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DEVELOPMENT OF A "DRAFT LIST OF SHARK SPECIES UNDER THE PURVIEW OF THE IATTC"

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EXECUTIVE SUMMARY

The industrial and small-scale (coastal 'artisanal') pelagic fisheries that operate throughout the eastern Pacific Ocean (EPO) commonly interact with a diverse suite of shark species, caught either as a target in multi-species fisheries or as incidental bycatch on fisheries targeting tuna and tuna-like species. Sharks, in general, can be particularly vulnerable to fishing impacts, as the majority of species interacting with pelagic fisheries are long-lived, exhibit slow growth rates and have a low reproductive capacity. In recognition of this, the IATTC has adopted several binding resolutions since 2005 on the conservation and management of several shark species. At its 101st meeting, the IATTC adopted Resolution C-23-07 "*Conservation measures for the protection and sustainable management of sharks*" which consolidates existing measures that pertain to sharks in IATTC Resolutions, and to strengthen shark conservation and management measures in the EPO. The resolution requires "*…the IATTC scientific staff, in consultation with the IATTC SAC and EBWG, shall develop a draft list of shark species under the purview of the Commission in the Convention Area for its consideration*". This paper includes 49 shark species documented to interact with pelagic fisheries in the EPO to present and discuss potential options for determining an interim list of species under the purview of the IATTC. Only 12 of the 49 species assessed were oceanodromous —a species that lives and migrates exclusively in the open ocean—and could be considered undoubtedly highly migratory species. The remaining 37 species predominantly occur in demersal habitats within neritic waters but occasionally venture to offshore waters, primarily as adults,

where they interact with tuna fisheries (*e.g.*, hammerhead and requiem sharks). Although tuna fisheries operating offshore, at a distance from the coast, are unlikely to pose a significant threat to the long-term sustainability of these species, many are of high conservation concern because they are endemic to the EPO, already referred to specifically in IATTC Resolutions, classified by the IUCN as "Critically Endangered" or "Endangered", or listed in CITES Appendix II. This paper presents for consideration by CPCs, six species lists alongside three existing species lists used for various purposes within the IATTC. The IATTC scientific staff present the option of two species lists for consideration for adoption by the IATTC: a) at a minimum, 19 oceanodromous and epipelagic species caught in the major industrial and artisanal pelagic fisheries in the EPO, b) the aforementioned list supplemented with a Recommendation pertaining to the willingness by the IATTC to support conservation efforts of relevant organizations for an additional 17 species of conservation concern that infrequently interact with, or occur in the typical fishing grounds of, tuna fisheries. Although both options are precautionary, the IATTC would need to make available sufficient resources to establish long-term monitoring programs to collect biological and catch data and undertake population assessments to support conservation and management of these species, if required.

1. INTRODUCTION

The tuna fisheries that operate in the eastern Pacific Ocean (EPO), for which the IATTC is responsible, are diverse in their operational characteristics and extensive in their spatial and temporal scope, which results in these fisheries interacting with a wide range of species. The primary 'industrial' tuna fleets target principally tuna (skipjack, yellowfin and bigeye tunas) and tuna-like (e.g., billfishes) species by deploying longlines or purse-seine nets. The passive gear deployments by the longline fleets typically soak for 12-18 hours. Longline sets can be broadly categorized as either "shallow sets" (<~150 m) that primarily target swordfish during the night or "deep sets" (>~150m) that target bigeye and albacore tuna during the day. Sets in the purse-seine fishery can be characterized in one of three ways; as either sets made on floating objects (OBJ), which attract small sized tuna and a range of non-tuna species, sets associated with dolphins (DOL) where large yellowfin tuna are targeted, and sets made on tuna schools that are not associated with either floating objects or dolphins (NOA). Given the large three-dimensional spatial footprint of these fisheries combined, it is inevitable that they interact with non-target species that belong to the same ecosystem and are affected by the fisheries or are associated or dependent upon the target tuna and tuna-like species of the fisheries under the purview Inter-American Tropical Tuna Commission (IATTC).

Sharks are a particularly common target and bycatch in both industrial and small-scale multi-species coastal (*i.e.*, 'artisanal') pelagic fisheries throughout the EPO. Unfortunately, sharks are also a particularly vulnerable group as the majority of species impacted by tuna fisheries are long-lived, exhibit slow growth rates and have a low reproductive capacity. Through its adoption of the Antigua Convention (IATTC, 2003) that entered into force in 2010, the IATTC has recognized its responsibility to ensure the long-term sustainability of sharks, and other non-target species, in Article VII 1(f) "*adopt, as necessary, conservation and management measures and recommendations for species belonging to the same ecosystem and that are affected by fishing for, or dependent on or associated with, the fish stocks covered by this Convention…*". As such, the IATTC has responded to the growing concern over the potential negative effects of impacts from tuna fishing on sharks by implementing several conservation and management measures (CMMs) across a range of resolutions since 2005 to limit or prohibit the retention of sharks (C-05-03 with amendments in C-16-04, C-11-10, C-19-05, C-21-06), setting on whale sharks (C-19-06), or to promote handling practices that maximize the post-release survival of sharks (C-16-05).

At its 101st meeting, the IATTC adopted Resolution C-23-07 "*Conservation measures for the protection and sustainable management of sharks*" which consolidates existing measures that pertain to sharks in IATTC Resolutions C-05-03, C-16-04, C-16-05, and strengthens shark conservation and management measures

in the EPO. In addition, the resolution sets forth various recommendations and mandates regarding research and data collection pertaining to sharks in order for the IATTC to comply with the provisions and measures of C-23-07, other relevant IATTC resolutions, and relevant items under the Antigua Convention. To define the scope of this research and data collection, Article 13 of the resolution requires "…*the IATTC scientific staff, in consultation with the IATTC SAC and EBWG, shall develop a draft list of shark species under the purview of the Commission in the Convention Area for its consideration*".

In 2022, the IATTC scientific staff conducted a comprehensive vulnerability assessment for sharks caught in the pelagic fisheries (industrial longline and purse-seine; artisanal longline and gillnet) in the EPO (SAC-13-11) using the Ecological Assessment of the Sustainable Impacts of Fisheries (EASI-Fish) methodology developed by IATTC staff in 2018 to specifically assess data-limited species and fisheries (Griffiths et al., 2019). The assessment included all shark species recorded to have interacted with eight fisheries by drawing upon all data held in IATTC databases. In total, 49 species (excluding taxonomic aggregations) were identified as interacting with EPO pelagic fisheries.

The aim of this paper is to analyze the ecological traits and conservation classifications of the 49 species to present options of species lists and discuss the implications for adopting a list as defining species under the purview of the IATTC.

2. METHODS

2.1 Scope of the 2022 vulnerability assessment for sharks in the EPO

In 2022, the IATTC staff undertook a comprehensive assessment of the vulnerability of shark species that interact with tuna fisheries in the EPO (SAC-13-11). The assessment was confined to the Antigua Convention Area in the EPO (the region from the coast of the Americas to 150°W between 50°S and 50°N) and included reported or observed data for the period 1994–2019 for both industrial tuna fisheries (i.e. purse-seine and longline) and small-scale coastal fisheries (i.e., surface-set gillnet and longline), herein termed 'artisanal fisheries', that target or catch incidentally tuna and tuna-like species. Given that all fisheries included in the assessment were not strictly tuna fisheries, they were collectively referred to as "pelagic fisheries", as they are in the current paper. The 2022 assessment was comprehensive in that it included all species recorded in at least one interaction in the available datasets pertaining to the pelagic fisheries and therefore the list of species was considered suitable for developing an interim list(s) of species under the purview of the IATTC.

The industrial fisheries included the fishery by large-scale tuna longline fishing vessels (LSTLFVs) (herein called the "industrial longline fishery") and two purse-seine fisheries (Class 6 with a carrying capacity >363 mt and Classes 1–5 ≤363 mt). The data for these fisheries were obtained from vessel logbooks or collected by onboard scientific observers, or submitted to the IATTC by its Members under Resolutions C-03-05 and C-19-08 and described in Document SAC-08-07b. Specifically, the industrial longline fishery data were derived from vessels >24 m length overall (LOA) included in the IATTC Regional Vessel Register that are authorized to fish for tuna and tuna-like species, which primarily provide monthly reports of catch and fishing effort at a resolution of at least 5° x 5°—although a few CPCs submit data at 1° x 1°—and from national scientific observer programs that monitor at least 5% of the fishing effort by LSTLFVs >20 m LOA first required under Resolution C-11-08 and later replaced by Resolution C-19-08.

Catch data for the fishery by Class 6 purse-seine vessels were collected by the onboard observer program of the Agreement on the International Dolphin Conservation Program (AIDCP) and National Programs, which covered 100% of the fishing effort. This fishery comprises three distinct sub-fisheries based on set type: i) sets associated with natural or artificial floating objects (OBJ), ii) sets associated with dolphins (DEL), and iii) sets on schools of tuna that are neither associated with dolphins or floating objects (NOA).

Other purse-seine vessels that operate in the EPO range from small vessels (Classes 1–2) that are generally confined to coastal areas, to larger commercial vessels (Classes 3–5) that frequently fish at a great distance from the coast. The AIDCP does not require these smaller vessels to carry an observer, except in specific situations. For example, of the 75 Class 1–5 vessels that fished in the EPO in 2019, only 10 (13.7%) carried an observer. However, the Tuna Conservation Group (TUNACONS)—a consortium of Ecuadorian tuna fishing companies—has voluntarily deployed observers on their vessels since 2018, with coverage being 27% of the total number of trips reported for all Class 1–5 vessels in the EPO in 2022 (IATTC, unpublished data). Although the IATTC scientific staff has plans to determine whether the data collected to date by TUNACONS is representative of the fleet in terms of gear characteristics, catch composition, and spatio-temporal distribution of effort, analyses have not yet been undertaken. However, given the paucity of information on this fishery in the past, these data were included and considered to represent the minimum catch by the fishery. Copies of logbook entries summarizing the fishing activities of Class 1–5 vessels were available via opportunistic collection by IATTC field staff at various landing ports. The fishery comprising Class 1–5 vessels can also be separated on the same set type as the Class 6 fleet, except Class 1–5 vessels (i.e., <363 mt) are not permitted to make DEL sets (AIDCP, 2017).

In contrast to the industrial purse-seine and longline fisheries in the EPO, the catch of sharks by the numerous artisanal fleets that operate closer to the coast in the EPO is generally poorly documented by national fisheries agencies, but have been shown to be heavily impacted by coastal gillnet and longline fisheries (Alfaro-Shigueto et al., 2010; Cartamil et al., 2011; Martínez-Ortiz et al., 2015; Sosa-Nishizaki et al., 2020). Since these fisheries interact with many of the shark species caught by industrial fleets (e.g., silky and hammerhead sharks) and the magnitude of catches was estimated by the IATTC scientific staff to be comparatively large (SAC-05 INF-F, SAC-11-13), these artisanal fisheries were required to be included in the 2022 assessment. The large magnitude of the catches of silky and hammerhead sharks taken by artisanal fisheries has received recent support by the Commission (SAC-14 INF-L).

Reasonably detailed catch data for artisanal longline vessels throughout Central America was available from IATTC's long-term research program that examined the effects of different hook types on bycatch rates, in part reported by Andraka et al. (2013). Some information was available from published scientific papers (Martínez-Ortiz et al., 2015) and reports (*e.g.*, Ayala et al., 2008; Martínez et al., 2017).

In some coastal States in the EPO there is often not a clear distinction between artisanal and industrial vessels, as the former are often multi-gear (longline and gillnets) and multi-species, shifting their target among tuna, billfish, sharks and dorado on a seasonal basis (Martínez-Ortiz et al., 2015; Siu and Aires-da-Silva, 2016). Although some of these vessels can reach offshore waters at a greater distance from the coast (*e.g.*, medium and large-scale fleets), the majority are less than 12-15 m LOA (generally called "pangas") (EMS-02-02) and are more coastal in their operation. Because catch data for these domestic fleets were not available by vessel size, these fleets were collectively classified as "artisanal". In contrast, the domestic Mexican longline fishery targets sharks using vessels (often >27 m LOA) and surface-set gear configurations similar to those used by the far seas industrial longline fleet (Sosa-Nishizaki et al., 2020). Therefore, in the 2022 assessment, the domestic Mexican longline fishery was included as part of the industrial longline fleet.

Most coastal States have some form of a landings fishing inspection program conducted mainly for compliance purposes (Siu and Aires-da-Silva, 2016). Unfortunately, observer coverage of these fleets is extremely low, and data are very limited for scientific purposes. However, pilot sampling programs are currently being developed (SAC-14 INF-M) or completed (SAC-11-13) by the IATTC for the coastal nation fleets and available data that could be attributed to a specific fishery (either longline or gillnet) was utilized (e.g., Lennert-Cody et al., 2022).

Because of their nature and their specific operational characteristics, these artisanal and industrial (purse

seine, longline) fisheries, incur a range of shark interaction rates in the EPO. For example, in the purse seine fishery, silky shark is the main shark species caught on floating objects sets while other species are predominantly caught on unassociated sets (SAC-14-10).

A detailed description of the datasets included in the 2022 assessment is provided in Table 1.

2.2 Species interactions

The 2022 assessment included all shark species recorded to have interacted with 8 pelagic fisheries in the EPO using all data held in the IATTC databases. Specifically, these fisheries were:

- Industrial longline
- Purse-seine Class 6 vessels: DEL, NOA, OBJ sets
- Purse-seine Class 1–5 vessels: NOA, OBJ sets
- Artisanal longline
- Artisanal gillnet

Assessment tools that can be used to prioritize species of potential concern (e.g., EASI-Fish) or assess stock status (stock assessment models) require species-specific information on biological productivity. Therefore, a requirement of these tools is to include only species—as opposed to taxonomic aggregations such as "Thresher shark, nei"—in assessments given the often high divergence in the ecology and life histories of even closely related species. Although there are many records in the data sources used where catches were reported as taxonomic aggregations, these were required to be omitted from the 2022 assessment.

To improve the process for determining which shark species could be "under the purview of the IATTC", as referred to in resolution C-23-07, the current paper expands on the 2022 assessment by incorporating additional attributes to each species. These include 1) ecological traits (geographic distribution, vertical habitat, and endemism in the EPO) that influence the extent to which a species is susceptible to interacting with pelagic fisheries, and 2) whether a species has already been recognized by the IATTC as having a conservation concern and therefore a specific IATTC resolution has been adopted. The staff believe it is also important for the Commission to formally recognize species of notable conservation concern that were assessed in SAC-13-11 to not be significantly directly impacted by tuna fisheries in the EPO but may infrequently inhabit areas where tuna fishing occurs. Therefore, included for each species is their classification by the IUCN Red List of Threatened Species (IUCN, 2024) for the EPO—or globally where an EPO assessment is lacking—and inclusion in Appendix II of the Convention on International Trade in Endangered Species (CITES) (CITES, 2016). A set of hierarchical criteria were developed using relevant fisheries, ecological traits, and conservation status by international instruments (Fig. 1) to present to the Members, after consultation with the EBWG and SAC, alternative lists of species. These lists were compared to three existing species lists used for various purposes within the IATTC including: 1) Annex I of Highly Migratory Species in the United Nations Convention on the Law of the Sea (UNCLOS), 2) the annual memorandum circulated to CPCs by the IATTC Director pertaining to specifications for data provision under resolution C-03-05, and 3) the list of key species recommended by the staff and participants of IATTC's workshop on improvements in data collection and provision in the industrial longline fishery undertaken in 2023 (WS-DAT-01-Report, SAC-14 INF-Q).

3. RESULTS

3.1 Shark interactions recorded in EPO pelagic fisheries

In total, 49 shark species were recorded in available datasets to have interacted with pelagic fisheries in the EPO between 1994–2019. The full list of species and the number of fishing events from which they were recorded in each fishery is shown in Table 2.

These species showed high diversity in their ecological traits (Table 3), that contribute to their susceptibility to interactions with pelagic fishing fleets, and IUCN classifications for the EPO. Only 12 species were oceanodromous and mostly occupy epipelagic waters where the tuna fisheries operate except for *Isistius brasiliensis* and *Pseudocarcharias kamoharai*, which occupy the deep bathypelagic and mesopelagic zones, respectively (Table 3). These latter two species were recorded only in longline fisheries and likely caught where longline sets were made on the shelf slope. It is important to note that although *Cetorhinus maximus* is oceanodromous and occupies epipelagic waters it was recorded on only one occasion in 26 years—in a Class 6 purse-seine NOA set (Table 2)—it is unlikely that tuna fisheries pose a significant threat to this filter-feeding species. Of the 12 oceanodromous species, five were classified by the IUCN in the EPO as either "Critically Endangered" (*Carcharhinus longimanus*) or "Endangered" (*Alopias pelagicus*, *C. maximus*, *Isurus oxyrinchus* and *I. paucus*) and all species except *I. brasiliensis*, *P. kamoharai*, and *Galeocerdo cuvier* are listed in CITES Appendix II. Two of these 12 oceanic species are the subject of specific IATTC resolutions including *C. falciformis* (C-23-08) and *C. longimanus* (C-11-10).

A further 10 of the 49 species predominately occupy neritic waters for the majority of their lives or as breeding and/or nursery areas, but at times venture into offshore epipelagic waters where they are occasionally caught by tuna fleets such as the hammerheads *Sphyrna lewini* and *S. zygaena*, threshers (*A. superciliocus* and *A. vulpinus*) and coastal requiem sharks (*C. galapagensis* and *C. brachyurus*). Of these 10 species, all are listed in CITES Appendix II, while three species are classified as "Critically Endangered" (*Sphyrna lewini* and *S. mokarran*) or "Endangered" (*Rhincodon typus*) by IUCN—and all have specific IATTC resolutions pertaining to their conservation (C-16-05 and C-19-06).

The remaining 27 of the 49 species are largely confined to shallow neritic habitats where they generally occupy demersal or benthic habitats, such as many small-sized requiem sharks (e.g., *Nasolamia velox*, *Carcharhinus limbatus*), are likely to have a very low susceptibility to capture by pelagic fisheries, which is indicated by most of these species being recorded on fewer than 100 occasions over the period of 1994–2019. Of this group of neritic species, six species (*C. porosus, Ginglymostoma cirratum, S. corona, M. dorsalis, M. henlei, M. lunulatus*) are endemic to the EPO and nine species are classified by the IUCN in the EPO as "Critically Endangered" (*C. porosus, Carcharias taurus, Galeorhinus galeus, N. velox, S. corona* and *S. media*) or "Endangered" (*C. obscurus*, *C. plumbeus* and *S. tiburo*). Furthermore, 15 species are listed in CITES Appendix II, of which 3 and 12 species represent the families Carcharhinidae and Sphyrnidae, respectively.

3.2 Options for an interim list of species under the purview of the IATTC

Arriving at a definitive list of shark species under the purview of the IATTC was facilitated based on the 49 species included in the 2022 shark vulnerability assessment and applying the set of hierarchical criteria shown in Figure 1, which vary the numbers and compositions of species at each stage in the process (Table 4). First, the IATTC must determine whether it shall include under its purview both industrial fisheries and the numerous artisanal fleets that deploy pelagic gears, which would result in the inclusion of all 49 species (List A), or consider only industrial tuna fleets, which would reduce the number of species to 43 (List B). Once a determination on fisheries is made, the Members could refine the list to include only oceanodromous species having epipelagic distributions or listed in an IATTC Resolution. In this case, both scenarios of including all EPO fisheries and only industrial tuna fisheries resulted in the same number (19 species) and composition (Lists C and D) of species (Table 4). These lists could be supplemented by species listed in international instruments pertaining to the conservation of sharks, such as CITES Appendix II or listed by the IUCN as "Critically Endangered" or "Endangered", which would result in the inclusion of the same 36 species for both scenarios (Lists E and F).

3.2 Comparisons with existing shark species lists

Comparing Lists A through F (Table 4) developed from the complete list of shark species from the 2022 IATTC shark vulnerability assessment with three existing species lists showed many similarities. The 34 species Lists E and F are almost identical in composition to Annex I of UNCLOS, with only *G. galeus* and *Galeocerdo cuvier* not included in Annex I. However, Annex I of UNCLOS includes all species of Carcharhinidae (59 species) and Sphyrnidae (11 species) (see Froese and Pauly, 2024), which would significantly increase the number of species in Lists E and F and include numerous neritic species.

The 36 species listed in IATTC SAC-14 INF-Q include most species in Lists E and F with the exception that the former list includes six additional species that were either bathypelagic (*I. brasiliensis*, *P. kamoharai*), neritic (*Dalatias licha*, *Ginglymostoma cirratum*, *Odontaspis noronhai*, *M. lunulatus*) species that infrequently interact with tuna fisheries (Table 4).

In contrast, the list of species included in the annual memorandum circulated to CPCs by the IATTC Director pertaining to specifications for data provision under resolution C-03-05, includes only 15 species, which closely resembles Lists C and D with the addition of four neritic species *C. limbatus*, *S. corona*, *S. media*, and *S. tiburo* species (Table 4).

4. DISCUSSION

An important first step in the management of sharks by the IATTC is to define the taxonomic scope of conservation and management responsibilities, which should be limited to species for which their biological capacity is potentially threatened by the activities of the fisheries for which the IATTC is responsible. The primary responsibility of the IATTC is to ensure the sustainability of tunas and tuna-like species, which are the target species of tuna fishing fleets. The Antigua Convention, in its Article I, par.1, defines "Fish stocks covered by this Convention" as meaning *"stocks of tunas and tuna-like species and other species of fish taken by vessels fishing for tunas and tuna-like species in the Convention Area".* However, the Antigua Convention does not include a prescriptive list of these species and of all those that may be considered more broadly under the purview of the IATTC, including those that are not caught but interact with, and may be impacted by, the tuna fisheries.

The Convention does, however, in its Preamble, refer to the Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Stocks and Highly Migratory Fish Stocks ("the 1995 UN Fish Stocks Agreement"). But, neither the Convention nor the IATTC has formally endorsed or adopted the list of highly migratory species in Annex I of the 1995 UN Fish Stocks Agreement as being under its purview. Although this allows IATTC Members flexibility for determining which species may, or may not, be under their purview as the dynamics of the fisheries change, this has resulted in ambiguity over the conservation and management responsibilities regarding some economically important pelagic species that are commonly caught by both pelagic fisheries that operate offshore and neritic waters in the EPO. For example, dorado (*Coryphaena hippurus*)—included in the UNCLOS Annex 1—has very similar biological and ecological traits to tropical tunas, yet only recently did the Commission adopt at its 101st meeting a resolution related to the conservation and management of this species (Resolution C-23-09).

In contrast to tuna and tuna-like species, sharks present more complex conservation and management issues for tuna fisheries since they have highly diverse ecological traits, which vary their susceptibility to capture by tuna fleets. For example, species such as shortfin mako (*Isurus oxyrinchus*) and blue shark (*Prionace glauca*) are highly migratory oceanodromous species that complete their life cycles predominately in the epipelagic waters of the open ocean and utilize similar habitats and prey as tuna and tuna-like species (Camhi et al., 2008). Consequently, these species are frequently captured as bycatch by tuna vessels. In contrast, other shark species such as scalloped hammerhead (*Sphyrna lewini*) and bull

shark (*Carcharhinus leucas*) utilize estuaries and mangroves as breeding and nursery areas, spend the majority of their sub-adult and adult lives in shallow neritic habitats (Corgos and Rosende-Pereiro, 2022; Lara-Lizardi et al., 2022), but a proportion of their populations—usually adults—forage in epipelagic waters of the open ocean (Ketchum et al., 2014). As a result, these species are caught in large numbers by artisanal fleets (*e.g.*, gillnet and longline) and to a lesser extent by tuna vessels in the open ocean at a greater distance from the coast.

Despite the differing life history traits of the aforementioned oceanodromous and neritic species, they could each be considered falling under the competence of the IATTC under Article VII 1(f) considering they are "…*species belonging to the same ecosystem and that are affected by fishing for, or dependent on or associated with, the fish stocks covered by this Convention*…". However, to this point the management of sharks has generally been *ad hoc* in that conservation measures have primarily focused on a small number of species that are either caught frequently in one or more fisheries (e.g., *Carcharhinus falciformis*), and that fishers, Members or relevant stakeholders perceive to be at risk of depletion under existing fishing effort regimes, or are aware also that they have been declared by other organizations such as the IUCN to have significant conservation concerns (*e.g.*, oceanic whitetip shark and whale shark). This *ad hoc* approach to shark conservation and management has primarily been due to the absence of reliable data and/or assessment methods, which has hindered the identification of data-limited species that may be truly vulnerable to the impacts by tuna fleets. However, using the EASI-Fish approach developed by IATTC staff, quantitative determinations of the relative vulnerability of data-limited bycatch species to pelagic fishery impacts is becoming possible, as has been demonstrated in the EPO for leatherback turtles (BYC-11-02), the spinetail devil ray (BYC-09-01), and for 32 of the 49 shark species included in this paper (SAC-13-11). As a result, the vulnerability status of species under the purview of the IATTC may be more effectively monitored and reported as part of developing efforts by the IATTC staff to improve ecological reporting using 'EcoCards' (EB-02-02). Furthermore, EASI-Fish may be used to assess the potential efficacy of specific conservation and management measures for sharks, and other bycatch species, under the IATTC's purview as has been demonstrated in recent scenario modelling by the IATTC staff for silky and hammerhead sharks (SAC-14-12).

The development of a species list of sharks for which the IATTC is responsible may be perceived to be a reasonably straightforward task using the process depicted in Figure 2 beginning from determining which species are impacted by fisheries under the purview of the IATTC and then subjecting these species to data collection and assessment, where required, to ensure their long-term sustainability. However, the resources required to manage shark species increase dramatically with both the number of species deemed as being "impacted" and the number of fisheries impacting them, which also potentially increases the political considerations that may influence the degree to which the IATTC can independently fulfill its sustainability objectives. In other words, if a species was to be considered under the purview of the IATTC, all the obligations regarding data provision, as defined in corresponding resolutions, would become applicable and data from all fishing mortality sources would have to be provided to the IATTC staff to undertake stock assessment to determine the status of the population in the EPO. For example, in the case of *S. lewini*, which is a neritic species that is predominately caught in the numerous artisanal fisheries of the EPO (SAC-14 INF-L), the IATTC would need to consider developing long-term data collection programs in each country where the species is caught.

Alternatively, if the IATTC determined that only industrial tuna fleets are under its purview then a more protracted and ecologically relevant existing list of species could be adopted for primarily oceanodromous species such as the migratory species listed in Annex I of UNCLOS, which is acknowledged by the IATTC and all other tuna RFMOs. Although it may be convenient to adopt Annex I of UNCLOS, it explicitly includes all species of Carcharhinidae and Sphyrnidae, which were shown in the present paper to include several

species that predominately occupy demersal habitats in neritic waters (e.g., *C. porosus*, *S. media*).

Therefore, this paper sought to use the best available scientific information from the quantitative 2022 shark vulnerability assessment (SAC-13-11) supplemented with ancillary ecological traits and conservation metrics (e.g., CITES and IUCN classifications) (Table 3), to develop a range of options (Fig. 1; Table 4) for the IATTC to consider in developing a list of shark species that may legitimately be vulnerable to fishing impacts by the fisheries it includes under its purview. These species lists were then compared to the list of species developed by independent means through stakeholder engagement such as the list of key species revised by the staff based on input from participants of IATTC's workshop on improvements in data collection and provision in the industrial longline fishery undertaken in 2023 (SAC-14 INF-Q), the species listed in the annual memorandum circulated to CPCs by the IATTC Director (Specifications for data provision under resolution C-03-05), and Annex I of UNCLOS to provide justifications for a species' inclusion in Lists A through F or to highlight potential erroneous exclusion.

5. CONCLUSIONS AND RECOMMENDATIONS

Given the aforementioned ecological and conservation considerations for shark species documented to have interacted with pelagic fisheries in the EPO, the IATTC staff recommends, at a minimum, the adoption of the 19 species in List C (noting List D for industrial fisheries only is identical) as an interim list of species that are under the purview of the IATTC, which is precautionary in the sense that all EPO pelagic fisheries (i.e., industrial and artisanal) are included—irrespective of whether or not the IATTC includes in the future other species of sharks caught or impacted by artisanal fisheries under its purview. This list is also practical in that it is restricted to species that are oceanodromous and epipelagic, or at least spend a reasonable proportion of their time in these habitats where they are susceptible to capture by pelagic fishing gears.

It is acknowledged that, although precautionary in its scope with respect to direct impacts by IATTC tuna fleets, List C does not include 17 species that were documented to infrequently interact with tuna fisheries in the EPO but have been classified as having notable conservation status such as being listed by the IUCN as "Critically Endangered" or "Endangered" or listed in Appendix II of CITES. Although the staff considers these species to be outside the purview of the IATTC, in the absence of any single organization being responsible for the conservation and management of elasmobranchs in the EPO, the staff encourages the Commission to consider developing a Recommendation on these EPO species. Such a Recommendation could recognize the ecological importance of these EPO species, acknowledge the conservation concerns highlighted by their IUCN and CITES listings, and signal the willingness of IATTC to support in a cooperative manner future conservation efforts initiated and supported by scientific work of other relevant organizations, if there is a clear role for IATTC to play in such efforts.

Finally, the staff believes that any species list adopted by the Commission should be updatable to allow for the inclusion/exclusion of species should the operational characteristics or spatio-temporal dynamics of the fleets under the IATTC's purview change through time, which may concomitantly change the susceptibility of shark species to interacting with tuna fishing operations. Therefore, the staff recommend that the final prescriptive list of shark species under the purview of the IATTC be implemented through the development of a specific resolution that can be updated as required.

REFERENCES

Agreement on the International Dolphin Conservation Program (Aidcp), 2017. Agreement on the International Dolphin Conservation Program. Last amended October 2017. Available from: http://iattc.org/PDFFiles2/AIDCP-amended-Oct-2009.pdf.

Alfaro-Shigueto, J., Mangel, J.C., Pajuelo, M., Dutton, P.H., Seminoff, J.A., Godley, B.J., 2010. Where small can have a large impact: Structure and characterization of small-scale fisheries in Peru. *Fisheries Research* **106**, 8-17.

Alfaro-Shigueto, J., Mangel, J.C., Bernedo, F., Dutton, P.H., Seminoff, J.A., Godley, B.J., 2011. Small-scale fisheries of Peru: a major sink for marine turtles in the Pacific. *Journal of Applied Ecology* **48**, 1432-1440.

Andraka, S., Mug, M., Hall, M., Pons, M., Pacheco, L., Parrales, M., Rendón, L., Parga, M.L., Mituhasi, T., Segura, Á., Ortega, D., Villagrán, E., Pérez, S., Paz, C., Siu, S., Gadea, V., Caicedo, J., Zapata, L.A., Martínez, J., Guerrero, P., Valqui, M., Vogel, N., 2013. Circle hooks: Developing better fishing practices in the artisanal longline fisheries of the Eastern Pacific Ocean. *Biological Conservation* **160**, 214-224.

Ayala, L., Amoros, S., Cespedes, C., 2008. Catch and by-catch of albatross and petrel in longline and gillnet fisheries in northern Peru. *Final Report to the Rufford Small Grants for Nature Conservation*.

Bizzarro, J.J., Smith, W.D., Hueter, R.E., Villavicencio–Garayzar, C.J., 2009a. Activities and catch composition of artisanal elasmobranch fishing sites on the eastern coast of Baja California Sur, Mexico. *Bulletin of the Southern California Academy of Sciences* **108**, 137-152.

Bizzarro, J.J., Smith, W.D., Márquez-Farías, J.F., Tyminski, J., Hueter, R.E., 2009b. Temporal variation in the artisanal elasmobranch fishery of Sonora, Mexico. *Fisheries Research* **97**, 103-117.

Camhi, M.D., Pikitch, E.K., Babcoc, E.A., 2008. *Sharks of the Open Ocean: Biology, Fisheries and Conservation*. Blackwell Science, Oxford, UK.

Carreón-Zapiain, M.T., Favela-Lara, S., González-Pérez, J.O., Tavares, R., Leija-Tristán, A., Mercado-Hernández, R., Compeán-Jiménez, G.A., 2018. Size, age, and spatial-temporal distribution of shortfin mako in the Mexican Pacific Ocean. *Marine and Coastal Fisheries* **10**, 402-410.

Cartamil, D., Santana-Morales, O., Escobedo-Olvera, M., Kacev, D., Castillo-Geniz, L., Graham, J.B., Rubin, R.D., Sosa-Nishizaki, O., 2011. The artisanal elasmobranch fishery of the Pacific coast of Baja California, Mexico. *Fisheries Research* **108**, 393-403.

Castillo-Geniz, J.L., Godinez-Padilla, C.L., Ortega-Salgado, I., Ajás-Terriquez, H.A., 2016. Programa de Observadores de Tiburón. In: Castillo Géniz, J. L., Tovar Ávila, J. (Eds.), *Tiburones Mexicanos de Importancia Pesquera en la CITES*. Instituto Nacional de Pesca, México, pp. 56–67.

Castillo-Geniz, J.L., Godinez-Padilla, C.L., González-Ania, L.V., Haro-Avalos, H., Mondragón-Sánchez, L.F., Tovar-Ávila, J., 2017. Size and sex of the blue sharks caught by the Mexican longline industrial fleets recorded by on board observers in the Pacific 2006-2015. *Meeting of the International Scientific Committee on Tuna and Tuna-like Species in the North Pacific Ocean (ISC) Shark Working Group Workshop, 17-24 March, 2017, La Jolla, USA. Document ISC/17/SHARKWG-1*.

Convention on International Trade in Endangered Species (Cites), 2016. *Consideration of proposals for amendment of Appendix I and II. CoP17 Prop. 44. Inclusion of the genus Mobula spp. in Appendix II*. Convention on International Trade in Endangered Species. Available at https://cites.org/sites/default/files/eng/cop/17/prop/060216/E-CoP17-Prop-44.pdf, Geneva, Switzerland.

Corgos, A., Rosende-Pereiro, A., 2022. Nursery habitat use patterns of the scalloped hammerhead shark, *Sphyrna lewini*, in coastal areas of the central Mexican Pacific. *Journal of Fish Biology* **100**, 117-133.

Doherty, P.D., Alfaro-Shigueto, J., Hodgson, D.J., Mangel, J.C., Witt, M.J., Godley, B.J., 2014. Big catch, little sharks: Insight into Peruvian small-scale longline fisheries. *Ecology and Evolution* **4**, 2375-2383.

Donoso, M., Dutton, P.H., 2010. Sea turtle bycatch in the Chilean pelagic longline fishery in the southeastern Pacific: opportunities for conservation. *Biological Conservation* **143**, 2672-2684.

Froese, R., Pauly, D.E., 2024. *FishBase. World Wide Web electronic publication. www.fishbase.org, version (02/2024)*.

Griffiths, S.P., Kesner-Reyes, K., Garilao, C., Duffy, L.M., Román, M.H., 2019. Ecological Assessment of the Sustainable Impacts of Fisheries (EASI-Fish): a flexible vulnerability assessment approach to

quantify the cumulative impacts of fishing in data-limited settings. *Marine Ecology Progress Series* **625**, 89-113.

Hernández, H.S., Valdez Flores, J., 2016. Colima. In: Castillo Géniz, J. L., Tovar Ávila, J. (Eds.), *Tiburones Mexicanos de Importancia Pesquera en la CITES*. Instituto Nacional de Pesca, México, pp. 46–48.

Inter-American Tropical Tuna Commission (Iattc), 2003. *Convention for the strengthening of the Inter-American Tropical Tuna Commission established by the 1949 Convention between the United States of America and the Republic of Costa Rica ("Antigua Convention")*. Inter-American Tropical Tuna Commission, La Jolla, CA.

Ketchum, J.T., Hearn, A., Klimley, A.P., Espinoza, E., Peñaherrera, C., Largier, J.L., 2014. Seasonal changes in movements and habitat preferences of the scalloped hammerhead shark (*Sphyrna lewini*) while refuging near an oceanic island. *Marine Biology* **161**, 755-767.

Lara-Lizardi, F., Hoyos-Padilla, E.M., Klimley, A.P., Grau, M., Ketchum, J.T., 2022. Movement patterns and residency of bull sharks, *Carcharhinus leucas*, in a marine protected area of the Gulf of California. *Environmental Biology of Fishes* **105**, 1765-1779.

Lennert-Cody, C.E., Mccracken, M., Siu, S., Oliveros-Ramos, R., Maunder, M.N., Aires-Da-Silva, A., Carvajal-Rodríguez, J.M., Opsomer, J.D., De Barros, P., 2022. Single-cluster systematic sampling designs for shark catch size composition in a Central American longline fishery. *Fisheries Research* **251**, 106320.

Martínez-Ortiz, J., Aires-Da-Silva, A.M., Lennert-Cody, C.E., Maunder, M.N., 2015. The Ecuadorian artisanal fishery for large pelagics: species composition and spatio-temporal dynamics. *PLoS One* **10**, e0135136.

Martínez, P.B., Pizarro, A.G., Cortés, D.D., Opazo, S.M., Pérez, H.M., Troncoso, F.C., Mieres, L.C., Ortega Carrasco, J.C., 2017. Informe Final. Seguimiento Pesquerías Recursos Altamente Migratorios, 2016. *Instituto de Fomento Pesquero, Chile*.

Moreno, C.A., Arata, J.A., Rubilar, P., Hucke-Gaete, R., Robertson, G., 2006. Artisanal longline fisheries in southern Chile: lessons to be learned to avoid incidental seabird mortality. *Biological Conservation* **127**, 27-36.

Nature, I.U.F.C.O., 2024. *The IUCN Red List of Threatened Species. Version 2023-1*, https://www.iucnredlist.org. Accessed on 14 March 2024.

Oliveros-Ramos, R., Siu, S., Salaverria, S., Lennert-Cody, C.E., Aires-Dasilva, A., Maunder, M.N., 2019. Pilot study for a shark fishery sampling program in Central America. *10th Meeting of the Scientific Advisory Committee of the IATTC, 13-17 May 2019, San Diego, California, USA. Document SAC-10-16*, 33.

Ortíz-Álvarez, C., Pajuelo, M., Grados, D., Abrego, M.E., Rebeca Barragán-Rocha, A., Barrantes, M., Cotto Sánchez, A., Fonseca, L.G., Gadea Espinal, V., Mangel, J.C., Rguez-Baron, J.M., Santidrian-Tomillo, P., Sarti, L., Santana-Hernández, H., Shillinger, G., Prado, M., Wallace, B., Williard, A.S., Zavala-Norzagaray, A.A., Alfaro-Shigueto, J., 2020. Rapid assessments of leatherback small-scale fishery bycatch in internesting areas in the eastern Pacific Ocean. *Frontiers in Marine Science* **6**.

Siu, S., Aires-Da-Silva, A., 2016. An inventory of sources of data in central America on shark fisheries operating in the Eastern Pacific Ocean. Metadata report. *7th Meeting of the Scientific Advisory Committee of the IATTC, 9-13 May 2016, La Jolla, California. Document SAC-07-06b(ii)*.

Smith, W.D., Bizzarro, J.J., Cailliet, G.M., 2009. The artisanal elasmobranch fishery on the east coast of Baja California, Mexico: Characteristics and management considerations. *Ciencias Marinas* **35**, 209-236.

Sosa-Nishizaki, O., García-Rodríguez, E., Morales-Portillo, C.D., Pérez-Jiménez, J.C., Rodríguez-Medrano, M.C., Bizzarro, J.J., Castillo-Géniz, J.L., 2020. Fisheries interactions and the challenges for target and nontargeted take on shark conservation in the Mexican Pacific. *Advances in Marine Biology* **85**, 39-69.

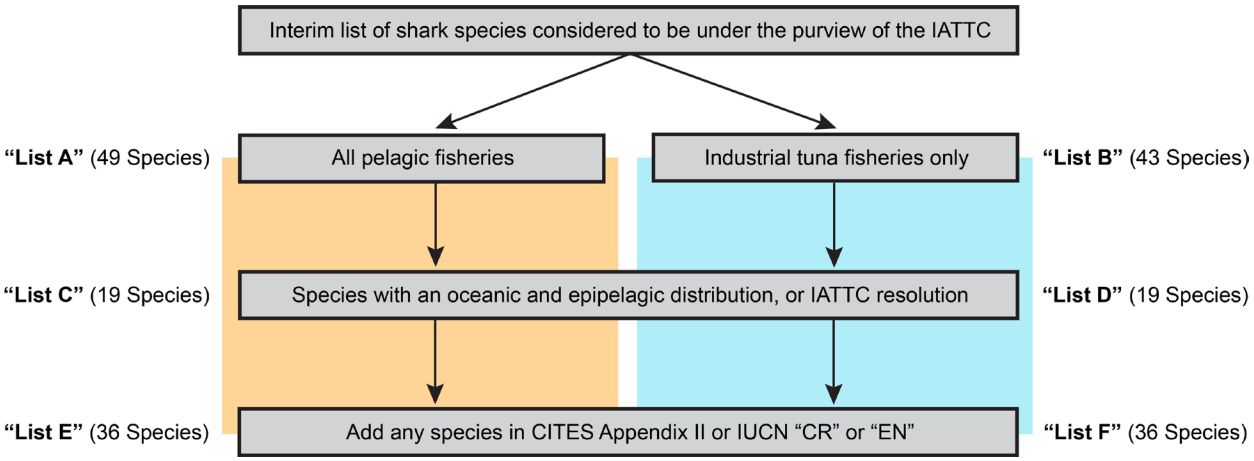

FIGURE 1. Diagram showing the number of the 49 shark species included in the 2022 shark vulnerability assessment (SAC-13-11) that may come under the purview of the IATTC given different criteria, including whether i) all pelagic fisheries (*i.e.*, industrial and artisanal) or only industrial tuna fisheries are considered, ii) species with an oceanic and epipelagic distribution or are listed in an IATTC Resolution, and iii) supplemented by species listed in CITES Appendix II or listed by the IUCN as "Critically Endangered" or "Endangered". The composition of species in the list shown at each stage of the decision process is shown in Table 4.

FIGURA 1. Diagrama que muestra el número de las 49 especies de tiburones incluidas en la evaluación de la vulnerabilidad de los tiburones de 2022 (SAC-13-11) que podrían ser competencia de la CIAT conforme a distintos criterios, incluyendo si i) se consideran todas las pesquerías pelágicas (o sea, industriales y artesanales) o solo se consideran las pesquerías atuneras industriales, ii) especies con distribución oceánica y epipelágica o incluidas en una resolución de la CIAT, y iii) complementadas por especies incluidas en el Apéndice II de la CITES o clasificadas por la UICN como "En Peligro Crítico" o "En Peligro". En la Tabla 4 se muestra la composición de especies de la lista en cada etapa del proceso de decisión.

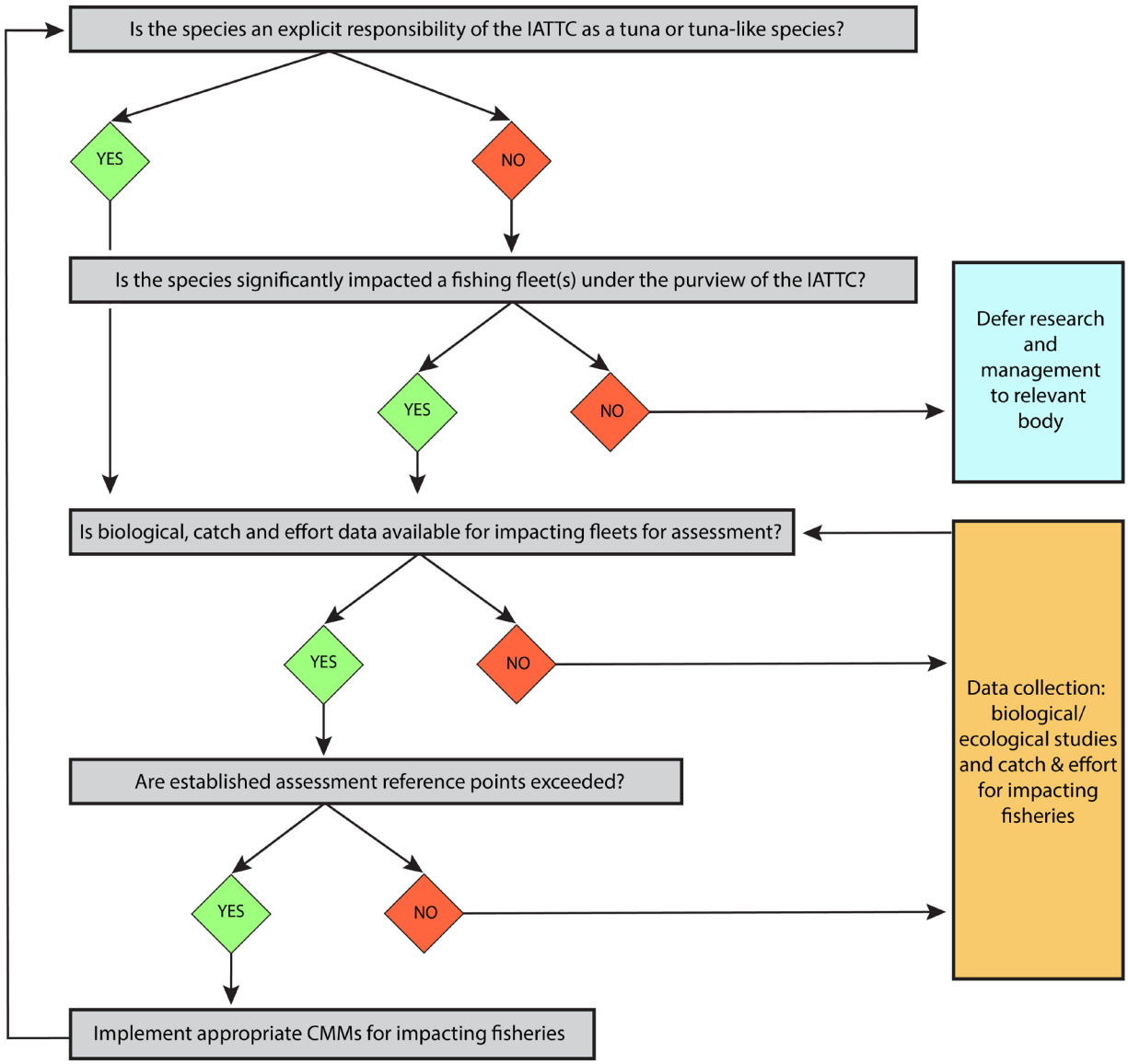

FIGURE 2. Decision tree diagram depicting a potential process to determine whether a species is under the purview of the IATTC and the subsequent responsibilities for ensuring the species remains biologically sustainable under the impacts of tuna fishing in the eastern Pacific Ocean.

FIGURA 2. Diagrama de árbol de decisiones que ilustra un proceso potencial para determinar si una especie está bajo competencia de la CIAT y las responsabilidades subsiguientes para asegurar que la especie siga siendo biológicamente sostenible bajo los impactos de las pesquerías atuneras en el Océano Pacífico oriental.

TABLE 1. Data sources and period of coverage for pelagic fisheries data used to develop the list of impacted shark species included in the 2022 vulnerability assessment for the EPO.
TABLA 1. Fuentes de datos y periodo de cobertura de los datos de pesquerías pelágicas utilizados para elaborar la lista de especies de tiburones impactadas incluidas en la evaluación de vulnerabilidad para el OPO de 2022.

Fishery	Region	Year	Comments and data source
Industrial fisheries			
Longline	IATTC Convention Area	2019	Unpublished data from logbooks and national observer programs submitted to the IATTC.
	Mexico (Pacific Ocean and Gulf of California)	2006–2009; 2006–2013; 2009–2012; 2018	Castillo-Geniz et al. (2016)*; Castillo-Geniz et al. (2017)*; Carreón-Zapiain et al. (2018)*; Pacific Large Pelagics Program, INAPESCA*.
	Mexico (Central Pacific coast)	2003–2011	Hernández and Valdez Flores (2016)*
Purse-seine (Class 6)	IATTC Convention Area	2019	Unpublished data collected by the AIDCP and National observer programs and held by the IATTC.
Purse-seine (Class 1–5)	IATTC Convention Area	2019	Unpublished data from logbooks, national observer programs and the TUNACONS observer program submitted to the IATTC.
Artisanal fisheries			
Surface-set gillnet	Chile (Northern and Central)	2016	Martínez et al. (2017)*
	Guatemala, El Salvador, Nicaragua, Costa Rica, Panama	2018	Oliveros-Ramos et al. (2019)
	Mexico (Northwestern Gulf of California)	1998–1999	Smith et al. (2009)*
	Mexico (Southwestern Gulf of California)	1998–1999	Bizzarro et al. (2009a)*
	Mexico (Northeastern Gulf of California)	1998–1999	Bizzarro et al. (2009b)*
	Mexico, Panama	2017–2018	Ortíz-Álvarez et al. (2020)
	Nicaragua, Costa Rica, Colombia	2016–2017	Ortíz-Álvarez et al. (2020)
	Peru and Chile	2005–2007;	Alfaro-Shigueto et al. (2011)*
	Peru	2007	Ayala et al. (2008)*
Surface-set longline	Chile (Northern and Central)	2001–2005; 2016	Donoso and Dutton (2010); Martínez et al. (2017)*
	Chile (Southern)	2002	Moreno et al. (2006)*
	Chile and Peru	2005–2010	Doherty et al. (2014)*
	Ecuador	2008–2012	Martínez-Ortiz et al. (2015)*
	Ecuador, Panama, Costa Rica	2004–2010	Unpublished IATTC observer data.
	Guatemala, El Salvador, Nicaragua, Costa Rica, Panama	2018	Oliveros-Ramos et al. (2019)
	Mexico (Western Sea of Cortez)	1998–1999	Bizzarro et al. (2009a)*
	Mexico (Northeastern Gulf of California)	1998–1999	Bizzarro et al. (2009b)*
	Mexico, Panama	2017–2018	Ortíz-Álvarez et al. (2020)
	Nicaragua, Costa Rica, Colombia	2016–2017	Ortíz-Álvarez et al. (2020)
	Peru	2004–2006; 2007	Ayala et al. (2008)*; Alfaro-Shigueto et al. (2011)*

TABLE 2. Number of fishing events where either numbers or weight was recorded for each shark species in IATTC data sources for each of the eight pelagic fisheries in the eastern Pacific Ocean included in the 2022 shark vulnerability assessment (SAC-13-11). Species represented by fewer than 20 fishing records (denoted by broken horizontal line) were not included in the EASI-Fish assessment, with the exception of white shark (*Carcharodon carcharias*). Abbreviations are purse seine (PS), Class 6 (C6), Class 1-5 (C1-5), dolphin sets (DEL), non-associated sets (NOA) and sets on floating objects (OBJ).

TABLA 2. Número de eventos de pesca en los que se registraron, en número o peso, cada especie de tiburón en las fuentes de datos de la CIAT para cada una de las ocho pesquerías pelágicas en el Océano Pacífico oriental incluidas en la evaluación de la vulnerabilidad de los tiburones de 2022 (SAC-13-11). Las especies con menos de 20 registros de pesca (señaladas con una línea horizontal discontinua) no se incluyeron en la evaluación EASI-Fish, con la excepción del jaquetón blanco (*Carcharodon carcharias*). Las abreviaturas utilizadas son las siguientes: cerco (PS), clase 6 (C6), clases 1-5 (C1-5), lances sobre delfines (DEL), lances no asociados (NOA) y lances sobre objetos flotantes (OBJ).

Species	Common name	Industrial longline	PS-C6 (DEL)	PS-C6 (NOA)	PS-C6 (OBJ)	PS-C1-5 (NOA)	PS-C1-5 (OBJ)	Artisanal gillnet/ longline	Artisanal longline	Total
Prionace glauca	Blue shark	16,8621	198	534	340	3	46	4	6,228	17,5974
Carcharhinus falciformis	Silky shark	13,440	5,761	2,722	55,272	4	5	484	5,335	83,023
Isurus oxyrinchus	Shortfin mako shark	18,492	48	445	614	6	7		1,973	21,585
Pseudocarcharias kamoharai	Crocodile shark	17,760						2	26	17,788
Carcharhinus longimanus	Oceanic whitetip shark	4,223	616	324	9,977	2	54		49	15,245
Alopias superciliosus	Bigeye thresher	8,111	621	710	213	8	1	29	241	9,934
Alopias pelagicus	Pelagic thresher	6,075	515	506	221	11	8	94	2,319	9,749
Sphyrna lewini	Scalloped hammerhead shark	583	331	476	1,851	33	55	1,009	762	5,100
Sphyrna zygaena	Smooth hammerhead shark	2,340	194	338	1,971	15	51	2	76	4,987
Zameus squamulosus	Velvet dogfish	3,038								3,038
Alopias vulpinus	Common thresher	290	155	216	59	4		99	53	876
Carcharhinus limbatus	Blacktip shark	285	78	24	35	1	1	97	338	859
Isurus paucus	Longfin mako shark	671								671
Sphyrna mokarran	Great hammerhead	72	35	42	213	2	3		68	435
Carcharhinus galapagensis	Galapagos shark	203		5	17			1		226
Carcharhinus brachyurus	Copper shark	8	22	24	114					168
Nasolamia velox	Whitenose shark	43	2	1			5	18	92	161
Rhizoprionodon longurio	Pacific sharpnose shark		1	3				140	5	149
Carcharhinus leucas	Bull shark	2	14	21	17	2		25	39	120
Galeocerdo cuvier	Tiger shark	56		5	1			18	24	104
Lamna nasus	Porbeagle shark	88								88
Carcharhinus obscurus	Dusky shark	45	2	15	10					72
Isistius brasiliensis	Cookie cutter shark	66								66
Rhincodon typus	Whale shark	1		30	29		2			62

Species	Common name	Industrial longline	PS-C6 (DEL)	PS-C6 (NOA)	PS-C6 (OBJ)	PS-C1-5 (NOA)	PS-C1-5 (OBJ)	Artisanal gillnet/ longline	Artisanal longline	Total
Dalatias licha	Kitefin shark	60								60
Lamna ditropis	Salmon shark	43								43
Carcharhinus porosus	Smalltail shark		3		30			5		38
Carcharhinus plumbeus	Sandbar shark		7	18	7					32
Carcharhinus altimus	Bignose shark		3		24					27
Sphyrna corona	Scalloped bonnethead	2	2	5	5			4	4	22
Sphyrna media	Scoophead		1	4	13				2	20
Mustelus lunulatus	Sicklefin smooth-hound							7	12	19
Galeorhinus galeus	Tope shark	19								19
Cynoponticus coniceps	Longnose velvet dogfish	18								18
Ginglymostoma cirratum	Nurse shark							2	13	15
Mustelus henlei	Brown smooth-hound							1	14	15
Odontaspis noronhai	Bigeye sand tiger shark	9								9
Carcharodon carcharias	Great white shark	6		1						7
Squatina californica	Pacific angelshark	4								4
Carcharias taurus	Sand tiger shark	3								3
Carcharhinus sorrah	Spottail shark	2								2
Mustelus dorsalis	Sharptooth smooth-hound							2		2
Squalus acanthias	Picked/Spiny dogfish	2								2
Negaprion brevirostris	Lemon shark		1	1						2
Sphyrna tiburo	Bonnethead			1	1					2
Carcharhinus albimarginatus	Silvertip shark								1	1
Cetorhinus maximus	Basking shark			1						1
Squalus suckleyi	Spotted spiny dogfish	1								1
Triaenodon obesus	Whitetip reef shark							1		1

TABLE 3. Ecological traits, conservation classifications and listings of 49 shark species (listed in alphabetical order) recorded in the 2022 IATTC shark vulnerability assessment (SAC-13-11) as interacting with pelagic fisheries in the eastern Pacific Ocean (EPO). Conservation classifications include endemism in the EPO, presence of a species-specific IATTC resolution, IUCN Red List of Threatened Species classification (IUCN, 2024) and listing in Appendix II of the Convention on International Trade in Endangered Species (CITES) (CITES, 2016). Comparison of the 49 species is made with three existing species lists acknowledged by the IATTC: Annex I of Highly Migratory Species in the United Nations Convention on the Law of the Sea (UNCLOS), the annual memorandum circulated to CPCs by the IATTC Director pertaining to specifications for data provision under resolution C-03-05, and the list of key species recommended by staff and participants of IATTC's workshop on improvements in data collection and provision in the industrial longline fishery undertaken in 2023 (SAC-14 INF-Q). Warmer colors imply greater relevance to pelagic fisheries and/or higher conservation status than cooler colors. Abbreviations for EASI-Fish and IUCN classifications are shown at the bottom of the table.
TABLA 3. Rasgos ecológicos, clasificaciones de conservación y listas de 49 especies de tiburones (en orden alfabético) registradas en la evaluación de la vulnerabilidad de los tiburones de la CIAT de 2022 (SAC-13-11) que interactúan con pesquerías pelágicas en el Océano Pacífico oriental (OPO). Las clasificaciones de conservación incluyen el endemismo en el OPO, la presencia de una resolución de la CIAT específica de la especie, la clasificación en la Lista Roja de Especies Amenazadas de la UICN (UICN, 2024) y la inclusión en el Apéndice II de la Convención sobre el Comercio Internacional de Especies Amenazadas de Fauna y Flora Silvestres (CITES) (CITES, 2016). Se comparan las 49 especies con tres listas de especies existentes reconocidas por la CIAT: el Anexo I de Especies Altamente Migratorias en la Convención de las Naciones Unidas sobre el Derecho del Mar (CNUDM), el memorándum anual circulado a los CPC por el Director de la CIAT relativo a las especificaciones para la provisión de datos en virtud de la resolución C-03-05, y la lista de especies clave recomendada por el personal y los participantes del taller de la CIAT sobre la mejora de la recolección y provisión de datos en la pesquería palangrera industrial llevado a cabo en 2023 (SAC-14 INF-Q). Los colores más cálidos implican mayor relevancia para las pesquerías pelágicas y/o mayor estado de conservación que los colores más fríos. Las abreviaturas de las clasificaciones de EASI-Fish y la UICN figuran en la parte inferior de la tabla.

Family	Species	Geographical distribution	Habitat	Endemic to EPO	IATTC Resolution	IUCN classification	CITES Appendix II	UNCLOS Annex I	IATTC Memo	IATTC SAC-14 INF-Q
Alopiidae	*Alopias pelagicus*	Oceanic	Pelagic	No	No	EN	Yes	Yes	Yes	Yes
Alopiidae	*Alopias superciliosus*	Neritic/Oceanic	Pelagic	No	No	VU	Yes	Yes	Yes	Yes
Alopiidae	*Alopias vulpinus*	Neritic/Oceanic	Pelagic	No	No	VU	Yes	Yes	No	Yes
Carcharhinidae	*Carcharhinus albimarginatus*	Neritic/Oceanic	Pelagic	No	No	VU	Yes	Yes	No	Yes
Carcharhinidae	*Carcharhinus altimus*	Neritic	Demersal	No	No	NT	Yes	Yes	No	No
Carcharhinidae	*Carcharhinus brachyurus*	Neritic/Oceanic	Pelagic	No	No	VU	Yes	Yes	No	Yes
Carcharhinidae	*Carcharhinus falciformis*	Oceanic	Pelagic	No	Yes	VU	Yes	Yes	Yes	Yes
Carcharhinidae	*Carcharhinus galapagensis*	Neritic/Oceanic	Pelagic	No	No	LC	Yes	Yes	No	Yes
Carcharhinidae	*Carcharhinus leucas*	Neritic	Pelagic	No	No	VU	Yes	Yes	No	Yes
Carcharhinidae	*Carcharhinus limbatus*	Neritic	Demersal	No	No	VU	Yes	Yes	Yes	Yes
Carcharhinidae	*Carcharhinus longimanus*	Oceanic	Pelagic	No	Yes	CR	Yes	Yes	Yes	Yes
Carcharhinidae	*Carcharhinus obscurus*	Neritic	Demersal	No	No	EN	Yes	Yes	No	Yes
Carcharhinidae	*Carcharhinus plumbeus*	Neritic	Demersal	No	No	EN	Yes	Yes	No	Yes
Carcharhinidae	*Carcharhinus porosus*	Neritic	Demersal	Yes	No	CR	Yes	Yes	No	No
Carcharhinidae	*Carcharhinus sorrah*	Neritic	Benthopelagic	No	No	NT	Yes	Yes	No	Yes
Carcharhinidae	*Carcharias taurus*	Neritic	Demersal	No	No	CR	Yes	Yes	No	Yes

Family	Species	Geographical distribution	Habitat	Endemic to EPO	IATTC Resolution	IUCN classification	CITES Appendix II	UNCLOS Annex I	IATTC Memo	IATTC SAC-14 INF-Q
Carcharhinidae	*Nasolamia velox*	Neritic	Demersal	No	No	CR	Yes	Yes	No	Yes
Carcharhinidae	*Negaprion brevirostris*	Neritic	Benthic	No	No	VU	Yes	Yes	No	No
Carcharhinidae	*Prionace glauca*	Oceanic	Pelagic	No	No	NT	Yes	Yes	Yes	Yes
Carcharhinidae	*Rhizoprionodon longurio*	Neritic	Benthopelagic	No	No	VU	Yes	Yes	No	No
Carcharhinidae	*Triaenodon obesus*	Neritic	Demersal	No	No	VU	Yes	Yes	No	No
Cetorhinidae	*Cetorhinus maximus*	Oceanic	Pelagic	No	No	EN	Yes	Yes	No	No
Dalatiidae	*Dalatias licha*	Neritic	Bathypelagic	No	No	VU	No	No	No	Yes
Dalatiidae	*Isistius brasiliensis*	Oceanic	Bathypelagic	No	No	LC	No	No	No	Yes
Galeocerdonidae	*Galeocerdo cuvier*	Oceanic	Pelagic	No	No	NT	No	No	No	Yes
Ginglymostomatidae	*Ginglymostoma cirratum*	Neritic	Benthic	Yes	No	VU	No	No	No	Yes
Lamnidae	*Carcharodon carcharias*	Neritic/Oceanic	Pelagic	No	No	VU	Yes	Yes	No	Yes
Lamnidae	*Isurus oxyrinchus*	Oceanic	Pelagic	No	No	NT*	Yes	Yes	Yes	Yes
Lamnidae	*Isurus paucus*	Oceanic	Pelagic	No	No	EN	Yes	Yes	Yes	Yes
Lamnidae	*Lamna ditropis*	Oceanic	Pelagic	No	No	LC	Yes	Yes	Yes	Yes
Lamnidae	*Lamna nasus*	Oceanic	Pelagic	No	No	VU	Yes	Yes	No	No
Muraenesocidae	*Cynoponticus coniceps*	Neritic	Benthic	No	No	DD	No	No	No	No
Odontaspididae	*Odontaspis noronhai*	Neritic	Bathypelagic	No	No	LC	No	No	No	Yes
Pseudocarchariidae	*Pseudocarcharias kamoharai*	Oceanic	Mesopelagic	No	No	LC	No	No	No	Yes
Rhincodontidae	*Rhincodon typus*	Neritic/Oceanic	Pelagic	No	Yes	EN	Yes	Yes	No	No
Somniosidae	*Zameus squamulosus*	Neritic	Mesopelagic	No	No	LC	No	No	No	No
Sphyrnidae	*Sphyrna corona*	Neritic	Demersal	Yes	No	CR	Yes	Yes	Yes	Yes
Sphyrnidae	*Sphyrna lewini*	Neritic	Pelagic	No	Yes	CR	Yes	Yes	Yes	Yes
Sphyrnidae	*Sphyrna media*	Neritic	Demersal	No	No	CR	Yes	Yes	Yes	Yes
Sphyrnidae	*Sphyrna mokarran*	Neritic/Oceanic	Pelagic	No	Yes	CR	Yes	Yes	Yes	Yes
Sphyrnidae	*Sphyrna tiburo*	Neritic	Demersal	No	No	EN	Yes	Yes	Yes	Yes
Sphyrnidae	*Sphyrna zygaena*	Neritic/Oceanic	Mesopelagic	No	Yes	VU	Yes	Yes	Yes	Yes
Squalidae	*Squalus suckleyi*	Neritic	Demersal	No	No	LC	No	No	No	No
Squalidae	*Squalus acanthias*	Neritic	Bathypelagic	No	No	VU*	No	No	No	No
Squatinidae	*Squatina californica*	Neritic	Benthic	No	No	NT	No	No	No	No
Triakidae	*Galeorhinus galeus*	Neritic	Demersal	No	No	CR	No	No	No	Yes
Triakidae	*Mustelus dorsalis*	Neritic	Benthic	Yes	No	VU	No	No	No	No
Triakidae	*Mustelus henlei*	Neritic	Demersal	Yes	No	LC	No	No	No	No
Triakidae	*Mustelus lunulatus*	Neritic	Demersal	Yes	No	LC	No	No	No	Yes

Definitions and abbreviations

Geographical distribution: Oceanodromous (primarily distributed on in the open ocean), neritic (distributed between the high tide mark to the continental shelf), neritic/oceanic (a primarily neritic species that spends a substantial proportion of its life in the open ocean)

Habitat: Epipelagic (0-200m), mesopelagic (200-1000m), bathypelagic (>1000m), demersal (neritic species living close to the substratum), benthic (neritic species living on the substratum), benthopelagic (neritic species living between benthic and epipelagic habitats).

IUCN classifications: Critically endangered (CR), Endangered (EN), Vulnerable (VU), Near Threatened (NT), Least Concern (LC), Data-deficient (DD), (*) classification specific to the EPO.

TABLE 4. Table showing the composition of shark species that may come under the purview of the IATTC given different criteria shown in Figure 1 compared to that of Annex I of Highly Migratory Species in the United Nations Convention on the Law of the Sea (UNCLOS), the annual memorandum circulated by the IATTC Director pertaining to specifications for data provision under resolution C-03-05, the list of key species recommended by the staff with input from participants of IATTC's workshop on improvements in data collection and provision in the industrial longline fishery undertaken in 2023 (SAC-14 INF-Q).

TABLA 4. Tabla que muestra la composición de las especies de tiburones que podrían ser competencia de la CIAT conforme a los distintos criterios presentados en la Figura 1 comparados con aquéllos del Anexo I de Especies Altamente Migratorias en la Convención de las Naciones Unidas sobre el Derecho del Mar (CNUDM), el memorándum anual circulado por el Director de la CIAT relativo a las especificaciones para la provisión de datos en virtud de la resolución C-03-05, la lista de especies clave recomendada por el personal con aportes de los participantes del taller de la CIAT sobre la mejora de la recolección y provisión de datos en la pesquería palangrera industrial llevado a cabo en 2023 (SAC-14 INF-Q).

Family	Species	Common name	List A	List B	List C	List D	List E	List F	UNCLOS Annex I	IATTC Memo	IATTC SAC-14 INF-Q
Alopiidae	*Alopias pelagicus*	Pelagic thresher	■	■	■	■	■	■	■	■	■
Alopiidae	*Alopias superciliosus*	Bigeye thresher	■	■	■	■	■	■	■	■	■
Alopiidae	*Alopias vulpinus*	Common thresher	■	■	■	■	■	■	■		■
Carcharhinidae	*Carcharhinus albimarginatus*	Silvertip shark	■				■	■	■		■
Carcharhinidae	*Carcharhinus altimus*	Bignose shark	■	■			■	■	■		
Carcharhinidae	*Carcharhinus brachyurus*	Copper shark	■	■	■	■	■	■	■		■
Carcharhinidae	*Carcharhinus falciformis*	Silky shark	■	■	■	■	■	■	■	■	■
Carcharhinidae	*Carcharhinus galapagensis*	Galapagos shark	■	■	■	■	■	■	■		■
Carcharhinidae	*Carcharhinus leucas*	Bull shark	■	■			■	■	■		■
Carcharhinidae	*Carcharhinus limbatus*	Blacktip shark	■	■			■	■	■	■	■
Carcharhinidae	*Carcharhinus longimanus*	Oceanic whitetip shark	■	■	■	■	■	■	■	■	■
Carcharhinidae	*Carcharhinus obscurus*	Dusky shark	■	■			■	■	■		■
Carcharhinidae	*Carcharhinus plumbeus*	Sandbar shark	■	■			■	■	■		■
Carcharhinidae	*Carcharhinus porosus*	Smalltail shark	■	■			■	■	■		
Carcharhinidae	*Carcharias taurus*	Sand tiger shark	■	■			■	■	■		■
Carcharhinidae	*Carcharhinus sorrah*	Spottail shark	■	■			■	■	■		■
Carcharhinidae	*Nasolamia velox*	Whitenose shark	■	■			■	■	■		■
Carcharhinidae	*Negaprion brevirostris*	Lemon shark	■	■			■	■	■		
Carcharhinidae	*Prionace glauca*	Blue shark	■	■	■	■	■	■	■	■	■
Carcharhinidae	*Rhizoprionodon longurio*	Pacific sharpnose shark	■	■			■	■	■		
Carcharhinidae	*Triaenodon obesus*	Whitetip reef shark	■				■	■	■		
Cetorhinidae	*Cetorhinus maximus*	Basking shark	■	■	■	■	■	■	■		
Dalatiidae	*Dalatias licha*	Kitefin shark	■	■							■
Dalatiidae	*Isistius brasiliensis*	Cookie cutter shark	■	■							■
Galeocerdonidae	*Galeocerdo cuvier*	Tiger shark	■	■	■	■	■	■			■
Ginglymostomatidae	*Ginglymostoma cirratum*	Nurse shark	■								■
Lamnidae	*Carcharodon carcharias*	Great white shark	■	■	■	■	■	■	■		■
Lamnidae	*Isurus oxyrinchus*	Shortfin mako shark	■	■	■	■	■	■	■	■	■
Lamnidae	*Isurus paucus*	Longfin mako shark	■	■	■	■	■	■	■	■	■

Family	Species	Common name	List A	List B	List C	List D	List E	List F	UNCLOS Annex I	IATTC Memo	IATTC SAC-14 INF-Q
Lamnidae	*Lamna ditropis*	Salmon shark	■	■	■	■	■	■	■	■	■
Lamnidae	*Lamna nasus*	Porbeagle shark	■	■	■	■	■	■	■		
Muraenesocidae	*Cynoponticus coniceps*	Longnose velvet dogfish	■	■							
Odontaspididae	*Odontaspis noronhai*	Bigeye sand tiger shark	■	■							■
Pseudocarchariidae	*Pseudocarcharias kamoharai*	Crocodile shark	■	■							■
Rhincodontidae	*Rhincodon typus*	Whale shark	■	■	■	■	■	■	■		
Somniosidae	*Zameus squamulosus*	Velvet dogfish	■	■							
Sphyrnidae	*Sphyrna corona*	Scalloped bonnethead	■	■			■	■	■	■	■
Sphyrnidae	*Sphyrna lewini*	Scalloped hammerhead	■	■	■	■	■	■	■	■	■
Sphyrnidae	*Sphyrna media*	Scoophead	■	■			■	■	■	■	■
Sphyrnidae	*Sphyrna mokarran*	Great hammerhead	■	■	■	■	■	■	■	■	■
Sphyrnidae	*Sphyrna tiburo*	Bonnethead	■	■			■	■	■	■	■
Sphyrnidae	*Sphyrna zygaena*	Smooth hammerhead	■	■	■	■	■	■	■	■	■
Squalidae	*Squalus suckleyi*	Spotted spiny dogfish	■	■							
Squalidae	*Squalus acanthias*	Picked/Spiny dogfish	■	■							
Squatinidae	*Squatina californica*	Pacific angelshark	■	■							
Triakidae	*Galeorhinus galeus*	Tope shark	■	■			■	■			■
Triakidae	*Mustelus dorsalis*	Sharptooth smooth-hound	■								
Triakidae	*Mustelus henlei*	Brown smooth-hound	■								
Triakidae	*Mustelus lunulatus*	Sicklefin smooth-hound	■								■
	Number of species		49	43	19	19	36	36	34	15	34