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Reducing Bycatch of Endangered, Threatened, and Protected Species in Key Fisheries

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1.Executive summary

Bycatch of endangered, threatened, and protected (ETP) species in fisheries remains one of the greatest threats to many species of sea turtles, marine mammals, seabirds, sharks, and rays. As key stakeholders of fishery improvement projects (FIPs) have already committed to improving sustainability of their fisheries, these FIPs can serve as catalysts for broader policy and market sustainability improvements. Through this project, SFP has focused on catalyzing improvements in bycatch monitoring and mitigation efforts in fisheries associated with FIPs, with the aim of leveraging change in other, similar fisheries.

In the first phase of this three-phase project, SFP completed a rapid assessment of FIPs with known, unknown, or likely interactions with ETP species and identified 27 FIPs that required further analysis on ETP interactions. SFP worked with external experts to assess which of these 27 FIPs have documented interactions with ETP species and/or are currently addressing bycatch issues within their work plans, and whether they are doing so adequately or not. Key stakeholders working in the targeted fisheries and on similar issues elsewhere were also

identified by the external experts (i.e., NGOs, donors, etc.) during Phase 1. The experts noted that 25 of the FIPs had identified or likely interactions with ETP species, while two FIPs either had none reported or lacked information specific to ETP interactions with the vessels in the FIP. Based on this expert analysis, tuna and large pelagic species FIPs had noted interactions with IUCN critically endangered, endangered, and vulnerable sea turtles (e.g. leatherbacks), seabirds (e.g. albatross), and sharks (e.g. hammerheads). The Chilean common hake bottom trawl fishery interacts with IUCN vulnerable seabirds and sharks and rays. The Mexican Pacific shrimp trawl fishery interacts with IUCN critically endangered and endangered fish and endangered sea turtles and sharks and rays. The Mexican Yucatan grouper longline fishery interacts with IUCN critically endangered and endangered fish, along with vulnerable fish and endangered sharks. The Philippines blue swimming crab fishery has had interactions with the IUCN critically endangered Irrawaddy river dolphin and the Peruvian anchovy purse-seine fisheries interact with endangered and vulnerable sea turtles and seabirds.

Based on the review of these FIPs and their work plans, SFP suggests the following six recommendations:

1. During an initial gap assessment or fishery assessment, ask questions (of fishery managers, fishers, producers) to determine the present level of monitoring and mitigation of bycatch impacts, and include activities in the FIP work plan to address gaps.
1. Engage with national and international management agencies to better monitor and mitigate bycatch.
2. Make data on incidental catches publicly available and provide information to the relevant management authorities.
3. Implement best practices for bycatch mitigation and regularly review new best practices.
4. Adopt precautionary bycatch practice mitigation for gear types where best practices are well-established (e.g. installing TEDs on shrimp trawl vessels).
5. Implement a traceability system that traces product back to the catch vessel or fishing area.

The results from Phase 1, mainly presented in the form of this summary report, are being used to inform the planning and delivery of Phases 2 and 3 of the work. The focus of these next two phases, to be undertaken through December 2019, is to work with key stakeholders to develop and implement best practices, improve recording and reporting of bycatch interactions, and reduce the levels of bycatch of ETP species in FIP fisheries, now and in the future.

2. Introduction

Bycatch of endangered, threatened, and protected (ETP) species in fisheries remains one of the greatest threats to many charismatic marine megafauna, such as sea turtles, marine mammals, seabirds, and sharks and rays. The type and amount of bycatch associated with individual fisheries depends on several things, including, among others: gear type and design (hook type),

fishing method (time of day, setting), and the spatial overlap between fishing effort and individual species' distributions (Wallace et al., 2008; Lewison et al., 2009). Despite some highly visible efforts to address specific issues in specific fisheries (e.g., dolphin-safe tuna), a review of global bycatch patterns suggests that the cumulative impacts of bycatch remain great, and that international and multi-sectoral approaches to improve both bycatch reporting and mitigation efforts are still needed (Lewison et al., 2014).

The incidental capture of non-target species, or bycatch, is a common occurrence in most fisheries, whether industrial or artisanal. Mortality from bycatch is a significant factor in population declines of certain species and/or groups of species (taxa) and is the main driver endangering some species (e.g., the critically endangered vaquita porpoise of Mexico's Gulf of California). Shark, ray, seabird, marine mammal, and sea turtle populations, among others, are often adversely impacted by incidental interactions with fisheries, due to factors such as their long life-history characteristics. For example, it is currently estimated that 1.1 percent of shark species assessed by the International Union for the Conservation of Nature (IUCN) are critically endangered, 1.4 percent are endangered, and 4.6 percent are vulnerable (Dulvy et al., 2014). Green sea turtles and Kemp's ridley are currently listed as endangered and critically endangered by the IUCN, respectively. Leatherback, olive ridley, and loggerhead sea turtles are all listed as vulnerable by the IUCN. In the western and eastern Pacific regions, leatherback sea turtle populations have declined by more than 80 percent and 97 percent, respectively (Wallace et al., 2013). In addition, seabirds include some of the most threatened groups of birds in the world, with 15 of 22 albatross species currently threatened with extinction, according to the IUCN. The loss of bycatch species can also lead to ecological impacts that can be far-reaching. For example, the loss of sharks can lead to changes in the abundance of their prey species, which it is postulated can lead to a cascade of other trophic-level impacts in the ecosystem (Schindler et al., 2002; Myers et al., 2007; Ferretti et al., 2010; Ruppert et al., 2013).

Ensuring that the seafood industry is adequately aware of and appropriately addressing the causes of bycatch mortality of ETP species in fisheries they source from would help to reduce fisheries impacts as a factor in ETP population declines, and subsequent consequences. As key stakeholders of fishery improvement projects (FIPs) have already committed to improving the sustainability of their fisheries, these FIPs can serve as catalysts for broader policy and market sustainability improvements, by influencing government agencies and promoting policy development.

This project has focused on assessing the level of adequacy to which existing, active FIPs are addressing or planning to address bycatch issues through their FIP work plans.

3. Methods

During Phase 1, we reviewed 80 FIPs¹ to identify if they were active (as of June 2017) and to determine the extent that fishery interactions with ETP species were known, unknown, or likely to occur. ETP species in this exercise included species that are listed in the IUCN Red List as critically endangered, endangered, and vulnerable²; species recognized as endangered, threatened, or protected by national legislation; and species recognized in binding international agreements, such as the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and the Convention on the Conservation of Migratory Species of Wild Animals (CMS) Appendix I listed species.³ For the purposes of this report, SFP defines bycatch as “the catch of non-target species, whether retained and sold or discarded” (Lezama-Ochoa et al., 2016). To identify the 80 FIPs for analysis, SFP reviewed information from [FishSource](#) profiles (narrative and environmental parameters)⁴ and/or information available in FIP public reports⁵ on ETP interactions in FIP-associated fisheries.

Based on this rapid review, FIP selection was further narrowed to include only FIPs with fisheries within SFP priority species groups⁶ and/or those included within the scope of SFP-convened supply chain roundtables (SRs). Those FIPs with known, likely, or unknown interactions with ETP species and where SFP had sufficient resources for further evaluation—a total of 51 FIPs—were selected for additional analysis. These FIPs were divided into two subgroups based on assumed interactions with ETP species being likely (n=32) or less likely (n=19). FIP leads for the 32 priority FIPs were contacted, informed of the project, and given the opportunity to provide names of experts who could conduct the Phase 1 analysis. Based on this initial outreach, two FIPs were initially identified as having no known interactions with ETP species (Dessy Anggraeni, Pers. comm.), three were found to not have interactions with ETP species (based on conclusions available in the respective draft FIP reports), and analyses of six US shrimp FIPs were put on hold as legislative changes to these were already anticipated based on interactions with ETP species. SFP was unable to secure experts to analyze four FIPs and ultimately contracted 13 experts to review the remaining 27 priority FIPs, to assess whether and with what means FIPs are currently addressing bycatch issues within their work plans and where further interventions are recommended. The experts’ reports included a review of the relevant sections of the FishSource profiles and provided updated narrative and bycatch principal sections for ecosystem impacts as well as bycatch principal scores. They also outlined

¹ We initially reviewed 83 FIPs, but found two were not active at the start of the study: Indonesia Tuna (WWF) and Solomon Islands longline FIP (Tri Marine); and one was still a prospective FIP: Mauritanian small pelagic, purse seine.

² IUCN species categorized as critically endangered, endangered, and vulnerable that were assessed within the past ten years and are relevant to the region in which the fishery occurs.

³ Unless it can be shown that the particular population of the CITES-listed species impacted by the fishery under assessment is not ETP.

⁴ FishSource is an SFP-managed, publicly accessible website containing reports called profiles of compiled and summarized publicly available information relating to fisheries around the world.

⁵ These reports were either pulled directly from the FIP website or from fisheryprogress.org.

⁶ SFP priority species groups include those in reduction, salmon, shrimp (small and large), tuna (with products destined for the fresh/frozen and shelf-stable markets), crabs (coldwater, warmwater, and blue swimming), snapper and grouper, whitefish, squid, and octopus fisheries.

known interactions of the fisheries with ETP species and identified opportunities for improved bycatch monitoring and mitigation efforts. Key stakeholders working in the targeted fisheries associated with these FIPs and on similar issues were also identified by the experts in a summary memo (i.e., NGOs, donors, etc.). SFP analyzed the received information and conducted a more in-depth review of donors contributing to fisheries bycatch reduction efforts. The results from Phase 1, as summarized in this report, are being used to inform the planning and delivery of Phases 2 and 3 of this work. The focus of the next two phases is to work with key stakeholders to develop and implement best practices to improve reporting of bycatch and to reduce the levels of bycatch of ETP species. The experts' deliverables and a list of all FIPs analyzed can be found in the Appendix.

During April 2018, a draft of this report was sent out to the experts for proofreading and to clarify some outstanding questions. Revisions were incorporated into a draft, which was then sent to the FIP implementers in August 2018, allowing them a chance to review what was provided by the experts contracted. Of the 25 emails sent, six FIP implementers replied with feedback. Some additional edits were made to the draft report based on comments from the FIP implementers. This version includes all edits.

4. Results – Deliverables from Experts

As few long-term studies on interactions with ETP species were available for the FIPs analyzed, much of the information was obtained from publicly available reports that often contained relatively little quantitative information from research generally conducted over relatively short time frames. Among the 27 fisheries analyzed, critically endangered and endangered marine mammals, sea turtles, seabirds, sharks and rays, and teleost fish species were found to have interactions or likely interactions with all but two fisheries (Table 1) of the analyzed FIPs. Experts most frequently referred to species by their IUCN Red List designations, probably because this is an easily accessible, online source that is global in nature. National protected status was added for species interacting with non-tuna FIPs and US Endangered Species Act (ESA) listings were added for species interacting with FIPs. Additional details, all related references, and information gathered by expert consultants for each of the FIPs analyzed are included in the Appendix.

SFP acknowledges that more ETP species than detailed below are likely to interact with the analyzed fisheries. In some instances, species-specific information was lacking, though interactions are known to occur with species groups containing ETP species. It should also be noted that, although there were no identified interactions within the FIPs in Table 1, further investigation into potential bycatch issues is recommended. For example, bycatch of sharks and rays in the western Sumatra handline tuna fishery has been recorded in other studies.

Table 1. FIPs analyzed with no identified interactions with ETP species

Country	FIP name	Gear Type
Mexico	Gulf of California Sinaloa artisanal shrimp	Cast net
Indonesia	Yellowfin tuna Fishery Indonesia (Sea Delight)	Hand line

5. Summary of interactions found in analyzed FIPs

Fisheries are listed alphabetically and grouped by whether they are tuna or large pelagic (e.g., mahi mahi) or other fisheries. Summary information provided in the deliverables from the contracted experts for each FIP analyzed is included below, including recommendations for improved bycatch monitoring and mitigation efforts, where provided by experts.

Tuna and Large Pelagic FIPs

Tuna and large pelagic fisheries interacted with an array of ETP species, including seabirds, marine mammals, sea turtles, and sharks and rays. Of these, turtles and sharks and rays were the most common IUCN critically endangered, endangered, or vulnerable bycatch in these fisheries (Figure 1).

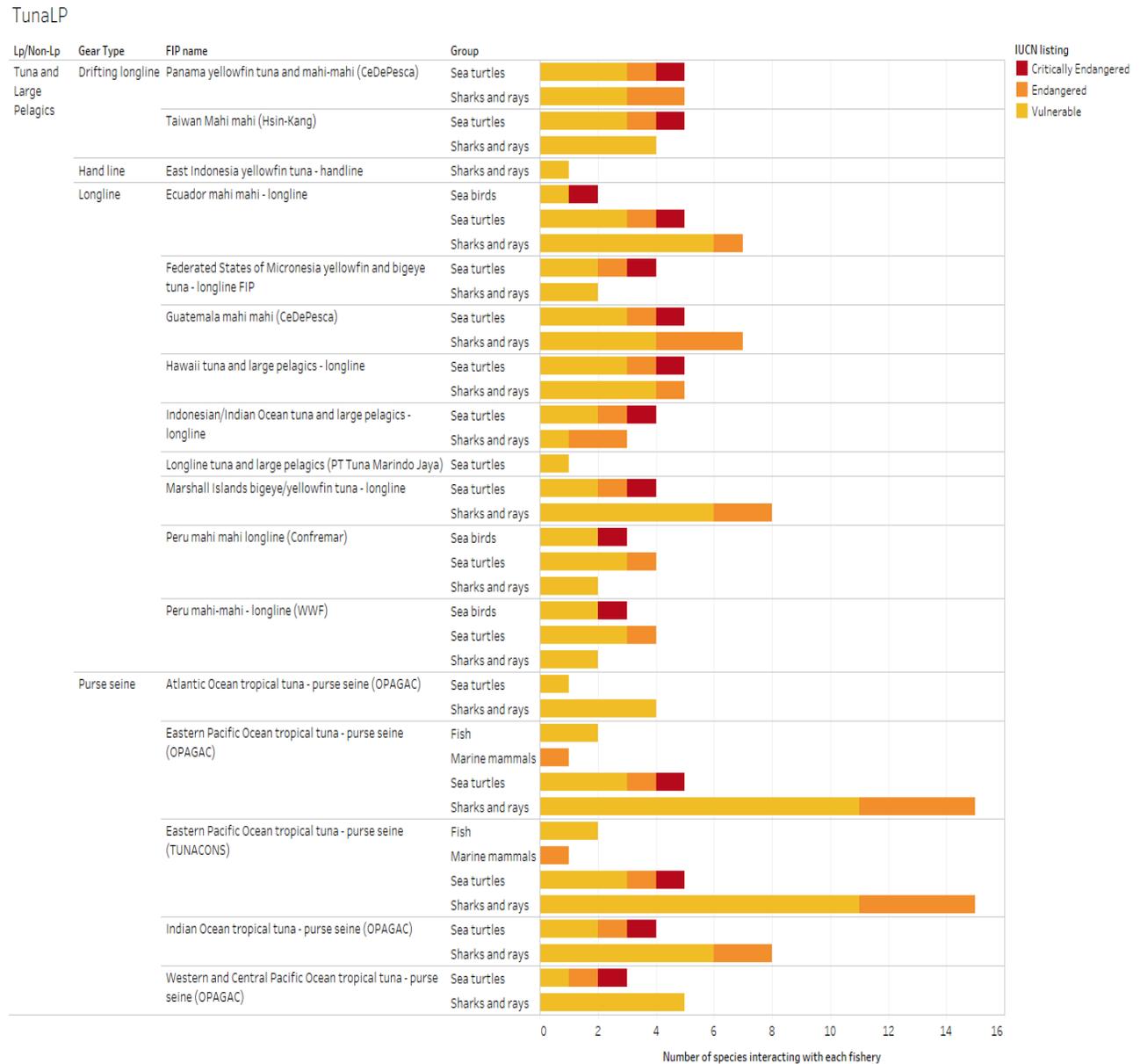


Figure 1: Summary of Interactions of IUCN-categorized critically endangered, endangered, and vulnerable species in analyzed tuna and large pelagic FIPs.

a). Atlantic Ocean Tropical Tuna – Purse Seine (OPAGAC)

Information specific to the fleet covered by this FIP was not available, but information from other fleets in the same area using the same gear type was (MRAG, 2014). By weight, bycatch species—including retained and discarded, non-target species—accounted for ~7 percent of the catch on purse-seine sets in the Atlantic, whereas bycatch accounted for 25-60 percent of catch in longline sets, varying with the depth of sets (MRAG, 2014). Only 15 percent of reported bycatch interactions between IUCN Red List threatened species (i.e., critically endangered, endangered, or vulnerable) and various fisheries in the Atlantic occurred in purse-seine fisheries (Arrizabalaga et al., 2011). The primary bycatch taxa in Atlantic purse-seine fisheries were sharks and rays, marine mammals, and sea turtles (Hall and Roman 2013). Approximately 218 (estimated range: 58-368) turtles were estimated incidentally captured annually between 1995 and 2011 in European Union (EU) purse-seine operations, and 91 percent of these were released alive (Bourjea et al. 2014). Olive ridley sea turtles were the most common incidentally captured sea turtle in purse seines, and they were almost always associated with (resting on) fish aggregating devices (FADs) (Amande et al., 2010; Bourjea et al., 2014). Bycatch of sharks and rays was typically less than one percent of the total catch weight, and 63 percent of sharks caught were retained (Amande et al., 2010; MRAG, 2014). Silky sharks were the most commonly captured sharks (80 percent of the number of sharks taken as bycatch, approximately 40 tonnes/year) in Atlantic purse-seine operations (Amande et al., 2010; Hall and Roman, 2013).

Table 1: ETP species (common and scientific names) known to interact with the Atlantic purse-seine fishery and correspondent conservation status by IUCN, CITES, CMS, ESA, and national status.

Group	Common name	Scientific name	IUCN listing	CITES Appendices	CMS Appendix	ESA status	National status
Sea turtles	Olive ridley sea turtle	<i>Lepidochelys olivacea</i>	Vulnerable	CITES Appendix I	I, II	Threatened	
Sharks and rays	Giant oceanic manta ray	<i>Manta birostris</i>	Vulnerable	CITES Appendix II	I, II	Threatened	
	Oceanic whitetip shark	<i>Carcharhinus longimanus</i>	Vulnerable	CITES Appendix II		Threatened	
	Shortfin mako shark	<i>Isurus oxyrinchus</i>	Vulnerable		II		
	Silky shark	<i>Carcharhinus falciformis</i>	Vulnerable	CITES Appendix II	II		

Monitoring

The International Commission for the Conservation of Atlantic Tunas (ICCAT) requires five-percent observer coverage on purse-seine vessels. This low observer coverage rate means that observer coverage is so sparsely distributed that reliable estimates of total sea turtle mortality in Atlantic purse seines cannot be made (Hall and Roman, 2013). This low observer coverage rate also suggests that interactions with rarer ETP species may never be observed and/or reported.

The expert noted that the final scoping document for the OPAGAC purse seine FIP determined that no improvement performance goals (IPGs) were “critical priorities” for Principle 2 of the Marine Stewardship Council (MSC) assessment criteria, although ETP species bycatch

outcome, management, and information were all scored as “priority IPGs.” The FIP work plan pre-assessment (MRAG, 2014) concluded that: “there are no target reference points for most ETP species, and stock assessments have not been possible for many ETP species due to lack of data. Increased observer coverage is therefore necessary to collect sufficient data from the fleet-wide operations to determine the number and size distribution of individuals of bycatch ETP species that interact with purse seines. In addition, available information on ETP bycatch should be made publicly available for additional analysis.”

The expert recommends the following actions by the FIP:

1. Observer coverage should continue to be increased and then maintained at high levels.
2. Reference points for ETP species (including overexploited shark species) should be developed in consultation with conservation scientists that have expertise in these taxonomic groups, to guide and track bycatch management in this fishery.
3. Available data on bycatch (from observers, logbooks, and other sources) should be made available for analyses of bycatch trends of ETP species to inform management.

Mitigation

OPAGAC have put in place a voluntary code of good practice for their purse seine fishery in all oceans, which includes a transition to non-entangling FADs and release of any entangled animals following best handling practices. Purse-seine vessels in the Atlantic are currently required to:

1. Avoid encirclement of sea turtles
2. Take measures to safely release turtles encircled or entangled in purse-seine nets and entangled in FADs or other fishing gear
3. Record and report to the ICCAT all incidents involving sea turtles during operations
4. Not retain or land hammerhead, oceanic whitetip, silky, and bigeye thresher sharks, and record all interactions, including discards, releases, and status of the animal upon release, in accordance with ICCAT measure 11-08.

The expert suggested that additional information is needed on OPAGAC's approach to the management of entangling FADs, i.e., whether they will be eliminated completely, including opportunistic fishing on remaining FADs (Gascoigne, 2015).

b). Eastern Indonesia Yellowfin Tuna Handline (Yellowfin tuna indonesia)

Based on a very small sample size of data collected between August and September 2016, no interactions with ETP species of sea turtles, marine mammals, or seabirds were found to occur in this fishery, though it is acknowledged that this time window was likely not sufficient to reach definitive conclusions on these groups. Two silky sharks (*Carcharhinus falciformis*), listed as vulnerable by the IUCN, were incidentally captured during the observed trip.

Table 2: ETP species (common and scientific name) known to interact with the FIP fleet and correspondent conservation status by IUCN, CITES, CMS, ESA, and national status.

Group	Common name	Scientific name	IUCN listing	CITES Appendices	CMS Appendix	ESA status	National status
Sharks and rays	Silky shark	<i>Carcharhinus falciformis</i>	Vulnerable	CITES Appendix II	II		

Monitoring

Landings are monitored (30 percent) by the Research Institute for Tuna Fisheries, but incidental captures at sea, which may be discarded, are not monitored. It has been suggested that regulation of FAD use (this fishery sometimes fishes on FADs) is needed for this fishery. It is suggested that incidental captures should be recorded and made public.

Mitigation

There are no specific bycatch mitigation measures currently in use. Additional information on potential ETP interactions would be needed to determine what sort of mitigation measures, if any, are needed in this fishery.

c). Eastern Pacific Ocean (EPO) tropical tuna – purse seine (OPAGAC)

The Eastern Pacific Ocean tropical tuna purse-seine fishery interacts with several ETP (IUCN) bycatch species, including one marine mammal, five species of sea turtles, bony fish, and multiple sharks and rays (Gascoigne, 2015).⁷ Information on bycatch comes mainly from the Inter-American Tropical Tuna Commission (IATTC) observer program on large-scale purse-seine vessels (>363 mt), though a recent study of bycatch in EPO purse-seine fisheries identified 72 species incidentally captured in FAD and free sets (Lezama et al., 2017). Sei whales are the only ETP marine mammal occurring in waters where fishing occurs. Five species of toothed whales and dolphins, all of which are protected species under EU law, also occur in the fishing waters, and interactions occur with several, including some with regulated dolphin sets (Hall & Roman, 2013; IATTC, 2017). Olive ridley sea turtles are the most commonly encountered turtle species, but mortality is low (IATTC, 2016; IATTC, 2017). IUCN vulnerable blue marlin and ocean sunfish were regularly captured in FAD and free sets, respectively. ETP shark species encountered include IUCN endangered hammerhead and whale, and vulnerable silky, pelagic and bigeye thresher, dusky, sandbar, oceanic whitetip, and shortfin mako sharks.⁸

⁷ The fishery also operates in waters with five toothed whales and dolphins: false killer whale (*Pseudorca crassidens*), spotted dolphin (*Stenella attenuata*), spinner dolphin (*Stenella longirostris*), common dolphin (*Delphinus delphis*) and sei whale (*Balaenoptera borealis*). All cetaceans are protected species under EU law through the habitat directive: <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:01992L0043-20130701>, and the false killer whale is protected under the US Endangered Species Act.

⁸ The fishery also interacts with IUCN near threatened copper (*Carcharhinus brachyurus*), Galapagos (*Carcharhinus galapagensis*), blue (*Prionace glauca*), bull (*Carcharhinus leucas*), and blacktip (*Carcharhinus limbatus*) sharks and

Silky sharks comprised 80 percent of the sharks captured by this fishery. The fishery also interacts with IUCN vulnerable giant oceanic manta and sicklefin devil rays, and other rays, though species level information is not available.

Table 3: ETP species (common and scientific name) known to interact with the FIP fleet and correspondent conservation status by IUCN, CITES, CMS, ESA, and national status.

Group	Common name	Scientific name	IUCN listing	CITES Appendices	CMS Appendix	ESA status	National status
Fish	Blue marlin	<i>Makaira nigricans</i>	Vulnerable				
	Ocean sunfish	<i>Mola mola</i>	Vulnerable				
Marine mammals	Sei whale	<i>Balaenoptera borealis</i>	Endangered	CITES Appendix I	I, II	Endangered	
	False killer whale	<i>Pseudorca crassidens</i>	Data Deficient			Endangered (Maine, Hawaiian Islands)	
Sea turtles	Green sea turtle	<i>Chelonia mydas</i>	Endangered	CITES Appendix I	I, II	Threatened	
	Hawksbill sea turtle	<i>Eretmochelys imbricata</i>	Critically Endangered	CITES Appendix I	I, II	Endangered	
	Leatherback sea turtle	<i>Dermodochelys coriacea</i>	Vulnerable	CITES Appendix I	I, II	Endangered	
	Loggerhead sea turtle	<i>Caretta caretta</i>	Vulnerable	CITES Appendix I	I, II	Endangered	
	Olive ridley sea turtle	<i>Lepidochelys olivacea</i>	Vulnerable	CITES Appendix I	I, II	Threatened	
Sharks and rays	Bentfin devil ray	<i>Mobula thurstoni</i>	Near Threatened		I, II		
	Bigeye thresher shark	<i>Alopias superciliosus</i>	Vulnerable	CITES Appendix II	II		
	Common thresher shark	<i>Alopias vulpinus</i>	Vulnerable	CITES Appendix II	II		
	Dusky shark	<i>Carcharhinus obscurus</i>	Vulnerable		II		
	Giant oceanic manta ray	<i>Manta birostris</i>	Vulnerable	CITES Appendix II	I, II	Threatened	
	Great hammerhead shark	<i>Sphyma mokarran</i>	Endangered	CITES Appendix II	II		
	Oceanic whitetip shark	<i>Carcharhinus longimanus</i>	Vulnerable	CITES Appendix II		Threatened	
	Pelagic thresher shark	<i>Alopias pelagicus</i>	Vulnerable	CITES Appendix II	II		
	Sandbar shark	<i>Carcharhinus plumbeus</i>	Vulnerable				
	Scalloped hammerhead	<i>Sphyma lewini</i>	Endangered	CITES Appendix II	II		
	Shortfin mako shark	<i>Isurus oxyrinchus</i>	Vulnerable		II		
	Sicklefin devil ray	<i>Mobula tarapacana</i>	Vulnerable		I, II		
	Silky shark	<i>Carcharhinus falciformis</i>	Vulnerable	CITES Appendix II	II		
	Smooth hammerhead	<i>Sphyma zygaena</i>	Vulnerable	CITES Appendix II			
	Smoothtail mobula	<i>Mobula munkiana</i>	Near Threatened	CITES Appendix II	I, II		
	Spinetail devil ray	<i>Mobula japanica</i>	Near Threatened	CITES Appendix II	I, II		
Whale shark	<i>Rhincodon typus</i>	Endangered	CITES Appendix II	I			

near threatened spinetail devil (*Mobula japanica*), smoothtail mobula (*Mobula munkiana*), bentfin devil (*Mobula thurstoni*), and pacific cow nose (*Rhinoptera steindachneri*) rays.

Monitoring

The IATTC requires 100-percent observer coverage on large (>363 mt) purse-seine vessels. Monitoring on small purse-seine vessels is not required by IATTC. It is recommended that the information being collected by observers is made publicly available and verification with the code of good practice in the EPO is conducted. The observer program should be expanded to cover small-scale purse-seine vessels, as well. In addition, the expert suggested that an explicit identification list of ETP species in the EPO be displayed on board vessels, so vessel operators can more correctly identify ETP species when interactions occur.

Mitigation

There are no specific mandated reference points or limits in place for these species, although some shark species are prohibited from being retained by IATTC management measures. High post-mortality of sharks released after entanglement with FADs has been reported, and the cumulative impacts of interactions with this gear, in addition to those from artisanal fisheries, are not yet known. Research into cumulative impacts on sharks and appropriate mitigation measures, and the adoption of these measures by the IATTC, are needed. Additionally, the FIP could engage more closely with the Tropical Eastern Pacific Marine Corridor (CMAR), as the platform could help advance conservation of ETP megafauna, such as sharks, rays, and turtles.

d). Eastern Pacific Ocean tropical tuna – purse seine (TUNACONS)

This fishery interacts with several ETP species, including five species of sea turtles and multiple species of sharks and rays (IUCN). Information on bycatch comes mainly from observers aboard large-scale (>363 t) purse seiners operating in the EPO. As mentioned above, a recent study of bycatch in EPO purse-seine fisheries identified 72 species incidentally captured in FAD and free sets (Lezama et al., 2017), some of which are ETP species. Olive ridley sea turtles are the most commonly caught sea turtle species in purse-seine fisheries, but mortality appears to be low. The most commonly caught ETP shark taxa are IUCN vulnerable silky sharks, accounting for 80 percent of captures, followed by endangered and vulnerable hammerhead sharks, accounting for nine percent of captured sharks, while interactions with other endangered and vulnerable shark species also occur, as outlined in the table below. Rays, including IUCN vulnerable giant oceanic manta rays and other species in the families Mobulidae and Dasyatidae are most commonly incidentally captured during unassociated purse-seine sets. There is limited quantitative information to determine the level of capture and associated mortality for these ETP species.

Table 4: ETP species (common and scientific name) known to interact with the FIP fleet and correspondent conservation status by IUCN, CITES, CMS, ESA, and national status.

Group	Common name	Scientific name	IUCN listing	CITES Appendices	CMS Appendix	ESA status	National status
Fish	Blue marlin	<i>Makaira nigricans</i>	Vulnerable				
	Ocean sunfish	<i>Mola mola</i>	Vulnerable				
Marine mammals	Sei whale	<i>Balaenoptera borealis</i>	Endangered	CITES Appendix I	I, II	Endangered	
Sea turtles	Green sea turtle	<i>Chelonia mydas</i>	Endangered	CITES Appendix I	I, II	Threatened	
	Hawksbill sea turtle	<i>Eretmochelys imbricata</i>	Critically Endangered	CITES Appendix I	I, II	Endangered	
	Leatherback sea turtle	<i>Dermochelys coriacea</i>	Vulnerable	CITES Appendix I	I, II	Endangered	
	Loggerhead sea turtle	<i>Caretta caretta</i>	Vulnerable	CITES Appendix I	I, II	Endangered	
	Olive ridley sea turtle	<i>Lepidochelys olivacea</i>	Vulnerable	CITES Appendix I	I, II	Threatened	
Sharks and rays	Bigeye thresher shark	<i>Alopias superciliosus</i>	Vulnerable	CITES Appendix II	II		
	Common thresher shark	<i>Alopias vulpinus</i>	Vulnerable	CITES Appendix II	II		
	Dusky shark	<i>Carcharhinus obscurus</i>	Vulnerable		II		
	Giant oceanic manta ray	<i>Manta birostris</i>	Vulnerable	CITES Appendix II	I, II	Threatened	
	Great hammerhead shark	<i>Sphyrna mokarran</i>	Endangered	CITES Appendix II	II		
	Oceanic whitetip shark	<i>Carcharhinus longimanus</i>	Vulnerable	CITES Appendix II		Threatened	
	Pelagic thresher shark	<i>Alopias pelagicus</i>	Vulnerable	CITES Appendix II	II		
	Sandbar shark	<i>Carcharhinus plumbeus</i>	Vulnerable				
	Scalloped hammerhead	<i>Sphyrna lewini</i>	Endangered	CITES Appendix II	II		
	Shortfin mako shark	<i>Isurus oxyrinchus</i>	Vulnerable		II		
	Sicklefin devil ray	<i>Mobula tarapacana</i>	Vulnerable		I, II		
	Silky shark	<i>Carcharhinus falciformis</i>	Vulnerable	CITES Appendix II	II		
	Smooth hammerhead	<i>Sphyrna zygaena</i>	Vulnerable	CITES Appendix II			
	Smoothtail mobula	<i>Mobula munkiana</i>	Near Threatened	CITES Appendix II	I, II		
	Spinetail devil ray	<i>Mobula japonica</i>	Near Threatened	CITES Appendix II	I, II		
	Whale shark	<i>Rhincodon typus</i>	Endangered	CITES Appendix II	I		

Monitoring

Monitoring requirements and recommendations are the same as for the EPO OPAGAC FIP, above.

Mitigation

Mitigation requirements and recommendations are the same as for the EPO OPAGAC FIP, above.

e). Ecuador mahi mahi longline

This fishery interacts with several ETP species of sharks and sea turtles. Bycatch appears to be low (1.1 percent) in the fishery (2008-2011) (Martinez-Ortiz and Zuniga-Flores, 2012 and 2015), but current information on bycatch is not publicly available. The highest bycatch rates are for sharks (0.81 percent of the catch) and sea turtles (0.04 percent of the catch). Nine species of sharks, six of which are ETP species, are incidentally captured in this fishery, with the pelagic thresher shark being the most commonly captured. The three most commonly caught sea turtle species are green, olive ridley, and hawksbill. Sea turtles are mostly released alive. Several incidental captures of ETP seabirds have been observed, but interaction rates are very low (0.0002-0.0005 percent of the catch – two waved albatross and one pink-footed shearwater between 2008 and 2011).

Table 5: ETP species (common and scientific name) known to interact with the FIP fleet and correspondent conservation status by IUCN, CITES, CMS, ESA, and national status.

Group	Common name	Scientific name	IUCN listing	CITES Appendices	CMS Appendix	ESA status	National status
Seabirds	Pink-footed shearwater	<i>Ardenna creatopus</i>	Vulnerable		I		
	Waved albatross	<i>Phoebastria irrorata</i>	Critically Endangered		II		
Sea turtles	Green sea turtle	<i>Chelonia mydas</i>	Endangered	CITES Appendix I	I, II	Threatened	
	Hawksbill sea turtle	<i>Eretmochelys imbricata</i>	Critically Endangered	CITES Appendix I	I, II	Endangered	
	Leatherback sea turtle	<i>Dermochelys coriacea</i>	Vulnerable	CITES Appendix I	I, II	Endangered	
	Loggerhead sea turtle	<i>Caretta caretta</i>	Vulnerable	CITES Appendix I	I, II	Endangered	
	Olive ridley sea turtle	<i>Lepidochelys olivacea</i>	Vulnerable	CITES Appendix I	I, II	Threatened	
	Sharks and rays	Bigeye thresher shark	<i>Alopias superciliosus</i>	Vulnerable	CITES Appendix II	II	
Japanese manta		<i>Mobula japonica</i>	Near Threatened	CITES Appendix II	I, II		
Manta de monk		<i>Mobula munkiana</i>	Near Threatened	CITES Appendix II	I, II		
Oceanic whitetip shark		<i>Carcharhinus longimanus</i>	Vulnerable	CITES Appendix II		Threatened	
Pelagic thresher shark		<i>Alopias pelagicus</i>	Vulnerable	CITES Appendix II	II		
Scalloped hammerhead		<i>Sphyma lewini</i>	Endangered	CITES Appendix II	II		
Shortfin mako shark		<i>Isurus oxyrinchus</i>	Vulnerable		II		
Silky shark		<i>Carcharhinus falciformis</i>	Vulnerable	CITES Appendix II	II		
Smooth hammerhead		<i>Sphyma zygaena</i>	Vulnerable	CITES Appendix II			

Monitoring

Monitoring of this fishery by observers occurred between 2008 and 2011. The latest information from ongoing observer programs is not currently available to the public. It is recommended that:

1. The FIP work plan be amended to include ETP sharks within the actions aimed at ETP species.
2. The FIP work plan promotes the processing and publication of information collected by onboard observers; information from observers should be made publicly available.
3. The required five-percent observer coverage rate is met or exceeded by the fishery

Mitigation

Directed fishing of rays is prohibited in Ecuadorian waters, and there are specific management measures in place for scalloped and smooth hammerhead, whale, basking, and white sharks (ETP species). There are no taxes on circle hooks (since 2012), which provides a small financial incentive to use this type of hook, and as a result, they are increasingly used, which reduces the incidental capture of sea turtles. There is no information on compliance and effectiveness of current measures. The following are recommendations to update the FIP work plan:

1. Work on additional modifications to fishing gear to reduce ETP interactions.
2. Make information on sea turtle catch rates available, in order to assess the effectiveness of current mitigation measures.

f). Federated States of Micronesia Yellowfin and Bigeye Tuna – longline

The fishery overlaps with leatherback, hawksbill, green, olive ridley, and loggerhead sea turtle ranges, all of which are ETP species. During 2016, observers reported four interactions with sea turtles, mostly olive ridleys. No seabird or marine mammal interactions were reported during 2016, although interactions with marine mammals were previously reported. The total impact of this fishery on ETP species is unclear, because information on at-vessel and post-release mortality rates are not available. Information on the potential bycatch of ETP shark species is lacking, though in 2016 incidental capture of silky sharks, listed as vulnerable by IUCN, was reported.⁹

Table 6: ETP species (common and scientific name) known to interact with the FIP fleet and correspondent conservation status by IUCN, CITES, CMS, ESA, and national status.

Group	Common name	Scientific name	IUCN listing	CITES Appendices	CMS Appendix	ESA status	National status
Sea turtles	Green sea turtle	<i>Chelonia mydas</i>	Endangered	CITES Appendix I	I, II	Endangered	

⁹ Blue sharks (*Prionace glauca*), which are listed as near threatened by the IUCN, were reported as incidentally captured in 2016.

	Hawksbill sea turtle	<i>Eretmochelys imbricata</i>	Critically Endangered	CITES Appendix I	I, II	Endangered	
	Leatherback sea turtle	<i>Demochelys coriacea</i>	Vulnerable	CITES Appendix I	I, II	Endangered	
	Olive ridley sea turtle	<i>Lepidochelys olivacea</i>	Vulnerable	CITES Appendix I	I, II	Threatened	
Sharks and rays	Blue shark	<i>Prionace glauca</i>	Near Threatened		II		
	Silky shark	<i>Carcharhinus falciformis</i>	Vulnerable	CITES Appendix II	II		
	Longfin mako shark	<i>Isurus paucus</i>	Vulnerable	CITES Appendix II	II		

Monitoring

The observer program covers about 2.6 percent of the fishery; six longline trips were observed during 2016. This coverage rate is below the mandated (WCPFC) five-percent coverage rate. The main challenges in the FIP and in improvements revolve around extremely low observer coverage rates and not enough information on discards, which increases uncertainty in evaluating fishery impacts on ETP species. Unless observer coverage is increased, all the training sessions on best release and handling practices of ETP species, regulations, and meetings will not be able to surmount the lack of data. Therefore, efforts need to be focused on increasing observer coverage to at least the target level of five percent, as this can generate immediately useful information on ETP interactions. Information on at-vessel mortality rates, health condition code, and/or disposition of discards also needs to be gathered. Additionally, in the FIP work plan, a stock assessment is suggested for the longfin mako shark.

Mitigation

There is a ban on shark retention and the use of wire leaders and shark lines in this fishery. There is voluntary use of circle hooks. However, additional research into effective bycatch-mitigation measures in this fishery are warranted.

g). Guatemala mahi mahi (CeDePesca)

There is limited information on ETP bycatch in this fishery, due to a lack of monitoring. Five species of sea turtles, all ETP species, occur in the region. The majority of incidentally captured turtles are olive ridleys. Although 28 species of marine mammals in the Guatemala List of Threatened Species (GLTS) (CONAP, 2009) have potential distribution in the Guatemalan EEZ, and eight of these are listed in CITES Appendix I, there are no records of interactions with marine mammals. Information on seabird interactions comes from secondary sources, such as interviews with fishermen, and none of the species reported is in the GLTS or the Agreement on the Conservation of Albatrosses and Petrels. Sharks are regularly captured in the fishery, and the fleet has a directed catch of sharks and rays. Silky sharks (vulnerable, IUCN) and scalloped hammerhead sharks (endangered, IUCN) comprised the majority of captures by weight, 70.7 percent and 12.5 percent respectively.¹⁰ IUCN endangered great hammerhead sharks (*Sphyrna*

¹⁰ Bull sharks, listed by IUCN as near threatened, comprise approximately 6.5 percent of captured sharks by weight.

mokarran) and whale sharks (*Rhincodon typus*), and IUCN vulnerable smooth hammerhead sharks (*Sphyrna zygaena*) occur in Guatemalan waters, though levels of interactions were not specified.¹¹

Table 7: ETP species (common and scientific name) known or likely (*) to interact with the FIP fleet and correspondent conservation status by IUCN, CITES, CMS, ESA, and national status.

Group	Common name	Scientific name	IUCN listing	CITES Appendices	CMS Appendix	ESA status	National status
Marine mammals	Various	Various		I			
Sea turtles	Green sea turtle*	<i>Chelonia mydas</i>	Endangered	CITES Appendix I	I, II	Endangered	
	Hawksbill sea turtle*	<i>Eretmochelys imbricata</i>	Critically Endangered	CITES Appendix I	I, II	Endangered	
	Leatherback sea turtle*	<i>Dermochelys coriacea</i>	Vulnerable	CITES Appendix I	I, II	Endangered	
	Loggerhead sea turtle*	<i>Caretta caretta</i>	Vulnerable	CITES Appendix I	I, II	Endangered	
	Olive ridley sea turtle	<i>Lepidochelys olivacea</i>	Vulnerable	CITES Appendix I	I, II	Threatened	
	Great hammerhead shark*	<i>Sphyrna mokarran*</i>	Endangered	CITES Appendix II	II		
	Oceanic whitetip shark*	<i>Carcharhinus longimanus</i>	Vulnerable	CITES Appendix II			
	Pelagic thresher shark	<i>Alopias pelagicus</i>	Vulnerable	CITES Appendix II	II		
	Scalloped hammerhead	<i>Sphyrna lewini</i>	Endangered	CITES Appendix II	II		
	Silky shark	<i>Carcharhinus falciformis</i>	Vulnerable	CITES Appendix II	II		
	Smooth hammerhead*	<i>Sphyrna zygaena</i>	Vulnerable	CITES Appendix II			
	Whale shark*	<i>Rhincodon typus</i>	Endangered	CITES Appendix II	I		

Monitoring

Despite the IATTC requiring five-percent observer coverage rates on longline vessels, there is currently no ongoing scientific observer program in place, and therefore there is no quantitative information on rates of bycatch and mortality of ETP species in this fishery. The only information currently available is from a research study conducted during 2008 and 2009. There appear to be operational and financial conditions currently in this fishery impacting the ability to implement a proper observer program. The following alternatives are proposed for inclusion in an updated FIP workplan:

1. Design and implement a strategy to improve the qualitative and quantitative collection of bycatch data in the fishery logbooks or through the training of selected fishers (including development of an incentive system to report).
2. Design a sampling program to collect fishery-dependent data on the fishery and its impact on ETP.

¹¹ The sailfish (*Istiophorus platypterus*) is incidentally captured in the fishery and is classified as a category 3 protected species in Guatemala.

3. Establish an alliance with universities and research centers to conduct research on the effectiveness of mitigation measures according to the conditions of the fishery, including information on ETP species.
4. Develop a bycatch mitigation training program strategy for trainers and fishers.
5. Carry out an analysis of capabilities needed to implement mitigation measures (FAO, IATTC, national legislation, among others), accompanied by experts, at the national level and within the framework of the IATTC, and promote resolutions for bycatch mitigation measures at IATTC.
6. Submit the annual report to the Inter-American Convention (IAC) for the Protection and Conservation of Sea Turtles.
7. Design an observer program to be managed by the Ministry of Agriculture, Livestock, and Food (DIPESCA), according to the conditions of the fishery, and ensure financial sustainability.

Mitigation

Sea turtles are protected by both national (General Law of fisheries and aquaculture, Decree No. 80-2002) and international (IATTC, IAC) regulations. Fishermen are required to use circle hooks, which reduce sea turtle bycatch, and there is some sporadic training of fishermen in best practice techniques. Several national and international (IATTC) measures are in place to regulate shark capture, handling, and release. The implementation of these measures by the fleet is important. The following are recommended updates to the FIP work plan regarding mitigation measures:

1. Establish a partnership with universities, research centers, and/or scientific consultants to carry out research on the effectiveness of mitigation measures according to the conditions of the fishery and collect information on ETP species.
2. Develop and implement a strategy to train fishermen in bycatch mitigation measures.
3. Support the adoption of resolutions by IATTC for the mitigation of incidental catch of ETP species.

h). Hawaii Tuna and Large Pelagics – longline

Both the deep-water and shallow-water longline fisheries are well observed. In 2016, interactions with ETP species included 23 loggerhead, 20 leatherback, 162 olive ridley, five green, and five unidentified sea turtles; seabirds (525 black-footed albatross and 192 Laysan albatross); marine mammals (17 interactions with eight species, including seven false killer whales captured); and sharks. ETP shark species incidentally captured include IUCN endangered scalloped hammerhead, and vulnerable mako, oceanic whitetip, thresher (*Alopias*

spp.), and silky sharks.¹² In addition to the identified sea turtle species recorded above, the fishery overlaps with IUCN critically endangered hawksbill sea turtle range.

Table 8: ETP species (common and scientific name) known to interact with the FIP fleet and correspondent conservation status by IUCN, CITES, CMS, ESA, and national status.

Group	Common Name	Scientific Name	IUCN listing	CITES Appendices	CMS Appendix	ESA Status	National status
Marine mammals	False killer whale	<i>Pseudorca crassidens</i>	Data Deficient			Endangered	
Sea turtles	Green sea turtle	<i>Chelonia mydas</i>	Endangered	CITES Appendix I	I, II	Threatened	
	Hawksbill sea turtle	<i>Eretmochelys imbricata</i>	Critically Endangered	CITES Appendix I	I, II	Endangered	
	Leatherback sea turtle	<i>Dermodochelys coriacea</i>	Vulnerable	CITES Appendix I	I, II	Endangered	
	Loggerhead sea turtle	<i>Caretta caretta</i>	Vulnerable	CITES Appendix I	I, II	Endangered	
	Olive ridley sea turtle	<i>Lepidochelys olivacea</i>	Vulnerable	CITES Appendix I	I, II	Threatened	
Sharks and rays	Oceanic whitetip shark	<i>Carcharhinus longimanus</i>	Vulnerable	CITES Appendix II		Threatened	
	Scalloped hammerhead	<i>Sphyrna lewini</i>	Endangered	CITES Appendix II	II		
	Shortfin mako shark	<i>Isurus oxyrinchus</i>	Vulnerable		II		
	Silky shark	<i>Carcharhinus falciformis</i>	Vulnerable	CITES Appendix II	II		
	Thresher sharks	<i>Alopias sp.</i>	Vulnerable	CITES Appendix II	some in II		

Monitoring

The deep-set and shallow-set longline fisheries have approximately 21-percent and 100-percent observer coverage, respectively. The FIP work plan should be amended to include the collection of information on at-vessel mortality rates, health condition code, and/or disposition of discards for ETP species.

Mitigation

Regulations in the shallow-set fishery include the use of 18/0 or larger circle hooks and mackerel bait (no squid); deep-set regulations include the use of weak hooks (circle hooks with diameter of 4.5 mm), branch lines with a diameter of 2.0 mm, and at least 15 hooks between floats. All of these are aimed at reducing sea turtle interactions. Seasonal-spatial closures and restrictions to mitigate seabird interaction are applied to both segments in the fishery. The FIP work plan and improvement sections appear to be out of date (latest entries ~2014) and are not sufficiently detailed to comment on newer methods to mitigate bycatch and/or reduce mortality of ETP species; they should therefore be updated accordingly.

¹² Black-footed albatross (*Phoebastria nigripes*), Laysan albatross (*Phoebastria immutabilis*), and blue sharks (*Prionace glauca*) are listed as near threatened by the IUCN.

i). Indian Ocean Tropical Tuna - Purse Seine (OPAGAC)

Catch, effort, and landings data were not available to determine which bycatch species interact with OPAGAC purse seine fleets (MRAG, 2014); therefore, information is presented from other sources. By weight, bycatch species—including retained and discarded, non-target species—account for ~7 percent of catch on purse-seine sets in the Indian Ocean, whereas bycatch accounts for 25-60 percent of catch in longline sets, varying with the depth of sets (MRAG, 2014). The primary bycatch taxa in Indian Ocean purse-seine operations are sharks and rays, marine mammals, and sea turtles (Hall and Roman, 2013). An MSC pre-assessment scored bycatch of baleen whales (e.g., Arabian Sea humpback whales) in the Indian Ocean as a “critical priority.” In the Indian Ocean (Gascoigne, 2015), approximately 250 sea turtles (estimated range: 93-407) were incidentally captured annually between 1995 and 2011 in the European Union (EU) purse-seine fishery, 77 percent of which were released alive (Bourjea et al., 2014). Out of the four sea turtle species captured, olive ridley sea turtles were the most common, particularly in the North Indian Ocean, though in the southern fishing area, hawksbills and green turtles are more commonly captured (Bourjea et al., 2014). Bycatch of all sharks and rays in Indian Ocean purse seines is typically less than one percent of total catch weight and 10 percent of non-tuna bycatch weight, and some species are sometimes retained and harvested commercially (MRAG, 2014). Silky sharks are the most commonly captured shark species, and bycatch of other elasmobranch species is much lower, though it includes other ETP elasmobranch species (Hall and Roman, 2013; MRAG, 2014; IOTC, 2016).

Table 9: ETP species (common and scientific name) known to interact with the Indian Ocean purse seine fleet and correspondent conservation status by IUCN, CITES, CMS, ESA and national status.

Group	Common name	Scientific name	IUCN listing	CITES Appendices	CMS Appendix	ESA status	National status
Marine mammals	Humpback whale	<i>Megaptera novaeangliae</i>	Least Concern		I	Endangered	
Sea turtles	Green sea turtle	<i>Chelonia mydas</i>	Endangered	CITES Appendix I	I, II	Threatened	
	Hawksbill sea turtle	<i>Eretmochelys imbricata</i>	Critically Endangered	CITES Appendix I	I, II	Endangered	
	Loggerhead sea turtle	<i>Caretta caretta</i>	Vulnerable	CITES Appendix I	I, II	Endangered	
	Olive ridley sea turtle	<i>Lepidochelys olivacea</i>	Vulnerable	CITES Appendix I	I, II	Threatened	
Sharks and rays	Bigeye thresher shark	<i>Alopias superciliosus</i>	Vulnerable	CITES Appendix II	II		
	Giant oceanic manta ray	<i>Manta birostris</i>	Vulnerable	CITES Appendix II	I, II	Threatened	
	Oceanic whitetip shark	<i>Carcharhinus longimanus</i>	Vulnerable	CITES Appendix II			
	Pelagic thresher shark	<i>Alopias pelagicus</i>	Vulnerable	CITES Appendix II	II		
	Scalloped hammerhead	<i>Sphyma lewini</i>	Endangered	CITES Appendix II	II		
	Shortfin mako shark	<i>Isurus oxyrinchus</i>	Vulnerable		II		
	Silky shark	<i>Carcharhinus falciformis</i>	Vulnerable	CITES Appendix II	II		
	Whale shark	<i>Rhincodon typus</i>	Endangered	CITES Appendix II	I		

Monitoring

Low observer coverage (five percent required by the IOTC) is so sparsely distributed across the entire purse-seine fleet in the Indian Ocean that reliable estimates of total sea turtle mortality are not possible.

The expert noted that, with the exception of a proposed goal for Arabian Sea humpback whales (WWF and OPAGAC, 2016), no improved performance goals for managing bycatch of ETP species were identified for the Indian Ocean purse-seine fishery by the MSC pre-assessment. There are improvements that can and should be made to ensure that bycatch is being properly monitored, reported, analyzed, and managed. In particular:

1. Observer coverage should continue to be increased and then maintained at higher levels.
2. Reference points for ETP species (including overexploited ETP shark species) should be developed, in consultation with scientists that have expertise in these taxonomic groups, to guide and track bycatch management in this fishery.
3. Available data on bycatch (from observers, logbooks, and other sources) should be made publicly available for analyses of bycatch trends of ETP species, to inform management.
4. Bycatch should be reported in numbers of individuals, rather than by tonnage, and information on the size distribution of individuals should also be recorded.

Mitigation

As previously mentioned, OPAGAC have put in place a voluntary code of good practice for their purse-seine fishery in all oceans, which includes a transition to non-entangling FADs and release of any entangled animals following best handling practice. Purse-seine vessels in the Indian Ocean are required to avoid encirclement of sea turtles or setting on whale sharks.

Clarity is needed on OPAGAC's approach to management of entangling FADs; i.e., whether they will be eliminated, including opportunistic fishing on remaining FADs.

j). Indonesia/Indian Ocean Tuna and Large Pelagics – longline

Scientific observers have recorded bycatch aboard Indonesian longline vessels since 2005. Interactions (2005-2015) with seabirds occurred most frequently in temperate waters.¹³ The fishery interacts with five species of sea turtle, most commonly with the olive ridley (40 of 43 reported sea turtle interactions from 2011-2016) (Fahimi Zulkarnaean, Pers. comm.). IUCN

¹³ IUCN near threatened white (*Thalassarche steadi*, n=3) and black (*Phoebastria nigripes*, n=22) albatross

vulnerable oceanic whitetip and endangered hammerhead sharks and whiptail rays (Dasyatidae)¹⁴ are the ETP shark and ray species incidentally captured in the fishery.¹⁵

Table 10: ETP species (common and scientific name) known to interact with the FIP fleet and correspondent conservation status by IUCN, CITES, CMS, ESA, and national status.

Group	Common name	Scientific name	IUCN listing	CITES Appendices	CMS Appendix	ESA status	National status
Sea turtles	Flatback sea turtle	<i>Natator depressus</i>	Data Deficient	CITES Appendix I	II		
	Green sea turtle	<i>Chelonia mydas</i>	Endangered	CITES Appendix I	I, II	Threatened	
	Hawksbill sea turtle	<i>Eretmochelys imbricata</i>	Critically Endangered	CITES Appendix I	I, II	Endangered	
	Leatherback sea turtle	<i>Dermochelys coriacea</i>	Vulnerable	CITES Appendix I	I, II	Endangered	
	Olive ridley sea turtle	<i>Lepidochelys olivacea</i>	Vulnerable	CITES Appendix I	I, II	Threatened	
Sharks and rays	Hammerhead sharks	<i>Sphyma spp.</i>	Endangered	Some in CITES Appendix II	some in II		
	Oceanic whitetip shark	<i>Carcharhinus longimanus</i>	Vulnerable	CITES Appendix II		Threatened	
	Whiptail stingrays	<i>Dasyatidae spp.</i>	Endangered				

Monitoring

There is limited (five percent) observer coverage of longline vessels operating in the Indian Ocean under IOTC mandate; however, observer coverage rates in Indonesia are often lower than five percent. Through 2014, only 15 observers were used to monitor vessels in this FIP. Increased observer coverage onboard the tuna longline fleet has therefore been suggested. In addition, training is needed for the skippers and crew in how to handle the turtles on board, in order to reduce their mortality and release them back into the sea alive and in good condition.

Mitigation

There are numerous international (IOTC) and national regulations relating to fishery and bycatch of ETP species. Tori lines are required on vessels fishing north of 25° S, and the government is developing a national plan of action for seabird mitigation. Currently, about 56 tuna longline vessels in the region use circle hooks, which reduce sea turtle interactions. It is suggested that the use of circle hooks should be implemented throughout this fishery, and this should be supported through government mandate. Information is lacking on bycatch and ecosystem impacts, and therefore additional management regulations are needed. Additionally, due to the large amount of bycatch that is discarded, it is suggested the FIP incorporate more management of bycatch species and use.

¹⁴ Dasyatidae species with distribution in the Indian Ocean range from IUCN least concern to endangered.

¹⁵ IUCN near threatened blue (*Prionace glauca*) and crocodile (*Pseudocarcharias kamoharai*) sharks were the predominantly captured shark species between 2011 and 2015.

k). Longline Tuna and Large Pelagics

There has been limited monitoring of vessels in this FIP. One observer was used during 2016, during which time one interaction with an olive ridley sea turtle and no interactions with marine mammals or seabirds were observed.¹⁶

Table 11: ETP species (common and scientific name) known to interact with the FIP fleet and correspondent conservation status by IUCN, CITES, CMS, ESA, and national status.

Group	Common name	Scientific name	IUCN listing	CITES Appendices	CMS Appendix	ESA status	National status
Sea turtles	Olive ridley sea turtle	<i>Lepidochelys olivacea</i>	Vulnerable	CITES Appendix I	I, II	Threatened	

Monitoring

Only one observer monitored vessels in this FIP during 2016, despite five-percent mandated observer coverage rates through the IOTC. The following recommendations to the FIP work plan have been made:

1. Improve catch recording by species.
2. Improve data recording on retained species and bycatch in tuna longline gear.
3. Support an onboard observer program, with the objective to improve catch recording retained and bycatch data.
4. Train skippers and crew members in best practices for bycatch mitigation, handling, and release of ETP species.

Mitigation

Vessels in this FIP do not use mitigation measures to prevent the incidental capture of ETP species. The FIP work plan should include the urgent implementation of best practice mitigation measures for, at least, turtles and seabirds, as well as means to investigate the use of mitigation measures and promote their adoption at the governmental and RFMO (i.e. IOTC) levels.

l). Marshall Islands Bigeye and Yellowfin Tuna Longline

Commercial shark fishing is prohibited (CMS, 2014), but the longline fleet incidentally captures IUCN endangered (great and scalloped hammerhead) and vulnerable (shortfin and longfin mako, oceanic whitetip, silky, smooth hammerhead and thresher [*Alopias spp.*]) sharks.¹⁷ The fishery overlaps with Regional Management Units for leatherback and hawksbill (critically endangered), green (endangered), and olive ridley (vulnerable) sea turtles. No seabird, sea turtle, or mammal interactions have been reported as observed in the fishery recently. However,

¹⁶ IUCN near threatened blue shark (*Prionace glauca*) is one of the primary shark species captured as bycatch in the fishery and IUCN near threatened striped marlin (*Kajikia audax*) is also commonly caught in the fishery and retained, while rays (species unknown) are discarded.

¹⁷ IUCN near threatened blue sharks (*Prionace glauca*) are incidentally captured in this fishery.

observer coverage is quite low, and more species than listed below may interact with the fishery.

Table 12: ETP species (common and scientific name) known to interact with the FIP fleet and correspondent conservation status by IUCN, CITES, CMS, ESA, and national status.

Group	Common name	Scientific name	IUCN listing	CITES Appendices	CMS Appendix	ESA status	National status
Sea turtles	Green sea turtle	<i>Chelonia mydas</i>	Endangered	CITES Appendix I	I, II	Endangered	
	Hawksbill sea turtle	<i>Eretmochelys imbricata</i>	Critically Endangered	CITES Appendix I	I, II	Endangered	
	Leatherback sea turtle	<i>Dermodochelys coriacea</i>	Vulnerable	CITES Appendix I	I, II	Endangered	
	Olive ridley sea turtle	<i>Lepidochelys olivacea</i>	Vulnerable	CITES Appendix I	I, II	Threatened	
Sharks and rays	Great hammerhead shark	<i>Sphyma mokarran</i>	Endangered	CITES Appendix II	II		
	Longfin mako shark	<i>Isurus paucus</i>	Vulnerable		II		
	Oceanic whitetip shark	<i>Carcharhinus longimanus</i>	Vulnerable	CITES Appendix II		Threatened	
	Scalloped hammerhead	<i>Sphyma lewini</i>	Endangered				
	Shortfin mako shark	<i>Isurus oxyrinchus</i>	Vulnerable		II		
	Silky shark	<i>Carcharhinus falciformis</i>	Vulnerable	CITES Appendix II	II		
	Smooth hammerhead	<i>Sphyma zygaena</i>	Vulnerable	CITES Appendix II			
	Thresher sharks	<i>Alopias sp.</i>	Vulnerable	CITES Appendix II	some in II		

Monitoring

The WCPFC requires five-percent observer coverage rates on longline vessels operating in the WCPO; the Marshall Islands achieves approximately six-percent observer coverage. The FIP mentions the problems associated with data collection and that there is not enough information on discards. The FIP provides remedies to address these problems. As an example, recording the life status (i.e. alive or dead) of ETP discards would allow estimation of at-vessel mortality rates. The FIP work plan lists target thresholds of >5 percent onboard observer coverage and >95 percent of port sampling records of landings identified to the species level. The FIP work plan should be updated to include an additional effort to compare the validity of observer records against the port sampling records, to increase the level of confidence in the observer data. There is also a need to record observer data on all discards (to the species level), as well as recording the final life status (i.e. dead or alive) of discarded/released animals; this should be updated in the work plan. The FIP should urge WCPFC to increase the level of required observer coverage to adequately record bycatch.

Mitigation

There is a ban on shark fishing and the use of wire leaders in this fishery, which reduces the bycatch of ETP sharks. In addition, there has been a voluntary switch from “J” to circle hooks,

which reduces sea turtle interactions, although the percentage of the fleet that has switched is unknown. To mitigate bycatch, the FIP suggests an effort to fish the shallowest hook deeper than ~100m, broadly in line with scientific advice to WCPFC (WCPFC, 2017). Other measures outlined in the current FIP work plan seem adequate.

m). Panama Yellowfin Tuna and Mahi Mahi

Five species of ETP sea turtles (green, loggerhead, hawksbill, olive ridley, and leatherback) are found in the waters surrounding Panama. Olive ridleys are the most commonly incidentally captured ETP species in the longline fishery, accounting for approximately 83 percent of turtles captured. Information on catch rates of sea turtles in this fishery (5.2/1000 hooks) is available from the time period of 2004-2009. There are eight species of marine mammals, all listed in Panama's threatened species list and in CITES Appendix I, with potential distribution in Panamanian waters. However, there are no reports of considerable interactions with, or mortalities of, marine mammals. Interactions with seabirds are considered negligible but may be underestimated, given the levels of observer coverage. Sharks are commonly caught by the fishery, and the same fleet also targets sharks. The principal species include members of the genera *Alopias*, *Carcharhinus*, and *Sphyma*.

Table 13: ETP species (common and scientific name) known to interact or occurring in the fishing waters and possibly interacting(*) with the FIP fleet and correspondent conservation status by IUCN, CITES, CMS, ESA, and national status.

Group	Common name	Scientific name	IUCN listing	CITES Appendices	CMS Appendix	ESA status	National status
Marine mammals	Various*	Various					Listed
Sea turtles	Green sea turtle*	<i>Chelonia mydas</i>	Endangered	CITES Appendix I	I, II		Endangered
	Hawksbill sea turtle*	<i>Eretmochelys imbricata</i>	Critically Endangered	CITES Appendix I	I, II		Endangered
	Leatherback sea turtle*	<i>Dermochelys coriacea</i>	Vulnerable	CITES Appendix I	I, II		Endangered
	Loggerhead sea turtle*	<i>Caretta caretta</i>	Vulnerable	CITES Appendix I	I, II		Endangered
	Olive ridley sea turtle	<i>Lepidochelys olivacea</i>	Vulnerable	CITES Appendix I	I, II	Threatened	Endangered
Sharks and rays	Great hammerhead shark	<i>Sphyma mokarran</i>	Endangered	CITES Appendix II	II		
	Hammerhead sharks	<i>Sphyma spp.</i>	Endangered	Some in CITES Appendix II			
	Requiem sharks	<i>Carcharhinus spp.</i>	Vulnerable				
	Silky shark	<i>Carcharhinus falciformis</i>	Vulnerable	CITES Appendix II	II		
	Thresher sharks	<i>Alopias spp.</i>	Vulnerable				

Monitoring

Monitoring of these fisheries is irregular. There is limited capacity in the Water Resources Authority of Panama (ARAP) to carry out the inspections and monitoring. The IATTC requires five-percent observer coverage of longline vessels, but it does not appear that Panama has met this level. The operational conditions of the fishery and financing are limitations to the establishment of a program of observers in the Panama tuna/mahi mahi fishery. Suggested alternatives that should be added to the FIP work plan are:

1. Develop and implement a strategy to improve the collection of qualitative and quantitative bycatch data in the fishing logbooks, through training of selected fishers.
2. Design and implement a sampling program to collect fishery-dependent information on the fishery and its impact on ETP species.
3. Design and ensure implementation of an observer program managed by ARAP according to the conditions of the fishery, and ensure financial sustainability.
4. Generate information for IAC's and IATTC's annual reports.

Mitigation

Executive Decree O.D. 126, which repeals the O.D. 486, incorporates new measures that include mitigation of ETP species mortality, including the use of specified circle hooks (aimed at reducing sea turtle interactions). National and international (IATTC, and in IAC for turtles) management measures are in place regarding sea turtle and shark capture, handling, and release. However, the level of compliance of all these measures is not known, and this should be determined and addressed in the FIP work plan, together with research on alternative mitigation measures. In addition, the following elements should be added to the FIP work plan:

1. Establish a partnership with universities, research centers, and/or scientific consultants to carry out research on the effectiveness of mitigation measures.
2. Coordinate with MiAmbiente on work plan actions.
3. Carry out an analysis of the need for implementing mitigation measures (FAO, CIAT, national legislation, among others), accompanied by experts, at the national level and within the framework of the CIT.
4. Develop and implement a strategy of training (trainers and fishermen) needs in the mitigation of bycatch.
5. Call for bycatch mitigation regulations to be adopted by the IATTC and take part in international and regional forums to communicate the country's positions regarding ETP species

n). Peru mahi mahi longline (CONFREMAR)

Information on bycatch in this artisanal fishery is limited and has mainly come from specific studies that used at-sea observers and monitoring of landings data. This fishery is reported to have interactions with two ETP shark species, four species of sea turtles, and two species of seabirds. Sharks are a principal component of incidental catch and include IUCN vulnerable shortfin mako and smooth hammerhead sharks.¹⁸ Loggerhead, green, and olive ridley sea

¹⁸ The IUCN near threatened blue shark (*Prionace glauca*) is the principal shark species captured in the fishery.

turtles are the most commonly captured marine turtle species. Bycatch of sea turtles peaks in February and March, and the majority of sea turtle bycatch occurs in the northern waters of Peru, where olive ridley and green turtle interactions are most prevalent; in the south, loggerhead and green turtles have higher catch rates. IUCN critically endangered waved albatross and vulnerable white-chinned petrels have been reported as bycatch in this fishery, although catch rates are very low (0.011 individuals/1000 hooks).¹⁹ The mahi mahi longline fishery has no direct interactions with marine mammals. While the shark fishery is separate, it is operated by the same fishers, and thus it is important to note that interactions with seabirds are much greater in that fishery and that it uses dolphin meat as bait for sharks.

Table 14: ETP species (common and scientific name) known to interact with the FIP fleet and correspondent conservation status by IUCN, CITES, CMS, ESA, and national status.

Group	Common name	Scientific name	IUCN listing	CITES Appendices	CMS Appendix	ESA status	National status
Seabirds	Petrels	<i>Procellaria spp.</i>	Vulnerable		II		Vulnerable
	Waved albatross	<i>Phoebastria irrorata</i>	Critically Endangered		II		Critically Endangered
	White-chinned petrel	<i>Procellaria aequinoctialis</i>	Vulnerable		II		Vulnerable
Sea turtles	Green sea turtle	<i>Chelonia mydas</i>	Endangered	CITES Appendix I	I, II	Threatened	Endangered
	Leatherback sea turtle	<i>Dermochelys coriacea</i>	Vulnerable	CITES Appendix I	I, II	Endangered	Critically Endangered
	Loggerhead sea turtle	<i>Caretta caretta</i>	Vulnerable	CITES Appendix I	I, II	Endangered	Endangered
	Olive ridley sea turtle	<i>Lepidochelys olivacea</i>	Vulnerable	CITES Appendix I	I, II	Threatened	Endangered
Sharks and rays	Shortfin mako shark	<i>Isurus oxyrinchus</i>	Vulnerable		II		
	Smooth hammerhead	<i>Sphyrna zygaena</i>	Vulnerable	CITES Appendix II			

Monitoring

Information is limited, because it comes from specific studies that used observers and/or sampling at port. The fishery does not currently meet the mandated (IATTC) five-percent observer coverage rate. The following updates to the FIP work plan are suggested:

1. The systematic collection of quantitative information on the bycatch of the fleet that is part of the certification unit. It is important to have information on the rates of capture of ETP species and include the number of individuals and size classes.
2. Define which ETP species are caught during the operation of the fleet that participates in the FIP.
3. Greater specificity regarding monitoring and reporting activities and demonstrable compliance with existing regulations are needed.

Mitigation

Although there are numerous regulations regarding the capture and retention of sharks and other species (marine mammals, seabirds, sea turtles) and development of a national plan of

¹⁹ IUCN near threatened sooty shearwaters (*Ardenna grisea*) are also captured in the fishery.

action for the conservation of marine turtles is underway, implementation and enforcement of these measures is low. There are no bycatch mitigation measures in place to address the bycatch of ETP species. The following updates to the FIP work plan have been suggested:

1. The fishery should ensure it is implementing existing conservation and management measures and investigate various measures (e.g., time/area closures, method/gear changes, incentives for fishermen, training) to reduce the capture and associated mortality of ETP species.
2. Additionally, as the same fishers target sharks and catch many more seabirds during that time, the FIP should include training on best handling practices of seabirds and encourage the development of a National Plan of Action for the conservation of seabirds of Peru, in order to advance its commitment to the Agreement on the Conservation of Albatross and Petrels.
3. Because many fishers do not participate in the FIP or participate in IUU activities, the FIP should implement a traceability system to reduce the likelihood that other product does not become “white-washed.”

o). Peru Mahi Mahi (WWF)

Information on bycatch in this artisanal fishery is limited and has mainly come from specific studies that used at-sea observers and monitoring of landings data. This fishery is reported to have interactions with two ETP shark species, four species of sea turtles, and two species of seabirds. Sharks are the main bycatch in this fishery and include IUCN vulnerable shortfin mako and smooth hammerheads.²⁰ Loggerhead, green, and olive ridley sea turtles are the most commonly captured marine turtle species. Bycatch of sea turtles peaks in February and March, and the majority of sea turtle bycatch occurs in the northern waters of Peru, where olive ridley and green turtle interactions are most prevalent. In the mid-latitudes, loggerhead and green turtles are more likely to be captured, and loggerheads are most frequently captured in the south. IUCN critically endangered waved albatross and vulnerable white chinned petrel have been reported as bycatch in this fishery, although catch rates are very low (0.011 individuals/1000 hooks).²¹ While no marine mammal bycatch occurs in the mahi mahi fishery, the same fishers operate the shark fishery. The shark fishery has a much higher incidental capture of seabirds and uses dolphin meat as bait.

Table 15: ETP species (common and scientific name) known to interact with the FIP fleet and correspondent conservation status by IUCN, CITES, CMS, ESA, and national status.

Group	Common name	Scientific name	IUCN listing	CITES Appendices	CMS Appendix	ESA status	National status
Seabirds	Petrels	<i>Procellaria spp.</i>	Vulnerable		II		Vulnerable

²⁰ IUCN near threatened blue shark (*Prionace glauca*) is the principal shark species captured in the fishery. Though the great hammerhead shark (*Sphyrna mokarran*, IUCN endangered) was considered a bycatch species in the FIP pre-evaluation, it has not been recorded in any of the observer data.

²¹ IUCN near threatened sooty shearwaters (*Ardenna grisea*) are incidentally captured in the fishery. Though Chatam albatross (*Thalassarche eremita*, IUCN vulnerable) and Galapagos petrel (*Pterodroma phaeopygia*, IUCN critically endangered) were considered bycatch species in the FIP pre-evaluation, there are no recorded interactions based on observer data.

	Waved albatross	<i>Phoebastria irrorata</i>	Critically Endangered		II		Critically Endangered
	White-chinned petrel	<i>Procellaria aequinoctialis</i>	Vulnerable		II		Vulnerable
Sea turtles	Green sea turtle	<i>Chelonia mydas</i>	Endangered	CITES Appendix I	I, II	Threatened	Endangered
	Leatherback sea turtle	<i>Dermochelys coriacea</i>	Vulnerable	CITES Appendix I	I, II	Endangered	Critically Endangered
	Loggerhead sea turtle	<i>Caretta caretta</i>	Vulnerable	CITES Appendix I	I, II	Endangered	Endangered
	Olive ridley sea turtle	<i>Lepidochelys olivacea</i>	Vulnerable	CITES Appendix I	I, II	Threatened	Endangered
Sharks and rays	Shortfin mako shark	<i>Isurus oxyrinchus</i>	Vulnerable		II		
	Smooth hammerhead	<i>Sphyrna zygaena</i>	Vulnerable	CITES Appendix II			

Monitoring

Information is limited because it comes from specific studies that used observers and/or sampling at port. The fishery does not currently meet the mandated (IATTC) five-percent observer coverage rate. The following updates to the FIP work plan have been suggested:

1. The implementation strategies for the onboard observer program should be rethought, so consistent reliable information on ETP bycatch can be collected.
2. Planned milestones related to the observer program and control and surveillance budgets must be addressed.
3. The work plan should address better monitoring, control, and surveillance of the fishery, particularly relating to detecting and sanctioning infractions such as incidental capture of birds and marine mammals and compliance with the minimum size of shark catch.
4. Additionally, as many fishers do not participate in the FIP or participate in IUU activities, the FIP should implement a traceability system.

Mitigation

There are no bycatch mitigation measures in place to address the bycatch of ETP species. The following updates to the FIP work plan have been suggested:

1. Investigate various measures (e.g. method/gear changes, incentives for fishermen, training) to reduce the capture and associated mortality of ETP species and implement best practices.
2. Additionally, as the same fishers target sharks and catch many more seabirds during that time, the FIP should include training on best handling practices of seabirds and encourage the development of a National Plan of Action for the conservation of seabirds of Peru, in order to advance its commitment to the Agreement on the Conservation of Albatross and Petrels.

p). Taiwan Hsing-Kang Mahi Mahi

There is virtually no available information to evaluate the impacts of ETP bycatch on sea turtles, cetaceans, seabirds, or sharks in this particular mahi mahi longline fishery, though interactions with these groups are known to occur in Taiwanese longline fisheries and likely do occur in this fishery (Fisheries Agency of Taiwan, 2017). All sea turtle species in the western and central Pacific Ocean qualify for some level of “threatened” status, according to the IUCN Red List and other status assessments, though longline bycatch impacts on sea turtles in this region are relatively low (Wallace et al., 2011; Wallace et al., 2013; Clarke, 2014; Lewison et al., 2014). Some shark species are likely experiencing overexploitation in this region, including IUCN vulnerable pelagic thresher, shortfin mako, oceanic whitetip, and silky sharks (see Rice and Harley, 2012a, 2012b; Clarke et al., 2014 for review; ISC SHARKWG, 2014, 2015; WCPFC).²² There are more than 50 seabird species present in China (including island provinces), but longline impacts on seabirds in the EEZ around Taiwan are unknown (Croxall et al., 2012). Taiwan has been highlighted as potentially high risk for longline interactions with albatrosses and petrels in the fall (April to June) and winter (July to September) (Waugh et al., 2012).

Table 16: ETP species (common and scientific name) known to occur in fishery waters and possibly interacting with the FIP fleet and correspondent conservation status by IUCN, CITES, CMS, ESA, and national status.

Group	Common name	Scientific name	IUCN listing	CITES Appendices	CMS Appendix	ESA status	National status
Marine mammals	unknown						
Seabirds	unknown						
Sea turtles	Green sea turtle	<i>Chelonia mydas</i>	Endangered	CITES Appendix I	I, II	Endangered	
	Hawksbill sea turtle	<i>Eretmochelys imbricata</i>	Critically Endangered	CITES Appendix I	I, II	Endangered	
	Olive ridley sea turtle	<i>Lepidochelys olivacea</i>	Vulnerable	CITES Appendix I	I, II	Threatened	
	Leatherback sea turtle*	<i>Dermodochelys coriacea</i>	Vulnerable	CITES Appendix I	I, II	Endangered	
	Loggerhead sea turtle*	<i>Caretta caretta</i>	Vulnerable	CITES Appendix I	I, II	Endangered	
Sharks and rays	Oceanic whitetip shark	<i>Carcharhinus longimanus</i>	Vulnerable	CITES Appendix II			
	Pelagic thresher shark	<i>Alopias pelagicus</i>	Vulnerable	CITES Appendix II	II		
	Shortfin mako shark	<i>Isurus oxyrinchus</i>	Vulnerable		II		
	Silky shark	<i>Carcharhinus falciformis</i>	Vulnerable	CITES Appendix II	II		
	unknown						

Monitoring

The WCPFC requires five-percent observer coverage of longline vessels operating in the region. Taiwan reported to the WCPFC Scientific Committee that the forms and protocols used by its tuna longline observer program conform with WCPFC standards, and observer coverage

²² IUCN near threatened blue sharks (*Prionace glauca*) are incidentally captured by pelagic longlines in the West and Central Pacific Ocean.

ranged between 1.9 percent (small-scale tuna fisheries) and 8.2 percent (large-scale tuna fisheries) of days at sea in 2016 (Fisheries Agency of Taiwan, 2017). However, it is unclear whether, and to what extent, the fishery complies with WCPFC observer program standards.

The information provided in the pre-assessment report and FIP work plan is very basic, and it is not possible to evaluate the simplest criteria regarding bycatch in this fishery, such as which species might be impacted, to what extent, where, etc.

The FIP work plan should provide sufficient further detail to enable ETP bycatch to be understood, especially requirements for:

1. Data collection and analysis related to monitoring bycatch in this fishery based on number of individuals and size ranges rather than tonnage.
2. Compiled mapping of shapefiles for the fishery range of operation, as well as for target and bycatch species ranges. Not all shapefiles would need to be developed; for example, shapefiles for sea turtles and seabirds are already developed and could be used.
3. The observer program in general.
4. Bycatch reduction measures that will be implemented for which species, who will implement them, how implementation will be verified, and over what timescales. Useful details would include priority species to be monitored, bycatch and associated fishing effort metrics, taxa-specific reduction goals, observer training plans, and verification of observer data.
5. Clarity is needed about expectations for individual observers (i.e., will there be dedicated observers for priority bycatch species? Or will observers be expected to monitor bycatch as well as standard fishing operations? How will amount and distribution of observer coverage be determined, and how will observer data be analyzed with logbook data?).

Mitigation

The WCPFC recommends limits on two longline gear features strongly related to interactions with oceanic whitetip sharks and allows the flag state flexibility to choose to exclude at least one of two measures (i.e., use of wire leaders and use of shark lines) (WCPFC, 2014). WCPFC members are asked to implement FAO Guidelines to Reduce Sea Turtle Mortality in Fishing Operations and proper handling and release guidelines when hard-shell turtles are incidentally captured, and to carry line cutters and de-hookers to allow for the safe handling and release of turtles (WCPFC, 2008). Longline vessels north of 23° N are required to use at least two seabird mitigation measures (WCPFC, 2015). The FIP work plan should be updated to include the use of bycatch mitigation measures for sea turtles, to conduct research into the viability of other bycatch mitigation measures, and to require the prohibition of both wire leaders and the use of shark lines. It is unclear to what extent the fishery is currently complying with WCPFC standards for bycatch mitigation.

q). Western and Central Pacific Tropical Tuna- Purse Seine (OPAGAC)

Catch, effort, and landings data were not available to determine which bycatch species interact with OPAGAC purse-seine fleets (MRAG, 2014). Therefore, this narrative summarizes information presented in other sources. By weight, bycatch species account for ~2 percent of catch on purse-seine sets in the Western and Central Pacific Ocean (WCPO), whereas bycatch accounts for 25-60 percent of catch in longline sets, depending on the depth of sets. The primary bycatch taxa in the WCPO purse-seine fishery are sharks and rays, marine mammals, and sea turtles; sea turtles tend to be highest in log and FAD sets. In the WCPO, 100-200 turtles per year interacted with purse-seine gear in 2014 and 2015, 88 percent or more of which were released alive. Olive ridleys are the most common ETP sea turtle species incidentally captured in purse seines, though hawksbill and green sea turtles are also commonly caught. ETP sharks taken as bycatch in WCPO purse-seine operations include shortfin mako sharks, which are sometimes retained. Since 1993, oceanic whitetip sharks were the most commonly captured ETP shark species in purse seines in the WCPO.

Table 17: ETP species (common and scientific name) known or likely(*) to interact with the FIP fleet and correspondent conservation status by IUCN, CITES, CMS, ESA, and national status.

Group	Common name	Scientific name	IUCN listing	CITES Appendices	CMS Appendix	ESA status	National status
Marine mammals	Various						
Sea turtles	Green sea turtle	<i>Chelonia mydas</i>	Endangered	CITES Appendix I	I, II	Endangered	
	Hawksbill sea turtle	<i>Eretmochelys imbricata</i>	Critically Endangered	CITES Appendix I	I, II	Endangered	
	Olive ridley sea turtle	<i>Lepidochelys olivacea</i>	Vulnerable	CITES Appendix I	I, II	Threatened	
Sharks and rays	Giant oceanic manta ray	<i>Manta birostris</i>	Vulnerable	CITES Appendix II	I, II	Threatened	
	Oceanic whitetip shark*	<i>Carcharhinus longimanus</i>	Vulnerable	CITES Appendix II		Threatened	
	Pelagic thresher shark*	<i>Alopias pelagicus</i>	Vulnerable	CITES Appendix II	II		
	Shortfin mako shark*	<i>Isurus oxyrinchus</i>	Vulnerable		II		
	Silky shark*	<i>Carcharhinus falciformis</i>	Vulnerable	CITES Appendix II	II		

Monitoring

The WCPFC requires 100-percent observer coverage on large purse-seine (>363 t) vessels operating in the WCPO. Although no improved performance goals for managing bycatch of ETP species were identified for the WCPFC purse-seine fishery during the MSC pre-assessment, there are improvements that can and should be made to ensure that bycatch is being properly monitored, reported, analyzed, and managed. In particular:

1. Observer coverage should be increased to, and maintained at, 100 percent, as required by WCPFC.

2. Reference points for ETP species (including ETP shark species) should be developed, in consultation with scientists who have expertise in these taxonomic groups, to guide and track bycatch management in this fishery.
3. Available data on bycatch (from observers, logbooks, and other sources) should be made publicly available for analyses of bycatch trends of ETP species, to inform management.
4. Bycatch of turtles, sharks, marine mammals, and seabirds should be recorded as number and sizes of individuals, rather than tonnage.

Mitigation

The OPAGAC fleet is also moving toward 100-percent use of non-entangling, biodegradable FADs. Purse-seine vessels in the WCPO are required to avoid encirclement of sea turtles or set on a school of tuna associated with a whale shark. Clarity is needed on OPAGAC's approach to management of entangling FADs; i.e., whether they will be eliminated completely, including opportunistic fishing on remaining FADs.

r). Yellowfin Handline Banda Sea

No interactions between ETP marine mammal, seabird, sea turtle, or shark species have been reported during data collection from vessels participating in this FIP. However, sharks and rays have been known to be captured in tuna handline fisheries operating in western Sumatra (Dharmadi et al., 2017). Further investigation into potential bycatch within that FIP is therefore recommended.

Table 18: ETP species (common and scientific name) known to interact with the Banda Sea handline fishery and likely with FIP fleet and correspondent conservation status by IUCN, CITES, CMS, ESA, and national status.

Group	Common name	Scientific name	IUCN listing	CITES Appendices	CMS Appendix	ESA status	National status
Sharks and rays	Various	Various					

Monitoring

Catch is monitored through trip reports and landings monitoring. There is no observer program in place, which would ensure proper monitoring of the fishery. There is a need for monitoring the use of FADs in this fishery. The FIP should implement some form of at-sea observer program or logbook scheme (with appropriate training) to collect data on ETP interactions, including the number and size classes of sharks.

Mitigation

There are no mitigation measures currently in use in this fishery. Best practice bycatch mitigation, handling, and release measures for sharks in handline fisheries should be implemented.

s). Yellowfin Tuna Handline Fishery in Indonesia (Sea Delight)

No interactions between ETP marine mammal, seabird, sea turtle, or shark species have been reported during data collection from vessels participating in this FIP. However, due to the lack of observer coverage, interactions with ETP species should not be ruled out.

Monitoring

Catch is monitored through trip reports and landings monitoring. There is no observer program in place, which would ensure proper monitoring of the fishery. There is a need for monitoring the use of FADs in this fishery. The FIP should implement some form of at-sea observer program or logbook scheme (with appropriate training) appropriate to the gear-type and scale of the fishery, to collect basic data on ETP interactions.

Mitigation

There are no mitigation measures currently in use in this fishery. Best practice bycatch mitigation, handling, and release measures for sharks in handline fisheries should be implemented.

Other Analyzed FIPs

The remaining analyzed FIPs cover different gears and a diverse group of target species: in South America, the industrial Chilean common hake fishery and both artisanal and industrial Peruvian anchovy fisheries; in Mexico, the grouper fishery in the Gulf of Mexico and the Pacific shrimp bottom trawl and artisanal fisheries; and southeast Asia, with Vietnamese and Philippines blue swimming crab fisheries. Critically endangered species had interactions with the Yucatan red and black grouper fishery, the Mexican Pacific shrimp fishery, and the Philippines blue swimming crab fishery (Figure 2).

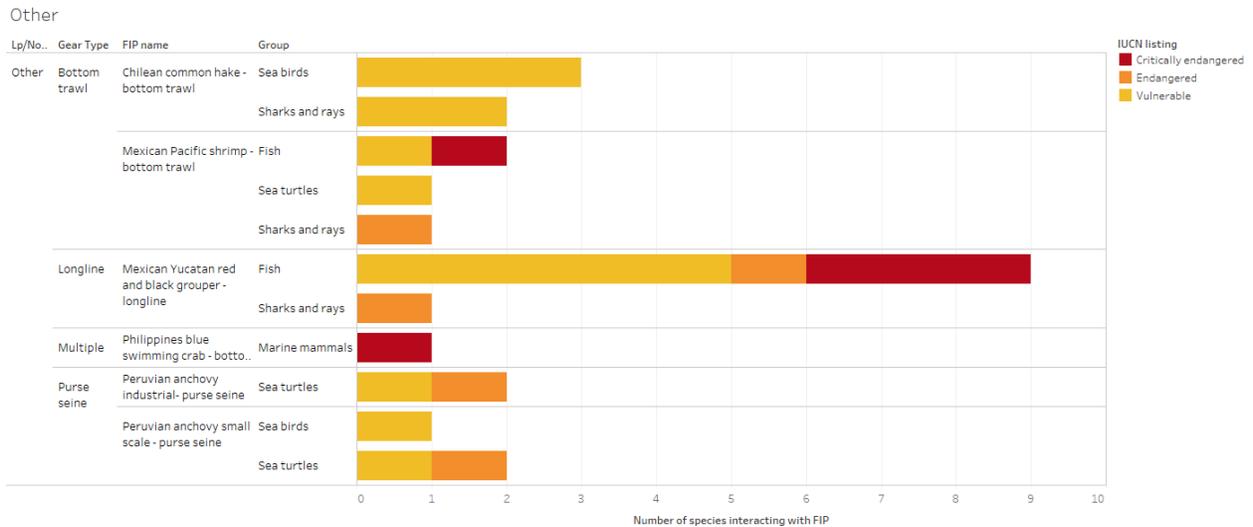


Figure 2: Summary of interactions of IUCN-categorized critically endangered, endangered, and vulnerable species in analyzed non-tuna or large pelagic FIPs.

t). Chilean common hake bottom trawl fishery FIP

The development of a research program to evaluate discards and incidental catches was promoted by the incorporation of the Discard Law (No. 20.625), in 2012, in the Law on Fisheries and Aquaculture amendment. There was systematic information about non-target species, but not about incidental catch of seabirds, marine mammals, or sea turtles. The plan to reduce discarding and bycatch focused on minimizing the impact on the target species itself, bycatch under quotas or Individual Transferable Quotas (ITQs), and unregulated bycatch and species classified as bycatch (seabirds, marine mammals, and sea turtles). Administrative and conservation measures were established, as well as a monitoring program of the plan and evaluation of measures, a training and dissemination program, code of best practices, and innovation and improvements in fishing gears.

No sea turtle species were listed as incidentally captured by the fishery. IUCN vulnerable kite ray (*Zearaja chilensis*) and roughskin skate (*Dipturus trachyderma*) are caught in the fishery and do not have catch quotas as a target species in the industrial fishery, but only as bycatch.²³ Both are currently under an extractive closure and, despite the measures taken to date, are currently overexploited. The fishery does regularly capture sea lions (*Otaria flavescens*), though it is a species of least concern according to the IUCN. Based on the only systematic study about the interaction of the fishery with seabirds, conducted from 2011-2012 (Birdlife, 2013), of the 34 seabird species known to interact with the fishery (22 of which are in the order Procellariiformes), the following are IUCN vulnerable: white shearwater (*Ardenna creatopus*) and

²³ IUCN near threatened speckled smoothhound sharks (*Mustelus mento*) are also incidentally captured in this fishery.

Salvin's albatross (*Thalassarche salvini*).²⁴ Approximately 890 seabird mortalities were estimated for the year, many of which followed interactions with trawl cables. The highest level of incidence and mortality occurred in the winter, during which pelican, black-browed, and Salvin's albatrosses had the greatest mortalities. More recent information indicated that Juan Fernández petrels, listed as endangered under the National Inventory of Chilean Species and vulnerable by IUCN, is one of the two most frequently captured seabird species in this fishery.

Table 19: ETP species (common and scientific name) known to interact with the FIP fleet and correspondent conservation status by IUCN, CITES, CMS, ESA, and national status.

Group	Common name	Scientific name	IUCN listing	CITES Appendices	CMS Appendix	ESA status	National status
Seabirds	Black-browed albatross	<i>Thalassarche melanophrys</i>	Least Concern				
	Juan Fernández Petrel	<i>Pterodroma externa</i>	Vulnerable				En Peligro (EN)
	Pink-footed shearwater	<i>Ardenna creatopus</i>	Vulnerable		I		
	Salvin's albatross	<i>Thalassarche salvini</i>	Vulnerable		II		
Sharks and rays	Kite ray	<i>Zearaja chilensis</i>	Vulnerable				
	Roughskin skate	<i>Dipturus trachydermus</i>	Vulnerable				

Monitoring

The available information does not allow the effects of the fishery on the viability of ETP populations to be determined, and more quantitative information is needed, particularly with regard to the artisanal fleet. Biological studies are required for a better understanding of ETP life-history data, as there is no information for the vast majority of species, and financing options for such studies should be developed. The existing plan to reduce discards and incidental captures should be reviewed for adequacy with respect to ETP bycatch. Although there is no information available, the continuity of the research program has allowed and will allow improvement in the recording of bycatch and incidental species in recent years, especially bycatch, while implementing the use of logbooks to record the interaction with non-target species, for example. The plan should be fully implemented and monitored. Analysis and the public reporting of progress to date should be undertaken as a priority, and communication among the various institutions linked to the fishery should be strengthened. Increased educational outreach to companies and fishing crews to enable understanding of ETP bycatch and improved species identification should be considered.

Mitigation

The FIP plan to reduce bycatch and discards includes specific mitigation measures, for example: the discarding of yellownose skate, seabirds, marine mammals, and sea turtles is prohibited (Article 7b in the Ley General de Pesca y Acuicultura [LPGA]) and selection/exclusion

²⁴ IUCN near threatened Peruvian pelican (*Pelecanus thagus*) accounted for 10.5 percent of seabird interactions by frequency of occurrence.

devices are mandatory, according to the fleet conditions. Known best practice mitigation (e.g. changes in fishing areas, duration of sets, tori lines, Brady bafflers, management of catches and discards, etc.) should be implemented in a participatory manner. For example, warp strikes should be universally implemented for all trawl vessels to reduce seabird mortalities, as foreseen in the plan. Additional changes in fishing, such as changes in fishing areas, duration of sets, and best practices in handling target and bycatch species, should be undertaken. The current FIP plan could better specify bycatch mitigation efforts. Finally, as IUU fishing is an issue in the artisanal sector, additional enforcement within the fishery is also warranted.

u). Gulf of California Sinaloa artisanal shrimp – cast nets

This is a high bycatch fishery, where the ratio of target species to bycatch was 1:1 in a 2006 study and more recently was reported as 1:0.5 (in a 2017 study), with the number of species captured reported as 83 and 15 species, respectively (Amezcuca et al., 2006; Balmori et al., 2012; Balmori-Ramírez, A., 2017). However, no interactions between ETP marine mammals, seabirds, sea turtles, or shark species have been reported during data collection from vessels participating in this FIP.

Monitoring

Catches are monitored through trip reports and landings. There is no observer program in place that would ensure proper monitoring of the fishery (if the boat size allows onboard observers). The FIP biannual bycatch monitoring program should be adopted and implemented by relevant governmental agencies (SAGARPA, CONAPESCA, and INAPESCA) to increase its coverage and include an onboard observer program. Formal participation in the FIP by all stakeholders is needed in order to ensure the development of a management plan for the artisanal shrimp fishery in Sinaloa, Mexico.

Mitigation

Given the lack of interaction between the fishery and ETP species, the only regulation in place (NOM-002-SAG/PESC-2013) regards the construction and operation of fishing gears to maximize the intra- and interspecific selectivity. Enforcement of established open and closed fishing seasons is also needed to ensure fishing occurs only during the open season.

v). Mexican Pacific shrimp – bottom trawl

The fishery operates in an area close to the Biosphere Reserve in the Upper Gulf of California and the refuge zone of vaquita (*Phocoena sinus*), which are designated as critically endangered on the IUCN Red List. However, there are no reported interactions with the vaquita. The FIP has been dedicated to the mitigation of the interaction of the fishery with the ETP species, given the fishing gear used: bottom shrimp trawls. It is known to interact with the IUCN critically endangered totoaba (*Totoaba macdonaldi*) and IUCN endangered scalloped hammerhead shark (*Sphyrna lewini*) at less than 0.01 percent; and the giant seahorse (*Hippocampus ingens*) (IUCN vulnerable) at 0.099 percent (INAPESCA 2016). Both totoaba and giant seahorse are protected species under Mexican law (Norma Oficial Mexicana NOM-059-SEMARNAT-2010).

The fishery is also known to interact with olive ridley sea turtles at minimal levels at present (0.04 percent; INAPESCA 2017). Interactions with bycatch species were recorded based on number of individuals.

Table 19: ETP species (common and scientific name) known to interact with the FIP fleet and correspondent conservation status by IUCN, CITES, CMS, ESA, and national status.

Group	Common name	Scientific name	IUCN listing	CITES Appendices	CMS Appendix	ESA status	National status
Fish	Giant Seahorse	<i>Hippocampus ingens</i>	Vulnerable				Subject to Special Protection
	Totoaba	<i>Totoaba macdonaldi</i>	Critically Endangered				Endangered
Sea turtles	Olive ridley sea turtle	<i>Lepidochelys olivacea</i>	Vulnerable	CITES Appendix I	I, II	Threatened	
Sharks and rays	Scalloped hammerhead	<i>Sphyrna lewini</i>	Endangered				

Monitoring

Since 1996, the fishery has been monitored through research studies, but a systematic monitoring program is not in place. Catch is monitored through trip reports and landings monitoring, and several experiments with different devices and mesh sizes have been performed. The interaction with totoaba has decreased to occasional events. The observer program in place covers three percent of the fleet, which will be ineffective at monitoring infrequent interactions with rare species. A vessel monitoring system is in place (Norma Oficial Mexicana 062-PESC-2007). The FIP should increase its observer coverage to at least 10 percent and make the databases available to the interested public, so that all the possible analyses that generate knowledge can be made of management support. The FIP work plan should consider the publication of periodic reports of the information collected to identify risk factors and propose changes to the management strategy of the ETP species.

Mitigation

Several mitigation measures are already in place, including:

1. Decreasing the size of the fishing fleet by 50 percent.
2. Spatial closures (particularly in the 0-5 fathoms depth zone and the mouths of coastal lagoons, trawls are forbidden in the Biosphere Reserve in the Upper Gulf of California and in the refuge zone of the vaquita), and seasonal no-fishing closures are in place from March to October.
3. Fish excluder devices are mandatory since 2017/2018.
4. Turtle excluder devices (TEDs) were first voluntarily applied by the fleet and have been mandatory since 1996; they are strictly applied and monitored, and compliance is high. There is regular training for the fleet crew to use and maintain TEDs. The Federal Office of Environmental Protection (PROFEPA) has a TED certification program which, prior to the start of the trawling operations, verifies and certifies that TEDs comply with the construction specifications set out in NOM 061 PESC 2006. Since 2017, Mexico has been certified by the US Government, under the Annual Certification of Shrimp-Harvesting Nations, for the efficiency of its marine turtle protection program in shrimp fishing. Mexico is a member of the Inter-American Convention for the Protection and

Conservation of Sea Turtles (IAC). There are, however, concerns about illegal fishing practices.

5. A minimum mesh size is part of a set of recommendations.

w). Mexican Yucatan red and black grouper longline fishery FIP

In contrast with many other fisheries where the ETP species that interact with the fisheries are principally seabirds, marine mammals, and turtles, for this FIP there are a number of fish species considered as ETP (critically endangered, endangered, and vulnerable) species in this report, based on their current IUCN criteria. These species are mostly groupers and snappers that are retained or even targeted by this fishery. It is important to acknowledge that the IUCN criteria were not developed for commercially harvested and managed fish species such as these, and the IUCN listing often conflicts with management targets (e.g. a 50-percent reduction in biomass is considered sustainable for a managed fishery, but also leads to an IUCN designation of vulnerable). For the sake of consistency, and to acknowledge the life-history characteristics that do make these species vulnerable to fishing pressure, we are including a list of species identified as ETP species in this report based on the IUCN criteria we have used (identified in the methods section) (Table 20). These species must be carefully monitored and managed to ensure sustainability. In addition to the snapper- and grouper-like species, scalloped hammerhead shark (*Sphyrna lewini*) is incidentally captured in this fishery and is considered endangered by the IUCN and listed under CITES Appendix II. No interactions with seabirds, marine mammals, and sea turtles have been reported in this fishery.

Table 20: ETP species (common and scientific name) known to interact with the FIP fleet and correspondent conservation status by IUCN, CITES, CMS, ESA, and national status.

Group	Common name	Scientific name	IUCN listing	CITES Appendices	CMS Appendix	ESA status	National status
Fish	Atlantic goliath grouper	<i>Epinephelus itajara</i>	Critically Endangered				
	Great northern tilefish	<i>Lopholatilus chamaeleonticeps</i>	Endangered				
	Hogfish	<i>Lachnolaimus maximus</i>	Vulnerable				
	Northern red snapper	<i>Lutjanus campechanus</i>	Vulnerable				
	Snowy grouper	<i>Hyporthodus niveatus</i>	Vulnerable				
	Speckled hind	<i>Epinephelus drummondhayi</i>	Critically Endangered				
	Vermilion snapper	<i>Rhomboplites aurorubens</i>	Vulnerable				
	Warsaw grouper	<i>Hyporthodus nigritus</i>	Critically Endangered				
	Yellowedge grouper	<i>Hyporthodus flavolimbatus</i>	Vulnerable				
Sharks and rays	Scalloped hammerhead	<i>Sphyrna lewini</i>	Endangered	CITES Appendix II	II		

Monitoring

Some information on the bycatch of ETP species is available, but it is inadequate to understand the risks and impacts or monitor change in the fishery performance. For this fishery, species-specific reporting should be implemented to provide information catches of all target and incidentally captured species. Fishery-dependent reporting should be verified by onboard observer and landing-site sampling programs. If reasonable fishery monitoring and management is implemented for commercially retained fish species, there is no need to consider them as ETP in the future. No interactions have been reported with ETP species of sea turtles, marine mammals, or seabirds in this fishery.

Mitigation

There are no specific mitigation measures for ETP fish species in this fishery, nor for turtles, marine mammals, or seabirds; however, there are measures that indirectly favor them, such as closed season on the fishery from 1 February through 31 March NOM-009-SAG/PESC-2015, DOF 2017, 03/03/2017, in order to protect fish during the spawning period. Though there is a management plan in place in the Yucatan Peninsula for target species (DOF 11/25/14), a percentage of incidentally captured species is not specified. Closed areas have been established (DOF 30/11/12, DOF 12/09/13, DOF 13/04/15) that should indirectly help ETP species.

x). Peruvian industrial anchovy purse seine fishery FIP

Publicly available information on the direct impact of the industrial anchovy fishery on ETP species is limited. Occasionally captured ETP species, known to be impacted by the fishery from distinct non-systematic studies, include dolphins, sea lions, and seabirds. Of these, the southern fur seal (*Arctocephalus australis*), Peruvian booby (*Sula variegata*), and Peruvian pelican (*Pelecanus thagus*) are listed as endangered in Peru, according to Decreto Supremo 034-2004-AG (Agricultura 2004). Quantitative data from several reports are available with respect to dolphins, though none of the dolphin species is known to be ETP (at capture rates of between 0 and 0.13 animals per set, or 640 individuals per year by one company). Freón et al. (2014) reported that approximately 640 dolphins interacted with the fishery per year in the industrial anchovy fishery. Recent results of the FIP observer program show limited interactions of the anchoveta industrial fishery with ETP species. Of the 1,537 monitored sets, only one dead dolphin was reported, and there was another set in which one “lobo chusco” (*Otaria byronia*) was released. Other mammals, such as “lobo fino” (*Arctophoca australis*) and bottlenose dolphins, interacted with the fishery but escaped alone or were released alive (CeDePesca, 2018). An interaction between this fishery and the IUCN critically endangered leatherback sea turtle was documented in one newspaper article but no official data concerning this interaction exists ([El Peruano, 2012](#)). This interaction occurred before the implementation of the FIP. There is no information on whether this was a single instance or a

wider issue in the fishery. Other reports suggest these types of fisheries have low bycatch of other species (Cashion et al. 2018).

Table 21: ETP species (common and scientific name) known to interact with the FIP fleet and correspondent conservation status by IUCN, CITES, CMS, ESA, and national status.

Group	Common name	Scientific name	IUCN listing	CITES Appendices	CMS Appendix	ESA status	National status
Marine mammals	Southern fur seal	<i>Arctocephalus australis</i>	Least Concern	CITES Appendix II	II		Endangered
	Southern sea lion	<i>Otaria byronia</i>	Least Concern				Vulnerable
	South American fur seal	<i>Arctophoca australis</i>	Least Concern				Endangered
Seabirds	Peruvian booby	<i>Sula vanegata</i>	Least Concern				Endangered
	Peruvian pelican	<i>Pelecanus thagus</i>	Near Threatened				Endangered
Sea turtles	Leatherback sea turtle	<i>Dermochelys coriacea</i>	Critically Endangered (Eastern Pacific Ocean subpopulation)				

Monitoring

All existing data and analyses relating to ETP bycatch, release and mortality held by government agencies, industry, and research institutes should be made publicly available as a priority.

Existing dolphin bycatch data need to be re-analyzed and published to:

1. better define the scale of the bycatch issue for each of the dolphin species; and
2. evaluate the effectiveness of all approaches to mitigation that are currently in use. With respect to marine mammal bycatch, this will likely become urgent to address the 2017 US MMPA import requirements.

An onboard observer program monitors about four percent of the industrial fleet, but focuses on monitoring fish bycatch, especially juvenile anchovy, and does not routinely collect information on ETP interactions. In order to assess incidental capture rates, Joo et al. (2017) estimate observer levels of 37 percent would be needed. Since February 2017, the anchovy FIP has initiated an observers program with the active participation of the anchovy industry fishing companies.

The existing observer program should:

6. Be standardized, strengthened, and extended, to cover a greater proportion of the fleet and collect data in a comparable manner.
7. Quantitatively record all interactions with ETP species (number of individuals and size classes). Observers should be adequately trained in ETP species identification and ETP

species identification sheets developed (if not already available) and deployed within the observer program and fishery. The scale of the overall monitoring program must be sufficiently extensive to provide adequate, representative information on interactions with ETP species, given the size and scale of the fishery and the encounter rates with ETP species.

Existing industry initiatives should be supported and strengthened to provide improved data quality in relation to ETP capture and release rates. This includes standardization of data collection across schemes and recording such items as fishing effort and observer effort (e.g. the number and proportion of fishing events specifically monitored for ETP interactions). Data collected on ETP species by IMARPE should be made publicly available.

All programs that monitor ETP bycatch at sea should record and report the interactions and fate of the ETP species (discarded dead, released alive uninjured, released alive injured).

Mitigation

In Peru there is strict national and international legislation in place for the conservation and protection of ETP species; however, there are no management measures in place to mitigate bycatch of ETP species. Though a private company is using acoustic alarms, data on their efficacy in purse-seine fisheries are lacking. The range of ETP species captured and gear are likely to produce broadly similar interactions, as seen in the artisanal anchovy purse-seine fishery. While as yet untested in the artisanal fishery, the same or similar mitigation measures would be expected to be effective there. As part of the bycatch monitoring program, the various approaches to mitigation should be monitored to provide data for evaluation. Specific trials of different mitigation methods should be evaluated based on an assessment of the ETP species at highest risk of adverse impacts by the fishery and using information known from the industrial fishery. The FIP should explore existing best practices for bycatch reduction in purse-seine fisheries and assess the feasibility of implementation. Before acoustic alarms are routinely used by the FIP, the efficacy of these devices should be further tested.

y). Peruvian artisanal anchovy purse seine fishery FIP

No systematic information quantifying the impact of this fishery on ETP species is available, but an occasional risk analysis, performed in 2012, identified seabirds, marine mammals, and sea turtles as bycatch species. Peruvian pelican (*Pelecanus thagus*), Guanay cormorant (*Phalacrocorax bougainvillea*), red-legged cormorant (*Phalacrocorax gaimardi*), Neotropic cormorant (*Phalacrocorax brasilianus*), and the bottlenose dolphin (*Tursiops truncatus*) were at highest risk of direct impact by the artisanal anchovy fishery. Green and olive ridley sea turtles are also known to be incidentally captured in the fishery. Most of the research has focused on the industrial anchovy fishery, although given the similar fishing gear used and fisheries characteristics, as well as operation area, it is likely that the impact in the artisanal fishery will be analogous to that observed in the industrial fishery.

Table 22: ETP species (common and scientific name) known to interact with the FIP fleet and correspondent conservation status by IUCN, CITES, CMS, ESA, and national status.

Group	Common name	Scientific name	IUCN listing	CITES Appendices	CMS Appendix	ESA status	National status
Marine mammals	Southern fur seal	<i>Arctocephalus australis</i>	Least Concern	CITES Appendix II	II		Endangered
	Southern sea lion	<i>Otaria byronia</i>	Least Concern				Vulnerable
	Humboldt penguin	<i>Spheniscus humboldti</i>	Vulnerable	CITES Appendix I	I	Threatened	Endangered
	Peruvian booby	<i>Sula variegata</i>	Least Concern				Endangered
	Peruvian pelican	<i>Pelecanus thagus</i>	Near Threatened				Endangered
	Red-legged cormorant	<i>Phalacrocorax gaimardi</i>	Near Threatened				Endangered
Sea turtles	Green sea turtle	<i>Chelonia mydas</i>	Endangered	CITES Appendix I	I, II	Threatened	Endangered
	Olive ridley sea turtle	<i>Lepidochelys olivacea</i>	Vulnerable	CITES Appendix I	I, II	Threatened	Endangered

Monitoring

Preliminary information suggests that, while there appears to be considerable overlap in the ETP species taken as bycatch in the artisanal and industrial fisheries, there may also be some significant differences, but better monitoring data are required to confirm this. A monitoring and reporting program is required to inform on the scale of interactions with the identified ETP species. With respect to marine mammal bycatch, this will likely become urgent to address the US MMPA import requirements. The scale of the monitoring program must be sufficiently extensive to provide adequate information on interactions with ETP species, given the size and scale of the fishery. Monitoring at sea will be required (e.g. an observer program and/or logbook scheme) and may need educational outreach to fishers to improve ETP species identification. Specific recommendations to improve monitoring in the FIP include:

1. Greatly increasing the planned number of observers for the FIP as the number of fishers in the artisanal fleet is equal to that of the industrial fleet.
2. Training fishers in the identification and release of commonly captured ETP species.
3. Recording ETP species bycatch (number of individuals and size classes) and differentiating bycatch categories.
4. Using rapid assessments methods such as surveys at key ports where this fishery operates (e.g., Chimbote, Callao) to improve information on ETP bycatch in the fishery.

Mitigation

Peruvian legislation bans the direct capture of marine protected species for commercial purposes; however, there are no management measures in place to mitigate bycatch of ETP species. The range of ETP species captured and gear used are likely to produce broadly similar interactions, as seen in the industrial anchovy purse seine fishery. Mitigation measures such as acoustic alarms should be tested for efficacy in the artisanal fishery before being implemented widely by the fishery. As part of the bycatch monitoring program, the various approaches to

mitigation should be monitored to provide data for evaluation. Specific trials of different mitigation methods should be evaluated based on an assessment of the ETP species at highest risk of adverse impacts by the fishery and using information known from the industrial fishery.

z). Philippines blue swimming crab – bottom trawls, Danish seines, gillnets, pots

This fishery is primarily artisanal and primarily uses entangling nets and pots and traps. Entangling nets have been found to have a higher bycatch rate compared to crab pots (Ingles, J. and Flores, J., 2000; Romero, F.G., 2009; Nieves, P. et al., 2015). There is some information on bycatch from specific analysis, and occasional studies that identify several non-target ETP species retained or discarded in this blue swimming crab fishery. Approximately 45 percent of the catch volume by weight is non-target retained or discarded catch in entangling nets and is comprised of other crab species, echinoderms, mollusks, and other benthic species (Ingles, J. and Flores, J., 2000; Romero, F.G. 2009; Nieves, P. et al. 2015). The non-target capture of ETP species includes several protected mollusk species (in the genera *Cassis*, *Lambis*, *Charonia*, *Turbo*, and *Murex*)²⁵ and the IUCN critically endangered Irrawaddy dolphin (*Orcaella brevirostris*).²⁶ As Irrawaddy dolphins feed on crustaceans such as crabs, they are vulnerable to entanglement in fishing lines and nets. Unless urgently addressed, this interaction with the dolphin will likely lead the fishery into conflict with the 2017 US MMPA import requirements. Rays, skates, and juvenile sharks also occur in the fishing area and are likely captured in the crab gillnet fishery, though species-level information was not available (Flores, J., 2005; Romero, F.G., 2009).²⁷

Table 23: ETP species (common and scientific name) known to, or that occur and possibly(*), interact with the FIP fleet and correspondent conservation status by IUCN, CITES, CMS, ESA, and national status.

Group	Common name	Scientific name	IUCN listing	CITES Appendices	CMS Appendix	ESA status	National status
Marine mammals	Irrawaddy dolphin	<i>Orcaella brevirostris</i>	Critically endangered	CITES Appendix I	I, II		Protected
		<i>Cassis spp.</i>		N/A			Protected
Mollusks		<i>Charonia spp.</i>		N/A			Protected
		<i>Lambis spp.</i>		N/A			Protected
		<i>Murex spp.</i>		N/A			Protected
		<i>Turbo spp.</i>		N/A			Protected

²⁵ Protected by regulations issued by the Bureau of Fisheries and Aquatic Resources (Fisheries Administrative Orders 208, 168, 158 and 157).

²⁶ News on Irrawaddy dolphin deaths:

- <https://philnews.ph/2017/09/06/endangered-irrawaddy-dolphin-found-dead-palawan/>
- https://en.wikipedia.org/wiki/Irrawaddy_dolphin
- <http://kickerdaily.com/posts/2017/09/critically-endangered-species-of-dolphin-found-dead-tail-ensnared-in-net/>
- http://www.nbcnews.com/id/8156858/ns/us_new_s-environment/t/nets-killing-dolphin-porpoise-species/#.WbnvpVFLfIU
- <http://maritimereview.ph/2017/05/24/irrawaddy-dolphins-in-the-philippines/>

²⁷ IUCN near threatened whitetip reef sharks (*Triaenodon obesus*) are incidentally captured in the fishery.

Sharks and rays*	Various	Various		N/A			
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Monitoring

There is no adequate non-target capture monitoring for ETP species. The FIP should set up a program of fisheries monitoring for its fishery that includes monitoring ETP catch by species and recording the number of individuals and sizes of ETP species, and that especially focuses on the gillnet component. Reports undertaken regarding the fishery and target and non-target catches should be made publicly available. The Philippine fishery code has been amended and provides provisions such as reference points (limit and target) and harvest control rules for crabs and traceability. Enforcement of traceability and other provisions may result in reduced impacts on ETP species, as much of the current effort is currently unregistered.

Mitigation

The specific issue of capture and entanglement of the critically endangered Irrawaddy dolphin needs urgent attention. The FIP should seek to work with government agencies, NGOs, and others to remove blue swimming crab gillnets from the defined areas used by these dolphins. Appropriate mitigation should be incorporated into the fisheries management plan.

More generally, catch and entanglement of ETP species in the gillnet fishery could be reduced by encouraging a switch from gillnetting to pot or trap fishing, as has been done in parts of the Indonesian blue swimming crab fishery. The FIP should start collecting basic information from the gillnet and pot/trap fisheries to assess how viable such a gear switch or new design could be in the Philippines. As most pots used in the fishing area are made from bamboo, these biodegrade and, as such, do not result in ghost fishing, a major issue in the gillnet fishery. With improved monitoring of target and non-target catches, gillnet-specific area and/or seasonal closures should also be considered for the areas and times where the highest levels of catch of ETP species occur. Mandatory measures for the FIP and wider fishery should be developed and implemented to reduce non-target catch levels and ghost fishing. The technical working group should revisit the management plan and administrative order to ensure improved compliance to crab size limits and reduction of non-target catch. It should also develop a plan to hold management officials accountable to implement management measures identified in the management plan for which they are responsible.

aa). Vietnam blue swimming crab – bottom/gillnet/pot/trap

There are some data on bycatch from specific studies that identify several IUCN near threatened species incidentally captured in gillnets and or traps.²⁸ No ETP species have been reported as incidentally captured in the fishery; however, it is recommended that the number of

²⁸ IUCN near threatened bluespotted fantail ray (*Taeniura lymma*) is rarely captured in the gillnet crab fishery; species frequently captured include IUCN near threatened grey carpet sharks (*Chiloscyllium punctatum*), the duskytail grouper (*Epinephelus bleekeri*), and sharpnose stingray (*Telatrygon zugei*).

individuals and size classes of near threatened species be recorded and that improved quantitative reporting of bycatch in the fishery take place.

Monitoring

While the fishery currently has some bycatch monitoring, monitoring and reporting of ETP bycatch in the blue swimming fishery is inadequate to be able to monitor rare interactions with ETP species; it is suggested that bycatch be reported in terms of individuals and size classes.

Mitigation

The FIP work plan includes activities relating to establishing closed seasons and non-fishing areas. The government is drafting a National Plan of Conservation of Shark Species and has a regulation on the proper handling and transporting of ETP species (Decree 103/2013/NĐ-CP). The following improvements to the work plan are recommended:

1. The work plan should put more efforts into bycatch mitigation activities and ensure that these activities are embedded with the national program and regulations.
2. The fishery should establish a limit on the number of interactions with ETP species.
3. A review of ETP species should be conducted and more species included as protected in the fishery law (Decree 59/2005 – Circulars 02/2006). This task may already be undertaken through the implementation of the new Fisheries Law (November 2017).
4. The amount of ETP bycatch could be reduced by encouraging a switch in gear types, as has been done in parts of the Indonesian blue swimming crab fishery. The FIP should start collecting basic information from the gillnet and pot/trap fisheries to assess how viable such gear changes could be in Vietnam.

6. Discussion

SFP chose to focus on FIPs within SFP's priority species groups and FIPs that provided opportunities for improvement through industry engagement. The aim of Phase 1 of this project was to investigate the level to which fisheries associated with analyzed FIPs had interactions with ETP species, and whether these interactions are being adequately addressed in the FIPs' work plans. The principal objective of the reviews by the experts was to examine the FIPs and assess the approach and adequacy of how the FIPs dealt with issues of bycatch of ETP species in their respective fisheries. The results of this project will allow SFP to better target outreach and work to improve bycatch monitoring and mitigation efforts in FIPs and associated fisheries. Phase 1 was not intended as a review or analysis of the success of national legislation, other national or regional elements of marine conservation, or fisheries management. We acknowledge that there are other active FIPs with known, unknown, or likely interactions of ETP species that fell outside of the scope of this work and were therefore not analyzed during Phase 1. In addition, in several cases, SFP was unable to procure an expert to assess a FIP of interest (e.g., Thai blue swimming crab, Indonesian snappers and groupers FIPs) and therefore analysis of some fisheries with potential ETP interactions could not be conducted. Additionally, as

mentioned in the results section, SFP acknowledges that, due to the challenges of obtaining information on bycatch in fisheries as well as species identification in some instances, the actual amount of bycatch and interactions of ETP species with the above fisheries is likely greater than outlined above.

The ETP species most commonly found to be interacting with the analyzed FIPs are late-maturing, long-lived species that often produce few offspring that reach sexual maturity. These life-history characteristics makes these species especially vulnerable to the impacts of fishing mortality. In addition, cumulative impacts of incidental interactions with ETP species across multiple fisheries, particularly highly migratory species that are susceptible to capture in numerous fisheries due to their large distribution, have been demonstrated to cause adverse ecological and biological impacts well beyond those of an individual fishery.

In order to properly manage and assess the status of these ETP populations, long-term data sets of high-quality data are needed. The results of this Phase 1 study indicate that quantitative information and monitoring of fisheries interactions with ETP species in the analyzed fisheries was in many instances sparse, and/or of low quality. This is likely one of the biggest hindrances to effectively reducing bycatch of ETP species in fisheries. Lack of data/quality can lead to severe underestimations of actual ETP interactions in fisheries, and therefore the full impact of this incidental mortality on these species is unknown. Impacts of bycatch on populations of ETP species should be measured in terms of the number of individuals and their sizes, not biomass or tonnage landed, which is often how it is currently monitored and reported. Proper levels of monitoring (e.g., onboard observers) are needed to ensure more accurate estimates of actual captures or removals of ETP species from individual fisheries and to make sure rare fishery bycatch events (i.e., when a species with a very low population size or range is incidentally captured) are also observed and recorded. These rare bycatch events can have catastrophic impacts for some species. For example, though there was only one reported instance of bycatch of the Irrawaddy dolphin in the Philippines blue swimming crab fishery, the species is critically endangered in Malampaya Sound and in a decreasing trend; urgent changes in fishing practices are needed to eliminate such future interactions. Several solutions to reduce bycatch have been tested and implemented worldwide in fisheries. Bycatch mitigation comprises a range of approaches to effectively reduce the interaction of fisheries with non-target species. Knowledge about the related species behavior, specification of the fishing gears, and fleet and crew characteristics is the starting point to create practical, workable measures and successfully implement them. Administrations and related entities need to be engaged and understand the importance of having these measures required by law, fully implemented, and enforced, a process that can be supported by evidence from applying such rules elsewhere.

In addition to increased monitoring and policy changes, the findings suggest that, in some instances, existing national and regional management measures are not being followed. In some cases, a lack of knowledge by fishers of regulations seems to be one of the impediments to implementation. Training and awareness campaigns (focused on the fleet crews) could help increase compliance and enforcement of the regulations already in place, as could using market pressure to push the skipper/crews toward implementation of bycatch mitigation measures. We

have developed general recommendations designed to encourage FIPs to seek change not solely at the fishery level of the FIP but also through other nationally regulated fisheries and, in some cases, regionally managed fisheries, which will have a larger overall impact on ETP conservation. For example, in the case of tuna fisheries, changes at the international regional fishery management organization (RFMO) level, in addition to at the national level, may be warranted. Findings in this analysis suggest that FIP stakeholders do hold the potential to galvanize conservation and sustainability improvements at the regional, national, and, in some cases, international level. At a smaller scale, but encompassing fisheries of economic importance in the country, monitoring and mitigation measures in non-tuna FIPs could represent case studies of success to positively influence the national government and naturally contribute to filling the gaps and improving the legislation.

The experts' analysis was provided in the previous section and, below, we have outlined some specific recommendations that FIPs can use to improve upon their respective work plans, to more effectively address ETP bycatch and conservation issues.

7. Recommendations

We recommend that all FIPs consider the following recommendations:

1. During an initial gap assessment or fishery assessment, ask questions to determine the present level of monitoring and mitigation of bycatch impacts and address gaps in their work plans.
2. Engage with national and international management agencies to better monitor and mitigate bycatch.
3. Make data on incidental catches publicly available and provide information to the relevant management authorities.
4. Implement best practices for bycatch mitigation and regularly review new best practices.
5. Adopt precautionary bycatch practice mitigation for gear types where best practices are well-established (e.g. installing TEDs on shrimp trawl vessels).
6. Implement a traceability system that traces product back to the catch vessel.

1) FIP implementers should consider the following general questions during the initial gap analysis or fishery assessment:

All FIPs should be able to answer a number of critical questions about their fisheries. If the answer to any of these questions is “no,” the FIP should add the issue to their work plan. From this analysis, the critical questions FIPs need to consider in order to most effectively reduce ETP interactions in their associated fisheries are:

Monitoring:

- a) Is information on best practice mitigation measures specific to your fishery available?
- b) Is the FIP conducting any research on bycatch mitigation?
- c) If best practice measures are not currently being used, is there a way to measure the effectiveness of other measures being implemented?
- d) Is information on the status of ETP species when discarded (i.e. alive, dead, injured) recorded, reported, and available?
- e) Are the potential impacts of fishery-related mortalities on the ETP species populations understood, i.e. quantitatively known?
- f) Are the cumulative impacts enough to lead to undesirable population outcomes (e.g. across fisheries)?
- g) Are data on interactions with ETP species recorded and reported accurately and are onboard observer levels sufficiently high to adequately monitor often-rare ETP interaction events?

Mitigation:

- a) Does the entire fishery work to minimize bycatch of ETP species (i.e. using best practice mitigation measures)?
- b) If best practice measures are not being used, why not?
- c) Are captured ETP individuals released alive, with minimal injury and with a high probability of survival where possible?
- d) Are the fishing crews aware of the impacts of the fishery on ETP species and trained to adequately identify, handle, and release the caught species?
- e) Are additional management and other policy changes needed to ensure voluntary measures by the FIP are not undermined by other uninvolved but similar fisheries?
- f) Are additional national level protections for vulnerable species required?
- g) With respect to bycatch mitigation, what measures will be implemented for which species, who will implement them, how will implementation be verified, and over what timescales?

2) Engagement with national and international management agencies

- a) If there is no National Plan of Action (NPOA) for seabirds, the FIP should engage with the relevant authorities to encourage the development and implementation of a NPOA for seabirds, following FAO NPOA guidelines (FAO, 1999).
- b) If there is no NPOA for sharks, rays, and other elasmobranchs, the FIP should engage with the relevant authorities to encourage the development and implementation of such a NPOA, following FAO NPOA guidelines (FAO, 1999; see review in Fischer, 2013).
- c) If there are no guidelines to reduce the interaction with sea turtles, the FIP should engage with the relevant authorities to encourage the development and implementation of these guidelines, following FAO guidelines to reduce sea turtle

mortality in fishing operations (Gilman et al., 2009). Countries in the American continent may be part of the Inter-American Convention for the Protection and Conservation of Sea Turtles.

- d) If there is evidence of illegal, unreported, and unregulated (IUU) fishing that might be targeting or otherwise impacting ETP species in the same location as the FIP (e.g., a fishery for sharks), the FIP should engage with the relevant authorities to encourage the development and implementation of an IUU management plan to define the scale of the issue, prioritize actions, and mitigate impacts through appropriate measures (e.g. through legislation, improved surveillance, and enforcement).
- e) Should any of the general recommendations be necessary, the FIP should try to coordinate with other FIPs and stakeholders working on fisheries in the same jurisdiction to present a single, simple perspective to the relevant authorities whenever possible.
- f) The FIP should be actively involved with the regional/national management authority, providing information on ETP interactions.
- g) For FIPs with fisheries targeting highly migratory species or other high seas fisheries, the FIP should 1) comply with RFMO management measures related to ETP species, 2) be aware of RFMO management measures that call for research into bycatch mitigation measures and employ this research in their respective fisheries, 3) promote and support the adoption of best practice bycatch mitigation measures at the national level and at the respective RFMOs, and 4) promote and support the adoption of higher observer coverage rates at the national level and at the respective RFMOs.
- h) For FIPs with interactions with marine mammals, the FIP should ensure it is meeting and/or exceeding the requirements for the US Marine Mammal Protection Act Ruling (MMPA).

3) Public availability of data and analyses

Information on ETP interactions with the fishery should be appropriately collected, collated, analyzed, and publicly reported, together with the raw data, in a manner consistent with any legislation pertaining to fishery data confidentiality. This should include all historical information up to and including the most recent data, where the recent information is typically not more than two or three years old. All pertinent sources of information should be reported, including, for example, collated vessel logbook reports, observations from scientific studies, and data monitoring (e.g. observer) programs. If there is no national reporting or public information scheme, the FIP must report information on its own fishery and should also press the relevant authorities for a national scheme of public reporting of ETP interactions. Where such data are held outside of the FIP, by companies, research institutes, or government agencies, the FIP should engage with the owners of the data and seek its release for analysis and publication.

4) FIP activities to implement best practices for bycatch mitigation

As best practice does change over time, for each ETP species and interaction type (hooked, entangled, etc.), the FIP implementer should check that the mitigation measures being implemented in the fishery meet the accepted current best practice (or are demonstrably equivalent to, or more effective than, the accepted current best practice). Where it is found that the fishery is not following accepted best practice, a time-bound objective should be added to the FIP work plan to fully implement best practice within the fishery. This check for best practice mitigation should be made and publicly reported each year.

5) Precautionary application of best practice mitigation

Where the fishing method(s) used within a fishery have established best practice ETP bycatch mitigation methods, these should be adopted and implemented across the fishery as a whole, whether or not there is any evidence of ETP bycatch. For example:

- a) All trawl fishing vessels should use bycatch reduction devices to minimize bycatch with trawl warps/net cables (turtles or fish excluder devices, bird scaring lines, retention of offal and discards) and/or interactions with trawl netting (reducing time in fishing operations and when nets are at the surface).
- b) All gillnet vessels should do experiments to optimize and test the bycatch mitigation performance of implementing devices with sound or visual stimulus to alert seabirds, sea turtles, marine mammals, tuna, and billfish.
- c) All longline vessels should adhere to the Agreement on the Conservation of Albatrosses and Petrels (ACAP) best [practices](#).
- d) Where longline vessels may or are known to interact with sea turtles, all vessels should use, for example, circle hooks (of an appropriate size) and fish rather than squid for bait, and, for surface longlines, remove between one and three hooks from each end of the line (i.e. those hooks nearest the surface) (Clarke 2017).

6) Implement a robust traceability system

As fisheries with ETP bycatch issues are generally identified as high-risk fisheries, SFP recommends sufficient traceability is implemented for those fisheries to ensure that product is legal and from a fishery implementing best practices for bycatch reduction. For seafood exported to the EU or US, product will need to comply with relevant traceability requirements for import. Ideally, product should be traced back to the vessel to ensure it is from a vessel participating in the FIP.

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