IINTER-AMERICAN TROPICAL TUNA COMMISSION

WORKING GROUP ON ECOSYSTEMS AND BYCATCH

3RD MEETING

La Jolla, California (USA)
26-27 May 2025

DOCUMENT EB-03-01

ECOSYSTEM CONSIDERATIONS

CONTENTS

SUMMARY

Over the past two decades, the scope of management of many fisheries worldwide has broadened to include the impacts of fishing on non-target species in particular, and the ecosystem more broadly. This ecosystem approach to fisheries management (EAFM) is important for maintaining the integrity and productivity of ecosystems while maximizing the utilization of commercially-important fisheries resources, but also ecosystem services that provide social, cultural and economic benefits to society. In response to the increasing interest in EAFM by the IATTC with the adoption of the Antigua Convention, the staff has presented an *Ecosystem Considerations* report since 2003 with information on non-target species and on the effect of the fishery on the ecosystem, and to describe how ecosystem research can

contribute to management advice and the decision-making process. It also describes some important recent advances in research related to assessing ecological impacts of fishing and the environment on the eastern Pacific Ocean (EPO) ecosystem and its associated species. Specifically, information presented herein includes: (1) fisheries interactions (e.g., incidental catches of non-target species, generally termed "bycatch", by broad taxonomic groups i.e., marine mammals, sea turtles, seabirds, elasmobranchs and teleosts), (2) a broad overview of the physical environment including short and medium- (e.g., El Niño Southern Oscillation conditions) and long-term (e.g., Pacific Decadal Oscillation) environmental indicators, (3) tools for identifying potentially vulnerable species[1] (e.g., the Ecological Assessment of Sustainable Impacts of Fisheries (EASI-Fish)), (4) ecosystem dynamics assessed through an eastern tropical Pacific Ocean (ETP) ecosystem model and corresponding ecological indicators, and (5) future developments for ecological research in the EPO to continue to guide science-based advice to the IATTC. It is important to note that data availability is poor for many bycatch taxa caught by fisheries other than the large vessel purse-seine fishery (class 6, >363 t), which has 100% observer coverage, such as the industrial longline fishery having a mandate of at least 5% observer coverage. Biological data is also lacking for many of these same species. This paucity in data has long been recognized by the staff (e.g., see SAC-07-INF C(d), SAC-08-07b, SAC-10 INF-B). Consequently, recommendations by the staff for improvements in data collection and submission are underway. These include data improvement workshops (e.g., "industrial longline" (see WSDAT-01, WSDAT-01-RPT); "small purse-seine vessels" i.e., ≤363 t (see WSDAT-02, WSDAT-02-RPT) and a compilation of updated recommendations for both fisheries based on participant feedback (SAC-16 INF-O)), a proposed biological sampling project (SAC-14 INF-J) and a list of ray species under the purview of the IATTC (SAC-16-08). The latter, similar to what was supported by the IATTC for sharks (see Resolution C-24-05), is expected to facilitate progress of science-based advice for guiding and implementing EAFM. Furthermore, updates to the proposal to restructure the *Ecosystem Considerations* report into two ecosystem-advice products (presented in EB-02-02): an indicator-based ecosystem report card ("*EcoCard*") and a complementary *Ecosystem Status Assessment* are presented in EB-03-04 to improve IATTC's communication of ecosystem status.

1. INTRODUCTION

The ecosystem approach to fisheries management (EAFM) was first formalized in the 1995 FAO *Code of Conduct for Responsible Fisheries*, which stipulates that "*States and users of living aquatic resources should conserve aquatic ecosystems*" and that "*management measures should not only ensure the conservation of target species, but also of species belonging to the same ecosystem or associated with or dependent upon the target species*". In 2001, the Reykjavik Declaration on Responsible Fisheries in the Marine Ecosystem elaborated on these principles with a commitment to incorporate an ecosystem approach into fisheries management.

The IATTC's Antigua Convention, which entered into force in 2010, is consistent with these instruments and principles. Article VII (f) establishes that one of the functions of the IATTC is to "*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, with a view to maintaining or restoring populations of such species above levels at which their reproduction may become seriously threatened*". Prior to that, the 1999 Agreement on the International Dolphin Conservation Program (AIDCP) introduced ecosystem considerations into the management of the tuna fisheries in the EPO.

[1] Unless specified otherwise, including but not limited to citations to vulnerability assessments and any qualitative/quantitative scores (e.g. BYC-10 INF-B; SAC-13-11; SAC-14-12), the staff's definition of "vulnerable species" refers to the species that, in the sensu latu, and due to their low-productive life-history traits (i.e. K species in r/K selection theory), are more vulnerable to the impacts of fisheries and other anthropogenic activities on these species or their habitat and ecosystem. This includes the marine mammals, seabirds, sea turtles and the elasmobranchs.

Consequently, for over twenty years the IATTC has been aware of ecosystem issues pertaining to tuna fishing activities, and has moved towards EAFM in many of its management decisions (e.g., SAC-10 INF-B; Juan-Jorda et al. 2018). Within the framework of the IATTC's 5-year Strategic Science Plan (SSP), first implemented in 2019, the IATTC staff conducts novel and innovative ecological research aimed at obtaining the data and developing the tools required to implement EAFM in the tuna fisheries of the EPO. Current and planned ecosystem-related activities by the staff is summarized in the SSP (IATTC-93-06a, SAC-16-07) and the Staff Activities and Research report (e.g., SAC-16 INF-E).

Assessing the ecological sustainability of EPO tuna fisheries is a significant challenge, given the wide range of species with differing life histories with which tuna fisheries interact. While relatively good information is available for catches of tunas and tuna-like species throughout the Convention area, this is not the case for most non-target (i.e., "bycatch") species, especially those that are less frequently encountered, discarded at sea or have low economic value (see section 2 and IATTC Special Report 25). Furthermore, environmental processes that operate on a variety of temporal and spatial scales (e.g., El Niño-Southern Oscillation, Pacific Decadal Oscillation, ocean warming, anoxia and acidification) can influence the abundance and horizontal and vertical distributions of species to differing degrees, which in turn affects their potential to interact with tuna fisheries (e.g., SAC-15 INF-L, SAC-16 INF-T). At its 101st meeting, the IATTC adopted its first Resolution on climate change (C-23-10). As a result, a proposed workplan towards climate resilient fisheries was presented at the 15th meeting of the Scientific Advisory Committee (SAC) to facilitate a better understanding of climate change and to prepare for potential predicted impacts on fisheries, target species, non-target species, and the broader EPO ecosystem (SAC-15-12). In 2024, during the 102nd meeting of the IATTC, the climate change Resolution was amended (C-24-10), and the 1st Workshop on Climate Change (WSCC-01) was held virtually in February 2025. Updated background information and staff's recommendations on the goal, scope and the framework of the proposed Climate Change workplan can be found in SAC-16 INF-P.

Biological reference points, based on estimates of fishing mortality, spawning stock biomass, recruitment, and other biological parameters, have been used for conventional single-species management of target species, but the catch and/or biological data required for determining such reference points, or alternative performance measures, are unreliable or unavailable for most bycatch species. Similarly, given the complexity of marine ecosystems, there is no single indicator that can holistically represent their structure and internal dynamics and thus be used to monitor and detect the impacts of fishing and the environment.

Due to the broadening array of ecological, environmental and fishery issues that are required to support EAFM of the EPO ecosystem, the length and complexity of this all-encompassing document has increased significantly in recent years to the extent that it is not optimal for succinctly conveying key messages to IATTC's Cooperating Members and Non-members (CPCs), stakeholders and the wider public. Therefore, the staff plan to restructure this report—considering ongoing work by the other tuna-Regional Fisheries Management Organizations (t-RFMOs)—into two complementary ecosystem-advice products: (1) an indicator-based Ecosystem Report Card or "EcoCard" highlighting a selected set of 'key' bycatch, ecosystem, and climate, indicators determined by the staff and through stakeholder consultation to best represent ecosystem status and (2) a complementary "Ecosystem Status Assessment" detailing the full suite of indicators considered to communicate the overall status of marine ecosystems and trends over time. A background paper (EB-02-02) details current efforts on EcoCards for the western and central Pacific Ocean by the Western and Central Pacific Fisheries Commission (WCPFC), the Atlantic Ocean by the International Commission for the Conservation of Atlantic Tunas (ICCAT) and the Indian Ocean by the Indian Ocean Tuna Commission (IOTC), along with a proposed workplan for IATTC to develop these ecosystem-advice products in support of EAFM. An update of this workplan is provided in EB-03-04, focused on establishing the purpose (i.e., goal and objective) and a framework for the proposed *Ecocard* workplan. In the interim, the staff will continue to update the Ecosystem Considerations report.

2. DATA SOURCES

In this report, estimated total annual catches of bycatch species were obtained from observer data for the large-vessel purse-seine fishery[2], nominal catches reported by the limited observer coverage onboard the small-vessel purse-seine fishery[3], and gross annual removals by the longline fishery were obtained from annual summary reports (TASK I data, see SAC-12-09, WSDAT-01-01, specifications for data provision) submitted to the IATTC by CPCs. Minimum catches in 2023 reported by observers on longline vessels are also included as an interim measure until observer coverage increases from the mandated 5% to at least 20%—as recommended to the Commission by the scientific staff—that may allow total annual catches for some bycatch species to be reliably estimated. Observer coverage for CPCs has not been considered by staff to be representative of the activities of their longline fleets (see section 2.2. below and BYC-10 INF-D), although for some CPCs observer coverage has been above the 5% minimum coverage requirement (see e.g., SAC-15 INF-B, SAC-16 INF-B). Longline data were available through 2023 as the deadline for data reporting for the previous year occurs after the annual SAC meeting (see Resolutions C-03-05; C-19-08). However, these data are incomplete as operational data have not yet been received by all CPCs at the time of this report. Purse-seine data were available through 2024, with data from the last 2 years considered preliminary as of March 2025. Each data source and their associated data gaps are described in detail below. Additional information on bycatch data is available by fishery (see e.g., SAC-07-INF-C(d), SAC-12-09, DAT-01-01, DAT-02-01, IATTC Special Report 25).

2.1. Purse-seine

Data from the purse-seine fishery is compiled from 3 data sources: 1) IATTC and National Program observer programs, 2) vessel logbooks that are obtained by staff at the Commission's field offices in Latin American tuna ports, and 3) canneries. The observer data from the large-vessel (Class 6) fishery are the most comprehensive in terms of bycatch species, since the 1992 Agreement on the Conservation of Dolphins (the La Jolla Agreement) has required an observer be onboard for all trips for Class- 6 vessels since 1993. An historical perspective of bycatch data collection from the observer programs is described in IATTC Special Report 25. Observers working in the IATTC and the various National Programs provide detailed bycatch data by species, catch, disposition and effort for the exact fishing position (i.e., the latitude and longitude of the purse-seine set). Both the fisher-completed logbook and cannery datasets contain very limited data on bycatch species as reporting is primarily focused on commercially important tuna species. The logbook data, like the observer data, includes exact fishing positions. The cannery (or "unloading") data do not have an exact fishing position but rather a broad geographic region where fish were caught (e.g., the eastern Pacific or western Pacific Ocean). These data contain bycatch species only if they were retained in a purse-seine well during the fishing operation and unloaded.

Smaller (Class 1–5) purse-seine vessels are not required to carry observers, except under specific circumstances (e.g., certification purposes, fishing during closure periods). The primary sources of unobserved data are logbook records and cannery unloading records. Some trips made by small purse-seine vessels are sampled for species composition and length frequencies (i.e., port sampling data). All of these data sources focus on tuna species. The FAD form, a logbook designed in late 2018 to be used by skippers of small vessels when fishing on FADs, is also a source of unobserved data for tunas and sensitive species groups, but bycatch data from this form is currently of little use for the purposes of the ecosystem considerations report as data are aggregated into broad taxonomic groups and data quality is uncertain. As such, there is limited information recorded on interactions with bycatch species by smaller purse-seine vessels. For additional information on data sources for the small purse-seine fishery see WSDAT-02-01.

[2] Size class 6 purse-seine vessels with a carrying capacity > 363 t

[3] Vessels with a carrying capacity ≤363 t

In recent years there has been an increase in the number of smaller vessels that have carried observers. This is due to AIDCP requirements for these vessels to fish during closure periods for Class 6 purse-seine vessels, a desire for dolphin-safe fishery certification, an IATTC pilot project trialing the efficacy of electronic monitoring methodologies (SAC-11-11), and a voluntary observer program for smaller vessels established by the Tuna Conservation Group (TUNACONS)—a consortium of Ecuadorian tuna fishing companies that began in 2018. The minimum observer-derived catch reported by observers for bycatch species by small vessel trips are included in this report (Table J-8) to provide rudimentary information currently available for this fishery, with a view to expanding reporting on this fishery as data provision is hoped to improve in future (but see WSDAT-02-02). The 2nd Workshop on Data Improvement focused on the small purse-seine fishery and was held virtually in February 2025 (WSDAT-02) to discuss possible means for improving data collection and provision with the overarching goal of producing recommendations for updating the data provision Resolution C-03-05 (see WSDAT-02-RPT) and updated recommendations based on participant feedback (SAC-16 INF-O). In 2024, most trips (53%) made by smaller vessels were unobserved, 37% were observed by the voluntary TUNACONS observer program, 6% from the Ecuadorian National observer program, and 4% from the IATTC observer program.

Therefore, in this report we primarily focus on the comprehensive observer dataset from large purse-seine vessels to provide catch estimates for bycatch species. The bycatch data provided by the observers are used to estimate total catches, by set type (i.e., floating objects (OBJ), unassociated tunas (NOA), and dolphins (DEL))[3]. The numbers of sets for each type made in the EPO during 2009–2024 are shown in Table A-7 of Document SAC-16-01.

Despite the observer requirement for all Class-6 trips, some sets are known to have taken place, based on logbooks and other sources, but were not observed. For example, at the start of bycatch data collection in 1993, about 46% of sets were observed, increasing to 70% in 1994. From 1994 to 2008, the average percent of sets observed was around 80%. From 2009 onwards, nearly 100% of sets were observed. Catch-per-day data for both target and non-target, bycatch species are extrapolated[4] to account for such instances.

2.2. Longline

The considerable variability in reporting formats, quality, completeness, and observer coverage levels of longline data has hindered the staff's ability to estimate EPO-wide catches for bycatch species (SAC-08-07b, SAC-08-07d, SAC-08-07e, BYC-10 INF-D). Bycatch data for longline fisheries reported herein were obtained using data of gross annual removals estimated by each CPC and reported to the IATTC in summarized form (i.e., termed "TASK I" data). Because there is uncertainty in whether the IATTC is receiving all bycatch data from the longline fishery of each CPC and considerable variability has been observed in the reported data by taxa, these data are considered incomplete, or 'sample data', and are therefore regarded as minimum annual reported catch estimates for 1994–2023. A staff- and stakeholder-wide collaboration is underway to provide recommendations for updating the data provision Resolution C-03-05 to improve the quality of data collection, reporting, and analysis to align

[4] The observed data is aggregated by species, year, flag and set type. The number of known unobserved sets is taken from logbooks and other sources. Additionally, there are known EPO trips for which the staff do not know the number and type of sets made. Therefore, known bycatch-per-day from observer data is calculated by species, year, flag and set type, and applied to the number of days-at-sea for each trip to estimate the bycatch.
In some instances, there may be unobserved sets or days-at-sea data by a flag that have no equivalent observer data for that year to facilitate a reliable estimation of catch. For these trips, yearly data from a proxy flag is used. The proxy flag is determined by subsequent 5 trips made by the vessel where an observer was onboard, and adopting the predominant flag used for those trips as the proxy flag. Then the bycatch-per-set or day of the known proxy flag for the year in question is applied to the data for the unrepresented flag.

with IATTC's responsibilities set forth in the Antigua Convention and the SSP (SAC-12-09). A preliminary objective of this work is to initiate a series of collaborative workshops between the staff and CPCs to assess the feasibility of collecting desirable data types and develop data collection templates for each gear type, with clear standards and procedures for data submission that will explicitly include interactions with bycatch species, especially those explicitly listed as priority species for research and management advice (e.g., see SAC-15-09, Resolution C-24-05). The first workshop in the series—focused on the industrial longline fishery—was held by videoconference on 09–10 January 2023 and was attended by nearly 100 participants. A background document detailing the need for improving longline data, along with case examples, and staff recommendations was prepared by the staff (WSDAT-01-01); a series of presentations on this document, as well as a presentation by an invited speaker, were discussed during the workshop. Staff recommendations for updating Resolution C-03-05, pertaining to industrial longline data, were further revised based on input from workshop participants and consultations with individual CPCs (see SAC-14-14). The workshop report has also been posted to the IATTC website (WSDAT-01-RPT) and a series of staff recommendations were revised based on participant feedback (see SAC-14 INF-Q; SAC-16 INF-O). In 2023, the SAC, in general terms, endorsed the recommendations on tunas presented by the staff in SAC-14-14 (see SAC-14-16, paragraph 1d, paragraph) as well as a recommendation that the Commission review and update Resolution C-03-05 on "Data Provision", taking into consideration document SAC-14 INF-Q (SAC-14-16, paragraph 7.1 Resolution C-03-05). In 2024, the SAC-15 Recommendations included two similar recommendations, stating, *"(c) That the Commission notes the importance and need of having operational data from the longline fleet in order for stock assessments of tuna and other associated species covered by the Antigua Convention to be completed and (d) That CPCs that maintain tuna longline fleets operating in the EPO provide the scientific staff with historical operational data to enable the implementation of the Scientific Plan with respect to the construction of indices of abundance and useful information for stock assessments of tropical and temperate tunas.*" Therefore, the importance of updating this resolution is reiterated in SAC-16-11 and encourages CPCs to update C-03-05 to better align data provision and submission requirements with the Antigua Convention's mandate to include non-target, dependent and associated species, and the effects of the fishery on the ecosystem.

As part of the data-review process for gathering information on data reported to the IATTC under Resolution C-03-05, the staff were able to determine that the longline catches of sharks reported by CPCs were several times higher than previously reported. A review of the data revealed that a high proportion of shark catches were assigned to "other gears" in the annual Fishery Status Reports since 2006 but were in fact taken by longline by coastal CPCs. Therefore, attributing the catch from "other gears" to "longline" significantly increased the longline catches of sharks from 2006 onwards (see Table A2c in SAC-11-03).

Longline observer data reporting for longline vessels >20 m has been improving since Resolution C-19-08 was adopted in 2019, updating the previous longline observer measure, C-11-08. The staff has received detailed set-by-set operational level observer data for several CPCs, but under coverage by observers was exacerbated by the challenges many CPCs had in placing observers during the COVID-19 pandemic. The program resumed in 2023 and the limited observer data (see section 2 Data Sources; SAC-16 INF-B), is included in this report. The IATTC staff, the Ecosystems and Bycatch Working Group (EBWG) and the Scientific Advisory Committee (SAC) have continued to recommend that the longline observer coverage requirement should be increased to at least 20%. IATTC staff discussed the inadequacy of 5% coverage for scientific purposes and the representativeness of the data to adequately describe the activities of longline fleets in the EPO (BYC-10 INF-D). Although CPCs have made a tremendous effort to improve their reporting of longline observer data, results from that analysis showed that 5% observer coverage is insufficient for estimating the total catch of the relatively data-rich yellowfin and bigeye tunas and so catch estimates for bycatch species are likely to be considerably less reliable given that less data are available for these species. The challenges to observer placement and reporting of observer data necessarily implies that the datasets presented in this report are provided for transparency and show only minimum interactions and mortalities submitted to the IATTC. IATTC staff will seek to provide fleet estimates of longline catches in the EPO based on observer data in the future, but the results of the aforementioned analyses highlight a clear need for data reporting of bycatch species to improve (see SAC-12-09, WSDAT-01-01, SAC-14 INF-Q) prior to data extrapolation attempts.

3. FISHERY INTERACTIONS WITH SPECIES GROUPS

3.1. Tunas and billfishes

Data on catches of the principal species of tunas and bonitos of the genera *Thunnus*, *Katsuwonis*, *Euthynnus*, and *Sarda*, and of billfishes in the Istiophoridae and Xiphiidae families, are reported in Document SAC-16-01. The staff has developed stock assessments—including benchmark assessments for bigeye tuna (SAC-15-02), yellowfin tuna (SAC-16-03, SAC-16 INF-F) and skipjack tuna (SAC-15-04)—and/or stock status indicators (SSIs) for tropical tunas (SAC-16-02). A risk analysis (SAC-16-04) and spatiotemporal modeling (SAC-16 INF-D) on skipjack tuna and results for the management strategy evaluation (MSE) for bigeye tuna (SAC-16-06) will be presented at the 16th meeting of the SAC. The staff has also collaborated on the assessments of Pacific bluefin (2024; SAC-16 INF-Q) and north Pacific albacore (2023)—along with a progress report on north Pacific albacore (SAC-16 INF-R)—tunas led by the International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean (ISC), the assessment of south Pacific albacore tuna (2024) led by the Western and Central Pacific Fisheries Commission (WCPFC), and collaborated on the ISC assessments for north Pacific swordfish (2023), western and central North Pacific striped marlin (2023), and blue marlin (2021). A southern EPO swordfish benchmark assessment is provided in SAC-14-15.

3.2. Marine mammals

Marine mammals, especially spotted dolphins (*Stenella attenuata*), spinner dolphins (*S. longirostris*), and common dolphins (*Delphinus delphis*), frequently co-occur with yellowfin tuna in the EPO. Purse-seine fishers commonly set their nets around herds of dolphins and the associated yellowfin tuna, and then release the dolphins while retaining the tunas. The incidental mortality of dolphins using this method was high during the early years of the fishery, but declined dramatically in the early 1990s, and has remained at low levels thereafter (AIDCP-43-02; Figure J-1). The IATTC staff is collaborating on two research projects on dolphins focused on improving current understanding of the potential impacts of tuna fisheries on dolphin populations (SAC-14 INF-K, SAC-16 INF-K), including a cow-calf separation study and a close kin mark recapture (CKMR) assessment pilot. Additionally, the staff co-organized a 2nd workshop on methods to monitor the status of dolphins in the EPO in May 2024 (see details here).

Estimates of incidental mortality of dolphins in the purse-seine fishery of large vessels during 1994–2024 are shown in Table J-1a. In 2024, the stock of dolphins with the highest incidental mortality was the eastern spinner (n=300), followed by the western-southern spotted (n=154), the northeastern spotted dolphins (n=151), and the whitebelly spinner (n=132). Common dolphins were least impacted by the fishery, with mortalities of 86 northern, 30 central, and 3 southern common dolphins.

In recent years, significant improvements have been made to the minimum data standards of longline observer data submitted to the IATTC, which now require submission of operational level data under Resolution C-19-08. However, as discussed in section 2.2, the low level of observer coverage (at least 5%) currently mandated for these vessels is not representative of the different fleet components and hinders the extrapolation of observed data to generate fleet totals (see BYC-10 INF-D). For the time being, only the minimum number of observed interactions and mortalities reported for marine mammals is presented for 2023 (Table J-1b). Interactions and mortalities were defined by subjective classification of fate (injured, discarded, released, or not reported) and release condition (alive, alive and healthy, alive and injured, dead, or not reported) as recorded by observers. Dispositions not reported or reported as discarded were precautionarily assumed to represent mortalities. Under these assumptions, three of the four interactions with marine mammals reported by observers in 2023 for the EPO were considered to be mortalities. These included 1 interaction with a false killer whale (*Pseudorca crassidens*), 1 interaction with a Risso's dolphin (*Grampus griseus*), and one with a Franciscana dolphin (*Pontoporia blainvillei*). The 1 interaction with a roughtoothed dolphin (*Steno bredanensis*) was recorded as released and was presumed to indicate survival. The staff reiterates that the level of observer coverage should be increased to at least the recommended 20% to help facilitate expansion of the number of interactions and mortalities to the total fleet activities for marine mammals and other vulnerable bycatch species.

3.3. Sea turtles

Sea turtles are occasionally caught in the purse-seine fishery in the EPO, usually when associated with floating objects that are encircled, although they are sometimes also caught by happenstance in sets on unassociated tunas or tunas associated with dolphins. They can also rarely become entangled in the webbing of fish-aggregating devices (FADs) or other floating objects (FAD-07-04) and drown or be injured or killed by fishing gear, although the impact of this is expected to be minimal due to improved FAD construction and design requirements (C-23-04 and C-23-05).

The number of estimated sea turtle mortalities and interactions recorded by observers on large purse-seine vessels, by set type, from 1994–2024 is shown in Figure J-2a and Figure J-2b, respectively. Interactions were defined from observer information recorded as fate on the dedicated turtle form as: entangled, released unharmed, light injuries, escaped from net, observed but not involved in the set and other/unknown, while mortalities were defined as those with fates recorded as: grave injuries, killed, or consumed. The Olive Ridley turtle (*Lepidochelys olivacea*) is, by far, the species of sea turtle most frequently caught, with a total of 21,469 interactions and 875 mortalities (~4%) during 1994–2024, but only 256 interactions and 1 mortality occurred in 2024 (Table J-2a). In 2024, there were 48 interactions recorded with eastern Pacific green, 35 loggerhead, 6 hawksbill, 3 leatherback, and 169 unidentified turtles and no mortalities.

In the longline fishery, sea turtles are caught when they swallow a baited hook, are foul hooked, or drown after becoming entangled in the mainline, floatlines or branchlines and cannot reach the surface to breathe. They are also caught in coastal pelagic and bottom-set gillnet fisheries, where they become enmeshed in the net or entangled in the floatlines or headrope. Although very few data are available on incidental mortality of turtles by longline and gillnet fishing, the mortality rates in the EPO industrial longline fishery are likely to be lowest in "deep" sets (around 200–300 m) targeting bigeye tuna and albacore, and highest in "shallow" sets (<150 m) targeting swordfish. There is also a sizeable fleet of artisanal longline and gillnet fleets from coastal nations that are known to catch sea turtles, but limited data are available (see BYC-11-02).

Data on sea turtle interactions and mortalities in the longline fishery have not been available (SAC-08-07b), but has been improving since 2019 with the submission of operational-level observer data pursuant to Resolution C-19-08. Recalling the observer coverage for most longline vessels is 5% or less (see BYC-10 INF-D), compared to 100% of observed trips in the large-vessel purse-seine fishery, the observer data provided by CPCs for 2023 are considered minimum numbers of interactions and mortalities (Table J-2b) that have been reported to the IATTC (see section 2.2). Here interactions and mortalities were defined by fate (discarded, injured, grave injuries, released, released with hook, or not reported) and/or release condition (alive and healthy, alive and injured, dead, unknown, or not reported) as recorded by observers. Observers reported 88 interactions of sea turtles in the EPO (50 black/green turtles, 16 Olive Ridley turtles, 11 loggerhead, 10 leatherback and 1 hawksbill) for 2023. Thirteen of the 88 interactions resulted in mortalities (6 black/green turtles (12%), 4 loggerhead turtles (36%) and 3 leatherback turtles (30%). The staff hopes to use the new operational observer data submissions required under C-19-08 to report the first total longline fleet catch estimate for sea turtle species in the future, although BYC-10 INF-D cautions that the current 5% observer coverage is insufficient for producing reliable estimates of total catch.

Various IATTC resolutions, most recently C-19-04, have been intended to mitigate fishing impacts on sea turtles and establish safe handling and release procedures for sea turtles caught by purse-seine and longline gears. Additionally, a "circle hook" workshop was held prior to the 13th SAC meeting to discuss a) the effects of different sizes of circle hooks on mitigating bycatch of sea turtles and other vulnerable species in the longline fishery and b) the minimum hook size to satisfy the requirements outlined in Resolution C-19-04. The workshop participants discussed the use of different circle hooks in longline fisheries to satisfy C-19-04, with minimum width of the hook defined on a fishery-specific basis and dependent upon the target species. However, no definitive conclusions or recommendations were made (WSHKS-01), although discussions on this topic resumed during the 11th Bycatch Working Group meeting in May 2022, the 1st EBWG meeting in May 2023, continued at the 2nd EBWG meeting in June 2024 and a 2nd circle hook workshop is planned for April 2025 (WSHKS-02). The EBWG requested the workshop to address several topics including: 1) Define the size characteristics that qualify as a 'large' circle hook (Resolution C-19-04, Paragraph 3(d)(i)); 2) Review of the impacts of fishing operations on the form and structure (i.e., longevity and integrity) of circle hooks of various sizes and from different manufacturers; 3) Develop a third mitigation measure as described in Paragraph 3(d)(iii) of Resolution C-19-04 for small coastal multi-species vessel fleets; and 4) Update best handling and release practice guidelines for shallow-set longline fisheries. A background document (WSHKS-02-01), with several reviews on the workshop topics, is available on the workshop website.

A preliminary vulnerability assessment was conducted in collaboration with the Inter-American Convention for the Protection and Conservation of Sea Turtles (IAC) for the eastern Pacific stock of leatherback turtles for 2018, using the Ecological Assessment of Sustainable Impacts of Fisheries (EASI-Fish) approach (see section 5) (BYC-10 INF-B). The vulnerability status of the stock was determined to be "most vulnerable" in 2018. The staff continued to collaborate with IAC in 2020–2023 to improve the species distribution model (BYC-11-01, Lopez et al. 2024) and vulnerability assessment using updated fisheries data from coastal CPCs (BYC-11-02, Griffiths, Wallace et al. 2024). The final assessment showed that the vulnerability status of the stock remained as "most vulnerable" in 2019. Modelling of 70 conservation and management scenarios showed that the implementation of improved handling and release practices by industrial and artisanal fleets, or use of circle hooks, or use of fish bait by longline fleets could reduce at-vessel and/or post-release mortality to an extent where the vulnerability status of the population could improve to "least vulnerable", assuming the fishing effort dynamics of all EPO fisheries do not change. The use of these three measures in concert was predicted to reduce vulnerability even further. Detailed results from this work were presented in 2022, at the Bycatch Working Group meeting (BYC-11-01, BYC-11-02) and at the Ecosystem and Bycatch Working Group of ICCAT in May 2023, as an example of a successful collaboration between two international organizations. Yet, Resolution C-19-04 has not been updated to reflect the potential benefits of such conservation and management measures on the leatherback turtle.

3.4. Seabirds

There are approximately 100 species of seabirds in the tropical EPO. Some of them associate with epipelagic predators, such as fishes (especially tunas) and marine mammals, near the ocean surface; for some, feeding opportunities are dependent on the presence of tuna schools feeding near the surface. Some seabirds, especially albatrosses and petrels, are attracted to the lights and baits of pelagic longline vessels and are caught on baited hooks—often in the process of their deployment—used by this fishery. Sightings-only data are available for the purse-seine fishery (IATTC Special Report 25).

The IATTC has adopted one resolution on seabirds (C-11-02), and draft guidelines for best handling and release practices (BHRP) of seabirds were presented to the 1st EBWG meeting in 2023 (EB-01-01, Annex

1) and the 2nd EBWG in 2024 (EB-02-03, Annex 1). The BHRPs were further developed for seabirds captured in all fisheries under IATTC purview (EB-03-05) and will be discussed again in 2025 during the 3rd EBWG (EB-03-06)

Participants in the circle hook workshop, held in March 2022 (WSHKS-01), discussed the influence of circle hooks on seabird capture and mortality. The available data seem to be inconclusive to comment on any conservation value of circle hooks over other hook shapes or sizes to seabirds, given a lack of empirical studies. In 2024 the EBWG adopted a seabird action plan (see SAC-15-15, Annex 1) , requesting the IATTC scientific staff to: 1) Conduct a comparison between IATTC seabird mitigation measures described in C-11-02 and mitigation measures used in other tuna RFMOs; 2) Update SAR-7-05b which examined the spatial distribution of seabird species in the IATTC Convention Area relative to longline fishing effort; 3) Generate an overview of mitigation measures in use by CPCs in the IATTC Convention Area, including those CPCs that may have vessels fishing in areas where bycatch mitigation measures are not required; and 4) Summarize observed and estimated seabird bycatch rates in the IATTC Convention Area to inform CPC discussions regarding a potential update to Resolution C-11-02. In 2025, two documents addressing the four objectives laid out in the seabird action plan will be presented at the 3rd EBWG. Document EB-03-02 provides information on seabird distribution overlap with longline fishing effort and seabird bycatch rates in the IATTC Convention Area, and document EB-03-03 provides a review of bycatch mitigation options, measures and use.

As with sea turtles, data on seabird interactions and mortalities in the longline fishery have been unavailable (SAC-08-07b), but with the submission of operational-level observer data for longline vessels >20 m beginning in 2019 some minimum values for 2023 are available (Table J-3) (but see section 2.2 for uncertainties and data gaps in reported data).

The observer data submitted by CPCs for 2023 contained 15 total interactions (14 mortalities) with two seabird taxa, the black-footed albatross, *Phoebastria nigripes*, (10 interactions; 10 mortalities) and unidentified albatross (5 interactions; 4 mortalities) in the EPO. Dispositions for 14 of the interactions were recorded as “discarded” and without additional information, these were precautionarily presumed to result in mortalities. One interaction with an unidentified albatross was recorded as “released” and this was presumed to indicate survival. The staff hopes to report the first total longline fleet catch estimate for seabird species in the future using the operational observer data as improvements in data collection continue—but see BYC-10 INF-D for a discussion on the current inadequacy of longline observer data for expanding data to the activities of the longline fleet to provide estimates of total catch.

3.5. Sharks

Sharks are caught as bycatch in EPO tuna purse-seine fisheries and as either bycatch or a target in longline and multi-species and multi-gear fisheries of the coastal nations. To mitigate the impacts of fishing on sharks, guidelines for best handling and release practices (BHRP) in IATTC fisheries were presented in SAC-15-11, as requested under Resolution C-23-07. An updated shark conservation Resolution C-24-05 was adopted in 2024 and incorporated BHRP recommendations with a request for the staff to work with the CPCs and industry representatives on updating the BHRP guidelines in 2025. Document SAC-16-10 addresses this request and provides the staff’s recommendations for updating the adopted BHRP guidelines. These recommendations are data driven and based upon practices that demonstrate measurable improvements to post release survival rates and include, among others, and to the extent possible, removing sharks from the purse seine net prior to sacking up, releasing entangled sharks promptly and ensuring that sharks are sorted on the main-work deck and do not go down the chutes to the wells, and minimizing handling stress and time onboard for purse-seine fisheries, and leaving sharks in the water, removing trailing gear, and minimizing handling stress to improve post-release survival for longline fisheries.

Stock assessments or stock status indicators (SSIs) are available for only 4 shark species in the EPO: silky

(*Carcharhinus falciformis*) (Lennert-Cody *et al*. 2018; BYC-10 INF-A, BYC-11 INF-A, EBWG-01 INF-A), blue (*Prionace glauca*) (ISC Shark Working Group), shortfin mako (*Isurus oxyrinchus*) (ISC Shark Working Group), and common thresher (*Alopias vulpinus*) (NMFS). As part of the FAO Common Oceans Tuna Project, Pacific-wide assessments of the porbeagle shark (*Lamna nasus*) in the southern hemisphere (Clarke 2017) and the bigeye thresher shark (*Alopias superciliosus*) (Fu *et al*. 2018) were completed in 2017, and for the silky shark (Clarke 2018a), as well as a risk assessment for the Indo-Pacific whale shark population (Clarke 2018b), both in 2018. Whale shark interactions with the tuna purse-seine fishery in the EPO are summarized in document BYC-08 INF-A. The staff is currently conducting a CKMR pilot for silky sharks, as well as improving data collection and the understanding of the catches of sharks by the small-scale coastal fisheries in Central America, Mexico, Peru and Ecuador, with an emphasis on silky sharks and hammerheads (e.g., SAC-14 INF-L, SAC-14 INF-M, SAC-16 INF-V, SAC-16 INF-W).

The first quantitative vulnerability assessment of sharks for EPO industrial and artisanal fisheries—using the EASI-Fish methodology (section 5)—was completed in 2022 and was presented at SAC-13 (SAC-13-11). A total of 49 shark species were recorded to interact with EPO tuna fisheries, of which 32 species were formally assessed using EASI-Fish for 2019. Overall, 20 species were classified as "most vulnerable", including hammerhead sharks (4 species), requiem sharks (10 species), threshers (*Alopias superciliosus* and *A. pelagicus*), mesopelagic sharks (3 species) and the commercially important blue shark (*Prionace glauca*) and shortfin mako (*Isurus oxyrinchus*). The remaining 12 species were classified as "least vulnerable" (9 species) or "increasingly vulnerable" (3 species). The staff recommended further analysis to explore a range of potential hypothetical conservation and management measures (CMMs) that may be implemented—in isolation or in combination—within the EPO to reduce fishery impacts on particularly vulnerable shark species identified, including silky, thresher and hammerhead sharks. The EASI-Fish approach was applied to silky shark and hammerhead sharks during 2022–2023 to determine the relative benefits of alternative management scenarios on species' vulnerability (SAC-14-12).

At its 101st meeting, the IATTC adopted Resolution C-23-07, which includes a provision for IATTC staff to draft, in collaboration with the EBWG and the SAC, an interim list of shark species for the consideration by Members to be under the purview of the Commission. A list of 49 species documented to interact with pelagic fisheries in the EPO was used in combination with other available species lists, ecological characteristics and conservation classifications by international instruments (e.g., IUCN Red List of Threatened Species) to provide potential recommendations from the staff for an interim list of shark species (SAC-15-09). As a result of this work, a final list of 18 species was adopted in 2024 in Annex 4 of Resolution C-24-05 to denote species of special research and management interest for the Commission.

Catches (t) of sharks in the large-vessel purse-seine fishery (1994–2024) and minimum reported catches[5] by longline fisheries (1994–2023) are provided in Table J-4a, while catches of the most frequently caught species, discussed below, are shown in Figure J-3a. Reporting of many shark species by longline gear began in 2006 (but see section 2 for data gaps, including high variability in this dataset). For purse seiners, the majority of the shark catch is from floating object sets, although this varies by species. Silky shark (family Carcharhinidae) is the most commonly caught shark species in the purse-seine fishery with annual catches averaging 551 t—primarily from sets on floating objects (Figure J-3a)—and being 727 t in 2024. In contrast, minimum reported annual catch in the longline sample data for 2006–2023 averaged 9,501 t while only 55 t were reported in 2023. Annual catch of the oceanic whitetip shark (Carcharhinidae) in the purse-seine fishery averaged 53 t (also primarily from sets on floating objects) and was 22 t in 2024. The minimum reported annual catch in the longline fishery from 2006–2018 averaged 165 t and none were reported in

[5] Sharks caught by longline vessels are recorded using different weight metrics (e.g., round, trunk or whole weight) and thus, total annual reported catch estimates may contain a mix of these weight metrics. The staff is working on harmonizing shark data collection to improve the reliability of total catch estimates (e.g., SAC-11-13).

2019–2023. Catches of oceanic whitetip have declined in the purse-seine fishery since the early 2000s, while minimum reported catches have been variable in the longline fishery (Figure J-3). Minimum annual reported catch of blue shark in the longline fishery from 1994–2023 averaged 6,715 t and was 10,268 t in 2023. By contrast, the annual catch in the purse-seine fishery from 1994–2024 averaged only 2 t, with 2 t caught in 2024. Some anomalies in the reporting of longline data are likely related to the COVID-19 pandemic or variability in reporting certain species or information, although it's important to note the reporting of bycatch data is not compulsory according to the data provision resolution (C-03-05) and the corresponding specifications (see SAC-12-09, WSDAT-01-01, SAC-14 INF-Q, SAC-16 INF-O). Additionally, a list of priority shark species was only recently formally established (see Resolution C-24-05), which contributes to the variability in reporting for fisheries other than the large purse-seine fishery. The staff reiterate the importance of updating C-03-05 to adapt to mandates set forth in the Antigua Convention and encourage CPCs to draft a revised resolution based on input from the staff and workshop participants in SAC-16 INF-O. These efforts are expected to reduce the variability in data reporting and quality.

Other important species of sharks caught in the purse-seine and longline fisheries include the smooth hammerhead (*Sphyrna zygaena*), the pelagic thresher (*Alopias pelagicus*), and mako sharks (*Isurus* spp.) (Table J-4a, Figure J-3a). Catch estimates for the smooth hammerhead shark in the purse-seine fishery averaged 26 t (primarily caught in floating-object sets) and was 11 t in 2024, while in the longline fishery minimum annual reported catch averaged 802 t (2006–2023) and was 17 t in 2023. In contrast, the pelagic thresher was caught primarily in unassociated tuna school sets by the purse-seine fishery with the estimated annual catch averaging 4 t and was 2 t in 2024. Minimum annual reported catch of the pelagic thresher by the longline fishery averaged 1,703 t (2007–2023) and only 19 t was reported in 2023. Catch estimates for the mako sharks by the purse-seine fishery were lower than the aforementioned shark species averaging 3 t and was 1 t in 2024. However, in the longline fishery the minimum annual reported catch averaged 1,467 t (1994–2024) and was 1,220 t in 2023.

Complementary to the shark catches presented in Figure J-3a and similar to the purse-seine based SSIs reported by set type for the tropical tunas (SAC-16-02), catch by set type was scaled so that their average equals 1 during the 1994–2024 time period for 3 species of sharks with the highest annual nominal catches by large purse-seine vessels (i.e., silky shark, oceanic whitetip shark and smooth hammerhead shark). This relative catch in weight (t), which helps to better understand trends and anomalies in species catch, is presented in Figure J-3b. In the earlier years (pre-2000), the silky shark relative catch was 3–3.5 times greater than the mean for those caught in dolphin sets, and about 3.5 times greater than the mean (1994) for those caught in unassociated sets, while relative catches were less variable in the floating-object set fishery. For the oceanic whitetip shark, a decreasing trend in relative catches is apparent for all set types with the highest relative catches occurring prior to 2000. The relative catches of smooth hammerhead sharks were variable, particularly in dolphin and unassociated sets; about 4 and 5 times greater than the mean in dolphin sets and in unassociated sets in 2004, respectively.

The spatial distribution (in 5°x5° grid cells) of the catch of the same 3 shark species by set type for the large-vessel purse-seine fishery is presented in Figure J-3c to provide an indication of current (i.e., 2024) and past (average of the last 5 years; 2019–2023) spatial catch dynamics. Catches of silky shark were widely distributed across the EPO, but primarily in the 10°N to 10°S latitudinal band and occurred mostly in floating-object sets. Silky shark catches were slightly lower in 2024 compared to the 5-year average throughout the EPO with the exception of higher catches in unassociated sets off the coast of southern Mexico in 2024. Catches of oceanic whitetip shark and smooth hammerhead shark were mostly negligible (i.e., primarily <1 t) in both time periods. Minimal catches of oceanic whitetip shark were observed in two locations from floating-object sets in 2024 (5°N–10°N, 140°W–150°W and 10°S–15°S, 125°W–135°W), with no catches >1 t in the 5-year average. For the smooth hammerhead shark, minimal catches (>1 t) were observed east of 85°W and south of 10°S off South America in 2024 while catches >1 t were observed east of 100°W along the equator and south of 5°S off South America during the 5-year average.

The limited observer data from small purse-seine vessels showed 29 t of silky shark and 3 t of scalloped hammerhead were caught in floating-object sets in 2024, while catches of other shark species or species groups (5 taxa) were minimal (≤ 1 t) (Table J-8).

The minimum catches derived only from the reported observer data for sharks caught by longline in 2023 are presented in Table J-4b (see section 2.2 and BYC-10 INF-D for uncertainties and data gaps in longline data). Blue shark was by far the most frequently caught shark species in this dataset with 4,508 interactions and 4,179 mortalities in 2023, followed by the crocodile shark with 545 interactions and 152 mortalities (~28%), the shortfin mako shark with 225 interactions, which all resulted in mortalities, bigeye thresher shark with 119 interactions and 111 mortalities (93%) and velvet dogfish with 115 interactions and 106 mortalities (92%). Less than 100 interactions were reported for all other shark taxa. Under the disposition criteria described in Table J-4b, ~86% of interactions with all sharks reported by observers resulted in mortalities.

The artisanal longline fisheries of the coastal CPCs seasonally target sharks, tunas, billfishes and dorado (*Coryphaena hippurus*), and some of these vessels are similar to industrial longline fisheries in that they operate in areas beyond national jurisdictions (Martínez-Ortiz *et al.* 2015, SAC-16-09). However, essential shark data from these longline fisheries are often lacking, and therefore conventional stock assessments and/or stock status indicators cannot be produced (see data challenges outlined in SAC-07-06b(iii)). In 2025, a document describing proposed fleet characteristics to define three categories of longline fisheries was produced (SAC-16-09) to address a recommendation by the EBWG (see SAC-15-15 "Fleet Characteristics"). These proposed classifications of longline fleets included (1) large-scale longline, (2) medium-scale longline and (3) small-scale fisheries of coastal States. Adoption of these proposed classifications is essential for the appropriate development of IATTC documents, research planning, management decisions and measures, and for providing clarity and guidance to CPCs, data handlers, scientists, policy makers and all relevant stakeholders.

Since 2014, the IATTC staff has carried out extensive collaborative research with Organización del Sector Pesquero y Acuícola del Istmo Centroamericano (OSPESCA) and IATTC's Central American CPCs to develop a robust sampling methodology to improve data collection for shark fisheries in Central American EPO states. After approximately 7 years (2015–2021), this work—funded by the Food and Agriculture Organization of the United Nations (FAO) and the Global Environmental Facility (GEF) under the framework of the ABNJ Common Oceans program, the IATTC capacity building fund, and the European Union—was completed in December 2021. The project's final results were presented at the 14th meeting of the SAC (e.g., SAC-14 INF-L), but there is a great need to maintain continuity of data collection to generate key fisheries data to assess and manage shark species in the EPO. Meanwhile, a second phase of the FAO-GEF ABNJ project is underway and the IATTC is receiving support to expand the previous work conducted in Central America to other EPO coastal States (SAC-14 INF-M). Two documents on the progress of this second phase will be provided at the 16th meeting of the SAC (see SAC-16 INF-V and SAC-16 INF-W). Data obtained from these projects may be included in future iterations of this report to provide improved catch estimates, albeit minimum estimates, for sharks by the various longline, gillnet and mixed gear fleets.

3.6. Rays

To better represent estimated annual catches of manta rays (Mobulidae) and stingrays (Dasyatidae), these taxa are now reported in numbers of individuals by the large-vessel purse-seine fishery (1994–2024) in Table J-5a, while catches of key species are shown in Figure J-4a. Rays have rarely been reported in the annual summary reports for the longline fishery, although data have been available in the more recently obtained observer data (see Table J-5b). The largest average catches in the purse-seine fishery were observed for unidentified mobulid rays (Mobulidae spp., average 1994–2024: 1,008 individuals; number of individuals in 2024: 612, followed by the pelagic stingray (average: 834; 2024: 944), the smoothtail manta (average: 336; 2024: 249), the spinetail manta (average: 249; 2024: 434), unidentified stingrays (Dasyatidae spp., average: 175; 190) and the giant manta ray (average: 108; 2024: 13 individuals). Although catches of these rays can vary by set type, they have been highest in unassociated sets, followed by dolphin sets, and lowest in floating-object sets (Figure J-4a).

Similar to sharks, relative catches of rays in numbers of individuals (i.e., scaled catch with the average equal to 1) by set type for large purse-seine vessels are provided in Figure J-4b. As with the reported observed catch (Figure J-4a), ray relative catches were highly variable with no apparent trends, and peaks of relatively high catches were not consistent between species and set type.

The spatial distribution of catches (5°x5° grid cells) was greatest for pelagic stingray with variability in catches by set type. Most catches occurred primarily in floating-object sets south of 5°N and east of 120°W, in dolphin sets north of the equator, and in unassociated tuna school sets along the coast of South America for the 5-year average (2019–2023). In 2024, the highest catches occurred in unassociated sets along the coast of South America and in dolphin sets in the Sea of Cortez (Figure J-4c). Minimal catches (<5 individuals) of the giant manta were observed across space and time while catches of the spinetail (primarily <30 individuals) and smoothtail (primarily <50 individuals) manta occurred in coastal areas. Catches of the spinetail manta occurred in dolphin sets off the coast of central America and mostly in unassociated sets off the coast of South America during both time periods. Catches of the smoothtail manta occurred in unassociated sets in the Sea of Cortez in both time periods with greater catches in the 5-year average, primarily in dolphin sets along the coast of central America in both time periods, and in unassociated sets off the coast of South America in 2024.

For the small purse-seine vessel fishery, the limited observer data available for 2024 showed floating-object sets contained the largest numbers of individual ray species, including the pelagic stingray (n=31), followed by the spinetail manta (n=11), Chilean devil ray (n=9) and the smoothtail manta (n=6) while the number of other rays were ≤2 (Table J-8).

The minimal data available from the reported longline observer dataset for 2023 (see section 2.2. for data gaps and BYC-10 INF-D) showed that the most interactions were with the pelagic stingray (*Pteroplatytrygon violacea*) (3,832 individuals) with 3,634 (95%) of these interactions resulting in mortalities, followed by unidentified rays and skates (Rajiiformes.) with 6 interactions (1 mortality, 17%), giant manta with 4 interactions (3 mortalities, 75%), and unidentified manta rays, Mobulidae (4 interactions, 4 mortalities) and *Mobula* spp. (1 interaction1, 1 mortality) (Table J-5b).

The vulnerability status and efficacy of potential conservation and management measures (CMMs) for the spinetail manta (*Mobula mobular*) impacted by industrial purse-seine and longline fisheries in the EPO was determined using the EASI-Fish methodology (section 5). In the assessment year of 2018, the estimated fishing mortality exceeded the $F/F_{40\%}$ and $SBR/SBR_{40\%}$ biological reference points, leading to a vulnerability classification of "most vulnerable". A retrospective analysis of vulnerability from 1979–2018 showed the species to be classified as "least vulnerable" between 1979 and 1993, but became "most vulnerable" from 1994, which coincided with the rapid spatial expansion of the industrial purse-seine fishery. Vulnerability increased significantly from 2011 following the rapid increase in the number of purse-seine sets made on floating objects to 2018. Simulating the CMMs in place in 2018 for EPO tuna fisheries (i.e., an EPO-wide closure) and for mobulids specifically (i.e., use of best handling and release practices under C-15-04) resulted in 31 of the 45 scenarios changing the classification of the species from "most vulnerable" to "least vulnerable", which primarily involved a reduction of post-capture mortality by as little as 20%. Implementing appropriate best handling and release practices can be a reasonably simple, rapid and cost-effective conservation measure, but a recommendation from the work was to extend the EASI-Fish analysis to all species of mobulids impacted by EPO tuna fisheries, improve estimates of post-release mortality for these species through dedicated tagging studies (which are currently being conducted: Project M.2.c), and improve species-specific catch reporting, especially in small scale coastal 'artisanal' fisheries, to improve the reliability of outputs from EASI-Fish assessments. The development of BHRP guidelines for rays is planned for 2026 (EB-02-03).

The IATTC has recognized the conservation importance of mobulids since 2015 when it implemented conservation and management measures in Resolution C-15-04. However, as was the case with shark species prior to 2024, there has been no prescriptive list of ray species that come under the purview of the IATTC. In 2024, the IATTC's Scientific Advisory Committee made a recommendation to the Commission that "…*the IATTC staff develop a draft list of ray and mobulid species under the purview of the IATTC for consideration by the EBWG and the SAC*". In 2025, the staff analyzed catch data from IATTC data holdings for industrial and artisanal pelagic fisheries in the EPO and identified interactions with 17 ray species. Of these, 7 species—6 mobulids and the pelagic stingray (*Pteroplatytrygon violacea*)—had oceanic distributions and occupied epipelagic habitats where IATTC pelagic fisheries operate and were recommended to the EBWG and the SAC to come under the purview of the IATTC (SAC-16-08).

3.7. Other large fishes

Species composition of catches varies between purse-seine and longline fisheries. Large pelagic fishes caught by the large-vessel purse-seine fishery, primarily in floating-object sets, (1994–2024) and longline (1994–2023) fisheries are shown in Table J-6a, with time series of catches of key species presented in Figure J-5. The most commonly-caught pelagic fish in both fisheries is dorado (Coryphaenidae) with the estimated average annual catch for the purse-seine fishery being 1,364 t (871 t in 2024) and the minimum reported annual catch for the longline fishery averaging 5,657 t (421 t in 2023). Dorado is also one of the most important species caught in the artisanal fisheries of the coastal nations of the EPO (SAC-07-06a(i)). Recommendations for potential reference points and harvest control rules for dorado in the EPO were presented at the 10th meeting of the SAC (SAC-10-11). Additionally, a Resolution (C-23-09) on the research for the management of dolphinfish was adopted at IATTC's 101st Commission meeting in 2023.

Other key species caught by the purse-seine fishery include wahoo (Scombridae) and rainbow runner (Carangidae). Wahoo had an estimated average annual catch of 361 t for the purse-seine fishery, although catches have declined from a peak of 1,025 t in 2001 to 233 t in 2024 (Figure J-5). Minimum reported annual catch of wahoo by the longline fishery have averaged 179 t and was 256 t in 2023. No catches of rainbow runner have been reported by the longline fishery. However, in the purse-seine fishery, estimated average annual catches of rainbow runner were 49 t, with the peak catch in 2007 at 158 t and declining thereafter to 87 t in 2024 (Figure J-5).

Pelagic fishes commonly reported by the longline fishery include opah (Lampridae), snake mackerels (Gempylidae) and pomfrets (Bramidae). Minimum reported annual catches for these species averaged 374 t (1994–2023), 357 t (2006–2023), and 55 t (1994–2023), respectively. Catches of all these taxa have increased after the mid-2000s (Figure J-5) but note the uncertainty and data gaps in this dataset (section 2.2). For the most recent reporting year (2023), there were 250 t, 288 t, and 64 t of opah, snake mackerels, and pomfrets reported, respectively (Table J-5a).

The limited observer data available for 2024 for the small purse-seine fishery included 126 t of dorado and 30 t of wahoo caught in floating-object sets, while the remaining species or species groups of large fishes (7 taxa) had ≤5 t reported (Table J-8).

For 2023, the limited available data from longline observers (see section 2.2. and BYC-10 INF-D) is provided in Table J-6b. These data show the most frequently caught species in this dataset was the long snouted lancetfish (*Alepisaurus ferox*) with 8,501 interactions (all resulted in mortalities), followed by escolar (*Lepidocybium flavobrunneum*) with 3,165 interactions, one of which resulted in a mortality, snake mackerel (*Gempylus* *serpens*) with 2,581 interactions and 2,544 mortalities (99%), dorado (Corpyhaenidae) with 2,468 interactions, all resulting in mortalities, wahoo (*Acanthocybium solandri*) with 1,707 interactions and 1,703 mortalities, opah (*Lampris* guttatus) with 1,171 interactions and 1,167 mortalities, and sickle pomfret (*Taractichthys steindachneri)* with 700 interactions and 697 mortalities. The remaining 7 taxa had approximately <500 interactions. Most interactions with large fishes resulted in mortalities (99%).

3.8. Forage species

A large number of taxa occupying the middle trophic levels in the EPO ecosystem—generically referred to as "forage" species—play a key role in providing a trophic link between primary producers at the base of the food web and the upper-trophic-level predators, such as tunas and billfishes. Some small forage fishes are incidentally caught in the EPO by purse-seine vessels on the high seas, mostly in sets on floating objects, and by coastal artisanal fisheries, but are generally discarded at sea. Catches of these species are presented in Table J-7 with key species as identified by catch data presented in Figure J-6 for the large-vessel purse-seine fishery.

Bullet and frigate tunas (Scombridae) are by far the most commonly reported forage species with estimated annual catches averaging 963 t from 1994–2024. However, their catches have declined from 1,921 in 2005 to 601 t in 2024 (Figure J-6). Triggerfishes (Balistidae) and filefishes (Monacanthidae) are the second most commonly reported forage group with annual estimated catches averaging 279 t and totaling 513 t in 2024. Combined catches for these two groups peaked in 2004 at 922 t but have otherwise been variable. Annual catches of sea chubs (Kyphosidae) have averaged 16 t and have remained minimal with 7 t in 2024. Lastly, annual catches of the various species in the category 'epipelagic forage fishes' averaged 7 t with 11 t estimated to be caught in 2024.

A total of 95 t of bullet and frigate tunas and 133 t of triggerfishes and filefishes caught in floating-object sets were reported by observers on the limited number of trips on small purse-seine vessels that carried an observer in 2024. Catches of all other species or species groups (4 taxa) of small fishes were minimal (≤1 t) (Table J-8).

4. PHYSICAL ENVIRONMENT

Environmental conditions affect marine ecosystems and therefore impact species distributions and abundance, the dynamics and catchability of target and bycatch species, and the activities of fishers[6] (e.g., SAC-10 INF-D, SAC-16 INF-T). At IATTC's 101st meeting in 2023, a resolution on climate change was adopted (C-23-10; amended in 2024 as C-24-10), and correspondingly, a proposed workplan towards climate resilient fisheries was presented at the 2nd EBWG meeting and the 15th meeting of the SAC (SAC-15-12). The following summary of the biophysical environment covers: 1) short-medium and long-term environmental indicators, and 2) environmental conditions and their potential effect on the fishery during the previous year, in this case, 2024.

4.1. Environmental indicators

The ocean environment changes on a variety of time scales, from seasonal to inter-annual, decadal, and longer "regimes". Longer-term climate-induced changes are typically decadal at intervals of around 10–30 years and are characterized by relatively stable average conditions and patterns in physical and biological variables. The dominant source of variability in the upper layers of the EPO is the El Niño-Southern Oscillation (ENSO), an irregular fluctuation involving the entire tropical Pacific Ocean and the world's atmosphere (Fiedler 2002). El Niño events occur at two- to seven-year intervals, and are characterized by weaker trade winds, deeper thermoclines, and higher sea-surface temperatures (SSTs) in the equatorial

[6] See SAC-04-08, *Physical Environment*, and SAC-06 INF-C for a comprehensive description of the effects of physical and biological oceanography on tunas, prey communities, and fisheries in the EPO.

EPO. El Niño's alternate phase is commonly called La Niña and is characterized by stronger trade winds, shallower thermoclines, and lower SSTs. The changes in the biogeochemical environment caused by ENSO have an impact on the biological productivity, feeding, and reproduction of fishes, seabirds, and marine mammals (Fiedler 2002).

ENSO is thought to cause considerable variability in the availability of commercially-important tunas and billfishes to capture by tuna fleets in the EPO (Bayliff 1989). For example, the shallow thermocline during a La Niña event can increase purse-seine catch rates for tunas by compressing the preferred thermal habitat of small tunas near the sea surface, while the deeper thermocline during an El Niño event likely could make tunas less susceptible to capture, and thus reduce catch rates. Furthermore, warmer- or cooler-than-average SSTs can also cause the fish to move to more favorable habitats, which may also affect catch rates as fishers expend more effort on locating the fish.

Recruitment of tropical tunas in the EPO may also be affected by ENSO events. For example, strong La Niña events in 2007–2008 may have been partly responsible for the subsequent lower recruitment of bigeye tuna, while the largest recruitments corresponded to the extreme El Niño events in 1982–1983 and 1998 (SAC-09-05). Yellowfin recruitment was also low in 2007, but high during 2015–2016, after the extreme El Niño event in 2014–2016 (SAC-09-06). Analyses on the potential effects of environment on tuna catches were presented at the 15th meeting of the SAC (SAC-15 INF-L) and updated for SAC-16 (SAC-16 INF-T).

The Climate Diagnostics Bulletin of the US National Weather Service reported that in 2024 anomalies—defined in the Bulletin as a departure from the monthly mean—in oceanic and atmospheric characteristics (e.g., surface and sub-surface temperatures, thermocline depth, wind, and convection) were consistent with weakening El Niño conditions from January through March, a transition to ENSO neutral conditions in April with these conditions lasting through November, and La Niña conditions in December.

Indices of variability in such conditions are commonly used to monitor the direction and magnitude of ENSO events in the Pacific Ocean. The Oceanic Niño Index (ONI) is used by the US National Oceanic and Atmospheric Administration (NOAA) as the primary indicator of warm El Niño and cool La Niña conditions within the Niño 3.4 region in the east-central tropical Pacific Ocean (Dahlman 2016) (Figure J-7a). Therefore, the ONI is used in this report to characterize inter-annual variability in SST anomalies. The ONI is a measure of El Niño defined by NOAA as "a phenomenon in the equatorial Pacific Ocean characterized by a five consecutive 3-month running mean of SST anomalies in the Niño 3.4 region that is above (below) the threshold of +0.5°C (-0.5°C)." The ONI categorizes ENSO events from "extreme" to "weak" (Figure J-7b). For example, the "extreme" El Niño event in 1997–1998 was followed by a "very strong" La Niña event in 1998–2000. "Strong" La Niña events were also observed in 2007–2008 and 2010–2011. The highest ONI values (>2.5) were recorded during the 2015–2016 "extreme" El Niño event. "Very strong" El Niño conditions began to weaken at the beginning of 2024 and transitioned to a neutral phase while the year ended in La Niña conditions, with values ranging from 1.8 to -0.5 during this time period (Figure J-7b).

The Pacific Decadal Oscillation (PDO; Figure J-8) index is used to describe longer-term environmental fluctuations in the Pacific Ocean. In the EPO, it has been used to explain the influence of environmental drivers on the vulnerability of some species, such as the silky shark, to capture by tuna fleets (Lennert-Cody *et al.* 2018). The PDO—a long-lived El Niño-like pattern of Pacific climate variability, with events persisting 20–30 years—tracks large-scale interdecadal patterns of environmental and biotic changes, primarily in the North Pacific Ocean (Mantua 1997), with secondary patterns observed in the tropical Pacific, the opposite of ENSO (Hare and Mantua 2000). As with ENSO, PDO phases are classified as "warm" or "cool". PDO values peaked at 2.79 in August 1997 and at 2.62 in April 2016, both of which coincided with the extreme El Niño events indicated by the ONI. The PDO has been in a "cool" phase since early 2020. During 2024, cool conditions persisted with the lowest value in October (-3.04) and the highest value in February (-1.07) (see ERSST V5 PDO Time series data).

4.2. Spatio-temporal exploration of environmental conditions

A time series of SST and chlorophyll-a concentration (CHL-a; an indicator of primary productivity biomass) (Figure J-9) in the eastern tropical Pacific (ETP) from 5°N to 5°S—the same latitudinal band used in the ONI—was developed to explore the variability in these variables across space and time using time-longitude Hovmöller diagrams. The SST time series show mean monthly values from 1993–2024, while monthly CHL-a concentrations covers data for 2003–2024 due to limitations with data availability. The SST plot (Figure J-9, top panel) clearly shows the extension of warmer waters during the extreme El Niño events of 1997–1998, 2015–2016, and for the latter half of 2023 into 2024 while cooler waters are observed during the strong La Niña events in 1999–2000, 2007–2008 and 2010–2011 across the ETP. The CHL-a plot (Figure J-9, bottom panel), although the pattern is less clear than the SST plot, shows an increase in CHL-a concentrations following the strong La Niña events particularly in 2010–2011, likely due to increases in nutrient availability.

4.3. Environmental conditions and distribution of catches

The availability of fish, and thus catches, are strongly related to environmental conditions and processes, particularly in pelagic waters (Fiedler and Lavín 2017; Chassot *et al*. 2011). ENSO conditions are influenced by many oceanic and atmospheric factors, but both SST and CHL-a levels are known to strongly influence the habitat and distributions of oceanic animals (Hobday and Hartog 2014).

Figures J-10 and J-11 show quarterly mean SSTs and CHL-a concentrations, respectively, to: 1) provide a general indication of seasonal environmental variability for 2024, and 2) overlay the distribution of tropical tuna catches, as a first step, to illustrate the potential influence of environmental conditions on catches across the EPO during 2024. In the future, the staff plans to incorporate catch distributions for key bycatch species and develop species distribution models (SDMs) to better describe potential relationships between environment and species. In 2021–2022, SDMs were developed for the leatherback sea turtle (BYC-11-01) and 32 species of sharks (SAC-13-11) and several high-resolution SDMs are underway for other vulnerable bycatch species, including oceanic whitetip, silky and hammerhead sharks.

Warm waters prevailed over much of the EPO during 2024, with the exception of the northern and southern extremities of the Convention Area where cooler waters occurred (Figure J-10). A warm pool off Central America was observed in quarter 1 that extended westwards during quarters 2 and 3 and retracted in quarter 4. A secondary, less intense, warm pool was observed in the southwestern EPO (below the equator–20°S, 130°–150°W) during quarters 1 and 2, which contracted in quarters 3 and 4.

Figure J-11 shows CHL-a concentrations were highest along the equator and the coast of the Americas year-round. The oligotrophic[7] South Pacific Gyre—located between 20°–40°S and extending from 150°–90°W—was present in quarter 1, retracted in quarters 2 and 3, and returned in quarter 4.

During quarters 1 and 2, skipjack predominated in the catches in waters ~20–25°C off the coast of South America (Fig. J-10), where CHL-a concentration was high (Fig. J-11). Yellowfin tuna was the predominant tuna species in the catch primarily north of the equator during these same quarters; yellowfin catches were present in the warmer waters (~29°C) off central America in quarters 2–4. Bigeye tuna catches mostly occurred south of 10°N with greater catches taken west of ~110°W, particularly in quarter 2. No tuna catches were recorded in the oligotrophic gyre located approximately south of 20°S and the western boundary of the EPO (150°W) to about 100°W.

[7] An area of low productivity, nutrients, and surface chlorophyll, often referred to as an "oceanic desert".

5. IDENTIFICATION OF SPECIES AT RISK

The primary goal of EAFM is to ensure the long-term sustainability of all species impacted—directly or indirectly—by fishing. However, this is a significant challenge for fisheries that interact with many non-target species with diverse life histories, for which reliable catch and biological data required for single-species assessments are lacking. An alternative for such data-limited situations, reflected in Goal L of the SSP, are Ecological Risk Assessments (ERAs), assessments that are designed to identify and prioritize potentially vulnerable species for data collection, research and management.

'Vulnerability', in this risk assessment context, is defined as the potential for the productivity of a stock to be diminished by the direct and indirect impacts of fishing activities. The IATTC staff has applied qualitative assessments using Productivity-Susceptibility Analysis (PSA) to estimate the relative vulnerability of data-limited, non-target species caught in the EPO by large purse-seine vessels (Duffy *et al*. 2019) and by the longline fishery (SAC-08-07d).

Because PSA is unable to quantitatively estimate the cumulative effects of multiple fisheries on data-poor bycatch species, a new approach—Ecological Assessment of Sustainable Impacts of Fisheries (EASI-Fish)—was developed by the IATTC staff in 2018 (SAC-09-12) to overcome this, and other, technical issues. This flexible, spatially-explicit method uses a smaller set of parameters than PSA to first produce a proxy for the instantaneous fishing mortality rate ($\tilde{F}$) of each species, based on the 'volumetric overlap' of each fishery on the geographic distribution of these species. The estimate of $\tilde{F}$ is then used in length-structured yield- and spawning biomass per-recruit models to assess the vulnerability of each species using conventional biological reference points (e.g., F_{MSY}, $SPR_{40\%}$).

EASI-Fish was successfully applied to 24 species representing a range of life histories, including tunas, billfishes, tuna-like species, elasmobranchs, sea turtles and cetaceans caught in EPO tuna fisheries as a 'proof of concept' assessment in 2018 (SAC-09-12). It was subsequently used to assess the vulnerability status of the spinetail manta (*Mobula mobular*) caught by all industrial tuna fisheries in the EPO (BYC-09-01), and the East Pacific regional management unit (RMU) of the Critically Endangered leatherback turtle (*Dermochelys coriacea*) (BYC-10 INF-B, BYC-11-02). Therefore, EASI-Fish is planned to be used by the staff in future to assess species-specific vulnerability within all species groups (e.g., elasmobranchs, sea turtles, teleosts) impacted by EPO tuna fisheries. In 2022, EASI-Fish was used to assess the vulnerability of the East Pacific stock of the leatherback turtle and shark bycatch species in EPO tuna fisheries and the results were presented at BYC-11 (BYC-11-02) and SAC-13, respectively (SAC-13-11). An EASI-Fish assessment for silky shark and hammerheads was presented at SAC-14, where the potential efficacy of 43 different conservation and management measures was simulated (SAC-14-12). The simulations showed that almost all CMMs were effective in reducing vulnerability, such as banning wire leaders, imposing a 100 cm total length minimum retention for all sharks, and prohibiting landing of all sharks. However, the positive effects of these measures were negated in most scenarios due to high post-release mortality of these species. These results highlighted that the most effective conservation measure for sharks is to avoid interaction with EPO fisheries.

6. ECOSYSTEM DYNAMICS

Although vulnerability assessments (e.g., EASI-Fish) are useful for assessing the ecological impacts of fishing by assessing the populations of individual species, ecosystem models are required to detect changes in the structure and internal dynamics of an ecosystem. These models are generally data- and labor-intensive to construct, and consequently, few fisheries worldwide have access to a reliable ecosystem model to guide conservation and management. These models require a good understanding of ecosystem components and the direction and magnitude of the trophic flows between them, which require detailed ecological studies involving stomach contents and/or stable isotope studies. Purposefully, IATTC staff have had a long history of undertaking such trophic studies, including the experimental determination of consumption estimates of yellowfin tuna at the NMFS Kewalo Basin facility on Oahu, HI in the 1980s, to more recent analyses of stomach content and stable isotope analysis of a range of top-level predators.

In 2003, the IATTC staff compiled the trophic data to complete the development of a model of the pelagic ecosystem in the tropical EPO (IATTC Bulletin, Vol. 22, No. 3)—named "ETP7"—to explore how fishing and climate variation might affect target species (e.g., tunas), byproduct species (e.g., wahoo, dorado), elasmobranchs (e.g., sharks), forage groups (e.g., flyingfishes, squids) and species of conservation importance (e.g., sea turtles, cetaceans). A simplified food-web diagram, with approximate trophic levels (TLs), from the model is shown in Figure J-12.

The model was calibrated to time series of biomass and catch data for yellowfin and bigeye tunas for 1961–1998. There have been significant improvements in data collection programs in the EPO since 1998, that has allowed the model to be updated with these new data up to 2018 ("ETP-8"). The model required a further update in 2021 due to a significant change in how the IATTC staff have reclassified the catch data submitted by the CPCs for "other gears" into longline and other gear types following an internal review of the data. This resulted in a dramatic increase in reported longline catches of high trophic level predators (sharks), which can have a strong influence on ecosystem dynamics. Therefore, annual catch estimates by species for 1993–2018 were assigned to the relevant functional groups in the ETP-21 model, which was then rebalanced and recalibrated to time series data to provide an updated ecosystem status for 2021 and to undertake simulations to assess potential impacts of the FAD fishery on the structure of the ecosystem (SAC-12-13).

6.1. Ecological indicators

Since 2017, the most recent Ecopath model has been used in the *Ecosystem Considerations* report to provide annual values for seven ecological indicators that, together, can identify changes in the structure and internal dynamics of the ETP ecosystem. These indicators are: mean trophic level of the catch (TL_c), the Marine Trophic Index (MTI), the Fishing in Balance (FIB) index, Shannon's index, and the mean trophic level of the modelled community for trophic levels 2.0–3.25 ($TL_{2.0}$), ≥3.25–4.0 ($TL_{3.5}$), and >4.0 ($TL_{4.0}$). A full description of these indicators is provided in SAC-10-14.

ETP-21 was updated in 2024 (named ETP-24) using annual catch estimates by species for 1993–2022 assigned to the relevant functional groups, which was then rebalanced to provide an updated ecosystem status for 2022.

Ecological indicators showed that values for TL_c and MTI decreased from their peak of 4.77 and 4.83 in 1991 to 4.66 and 4.69 in 2022, respectively, as the purse-seine fishing effort on floating objects significantly increased (Figure J-13), where there was increasing catches of high trophic level bycatch species that tend to aggregate around floating objects (e.g., sharks, billfish, wahoo and dorado). Since its peak in 1991, TL_c declined by 0.170 of a trophic level in the subsequent 30 years, or 0.057 trophic levels per decade. The increasing number of OBJ sets is also seen in the FIB index that exceeds zero after 1990, as well as the continual change in the evenness of biomass of the community indicated by Shannon's index.

The above indicators generally describe the change in the exploited components of the ecosystem, whereas community biomass indicators describe changes in the structure of the ecosystem once biomass has been removed due to fishing. The biomass of the $TL_{MC\mathit{4.0}}$ community was at one of its highest values (4.493) in 1986 but has continued to decline to 4.467 in 2022 (Figure J-13). As a result of changes in predation pressure on lower trophic levels, between 1993 and 2022 the biomass of the $TL_{MC\mathit{3.25}}$ community increased from 3.801 to 3.829, while interestingly, the biomass of the $TL_{MC\mathit{2.0}}$ community also increased from 3.092 to 3.107.

Together, these indicators show that the ecosystem structure has likely changed over the 43-year analysis period. The consistent patterns of change in each ecological indicator, particularly in the mean trophic level of the communities since 1993, certainly warrant the continuation, and ideally an expansion, of monitoring programs for fisheries in the EPO. The COVID-19 pandemic in 2020 allowed staff to examine the direct effects of reduced fishing effort on the ecosystem through use of ecological indicators. The most notable change was a 23% decrease in the number of purse-seine floating-object sets from 14,987 sets in 2019 to 11,543 sets in 2020. This decrease in effort resulted in abrupt changes in most ecological indicators for 2020 and increasing beyond pre-pandemic levels in 2022 when the number of floating-object sets increased significantly to 17,699 (Figure J-13). These results suggest that the increase in floating-object sets may be primarily responsible for the continued change in ecosystem structure over the past two decades.

7. FUTURE DEVELOPMENTS

It is unlikely, in the near future at least, that there will be stock assessments for most of the bycatch species caught by IATTC tuna fisheries. Therefore, the IATTC must continue to undertake ecological research and assessments that can provide managers with reliable information to guide the development of science-based conservation and management measures, where required, to ensure the IATTC continues to fulfil its responsibilities under the Antigua Convention and the objectives of the SSP. The priority research areas that have been identified by the scientific staff that require further development are detailed below:

- Following the development of the EASI-Fish approach, analysis of the full suite of over 100 impacted bycatch species will be conducted in stages, by taxonomic group (e.g., sharks, rays, teleosts, turtles and cetaceans). All pelagic shark species and the critically endangered eastern Pacific leatherback turtle stock were assessed in 2022.
- Given the high number of species classified as "most vulnerable" in the 2022 shark EASI-Fish assessment, a high priority is to develop a strategy for future conservation and management of these vulnerable species. As a first step EASI-Fish was used to explore the potential efficacy of hypothetical conservation and management measures for silky and hammerhead sharks in 2023 (SAC-14-12). This assessment is expected to be resumed in the near future with an external review of the EASI-Fish assessment planned for 2025 and the collaboration of the shark technical workshops of the IATTC.
- Significant knowledge gaps identified for sharks in the EASI-Fish assessment pertained to the fundamental parameter values required to characterize the population dynamics of several species in the EPO, even those that have been commonly recorded as bycatch for decades. Therefore, significant efforts are required by the IATTC and its Members to establish a strategy for undertaking cost-effective studies to collect data to develop morphometric relationships (e.g., length-weight and length-length), growth curves, and maturity ogives. In addition to the GEF-FAO ABNJ shark fishery data collection work recently completed in Central America and expanded to Mexico, Ecuador and Peru in 2023, which could be seen as an opportunity to achieve such a strategy (SAC-13-12, SAC-14 INF-L, SAC-14 INF-M), the IATTC staff has prepared a document identifying data gaps and potential opportunities for a phase-based approach to obtaining morphometric measurements and biological sampling of tunas, billfishes, and priority bycatch species on purse seiners and longliners (SAC-14 INF-J). In 2024, the staff proposed using the Enhanced Monitoring Program (EMP) as a means for collecting morphometric data for use in tuna stock assessments (SAC-15 INF-H). The Commission approved the initiation of morphometric sampling of tunas within the EMP framework, and during the last quarter of 2024 an experimental design was derived. Trials were conducted to guide the implementation of the sampling and sampling was initiated in January of 2025 in the ports of Mazatlán, Mexico and Manta, Ecuador. Opportunistic

sampling of various retained bycatch species, including sharks, have been included in morphometric data collection.

- A shortcoming of the ETP-24 ecosystem model, from which the ecological indicators are derived, is that its structure is based on stomach content data from fish collected in 1992–1994. Given the significant environmental and fishery changes that have been observed in the EPO over the past decade, there is a critical need to collect updated trophic information. There have been proposals made by the staff in 2018–2024 to establish an ecological monitoring program to collect stomach content data to update the ecosystem model. Given the emerging requirements for biological data on sharks, such a monitoring program could incorporate all biological and ecological requirements of the IATTC. Again, the GEF-FAO ABNJ project which continues to expand among IATTC Members offers some opportunities for integrating such a sampling program, especially if the ABNJ pilot project continues in perpetuity as recommended by the staff. In addition, the proposed morphometric and biological sampling study (SAC-14 INF-J) aims to opportunistically collect biological samples, including stomachs, to obtain updated diet data for future use in a spatially-explicit ecosystem model.
- A second limitation of the ETP-24 model is that it describes only the tropical component of the EPO ecosystem, and results cannot be reliably extrapolated to other regions of the EPO. Therefore, after updated diet information is collected, future work will aim to develop a spatially-explicit model that covers the entire EPO and calibrate the model with available time series of catches, ideally for species representing different trophic levels, and effort data for key fisheries in the EPO.
- Environmental variables can have a profound influence on the catches of target and bycatch species, as has been shown previously by IATTC staff and now undertaken annually in this report, with a dedicated workplan on climate resilient fisheries resulting from Resolution C-23-10, amended in C-24-10, was proposed at SAC-15 (SAC-15-12). However, the staff's research to investigate the impact of environmental conditions on the fishery could be greatly improved with the availability of high-resolution operational level data for the longline fishery. Although IATTC Members and CPCs are now required to submit operational level observer data to the IATTC that covers at least 5% of their fleets, analyses conducted by the staff provide conclusive evidence that these data are not representative of the fleet (BYC-10 INF-D) and therefore brings into question the validity of using submitted longline data for future environmental analyses until the observer coverage reaches at least 20%.
- The task of disentangling the spatial and temporal overlap of multiple target and non-target species requires an in-depth exploration of risk and trade-offs across management scenarios and species groups. Although the scientific community has argued for the importance of exploring dynamic spatial management over the past 20 years, there are currently few examples of dynamic or adaptive spatial management measures being implemented in tuna fisheries to reduce bycatch. In fact, no spatial management measures have been implemented to date to specifically reduce the catch of non-target species in tuna RFMOs. The identification of areas of potential interest for spatial management in the open ocean is directly dependent on the ever-changing species-environment relationship, which can be modeled to estimate and predict species' distributions and relative abundance across space and time and inform the design of adaptive management measures. Although the IATTC staff has started to investigate this issue in the EPO for both target and non-target species (e.g., SAC-10 INF-D, Pons et al 2022, BYC-11-04, Druon et al 2022, Ortuno-Crespo et al. 2024), the potential implementation and operationalization of adaptive management options for the IATTC should be explored in the coming years.
- The quality of ecological analyses and the annual reporting of EPO-wide catch estimates for bycatch species is currently hampered by IATTC's existing resolution on data provision (C-03-05), which no longer aligns with IATTC's evolving responsibilities under the Antigua Convention

(see SAC-12-09). Such responsibilities include ensuring and monitoring the sustainable impacts of EPO fisheries on associated and dependent species, which is the primary reason for the creation, and annual updates of, this *Ecosystem Considerations* report. Presently, the only reliable source of bycatch data is from observers onboard large, size Class-6, purse-seine vessels. Limited data on bycatch exists for other pelagic fisheries in the EPO. Proposed capacity building opportunities and a series of workshops involving IATTC staff and CPCs to develop clear data reporting standards are expected to facilitate improved data submission, catch estimates and reporting, which in turn will improve ecological analyses to allow the IATTC to meet its obligations under the Antigua Convention. Discussions commenced during the first workshop on improving data collection for the industrial longline fisheries (WSDAT-01, WSDAT-01 RPT) and during the second workshop focused on the small purse-seine fishery (i.e., vessels with a carrying capacity ≤363 t) (WSDAT-02, WSDAT-02-01, WSDAT-02-02, WSDAT-02 RPT). A series of updated staff recommendations, which culminated from workshop participation and individual consultation with CPCs, is described in SAC-16 INF-O (compilation of updated recommendations for industrial longline and small purse-seine fisheries).

- During the 2nd meeting of the EBWG, a recommendation was adopted stating, "*the staff, in coordination with CPCs, develop and present to the Commission results of a process to characterize and classify the longline fleets and their fisheries in the Convention Area, distinguishing their dynamics and differentiated impacts, as well as the catchability of species, whether directed, associated or incidental*." Consequently, the IATTC staff developed an approach to produce, in coordination with CPCs, a formal classification and definition of longline fisheries in the eastern Pacific Ocean (EPO) (SAC-16-09). The results of that discussion will be useful for improving data collection and other provisions for the longline fisheries in the IATTC.
- The IATTC staff is collaborating on two research projects on dolphins focused on improving current understanding of the potential impacts of tuna fisheries on dolphin populations (SAC-14 INF-K), including a cow-calf separation study and a CKMR assessment pilot.
- The staff aim to restructure this *Ecosystem Considerations* report into two ecosystem-advice products: 1) an indicator-based ecosystem report card ("*EcoCard*") and corresponding *Ecosystem Status Assessment* to detail indicator selection, calculation, and validation, with a main goal of improving IATTC's communication of ecosystem status (see EB-02-02). The workplan in EB-02-02 was presented to, and supported by, the EBWG (see WGEB-02 Recommendations, SAC-15 Recommendations) and an update on the purpose (i.e., goal and objective) and framework of the proposed workplan is presented in EB-03-04 for discussion with EBWG participants.

ACKNOWLEDGMENTS

We would like to thank Sylvain Caillot, Nick Vogel, and Joydelee Marrow for their assistance with data preparation, Alexandre Aires-da-Silva and Paulina Llano for their reviews of this document, and Christine Patnode for improving the figures. We gratefully acknowledge the early ecosystem research by Robert Olson that contributed to this report. His initiation of the *Ecosystem Considerations* report in 2003 was first presented at the 8th Meeting of the Working Group to Review Stock Assessments in 2007 (SAR-8-17 J) and has been updated annually.

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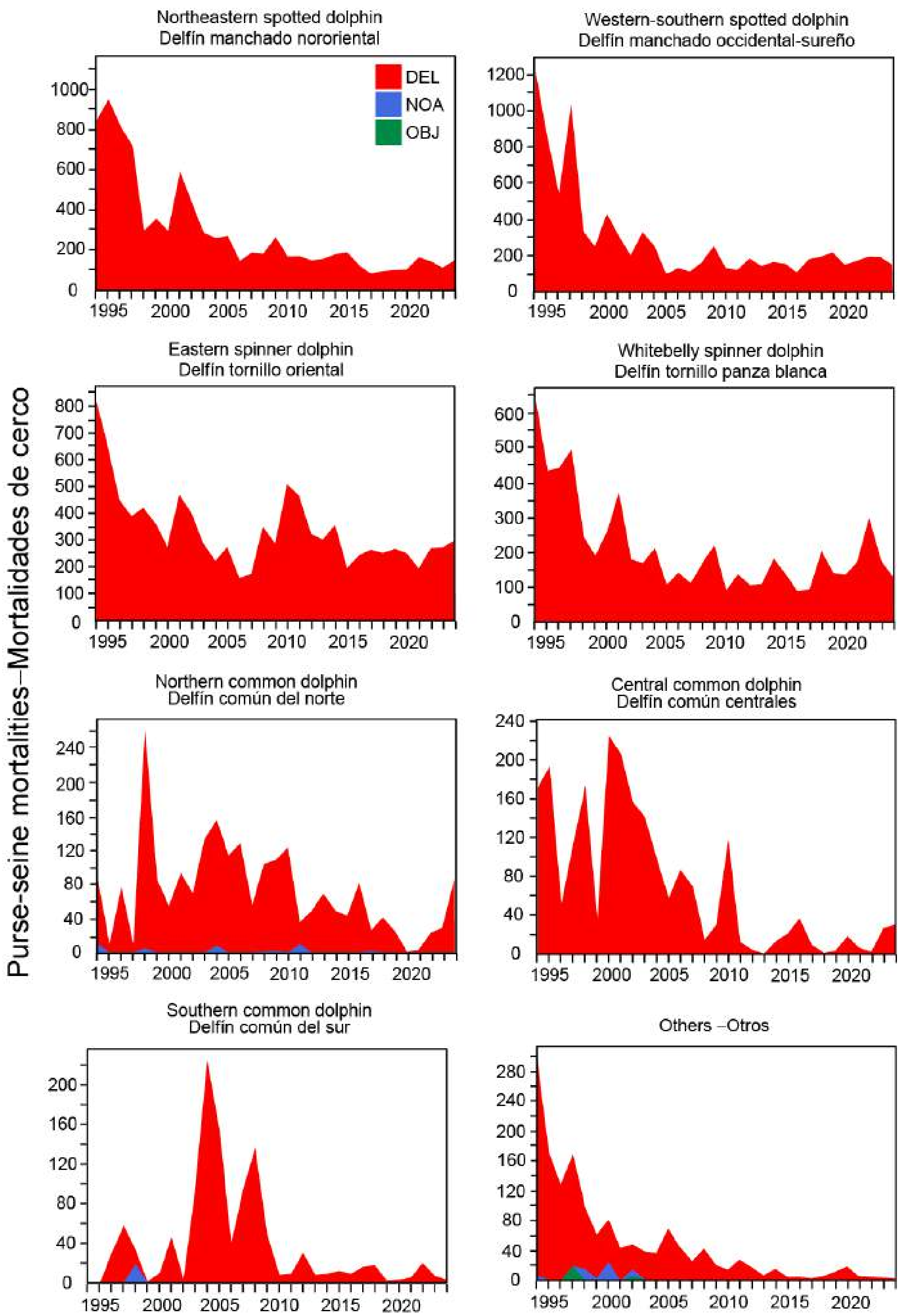

FIGURE J-1. Estimated number of incidental dolphin mortalities by observers onboard purse-seine vessels, 1994–2024.

FIGURA J-1. Número estimado de mortalidades incidentales de delfines por observadores a bordo de buques cerqueros grandes, 1994–2024.

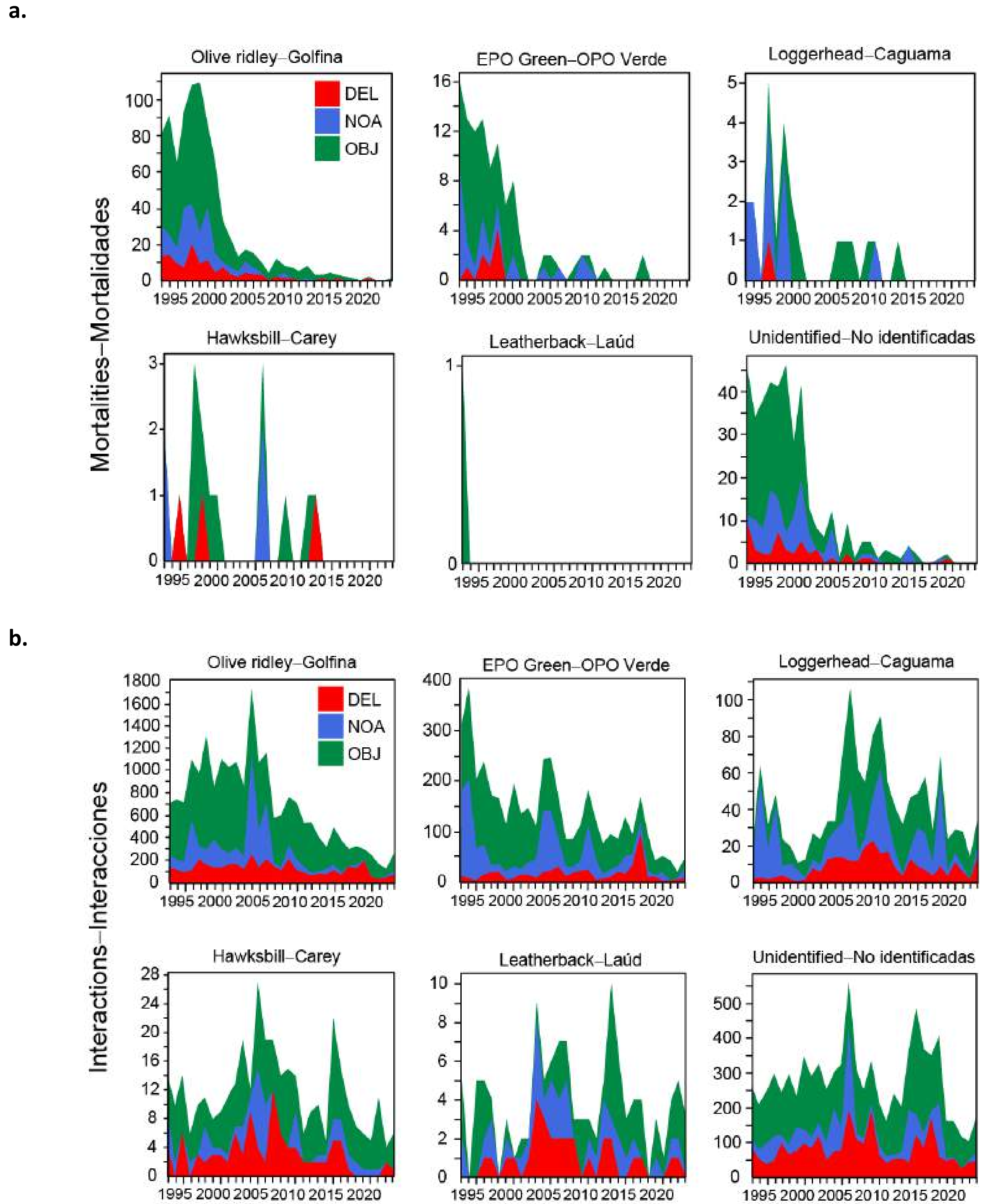

FIGURE J-2. Estimated number of sea turtle a) mortalities and b) interactions by observers onboard large purse-seine (Class 6, carrying capacity > 363 t) vessels, 1994–2024, by set type (dolphin (DEL), unassociated (NOA), floating object (OBJ)).

FIGURA J-2. Número estimado de a) mortalidades y b) interacciones de tortugas marinas por observadores a bordo de buques cerqueros grandes (clase 6, capacidad de acarreo > 363 t), 1994-2024, por tipo de lance (delfín (DEL), no asociado (NOA), objeto flotante (OBJ)).

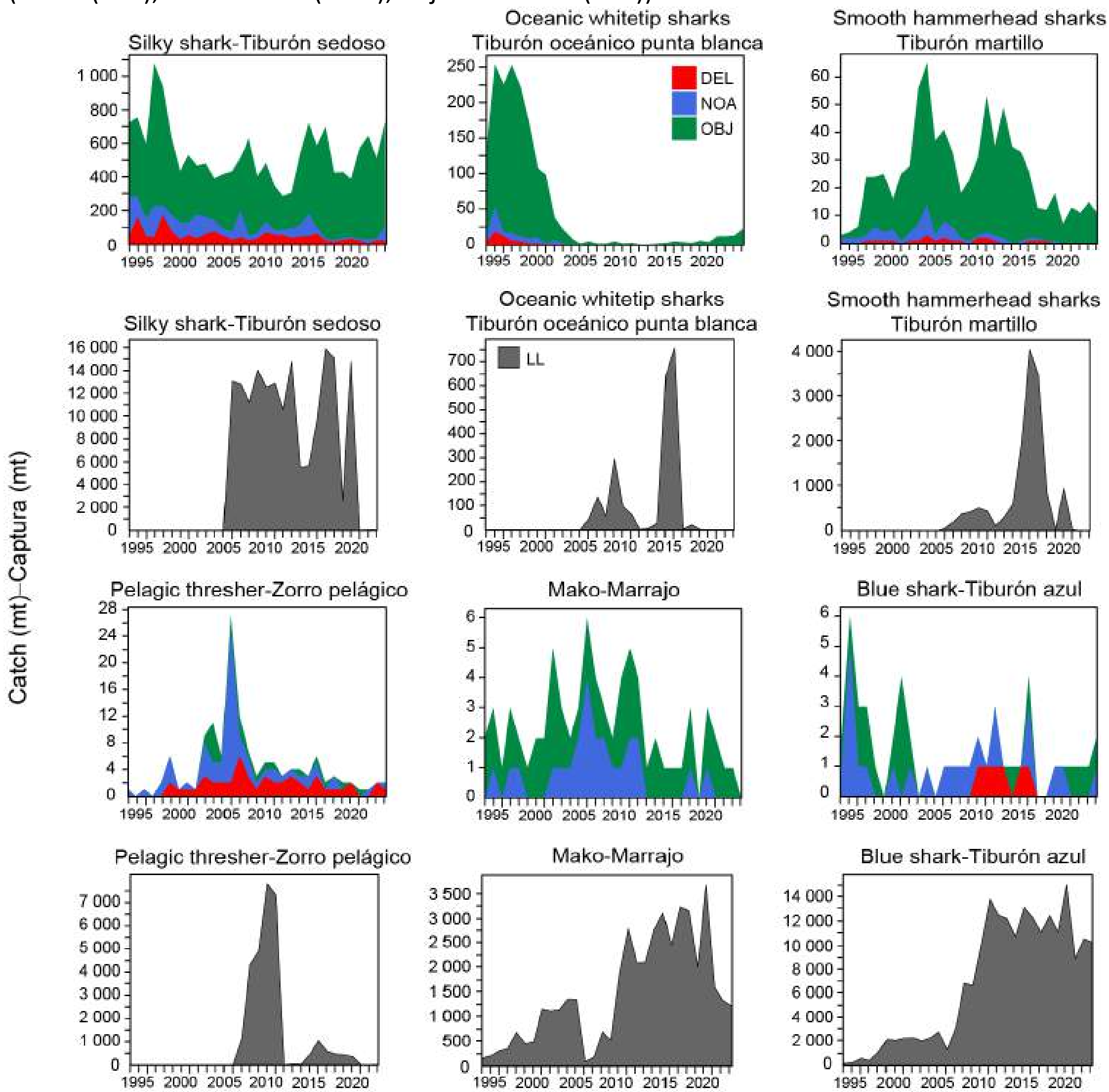

FIGURE J-3a. Estimated catches in metric tons (t) of key shark species in the eastern Pacific Ocean recorded by observers onboard large purse-seine (Class 6, carrying capacity > 363 t) vessels and minimum longline (LL) estimates of gross annual removals reported by CPCs (see section 2.2. for uncertainty and data gaps in reporting of bycatch species caught by longline). Purse-seine catches are provided for size-class 6 vessels with a carrying capacity >363 t (1994–2024) by set type: floating object (OBJ), unassociated tuna schools (NOA) and dolphins (DEL). Longline catches (1994–2023) are minimum reported gross-annual removals that may have been estimated using a mixture of different weight metrics (see footnote in section 3.5).

FIGURA J-3a. Capturas estimadas en toneladas (t) de especies clave de tiburones en el Océano Pacífico oriental registradas por observadores a bordo de buques cerqueros grandes (clase 6, capacidad de acarreo > 363 t) y estimaciones mínimas de palangre (LL) de extracciones anuales brutas reportadas por los CPC (ver Sección 2.2. para consultar información sobre la incertidumbre y las deficiencias de los datos en la notificación de especies capturadas incidentalmente con palangre). Se presentan las capturas cerqueras para buques de clase 6 con una capacidad de acarreo >363 t (1994-2024) por tipo de lance: objeto flotante (OBJ), atunes no asociados (NOA) y delfines (DEL). Las capturas palangreras (1994–2023) son extracciones anuales brutas mínimas reportadas que pueden haber sido estimadas usando una mezcla de diferentes métricas de peso (ver nota al pie de página en la sección 3.5).

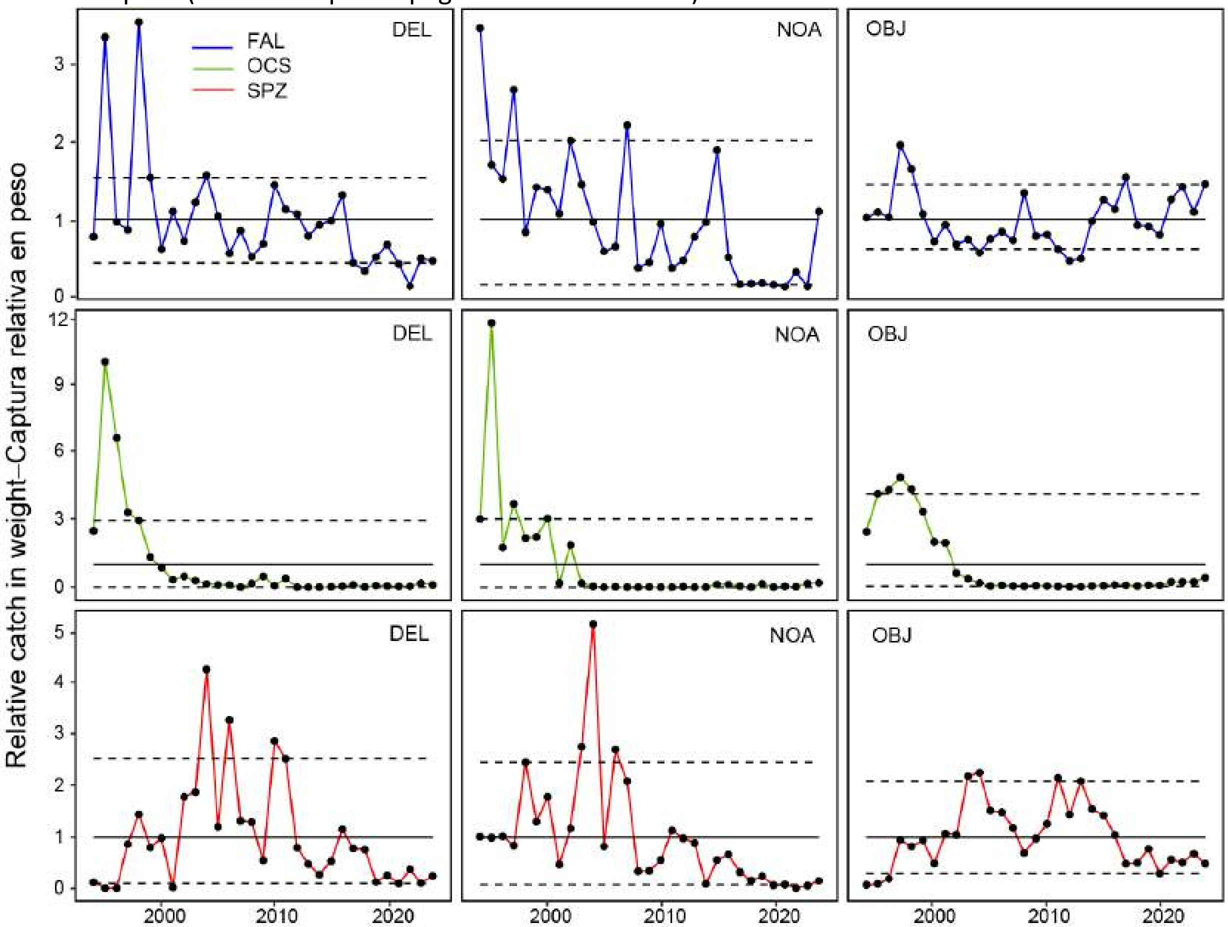

FIGURE J-3b. Indicators of relative catch of key shark species reported by observers onboard large purse-seine vessels (Class 6, carrying capacity > 363 t) by set type: dolphins (DEL), unassociated tuna schools (NOA) and floating object (OBJ). The solid line is the average total annual catch for the period 1994–2024 and scaled to 1 and the dashed lines represent the 10th and 90th percentiles. FAL: silky shark (*Carcharhinus falciformis*), OCS: oceanic whitetip shark (*Carcharhinus longimanus*), SPZ: smooth hammerhead shark (*Sphyrna zygaena*).

FIGURA J-3b. Indicadores de captura relativa de especies clave de tiburones notificada por observadores a bordo de buques cerqueros grandes (clase 6, capacidad de acarreo > 363 t) por tipo de lance: sobre delfines (DEL), no asociados (NOA) y sobre objetos flotantes (OBJ). La línea continua es el promedio de captura anual total para el periodo 1994-2024 y está escalada a 1 y las líneas punteadas representan los percentiles de 10 y 90%. FAL: tiburón sedoso (*Carcharhinus falciformis*), OCS: tiburón oceánico punta blanca (*Carcharhinus longimanus*), SPZ: cornuda cruz (*Sphyrna zygaena*).

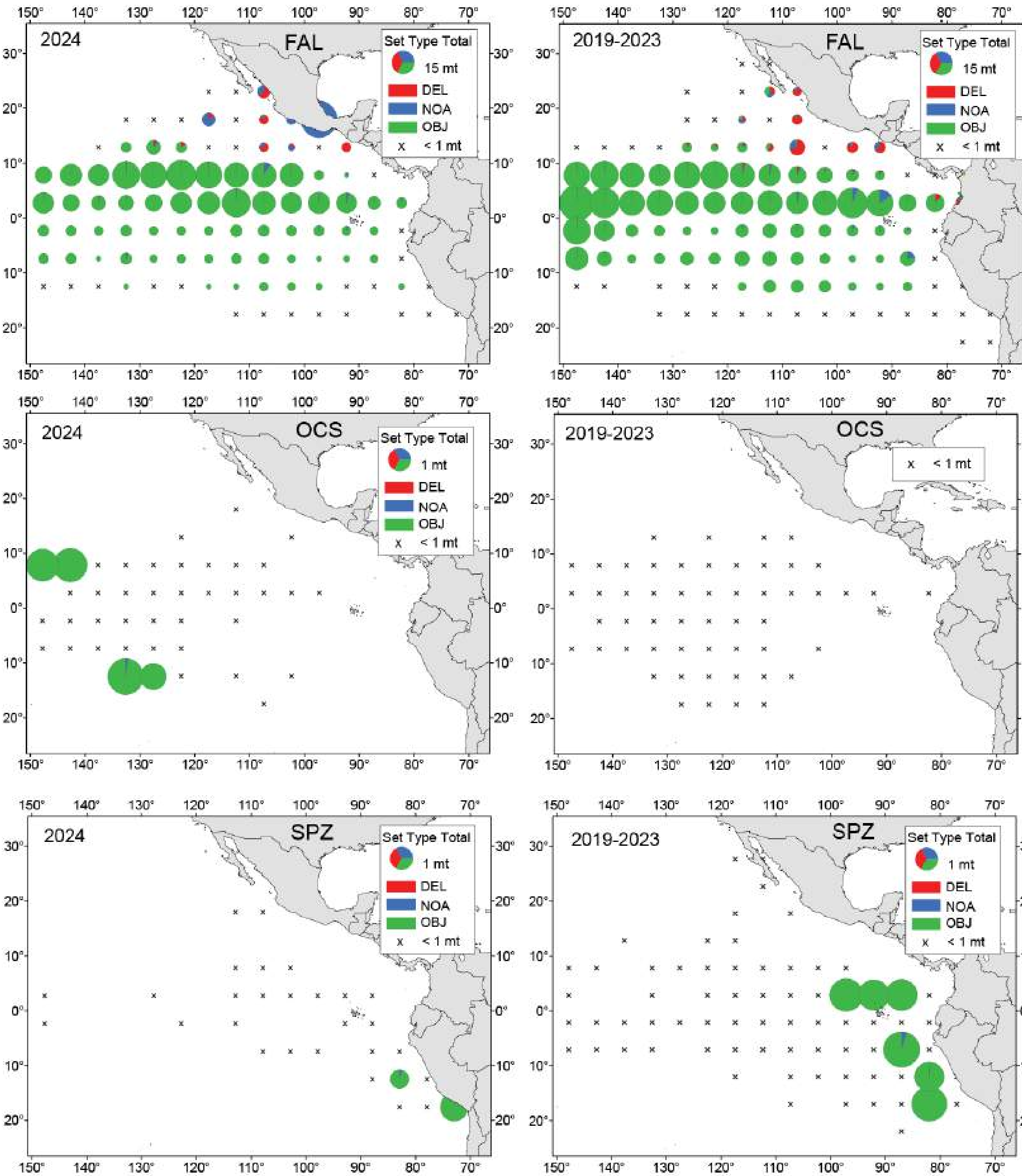

FIGURE J-3c. Purse-seine catches (Class 6, carrying capacity > 363 t) (at 5°x5° resolution) of key species of sharks by set type: floating object (OBJ) unassociated tuna schools (NOA) and dolphins (DEL), for 2024 (left panel) and the 2019–2023 averages (right panel). FAL: silky shark (*Carcharhinus falciformis*), OCS: oceanic whitetip shark (*Carcharhinus longimanus*), SPZ: smooth hammerhead shark (*Sphyrna zygaena*).

FIGURA J-3c. Capturas cerqueras (clase 6, capacidad de acarreo > 363 t) (resolución de 5°x5°) de especies clave de tiburones por tipo de lance: sobre objetos flotantes (OBJ), no asociados (NOA) y sobre delfines (DEL), para 2024 (panel izquierdo) y los promedios de 2019–2023 (panel derecho). FAL: tiburón sedoso (*Carcharhinus falciformis*), OCS: tiburón oceánico punta blanca (*Carcharhinus longimanus*), SPZ: cornuda cruz (*Sphyrna zygaena*).

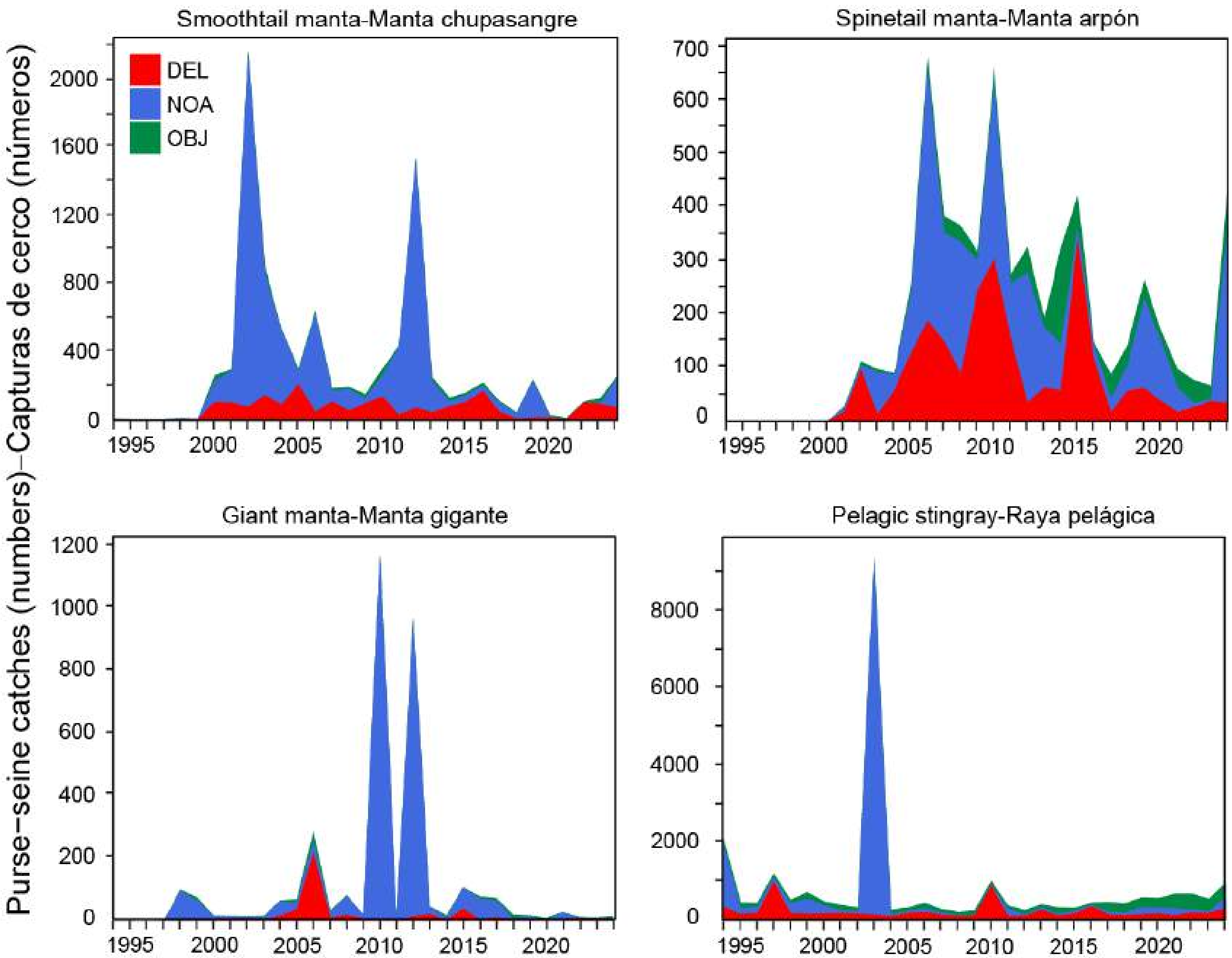

FIGURE J-4a. Estimated purse-seine catches in numbers of individuals of key species of rays in the eastern Pacific Ocean. Purse seine catches are provided for size-class 6 vessels with a carrying capacity >363 t (1994–2024) by set type: floating object (OBJ), unassociated tuna schools (NOA) and dolphins (DEL).

FIGURA J-4a. Capturas cerqueras estimadas en número de individuos de especies clave de rayas en el Océano Pacífico oriental. Se presentan las capturas cerqueras para buques de clase 6 con una capacidad de acarreo >363 t (1994-2024) por tipo de lance: objeto flotante (OBJ), atunes no asociados (NOA) y delfines (DEL).

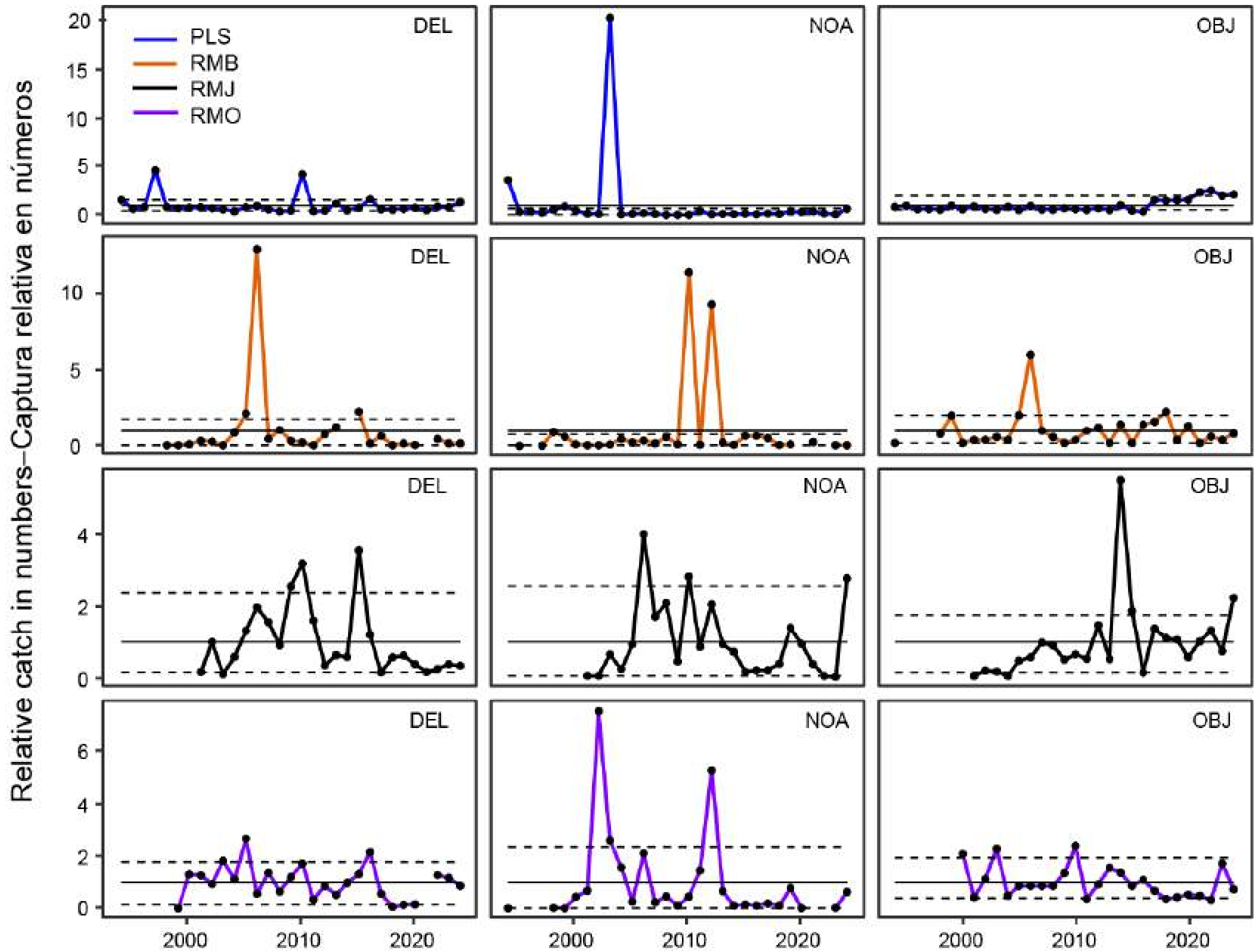

FIGURE J-4b. Indicators of relative number of individuals of rays reported by observers onboard large purse-seine vessels (Class 6, carrying capacity > 363 t) by set type: dolphins (DEL), unassociated tuna schools (NOA) and floating object (OBJ). The solid line is the average total annual catch for the period 1994–2024 and scaled to 1 and the dashed lines represent the 10th and 90th percentiles. PLS: pelagic stingray (*Pteroplatytrygon violacea*), RMB: giant manta (*Mobula birostris*), RMJ: spinetail manta (*Mobula mobular*), RMO: smoothtail manta (*Mobula thurstoni*).

FIGURA J-4b. Indicadores del número relativo de individuos de rayas notificado por observadores a bordo de buques cerqueros grandes (clase 6, capacidad de acarreo > 363 t) por tipo de lance: sobre delfines (DEL), no asociados (NOA) y sobre objetos flotantes (OBJ). La línea continua es el promedio de captura anual total para el periodo 1994-2024 y está escalada a 1 y las líneas punteadas representan los percentiles de 10 y 90%. PLS: raya pelágica (*Pteroplatytrygon violacea*), RMB: manta gigante (*Mobula birostris*), RMJ: manta mobula (*Mobula mobular*), RMO: manta diablo (*Mobula thurstoni*).

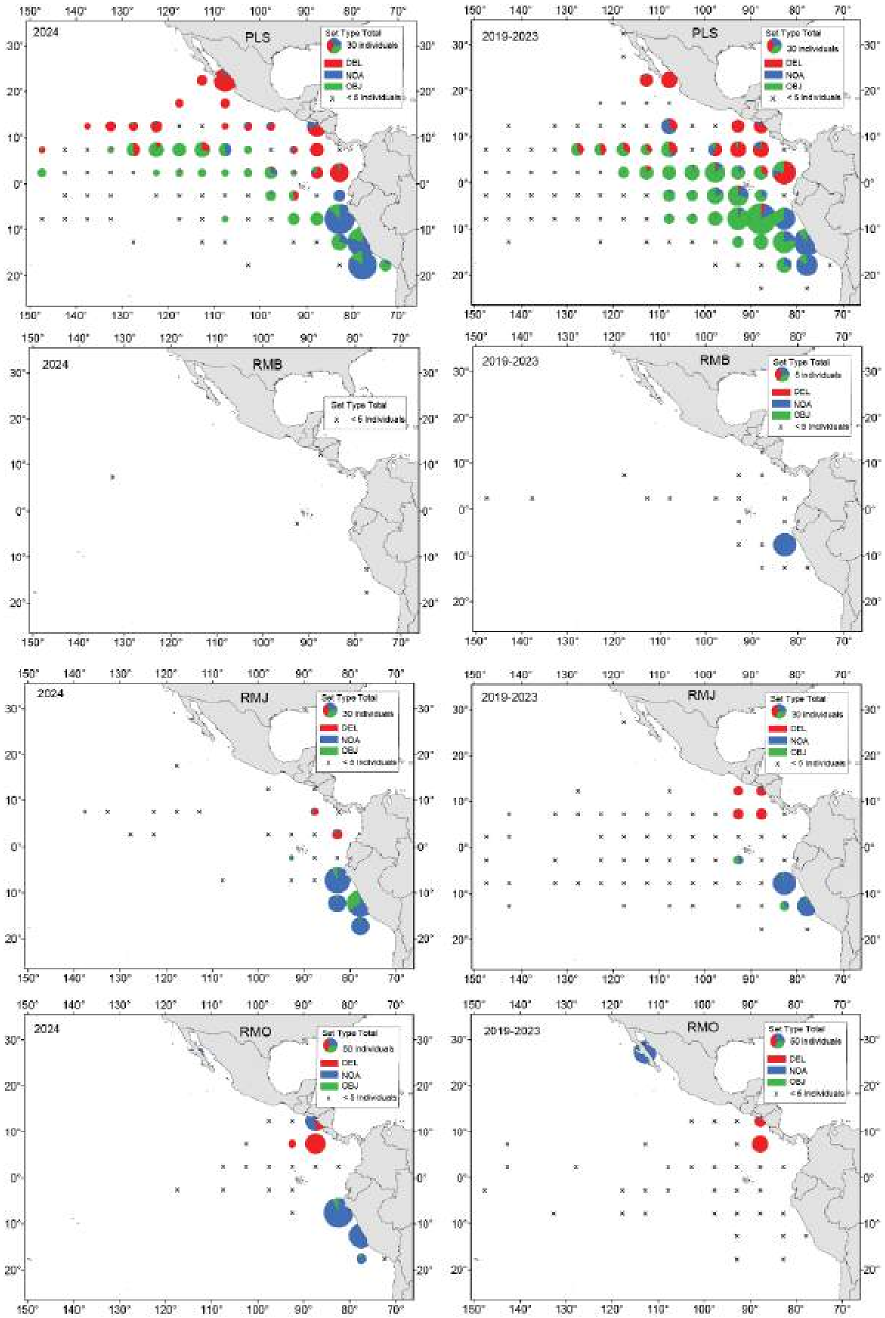

FIGURE J-4c. Purse-seine catches (Class 6, carrying capacity > 363 t) (at 5°x5° resolution) of key species of rays by set type: floating object (OBJ) unassociated tuna schools (NOA) and dolphins (DEL), for 2024 (left panel) and the 2019-2023 averages (right panel). PLS: pelagic stingray (*Pteroplatytrygon violacea*), RMB: giant manta (*Mobula birostris*), RMJ: spinetail manta (*Mobula mobular*), RMO: smoothtail manta (*Mobula thurstoni*).

FIGURA J-4c. Capturas cerqueras (clase 6, capacidad de acarreo > 363 t) (resolución de 5°x5°) de especies clave de rayas por tipo de lance: sobre objetos flotantes (OBJ), no asociados (NOA) y sobre delfines (DEL), para 2024 (panel izquierdo) y los promedios de 2019-2023 (panel derecho). PLS: raya pelágica (*Pteroplatytrygon violacea*), RMB: manta gigante (*Mobula birostris*), RMJ: manta mobula (*Mobula mobular*), RMO: manta diablo (*Mobula thurstoni*).

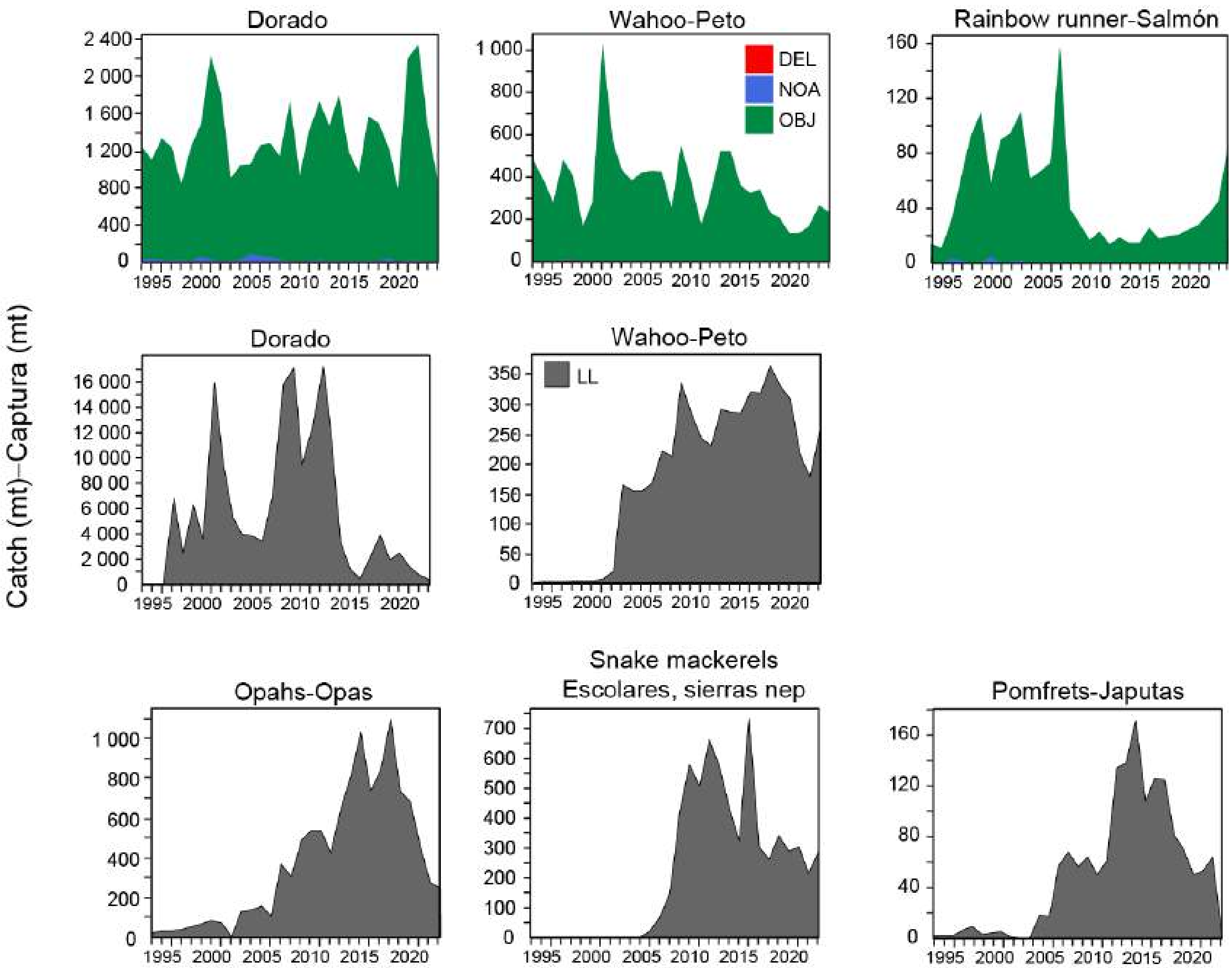

FIGURE J-5. Estimated purse-seine and longline catches in metric tons (t) of key species of large fishes in the eastern Pacific Ocean. Purse-seine catches are provided for size-class 6 vessels with a carrying capacity >363 t (1994–2024) by set type: floating object (OBJ), unassociated tuna schools (NOA) and dolphins (DEL). Longline (LL) catches (1994–2023) are minimum reported gross-annual removals (see section 2.2. for uncertainty and data gaps in reporting of bycatch species caught by longline).

FIGURA J-5. Capturas cerqueras y palangreras estimadas en toneladas (t) de especies clave de peces grandes en el Océano Pacífico oriental. Se presentan las capturas cerqueras para buques de clase 6 con una capacidad de acarreo >363 t (1994-2024) por tipo de lance: objeto flotante (OBJ), atunes no asociados (NOA) y delfines (DEL). Las capturas palangreras (LL) (1994–2023) son extracciones anuales brutas mínimas reportadas (ver la Sección 2.2 para consultar información sobre la incertidumbre y las deficiencias de los datos en la notificación de especies capturadas incidentalmente con palangre).

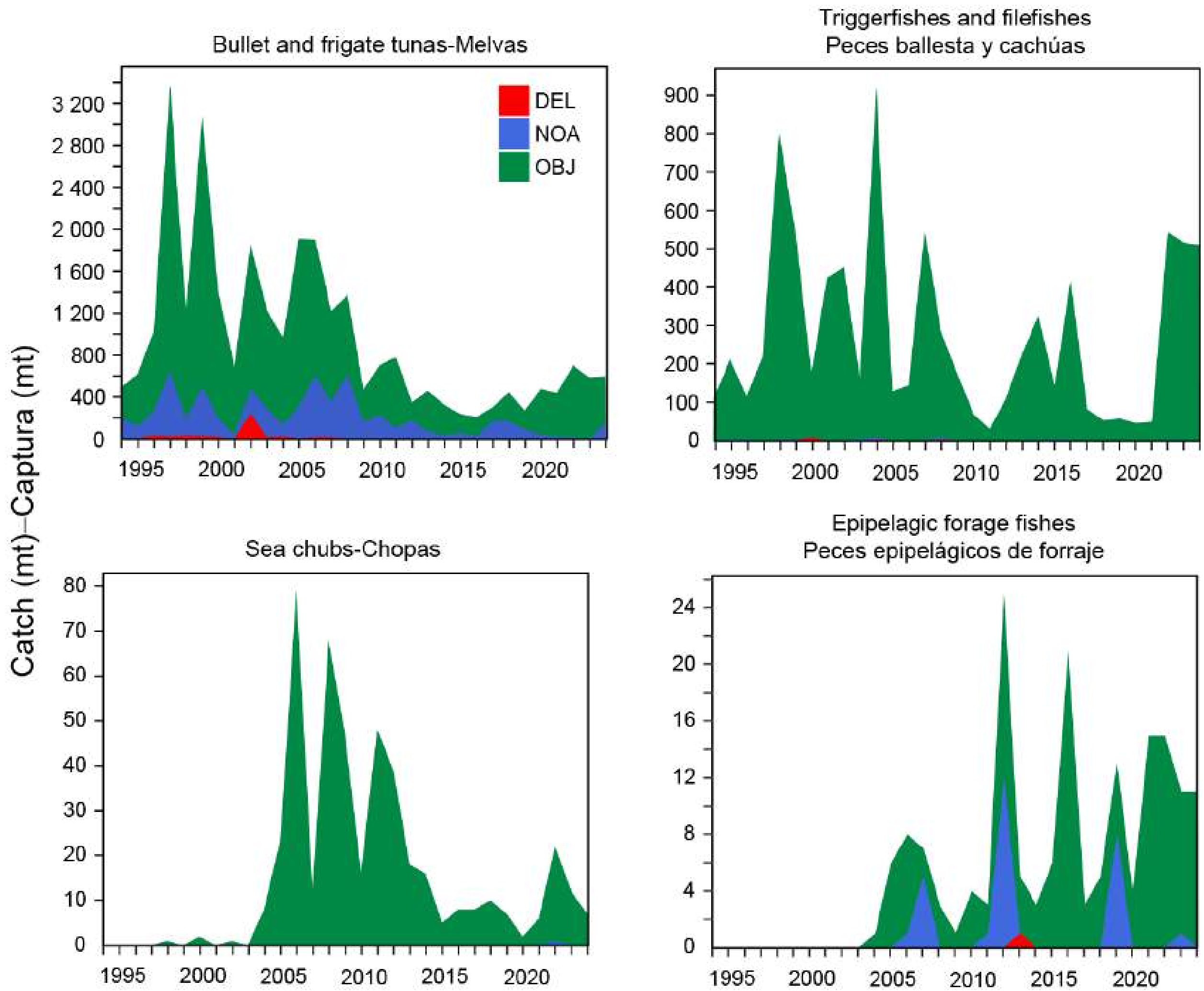

FIGURE J-6. Estimated purse-seine catches in metric tons (t) of key species of small fishes in the eastern Pacific Ocean. Purse seine catches are provided for size-class 6 vessels with a carrying capacity >363 t (1994–2024) by set type: floating object (OBJ), unassociated tuna schools (NOA) and dolphins (DEL).

FIGURA J-6. Capturas cerqueras estimadas en toneladas (t) de especies clave de peces pequeños en el Océano Pacífico oriental. Se presentan las capturas cerqueras para buques de clase 6 con una capacidad de acarreo >363 t (1994-2024) por tipo de lance: objeto flotante (OBJ), atunes no asociados (NOA) y delfines (DEL).

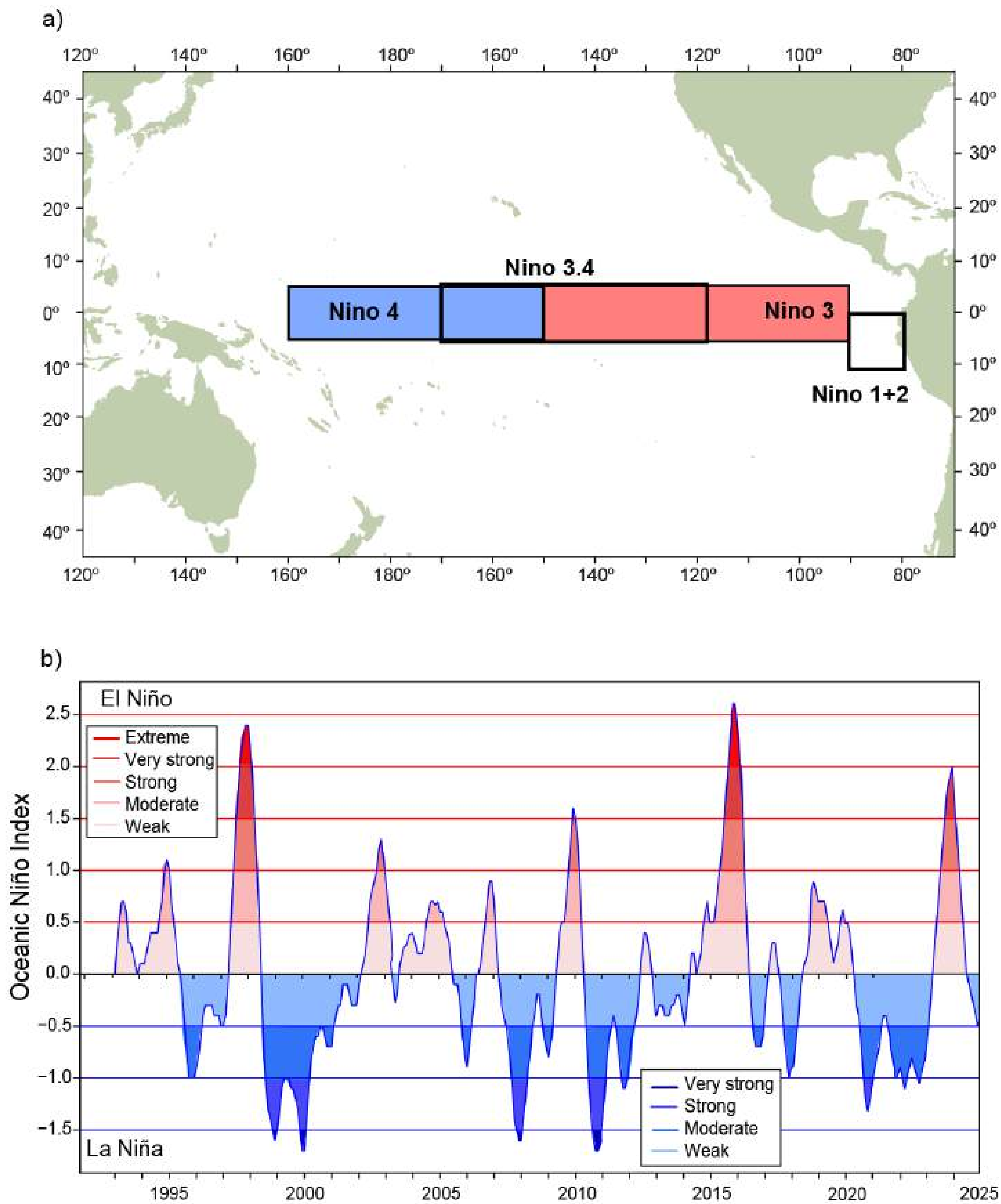

FIGURE J-7. El Niño regions used as indicators of El Niño Southern Oscillation (ENSO) events in the Pacific Ocean (top panel), and the Oceanic Niño Index (ONI) used to monitor ENSO conditions in Niño region 3.4 from 5°N to 5°S and 120°W to 170°W (bottom panel). Time series shows the running 3-month mean ONI values from the start of the IATTC observer program through December 2024. ONI data obtained from: http://origin.cpc.ncep.noaa.gov/products/analysis_monitoring/ensostuff/ONI_v5.php

FIGURA J-7. Regiones de El Niño utilizadas como indicadores de los eventos de El Niño-Oscilación del Sur (ENOS) en el Océano Pacífico (panel superior), e Índice de El Niño Oceánico (ONI) usado para dar seguimiento a las condiciones de ENOS en la región Niño 3.4 de 5°N a 5°S y de 120°O a 170°O (panel inferior). Las series de tiempo muestran los valores del promedio móvil de 3 meses del ONI desde el inicio del programa de observadores de la CIAT hasta finales de diciembre de 2024. Datos del ONI obtenidos de: http://origin.cpc.ncep.noaa.gov/products/analysis_monitoring/ensostuff/ONI_v5.php

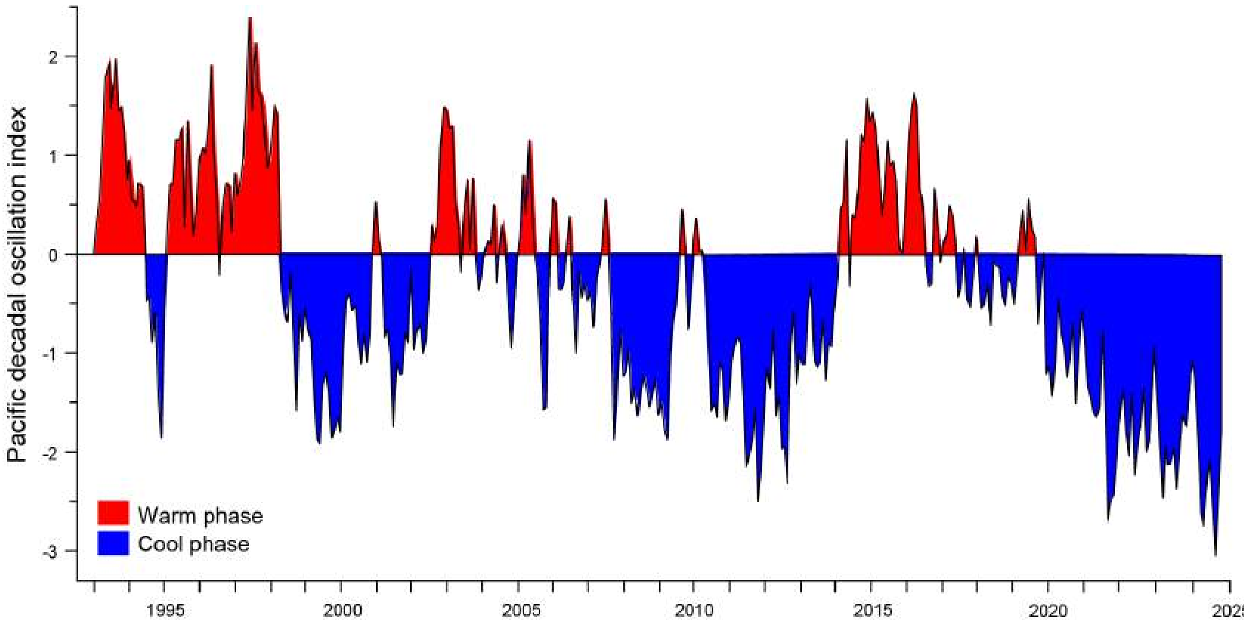

FIGURE J-8. Monthly values of the Pacific Decadal Oscillation (PDO) Index, January 1993–December 2024. ERSST V5 PDO Time Series data obtained from: https://psl.noaa.gov/pdo/

FIGURA J-8. Valores mensuales del índice de Oscilación Decadal del Pacífico (PDO), enero de 1993–diciembre de 2024. Datos de la serie de tiempo ERSST V5 PDO obtenidos de: https://psl.noaa.gov/pdo/

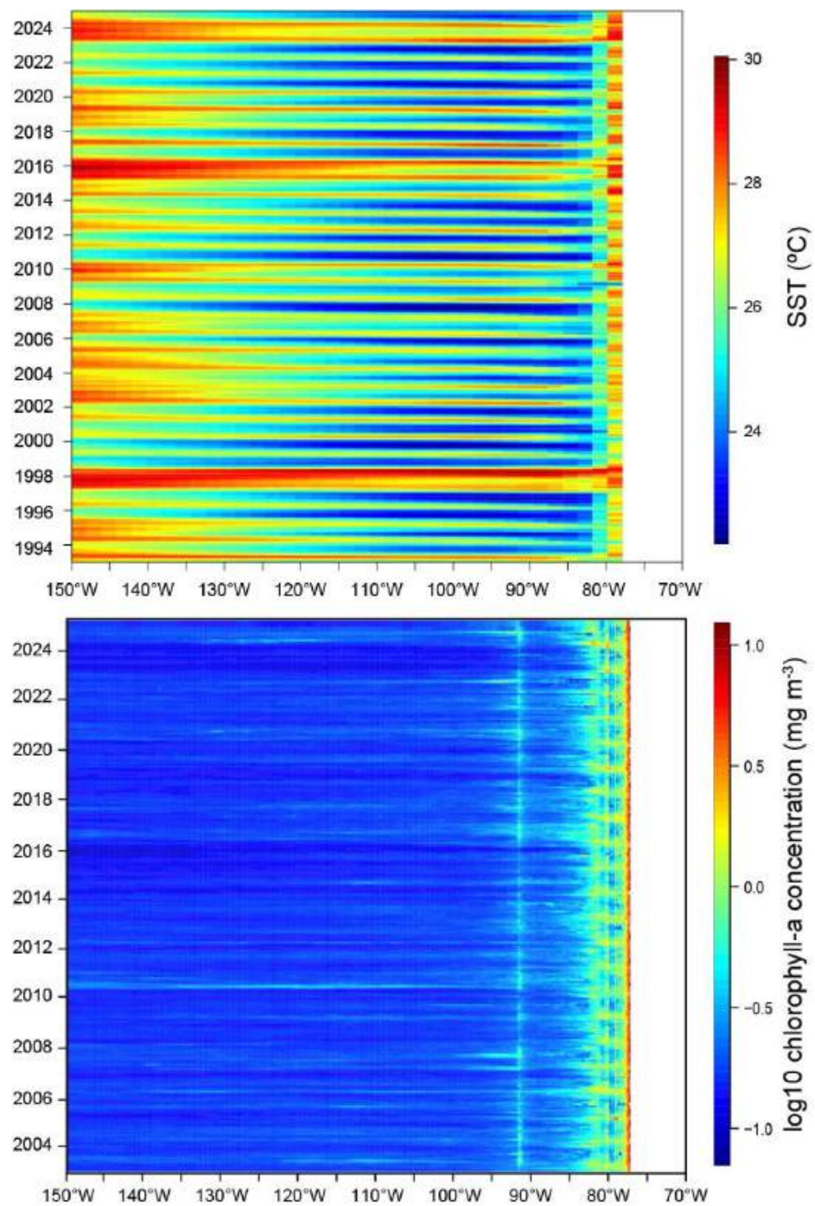

FIGURE J-9. Time-longitude Hovmöller diagram with data averaged across the tropical eastern Pacific Ocean from 5°N to 5°S for mean monthly SST for January 1993–December 2024 (top panel) (https://coastwatch.pfeg.noaa.gov/erddap/griddap/nceiErsstv5_LonPM180.html) and mean monthly chlorophyll-a concentration for January 2003–December 2024 (bottom panel) (https://coastwatch.pfeg.noaa.gov/erddap/info/erdMH1chlamday_R2022SQ/index.html.

FIGURA J-9. Diagrama de Hovmöller tiempo-longitud con datos promediados en el Océano Pacífico tropical oriental de 5°N a 5°S para la TSM promedio mensual de enero de 1993 a diciembre de 2024 (panel superior) (https://coastwatch.pfeg.noaa.gov/erddap/griddap/nceiErsstv5_LonPM180.html) y concentración promedio mensual de clorofila-a de enero de 2003 a diciembre de 2024 (panel inferior) (https://coastwatch.pfeg.noaa.gov/erddap/info/erdMH1chlamday_R2022SQ/index.html);

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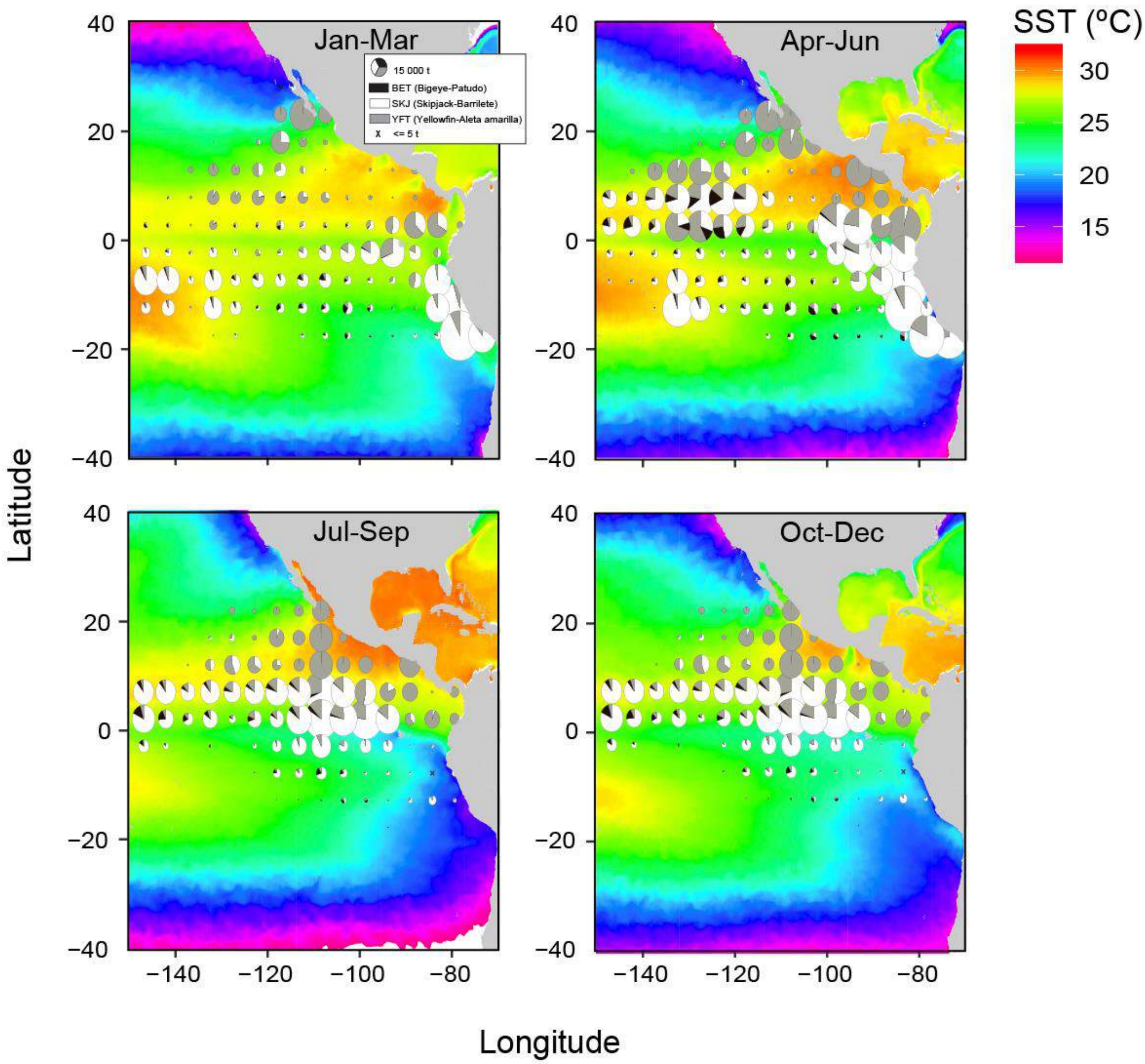

FIGURE J-10. Mean sea surface temperature (SST) for each quarter during 2024 with catches of tropical tunas overlaid. SST data obtained from NOAA NMFS SWFSC ERD on March 06, 2025, “Multi-scale Ultra-high Resolution (MUR) SST Analysis fv04.1, Global, 0.01°, 2002–present, Monthly”, https://coastwatch.pfeg.noaa.gov/erddap/info/jplMURSST41mday/index.html.

FIGURA J-10 Temperatura superficial del mar (TSM) promedio para cada trimestre de 2024 con las capturas de atunes tropicales superpuestas. Datos de TSM obtenidos de NOAA NMFS SWFSC ERD el 6 de marzo de 2025, “Multi-scale Ultra-high Resolution (MUR) SST Analysis fv04.1, Global, 0.01°, 2002–present, Monthly”, https://coastwatch.pfeg.noaa.gov/erddap/info/jplMURSST41mday/index.html.

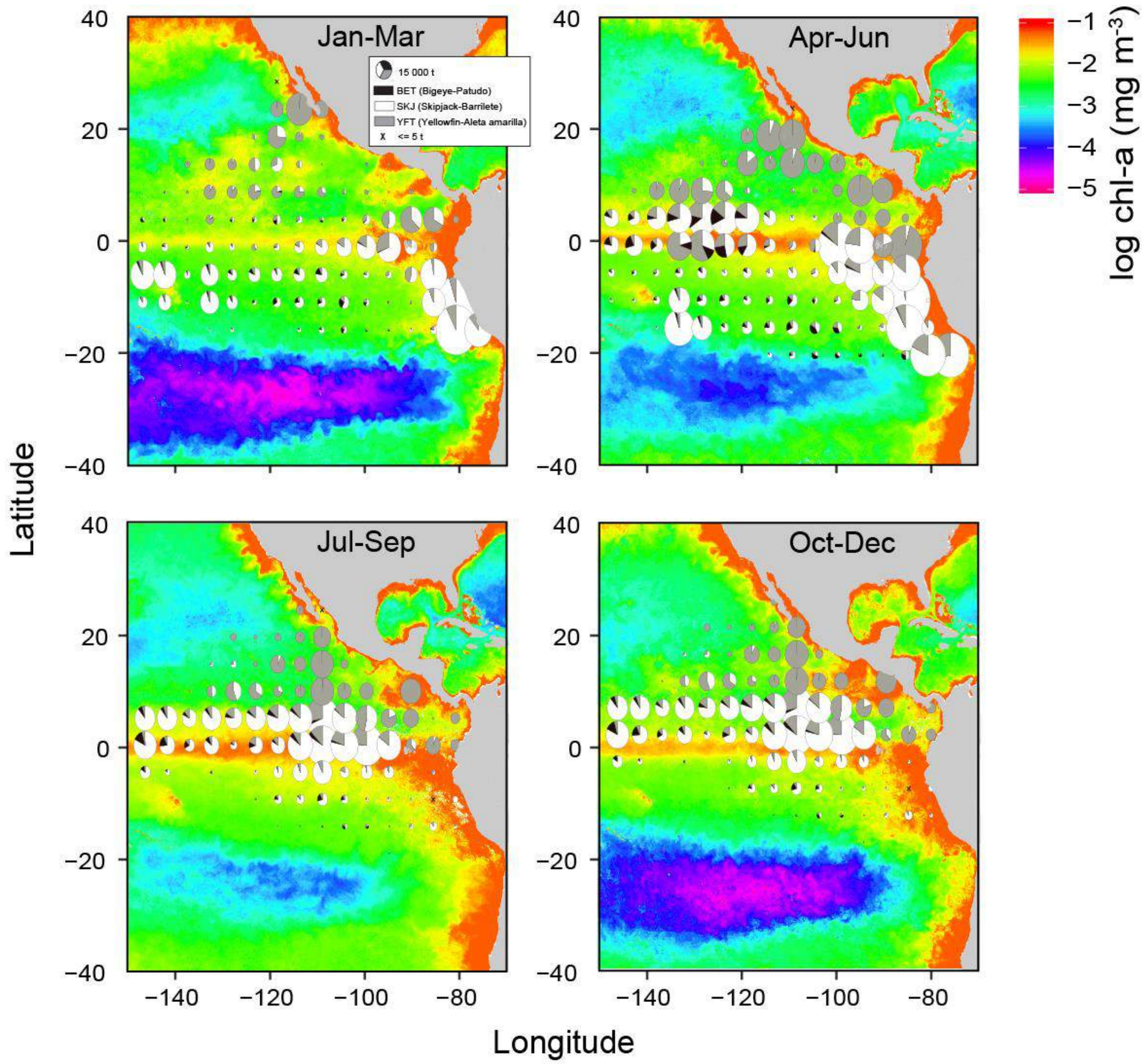

FIGURE J-11. Mean log chlorophyll-a concentration (in mg m^3) for each quarter during 2024 with catches of tropical tunas overlaid. Chlorophyll data obtained from NOAA CoastWatch on March 6, 2025, "Chlorophyll-a, Aqua MODIS, NPP, L3SMI, Global, 4km, R2022 SQ, 2003-present (Monthly Composite)", NOAA NMFS SWFSC ERD, https://coastwatch.pfeg.noaa.gov/erddap/info/erdMH1chlamday_R2022SQ/index.html.

FIGURA J-11. Concentración promedio de clorofila-a (en mg m^3) para cada trimestre de 2024 con las capturas de atunes tropicales superpuestas. Datos de clorofila obtenidos de NOAA CoastWatch el 6 de marzo de 2024, "Chlorophyll-a, Aqua MODIS, NPP, L3SMI, Global, 4km, R2022 SQ, 2003-present (Monthly Composite)", NOAA NMFS SWFSC ERD, https://coastwatch.pfeg.noaa.gov/erddap/info/erdMH1chlamday_R2022SQ/index.html.

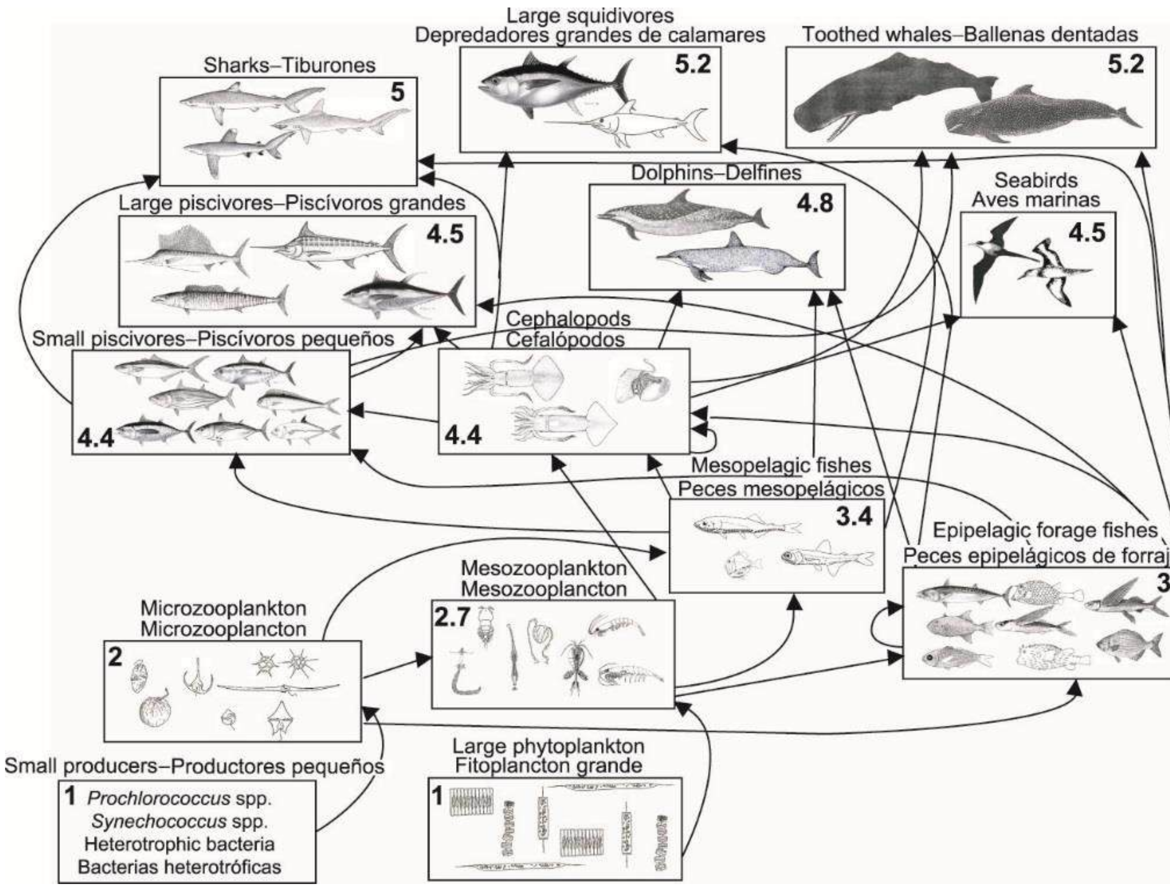

FIGURE J-12. Simplified food-web diagram of the pelagic ecosystem in the tropical EPO. The numbers inside the boxes indicate the approximate trophic level of each group.

FIGURA J-12. Diagrama simplificado de la red trófica del ecosistema pelágico en el OPO tropical. Los números en los recuadros indican el nivel trófico aproximado de cada grupo.

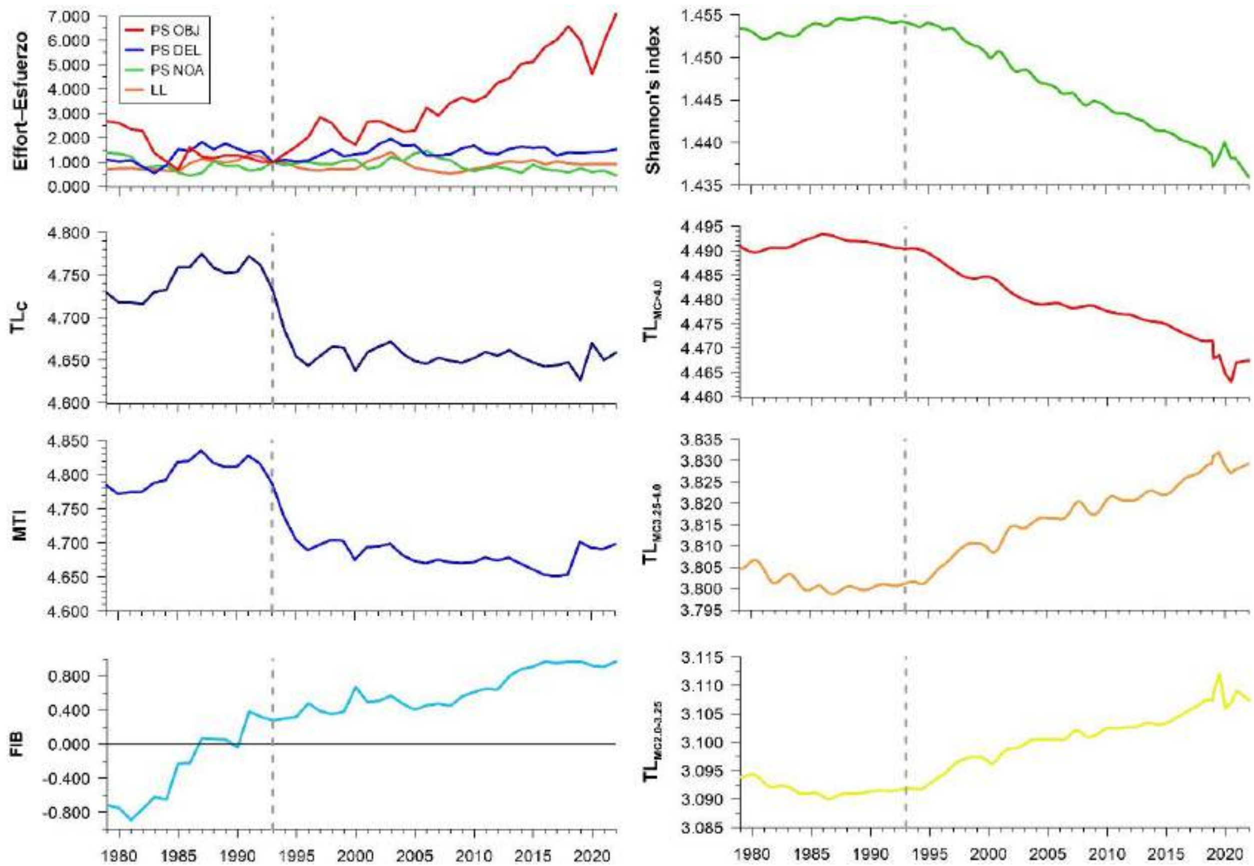

FIGURE J-13. Annual values for seven ecological indicators of changes in different components of the tropical EPO ecosystem, 1979–2022 (see Section 6 of text for details), and an index of longline (LL) and purse-seine (PS) fishing effort, by set type (dolphin (DEL), unassociated (NOA), floating object (OBJ)), relative to the model start year of 1993 (vertical dashed line), when the expansion of the purse-seine fishery on FADs began.

FIGURA J-13 Valores anuales de siete indicadores ecológicos de cambios en diferentes componentes del ecosistema del OPO tropical, 1979–2022 (ver detalles en la sección 6 del texto), y un índice de esfuerzo palangrero (LL) y cerquero (PS), por tipo de lance (delfín (DEL), no asociado (NOA), objeto flotante (OBJ)) relativo al año de inicio del modelo de 1993 (línea de trazos vertical), cuando comenzó la expansión de la pesquería cerquera sobre plantados.

Table J-1a. Estimated number of individuals of incidental dolphin mortalities by set type and stock in the eastern Pacific Ocean by the purse-seine fishery from 1994-2024. Purse-seine set types: floating object (OBJ), unassociated tuna schools (NOA) and dolphins (DEL). Data for 2023–2024 are considered preliminary.

Tabla J-1a. Número estimado de individuos de mortalidades incidentales de delfines por la pesquería de cerco durante 1994-2024, por tipo de lance y población en el Océano Pacífico oriental. Tipos de lances de cerco: sobre objetos flotantes (OBJ), no asociados (NOA) y sobre delfines (DEL). Los datos de 2023–2024 se consideran preliminares.

	Northeastern spotted Purse seine			Western-southern spotted Purse seine			Eastern spinner Purse seine			Whitebelly spinner Purse seine		
Year	DEL	NOA	OBJ	DEL	NOA	OBJ	DEL	NOA	OBJ	DEL	NOA	OBJ
1994	847	-	-	1,228	-	-	828	-	-	640	-	-
1995	952	-	-	859	-	-	654	-	-	431	5	-
1996	818	-	-	545	-	-	450	-	-	447	-	-
1997	718	3	-	1,044	-	-	391	-	-	498	-	-
1998	298	-	-	341	-	-	422	-	-	249	-	-
1999	358	-	-	253	-	-	363	-	-	192	-	-
2000	295	-	-	435	-	-	275	-	-	262	-	-
2001	592	-	-	315	-	-	470	-	-	374	-	-
2002	435	-	-	203	-	-	403	-	-	182	-	-
2003	288	-	-	335	-	-	290	-	-	170	-	-
2004	261	-	-	256	-	-	223	-	-	214	-	-
2005	273	-	-	100	-	-	275	-	-	108	-	-
2006	147	-	-	135	-	-	160	-	-	144	-	-
2007	189	-	-	116	-	-	175	-	-	113	-	-
2008	184	-	-	167	-	-	349	-	-	171	-	-
2009	266	-	-	254	-	-	288	-	-	222	-	-
2010	170	-	-	135	-	-	510	-	-	92	-	-
2011	172	-	-	124	-	-	467	-	-	139	-	-
2012	151	-	-	187	-	-	324	-	-	107	-	-
2013	158	-	-	145	-	-	303	-	-	111	-	-
2014	181	-	-	168	-	-	356	-	-	183	-	-
2015	191	-	-	158	-	-	196	-	-	139	-	-
2016	127	-	-	111	-	-	243	-	-	89	-	-
2017	85	-	-	183	-	-	266	-	-	95	-	-
2018	99	-	-	197	-	-	252	-	-	205	-	-
2019	104	-	-	220	-	-	269	-	-	143	-	-
2020	106	-	-	153	-	-	251	-	-	138	-	-
2021	166	-	-	173	-	-	194	-	-	172	-	-
2022	147	-	-	197	-	-	271	-	-	300	-	-
2023	115	-	-	195	-	-	274	-	-	178	-	-
2024	151	-	-	154	-	-	300	-	-	132	-	-
Total	9,044	3	-	9,086	-	-	10,492	-	-	6,640	5	-

Table J-1a continued

	Northern common Purse seine			Central common Purse seine			Southern common Purse seine			Other dolphins Purse seine		
Year	DEL	NOA	OBJ	DEL	NOA	OBJ	DEL	NOA	OBJ	DEL	NOA	OBJ
1994	75	10	-	170	-	-	-	-	-	291	7	-
1995	9	-	-	192	-	-	-	-	-	171	1	-
1996	77	-	-	51	-	-	30	-	-	129	-	-
1997	9	-	-	114	-	-	58	-	-	150	-	20
1998	256	5	-	172	-	-	14	19	-	84	16	-
1999	85	-	-	34	-	-	1	-	-	59	3	-
2000	54	-	-	223	-	-	10	-	-	57	24	1
2001	94	-	-	205	-	-	46	-	-	44	-	-
2002	69	-	-	155	-	-	3	-	-	34	9	6
2003	133	-	-	140	-	-	97	-	-	37	-	2
2004	148	8	-	97	-	-	225	-	-	37	-	-
2005	114	-	-	57	-	-	154	-	-	70	-	-
2006	129	-	-	86	-	-	40	-	-	43	2	-
2007	55	-	-	69	-	-	95	-	-	25	1	-
2008	103	1	-	14	-	-	137	-	-	43	-	-
2009	107	2	-	30	-	-	49	-	-	21	-	-
2010	124	-	-	116	-	-	8	-	-	14	-	1
2011	25	10	-	12	-	-	9	-	-	28	-	-
2012	49	-	-	4	-	-	30	-	-	18	-	-
2013	69	-	-	-	-	-	8	-	-	6	1	-
2014	49	-	-	13	-	-	9	-	-	15	-	1
2015	43	-	-	21	-	-	12	-	-	5	-	-
2016	82	-	-	36	-	-	9	-	-	4	-	1
2017	24	2	-	9	-	-	16	-	-	3	-	-
2018	41	-	-	1	-	-	18	-	-	6	-	-
2019	25	-	-	3	-	-	2	-	-	10	-	2
2020	1	-	-	18	-	-	3	-	-	19	-	-
2021	3	-	-	6	-	-	5	-	-	6	-	-
2022	23	-	-	2	-	-	20	-	-	5	-	-
2023	29	-	-	26	-	-	7	-	-	4	-	-
2024	86	-	-	30	-	-	3	-	-	3	-	-
Total	2,190	38	-	2,106	-	-	1,118	19	-	1,441	64	34

Table J-1b. Minimum number of marine mammal interactions and mortalities in the eastern Pacific Ocean (EPO) in 2023 reported by observers onboard longline vessels under the current mandate of at least 5% coverage (C-19-08) of each CPC fleet operating in the EPO. Reported marine mammal interactions were precautionarily presumed to be mortalities (i.e., disposition was either not reported or a detailed disposition was not provided e.g., “discarded”, “injured”) unless release condition was reported as “alive”, “alive and healthy”, or “released”. These data are considered incomplete as data are insufficient for expanding to fleet totals (BYC-10 INF-D) (see section 2.2 for uncertainty and data gaps associated with longline data reporting).
Tabla J-1b. Número mínimo de interacciones con mamíferos marinos y mortalidades en el Océano Pacífico oriental (OPO) en 2023 reportadas por observadores a bordo de buques palangreros bajo el mandato actual de al menos 5% de cobertura (C-19-08) de cada flota de los CPC que opera en el OPO. Se supuso precautoriamente que las interacciones con mamíferos marinos reportadas resultaron en mortalidades (es decir, no se reportó la disposición o no se proporcionó una disposición detallada, por ejemplo, "descartado", "herido", a menos que la condición de liberación fuera reportada como "vivo", "vivo y sano" o "liberado"). Estos datos se consideran incompletos ya que son insuficientes para expandirlos a totales de la flota (BYC-10 INF-D) (ver Sección 2.2. para consultar información sobre la incertidumbre y las deficiencias de los datos asociadas a la notificación de datos de palangre)

Common name	Scientific name	Interactions	Mortalities
Roughtoothed dolphin	*Steno bredanensis*	1	1
Risso's dolphin	*Grampus griseus*	1	1
False killer whale	*Pseudorca crassidens*	1	1
Franciscana	*Pontoporia blainvillei*	1	1
Total numbers		4	4

Table J-2a. Estimated number of turtle interactions and mortalities by observers onboard purse-seine size-class 6 vessels with a carrying capacity >363 t (1994–2024). Purse-seine set types: floating object (OBJ), unassociated tuna schools (NOA) and dolphins (DEL). Data for 2023–2024 are considered preliminary.

Tabla J-2a. Número estimado de mortalidades e interacciones de tortugas por observadores a bordo de buques cerqueros de clase 6 con una capacidad de acarreo >363 t (1994–2024). Tipos de lances cerqueros: objeto flotante (OBJ), atunes no asociados (NOA) y delfines (DEL). Los datos de 2023–2024 se consideran preliminares.

	Lepidochelys olivacea, Olive ridley (LKV)						*Chelonia agassizii, Chelonia mydas*, eastern Pacific green (TUG)						*Caretta caretta*, loggerhead (TTL)					
	Purse seine						Purse seine						Purse seine					
	interactions			mortality			interactions			mortality			interactions			mortality		
Year	**OBJ**	**NOA**	**DEL**	**OBJ**	**NOA**	**DEL**	**OBJ**	**NOA**	**DEL**	**OBJ**	**NOA**	**DEL**	**OBJ**	**NOA**	**DEL**	**OBJ**	**NOA**	**DEL**
1994	455	114	137	50	17	13	132	170	12	7	9	-	6	15	2	-	2	-
1995	537	89	117	66	11	14	181	196	8	10	2	1	9	52	3	-	2	-
1996	520	97	96	47	9	9	138	63	4	11	1	-	12	18	2	-	-	-
1997	544	439	112	54	33	7	164	59	16	8	3	2	7	38	3	1	3	1
1998	649	116	209	66	22	20	141	13	20	7	1	1	15	5	4	1	-	-
1999	1,005	140	160	82	18	9	130	16	21	5	2	4	9	9	2	1	3	-
2000	463	248	139	46	29	11	93	17	5	6	-	-	4	6	1	2	-	-
2001	802	162	136	51	11	4	164	24	8	6	2	-	10	1	2	1	-	-
2002	767	97	165	23	3	7	110	11	15	3	-	-	14	5	8	-	-	-
2003	762	147	168	16	4	3	107	25	15	-	-	-	14	4	6	-	-	-
2004	624	110	120	8	3	2	65	38	8	-	-	-	10	11	13	-	-	-
2005	606	872	249	7	6	4	101	122	21	1	1	-	5	15	14	-	-	-
2006	595	337	140	8	4	3	106	119	23	2	-	-	39	19	14	1	-	-
2007	450	494	210	6	1	3	83	56	31	-	1	-	56	38	12	1	-	-
2008	408	27	147	4	-	-	54	20	12	-	-	-	45	5	12	1	-	-
2009	464	30	110	10	-	2	56	12	19	1	-	-	30	5	20	-	-	-
2010	424	128	212	4	3	1	71	20	23	-	2	-	34	24	23	1	-	-
2011	502	96	115	6	-	1	70	89	25	1	1	-	29	46	16	-	1	-
2012	388	53	91	5	-	-	77	42	5	-	-	-	19	19	17	-	-	-
2013	454	20	66	7	1	-	61	10	7	1	-	-	24	9	8	-	-	-
2014	304	19	83	3	-	-	69	16	10	-	-	-	27	1	4	1	-	-
2015	195	49	78	2	-	1	54	12	21	-	-	-	28	6	13	-	-	-
2016	333	49	113	4	-	-	78	35	17	-	-	-	19	21	9	-	-	-
2017	285	24	72	2	-	1	39	21	34	-	-	-	31	20	7	-	-	-
2018	150	5	147	2	-	-	50	24	96	2	-	-	17	7	4	-	-	-
2019	170	28	129	1	-	-	72	13	10	-	-	-	14	46	9	-	-	-
2020	91	14	197	-	-	-	29	4	11	-	-	-	17	3	4	-	-	-
2021	191	2	54	1	-	1	32	17	3	-	-	-	13	5	11	-	-	-
2022	133	2	33	-	-	-	40	-	4	-	-	-	19	3	6	-	-	-
2023	65	14	47	-	-	-	13	2	6	-	-	-	12	-	2	-	-	-
2024	154	29	73	1	-	-	19	22	7	-	-	-	14	7	14	-	-	-
Total	13,491	4,052	3,926	583	174	117	2,597	1,288	517	71	25	8	602	463	265	11	10	1

Table J-2a continued

	Eretmochelys imbricata, hawksbill (TTH)						*Dermochelys coriacea*, leatherback (DKK)						Unidentified turtles					
	Purse seine						Purse seine						Purse seine					
	interactions			mortality			interactions			mortality			interactions			mortality		
Year	**OBJ**	**NOA**	**DEL**	**OBJ**	**NOA**	**DEL**	**OBJ**	**NOA**	**DEL**	**OBJ**	**NOA**	**DEL**	**OBJ**	**NOA**	**DEL**	**OBJ**	**NOA**	**DEL**
1994	5	5	4	-	2	-	3	2	-	1	-	-	151	27	83	34	2	9
1995	8	2	-	-	-	-	-	-	-	-	-	-	130	27	52	24	7	3
1996	8	-	6	-	-	1	5	-	-	-	-	-	151	58	37	30	6	2
1997	4	2	-	-	-	-	3	1	1	-	-	-	180	72	46	25	15	2
1998	7	-	3	3	-	-	1	2	1	-	-	-	121	24	97	26	8	7
1999	4	5	2	1	-	1	-	-	-	-	-	-	202	28	65	39	4	3
2000	4	1	3	1	-	-	1	1	1	-	-	-	92	68	74	17	9	2
2001	5	1	3	1	-	-	-	-	1	-	-	-	206	43	96	22	14	5
2002	8	1	2	-	-	-	1	1	-	-	-	-	175	33	82	6	5	2
2003	6	1	6	-	-	-	-	1	1	-	-	-	169	40	117	5	-	3
2004	12	4	3	-	-	-	1	4	4	-	-	-	151	53	48	4	2	-
2005	1	2	9	-	-	-	1	1	3	-	-	-	103	126	73	4	7	1
2006	12	11	4	-	-	-	1	3	2	-	-	-	184	64	77	1	-	-
2007	9	8	2	1	2	-	3	2	2	-	-	-	130	240	191	7	-	2
2008	7	-	12	-	-	-	2	3	2	-	-	-	182	18	107	1	-	-
2009	8	-	6	-	-	-	1	-	2	-	-	-	141	16	95	3	1	1
2010	11	-	4	1	-	-	3	-	-	-	-	-	122	24	187	3	1	1
2011	5	5	4	-	-	-	1	1	1	-	-	-	125	28	63	-	1	-
2012	4	-	2	-	-	-	1	1	-	-	-	-	99	19	40	3	-	-
2013	7	-	2	1	-	-	1	2	2	-	-	-	175	13	51	2	-	-
2014	7	1	2	-	-	1	7	1	2	-	-	-	132	18	53	1	-	-
2015	2	1	2	-	-	-	4	2	-	-	-	-	174	152	42	-	4	-
2016	14	3	5	-	-	-	2	1	-	-	-	-	307	59	120	2	-	-
2017	7	3	5	-	-	-	2	1	1	-	-	-	243	43	83	-	-	-
2018	7	2	1	-	-	-	3	-	1	-	-	-	160	22	169	-	-	-
2019	5	2	-	-	-	-	-	-	-	-	-	-	193	155	59	-	1	-
2020	5	1	-	-	-	-	2	1	-	-	-	-	108	8	45	1	-	1
2021	4	1	-	-	-	-	1	-	-	-	-	-	102	5	53	-	-	-
2022	10	1	-	-	-	-	2	1	1	-	-	-	92	1	23	-	-	-
2023	2	-	2	-	-	-	3	1	1	-	-	-	55	6	42	-	-	-
2024	5	-	1	-	-	-	3	-	-	-	-	-	102	21	46	-	-	-
Total	203	63	95	9	4	3	58	33	29	1	-	-	4,658	1,509	2,415	261	87	44

Table J-2b. Minimum number of sea turtle interactions and mortalities in the eastern Pacific Ocean (EPO) in 2023 reported by observers onboard longline vessels under the current mandate of at least 5% coverage (C-19-08) of each CPC fleet operating in the EPO. Dispositions considered to indicate a survival event are those reported by observers as "Alive and Healthy", "Light injuries", "Released" and "Released with a hook", while those considered to indicate a mortality event are dispositions reported as "Dead", "Discarded", "Grave Injuries", "Injured", "Alive and injured", or precautionarily where disposition was not reported. These data are considered incomplete as data are insufficient for expanding to fleet totals (BYC-10 INF-D) (see section 2.2 for uncertainty and data gaps associated with longline data reporting).

Tabla J-2b. Número mínimo de interacciones con tortugas marinas y mortalidades en el Océano Pacífico oriental (OPO) en 2023 reportadas por observadores a bordo de buques palangreros bajo el mandato actual de al menos 5% de cobertura (C-19-08) de cada flota de los CPC que opera en el OPO. Las disposiciones que se considera que indican un evento de supervivencia son las reportadas por los observadores como "Viva y sana", "Heridas leves", "Liberada" y "Liberada con un anzuelo", mientras que las que se considera que indican un evento de mortalidad son las disposiciones reportadas como "Muerta", "Descartada", "Heridas graves", "Herida", "Viva y herida" o, de manera precautoria, cuando la disposición no fue reportada. Estos datos se consideran incompletos ya que son insuficientes para expandirlos a totales de la flota (BYC-10 INF-D) (ver Sección 2.2. para consultar información sobre la incertidumbre y las deficiencias de los datos asociadas a la notificación de datos de palangre).

Common name	Scientific name	Interactions	Mortalities
Black/Green turtle	*Chelonia mydas*	50	6
Olive ridley turtle	*Lepidochelys olivacea*	16	-
Loggerhead turtle	*Caretta caretta*	11	4
Leatherback turtle	*Dermochelys coriacea*	10	3
Hawksbill turtle	*Eretmochelys imbricata*	1	-
Total numbers		88	13

Table J-3. Minimum number of seabird interactions in the eastern Pacific Ocean (EPO) in 2023 reported by observers onboard longline vessels under the current mandate of at least 5% coverage (C-19-08) of each CPC fleet operating in the EPO. Seabird interactions with reported dispositions as "discarded" was precautionarily presumed to be mortalities; one interaction reported as "released" was presumed to indicate survival. These data are considered incomplete as data are insufficient for expanding to fleet totals (BYC-10 INF-D) (see section 2.2 for uncertainty and data gaps associated with longline data reporting).

Tabla J-3. Número mínimo de interacciones con aves marinas en el Océano Pacífico oriental (OPO) en 2022 reportadas por observadores a bordo de buques palangreros bajo el mandato actual de al menos 5% de cobertura (C-19-08) de cada flota de los CPC que opera en el OPO. Se supone precautoriamente que las interacciones con aves marinas con disposiciones reportadas como "descartada" son mortalidades; se supuso que una interacción reportada como "liberada" indicaba supervivencia. Estos datos se consideran incompletos ya que son insuficientes para expandirlos a totales de la flota (BYC-10 INF-D) (ver Sección 2.2. para consultar información sobre la incertidumbre y las deficiencias de los datos asociadas a la notificación de datos de palangre).

Common name	Scientific name	Interactions	Mortalities
Black-footed albatross	*Phoebastria nigripes*	10	10
Albatross nei	*Diomedea* spp.	5	4
Total numbers		15	14

Table J-4a. Estimated purse-seine catches by set type in metric tons (t) of sharks by observers onboard size-class 6 vessels with a carrying capacity >363 t (1994–2024) and minimum reported longline (LL) catches of sharks (gross-annual removals in t) (1994–2023, *data not available; see section 2.2. for uncertainty and data gaps in reporting of bycatch caught by longline). Purse-seine set types: floating object (OBJ), unassociated tuna schools (NOA) and dolphins (DEL). Species highlighted bold are discussed in main text. Data for 2019–2023 (longline) and 2023–2024 (purse-seine) are considered preliminary.

Tabla J-4a. Capturas cerqueras estimadas de tiburones, por tipo de lance, en toneladas (t), por observadores a bordo de buques de clase 6 con una capacidad de acarreo >363 t (1994–2024) y capturas palangreras (LL) mínimas reportadas de tiburones (extracciones anuales brutas en t) (1994–2023, *datos no disponibles; ver Sección 2.2. para consultar información sobre la incertidumbre y las deficiencias de los datos en la notificación de especies capturadas incidentalmente con palangre). Tipos de lances cerqueros: objeto flotante (OBJ), atunes no asociados (NOA) y delfines (DEL). Las especies en negritas se discuten en el texto principal. Los datos de 2019–2023 (palangre) y 2023–2024 (cerco) se consideran preliminares.

	Carcharhinidae															
	***Carcharhinus falciformis*, silky shark**				***Carcharhinus longimanus*, oceanic whitetip**				***Prionace glauca*, blue shark**				Other Carcharhinidae, requiem sharks			
	Purse seine				Purse seine				Purse seine				Purse seine			
Year	**OBJ**	**NOA**	**DEL**	**LL**	**OBJ**	**NOA**	**DEL**	**LL**	**OBJ**	**NOA**	**DEL**	**LL**	**OBJ**	**NOA**	**DEL**	**LL**
1994	439	244	38	-	119	9	4	-	<1	1	<1	209	24	14	5	-
1995	471	120	162	-	200	36	18	-	<1	5	<1	280	4	2	11	-
1996	442	107	47	-	209	5	12	-	2	<1	<1	606	12	<1	7	-
1997	843	188	42	-	236	11	6	-	2	<1	<1	425	18	3	5	-
1998	710	59	171	-	211	7	5	-	1	<1	<1	1,164	4	<1	<1	-
1999	460	100	74	-	163	7	2	-	<1	<1	<1	2,185	9	<1	<1	-
2000	308	97	30	-	98	9	2	-	<1	<1	<1	2,112	5	<1	<1	-
2001	399	76	53	-	96	<1	<1	-	4	<1	<1	2,304	9	<1	-	-
2002	291	142	35	-	31	6	<1	<1	1	<1	<1	2,356	4	17	<1	-
2003	320	102	59	-	19	<1	<1	-	<1	<1	<1	2,054	7	6	<1	-
2004	247	68	76	-	9	<1	<1	<1	<1	<1	-	2,325	5	3	<1	-
2005	322	41	51	-	2	-	<1	-	<1	<1	-	2,825	4	2	3	-
2006	361	46	27	13,053	5	<1	<1	46	<1	1	<1	1,341	13	3	8	280
2007	316	156	41	12,771	2	-	<1	136	<1	1	-	3,169	8	24	11	419
2008	577	27	25	11,205	2	-	<1	55	<1	1	<1	6,838	11	<1	1	741
2009	339	31	33	14,042	4	<1	<1	294	<1	<1	<1	6,678	29	4	20	431
2010	347	66	70	12,510	2	-	<1	94	<1	1	1	10,130	17	10	21	4,259
2011	266	26	55	12,866	2	-	<1	63	<1	<1	1	13,863	20	6	4	4,730
2012	200	33	52	10,585	<1	<1	-	1	<1	2	<1	12,565	8	<1	1	4,082
2013	212	55	38	14,762	<1	<1	-	5	<1	<1	1	12,237	12	2	3	753
2014	422	68	45	5,511	2	-	-	25	1	<1	<1	10,728	13	<1	5	1,515
2015	540	133	48	5,690	3	<1	<1	647	<1	<1	<1	13,194	31	7	2	1,901
2016	488	36	63	9,610	5	<1	<1	755	<1	2	1	12,381	35	<1	3	2,755
2017	665	12	21	15,893	4	<1	<1	3	<1	<1	-	11,086	54	<1	2	2,562
2018	397	12	16	15,072	3	-	<1	19	<1	<1	<1	12,499	28	3	1	1,360
2019	392	13	25	2,599	5	<1	<1	-	<1	<1	<1	11,070	26	4	6	10
2020	345	11	33	14,752	4	-	<1	-	<1	<1	-	15,080	87	5	4	2,896
2021	542	10	21	12	12	<1	<1	-	<1	<1	<1	8,920	30	<1	<1	-
2022	614	23	7	37	12	<1	<1	-	1	<1	-	10,563	30	2	2	-
2023	473	10	24	55	12	<1	<1	-	<1	<1	-	10,268	26	<1	2	-
2024	626	78	23	*	21	<1	<1	*	<1	1	-	*	25	<1	1	*
Total	13,377	2,190	1,504	171,025	1,494	95	56	2,143	23	24	9	201,459	607	126	131	28,694

Table J-4a Continued

	Sphyrnidae															
	***Sphyrna zygaena*, smooth hammerhead**				*Sphyrna lewini*, scalloped hammerhead				*Sphyrna mokarran*, great hammerhead				*Sphyrna* spp., hammerheads, nei			
	Purse seine				Purse seine				Purse seine				Purse seine			
Year	**OBJ**	**NOA**	**DEL**	**LL**	**OBJ**	**NOA**	**DEL**	**LL**	**OBJ**	**NOA**	**DEL**	**LL**	**OBJ**	**NOA**	**DEL**	**LL**
1994	1	2	<1	-	<1	4	<1	-	-	-	-	-	102	24	2	-
1995	2	2	-	-	<1	<1	<1	-	<1	-	-	-	71	15	4	-
1996	4	2	-	-	1	<1	-	-	<1	-	-	-	87	39	5	-
1997	21	2	<1	-	10	3	<1	-	1	<1	<1	-	63	10	3	-
1998	18	5	1	-	8	9	<1	-	3	<1	3	-	37	12	5	-
1999	21	3	<1	-	16	3	1	-	1	<1	<1	-	18	5	3	-
2000	11	4	<1	-	7	15	1	-	7	<1	<1	-	7	2	7	-
2001	24	1	<1	-	12	1	<1	-	5	-	<1	-	23	<1	1	-
2002	24	3	1	-	47	<1	1	-	7	-	<1	-	46	4	2	-
2003	49	6	1	-	38	3	3	-	13	<1	<1	-	52	3	2	-
2004	51	11	3	-	25	3	2	-	3	<1	<1	-	60	2	<1	-
2005	34	2	<1	-	25	10	3	-	2	-	<1	-	19	<1	<1	<1
2006	33	6	2	58	19	3	1	-	1	<1	<1	-	3	<1	<1	5
2007	27	5	<1	200	12	3	1	<1	-	<1	<1	-	1	1	<1	43
2008	16	<1	<1	381	16	11	<1	64	<1	-	<1	-	6	<1	1	42
2009	22	<1	<1	423	13	2	1	50	<1	-	-	-	5	1	<1	22
2010	28	1	2	508	13	1	1	143	<1	-	<1	-	3	<1	<1	118
2011	49	2	2	443	13	6	2	191	3	<1	<1	-	12	<1	1	131
2012	32	2	<1	118	9	4	<1	89	<1	<1	<1	-	5	2	1	130
2013	47	2	<1	311	22	2	<1	87	<1	<1	<1	-	9	1	<1	296
2014	35	<1	<1	593	23	2	<1	5	1	<1	<1	-	14	<1	<1	208
2015	32	1	<1	1,961	9	<1	<1	11	<1	<1	-	-	9	<1	<1	392
2016	24	1	<1	4,052	12	1	<1	6	5	<1	-	-	11	1	<1	338
2017	11	<1	<1	3,495	8	3	<1	83	<1	<1	<1	-	6	<1	<1	197
2018	11	<1	<1	851	7	<1	<1	<1	<1	-	-	-	6	<1	<1	173
2019	17	<1	<1	33	11	2	<1	43	1	-	<1	-	5	<1	<1	5
2020	7	<1	<1	941	13	<1	<1	39	<1	-	<1	-	5	<1	<1	1,021
2021	13	<1	<1	37	31	<1	<1	<1	2	-	<1	-	7	-	<1	-
2022	11	-	<1	7	47	<1	<1	<1	<1	-	-	-	9	<1	<1	-
2023	15	<1	<1	17	19	<1	<1	40	<1	<1	-	-	8	<1	<1	-
2024	11	<1	<1	*	15	<1	<1	*	3	1	<1	*	4	<1	<1	*
Total	702	68	22	14,430	503	97	27	854	65	5	5	-	712	130	45	3,122

Table J-4a Continued

	Alopiidae															
	***Alopias pelagicus*, pelagic thresher**				*Alopias superciliosus*, bigeye thresher				*Alopias vulpinus*, thresher shark				*Alopias* spp., thresher shark, nei			
	Purse seine				Purse seine				Purse seine				Purse seine			
Year	**OBJ**	**NOA**	**DEL**	**LL**	**OBJ**	**NOA**	**DEL**	**LL**	**OBJ**	**NOA**	**DEL**	**LL**	**OBJ**	**NOA**	**DEL**	**LL**
1994	-	<1	<1	-	-	6	<1	-	-	3	<1	-	<1	11	3	87
1995	<1	<1	<1	-	<1	2	<1	-	<1	1	1	-	1	6	3	200
1996	-	1	-	-	<1	1	<1	-	<1	<1	<1	-	<1	2	4	28
1997	<1	<1	-	-	<1	1	<1	-	<1	<1	<1	-	<1	4	<1	5
1998	<1	2	<1	-	<1	4	1	-	<1	2	<1	-	<1	5	3	5
1999	<1	4	2	-	<1	1	6	-	<1	<1	<1	-	<1	3	2	5
2000	<1	<1	<1	-	<1	8	1	-	<1	<1	<1	-	<1	<1	6	64
2001	<1	<1	<1	-	<1	4	2	-	<1	<1	<1	-	<1	4	1	172
2002	<1	<1	<1	-	2	8	1	-	<1	2	<1	-	<1	6	4	88
2003	1	5	3	-	<1	8	6	-	<1	<1	<1	-	<1	4	3	134
2004	6	3	2	-	<1	16	1	-	<1	2	<1	-	<1	4	2	43
2005	1	3	2	-	<1	6	3	-	<1	1	2	-	<1	<1	<1	12
2006	2	23	2	-	<1	22	3	187	<1	7	<1	60	<1	3	<1	8
2007	3	3	6	1,133	2	3	3	115	<1	<1	<1	35	<1	1	1	15
2008	1	3	3	4,323	<1	3	3	240	<1	2	<1	38	<1	1	2	17
2009	<1	<1	1	4,909	<1	<1	2	343	<1	<1	<1	76	<1	<1	1	4
2010	<1	<1	3	7,828	<1	<1	2	373	1	<1	<1	34	<1	<1	1	389
2011	<1	2	2	7,302	<1	2	2	458	<1	<1	<1	61	<1	1	<1	430
2012	<1	1	2	7	<1	1	2	326	<1	<1	<1	86	<1	1	<1	526
2013	<1	<1	3	46	<1	<1	2	543	<1	<1	<1	49	<1	<1	1	109
2014	<1	1	2	36	<1	3	2	636	<1	<1	<1	2	<1	<1	<1	850
2015	<1	2	1	463	<1	1	<1	859	<1	-	<1	13	<1	<1	<1	283
2016	<1	2	3	1,045	<1	<1	4	944	<1	1	<1	549	<1	<1	1	96
2017	<1	<1	<1	582	<1	<1	<1	1,148	-	<1	<1	1,682	<1	<1	<1	153
2018	<1	2	<1	464	<1	<1	<1	32	<1	<1	<1	1,684	<1	<1	<1	39
2019	1	<1	<1	444	<1	<1	<1	17	-	-	<1	<1	<1	<1	<1	31
2020	<1	<1	2	342	<1	<1	1	1,273	-	-	<1	745	<1	<1	<1	6
2021	<1	<1	<1	1	<1	<1	<1	3	<1	<1	<1	<1	<1	<1	<1	1
2022	<1	<1	<1	4	<1	<1	<1	85	<1	<1	<1	-	<1	<1	<1	3
2023	<1	<1	2	19	<1	<1	6	90	-	<1	<1	-	<1	<1	<1	<1
2024	<1	<1	<1	*	<1	<1	<1	*	-	<1	-	*	<1	<1	<1	*
Total	23	65	47	28,947	17	106	59	7,671	5	29	13	5,114	13	63	47	3,803

Table J-4a Continued

	Lamnidae								Triakidae											
	***Isurus* spp., mako sharks**				Lamnidae spp., mackerel sharks, porbeagles nei				Triakidae spp., houndsharks, nei				Other sharks				All sharks			
	Purse seine				Purse seine				Purse seine				Purse seine				Purse seine			
Year	**OBJ**	**NOA**	**DEL**	**LL**	**OBJ**	**NOA**	**DEL**	**LL**	**OBJ**	**NOA**	**DEL**	**LL**	**OBJ**	**NOA**	**DEL**	**LL**	**OBJ**	**NOA**	**DEL**	**LL**
1994	2	<1	<1	156	-	-	-	-	-	-	-	-	69	47	7	782	759	367	62	1,234
1995	2	<1	<1	216	-	-	-	-	-	-	-	-	103	29	13	226	856	220	213	922
1996	1	<1	<1	318	-	-	-	-	-	-	-	-	69	41	34	168	830	202	110	1,120
1997	2	1	-	361	-	-	-	-	-	-	-	-	88	4	2	166	1,287	230	62	956
1998	1	<1	<1	693	-	-	-	-	-	-	-	-	90	10	6	237	1,085	116	198	2,099
1999	<1	<1	<1	460	-	-	-	-	-	-	-	-	50	12	4	3,347	739	140	97	5,997
2000	2	<1	-	502	-	-	-	-	-	-	-	-	21	67	178	5,740	466	207	227	8,418
2001	2	<1	<1	1,168	-	-	-	-	-	-	-	-	29	4	2	8,896	605	94	62	12,540
2002	4	<1	<1	1,131	-	-	-	-	-	-	-	1,484	40	11	3	7,339	497	201	51	12,398
2003	2	<1	<1	1,156	-	-	-	-	-	-	-	1,287	12	37	4	9,866	516	177	83	14,498
2004	1	<1	<1	1,374	-	-	-	-	-	-	-	846	36	10	5	6,684	446	125	95	11,273
2005	1	2	<1	1,367	-	-	-	-	-	-	-	838	5	1	1	7,075	417	71	67	12,117
2006	2	4	<1	95	-	-	-	2	-	-	-	674	8	<1	<1	4,770	449	118	46	20,579
2007	2	2	-	181	-	-	-	1	-	-	-	996	5	3	1	5,786	380	203	67	25,000
2008	<1	2	<1	707	-	-	-	1	-	-	-	1,398	12	<1	2	4,091	644	52	40	30,141
2009	1	<1	<1	534	-	-	-	7	-	-	-	695	19	3	1	2,478	434	46	63	30,988
2010	3	<1	<1	1,901	-	-	-	<1	-	-	-	<1	17	4	2	2,246	433	87	104	40,533
2011	3	2	<1	2,802	-	-	-	26	-	-	-	7	30	<1	<1	2,074	401	51	72	45,449
2012	2	2	<1	2,120	-	-	-	12	-	-	-	-	10	<1	<1	1,242	272	50	62	31,889
2013	1	<1	<1	2,121	-	-	-	44	-	-	-	211	45	2	<1	1,517	351	67	49	33,090
2014	2	<1	<1	2,778	-	-	-	51	-	-	-	4,067	24	<1	<1	2,075	540	78	56	29,081
2015	<1	<1	<1	3,118	-	-	-	79	-	-	-	621	18	3	3	10,593	645	151	58	39,825
2016	1	<1	<1	2,476	-	-	-	91	-	-	-	538	19	3	<1	2,245	602	50	78	37,880
2017	<1	<1	-	3,256	-	-	-	112	-	-	-	987	16	1	<1	1,267	766	21	27	42,506
2018	2	<1	<1	3,161	-	-	-	111	-	-	-	730	5	<1	<1	1,161	460	21	20	37,357
2019	<1	<1	<1	2,021	-	-	-	8	-	-	-	<1	6	<1	<1	53	465	23	34	16,335
2020	2	<1	-	3,693	-	-	-	95	-	-	-	1,032	3	2	<1	2,381	467	21	42	44,297
2021	2	<1	-	1,604	-	-	-	7	-	-	-	2	6	<1	<1	162	646	12	24	10,750
2022	1	<1	-	1,324	-	-	-	5	-	-	-	-	2	<1	<1	121	729	27	11	12,150
2023	1	-	<1	1,220	-	-	-	6	-	-	-	-	1	<1	<1	4	557	13	36	11,719
2024	<1	<1	<1	*	-	-	-	*	-	-	-	*	2	1	<1	*	709	86	26	*
Total	50	26	3	44,013	-	-	-	660	-	-	-	16,414	860	301	274	94,793	18,451	3,325	2,242	623,140

Table J-4b. Minimum number of shark interactions and mortalities in the eastern Pacific Ocean (EPO) in 2023 reported by observers onboard longline vessels under the current mandate of at least 5% coverage (C-19-08) of each CPC fleet operating in the EPO. Data are considered incomplete and are deemed by the staff to be insufficient for expanding to fleet totals (BYC-10 INF-D) (see section 2.2 for uncertainty and data gaps associated with longline data reporting). Dispositions considered to indicate a survival event are those reported by observers as “Alive and Healthy”, “Alive with light injuries” and “Alive”, while those considered to indicate a mortality event are dispositions reported as “Dead”, “Alive mortal”, “Alive injured”, “Discarded”, “Unknown”, or precautionarily where disposition was not reported.

Tabla J-4b. Número mínimo de interacciones con tiburones y mortalidades en el Océano Pacífico oriental en 2023 reportadas por observadores a bordo de buques palangreros bajo el mandato actual de al menos 5% de cobertura (C-19-08) de cada flota de los CPC que opera en el OPO. Los datos se consideran incompletos y el personal considera que son insuficientes para expandirlos a totales de la flota (BYC-10 INF-D) (ver Sección 2.2. para consultar información sobre la incertidumbre y las deficiencias de los datos asociadas a la notificación de datos de palangre). Las disposiciones que se considera que indican un evento de supervivencia son las reportadas por los observadores como "Vivo y sano", "Vivo con heridas leves" y "Vivo", mientras que las que se considera que indican un evento de mortalidad son las disposiciones reportadas como "Muerto", "Vivo, mortalidad probable", “Vivo herido", “Descartado", "Desconocida" o precautoriamente cuando la disposición no fue reportada.

Common name	Scientific name	Interactions	Mortalities
Blue shark	*Prionace glauca*	4,508	4,179
Crocodile shark	*Pseudocarcharias kamoharai*	545	152
Short fin mako shark	*Isurus oxyrinchus*	225	225
Bigeye thresher shark	*Alopias superciliosus*	119	111
Velvet dogfish	*Zameus squamulosus*	115	106
Various sharks nei	Euselachii	98	98
Pelagic thresher shark	*Alopias pelagicus*	76	44
Thresher shark, nei	*Alopias* spp.	35	31
Oceanic whitetip shark	*Carcharhinus longimanus*	26	22
Longfin mako shark	*Isurus paucus*	21	20
Shark - identified	Euselachii	21	21
Silky shark	*Carcharhinus falciformis*	12	8
Other sharks*		29	26
Total numbers		5,830	5,043

*"Other sharks" include those with ≤10 interactions from 11 taxa in 2023

Table J-5a. Estimated purse-seine catches by set type in numbers of rays by observers onboard size-class 6 vessels with a carrying capacity >363 t (1994–2024). Purse-seine set types: floating object (OBJ), unassociated tuna schools (NOA) and dolphins (DEL). Species highlighted bold are discussed in main text. Data for 2023–2024 are considered preliminary.

Tabla J-5a. Capturas cerqueras estimadas de rayas, por tipo de lance, en número de rayas, por observadores a bordo de buques de clase 6 con una capacidad de acarreo >363 t (1994–2024). Tipos de lances cerqueros: objeto flotante (OBJ), atunes no asociados (NOA) y delfines (DEL). Las especies en negritas se discuten en el texto principal. Los datos de 2023–2024 se consideran preliminares.

	Mobulidae														
	***Mobula thurstoni*, smoothtail manta**			***Mobula mobular*, spinetail manta**			*Mobula munkiana*, munk's devil ray			*Mobula tarapacana*, Chilean devil ray			***Mobula birostris*, giant manta**		
	Purse seine			Purse seine			Purse seine			Purse seine			Purse seine		
Year	OBJ	NOA	DEL	OBJ	NOA	DEL	OBJ	NOA	DEL	OBJ	NOA	DEL	OBJ	NOA	DEL
1994	-	3	-	-	-	-	-	-	-	-	-	-	1	-	-
1995	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
1996	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1997	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-
1998	-	8	-	-	-	-	-	-	-	-	-	-	4	94	1
1999	-	2	1	-	-	-	-	-	-	-	-	-	10	63	1
2000	34	121	101	-	-	-	-	-	-	-	-	-	1	12	2
2001	7	185	98	2	8	16	-	-	3	4	-	-	2	6	6
2002	18	2,048	72	7	8	96	1	3	10	7	15	7	2	6	5
2003	37	707	141	6	79	11	7	35	26	-	-	8	3	10	1
2004	8	429	86	2	30	57	-	15	17	1	28	4	2	47	15
2005	14	72	205	16	111	126	-	21	14	3	42	79	10	23	36
2006	14	572	43	19	473	187	-	65	31	5	52	45	30	37	219
2007	14	64	105	32	202	148	2	29	24	24	37	55	5	17	8
2008	14	126	50	30	247	87	8	127	36	10	276	30	3	61	18
2009	22	31	93	17	56	243	9	45	6	2	21	190	1	11	6
2010	39	123	132	22	334	303	1	48	33	7	12	148	2	1,163	4
2011	6	397	27	18	104	152	11	58	29	9	28	78	5	9	1
2012	15	1,435	67	48	243	34	3	63	6	7	94	21	6	949	13
2013	25	180	40	18	112	62	6	55	6	7	29	26	1	24	21
2014	22	29	75	179	87	57	6	4	15	5	10	18	7	9	-
2015	14	41	101	61	21	338	6	11	74	12	25	93	1	67	38
2016	18	31	166	5	26	115	2	236	86	13	17	26	7	68	3
2017	11	52	43	45	26	15	8	15	10	10	-	11	8	53	11
2018	6	29	5	37	48	56	22	4	12	8	2	2	11	7	1
2019	7	214	11	35	167	61	9	-	8	24	8	18	2	11	3
2020	9	4	12	19	113	37	1	-	47	5	2	7	7	-	1
2021	8	-	-	34	46	16	10	5	-	11	3	13	1	26	-
2022	5	-	98	43	8	25	12	-	4	23	-	12	3	-	8
2023	28	6	90	25	4	37	5	8	220	73	8	14	2	5	3
2024	12	171	67	73	328	33	2	32	69	39	23	12	4	6	3
Total	408	7,081	1,928	792	2,881	2,313	132	879	787	310	733	918	141	2,788	428

Table J-5a Continued

	Mobulidae			Dasyatidae											
	Mobulidae spp., mobulid rays, nei			***Pteroplatytrygon violacea*, pelagic stingray**			**Dasyatidae spp., stingrays, nei**			Other rays			All rays		
	Purse seine			Purse seine			Purse seine			Purse seine			Purse seine		
Year	OBJ	NOA	DEL	OBJ	NOA	DEL	OBJ	NOA	DEL	OBJ	NOA	DEL	OBJ	NOA	DEL
1994	52	1,266	375	140	1,632	337	-	-	-	-	-	-	193	2,901	712
1995	69	2,248	500	159	151	144	-	-	-	-	-	-	228	2,400	643
1996	124	1,341	385	101	165	176	-	-	-	-	-	-	225	1,506	561
1997	126	707	396	106	106	993	-	-	-	-	-	-	232	816	1,390
1998	73	2,906	337	95	258	170	-	1,136	-	2	1	-	174	4,403	508
1999	140	1,498	474	164	403	151	-	-	-	-	-	-	314	1,966	627
2000	36	1,805	1,276	104	221	159	-	-	-	-	-	-	175	2,159	1,537
2001	50	289	447	150	64	174	-	-	-	-	-	-	215	553	744
2002	40	1,994	723	113	60	153	2	-	-	-	-	-	190	4,133	1,066
2003	130	1,005	904	94	9,188	135	-	-	-	-	-	-	277	11,025	1,226
2004	63	656	351	138	39	86	4	282	5	-	-	-	218	1,526	620
2005	36	259	177	91	52	173	9	13	20	-	1,724	-	179	2,317	831
2006	43	340	295	153	91	202	29	764	30	-	-	160	293	2,394	1,213
2007	40	205	237	98	54	132	9	931	21	-	19	-	225	1,557	730
2008	41	145	91	97	19	87	14	20	28	-	-	-	217	1,022	427
2009	37	107	270	116	17	105	5	4	68	-	-	-	209	292	981
2010	97	629	256	101	21	901	5	-	60	-	1,596	-	274	3,926	1,837
2011	27	227	81	92	193	90	13	114	18	-	24	-	181	1,154	476
2012	18	186	41	121	30	100	13	17	3	1	12	7	232	3,029	292
2013	15	121	323	90	59	255	27	2	6	-	-	403	189	582	1,142
2014	24	72	24	173	43	108	19	22	18	-	-	-	436	277	315
2015	20	54	141	82	65	163	11	5	32	-	-	-	207	289	980
2016	41	248	162	60	37	352	12	-	70	-	-	-	159	663	980
2017	141	290	100	258	76	130	31	68	144	-	-	137	512	580	601
2018	102	117	155	247	61	123	62	17	14	-	-	-	495	286	368
2019	87	484	165	255	185	143	40	38	27	-	8	1	460	1,114	437
2020	62	67	163	260	145	160	17	14	41	-	-	-	380	345	468
2021	85	73	154	388	178	117	46	3	14	-	25	-	584	360	314
2022	128	23	95	422	76	187	34	9	7	-	-	-	671	116	437
2023	112	20	81	333	37	173	40	12	5	1	-	20	618	100	643
2024	144	367	101	349	304	291	42	60	88	-	1	-	665	1,292	664
Total	2,203	19,750	9,280	5,150	14,029	6,669	485	3,531	719	4	3,410	729	9,626	55,082	23,771

Table J-5b. Minimum number of ray interactions and mortalities in the eastern Pacific Ocean (EPO) in 2023 reported by observers onboard longline vessels under the current mandate of at least 5% coverage (C-19-08) of each CPC fleet operating in the EPO. Data are considered incomplete as data are insufficient for expanding to fleet totals (BYC-10 INF-D) (see section 2.2 for uncertainty and data gaps associated with longline data reporting). Dispositions considered to indicate a survival event are those reported by observers as “Alive and Healthy”, “Alive with light injuries”, “Alive” and “Escaped”, while those considered to indicate a mortality event are dispositions reported as “Dead”, “Alive mortal”, Alive injured”, Discarded”, “Unknown”, or precautionarily where disposition was not reported.
Tabla J-5b. Número mínimo de interacciones con rayas y mortalidades en el Océano Pacífico oriental en 2023 reportadas por observadores a bordo de buques palangreros bajo el mandato actual de al menos 5% de cobertura (C-19-08) de cada flota de los CPC que opera en el OPO. Los datos se consideran incompletos ya que los datos son insuficientes para expandirlos a totales de la flota (BYC-10 INF-D) (ver Sección 2.2. para consultar información sobre la incertidumbre y las deficiencias de los datos asociadas a la notificación de datos de palangre). Las disposiciones que se considera que indican un evento de supervivencia son las reportadas por los observadores como "Viva y sana", "Viva con heridas leves", "Viva" y "Escapada", mientras que las que se considera que indican un evento de mortalidad son las disposiciones reportadas como "Muerta", "Viva, mortalidad probable", “Viva herida", “Descartada", "Desconocida" o precautoriamente cuando la disposición no fue reportada.

Common name	Scientific name	Total interactions	Mortalities
Pelagic stingray	*Pteroplatytrygon violacea*	3,832	3,634
Rays, skates, nei	Rajiformes	6	1
Giant manta	*Mobula birostris*	4	3
Manta rays	Mobulidae	4	4
Manta ray, nei	*Mobula* spp.	1	1
Total numbers		3,847	3,643

Table J-6a. Estimated purse-seine catches by set type in metric tons (t) of large fishes by observers onboard size-class 6 vessels with a carrying capacity >363 t (1994–2024) and minimum reported longline (LL) catches of large fishes (gross-annual removals in t) (1994–2023, *data not available , see section 2.2. for uncertainty and data gaps in reporting of bycatch caught by longline). Purse-seine set types: floating object (OBJ), unassociated tuna schools (NOA) and dolphins (DEL). Species highlighted bold are discussed in main text. Data for 2019–2023 (longline) and 2023–2024 (purse-seine) are considered preliminary.

Tabla J-6a. Capturas cerqueras estimadas de peces grandes, por tipo de lance, en toneladas (t), por observadores a bordo de buques de clase 6 con una capacidad de acarreo >363 t (1994–2024) y capturas palangreras (LL) mínimas reportadas de peces grandes (extracciones anuales brutas en t) (1994–2023, *datos no disponibles; ver Sección 2.2. para consultar información sobre la incertidumbre y las deficiencias de los datos en la notificación de especies capturadas incidentalmente con palangre). Tipos de lances cerqueros: objeto flotante (OBJ), atunes no asociados (NOA) y delfines (DEL). Las especies en negritas se discuten en el texto principal. Los datos de 2019–2023 (palangre) y 2023–2024 (cerco) se consideran preliminares.

	Coryphaenidae				Scombridae				Carangidae											
	Coryphaenidae spp., dorado				***Acanthocybium solandri, wahoo***				***Elagatis bipinnulata, rainbow runner***				*Seriola spp., amberjacks, nei*				*Caranx* spp., jacks, crevalles, nei			
	Purse seine				Purse seine				Purse seine				Purse seine				Purse seine			
Year	OBJ	NOA	DEL	LL	OBJ	NOA	DEL	LL	OBJ	NOA	DEL	LL	OBJ	NOA	DEL	LL	OBJ	NOA	DEL	LL
1994	1,221	20	<1	46	472	1	1	<1	14	<1	<1	-	<1	-	-	-	-	-	-	-
1995	1,071	22	3	39	379	<1	<1	1	11	<1	<1	-	<1	<1	-	-	-	-	-	-
1996	1,312	18	<1	43	271	<1	<1	1	28	3	<1	-	4	-	-	-	-	-	-	-
1997	1,225	12	<1	6,866	475	3	1	<1	60	2	<1	-	1	-	-	-	<1	-	-	-
1998	816	18	<1	2,528	396	<1	4	2	93	<1	<1	-	4	-	-	-	<1	-	-	-
1999	1,238	4	<1	6,283	161	<1	<1	2	110	<1	<1	-	<1	-	-	-	<1	-	-	-
2000	1,437	51	2	3,537	277	2	<1	2	53	5	<1	-	<1	-	-	-	<1	-	-	-
2001	2,202	17	3	15,942	1,023	2	<1	6	90	<1	<1	-	1	-	-	-	<1	-	-	-
2002	1,815	8	<1	9,464	571	<1	<1	18	94	1	<1	-	<1	<1	-	-	<1	-	-	-
2003	894	11	1	5,301	428	<1	<1	164	108	2	-	-	1	<1	-	-	<1	-	-	-
2004	1,018	17	1	3,986	380	<1	<1	155	62	<1	-	-	56	9	<1	1	2	<1	-	-
2005	972	75	1	3,854	420	<1	<1	155	66	<1	<1	-	26	2	<1	-	2	1	-	-
2006	1,197	58	<1	3,408	424	1	<1	167	73	<1	<1	-	53	8	<1	-	10	220	<1	-
2007	1,235	47	1	6,907	421	2	<1	221	157	<1	-	-	18	80	<1	-	1	11	-	-
2008	1,112	17	2	15,845	249	1	<1	213	40	<1	<1	-	27	<1	-	-	17	18	-	-
2009	1,722	7	<1	17,136	547	<1	<1	336	28	<1	<1	-	13	<1	-	-	11	8	-	-
2010	912	3	<1	9,484	373	1	<1	284	17	<1	<1	-	3	23	-	-	1	48	-	-
2011	1,410	7	<1	12,438	169	2	<1	242	22	<1	-	-	7	33	-	<1	4	14	-	1
2012	1,705	18	<1	17,255	313	<1	<1	230	13	1	-	-	10	7	-	-	2	15	<1	-
2013	1,455	7	<1	11,249	518	1	<1	291	19	<1	-	-	6	<1	<1	-	4	2	<1	-
2014	1,779	9	<1	3,342	517	2	<1	287	15	<1	<1	-	6	2	-	-	3	<1	<1	-
2015	1,167	8	<1	1,206	357	1	<1	285	15	<1	-	-	6	<1	-	-	9	8	<1	-
2016	949	7	<1	446	318	2	<1	321	26	<1	<1	-	12	<1	<1	-	4	<1	8	-
2017	1,557	11	<1	2,118	335	<1	<1	319	18	<1	<1	-	12	5	<1	-	4	12	-	-
2018	1,483	5	5	3,932	230	<1	<1	366	20	<1	-	-	62	<1	-	-	9	<1	-	-
2019	1,208	29	<1	1,971	201	<1	<1	331	21	<1	<1	-	12	4	<1	-	5	<1	-	-
2020	783	4	<1	2,507	130	<1	<1	309	23	-	<1	-	9	1	-	<1	3	<1	<1	-
2021	2,183	13	<1	1,431	132	<1	<1	214	28	<1	<1	-	81	3	-	-	3	<1	-	-
2022	2,325	12	2	738	164	<1	<1	178	35	<1	-	-	25	4	-	-	6	<1	-	-
2023	1,457	4	2	421	264	<1	<1	256	45	<1	<1	-	9	<1	-	-	3	-	-	-
2024	865	5	<1	*	232	<1	<1	*	86	<1	<1	*	16	-	-	*	7	<1	<1	*
Total	41,727	545	36	169,724	11,150	32	10	5,358	1,491	20	<1	-	484	183	<1	2	111	360	9	1

Table J-6a Continued

	Carangidae *Seriola, Caranx spp., amberjacks, jacks, crevalles, nei*				Molidae *Molidae spp., molas, nei*				Lobotidae *Lobotes surinamensis, tripletail*				Sphyraenidae *Sphyraenidae spp., barracudas*				Lampridae ***Lampris spp., opahs***			
	Purse seine				Purse seine				Purse seine				Purse seine				Purse seine			
Year	OBJ	NOA	DEL	LL	OBJ	NOA	DEL	LL	OBJ	NOA	DEL	LL	OBJ	NOA	DEL	LL	OBJ	NOA	DEL	LL
1994	19	6	<1	-	1	3	2	-	<1	-	-	-	<1	34	-	-	-	-	-	23
1995	17	19	-	-	2	4	<1	-	<1	<1	-	-	<1	3	-	-	-	-	-	33
1996	29	153	-	-	5	6	<1	-	<1	-	-	-	<1	<1	-	-	-	-	-	33
1997	68	16	3	-	5	4	3	-	1	<1	<1	-	<1	<1	-	-	-	-	-	40
1998	72	7	<1	-	2	2	1	-	16	<1	-	-	<1	<1	-	-	-	-	-	54
1999	52	46	-	-	2	5	1	-	8	<1	-	-	-	-	-	-	-	-	-	68
2000	29	19	<1	4	2	4	1	-	4	<1	-	-	<1	-	<1	-	-	-	-	88
2001	70	<1	<1	18	6	2	1	-	<1	-	-	-	<1	<1	-	-	-	-	-	73
2002	26	9	<1	15	6	2	1	-	3	-	-	-	<1	-	-	-	-	-	-	6
2003	43	<1	<1	54	<1	4	<1	-	3	<1	-	-	<1	-	-	-	-	-	-	132
2004	8	7	<1	-	6	<1	1	-	1	<1	-	-	<1	-	-	-	-	-	-	139
2005	1	<1	-	-	2	9	2	-	7	<1	<1	-	<1	-	<1	-	-	-	-	159
2006	29	-	-	-	26	14	2	-	9	<1	<1	-	<1	-	-	-	-	-	-	109
2007	2	2	-	6	9	8	2	-	3	<1	<1	-	<1	1	-	-	-	-	-	370
2008	4	-	-	5	9	6	4	-	2	<1	-	-	<1	-	<1	-	-	-	-	308
2009	3	<1	<1	10	6	5	1	-	7	<1	<1	-	1	<1	-	-	-	-	-	488
2010	<1	4	-	8	9	44	1	-	<1	-	-	-	<1	-	<1	-	-	<1	-	539
2011	<1	4	-	7	4	113	<1	-	3	<1	-	-	<1	2	<1	8	-	-	-	539
2012	7	1	-	1	9	12	<1	-	3	<1	-	-	<1	<1	-	-	-	<1	-	425
2013	2	<1	-	<1	9	28	2	-	2	-	<1	-	<1	-	<1	-	-	<1	-	648
2014	2	2	-	11	3	9	1	-	2	-	<1	-	<1	<1	-	-	-	<1	-	818
2015	2	-	<1	11	6	12	1	87	2	<1	-	-	<1	-	-	-	-	-	-	1,039
2016	7	5	<1	11	10	7	<1	275	2	-	-	-	<1	<1	-	-	-	-	-	741
2017	4	4	-	-	8	4	<1	<1	5	-	<1	-	<1	-	-	-	-	-	-	846
2018	2	-	-	-	5	2	<1	-	3	<1	-	-	<1	<1	-	-	-	-	-	1,102
2019	3	<1	-	-	2	6	<1	-	2	-	<1	-	<1	-	-	-	-	-	<1	740
2020	<1	1	-	-	1	<1	<1	-	2	<1	-	-	<1	-	-		-	-	-	684
2021	2	<1	-	-	<1	2	<1	-	1	<1	-	-	1	<1	-	-	-	-	-	454
2022	4	<1	-	-	2	2	<1	-	4	<1	<1	-	<1	-	-	-	-	-	-	279
2023	1	-	-	-	2	<1	<1	4	2	-	<1	-	2	-	<1	<1	-	-	-	250
2024	9	<1	<1	*	<1	6	<1	*	3	<1	-	*	<1	-	-	*	-	-	-	*
Total	520	307	4	162	162	325	35	366	102	<1	<1	-	13	41	<1	8	-	<1	<1	11,226

Table J-6a Continued	***Gempylidae* spp., snake mackerels, nei**				***Bramidae* spp., pomfrets, nei**				Other large fishes				Unidentified fishes				All fishes			
	Purse seine				Purse seine				Purse seine				Purse seine				Purse seine			
Year	OBJ	NOA	DEL	LL	OBJ	NOA	DEL	LL	OBJ	NOA	DEL	LL	OBJ	NOA	DEL	LL	OBJ	NOA	DEL	LL
1994	-	-	-	-	-	-	-	2	3	87	<1	-	<1	<1	12	250	1,731	152	16	321
1995	-	-	-	-	-	-	-	2	<1	3	<1	-	3	1	<1	209	1,485	53	4	285
1996	-	-	-	-	-	-	-	2	3	125	<1	-	3	<1	<1	456	1,655	306	1	535
1997	-	-	-	-	-	-	-	6	7	5	<1	-	7	2	-	847	1,850	44	7	7,760
1998	-	-	-	-	-	-	-	9	13	10	<1	-	7	<1	<1	1,338	1,420	38	7	3,931
1999	-	-	-	-	-	-	-	3	4	54	<1	-	22	4	<1	974	1,599	114	2	7,330
2000	-	-	-	-	-	-	-	4	1	1	-	-	1	<1	<1	1,485	1,804	82	4	5,119
2001	-	-	-	-	-	-	-	5	2	9	<1	-	3	<1	<1	1,720	3,398	30	4	17,763
2002	-	-	-	-	-	-	-	<1	2	<1	<1	-	2	6	<1	1,895	2,521	27	2	11,399
2003	-	-	-	-	-	-	-	-	4	<1	-	-	2	2	-	4,386	1,484	19	2	10,037
2004	-	-	-	-	-	-	-	-	4	<1	<1	-	10	<1	<1	377	1,548	35	3	4,658
2005	-	-	-	-	-	-	-	18	<1	<1	<1	-	3	<1	<1	303	1,501	89	3	4,489
2006	-	-	-	18	-	<1	-	17	<1	<1	<1	7	3	<1	<1	285	1,824	302	3	4,011
2007	-	-	-	65	-	-	-	57	1	<1	<1	5	1	5	<1	1,763	1,848	158	4	9,394
2008	-	-	-	144	-	-	-	68	1	<1	<1	-	<1	<1	<1	793	1,462	44	6	17,375
2009	-	-	-	412	-	-	-	56	1	<1	<1	67	2	-	<1	1,077	2,343	21	2	19,581
2010	-	-	-	575	-	-	-	64	<1	-	<1	-	<1	<1	-	879	1,318	122	2	11,833
2011	-	-	-	506	-	<1	-	50	<1	<1	-	15	<1	-	<1	612	1,621	175	<1	14,418
2012	-	-	-	661	-	-	-	61	<1	2	<1	11	1	<1	-	1,305	2,065	57	1	19,949
2013	-	-	-	574	-	-	-	134	<1	<1	<1	36	<1	<1	-	1,112	2,016	40	3	14,045
2014	-	-	-	431	-	-	-	138	<1	<1	-	77	<1	-	-	1,013	2,329	25	2	6,116
2015	-	-	-	321	<1	-	-	172	<1	<1	-	7	2	<1	-	1,367	1,568	30	2	4,495
2016	<1	-	-	730	-	-	-	108	<1	<1	<1	100	<1	1	-	506	1,328	23	9	3,238
2017	-	-	-	301	-	-	-	126	<1	<1	-	62	1	-	-	1,532	1,946	36	1	5,304
2018	-	-	-	260	-	-	-	125	<1	-	-	1	-	-	-	222	1,816	9	6	6,009
2019	-	-	-	338	-	-	-	81	<1	-	-	26	<1	<1	<1	272	1,455	41	1	3,759
2020	-	-	-	288	-	-	-	70	<1	-	-	213	<1	<1	<1	462	953	9	<1	4,534
2021	-	-	-	302	-	-	-	50	<1	<1	-	<1	<1	<1	-	1,153	2,432	19	1	3,607
2022	-	-	-	212	<1	-	-	53	<1	<1	-	<1	<1	-	-	1,902	2,564	19	3	3,364
2023	-	-	-	288	<1	<1	-	64	<1	-	-	7	-	-	-	2,326	1,785	5	3	3,616
2024	-	-	-	*	-	-	-	*	<1	<1	<1	*	<1	-	-	*	1,220	13	1	*
Total	<1	-	-	6,427	<1	<1	-	1,544	54	298	<1	636	75	24	12	32,822	55,888	2,136	108	228,276

Table J-6b. Minimum number of interactions and mortalities of large fishes in the eastern Pacific Ocean (EPO) in 2023 reported by observers onboard longline vessels under the current mandate of at least 5% coverage (C-19-08) of each CPC fleet operating in the EPO. Data are incomplete and considered insufficient for expanding to fleet totals (BYC-10 INF-D) (see section 2.2 for uncertainty and data gaps associated with longline data reporting). Dispositions considered to indicate a survival event are those reported by observers as “Alive and Healthy”, “Alive with light injuries” and “Alive”, while those considered to indicate a mortality event are dispositions reported as “Dead”, “Alive mortal”, Alive injured”, Discarded”, “Unknown”, or where disposition was not reported.

Tabla J-6b. Número mínimo de interacciones y mortalidades de peces grandes en el Océano Pacífico oriental en 2023 reportadas por observadores a bordo de buques palangreros bajo el mandato actual de al menos 5% de cobertura (C-19-08) de cada flota de los CPC que opera en el OPO. Los datos se consideran incompletos y se consideran insuficientes para expandirlos a totales de la flota (BYC-10 INF-D) (ver Sección 2.2. para consultar información sobre la incertidumbre y las deficiencias de los datos asociadas a la notificación de datos de palangre). Las disposiciones que se considera que indican un evento de supervivencia son las reportadas por los observadores como "Vivo y sano", "Vivo con heridas leves" y "Vivo", mientras que las que se considera que indican un evento de mortalidad son las disposiciones reportadas como "Muerto", "Vivo, mortalidad probable", “Vivo herido", “Descartado", "Desconocida" o cuando la disposición no fue reportada.

Common name	Scientific name	Interactions	Mortalities
Long snouted lancetfish	*Alepisaurus ferox*	8,501	8,501
Escolar	*Lepidocybium flavobrunneum*	3,165	3,164
Snake mackerel	*Gempylus serpens*	2,581	2,544
Dorado, mahi mahi, dolphin fish, nei	Coryphaenidae	2,468	2,468
Wahoo	*Acanthocybium solandri*	1,707	1,703
Opah	*Lampris guttatus*	1,171	1,167
Sickle pomfret	*Taractichthys steindachneri*	700	697
Common dolphinfish	*Coryphaena hippurus*	505	502
Oilfish	*Ruvettus pretiosus*	316	316
Pomfrets, ocean breams nei	Bramidae	275	267
Lancetfishes nei	*Alepisaurus* spp.	247	247
Snake mackerels, escolars nei	Gempylidae	73	73
Pompano dolphinfish	*Coryphaena equiselis*	52	52
Atlantic pomfret	*Brama brama*	27	27
Other large fishes*		97	95
Total numbers		21,885	21,823

*"Other large fishes" includes those with ≤15 interactions from 21 taxa in 2023.

Table J-7. Estimated purse-seine catches by set type in metric tons (t) of small forage fishes by observers onboard size-class 6 vessels with a carrying capacity >363 t (1994–2024) and minimum reported longline (LL) catches of small forage fishes (gross-annual removals in t) (1994–2023, *data not available, see section 2.2. for uncertainty and data gaps in reporting of bycatch caught by longline). Purse-seine set types: floating object (OBJ), unassociated tuna schools (NOA) and dolphins (DEL). Species highlighted bold are discussed in main text. Data for 2019–2023 (longline) and 2023–2024 (purse seine) are considered preliminary. "Epipelagic forage fishes" include various mackerels and scad (*Decapterus* spp., *Trachurus* spp., *Selar crumenophthalmus*), Pacific saury (*Cololabis saira*), and tropical two-wing flyingish (*Exocoetus volitans*).

Tabla J-7. Capturas cerqueras estimadas de peces forrajeros pequeños, por tipo de lance, en toneladas (t), por observadores a bordo de buques de clase 6 con una capacidad de acarreo >363 t (1994–2024) y capturas palangreras (LL) mínimas reportadas de peces forrajeros pequeños (extracciones anuales brutas en t) (1994-2023, *datos no disponibles; ver Sección 2.2. para consultar información sobre la incertidumbre y las deficiencias de los datos en la notificación de especies capturadas incidentalmente con palangre). Tipos de lances cerqueros: objeto flotante (OBJ), atunes no asociados (NOA) y delfines (DEL). Las especies en negritas se discuten en el texto principal. Los datos de 2019–2023 (palangre) y 2023–2024 (cerco) se consideran preliminares. "Peces epipelágicos de forraje" incluyen varias caballas y jureles (*Decapterus* spp., *Trachurus* spp., *Selar crumenophthalmus*), paparda del Pacífico (*Cololabis saira*), y volador tropical (*Exocoetus volitans*).

	***Auxis* spp., bullet and frigate tunas**				**Balistidae, Monacanthidae spp., triggerfishes and file-fishes**				**Kyphosidae, sea chubs**				**Epipelagic forage fishes**				Small Carangidae spp., carangids, nei				Other small fishes			
	Purse seine				Purse seine				Purse seine				Purse seine				Purse seine				Purse seine			
Year	OBJ	NOA	DEL	LL	OBJ	NOA	DEL	LL	OBJ	NOA	DEL	LL	OBJ	NOA	DEL	LL	OBJ	NOA	DEL	LL	OBJ	NOA	DEL	LL
1994	294	200	2	-	114	<1	<1	-	<1	-	-	-	-	-	-	-	<1	-	-	-	53	15	2	-
1995	501	119	6	-	208	4	<1	-	<1	-	-	-	-	-	-	-	<1	-	-	-	319	4	4	-
1996	761	234	33	-	113	2	<1	-	-	-	-	-	-	-	-	-	-	<1	-	-	55	8	25	-
1997	2,734	623	25	-	219	<1	<1	-	-	-	-	-	-	-	-	-	<1	-	-	-	151	12	2	-
1998	1,033	168	32	-	801	2	1	-	<1	-	-	-	<1	-	-	-	<1	-	-	-	91	15	3	-
1999	2,589	473	29	-	551	3	<1	-	<1	<1	-	-	<1	-	-	-	<1	<1	-	-	85	3	2	-
2000	1,210	181	19	-	168	<1	9	-	2	-	-	-	-	-	-	-	<1	-	-	-	68	8	6	-
2001	641	38	-	-	426	1	-	-	<1	-	-	-	-	-	-	-	<1	-	-	-	27	2	<1	-
2002	1,382	234	248	-	453	<1	-	-	<1	-	-	-	-	-	-	-	<1	-	-	-	25	3	<1	-
2003	944	278	16	-	157	4	<1	-	<1	-	-	-	<1	-	-	-	<1	-	-	-	75	1	1	-
2004	834	115	24	-	914	7	2	-	8	<1	<1	-	<1	<1	-	-	<1	<1	-	-	22	1	<1	-
2005	1,606	309	6	-	129	<1	<1	-	23	<1	<1	-	6	<1	<1	-	2	<1	<1	-	<1	9	<1	-
2006	1,300	591	19	-	145	<1	<1	-	79	<1	<1	-	7	1	-	-	2	<1	<1	-	5	1	<1	-
2007	868	336	18	-	544	1	<1	-	12	<1	<1	-	2	5	-	-	<1	<1	<1	-	4	<1	<1	-
2008	759	619	2	-	276	7	2	-	68	<1	<1	-	3	<1	-	-	10	<1	-	-	2	<1	<1	-
2009	303	165	1	-	174	1	<1	-	47	<1	-	-	<1	<1	-	-	<1	<1	<1	-	1	<1	<1	-
2010	474	234	<1	-	69	<1	<1	-	16	-	<1	-	4	<1	<1	-	1	<1	-	-	<1	-	<1	-
2011	677	97	11	-	31	<1	-	-	48	<1	-	-	2	<1	<1	-	<1	<1	-	-	<1	<1	<1	-
2012	173	179	1	-	110	<1	-	-	39	-	-	-	13	12	-	-	<1	<1	-	-	4	2	-	-
2013	385	77	-	-	228	<1	<1	-	18	-	<1	-	4	-	<1	-	<1	4	<1	-	2	<1	<1	-
2014	297	30	<1	-	325	<1	<1	-	16	-	-	-	3	<1	<1	-	<1	<1	-	-	1	<1	<1	-
2015	177	64	-	-	140	4	<1	-	5	-	<1	-	6	-	-	-	<1	<1	-	-	1	<1	<1	-
2016	189	23	<1	-	416	2	<1	-	8	-	-	-	21	-	<1	<1	<1	<1	-	-	3	<1	<1	77
2017	131	172	-	-	83	<1	-	-	8	-	-	-	3	-	-	-	<1	<1	-	-	<1	<1	-	-
2018	276	172	-	-	54	<1	<1	-	10	-	-	-	5	<1	-	-	<1	-	-	-	<1	<1	<1	-
2019	182	94	<1	-	57	<1	<1	-	7	<1	<1	-	5	8	<1	-	<1	<1	-	-	<1	5	-	-
2020	435	44	<1	-	47	<1	<1	-	2	-	<1	-	4	<1	-	<1	<1	<1	-	<1	<1	<1	<1	<1
2021	423	18	-	-	50	<1	-	-	6	-	<1	-	15	-	-	-	<1	<1	-	-	<1	1	<1	<1
2022	687	17	<1	-	543	2	<1	-	21	1	-	-	15	-	<1	-	<1	<1	-	-	1	3	<1	-
2023	588	<1	<1	-	518	<1	<1	-	12	-	-	-	10	<1	<1	-	3	<1	<1	-	1	12	<1	<1
2024	446	155	-	*	513	<1	-	*	7	-	-	*	11	<1	-	*	2	<1	-	*	<1	<1	<1	*
Total	23,300	6,060	494	-	8,573	48	16	-	463	2	<1	-	139	29	<1	<1	27	6	<1	<1	1,003	108	47	79

Table J-8a. Minimum nominal purse-seine catches of a) sharks, large fishes and small fishes in metric tons (t) and **b)** rays in numbers of individuals in 2024 for size-class 1–5 vessels with a carrying capacity <363 t as reported by observers in 47% of all trips that carried an observer. Purse-seine set types: floating object (OBJ) and unassociated tuna schools (NOA).

Tabla J-8a. Capturas cerqueras nominales mínimas de a) tiburones, peces grandes y peces pequeños, en toneladas (t), y **b)** rayas en número de individuos en 2024 para buques de clases 1-5 con una capacidad de acarreo <363 t según lo reportado por los observadores en el 47% de todos los viajes que llevaban observador a bordo. Tipo de lances cerqueros: objeto flotante (OBJ) y atunes no asociados (NOA).

a.

			Set type	
Broad group	Common name	Scientific name	OBJ	NOA
Sharks	Silky shark	*Carcharhinus falciformis*	29	<1
	Scalloped hammerhead shark	*Sphyrna lewini*	3	
	Smooth hammerhead shark	*Sphyrna zygaena*	1	
	Oceanic whitetip shark	*Carcharhinus longimanus*	<1	
	Blue shark	*Prionace glauca*	<1	
	Thresher shark	*Alopias vulpinus*	<1	
	Mako shark	*Isurus* spp.	<1	
Large fishes	Dorado	Coryphaenidae spp.	126	<1
	Wahoo	*Acanthocybium solandri*	30	
	Rainbow runner	*Elagatis bipinnulata*	5	
	Amberjack, nei	*Seriola* spp.	2	
	Jacks, crevalles, nei	*Caranx* spp.	<1	
	Amberjack, jack, crevalles, nei	*Seriola*, *Caranx* spp.	<1	
	Tripletail	*Lobotes surinamensis*	<1	
	Mola, nei	Molidae spp.	<1	3
	Other large fish		<1	
Small fishes	Triggerfishes, Filefishes	Balistidae, Monacanthidae spp.	133	
	Bullet and frigate tunas	*Auxis* spp.	95	
	Sea chubs	Kyphosidae spp.	1	
	Small carangid, nei	Carangidae spp.	<1	<1
	Epipelagic forage fishes		<1	
	Other small fish		<1	

b.

Broad group	Common name	Scientific name	OBJ	NOA
Rays	Pelagic stingray	*Pteroplatytrygon violacea*	31	3
	Spinetail manta	*Mobula mobular*	11	2
	Chilean devil ray	*Mobula tarapacana*	9	
	Smoothtail manta	*Mobula thurstoni*	6	
	Munk's devil ray	*Mobula munkiana*	2	
	Mobulidae ray, nei	Mobulidae spp.	1	
	Stingray nei	Dasyatidae spp.	1	