common for all tuna regional fisheries management organizations (Regional Fisheries Management Organizations, RFMOs, International Commission for the Conservation of Atlantic Tuna, ICCAT, in the Atlantic Ocean, Indian Ocean Tuna Commission, IOTC, in the Indian Ocean, Inter American Tropical Tuna Commission, IATTC, in the Eastern Pacific Ocean, and the Western Central Pacific Fishery Commission, WCPFC, in the Western Pacific Ocean): (1) reduction in yield per recruit of some target species (i.e. yellowfin and bigeye tuna); (2) increased by-catch and perturbation of pelagic ecosystem balance, including ghost fishing of sensitive species (e.g. sharks, turtles); (3) source of marine debris and impacts on coastal habitats as a result of beaching events; and (4) alteration of the tuna behavior (Bromhead *et al.* 2003; Hallier and Gaertner, 2008; Dagorn *et al.* 2012; Filmalter *et al.*, 2013).

Among others, fishing mortality of non-target species is commonly used to measure the environmental impacts of a fishery, which is a direct driver of change and loss of global marine biodiversity (Pauly *et al.*, 2005; Worm *et al.*, 2006). Recent studies have shown that tropical tuna purse seine fisheries have an overall bycatch rate for non-target fish species (including minor tuna as bycatch) of 1.40% relative to target tuna caught. These estimates decreased to 0.92% of non-tuna species when minor tunas are excluded from bycatch (Justel-Rubio and Restrepo, 2017). These minor tunas can comprise 80% of the bycatch in FAD fishing (Hall and Roman, 2013). Stocks of these fish bycatch species are considered in a healthy state and are commercialized in the local markets, especially in Côte d'Ivoire (Amandè *et al.*,2010; Chavance *et al.*, 2015; Amandè *et al.*, 2016). These estimates are variable depending on the region and fishing mode, with higher bycatch rates and more diversity observed in FAD fishing, i.e. about 2–9% of total catch by weight, than in free-schools sets, i.e. <2% of total catch by weight (Hall and Roman, 2013; Amandè *et al.*, 2012; Torres-Irineo *et al.*, 2014; Ruiz Gondra *et al.*, 2017a; Justel-Rubio and Restrepo, 2017; Lezama-Ochoa *et al.*, 2017; Lezama-Ochoa *et al.*, 2018; Ruiz Gondra *et al.*, 2018).

On the other hand, man-made FADs traditionally consisted of floating bamboo rafts with PS net panels hanging underneath, but designs have been evolving to favor desirable characteristics that increase fish aggregation potential (Murua *et al.*, 2018). FADs themselves, due to materials used in their construction, are a concern due to the increase in use of synthetic materials like plastic netting and flotation (Moreno et al 2017; Murua *et al.*, 2018; Moreno et al 2018a, 2018b). These long-lasting synthetic materials may eventually end up sinking or reaching coastal ecosystems such as beaches, coral reefs or mangroves (i.e. beaching); damaging coastal habitats and contributing to marine debris. Studies in the Indian Ocean provide variable estimates of beaching rates, i.e. from 1% to 45% (Maufroy *et al.* 2015, 2017; Davies *et al.* 2017; Zudaire *et al.*, 2018). Also, if entangling materials, such as large mesh size netting, are used in FAD construction, they can contribute to ghost fishing of associated fauna (e.g. sharks) (Filmalter *et al.*, 2013). Results on turtles show that entangling rate is low for this group of animals (Bourjea *et al.*, 2014).

In this context, mortality reduction and conservation of by-catch species has become a priority for RFMOs and for the fishing industry that are working for sustainability standards (e.g. Marine Stewardship Council). Considering all these potential impacts, since 2013 most RFMOs have gradually adopted the use of non-entangling FADs as bycatch mitigation measures and have promoted the use of biodegradable materials to reduce the incidence of entanglement of non-target species and littering on marine and coastal ecosystem. In addition, measures to safely release the sensitive fauna as turtles, sharks, whale sharks, and mantas are included, and the obligation of recording all the interactions with these species' groups to fill the data gaps and improve the managements of bycatch. These binding conservation measures are coming in force gradually in ICCAT (**Table 1**) and in other RFMOs.

In this line, the Spanish tuna purse seiner associations ANABAC and OPAGAC, operating in all oceanic regions pioneered in 2012 a voluntary agreement for the application of a code of good practices (CGP) for responsible tuna fishing activities. Some of the mitigation measures were adopted voluntarily before the tuna RFMOs did and efforts were also devoted for the adoption of similar standards at the RFMO level. The CGP was developed with the aim of reducing bycatch mortality and potential environmental impacts of FADs. The program is subjected to continuous revisions and adjustments, to respond to newly identified needs. This initiative has been also the precursor for other sustainability initiatives and standards such as the UNE 195006:2016 for Tuna from Responsible Fishing which includes the Best Practices as a must, or the recently adopted conservation measure on transactions with vessels that use only non-entangling FADs by ISSF (International Seafood Sustainability Foundation).

The aim of this work is to present the progress made on the implementation of the good practices in the Atlantic Ocean in terms of FAD use and methods to release fauna during the period 2015 to 2017.

2. Material and methods

2.1 Observer data

ICCAT (ICCAT Rec. 10-10) establish a 5 % coverage as the minimum standard for their scientific observer programs. Additionally, ICCAT Rec. 14-01 (superseded by Rec. 15-01) requires 100% observer coverage, to all purse seine vessels (PS) targeting tropical tunas and supply vessels, during the two months FAD area/time closure in the Atlantic Ocean. In addition, 10% coverage is required by the European Union (EU) that is ensured via EU-funded data collection programs. Going beyond these requirements the CGP stablishes a 100% observer coverage for PS from 2015 and for supply vessels from 2017 onwards. This monitoring can be either done by human observers or by electronic monitoring systems (EMS). If this last case is chosen by a vessel, EMS should follow minimum standards described by Ruiz Gondra *et al.* (2017b). In this case, in order to reach the 100% coverage, it is mostly managed by private contracts between industry and human observer or EM service providers. In the Atlantic Ocean, most human observers are managed by Sea Eye or Ocean Eye (Côte d'Ivoire), while some trips are observed by Spanish Institute of Oceanography (IEO – Instituto Español de Oceanografía) and AZTI under the EU Data Collection Framework (DCF) (Commission Regulation (EC) Nº 665/2008) and coastal countries due to other private agreements (e.g., Gabon, Liberia, Curacao). Since 2016, a significant number of trips is being covered through EMS by DOS (Digital Observer Service) and AZTI. Data in the Atlantic Ocean are collected in the specific observer forms designed for the evaluation of the CGP (**Annex 1**).

Observers collect specific information on FAD structures and components including the mesh size on the floating and underwater structure, if meshed material is present, and its configuration (i.e. open net or wrapped in coils) (**Annex 1**). All FADs are evaluated, the ones deployed by the fleet and any other FAD encountered at sea, either when arriving to the FAD or when leaving it at sea, to evaluate modifications on FAD material and design in each interaction if occurring. The non-entangling classification followed the definitions of the CGP, including as non-entangling, lower entanglement risk FADs that are constructed with non-entangling mesh (i.e. mesh size ≤ 7 cm) if the open net is present or tied-up in sausages, and non-entangling FADs constructed with no meshed material as referred in the ISSF classification criteria (ISSF, 2015). Thus, any open net above 7 cm mesh size was considered as entangling.

For sensitive fauna release, the CGP developed species-specific handling procedures that always prioritise crew safety while discouraging other practices that are less desirable, and specific material has been developed to inform observers and the crew about the best handling practices (**Annex 1** and **Annex 2**). These release procedures are based on the outputs of the EU project MADE (Poisson *et al.*, 2012, 2014a), which have been used as standard best practice for safe bycatch release operations in RFMOs. AZTI in charge of coordinating, collecting, processing and analysing bycatch release data developed specific forms in English, French and Spanish to collect detailed information on bycatch release operations through scientific observers (**Annex 1**). In each interaction the releasing mode is recorded as described in the CGP: (i) using the brailer, (ii) using light equipment such as stretcher, fabric, *sarria* or cargo net, (iii) using specific equipment such as a hopper or lateral doors, (iv) manually from deck, (v) after disentangling; if in each release the practices applied were in line with the ones defined in the CGP, and since 2016, the cause of the non-application of the best releasing practices (i.e. residual mortality: RI; lack of specific material for the manipulation; application of incorrect practices), as well as the time used to release animals are registered for each species and species group (i.e. sharks other than hammerhead sharks and whale sharks, hammerheads sharks, whale sharks, mantas, rays and turtles). Also, the state of the animal when it is released at sea is registered based in the states proposed by Heuter and Manire

(1994), (i) excellent (very active and energetic, strong signs of life on deck and when returned to water); (ii) good (active and energetic, moderated signs of life on deck and when returned to water); (iii) correct (tired and sluggish, limited signs of life, moderate revival time required when returned to water, slow or atypical swimming away); (iv) poor (exhausted, no signs of life, bleeding from gills, jaw or cloaca, long revival time required when returned to water, limited or no swimming observed upon release); (v) very poor or moribund: moribund, no signs of life, excess bleeding from gills, jaw or cloaca, unable to revive upon return to water, no swimming movement, sinks.

In the evaluation, the whale sharks and hammerheads sharks are classified in an independent group apart from sharks due to their size, morphology and sensibility which require specific handling. Information on biological parameters such as the size and sex of the specimens is also recorded when possible.

Entangling events on FADs were included in observer forms since 2016, when specific guidelines were included in the observer manuals for the registration of fauna entanglements on FADs. When a FAD is found by a purse seiner or a supply vessel at sea, observers record the presence or absence of specimens entangled in the FAD. The number of specimens or species is not generally recorded.

2.2 Evaluation of the coverage and data available for the assessment

Since 2015, in purse seiners 100% of the fishing trips are monitored by human observers or by EMS. This has been gradually implemented in supply vessels since 2017. In this study for the assessment on best practices, on those trips in which data on CGP have been collected, a cleaning data processing has been applied and the percentage of days monitored with valid data on best practices was computed, by summing up the duration of each fishing trip with data on the CGP relative to the total number of days of vessel activity. In case of support vessels, when the vessel entries and departures were not available for a given vessel, a yearly mean of activity is applied.

For purse seiners, the observed coverage, in the sense of availability of data in good practices for this specific study, in terms of production (i.e. catch of yellowfin, skipjack and bigeye tuna) and coverage percentage of the number of sets is also given.

2.3 Evaluation of the entangling risk of FADs

In each interaction with FADs, FADs are evaluated when encountered at sea through either random encounter with non-owned or targeted encounters with owned and tracked FADs (i.e. at arrival), and thereafter when placed at sea after the encounter or as the result of a new deployment (i.e. at departure). 7 FAD categories are established as follows (from lowest to highest risk of entanglement): 1- Totally non-entangling, constructed with materials with non-entangling characteristics (i.e. if mesh material is present the mesh size is ≤ 7 cm or rolled in sausages); 2 - net of >7 cm in the bottom part of the raft; 3- net of >7cm in the upper part of the raft; 4: pieces of net >7cm in the underwater part; 5: underwater part with net >7cm; 6: raft and underwater part with net >7cm. 0- not visible (this last category was used when the underwater structure of the FAD was not visible for observers because the FAD was not lifted from the water to avoid interfering with the aggregation underneath or breaking the submerged structure and not evaluated by the observer). Given the FAD characteristics, in each interaction each of the FAD is classified in one of these categories. Note that, the same FAD could be subjected to multiple evaluations during its lifetime, i.e. at arrival and at departure. The resulting percentage in each category is the number of FADs classified in the corresponding category relative to the total visible FADs by timeframe (i.e. at arrival and at departure). The totally non-entangling FADs are the ones classified in the category 1 in which if mesh material is present the mesh size is ≤ 7 cm or rolled in sausages.

2.4 Evaluation of the interactions with fauna and releasing methods used by the crew

For the estimation of the bycatch rates, a mean weight by species is applied in this work. In this work the number of specimens released by set, number by 1,000 tonnes and tonnes by 1,000 tonnes is estimated based in the data collected in the frame of the Code of Good Practices Program.

The code of good practices stablishes several releasing practices for each species group (**Annex 1 and 2**) and observers when possible measure the time dedicated by the crew for fauna release. In this study the percentage of individuals released using each method is quantified by summing up the releases following each handling method relative to the total observed releases by species group in each year. In addition, the percentage of release actions occurring in 1 to 10 minutes, an hour and more than an hour from detection is computed by group and year.

3. Results and Discussion

3.1 Coverage and data available for the assessment on good practices

Since 2015 100% of the fishing trips on purse seiners were covered by observers (human or EMS). Different organisms and flag states have been gradually introduced in the collection on best practices data, and sometimes in order to assure the collection of official data, official data collection programs have been prioritized, as the information to be collected by observers in each set is significant. In this sense, in this work, between 2015 and 2017 information on 697 fishing trips (i.e. 639 and 58 in supply vessels) on 28 purse seine and 8 support vessels in the Atlantic Ocean has been analyzed under the Code of Good Practices Program. These trips have been monitored by 86 observers trained on Good Practices from different organisms (**Table 2**), for which specific observer guide was created as supporting material. The last version can be found in the **Annex 1**.

In terms of production (catches of target tuna-species - skipjack. yellowfin and bigeye tuna) and number of sets, data on good practices on purse seiners included in this study correspond to a coverage of 80-85% (**Table 3**). In terms of fishing days, the percentage of days with data on good practices on purse seiners is high and stable during the study period (i.e., over 80%) (**Figure 1**). On supply vessels, a gradual increase is observed in the availability on good practices data since 2016 when the monitoring on best practices was gradually implemented prior to the integration of supplies in the CGP program and during 2017 when supply vessels were joined to the CGP. In purse seiners and supply vessels an increasing tendency is observed in the EMS, mainly in supply vessels, where due to the reduced space onboard the EMS is the main monitoring method (**Figure 1**).

The sampling coverage impacts on the bycatch estimates and 20-50% of bycatch sampling coverage has been estimated for a reasonable bycatch estimation in previous studies (Lenner-Cody., 2001; Babcock *et al.*, 2003; Sanchez *et al.*, 2007; Amandè *et al.*, 2012). In the Atlantic Ocean a reduction in fluctuations was observed with the increase of observer coverage thanks to private contract agreements (Ruiz Gondra *et al.*, 2017a). While RFMOs in the Pacific Ocean require a 100% coverage, in the Atlantic Ocean the Rec. 10-10 set a minimum of 5 % coverage for the scientific observer programs, and a 100% during the two months FAD area/time closure, being well below the recommendations (Lenner-Cody., 2001; Babcock *et al.*, 2003; Sanchez *et al.*, 2007; Amandè *et al.*, 2012) which restricts the coverage to a time window and can induce to changes in the behavior of the crew when observers are present, resulting on statistical biases (Hall *et al.*, 2017). In this sense the CGP allows to go further beyond RFMOs observer coverage requirements, provides data that can be used for accurate bycatch estimates (Ruiz Gondra *et al.*, 2017a, 2018), has allowed to evaluate the FADs used by the purse seine fleet and support vessels and provided unique information to allow the industry and scientists to monitor the implementation of the good practices on board and to design of corrective actions for a continuous improvement on the application of the mitigation measures.

3.2 The use of Non-entangling FADs

Traditionally the FADs used by industrial purse seiners consisted of bamboo rafts with extra floats (platform) and nets hanging below (submerged appendage), typically constructed using reused purse seine nets with large mesh size (>12 cm). As this kind of FAD with large mesh size is supposed to entail higher risk of entanglement for sensitive species like sharks or turtles (Filmanter *et al.*, 2013), the CGP promoted a design, construction and deployment of FADs that minimize the potential of accidental animal entanglements. As such, the replacement and use of non-entangling FADs (including lower entanglement risk FADs referring to ISSF categories, ISSF 2015) has been promoted since 2012. This voluntarily adopted mitigation measure came before the ICCAT guidelines for FAD designs (Rec. 14-01) and has allowed replacing the traditional FADs by non-entangling FADs. In order to further assure that FADs are in line with the criteria stablished in the CGP, nowadays FADs used by the target fleet are mainly made in port, where the construction is supervised by companies (**Figure 2**), and these facilities have been visited by AZTI.

At sea, observers on board evaluate the FADs' condition when the devices are encountered at sea due to either random encounters with non-tracked or planned encounters with tracked FADs (i.e. at arrival), and thereafter when placed at sea after the encounter or as the result of a new deployment (i.e. at departure). During the 3 years (2015-2017) 36,439 FAD evaluations "at arrival" and 49,721 "at departure" were recorded (note that for FAD activities other than new deployment the same FAD could be evaluated multiple times as subjected to the two evaluations in each visit, i.e., at arrival and at departure, and multiple visits during FAD lifetime) (**Table 4**).

In the Atlantic Ocean, from 2015 to 2017, the annual mean percentage of 35.9% (± 5.3) of the FADs at departure (e.g. a deployment or left at sea after an unplanned or a planned activity) were classified as not visible (Category 0). Discarding these cases and considering only those FADs that could be evaluated by observers at departure, the percentage of non-entangling FADs during 2017 has been high, being 81.3% of the visible FADs that were left at sea totally non-entangling (i.e., category 1: raft and underwater structure totally non-entangling). As shown in **Figure 3**, a progressive improvement is observed since 2015, in which the percentage of evaluated FADs classified in the category 1 increases. The percentage of FADs evaluated at departure, made entirely with non-entangling material increased from 31.9% in 2015 to 61.2% in 2016 and to 81.3% in 2017.

A similar pattern is observed when analyzing characteristics of visible FADs at arrival or when encountered at sea (which could refer to tracked FADs or randomly encountered non-tracked FADs). Discarding the non-visible cases for the analysis (Category 0; annual mean of 50% (± 1.9), the percentage of totally non-entangling FADs (Category 1) encountered at sea increased from 38.8% in 2015 to 58.6% in 2016, reaching 82.4% during 2017 (**Figure 3**).

In 2017, entangling netting (i.e. open netting with mesh size >7cm) in the submerged structure of FADs used was a residual component of the total numbers of evaluated FADs at sea (at arrival: 3.3%; at departure: 2.9% [Ind.4. Ind.5. and Ind.6]). Although the entangling character of the floating structure has significantly been improved during the study period, some rafts (i.e. floating structure) in 2017 were found to be covered by entangling nets, mainly in the bottom part which may suppose a minor risk for turtle entanglement (i.e. 9 % at arrival and 11% at departure of FADs with entangling material in the bottom part of the raft [Ind.2]; and 5.2% at arrival and 4% at departure in the case of the upper part [Ind.3]). Those FADs that were left in the water or FADs at water classified as having entangling material could partially correspond to re-used FADs deployed by the fleet which had lost the non-entangling character due to the deterioration of the raft cover or break of the submerged structure. Could be also the case of FADs not deployed by the target fleet, which were not replaced by non-entangling material after a visit. However, in order to further reduce the entangling character of FADs in the water, whenever possible, the entangling material should be replaced by the non-entangling material or FADs should be repair if the material is deteriorated.

Results show that the voluntarily adopted commitment by the ANABAC and OPAGAC fleets and the effort made since the implementation of Good Practices is gradually replacing the traditional FADs in the water by non-entangling FADs, as shown by the characteristics of the FADs evaluated at arrival (i.e., tracked FADs or randomly encountered non-tracked FADs), and at departure (i.e., FADs left at sea as a result of a deployment or after a visit). The percentage of totally non-entangling FADs evaluated at departure and at arrival has increased since 2015, being over 80% of the visible FADs classified as totally non-entangling following the CGP classification criteria [Category 1] in 2017 (**Figure 3**)**.**

Entanglement events on FADs started to be recorded in 2016. In 14,507 evaluations made on FADs at arrival, 24 cases of FADs with entangled fauna has been registered, i.e. 0.17% of FADs with entangled fauna have been observed. The entangling rate by FAD type is shown in **Table 5**. The highest entangling rate is observed in FADs with entangling material in the submerged structure. In best practices forms the absence or presence of entangled fauna is recorded, but the number of specimens or species is not usually recorded. In order to further evaluate the entangling rate, the forms should be adapted to enable collecting detailed information of the number of specimens and species entangled in FADs.

Moving to non-entangling FADs constructed entirely without any net and with biodegradable material will help to minimize the potential entangling risk, detected when netting material is deteriorated over time. Besides, eliminating all synthetic materials used in the construction of FADs will reduce their residence time at sea, and consequently their associated impacts in marine ecosystem (i.e. beaching), which will suppose a significant progress to the fishery (Davis *et al.*, 2017; Moreno *et al.*, 2018a). Currently, this fleet, together with the other EU and associated purse seine fleets, is working in parallel in different projects in the Indian and Eastern and Central Pacific Ocean to test new FAD prototypes built with biodegradable and non-entangling material (Moreno *et al.*, 2017; Zudaire *et al.*, 2017; Moreno *et al.*, 2018b). The findings of these ongoing projects will potentially contribute to identify effective FAD designs and materials for those oceans, which will make possible at a short-medium term to stablish the basis for the gradual replacement of traditional FAD by biodegradable NEFAD.

3.3 Interactions with sensitive fauna and release operations

A total of 37,468 interactions with vulnerable specimens were registered during the study period (2015-2017) in the Atlantic Ocean (**Table 6**). Sharks (other than hammerhead shark and whale shark) were the dominant group with 28,036 records (74.8%), followed by hammerheads sharks (n=5,015, 13.4%), turtles (n=2,674, 7.1%), mantas (n=1,360, 3.6%), rays (n=250; 0.7%) and whale sharks (n=118, 0.3%). The most frequent species for sharks, hammerheads, mantas, rays and turtles were the *Carcharhinus falciformis*, *Sphyrna lewini*, *Mobula japonica*, *Dasyatis violacea* and *Lepidochelys olivacea*, respectively. Number of specimens registered by species group per set and catch of target species is included in **Table 7** for each year and by species group.

Shark species bycatch rates observed in this study are in line with those presented by Ruiz Gondra *et al.* (2017a) in the Atlantic, which estimated a 5-6 t by 1000 tons of tuna production for Atlantic for FAD fishery in recent years. In the case of sharks, purse seine bycatch rates are relatively low in comparison with longline gears fishing tuna (Gilman, 2011; Oliver *et al.*, 2015; Hall and Roman, 2013; Garcia and Herrera, 2018). For instance, in longline fisheries targeting tuna, the shark bycatch ratios can surpass the 20% and can reach the 50-60%, in some cases, becoming target species (Gilman *et al.*, 2008; Oliver *et al.*, 2015).

Meanwhile, interactions with turtles, manta-rays and whale sharks are infrequent as shown in the **Table** 7 and previous studies (<0.1% of the bycatch weight) (Amandè *et al.*, 2010; Bourjea *et al.*.2014, Hall and Roman, 2013; Ruiz Gondra *et al.*, 2017a; Ruiz Gondra *et al.*, 2018; Garcia and Herrera, 2018). Overall 2,674 specimens of turtles were registered in the frame of the Good Practices for 3 years period, and an annual mean number of 891. Estimates in this work are higher than in previous ones in the area (Bourjea *et al.*, 2014) which could be an effect of the higher sampling coverage on the present study. Regarding turtles, higher bycatch rates are also observed in longlines fishing tuna or swordfish, being turtle bycatch in the order of 200,000 individuals caught annually in the Atlantic (Lewison *et al.*, 2004) and with 25% of death at retrieval (Gilman, 2011), while in PS tropical tuna fisheries the annual number is 3 orders of magnitude lower, with a high rate of post-release survival, i.e. > 90% (Bourjea *et al.*, 2014).

Overall, compared with other fisheries and other gears fishing tuna, PS bycatch rates are much lower (Hurrington *et al.*, 2005; Gilman, 2011; Hall and Roman, 2013; Oliver *et al.*, 2015, Garcia and Herrera 2018). For instance, global bycatch rates of purse seiner are residual if comparing with trawls, crustacean or demersal fishery which can go to 80% of bycatch by target species (Hurrington *et al.*, 2005). Bycatch levels on purse seiners are also lower than the overall estimates for the global tuna fishery which oscillates from 5% to 14% of the total catch depending on the study (Kelleher, 2005. Gilman *et al.*, 2017). Global raised bycatch of tuna purse seiners are in particular 1.75 to 3 times lower than the estimates for longline fishery bycatch which accounts for the 7.5% to 22% of the total catch weight (Kelleher, 2005. Gilman *et al.*, 2017). However, sensitive species are less resilient due to their K-selected life history strategy with slow growth, delayed sexual maturity and low fecundity (Heppell *et al.* 2000), making them vulnerable to fishing. For example, the population status of silky sharks, which are the dominant elasmobranch bycatch species of tropical tuna purse seiner (Amandè *et al.*, 2012; Lezama-Ochoa *et al.*, 2018), could potentially be affected. Declines in shark populations due to multiple causes can potentially impact ecosystem functioning, including extensive cascading effects on lower trophic levels.

When possible in each interaction observers note the handling method used for releasing the sensitive fauna. The percentage of specimens released by each method and species group, in those cases in which the releasing mode was observed, is shown in the **Figure 4**. Except for whale sharks, the specimens are mainly handled by hand, a technique that is described in the CGP (**Annex 1 and Annex 2**) which allows a quick release from the deck specially when various specimens are caught in a set. However, this also supposes a risk for the crew especially in case of sharks. Indeed, some accidents have been registered during the last years. Specific tools like stretchers or cargo nets are used mainly when releasing mantas. Mantas occur occasionally, and due to the size and specific morphology of this animals the handling usually requires the use of specific material. In case of whale sharks, the animals are released by submerging the floats or by breaking the net as described in the CGP (**Annex 1** and **Annex 2**).

Whenever possible, observers also record the time passed between detection and release by the crew, making it possible to assess the response of the crew when a specimen is detected on board. Since 2015, thanks to the crew training and implication of the companies, the release time has been reduced in almost all species groups, which can positively affect post-release survival rates (**Figure 5**). Concerning whale sharks, this reduction in release time is not evident as it highly depends on where the fish is positioned inside the net. In addition, it is observed how the handling of mantas takes in general more time than other species groups, mainly due to their size and morphology which requires the use of specific release tools as cargo nets and stopping the fishing maneuver.

In recent years, different tagging studies have been conducted to aim at exploring post release survival rates as well as the contribution of best fishing practices to the reduction of bycatch fishing mortality (**Table 8**). Results on sharks (including hammerheads and other sharks) show that bycatch rates are generally low, but on vessel mortality in purse seiners is high. i.e. 52% to 72% depending on the study, species and set catch volume (in which on vessel mortality rates are directly correlated with set size) (Poisson *et al.*, 2014b; Eddy *et al.*, 2016). Post-release survival often depends on whether shark bycatch is entangled in the net or not, and on the time spent between the net closure and the release, e.g. first or subsequent brails, as well as on the state of the specimen at release (Poisson *et al.*, 2014b; Hutchinson *et al.*, 2015. Filmalter *et al.*, 2015. Eddy *et al.*, 2016). Overall, based on these studies, conformity with the best practices could contribute to increased survival rates, from a minimum of 5% to a maximum of 19% of incidentally caught sharks (**Table 8**). For whale sharks encircled and released following the Good Practices, the survival was estimated to be 100% (Murua *et al.*, 2014; Escalle *et al.*, 2018) and, thus, the tuna purse seiners' impact on direct mortality of this species is negligible if the recommended practices are observed, as is the case of the target fleet.

Interaction with mantas on purse seine FAD sets is very low, while non-associated sets have higher but still very sporadic mobulid catch rates (Hall and Roman. 2013). One study on purse seiners conducted on mantas in New Zealand showed that from 8 tagged mantas 3 survived (37.5%) which were the ones brailed on board, while the ones entangled in the net and released did not survive. Thus, various authors recommend the adoption of Good Practices to decrease the fishing mortality of mobulids (Poisson *et al.*, 2014a; Francis and Jones, 2017; Hutchinson *et al.*, 2017). However, further tagging work should be developed in tuna purse seiners to assess the post release survival estimates on this species group.

Finally, interactions with marine turtles in the tropical tuna purse seine fishery were shown to be low, with high survival rates (Bourjea *et al.*, 2014; Ruiz Gondra *et al.*, 2017a); therefore, the impact of the purse seine fishery over species within this group is low (Bourjea *et al.*, 2014) whenever good practices are observed, as is the case of this program.

4. Conclusions and recommendations

Since the implementation of the Good Practices program, the commitment of the fleet and continuous training of crew on the application of the Code has contributed significantly to the improvement on FAD use. Traditional FADs deployed by the fleet have been gradually replaced by non-entangling FADs. The percentage of non-entangling FADs at departure and at arrival has increased since 2015 to reach the maximum percentage of non-entangling FADs in 2017.

Regarding interactions with fauna, bycatch rates of sensitive species are low when compared with other industrial fisheries (i.e. demersal and driftnet fisheries) and other fisheries fishing tuna (i.e. longline). It is observed that for sharks (other than whale sharks) turtles, mantas and rays the animals are handled by hand and release time has been reduced, which can contribute positively to survival rates.

Based on the results from the study period the following recommendations are proposed:

- The adoption of high observer coverage has resulted in the stabilization of bycatch rates, as shown by Ruiz Gondra *et al.* (2017a). Therefore, in order to provide accurate estimates of bycatch for those sensitive species under assessment it is recommended to set mitigation measures as the one proposed in this study and increase the observer coverage requirement in the ICCAT area, in line with recommendations made in previous works evaluating the optimum coverage needed for an accurate assessment.

- Follow with the construction and deployment of non-entangling FADs, avoiding the use of entangling nets (open netting with mesh size >7cm) on the raft and submerged structure, and through replacement of traditional FADs for non-entangling FADs when encountered at sea.

- In a short/medium term, move to non-entangling FADs constructed entirely without any net and with biodegradable material which will help to eliminate the potential entangling risk and other associated habitat impacts.

- In order to increase the survival of vulnerable species (mainly of sharks), new mitigation approaches should be explored, e.g. promoting release from the net or avoidance of shark hot spots.

- Shorten detection time on deck of fauna and aim an immediate release in order to reduce mortality, in particular in time/area windows with high presence of sharks.

- In sets where high incidence of sharks is observed, avoid loading them onboard by brailing them directly to the sea.

- Improve handling methods while ensuring the safety of the crew, through the use of suitable tools for release including canvas or carriage nets, or through the development of new tools and gear to assist in release operations.

- Strengthen training of the crew involved in the handling of sensitive species both in the upper and lower decks.

Acknowledgments

Authors would like to acknowledge organizations responsible of the data collection funding: Data presented in this paper where collected in the frame of the EU Data Collection Framework, IATTC observer program and the Spanish “Good practices monitoring program” supported by Spanish purse seine associations (ANABAC and OPAGAC). The authors would like to thank to Izaskun Alberdi Landaluze, student of the postgraduate course Scientific Illustration of the UPV/EHU, for the Illustrations/Figures in **Annex 2**.

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Table 1. List of Conservation and Management Measures (CMMs) for sensitive fauna (i.e. elasmobranch and turtles) and Fish Aggregating Devices (FADs) for the International Commission for the Conservation of Atlantic Tuna, ICCAT, in the Atlantic Ocean.

Issue	***Rec.***	***Description***
Elasmobranchs	Rec 03-10*	Implementation of National Plan of Action, in accordance with the FAO IPOA, for the conservation and management of sharks.
	Rec 04-10*	Sets out a scientific and management framework on the conservation of sharks caught in association with ICCAT managed fisheries. Includes data report requirements (Task I and II), full utilization of catch, 5% fin/ body ratio for retained catches, encouragement for release of live sharks captured as bycatch and research implementation (identification nursery areas, fishing gear selectivity)
	Rec 09-07*	Sets out a scientific and management framework on the conservation of Thresher sharks caught in association with ICCAT managed fisheries. Includes directed fishery ban, prohibition of retention of bigeye thresher shark (*Alopias superciliosus*), data report requirements (Task I and II), encouragement for release of live sharks and research implementation (identification nursery areas)
	Rec 10-06*	Sets out a scientific and management framework on the conservation of Atlantic shortfin mako sharks (*Isurus oxyrinchus*) caught in association with ICCAT managed fisheries. Includes data report requirements (Task I and II), prohibition of retention for CPS that do not report Task I.
	Rec 10-07*	Sets out a scientific and management framework on the conservation of oceanic whitetip sharks (*Carcharhinus longimanus*) caught in association with ICCAT managed fisheries. Includes prohibition of retention, data report requirements (discards and release through observer programs), and recommendation for adoption of minimum size of 200 cm
	Rec 10-08*	Sets out a scientific and management framework on the conservation of Hammerhead sharks (except *Sphyrna tiburo*) caught in association with ICCAT managed fisheries. Includes prohibition of retention, data report requirements (discards and releases; and Task I and II for developing coastal CPCs catching silky shark for local consumption), encouragement for release of live sharks and research implementation (identification nursery areas)

	Rec 11-08*	Sets out a scientific and management framework on the conservation of silky sharks (*Carcharhinus falciformis*) caught in association with ICCAT managed fisheries. Includes prohibition of retention, data report requirements (discards and release through observer programs and Task I and II for developing coastal CPCs catching silky shark for local consumption), encouragement for release of live sharks, including additional measures needed to increase survival rates of shark incidentally caught by purse seiners and research implementation (identification nursery areas).
	Rec 14-06*	Sets out a scientific and management framework on the conservation of Atlantic shortfin mako sharks (*Isurus oxyrinchus*) caught in association with ICCAT managed fisheries. Includes data report requirements (Task I and II), research implementation (biological/ecological parameters, life-history and behavioural traits, identification of potential mating, pupping and nursery grounds) and stock assessment by 2016.
	Rec 15-06*	Sets out a scientific and management framework on the conservation of Porbeagle Shark (*Lamna nasus*) caught in association with ICCAT managed fisheries. Includes encouragement for release of live sharks, data report requirements (Task I and II) and scientific research encouragement (key biological data and identification of areas of high abundance of important life-history stages).
	Rec 16-12*	Sets out a scientific and management framework on the conservation of Atlantic blue sharks (Prionace glauca) caught in association with ICCAT managed fisheries. Includes catch limit, data report requirements (Task I and II) and scientific research encouragement (biological/ecological parameters, life-history, migrations, post-release survivorship and behavioural traits)

Turtles	Rec 03-11*	Sets out a scientific and management framework on the conservation of sea turtles, including data collection on interactions with sea turtles in ICCAT fisheries; releasing of marine turtles that are incidentally caught alive, and sharing all available information such as technical measures to reduce the incidental catch of turtles and to ensure the safe handling of all turtles that are released, in order to improve their survivability; the development of data collection and reporting methods for the incidental by-catch of sea turtles in tuna and tuna-like species fisheries; support efforts by FAO to address the conservation and management of sea turtles.
	Rec 05-08*	Sets out a scientific and management framework on the conservation of sea turtles in relation to circle hooks, including undertaking research trials of appropriate-size circle hooks in commercial pelagic longline fisheries and in recreational and artisanal fisheries; to exchange ideas regarding fishing methods and technological gear changes that improve the safe handling and release of incidentally caught species including; SCRS should present the Commission with an assessment of the impact of circle hooks on the dead discard levels
	Rec 10-09*	Sets out a scientific and management framework on the conservation of sea turtles; including the requirement of mitigation measures to reduce the mortality such as best handling and releasing practices, avoiding setting on turtles; to conduct an assessment of the impact of the incidental catch of sea turtles resulting from ICCAT fisheries
FADs	Rec 14-01	Sets out a scientific and management framework on conservation of tropical tuna, including reporting obligations on FADs for purse seine and bait boat fishing vessels and all support vessels (including supply vessels); stablishes guidelines for FAD Management Plans and FAD designs; and the obligation of replacement by 2016 existing FADs with non-entangling FADs

	Rec 15-01	This recommendation replaces the Rec. [14-01]. Sets out a scientific and management framework on conservation of tropical tuna, including reporting obligations on FADs for purse seine and bait boat fishing vessels and all support vessels (including supply vessels); stablishes guidelines for FAD Management Plans and FAD designs; the obligation of replacement by 2016 existing FADs with non-entangling FADs; stablishes FAD area closures and limits for the number of active FADs
	Rec 16-01*	Sets out a scientific and management framework on conservation of tropical tuna, including reporting obligations on FADs for purse seine and bait boat fishing vessels and all support vessels (including supply vessels); stablishes guidelines for FAD Management Plans; the obligation of replacement by 2016 existing FADs with non-entangling FADs; stablishes FAD area closures and limits for the number of active FADs.
	Rec 17-01*	Sets out a scientific and management framework on conservation of tropical tuna, including obligations to achieve a substantial reduction in discards of tropical tunas by 2020.

*Recommendations in force.

Table 2. Number of trips on best practices included in this study, analyzed by each organism, and number of trainned observers collecting the data.

Organism	***N of trips***	***N of observers***
AZTI	57	10
Digital Observer System	135	11
Instituto Español de Oceanografía	155	28
Sea Eye/Ocean Eye	350	37

Table 3. Total number of trips covered by observers (Tot n trips), the corresponding total catch and total number of sets (Tot. catch and Tot. n sets, respectively); and the number of trips included in this work for the assessment of good practices (n trips) and the corresponding number of sets (n set) and catch (catch (t)). The percentage of the sets evaluated on Good Practices (% sets) in this study and the corresponding catch (% catch) is shown.

year	***n trips***	***n set***	***catch (t)***	***Tot n trips***	***Tot n sets***	***Tot catch***	***% sets***	***% catch***
2015	206	4583	141,160.0	242	5,460	164,772	83.9	85.7
2016	219	5259	143,880.1	263	6,378	177,184	82.5	81.2
2017	214	5811	144,546.4	250	6,968	177,410	83.4	81.5

Table 4. Number of evaluations on FADs done by observers "at arrival" (during unplanned or planned FAD encounters) and "at departure" (when placed at sea after the encounter or because of a deployment) by year and ocean during the study period (2015 to 2017).

year	**At arrival**	**At departure**
2015	10,484	12,919
2016	11,703	14,800
2017	14,252	22,002

Table 5. Number of entangling events registered by FAD category. Ind: FAD categories: Ind 1 (non-entangling); Ind 2 - net of >7 cm in the bottom part of the raft; Ind 3- net of >7cm in the upper part of the raft; Ind 4: pieces of net >7cm in the underwater part; Ind 5: underwater part with open net >7cm; Ind 6: raft and underwater part with net >7cm); n FAD: number of FADs evaluated for entangling events; n FADs with entangled fauna; number of FADs with specimens entangled.

FAD categories	*n FADs evaluated*	*n of FADs with entangled fauna*	*% of FAD with entangled fauna*
Ind.0	6,875	2	0.03
Ind.1	6,494	13	0.20
Ind.2	601	2	0.33
Ind.3	313	3	0.96
Ind.4	14	1	7.14
Ind.5	151	1	0.66
Ind.6	59	2	3.39

Table 6. Number (n) of specimens by species registered in the framework of the Code of Good Practices Data Collection program from 2015 to 2017 in the Atlantic Ocean.

Groups	***Scientific_name***	***FAO code***	***n***
Hammerheads sharks	*Sphyrna mokarran*	SPK	376
	Sphyrna lewini	SPL	2,767
	Sphyrnidae	SPY	772
	Sphyrna zygaena	SPZ	1,100
Whale Sharks	*Rhincodon typus*	RHN	118
Other sharks	*Carcharhinus brachyurus*	BRO	44
	Prionace glauca	BSH	650
	Alopias superciliosus	BTH	47
	Carcharhinus altimus	CCA	7
	Carcharhinus limbatus	CCL	18
	Carcharhinus obscurus	DUS	67
	Carcharhinus falciformis	FAL	21,746
	Isurus paucus	LMA	2
	Megachasma pelagios	LMP	1
	Isurus spp.	MAK	10
	Lamnidae	MSK	10
	Carcharhinus longimanus	OCS	86
	Lamna nasus	POR	5
	Carcharhinidae	RSK	4,941
	Selachimorpha (Pleurotremata)	SKH	69
	Isurus oxyrinchus	SMA	318
	Alopias spp.	THR	14
	Galeocerdo cuvier	TIG	1
mantas	Mobulidae	MAN	11
	Manta spp.	MNT	15
	Manta alfredi	RMA	1
	Manta birostris	RMB	267
	Mobula japanica	RMJ	478
	Mobula mobular	RMM	195
	Mobula thurstoni	RMO	20
	Mobula tarapacana	RMT	148
	Mobula spp.	RMV	225
rays	*Myliobatis aquila*	MYL	6
	Dasyatis violacea	PLS	231
	Rajiformes	SRX	5
	Dasyatidae	STT	8
Turtles	*Dermochelys coriacea*	DKK	96
	Lepidochelys olivacea	LKV	1,162
	Lepidochelys kempii	LKY	21
	Eretmochelys imbricata	TTH	21
	Caretta caretta	TTL	809
	Testudinata	TTX	431
	Chelonia mydas	TUG	134

Table 7. The number of specimens (n), number of specimens by set (n/set) and number and tones by 1,000 tons catch (n/1000t and t/1000t, respectively) by group and year based on the 639 evaluated trips, which correspond to over 80% of the trips by year (see **Table 3**).

		2015				*2016*				*2017*		
Species group	*n*	*n/set*	*n/1000t*	*t/1000t*	*n*	*n/set*	*n/1000t*	*t/1000t*	*n*	*n/set*	*n/1000t*	*t/1000t*
hammerheads	1,583	0.3	11.2	0.7	1,728	0.3	12.0	0.8	1,704	0.3	11.8	0.8
mantas	316	0.1	2.2	0.3	562	0.1	3.9	0.5	482	0.1	3.3	0.5
rays	63	<0.1	0.4	<0.1	100	<0.1	0.7	0.0	87	<0.1	0.6	<0.1
sharks	4,065	0.9	28.8	1.6	11,045	2.1	76.8	4.4	12,941	2.2	89.5	5.0
turtles	708	0.2	5.0	0.2	1,019	0.2	7.1	0.3	947	0.2	6.6	0.3
whale shark	21	<0.1	0.1	0.6	62	<0.1	0.4	1.7	35	<0.1	0.2	0.9

Table 8. Post release mortality on vulnerable species estimated in previous studies conducted in the Atlantic Ocean (AO), Indian Ocean (IO), Western and Central Pacific Ocean (WCPO) and Eastern Pacific Ocean (EPO)

Species group	Reference	Ocean	fishing stage	mortality rate of the released individual	Overall mortality rate
Sharks	Poisson *et al.*, 2014	IO	entangled in the net	18%	81%
			brailing	48%	
	Hutchinson *et al.*, 2015	WCPO	pre-set	0%	84%
			entangled in the net	31.3%	
			First brail	83.3%	
			posterior brails	93.3%	
	Eddy *et al.*, 2016	EPO	brailing	62%	80% - 95%.
	Sancristobal *et al.*, 2016	AO	pre-set	0%	-
Whale sharks	Escalle *et al.*, 2018	AO	encircled	0%	0%
	Capietto *et al.*, 2014	AO/IO	encircled	1.4%	1.4%
	Murua *et al.*, 2014	AO	encircled	0%	0%
Turtles*	Bourjea *et al.*, 2014	AO/IO	encircled	-	AO = 9% IO = 23%
	Ruiz Gondra *et al.*, 2017a	AO	encircled		1%
Mantas	Francis and Jones., 2016	New Zealand	brailed	62.5	62.5

**Overall mortality rate on turtles is estimated from observers records and not from tagging studies*

Figure 1. Percentage of days with data on good practices (GP) which has been included in this anlysis by type of observation method (i.e. Electronic Monitoring System, EMS, or human observerd) in purse seiners and support vessels in the Atlantic Ocean during 2015-2017. Discarded data refers to days in which priority has been given to official data collection programs or failure on EMS.

Figure 2. Example of non-entangling FADs constructed in Abidjan and used in the Atlantic Ocean

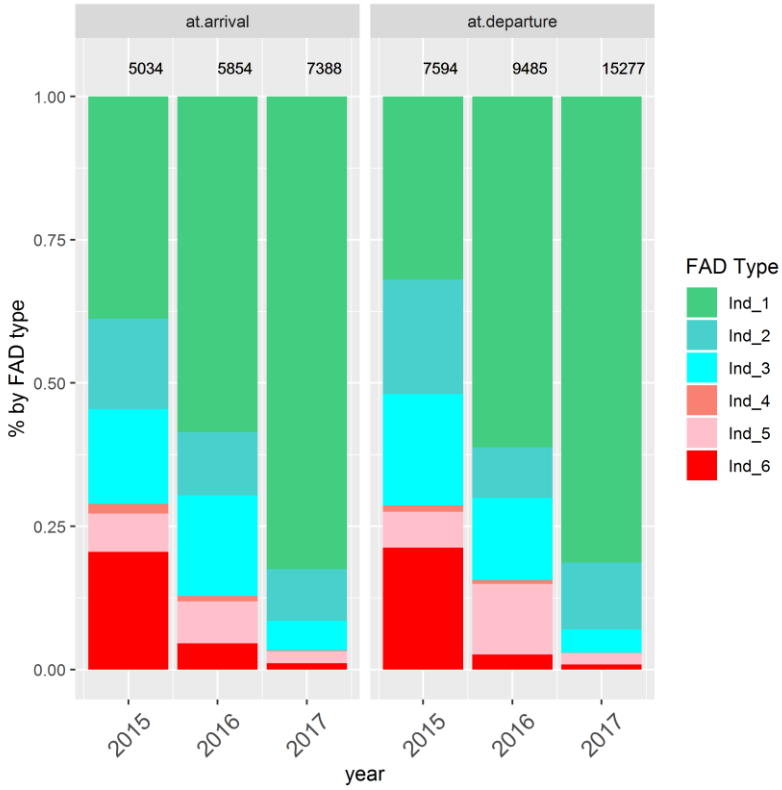

Figure 3. Evolution of the FAD types (% of number of FADs by category) in interactions with FADs for observed FADs at arrival and at departure during the study period (re-scaled with no consideration of unknowns [mean percentage of 35.9% at departure and 50.1% of observations in case of at arrival]). The indices refer to FAD categories classified from lowest to highest risk of entanglement: Ind 1 (totally non-entangling); Ind 2 - net of >7 cm in the bottom part of the raft; Ind 3- net of >7cm in the upper part of the raft; Ind 4: pieces of net >7cm in the underwater part; Ind 5: underwater part with open net >7cm; Ind 6: raft and underwater part with net >7cm. The coverage fluctuates depending on the vessel type and year (see Figure 1), which is near 80% for purse seiners and goes from 10% in 2016 to 40% in 2017 in supply vessels.

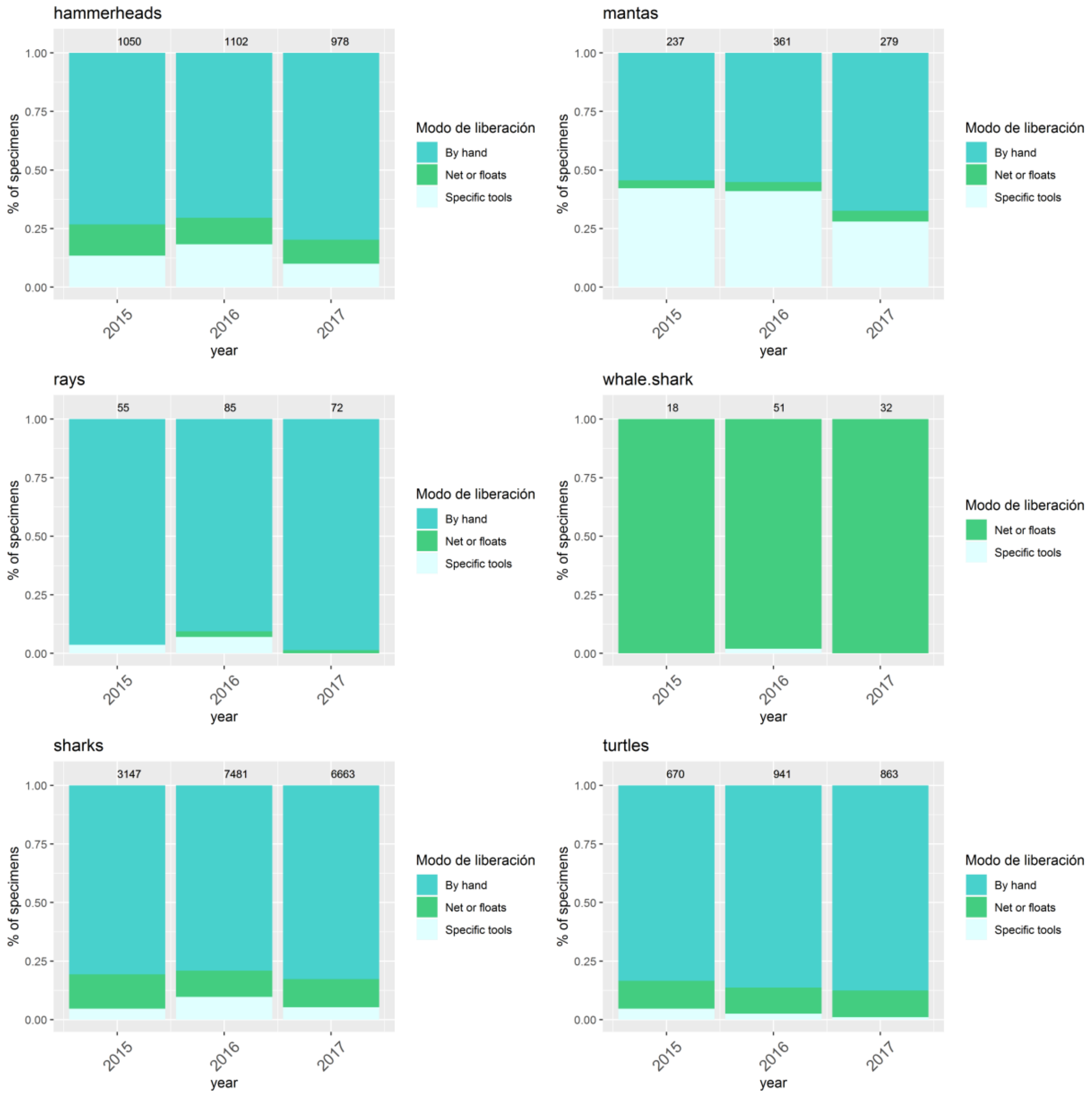

Figure 4. The percentage of specimens released by each handling by each animal group and year in the Atlantic Ocean, for interactions in which the animal handling method was recorded [the releasing mode was not recorded on a yearly mean percentage of 37.5%, 34.2%, 14.9%, 13.5%, 34.4%, and 7.3% of interactions in hammerheads, mantas, rays, whale sharks, sharks and turtles, respectively]. These are the results of the 639 trips analysed on purse seiners, which correspond to over 80% of the total number of trips (see **Table 3**).

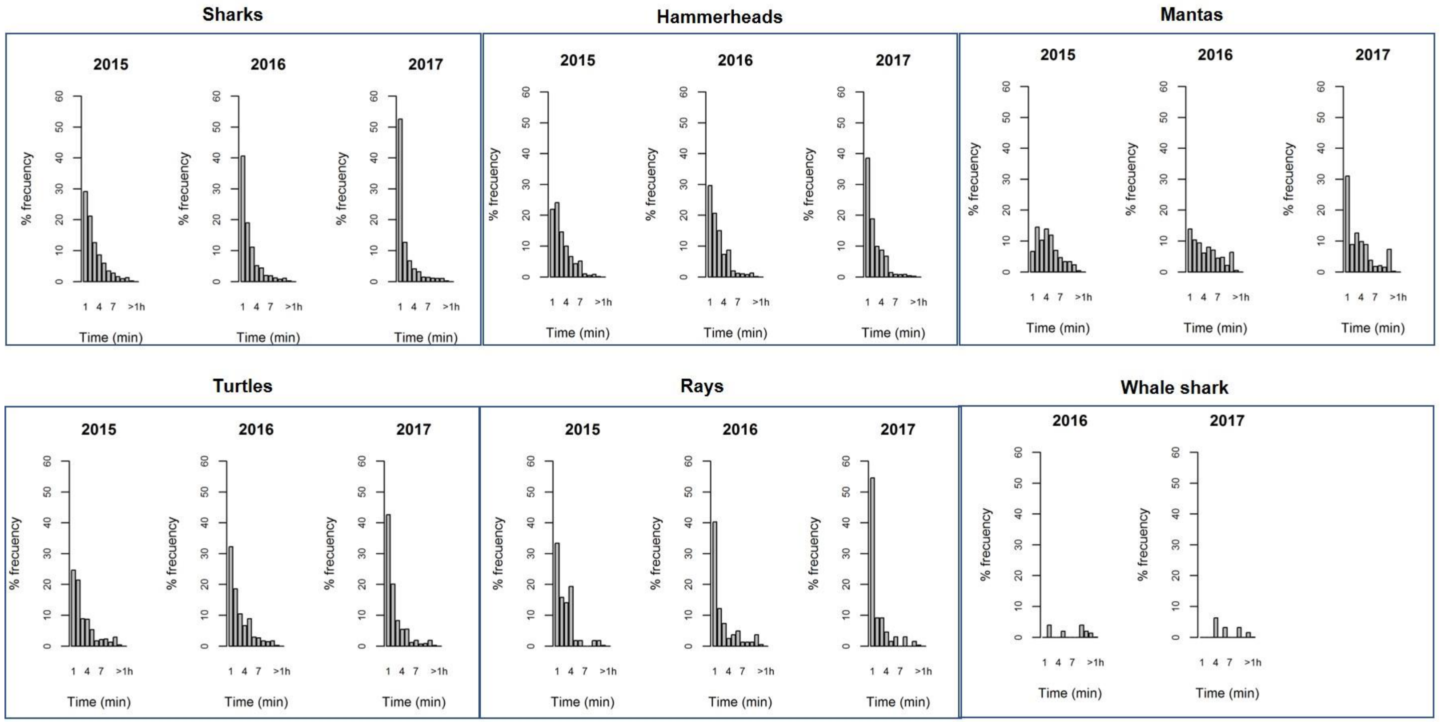

Figure 5. Time dedicated to release fauna of each species group from 2015 to 2017. These are the results of the 639 trips analysed on purse seiners, which correspond to over 80% of the total trips (see **Table 3**).

Annex 1

Introduction – Context and general instructions

The organizations of tuna purse-seiners ANABAC and OPAGAC signed in February 2012 a Code of Good Practices for responsible tuna purse-seine fishing. This code, in force in all the OPAGAC-AGAC and ANABAC-OPTUC fleets, aims to (1) improve the operations performed in the tuna purse-seine fleet by both organizations, (2) improve the selectivity of fishing with FADs and (3) minimize the impact of fishing on the ecosystem.

To do this, rules were established regarding the design of fish aggregating devices (FADs) and the release of the fauna that can be found associated with the FADs. Specific objectives are the total replacement of non-conform FADs by non-entangling FADs, and the release of incidentally caught or FAD-associated fauna, ensuring the safety of the crew and maximizing the survival of released animals.

AZTI Foundation is in charge of developing and implementing a system of verification of this Code of Good Practices in tuna purse-seine fishery. In this system, the role of observers will be primordial. You will be in charge of registering information on each FAD that is being planted, visited or on which a fishing event occurs, and on animals that are released. The correct registry of the information will be the base of the functioning of all the system of verification. Just as the forms you usually fill in, for these new ones you will be responsible of the exactness of the data you record. **Falsifying information is MUCH MORE SERIOUS than not recording it.** The information that you record is **STRICTLY CONFIDENTIAL**. You must not make copies, or make any comment or statement in front of others, except for the skipper or captain, both at sea and on land. The skipper or the captain have the right to check every moment the notes that you take. During the fishing trip, you must not make any personal activity that may hinder your ability to collect the required information.

This manual summarizes the information you need to collect to conduct this project as well as the forms (paper and Excel) and the instructions to fill them. The technical notes to identify species and the protocol for shooting are the same as in the current observers' handbook. Check often and regularly both handbooks. This can avoid repeated errors in the data you collect.

1. Release of associated fauna (Forms B2 and B3)

The aim is to record the operations of release of sharks, whale sharks, rays / skates and turtles. The priority will always be the quick and gentle release of animals. If in some cases the rapid release of an animal does not allow to record all the required information, the release of the animal will be prioritized. If there is little time to observe an animal, observe in priority its release mode, then it's state, then its individual characteristics (size, sex). You should never intervene in the operations performed by the crew.

Two forms need to be completed in conjunction with the current form B on the characteristics of catch: **B2** form in which you record individual shark releases (except whale shark) and **B3** form in which you will record the releases of whale sharks, rays / skates, and turtles.

Next, in paragraphs 1.1, 1.2, 1.3 and 1.4 you will find a description of the practices to be performed for the release of bycatch species to be considered good practice.

1.1. Sharks

1.1.1. Operations of release

When sharks are dispersed within a tuna aggregation under an object, there is currently no efficient method to remove them from the purse-seine. Sometimes a large shark can be detected at the surface inside the purse-seine; in that case the brailer can be used to remove it. In most cases sharks are released when they appear on deck or entangled in the net. If they are small, the fishermen can manually release them quickly and carefully, avoiding damage to the animal and preserving the safety of the crew during the operation. The crew shall handle the sharks holding (not pulling) the tail and holding the fins (**Figure 1**).

Medium-sized sharks shall be handled by two crew members. For larger sharks, and depending on the availability of material, the crew can use equipment to help release, such as stretchers, “sarrias” (see 1.3.1.), cargo nets or tarpaulins placed near the brailer. More specific equipment may also be used, such as a hopper or tray with ramp or deck hatches.

Important:

- The crew members **avoid** using ties or poles, to avoid damaging the animal
- They **avoid** dragging, pushing, hitting or squeezing the animal.
- As far as possible, they **avoid** leaving sharks much time on deck under direct sunlight.
- They **avoid** lifting the shark by the tail, or handling it by the gill slits (gill operculum). This harms the animal and it can have dangerous reactions.

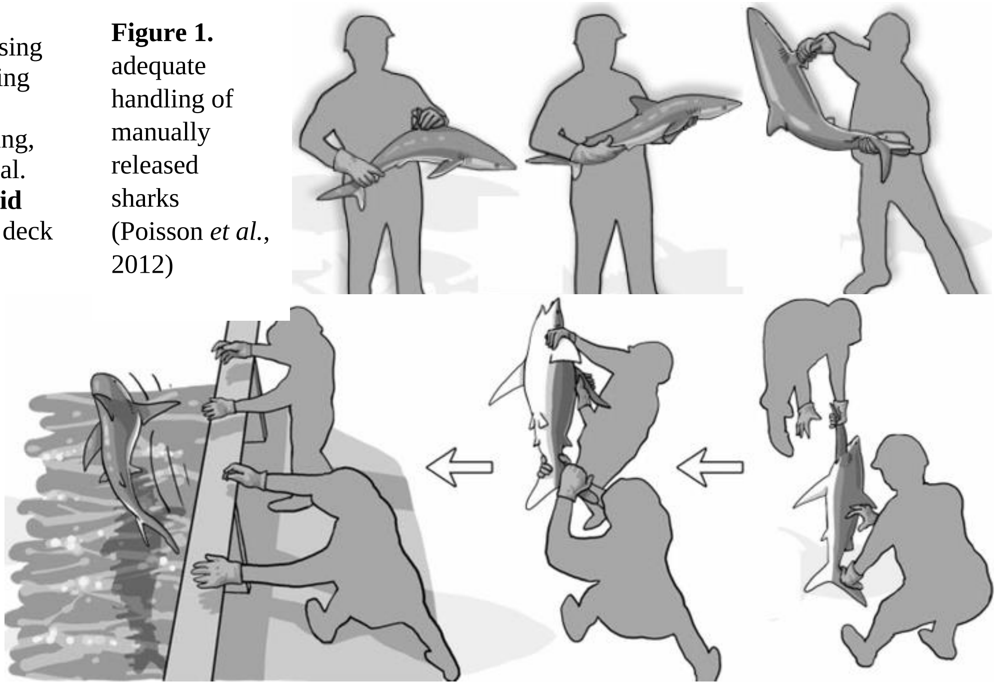

Figure 1. adequate handling of manually released sharks (Poisson *et al.*, 2012)

1.1.2. Registry of the information

You will fill the FORM **B2** (see next page). If you have taken pictures, mention the codes of the corresponding ones (see example page 14).

1.2. Whale Sharks

1.2.1. Release operation

If a whale shark is found in the purse-seine, the purse-seine is hauled carefully to isolate the animal in a small area of the purse. Fishermen collect the purse-seine to drive the whale shark near the closest cork line. The purse-seine is always hauled from the tail to the head of the animal and on its underside, trying to make the fish slide to the cork line. The cork line is submersed to ease the exit of the whale shark, and the crew waits for the whale shark to swim out by itself from the purse-seine (**fig 2**).

If the whale shark is pushing with his head against the purse-seine before the cork line could be submersed and if it cannot move back so as to submerse the corks, from the vessel the crew will proceed to submerge the cork line with poles or rods, so that the animal can release its head above the cork (**fig 2**).

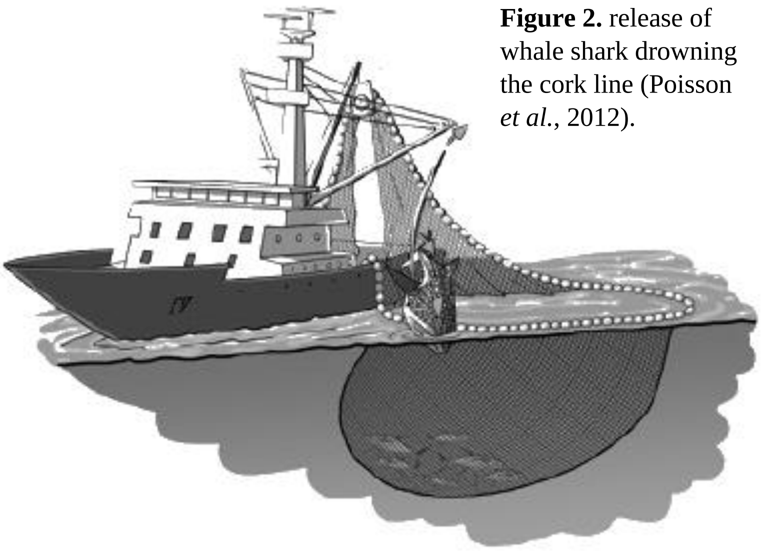

Figure 2. release of whale shark drowning the cork line (Poisson *et al.*, 2012).

Form B2 - Head (identical in B2 and B3)	
Setting nº	Number correlatively each of the settings, as in form B
Date	Format of date: **dd/mm/aaaa**
Route form nº: **Route line nº:**	Put the number of form A and the number of the line that corresponds to the set, as in form B
Release form nº	Put a correlative number for each form, starting with 1 at the beginning of each trip.
Trip code	See example page 14.
Purse shaping start time	When the fishermen start to strap the purse-seine to concentrate the tuna. Time GMT/UTC (Greenwich Mean Time / Coordinated Universal Time) (4 digits)
Released fauna - sharks	
There is room for 30 individuals. The information of each individual is registered in a same row, following the example given in row 0. If more than 30 sharks appear in the fishing event, you will use a second form that you will number correlatively. If you have taken pictures, mention the codes of the corresponding pictures (see example page 14).	
Individual	
CODE of the species	See species codes (3 digits) in the observers' handbook
Size	Estimated or measured (if possible) size, in centimeters. If there is no time to measure the animal, you will try to take a picture close from an object of known size.
Sex	If it can be identified. 1: male, 2: female, 3: undetermined.
Release mode	
Following details mentioned in the previous paragraph, the sharks will be released through 5 possible ways	
by brailer	They use the same brailer used to brail the catch onboard, in that case it is used to extract the ray or skate from the purse seine.
by stretcher, tarpaulin, "sarria" or cargo net	This light equipment, if available on the boat, can be found near the brailer.
by specific equipment	The specific equipment can be a Hopper or tray with ramp, deck hatches, or other equipment. In notes you will mention the equipment.
manual from deck	The crew members handle the sharks taking them by the fins and sustaining carefully the caudal part.
after disentangling	When a shark is entangled in the purse seine the crew members proceed to cut the mesh to extract the animal.
non conform	The release of the shark is not conform to good practices
Reason of non conformity	In case of non-conform release, mention the reason: RI (residual unavoidable mortality: the animal comes dead, or is not detected and is kept on board, o is detected in lower deck and cannot be handled safely); M (lack of material); NC (not complying: good practices are not applied although the conditions allow their application
Time	
detection of the animal	When the shark is detected on deck, or in the net (if entangled) or at the surface of the water (if extracted by brailer). Time in format GMT / UTC (Greenwich Mean Time / Coordinated Universal Time) (4 digits)
release of the animal	When the shark is released at sea. Time in the same format.
State of the animal	
Excellent, Good, Correct, Poor, Unacceptable	For each animal, you value on a scale of 5 values the general condition of the animal. **Excellent**: Very active and energetic, strong signs of life on deck and when returned to water; **Good**: active and energetic, moderated signs of life on deck and when returned to water; **Correct**: tired and sluggish, limited signs of life, moderate revival time required when returned to water, slow or atypical swimming away; **Poor**: exhausted, no signs of life, bleeding from gills, jaw or cloaca, long revival time required when returned to water, limited or no swimming observed upon release; **Inacceptable**: moribund, no signs of life, excess bleeding from gills, jaw or cloaca, unable to revive upon return to water, no swimming movement, sinks.

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Verification of Good Practices ANABAC/OPAGAC

RELEASE OF ASSOCIATED FAUNA

Form **B2**

version 2017

fishing set nº:

Date:

fishing trip code

route form nº:

route line nº:

fauna liberation form nº:

purse shaping start time			
h	h	m	m

Released fauna - sharks (1 line by individual, see example)

	individual			release mode							time		(4) state of the animal				
	(1) species	(2) size	(3) sex	using brailer	by stretcher, fabric, sarria, cargo net	with specific equipment	manual from deck	after disentangling	non conform	reason of non conformity (6)	animal detected	animal released	Excellent	Good	Fair	Poor	Unacceptable
0	FAL	140	2					1			7:35	7:47		X			
1																	
2																	
3																	
4																	
5																	
6																	
7																	
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27																	
28																	
29																	
30																	

Notes (5):

(1) put species code - see usual observers handbook. **(2)** in centímeters

Data verified

(3) sex: 1 male; 2 female; 3 undetermined **(4)** score as shown in the manual: Excellent, Good, Fair, Poor, Unacceptable;

(5) if photos of the individuals were taken, mention code of the corresponding photos **(6)** RI (residual unavoidable mortality: the animal comes dead, or is not detected and is kept on board, o is detected in lower deck and cannot be handled safely); M (lack of material); NC (not complying: good practices are not applied although the conditions allow their application

If more than 30 individuals are released, continue on a new form

If the whale shark is caught in the purse seine with its head facing stern, the crew members localize the junction between two panels that is closest to the head of the animal, proceeding to cut the junction on a couple of fathoms so as to create a window through which the whale shark can escape, pulling down the panels until submersing this window (**fig.3**).
If the whale shark does not appear at the surface, they start to brail the catch until the whale shark appears at the surface. In that moment they stop brailing the tuna and proceed as indicated initially.
If the whale shark is small (less than 2m) they release it using the brailer.

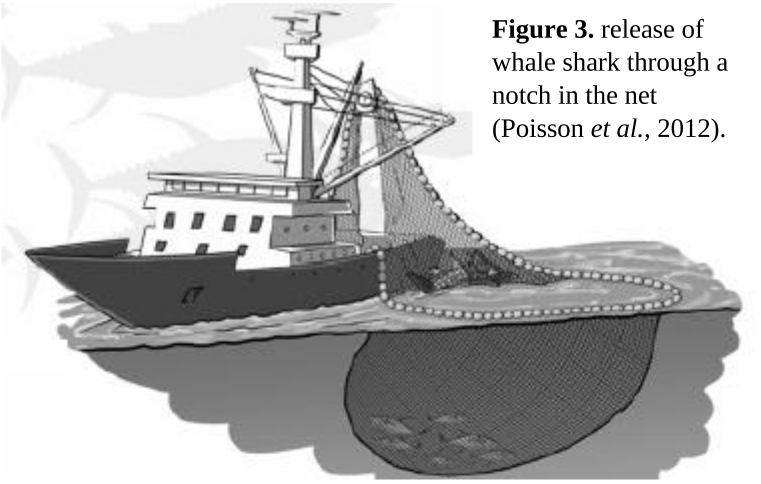

Figure 3. release of whale shark through a notch in the net (Poisson *et al.*, 2012).

1.2.2. Registry of the information

Form B3 - Head (identical to B2, see previous table)	
Released fauna – whale sharks	
There is room for 3 individuals. Very few times you will find more in a same set. The information of each individual is registered in a same row, following the example given in row 0. If more than 3 whale sharks appear in the fishing event, you will use a second form that you will number correlatively. If you have taken pictures, mention the codes of the corresponding pictures (see example page 14).	
Individual	
Code of species	Only one species: *Rhincodon typus*. Code RHN
Size	Estimated size, in centimeters. You will always try to take a picture of the whale shark.
Sex	If it can be identified by the pterygopodes. 1: male, 2: female, 3: undetermined
Release mode	
Following details mentioned in the previous paragraph, the whale shark the sharks will be released through 3 possible ways	
By brailer	If the animal is small (< 2m) they use the same brailer used to brail the catch onboard, in that case it is used to extract the whale shark from the purse seine.
Drowning the cork line	The crew members drown the cork line so that the whale shark can swim above it.
Notch in the purse seine	The crew members make a notch in the purse seine net close to the head of the animal to create a window, through which the whale shark can get out.
Non conform	The release of the whale shark is not conform to the good practices
Reason of non conformity	In case of non-conform release, mention the reason: RI (residual unavoidable mortality: the animal comes dead, or is not detected and is kept on board, o is detected in lower deck and cannot be handled safely); M (lack of material); NC (not complying: good practices are not applied although the conditions allow their application
Time	
Detection of the animal	When the whale shark is detected in the purse seine. Time in GMT / UTC format (Greenwich Mean Time / Coordinated Universal Time) (4 digits).
Release of the animal	When the whale shark gets out of the purse seine. Time in the same format.
State of the animal	
	Same instructions as for form B2, see previous table

Verification of Good Practices ANABAC/OPAGAC

RELEASE OF ASSOCIATED FAUNA

Form **B3**

version 2017

fishing set nº:	Date:	fishing trip code
route form nº:	route line nº:	
fauna release form nº:		

purse shaping start time			
h	h	m	m

Released fauna - whale sharks, rays (1 line/individual, see example)

	individual			release mode									time		(4) state of the animal				
	(1) species	(2) size	(3) sex	drowning the corks	notch in the net	using the brailer (small shark)	using the brailer	by stretcher, fabric, sarria, cargo net	with specific equipment	manual from deck	non conform	reason of non conformity (6)	animal detected	animal released	Excellent	Good	Fair	Poor	Unacceptable
0	RHN	520	3	1									7:49	8:36	X				
1																			
2																			
3																			
0	RMB	120	2							1			8:44	8:49		X			
1																			
2																			
3																			
4																			
5																			
6																			
7																			
8																			
9																			
10																			
11																			
12																			

Released fauna - turtles (1 line/individual, see example)

	individual			release mode					time			(4) state of the animal				
	(1) species	(2) size	(3) sex	after disentang.	manual from deck	through removing net/plastic remains or hook	non conform	reason n.c.	onboard 1d	animal detected	animal released	Excellent	Good	Fair	Poor	Unacceptable
0	TTL	90	1		1					9:04	9:21	X				
1																
2																
3																
4																
5																
6																
7																

Notes (5):

(1) put species code - see usual observers handbook. (2) in centimeters

Data verified

(3) sex: 1 male; 2 female; 3 undetermined **(4)** score as shown in the manual: Excellent, Good, Fair, Poor, Unacceptable;

(5) if photos of the individuals were taken, mention code of the corresponding photos **(6)** RI (residual unavoidable mortality: the animal comes dead, or is not detected and is kept on board, o is detected in lower deck and cannot be handled safely); M (lack of material); NC (not complying: good practices are not applied although the conditions allow their application

1.3. Rays and Skates

1.3.1. Release operations

If manta rays or skates appear on the surface when the purse seine is closed or when the crew is brailing the catch, the brailer can be used to take them directly from the purse seine and release them at sea. If not, they will be released when they appear on deck. If they are small, they are manually released by crew members, up by their fins, avoiding damage to the animal and without compromising the safety of the crew. If they are larger, other device type can be used, such as a tarpaulins, stretchers, sarrias (small round nets, Figure 4) or cargo nets, which prevent any damage to the animal and the crew. Depending on availability of materials, more specific equipment may also be used, such as hopper or tray with ramp or deck hatches.

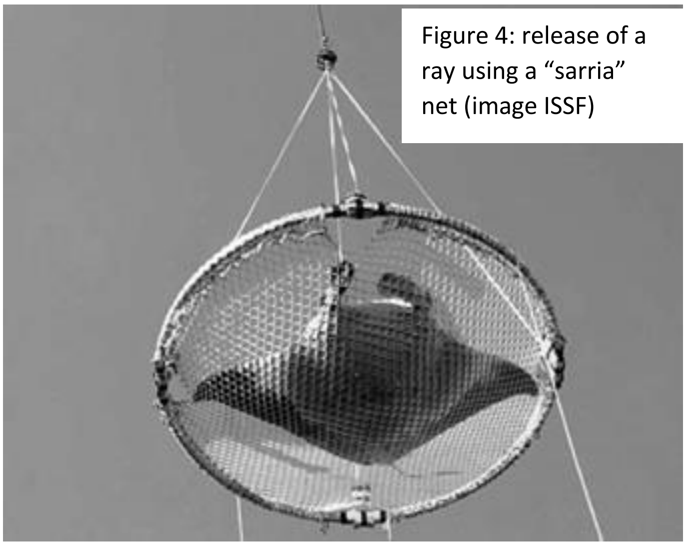

Figure 4: release of a ray using a “sarria” net (image ISSF)

Important:

- Crew members **avoid** dragging, pushing, hitting or squeezing the animal.

- As far as possible, they **avoid** leaving manta rays and skates much time on deck under direct sunlight.

- They **avoid** lifting manta rays and skates by the tail, or manipulating them by the gills or the cephalic lobes. This harms the animal and it can have dangerous reactions. In particular, handle a ray's tail is dangerous for the spine that many of these animals have on their tail.

1.3.2. Registry of the information

Form B3 - Head (same as B2, see corresponding table)	
Released fauna – rays and skates	
There is space for 12 individuals. Information of each individual is recorded in one row, following the example given in row 0. If more than 12 rays or skates appear in the set, a second form will be used and consecutively numbered. If you have taken pictures, photos mention corresponding codes (see example page 14).	
Individual	
CODE of the species	See species codes (3 digits) in your usual handbook
Size	Estimated or measured (if possible) size, in centimeters. If there is no time to measure the animal, you will try to take a picture close to an object of known size.
Sex	If it can be identified. 1: male, 2: female, 3: undetermined.
Release mode	
Following details of paragraph 1.3.1., skates and rays are released by 4 modalities	
by brailer	They use the same brailer used to brail the catch onboard, in that case it is used to extract the ray or skate from the purse seine.
by stretcher, “sarria” tarpaulin, cargo net	This light equipment, if available on the boat, can be found near the brailer.
by specific equipment	The specific equipment can be a hopper or tray with ramp, deck hatches, or other equipment. The equipment will be mentioned in notes.
manual from deck	The crew members manipulate the rays and skates holding them by the fins and avoiding manipulating the tail, the gills slits or the cephalic lobes.
non conform	The release of the ray/skate is not conform to the good practices
Reason of non-conformity	In case of non-conform release, mention the reason: RI (residual unavoidable mortality: the animal comes dead, or is not detected and is kept on board, o is detected in lower deck and cannot be handled safely); M (lack of material); NC (not complying: good practices are not applied although the conditions allow their application
Time	
Detection of the animal	When the ray or skate is detected at the surface (if extracted using brailer) or on deck. Time in GMT / UTC (Greenwich Mean Time / Coordinated Universal Time) (4 digits)
Release of the animal	When the ray or skate is released at sea. Time in the same format.
State of the animal	
	Same instructions as for form B2, see corresponding table

1.4. Turtles

1.4.1. Release operations

If turtles are encountered entangled in devices or in the purse seine when it is being closed, the crew tries by all means to release them. They avoid above all making turtles pass through the power-block, stopping immediately the operation when detecting a turtle entangled. They proceed to the release of all turtles that can be located inside the purse seine, avoiding damaging them. Turtles are handled by the shell either by one crew member (Fig 5) or by two for large turtles. In this case they will avoid holding the shell right behind the head, to keep their hands safe if the animal retracts its head.

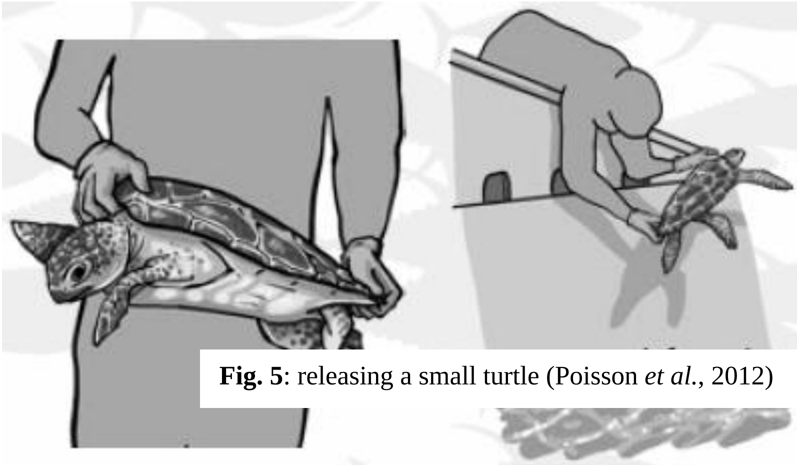

Fig. 5: releasing a small turtle (Poisson *et al.*, 2012)

Important:

- The crew members **avoid** dragging, pushing, hitting or squeezing the animal.
- As far as possible, they **avoid** leaving the turtles much time on deck with direct sun.
- **They avoid** leaving turtles upside down or handling them by the legs.

If any damage to the animal occurs during the operation, if possible the animal is kept one day onboard at shade, periodically wetted and verifying that it recovers before releasing. If the animal carries plastic or net remains or longline hooks inserted, the crew can remove them, even if they do not come from the recent activity of the vessel. Also, if when visiting an object without fishing, a turtle is found entangled, the crew should disentangle and release it in the same way.

1.4.2. Registry of the information

Form B3 - Head (same as B2, see corresponding table)	
Released fauna – turtles	
There is room for 7 individuals. The information of each individual is registered in a same row, following the example given in row 0. If more than 7 turtles appear in the fishing event, you will use a second form that you will number correlatively. If you have taken pictures, mention the codes of the corresponding pictures (see example page 14).	
Individual	
CODE of the species	See species codes (3 digits) in your usual handbook
Size	Estimated or measured (if possible) size, in centimeters. If there is no time to measure the animal, you will try to take a picture close to an object of known size.
Sex	If it can be identified. 1: male, 2: female, 3: undetermined.
Release mode	
Following details mentioned in the previous paragraph, the turtles are released through 4 possible modes	
After disentangling	The turtle is disentangled from the purse-seine or from the FAD
Manual from deck	The crew members handle the turtle holding it by the Shell and avoiding holding it by the legs.
After removing net or plastic remains / hook	If the animal carries plastic or net remains, or a longline hook inserted, the crew can remove and / or disentangle them, even if they do not come from the recent activity of the vessel
Day onboard	If the turtle is kept one day on board to help it recover, put 1 in the corresponding square.
Non conform	The release of the turtle is not conform to the good practices
Reason of non-conformity	In case of non-conform release, mention the reason: **RI** (residual unavoidable mortality: the animal comes dead, or is not detected and is kept on board, o is detected in lower deck and cannot be handled safely); **M** (lack of material); **NC** (not complying: good practices are not applied although the conditions allow their application
Time	
Detection of the	When the turtle is detected in the purse-seine or on the FAD. Time in GMT / UTC

animal	format (Greenwich Mean Time / Coordinated Universal Time) (4 digits)
Release of the animal	When the turtle is released at sea. Time in the same format.
State of the animal	
	Same instructions as for form B2, see corresponding table

2. Structure of the devices (FADs)

2.1. Design

The objective will be to record the detailed characteristics of all the devices that are planted, that are removed and kept on board, that are visited and on which fishing events occur. The goal will be on the one hand to be able to determine precisely the non-entangling nature of the devices, on the other hand to get detailed information on their structure and to be able to know the evolution of the type of devices. You will observe the structure and coverage of the raft (superficial part) of the devices as well as the submersed part. After notifying the captain or skipper, you can also take pictures of the devices.

Same as for fauna release, the observer should never take part in the operations done by the crew members on the devices.

Together with the current form **D** regarding the monitoring of drifting FADs, you will fill the form **D2**, in which you will record the characteristics of each device encountered and/or left at sea.

Note: the submerged part of the devices can be of three types according to the code of good practices:
- made of loose ropes or any other non-entangling material (**fig.6**)
- made of open nets with a mesh size ≤ 7cm
- made of old tuna nets rolled in “sausages” (**fig. 7**)

If the crew members modify or replace a part of a device, this will be recorded in the form.

Fig 6. Device with uncovered raft and submersed part made of loose ropes

2.2. Registry of the information

<table>
<tr><th colspan="5">Form D2 - identification</th></tr>
<tr><td colspan="2">Form D2 nº</td><td colspan="3">Put a correlative number for each form, starting with 1 at the beginning of each trip.</td></tr>
<tr><td colspan="2">Boat name:</td><td>Full name of the boat</td><td>Trip start date:</td><td>Format: dd/mm/aaaa</td></tr>
<tr><td colspan="2">Observer:</td><td>Your full name</td><td>Fishing trip code:</td><td>See example page 14</td></tr>
<tr><td colspan="2">Form D nº</td><td colspan="3">The number of form D corresponding to the device you describe.
REGISTER INFORMATION FOR ALL VISIT, FISHED AT, DEPLOYED OR MODIFIED FADs.</td></tr>
<tr><td colspan="2">When arriving / when leaving</td><td colspan="3">Tick the square “when arriving” and fill the row with device characteristics when encountering the device at sea.
Tick the square “when leaving” and fill the row with device characteristics when the device is left at sea, if modifications have been done.
If the device is not modified during the operation, fill only one row and tick both “when arriving” and “when leaving”.
If it is a new device deployed, fill only one row and tick “when leaving”.
If the device encountered is kept on board, fill only one row and tick “when arriving”.</td></tr>
<tr><td colspan="2" rowspan="2">Own / else’s</td><td rowspan="2">Note P (personal) if the FAD belongs to the vessel, A (another) if it belongs to another one</td><td>Date</td><td>Format: dd/mm/aaaa</td></tr>
<tr><td>Time
(GMT/UTC)</td><td>Hour and minutes</td></tr>
<tr><th colspan="5">Characteristics of the FAD</th></tr>
<tr><td>Raft</td><td colspan="4">For each row, put a cross in the relevant options:
Canes/bamboo (canes and/or other vegetal material), metallic or PVC (made of metal and/or plastic elements or any other synthetic material). Write a cross on both fields if the FAD is made of both natural and synthetic materials.
NET (exterior): covered with net whose mesh whose size is ≤ 7cm or > 7cm, above and/or below.
Cover. no mesh: the raft is covered with a non-meshed material, above and/or below
No cover: the superior and/or inferior part of the raft is not covered
Cannot see: it is not possible to see the upper and/or lower coverage of the raft
They modify it: the crew members modify some elements of the raft
They replace it: the raft is entirely replaced by another one</td></tr>
<tr><td>Subsurface structure</td><td colspan="4">For each row, put a cross in the relevant options:
Sausage: the subsurface structure is made of nets rolled in “sausages” (fig 7).
Open net: the subsurface structure is made of open net.
Single pieces: the subsurface structure contains open single pieces of net
For the 3 previous options, tick either ≤ 7cm or > 7cm according to the mesh size.
Rope / no mesh: the subsurface structure contains no mesh and/or is made if loose ropes
Cannot see: it is not possible to see the subsurface structure
Without tail: there is no subsurface structure
They modify it: the crew members modify some elements of the subsurface structure
They replace it: the submersed structure is entirely replaced by another one</td></tr>
<tr><td colspan="5">Other components: If other components are present, put crosses in the corresponding squares (fields). If an animal is entangled, note the species if you can identify it (note the state of the animal in observations).</td></tr>
</table>

Fig 7: Device with raft covered above with non-entangling material and submersed part made with old nets rolled in "sausages" (image ISSF)

Fig 8: Raft uncovered (image ISSF)

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Verification of Good Practices ANABAC/OPAGAC **Form D2 nº:**

1 line by FAD if no modification, 2 lines by FAD if modification (state when arriving and state when leaving)

BOAT name: **Fishing trip start date:**

OBSERVER: **Fishing trip code:**

Nº Form D	when arriving	when leaving	own / else's	DATE	TIME	RAFT														SUBSURFACE STRUCTURE											OTHER COMPONENTS						
						Canes / Vegetal	Metallic or PVC	Superior					Inferior coverage					they modify it	they replace it	net in sausage		open net		single net pieces		rope / no mesh	not visible	no subs. struct.	they modify it	they replace it	plastic	Corks	Bags	Palms, canes…	Color belts	weights	entangled animal
								Net		cov. w/o net	non covered	not visible	Net		cov. w/o net	non covered	not visible																				
								≤ 7cm	> 7cm				≤ 7cm	> 7cm						≤ 7cm	> 7cm	≤ 7cm	> 7cm	≤ 7cm	> 7cm												
45	X			14/03/2014	13:22	X		X								X		X		X														X			
45		X		14/03/2014	13:22	X				X					X					X														X			

3. Transmission of the information

3.1. Excel File

The information registered during the day in the forms will also be introduced in the attached Excel file. You will find a common table for the information of forms B2 and B3, and another one for the information of forms D2.

In these tables you will fill **one row by individual** in the case of release operations (forms B2 and B3) and **one or two rows by device** in the case of form D2 (just as in in the paper form).

These tables are composed of three fields (from left to right): one field for general information, one field for event identification, and one field for release characteristics (forms B2 and B3) or device characteristics (forms D2). The subfields to be filled in each one are the following:

General information (both sheets):
- Observer’s Name
- idBoat
- Boat
- idObserver
- trip code

Identification of the event (forms B2 and B3)
- fishing set nº
- date
- route form nº
- route line nº
- quadrant sector (same as in ObServe Data Base)
1 for NE, 2 for SE, 3 for SW, 4 for NW)
- latitude (deg and min, degrees South as negative)
- longitude (deg and min, degrees West as negative)
- release form nº
- purse shaping start time

Identification of the event (form D2)
- form D2 nº
- form D nº date
- when arriving / when leaving
- own /else’s (write P or A)
- date and time
- quadrant sector (same as in ObServe Data Base)
1 for NE, 2 for SE, 3 for SW, 4 for NW)
- latitude (deg and min, degrees South as negative)
- longitude (deg and min, degrees West as negative)
- number of photos / - code first photo

Characteristics of release (forms B2 and B3)
- individual
- species
- size
- sex
- release mode
- using the brailer
- by stretcher, tarpaulin, “sarria” or cargo net
- by specific equipment
- manual from deck
- after disentangling
- drowning the cork line
- through a notch in the net
- after removing net / plastic remains or hook
- onboard 1 day
- non conform
- reason of non-conformity
- detection time and release time of the animal
- State of the animal – value (P, M, S or U) each part : eyes, head, skin, fins and gill slits (sharks, rays) or legs and shell (turtles)

Characteristics of the device (form D2)
- Raft
- Canes/vegetal
- Metal or PVC
- net with mesh ≤ 7 cm above
- net with mesh > 7 cm above
- covered without mesh above
- non covered above
- cannot see above
- net with mesh ≤ 7 cm below
- net with mesh > 7 cm below
- covered w/o mesh below
- - non covered below
- - cannot see below
- - they modify it
- - they replace it

- Submersed part
- « sausage » with mesh ≤ 7 cm
- « sausage » with mesh ≤ 7 cm
- open with mesh ≤ 7 cm
- open with mesh > 7 cm
- single net pieces w mesh ≤ 7 cm
- single net pieces w mesh > 7 cm
- - rope / no mesh
- - cannot see
- - no submersed part
- - they modify it
- - they replace it

- Other elements
- plastic containers
- corks
- bags
- entangled animal (species) (note the state of the animal in observations).
- - palms / canes
- - color belts
- - weights

The data of latitude and longitude will be taken from the usual form A.

The goal is simply to introduce the same information in one single Excel file, always filling **one row by individual** in the case of release operations (forms B2 y B3) and **one or two files by FAD (according to the case)** in the case of device characteristics (form D2).

3.2. After the fishing trip

- **The filled forms must be always under your control during the way back.** They must never be delivered to a third person, or put into a bag that will travel in the baggage hold, or deposited in a left-luggage office.
- Notify, immediately after your arrival, Foundation AZTI (contacts below) and follow the instructions that will be given to you for data sending.
- **You will then deliver all the forms ordered and the material that was given to you, as well as all the samples and pictures you have taken.**

AZTI		
SFA - AZTI Fishing Port, Victoria Mahe, SEYCHELLES Tel + 248 670300 Fax: + 248 224508	Herrera kaia portualdea z/g 20110 Pasaia (Gipuzkoa) SPAIN Tel +34 94 657 40 00 Fax: +34 94 657 25 55	Txatxarramendi ugartea z/g 48395 Sukarrieta (Bizkaia) SPAIN Tel +34 94 657 40 00 Fax: +34 94 657 25 55
Iñigo Krug Tel. +248 278 69 94 ikrug@azti.es	**Jon López** Tel. +34 634 20 97 38 jlopez@azti.es	**Jon Ruiz** Tel. +34 667 17 43 75 jruiz@azti.es

Other addresses where to let the paper forms for sending	
Atlantic Ocean	**Indian Ocean**
Centre de Recherche Océanologique (C.R.O.) BP V18 ABIDJAN **CÔTE D'IVOIRE** Fax: (225) 21 35 11 55	Seychelles Fishing Authority (SFA / AZTI*)* BP 449 VICTORIA, Mahé **SEYCHELLES** Fax: (248) 670300
Centre de Recherches Océanographiques Dakar-Thiaroye (C.R.O.D.T.) BP 2241 DAKAR **SENEGAL** Fax: (221) 33 832 82 62	Terres australes et antarctiques françaises (TAAF) Rue Gabriel Dejean 97410 Saint-Pierre, île of the Réunion **FRANCE** Tel: 0(033)2 62 96 78 78

As specified in the observers' handbook, when finalizing your trip onboard you must provide **a report** of three or four pages summarizing your general impression, as well as problems, observations and suggestions. Apart from this report, you will summarize on one page the following points:

Fauna release:

Eventual problems or difficulties to observe and/or identify the operations, to identify the species, to estimate the state of the animals.

Easiness or difficulties for the crew members to realize release operations that are conform to the code of good practices.

Non entangling devices:

Eventual problems or difficulties to observe and/or identify the non-entangling devices

Suggestions

to solve those problems, if encountered

Other problems or difficulties and other suggestions

4. General recommendations

- Note down the information right after their observation. Do not rely on your memory.
- All the information will be noted, by pencil (type B1 or HB2), at the moment of their observation.
- The information must be readable and the corresponding forms and spaces must be completed.
- If you are not sure about a given element, leave the corresponding space blank and put an explanatory note in the section **NOTES**.
- At night, check all the information you have taken during the day.
  - If you see you have forgotten to mention an element and can recover it, add it on the form.
  - However, if you are not sure about the exactness of the recovered information, do not mention it in the form.
- Once you have checked that all the data are as complete as possible, tick the square **Data verified**, situated in in the lower part of each form.

HANDBOOKS THAT MUST BE IN YOUR POSSESSION

- Handbook of observers onboard tuna purse-seiners 1
- Handbook of observation of good practices onboard ANABAC and OPAGAC tuna purse seiners (the present handbook) 1

FORMS (in addition to the usual ones):

The following amounts refer to the needs for 1 or 2 trips (60 to 85 days at sea):

✓	Forms B2 (release)	80	YES / NO
✓	Forms B3 (release)	50	YES / NO
✓	Forms D2 (devices D2)	25	YES / NO

CODE of the FISHING TRIP:

It is a 14-digit alphanumeric code. You will make this code using the initials of the observer, of the name of the ship and the trip start date (departure from port) be drawn. Example:
Observer: Gorka Ocio Andrés; Boat Egaluze; start date 2014-april-05: **GOAEGA20140405**

CODE of the PICTURES:

You will use the code of the fishing trip + the FAO code of the species and a correlative number. In the case of devices, you will add FAD and a correlative number, starting from 1. The numbering will be distinct for released species and for FADs. Examples:

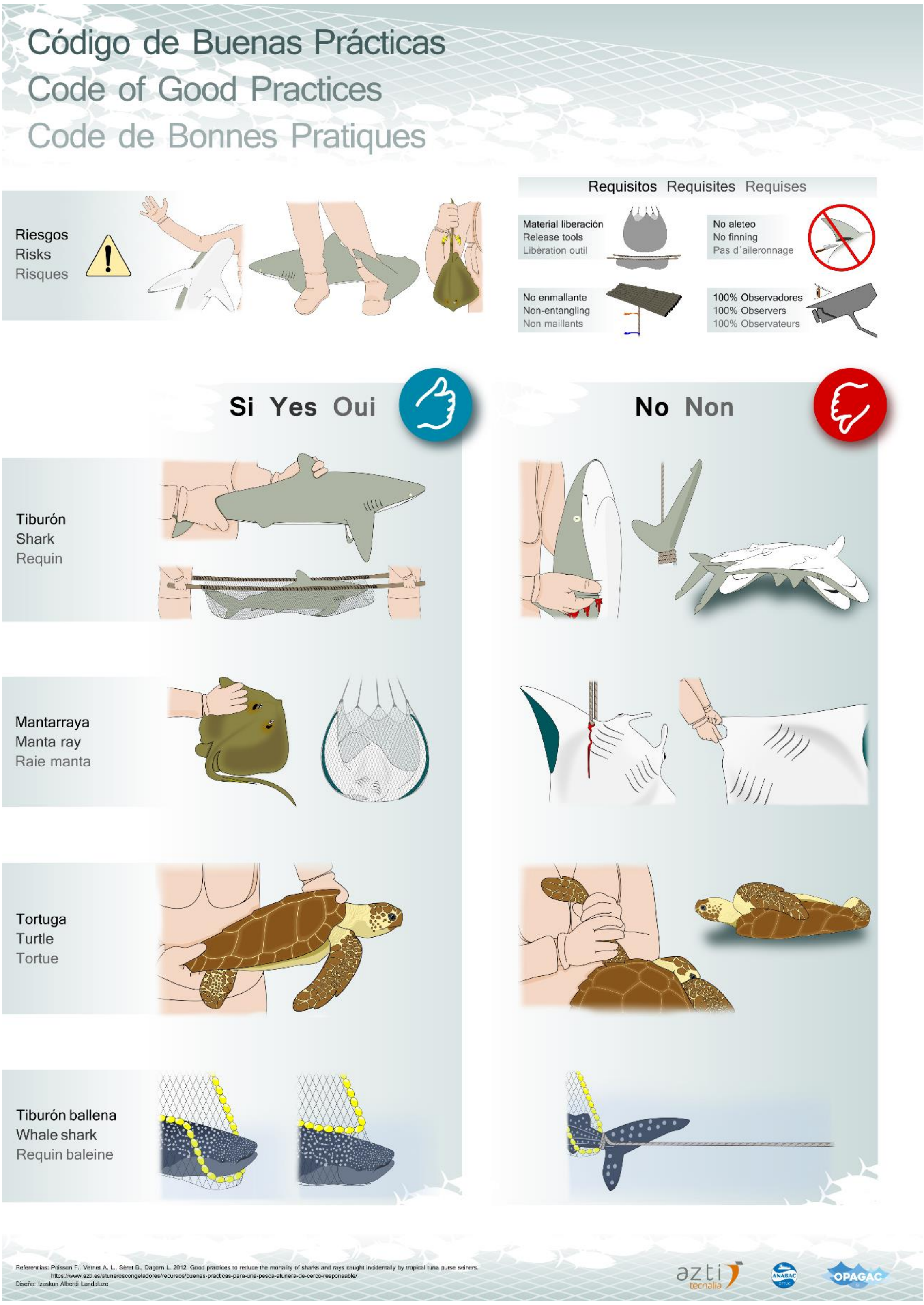
Rhincodon typus (shark whale shark): GOAEGA20140405_RHN.01
Device: GOAEGA20140405_FAD.01

OTHER:

Among your persona effects, you must wear a watch. We suggest including waterproof clothes and shoes for use in the inner rooms (rest).

Japanese-type cotton gloves, helmet and safety footwear for use in working deck and / or lower deck are provided by the owner and should be requested to the supervisor once shipped.

RETURN THE UNUSED FORMS TO SFA-AZTI, do not leave any equipment onboard


Código de Buenas Prácticas
Code of Good Practices
Code de Bonnes Pratiques
Riesgos
Risks
Risques
Requisitos Requisites Requises
Material liberación
Release tools
Libèration outil
No aleteo
No finning
Pas d´ailleronnage
No enmallante
Non-entangling
Non maillants
100% Observadores
100% Observers
100% Observateurs
Si Yes Oui
No Non
Tiburón
Shark
Requin
Mantarraya
Manta ray
Raie manta
Tortuga
Turtle
Tortue
Tiburón ballena
Whale shark
Requin baleine
Referencias: Poisson F., Vernet A. L., Séret B., Dagorn L. 2012. Good practices to reduce the mortality of sharks and rays caught incidentally by tropical tuna purse seiners.
https://www.azti.es/atuneroscongeladores/recursos/buenas-practicas-para-una-pesca-atunera-de-cerco-responsable/
Diseño: Izaskun Alberdi Landaluze
azti tecnalia
ANABAC
OPAGAC