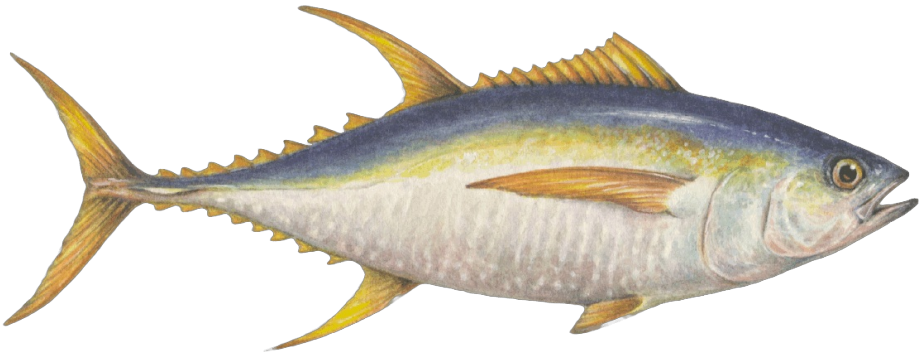
Environmental sustainability of wild-caught tuna and large pelagic species from the Eastern Pacific Ocean caught using longlines, purse seines and trolling lines



Species:	Albacore *(Thunnus alalunga)*, Bigeye tuna *(Thunnus obesus)*, Yellowfin tuna *(Thunnus albacares)*, Dolphinfish *(Coryphaena hippurus)*, Skipjack tuna *(Katsuwonus pelamis)*, Swordfish *(Xiphias gladius)*
Location:	Eastern Central Pacific Ocean
Gear:	Longlines, Floating object purse seine (FAD), Dolphin set purse seine, Unassociated purse seine (non-FAD), Trolling lines
Type:	Wild Caught
Author:	Seafood Watch
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Assessed using Seafood Watch Fisheries Standard v4

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About the Monterey Bay Aquarium Seafood Watch Program

The mission of the Monterey Bay Aquarium is to inspire conservation of the ocean and enable a future where the ocean flourishes and people thrive in a just and equitable world. To do this, the Aquarium is focused on creating extraordinary experiences that inspire awe and wonder, championing science-based solutions, and connecting people across the planet to protect and restore the ocean. We know that healthy ocean ecosystems are critical to enabling life on Earth to exist, and that our very survival depends on them. As such, our conservation objectives are to mobilize climate action, improve the sustainability of global fisheries and aquaculture, reduce sources of plastic pollution, and restore and protect ocean wildlife and ecosystems.

The aquarium is focused on improving the sustainability of fisheries and aquaculture given the role seafood plays in providing essential nutrition for 3 billion people globally, and in supporting hundreds of millions of livelihoods. Approximately 180 million metric tons of wild and farmed seafood is harvested each year (excluding seaweeds). Unfortunately, not all current harvest practices are sustainable and poorly managed fisheries and aquaculture pose the greatest immediate threat to the health of the ocean and the economic survival and food security of billions of people.

The Seafood Watch program was started 25 years ago as a small exhibit in the Monterey Bay Aquarium highlighting better fishing practices and grew into one of the leading sources of information on seafood sustainability, harnessing the power of consumer choice to mobilize change. The program's comprehensive open-source information and public outreach raises awareness about global sustainability issues, identifies areas for improvement, recognizes and rewards best practices and empowers individuals and businesses to make informed decisions when purchasing seafood.

We define sustainable seafood as seafood from sources, whether fished or farmed, that can maintain or increase production without jeopardizing the structure and function of affected ecosystems, minimize harmful environmental impacts, assure good and fair working conditions, and support livelihoods and economic benefits throughout the entire supply chain. As one aspect of this vision, Seafood Watch has developed trusted, rigorous standards for assessing the environmental impacts of fishing and aquaculture practices worldwide. Built on a solid foundation of science and collaboration, our standards reflect our guiding principles for defining environmental sustainability in seafood.

Seafood Watch Ratings

The Seafood Watch Standard for Fisheries is used to produce assessments for wild-capture fisheries resulting in a Seafood Watch rating of green, yellow, or red. Seafood Watch uses the assessment criteria to determine a final numerical score as well as numerical subscores and colors for each criterion. These scores are translated to a final Seafood Watch color rating according to the methodology described in the table below. The table also describes how Seafood Watch defines each of these categories. The narrative descriptions of each Seafood Watch rating, and the guiding principles listed below, compose the framework on which the criteria are based.

Green	Final Score >3.2, and either criterion 1 or criterion 3 (or both) is green, and no red criteria, and no critical scores	Wild-caught and farm-raised seafood rated green are environmentally sustainable, well managed and caught or farmed in ways that cause little or no harm to habitats or other wildlife. These operations align with all of our guiding principles.
Yellow	Final score >2.2, and no more than one red criterion, and no critical scores, and does not meet the criteria for green (above)	Wild-caught and farm-raised seafood rated yellow cannot be considered fully environmentally sustainable at this time. They align with most of our guiding principles, but there is either one conservation concern needing substantial improvement, or there is significant uncertainty associated with the impacts of the fishery or aquaculture operations.
Red	Final Score ≤2.2, or two or more red criteria, or one or more critical scores.	Wild-caught and farm-raised seafood rated red are caught or farmed in ways that have a high risk of causing significant harm to the environment. They do not align with our guiding principles and are considered environmentally unsustainable due to either a critical conservation concern, or multiple areas where improvement is needed.

Recommended Citation: Seafood Watch (2025) Environmental sustainability of wild-caught tuna and large pelagic species from the Eastern Pacific Ocean caught using longlines, purse seines and trolling lines Monterey Bay Aquarium

Guiding Principles

Monterey Bay Aquarium defines sustainable seafood as seafood from sources, whether fished or farmed, that can maintain or increase production without jeopardizing the structure and function of affected ecosystems, minimize harmful environmental impacts, assure good and fair working conditions, and support livelihoods and economic benefits throughout the entire supply chain.

As one aspect of this vision, Seafood Watch has developed trusted, rigorous standards for assessing the environmental impacts of fishing and aquaculture practices worldwide. Environmentally sustainable wild capture fisheries:

1. **Follow the principles of ecosystem-based fisheries management**

   The fishery is managed to ensure the integrity of the entire ecosystem, rather than solely focusing on maintenance of single species stock productivity. To the extent allowed by the current state of the science, ecological interactions affected by the fishery are understood and protected, and the structure and function of the ecosystem is maintained.

2. **Ensure all affected stocks[1] are healthy and abundant**

   Abundance, size, sex, age and genetic structure of the main species affected by the fishery (not limited to target species) is maintained at levels that do not impair recruitment or long-term productivity of the stocks or fulfillment of their role in the ecosystem and food web.

   Abundance of the main species affected by the fishery should be at, above, or fluctuating around levels that allow for the long-term production of maximum sustainable yield. Higher abundances are necessary in the case of forage species, in order to allow the species to fulfill its ecological role.

3. **Fish all affected stocks at sustainable levels**

   Fishing mortality for the main species affected by the fishery should be appropriate given current abundance and inherent resilience to fishing while accounting for scientific uncertainty, management uncertainty, and non-fishery impacts such as habitat degradation.

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[1]"Affected" stocks include all stocks affected by the fishery, no matter whether target or bycatch, or whether they are ultimately retained or discarded.

The cumulative fishing mortality experienced by affected species must be at or below the level that produces maximum sustainable yield for single-species fisheries on typical species that are at target levels.

Fishing mortality may need to be lower than the level that produces maximum sustainable yield in certain cases such as forage species, multispecies fisheries, highly vulnerable species, or fisheries with high uncertainty.

For species that are depleted below target levels, fishing mortality must be at or below a level that allows the species to recover to its target abundance.

4. **Minimize bycatch**

   Seafood Watch defines bycatch as all fisheries-related mortality or injury other than the retained catch. Examples include discards, endangered or threatened species catch, pre-catch mortality and ghost fishing. All discards, including those released alive, are considered bycatch unless there is valid scientific evidence of high post-release survival and there is no documented evidence of negative impacts at the population level.

   The fishery optimizes the utilization of marine and freshwater resources by minimizing post-harvest loss and by efficiently using marine and freshwater resources as bait.

5. **Have no more than a negligible impact on any threatened, endangered or protected species**

   The fishery avoids catch of any threatened, endangered or protected (ETP) species. If any ETP species are inadvertently caught, the fishery ensures and can demonstrate that it has no more than a negligible impact on these populations.

6. **Are managed to sustain the long-term productivity of all affected species**

   Management should be appropriate for the inherent resilience of affected marine and freshwater life and should incorporate data sufficient to assess the affected species and manage fishing mortality to ensure little risk of depletion. Measures should be implemented and enforced to ensure that fishery mortality does not threaten the long term productivity or ecological role of any species in the future.

   The management strategy has a high chance of preventing declines in stock productivity by taking into account the level of uncertainty, other impacts on the stock, and the potential for increased pressure in the future.

   The management strategy effectively prevents negative population impacts on bycatch species, particularly species of concern.

7. **Avoid negative impacts on the structure, function or associated biota of aquatic habitats where fishing occurs**

The fishery does not adversely affect the physical structure of the seafloor or associated biological communities.

If high-impact gears (e.g. trawls, dredges) are used, vulnerable seafloor habitats (e.g. corals, seamounts) are not fished, and potential damage to the seafloor is mitigated through substantial spatial protection, gear modifications and/or other highly effective methods.

8. **Maintain the trophic role of all aquatic life**

   All stocks are maintained at levels that allow them to fulfill their ecological role and to maintain a functioning ecosystem and food web, as informed by the best available science.

9. **Do not result in harmful ecological changes such as reduction of dependent predator populations, trophic cascades, or phase shifts**

   Fishing activities must not result in harmful changes such as depletion of dependent predators, trophic cascades, or phase shifts.

   This may require fishing certain species (e.g., forage species) well below maximum sustainable yield and maintaining populations of these species well above the biomass that produces maximum sustainable yield.

10. **Ensure that any enhancement activities and fishing activities on enhanced stocks do not negatively affect the diversity, abundance, productivity, or genetic integrity of wild stocks**

    Any enhancement activities are conducted at levels that do not negatively affect wild stocks by reducing diversity, abundance or genetic integrity.

    Management of fisheries targeting enhanced stocks ensures that there are no negative impacts on the wild stocks, in line with the guiding principles described above, as a result of the fisheries.

    Enhancement activities do not negatively affect the ecosystem through density dependent competition or any other means, as informed by the best available science.

Final Ratings

Ratings Details	C 1 Target Species	C 2 Other Species	C 3 Management	C 4 Habitat	Rating
Albacore North Pacific Stock - - Eastern Central Pacific Ocean | Northeast Pacific Ocean - Drifting longlines - 31,800 mt	5.000	1.000	1.000	3.162	Red (1.994)
Albacore South Pacific Stock - - Eastern Central Pacific Ocean | Southeast Pacific Ocean - Drifting longlines - 31,800 mt	4.284	1.000	1.000	3.162	Red (1.918)
Albacore North Pacific Stock - Canada | United States - British Columbia | California | Oregon | Washington - Eastern Central Pacific Ocean | Northeast Pacific Ocean | Northwest Pacific Ocean - Trolling lines - 12,081 mt	5.000	5.000	3.000	3.873	Green (4.128)
Bigeye tuna Eastern Pacific Ocean Stock - - Eastern Central Pacific Ocean | Northeast Pacific Ocean - Drifting longlines - 20,684 mt	5.000	1.000	1.000	3.162	Red (1.994)
Bigeye tuna Eastern Pacific Ocean Stock - - Eastern Central Pacific Ocean | Southeast Pacific Ocean - Drifting longlines - 20,684 mt	5.000	1.000	1.000	3.162	Red (1.994)
Bigeye tuna Eastern Pacific Ocean Stock - - Eastern Central Pacific Ocean - Floating object purse seine (FAD) - 46,031 mt	5.000	1.000	3.000	3.873	Yellow (2.761)
Dolphinfish - Eastern Central Pacific Ocean | Northeast Pacific Ocean - Drifting longlines - 713 mt	2.644	1.000	1.000	3.162	Red (1.700)
Dolphinfish - Eastern Central Pacific Ocean | Southeast Pacific Ocean - Drifting longlines - 713 mt	4.284	1.000	1.000	3.162	Red (1.918)

Ratings Details	C 1 Target Species	C 2 Other Species	C 3 Management	C 4 Habitat	Rating
Skipjack tuna Eastern Pacific Ocean Stock - - Eastern Central Pacific Ocean - Floating object purse seine (FAD) - 205,345 mt	5.000	1.000	3.000	3.873	Yellow (2.761)
Skipjack tuna Eastern Pacific Ocean Stock - - Eastern Central Pacific Ocean - Unassociated purse seine (non-FAD) - 88,765 mt	5.000	1.526	3.000	3.873	Yellow (3.068)
Swordfish - Eastern Central Pacific Ocean | Northeast Pacific Ocean - Drifting longlines - 19,645 mt	5.000	1.000	1.000	3.162	Red (1.994)
Swordfish Southeastern Pacific Ocean Stock - - Eastern Central Pacific Ocean | Southeast Pacific Ocean - Drifting longlines - 19,645 mt	3.318	1.000	1.000	3.162	Red (1.800)
Yellowfin tuna Eastern Pacific Ocean Stock - - Eastern Central Pacific Ocean - Dolphin set purse seine - 182,145 mt	4.284	1.526	3.000	3.873	Yellow (2.952)
Yellowfin tuna Eastern Pacific Ocean Stock - - Eastern Central Pacific Ocean | Northeast Pacific Ocean - Drifting longlines - 6,655 mt	4.284	1.000	1.000	3.162	Red (1.918)
Yellowfin tuna Eastern Pacific Ocean Stock - - Eastern Central Pacific Ocean | Southeast Pacific Ocean - Drifting longlines - 6,655 mt	4.284	1.000	1.000	3.162	Red (1.918)
Yellowfin tuna Eastern Pacific Ocean Stock - - Eastern Central Pacific Ocean - Floating object purse seine (FAD) - 6,655 mt	4.284	1.000	3.000	3.873	Yellow (2.656)
Yellowfin tuna Eastern Pacific Ocean Stock - - Eastern Central Pacific Ocean - Unassociated purse seine (non-FAD) - 33,136 mt	4.284	1.526	3.000	3.873	Yellow (2.952)

Summary

This report focuses on the following fisheries in the Eastern Pacific Ocean: 1) the longline fishery targeting swordfish (*Xiphias gladius*), albacore tuna (*Thunnus alalunga*), bigeye tuna (*Thunnus obesus*), and yellowfin tuna (*Thunnus albacares*); 2) three purse seine fisheries (unassociated sets, associated sets, dolphin sets) targeting yellowfin, bigeye, and skipjack (*Katsuwonus pelamis*); and 3) troll fisheries for albacore tuna.

Skipjack and albacore tuna have healthy stocks, with fishing mortality rates below reference points. Updates to the yellowfin assessment of 2020 indicate that yellowfin tuna abundance and fishing mortality are healthy relative to appropriate reference points. Bigeye tuna and swordfish abundance are above reference points. But fishing mortality rates for the southeast swordfish stock are uncertain. Dorado (dolphinfish) stock status in the northeast is unknown, and a recent assessment for the southeast stock suggests that it is not overfished, but the assessment includes considerable uncertainty.

The purse seine fisheries have different levels of bycatch; the associated fishery (FADs) has the highest. Sharks (primarily silky), bony fish, rays, and other tunas are incidentally captured in the associated fishery. The unassociated purse seine fisheries typically have relatively lower bycatch; however, both manta ray and silky shark are reported as incidental takes, and both species are of high concern because of their stock status. The dolphin set fishery historically had issues with lethal dolphin bycatch, but dolphin mortality in the fishery has been reduced considerably since the 1990s, mostly because of the Agreement of the International Dolphin Conservation Program. But this fishery has also reported catches of silky shark and rays. Bycatch is typically much lower in troll fisheries for pelagic species. The United States/Canada troll fishery for albacore has no significant bycatch. Longline fisheries in the EPO have high levels of bycatch, incidentally capturing sharks, seabirds, sea turtles, and marine mammals, among other non-ETP species.

Tuna, large pelagics, and swordfish in the EPO are managed by the Inter-American Tropical Tuna Commission (IATTC). Species with a single stock in the North/South Pacific (e.g., albacore) are comanaged by the IATTC and the Western & Central Pacific Fisheries Commission (WCPFC). North Pacific albacore has reference points and a harvest control rule that has been passed but has not yet been implemented. Tropical tunas have a harvest control rule in place, but it lacks specific management actions, leading to uncertainty regarding its effectiveness. Recent measures have been adopted to reduce the impacts of associated purse seines on bycatch species. Management measures specific to the longline fishery are insufficient to account for uncertainty and the overexploitation risk to target and bycatch species. In addition to target species, the Eastern Pacific Ocean longline fishery captures a number of secondary target and bycatch species, including vulnerable/endangered turtles, shark species, finfish, and false killer whales. There are no management measures in place for dorado.

The IATTC considers ecosystem-based fisheries management principles, and measures are in place to minimize adverse impacts to turtles and sharks. But the efficacy of these measures is

unknown due to limited observer coverage, especially in the longline fishery. The IATTC is currently working to improve ecosystem management of longline and purse seine fisheries by developing ecological risk assessments. Purse seine and longline gears typically have little contact with bottom habitats, although associated/fish aggregating device gear can be anchored to the bottom.

All purse seine fisheries (unassociated, dolphin-set, and FAD-set, regardless of target tuna species) receive a yellow rating. All longline fisheries in the Eastern Pacific Ocean receive a red rating. Troll fisheries for albacore receive a green rating.

Introduction

Scope of the analysis and ensuing rating

This assessment focuses on longline, purse seine, and troll fisheries for tunas and other large pelagic species in the Eastern Pacific Ocean (EPO). Ratings are included in this assessment for the following species.

Table 1

Species group	Scientific Name	English Name	Spanish Name
Tuna	*Thunnus alalunga*	Albacore	Albacora, atún blanco
	Thunnus obesus	Bigeye tuna	Atún patudo, ojo grande
	Katsuwonus pelamis	Skipjack tuna	Atún barrilete, listado
	Thunnus albacares	Yellowfin tuna	Atún aleta amarilla, rabil
Billfish	*Xiphias gladius*	Swordfish	Pez espada
Other large fish	*Coryphaena hippurus*	Common dolphinfish	Dorado común

Fisheries

Purse seine fisheries

Purse seine landings by country and species are presented in Table 2. Purse seine fisheries are further defined by set type: those that target large yellowfin associated with dolphins (dolphin-set), those that use fish aggregating devices (FAD-set), and those that set on schools of tuna (unassociated or free school) (Table 3). The IATTC presents these set-type data for a number of tuna, billfish, large pelagic, and shark species, but does not present them by country (see PublicPSTuna, PublicPSBillfish, and PublicPSShark at (IATTC 2024d)). These data are a subset of the full dataset (see CatchbyFlag Gear at (IATTC 2024d)) due to confidentiality concerns, but still provide an indication of the relative importance of the different set types. Because country by set-type landings are not available, all countries listed as having landings with any purse seine are listed for all set types. For the purposes of this Seafood Watch Assessment, the following are defined as separate fisheries:

- Unassociated purse seines: Ecuador, Mexico, Panama, Colombia, Venezuela, United

States, Nicaragua, Peru, El Salvador, Spain
- FAD purse seines: same countries as for unassociated sets
- Dolphin-set purse seines: Mexico, Venezuela, Panama, Ecuador, Colombia, Nicaragua, El Salvador, United States (sorted by number of dolphin mortality limits utilized in 2022 (IDCP 2023) as a proxy for relative catch).

Table 2: Purse seine landings (MT) of tunas, billfish, and other large pelagics by country, summed 2017–21 (data source is CatchByFlagGear at (IATTC 2024d)). The countries that form the "Others" category vary by year, but were Spain and El Salvador in all years presented here, as well as Peru in 2021 only (see supporting information in CatchByFlagGear file, as noted). Other species are unspecified marine fishes (38%), unspecified tunas (28%), marlins and sailfishes (30%), unidentified carangids (jacks) (2%), and sharks, swordfish, and rays (combined about 1%).

Country	Skipjack tuna	Yellowfin tuna	Bigeye tuna	Dolphinfishes	Bonitos	Black skipjack	Pacific bluefin tuna	Other Species
Ecuador	962,732	249,587	196,346	4,143	2,364	6,583		3,267
Mexico	73,225	498,127	3,907	432	18,094	14,983	15,024	730
Panama	190,664	112,644	49,994	388		214		693
Colombia	98,621	85,431	17,509	385	11	102		224
Venezuela	31,613	116,570	4,368	253		43		191
United States	94,900	25,205	21,941	311	207	21	864	137
Others	69,132	18,990	33,623	131	20	2		114
Nicaragua	39,140	36,804	9,320	111		19		69
Peru	21,938	7,150	169	30	2,468			13
Total	**1,581,965**	**1,150,508**	**337,177**	**6,184**	**23,164**	**21,967**	**15,888**	**5,447**

Table 3: Purse seine landings (MT) of tunas, billfish, and other large pelagics by set type, summed 2017–21. Note that this dataset is a subset of the dataset in Table 2, so numbers will differ.

Region and set type	Albacore	Bigeye tuna	Black skipjack	Bonitos	Pacific bluefin tuna	Skipjack	Unspecified tuna	Yellowfin tuna
South EPO	**10**	**159,958**	**1,318**	**4,676**	**0**	**1,001,640**	**9**	**310,001**
Dolphin	0	44	0	0	0	4,628	0	127,130
Unassociated	8	2,154	275	4,649	0	376,357	0	59,015
FAD	2	157,759	1,043	27	0	620,655	9	123,856
North EPO	**0**	**126,373**	**21,780**	**17,798**	**15,026**	**628,654**	**0**	**824,336**
Dolphin	0	25	64	0	0	7,831	0	585,560
Unassociated	0	1,540	14,366	17,791	15,026	127,080	0	69,851
FAD	0	124,808	7,350	7	0	493,743	0	168,925
Total	**10**	**286,331**	**23,098**	**22,474**	**15,026**	**1,630,294**	**9**	**1,134,338**

Note that Mexico and United States unassociated purse seines targeting Pacific bluefin tuna are assessed in a separate SFW report focused on EPO-based Pacific bluefin fisheries.

Longline fisheries

Longline landings by country and species are presented in Table 4. The countries that form the "Others" category vary by year, but were Portugal, Guatemala, El Salvador, Belize, and Peru in different mixes by year across the time series presented here (see supporting information in the CatchByFlagGearfile) (Table 4). The IATTC presents a georeferenced subset of the longline landings in PublicLLTunaBillfish and PublicLLShark at (IATTC 2024d)) (Table 5).

For the purposes of this Seafood Watch assessment, the following are defined as separate

fisheries:

- Longlines in the Northeast Pacific: China, Chinese Taipei, South Korea, Panama, Vanuatu, and Belize. Costa Rica, Panama, and Guatemala are also assumed to be fishing in the North EPO. Ecuador, Japan, and Spain are assumed to be fishing in both the North and the South EPO.
- Longlines in the Southeast Pacific: China, Chinese Taipei, South Korea, Panama, Vanuatu, and Belize. Chile is assumed to be fishing in the South EPO. Ecuador, Japan, and Spain are assumed to be fishing in both the North and the South EPO.

Fisheries not included in this assessment:

- Longlines in Peru (landings are dominated by dorado, which is included in a separate Seafood Watch assessment)
- Longlines in Mexico (this is essentially a shark and tuna/large pelagics fishery. Sharks are generally not imported into the U.S. and the U.S. generally exports its own shark catch (NOAA foreign trade statistics https://www.fisheries.noaa.gov/foss/f?p=215:2:4624470407272:::::).

Table 4: Longline landings (MT) of tunas, billfish, and other large pelagics by country, summed 2017–21 (data source is IATTC CatchByFlagGear.zip). In this Seafood Watch assessment, the gear type is assumed to be longline, and the landings volumes in the table are the 2018 landings multiplied by five.

Country	Skipjack tuna	Yellowfin tuna	Bigeye tuna	Albacore	Sharks	Swordfish	Marlins and sailfishes	Dolphinfishes	Other Species
China		17,356	26,054	72,526	8,769	8,342	8,944		854
Spain	0	148	530	41	35,461	50,799	2,612	388	1,128
Mexico		10			76,693	61	9	1	32
Chinese Taipei	263	6,111	26,119	21,283	5,966	9,887	4,095		1,120
Japan	121	7,242	29,662	4,920	3,578	8,795	3,153		1
South Korea	376	7,841	36,222	3,242	244	4,463	2,632		1,399

Costa Rica	1,039	5,236	88	1	12,364	4,409	5,053	6,954	341
French Polynesia	54	6,154	4,048	10,675		693	1,279	180	1,342
Vanuatu	42	1,500	6,899	5,394	355	3,574	939	6	320
United States	130	1,849	9,785	233	101	1,610	841	275	4,083
Panama	113	2,288	1,302	3,669	2,322	2,750	1,063	734	345
Ecuador	0	309	300	62		5,390	354	2,068	265
Others		20	72	3	1,668	2,366	123	22	38
Portugal		13	4	0	977	1,100	73	10	34
Chile	0	0	1	0	1,144	437	0	332	3
Belize		0			367	100	14		
Guatemala				0	150	5	0	1	
Peru*	345	1,895				965		75,555	1,115
Total	**2,138**	**56,077**	**141,086**	**122,049**	**150,159**	**104,781**	**31,184**	**10,971**	**11,305**

* Peru's landings are recorded by IATTC as caught by "Unknown" gear type, that no data have been reported for 2020 or 2021, and that the 2019 data are dubious. IATTC staff are working with Peru on resolving this (in addition to fixing data from 2019, and receiving data from 2020 and 2021) (IATTC staff April 2023, pers comm).

Table 5: Longline landings (MT) of tunas, billfish, and other large pelagics by EPO region, summed 2017–21 (data source is IATTC CatchByFlagGear.zip). Note that this dataset is a subset of the dataset in Table 4, so numbers will differ.

Region and Country	Skipjack tuna	Yellowfin tuna	Bigeye tuna	Albacore	Sharks	Swordfish	Marlins and sailfishes
South EPO	**497**	**26,600**	**73,614**	**100,788**	**7,575**	**61,169**	**9,923**
China		9,709	22,385	70,496	107	5,965	4,578
Chinese Taipei	127	4,513	21,894	12,708	5,113	8,968	2,818
Spain						41,522	
South Korea	256	5,467	23,710	3,090	138	2,877	1,186
French Polynesia	23	6,138	4,029	10,661		665	1,172
Panama	91	625	975	2,996	1,806	706	114
Vanuatu		148	620	837	180	255	52
Belize			1		232	211	3
North EPO	**75**	**10,899**	**18,076**	**5,008**	**2,079**	**15,572**	**5,828**
China		7,542	3,602	1,989	486	2,265	4,057
South Korea	55	1,878	10,557	3	101	986	1,035
Spain						9,268	
Chinese Taipei	20	822	3,562	2,716	833	664	332
Panama		570	184	103	259	1,711	293
Vanuatu		87	171	197	29	557	99

Belize					371	121	12

Other fisheries

Landings for other gears by country and species are presented in Table 6. For the purposes of this Seafood Watch assessment, the following are defined as separate fisheries:

- Troll for albacore: United States and Canada

In addition, the following fisheries are included in separate Seafood Watch assessments:

- Gillnet for swordfish: Chile
- Gillnet for swordfish: United States
- Handline for Pacific bluefin tuna (assessed in the same report that the aforementioned unassociated PBF fisheries are in).

Table 6: Landings of tunas, billfish, and other large pelagics (MT) by country and other gear types, summed 2017–21 (primary data source is IATTC CatchByFlagGear.zip; data for NW Pacific-caught albacore by the U.S. is from WCPFC).

Gear and Country	Albacore	Swordfish	Sharks
Troll	**46,013**	**1**	**46**
United States	34,284 (NE) 3,897 (NW)		0
Canada	11,724		
Chile	5	1	46
Gillnet	**68**	**33,673**	**2,166**
Chile	68	33,246	1,991
United States	0	427	175
Handline	**0**	**12**	**13**
Chile	0	12	13
Harpoon	**0**	**144**	**2**
Chile	0	82	1
United States		62	1

Note that the United States and Canada albacore troll fisheries are combined in this assessment, because the majority of U.S. and Canadian albacore catch in the EPO is obtained under a treaty agreement between the two nations. The U.S. albacore troll fishery only operates in the Northeast Pacific Ocean and Northwest Pacific Ocean, and the Canadian albacore troll fishery primarily operates in the Northeast but may include occasional, small catch numbers from the Northwest Pacific Ocean.

Species Overview

Skipjack, bigeye, yellowfin, and albacore tuna are found in tropical and subtropical waters throughout the Pacific Ocean. There are six populations of albacore tuna: North and South Pacific Ocean, North and South Atlantic Ocean, Indian Ocean, and Mediterranean Sea (ISC 2011). There are four populations of yellowfin and bigeye and five of skipjack: Western and Central Pacific Ocean, EPO, Atlantic Ocean (Eastern and Western for skipjack), and Indian Ocean. Juvenile yellowfin and bigeye tuna tend to form schools with skipjack tuna, which are mostly found in surface waters. Larger tunas are found in subsurface waters, where they also form schools (ISSF 2017).

Swordfish is a widely distributed billfish species, found globally from lat. 50° N. to 50° S. and at all longitudes in the Pacific Ocean. Swordfish is most recently assessed as a single population in the North Pacific Ocean, two populations in the South Pacific Ocean, two populations in the Atlantic Ocean (South and North), and a single population in both the Indian Ocean and Mediterranean Sea (ISC 2014).

Dorado (mahi mahi) is highly migratory and found worldwide in tropical and subtropical waters. Dorado is typically found in pelagic habitats, where it forms schools and is commonly found associated with floating objects. This species is a top predator, feeding on small fish and squid (Froese and Pauly 2020).

Longlines are the most common method globally to capture swordfish, albacore, and bigeye tuna, while purse seines are the primary gear used to capture yellowfin and skipjack tuna (Hall & Roman 2013). Albacore catches have increased since the 1950s, fluctuating between 200,000 and 250,000 MT over the past decade. Bigeye, skipjack, and yellowfin tuna catches have all increased substantially over time, peaking in the early 2000s, after which catches stabilized (ISSF 2017). Swordfish catches have varied over time (IATTC 2018c).

The United Nations Straddling and Highly Migratory Fish Stocks Agreement (1995) indicated that the management of straddling and highly migratory fish stocks should be carried out through Regional Fisheries Management Organizations (RFMOs). RFMOs are the legally mandated fishery management bodies on the high seas and within EEZ waters. There are currently 18 RFMOs that cover nearly all the world's waters. The Inter-American Tropical Tuna Commission (IATTC) is the RFMO responsible for managing the EPO tuna fisheries, although the Western and Central Pacific Fisheries Commission (WCPFC) also manages stocks that are

shared between the Eastern and Western Pacific. IATTC member countries must abide by the management measures set forth by individual RFMOs in order to fish in their waters. IATTC members include: Belize, Canada, China, Colombia, Costa Rica, Ecuador, El Salvador, European Union, France, Guatemala, Japan, Kiribati, South Korea, Mexico, Nicaragua, Panama, Peru, Chinese Taipei, United States, Vanuatu, and Venezuela (IATTC 2018c).

Production Statistics

Tuna

Total global landings of tuna have been around 5 million MT in recent years. Skipjack and yellowfin tuna dominate those landings (55% and 30% of summed landings 2000–21, respectively), with bigeye and albacore making up significant volumes (9% and 5%, respectively). The three species of bluefin tuna account for around 1% of landings.

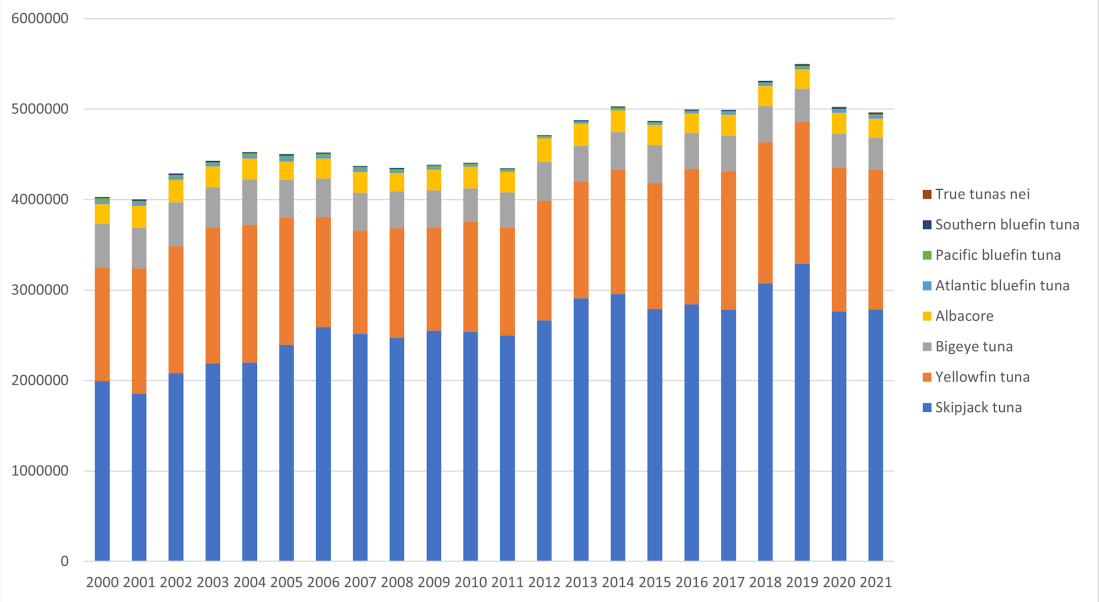

Figure 1: Landings of the major tuna species by year. Data from the UN FAO FishStatJ database (https://www.fao.org/fishery/en/statistics/software/fishstatj).

The majority of landings are in the Western Central Pacific Ocean (50% of summed landings 2000–21), followed by the Indian Ocean (22%), Eastern Pacific Ocean (17%), and Atlantic Ocean (10%).

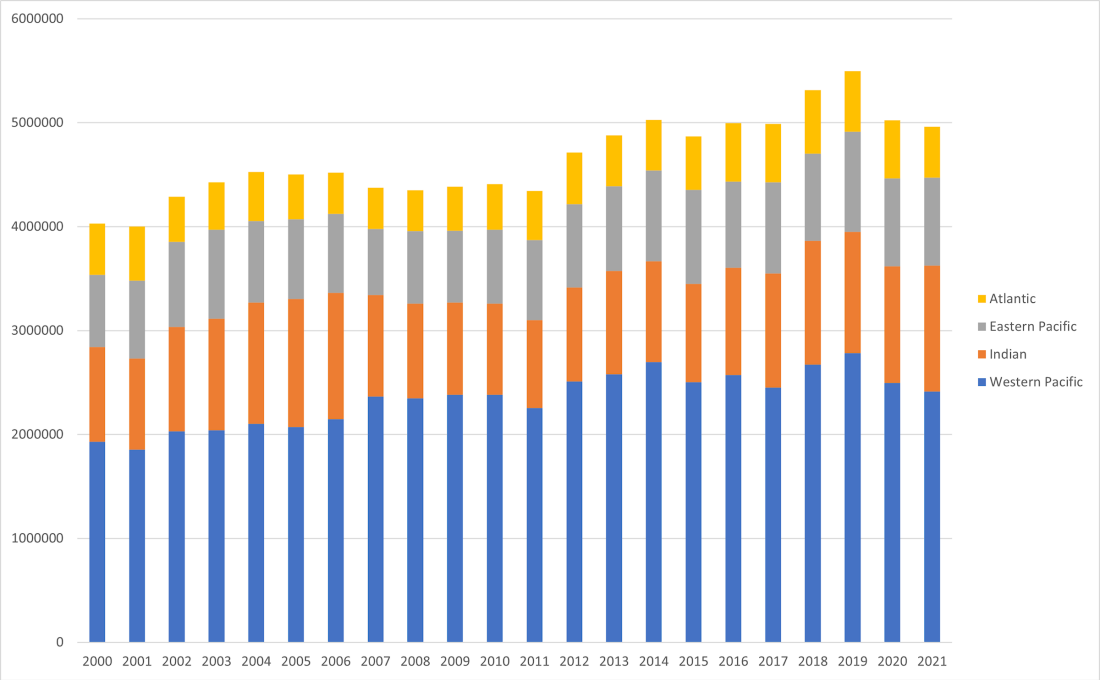

Figure 2: Landings of the major tuna species by year and ocean. Species are skipjack, yellowfin, bigeye, albacore, Pacific bluefin, Atlantic bluefin, and southern bluefin. Data from the UN FAO FishStatJ database (https://www.fao.org/fishery/en/statistics/software/fishstatj). The Pacific Ocean is separated into Eastern and Western to approximately match the Regional Fisheries Management Organization structures (FAO and RFMO fishing areas do not match perfectly).

In the Eastern Pacific Ocean, which is the focus of this Seafood Watch assessment, skipjack, yellowfin, and bigeye dominate landings. Virtually all skipjack, as well as the majority of yellowfin, bigeye, and Pacific bluefin, are caught using purse seines. Albacore is primarily caught with longline and troll—the latter occurs virtually all in the waters off the United States and Canada.

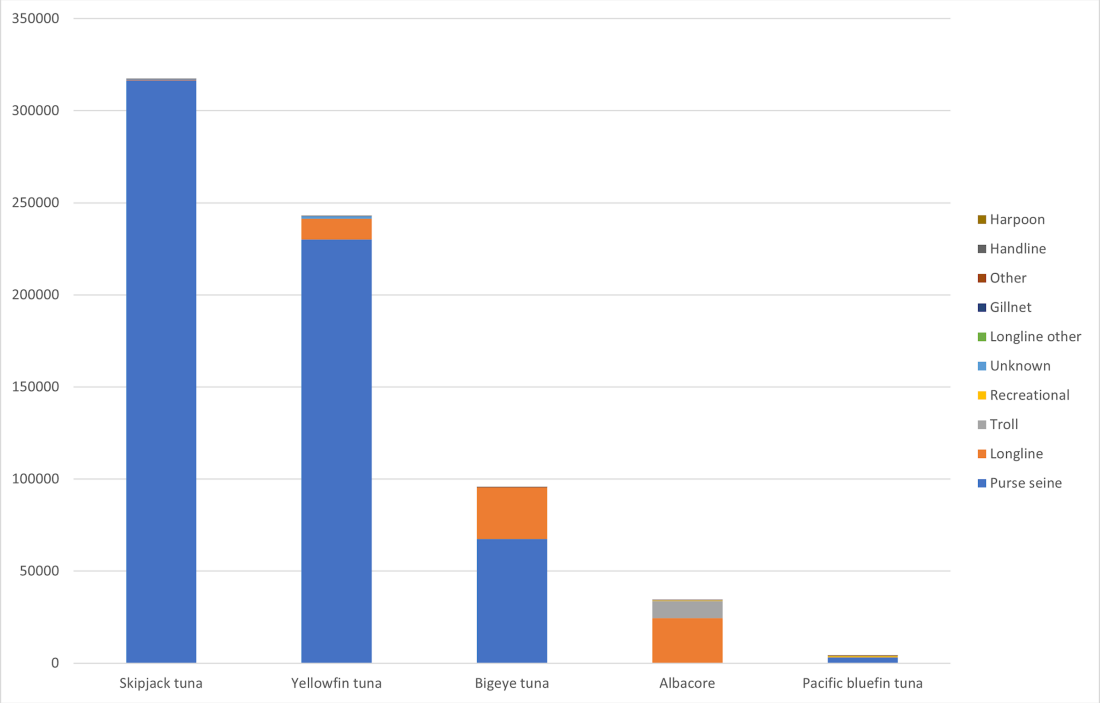

Figure 3: Average landings from 2017 to 2021 (MT) by species and gear type for major tuna species in the Eastern Pacific Ocean (i.e., the jurisdictional area of IATTC). Data from IATTC (Sept 2022 CatchByFlagGear.zip file available at https://www.iattc.org/en-US/Data/Public-domain).

Purse seiners can be further separated into set type, which affects the relative catch of tuna and other species. The majority of skipjack and virtually all bigeye are caught in fisheries where the purse seine is set on fish aggregation devices (FAD). Approximately one quarter of yellowfin is also caught in these FAD sets, but the majority is caught where the purse seine is set on dolphins, which tend to aggregate with yellowfin tuna in the EPO. Smaller percentages of the catch of skipjack and yellowfin are caught when purse seines are set on tunas. The majority of the Pacific bluefin catch is with unassociated purse seine sets by Mexico, for which the entire catch is destined to sea ranches for fattening (see Seafood Watch EPO PBF and Mexican farmed tuna assessments for more information).

Purse seiners also vary in size, from small vessels (Classes 1–2) that are generally confined to coastal areas, to larger vessels (Classes 3–5) that frequently fish on the high seas, to the largest vessels (Class 6) that have a carrying capacity of over 363 MT. Smaller purse seine vessels (Classes 1–5) currently account for about 15% of the purse seine catch of yellowfin, bigeye, and skipjack (based on the data in the IATTC catch and effort database for the years 1980–2015) (Román et al 2016). Only Class 6 vessels are permitted to set on dolphins (Griffiths et al 2022). The smaller vessels are often multigear and multispecies, shifting their target among tuna, billfish, sharks, and dorado on a seasonal basis (Griffiths et al 2022). Other vessels primarily target entirely different species but catch tuna opportunistically; for example, the U.S. coastal purse seine fleet off the coast of California, Oregon, and Washington typically targets squid,

sardine, and anchovy, but switches to target bluefin and other tunas when those taxa are available (see EPO PBF assessment for more information).

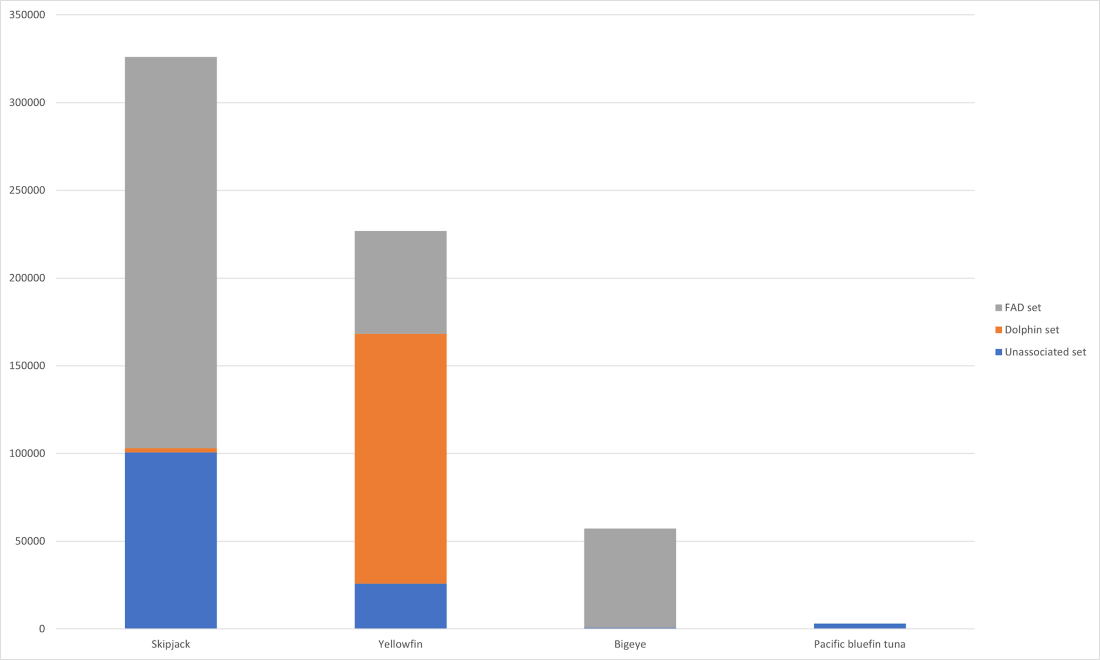

Figure 4: Average landings from 2017 to 2021 (MT) by species and purse seine set type for major tuna species in the EPO. Data from IATTC (April 2023 PublicPSTuna.zip file available at https://www.iattc.org/en-US/Data/Public-domain). Data about which nations are fishing with which set types are not made available to the public (IATTC staff April 2023, pers comm).

Other large pelagics associated with tuna

Other species caught and retained in these fisheries include swordfish, various shark species, and dorado. These three taxa are included in the ratings in this assessment or other Seafood Watch assessments. Other species caught in these fisheries and not rated in this or other seafood assessments—because they do not generally appear in international markets and/or have relatively low landings volume—include bonitos (*Sarda* spp.), black skipjack (*Euthynnus lineatus*), billfish, frigate and bullet tunas, manta rays (Mobulidae) and stingrays (Dasyatidae), opah (Lampridae, which does have one rating in a different Seafood Watch assessment), escolar (*Lepidocybium flavobrunneum*), snake mackerels (Gempylidae), pomfrets (Bramidae), long-snouted lancetfish (*Alepisaurus ferox*), and rainbow runner (Carangidae) (although they may be considered as main bycatch species caught in the fisheries; see Criterion 2).

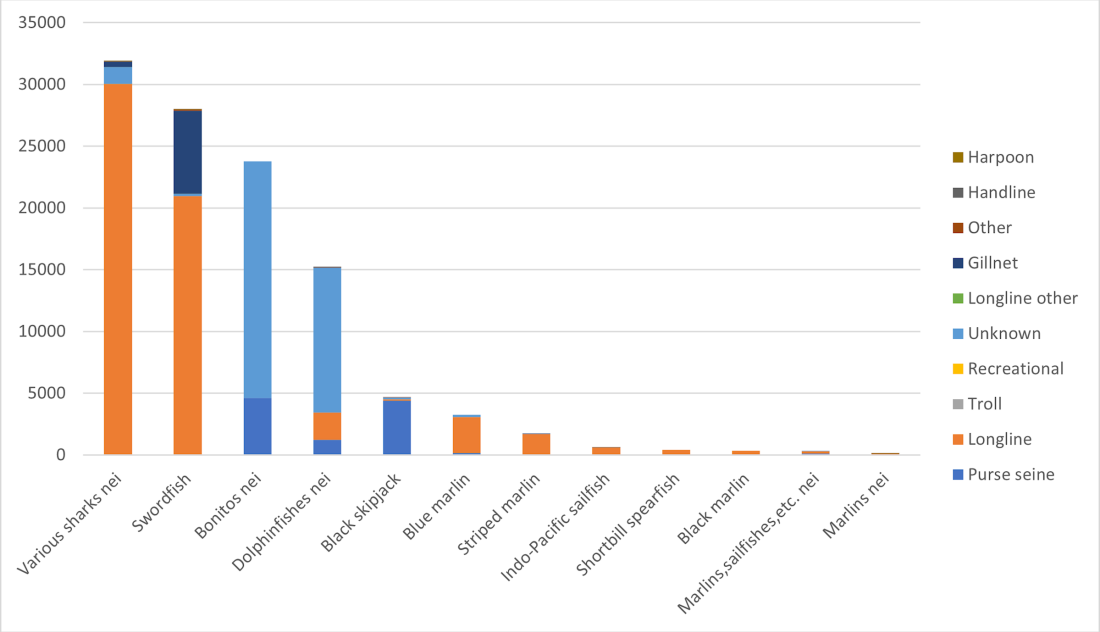

Figure 5: Average landings from 2017 to 2021 (MT) by species associated with tuna fisheries in the Eastern Pacific Ocean (i.e., the jurisdictional area of IATTC). Data from IATTC (Sept 2022 CatchByFlagGear.zip file available at https://www.iattc.org/en-US/Data/Public-domain). Shark species are not specified in this dataset. The majority of the catch using "Unknown" gear type is made by Peru-flagged vessels, most likely using longline gear. IATTC staff are working with Peru on resolving this (in addition to fixing data from 2019, and receiving data from 2020 and 2021) (IATTC staff April 2023, pers comm).

Swordfish

Landings are dominated by vessels using longline gear, though gillnet accounts for virtually all of Chile's catch and a minor portion of the United States' catch. There are also small harpoon fisheries for swordfish in Chile and the United States.

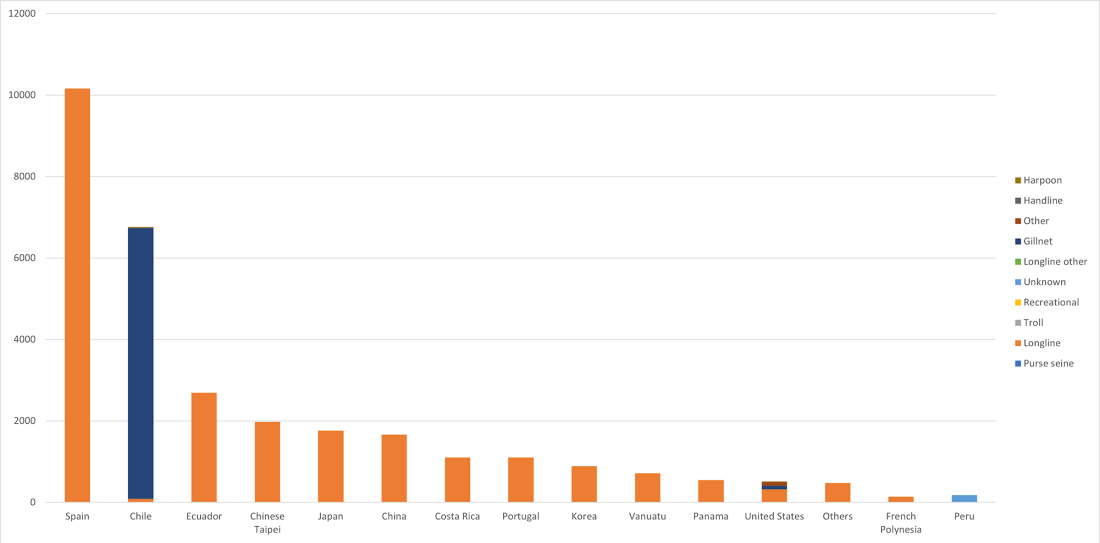

Figure 6: Average landings from 2017 to 2021 (MT) of swordfish in the Eastern Pacific Ocean (i.e., the jurisdictional area of IATTC). Data from IATTC (Sept 2022 CatchByFlagGear.zip file available at https://www.iattc.org/en-US/Data/Public-domain).

Dorado

Landings are dominated by Peru, which primarily uses longlines. This is assessed in other Seafood Watch reports.

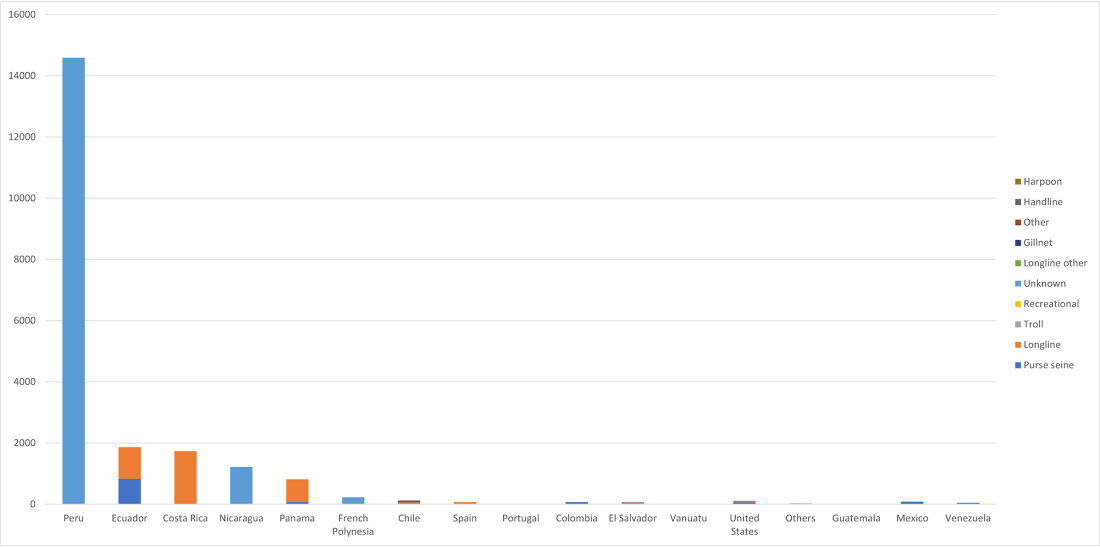

Figure 7: Average landings from 2017 to 2021 (MT) of dorado in the Eastern Pacific Ocean (i.e., the jurisdictional area of IATTC). Data from IATTC (Sept 2022 CatchByFlagGear.zip file available at https://www.iattc.org/en-US/Data/Public-domain). The majority of the catch is made using "Unknown" gear by Peru-flagged vessels, which is most likely longline gear. IATTC staff are working with Peru on resolving this (in addition to fixing data from 2019, and receiving data from 2020 and 2021) (IATTC staff April 2023, pers comm).

Importance to the US/North American market

Along with shrimp and salmon, whole tuna and canned tuna are the top imported seafoods in the U.S. (NOAA 2022b). U.S. trade of tuna, swordfish, and dorado (mahi mahi/dolphinfish) is dominated by imports, which have averaged 300,000 to 350,000 MT in the past two decades (NOAA 2023). Imports are dominated by tuna of unspecified species. Where the species is specified, yellowfin, bigeye, bluefin, swordfish, and dorado are typically imported as fresh or frozen fillets or meat. Albacore is typically canned or in some other shelf-stable product form (e.g., pouches), and skipjack also is often canned. The majority of the unspecified tuna is also shelf stable (NOAA 2023). Asian countries account for the majority of U.S. tuna imports, with imports from Mexico, Ecuador, Senegal, and Fiji also each accounting for more than 10,000 MT of U.S. tuna imports in 2022. Dorado and swordfish are imported fresh or frozen from many different countries, with South America, Central America, and Asia dominating U.S. imports of dorado, and the Americas and Asia dominating U.S. imports of swordfish (NOAA 2023).

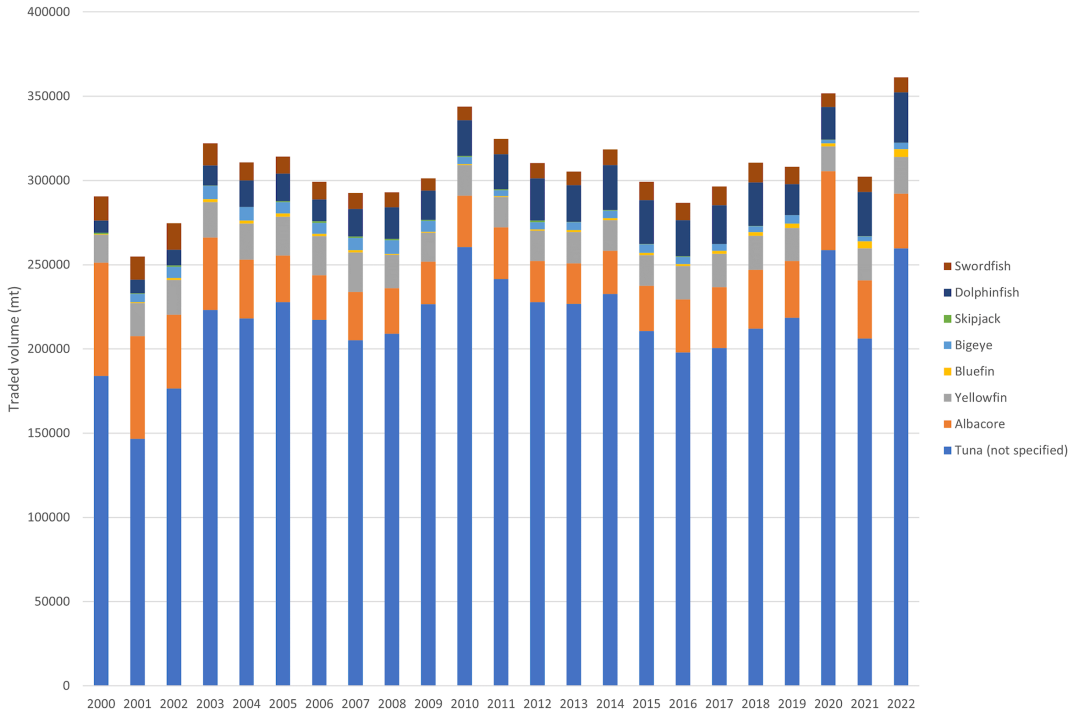

Figure 8: U.S. imports of tuna, swordfish, and dorado, 2000–22 (MT) (NOAA 2023).

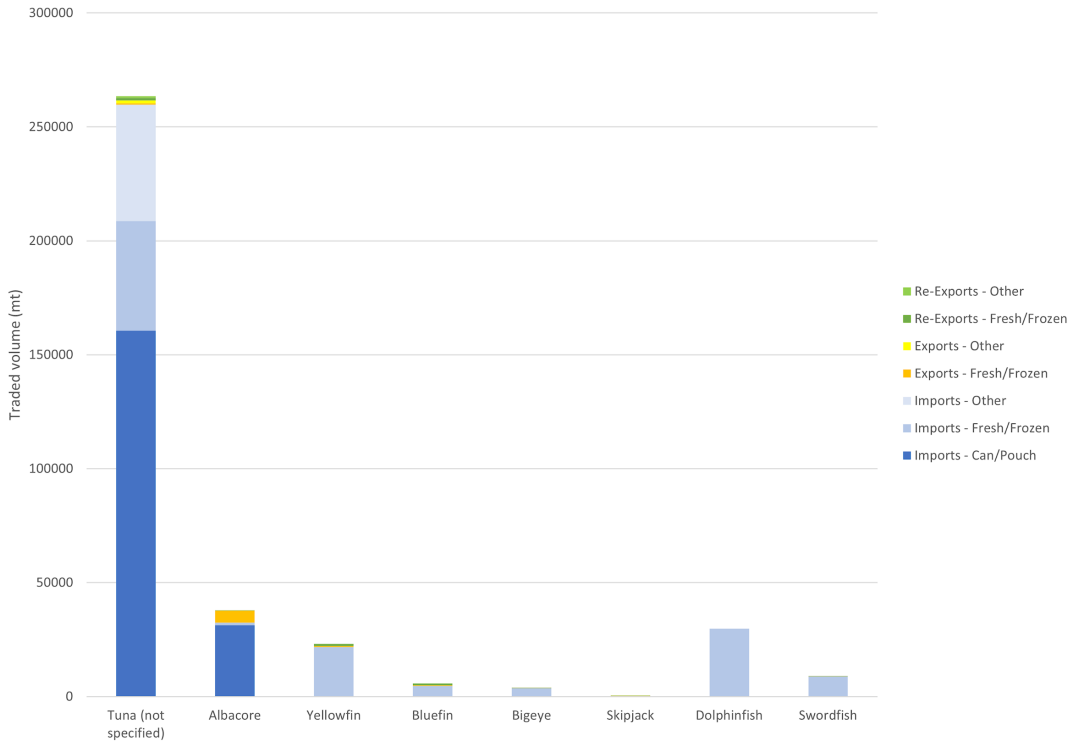

Figure 9: U.S. imports, exports, and re-exports (imported product that is effectively unchanged before export) of tuna, dorado, and swordfish, 2022 (MT) (NOAA 2023).

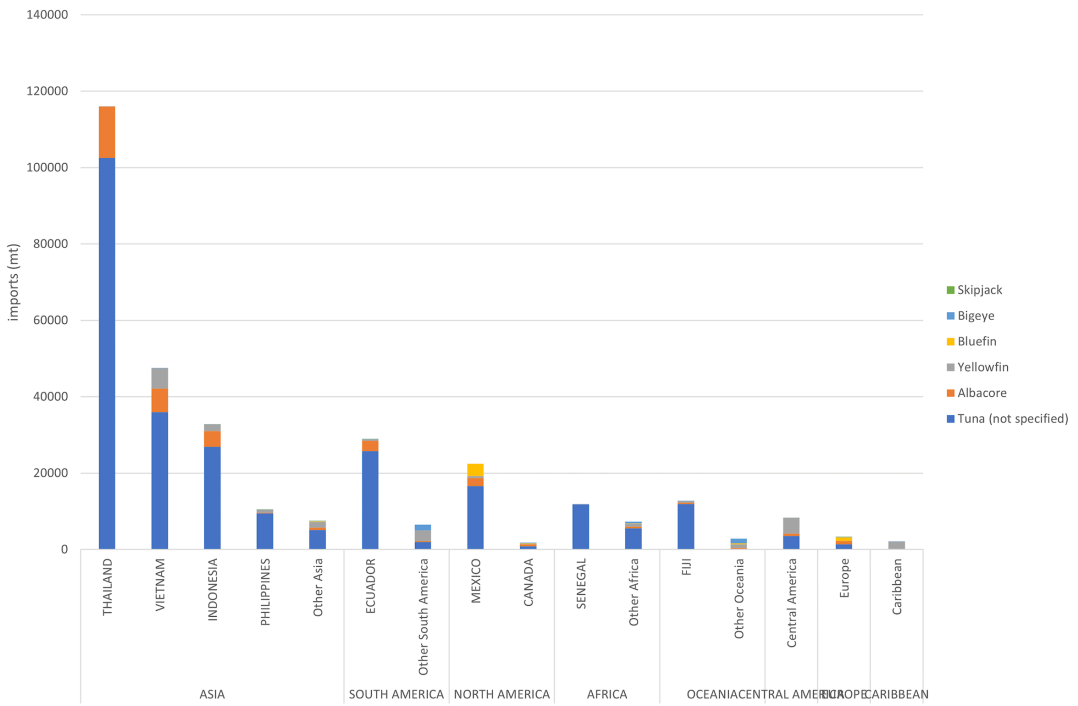

Figure 10: U.S. imports of tuna by country and species, 2022 (MT) (NOAA 2023).

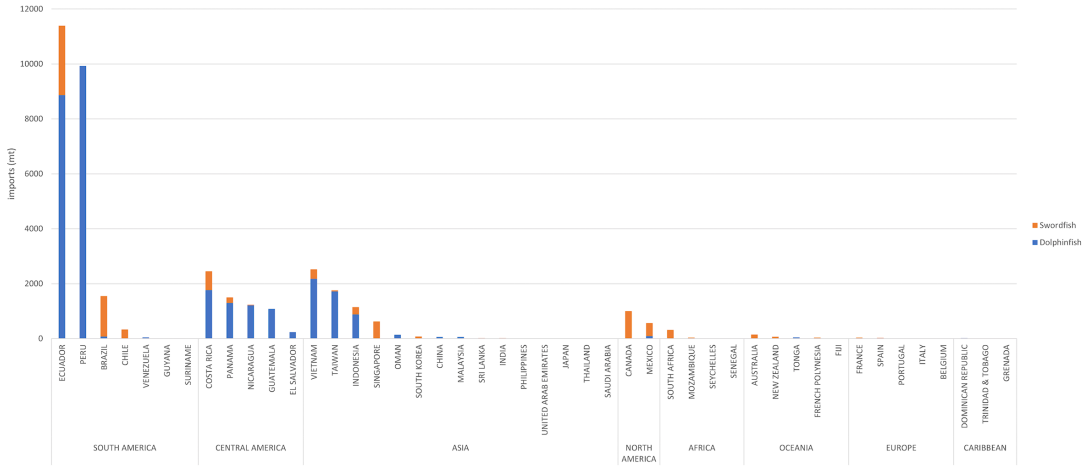

Figure 11: U.S. imports of swordfish and dorado by country, 2022 (MT) (NOAA 2023).

Common and market names

Table 7: Common and market names and primary product forms of tuna and swordfish (FDA 2019).

Species	Common/Market Name	Product Forms
Skipjack tuna	Bonito, lesser tuna, aku	Fresh, frozen, canned, fillet, rounds
Bigeye tuna	Bigeye, ahi	Fresh, sashimi, frozen, canned, fillet, rounds
Yellowfin tuna	Ahi	Fresh, frozen, canned, fillet, rounds
Albacore tuna	Germon, longfinned tuna, tombo ahi	Fresh, frozen, canned, fillet, rounds
Swordfish	Broadbill, espada, emperado	Fresh, frozen, fillet, rounds
Dorado	Mahi mahi, dolphinfish	Fresh, frozen, fillet

Primary product forms

See Table 7.

Production volume notes

Table 8: Production volumes from IATTC. The breakdown of catch of yellowfin, bigeye, and skipjack across the different purse seine set types is from ISSF. Volumes are calculated by applying the ratios for the most recent year in the ISSF purse seine set type dataset (2021) to the latest catch data (2022).

Purse Seine Set Type	Bigeye	Yellowfin	Skipjack
DOL (%)	0	62	1
FAD (%)	99	26	69
FSC (%)	1	11	30
DOL (MT)	0	182,145	2,344
FAD (MT)	46,031	76,545	205,345
FSC (MT)	659	33,136	88,765
Total 2022 catch (MT)	**46,690**	**291,826**	**296,454**

Summary

This report focuses on the following fisheries in the Eastern Pacific Ocean: 1) two longline fisheries targeting swordfish (*Xiphias gladius*), albacore tuna (*Thunnus alalunga*), bigeye tuna (*Thunnus obesus*), and yellowfin tuna (*Thunnus albacares*); 2) three purse seine fisheries (unassociated sets, associated sets, dolphin sets) targeting yellowfin, bigeye, and skipjack tuna (*Katsuwonus pelamis*); and 3) a troll fishery for albacore tuna (*Thunnus alalunga*). Unassociated, FAD, and dolphin sets targeting skipjack and yellowfin tuna (and bigeye tuna, in FAD-set fisheries) in the Eastern Pacific Ocean purse seine fishery receive a yellow rating. Albacore trolls in the United States and Canada receive a green rating. All longline fisheries in the Eastern Pacific Ocean receive a red rating. These red ratings also apply to dorado (*Coryphaena hippurus*) that is caught in longlines.

Eco-Certification information

Several fisheries in the EPO are engaged in Fishery Improvement Projects (FIPs), including: i) the Costa Rican longline and greenstick fishery for yellowfin tuna, dorado, and swordfish (in progress); ii) the Panamanian purse seine fishery for yellowfin, skipjack, and bigeye tuna; iii) the Taiwanese longline fishery for albacore tuna; iv) Cheng Hung Seafood Frozen Produce Co., Ltd.'s Pacific-wide multispecies tuna longline fishery; v) FCF Co., Ltd.'s central and southern Pacific albacore, bigeye, skipjack, and yellowfin longline fishery; vi) Fue Shin's Pacific-wide

albacore, bigeye, yellowfin, and skipjack longline fishery; and vii) the Starkist Pacific-wide multispecies tuna longline fishery. Engagement in an FIP does not affect the Seafood Watch score, because our assessments are based on the current situation. The Monterey Bay Aquarium is a member organization of the Conservation Alliance for Seafood Solutions. The Alliance has outlined guidelines for credible Fishery Improvement Projects. Thus, Seafood Watch will support procurement from fisheries engaged in an FIP, provided that a third party can verify that the FIP meets the Alliance guidelines. It is not the responsibility of Monterey Bay Aquarium to verify the credibility or progress of an FIP, or to promote the fisheries engaged in improvement projects.

Assessments

This section assesses the sustainability of the fishery(s) relative to the Seafood Watch Standard for Fisheries, available at www.seafoodwatch.org. The specific standard used is referenced on the title page of all Seafood Watch assessments.

Criterion 1: Impacts on the Species Under Assessment

This criterion evaluates the impact of fishing mortality on the species, given its current abundance. When abundance is unknown, abundance is scored based on the species' inherent vulnerability, which is calculated using a Productivity-Susceptibility Analysis. The final Criterion 1 score is determined by taking the geometric mean of the abundance and fishing mortality scores. The Criterion 1 rating is determined as follows:

- Score >3.2 = **Green** or Low Concern
- Score >2.2 and ≤3.2 = **Yellow** or Moderate Concern
- Score ≤2.2 = **Red** or High Concern

Rating is Critical if Factor 1.3 (Fishing Mortality) is Critical.

Guiding principles

- *Ensure all affected stocks are healthy and abundant.*
- *Fish all affected stocks at sustainable level*

Criterion 1 Summary

Albacore			
Region / Method	**Abundance**	**Fishing Mortality**	**Score**
North Pacific Stock - - Eastern Central Pacific Ocean | Northeast Pacific Ocean - Drifting longlines - 31,800 mt	5.000 Very Low Concern	5.000 Low Concern	**Green (5.000)**
South Pacific Stock - - Eastern Central Pacific Ocean | Southeast Pacific Ocean - Drifting longlines - 31,800 mt	3.670 Low Concern	5.000 Low Concern	**Green (4.284)**
North Pacific Stock - Canada | United States - British Columbia | California | Oregon | Washington - Eastern Central Pacific Ocean | Northeast Pacific Ocean | Northwest Pacific Ocean - Trolling lines - 12,081 mt	5.000 Very Low Concern	5.000 Low Concern	**Green (5.000)**

Bigeye tuna			
Region / Method	**Abundance**	**Fishing Mortality**	**Score**
Eastern Pacific Ocean Stock - - Eastern Central Pacific Ocean | Northeast Pacific Ocean - Drifting longlines - 20,684 mt	5.000 Very Low Concern	5.000 Low Concern	**Green (5.000)**
Eastern Pacific Ocean Stock - - Eastern Central Pacific Ocean | Southeast Pacific Ocean - Drifting longlines - 20,684 mt	5.000 Very Low Concern	5.000 Low Concern	**Green (5.000)**
Eastern Pacific Ocean Stock - - Eastern Central Pacific Ocean - Floating object purse seine (FAD) - 46,031 mt	5.000 Very Low Concern	5.000 Low Concern	**Green (5.000)**

Dolphinfish			
Region / Method	**Abundance**	**Fishing Mortality**	**Score**
- Eastern Central Pacific Ocean | Northeast Pacific Ocean - Drifting longlines - 713 mt	2.330 Moderate Concern	3.000 Moderate Concern	**Yellow (2.644)**
- Eastern Central Pacific Ocean | Southeast Pacific Ocean - Drifting longlines - 713 mt	3.670 Low Concern	5.000 Low Concern	**Green (4.284)**

Skipjack tuna			
Region / Method	**Abundance**	**Fishing Mortality**	**Score**
Eastern Pacific Ocean Stock - - Eastern Central Pacific Ocean - Floating object purse seine (FAD) - 205,345 mt	5.000 Very Low Concern	5.000 Low Concern	**Green (5.000)**
Eastern Pacific Ocean Stock - - Eastern Central Pacific Ocean - Unassociated purse seine (non-FAD) - 88,765 mt	5.000 Very Low Concern	5.000 Low Concern	**Green (5.000)**

Swordfish			
Region / Method	**Abundance**	**Fishing Mortality**	**Score**
- Eastern Central Pacific Ocean | Northeast Pacific Ocean - Drifting longlines - 19,645 mt	5.000 Very Low Concern	5.000 Low Concern	**Green (5.000)**
Southeastern Pacific Ocean Stock - - Eastern Central Pacific Ocean | Southeast Pacific Ocean - Drifting longlines - 19,645 mt	3.670 Low Concern	3.000 Moderate Concern	**Green (3.318)**

Yellowfin tuna			
Region / Method	**Abundance**	**Fishing Mortality**	**Score**
Eastern Pacific Ocean Stock - - Eastern Central Pacific Ocean - Dolphin set purse seine - 182,145 mt	3.670 Low Concern	5.000 Low Concern	**Green (4.284)**
Eastern Pacific Ocean Stock - - Eastern Central Pacific Ocean | Northeast Pacific Ocean - Drifting longlines - 6,655 mt	3.670 Low Concern	5.000 Low Concern	**Green (4.284)**
Eastern Pacific Ocean Stock - - Eastern Central Pacific Ocean | Southeast Pacific Ocean - Drifting longlines - 6,655 mt	3.670 Low Concern	5.000 Low Concern	**Green (4.284)**
Eastern Pacific Ocean Stock - - Eastern Central Pacific Ocean - Floating object purse seine (FAD) - 6,655 mt	3.670 Low Concern	5.000 Low Concern	**Green (4.284)**
Eastern Pacific Ocean Stock - - Eastern Central Pacific Ocean - Unassociated purse seine (non-FAD) - 33,136 mt	3.670 Low Concern	5.000 Low Concern	**Green (4.284)**

Criterion 1 Assessment

Scoring Guidelines

Factor 1.1 - Abundance

Goal: Stock abundance and size structure of native species is maintained at a level that does

not impair recruitment or productivity.

- *5 (Very Low Concern) — Strong evidence exists that the population is above an appropriate target abundance level (given the species' ecological role), or near virgin biomass.*
- *3.67 (Low Concern) — Population may be below target abundance level, but is at least 75% of the target level, OR data-limited assessments suggest population is healthy and species is not highly vulnerable.*
- *2.33 (Moderate Concern) — Population is not overfished but may be below 75% of the target abundance level, OR abundance is unknown and the species is not highly vulnerable.*
- *1 (High Concern) — Population is considered overfished/depleted, a species of concern, threatened or endangered, OR abundance is unknown and species is highly vulnerable.*

Factor 1.2 - Fishing Mortality

Goal: Fishing mortality is appropriate for current state of the stock.

- *5 (Low Concern) — Probable (>50%) that fishing mortality from all sources is at or below a sustainable level, given the species ecological role, OR fishery does not target species and fishing mortality is low enough to not adversely affect its population.*
- *3 (Moderate Concern) — Fishing mortality is fluctuating around sustainable levels, OR fishing mortality relative to a sustainable level is uncertain.*
- *1 (High Concern) — Probable that fishing mortality from all source is above a sustainable level.*

Albacore *(Thunnus alalunga)*

1.1 Abundance

North Pacific Stock | Eastern Central Pacific, Northeast Pacific - Drifting longlines

North Pacific Stock | Eastern Central Pacific, North Pacific - Canada | United States - British Columbia | California | Oregon | Washington - Trolling lines

Very Low Concern

Albacore is assessed as a single stock in the North Pacific. The most recent stock assessment was conducted using data through 2021 and a length-based, sex-structured modeling approach (ISC 2023b). The spawning stock biomass (SSB) in 2021 was estimated to be 54%$SSB_{current}$, which is 1.8 times greater than the threshold reference point of 30%$SSB_{current, F = 0}$ and is also above the limit reference point of 14%$SSB_{current, F = 0}$ (ibid). Based on a stock assessment using data < 5 years old with a finding that biomass is above appropriate reference points, abundance is considered a “very low concern” (per line 1.1 in table 1.1.1 of the Seafood Watch Standard).

Supplementary Information

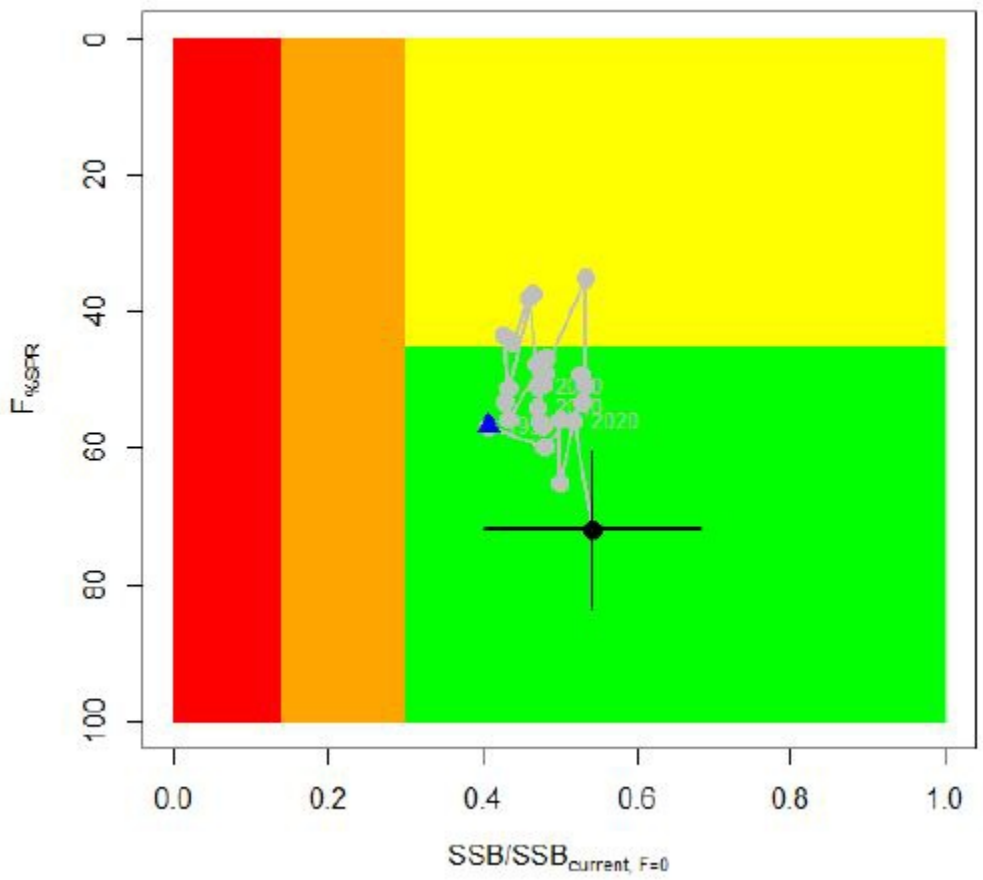

Figure 12: Phase plot of biomass and fishing mortality of North Pacific albacore compared to threshold and limit reference points, as well as the target fishing mortality reference point, from the 2023 stock assessment. Source: (ISC 2023b).

South Pacific Stock | Eastern Central Pacific, Southeast Pacific - Drifting longlines

Low Concern

Albacore is assessed as a single stock in the South Pacific. The most recent stock assessment was conducted in 2024 using biomass data through 2022. The limit reference point (LRP) for this stock is a spawning depletion ratio of 0.2, and the recent (2019–22) spawning depletion ratio was found to be above the limit reference point ($SB_{2019–22}/SB_{F=0}$ = 0.48), with a zero percent probability that the stock was below the LRP (Teears et al. 2024). There is no officially adopted target reference point (TRP) for the entire stock, but an interim TRP has been adopted. Recent biomass was just below this interim TRP (median $SB_{2019–22}/SB_{F=0}$:iTRP = 0.952) (ibid). Based on a stock assessment < 5 years old indicating that the stock is above the adopted LRP but between 75% and 100% of the iTRP, abundance is considered a “low concern” (per line 2.1.a in table 1.1.1 of the Seafood Watch Standard).

Supplementary Information

The stock was also estimated to be above the maximum sustainable yield (MSY) level ($SB_{2019–22}/SB_{MSY}$ = 3.02) (Teears et al. 2024). But the official management interim target reference point is used for scoring purposes, because it is more precautionary and has been determined by managers to be appropriate for the stock.

1.2 Fishing Mortality

North Pacific Stock | Eastern Central Pacific, Northeast Pacific - Drifting longlines

North Pacific Stock | Eastern Central Pacific, North Pacific - Canada | United States - British Columbia | California | Oregon | Washington - Trolling lines

Low Concern

The latest stock assessment of North Pacific albacore found that fishing intensity from 2018 to 2020 was $F_{59\%SPR}$, which is below the target of $F_{45\%SPR}$ (ISC 2023b). Based on a stock assessment using data < 10 years old with a finding that fishing mortality is below an appropriate target reference point, fishing mortality is considered a “low concern” (per line 1.1 in table 1.2.1 of the Seafood Watch Standard).

South Pacific Stock | Eastern Central Pacific, Southeast Pacific - Drifting longlines

Low Concern

The latest stock assessment of South Pacific albacore found that recent fishing mortality was below the MSY level (median F_{recent}/F_{MSY} = 0.18), with a zero percent probability that fishing mortality was above MSY (Teears et al. 2024). Based on a stock assessment using data < 10 years old with a finding that fishing mortality is below a sustainable level, fishing mortality is considered a “low concern” (per line 1.1 in table 1.2.1 of the Seafood Watch Standard).

Bigeye tuna *(Thunnus obesus)*

1.1 Abundance

Eastern Pacific Ocean Stock | Eastern Central Pacific, Northeast Pacific - Drifting longlines

Eastern Pacific Ocean Stock | Eastern Central Pacific, Southeast Pacific - Drifting longlines

Eastern Pacific Ocean Stock | Eastern Central Pacific - Floating object purse seine (FAD)

Very Low Concern

Bigeye tuna is assessed as a single stock in the EPO. The most recent stock assessment used biomass data through the beginning of 2024 and estimated that spawning biomass at that time was greater than the dynamic MSY level ($S_{current}/S_{MSY}$ = 1.29) (IATTC 2024a).

Based on a stock assessment < 5 years old indicating that biomass is above a target reference point, abundance is considered a “very low concern” (per line 1.1 in table 1.1.1 of the Seafood Watch Standard).

Supplementary Information

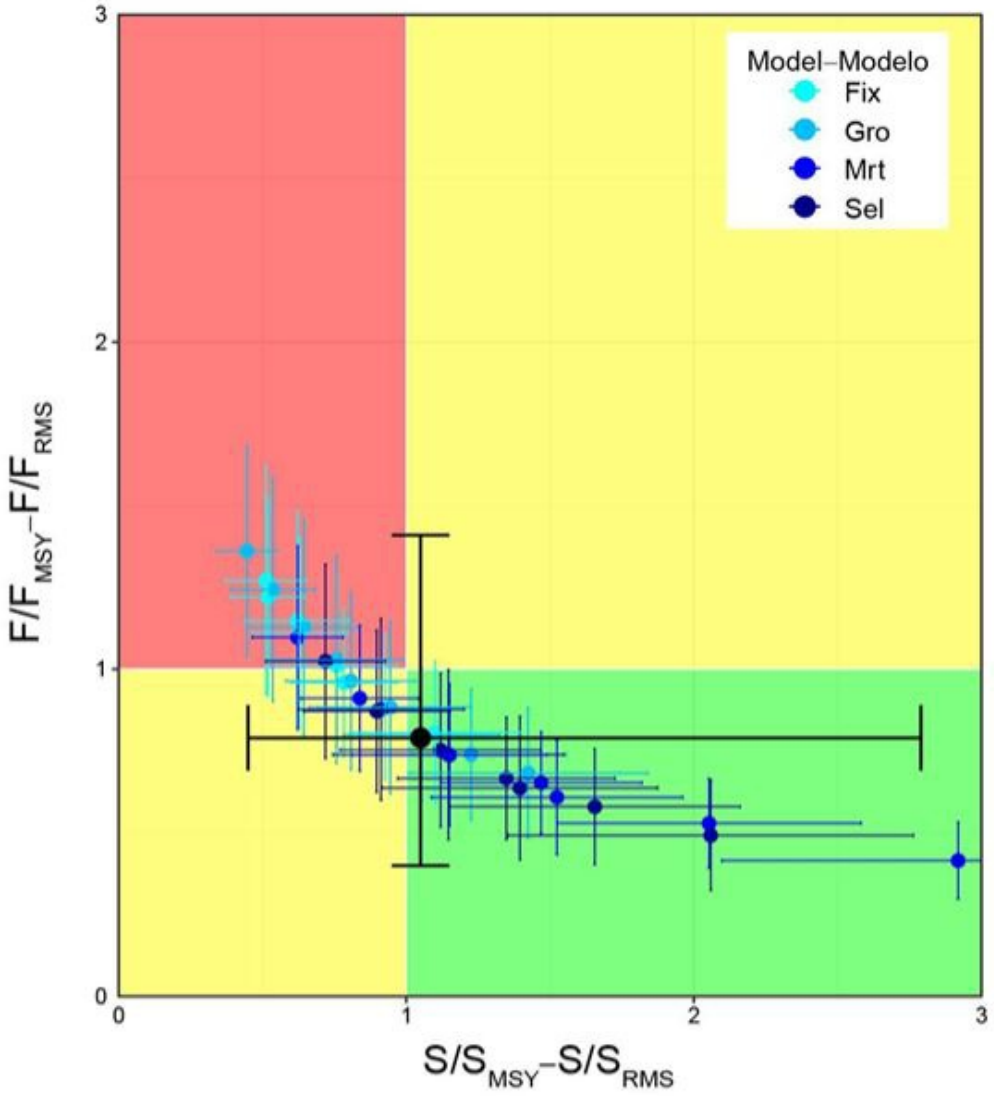

Figure 13: Kobe plot of biomass and fishing mortality for EPO bigeye tuna compared to MSY reference points in the 2024 stock assessment. Source: (IATTC 2024a).

1.2 Fishing Mortality

Eastern Pacific Ocean Stock | Eastern Central Pacific, Northeast Pacific - Drifting longlines

Eastern Pacific Ocean Stock | Eastern Central Pacific, Southeast Pacific - Drifting longlines

Eastern Pacific Ocean Stock | Eastern Central Pacific - Floating object purse seine (FAD)

Low Concern

The 2024 assessment of EPO bigeye tuna found that there was a 24.7% probability that 2021–23 fishing mortality was above the TRP of F_{MSY}, compared to a 58.5% probability that it was above the TRP in 2017–19 (IATTC 2024a). Fishing mortality was estimated to be 18% lower than the MSY level ($F_{current}/F_{MSY}$ = 0.82). Thus, fishing mortality has decreased in recent years to below a sustainable level, and based on this finding from a stock assessment <10 years old, fishing mortality is considered a "low concern" (per line 1.1 in table 1.2.1 of the Seafood Watch Standard).

Dolphinfish *(Coryphaena hippurus)*

1.1 Abundance

Eastern Central Pacific, Northeast Pacific - Drifting longlines

Moderate Concern

Data are limited for dolphinfish (also known as mahi mahi and dorado) in the EPO and WCPO. In the Eastern Pacific, a stock assessment only exists for the southern EPO. The International Union for the Conservation of Nature (IUCN) has assessed dolphinfish as a species of "Least Concern," but this assessment is > 10 years old (Collette et al. 2011a). Therefore, a productivity-susceptibility analysis (PSA) was performed, resulting in a score of 3.10 (medium vulnerability). Based on the PSA results indicating that dorado has a medium vulnerability, abundance is considered a "moderate concern" (per 3.2.e in table 1.1.1 of the Seafood Watch Standard).

Supplementary Information

PSA for dorado in the Eastern Pacific (see Seafood Watch Fisheries Standard Version 4 for methodology details).

Table 9

Productivity Attribute	High productivity (score = 1)	Medium productivity (score = 2)	Low productivity (score = 3)	Score	Value; {Reference(s)}
Average age at maturity (yrs)	< 5	5–15	> 15	1	< 1 year (Froese and Pauly 2020; Collette et al. 2011a)

Average maximum age (yrs) (do not use if max size is available)	< 10	10–25	> 25	N/A	11 years (Sun et al. 2015a)
Von Bertalanffy (Brody) Growth Coefficient (K)	> 0.25	0.15–0.25	< 0.15	1	0.4 (Froese and Pauly 2020)
Fecundity (eggs/yr)	> 20,000	100–20,000	< 100	1	85,000 (Froese and Pauly 2020)
Average maximum size (cm)	< 100	100–300	> 300	2	210 cm (Froese and Pauly 2020)
Average size at maturity (cm)	< 40	40–200	> 200	2	55.8 cm (Froese and Pauly 2020)
Reproductive strategy	Broadcast spawner	Demersal egg layer or brooder	Live bearer	1	Broadcast spawner (Froese and Pauly 2020)
Productivity score (mean of attribute scores)				**1.33**	

Table 10

Susceptibility Attribute (default scores in bold)	**Low S (score = 1)**	**Medium S (score = 2)**	**High S (score = 3)**	**Score**	**Value/notes; {Reference(s)}**
Areal overlap (all fisheries)	> 90% of species concentration is unfished	70%–90% of species concentration is unfished	**> 30% of the species concentration is fished**	3	

Vertical overlap (all fisheries)	> 67% of species' depth range is unfished	33–66% of species' depth range is unfished	**> 33% of species' depth range is unfished**	3	Unknown; Default (bolded) scores selected
Seasonal availability (all fisheries)	Fisheries overlap with species < 3 months/year	Fisheries overlap with species 3–6 months/year	**Fisheries overlap with species > 6 months/year**	3	
Selectivity of fishery (specific to fishery under assessment)	Species is not targeted AND is not likely to be captured by gear	**Species is targeted, or is incidentally encountered AND is not likely to escape the gear**	Species is targeted or is incidentally encountered AND combination of fishery attributes and species' biology increase its susceptibility to the gear	2	
Post-capture mortality (specific to fishery under assessment)	> 66% individuals survive post-capture	33–66% individuals survive post-capture	**Retained species, or > 66% do not survive post-capture**	3	
Susceptibility score (mean of attribute scores)				**2.8**	

Table 11

Productivity-Susceptibility Score ($V = v(P^2 + S^2)$)	**3.10**
Vulnerability Rating: < 2.64 = Low vulnerability; >= 2.64 and <= 3.18 = Medium vulnerability; > 3.18 = High vulnerability	Medium

Eastern Central Pacific, Southeast Pacific - Drifting longlines

Low Concern

The first comprehensive stock assessment for common dolphinfish in the southeastern

Pacific used fisheries-dependent data from Peru and Ecuador through 2019 (Roa-Ureta et al 2021a). The results confirm earlier characterizations of the stock as being highly productive and able to recover quickly from low biomass and high mortality (e.g. ,(Aires da Silva et al. 2016)) and a life history more akin to a small pelagic species than a large pelagic species. These characteristics lead to widely fluctuating biomass, leading the authors to suggest that MSY-based reference points are not appropriate (because MSY is a constant) and likely lead to an excessive harvest rate. They assert that "latent productivity," which is similar to MSY but varies with fluctuations in abundance, is a more appropriate reference point {Roa-Ureta et al. 2021a} (for further discussion of latent production, see {Roa-Ureta et al. 2021b}). Regardless of the reference point used, the authors found biomass in the most recent year to be above the reference point, so the stock not overfished. But sources of uncertainty in this assessment include the assessment having not yet been peer reviewed, an incomplete catch dataset (purse seine catch is not included, nor is the 20% of the catch from other countries as it was in an earlier stock status evaluation (Aires da Silva et al. 2016)), a lack of fisheries-independent data, and only a nascent understanding of stock dynamics (Diaz-Jaimes and Ortega-Garcia 2021)—all of which, alongside the age of the data, preclude a score of 5 ("very low concern"). Based on a stock assessment < 10 years old indicating (with potential scientific controversy) that the stock is above appropriate reference points, abundance is considered a "low concern" (per lines 1.1.a and 2.1.b in table 1.1.1 of the Seafood Watch Standard).

1.2 Fishing Mortality

Eastern Central Pacific, Northeast Pacific - Drifting longlines

Moderate Concern

Although fishing mortality in the southeast Pacific has been calculated, there is no estimate for the northeast Pacific. Because this estimate is unknown, fishing mortality is considered a "moderate concern" (per line 2.3 in table 1.2.1 of the Seafood Watch Standard).

Eastern Central Pacific, Southeast Pacific - Drifting longlines

Low Concern

The recent stock assessment found fishing mortality over the time series (2004–19) to be less than 20% of MSY and around 50% of the total average latent productivity, indicating that overfishing is not occurring (Roa-Ureta et al 2021a). This finding of relatively low fishing mortality is consistent with an earlier exploratory evaluation, which found fishing mortality at MSY to be two times the actual fishing mortality at the time (Aires da Silva et al. 2016), and with a recent data-limited assessment using EASI-Fish, which found that fishing mortality in 2019 was less than that at an F_{MSY} proxy (i.e., $F_{2019}/F_{40\%} = 0.73$)

(Griffiths et al 2019a); however, the authors do stress that the study is not a stock assessment and so should not be used to determine overfished or overfishing status. Based on a stock assessment < 10 years old indicating that exploitation is below a sustainable level, fishing mortality is considered a "low concern" (per line 1.1 in table 1.2.1 of the Seafood Watch Standard).

Skipjack tuna *(Katsuwonus pelamis)*

1.1 Abundance

Eastern Pacific Ocean Stock | Eastern Central Pacific - Floating object purse seine (FAD)

Eastern Pacific Ocean Stock | Eastern Central Pacific - Unassociated purse seine (non-FAD)

Very Low Concern

Skipjack tuna is assessed as a single stock in the EPO. The most recent assessment was completed in 2024 and notes that MSY-based quantities are unreliable for this stock, leading to the use of a proxy TRP of a spawning biomass ratio (SBR) equal to 0.3 (IATTC 2024b). The assessment found that spawning biomass was above this proxy reference point and the LRP of an SBR equal to 0.077. The reference model used in the assessment found SBR to be 0.43 (ibid). Based on a stock assessment < 5 years old indicating that biomass is above an appropriate target reference point, abundance is considered a "very low concern" (per line 1.1 in table 1.1.1 of the Seafood Watch Standard).

Supplementary Information

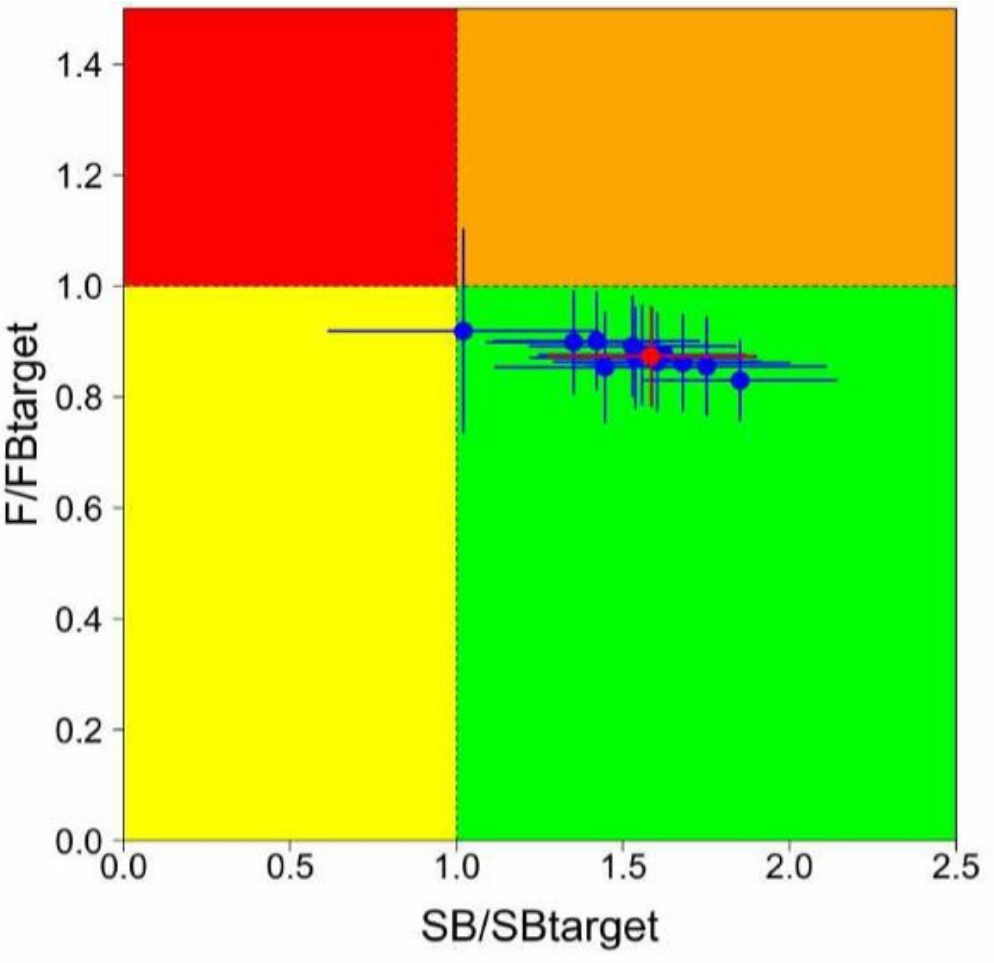

Figure 14: Kobe plot of biomass and fishing mortality for EPO skipjack tuna in comparison to reference points used in the 2024 stock assessment. Source: (IATTC 2024b).

1.2 Fishing Mortality

Eastern Pacific Ocean Stock | Eastern Central Pacific - Floating object purse seine (FAD)

Eastern Pacific Ocean Stock | Eastern Central Pacific - Unassociated purse seine (non-FAD)

Low Concern

The 2024 benchmark stock assessment of EPO skipjack tuna did not calculate MSY-based reference points. Relative to the selected reference point, the authors found that current fishing mortality is below the proxy target reference point ($F_{current}/Fb_{target}$ = 0.87, according to the reference model used in the assessment). Based on a stock assessment using data < 10 years old indicating that exploitation is below a sustainable level, fishing mortality is considered a “low concern” (per line 1.1 in table 1.2.1 of the Seafood Watch Standard).

Swordfish *(Xiphias gladius)*

1.1 Abundance

Eastern Central Pacific, Northeast Pacific - Drifting longlines

Very Low Concern

North Pacific swordfish was last assessed in 2023, using data up to 2021. There are no defined reference points for this stock, but MSY-based reference points were used for the 2023 assessment. The assessment found that SSB in 2021 was well above SSB_{MSY} (SSB_{2021}/SSB_{MSY} = 2.18) (ISC 2023a). The assessment further concluded that there was a > 99% probability that the stock was not overfished in 2021. Because the stock is well above a sustainable target reference point, based on an assessment < 5 years old, abundance is considered a "very low concern" (per line 1.1 in table 1.1.1 of the Seafood Watch Standard).

Supplementary Information

Previous stock assessments for North Pacific swordfish were divided into two stock delineations: Western Central and North Pacific stock and Eastern Pacific stock; however, the 2023 stock assessment was performed for a single, North Pacific stock delineation that covers both stock areas (ISC 2023a).

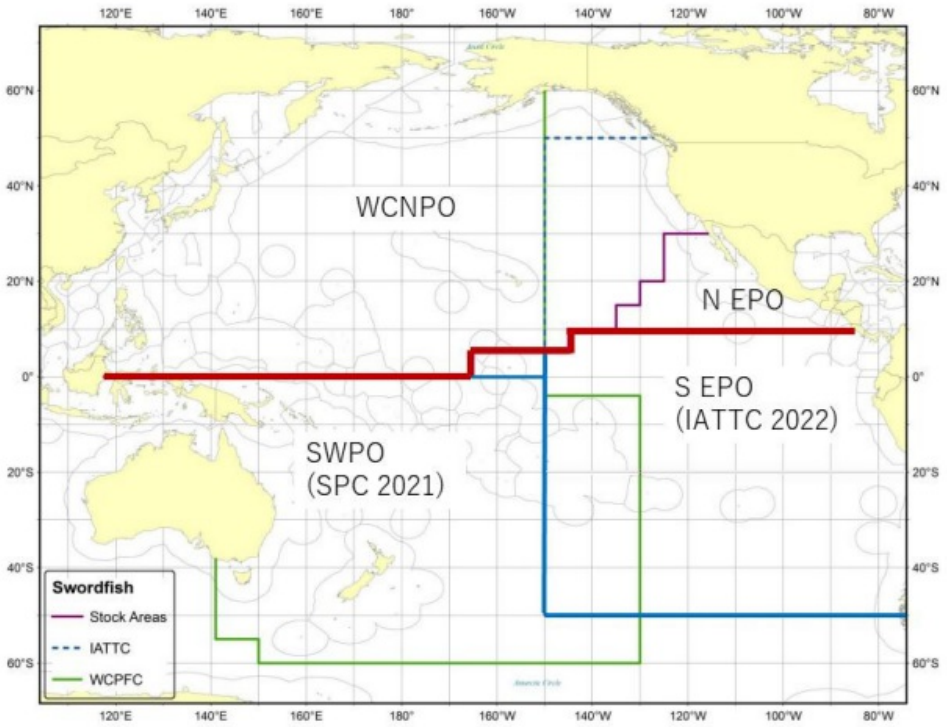

Figure 15: Stock boundaries for the 2023 North Pacific swordfish assessment. WCNPO and N EPO are treated as one stock in 2023. Source: {WCPFC 2024d}.

Low Concern

An assessment for swordfish in the Southeast Pacific Ocean was conducted in 2023 by the Inter-American Tropical Tuna Commission (IATTC) and used catch data through 2019 (Minte-Vera et al. 2023). Because of the uncertainty in stock structure, four models were developed to correspond with the three stock structure hypotheses (see Justification) (ibid). Considering that the IATTC has yet to adopt reference points for swordfish in the SEPO, arbitrary (dynamic and equilibrium) reference points were used to determine stock status, which were based on those used for comparable tropical tunas in the IATTC (ibid). Compared to a biomass limit reference point (LRP) of 20% unfished biomass and a target reference point (TRP) of 40% unfished biomass, the stock is either near or above the TRP, depending on which model was used (Model 3: $SSB_{current}/SSB_{F=0} = 0.42$; Models 1, 2, 4: $SSB_{current}/SSB_{F=0} > 0.5$), and all models suggested that the stock did not fall below the suggested biomass limit reference point (Figures 16–17 in Justification) (ibid). Therefore, based on a stock assessment using data < 10 years old that identifies that biomass is above a target reference point, abundance is considered a “low concern” (per line 2.1.b in table 1.1.1 of the Seafood Watch Standard).

Supplementary Information

The three stock structure hypotheses were developed as follows: H1 assumed the stock was distributed south of 5° S. and east of 150° W. (similar to the previous 2011 stock assessment), H2 assumed the stock was distributed south of 10° N. and east of 150° W., and H3 assumed the stock was distributed south of 10° N. and east of 170° W. (Minte-Vera et al. 2023). In addition, four models were constructed to explain the simultaneous increase in catch and indices of abundance and were structured as follows: Model 1 focused on a real increase in productivity, Model 2 focused on an increase in availability, Model 3 focused on increases in both productivity and availability, and Model 4 focused on stock structure and connectivity (ibid).

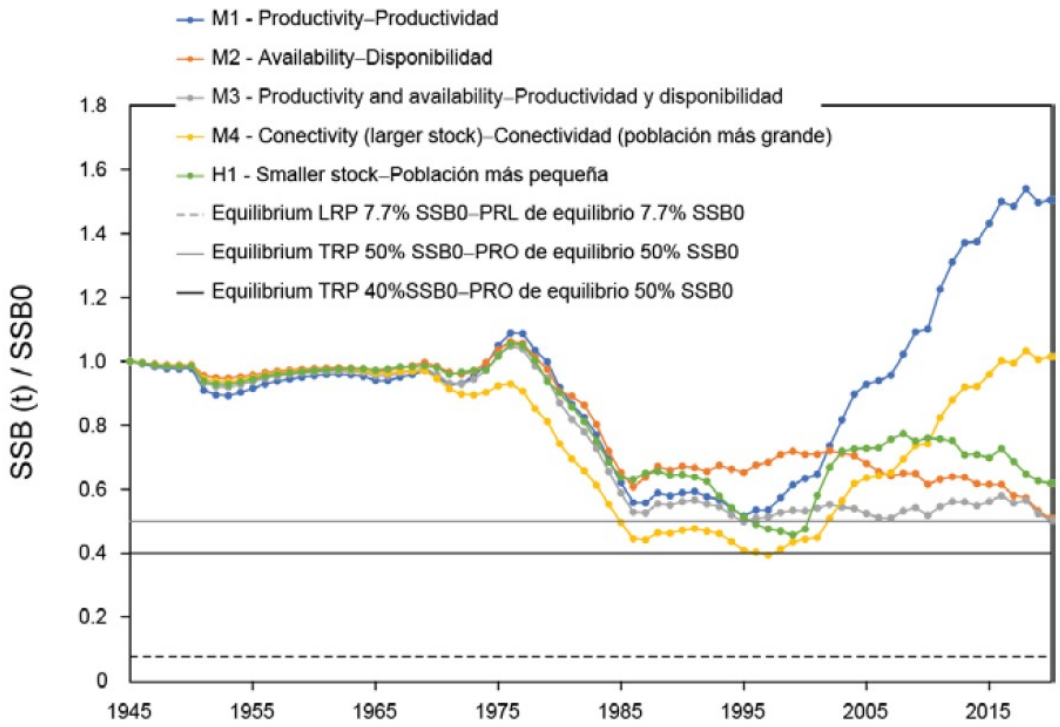

Figure 16: Ratio of the estimated spawning stock biomass and the virgin spawning stock biomass (equilibrium) for the models corresponding to the four hypotheses that explain the simultaneous increase in indices of abundance and catches and the model corresponding to the stock structure hypothesis H1 (north boundary at 5° S.) (Minte-Vera et al. 2023). Note that M4 corresponds to the stock structure hypothesis H3 (western boundary at 170° W.) (ibid).

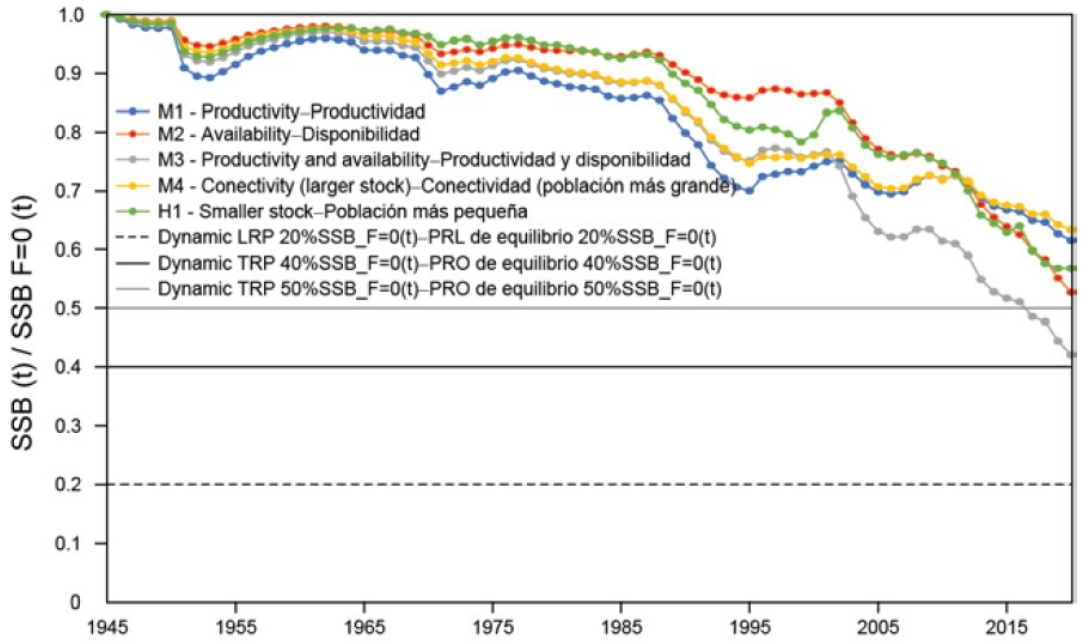

Figure 17: Ratio of the estimated spawning stock biomass and spawning stock biomass with no fishing (dynamic) for the models corresponding to the four hypotheses that explain the simultaneous increase in indices of abundance and catches and the model corresponding to the stock structure hypothesis H1 (north boundary at 5° S.) (Minte-Vera et al. 2023). Note that M4 corresponds to the stock structure hypothesis H3 (western boundary at 170° W.) (ibid).

1.2 Fishing Mortality

Eastern Central Pacific, Northeast Pacific - Drifting longlines

Low Concern

The 2023 North Pacific swordfish stock assessment found that fishing mortality generally decreased from 1978 to 2021 and was below the MSY level in the final year of the assessment (F_{2021}/F_{MSY} = 0.49) (ISC 2023a). There was a > 99% probability that the stock was not subject to overfishing in 2021. Based on a stock assessment < 10 years old indicating that fishing mortality is below a sustainable level, fishing mortality is considered a “low concern” (per line 1.1 in table 1.2.1 of the Seafood Watch Standard).

Southeastern Pacific Ocean Stock | Eastern Central Pacific, Southeast Pacific - Drifting longlines

Moderate Concern

The dynamic fisheries mortality reference points utilized in the 2023 stock assessment were based on reference points used for comparable tropical tunas by the WCPFC [TRPs: $40\%SSB_{F=0}$ (t) and $50\%SSB_{F=0}$ (t); LRP: $20\%SSB_{F=0}$ (t)] (Minte-Vera et al. 2023). All models indicated an increase in fishing mortality, with fishing intensity being slightly above or below the TRPs (depending on which model was used), and no model estimates

were above the LRP (Figure 18) (ibid). Therefore, fishing mortality is considered a "moderate concern" to account for conflicting model conclusions indicating that fishing mortality relative to a sustainable level is unknown (per line 2.3 in table 1.2.1 of the Seafood Watch Standard).

The 2023 stock assessment measured fishing mortality as the decline in the proportion of the spawning biomass produced by each recruit due to fishing, with relation to the biomass per recruit in the unfished condition (SPR) (Minte-Vera et al. 2023). The fisheries mortality reference points were identified as the fishing morality that declined the population to depletion, while considering the mix of selectiveness in the various swordfish fisheries in the SEPO (ibid).

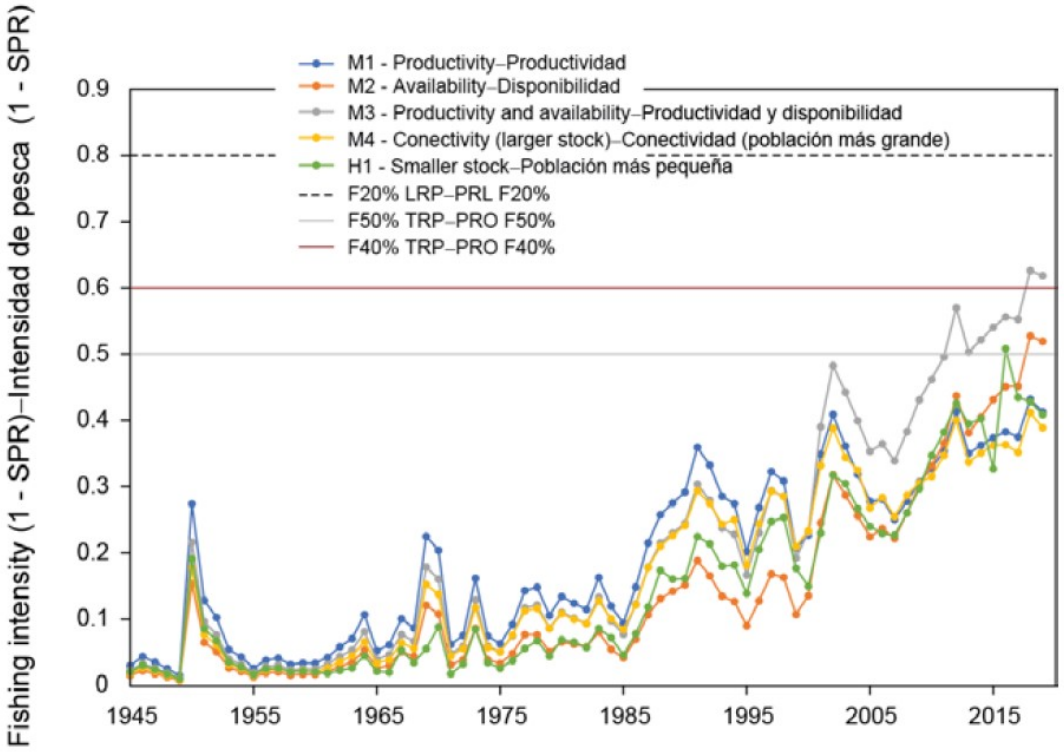

Figure 18: Fishing intensity (1 – SPR) for the models corresponding to the four hypotheses that explain the simultaneous increase in indices of abundance and catches and the model corresponding to the stock structure hypothesis H1 (north boundary at 5° S.) (Minte-Vera et al. 2023). Note that M4 corresponds to the stock structure hypothesis H3 (western boundary at 170° W.) (ibid). Large SPRs are indicative of low fishing mortality, thus a proxy for fishing mortality is 1 – SPR (ibid).

Swordfish are primarily caught in the SEPO by the Spanish longline fleet (30% of catches), followed by the Chilean drift gillnet fleet (22% of catches) and the Ecuadorian longline fleet (20% of catches) (Minte-Vera et al. 2023). The average catch per year from 2000 to 2009 was ≈15,000 t, while the average catch per year from 2010 to 2019 was ≈29,000 t, including a peak in 2018 at 36,500 t (ibid). Catches have increased in all areas in the last decade (the largest increase was in the northern coastal area) (ibid).

Yellowfin tuna *(Thunnus albacares)*

1.1 Abundance

Eastern Pacific Ocean Stock | Eastern Central Pacific - Dolphin set purse seine

Eastern Pacific Ocean Stock | Eastern Central Pacific, Northeast Pacific - Drifting longlines

Eastern Pacific Ocean Stock | Eastern Central Pacific, Southeast Pacific - Drifting longlines

Eastern Pacific Ocean Stock | Eastern Central Pacific - Floating object purse seine (FAD)

Eastern Pacific Ocean Stock | Eastern Central Pacific - Unassociated purse seine (non-FAD)

Low Concern

Yellowfin tuna is assessed as a single stock in the EPO. The stock has an adopted, interim limit reference point of S_{LIMIT}, which is currently $0.077S_0$, and a target reference point of S_{MSY}. The latest stock assessment was a 2020 benchmark assessment using data through 2019 (Minte-Vera et al. 2020; ISSF 2023). The authors found that spawning biomass in 2020 was above the MSY level, averaged across all models ($SSB_{current}/SSB_{MSY} = 1.57$), with a 12% probability that $SSB_{current}$ is below SSB_{MSY}. Because a stock assessment between 5 and 10 years old indicates that biomass is above the target reference point, abundance is considered a "low concern" (per line 2.1.b in table 1.1.1 of the Seafood Watch Standard).

1.2 Fishing Mortality

Eastern Pacific Ocean Stock | Eastern Central Pacific - Dolphin set purse seine

Eastern Pacific Ocean Stock | Eastern Central Pacific, Northeast Pacific - Drifting longlines

Eastern Pacific Ocean Stock | Eastern Central Pacific, Southeast Pacific - Drifting longlines

Eastern Pacific Ocean Stock | Eastern Central Pacific - Floating object purse seine (FAD)

Eastern Pacific Ocean Stock | Eastern Central Pacific - Unassociated purse seine (non-FAD)

Low Concern

The 2020 stock assessment of EPO yellowfin tuna found an $F_{current}/F_{MSY}$ ratio of 0.67 (Minte-Vera et al. 2020; ISSF 2023). The probability across all models that $F_{current} > F_{MSY}$ is 9%. Based on a stock assessment using data < 10 years old with a finding that there is a > 50% probability that fishing mortality is below F_{MSY}, fishing mortality is considered a "low concern" (per line 1.1 in table 1.2.1 of the Seafood Watch Standard).

Criterion 2: Impacts on Other Species

All main retained and bycatch species in the fishery are evaluated under Criterion 2. Seafood Watch defines bycatch as all fisheries-related mortality or injury to species other than the retained catch. Examples include discards, endangered or threatened species catch, and ghost fishing. Species are evaluated using the same guidelines as in Criterion 1. When information on other species caught in the fishery is unavailable, the fishery's potential impacts on other species is scored according to the Unknown Bycatch Matrices, which are based on a synthesis of peer-reviewed literature and expert opinion on the bycatch impacts of each gear type. The fishery is also scored for the amount of non-retained catch (discards) and bait use relative to the retained catch. To determine the final Criterion 2 score, the score for the lowest scoring retained/bycatch species is multiplied by the discard/bait score. The Criterion 2 rating is determined as follows:

- Score >3.2 = **Green** or Low Concern
- Score >2.2 and ≤3.2 = **Yellow** or Moderate Concern
- Score ≤2.2 = **Red** or High Concern

Rating is Critical if Factor 2.3 (Fishing Mortality) is Crtitical

Guiding principles

- *Ensure all affected stocks are healthy and abundant.*
- *Fish all affected stocks at sustainable level.*
- *Minimize bycatch.*

Criterion 2 Summary

Criterion 2 score(s) overview

This table(s) provides an overview of the Criterion 2 subscore, discards+bait modifier, and final Criterion 2 score for each fishery. A separate table is provided for each species/stock that we want an overall rating for.

Albacore			
Region / Method	**Sub Score**	**Discard Rate/Landings**	**Score**
North Pacific Stock - - Eastern Central Pacific Ocean | Northeast Pacific Ocean - Drifting longlines - 31,800 mt	1.000	1.000: < 100%	Red (1.000)
South Pacific Stock - - Eastern Central Pacific Ocean | Southeast Pacific Ocean - Drifting longlines - 31,800 mt	1.000	1.000: < 100%	Red (1.000)
North Pacific Stock - Canada | United States - British Columbia | California | Oregon | Washington - Eastern Central Pacific Ocean | Northeast Pacific Ocean | Northwest Pacific Ocean - Trolling lines - 12,081 mt	5.000	1.000: < 100%	Green (5.000)

Bigeye tuna			
Region / Method	**Sub Score**	**Discard Rate/Landings**	**Score**
Eastern Pacific Ocean Stock - - Eastern Central Pacific Ocean | Northeast Pacific Ocean - Drifting longlines - 20,684 mt	1.000	1.000: < 100%	Red (1.000)
Eastern Pacific Ocean Stock - - Eastern Central Pacific Ocean | Southeast Pacific Ocean - Drifting longlines - 20,684 mt	1.000	1.000: < 100%	Red (1.000)
Eastern Pacific Ocean Stock - - Eastern Central Pacific Ocean - Floating object purse seine (FAD) - 46,031 mt	1.000	1.000: < 100%	Red (1.000)

Dolphinfish			
Region / Method	**Sub Score**	**Discard Rate/Landings**	**Score**
- Eastern Central Pacific Ocean | Northeast Pacific Ocean - Drifting longlines - 713 mt	1.000	1.000: < 100%	Red (1.000)
- Eastern Central Pacific Ocean | Southeast Pacific Ocean - Drifting longlines - 713 mt	1.000	1.000: < 100%	Red (1.000)

Skipjack tuna			
Region / Method	**Sub Score**	**Discard Rate/Landings**	**Score**
Eastern Pacific Ocean Stock - - Eastern Central Pacific Ocean - Floating object purse seine (FAD) - 205,345 mt	1.000	1.000: < 100%	Red (1.000)
Eastern Pacific Ocean Stock - - Eastern Central Pacific Ocean - Unassociated purse seine (non-FAD) - 88,765 mt	1.526	1.000: < 100%	Red (1.526)

Swordfish			
Region / Method	**Sub Score**	**Discard Rate/Landings**	**Score**
- Eastern Central Pacific Ocean | Northeast Pacific Ocean - Drifting longlines - 19,645 mt	1.000	1.000: < 100%	Red (1.000)
Southeastern Pacific Ocean Stock - - Eastern Central Pacific Ocean | Southeast Pacific Ocean - Drifting longlines - 19,645 mt	1.000	1.000: < 100%	Red (1.000)

Yellowfin tuna			
Region / Method	**Sub Score**	**Discard Rate/Landings**	**Score**
Eastern Pacific Ocean Stock - - Eastern Central Pacific Ocean - Dolphin set purse seine - 182,145 mt	1.526	1.000: < 100%	Red (1.526)
Eastern Pacific Ocean Stock - - Eastern Central Pacific Ocean | Northeast Pacific Ocean - Drifting longlines - 6,655 mt	1.000	1.000: < 100%	Red (1.000)
Eastern Pacific Ocean Stock - - Eastern Central Pacific Ocean | Southeast Pacific Ocean - Drifting longlines - 6,655 mt	1.000	1.000: < 100%	Red (1.000)
Eastern Pacific Ocean Stock - - Eastern Central Pacific Ocean - Floating object purse seine (FAD) - 6,655 mt	1.000	1.000: < 100%	Red (1.000)
Eastern Pacific Ocean Stock - - Eastern Central Pacific Ocean - Unassociated purse seine (non-FAD) - 33,136 mt	1.526	1.000: < 100%	Red (1.526)

Criterion 2 main assessed species/stocks table(s)

This table(s) provides a list of all species/stocks included in this assessment for each 'fishery' (as defined by a region/method combination). The text following this table(s) provides an explanation of the reasons the listed species were selected for inclusion in the assessment.

Eastern Central Pacific - Dolphin set purse seine			
Sub Score: 1.526	**Discard Rate: 1.000**		**Score: 1.526**
Species	**Abundance**	**Fishing Mortality**	**Score**
Pelagic stingray	2.330: Moderate Concern	1.000: High Concern	Red (1.526)
Manta rays and devil rays	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Spinner dolphin	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Sharks	1.000: High Concern	5.000: Low Concern	Yellow (2.236)
Silky shark	1.000: High Concern	5.000: Low Concern	Yellow (2.236)
Pantropical spotted dolphin	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Yellowfin tuna	3.670: Low Concern	5.000: Low Concern	Green (4.284)
Eastern Central Pacific - Floating object purse seine (FAD)			
Sub Score: 1.000	**Discard Rate: 1.000**		**Score: 1.000**
Species	**Abundance**	**Fishing Mortality**	**Score**
Silky shark	1.000: High Concern	1.000: High Concern	Red (1.000)
Pelagic stingray	2.330: Moderate Concern	1.000: High Concern	Red (1.526)
Manta rays and devil rays	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Yellowtail	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Sharks	1.000: High Concern	5.000: Low Concern	Yellow (2.236)
Black skipjack	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Bullet tuna	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Frigate tuna	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Rainbow runner	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Wahoo	3.670: Low Concern	5.000: Low Concern	Green (4.284)
Yellowfin tuna	3.670: Low Concern	5.000: Low Concern	Green (4.284)
Bigeye tuna	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Skipjack tuna	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)

Eastern Central Pacific - Unassociated purse seine (non-FAD)			
Sub Score: 1.526	**Discard Rate: 1.000**		**Score: 1.526**
Species	**Abundance**	**Fishing Mortality**	**Score**
Pelagic stingray	2.330: Moderate Concern	1.000: High Concern	Red (1.526)
Manta rays and devil rays	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Sharks	1.000: High Concern	5.000: Low Concern	Yellow (2.236)
Silky shark	1.000: High Concern	5.000: Low Concern	Yellow (2.236)
Black skipjack	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Bonitos	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Yellowfin tuna	3.670: Low Concern	5.000: Low Concern	Green (4.284)
Skipjack tuna	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Eastern Central Pacific, North Pacific - Canada | United States - British Columbia | California | Oregon | Washington - Trolling lines			
Sub Score: 5.000	**Discard Rate: 1.000**		**Score: 5.000**
Species	**Abundance**	**Fishing Mortality**	**Score**
Albacore	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)

Eastern Central Pacific, Northeast Pacific - Drifting longlines			
Sub Score: 1.000	**Discard Rate: 1.000**		**Score: 1.000**
Species	**Abundance**	**Fishing Mortality**	**Score**
Seabirds	1.000: High Concern	1.000: High Concern	Red (1.000)
Striped marlin	1.000: High Concern	1.000: High Concern	Red (1.000)
Sharks	1.000: High Concern	1.000: High Concern	Red (1.000)
Leatherback turtle	1.000: High Concern	1.000: High Concern	Red (1.000)
Silky shark	1.000: High Concern	1.000: High Concern	Red (1.000)
Pelagic stingray	2.330: Moderate Concern	1.000: High Concern	Red (1.526)
Olive Ridley turtle	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Laysan albatross	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Hawksbill turtle	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
False killer whale	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Black-footed albatross	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Black marlin	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
East Pacific green sea turtle	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Loggerhead turtle	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Dolphinfish	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Snake mackerels	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Shortfin mako shark	3.670: Low Concern	5.000: Low Concern	Green (4.284)
Yellowfin tuna	3.670: Low Concern	5.000: Low Concern	Green (4.284)
Opah	3.670: Low Concern	5.000: Low Concern	Green (4.284)
Wahoo	3.670: Low Concern	5.000: Low Concern	Green (4.284)
Blue marlin	3.670: Low Concern	5.000: Low Concern	Green (4.284)
Sailfish	3.670: Low Concern	5.000: Low Concern	Green (4.284)
Blue shark	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Bigeye tuna	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Swordfish	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Albacore	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)

Eastern Central Pacific, Southeast Pacific - Drifting longlines			
Sub Score: 1.000	**Discard Rate: 1.000**		**Score: 1.000**
Species	**Abundance**	**Fishing Mortality**	**Score**
Seabirds	1.000: High Concern	1.000: High Concern	Red (1.000)
Silky shark	1.000: High Concern	1.000: High Concern	Red (1.000)
Striped marlin	1.000: High Concern	1.000: High Concern	Red (1.000)
Leatherback turtle	1.000: High Concern	1.000: High Concern	Red (1.000)
Sharks	1.000: High Concern	1.000: High Concern	Red (1.000)
Pelagic stingray	2.330: Moderate Concern	1.000: High Concern	Red (1.526)
Loggerhead turtle	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Laysan albatross	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Hawksbill turtle	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
East Pacific green sea turtle	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Black-footed albatross	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Black marlin	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
False killer whale	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Olive Ridley turtle	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Snake mackerels	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Shortbill spearfish	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Pomfrets	2.330: Moderate Concern	3.000: Moderate Concern	Yellow (2.644)
Swordfish	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)
Albacore	3.670: Low Concern	5.000: Low Concern	Green (4.284)
Opah	3.670: Low Concern	5.000: Low Concern	Green (4.284)
Wahoo	3.670: Low Concern	5.000: Low Concern	Green (4.284)
Dolphinfish	3.670: Low Concern	5.000: Low Concern	Green (4.284)
Blue marlin	3.670: Low Concern	5.000: Low Concern	Green (4.284)
Sailfish	3.670: Low Concern	5.000: Low Concern	Green (4.284)
Yellowfin tuna	3.670: Low Concern	5.000: Low Concern	Green (4.284)
Bigeye tuna	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)

The Criterion 2 score for the rated stock is the lowest score of all the other main species caught with it (including target and nontarget, retained, and discarded species), multiplied by the

discard + bait use rate. The dolphin-set purse seine and unassociated purse seine fisheries' Criterion 2 scores are limited by pelagic stingrays, while the FAD-set purse seine fishery's score is limited by silky shark. The Criterion 2 scores for drifting longlines are limited by seabirds, striped marlin, sharks, leatherback turtle, and silky shark. The troll fishery has no Criterion 2 species.

Overview of catch composition data available for each fishery

Purse seines

The IATTC requires 100% observer coverage for large purse seiners (Class 6, > 363 MT) (Griffiths et al 2022). These vessels compose the majority of registered purse seine vessels operating in the EPO, and account for some 85% of the total purse seine catch of yellowfin, skipjack, and bigeye (based on the data in the IATTC catch and effort database for the years 1980–2015) (Román et al 2016). Nonetheless, there are still significant numbers of smaller purse seine vessels registered in some countries, including Ecuador, Mexico, United States, and Peru (Figure 27). These fleets account for a greater portion of the catch of yellowfin and skipjack in coastal areas (Román et al 2016). There are likely many more small purse seine vessels that catch and land tuna and other large pelagics in Central America, but many are not registered to IATTC because tuna is not the stated target. Most of the small-scale purse seine fleet is unobserved (see factor 3.3). For now, though the catch composition of the large vessels may be well understood, the lack of appropriate monitoring data hampers understanding in the smaller vessel fleets, which in turn undermines the understanding of the fishery-specific and cumulative impacts on target and nontarget species. Catch composition data for the component of the purse seine fleet that sets on dolphins are better, because only Class 6 vessels are permitted in that fishery (and therefore must adhere to the 100% observer requirement). The limited observer programs that are in place for smaller vessels do suggest that many of the same taxa are caught in these fleets (see Table L-8 in (IATTC 2022c)). Further, a recent effort to characterize shark catch across IATTC fisheries suggests that, while shark species are caught in smaller purse seine fleets, their contribution to overall fishing mortality is generally much lower than the contribution of industrial longlines, artisanal longlines, and Class 6 purse seines (see Figure 6 in (Griffiths et al 2022)).

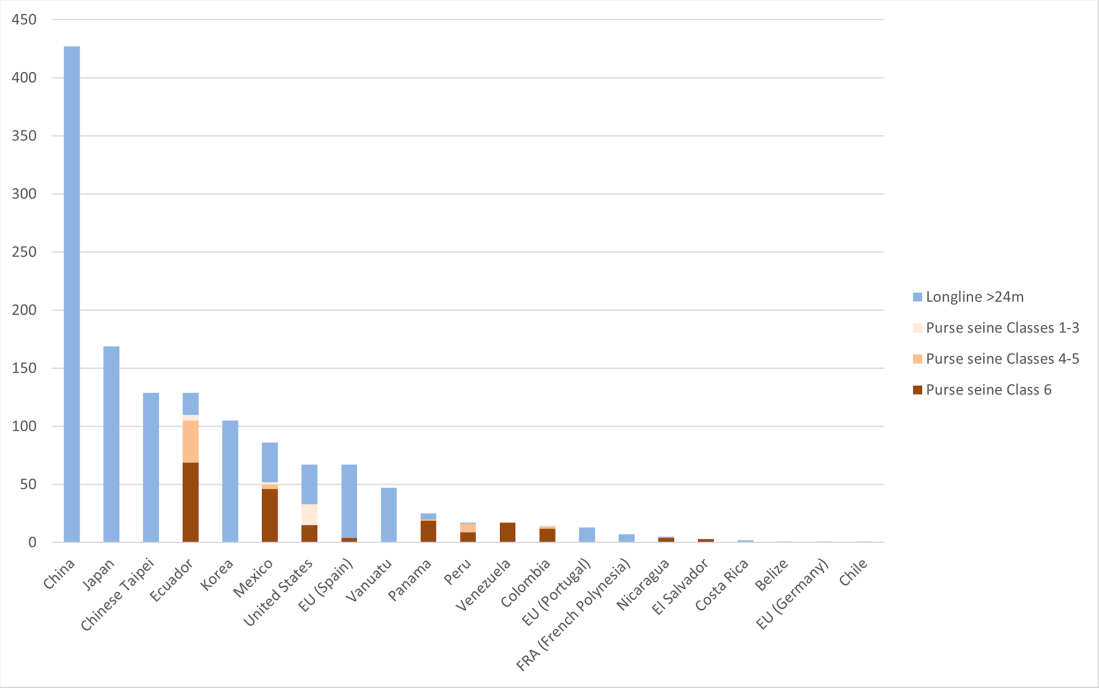

Figure 27: Number of active purse seine vessels by class/carrying capacity (Class 6 is the largest) and active longline vessels > 24 m in length in the EPO (IATTC Vessel Register 2023). The many longline vessels of less than 24 m are not included [e.g., the Fishery Improvement Project for the Peruvian mahi mahi fishery has over 3,600 longline vessels registered (vessel list from https://fisheryprogress.org/node/663/info); they are all reportedly over 12 m].

Longlines
(Note: a number of domestic longline fisheries for dorado are assessed in separate Seafood Watch assessments.)

Similar to the purse seine fleets, longline fleets in the EPO vary in size and number of vessels, with many Central and South American countries having quite large numbers of "artisanal" vessels, varying from pangas to larger vessels of 15–20 m in length. Monitoring of catch and effort of such fleets is a significant challenge, and few reliable data have historically existed for these fisheries throughout the EPO, because they are also poorly monitored by national fisheries agencies, if at all (Salas et al 2007) (Griffiths et al 2022). But more recent efforts from IATTC have led to data collection on shark catch (particularly hammerhead and silky) in these coastal artisanal fleets (Ovando et al 2023). Efforts to collect additional shark data for these fisheries are ongoing (IATTC Scientific Advisory Committee 2023). The artisanal longline fisheries 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 (IATTC 2022c).

Effective monitoring is not in place for these fisheries (see factor 3.3). This limits our understanding of the impacts of these fisheries on both target and nontarget species (see

factor 3.3). What is known is that many different taxa are caught in these fisheries, including tunas, swordfish, and other billfish (with bigeye, yellowfin, albacore, and swordfish the main targets), sharks, dorado, and other species of commercial interest that are typically retained, in addition to incidental catch of turtles, seabirds, and possibly mammals (e.g., see (Anderson 2009; IATTC 2017b; IATTC 2017c; IATTC 2018c; IATTC 2019j; IATTC 2022c) (Griffiths et al 2022)). Though it is unlikely that all longline fisheries catch all these taxa, all these fisheries likely catch one or more vulnerable taxon, so all the taxa are considered in the assessment of these fisheries until improved monitoring data allow for their exclusion.

Longline fisheries also typically use bait when targeting tunas and large pelagics—a factor that is typically considered in a Seafood Watch assessment because the volume of bait used in some fisheries (not necessarily tuna fleets) can have population-level impacts on the bait species. This factor will be explored further in future iterations of this assessment when monitoring and bycatch reduction efforts are more mature (it is considered in factor 3.2, bycatch management, of this assessment because bait choice can affect the mortality of turtles).

Trolls

Trolling is conducted almost exclusively by the United States and Canada (a small volume, < 6 MT in 2021, of tuna and large pelagics is also reportedly caught by troll in Chile, but this catch is not included in the present Seafood Watch assessment) (IATTC CatchByFlagGear 2022). The U.S. and Canadian fishery uses jigs and operates through treaty agreements, where U.S. vessels are permitted to fish in Canadian waters and vice versa. Virtually the entire catch is of albacore (IATTC CatchByFlagGear 2022; PacFIN 2023). There is no current observer program in the fishery (PFMC 2023). In the United States (the "surface hook-and-line fishery targeting albacore tuna fishery"), limited observer data from the 1990s and 2006 suggest that discards are minimal and of small albacore. Other tunas and billfish are caught in small quantities and are generally retained and sold (PFMC 2023). The U.S. troll-caught albacore rating in this assessment also includes albacore caught in the Northwest Pacific Ocean, which makes up a much smaller percentage of overall U.S. troll-caught North Pacific albacore. In Canada (the "Pacific Albacore Tuna fishery"), the fishery operates in the Canadian EEZ, in the U.S. EEZ, and on the high seas in the EPO (DFO 2019). This fishery may occasionally extend to the Northwestern Pacific as well (e.g., 1 vessel of 112 total fished in the NWPO in 2021, but all vessels fished in the EPO in 2019, 2020, and 2022) (cite CA annual reports to ISC). There is no observer program in the fishery. The Integrated Fishery Management Plan for the fishery notes that harvesters have reported minimal bycatch and little to no impact to marine mammals and seabirds. Although improved monitoring would help verify these claims in both fisheries, trolling is generally considered to be highly selective and to have minimal impacts on bycatch species (Pérez Roda et al 2019; DFO 2019).

Other gears

In the EPO, harpoons are used to catch swordfish off the U.S. West Coast and in Chilean waters, though landings are negligible compared to total landings (no more than 10 MT a year from either fishery) (IATTC CatchByFlagGear 2022) (PacFIN 2023). Harpoon fisheries are

highly selective, so discards and unwanted incidental catch are likely minimal. The U.S. fishery targets and lands swordfish almost exclusively (90 MT and 0.36 MT of swordfish and shortfin mako shark, respectively, in 2021) (PacFIN 2023), and while there are anecdotal reports of using blue shark as "target practice," the population impacts are likely nil (PFMC 2023). In Chile, marlin may also be caught and landed in small volumes (IATTC CatchByFlagGear 2022). Seafood Watch does not have an assessment for the harpoon fishery.

Large-scale drift gillnetting is banned from the high seas. In the EPO, recorded volumes of the gillnet catch of tunas and other large pelagics are dominated by Chile, with a smaller volume landed in California. These fisheries are assessed in separate Seafood Watch assessments. A new fishery for swordfish using deep-set buoy gear has recently developed off California. This fishery is assessed in a separate Seafood Watch assessment. Recorded handline and pole-and-line landings of tuna and large pelagics in the EPO are minimal (IATTC CatchByFlagGear 2022) and are largely not covered in Seafood Watch assessments; however, one handline fishery for Pacific bluefin tuna is covered in a separate SFW assessment. Also, small-scale coastal fisheries are important to many of the flag states fishing in the areas covered under this assessment, but these fisheries are not assessed here.

Determining which species to include in the assessment of each fishery

As noted, the Criterion 2 score for the rated stock is the lowest score of all the other "main species" caught with it (including both target and nontarget, retained, and discarded species), multiplied by the discard + bait use rate. A species is a main species if it meets any of the following conditions ("catch" here includes landings plus discards):

- A common component of the catch (as guidance, > 5% of the catch in most cases), or
- Overfished, endangered, threatened, undergoing overfishing, or otherwise a species of concern, where catch occurs regularly and may significantly contribute to the conservation concern (i.e., more than a negligible and/or sporadic level of catch). As guidance, the mortality of the species caused by this fishery is > 5% of a sustainable level, or
- The fishery under assessment is one of the main sources of fishing mortality for the species, including bait species if known (as guidance, ≈20% or more of total fishing mortality), and
- In fisheries that use bait, the bait species should be treated as a bycatch species if it meets the preceding main species criteria. If the species used as bait are unknown but together account for > 5% of the catch and no other main species have been identified, then add "unknown finfish" with abundance and fishing mortality both scored a "moderate concern."

In Tables 33–36, values > 5% are highlighted in blue, and other main species are highlighted in orange.

Tunas and billfishes

Table 33: Estimated commercial landings of tunas and billfish by gear in 2021 (IATTC CatchByFlagGear 2022; IATTC PublicPSTuna 2023). Purse seine tuna catch is all vessels (Table A-7 in {IATTC 2022a}); purse seine billfish catch is Class 6 vessels only (Table A-2b). Discards of tuna and billfish appear negligible (based on Class 6 purse seine vessels only (Tables A-2a, A-2b). Landings of Pacific bluefin are dominated by unassociated sets from Mexican purse seines, with a far smaller volume from U.S. purse seines; these two fisheries are separated from the broader unassociated purse seine fishery in this assessment. Most of the Mexican catch is transported live to grow-out pens near the coast of Mexico (IATTC 2022c). "Other" gears include gillnet, troll, and pole and line. The "Other" gear for swordfish is 95% or more gillnet (virtually all from Chile), and that for albacore is 95% or more troll (all from the United States and Canada) (*data source 1). Pole-and-line catch is quite a low volume, and confidential (Table A-2a). Recreational catch is excluded (the U.S. reported 253 MT and 1,161 MT of recreational catch of albacore and Pacific bluefin, respectively, in 2021).

	Purse seine (Dolphin)	Purse seine (FAD)	Purse seine (Unassociated)	Longline	Other or unknown gears
Tunas					
Skipjack	2,735	240,177	102,524	225	2
Yellowfin	159,040	66,871	28,759	9,458	82
Bigeye		42,599	575	21,621	1
Albacore				31,407	6,693 (6,610 troll)
Bonitos		10	6,735		
Black skipjack	1	1,480	2,994		3
Pacific bluefin			3,069 (3,026 Mexico, 43 United States)	115 (LL + LLX)	58 (55 gillnet)

Unidentified tunas				26	
Billfish					
Swordfish	2			17,606	4,852 (4,779 gillnet)
Blue marlin	116			1,614	
Striped marlin	12			1,335	
Shortbill spearfish				130	
Indo-Pacific sailfish				595	
Black marlin	38			281	
Unidentified billfishes	72			77	9

Sharks and large fish

Table 34: Estimated observed catch of sharks and large fishes (MT) in the Eastern Pacific Ocean by the large (Class 6) purse seine fishery in 2021, and *minimum* catch of these taxa in longline fisheries in 2021 (based on limited observer coverage; see *Longlines* text) (Tables J-4a and J-6a in (IATTC 2023a)).

	Purse seine (Dolphin)	Purse seine (FAD)	Purse seine (Unassociated)	Longline (Minimum)
Sharks				
Blue	1	1	1	11,491
Silky	21	542	10	5,788
Mako		2	1	2,371

Houndsharks not elsewhere included (NEI)				345
Requiem sharks NEI	1	30	1	1,453
Other sharks	1	5	1	770
Bigeye thresher	1	1	1	431
Hammerheads NEI	1	7		513
Thresher	1	1	1	249
Smooth hammerhead	1	12	1	337
Pelagic thresher	1	1	1	262
Mackerel sharks, porbeagle shark				37
Scalloped hammerhead	1	31	1	28
Thresher shark NEI	1	1	1	13
Oceanic whitetip	1	12	1	
Great hammerhead	1	2		
Large fish				
Dorado	1	2,183	13	1,961
Opahs				624
Snake mackerel NEI				301
Unidentified fishes		1	1	629
Wahoo	1	132	1	284

Pomfrets NEI				67
Other large fishes		1	1	80
Amberjacks NEI		81	3	1
Rainbow runner	1	28	1	
Jacks, crevalles NEI		3	1	
Molas NEI	1	1	2	
Amberjacks, jacks, crevalles NEI		2	1	
Tripletail		1	1	
Barracudas		1	1	

In Criterion 2, sharks that have up-to-date stock assessments (and thus a calculated sustainable level of fishing mortality) are separated out individually, while other sharks are lumped into a general "Sharks" category, alongside sharks that were not identified to the species level in IATTC data ("various sharks," "thresher sharks," "mako sharks," "hammerhead sharks," etc.).

Rays and small fish

Table 35: Estimated observed catch of rays and small fishes (MT) in the Eastern Pacific Ocean by the large (Class 6) purse-seine fishery in 2021 (Tables J-5a and J-7a in (IATTC 2023a)). Rays were also observed interacting with longline fisheries in 2021, but these data are presented in number of individuals interacted with rather than in MT caught. These consisted of 3,909, 45, and 4 interactions with pelagic stingrays, unspecified stingrays, and unspecified manta rays, respectively (Table J-5b). The majority (3,708) of the interactions were assumed to lead to death. No catch in terms of MT was presented. No significant volumes of small fishes were observed caught in the longline fishery (Table J-7).

	Purse seine (Dolphin)	**Purse seine (FAD)**	**Purse seine (Unassociated)**

Rays			
Pelagic stingray	117	388	178
Mobulid rays NEI	154	85	73
Spinetail manta	16	34	46
Smoothtail manta		8	
Stingray NEI	14	46	3
Munk's devil ray		10	5
Other rays			25
Chilean devil ray	13	11	3
Giant manta		1	26
Small fish			
Bullet and frigate tunas		423	18
Triggerfishes and filefishes		50	1
Epipelagic forage fishes		15	
Sea chubs	1	6	
Other small fishes	1	1	1
Carangids NEI		1	1

Dolphins, turtles, and seabirds

Table 36: Estimated number of incidental dolphin mortalities, turtle interactions, and seabird interactions in the Eastern Pacific Ocean by the purse seine fishery in 2021, and the *minimum* number of mortalities of these taxa in longline fisheries in 2021 (based on limited observer coverage; see the *Longlines* text) (Tables J-1a, J-1b, J-2a, J-2b, and J3 in (IATTC 2023a)). Virtually all turtles caught in the purse seine fishery were released alive (six were released dead). Marine mammal interactions

observed in the longline fleet were with bottlenose dolphin, false killer whale, pygmy killer whale, and unspecified spinner dolphin, dolphins, and cetacea. All mammals, turtles, and seabird interactions in longlines were assumed to lead to death (no seabirds were recorded caught in the purse seine fleet) (IATTC 2023a).

	Purse seine (Dolphin)	Purse seine (FAD)	Purse seine (Unassociated)	Longline (2021 Minimum)
Dolphins (mortalities, number of dolphins)				
Eastern spinner	194			
Western-southern spotted	173			
Whitebelly spinner	172			
Northeastern spotted	166			
Northern common	3			
Other dolphins	6			
Central common	6			
Southern common	5			
All mammal species				11
Turtles [number of interactions (number of mortalities at release)]				
Olive ridley	54 (1)	191 (1)	2 (0)	5

Unidentified turtles	53 (0)	102 (0)	5 (0)	
Eastern Pacific green	3 (0)	32 (0)	17 (0)	
Loggerhead	11 (0)	13 (0)	5 (0)	3
Hawksbill		4 (0)	1 (0)	
Leatherback		1 (0)		
Seabirds (interactions, number of individuals)				
White-chinned petrel				63
Wandering albatross				58
Black-browed albatross				53
Laysan albatross				45
Black-footed albatross				44
Cape petrel				27
Albatross NEI				25
Boobies and gannets NEI				16
White-capped albatross				3
Terns NEI				3
Great shearwater				2
Petrels or shearwaters NEI				1

A recently conducted pilot study points to concerns around dolphin calf-cow separation during dolphin-set purse seine operations, with an additional main study underway (Pearson et al. 2024). But the pilot study was not able to point to population-level impacts stemming from calf-cow separation in the studied stocks (spotted and spinner dolphins), thus no additional dolphin mortalities were added to dolphin-set purse seines based on this work.

Criterion 2 Assessment

Scoring Guidelines

Factor 2.1 - Abundance

(same as Factor 1.1 above)

Factor 2.2 - Fishing Mortality

(same as Factor 1.2 above)

Factor 2.3 - Modifying Factor: Discards and Bait Use

Goal: Fishery optimizes the utilization of marine and freshwater resources by minimizing post-harvest loss. For fisheries that use bait, bait is used efficiently.

Scoring Guidelines: The discard rate is the sum of all dead discards (i.e. non-retained catch) plus bait use divided by the total retained catch.

Ratio of bait + discards/landings	**Factor 2.3 score**
<100%	1
>=100	0.75

Black marlin *(Istiompax indica)*

2.1 Abundance

Eastern Central Pacific, Northeast Pacific - Drifting longlines

Eastern Central Pacific, Southeast Pacific - Drifting longlines

High Concern

No assessment for black marlin has been conducted in the Pacific Ocean. The International Union for Conservation of Nature (IUCN) has classified this species as "Data Deficient" with an unknown population trend (Collette et al 2022d) . Black marlin have a high vulnerability to fishing (PSA=3.21, see detailed section below). We have awarded a score of 1 (high concern) because abundance is unknown and they have a high vulnerability to fishing.

Supplementary Information

PSA for black marlin in the Pacific (see Seafood Watch Fisheries Standard Version 4 for methodology details).

Table 12

Productivity Attribute	High productivity (score=1)	Medium productivity (score = 2)	Low productivity (Score=3)	Score	Value; {Reference(s)}
Average age at maturity (yrs)	< 5	5-15	>15	1	2 years (females); 4-5 years (males) (Sun et al. 2015b)
Von Bertalanffy (Brody) Growth Coefficient (K)	>0.25	0.15-0.25	<0.15	1	0.47 (Froese and Pauly 2020)
Fecundity (eggs/yr)	>20,000	100-20,000	<100	1	11,000,000 (Sun et al. 2015b)

Average maximum size (cm)	< 100	100-300	>300	3	400 cm (Sun et al. 2015a)
Average size at maturity (cm)	<40	40-200	>200	3	209 cm (Sun et al. 2015b)
Reproductive strategy	Broadcast spawner	Demersal egg layer or brooder	Live bearer	1	Broadcast spawner
Productivity score (mean of attribute scores)				1.57	

Table 13

Susceptibility Attribute (default scores in bold)	**Low S (score = 1)**	**Medium S (score = 2)**	**High S (score = 3)**	**Score**	**Value/notes; (reference)**
Areal overlap (all fisheries)	>90% of species concentration is unfished	70%-90% of species concentration is unfished	**>30% of the species concentration is fished**	3	Default (bolded) scores selected
Vertical overlap (all fisheries)	>67% of species' depth range is unfished	33-66% of species' depth range is unfished	**>33% of species' depth range is unfished**	3	
Seasonal Availability (all fisheries)	Fisheries overlap with species <3 months/year	Fisheries overlap with species 3-6 months/year	**Fisheries overlap with species >6 months/year**	3	

Selectivity of fishery (specific to fishery under assessment)	Species is not targeted AND is not likely to be captured by gear	**Species is targeted, or is incidentally encountered AND is not likely to escape the gear**	Species is targeted or is incidentally encountered AND combination of fishery attributes and species' biology increase its susceptibility to the gear	2	
Post-capture mortality (specific to fishery under assessment)	>66% individuals survive post-capture	33-66% individuals survive post-capture	**Retained species, or >66% do not survive post capture**	3	
Susceptibility score (mean of attribute scores)				**2.8**	

Table 14

Productivity-Susceptibility Score ($V=v(P^2+S^2)$)	**3.21**
Vulnerability Rating: < 2.64 = Low vulnerability >=2.64 and <=3.18 = Medium vulnerability >3.18 = High vulnerability	High

2.2 Fishing Mortality

Eastern Central Pacific, Northeast Pacific - Drifting longlines

Eastern Central Pacific, Southeast Pacific - Drifting longlines

Moderate Concern

There are no reference points or stock assessments for black marlin in the Pacific. Because fishing mortality relative to a sustainable level is unknown, fishing mortality is considered a “moderate concern” (per line 2.3 in table 1.2.1 of the Seafood Watch Standard).

Black skipjack *(Euthynnus lineatus)*

2.1 Abundance

Eastern Central Pacific - Floating object purse seine (FAD)

Eastern Central Pacific - Unassociated purse seine (non-FAD)

Moderate Concern

Black skipjack has not been assessed in the Pacific Ocean. The IUCN Red List last assessed the species in 2022, resulting in a "Least Concern" status {Collette et al. 2023}. Based on this IUCN status that is < 10 years old, abundance is considered a "moderate concern" (per line 3.3 in table 1.1.1 of the Seafood Watch Standard).

2.2 Fishing Mortality

Eastern Central Pacific - Floating object purse seine (FAD)

Eastern Central Pacific - Unassociated purse seine (non-FAD)

Moderate Concern

There are no reference points or stock assessments for black skipjack in the Pacific. Because fishing mortality relative to a sustainable level is unknown, fishing mortality is considered a "moderate concern" (per line 2.3 in table 1.2.1 of the Seafood Watch Standard).

Black-footed albatross *(Phoebastria nigripes)*

2.1 Abundance

Eastern Central Pacific, Northeast Pacific - Drifting longlines

Eastern Central Pacific, Southeast Pacific - Drifting longlines

High Concern

According to the IUCN, black-footed albatross is classified as "Near Threatened" with a stable or increasing population trend (BirdLife International 2020). The previous assessments classified this species as "Endangered" and "Vulnerable," but recent data suggest that rapid population declines are no longer occurring (ibid). Although populations may have stabilized, they remain at depleted levels relative to historic populations. Based on the depleted population abundance and IUCN "Near Threatened" status, abundance is considered a "high concern" (per line 4.1 in table 1.1.1 of the Seafood Watch Standard).

2.2 Fishing Mortality

Eastern Central Pacific, Northeast Pacific - Drifting longlines

Eastern Central Pacific, Southeast Pacific - Drifting longlines

Moderate Concern

Black-footed albatross has been identified as a species of concern for longline fisheries operating in the Eastern Pacific Ocean (EPO) (IATTC 2006). It is estimated that 36% of its distribution during the breeding season occurs within the convention area of the Inter-American Tropical Tuna Commission (Anderson 2009). Low observer coverage makes it difficult to estimate seabird mortality in longline fisheries; however, albatross species are among the most susceptible to incidental longline capture (Anderson 2009b). It has been estimated that more than 4,000 birds (all species combined) are killed within IATTC waters per year (Anderson 2009b). The potential biological removal (PBR) for this species has been estimated at 11,980 birds annually, but the full estimate of black-footed albatross mortality in EPO longlines is not known (Arata et al. 2009). Because mortality is unknown in this fishery, fishing mortality is considered a "moderate concern" (per line 2.3 in table 1.2.1 of the Seafood Watch Standard).

Blue marlin *(Makaira nigricans)*

2.1 Abundance

Eastern Central Pacific, Northeast Pacific - Drifting longlines

Eastern Central Pacific, Southeast Pacific - Drifting longlines

Low Concern

Blue marlin is assessed as a single stock in the Pacific. The latest stock assessment was completed in 2021 using data through 2019, and found a SSB/SSB_{MSY} ratio of 1.17 (ISC 2021). Based on a stock assessment using data > 5 but < 10 years old with a finding that $SSB > SSB_{MSY}$, abundance is considered a "low concern" (per line 2.1.b in table 1.1.1 of the Seafood Watch Standard).

2.2 Fishing Mortality

Eastern Central Pacific, Northeast Pacific - Drifting longlines

Eastern Central Pacific, Southeast Pacific - Drifting longlines

Low Concern

Blue marlin is frequently caught and retained in the EPO longline fishery (IATTC 2017b), although data are limited. Results from the base case assessment model indicate that the Pacific blue marlin stock is currently not experiencing overfishing. The current fishing mortality on the stock (average F, ages 1–10) was above F_{MSY} levels from 2003 to 2006 but has been well below F_{MSY} since 2017. Current fishing mortality rates (average ages 1–10, 2017–19) are 40% below F_{MSY}. Although data are limited due to low observer coverage, the best available information suggests that blue marlin fishing mortality is below a sustainable level; therefore, fishing mortality is considered a "low concern" (per line 1.1 in table 1.2.1 of the Seafood Watch Standard).

Blue shark *(Prionace glauca)*

2.1 Abundance

North Pacific Stock | Eastern Central Pacific, Northeast Pacific - Drifting longlines

Very Low Concern

Blue shark is assessed as a single stock in the North Pacific. The most recent assessment was conducted in 2022 using data through 2020, and found female spawning biomass to be above the MSY level ($SSB_{current}/SSB_{MSY}$ = 1.17) (ISC 2022). Based on a stock assessment using data < 5 years old with a finding that SSB > SSB_{MSY}, abundance is considered a "very low concern" (per line 1.1 in table 1.2.1 of the Seafood Watch Standard).

2.2 Fishing Mortality

North Pacific Stock | Eastern Central Pacific, Northeast Pacific - Drifting longlines

Low Concern

The 2022 stock assessment of North Pacific blue shark found that fishing mortality is below the MSY level ($F_{2017–19}/F_{MSY}$ = 0.445) (ISC 2022). Based on a stock assessment using data < 10 years old with a finding that fishing mortality is around fishing mortality at MSY, fishing mortality is considered a "low concern" (per line 1.1 in table 1.2.1 of the Seafood Watch Standard).

Supplementary Information

Blue shark is widely distributed throughout the North Pacific and dominates shark catches in that region. The primary source of known blue shark fishing mortality is oceanic longline fisheries targeting swordfish and tuna, including mostly shallow-set longline fisheries in temperate waters and deep-set longline fisheries in more tropical areas. Sharks are targeted less often than tunas and swordfish, although new Asian shark markets have been developing for over a decade (Clarke et al. 2014; ISC 2017b}.

Bonitos *(Sarda spp)*

2.1 Abundance

Eastern Central Pacific - Unassociated purse seine (non-FAD)

Moderate Concern

No bonito (*Sarda s*pp.) stock has been assessed in the Eastern Pacific. Pacific bonito (*Sarda chiliensis*) was categorized as "Least Concern" by the IUCN in 2021 (Collette et al. 2023e). In lieu of better information, the IUCN listing (which is < 10 years old) for this specific bonito species indicates that abundance is considered a "moderate concern" (per line 2.3 in table 1.1.1 of the Seafood Watch Standard).

2.2 Fishing Mortality

Eastern Central Pacific - Unassociated purse seine (non-FAD)

Moderate Concern

There are no reference points or stock assessments for bonito in the Pacific. Because fishing mortality relative to a sustainable level is unknown, fishing mortality is considered a "moderate concern" (per line 2.3 in table 1.2.1 of the Seafood Watch Standard).

Bullet tuna *(Auxis rochei)*

2.1 Abundance

Eastern Central Pacific - Floating object purse seine (FAD)

Moderate Concern

There are no stock assessments for bullet tuna in the Eastern Pacific. The IUCN Red List assessed the species in 2022, resulting in a "Least Concern" listing (Collette et al. 2023b). Based on an IUCN listing that is < 10 years old, abundance is considered a "moderate concern" (per line 3.3 in table 1.1.1 of the Seafood Watch Standard).

2.2 Fishing Mortality

Eastern Central Pacific - Floating object purse seine (FAD)

Moderate Concern

There are no reference points or stock assessments for bullet tuna in the Pacific. Because fishing mortality relative to a sustainable level is unknown, fishing mortality is considered a "moderate concern" (per line 2.3 in table 1.2.1 of the Seafood Watch Standard).

East Pacific green sea turtle *(Chelonia mydas agassizi)*

2.1 Abundance

Eastern Central Pacific, Northeast Pacific - Drifting longlines

Eastern Central Pacific, Southeast Pacific - Drifting longlines

High Concern

The IUCN has classified the East Pacific subpopulation of green sea turtles as “Vulnerable” with an increasing population trend (Seminoff 2023). Based on the IUCN listing that is < 10 years old, abundance is considered a “high concern” (per line 4.1 in table 1.1.1 of the Seafood Watch Standard).

Supplementary Information

The IUCN has classified green sea turtles globally as “Endangered” with a decreasing population trend. Green sea turtles have been listed on the Convention on International Trade in Endangered Species (CITES) since 1975 and are currently listed on Appendix 1 because they are threatened with extinction, and international trade is prohibited. The mean annual number of nesting turtles worldwide has decreased between 48% and 67% over the past 100–150 years (Seminoff 2004). The United States has listed the central north Pacific distinct population segment (DPS) as “Endangered” under the Endangered Species Act (ESA), and the central Pacific DPS is listed as “Threatened” under the ESA.

2.2 Fishing Mortality

Eastern Central Pacific, Northeast Pacific - Drifting longlines

Eastern Central Pacific, Southeast Pacific - Drifting longlines

Moderate Concern

Data are extremely limited on sea turtle bycatch in the EPO longline fleets, largely because of a lack of sufficient observer coverage on longlines (IATTC 2023f). Fishing mortality is unknown for Eastern Pacific Ocean longline fisheries, so green sea turtle fishing mortality is considered a “moderate concern” (per line 2.3 in table 1.2.1 of the Seafood Watch Standard).

Supplementary Information

Green sea turtles are reported as incidentally captured in longline fisheries in the EPO but the impacts are considered unknown (IATTC 2018c). Although no interactions were reported in longlines in 2021, this is based on a maximum 5% observer coverage, and the IATTC is hoping to expand its knowledge of sea turtle interactions in longlines (IATTC 2023f). Recent information suggests that bycatch in the region has been reduced for this stock, but an issue remains, particularly in gillnets and longlines (Seminoff 2023).

False killer whale *(Pseudorca crassidens)*

2.1 Abundance

Eastern Central Pacific, Northeast Pacific - Drifting longlines

Eastern Central Pacific, Southeast Pacific - Drifting longlines

High Concern

False killer whale was listed as "Data Deficient" on the IUCN Red List in 2008, and the species remains data poor for most of its range. More recent information resulted in the updated rating of IUCN "Near Threatened" in 2018 {Baird 2019}. There are a number of different stocks globally, and abundance trends are unclear for most stocks. But the IUCN notes that there has been an estimated population decline of > 50% in two generations in the one population that has been quantitatively assessed, with the primary cause thought to be fishery interactions, and the Hawaiian Islands Insular Distinct Population Segment is ESA "Endangered." In light of the endangered status of some portions of the false killer whale population, the unknown stock status of pelagic false killer whales, and the IUCN "Near Threatened" status, abundance is considered a "high concern" (per line 4.1 in table 1.1.1 of the Seafood Watch Standard).

2.2 Fishing Mortality

Eastern Central Pacific, Northeast Pacific - Drifting longlines

Eastern Central Pacific, Southeast Pacific - Drifting longlines

Moderate Concern

Data on marine mammal takes and bycatch in EPO longline fisheries are limited. The United States is the only country that has 100% coverage on shallow sets and roughly 20% observer coverage on deep sets in the IATTC convention area (IATTC 2019f). Thus, fishing mortality is largely unknown and unreported, but the 2018 United States Annual Observer Program Report did confirm three "catches" of false killer whale in the U.S. deep-set fishery in 2018 (IATTC 2019i). But this deep-set fishery is assessed in a separate Seafood Watch report, and cumulative and EPO longline fishing mortality of false killer whale

remains largely unknown; therefore, fishing mortality is considered a “moderate concern” (per line 2.3 in table 1.2.1 of the Seafood Watch Standard).

Supplementary Information

The overlap of false killer whale diet with species targeted by large-scale fisheries, in particular high-value species such as tunas and billfishes, results in a number of types of interactions that can reduce local populations, although the sparseness of observer coverage in most hook-and-line and other fisheries limits data availability (Baird 2018). One study did estimate the incidental catch rate (including animals hooked but released alive) from 1992 to 2005 from observers in the Spanish longline fleet to be 1.464, 1.685, and 0.797 individuals per million hooks for the Atlantic, Indian, and Pacific Oceans, respectively (Ramos-Cartelle & Mejuto 2008). Although overall mortality is unknown, available information suggests that the EPO longline fishery is likely to interact with false killer whale; however, the impacts of fishing on the population are unknown due to data limitations.

Frigate tuna *(Auxis thazard)*

2.1 Abundance

Eastern Central Pacific - Floating object purse seine (FAD)

Moderate Concern

There are no stock assessments for frigate tuna in the Eastern Pacific. The IUCN Red List assessed the species in 2022, resulting in a “Least Concern” finding (Collette et al. 2023c). Based on this IUCN listing that is < 10 years old, abundance is considered a “moderate concern" (per line 3.3 in table 1.1.1 of the Seafood Watch Standard).

2.2 Fishing Mortality

Eastern Central Pacific - Floating object purse seine (FAD)

Moderate Concern

There are no reference points or stock assessments for frigate tuna in the Pacific. Because fishing mortality relative to a sustainable level is unknown, fishing mortality is considered a “moderate concern” (per line 2.3 in table 1.2.1 of the Seafood Watch Standard).

Hawksbill turtle *(Eretmochelys imbricata)*

2.1 Abundance

Eastern Central Pacific, Northeast Pacific - Drifting longlines

Eastern Central Pacific, Southeast Pacific - Drifting longlines

High Concern

The IUCN has classified hawksbill turtle as “Critically Endangered” with a decreasing population trend (Mortimer and Donnelly 2008). The North Central, West Central, and West Pacific hawksbill Regional Management Units (RMUs) were previously found to be at a high risk of population decline with high threats, but a more recent, similar examination of the vulnerability of these RMUs has not been conducted (Wallace et al. 2011; Wallace et al. 2013). Hawksbill turtle has been listed on CITES since 1977 and is currently listed on CITES Appendix 1, meaning that it is threatened with extinction, and international trade is prohibited. Hawksbill sea turtle is listed as “Endangered” under the ESA throughout the species’ range (NOAA 2017). Based on the IUCN and ESA listings, abundance is considered a “high concern” (per line 4.1 in table 1.1.1 of the Seafood Watch Standard).

2.2 Fishing Mortality

Eastern Central Pacific, Northeast Pacific - Drifting longlines

Eastern Central Pacific, Southeast Pacific - Drifting longlines

Moderate Concern

Data are extremely limited on sea turtle bycatch in the EPO longline fleets, largely because of a lack of sufficient observer coverage on longlines (IATTC 2023f). Because fishing mortality is unknown for EPO longline fisheries, fishing mortality is considered a “moderate concern” (per line 2.3 in table 1.2.1 of the Seafood Watch Standard).

Laysan albatross *(Phoebastria immutabilis)*

2.1 Abundance

Eastern Central Pacific, Northeast Pacific - Drifting longlines

Eastern Central Pacific, Southeast Pacific - Drifting longlines

High Concern

Laysan albatross is listed by the IUCN as “Near Threatened” with a stable population trend. Globally, there are estimated to be over 1.6 million mature birds (Birdlife International 2019). This species declined significantly in the late 1990s and early 2000s, and has stabilized since then. But given the difficulty of predicting long-term trends for such a long-lived species in light of changing oceanic conditions, the species is projected to undergo a moderately rapid population decline over three generations (84 years) (Birdlife International 2019). Based on the IUCN status that is < 10 years old, abundance

for Laysan albatross is considered a “high concern” (per line 4.1 in table 1.1.1 of the Seafood Watch Standard).

2.2 Fishing Mortality

Eastern Central Pacific, Northeast Pacific - Drifting longlines

Eastern Central Pacific, Southeast Pacific - Drifting longlines

Moderate Concern

Laysan albatross has a 5% distributional overlap with the IATTC area in the Eastern Pacific Ocean {Anderson 2009a}, but has been reported as one of the most commonly caught species in some longline fisheries operating in these waters (IATTC 2006). Estimates of seabird mortality in longlines operating within the EPO are highly uncertain due to low observer coverage (Anderson 2009b). It has been estimated that at least 4,000 birds (all species combined) are killed within IATTC waters per year (Anderson 2009b). The PBR for the global stock in 2005 was estimated at ≈32,000 to 35,000 birds annually, but IATTC longlines’ true contribution to this estimate is unknown (Bakker et al. 2018). The impact of fishing mortality in this fishery on Laysan albatross specifically is unknown, so fishing mortality is considered a “moderate concern” (per line 2.3 in table 1.2.1 of the Seafood Watch Standard).

Leatherback turtle *(Dermochelys coriacea)*

2.1 Abundance

Eastern Central Pacific, Northeast Pacific - Drifting longlines

Eastern Central Pacific, Southeast Pacific - Drifting longlines

High Concern

Leatherback sea turtle has been listed as “Endangered” under the ESA since 1970 {NMFS 2012}, and the Eastern Pacific Ocean subpopulation is listed by the IUCN as “Critically Endangered” with a decreasing population trend (Wallace et al. 2013b). Leatherback turtle has been listed on CITES since 1975 and is currently listed on Appendix 1 because it is threatened with extinction, and international trade is prohibited. Over the past 25 years, the population of leatherback turtle in the Pacific Ocean has decreased by 97% (NOAA 2016). Based on the ESA, IUCN, and CITES listings, abundance is considered a “high concern” (per line 4.1 in table 1.1.1 of the Seafood Watch Standard).

2.2 Fishing Mortality

Eastern Central Pacific, Northeast Pacific - Drifting longlines

Eastern Central Pacific, Southeast Pacific - Drifting longlines

High Concern

The population of leatherback turtle in the EPO continues to decline for several reasons, including incidental capture in commercial fisheries and nesting habitat destruction (NOAA 2016). A 2020 data-limited ecological risk assessment suggests that the stock is highly vulnerable, with a proxy fishing mortality reference point being exceeded in > 50% of scenarios modeled during the process (Griffiths et al. 2020). Though the authors stress that this assessment should not be used to replace an official stock assessment, its results suggest that fishing mortality is above a sustainable level. Based on this assessment, fishing mortality is considered a "high concern" (per line 3.1 in table 1.2.1 of the Seafood Watch Standard).

Loggerhead turtle *(Caretta caretta)*

2.1 Abundance

Eastern Central Pacific, Northeast Pacific - Drifting longlines

Eastern Central Pacific, Southeast Pacific - Drifting longlines

High Concern

The IUCN classified loggerhead turtle in the North Pacific Regional Management Unit (RMU) as "Least Concern" with an increasing population trend (Casale & Tucker 2017), and loggerhead in the South Pacific RMU as "Critically Endangered" with a decreasing population trend. Loggerhead is listed on Appendix 1 of CITES. In the North Pacific Ocean, loggerhead has been listed as "Endangered" on the ESA since 1978 {FR 2011}. Based on the ESA and CITES listings, abundance is considered a "high concern" (per line 4.1 in table 1.1.1 of the Seafood Watch Standard).

Supplementary Information

Data are limited on population trends in the Pacific; however, available long-term series of nest counts (used as an index of population abundance) suggest recent population-level decreases (47%) and regionally significant declines (especially in the South Pacific population) (Casale & Tucker 2017).

2.2 Fishing Mortality

Eastern Central Pacific, Northeast Pacific - Drifting longlines

Eastern Central Pacific, Southeast Pacific - Drifting longlines

Moderate Concern

The incidental capture of loggerhead turtle is considered a primary threat to its

populations {Casale and Tucker 2017; Clarke et al. 2014). The populations in the eastern and southern Pacific continue to decline, and incidental capture in longline fisheries is a contributing factor to this decline (NMFS 2017). But these data are somewhat outdated, and current fishing mortality is unknown, so fishing mortality is considered a "moderate concern" (per line 2.3 in table 1.2.1 of the Seafood Watch Standard).

Manta rays and devil rays *(Mobula spp.)*

2.1 Abundance

Eastern Central Pacific - Dolphin set purse seine

Eastern Central Pacific - Floating object purse seine (FAD)

Eastern Central Pacific - Unassociated purse seine (non-FAD)

High Concern

Manta rays (species) are data deficient and tend to exhibit K-selected life history traits including slow growth and low fecundity (IATTC 2019e). Manta rays in general are of concern because stock structure data are unknown and local impacts of fishing may be significant (IATTC 2019d). Stock status indicators based on observed large purse seine vessel catches show no apparent trends (see Justification and (IATTC 2023a)). All *Mobula* spp. that IUCN has assessed are "Endangered" or "Vulnerable" (https://www.iucnredlist.org/). Based on IUCN listings that are < 10 years old, abundance for manta rays (species) is considered a "high concern" (per line 4.1 in table 1.1.1 of the Seafood Watch Standard).

Supplementary Information

The population sizes and status of giant manta ray for individual areas is typically unknown, but it is thought that subpopulations are small in size. Although widely distributed throughout the oceans, the populations are considered fragmented and highly dispersed. Subsequently, regional depletions are more likely for manta rays, and it is highly likely that population declines have occurred in areas that are fished. It is suspected that the overall global population of giant manta ray has declined by 30% over the past 75 years (Marshall et al. 2011).

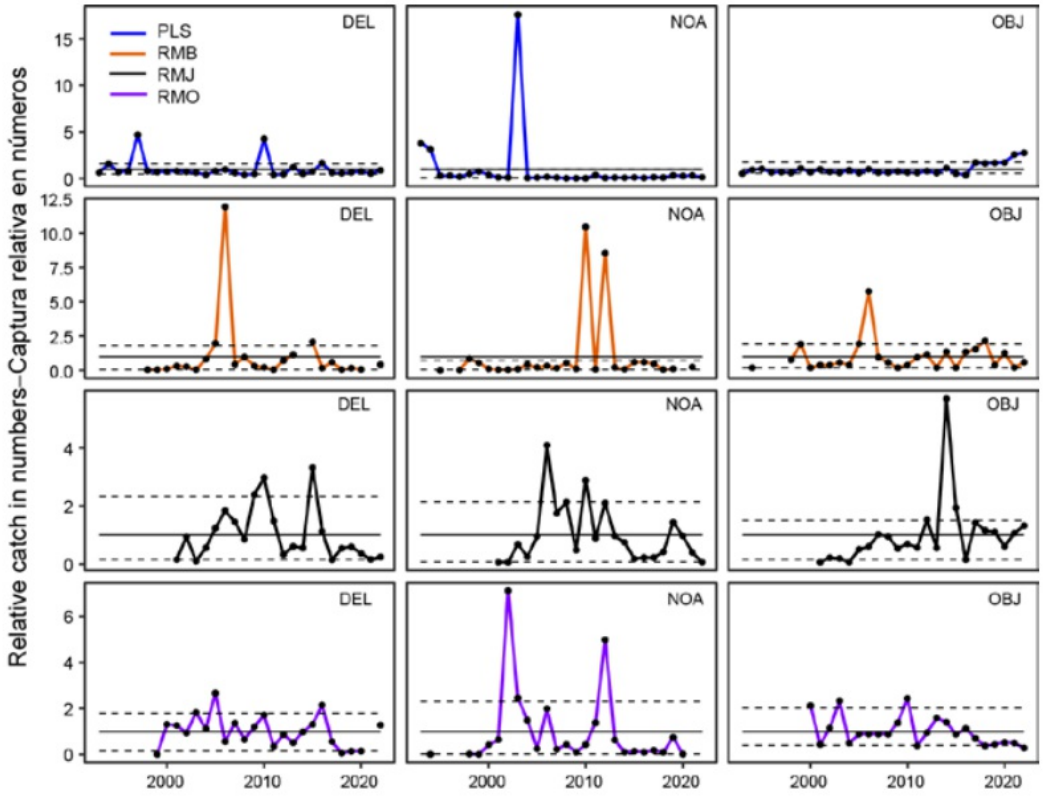

Figure 19: Indicators of relative number of individuals of rays reported by observers onboard large purse-seine vessels (Class 6, carrying capacity > 363 t) by set type: dolphins (DEL), unassociated tuna schools (NOA), and floating object (OBJ). The solid line is the average equal to 1 and the dashed 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*). Chart and text from (IATTC 2023a).

A recent draft management strategy evaluation explored spinetail devil ray vulnerability status using a new, spatially explicit, ecological risk assessment (ERA) approach called the Ecological Assessment for the Sustainable Impacts of Fisheries (EASI-Fish) {Griffiths et al. 2019}. The "status quo" and other explored management scenarios revealed that the SSB_{2016} was well below the precautionary biological reference point ($SSB/SSB_{40\%} = 0.15$), rendering stock status a conservation concern (Griffiths et al 2019). Another application of EASI-Fish found that, in 2016, spinetail mobula (*Mobula japanica*) in the EPO had a biomass below a reference point that is appropriate for elasmobranch species, though this estimate was > 75% of that reference point ($SSB/SSB_{40\%} = 0.91$) (Griffiths et al 2019a). But the less healthy stock status of other mobulids limits this score.

Table 15: IUCN status, EASI-Fish outcomes, and CITES status of mobulids observed caught (in number of species) in purse seines in the EPO.

Species	Scientific Name	$F/F_{40\%}$	$SSB/SSB_{40\%}$	IUCN Category	CITES	Purse seine (Dolphin)	Purse seine (FAD)	Purse seine (Unassociated)
Mobulid rays NEI	*Mobulidae* spp.					161	78	208
Spinetail manta/ Spinetail devil ray	*Mobula mobular*	3.34	0.15	EN (2022)	II	38	29	109
Smoothtail manta/ Bentfin devil ray	*Mobula thurstoni*			EN (2022)	II	12	8	109
Munk's devil ray	*Mobula munkiana*			VU (2022)	II	28	7	5
Chilean devil ray/Sicklefin devil ray	*Mobula tarapacana*			EN (2022)	II	13	13	4
Giant manta/ Oceanic manta ray	*Mobula birostris*			EN (2022)	II	2	3	19

2.2 Fishing Mortality

Eastern Central Pacific - Dolphin set purse seine

Eastern Central Pacific - Floating object purse seine (FAD)

Eastern Central Pacific - Unassociated purse seine (non-FAD)

Moderate Concern

There are no stock assessments or fishing mortality indicators for mobulids in the EPO. The EASI-Fish assessment for spinetail devil ray (*Mobula mobular*), which is the mobulid species most frequently observed caught in purse seines, suggests that catches were too high through 2016 (see Justification in factor 2.1 abundance) (Griffiths et al 2019). Since then, the IATTC has implemented a retention and transshipping ban on purse seine vessels, so a more recent, accurate estimate of fishing mortality for species within this group is unknown (Resolution C-15-04 2015) (see Criterion 3.2). Because fishing mortality relative to a sustainable level for individual species within this group is unknown, fishing mortality is considered a "moderate concern" (per line 2.3 in table 1.2.1 of the Seafood Watch Standard).

Olive Ridley turtle *(Lepidochelys olivacea)*

2.1 Abundance

Eastern Central Pacific, Northeast Pacific - Drifting longlines

Eastern Central Pacific, Southeast Pacific - Drifting longlines

High Concern

The IUCN considers olive ridley sea turtle to be "Vulnerable" globally with a decreasing population trend {Abreu-Grobis and Plotkin 2008}. Olive ridley turtle has been listed as "Threatened" on the ESA since 1978 {FR 1978}. The breeding population off the coast of Mexico is considered "Endangered" under the ESA, and all other populations in the region are considered "Threatened" under the ESA. Based on the IUCN and ESA listings, abundance is considered a "high concern" (per line 4.1 in table 1.1.1 of the Seafood Watch Standard).

2.2 Fishing Mortality

Eastern Central Pacific, Northeast Pacific - Drifting longlines

Eastern Central Pacific, Southeast Pacific - Drifting longlines

Moderate Concern

The incidental capture of olive ridley sea turtle occurs worldwide {Abreu-Grobois & Plotkin 2008}. Olive ridley turtle had the highest number of reported interactions with EPO longlines in 2021, but this is based on quite limited observer coverage (IATTC 2023f).

Overall estimates of olive ridley fishing mortality rates are unknown, so fishing mortality is considered a “moderate concern” (per line 2.3 in table 1.2.1 of the Seafood Watch Standard).

Opah *(Lampris guttatus)*

2.1 Abundance

Eastern Central Pacific, Northeast Pacific - Drifting longlines

Eastern Central Pacific, Southeast Pacific - Drifting longlines

Low Concern

There are no stock assessments for opah in the Pacific. The species is categorized as “Least Concern” by the IUCN (Smith-Vaniz et al 2015b), but that assessment is based on data that are over 10 years old and so cannot be used for scoring. A data-poor ecological risk assessment suggests that opah is not highly vulnerable to the fisheries in the EPO and has a healthy stock status ($SSB/SSB_{MSY} = 2.66$) {Griffiths et al. 2019a}. Based on a data-limited assessment < 10 years old indicating that the stock is above a sustainable level, abundance is considered a “low concern” (per line 2.2 in table 1.1.1 of the Seafood Watch Standard).

Supplementary Information

IATTC staff have conducted an ecological risk assessment for opah and other species in the EPO using a tool developed specifically to quantify the cumulative impacts of multiple fisheries for data-limited bycatch species (Griffiths et al 2019a). This Ecological Assessment of Sustainable Impacts of Fisheries, or EASI-Fish, tool comprises separate susceptibility and productivity components. The susceptibility component is used to approximate the instantaneous fishing mortality rate (F) that is compared to biological reference points used in the productivity component: specifically, length-structured yield and biomass per-recruit models (Griffiths et al 2019a). The authors estimate spawning stock biomass-per-recruit for the year 2016 at about 147% of that at a proxy for a sustainable level (i.e., $SBB_{2016}/SBB_{40\%} = 1.47$). The authors do stress that the study is not a stock assessment and so should not be used to determine overfished or overfishing status; nonetheless, the results suggest that the species is not particularly vulnerable to fishing impacts from the EPO fisheries.

2.2 Fishing Mortality

Eastern Central Pacific, Northeast Pacific - Drifting longlines

Eastern Central Pacific, Southeast Pacific - Drifting longlines

Low Concern

There are no reference points or stock assessments for opah in the Pacific. The EASI-Fish analysis suggests that fishing mortality is well below a sustainable level (F_{2016}/F_{MSY} = 0.32) (Griffiths et al 2019a), though the authors do stress that the approach should not be used by managers to determine an official overfishing status. Still, the results of an assessment < 10 years old indicated that it is likely that fishing mortality is below a sustainable level, therefore, fishing mortality is considered a "low concern" (per line 1.1 in table 1.2.1 of the Seafood Watch Standard).

Pantropical spotted dolphin *(Stenella attenuata)*

2.1 Abundance

Eastern Central Pacific - Dolphin set purse seine

Moderate Concern

No current data on population abundance are available because surveys conducted by the National Marine Fisheries Service ended in 2006, and the population status of pantropical spotted dolphin is considered ambiguous (Scott et al. 2016). The IUCN lists the pantropical spotted dolphin as a species of "Least Concern" (Kiszka and Braulik 2018), so abundance is considered a "moderate concern" (per line 3.3 in table 1.1.1 of the Seafood Watch Standard).

Supplementary Information

The abundance of pantropical spotted dolphin in 2010 was estimated to be 911,177 and 911,830 individuals for the northeastern and western/southern populations, respectively. Abundances have been fairly stable since the late 1970s, with slightly increasing trends for the eastern spinner and northeastern pantropical spotted dolphins over the past decade; however, the population rate of increase remains low (Scott et al. 2016). Abundances were the highest during the 1960s and have not returned to historic levels (IATTC 2009a; IATTC 2011e). Studies to resurvey eastern tropical Pacific dolphins have been designed and submitted, but not yet carried out {Oedekoven et al. 2021} (Oedekoven May 2023, pers comm).

2.2 Fishing Mortality

Eastern Central Pacific - Dolphin set purse seine

Moderate Concern

Total dolphin mortality in purse seine fisheries operating in the EPO has decreased significantly since peak levels occurred in the 1960s with dolphin-encircling sets (IATTC 2011e). Reductions in dolphin mortality are associated with the 1992 Agreement on the Conservation of Dolphins and the 1999 Agreement on the International Dolphin

Conservation Program (AIDCP). The goal of both agreements is to reduce dolphin mortalities in purse seine fisheries to levels approaching zero (IATTC 2013h). Mortality levels for all dolphins reduced from 132,000 documented mortality events in 1986 to 729 in 2021 (IATTC 2022d). The AIDCP also requires the establishment of a per-stock, per-year dolphin mortality cap, called a Stock Mortality Limit, or SML; if that cap is exceeded, then fishing on that stock must cease for the remainder of the year (IDCP 2002). Since 2001, the SML has been set at 0.1% of the minimum estimated abundance for each stock (IDCP 2002).

The estimated incidental take of northeastern spotted dolphin in 2021 was 167 individuals, or 18% of the most recent SML (911) (IATTC 2022d). For western spotted dolphin, the 2021 estimated incidental take was 174 individuals, or 19% of the SML (912). The average takes of these two species over a recent decade (2012–21) were 137 and 169 individuals, respectively (IATTC 2022d). These numbers suggest that the take is likely not contributing to any lack of recovery of the species. But the lack of recent estimates of abundance for these stocks (see factor 2.1 abundance), which the SML is based on, is a source of significant uncertainty. In addition, population-level research suggests that there may be significant stress effects and the potential for reduced reproductive output as a result of incidental capture and interactions with purse seine fisheries, which could be negatively affecting the ability of this species to recover (Cramer et al. 2008; Keller et al. 2013; Wade et al. 2007; Edwards 2007). Ultimately, fishing mortality relative to a sustainable level is unknown, so fishing mortality is considered a “moderate concern” (per line 2.3 in table 1.2.1 of the Seafood Watch Standard).

Pelagic stingray *(Pteroplatytrygon violacea)*

2.1 Abundance

Eastern Central Pacific - Dolphin set purse seine

Eastern Central Pacific, Northeast Pacific - Drifting longlines

Eastern Central Pacific, Southeast Pacific - Drifting longlines

Eastern Central Pacific - Floating object purse seine (FAD)

Eastern Central Pacific - Unassociated purse seine (non-FAD)

Moderate Concern

There are no stock assessments or status indicators for pelagic stingray in the Eastern Pacific Ocean. The species was recently categorized as “Least Concern” by the IUCN (Kyne et al 2019), and a data-poor ecological risk assessment (EASI-Fish, which the authors note should not be used to determine official overfishing/overfished stock status) indicates that the stock is below the MSY level and the $SSB_{40\%}$ level, both of which are commonly used reference points for large pelagic species (SSB/SSB_{MSY} = 0.75; $SSB/SSB_{40\%}$ = 0.69) (Griffiths et al 2019a). The authors also note that the $SSB_{40\%}$

reference point is more appropriate for elasmobranch species because it is more precautionary in nature (ibid). Though the data-limited assessment suggests that the stock is at 75% of the MSY level, it is below 75% of another commonly used reference point that is likely more appropriate for the species, so abundance is considered a "moderate concern" (per line 3.1 in table 1.1.1 of the Seafood Watch Standard).

2.2 Fishing Mortality

Eastern Central Pacific - Dolphin set purse seine

Eastern Central Pacific, Northeast Pacific - Drifting longlines

Eastern Central Pacific, Southeast Pacific - Drifting longlines

Eastern Central Pacific - Floating object purse seine (FAD)

Eastern Central Pacific - Unassociated purse seine (non-FAD)

High Concern

There are no reference points or stock assessments for pelagic stingray in the EPO. The EASI-Fish analysis suggests that fishing mortality may be above a sustainable level (F_{2016}/F_{MSY} = 1.26 and $F/F_{40\%}$ = 1.51) (Griffiths et al 2019a), but the authors do stress that the approach should not be used to determine an official overfishing status for management purposes. Because a data-limited stock assessment < 10 years old estimates that fishing mortality is above a sustainable level, fishing mortality is considered a "high concern" (per line 4.1 in table 1.2.1 of the Seafood Watch Standard).

Pomfrets *(Bramidae)*

2.1 Abundance

Eastern Central Pacific, Southeast Pacific - Drifting longlines

Moderate Concern

There are no stock assessments of pomfrets (Bramidae) in the Pacific. Likely species in this group include sickle pomfret (*Taractichthys steindachneri*) and rough pomfret (*Taractes asper*), which have been recorded by observers on longline vessels in the EPO {IATTC 2023}. Sickle pomfret is found in the northeast Pacific waters around the United States and Mexico, while rough pomfret is found in both the northeastern (United States and Canada) and southeastern (Chile) Pacific {Vega-Cendajas et al. 2019}. Black pomfret is found in tropical waters of the eastern central and southeast Pacific, so it also seems a likely candidate for unspecified pomfrets. Rough pomfret is considered "Least Concern" by the IUCN {Vega-Cendajas et al. 2019}, as is black pomfret (Iwamoto et al 2015). There is no IUCN assessment for sickle pomfret, but all pomfrets that have been assessed are categorized "Least Concern." A productivity-susceptibility analysis (PSA) for sickle

pomfret suggests a moderate vulnerability to fishing (see Justification). Based on the results of the PSA, as well as the IUCN statuses, abundance is considered a "moderate concern" (per lines 2.2.e and 2.3 in table 1.1.1 of the Seafood Watch Standard).

Supplementary Information

PSA for sickle pomfret in the Pacific (see Seafood Watch Fisheries Standard Version 4 for methodology details).

Table 16

Productivity Attribute	High productivity (score = 1)	Medium productivity (score = 2)	Low productivity (score = 3)	Score	Value; {Reference(s)}
Average age at maturity (yrs)	< 5	5–15	> 15	1	2.47 years (Kindong et al. 2020)
Von Bertalanffy (Brody) Growth Coefficient (K)	> 0.25	0.15–0.25	< 0.15	1	0.52 (Kindong et al. 2020)
Average maximum size (cm)	< 100	100–300	> 300	1	60–91 cm (Smith, M. 1986)
Average size at maturity (cm)	< 40	40–200	> 200	2	60 cm (Froese and Pauly 2020)
Reproductive strategy	Broadcast spawner	Demersal egg layer or brooder	Live bearer	1	Broadcast spawner
Productivity score (mean of attribute scores)				**1.2**	

Table 17

Susceptibility Attribute (default scores in bold)	Low S (score = 1)	Medium S (score = 2)	High S (score = 3)	Score	Value/notes; {Reference(s)}

Areal overlap (all fisheries)	> 90% of species concentration is unfished	70%–90% of species concentration is unfished	**> 30% of the species concentration is fished**	3	Default (bolded) scores selected
Vertical overlap (all fisheries)	> 67% of species' depth range is unfished	33%–66% of species' depth range is unfished	**> 33% of species' depth range is unfished**	3	
Seasonal availability (all fisheries)	Fisheries overlap with species < 3 months/year	Fisheries overlap with species 3–6 months/year	**Fisheries overlap with species > 6 months/year**	3	
Selectivity of fishery (specific to fishery under assessment)	Species is not targeted AND is not likely to be captured by gear	**Species is targeted, or is incidentally encountered AND is not likely to escape the gear**	Species is targeted or is incidentally encountered AND combination of fishery attributes and species' biology increase its susceptibility to the gear	2	
Post-capture mortality (specific to fishery under assessment)	> 66% individuals survive post-capture	33%–66% individuals survive post-capture	**Retained species, or > 66% do not survive post-capture**	3	
Susceptibility score (mean of attribute scores)				**2.8**	

Table 18

Productivity-Susceptibility Score ($V = \sqrt{(P^2 + S^2)}$)	**2.98**
Vulnerability Rating: < 2.64 = Low vulnerability, ≥ 2.64 and ≤ 3.18 = Medium vulnerability, > 3.18 = High vulnerability	Moderate

Note that fecundity is unknown and thus is not included in this PSA.

2.2 Fishing Mortality

Eastern Central Pacific, Southeast Pacific - Drifting longlines

Moderate Concern

There are no reference points or stock assessments for pomfrets in the Pacific, so fishing mortality relative to a sustainable level is unknown. Because it is unknown, fishing mortality is considered a "moderate concern" (per line 2.3 in table 1.2.1 of the Seafood Watch Standard).

Rainbow runner *(Elagatis bipinnulata)*

2.1 Abundance

Eastern Central Pacific - Floating object purse seine (FAD)

Moderate Concern

No formal stock assessments for rainbow runner have been conducted in the EPO. The IUCN assessed the species in 2012 as "Least Concern," but this assessment is > 10 years old (Smith-Vaniz et al 2015). Therefore, a PSA was performed and resulted in a numerical score of 3.10, indicating medium vulnerability; thus, abundance is considered a "moderate concern" (per line 3.2.e in table 1.1.1 of the Seafood Watch Standard).

Supplementary Information

PSA for rainbow runner in the Pacific (see Seafood Watch Fisheries Standard Version 4 for methodology details).

Table 19

Productivity Attribute	High productivity (score = 1)	Medium productivity (score = 2)	Low productivity (score = 3)	Score	Value; {Reference(s)}
Average age at maturity (yrs)	< 5	5–15	> 15		Unknown

Average maximum age (yrs) (do not use if max. size is available)	< 10	10–25	> 25	1	6 yrs (Molony 2008)
Von Bertalanffy (Brody) Growth Coefficient (K)	> 0.25	0.15–0.25	< 0.15	1	0.214–0.6 (Molony 2008; Ingles and Pauly 1984)
Fecundity (eggs/yr)	> 20,000	100–20,000	< 100	1	> 1,000,000 (Pinheiro et al 2011)
Average maximum size (cm)	< 100	100–300	> 300	2	180 cm (Claro 1994)
Average size at maturity (cm)	< 40	40–200	> 200	2	64.6 cm (Trindade-Santos and Freire 2015)
Reproductive strategy	Broadcast spawner	Demersal egg layer or brooder	Live bearer	1	Broadcast spawner
Productivity score (mean of attribute scores)				**1.33**	

Table 20

Susceptibility Attribute (default scores in bold)	**Low S (score = 1)**	**Medium S (score = 2)**	**High S (score = 3)**	**Score**	**Value/notes; {Reference(s)}**
Areal overlap (all fisheries)	> 90% of species concentration is unfished	70%–90% of species concentration is unfished	**> 30% of the species concentration is fished**	3	Default (bolded) scores selected

Vertical overlap (all fisheries)	> 67% of species' depth range is unfished	33%–66% of species' depth range is unfished	**> 33% of species' depth range is unfished**	3	
Seasonal availability (all fisheries)	Fisheries overlap with species < 3 months/year	Fisheries overlap with species 3–6 months/year	**Fisheries overlap with species > 6 months/year**	3	
Selectivity of fishery (specific to fishery under assessment)	Species is not targeted AND is not likely to be captured by gear	**Species is targeted, or is incidentally encountered AND is not likely to escape the gear**	Species is targeted or is incidentally encountered AND combination of fishery attributes and species' biology increase its susceptibility to the gear	2	
Post-capture mortality (specific to fishery under assessment)	> 66% individuals survive post-capture	33%–66% individuals survive post-capture	**Retained species, or > 66% do not survive post-capture**	3	
Susceptibility score (mean of attribute scores)				**2.8**	

Table 21

Productivity-Susceptibility Score ($V = \sqrt{(P^2 + S^2)}$)	**3.10**
Vulnerability Rating: < 2.64 = Low vulnerability; ≥ 2.64 and ≤ 3.18 = Medium vulnerability; > 3.18 = High vulnerability	Medium

2.2 Fishing Mortality

Eastern Central Pacific - Floating object purse seine (FAD)

Moderate Concern

Fishing mortality rates for rainbow runner are not available in the EPO, but it is frequently caught in the floating object purse seine fishery and in the unassociated fishery. The average catch of rainbow runner from 1992 to 2017 was 50 t, with 50% coming from each of the two purse seine fisheries, and bycatch of rainbow runner shows a general declining trend since the early 2000s (IATTC 2019d). The capture probability (percent of sets with capture) of rainbow runner remained fairly stable from 1994 to 2008: between 20% and 30% for the floating object purse seine fishery {Hall & Ramon 2013}. But fishing mortality relative to a sustainable level is unknown, so fishing mortality is considered a "moderate concern" (per line 2.3 in table 1.2.1 of the Seafood Watch Standard).

Sailfish *(Istiophorus platypterus)*

2.1 Abundance

Eastern Central Pacific, Northeast Pacific - Drifting longlines

Eastern Central Pacific, Southeast Pacific - Drifting longlines

Low Concern

Sailfish are most abundant in waters relatively near the continents and the Indo-Pacific land masses bordering the Pacific, and infrequent in the high seas separating them. The populations in the EPO and the WPO are genetically distinct (IATTC 2013e; IATTC 2018c). An assessment of Indo-Pacific sailfish populations in the EPO was conducted in 2010 and updated in 2013; however, the model presented unreliable results and could not be used to assess the status of the population regarding management reference points against SSB and MSY. The abundance data used in the model did show a downward trend in abundance from 1994 to 2009, with a more moderate stable trend since then (IATTC 2018c; IATTC 2013e). A more recent ecological risk assessment determined that, in 2016, the EPO sailfish stock was above the estimated MSY level ($SSB/SSB_{MSY} = 1.89$) but below another commonly used abundance reference point ($SSB/SSB_{40\%} = 0.19$) (Griffiths et al 2019a). But the authors also note that the $SSB_{40\%}$ reference point is likely most appropriate for elasmobranchs, sea turtles, and dolphins due to its more precautionary nature, and that their results should not be confused with official stock statuses originating from formal stock assessments (ibid). Therefore, because a data-limited assessment suggests that the stock is above an appropriate biomass reference point, abundance is considered a "low concern" (per line 2.2 in table 1.1.1 of the Seafood Watch Standard).

2.2 Fishing Mortality

Eastern Central Pacific, Northeast Pacific - Drifting longlines

Eastern Central Pacific, Southeast Pacific - Drifting longlines

Low Concern

The principal fisheries that capture sailfish in the EPO include the large-scale tuna longline fishery primarily consisting of China, Chinese Taipei, Japan, and Korea; the smaller-vessel longline fisheries targeting tuna and other species, particularly those operating off Central America; and the artisanal and recreational fisheries of Central and South America. Sailfish are also taken occasionally in the purse-seine fisheries targeting tropical tunas (IATTC 2018c). The 2013 Indo-Pacific sailfish assessment was unable to quantify fishing mortality rates, but results did suggest it is likely that catches are severely underreported for this species (IATTC 2018c). The more recent risk assessment found that fishing mortality was below the MSY level in 2016 (F/F_{MSY} = 0.78) (Griffiths et al 2019a). Because a data-limited assessment <10 years old suggests F is below a sustainable level, Fishing Mortality is considered "low concern" (per line 1.1 in table 1.2.1 of the Seafood Watch Standard).

Seabirds *(Aves)*

2.1 Abundance

Eastern Central Pacific, Northeast Pacific - Drifting longlines

Eastern Central Pacific, Southeast Pacific - Drifting longlines

High Concern

A number of seabird species interact with EPO pelagic longline fisheries (Table 22). Species include those considered "Vulnerable" and "Near Threatened" by the IUCN, and individuals that are not identified to the species level but that are in genera that are frequently species of concern (IUCNredlist.org). Based on the IUCN listings that are < 10 years old, abundance is considered a "high concern" (per line 4.1 in table 1.1.1 of the Seafood Watch Standard).

Table 22: Seabird species in observer records for EPO longline fisheries (> 20m) (IATTC 2023a). Interactions were assumed to lead to death (IATTC 2023a). IUCN Category and Range from IUCNredlist.org.

Species	Scientific Name	IUCN Category	Range (Hemisphere)	Minimum number of interactions
White-chinned petrel	*Procellaria aequinoctialis*	VU	South	63
Wandering albatross	*Diomedea exulans*	VU	South	58
Black-browed albatross	*Thalassarche melanophrys*	LC	South	53
Laysan albatross	*Phoebastria immutabilis*	NT	North (in the EPO)	45
Black-footed albatross	*Phoebastria nigripes*	NT	North (in the EPO)	44
Cape petrel	*Daption capense*	LC	South	27
Albatross NEI	*Diomedea* spp.			25
Boobies and gannets NEI	Sulidae			16
White-capped albatross	*Thalassarche steadi*	NT	South	3
Terns NEI	*Sterna* spp.			3
Great shearwater	*Puffinus gravis*	LC	Atlantic	2
Petrels or shearwaters NEI	Procellariidae			1

2.2 Fishing Mortality

Eastern Central Pacific, Northeast Pacific - Drifting longlines

Eastern Central Pacific, Southeast Pacific - Drifting longlines

High Concern

Globally, industrial longlining results in the death of an estimated 160,000 seabirds a year (Phillips and Wood 2020). Albatrosses and petrels are among the seabird species most vulnerable to incidental capture in fisheries, and a number of both species are caught in IATTC fisheries (14 and 4 species, respectively) (Hutchinson et al 2023). Only minimal estimates of total mortality in EPO longline fisheries are available, and the extent of seabird mortality in artisanal (longline and other) fleets is unknown (Hutchinson et al 2023). Because this is a broad species group, the Seafood Watch Unknown Bycatch Matrix is used for scoring. The UBM points to scores of 2 for pelagic longlines in the Southeast/Eastern Tropical Pacific and 1 for longlines in the Northeast Pacific; thus, fishing mortality is considered a "high concern" (per line 3.1 in table 2.2.2 of the Seafood Watch Standard).

Sharks *(Selachimorpha)*

2.1 Abundance

Eastern Central Pacific - Dolphin set purse seine

Eastern Central Pacific, Northeast Pacific - Drifting longlines

Eastern Central Pacific, Southeast Pacific - Drifting longlines

Eastern Central Pacific - Floating object purse seine (FAD)

Eastern Central Pacific - Unassociated purse seine (non-FAD)

High Concern

A number of different shark species and categories are recorded in longline and purse seine catch data from IATTC, including sharks (various), thresher and hammerhead sharks, specific hammerhead species, oceanic whitetip shark, mako shark, requiem shark, and houndshark. Sharks included in this "sharks" species category are either not identified to a species level or lack a stock assessment in the EPO, so they have been lumped together into this general category due to their unknown stock status. Sharks are considered highly vulnerable species by Seafood Watch; thus, abundance is considered a "high concern" (per line 2.a in the scoring description for C2.1 of the Seafood Watch Standard).

2.2 Fishing Mortality

Eastern Central Pacific - Dolphin set purse seine

Eastern Central Pacific - Floating object purse seine (FAD)

Eastern Central Pacific - Unassociated purse seine (non-FAD)

Low Concern

Sharks are recorded in IATTC catches from FAD-set, dolphin-set, and unassociated purse seines. Though some sharks are identified to the species level, others are not, and all purse seine gears catch a general “sharks” category, a general “thresher sharks” category, and at least one category of hammerhead sharks (smooth, scalloped, or unspecified). From 2018 to 2022, a total of 10,549 unidentified sharks were captured in FAD-set purse seines, alongside 411 and 682 unidentified sharks in dolphin-set and unassociated purse seines, respectively [cite database]. Longline catches of unidentified sharks during the same period were recorded at 121,310 MT, an amount that dwarfs the number of sharks captured in all purse seine categories. Based on these catch numbers, all purse seine types are unlikely to be substantial contributors to shark fishing mortality; thus, fishing mortality is considered a “low concern” (per line 1.3 in table 1.2.1 of the Seafood Watch Standard).

Eastern Central Pacific, Northeast Pacific - Drifting longlines

Eastern Central Pacific, Southeast Pacific - Drifting longlines

High Concern

Several shark species and groups are recorded in IATTC catches from drifting longlines. Though some sharks are identified to the species level, others are not, and longlines catch a general “sharks” category, a general “thresher sharks” category, a general “mako sharks” category, and a general “hammerhead sharks” category. Although blue shark, shortfin mako shark, and silky shark are assessed separately in the Northwest Pacific, these species lack assessments in the Southwest Pacific, so they are included in this general “sharks” category for Southwest longlines. From 2018 to 2022, a total of 121,310 MT of unidentified sharks were captured in drifting longlines, alongside at least 168 MT of thresher sharks, 41 MT of mako sharks, and 114 MT of hammerhead sharks. Based on these catch numbers, drifting longlines may be substantial contributors to shark mortality; however, a sustainable level of mortality is unknown for this species group, so the Seafood Watch Unknown Bycatch Matrix is used for scoring. Sharks score 1 in pelagic longlines in the Eastern Pacific; thus, fishing mortality is considered a “high concern” (per line 3.1 in table 2.2.2 of the Seafood Watch Standard).

Supplementary Information

Shark catch in longlines is recorded in both a total estimated catch (all EPO estimated retained catch) and a separate file containing recorded shark captures in longlines. The total estimated retained catch of “various sharks” in the full EPO dataset is 121,310 MT, while the weight of “various sharks” in the shark-specific longline data file is 1,319 MT.

Shortbill spearfish *(Tetrapturus angustirostris)*

2.1 Abundance

Eastern Central Pacific, Southeast Pacific - Drifting longlines

Moderate Concern

There are no stock assessments for shortbill spearfish. The species is categorized as "Data Deficient" by the IUCN {Collette et al. 2023f}. In lieu of better information, a productivity-susceptibility analysis (see Justification) suggests a medium vulnerability, so abundance is considered a "moderate concern" (per line 3.2.e in table 1.1.1 of the Seafood Watch Standard).

Supplementary Information

PSA for shortbill spearfish in the Pacific (see Seafood Watch Fisheries Standard Version 4 for methodology details).

Table 23

Productivity Attribute	High productivity (score = 1)	Medium productivity (score = 2)	Low productivity (score = 3)	Score	Value; {Reference(s)}
Average age at maturity (yrs)	< 5	5–15	> 15	1	3 yrs (Froese and Pauly 2020)
Von Bertalanffy (Brody) Growth Coefficient (K)	> 0.25	0.15–0.25	< 0.15	1	0.5 (Salcedo-Bojorquez and Arreguin-Sanchez 2011)
Average maximum size (cm)	< 100	100–300	> 300	2	230 cm total length (Salcedo-Bojorquez and Arreguin-Sanchez 2011)

Average size at maturity (cm)	< 40	40–200	> 200	2	132 cm (Salcedo-Bojorquez and Arreguin-Sanchez 2011)
Reproductive strategy	Broadcast spawner	Demersal egg layer or brooder	Live bearer	1	Broadcast spawner (Froese and Pauly 2020)
Productivity score (mean of attribute scores)				**1.4**	

Table 24

Susceptibility Attribute (default scores in bold)	**Low S (score = 1)**	**Medium S (score = 2)**	**High S (score = 3)**	**Score**	**Value/notes; {Reference(s)}**
Areal overlap (all fisheries)	> 90% of species concentration is unfished	70%–90% of species concentration is unfished	**> 30% of the species concentration is fished**	3	Default (bolded) scores selected
Vertical overlap (all fisheries)	> 67% of species' depth range is unfished	33%–66% of species' depth range is unfished	**> 33% of species' depth range is unfished**	3	
Seasonal availability (all fisheries)	Fisheries overlap with species < 3 months/year	Fisheries overlap with species 3–6 months/year	**Fisheries overlap with species > 6 months/year**	3	

Selectivity of fishery (specific to fishery under assessment)	Species is not targeted AND is not likely to be captured by gear	**Species is targeted, or is incidentally encountered AND is not likely to escape the gear**	Species is targeted or is incidentally encountered AND combination of fishery attributes and species' biology increase its susceptibility to the gear	2	
Post-capture mortality (specific to fishery under assessment)	> 66% individuals survive post-capture	33%–66% individuals survive post-capture	**Retained species, or > 66% do not survive post-capture**	3	
Susceptibility score (mean of attribute scores)				**2.8**	

Table 25

Productivity-Susceptibility Score ($V = v(P^2 + S^2)$)	**3.13**
Vulnerability Rating: < 2.64 = Low vulnerability; >= 2.64 and <= 3.18 = Medium vulnerability; > 3.18 = High vulnerability	Moderate

Note that fecundity is unknown and thus not included in this PSA.

2.2 Fishing Mortality

Eastern Central Pacific, Southeast Pacific - Drifting longlines

Moderate Concern

There are no reference points or stock assessments for shortbill spearfish in the Pacific. Because fishing mortality relative to a sustainable level is unknown, fishing mortality is considered a "moderate concern" (per line 2.3 in table 1.2.1 of the Seafood Watch Standard).

Shortfin mako shark *(Isurus oxyrinchus)*

2.1 Abundance

North Pacific Stock | Eastern Central Pacific, Northeast Pacific - Drifting longlines

Low Concern

Shortfin mako shark has no adopted reference points, but stock assessments use MSY to determine stock status. Stock abundance is reported in terms of spawning abundance rather than spawning biomass. The 2018 stock assessment indicated that the most recent spawning abundance (SA_{2016}) was 860,200 sharks (CV = 46%) and was above the spawning abundance level at MSY (SA_{MSY}) (SA_{2016}/SA_{MSY} = 1.36) (ISC 2018b). The estimated SA has slightly increased since 1999 but generally exhibits a declining long-term trend since 1975 (ibid). The maximum likelihood estimate suggests that SA has been above MSY throughout the entire assessment period, and shortfin mako is not considered overfished (ISC 2018b; NOAA 2019a). Because a stock assessment between 5 and 10 years old suggests that abundance is above a sustainable level, abundance is considered a "low concern" (per line 2.1.b in table 1.1.1 of the Seafood Watch Standard).

2.2 Fishing Mortality

North Pacific Stock | Eastern Central Pacific, Northeast Pacific - Drifting longlines

Low Concern

The most recent stock assessment for shortfin mako shark in the North Pacific suggests that fishing mortality has been less than that at MSY since the mid-1990s and remains below in the latest year (2016). Based on a stock assessment < 10 years old with a finding that fishing mortality is below a sustainable level, fishing mortality is considered a "low concern" (per line 1.1 in table 1.2.1 of the Seafood Watch Standard).

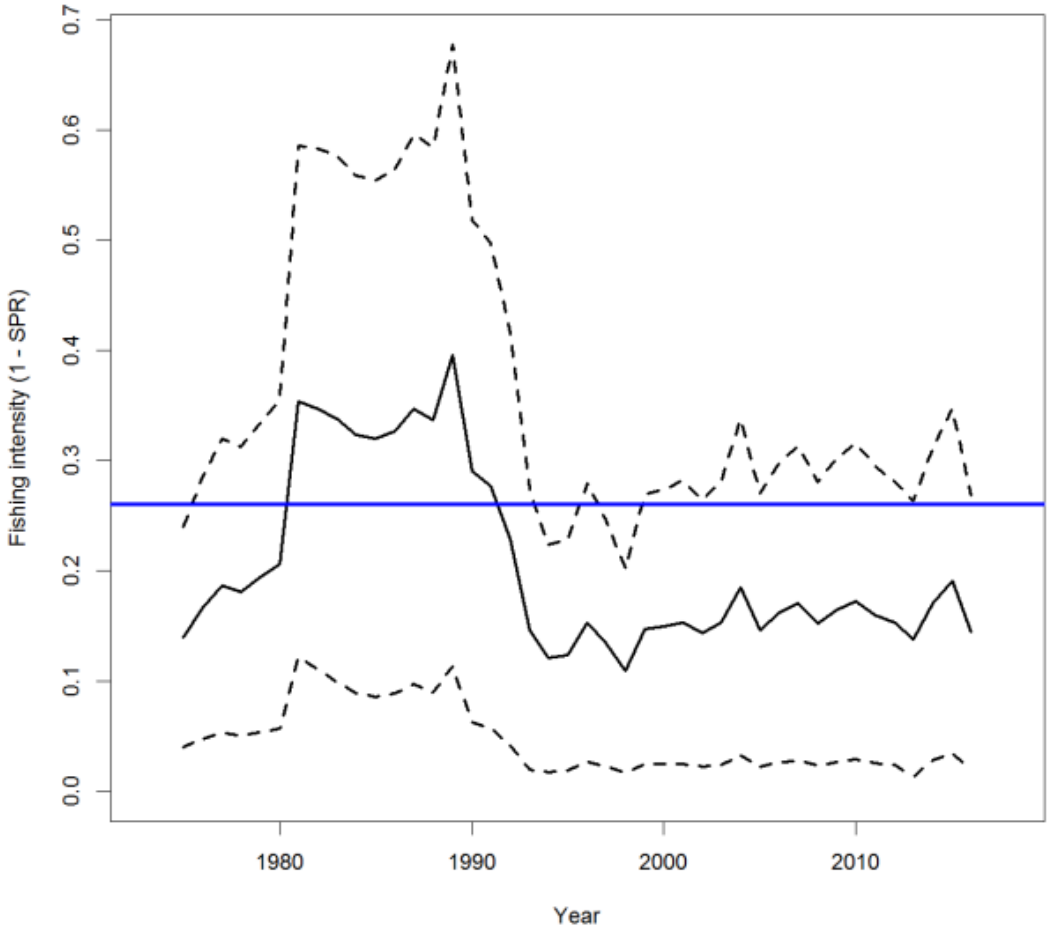

Figure 20: Estimated fishing intensity (1 – SPR) on the North Pacific shortfin mako shark stock. Dashed lines indicate 95% confidence intervals. Blue solid line indicates the estimate of (1 – SPR) at maximum sustainable yield (MSY) (1 – SPR_{MSY}). Chart and text from (ISC 2018b).

Silky shark *(Carcharhinus falciformis)*

2.1 Abundance

Eastern Central Pacific - Dolphin set purse seine

Eastern Central Pacific, Northeast Pacific - Drifting longlines

Eastern Central Pacific, Southeast Pacific - Drifting longlines

Eastern Central Pacific - Floating object purse seine (FAD)

Eastern Central Pacific - Unassociated purse seine (non-FAD)

High Concern

No formal stock assessment exists for silky shark in the Eastern Pacific Ocean. An

updated vulnerability assessment (EASI-Fish) was performed in 2023 for silky and hammerhead sharks in the EPO, which categorized silky shark as “most vulnerable” to coastal/pelagic EPO fisheries, based on fishing mortality and SBR reference points (Griffiths et al. 2023). All models used in the assessment indicated that the 2019 SBR of silky shark was below $SBR_{40\%}$ (a precautionary reference point that the authors have determined is appropriate for elasmobranch species), with the majority of models indicating the $SBR/SBR_{40\%}$ ratio of 0.5 (5 of 44 runs indicated the ratio was > 0.5) (ibid). Because this data-limited assessment suggests that the biomass of silky shark in the EPO is most likely below 50% of a sustainable level, abundance is considered a “high concern” (per line 4.1 in table 1.1.1 of the Seafood Watch Standard).

2.2 Fishing Mortality

Eastern Central Pacific - Dolphin set purse seine

Eastern Central Pacific - Unassociated purse seine (non-FAD)

Low Concern

The 2023 vulnerability assessment for silky sharks in the Eastern Pacific Ocean suggested that fishing mortality is above a sustainable level (in this case, $F_{40\%}$) (Griffiths et al. 2023). IATTC recorded catches of silky sharks from 2018 to 2022 include: 145mt *minimum* in longlines (a separate dataset notes 4,686 as the *minimum* number of individuals in longlines), 126,256 individual sharks in FAD-set purse seines, 3,116 individual sharks in dolphin-set purse seines, and 2,545 individual sharks in unassociated purse seines (IATTC 2024d). Though the vulnerability assessment suggests that fishing mortality is above a sustainable level, catch numbers suggest that both dolphin-set and unassociated purse seines are not substantial contributors to silky shark fishing mortality, thus Fishing Mortality is considered “low concern” (per line 1.3 in table 1.2.1 of the Seafood Watch Standard).

Eastern Central Pacific, Northeast Pacific - Drifting longlines

Eastern Central Pacific, Southeast Pacific - Drifting longlines

Eastern Central Pacific - Floating object purse seine (FAD)

High Concern

The 2023 vulnerability assessment for silky shark in the EPO suggested that fishing mortality is above a sustainable level (in this case, $F_{40\%}$) (Griffiths et al. 2023). Longline fisheries specifically were found to have the highest impact on silky shark (ibid). EPO data suggest that purse seines also catch silky shark in significant numbers, though the vulnerability assessment exhibits that a much larger fraction of fishing mortality comes from industrial longlines compared to purse seines. Though the vulnerability assessment is not a formal stock assessment, its results suggest that fishing mortality is above a sustainable level; thus, fishing mortality is considered a “high concern” (per line 3.1 in table 1.2.1 of the Seafood Watch Standard).

Supplementary Information

IATTC-recorded catches of silky shark from 2018 to 2022 include: 145 MT in longlines, 126,356 individual sharks in FAD-set purse seines, 3,116 individual sharks in dolphin-set purse seines, and 2,545 individual sharks in unassociated purse seines (IATTC 2024d).

Snake mackerels *(Gempylidae)*

2.1 Abundance

Eastern Central Pacific, Northeast Pacific - Drifting longlines

Eastern Central Pacific, Southeast Pacific - Drifting longlines

Moderate Concern

There are no stock assessments of snake mackerels (family *Gempylidae*) in the Pacific. Likely species in this group include the snake mackerel (*Gempylus serpens*), which has been recorded by observers on longline vessels in the EPO {IATTC 2023}. The species is categorized a "Least Concern" by the IUCN {Collette et al. 2015}; however, the data used are > 10 years old, so they cannot be used for scoring. In lieu of better information, a PSA (see Justification) suggests a medium vulnerability to fishing; thus, fishing mortality is considered a "moderate concern" (per line 3.2.e in table 1.1.1 of the Seafood Watch Standard).

Supplementary Information

PSA for snake mackerel in the Pacific (see Seafood Watch Fisheries Standard Version 4 for methodology details).

Table 26

Productivity Attribute	High productivity (score = 1)	Medium productivity (score = 2)	Low productivity (score = 3)	Score	Value; {Reference(s)}
Average age at maturity (yrs)	< 5	5–15	> 15		Unknown

Average maximum age (yrs) (do not use if max. size is available)	< 10	10–25	> 25		Unknown
Von Bertalanffy (Brody) Growth Coefficient (K)	> 0.25	0.15–0.25	< 0.15		Unknown
Fecundity (eggs/yr)	> 20,000	100–20,000	< 100	1	300,000–1,000,000 eggs {Collette et al. 2015}
Average maximum size (cm)	< 100	100–300	> 300	1	< 100 cm {Collette et al. 2015}
Average size at maturity (cm)	< 40	40–200	> 200	2	43–50 cm {Collette et al. 2015}
Reproductive strategy	Broadcast spawner	Demersal egg layer or brooder	Live bearer	1	Broadcast spawner {Collette et al. 2015}
Productivity score (mean of attribute scores)				**1.25**	

Table 27

Susceptibility Attribute (default scores in bold)	**Low S (score = 1)**	**Medium S (score = 2)**	**High S (score = 3)**	**Score**	**Value/notes; {Reference(s)}**
Areal overlap (all fisheries)	> 90% of species concentration is unfished	70%–90% of species concentration is unfished	**> 30% of the species concentration is fished**	3	Default (bolded) scores selected

Vertical overlap (all fisheries)	> 67% of species' depth range is unfished	33%–66% of species' depth range is unfished	**> 33% of species' depth range is unfished**	3	
Seasonal availability (all fisheries)	Fisheries overlap with species < 3 months/year	Fisheries overlap with species 3–6 months/year	**Fisheries overlap with species > 6 months/year**	3	
Selectivity of fishery (specific to fishery under assessment)	Species is not targeted AND is not likely to be captured by gear	**Species is targeted, or is incidentally encountered AND is not likely to escape the gear**	Species is targeted or is incidentally encountered AND combination of fishery attributes and species' biology increase its susceptibility to the gear	2	
Post-capture mortality (specific to fishery under assessment)	> 66% individuals survive post-capture	33%–66% individuals survive post-capture	**Retained species, or > 66% do not survive post-capture**	3	
Susceptibility score (mean of attribute scores)				**2.8**	

Table 28

Productivity-Susceptibility Score ($V = \sqrt{(P^2 + S^2)}$)	**3.07**
Vulnerability Rating: < 2.64 = Low vulnerability; ≥ 2.64 and ≤ 3.18 = Medium vulnerability; > 3.18 = High vulnerability	Moderate

2.2 Fishing Mortality

Eastern Central Pacific, Northeast Pacific - Drifting longlines

Eastern Central Pacific, Southeast Pacific - Drifting longlines

Moderate Concern

There are no reference points or stock assessments for snake mackerels in the Pacific. Because fishing mortality relative to a sustainable level is unknown, fishing mortality is considered a "moderate concern" (per line 2.3 in table 1.2.1 of the Seafood Watch Standard).

Spinner dolphin *(Stenella longirostris)*

2.1 Abundance

Eastern Central Pacific - Dolphin set purse seine

High Concern

The IUCN lists eastern spinner dolphin as "Vulnerable" with an increasing population trend (Hammond et al. 2012), and "Least Concern" globally (Braulik and Reeves 2018). The National Marine Fisheries Service considers the eastern stock of spinner dolphin "Depleted" under the Marine Mammal Protection Act (MMPA) (NOAA 2022). But both the NOAA determination and the IUCN assessment of eastern spinner dolphin are based on data that are > 10 years old (see Justification), suggesting that current abundance is not well understood. Therefore, abundance is considered a "high concern" based on default conditions for marine mammal species (per line 2.a in the description for C2.1 in the Seafood Watch Standard).

Supplementary Information

The abundance of spinner dolphin in 2010 was estimated to be 790,613 and 711,883 individuals for the eastern and white belly populations, respectively (IATTC 2012a). Abundances were the highest during the 1960s and have not recovered to historic levels (IATTC 2009a). More recent information on population abundance is limited because biomass surveys conducted by the NMFS ended in 2006 (Scott et al. 2016). Studies to resurvey eastern tropical Pacific dolphins have been designed and submitted, but not yet carried out (Oedekoven et al 2021) (Oedekoven May 2023, pers. comm).

2.2 Fishing Mortality

Eastern Central Pacific - Dolphin set purse seine

Moderate Concern

Total dolphin mortality in purse seine fisheries operating in the EPO has decreased significantly since peak levels occurred in the 1960s with dolphin-encircling sets (IATTC 2011e). Reductions in dolphin mortality are associated with the 1992 Agreement on the Conservation of Dolphins and the 1999 Agreement on the International Dolphin

Conservation Program (AIDCP). The goal of both agreements is to reduce dolphin mortalities in purse seine fisheries to levels approaching zero (IATTC 2013h). Mortality levels for all dolphins reduced from 132,000 documented mortality events in 1986 to 729 in 2021 (IATTC 2022d). The AIDCP also requires the establishment of a per-stock, per-year dolphin mortality cap, called a Stock Mortality Limit, or SML; if that cap is exceeded, then fishing on that stock must cease for the remainder of the year (IDCP 2002). Since 2001, the SML has been set at 0.1% of the minimum estimated abundance for each stock (IDCP 2002).

The estimated incidental takes of eastern spinner dolphin in 2021 was 195 individuals or 25% of the most recent SML (791) (IATTC 2022d). For white belly spinner dolphin, the 2021 estimated incidental take was 173 individuals or 24% of the SML (712). The average takes of these species over the last decade (2012–21) were 266 and 139 individuals, respectively (IATTC 2022d). These numbers suggest that the take is likely not contributing to any lack of recovery of the species; however, the lack of recent estimates of abundance for these stocks (see factor 2.1 abundance), which the SML is based on, is a source of significant uncertainty. In addition, population-level research suggests that there may be significant stress effects and the potential for reduced reproductive output as a result of incidental capture and interactions with purse seine fisheries, which could be negatively affecting the ability of this species to recover (Cramer et al. 2008; Keller et al. 2013; Wade et al. 2007; Edwards 2007). For these reasons, fishing mortality relative to a sustainable level is unknown, so fishing mortality is considered a "moderate concern" (per line 2.3 in table 1.2.1 of the Seafood Watch Standard).

Striped marlin *(Kajikia audax)*

2.1 Abundance

Eastern Central Pacific, Northeast Pacific - Drifting longlines

Eastern Central Pacific, Southeast Pacific - Drifting longlines

High Concern

Striped marlin was last assessed in the EPO in 2008, and this assessment indicated that the stock was not overfished and the spawning stock biomass was above maximum sustainable yield levels (IATTC 2022c). The biomass was expected to continue to grow in the years following this assessment (IATTC 2022c). The IUCN Red List has identified striped marlin populations as "Least Concern" with a decreasing population trend {Collette et al. 2022c}. More recently, a risk assessment found that striped marlin in the EPO in 2016 was below the estimated MSY level ($SSB/SSB_{MSY} = 0.43$) {Griffiths et al. 2019a}. Based on a data-limited assessment indicating that the stock is below 50% of the MSY level, abundance is considered a "high concern" (per line 4.1 in table 1.1.1 of the Seafood Watch Standard).

2.2 Fishing Mortality

Eastern Central Pacific, Northeast Pacific - Drifting longlines

Eastern Central Pacific, Southeast Pacific - Drifting longlines

High Concern

Information on fishing levels of striped marlin in the EPO are limited, but there is some indication that they have increased over the past decade. The last full assessment was conducted in 2008 and indicated that overfishing was not occurring (IATTC 2022c). Average catches between 2016 and 2020 were half the maximum sustainable yield levels estimated in 2010 (IATTC 2022c). The recent risk assessment found that striped marlin in the EPO had a 2016 fishing mortality level above MSY and other calculated F reference points (F/F_{MSY} = 1.59) {Griffiths et al. 2019a}. Because this data-limited assessment suggests that fishing mortality is above sustainable levels, fishing mortality is considered a "high concern" (per line 3.1 in table 1.2.1 of the Seafood Watch Standard).

Wahoo *(Acanthocybium solandri)*

2.1 Abundance

Eastern Central Pacific, Northeast Pacific - Drifting longlines

Eastern Central Pacific, Southeast Pacific - Drifting longlines

Eastern Central Pacific - Floating object purse seine (FAD)

Low Concern

Wahoo is listed as a species of "Least Concern" by the IUCN (Collette et al. 2023d). The species is widespread in the EPO, and there are no targeted fisheries for it, but it is caught as bycatch and is increasingly retained {Hall & Ramon 2013}. A recent ecological risk assessment (EASI-Fish) found that the EPO stock of wahoo was above the estimated MSY level in 2016 (SSB/SSB_{MSY} = 1.51), as well as other calculated biomass reference points {Griffiths et al. 2019a}. Based on a data-limited stock assessment indicating that biomass is above a sustainable level, abundance is considered a "low concern" (per line 2.2 in table 1.1.1 of the Seafood Watch Standard).

2.2 Fishing Mortality

Eastern Central Pacific, Northeast Pacific - Drifting longlines

Eastern Central Pacific, Southeast Pacific - Drifting longlines

Eastern Central Pacific - Floating object purse seine (FAD)

Low Concern

Although no targeted fisheries occur in the EPO for wahoo, it is caught as bycatch in several fisheries, including purse seine and longline fisheries, and is increasingly retained. Catches of wahoo in the region have been increasing over the past 20 years, with a particularly sharp uptick around 2006. Higher catches of wahoo are likely related to changes in longline data reporting and an increasing number of floating object purse seine sets (Collette et al. 2011c; IATTC 2018c). Roughly 368 t and 243 t of wahoo were caught in 2017 in purse seine and longline fisheries, respectively (IATTC 2018c). The recent risk assessment indicated that fishing mortality was below sustainable levels in 2016 (F/F_{MSY} = 0.44) {Griffiths et al. 2019a}, so fishing mortality is considered a "low concern" (per line 1.1 in table 1.2.1 of the Seafood Watch Standard).

Yellowtail *(Seriola lalandi)*

2.1 Abundance

Eastern Central Pacific - Floating object purse seine (FAD)

High Concern

No stockwide assessment of yellowtail has been conducted in the EPO. This species has been assessed by the IUCN as "Least Concern," but this listing is > 10 years old (Smith-Vaniz and Williams 2015). Therefore, a PSA was performed, resulting in a score of 3.32. Based on the PSA indicating a high vulnerability to fishing, abundance is considered a "high concern" (per line 4.3.e in table 1.1.1 of the Seafood Watch Standard).

Supplementary Information

Table 29

Productivity Attribute	High productivity (score = 1)	Medium productivity (score = 2)	Low productivity (score = 3)	Score	Value; {Reference(s)}
Average age at maturity (yrs)	< 5	5–15	> 15	1	2 years (Froese and Pauly 2020)
Von Bertalanffy (Brody) Growth Coefficient (K)	> 0.25	0.15–0.25	< 0.15	3	0.13 (Froese and Pauly 2020)

Average maximum size (cm)	< 100	100–300	> 300	2	250 cm (Froese and Pauly 2020)
Average size at maturity (cm)	< 40	40–200	> 200	2	51 cm (Froese and Pauly 2020)
Reproductive strategy	Broadcast spawner	Demersal egg layer or brooder	Live bearer	1	Broadcast spawner (Sea Grant California 2025)
Productivity score (mean of attribute scores)				**1.8**	

Table 30

Susceptibility Attribute (default scores in bold)	**Low S (score = 1)**	**Medium S (score = 2)**	**High S (score = 3)**	**Score**	**Value/notes; {Reference(s)}**
Areal overlap (all fisheries)	> 90% of species concentration is unfished	70%–90% of species concentration is unfished	**> 30% of the species concentration is fished**	3	Unknown; Default (bolded) scores selected
Vertical overlap (all fisheries)	> 67% of species' depth range is unfished	33%–66% of species' depth range is unfished	**> 33% of species' depth range is unfished**	3	
Seasonal availability (all fisheries)	Fisheries overlap with species < 3 months/year	Fisheries overlap with species 3–6 months/year	**Fisheries overlap with species > 6 months/year**	3	

Selectivity of fishery (specific to fishery under assessment)	Species is not targeted AND is not likely to be captured by gear	**Species is targeted, or is incidentally encountered AND is not likely to escape the gear**	Species is targeted or is incidentally encountered AND combination of fishery attributes and species' biology increase its susceptibility to the gear	2	Unknown; Default (bolded) scores selected
Post-capture mortality (specific to fishery under assessment)	> 66% individuals survive post-capture	33%–66% individuals survive post-capture	**Retained species, or > 66% do not survive post-capture**	3	
Susceptibility score (mean of attribute scores)				**2.8**	

Table 31

Productivity-Susceptibility Score ($V = v(P^2 + S^2)$)	**3.32**
Vulnerability Rating: < 2.64 = Low vulnerability; >= 2.64 and <= 3.18 = Medium vulnerability; > 3.18 = High vulnerability	High

2.2 Fishing Mortality

Eastern Central Pacific - Floating object purse seine (FAD)

Moderate Concern

Yellowtail is taken primarily in school (unassociated) and floating object associated sets, with 24 t and 37 t, respectively, taken in the 2017 purse seine fisheries (IATTC 2018c). A review conducted in Mexican waters found that the population of California yellowtail was fully exploited (SAGARPA 2010). But fishing mortality rates for the entire population are unknown. Yellowtail is reported to have a frequency of occurrence rate in floating object purse seine fisheries of 10%–18% (1994–2009) {Hall & Ramon 2013}. Because fishing mortality rates are unknown, fishing mortality is considered a "moderate concern" (per line 2.3 in table 1.2.1 of the Seafood Watch Standard).

2.3 Discard Rate/Landings

Eastern Pacific Ocean Stock | Eastern Central Pacific - Floating object purse seine (FAD)

Eastern Pacific Ocean Stock | Eastern Central Pacific - Unassociated purse seine (non-FAD)

Eastern Pacific Ocean Stock | Eastern Central Pacific - Dolphin set purse seine

< 100%

Purse seine fisheries have an average discard rate of just under 5% (Pérez Roda et al 2019); however, discard rates vary by gear type and have decreased moderately in more recent years. Floating object associated sets have the highest discard rate (≈6.4%), followed by school sets (≈2%) and dolphin sets (0.3%) from 1993 to 2017 (IATTC 2019f). Discard rate/landings are considered < 100% in tuna purse seine fisheries (per line 1.1 in table 2.3.1 of the Seafood Watch Standard).

North Pacific Stock | Eastern Central Pacific, North Pacific - Canada | United States - British Columbia | California | Oregon | Washington - Trolling lines

< 100%

Trolling is generally considered to be highly selective and has minimal discards {Pérez Roda et al. 2019; DFO 2019; PFMC 2023). Therefore, discard rate/landings is considered < 100% (per line 1.1. in table 2.3.1 of the Seafood Watch Standard).

North Pacific Stock | Eastern Central Pacific, Northeast Pacific - Drifting longlines

South Pacific Stock | Eastern Central Pacific, Southeast Pacific - Drifting longlines

Eastern Pacific Ocean Stock | Eastern Central Pacific, Northeast Pacific - Drifting longlines

Eastern Pacific Ocean Stock | Eastern Central Pacific, Southeast Pacific - Drifting longlines

Eastern Central Pacific, Northeast Pacific - Drifting longlines

Eastern Central Pacific, Southeast Pacific - Drifting longlines

Southeastern Pacific Ocean Stock | Eastern Central Pacific, Southeast Pacific - Drifting longlines

< 100%

The average overall discard rate in pelagic longline fisheries worldwide is 7.4% {Pérez Roda et al. 2019}. Data on bait use are limited. Extant information indicates that bait species vary by region and target species, but longline fisheries in the EPO are known to use squid, sardine, milkfish, etc. (Clarke et al. 2014). In summary, information on discard rates and bait use from IATTC longline fisheries is not well reported, but the combined discards and bait use ratio to landings is likely well under 100%, so longlines' discard rate/landings is considered < 100% (per line 1.1 in table 2.3.1 of the Seafood Watch Standard).

Criterion 3: Management Effectiveness

Five factors are evaluated in Criterion 3: Management Strategy and Implementation, Bycatch Strategy, Scientific Research/Monitoring, Enforcement of Regulations, and Inclusion of Stakeholders. Each is scored as either 'highly effective', 'moderately effective', 'ineffective,' or 'critical'. The final Criterion 3 score is determined as follows:

- *5 (Very Low Concern) — Meets the standards of 'highly effective' for all five factors considered.*
- *4 (Low Concern) — Meets the standards of 'highly effective' for 'management strategy and implementation' and at least 'moderately effective' for all other factors.*
- *3 (Moderate Concern) — Meets the standards for at least 'moderately effective' for all five factors.*
- *2 (High Concern) — At a minimum, meets standards for 'moderately effective' for Management Strategy and Implementation and Bycatch Strategy, but at least one other factor is rated 'ineffective.'*
- *1 (Very High Concern) — Management Strategy and Implementation and/or Bycatch Management are 'ineffective.'*
- *0 (Critical) — Management Strategy and Implementation is 'critical'.*

The Criterion 3 rating is determined as follows:

- Score >3.2 = **Green** or Low Concern
- Score >2.2 and ≤3.2 = **Yellow** or Moderate Concern
- Score ≤2.2 = **Red** or High Concern

Rating is Critical if Management Strategy and Implementation is Critical.

Guiding principle

- The fishery is managed to sustain the long-term productivity of all impacted species.

Five factors are evaluated in Criterion 3: Management Strategy and Implementation, Bycatch Strategy, Scientific Research/Monitoring, Enforcement of Regulations, and Inclusion of Stakeholders. Each is scored as either 'highly effective', 'moderately effective', 'ineffective,' or 'critical'. The final Criterion 3 score is determined as follows:

Criterion 3 Summary

Fishery	Management Strategy And Implementation	Bycatch Strategy	Scientific Data Collection and Analysis	Enforcement of and Compliance with Management Regulations	Stakeholder Inclusion	Score
Eastern Central Pacific - Dolphin set purse seine	Moderately Effective	Moderately Effective	Highly effective	Moderately Effective	Highly effective	Yellow (3.000)
Eastern Central Pacific - Floating object purse seine (FAD)	Moderately Effective	Moderately Effective	Moderately Effective	Moderately Effective	Highly effective	Yellow (3.000)
Eastern Central Pacific - Unassociated purse seine (non-FAD)	Moderately Effective	Moderately Effective	Moderately Effective	Moderately Effective	Highly effective	Yellow (3.000)
Eastern Central Pacific, North Pacific - Canada | United States - British Columbia | California | Oregon | Washington - Trolling lines	Moderately Effective	Highly effective	Moderately Effective	Highly effective	Moderately Effective	Yellow (3.000)
Eastern Central Pacific, Northeast Pacific - Drifting longlines	Moderately Effective	Ineffective	Ineffective	Moderately Effective	Moderately Effective	Red (1.000)
Eastern Central Pacific, Southeast Pacific - Drifting longlines	Moderately Effective	Ineffective	Ineffective	Moderately Effective	Moderately Effective	Red (1.000)

The IATTC is responsible for the management of fishery impacts on tuna and tuna-like species, associated species, and their ecosystems throughout the Eastern Pacific Ocean from Alaska to Chile. It does this through the adoption of Recommendations and Resolutions (collectively, Conservation and Management Measures or CMMs), which CPCs are expected to implement for their fisheries. (The acronym "CPC" is used by the IATTC in all Resolutions, instruments, and documents to encompass both members and cooperating nonmembers; https://www.iattc.org/en-US/About/Role .)

The current members of the IATTC are: Belize, Canada, China, Colombia, Costa Rica, Ecuador, El Salvador, European Union, France, Guatemala, Japan, Kiribati, South Korea, Mexico, Nicaragua, Panama, Peru, Chinese Taipei, United States, Vanuatu, and Venezuela. Cooperating nonmembers of the IATTC are Bolivia, Chile, Honduras, Indonesia, and Liberia. The latter are bound by the same obligations as members regarding measures adopted by the Commission.

Criterion 3 Assessment

Scoring Guidelines

Factor 3.1 - Management Strategy and Implementation

Considerations: What type of management measures are in place? Are there appropriate management goals, and is there evidence that management goals are being met? Do manages follow scientific advice? To achieve a highly effective rating, there must be appropriately defined management goals, precautionary policies that are based on scientific advice, and evidence that the measures in place have been successful at maintaining/rebuilding species.

Factor 3.2 - Bycatch Strategy

Considerations: What type of management strategy/measures are in place to reduce the impacts of the fishery on bycatch species and when applicable, to minimize ghost fishing? How successful are these management measures? To achieve a Highly Effective rating, the fishery must have no or low bycatch, or if there are bycatch or ghost fishing concerns, there must be effective measures in place to minimize impacts.

Factor 3.3 - Scientific Research and Monitoring

Considerations: How much and what types of data are collected to evaluate the fishery's impact on the species? Is there adequate monitoring of bycatch? To achieve a Highly Effective rating, regular, robust population assessments must be conducted for target or retained species, and an adequate bycatch data collection program must be in place to ensure bycatch management goals are met.

Factor 3.4 - Enforcement of Management Regulations

Considerations: Do fishermen comply with regulations, and how is this monitored? To achieve a Highly Effective rating, there must be regular enforcement of regulations and verification of compliance.

Factor 3.5 - Stakeholder Inclusion

Considerations: Are stakeholders involved/included in the decision-making process? Stakeholders are individuals/groups/organizations that have an interest in the fishery or that may be affected by the management of the fishery (e.g., fishermen, conservation groups, etc.). A Highly Effective rating is given if the management process is transparent, if high participation by all stakeholders is encouraged, and if there a mechanism to effectively address user conflicts.

3.1 Management Strategy And Implementation

Eastern Central Pacific - Floating object purse seine (FAD)

Eastern Central Pacific - Unassociated purse seine (non-FAD)

Eastern Central Pacific - Dolphin set purse seine

Moderately Effective

Purse seines in the EPO target and retain tropical tunas (yellowfin, bigeye, and skipjack). Purse seine fisheries are required by the IATTC to release all other (nontarget) species caught, including sharks, rays, turtles, and nontarget pelagic fishes (IATTC 2006b). Tropical tunas have official reference points in place that are appropriately conservative and have a harvest control rule in place via Resolution C-23-06. But the harvest strategy is lacking some elements for a highly effective management strategy for yellowfin, bigeye, and skipjack. The most recent tropical tunas resolution does not define specific management actions that should be taken if stocks approach their LRPs and was not developed using management strategy evaluation (MSE). However, there is an MSE now in development for bigeye tuna. Although there is no particular concern with the status of any of these stocks, the lack of specified management actions in the HCR creates uncertainty around its effectiveness; thus, management strategy and implementation is considered “moderately effective” (per lines 2.1 and 2.2a in table 3.1.1 of the Seafood Watch Standard).

Supplementary Information

Reference points

Target and limit reference points are in place for the main stocks retained by the purse seine fleet in the EPO (yellowfin, skipjack, and bigeye) (Resolution C-16-02 2016) as replaced by (Resolution C-23-06 2023); (IATTC 2019a). The target reference points are spawning biomass at MSY (S_{MSY}) and fishing mortality rate at MSY (F_{MSY}), or proxies where MSY cannot be reliably estimated (Resolution C-23-06 2023). For bigeye and yellowfin, S_{MSY} is around 21% and 27% of B_0, respectively [using a conservative assumption of stock-recruitment relationship (steepness, or h = 0.75)] (p. 40 in {Valero et al. 2017}). The limit reference points are based on the equilibrium spawning biomass and fishing mortality corresponding to that which produces a 50% reduction in recruitment from the unfished level (referred to as $F0.5_{R0}$ and $S0.5_{R0}$) (Resolution C-23-06 2023). This corresponds to a spawning biomass that is about 8% of the unfished level (IATTC 2019a) (p. 41 in (Valero et al 2017)). Although this LRP is low, the equally low allowable probability of breaching it (10%) adds a precautionary buffer to this reference point.

Harvest control rules

There is an HCR in place for these stocks for the purse seine fishery based on the preceding reference points (Resolution C-23-06 2023). The HCR requires measures to be

in place to prevent fishing mortality from exceeding F_{MSY} for the tropical tuna stock (i.e., yellowfin, bigeye, or skipjack) that requires the strictest management. The HCR requires the establishment of additional management measures if there were a greater than 10% probability of the limit reference points being exceeded. But the HCR is not explicit regarding the measures that must be put into place, or the timeline for doing so ("...as soon as is practical management measures shall be established...") (Resolution C-23-06 2023). This language introduces uncertainty into the ability of these measures to effectively protect stocks in a timely manner. A more recent management measure puts catch limits and resulting closure requirements in place for purse seiners landing bigeye tuna and works to improve bigeye catch data toward this end for 2025 and 2026 (IATTC 2024f).

Management measures

The main measures currently in place to manage fisheries for yellowfin, bigeye, and skipjack in the EPO include time and area closures for the purse seine fishery; full retention of all yellowfin, bigeye, and skipjack by purse seiners; and limits on the number of FADs vessels can carry and when they can be deployed (Resolution C-21-04 2021; ISSF 2023; IATTC 2024f). An analysis of the limits in place from 2018 to 2022 suggests that the limits were set above then-current activity levels, do not reduce FAD use, and would actually allow the average vessel to increase its FAD use {Gershman et al. 2019}. Resolution C-21-04, though, increasingly limits the number of active FADs over the years 2022 to 2024 (Table 32).

Effectiveness of measures

Efforts to assess the effectiveness of the current management regime through Management Strategy Evaluation have been underway since 2019 (Resolution C-19-07 2019). The most recent meeting of the working group was in December 2022, with MSE results expected in 2024 (Valero and Aires-da-Silva 2022). Stock status is not of particular concern for any of the three stocks (though there is significant uncertainty; see Criterion 1), suggesting that management has been effective at maintaining fishing mortality at a sustainable level.

Table 32: FAD limits: number of active FADs permitted by year and vessel size.

Size of vessel	Res. C-17-02	Res. C-21-04		
	2018–22	2022	2023	2024
Class 6 (1,200 m^3 and greater)	450	400	340	340

Class 6 (< 1,200 m^3)	300	270	255	210
Classes 4–5	120	110	105	85
Classes 1–3	70	66	64	50

Eastern Central Pacific, North Pacific - Canada | United States - British Columbia | California | Oregon | Washington - Trolling lines

Moderately Effective

The United States and Canada troll fishery almost exclusively catches albacore (PFMC 2023) (DFO 2019). The fishery is conducted by the United States in U.S. and Canadian waters, and vice versa, through a treaty agreement (PFMC 2023) (DFO 2019). Reference points are in place in the EPO for the North Pacific stock {Resolution C-22-04 (2022)}. The target fishing mortality is F45%, which is the fishing intensity (F) level that results in the stock producing 45% of the spawning potential ratio. There is no biomass target reference point, but a threshold reference point is expressed in terms of biomass ($30\%SSB_{current,\ F=0}$, which is 30% of the dynamic unfished spawning stock biomass). The limit reference point is $14\%SSB_{current,\ F=0}$; there is no fishing mortality threshold {Resolution C-22-04 (2022)}. An updated harvest strategy was adopted in 2023 by the IATTC, which lays out management objectives relative to F and SSB reference points and biomass depletion, sets an acceptable level of risk relative to breaching the SSB LRP, and creates an HCR (Resolution C-23-02 2023). This HCR includes adjusting fishing intensity relative to SSB and collaborating with the WCPFC in rebuilding efforts (should they be necessary). There are currently no concerns with the North Pacific albacore stock (see Criterion 1). But the 2023 harvest strategy has not yet been officially implemented, because IATTC members are deciding on how to transform fishing intensity estimates into management action.

There are reference points in place and no particular concerns with current levels of fishing mortality, but the harvest strategy and HCR for this stock are not yet fully in place, creating uncertainty in their implementation; thus, management strategy and implementation is considered “moderately effective” (per lines 2.1 and 2.2.a in table 3.1.1 of the Seafood Watch Standard).

Eastern Central Pacific, Northeast Pacific - Drifting longlines

Eastern Central Pacific, Southeast Pacific - Drifting longlines

Moderately Effective

Pelagic longline fisheries in the EPO catch and retain many different species, but the lack of effective monitoring of the fleets makes it impossible to fully understand which species are targeted, which are not targeted but retained, and which are discarded across the

many different fleets (see Criterion 2 Summary and Criterion 3.3). The available data suggest that the main retained species are highly variable across fleets, but include bigeye, yellowfin, albacore, swordfish, dorado, and a number of sharks (silky shark, blue shark, and shortfin mako shark in particular). Stocks meeting the Seafood Watch main species criteria include yellowfin tuna, bigeye tuna, albacore, swordfish, multiple other marlin/billfish species, multiple large pelagic finfish species (e.g., wahoo, dorado), and multiple shark species (see Criterion 2 Summary). Of these, reference points have been adopted for the tunas, a harvest control rule is in place for yellowfin and bigeye (but lacking some effectiveness; see Justification), and there is no particular concern with current levels of fishing mortality (see Criterion 1). There are no reference points or harvest control rules for billfishes, sharks, and other large pelagics. Management strategy and implementation is considered "moderately effective" because some management measures are in place for target tuna species, but other retained species lack management measures (per lines 2.1 and 2.2.a in table 3.1.1 of the Seafood Watch Standard).

Supplementary Information

Reference points

- Yellowfin and bigeye: Target and limit reference points and a harvest control rule are in place (Resolution C-23-06 2023). But the effectiveness of the HCR is uncertain, given its lack of specified management actions (see the preceding factor 3.1 for purse seines).
- Albacore: Management of fisheries for albacore tuna in the Pacific is under the purview of the IATTC in the EPO and the WCPFC in the WCPO.
    - Reference points are in place in the EPO for the North Pacific stock {Resolution C-22-04 (2022)}. The target fishing mortality is F45%, which is the fishing intensity (F) level that results in the stock producing 45% of the spawning potential ratio. There is no biomass target reference, but a threshold reference point is expressed in terms of biomass ($30\%SSB_{current,\ F = 0}$, which is 30% of the dynamic unfished spawning stock biomass. The limit reference point is $14\%SSB_{current,\ F = 0}$; there is no fishing mortality threshold {Resolution C-22-04 (2022)}. An updated harvest strategy was adopted in 2023 by the IATTC, which lays out management objectives relative to F and SSB reference points and biomass depletion, and sets an acceptable level of risk relative to breaching the SSB LRP (Resolution C-23-02 2023).
    - The WCPFC has adopted target and limit biomass reference points for the South Pacific stock of albacore (ISSF 2024), but no fishing mortality reference points. The target reference point is 56% of spawning stock biomass in the absence of fishing ($0.56SSB_{F = 0}$). The limit reference point is 20% of spawning stock biomass in the absence of fishing ($0.2SSB_{F = 0}$) (ISSF 2024).
- Other retained species: the IATTC has not adopted reference points for swordfish,

sharks, dorado, billfish, large pelagics like opah and wahoo, or rays, all of which may be retained by the longline fleet, though it is not clear if rays meet Seafood Watch main species criteria, based on the format of longline-ray interaction data (data are presented as number of minimum interactions in longlines, versus weight of catches in purse seines, making a direct comparison impractical).

Harvest control rules

- Yellowfin and bigeye: The HCR in place for these stocks applies specifically to the purse seine fishery rather than all fisheries ((Resolution C-23-06 2023); see the preceding factor 3.1 for purse seines). A more recent management measure puts catch limits in place for longlines landing bigeye tuna for 2025 and 2026 (IATTC 2024f).
- Albacore:
    - The IATTC has established an HCR for the North Pacific stock (Resolution C-23-02 2023). Within this is the requirement to rebuild the stock if it is at or below the limit reference point with a probability greater than 50%, but the HCR does not specify what these measures must be (although it does require that allowable fishing mortality be set at F_{min} in the absence of measures; F_{min} is the fishing intensity level that results in the stock producing 87% of the spawning potential ratio). Full implementation of this HCR has not yet occurred.
    - There is no HCR in place for the South Pacific stock, though resolutions are in place that call for the WCPFC to develop a harvest strategy that includes harvest control rules (CMM-2022-03, which supercedes CMM 2014-06) (ISSF 2024). At its 2024 meeting, the WCPFC adopted an interim TRP for the stock that is based on spawning depletion from 2017 to 2019 (Pilling et al. 2024). While it has been noted that catch should be reduced in longline and troll fisheries (ibid), there are no limits on fishing for this stock in the EPO.
- Other retained species: the IATTC has not adopted harvest control rules for swordfish, sharks, dorado, billfish, large pelagics like opah and wahoo, or rays, all of which may be retained by the longline fleet.

Management measures

- Yellowfin and bigeye: Most of the management measures in place for fisheries retaining yellowfin and bigeye are for the purse seine fleets only (see the preceding factor 3.1 for purse seines), though there are limits on the longline catch of bigeye (Resolution C-21-04 2021).
- Albacore: the WCPFC and IATTC have both adopted binding measures that call for members to not increase fishing effort for albacore in the North Pacific, beyond 2002–04 average levels (WCPFC—CMM 2019-03) and beyond the "current level" (IATTC—Resolution C-05-02 as amended by C-13-03 and C-18-03).
- Sharks: the IATTC has adopted a number of measures that apply to the longline

fleet:

- A 5% shark fin rule, meaning that shark fins can weigh no more than 5% of the total sharks onboard (Resolution C-05-03 2005).
- A retention and transshipment ban for oceanic whitetip shark (Resolution C-11-10 2011). Applies to longliners and purse seiners.
- A number of rules on retention of silky shark (Resolution C-21-06 2021; Resolution C-23-08 2023). These are mostly focused on reducing bycatch in nontargeted fisheries, but there are also measures for "multispecies" fisheries in some cases. This generally excludes the small vessel fleets that do not use mechanized hauls or winches. Unlike in purse seines, silky shark may be retained by longline vessels but can make up only 20% of the total catch.

- Other species: the IATTC has not implemented any management measures for the longline fleet for swordfish, dorado, billfish, large pelagics like opah and wahoo, or rays.

Effectiveness of measures

As noted in the factor 3.1 for purse seines, an MSE has been in development since 2019 and results are expected in 2024 (Valero and Aires-da-Silva 2022). This effort has to date been focused on the tropical tunas, with no similar effort in place for the other species retained by the longline fleets. Nonetheless, recent stock assessments suggest that fishing mortality has been at a sustainable level for the tropical tunas, albacore, and swordfish (see Criterion 1).

3.2 Bycatch Strategy

Eastern Central Pacific - Dolphin set purse seine

Moderately Effective

The main bycatch concerns in the dolphin-set purse seine fishery are dolphins and rays, though sharks are also captured, albeit in smaller quantities than by other gear types (see Criterion 2). Measures are in place to mitigate the impacts of the fishery on both of these taxa. In both cases, the measures are designed to reduce mortality once caught, and do appear to be aligned with best practices *for handling and release.* Although such approaches are often considered more cost-effective and therefore easier to implement than "avoidance" policies (such as closed areas and hard caps on bycatch mortality) (Cronin et al. 2022) and may help to discourage targeting and reduce mortality for some species, the injuries sustained can still lead to mortality and have population-level impacts {Hutchinson et al. 2023}. For this fishery, the observed mortality of dolphins has decreased by 99% since they were implemented. The measures to reduce the mortality of rays are more recent, and their effectiveness is not yet well understood. Though some measures are in place, effectiveness for some species is uncertain; thus, bycatch strategy is considered "moderately effective" (per line 2.2 in table 3.2.1 of the Seafood Watch Standard).

Supplementary Information

The IATTC recently established a Working Group on Ecosystem and Bycatch (Resolution C-22-06 2022). A focus of that group's first meeting was on understanding the knowledge and research gaps to the implementation of best handling and release practices for vulnerable species {Hutchinson et al. 2023}. This work reviewed the currently available data on post-release survival as well as best practices for reducing mortality relative to current requirements at the IATTC {Hutchinson et al. 2023}.

Dolphins

Under the Agreement of the International Dolphin Conservation Program (AIDCP), IATTC member countries use fisheries observers and are responsible for tracking tuna caught in dolphin sets and ensuring limited serious injury or mortality to dolphins during their capture (IATTC 2003). The aim of the AIDCP program is to reduce the incidental mortality of dolphins to levels approaching zero while maintaining the long-term stability of tunas (IATTC 1999). Associated agreements regulated the equipment the vessels should carry; established a system based on an overall dolphin mortality limit, complemented with individual vessel dolphin mortality limits; raised observer coverage to 100 percent; instituted a captain training system; promoted research on gear and techniques to reduce dolphin bycatch; promoted research on alternative ways of caching tunas; and established a tuna-tracking system {Hall & Ramon 2013}. Largely because of this program, the IATTC is considered a leader among RFMOs on dolphin bycatch mitigation {Elliott et al. 2023}.

The main technique used to release dolphins from encirclement is the "backdown" maneuver with a dolphin safety panel, which, combined with other measures as required in the AIDCP, has reduced mortalities of dolphins by 99% {Hutchinson et al. 2023}. There is some concern that the backdown maneuver itself may increase stress and thereby reduce fitness, though field observations suggest that some dolphins become familiar with the method and do not exhibit panicked behavior {Hutchinson et al. 2023}.

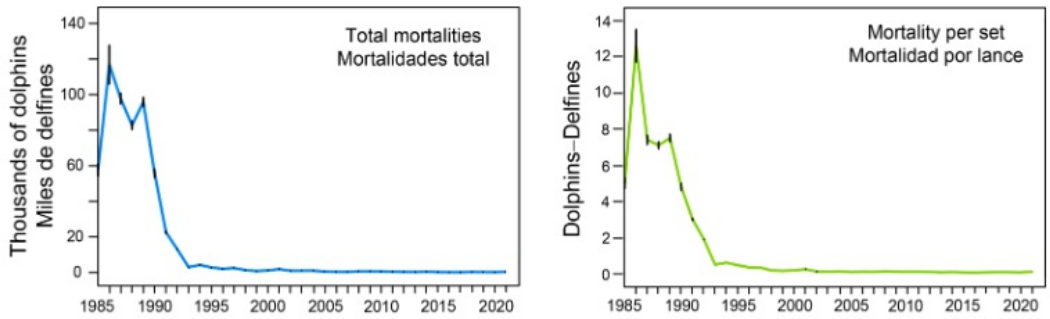

Figure 21: Dolphin mortality in the Eastern Pacific Ocean purse seine fisheries, 1985–2021 (from https://www.iattc.org/en-US/AIDCP/Instruments).

Rays

Purse seiners in the EPO are required to promptly release unharmed, to the extent practicable, all sharks, billfishes, rays, dorado, and other nontarget species (Resolution C-04-05 2006). Purse seiners are also encouraged to develop and use safe handling techniques (Resolution C-04-05 2006) for these taxa. In addition, mobulid retention and transshipping is prohibited on purse seine and longline vessels (Resolution C-15-04 2015). These taxa must be released alive when possible, consistent with best handling and release practices (BHRP) for purse seines {Poisson et al. 2014; Hutchinson et al. 2023} (Resolution C-15-04 does not provide BHRPs for longlines). Unintentional catch that is frozen must be landed and not sold. These measures exclude small-scale vessels when landing for domestic consumption (< 1.99 t) (Resolution C-15-04 2015), but this is not applicable to the dolphin-set fleet because these are all Class 6 vessels. Post-release survival of mobulids in purse seine fisheries in the EPO is not well understood, but the small datasets that do exist suggest PRS rates of 17%–92%, depending on the size of the animal, handling times, and possibly species, with large animals having lower PRS rates as a result of the increased difficulty in handling {Hutchinson et al. 2023}. In addition to improved data collection to better understand the impacts and effectiveness of measures to reduce those impacts, the IATTC Working Group on Ecosystem and Bycatch has recommended further testing of bycatch reduction devices (e.g., manta grids and hoppers) and testing strategies for avoidance {Hutchinson et al. 2023}—recommendations that have also been endorsed by the IATTC Science Advisory Committee (SAC 2023).

Sharks

As noted, IATTC purse seiners are required to release sharks (Resolution C-04-05 2006). In addition, specifically for silky shark, which is captured in dolphin-set purse seines, a retention ban is in place (IATTC 2023c; Resolution C-23-08 2023; Resolution C-23-07 2023). Measures to prevent shark capture are not in place, because current measures only focus on release of captured sharks.

Ghost fishing

In a recent global risk analysis on the impacts of derelict gear (including ghost fishing), Gilman et al. found that tuna purse seines with drifting FADs had larger global adverse effects from derelict gear than any other gear type, except gillnets and trammel nets (Figure 22) {Gilman et al. 2021}. The impacts of derelict tuna purse seine nets without FADs are likely to be minimal, because the loss of an entire net is a rare event and sections of the net that do get ripped off during use have low to no impacts on target or vulnerable species ({Gilman et al. 2021} Supplementary Info).

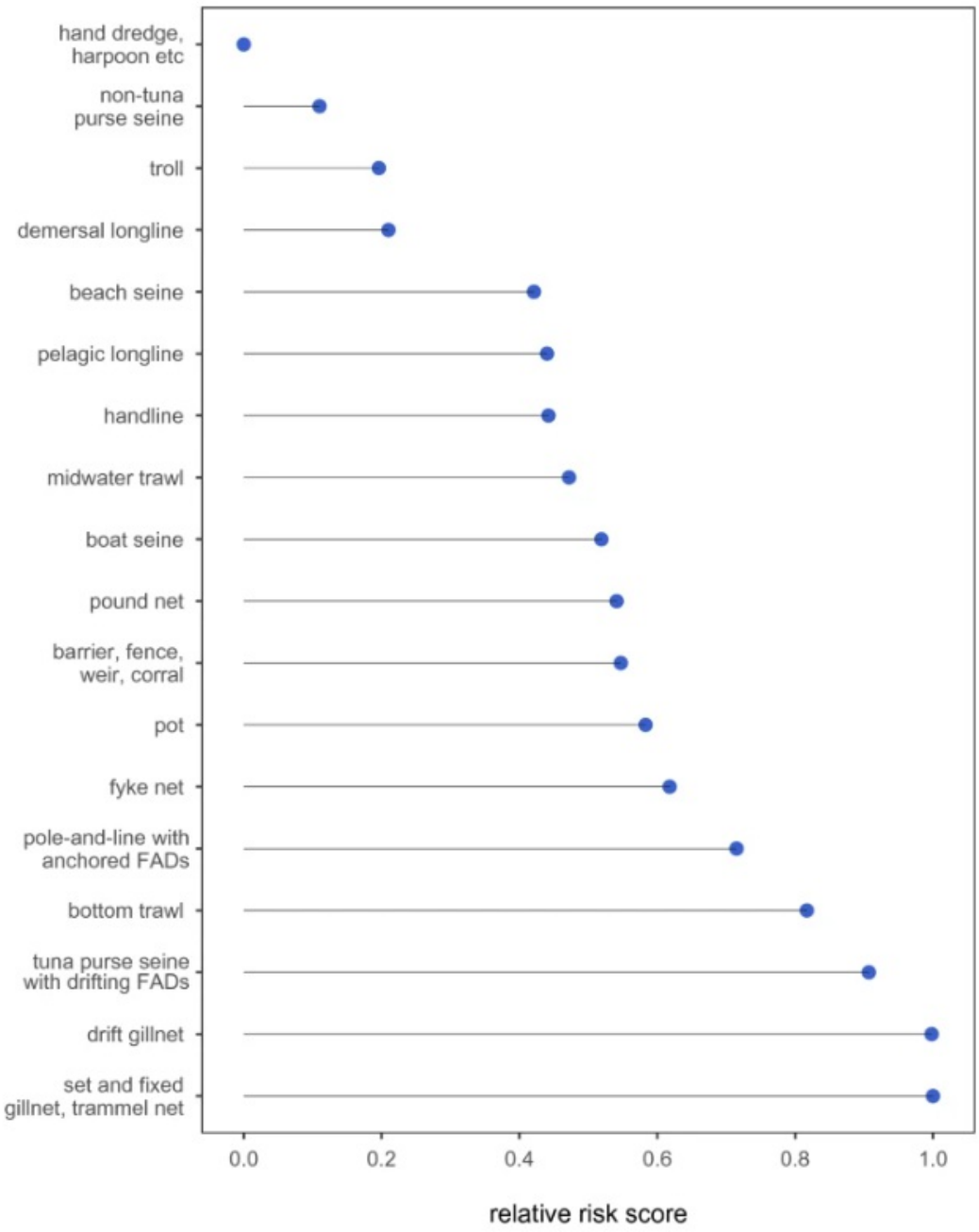

Figure 22: Gear-specific relative risk from abandoned, lost, and discarded fishing gear (ALDFG). From the top of the y-axis, fishing gears are listed from lowest overall relative risk score, which accounts for: (a) rate of production of ALDFG, (b) fishing effort (accounts for gear-specific weight of total catch and geospatial area of fishing grounds), and (c) adverse ecological and socioeconomic impacts of ALDFG (accounts for: ghost fishing, dispersal and transfer of toxins and microplastic into marine food webs, dispersal of invasive alien species and microalgae that cause harmful algal blooms, habitat degradation, obstruction and safety risks to navigation and in-use fishing gear, and reduced socioeconomic, aesthetic, and use values of coastal and nearshore habitats). The higher the relative risk score, the larger the amount of global adverse effects from ALDFG the gear is estimated to be causing, based on the quantity of derelict gear that the gear type leaks into the oceans and the relative adverse effects caused by ALDFG from that gear type. The

first gear category includes boat-based and shore-based hand dredge, harpoon, spear, lance, tongs, rakes, and hand-collected, including diving. Figure and text from {Gilman et al. 2021}. Original manuscript licensed under a Creative Commons Attribution 4.0 International License: http://creativecommons.org/licenses/by/4.0/

Eastern Central Pacific - Floating object purse seine (FAD)

Moderately Effective

The main bycatch species in the FAD fishery are sharks, rays, and various finfish. There are a number of measures in place in purse seine fisheries to reduce impacts on sharks, mobulids, and turtles that are mainly aimed at reducing mortality upon release (see Justification). These "remediation" approaches are often considered more cost-effective and therefore easier to implement than "avoidance" policies, such as closed areas and hard caps on bycatch mortality (Cronin et al. 2022). Although such measures may help discourage targeting and reduce mortality for some species, the injuries sustained can still lead to mortality and have population-level impacts. The IATTC Working Group on Ecosystem and Bycatch recently reviewed post-release survival of vulnerable species caught in IATTC fisheries {Hutchinson et al. 2023}. Unfortunately, post-release mortality is typically poorly understood (e.g., {Griffiths et al. 2022} for sharks), thus limiting an understanding of the effectiveness of such measures. FAD purse seine vessels must only use nonentangling FADs—the intent being to reduce entanglement of sharks, turtles, and other species ((Resolution C-19-01 2019) as amended by (Resolution C-23-05 2023)). This measure may also help reduce the chances of abandoned FADs leading to ghost fishing, a concern raised by Beverly et al. (2012), among others.

Despite management measures in place and some best practice recommendations that exist, there are no catch limits in place for the majority of bycatch species in the FAD fishery. Mitigation measures for most bycatch taxa (especially vulnerable sharks and rays) are minimal, but nonentangling FAD measures may significantly reduce mortality rates for these species in the fishery. Although recent management changes may reduce bycatch impacts, the full use of nonentangling FADs does not begin until 2025, so their effectiveness is unknown; therefore, bycatch strategy is considered "moderately effective" in FAD-set purse seines (per lines 2.2 and 2.3 in table 3.2.1 of the Seafood Watch Standard).

Supplementary Information

The IATTC recently established a Working Group on Ecosystem and Bycatch (Resolution C-22-06 2022). A focus of that group's first meeting was on understanding the knowledge and research gaps to the implementation of best handling and release practices for vulnerable species {Hutchinson et al. 2023}. This work reviewed the currently available data on post-release survival as well as best practices for reducing mortality relative to current requirements at the IATTC {Hutchinson et al. 2023}.

Sharks

The IATTC has adopted a number of measures that apply to the purse seine fleets:

- A 5% shark fin rule, meaning that shark fins can weigh no more than 5% of the total sharks onboard (Resolution C-05-03 2005).
- A retention and transshipment ban for oceanic whitetips (Resolution C-11-10 2011).
- A requirement for safe handling techniques to be deployed, and that those are aligned with specific best handling and release practices (Resolution C-16-05 2016).
- A retention and transshipment ban for white shark (Resolution C-19-06 2019).
- A retention and transshipment ban for silky shark, except that nonmechanical purse seine vessels are excluded (Resolution C-21-06 2021; Resolution C-23-08 2023).

Shark at-vessel and subsequent discard mortality rates are quite high, suggesting that retention bans (even when married to safe handling techniques) may not be as effective a measure for reducing shark mortality as releasing the sharks alive while still free swimming {Hutchinson et al. 2023}.

Rays

Purse seiners in the EPO are required to promptly release unharmed, to the extent practicable, all sharks, billfishes, rays, dorado, and other nontarget species (Resolution C-04-05 2006). Purse seiners are also encouraged to develop and use safe handling techniques (Resolution C-04-05 2006) for these taxa. In addition, mobulid retention and transshipping is prohibited on purse seine and longline vessels (Resolution C-15-04 2015). These taxa must be released alive when possible, consistent with best handling and release practices for purse seines {Poisson et al. 2014; Hutchinson et al. 2023} (Resolution C-15-04 does not provide BHRPs for longlines). Unintentional catch that is frozen must be landed and not sold. These measures exclude small-scale vessels when landing for domestic consumption (< 1.99 t) (Resolution C-15-04 2015). Post-release survival (PRS) of mobulids in purse seine fisheries in the EPO is not well understood, but the small datasets that do exist suggest PRS rates of 17%–92%, depending on the size of the animal, handling times, and possibly species, with large animals having lower PRS rates as a result of the increased difficulty in handling {Hutchinson et al. 2023}. In addition to improved data collection to better understand the impacts and effectiveness of measures to reduce those impacts, the IATTC Working Group on Ecosystem and Bycatch has recommended further testing of bycatch reduction devices (e.g., manta grids and hoppers) and testing strategies for avoidance {Hutchinson et al. 2023}—recommendations that have also been endorsed by the IATTC Science Advisory Committee (SAC 2023).

Other finfish

Purse seiners in the EPO are required to promptly release unharmed, to the extent practicable, all sharks, billfishes, rays, dorado, and other nontarget species (Resolution C-04-05 2006). Purse seiners are also encouraged to develop and use safe handling

techniques (Resolution C-04-05 2006). FAD purse seine vessels must only use fully nonentangling FADs from January 1, 2025, and fully nonentangling and biodegradable FADs by January 1, 2029 (Resolution C-23-04 2023).

Turtles

The IATTC requires safe release and safe handling of sea turtles for purse seines and longlines (Resolution C-19-04 2019). Moving to fully nonentangling and biodegradeable FADs is also an attempt to reduce turtle (and other incidental catch species) mortality (Resolution C-23-04 2023).

Ghost fishing

In a recent global risk analysis on the impacts of derelict gear (including ghost fishing), Gilman et al. found tuna purse seines with drifting FADs to have larger global adverse effects from derelict gear than any other gear type, except gillnets and trammel nets {Gilman et al. 2021}. The impacts of derelict tuna purse seine nets without FADs are likely to be minimal, because the loss of an entire net is a rare event and sections of the net that do get ripped off during use have low to no impacts on target or vulnerable species ({Gilman et al. 2021} Supplementary Info). But derelict FADs can remain quite efficient at catching vulnerable species until the FAD sinks or runs aground ({Gilman et al. 2021} Supplementary Info). Efforts to reduce the risk from derelict FADs include restrictions on the number of active FADs (Resolution C-21-04 2021), encouraging the initiation of FAD recovery programs (Resolution C-23-03 2023), establishing deadlines for transitioning to fully nonentangling (from 2025 onward) and biodegradable FADs (from 2029) (Resolution C-23-04 2023), and establishing design and deployment of nonentangling FADs (Resolution C-23-05 2023). Recently, an effort to increase data collection for FAD stranding events in Pacific Island Countries and Territories (PICTs) has resulted in the development of a stranding database created through joint efforts with the Pacific Community (Mourot et al. 2023). This database is the first step in realizing the potential impacts of ghost FAD gear and beginning a retrieval and cleanup program. Though the project is still in the data collection phase, IATTC members such as French Polynesia are pushing for its transition into a FAD retrieval phase (Escalle et al. 2023).

Eastern Central Pacific - Unassociated purse seine (non-FAD)

Moderately Effective

The main bycatch concerns in the unassociated purse seine fisheries are mobulids and, to a lesser extent, stingrays, sharks, and other fish (see Criterion 2). The IATTC has generally implemented measures to reduce bycatch rather than avoid it (for example, retention bans rather than closed areas or bycatch caps), and questions remain over the effectiveness of such measures because post-release mortality is poorly understood. These “remediation” approaches are often considered more cost-effective and therefore easier to implement than “avoidance” policies, such as closed areas and hard caps on bycatch mortality (Cronin et al. 2022).

Some management measures are in place, yet there are no catch limits for the majority of bycatch species in unassociated purse seines; however, this gear type is likely to have less of an impact on sensitive populations than longlines and FAD fisheries. Because measures are focused on avoidance rather than limitations, their effectiveness is uncertain, so bycatch strategy is considered “moderately effective.”

Supplementary Information

Sharks

The IATTC has adopted a number of measures that apply to the purse seine fleets:

- A 5% shark fin rule, meaning that shark fins can weigh no more than 5% of the total sharks onboard (Resolution C-05-03 2005).
- A retention and transshipment ban for oceanic whitetip (Resolution C-11-10 2011).
- A requirement for safe handling techniques to be deployed, and that those are aligned with specific best handling and release practices (Resolution C-16-05 2016).
- A retention and transshipment ban for white shark (Resolution C-19-06 2019).
- A retention and transshipment ban for silky shark, except that nonmechanical purse seine vessels are excluded (Resolution C-21-06 2021; Resolution C-23-08 2023).

Shark at-vessel and subsequent discard mortality rates are quite high, suggesting that retention bans (even when married to safe handling techniques) may not be as effective a measure for reducing shark mortality as releasing the sharks alive while still free-swimming {Hutchinson et al. 2023}.

Rays

Purse seiners in the EPO are required to promptly release unharmed, to the extent practicable, all sharks, billfishes, rays, dorado, and other nontarget species (Resolution C-04-05 2006). Purse seiners are also encouraged to develop and use safe handling techniques (Resolution C-04-05 2006) for these taxa. In addition, mobulid retention and transshipping is prohibited on purse seine and longline vessels (Resolution C-15-04 2015). These taxa must be released alive when possible, consistent with best handling and release practices for purse seines {Poisson et al. 2014; Hutchinson et al. 2023}. Unintentional catch that is frozen must be landed and not sold. These measures exclude small-scale vessels when landing for domestic consumption (< 1.99 t) (Resolution C-15-04 2015). Post-release survival (PRS) of mobulids in purse seine fisheries in the EPO is not well understood, but the small datasets that do exist suggest PRS rates of 17%–92%, depending on the size of the animal, handling times, and possibly species, with large animals having lower PRS rates because of the increased difficulty in handling {Hutchinson et al. 2023}. In addition to improved data collection to better understand the impacts and effectiveness of measures to reduce those impacts, the IATTC Working Group on Ecosystem and Bycatch has recommended further testing of bycatch reduction devices (e.g., manta grids and hoppers) and testing strategies for avoidance {Hutchinson et al. 2023}—recommendations that have also been endorsed by the IATTC Science Advisory Committee (SAC 2023).

Eastern Central Pacific, North Pacific - Canada | United States - British Columbia | California | Oregon | Washington - Trolling lines

Highly effective

There is no observer program in place that produces bycatch data, though some sporadic observer data are available from the 1990s through 2006. The limited evidence available indicates that there are no significant bycatch concerns in the fishery. Because this fishery has no or very low (< 5%) bycatch, bycatch strategy is considered “highly effective” (per the descriptor in line 1 in table 3.2.1 of the Seafood Watch Standard).

Eastern Central Pacific, Northeast Pacific - Drifting longlines

Eastern Central Pacific, Southeast Pacific - Drifting longlines

Ineffective

Bycatch concerns in the pelagic longline fleets include turtles, mammals, seabirds, sharks, rays, billfish, and other pelagic finfish (though some of these taxa are likely targeted by some of the smaller multispecies fleets; see the Criterion 2 Summary). A number of management measures aimed at protecting vulnerable bycatch species have been adopted by the IATTC (see Justification). For seabirds, measures are designed to avoid capture; however, even though they are among best practices (Swimmer et al. 2020), they fall short of practices recommended by the Agreement on the Conservation of Albatrosses and Petrels ((ACAP 2018) and apply only to large longline vessels. The measures for mobulids, oceanic whitetip shark, and turtles are designed to reduce mortality once caught. These “remediation” or “minimize” approaches are often considered more cost-effective and therefore easier to implement than “avoidance” policies, such as closed areas and hard caps on bycatch mortality (Cronin et al. 2022); however, measures that reduce or avoid interactions in the first place should reduce impacts the most (e.g., (IATTC WGB 2022) for leatherback sea turtles). The measures stipulated for turtles are among best practices, including circle hooks, finfish bait instead of squid, and deep setting (inferred here based on the resolution only requiring the other measures on shallow sets) (Swimmer et al. 2020). The effectiveness of nonretention policies (i.e., for mobulids, oceanic whitetip shark) depends on the implementation of best handling and release practices to reduce post-release mortality, which is typically poorly understood (e.g., {Griffiths et al. 2022; IATTC 2023a; Hutchinson et al. 2023}).

A suite of measures was put into place in 2021 to reduce mortality of silky shark (including a limit on the percentage of the catch that can be silky shark and to avoid pupping areas), along with requirements for better data collection. But the policy does not define the geographic location of the silky shark pupping areas, thus making that requirement unlikely to meaningfully avoid silky shark bycatch (Cronin et al. 2022). Also, small-scale vessels without mechanical winches that do not land their catch at motherships are exempt. Resolution C-23-07 requires CPCs to create National Plans of Action (NPOAs)

for shark species, bans shark finning, and requires longline vessels to use line cutters to release nonretained sharks (IATTC 2023d). But the measure does not put in place any catch limits for shark species or any measures to initially prevent interactions with sharks.

The IATTC has adopted measures that are likely effective in reducing bycatch (or bycatch mortality) for some taxa, but measures to reduce mortality of silky and other sharks across the myriad longline fleets targeting or bycatching pelagic sharks are likely insufficient, given the potential impacts of the fishery; therefore, bycatch strategy is considered "ineffective" (per line 3.1 in table 3.2.1 of the Seafood Watch Standard).

Supplementary Information

The IATTC recently established a Working Group on Ecosystem and Bycatch (Resolution C-22-06 2022). A focus of that group's first meeting was on understanding the knowledge and research gaps to the implementation of best handling and release practices for vulnerable species {Hutchinson et al. 2023}. This work reviewed the currently available data on post-release survival as well as best practices for reducing mortality relative to current requirements at the IATTC {Hutchinson et al. 2023}.

Sharks

The IATTC has adopted a number of measures that apply to the longline fleets:

- A 5% shark fin rule, meaning that shark fins can weigh no more than 5% of the total sharks onboard (Resolution C-05-03 2005).
- A retention and transshipment ban for oceanic whitetip shark (Resolution C-11-10 2011).
- A number of measures on longline catch of silky shark (primarily a limit on the percentage of the catch that can be silky shark, and a limit on the number of smaller sharks that can be retained), but retention is still permitted (Resolution C-21-06 2021). Silky shark can make up only 20% of the total catch on IATTC longline vessels, though this percentage is not based on any scientific population assessment for the species (IATTC 2023c).
- A requirement for NPOAs for sharks, release techniques on purse seine and longline vessels for nonretained sharks, and a ban on shark finning (IATTC 2023d).

There is evidence that shark at-vessel and subsequent discard mortality rates in longline fisheries can be significantly reduced through the application of best handling and release techniques, including leaving the sharks in the water and cutting the line at the hook with < 0.5 m of trailing line left attached {Hutchinson et al. 2023}. But none of the preceding measures provides guidance on what those best practices are. IATTC staff have recently noted that there is no scientific basis for the 5% shark fin rule, and instead recommend the prohibition of shark fins onboard vessels and requiring fins to be naturally attached to the shark carcass until the first point of landing (IATTC 2023b).

Rays

Mobulid retention and transshipping is prohibited on longline vessels (Resolution C-15-04 2015). These taxa must be released alive when possible, though Resolution C-15-04 does not provide BHRPs for longlines. Unintentional catch that is frozen must be landed and not sold. These measures excludes small-scale vessels when landing for domestic consumption (< 1.99 t) (Resolution C-15-04 2015). But Resolution C-15-04 does not apply to nonmobulid rays, and pelagic rays are the ray species of most concern in these fisheries (see Criterion 2).

Turtles

Longliners are required to utilize best practices and make the safe release of sea turtles a priority, carry safe handling tools, and ensure that fishers are trained in best handling measures (Resolution C-19-04 2019). That Resolution also contains the adopted handling and safe release guidelines, though the effectiveness of the measures as laid out has not been validated by the IATTC (also, training and vessel inspections are not generally reported to the IATTC either) (Hutchinson et al 2023). Shallow-set longliners must employ at least one of the following: large circle hooks, finfish for bait, or other Commission-approved measures (of which none has yet been adopted) (Resolution C-19-04 2019). IATTC staff have recommended revisions to Resolution C-19-04 based on an EASI-Fish modeling study, which found that a combination of circle hooks, finfish bait, and best handling and release approaches was by far the most effective way to reduce leatherback turtle mortality in EPO longline fisheries (IATTC WGB 2022; IATTC 2023b).

Seabirds

Large longliners (> 20 m, and other exclusions) fishing in a specific part of the IATTC area have to use at least two measures from the following two lists, including at least one from list A and not the same measure from both (Resolution C-11-02 2011):

- A
    - Side-setting with bird curtains and weighted branch lines
    - Night setting with minimum deck lighting
    - Tori line
    - Weighted branch lines
- B
    - Tori line
    - Weighted branch lines
    - Blue-dyed bait
    - Deep-setting line shooter
    - Underwater setting chute
    - Management of offal discharge

The Agreement on the Conservation of Albatrosses and Petrels (ACAP) recommends that the most effective way to reduce seabird bycatch in pelagic longline fisheries is to use the following three best practice measures simultaneously: branch line weighting, night

setting, and bird scaring lines (ACAP 2018). IATTC staff have recommended that the preceding two-part list approach be replaced by a requirement that at least two of the three mitigation methods (line weighting, night setting, and bird-scaring lines) are used in combination, in a way that will meet the minimum standards of ACAP and Birdlife International (IATTC 2023b). The staff also recommend that all other possible mitigation measures be removed as options until shown to be effective.

Mammals

There are no IATTC resolutions regarding mitigation of marine mammal bycatch impacts in longline fisheries {Hutchinson et al. 2023}.

Other finfish

There are no IATTC resolutions regarding mitigation of other pelagic finfish bycatch in longline fisheries.

Ghost fishing

In a recent global risk analysis on the impacts of derelict gear (including ghost fishing), Gilman et al. (2021) found pelagic longline fisheries to be just below average in terms of their global adverse effects from derelict gear, compared to other gear types (Gilman et al 2021). The loss of the entire mainline or sections of the mainline is rare in industrial longline fisheries, and the main sources of derelict gear from these fisheries are through discarding of damaged line and bite-offs of terminal tackle. Loss of the mainline is more likely in small-scale longline fisheries that do not use technology to track the lines. In either case, the lines could continue to catch target and nontarget species, but only briefly, while hooks remain baited (a few days) ({Gilman et al. 2021} Supplemental Information). No measures are in place at the IATTC to reduce the quantity of longlines or otherwise mitigate these impacts.

3.3 Scientific Data Collection and Analysis

Eastern Central Pacific - Dolphin set purse seine

Highly effective

Stock assessment

Yellowfin, bigeye, and skipjack tuna are assessed on a regular basis (IATTC 2018a). A variety of information including catch and effort data, size (for some species), and biological information is included in tuna assessments, although high levels of uncertainty are problematic for all species caught in the EPO tuna purse seine fishery. In addition, the IATTC is starting a process to advance a Management Strategy Evaluation (MSE) for tropical tunas, in working toward a more comprehensive harvest strategy (Valero and Aires-da-Silva 2019). The IATTC also strives to assess the sustainability of primary

bycatch species when there are sufficient data, including a recent review of silky shark and a developing ecological risk assessment for mobulid rays (IATTC 2018b; IATTC 2019e; IATTC 2018e).

Observer coverage

Large purse seine vessels (Class 6, carrying capacity of greater than 363 MT) must carry an observer (Resolution C-09-04). From 2009 onward, nearly 100% of these sets have been observed (94% in 2021 due to COVID-19) (IATTC 2022c; IATTC 2022d). All dolphin-set purse seine vessels are Class 6, so the fleet is nearly fully observed.

Other sources of information on catch composition include logbook records, cannery unloading records, and port sampling by IATTC field office staff. These solely focus on tuna species. Logbook data are available for all purse seine class sizes, with about 80%–90% coverage of all trips in recent years {Román et al. 2016}, as well as data from the IATTC port sampling program; however, these sources contain little information on bycatch or discards {Román et al. 2020}. Though this presents an issue for smaller vessel fleets, observer coverage adequately fills this gap for Class 6 vessels.

Catch composition is well understood for large purse seine vessels and target tuna species are regularly assessed, so scientific data collection and analysis is considered "highly effective" (per lines 1.1-2 and 1.4-5 in table 3.3.1 of the Seafood Watch Standard).

Eastern Central Pacific - Floating object purse seine (FAD)

Eastern Central Pacific - Unassociated purse seine (non-FAD)

Moderately Effective

Stock assessment

Yellowfin, bigeye, and skipjack tuna are assessed on a regular basis (IATTC 2018a). A variety of information including catch and effort data, size (for some species), and biological information is included in tuna assessments, although high levels of uncertainty are problematic for all species caught in the EPO tuna purse seine fishery. In addition, the IATTC is starting a process to advance a Management Strategy Evaluation (MSE) for tropical tunas, in working toward a more comprehensive harvest strategy (Valero and Aires-da-Silva 2019). The IATTC also strives to assess the sustainability of primary bycatch species when there are sufficient data, including a recent review of silky shark and a developing ecological risk assessment for mobulid rays (IATTC 2018b; IATTC 2019e; IATTC 2018e).

Observer coverage

Large purse seine vessels (Class 6, carrying capacity of greater than 363 MT) must carry an observer (Resolution C-09-04). From 2009 onward, nearly 100% of these sets have been observed (94% in 2021 due to COVID-19) (IATTC 2022c; IATTC 2022d). These

vessels compose the majority of registered purse seine vessels operating in the EPO and account for some 85% of the total purse seine catch of yellowfin, skipjack, and bigeye (based on the data in the IATTC catch and effort database for the years 1980–2015) {Román et al. 2016}. Nonetheless, there are still significant numbers of smaller purse seine vessels registered in some countries, including Ecuador, Mexico, the United States, and Peru. These fleets account for a greater portion of the catch of yellowfin and skipjack in coastal areas {Román et al. 2016}. There are likely many more small purse seine vessels that catch and land tuna and other large pelagics in Central America, but many are not registered to the IATTC because tuna is not the stated target. Given these weaknesses, reliable information on the relative contribution to the catch (and bycatch) from the different fleets is not yet forthcoming. There are no requirements for observer coverage on these smaller (Classes 1–5) vessels except in specific situations {Griffiths et al. 2022; IATTC 2023b). Of the 75 registered Classes 1–5 vessels in operation in 2021, only 10 (13.7%) had an observer. There are private efforts underway too, such as the voluntary program by the Ecuador-based Tuna Conservation Group (TUNACONS) implemented in 2018, with coverage being 12% of the number of trips for all Classes 1–5 vessels in the EPO in 2019. IATTC scientists have yet to determine how representative the TUNACONS data are of the wider fleet {Griffiths et al. 2022}. In all, most (73%) of these smaller vessels were unobserved in 2021 {Griffiths et al. 2022}. IATTC staff have recently recommended that the IATTC establish a nonvoluntary, fleet-wide observer program for Classes 1–5 vessels, with a sampling coverage of at least 20% (IATTC 2023b).

Other sources of information on catch composition include logbook records, cannery unloading records, and port sampling by IATTC field office staff. These solely focus on tuna species. Skippers of small vessels fishing on FADs are required to use the FAD form, which is a logbook that does include some information on bycatch species, but the data are too aggregated and uncertain to estimate impacts on these taxa (IATTC 2022c). Efforts are underway by IATTC staff to investigate the value and effectiveness of electronic monitoring systems, mainly in the poorly observed small vessel fleets, but also for supplementing human observer coverage {Román et al. 2020}. IATTC staff recently passed a measure outlining interim minimum standards for electronic monitoring (EM) on longline and purse seine vessels (IATTC 2024e). Although a step in the right direction, these standards do not implement requirements for the use of EM. In addition, EM cannot be used to replace observer coverage requirements. Logbook data are available for all purse seine class sizes, with about 80%–90% coverage of all trips in recent years {Román et al. 2016}, as well as data from the IATTC port sampling program, but these sources contain little information on bycatch or discards {Román et al. 2020}.

For now, while the catch composition of the large vessels may be well understood, the lack of appropriate monitoring data hampers understanding in the smaller vessel fleets, which in turn undermines our understanding of the fishery-specific and cumulative impacts on target and nontarget species. Catch composition data are better for the component of the purse seine fleet that sets on dolphins, because only Class 6 vessels are permitted in that fishery (and therefore must adhere to the 100% observer requirement).

Because some data are collected but are not collected for smaller purse seines at levels sufficient to meet a “highly effective” rating, scientific data collection and analysis is considered “moderately effective” (per line 2.1 in table 3.3.1 of the Seafood Watch Standard).

Eastern Central Pacific, North Pacific - Canada | United States - British Columbia | California | Oregon | Washington - Trolling lines

Moderately Effective

Albacore in the North Pacific is regularly assessed through a peer-reviewed process, but the lack of any recent objective information on catch composition in the fishery (e.g., video monitoring or observer coverage) leaves some room for concern. Because some data are collected but are not collected at levels sufficient to meet a “highly effective” rating, scientific data collection and analysis is considered “moderately effective” (per line 2.1 in table 3.3.1 of the Seafood Watch Standard).

Supplementary Information

Stock assessment

Albacore tuna is assessed on a regular basis, most recently in 2020 (ISC 2020). Fisheries-dependent catch (MT and size) and effort data from a number of fleets were used in the most recent assessment, along with biological information. In addition, the IATTC recently completed a Management Strategy Evaluation (MSE) for North Pacific albacore, to inform a more comprehensive harvest strategy (IATTC 2022c).

Observer coverage

There is no observer program for the troll fishery in the United States or Canada, though sporadic observer data from the 1990s and 2006 suggest that there is little bycatch (or catch of anything but albacore) (see the Criterion 2 Summary). Catch is documented in logbooks.

Eastern Central Pacific, Northeast Pacific - Drifting longlines

Eastern Central Pacific, Southeast Pacific - Drifting longlines

Ineffective

Stock assessment

Yellowfin and bigeye tuna are assessed on a regular basis (IATTC 2018a) (see factor 3.3 for purse seine fisheries). The IATTC also strives to assess the sustainability of primary bycatch species when there are sufficient data, including a recent review of silky shark and a developing ecological risk assessment for mobulid rays (IATTC 2018b; IATTC 2019e; IATTC 2018e).

Catch and effort monitoring

Similar to the purse seine fleets, longline fleets in the EPO vary in the size and number of vessels, with many Central and South American countries having quite large numbers of "artisanal" vessels, varying from pangas to larger vessels of 15–20 m in length. Monitoring of catch and effort of such fleets is a significant challenge, and few reliable data exist for these fisheries throughout the EPO because they are also poorly monitored by national fisheries agencies, if at all {Salas et al. 2007; Griffiths et al. 2022}. Unlike for purse seine fleets, IATTC staff do not obtain data directly from longline vessels; instead, data are collected by the CPC and are provided in summary form, with limited information on gear characteristics, discards, and bycatch {Román et al. 2020}. Thus, scientific data collection and verification or enforcement of regulations is lacking, leading to substantial barriers to achieving long-term conservation objectives and the sustainable use of resources {Rogers et al. 2022}. This situation is most severe in the longline fleet, where small vessel size, the sheer number of vessels, and the extensive footprint of the gear combine into a high potential for environmental impacts with low oversight {Román et al. 2020; Rogers et al. 2022}. But IATTC staff recently passed a measure outlining interim minimum standards for electronic monitoring (EM) on longline and purse seine vessels (IATTC 2024e). While a step in the right direction, these standards do not implement requirements for the use of EM. In addition, EM cannot be used to replace observer coverage requirements.

Observer coverage

The IATTC has required 5% observer coverage (effective days of fishing or hooks deployed) on longline vessels greater than 20 m in length since 2013 (Resolution C-19-08, replacing Resolution C-11-08 (IATTC 2019l)). Despite this mandate, few countries have consistently reported observer data, and few currently achieve the 5% coverage level (see Justification). Furthermore, the IATTC scientific staff, Bycatch Working Group, and Scientific Advisory Committee have consistently called for an increase in coverage to 20%, because the 5% mandate is not high enough to estimate the total catch of relatively data-rich species such as yellowfin and bigeye tunas, let alone bycatch species (IATTC 2022c). This recommendation has yet to be adopted by the IATTC (IATTC 2019l; IATTC 2022c). The United States is the only country to meet this level of coverage in 2022, though (by some measures) Mexico was close (see Justification) (IATTC SAC 2023a).

Overall, the lack of effective monitoring limits our understanding of the impacts of these fisheries on both target and nontarget species, so scientific data collection and analysis is considered "ineffective" (per line 3.2 in table 3.3.1 of the Seafood Watch Standard).

Supplementary Information

Longline observer program reporting requirements at IATTC were recently reviewed by IATTC staff during the 14th meeting of the Scientific Advisory Committee, May 15–19, 2023 (IATTC SAC 2023a).

CPC	Annex A Summary submitted?	% Observer coverage reported 2022
BLZ	NA	Qualifying vessels did not operate in 2022
CHL	NA	Qualifying vessels did not operate in 2022
CHN	yes	7% (# hooks), 6.8% (effective days fished)
CRI	NR	Did not have a LL observer program in 2022
ECU	yes	9% (# hooks), 5% (effective days fished)
EU	yes	6% (effective days fished), 5% (# hooks)
FRA	NA	CPC reports that 100% of LL catches are from the IATTC/WCPFC overlap area, where they have elected to apply the requirements of WCPFC
JPN	yes	0% because of COVID-19 pandemic
KOR	yes	5% (effective days fished), 3% (# hooks)
MEX	yes	18% (effective days fished), 13% (# hooks)
NIC	NA	Qualifying vessels did not operate in 2022
PAN	yes	4.4% (# hooks), 3% (effective days fished)
PER	NA	Qualifying vessels did not operate in 2022
TWN	yes	5.1% (effective days fished) 3.3% (# hooks)
USA	yes	21% (# of hooks)
VEN	NA	Qualifying vessels did not operate in 2022
VUT		No reporting received

Figure 23: Summary of Annex A reporting by CPC showing whether Annex A was submitted for the 2022 fishing year, the percent observer coverage achieved, and the fishing effort metric used to calculate observer coverage. Red denotes that a CPC had longline vessels > 20 LOA on the IATTC RVR (or longline vessels without registered LOAs) but did not report. Black indicates that the CPC had qualifying vessels on the RVR, but the CPC has communicated that C-19-08 did not apply in 2022 because the relevant vessel(s) were not active or did not fish for IATTC species. Green indicates that the CPC submitted summary reporting in the required format and, in the % observer coverage column, that the 5% minimum coverage requirement was met. Yellow highlights that reporting was received, but the % coverage reported was below 5%. Chart and text directly from (IATTC SAC 2023a).

3.4 Enforcement of and Compliance with Management Regulations

Eastern Central Pacific, North Pacific - Canada | United States - British Columbia | California | Oregon | Washington - Trolling lines

Highly effective

The majority of IATTC and WCPFC resolutions are focused on purse seines and, to a lesser extent, longlines, with no resolutions created specifically for troll fisheries at the RFMO level. There are also no observer requirements in place for this fishery; however, a required logbook program (via NOAA) is in place, and permitting for U.S. fishers is done through NOAA as well (PFMC 2023; NOAA Fisheries 2023). Canada also collects logbook data and fishing vessel information that is required through the Canada–United States Albacore Treaty and the IATTC, and permitting is done through Fisheries and Oceans Canada (DFO 2020). The U.S. Coast Guard works with the Canadian government to conduct aerial surveillance, to supplement logbooks as a method of confirming compliance within the fishery (ibid). Compliance is assessed annually, and the latest information from Canada suggests few compliance issues; namely, occasional noncompliance with reporting requirements (ibid). This is being addressed via stakeholder meetings and advisory groups and working with individual vessel owners. Because enforcement is appropriate to the smaller scale of the troll fisheries, and there is generally a strong capacity to ensure compliance and resolve compliance issues, enforcement and compliance is considered "highly effective" (per lines 1.1 and 1.2 in table 3.4.1 of the Seafood Watch Standard).

Eastern Central Pacific, Northeast Pacific - Drifting longlines

Eastern Central Pacific - Floating object purse seine (FAD)

Eastern Central Pacific - Unassociated purse seine (non-FAD)

Eastern Central Pacific - Dolphin set purse seine

Moderately Effective

The IATTC has a Committee for the Review of Implementation of Measures Adopted by the Commission that collects compliance information. The Committee receives compliance reports and uses them to identify potential compliance issue areas and improvement suggestions/incentives. Under Resolution C-11-07, CPCs with compliance issues must create plans of action to improve compliance (Belmontes 2022). In 2022, the Committee held a workshop in which it identified several compliance issues seen in the purse seine fleets in 2021 (see Justification) (ibid). The Committee has also noted that compliance issues are much more difficult to identify in longline fleets because of their low observer coverage (5%) (Committee for the Review of Implementation of Measures Adopted by the Commission 2022). Resolution C-23-11 requires vessels > 24 m in length to be equipped with a vessel monitoring system (VMS), if they are flagged to IATTC Members, and non-Member states are encouraged but not required to do the same (IATTC 2023e). Monitoring committees and/or observers are generally in place to ensure that IATTC goals are successfully met, although the effectiveness of enforcement/monitoring may be uncertain in some cases because of the limited application of sanctions (Koehler 2013). Further, although the Committee has noted improvements in purse seine compliance, issues of noncompliance are still seen via compliance reports and observer coverage (Committee for the Review of Implementation

of Measures Adopted by the Commission 2022). Therefore, enforcement and compliance is considered "moderately effective" (per line 2 in table 3.4.1 of the Seafood Watch Standard).

Supplementary Information

Information on catches of tuna and tuna-like species in the EPO is provided to the IATTC through vessel logbooks, observer programs, unloading records, export/import records, and sampling programs (IATTC 2013f). There are several purse seine-specific enforcement measures in place. For example, countries must report the names of purse seine vessels and relevant closure dates to IATTC. Countries are also responsible for taking legal and administrative actions necessary to implement closures and inform the IATTC Director that such steps have been taken (IATTC 2013i). The compliance committee has noted that the amount of noncompliance has been reduced in recent years (IATTC 2014g; Committee for the Review of Implementation of Measures Adopted by the Commission 2022). Vessels larger than 24 m in length must have a VMS in place (IATTC 2023e).

The IATTC reviews the implementation of management measures and other obligations requested within resolutions. There is some transparency in this process, because the IATTC Review Committee is open to observers and documents are made available to member countries and observers. But all information on compliance (e.g., reports and report summaries) within the IATTC is not publicly available on its website. The most recent publicly available information on its website stems from a Committee workshop meeting held in 2022 (Belmontes 2022). Several noncompliance issues in purse seines and carrier vessels (transshipment vessels) were identified for the 2021 fishing year, including set incidents with sea turtles and shark interactions.

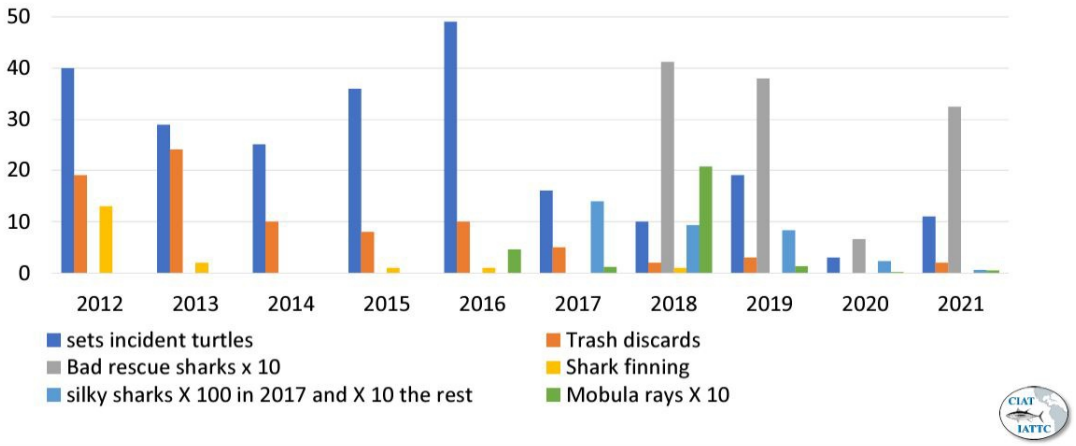

Figure 24: Possible infractions in IATTC purse seines from 2012 to 2021. Source: (Belmontes 2022).

Posibles infracciones reportadas por observadores en buques cargueros Possible infractions reported by observers. Carrier vessels 2017 - 2021					
Possible infraction and relevant resolution	2017	2018	2019	2020	2021
Poor sanitary conditions (C-12-07, Annex 3)	12	7	8	6	4
Differences between fish reported in the TD by vessels and the observer (C-12-07, Annex 3)	5	8	4	8	2
Trash discarded at sea (C-04-05)	2	4	2	2	0
Shark fin on board (C-05-03)	2	2	1	4	1
Unreported transshipped tuna. C-12-07. Annex 3	2	1	1	2	0
Interference with observer's work C-12-07, Annex 3	3	1	0	0	0
Insufficient Support for the observer's work (idem)	-	3	1	5	0
Possible falsified declaration.C-12-07 Annex 3)	-	1	0	1	0
Fuel Split at sea (MARPOL)	1	1	2	1	0
Poor safety conditions (SOLAS)	-	2	4	4	2

Figure 25: Possible infractions in IATTC transshipment vessels, as reported by observers, from 2017 to 2021. Source: (Belmontes 2022).

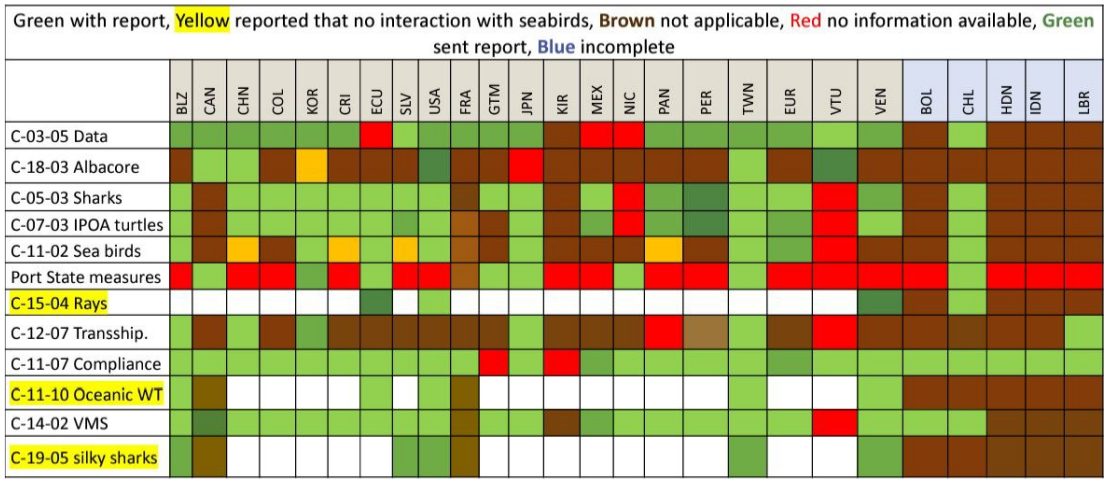

Figure 26: Summary of reports sent by CPCs to the Compliance Committee in 2021. Source: (Belmontes 2022).

Eastern Central Pacific, Southeast Pacific - Drifting longlines

Moderately Effective

The IATTC has a Committee for the Review of Implementation of Measures Adopted by the Commission that collects compliance information. The Committee receives compliance reports and uses them to identify potential compliance issue areas and improvement suggestions/incentives. Under Resolution C-11-07, CPCs with compliance issues must create plans of action to improve compliance (Belmontes 2022). In 2022, the

Committee held a workshop in which it noted that compliance issues are much more difficult to identify in longline fleets because of their low observer coverage (5%) (Committee for the Review of Implementation of Measures Adopted by the Commission 2022). Thus, monitoring committees and/or observers are generally in place to ensure that IATTC goals are successfully met, although the effectiveness of enforcement/monitoring may be uncertain in some cases because of the limited application of sanctions (Koehler 2013). This uncertainty is furthered by the low observer coverage in longline fleets, which prevents adequate compliance data from being collected. Because of the uncertain nature of compliance and enforcement in longline fleets, enforcement and compliance is considered "moderately effective" (per line 2 in table 3.4.1 of the Seafood Watch Standard).

Supplementary Information

Information on catches of tuna and tuna-like species in the EPO is provided to the IATTC through vessel logbooks, observer programs, unloading records, export/import records, and sampling programs (IATTC 2013f). The compliance committee has noted that the amount of noncompliance has been reduced in recent years, though this is mostly relative to purse seine rather than longline fleets (IATTC 2014g; Committee for the Review of Implementation of Measures Adopted by the Commission 2022). But the Committee did note that they surmise a similar positive trend in the longline fleet (Committee for the Review of Implementation of Measures Adopted by the Commission 2022). The IATTC reviews the implementation of management measures and other obligations requested within resolutions. There is some transparency in this process, because the IATTC Review Committee is open to observers and documents are made available to member countries and observers. But all information on compliance (e.g., reports and report summaries) within the IATTC is not publicly available on its website. The most recent publicly available information on its website stems from a Committee workshop meeting held in 2022, which focused on purse seine compliance (Belmontes 2022).

3.5 Stakeholder Inclusion

Eastern Central Pacific - Floating object purse seine (FAD)

Eastern Central Pacific - Unassociated purse seine (non-FAD)

Eastern Central Pacific - Dolphin set purse seine

Highly effective

The IATTC allows for outside accredited observers, which can comprise scientists, NGOs, or other interested parties, to attend and present at meetings. In addition, individual country delegations have representatives from various stakeholders, including NGOs, government, producers, suppliers, and exporters (Koehler 2013). Also, the IATTC will conduct a series of Management Strategy Evaluations going forward and is actively seeking input from interested stakeholders to inform the process (IATTC 2018d).

Decisions regarding newly passed resolutions or meeting outcomes are posted on its website and are publicly available, though compliance reports are only seen by IATTC staff and approved meeting observers. Further, NGOs are excluded from IATTC private sessions (Fischer 2022). In a 2015 evaluation of RFMO transparency, the IATTC scored quite well (top three) {Clark et al. 2015}. Overall, the IATTC is generally transparent in its processes and seeks input from all relevant stakeholders, so stakeholder inclusion is considered "highly effective" (per lines 1.1 through 1.5 in table 3.5.1 of the Seafood Watch Standard).

Eastern Central Pacific, Northeast Pacific - Drifting longlines

Eastern Central Pacific, Southeast Pacific - Drifting longlines

Eastern Central Pacific, North Pacific - Canada | United States - British Columbia | California | Oregon | Washington - Trolling lines

Moderately Effective

The IATTC allows for outside accredited observers, which can comprise scientists, NGOs, or other interested parties, to attend and present at meetings. In addition, individual country delegations have representatives from various stakeholders, including NGOs, government, producers, suppliers, and exporters (Koehler 2013). Also, the IATTC will conduct a series of Management Strategy Evaluations going forward and is actively seeking input from interested stakeholders to inform the process (IATTC 2018d). Decisions regarding newly passed resolutions or meeting outcomes are posted on its website and are publicly available, though compliance reports are only seen by IATTC staff and approved meeting observers. Further, NGOs are excluded from IATTC private sessions (Fischer 2022). In a 2015 evaluation of RFMO transparency, the IATTC scored quite well (top three) {Clark et al. 2015}. But many of the IATTC's decisions are guided by assessments and scientific advice from the International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean (ISC), an independent body that conducts stock assessments for North Pacific albacore, Pacific blue marlin, and other species. The ISC does not allow observers into species working-group meetings, through which scientific advice for the IATTC is created and stock assessment results are discussed and finalized. Overall, the IATTC is generally transparent in its processes and seeks input from all relevant stakeholders, but not all stakeholders are able to participate in the assessment process as a result of the lack of transparency at ISC; thus, stakeholder inclusion is considered "moderately effective" (per lines 2.1 and 2.2 in table 3.5.1 of the Seafood Watch Standard).

Criterion 4: Impacts on the Habitat and Ecosystem

This Criterion assesses the impact of the fishery on seafloor habitats, and increases that base score if there are measures in place to mitigate any impacts. The fishery's overall impact on the ecosystem and food web and the use of ecosystem-based fisheries management (EBFM) principles is also evaluated. Ecosystem Based Fisheries Management aims to consider the interconnections among species and all natural and human stressors on the environment. The final score is the geometric mean of the impact of fishing gear on habitat score (factor 4.1 + factor 4.2) and the Ecosystem Based Fishery Management score. The Criterion 4 rating is determined as follows:

- Score >3.2 = **Green** or Low Concern
- Score >2.2 and ≤3.2 = **Yellow** or Moderate Concern
- Score ≤2.2 = **Red** or High Concern

Guiding principles

- Avoid negative impacts on the structure, function or associated biota of marine habitats where fishing occurs.
- Maintain the trophic role of all aquatic life.
- Do not result in harmful ecological changes such as reduction of dependent predator populations, trophic cascades, or phase shifts.
- Ensure that any enhancement activities and fishing activities on enhanced stocks do not negatively affect the diversity, abundance, productivity, or genetic integrity of wild stocks.
- Follow the principles of ecosystem-based fisheries management.

Rating cannot be Critical for Criterion 4.

Criterion 4 Summary

Fishery	Physical Impact of Fishing Gear on the Habitat/Substrate	Modifying Factor: Mitigation of Gear Impacts	Ecosystem-based Fisheries Management	Score
Eastern Central Pacific - Dolphin set purse seine	Score: 5	Score: 0	Moderate Concern	Green (3.873)
Eastern Central Pacific - Floating object purse seine (FAD)	Score: 5	Score: 0	Moderate Concern	Green (3.873)
Eastern Central Pacific - Unassociated purse seine (non-FAD)	Score: 5	Score: 0	Moderate Concern	Green (3.873)
Eastern Central Pacific, North Pacific - Canada | United States - British Columbia | California | Oregon | Washington - Trolling lines	Score: 5	Score: 0	Moderate Concern	Green (3.873)
Eastern Central Pacific, Northeast Pacific - Drifting longlines	Score: 5	Score: 0	High Concern	Yellow (3.162)
Eastern Central Pacific, Southeast Pacific - Drifting longlines	Score: 5	Score: 0	High Concern	Yellow (3.162)

Criterion 4 Assessment

Scoring Guidelines

Factor 4.1 - Physical Impact of Fishing Gear on the Habitat/Substrate

Goal: The fishery does not adversely impact the physical structure of the ocean habitat, seafloor or associated biological communities.

- *5 - Fishing gear does not contact the bottom*
- *4 - Vertical line gear*
- *3 - Gears that contacts the bottom, but is not dragged along the bottom (e.g. gillnet, bottom longline, trap) and is not fished on sensitive habitats. Or bottom seine on resilient mud/sand habitats. Or midwater trawl that is known to contact bottom occasionally. Or purse seine known to commonly contact the bottom.*
- *2 - Bottom dragging gears (dredge, trawl) fished on resilient mud/sand habitats. Or gillnet, trap, or bottom longline fished on sensitive boulder or coral reef habitat. Or bottom seine except on mud/sand. Or there is known trampling of coral reef habitat.*
- *1 - Hydraulic clam dredge. Or dredge or trawl gear fished on moderately sensitive habitats (e.g., cobble or boulder)*
- *0 - Dredge or trawl fished on biogenic habitat, (e.g., deep-sea corals, eelgrass and maerl) Note: When multiple habitat types are commonly encountered, and/or the habitat classification is uncertain, the score will be based on the most sensitive, plausible habitat type.*

Factor 4.2 - Modifying Factor: Mitigation of Gear Impacts

Goal: Damage to the seafloor is mitigated through protection of sensitive or vulnerable seafloor habitats, and limits on the spatial footprint of fishing on fishing effort.

- *+1 —>50% of the habitat is protected from fishing with the gear type. Or fishing intensity is very low/limited and for trawled fisheries, expansion of fishery's footprint is prohibited. Or gear is specifically modified to reduce damage to seafloor and modifications have been shown to be effective at reducing damage. Or there is an effective combination of 'moderate' mitigation measures.*
- *+0.5 —At least 20% of all representative habitats are protected from fishing with the gear type and for trawl fisheries, expansion of the fishery's footprint is prohibited. Or gear modification measures or other measures are in place to limit fishing effort, fishing intensity, and spatial footprint of damage caused from fishing that are expected to be effective.*
- *0 —No effective measures are in place to limit gear impacts on habitats or not applicable because gear used is benign and received a score of 5 in factor 4.1*

Factor 4.3 - Ecosystem-Based Fisheries Management

Goal: All stocks are maintained at levels that allow them to fulfill their ecological role and to maintain a functioning ecosystem and food web. Fishing activities should not seriously reduce ecosystem services provided by any retained species or result in harmful changes such as trophic cascades, phase shifts or reduction of genetic diversity. Even non-native species should be considered with respect to ecosystem impacts. If a fishery is managed in order to eradicate a non-native, the potential impacts of that strategy on native species in the ecosystem should be considered and rated below.

- *5 — Policies that have been shown to be effective are in place to protect species' ecological roles and ecosystem functioning (e.g. catch limits that ensure species' abundance is maintained at sufficient levels to provide food to predators) and effective spatial management is used to protect spawning and foraging areas, and prevent localized depletion. Or it has been scientifically demonstrated that fishing practices do not have negative ecological effects.*
- *4 — Policies are in place to protect species' ecological roles and ecosystem functioning but have not proven to be effective and at least some spatial management is used.*
- *3 — Policies are not in place to protect species' ecological roles and ecosystem functioning but detrimental food web impacts are not likely or policies in place may not be sufficient to protect species' ecological roles and ecosystem functioning.*
- *2 — Policies are not in place to protect species' ecological roles and ecosystem functioning and the likelihood of detrimental food impacts are likely (e.g. trophic cascades, alternate stable states, etc.), but conclusive scientific evidence is not available for this fishery.*
- *1 — Scientifically demonstrated trophic cascades, alternate stable states or other detrimental food web impact are resulting from this fishery.*

4.1 Physical Impact of Fishing Gear on the Habitat/Substrate

Eastern Central Pacific, Northeast Pacific - Drifting longlines

Eastern Central Pacific, Southeast Pacific - Drifting longlines

Eastern Central Pacific, North Pacific - Canada | United States - British Columbia | California | Oregon | Washington - Trolling lines

Eastern Central Pacific - Floating object purse seine (FAD)

Eastern Central Pacific - Unassociated purse seine (non-FAD)

Eastern Central Pacific - Dolphin set purse seine

Score: 5

Surface gears such as those used to catch tunas and large pelagics are unlikely to touch the seafloor {Hall & Ramon 2013; DFO 2019; PFMC 2023), and when they do (as can happen with anchored FADs and shallow set longlines (Beverly et al. 2012; Passfield and Gillman 2010)), they are likely to result in only minimal damage to seafloor habitats (Beverly et al. 2012; Gilman et al. 2013). Therefore, physical impacts are considered a “5” (per line 1 in table 4.1.1 of the Seafood Watch Standard).

4.2 Modifying Factor: Mitigation of Gear Impacts

Eastern Central Pacific, Northeast Pacific - Drifting longlines

Eastern Central Pacific, Southeast Pacific - Drifting longlines

Eastern Central Pacific, North Pacific - Canada | United States - British Columbia | California | Oregon | Washington - Trolling lines

Eastern Central Pacific - Floating object purse seine (FAD)

Eastern Central Pacific - Unassociated purse seine (non-FAD)

Eastern Central Pacific - Dolphin set purse seine

Score: 0

Not applicable because the gear used is benign and the fishery received a score of 5 for factor 4.1.

4.3 Ecosystem-based Fisheries Management

Eastern Central Pacific, North Pacific - Canada | United States - British Columbia | California | Oregon | Washington - Trolling lines

Eastern Central Pacific - Floating object purse seine (FAD)

Eastern Central Pacific - Unassociated purse seine (non-FAD)

Eastern Central Pacific - Dolphin set purse seine

Moderate Concern

Fisheries managed by the IATTC catch a number of high trophic-level species as target or as bycatch, including tunas, swordfish and other billfish, dorado, and wahoo (see the Criterion 2 Summary). In particular, sharks are considered top predators in many ecosystems and play a critical role in how these ecosystems are structured and function (Piraino et al. 2002; Stevens et al. 2000). But only longline fisheries retain sharks, and the main species across other fisheries (purse seines, troll, handline) only consist of target tunas.

According to IATTC staff (Griffiths and Fuller 2019), the Commission has explicitly defined an ecosystem approach to the management of tuna fisheries, as required by the Antigua Convention, as follows: "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" (IATTC 2018c). To date, many efforts have been taken to understand the ecological impacts of EPO fisheries on target and nontarget species, including stock assessments and vulnerability analyses (see Criterion 1 and Criterion 2). In addition, staff have developed an ecosystem model of the tropical EPO that allows for improved understanding of complex predator-prey relationships and other elements of the marine ecosystem, and facilitates forecasting of the impacts from specific perturbations such as fishing and climate change (Griffiths and Fuller 2019). That model provides yearly estimates for seven ecological indicators, which in combination show that ecosystem structure has likely changed over the last few decades (1993–2021) and that these changes have been driven primarily by the sixfold increase in FAD sets over the past two decades (IATTC 2023a). There are now efforts to at least limit the number of FAD sets to the status quo, if not bring the number of sets down significantly (Resolution C-21-04 2021).

Though some effort has been put into creating EBFM policies and HCRs at the RFMO level, the ecological role of large tunas is not fully protected by current management measures; thus, ecosystem-based fisheries management is considered a "moderate concern" (per line 3.2.a in table 4.3.1 of the Seafood Watch Standard).

Eastern Central Pacific, Northeast Pacific - Drifting longlines

Eastern Central Pacific, Southeast Pacific - Drifting longlines

High Concern

Longline fisheries managed by the IATTC catch and retain a number of high trophic-level species as target, including tunas, swordfish and other billfish, dorado, and wahoo (see the Criterion 2 Summary; see Criterion 3.1 for a list of main species). In particular, sharks are considered top predators in many ecosystems and play a critical role in how these ecosystems are structured and function (Piraino et al. 2002; Stevens et al. 2000). The loss of these predators can cause many changes, such as to prey abundances, that can lead to a

cascade of other effects (Duffy 2003; Myers et al. 2007; Ferretti et al. 2010; Schindler et al. 2002) and behavioral changes (Heithaus et al. 2007).

According to IATTC staff (Griffiths and Fuller 2019), the Commission has explicitly defined an ecosystem approach to the management of tuna fisheries, as required by the Antigua Convention, as follows: "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" (IATTC 2018c). To date, many efforts have been taken to understand the ecological impacts of EPO fisheries on target and nontarget species, including stock assessments and vulnerability analyses (see Criterion 1 and Criterion 2). In addition, IATTC staff have developed an ecosystem model of the tropical EPO that allows for improved understanding of complex predator-prey relationships and other elements of the marine ecosystem, and facilitates forecasting of impacts from specific perturbations such as fishing and climate change (Griffiths and Fuller 2019). That model provides yearly estimates for seven ecological indicators, which in combination show that ecosystem structure has likely changed over the last few decades (1993–2021) and that these changes have been driven primarily by the sixfold increase in FAD sets over the past two decades (IATTC 2023a). Though this research points to ecosystem impacts driven by FADs, longline fisheries also may create negative impacts on the ecosystem, based on their retention of shark species, versus purse seines in the EPO, which are instructed to release any captured sharks. Further, many of the main species in longline fisheries (large pelagic finfish, billfish) lack harvest control rules, and it is unknown if longline captures of these species could create harmful ecosystem impacts.

Although some effort has been put into creating EBFM policies at the RFMO level, longlines retain top predators such as sharks without fully protective management in place, which may create detrimental food web impacts; thus, ecosystem-based management in longline fisheries is considered a "high concern" (per lines 4.1.a and 4.1.b in table 4.3.1 of the Seafood Watch Standard).

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References

Smith, M.M., 1986. Bramidae. p. 633-636. In M.M. Smith and P.C. Heemstra (eds.) Smiths' sea fishes. Springer-Verlag, Berlin.

. Inter-American Tropical Tuna Commission (IATTC). 2013e. Status of sailfish in the Eastern Pacific Ocean in 2011 and outlook for the future. Document SAC-04-07c.

1408

ACAP 2018. ACAP Review and Best Practice Advice for Reducing the Impact of Pelagic Longline Fisheries on Seabirds. IATTC SAC 9th meeting, 14-18 May 2018 Document BYC-08 INF J(b). Accessed 7/18/23 at https://www.iattc.org/GetAttachment/d1974178-6027-4565-ad0f-e10bddffe25d/BYC-08-INF-J(b)_ACAP-Review-and-best-practice-advice-for-reducing-the-impact-of-pelagic-longline-fisheries-on-seabirds.pdf

Aires da Silva, A., Valero, J.L., Maunder, M., Minte-Vera, C., Lennert-Cody, C., Roman, M.H., Martinez-Ortiz, J., Torrejon-Magallanes, E.J. and Carranza, M.N. 2016. Exploratory stock assessment of dorado (*Coryphaena hippurus*) in the southeastern Pacific Ocean. Seventh Meeting Scientific Advisory Committee.

Anderson. 2009. Anderson, O. 2009. Albatross and petrel distribution within the IATTC area: an addendum. Seabird Technical Meeting of the IATTC Stock Assessment Working Group.

Anderson. 2009. Anderson, O. 2009b. Estimating seabird bycatch rates in IATTC industrial longline fisheries. Seabird Technical Meeting of the IATTC Stock Assessment Workshop, 11 May 2009, La Jolla, Ca.

Arata, J. A., P. R. Sievert, and M. B. Naughton. 2009. Status Assessment of Laysan and Black-Footed Albatrosses, North Pacific Ocean, 1923-2005. United States Geological Survey, Reston, VA.

Baird, R.W. 2018. Pseudorca crassidens (errata version published in 2019). The IUCN Red List of Threatened Species 2018: e.T18596A145357488. http://dx.doi.org/10.2305/IUCN.UK.2018-2.RLTS.T18596A145357488.en. Downloaded on 22 July 2019.

Bakker, V. J., M. E. Finkelstein, D. F. Doak, E. A. VanderWerf, L. C. Young, J. A. Arata, P. R. Sievert, and C. Vanderlip. 2018. The albatross of assessing and managing risk for long-lived pelagic seabirds - *supplemental information*. Biological Conservation 217:83-95.

basic

Belmontes, R. 2022. Advances and challenges in the compliance committee. Inter-American Tropical Tuna Commission, La Jolla, CA.

Beverly, S., D. Griffiths, and R. Lee. 2012. Anchored fish aggregating devices for artisanal fisheries in South and Southeast Asia: benefits and risks. The Food and Agriculture Organization of the United Nations, Bangkok 2012.

Birdlife International. 2019. Laysan Albatross Phoebastria immutabilis Data Zone Factsheet. Available at: http://datazone.birdlife.org/species/factsheet/laysan-albatross-phoebastria-immutabilis

BirdLife International. 2020. *Phoebastria nigripes*. *The IUCN Red List of Threatened Species* 2020: e.T22698350A181896323. https://dx.doi.org/10.2305/IUCN.UK.2020-3.RLTS.T22698350A181896323.en. Accessed on 26 January 2023.

Braulik, G. & Reeves, R. 2018. *Stenella longirostris* (errata version published in 2019). *The IUCN Red List of Threatened Species* 2018: e.T20733A156927622. https://dx.doi.org/10.2305/IUCN.UK.2018-2.RLTS.T20733A156927622.en. Accessed on 26 January 2023.

Casale, P. & Tucker, A.D. 2017. Caretta caretta (amended version of 2015 assessment). The IUCN Red List of Threatened Species 2017: e.T3897A119333622. http://dx.doi.org/10.2305/IUCN.UK.2017-2.RLTS.T3897A119333622.en. Downloaded on 08 October 2019.

Clarke et al. 2014. Bycatch in longline fisheries for tuna and tuna-like species: A global review of status and mitigation measures. FAO Technical Paper 588. 228 pp.

Claro, R., 1994. Características generales de la ictiofauna. p. 55-70. In R. Claro (ed.) Ecología de los peces marinos de Cuba. Instituto de Oceanología Academia de Ciencias de Cuba and Centro de Investigaciones de Quintana Roo.

Collette, B. B., A Di Natale, S. Miller, and D. A. Pollard. 2023b. Auxis rochei. The IUCN Red List of Threatened Species 2023. Accessed 26 February 2024.

Collette, B. B., A. Di Natale, S. Miller, and D. A. Pollard. 2023c. Auxis thazard. The IUCN Red List of Threatened Species 2023. Accessed 26 February 2024.

Collette, B. B., C. Canales Ramirez, M. Hinton, R. Serra, and E. Yanez. 2023e. Sarda chiliensis. The IUCN Red List of Threatened Species 2023.

Collette, B. B., J. Graves, and F. G. Viera Hazin. 2023. Acanthocybium solandri. The IUCN Red List of Threatened Species 2023. Accessed 26 February 2024.

Collette, B., Acero, A., Amorim, A.F., Boustany, A., Canales Ramirez, C., Cardenas, G., Carpenter, K.E., de Oliveira Leite Jr., N., Di Natale, A., Die, D., Fox, W., Fredou, F.L., Graves, J., Guzman-Mora, A., Viera Hazin, F.H., Hinton, M., Juan Jorda, M., Kada, O., Minte Vera, C., Miyabe, N.,

Montano Cruz, R., Nelson, R., Oxenford, H., Restrepo, V., Salas, E., Schaefer, K., Schratwieser, J., Serra, R., Sun, C., Teixeira Lessa, R.P., Pires Ferreira Travassos, P.E., Uozumi, Y. Yanez, E. 2011c. Acanthocybium solandri. In: IUCN 2013. IUCN Red List of Threatened Species. Version 2013.1.

Collette, B., Acero, A., Amorim, A.F., Boustany, A., Canales Ramirez, C., Cardenas, G., Carpenter, K.E., de Oliveira Leite Jr., N., Di Natale, A., Fox, W., Fredou, F.L., Graves, J., Viera Hazin, F.H., Juan Jorda, M., Minte Vera, C., Miyabe, N., Montano Cruz, R., Nelson, R., Oxenford, H., Schaefer, K., Serra, R., Sun, C., Teixeira Lessa, R.P., Pires Ferreira Travassos, P.E., Uozumi, Y. Yanez, E. 2011a. Coryphaena hippurus. In: IUCN 2013. IUCN Red List of Threatened Species. Version 2013.1.

Collette, B.B., Di Natale, A., Fox, W., Graves, J., Juan Jorda, M., Pohlot, B. & Schratwieser, J. 2022. *Makaira nigricans*. *The IUCN Red List of Threatened Species* 2022: e.T170314A46936155. https://dx.doi.org/10.2305/IUCN.UK.2022-1.RLTS.T170314A46936155.en. Accessed on 03 April 2023.

Collette, B.B., Di Natale, A., Fox, W., Juan Jorda, M., Pohlot, B., Schratwieser, J. & Graves, J. 2022. *Istiompax indica*. The IUCN Red List of Threatened Species 2022. Accessed on 16 May 2023 from https://www.iucnredlist.org/species/170312/46646193

Committee for the Review of Implementation of Measures Adopted by the Commission. 2022. Report of the Workshop on Compliance. Inter-American Tropical Tuna Commission, La Jolla, CA.

Cramer, K.L., Perryman, W.L. and Gerrodette, T. 2008. Declines in reproductive output in two dolphin populations depleted by the yellowfin tuna purse-seine fishery. Marine Ecology Progress Series 369:273-285.

Cronin, M.R., Amaral, J.E., Jackson, A.M., Jaquet, J., Seto, KL., and Donald A Croll 2022. Policy and transparency gaps for oceanic shark and rays in high seas tuna fisheries. Fish and Fisheries. 2022;00:1–15.

DFO 2019. Integrated Fishery Management Plan Albacore Tuna April 1 2019-March 31 2020. Accessed 04/27/23 from https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/4077790x.pdf

DFO. 2020. Integrated Fisheries Management Plan. Fisheries and Oceans Canada, Ottowa, ON.

Diaz-Jaimes, P., and Sofia Ortega-Garcia 2021. Genomic characterization of dorado in the EPO. IATTC SAC 13th meeting 16-20 May 2022. Document SAC-13 INF-P. Accessed 7/10/23 from https://www.iattc.org/GetAttachment/0fc324dd-48a3-4619-8c54-8c25b92031f9/SAC-13-INF-P_Genomic-characterization-of-dorado-in-the-EPO.pdf

Duffy, J.E. 2003. Biodiversity loss, trophic skew and ecosystem functioning. Ecology Letters 6:680-687.

Edwards, E. 2007. Fishery effects on dolphins targeted by tuna-purse seiners in the eastern tropical Pacific Ocean. International Journal of Comparative Psychology 20:217-227.

Escalle, L., J. Mourot, T. Thellier, J. Lopez, L. Fuller, J. Wichman, S. J. Royer, L. Hood, B. Bigler, B. Jaugeon, T. R. Nicholas, K. Pollock, F. Prioul, A. Marks, M. Kutan, J. Jones, J. M. Lynch, H. Tait, and P. Hamer. 2023. Analyses of the regional database of stranded drifting Fish Aggregating Devices (dFADs) in the Pacific Ocean. Presentation to the 7th Meeting of the Ad Hoc Working Group on FADs. Western and Central Pacific Fisheries Commission, Pohnpei, Micronesia.

Ferretti, F., B. Worm, G.L. Britten, M.R. Heithaus, H.K. and Lotze. 2010. Patterns and ecosystem consequences of shark declines in the ocean. Ecology Letters, 13: 1055– 1071.

Fischer, Johanne 2022. How transparent are RFMOs? Achievements and challenges. Marine Policy Volume 136, February 2022, 104106. Accessed 7/11/23 from https://www.sciencedirect.com/science/article/abs/pii/S0308597X19307158

Froese, R., and D. Pauly. Editors. 2020. FishBase. Worldwide web electronic publication. www.fishbase.org, version (10/2019).

Gilman, E., Musyl, M., Suuronen, P.
et al.
Highest risk abandoned, lost and discarded fishing gear.
Sci Rep
11
, 7195 (2021).

Gilman, E., Suuronen, P., Hall, M., Kennelly, S. 2013. Causes and methods to estimate cryptic sources of fishing mortality. Journal of Fish Biology.

Griffiths, S. and Leanne Fuller 2019. An Updated Ecosystem Model of the Eastern Tropical Pacific OCean: Analysis of Ecological Indicators and the Potential Impacts of FAD Fishing on Ecosystem Dynamics. IATTC Scientific Advisory Committee, 10th meeting 13-17 May 2019, Document SAC-10-15. Accessed 7/1923 from https://www.iattc.org/GetAttachment/e1550b4f-4962-4092-936c-f8b14ed0dcaa/SAC-10-15_Towards-standardized-ecological-indicators-for-monitoring-ecosystem-health-an-updated-ecosystem-model-of-the-tropical-EPO.pdf

Griffiths, S., S. Siu, M. Hutchinson, J. Lopez, and A. Aires-da-Salva. 2023. Vulnerability Assessment and Simulation of Potential Conservation and Management Measures for Silky and Hammerhead Sharks Caught in Eastern Pacific Ocean Pelagic Fisheries. SAC-14-12. Inter-American Tropical Tuna Commission, La Jolla, CA.

Griffiths, S., Y. Swimmer, B. P. Wallace, and J. A. Shigueto. 2020. Vulnerability status and efficacy of potential conservation measures for the east Pacific leatherback turtle

(Dermochelys coriacea) stock using the EASI-Fish approach. Inter-American Tropical Tuna Commission, La Jolla, CA.

Griffiths, S.P., Kesner-Reyes, K., Garilao, C., Duffy, L.M., Román, M.H., 2019a. Ecological Assessment of the Sustainable Impacts of Fisheries (EASI-Fish): a flexible vulnerability assessment approach to quantify the cumulative impacts of fishing in data-limited settings. Marine Ecology Progress Series 625, 89-113.

Griffiths, SP., Nerea Lezama-Ochoa, and Marlon H. Román 2019. Moving towards quantitative ecological risk assessment for datalimited tuna fishery bycatch: Application of "EASI-Fish" to the spinetail devil ray (*Mobula mobular*) in the eastern Pacific Ocean. IATTC Working Group on Bycatch 9th meeting San Diego, California (USA) 11 May 2019. Document BYC-09-01. Accessed 5/19/23 from https://www.iattc.org/getattachment/8299c328-3177-4285-b81d-d15c142c1bf9/BYC-09-01_Ecological-risk-assessment-of-Mobulid-rays-in-the-eastern-Pacific-Ocean.pdf

Hall & Roman. 2013. Bycatch and non-tuna catch in the tropical tuna purse seine fisheries of the world. FAO Technical Paper 568. 262 pp.

Hammond, P.S., Bearzi, G., Bjørge, A., Forney, K.A., Karkzmarski, L., Kasuya, T., Perrin, W.F., Scott, M.D., Wang, J.Y. , Wells, R.S. Wilson, B. 2012. Stenella attenuata. In: IUCN 2013. IUCN Red List of Threatened Species. Version 2013.1.

Heithaus, M.R., Frid, A., Wirsing, A.J., Dill, L.M., Fourqurean, J.W., Burkholder, D., Thomson, J. and Bejder, L 2007. State-dependent risk taking by green sea turtles mediates top-down effects of tiger shark intimidation in a marine ecosystem. Journal of Animal Ecology 76:837-844.

Hutchinson, M., Jon Lopez, Brad Wiley, Jean-Francois Pulvenis, Ernesto Altamirano and Alexandre Aires-da-Silva 2023. Knowledge and Research Gaps to the Implementation of Best Handling and Release Practices for Vulnerable Species. IATTC Working Group on Ecosystem and Bycatch, 1st meeting 11-12 May 2023. Accessed 7/17/23 from https://www.iattc.org/GetAttachment/724828be-b324-4f98-ad54-14d783143e62/EB-01-01_Knowledge-and-research-gaps.pdf

IATTC 2018. Amendment of Resolution C-16-01 on the Collection and Analyses of Data on Fish-Aggregating Devices. Inter-American Tropical Tuna Commission. 93rd Meeting. Available at: http://www.iattc.org/PDFFiles/Resolutions/IATTC/_English/C-18-05-Active_Amends%20and%20replaces%20C-16-01%20FADs.pdf

IATTC 2018b. Mobulid rays in the eastern Pacific. Available at: https://www.iattc.org/Meetings/Meetings2018/SAC-09/BYC-08/PDFs/PRES/_English/BYC-08-PRES_Mobulid-ray-in-the-eastern-Pacific.pdf

IATTC 2019l. Resolution on scientific observers for longline vessels. Resolution C-19-08

IATTC 2022. Synopsis of longline observer data reporting persuant to resolution C-19-08. Document SAC-13-04.

IATTC 2023a. Ecosystem Considerations, Document SAC-14-11. IATTC SAC 14th meeting, Ja Jolla, California (USA), 15-19 May 2023. Accessed 5/15/23 from https://iattc.org/GetAttachment/a1ca3a3a-64e3-46ab-ba13-000df1ecacfe/SAC-14-11_Ecosystem-considerations.pdf

IATTC 2023b. Staff Recommendations for Management and Data Collection, 2023. IATTC 101st meeting, 7-11 August 2023. Document IATTC-101-04. Accessed 7/18/23 from https://iattc.org/GetAttachment/35d28a85-4428-444b-be41-22d06384addc/IATTC-101-04_Staff-recommendations-to-the-Commission.pdf

IATTC CatchByFlagGear 2022. IATTC Public domain data: EPO total estimated catch by year, flag, gear, species Sept 2022. Accessed 8/15/23 from https://www.iattc.org/en-US/Data/Public-domain

IATTC PublicPSTuna 2023. IATTC Public domain data: Tuna EPO purse seine catch and effort aggregated by year, month, flag or set type, 1°x1°. April 2023. Accessed 8/15/23 from https://www.iattc.org/en-US/Data/Public-domain

IATTC SAC 2023a. Synopsis of longline observer data reporting pursuant to Resolution C-19-08. IATTC Scientific Advisory Committee 15th meeting, La Jolla, California (USA) 15-19 May 2023. DOC SAC-14 INFO-B REV, Accessed 5/19/23 from https://www.iattc.org/GetAttachment/1ac31c66-20b5-46af-bd45-d240920122a6/SAC-14-INF-B_Longline-observer-reporting.pdf

IATTC Scientific Advisory Committee. 2023. Improving Data Collection and Assessment of Shark Stocks in the Eastern Pacific Ocean: Expansion to Fisheries in Coastal States. Inter-American Tropical Tuna Commission, La Jolla, CA.

IATTC Vessel Register 2023. Accessed 8/15/23 from https://www.iattc.org/en-US/Management/Vessel-register

IATTC WGB 2022. Vulnerability Status and Efficacy of Potential Conservation Measures for the East Pacific Leatherback Turtle (Dermochelys coriacea) stock using hte EASI-Fish Approach. IATTC Workign Group on Bycatch, 11th Meeting 10-11 May 2022. DOcument BYC-11-02 REV. Accessed 7/18/23 from https://www.iattc.org/GetAttachment/e5b273d6-d37c-421c-87c2-0c8587bcaa85/BYC-11-02%20-%20EASI-Fish%20assessment%20for%20leatherback%20turtle

IATTC. 2006b. Consolidated Resolution on Bycatch. Inter-American Tropical Tuna Commission, La Jolla, CA.

IATTC. 2014. Best practices to reduce the bycatch of seabirds in the convention area. Prepared by the Agreement on the Conservation of Albatrosses and Petrels (ACAP)1 and BirdLife International.

IATTC. 2014g. Recommendations by the staff for conservation measures in the eastern Pacific Ocean, 2014. Document IATTC-87-03d.

IATTC. 2017. Conservation measures for tropical tunas in the eastern Pacific Ocean during 2018-2020 and Amendment to Resolution C-17-01. Resolution C-17-02.

IATTC. 2017. Conservation of tuna in the EPO during 2017. Available at: https://www.iattc.org/PDFFiles/Resolutions/IATTC/_English/C-17-01_Tuna%20conservation%20in%20the%20EPO%202017.pdf

IATTC. 2017b. A preliminary metadata analysis of large-scale tuna longline fishery data in the eastern Pacific Ocean: a precursor to ecological risk assessment. Available at: https://www.iattc.org/Meetings/Meetings2017/SAC-08/PDFs/Docs/_English/SAC-08-07b_Preliminary-metadata-review-for-the-high-seas-longline-fishery.pdf

IATTC. 2017c. A preliminary ecological risk assessment of the large-scale tuna longline fishery in the EPO using productivity-susceptibility analysis. Available at: https://pdfs.semanticscholar.org/d06c/74367584d6ff6f5c141379f99231b75c63b6.pdf

IATTC. 2018a. Status of bigeye tuna in the Eastern Pacific Ocean in 2017 and outlook for the future. Available at: https://www.iattc.org/Meetings/Meetings2018/SAC-09/PDFs/Docs/_English/SAC-09-05-EN_Bigeye-tuna-assessment-for-2017.pdf

IATTC. 2018c. Tunas billfishes and other pelagic species in the eastern Pacific Ocean in 2017. Available at: https://www.iattc.org/PDFFiles/FisheryStatusReports/_English/No-16-2018_Tunas%20billfishes%20and%20other%20pelagic%20species%20in%20the%20eastern%20Pacific%20Ocean%20in%202017.pdf

IATTC. 2018d. Staff research Activities. Available at: https://www.iattc.org/Meetings/Meetings2018/IATTC-93/PDFs/Docs/_English/IATTC-93-06b_Staff%20research%20activities.pdf

IATTC. 2018e. Pacific-wide Silky Shark (Carcharhinus falciformis) Stock Status Assessment. WCPFC-SC14-2018/SA-WP-08. Accessed 5/4/23 from https://meetings.wcpfc.int/node/10691

IATTC. 2019. Stock status incidators for yellowfin tuna in the Eastern Pacific Ocean. Document SAC-10-07. Available at: https://www.iattc.org/Meetings/Meetings2019/SAC-

10/Docs/_English/SAC-10-08_Yellowfin%20tuna%20Stock%20status%20indicators.pdf

IATTC. 2019a. Status of yellowfin tuna in the EPO in 2018 and outlook for the future. SAD-10-07. Available at: https://www.iattc.org/Meetings/Meetings2019/SAC-10/Docs/_English/SAC-10-07_Yellowfin%20tuna%20assessment%20for%202018.pdf

IATTC. 2019d. The fishery on FADs in the Eastern Pacific Ocean. Document SAC-10-015. Available at: https://www.iattc.org/Meetings/Meetings2019/SAC-10/Docs/_English/SAC-10-05_The%20fishery%20on%20FADs%20in%20the%20EPO.pdf.

IATTC. 2019e. Updated stock status indicators for silky sharks in the EPO, 1994-2018. Available at: https://www.iattc.org/Meetings/Meetings2019/SAC-10/Docs/_English/SAC-10-17_Purse-seine%20indicators%20for%20silky%20sharks%20in%20the%20EPO.pdf.

IATTC. 2019f. IATTC Catch and Discard Data.

IATTC. 2019i. 2018 Annual Scientific Observer report for the United States tuna longline fishery in the IATTC convention area. Available at: https://www.iattc.org/Meetings/Meetings2019/SAC-10/INF/_English/SAC-10-INF-A(i)_USA%20Annual%20report%202018.pdf

IATTC. 2019j. Synopsis of longline observer data reported pursuant to resolution C-11-08. Available at: https://www.iattc.org/Meetings/Meetings2019/SAC-10/Docs/_English/SAC-10-04-REV-26-June-19_Longline%20observer%20program%20reports.pdf

IATTC. 2022c. Report on the tuna fishery, stocks and ecosystem in the eastern Pacific Ocean in 2021. Inter-American Tropical Tuna Commission.

IATTC. 2022d. Report on the International Dolphin Conservation Program. Inter-American Tropical Tuna Commission.

IATTC. 2023c. Resolution C-23-08. Conservation Measures for Shark Species, with Special Emphasis on the Silky Shark (Carcharhinus facliformis), for the Years 2024 and 2025. Inter-American Tropical Tuna Commission, La Jolla, CA.

IATTC. 2023d. Resolution C-23-02. Amendment to Harvest Strategy for North Pacific Albacore in the Eastern Pacific Ocean. IATTC 101st meeting, August 2023. Accessed 05/19/24 from https://www.iattc.org/GetAttachment/03fdcf3e-2e64-4010-bf92-8b3886e460d0/C-23-02_North-Pacific-albacore.pdf

IATTC. 2023d. Resolution C-23-07: Conservation Measures for the Protection and Sustainable Management of Sharks. Inter-American Tropical Tuna Commission, La Jolla, CA.

IATTC. 2023e. Resolution C-23-11: On the Establishment of a Vessel Monitoring System (VMS). Inter-American Tropical Tuna Commission, La Jolla, CA.

IATTC. 2023f. The Tuna Fishery in the Eastern Pacific Ocean in 2022. Inter-American Tropical Tuna Commission, La Jolla, CA.

IATTC. 2024a. Bigeye Tuna Benchmark Assessment 2024. Inter-American Tropical Tuna Commission, La Jolla, CA.

IATTC. 2024b. Skipjack Tuna Benchmark Assessment 2024. Inter-American Tropical Tuna Commission, La Jolla, CA.

IATTC. 2024d. Public domain data for download. [online database]. Inter-American Tropical Tuna Commission, La Jolla, CA. Available: https://iattc.org/en-US/Data/Public-domain.

IATTC. 2024e. Interim Minimum Standards for the use of Electronic Monitoring Systems (EMS) in IATTC Fisheries. Inter-American Tropical Tuna Commission, La Jolla, CA.

IATTC. 2024f. Conservation Measures for Tropical Tunas in the Eastern Pacific Ocean During 2025-2026. Inter-American Tropical Tuna Commission, La Jolla, CA.

IDCP 2002. Procedures for implementing Stock Mortality Limits (SMLs). International Review Panel 30th Meeting June 19-20, 2002. Accessed 7/13/23 from https://www.iattc.org/getattachment/6e695266-9208-4d9a-bb96-c25cb42f8f20/IRP-30-17_Procedures-for-implementing-Stock-Mortality-Limit-(SML).pdf

IDCP 2023. Review of Dolphin Mortality Limits (DMLs) for 2022 and 2023. Document IRP-71-01. International Dolphin Conservation Program International Review Panel (IRP) 71st meeting 31 July 2023. Accessed 05/22/24 from https://www.iattc.org/GetAttachment/95aff56d-6959-49e6-9531-473d3d655576/IRP-71-01_Review-of-Dolphin-Mortality-Limits-DML-for-2022-and-2023.pdf

Ingles, J. and D. Pauly, 1984. An atlas of the growth, mortality and recruitment of Philippines fishes. ICLARM Tech. Rep. 13. 127 p. International Center for Living Aquatic Resources Management, Manila, Philippines.

Inter-American Tropical Tuna Commission (IATTC). 1999. Agreement on the International Dolphin Conservation Program. Inter-American Tropical Tuna Commission

Inter-American Tropical Tuna Commission (IATTC). 2003. International Dolphin Conservation Program system for tracking and verifying tuna (amended). AIDCP tuna tracking system amended 11 October 23.

Inter-American Tropical Tuna Commission (IATTC). 2006. Review of seabird status and incidental catch in Eastern Pacific Ocean fisheries. Document BWG-5-05.a.i, Working Group on Bycatch, 5th Meeting.

Inter-American Tropical Tuna Commission (IATTC). 2009a. Updated estimates of Nmin and stock mortality limits. 7th Meeting of the Scientific Advisory Board, 30 October, 2009, La Jolla, Ca. Available at: http://www.iattc.org/Meetings/Meetings2009/AIDCP-22/Docs/_English/SAB-07-05_Updated%20estimates%20of%20Nmin%20and%20Stock%20Mortality%20Limits.pdf

Inter-American Tropical Tuna Commission (IATTC). 2013. Preliminary results from mahimahi (dorado) collaborative research with IATTC member countries. 4th Meeting of the IATTC Scientific Advisory Meeting, 29 April - 3 May, 2013, La Jolla, CA.

Inter-American Tropical Tuna Commission (IATTC). 2013f. Fishery status report No. 11. Tunas and billfishes in the Eastern Pacific Ocean in 2012. Inter-American Tropical Tuna Commission.

Inter-American Tropical Tuna Commission (IATTC). 2013h. IATTC-International Dolphin Conservation Program (IDCP). IATTC.

Inter-American Tropical Tuna Commission (IATTC). 2013i. Multiannual program for the conservation of tuna in the Eastern Pacific Ocean during 2014-2016. Resolution C-13-01.

Inter-American Tropical Tuna Commission (IATTC). 2011e. Bycatch issues. 2nd Meeting of the Scientific Advisory Committee 9-14 May 2011, La Jolla, CA

Inter-American Tropical Tuna Commission (IATTC). 2012a. Bycatch issues. 2nd Meeting of the Scientific Advisory Committee 9-14 May 2011, La Jolla, CA

ISC Albacore Working Group. 2011. Stock assessment of albacore tuna in the North Pacific Ocean in 2011. Scientific Committee Seventh Regular Session, Pohnpei, Federated States of Micronesia, 9-17, August 2011. WCPFC-SC7-2011/SA-WP-10

ISC. 2014. North Pacific swordfish stock assessment in 2014. International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean. Available at: http://isc.fra.go.jp/pdf/ISC14/Annex9-NP_Swordfish_Stock_Assessment_2014.pdf

ISC. 2017. Stock assessment of albacore in the North Pacific Ocean in 2017. WCPFC-SC13-2017/SA-WP-09. Available at: https://www.wcpfc.int/system/files/SC13-SA-WP-09%20Stock%20Assessment%20N%20Pacific%20Albacore%20Rev%202%20%28combo%20v06%29_1.pdf

ISC. 2018b. Stock assessment of shortfin mako sharks in the North Pacific Ocean through 2016. WCPFC-SC14-2018/SA-WP-11

ISC. 2020. Stock assessment of albacore tuna in the North Pacific Ocean in 2020. International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean. ISC/20/ANNEX/12. 20th Meeting of the International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean. Held virtually. 15-20 July 2020.

ISC. 2021. Stock assessment for blue marlin in the Pacific Ocean through 2019. International Scientific Committee for Tuna and Tua-like species in the North Pacific Ocean.

ISC. 2022 Stock assessment and future projections of blue shark in the north Pacific Ocean through 2022. International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean.

ISC. 2023a. Stock Assessment Report for Swordfish (Xiphias gladius) in the North Pacific Through 2021. International Scientific Committee for Tuna and Tuna-Like Species in the North Pacific Ocean.

ISC. 2023b. Stock Assessment of Albacore Tuna in the North Pacific Ocean in 2023. International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean.

ISSF 2024. Status of the world fisheries for tuna. Mar. 2024. ISSF Technical Report 2024-02. International Seafood Sustainability Foundation, Pittsburgh, PA, USA. Accessed 05/21/24 from https://www.iss-foundation.org/about-issf/what-we-publish/issf-documents/issf-2024-02-status-of-the-world-fisheries-for-tuna-march-2024/

ISSF Tuna Stock Status Update. 2017. Status of the world fisheries for tuna. ISSF Technical Report 2017-02. International Seafood Sustainability Foundation, Washington, D.C., USA.

ISSF. 2023. Status of the world fisheries for tuna. Mar. 2023. ISSF Technical Report 2023-01. International Seafood Sustainability Foundation, Pittsburgh, PA, USA.

Iwamoto, T., Singh-Renton, S., Pina Amargos, F., Marechal, J., Dooley, J., Aiken, K.A., Collette, B.B., Kishore, R., Oxenford, H. & Robertson, R. 2015. *Taractes rubescens*. The IUCN Red List of Threatened Species 2015. Accessed on 16 May 2023 from https://www.iucnredlist.org/species/16506080/16510307

Keller, N.M., Trego, M.L., Chivers, S.J. and Archer, F.I. 2013. Pregnancy patterns of pantropical spotted dolphins (Stenella attenuata) in the eastern tropical Pacific determined from hormonal analysis of blubber biopsies and correlations with the purse seine tuna fishery. Marine Biology 160:3113-3124.

Kindong, R., Wu, F., Tian, S., Zhu, J., Dai, X., Wang, J., and Dai, L. 2020. Biological parameters estimate for the sickle pomfret (Taractichthys steindachneri) in the west-central and eastern Pacific Ocean. Indian Journal of Geo Marine Sciences 49(03):373-381.

Kiszka, J. & Braulik, G. 2018. Stenella attenuata. The IUCN Red List of Threatened Species 2018: e.T20729A50373009. http://dx.doi.org/10.2305/IUCN.UK.2018-2.RLTS.T20729A50373009.en. Downloaded on 08 February 2019.

Koehler, H.R. 2013. Promoting compliance in tuna RFMOS: A comprehensive baseline survey of the current mechanics of reviewing, assessing and addressing compliance with RFMO obligations and measures. ISSF Technical Report 2013-02. 53 pp.

Kyne, P.M., Barreto, R., Carlson, J., Fernando, D., Francis, M.P., Fordham, S., Jabado, R.W., Liu, K.M., Marshall, A., Pacoureau, N., Romanov, E., Sherley, R.B. & Winker, H. 2019. *Pteroplatytrygon violacea*. The IUCN Red List of Threatened Species 2019. Accessed on 19 May 2023 from https://www.iucnredlist.org/species/161731/896169

Marshall, A., Bennett, M.B., Kodja, G., Hinojosa-Alvarez, S., Galvan-Magana, F., Harding, M., Stevens, G. & Kashiwagi, T. 2018. Mobula birostris (amended version of 2011 assessment). The IUCN Red List of Threatened Species 2018: e.T198921A126669349. http://dx.doi.org/10.2305/IUCN.UK.2018-1.RLTS.T198921A126669349.en. Downloaded on 31 January 2019.

Minte-Vera, C., M. N. Maunder, H. Xu, J. Valero, A. Aires-da-Silva. 2022. South EPO swordfish benchmark assessment in 2019. Inter-American Tropical Tuna Commission. 14th Meeting. Scientific Advisory Committee. La Jolla, California (USA). May 2023. Accessed 5/1/23 from https://s3-us-west-2.amazonaws.com/sfw-images/reportsresources/27679/references/2023%20SAC-14-15_South-EPO-Swordfish-Benchmark-Assessment-in-2019.pdf

Minte-Vera, C., Maunder, M.N., Xu, H., Valero, J.L., Lennert-Cody, C. and Aires-da-Silva, A. 2020. Yellowfin tuna in the eastern Pacific Ocean 2019 benchmark assessment. Document SAC-11-07 REV

Molony, B., 2008. Fisheries biology and ecology of highly migratory species that commonly interact with industrialized longline and purse-seine fisheries in the western and central Pacific Ocean. Western and Central Pacific Fisheries Commission, WCPFC-SC4-2008/EB-IP-6. 228 p.

Mortimer, J.A Donnelly, M. (IUCN SSC Marine Turtle Specialist Group). 2008. Eretmochelys imbricata. In: IUCN 2012. IUCN Red List of Threatened Species. Version 2012.2.

Mourot, J., L. Escalle, T. Thellier, J. Lopez, J. Wichman, S. J. Royer, L. Hood, B. Bigler, B. Jaugeon, T. R. Nicholas, K. Pollock, F. Prioul, M. Lercai, A. Marks, M. Kutan, J. Jones, J. M. Lynch, H. Tait, P. Hamer, and PNA Office. 2023. Analyses of the regional database of stranded drifting Fish Aggregating Devices (dFADs) in the Pacific Ocean. Western and Central Pacific Fisheries Commission, Pohnpei, Micronesia.,

Myers, R.A., Baum, J.K., Shepherd, T.D., Powers, S.P. and Peterson, C.H. 2007. Cascading effects of the loss of apex predatory sharks from a coastal. Science 315:1846-1850.

NMFS. 2017. Commercial fisheries statistics: annual trade data by product, country/association. National Marine Fisheries Service.

NMFS. 2017. Loggerhead turtle (Caretta caretta). NOAA Fisheries Office of Protected Resources. Available at: http://www.nmfs.noaa.gov/pr/species/turtles/loggerhead.html

NOAA 2022b. Fisheries of the United States, 2020. Published May 11, 2022. Accessed 7/7/23 from https://www.fisheries.noaa.gov/resource/document/fisheries-united-states-2020

NOAA 2023. NOAA Fisheries Office of Science and Technology, Foreign Trade Query, Available at: www.fisheries.noaa.gov/foss. Accessed 7/7/23

NOAA Fisheries. 2023. WA/OR/CA Albacore Surface Hook and Line/Troll Fishery - MMPA List of Fisheries. National Oceanic and Atmospheric Administration, Silver Spring, MD.

NOAA. 2016. Species in the spotlight. Priority Actions: 2016-2020. Pacific leaterback turtle Dermochelys coriacea. NOAA Fisheries. Available at: http://www.nmfs.noaa.gov/pr/species/Species%20in%20the%20Spotlight/leatherback_spotlight_species_5-year_action_plan_final_jan_26_2016.pdf

NOAA. 2017. Hawkbill turtle (Eretmochelys imbricata). NOAA FIsheries Protected Resources Division. Available at: http://www.nmfs.noaa.gov/pr/species/turtles/hawksbill.html

NOAA. 2019a. Pacific shortfin mako shark. Available at: https://www.fisheries.noaa.gov/species/pacific-shortfin-mako-shark

NOAA. 2022. Spinner dolphin. NOAA Fisheries Species Directory. Accessed on 4/10/2023.

Oedekoven, CS., Lewis McMillan, Sakina Fatima, David Harris-Birtill, Claudia Faustino, Laura Marshall, Stephen T. Buckland, Cleridy E. Lennert-Cody 2021. Trial survey for eastern tropical Pacific dolphins: Project report. IATTC Special Report 24. Accessed 7/13/23 from https://www.iattc.org/getattachment/a52969b9-08a7-4b5e-83cb-12aa25bdc217/No-24-2021-Mulitiple_Trial-survey-for-Eastern-Tropical-Pacific-dolphins-Project-report.pdf

Ovando, D., Salvador Siu, Cleridy Lennert-Cody, Mark Maunder, Jon Lopez, Shane Griffiths, Omar Santana, Alexandre Aires-da-Silva 2023. Silky and hammerhead shark catches in Central American coastal artisanal fisheries. IATTC SAC 14th meeting La Jolla, California (USA) 15-19 May 2023 Document SAC-14 INF-F. Accessed 5/18/23 from https://www.iattc.org/GetAttachment/530bbb1b-7178-4fbd-8107-8fd38c60c5d3/SAC-14-INF-L_Silky-and-hammerhead-shark-catches-in-coastal-artisanal-fisheries.pdf

PacFIN 2023. Reports dashboard: HMS005 tab. Accessed 8/15/23 from https://apex.psmfc.org/pacfin/f?p=501:1000:5736987231865:::::

Pacific Fishery Management Council 2023. Fishery Management Plan for U.S. West Coast Fisheries for Highly Migratory Species amended through Amendment 7. Accessed 04/27/23 from https://www.pcouncil.org/documents/2023/04/fishery-management-plan-for-west-

coast-fisheries-for-highly-migratory-species-through-amendment-5.pdf/

Passfield, K., Gilman, E. (2010) Effects of Pelagic Longline Fishing on Seamount Ecosystems based on Interviews with Pacific Island Fishers. Technical Report produced under the Global Environment Facility Oceanic Fisheries Management Project. International Union for the Conservation of Nature, Gland, Switzerland.

Pearson. H. C., J. Castro, A. Cid, and F. L. Matos. 2024. Scientific Experiment to Evaluate Dolphin Cow-Calf Separation During Purse Seine Operations in the Eastern Tropical Pacific Ocean: Progress Summary Report. Inter-American Tropical Tuna Commission, La Jolla, CA.

Pérez Roda, M.A. (ed.), Gilman, E., Huntington, T., Kennelly, S.J., Suuronen, P., Chaloupka, M. and Medley, P. 2019. A third assessment of global marine fisheries discards. FAO Fisheries and Aquaculture Technical Paper No. 633. Rome, FAO. 78 pp. Accessed 7/10/23 from https://www.fao.org/3/ca2905en/CA2905EN.pdf

Phillips, RA., and A.G. Wood 2020. Variation in live-capture rates of albatrosses and petrels in fisheries, post-release survival and implications for management. Biological Conservation Volume 247, July 2020. Accessed 7/18/23 from https://www.sciencedirect.com/science/article/pii/S0006320720306996

Pilling, G., R. Scott, P. Hamer, F. Scott, and N. Yao. 2024. Recalibration of the Adopted South Pacific Albacore Interim Target Reference Point and Review of WCPFC20 Requested Options. Western and Central Pacific Fisheries Commission, Pohnpei, Micronesia.

Pinheiro, P.B., F.H.V. Hazin, P. Travassos, P.G.V. Oliveira, F. Carvalho and M.G. Rêgo, 2011. The reproductive biology of the rainbow runner, Elagatis bipinnulata (Quoy & Gaimard, 1825) caught in the São Pedro and São Paulo Archipelago. Braz. J. Biol. 71(1):99-106.

Piraino, S., Fanelli, G., Boero, F. 2002. Variability of species roles in marine communities: change of paradigms for conservation priorities. Marine Biology 140:1067-1074.

Ramos-Cartelle, A. and Mejuto, J. 2008. Interaction of the false killer whale (Pseudorca crassidens) and the depredation on the swordfish catches of the Spanish surface longline fleet in the Atlantic, Indian and Pacific Oceans. Report, International Commission for the Conservation of Atlantic Tunas (ICCAT), Collective Volume of Scientific Papers (SCRS/2007/025) 62: 1721-1783.

Resolution C-04-05 (2006). Consolidated resolution on bycatch. IATTC 74th Meeting. Pusan (Korea) 26-30 June 2006. Accessed 5/1/23 from https://www.iattc.org/GetAttachment/1159f2bf-9b6c-42a5-8d6c-5b891282bc71/C-04-05-REV-Jun-2006-Active_Consolidated-bycatch-resolution.pdf

Resolution C-05-03 (2005). Resolution on the conservation of sharks caught in association

with fisheries in the eastern Pacific ocean. IATTC 73rd meeting Lanzarote (Spain) 20-24 June 2005. Accessed 5/1/2023 from https://www.iattc.org/GetAttachment/92e97e61-eb12-40e1-aa62-291eb7f69b82/C-05-03-Active_Sharks.pdf

Resolution C-11-02 (2011). Resolution to mitigate the impacts on seabirds of fishing for species covered by the IATTC. IATTC 82nd meeting. La Jolla, California (USA) 4-8 July 2011. Accessed 5/1/2023 from https://www.iattc.org/GetAttachment/6117c3fd-ad66-46fe-8005-f6af18f0ee92/C-11-02-Active_Seabirds.pdf

Resolution C-11-10 (2011). Resolution on the conservation of oceanic whitetips sharks caught in association with fisheries in the Antigua Convention Area. IATTC 82nd meeting, La Jolla, California (USA) 4-8 July 2011. Accessed 5/1/2023 from https://www.iattc.org/GetAttachment/71fc2096-c12b-4560-83a4-60fd07dcd07f/C-11-10-Active_Conservation-of-Oceanic-whitetip-sharks.pdf

Resolution C-15-04 (2015). Resolution on the conservation of mobulid rays caught in association with fisheries in the IATTC convention area. IATTC 89th meeting, Guayaquil, Ecuador 22-June-3 July 2015. Accessed 5/1/2023 from https://www.iattc.org/GetAttachment/88759268-a4f8-4f37-aefa-57d640277f4e/C-15-04-Active_Conservation-of-Mobulid-Rays.pdf

Resolution C-16-02 (2016). Harvest Control Rules for tropical tunas (yellowfin, bigeye, and skipjack). IATTC 90th meeting La Jolla, California (USA) 27 June-1 July 2016. Accessed 5/1/23 at https://iattc.org/GetAttachment/79173db8-ebc3-49ca-9fa6-c46d0ffe5979/C-16-02-Active_Harvest-control-rules.pdf

Resolution C-16-05 (2016). Resolution on the management of shark species. IATTC 90th meeting, La Jolla, California (USA) 27 June-1 July 2016. Accessed 5/1/2023 from https://www.iattc.org/GetAttachment/ab97fba4-bc24-4d67-9552-43294fc679f9/C-16-05-Active_Management-of-sharks-species.pdf

Resolution C-19-01 (2019). Amendment to Resoultion C-18-05 on the collection and anlayses of data on fish-aggregating devices. IATTC 94th meeting, Bilbao (Spain) 22-26 July 2019. Accessed 5/4/23 from https://www.iattc.org/GetAttachment/5cf03e70-c29d-4ec0-a891-8da28780233d/C-19-01-Active_Amends-and-replaces-C-18-05-FADs.pdf

Resolution C-19-04 (2019). Resolution to mitigate impacts on sea turtles. IATTC 94th meeting, Bilbao, Spain 22-26 July 2019. Accessed 5/1/2023 from https://www.iattc.org/GetAttachment/7ef88817-47f2-4c98-8e29-883729e60a95/C-19-04-Active_Sea-turtles.pdf

Resolution C-19-06 2019. Conservation of whale sharks. Accessed 5/1/2023 from https://www.iattc.org/GetAttachment/72ae537f-3b91-4990-91fb-1dbbe9e618c0/C-19-06-

Active_Whale-sharks.pdf

Resolution C-19-07 (2019). Terms of Reference for Management Strategy Evaluation workshops. IATTC 94TH MEETING Bilbao, Spain 22-26 July 2019. Accessed 5/1/2023 at https://www.iattc.org/GetAttachment/8a9f3c84-39dc-48bf-99ae-1a6b6b545891/C-19-07-Active_Management-Strategy-Evaluation-workshops.pdf

Resolution C-21-04 (2021). Conservation Measures for tropical tunas in the eastern Pacific ocean during 2022-2024. IATTC 98th Meeting 18-22 October 2021. Accessed 5/1/23 from https://www.iattc.org/GetAttachment/e3dc0a7e-e73c-4b8e-889e-a4cd2cdd7b8b/C-21-04-Active_Tuna-conservation-in-the-EPO-2022-2024.pdf

Resolution C-21-06 (2021). Amendment to Resolution C-19-05. Conservation measures for shark species, with special emphasis on the silky shark (*Carcharinus falciformis*), for the years 2022 and 2023. IATTC 98th meeting (resumed) (by videoconference) 18-22 October 2021. Accessed 5/1/2023 from https://www.iattc.org/GetAttachment/1a67519e-f11c-44d5-ab05-6b0b67418068/C-21-06-Active_Silky-sharks.pdf

Resolution C-22-06 (2022). Resolution on Terms of Reference for a Working Group on Ecosystem and Bycatch. 100th meeting, Phoenix, Arizona USA 01-05 August 2022. Accessed 5/1/23 from https://www.iattc.org/GetAttachment/2ce242d5-f82f-42ad-84b5-ab930756c3ae/C-22-06_Terms-of-reference-for-a-Working-Group-on-Ecosystem-and-Bycatch.pdf

Resolution C-23-03 2023. Amendment to Resolution C-99-07 on fish-aggregating devices. IATTC 101st meeting, August 2023. Accessed 05/19/24 from https://www.iattc.org/GetAttachment/21ce5db4-d7d8-418b-95a0-3b1b0dd28a76/C-23-03_FADs-amends-and-replaces-C-99-07.pdf

Resolution C-23-04 2023. On the design and biodegradability of drifting fish aggregating devices (DFADS) in the IATTC area of competence. IATTC 101st meeting, August 2023. Accessed 05/19/23 from https://www.iattc.org/GetAttachment/c4f92d00-b6e3-4e03-84cb-d4e876ce9ab8/C-23-04_FADS-biodegradables.pdf

Resolution C-23-05 2023. Amendment to Resolution C-19-01 on the collection and analyses of data on fish=aggregating devices. IATTC 101st meeting, August 2023. Accessed 05/19/24 from https://www.iattc.org/GetAttachment/4243e834-e8c1-4926-ad8f-078b6d4fa079/C-23-05_FADs-amends-C-19-01.pdf

Resolution C-23-06. Amendment to Resolution C-16-02 on Harvest Control Rules for tropical tunas (yellowfin, bigeye and skipjack). IATTC 101st Meeting August 2023. Accessed 05/18/24 from https://www.iattc.org/GetAttachment/cbda923b-b77c-4f4d-a44a-3cdbe3b5fbc6/C-23-06_Harvest-Control-Rules-amends-and-replaces-C-16-02.pdf

Resolution C-23-07 2023. Conservation measures for the protection and sustainable management of sharks. IATTC 101st meeting, August 2023. Accessed 05/19/24 from https://www.iattc.org/GetAttachment/6e08563b-454c-4df2-961b-0b9ffef04fcd/C-23-07_Sharks–consolidates-and-replaces-C-05-03,-C-16-04,-and-C-16-05.pdf

Resolution C-23-08 2023. Conservation measures for shark species, with special emphasis on the silky shark (*Carcharinus falciformis*), for the years 2024 and 2025. IATTC 101st meeting, August 2023. Accessed 05/19/24 from https://www.iattc.org/GetAttachment/807064ae-38c8-4887-aa20-79cec06007a9/C-23-08_Silky-sharks–amends-and-replaces-C--21-06.pdf

Roa-Ureta, RH., Román Amancio, G., Marín Abanto, P., Guevara Izquierdo, I., Norza Sior, AA., Elías, E., and Manuel Peralta 2021a. Stock Assessment of the dolphinfish (*Coryphaena hippurus*) in the South-East Pacific Ocean. IATTC SAC 13th meeting 16-20 May 2022. Accessed 7/10/23 from https://www.iattc.org/GetAttachment/6d3cf4f6-d196-4d82-905b-7a957ab9ee7d/SAC-13-INF-O_Stock-assessment-dorado-South-EPO.pdf

Román, M., C. Lennert-Cody, M. Maunder, A. Aires-da-Silva, and N. Vogel. 2016. Changes in the purse seine fleet fishing on floating objects and the need to monitor small vessels. IATTC. Seventh Meeting of the Scientific Advisory Committee. Document SAC-07-07f.i. Accessed 5/5/23 from https://www.iattc.org/getattachment/3e67e3b4-726a-4f79-b1a8-0197a65051dc/SAC-07-07f(i)_Changes-in-purse-seine-fleet-fishing-on-floating-objects-and-the-need-to-monitor-small-vessels.pdf

SAC 2023. Recommendations of the Scientific Advisory Committee (SAC) to the Commission. IATTC SAC 14th meeting, 15-19 May 2023. Accessed 7/17/23 from https://www.iattc.org/GetAttachment/4a7ad501-efca-4840-a41a-a07424df2a7b/SAC-14-16_Recommendations-of-the-Scientific-Advisory-Committee-(SAC)-to-the-Commission.pdf

Salas, S., Chuenpagdee, R., Seijo, J.C., Charles, A., 2007. Challenges in the assessment and management of small-scale fisheries in Latin America and the Caribbean. Fisheries Research 87, 5-16.

Salcedo-Bojorquez, S. and F. Arreguin-Sanchez.2011. An Exploratory Analysis to Identify Repoductive Strategies of Billfishes. Journal of Fisheries and Aquatic Science 6(6):578-591. Accessed 5/16/23 from https://www.researchgate.net/profile/Francisco_Arreguin-Sanchez/publication/230669609_An_Exploratory_Analysis_to_Identify_Reproductive_Strategies_of_Billfishes/links/0912f502bfb0c4e813000000/An-Exploratory-Analysis-to-Identify-Reproductive-Strategies-of-Billfishes.pdf

Schindler, D.E., Essington, T.E., Kitchell, J.F., Boggs, C. and Hilborn, R. 2002. Sharks and tunas: fisheries impacts on predators with contrasting life histories. Ecological Applications 12:735-748.

Scott, M.D., Lennert-Cody, C.E., Gerrodette, T., Skaug, H.J., Minte0Vera, C.V., Hofmeister, J., Barlow, J., Chivers, S.J., Danil, K., Duffy, L.M., Olson, R.J., Hohn, A.A., Fiedler, P.C., Ballance, L.T. and Forney, K.A. 2016. Data available for assessing dolphin population status in the eastern tropical Pacific Ocean. Workshop on Methods for Monitoring the Status of Eastern Tropical Pacific Ocean Dolphin Populations, 18-20 October 2016, La Jolla, California. Available at: http://www.iattc.org/Meetings/Meetings2016/DolphinWorkshop/IATTC-Dolphin-Workshop-October%202016-Background01.pdf

Sea Grant California. 2025. Yellowtail. Regents of the University of California, La Jolla, CA.

Secretary of Agriculture, Rural Development, Fisheries and Food (SAGARPA). 2010. National fisheries chart 2010. SAGARPA, National Fisheries Institute, Mexico.

Seminoff, J. A. 2023. Chelonia mydas (East Pacific subpopulation). The IUCN Red List of Threatened Species 2023.

Seminoff, J.A. (Southwest Fisheries Science Center, U.S.) 2004. Chelonia mydas. In: IUCN 2012. IUCN Red List of Threatened Species. Version 2012.2.

Shane Griffiths, S., Fuller, L., Potts, J., and Simon Nicol 2022. Vulnerability assessment of sharks caught in eastern Pacific ocean pelagic fisheries using the EASI-fish approach. Inter-American Tropical Tuna Commission, Document sac-13-11, Scientific Advisory Committee, 13th meeting (by videoconference), 16-20 may 2022. Accessed 4/12/23 from https://www.iattc.org/GetAttachment/57b58325-ecdd-4133-acd0-84f0959f332b/SAC-13-11_Vulnerability-status-for-sharks-in-the-EPO-EASI-fish-assessment.pdf

Smith-Vaniz, W.F. & Williams, I. 2015. *Seriola lalandi*. *The IUCN Red List of Threatened Species* 2015. Accessed on 04 April 2023.

Smith-Vaniz, W.F., Collette, B., Moore, J., Polanco Fernandez, A., Russell, B. & McEachran, J.D. 2015. *Lampris guttatus* (errata version published in 2017). The IUCN Red List of Threatened Species 2015. Accessed on 16 May 2023 from https://www.iucnredlist.org/species/195038/115338069

Smith-Vaniz, W.F., Williams, J.T., Pina Amargos, F., Curtis, M. & Brown, J. 2015. *Elagatis bipinnulata*. *The IUCN Red List of Threatened Species* 2015. Accessed on 04 April 2023.

Stevens, J.D., Bonfil, R., Dulvy, N.K. and Walker, P.A. 2000. The effects of fishing on sharks, rays, and chimaeras (chondrichthuyans), and the implications for marine ecosystems. ICES Journal of Marine Science 57:476-494.

Sun, C., Chang, H., Liu, T., Yeh, S., and Chang, Y. 2015. Reproductive biology of the black marlin, Istiompax indica, off southwestern and eastern Taiwan. Fisheries Research, 166:12-20.

Sun, C.-L., S.-Z. Yeh, C.-S. Liu, N.-J. Su and W.-C. Chiang, 2015a. Age and growth of black marlin (Istiopomax indica) off eastern Taiwan. Fish. Res. 166:4-11.

Swimmer, Y., Zollett, E.A., Alexis Gutierrez 2020. Bycatch mitigation of protected and threatened species in tuna purse seine and longline fisheries. Endangered Species Research, 43, 517–542.

Teears, T., C. Castillo-Jordan, N. Davies, J. Day, J. Hampton, A. Magnusson, T. Peatman, G. Pilling, H. Xu, T. Vidal, P. Williams, and P. Hamer. 2024. Stock Assessment of South Pacific Albacore: 2024. Western and Central Pacific Fisheries Commission, Pohnpei, Micronesia.

Trindade-Santos, I. and K.M.F. Freire, 2015. Analysis of reproductive patterns of fishes from three large marine ecosystems. Front. Mar. Sci. 2:38.

Valero and Aires-da-Silva 2022. 3rd workshop on Management Strategy Evaluation (MSE) for tropical tunas. 08-09 December 2022. Accessed 05/21/24 from https://iattc.org/GetAttachment/7d645866-feb1-48d7-9998-e68ebb798e58/WSMSE-03-RPT_3rd-Workshop-on-Management-Strategy-Evaluation-(MSE)-for-tropical-tunas.pdf

Valero, J.L. and A. Aires-da-Silva. 2019. First Workshop on Management Strategy Evaluation (MSE) for Tropical Tunas: Overview, objectives and performance metrics. IATTC, Report of the Meeting. La Jolla, CA. 9-10 December 2019. 22pp.

Valero, J.L., Maunder, M., Aires-de-Silva, A.M., Minte-Vera, C., Jiangfeng Zhu 2017. Limit reference points in fisheries management and their application for tuna and billfish stocks. IATTC SAC-08-05e(ii). Accessed 05/18/24 from https://www.iattc.org/GetAttachment/07fdf363-a81c-43f4-8ba4-a5c665f2d11e/SAC-08-PRES_Review-of-limit-reference-points.pdf

Wade, P.R., Watters, G.M., Gerrodette, T. and Reilly, S.B. 2007. Depletion of spotted spinner dolphins in the eastern tropical Pacific: modeling hypotheses for their lack of recovery. Marine Ecology Progress Series 343:1-14.

Wallace, B.P., A.D. DiMatteo, A.B. Bolten, M.Y. Chaloupka, B.J. Hutchinson, F. A. Abreu-Grobois, J. A. Mortimer, J. A. Seminoff, D. Amorocho, K.A. Bjorndal, J. Bourjea, B.W. Bowen, R. Briseño Dueñas, P. Casale, B.C. Choudhury, A. Costa, P.H. Dutton, A. Fallabrino, E.M. Finkbeiner, A. Girard, M. Girondot, M. Hamann, B.J. Hurley, M. López-Mendilaharsu, M.A. Marcovaldi, J.A. Musick, R. Nel, N.J. Pilcher, S. Troëng, B. Witherington, R.B. Mast. 2011. Global conservation priorities for marine turtles. PLos ONE 6(9): e24510.

Wallace, B.P., Kot, C.Y., MiMatteo, A.D., Lee, T., Crowder, L.B. and Lewison, R.L. 2013. Impacts of fisheries bycatch on marine turtle populations worldwide: toward conservation and research priorities. Ecosphere 4:40.http://dx.doi.org/10.1980/ES12-00388.1

Wallace, B.P., Tiwari, M. & Girondot, M. 2013. *Dermochelys coriacea (East Pacific Ocean subpopulation). The IUCN Red List of Threatened Species* 2013: e.T46967807A46967809. https://dx.doi.org/10.2305/IUCN.UK.2013-2.RLTS.T46967807A46967809.en. Accessed on 26 January 2023.

Appendix A: Update 2024

Updates to this assessment were made on __, 2024, which resulted in some ratings changes. These updates are summarized as follows:

Criterion 1

- North and South Pacific albacore updated with new stock assessments; both maintained green scores.
- Eastern Pacific bigeye updated with a new stock assessment and improved from yellow to green.
- Dolphinfish (dorado) in the Southeast Pacific updated with a new data-limited assessment, improving numerically and maintaining a green score.
- Eastern Pacific skipjack updated with a new stock assessment, improving numerically and maintaining a green score.
- Swordfish in the Northeast and Southeast updated with new stock assessments, improving both scores from red to green, with the northern stock scoring better numerically than the southern.
- Eastern Pacific yellowfin updated with a new stock assessment and improved numerically, maintaining a green score.
- Ratings for blue shark, silky shark, wahoo, and dorado caught in purse seines removed, because these species were moved to Criterion 2.
- Rating for albacore caught in Canada/United States trolls added.

Criterion 2

- Main species were updated according to the latest available data from IATTC:
    - **Removed** from existing fisheries:
        - Dolphin-set purse seine: hawksbill turtle, olive ridley turtle, skipjack
        - FAD-set purse seine: Pacific bluefin tuna, whitetip shark, E. Pacific green sea turtle, loggerhead turtle, olive ridley turtle, dorado
        - Unassociated purse seine: dolphinfish, rainbow runner, yellowtail
    - **Added** to existing fisheries:
        - Dolphin-set purse seine: sharks, manta/devil rays, pelagic stingray
        - FAD-set purse seine: pelagic stingray, manta/devil rays, black skipjack, bullet and frigate tuna
        - Unassociated purse seine: pelagic stingray, sharks, black skipjack, bonitos
        - NE longline: sharks, seabirds, striped marlin, pelagic stingray, black marlin, snake mackerels, opah
        - SE longline: sharks, seabirds, pomfrets, shortbill spearfish, snack mackerels, pelagic stingray, opah
- Individual, existing species' score changes include:
    - Silky shark fishing mortality improved to "low concern" for dolphin-set purse seine (based on bycatch data indicating low overall contribution to mortality)

- Wahoo improved to “low concern” for both factors 2.1 and 2.2 in FAD-set fisheries.

Criterion 3

- Management strategy (3.1) improved to “moderately effective” for FAD-set purse seines
- Bycatch strategy (3.2) improved from “ineffective” to “moderately effective” for FAD-set purse seines
- Research and monitoring (3.3) downgraded to “ineffective” for drifting longlines (NE and SE)
- Inclusion (3.4) downgraded to “moderately effective” for drifting longlines (NE and SE) because of the lack of transparency at ISC.

Criterion 4

- Ecosystem-based fisheries management (4.3) downgraded to “high concern” for drifting longlines (NE and SE), leading to a downgrade in the overall C4 score from green to yellow.
- Factor 4.3 improved from “high concern” to “moderate concern” for FAD-set purse seines.

Overall

FAD-set purse seine ratings improved overall, and the newly added fishery was rated green. Other existing ratings (longlines, other purse seines) remained the same.