Annual Stock Assessment and Fishery Evaluation Report for U.S. Pacific Island Pelagic Fisheries Ecosystem Plan 2022

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Cover Photo: Hawaiian Fresh Seafood.

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Published in the United States by the Western Pacific Regional Fishery Management Council under NOAA Award #NA20NMF4410013.

ISBN 978-1-950193-32-5

Version Edits:

v2 (7/20/2023) – Added Appendix E to the document; revised text in Section 3.2.3; revised data in Table A-112.

v3 (8/23/2023) – Further revised text in Section 3.2.3; revised Figures 57, 122, 135, and 136; revised Tables A-58, A-115, and A-120.

v4 (9/8/2023) – Addressed various grammatical typos and formatting errors throughout the document.

This document can be cited as follows:

WPRFMC. 2023. Annual Stock Assessment and Fishery Evaluation Report for the Pacific Pelagic Fisheries Fishery Ecosystem Plan 2022. T Remington, M Fitchett, A Ishizaki (Eds.). Honolulu: Western Pacific Regional Fishery Management Council.

The **Western Pacific Regional Fishery Management Council** acknowledges the valuable contributions of the following Plan Team members for contributing to this report:

Hawaii Division of Aquatic Resources: Jason Helyer and Bryan Ishida.

American Samoa Department of Marine and Wildlife Resources: Sean Felise and Domingo Ochavillo.

Guam Division of Aquatic and Wildlife Resources: Frank Roberto and Brent Tibbatts.

CNMI Division of Fish and Wildlife: Nathan VanEe and Kelsey Lizama.

NMFS Pacific Islands Fisheries Science Center: Donald Kobayashi, Russel Ito, Jenny Suter, Phoebe Woodworth-Jefcoats, T. Todd Jones, Ashley Tomita, Minling Pan, Michael Kinney, Kirsten Leong, Robert Ahrens, Réka Domokos, and Felipe Carvalho.

NMFS Pacific Islands Regional Office: Chelsey Young, Lynn Rassel, Melissa Snover, and Valerie Post.

The Council also acknowledges the staff of the **NMFS PIFSC Fisheries Research and Monitoring Division data programs** for providing the technical support to generate the data summaries.

The Council would like to thank Clay Tam, Roy Morioka, Justin Hospital, Johanna Wren, Amanda Bradford, Alexander Goas, Eric Forney, and Michael Marsik for their contributions to the report.

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GLOSSARY OF TERMS AND LIST OF ACRONYMS

Term	Definition
Alia	Samoan fishing catamaran, about 30 ft. long, constructed of aluminum or wood with fiberglass. Used for various fisheries including trolling, longline, and bottomfish fishing.
American Samoa	A U.S. territory in the South Pacific Ocean, southeast of Samoa.
Bycatch	Fish harvested in a fishery that are not sold or kept for personal use, including economic discards and regulatory discards, except in a recreational fishery catch and release fishery management program.
Commercial	Commercial fishing, where the catch is intended to be sold, bartered, or traded.
CNMI	A U.S. territory in the Marianas Archipelago. North of and adjacent to Guam.
Council	The Western Pacific Regional Fishery Management Council, one of eight regional fishery management councils established by Congress in 1976. Under the Magnuson-Stevens Fishery Conservation and Management Act, it has authority over fisheries seaward of state/territorial waters of Hawaii and the U.S. Pacific Islands.
Guam	A U.S. territory in the Marianas Archipelago. South of and adjacent to the Commonwealth of the Northern Marianas Islands.
Hawaii	U.S. state. See MHI, NWHI. Composed of the islands, atolls, and reefs of the Hawaiian Archipelago from Hawaii to Kure Atoll, except the Midway Islands. Capitol - Honolulu.
Ika-Shibi	Hawaiian term for night tuna handline fishing method. Fishing for tuna using baited handlines at night with a nightlight and chumming to attract squid and tuna.
Incidental Catch	Fish caught that are retained in whole or part, though not necessarily the targeted species. Examples include monchong, opah, and sharks.
Interaction	Catch of protected species, which is required to be released. Examples: sea turtles, marine mammals, seabirds.
Logbook	Journal kept by fishing vessels for each fishing trip; records catch data, including bycatch and incidental catch. Required in the federally regulated longline and crustacean fisheries in the Hawaiian EEZ.
Longline	Fishing method utilizing a main line that exceeds 1 nm in length, is suspended horizontally in the water column either anchored, floating, or attached to a vessel, and from which branch or dropper lines with hooks are attached; except that, within the protected species zone, longline gear means a type of fishing gear consisting of a main line of any length that is suspended horizontally in the water column either anchored, floating, or attached to a vessel, and from which branch or dropper lines with hooks are attached.
Longliner	Fishing vessel specifically adapted to use the longline fishing method.
Palu-Ahi	Hawaiian term for day tuna handline fishing. Fishing for tuna using baited handlines and chumming with cut bait in a chum bag or wrapped around a stone. Also, drop-stone, make-dog, etc.

Term	Definition
Pelagic	The pelagic habitat is the upper layer of the water column from the surface to the thermocline. The pelagic zone is separated into several subzones depending on water depth: epipelagic - ocean surface to 200 meters depth; mesopelagic – 200 to 1,000 meters depth; bathypelagic – 1,000 to 4,000 meters depth; and abyssopelagic – 4,000 to 6,000 meters depth. The pelagic species include all commercially targeted highly migratory species such as tuna, billfish, and some incidental-catch species such as sharks, as well as coastal pelagic species such as akule and opelu.
Pole-and-Line	Fishing for tuna using poles and fixed leaders with barbless lures and chumming with live baitfish. Poles can be operated manually or mechanically. Also, fishing vessels called baitboats or aku-boats (Hawaii).
PRIA	A group of U.S. island territories in the Central Pacific Ocean.
Protected Species	Refers to species which are protected by federal legislation such as the Endangered Species Act, Marine Mammal Protection Act, and Migratory Bird Treaty Act. Examples: Black-footed and Laysan albatrosses, sea turtles, dolphins.
Purse Seine	Fishing for tuna by surrounding schools of fish with a large net and trapping them by closing the bottom of the net.
Recreational	Recreational fishing for sport or pleasure, where the catch is not sold, bartered, or traded. Also, non-commercial.
Secretary	When capitalized and used in reference to fisheries within the U.S. EEZs, it refers to the U. S. Secretary of Commerce.
Small Pelagics	Species such as akule (big-eye scad - *Selar* spp.) And opelu (mackerel scad - *Decapterus* spp). These fish occur mainly in shallow inshore waters but may also be found in deeper offshore waters. Classified as ecosystem component species in the FEP and not part of the PMUS.
Trolling	Fishing by towing lines with lures or live-bait from a moving vessel.

Acronym	Meaning
ACE	Accumulated Cyclone Energy
ACL	Annual Catch Limit
AS	American Samoa. Includes the islands of Tutuila, Manua, Rose and Swains Atolls
ASG	American Samoa Government
AVHRR	Advanced Very High Resolution Radiometer
B	Biomass
B_{FLAG}	Warning Reference Point. Set equal to B_{MSY}
B_{MSY}	Biomass at MSY
BET	Bigeye Tuna
BiOp	Biological Opinion
BOEM	Bureau of Ocean Energy Management
BSIA	Best Scientific Information Available
C	Recent Average Catch
CFEAI	Commercial Fishing Economic Assessment Index
CFR	Code of Federal Regulations
CML	Commercial Marine License data
CNMI	Commonwealth of the Northern Mariana Islands. Also, Northern Mariana Islands, Northern Marianas, and NMI. Includes the islands of Saipan, Tinian, Rota, and many others in the Marianas Archipelago
CO_2	Carbon Dioxide
CMM	Conservation and Management Measures
CPC	Climate Prediction Center, NOAA
CPDF	Catch-Per-Day-Fished
CPI	Consumer price index
CPUE	Catch-Per-Unit-Effort. A standard fisheries index usually expressed as numbers of fish caught per unit of gear per unit of time, e.g., number of fish per hook per line-hour or number of fish per 1,000 hooks
CV	Coefficient of Variation
DAR	Division of Aquatic Resources, State of Hawaii
DAWR	Division of Aquatic and Wildlife Resources, Guam
DEIS	Draft Environmental Impact Statement
DFW	Division of Fish and Wildlife, Northern Mariana Islands
DIC	Dissolved Inorganic Carbon
DMWR	Department of Marine and Wildlife Resources, American Samoa
DOD	Department of Defense
DOJ	Department of Justice
DPS	Distinct Population Segment
DWFN	Distant Water Fishing Nation
E-A	Euro-American

Acronym	Meaning
EEZ	Exclusive Economic Zone, refers to waters of a nation, recognized internationally under the United Nations Convention on the Law of the Sea as extending 200 nautical miles from shore. Within the U.S., the EEZ is typically between three and 200 nautical miles from shore
EF	Expansion Factor
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
ELAPS	Effort Limit Area for Purse Seine
ENSO	El Niño-Southern Oscillation Index
EO	Executive Order
EPO	East Pacific Ocean
ESA	Endangered Species Act. An Act of Congress passed in 1966 that establishes a federal program to protect species of animals whose survival is threatened by habitat destruction, overutilization, disease, etc.
ESD	Equivalent Spherical Diameter
ESRL	Earth System Research Laboratory, NOAA
F	Fishing Mortality
F_{MSY}	Fishing Mortality at MSY
FAD	Fish Aggregating Device; a raft or buoy, drifting or anchored to the sea floor, and under which, pelagic fish will concentrate
FDM	Farallon de Medinilla, CNMI
FEP	Fisheries Ecosystem Plan
FMP	Fishery Management Plan
FR	Federal Register
FWS	Fish and Wildlife Service
GAC	Global Area Coverage
GAM	General Additive Models
GOES	Geostationary Operational Environmental Satellites
GFCA	Guam Fishermen's Cooperative Association
GODAS	Global Ocean Data Assimilation System
GRT	Gross Registered Tonnes
HAPC	Habitat Areas of Particular Concern
HDAR	Hawaii Division of Aquatic Resources. Also, DAR
HLF	Hawaii Longline Fishery
HMRFS	Hawaii Marine Recreational Fishing Survey
HOT	Hawaii Ocean Time Series
HP	Horsepower
HSTT	Hawaii-Southern California Training and Testing
IATTC	Inter-American Tropical Tuna Commission
IFA	Interjurisdictional Fisheries Act
IFP	International Fisheries Program

Acronym	Meaning
ISC	International Scientific Committee
ITS	Incidental Take Statement
K-A	Korean-American
LAA	Likely to adversely affect
LOC	Letter of Concurrence
LOF	List of Fisheries
LRP	Limit Reference Point
LVPA	Large Vessel Protected Area
M	Natural Mortality
M&SI	Mortality and Serious Injury
MSA	Magnuson-Stevens Fishery Conservation and Management Act
ME	McCracken Estimates
MEI	Multivariate ENSO Index
MFMT	Maximum Fishing Mortality Threshold
MHI	Main Hawaiian Islands
MITT	Mariana Islands Training and Testing
MMA	Marine Managed Area
MMPA	Marine Mammal Protection Act
MODIS	Moderate Resolution Imaging Spectroradiometer
MOU	Memorandum of Understanding
MPA	Marine Protected Area
MPCC	Marine Planning and Climate Change
MPCCC	Marine Planning and Climate Change Committee
MRFSS	Marine Recreational Fishing Statistical Survey
MSST	Minimum Stock Size Threshold
MSY	Maximum Sustainable Yield
MUS	Management Unit Species
MW	Megawatt
NA	Not applicable
NCADAC	National Climate Assessment and Development Advisory Committee
NCDC	National Climatic Data Center
NCEI	National Centers for Environmental Information, NOAA
NCRMP	National Coral Reef Monitoring Program
NELHA	Natural Energy Laboratory of Hawaii Authority
NEPA	National Environmental Policy Act
NESDIS	National Environmental Satellite, Data, and Information Service
NLAA	Not likely to adversely affect
NMFS	National Marine Fisheries Service, National Oceanic and Atmospheric Administration, Department of Commerce. Also, NOAA Fisheries
NMSAS	National Marine Sanctuary of American Samoa
NOAA	National Oceanic and Atmospheric Administration, U.S. Department of Commerce

Acronym	Meaning
NOI	Notice of Intent
NS2	National Standard 2
NS8	National Standard 8
NWHI	Northwestern Hawaiian Islands. All islands in the Hawaiian Archipelago, other than the Main Hawaiian Islands (MHI)
NWR	National Wildlife Refuge
OC-CCI	Ocean Color Climate Change Initiative
OEIS	Overseas Environmental Impact Statement
OFP-SPC	Oceanic Fisheries Program of the Secretariat of the Pacific Community
OFL	Overfishing Limit
OLE	Office of Law Enforcement, NOAA
ONI	Oceanic Niño Index
OTEC	Ocean Thermal Energy Conversion
OY	Optimum Yield
PBF	Pacific Bluefin Tuna
PBR	Potential Biological Removal
PDO	Pacific Decadal Oscillation
PICTs	Pacific Island Countries and Territories
PIFSC	Pacific Islands Fisheries Science Center
PIRO	Pacific Islands Regional Office, National Marine Fisheries Service. Also, NMFS PIRO
PMUS	Pacific Pelagic Management Unit Species. Species managed under the Pelagic FEP
POES	Polar Operational Environmental Satellites
PPGFA	Pago Pago Game Fishing Association
ppm	Parts per Million
PPT	Pelagic Fishery Ecosystem Plan Team
PRIA	Pacific Remote Island Areas
RFMA	Regional Fishery Management Agreements
RFMO	Regional Fishery Management Organization
RIMPAC	Rim of the Pacific
RPB	Regional Planning Body
ROD	Record of Decision
SA	Spawning Abundance
SA_{MSY}	Spawning Abundance at MSY
SAFE	Stock Assessment and Fishery Evaluation
SAR	Stock Assessment Report
SB	Spawning Biomass
SB_{MSY}	Spawning Biomass at MSY
SC	Standing Committee of the Western and Central Pacific Fisheries Commission
SDC	Status Determination Criteria

Acronym	Meaning
SEIS	Supplemental Environmental Impact Statement
SEZ	Southern Exclusion Zone, Hawaii
SFA	Saipan Fishermen's Association
SFD	Sustainable Fisheries Division, NMFS PIRO
SFM	Shortfin Mako shark
SHARKWG	Shark Working Group, ISC
SPC	Secretariat of the Pacific Community. A technical assistance organization comprising the independent island states of the tropical Pacific Ocean, dependent territories and the metropolitan countries of Australia, New Zealand, USA, and France; now Pacific Community
SPR	Spawning Potential Ratio. A term for a method to measure the effects of fishing pressure on a stock by expressing the spawning potential of the fished biomass as a percentage of the unfished virgin spawning biomass. Stocks are deemed to be overfished when the SPR<20%.
SSB	Spawning Stock Biomass
SSB_{MSY}	Spawning Stock Biomass at MSY
SSC	Scientific and Statistical Committee, an advisory body to the Council comprising experts in fisheries, marine biology, oceanography, etc.
SST	Sea Surface Temperature
STD	Standard Deviation
STF	Subtropical Front
SWAC	Seawater Air Conditioning
SWG	Spatial Working Group
SWO	Swordfish
TA	Total Alkalinity
TRP	Target Reference Point
TZCF	Transition Zone Chlorophyll Front
US	United States
USAF	United States Air Force
USACE	United States Army Corps of Engineers
USFWS	United States Fish and Wildlife Service, Department of Interior
V-A	Vietnamese-American
WCNPO	Western and Central North Pacific Ocean
WCP–CA	Western and Central Pacific Fisheries Commission Convention Area
WCPFC	Western and Central Pacific Fisheries Commission
WCPO	Western and Central Pacific Ocean
WETS	Wave Energy Test Site
WPacFIN	Western Pacific Fishery Information Network, NMFS
WPRFMC	Western Pacific Regional Fishery Management Council
WPUE	Weight per Unit Effort
WSEP	Weapon Systems Evaluation Program
XBT	Expendable Bathythermographs

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EXECUTIVE SUMMARY

The Western Pacific Regional Fishery Management Council (WPRFMC; the Council) manages the pelagic resources specified in the Magnuson-Stevens Fishery Conservation and Management Act of 1976 (MSA) and that occur in the United States (U.S.) Exclusive Economic Zone (EEZ) around American Samoa, the Commonwealth of the Northern Mariana Islands (CNMI), Guam, Hawaii, and the U.S. possessions in the Western Pacific Region (Johnston Atoll, Kingman Reef and Palmyra, Jarvis, Howland, Baker, Midway, and Wake Islands) known as the Pacific Remote Island Area (PRIA). The Council developed and the National Oceanic and Atmospheric Administration's (NOAA) National Marine Fisheries Service (NMFS) implemented the Fishery Management Plan (FMP) for Pelagic Fisheries of the Western Pacific Region in 1987, which has since been replaced by the Fishery Ecosystem Plan (FEP) implemented in 2010. Since this time, the Council has generated an annual report that provides fishery performance data, including but not limited to landings, value of the fishery, and catch rates, for each of the areas the Council manages.

In July 2013, NMFS issued a final rule (78 FR 43066, July 19, 2013) that revised National Standard 2 (NS2) guidelines and clarified the content and purpose of the Stock Assessment and Fishery Evaluation (SAFE) report to manage fisheries using of the best scientific information available (BSIA) (see Title 50 Code of Federal Regulations [CFR] Part 600.315). In 2015, the Council, in partnership with NMFS Pacific Islands Fisheries Science Center (PIFSC), local fishery resource management agencies, and the NMFS Pacific Islands Regional Office (PIRO), agreed to revise and expand the contents of future annual reports to include the range of ecosystem elements, including protected species interactions, oceanographic parameters, essential fish habitat (EFH) review, and marine planning activities. SAFE reports provide regional fishery management councils and NMFS with information for determining the annual catch limits (ACLs) for each stock in the fishery, documenting significant trends or changes in the resource, marine ecosystems, and fishery over time, implementing required EFH provisions, and assessing the relative success of existing relevant state and federal fishery management programs. The annual SAFE report is intended to serve as a source document for developing the FEPs, amendments, and other analytical documents needed for management decisions.

Table ES-1 was developed from a review of NS2 guidelines and the 2013 revisions under the Final Rule for Provisions on Scientific Information for NS2 (78 FR 43066).

Table ES-1. Fulfillment of National Standard 2 requirements within the 2022 annual SAFE report for the U.S. Pacific Island Pelagic Fisheries Ecosystem Plan

Requirement	Data Needs	Citation for Additional Guidance	Section
Description of the Status Determination Criteria (SDC)	Maximum fishing mortality threshold (MFMT), OFL, and minimum stock size threshold (MSST)	600.310(e)(2)	2.6.5.1
Information on Overfishing Level (OFL)	Data collection, estimation methods, and consideration of uncertainty	600.310(f)(2)	2.6.6
Information determining Annual Catch Limits (ACLs)	Needed for each stock to document significant trends or changes in the resource or marine ecosystem	600.310(f)(5)	2.6.6
Information on Optimum Yield (OY)	The harvest level for a species that achieves the greatest overall benefits, including economic, social, and biological considerations	600.310	NA[1]
Information on Acceptable Biological Catch	Most recent stock assessment	600.310(c) 600.310(f)(2)	2.6.7
Fishing mortality	Sources of fishing mortality (both landed and discarded), including commercial and recreational catch and bycatch in other fisheries	600.310(i)	Ch. 2
Bycatch by fishery	Including target and non-target species		Ch. 2
Rebuilding overfished stocks	Best Scientific Information Available[2] on biological condition of stocks		NA
Condition of ecosystems	BSIA to assess success of FEP		3.5 + Ch. 4
Condition of EFH	Report on review of available information; full review every five years	600.815(a)(10)	3.6
Socioeconomic conditions of fishery	BSIA to assess success of FEP		3.3
Socioeconomic conditions of fishing communities	BSIA to assess success of FEP		3.3
Socioeconomic conditions of processing industry	BSIA to assess success of FEP		NA
Safety at sea by fishery	BSIA to assess success of FEP		NA
Information/data gaps	Explanation of data gaps and emphasis on future scientific work to address gaps		NA

NA = 'Not Applicable'

[1] A numeric OY is not currently used to manage pelagic fisheries in the Pacific Islands Region.

[2] The National Standard 2 Guidelines define BSIA as: "Relevance, inclusiveness, objectivity, transparency, timeliness, verification, validation, and peer review of fishery management information as appropriate. The revised NS2 guidelines do not prescribe a static definition of BSIA because science is a dynamic process involving continuous improvements." (78 FR 43067).

SUMMARY OF SAFE STOCK ASSESSMENT REQUIREMENTS

Many of the fish managed under the Pacific Island Pelagic Fisheries Ecosystem Plan (Pelagic FEP) are also managed under the international agreements governing the Western and Central Pacific Fisheries Commission (WCPFC) and/or the Inter-American Tropical Tuna Commission (IATTC), to which the U.S. is a party. Both the WCPFC and IATTC have adopted criteria for 'overfishing' and 'overfished' designations for certain species that differ from those under the Pelagic FEP. For the purposes of stock status determinations, NMFS will determine stock status of pelagic management unit species (MUS) using the Status Determination Criteria (SDC) described in the Pelagic FEP.

For all pelagic MUS (PMUS) the Council adopted a maximum sustainable yield (MSY) control rule (see Section 2.6.5). The Council has also adopted a warning reference point, B_{FLAG}, set equal to B_{MSY} to provide a trigger for consideration of management action before a stock's biomass reaches the minimum stock size threshold (MSST). A stock is approaching an overfished condition when there is more than a 50 percent chance that the biomass will decline below the MSST within two years.

For pelagic species in the Pacific Island Region, most stock assessments are conducted by several international organizations. In the eastern Pacific Ocean (EPO), IATTC staff conduct stock assessments for Eastern Pacific Ocean bigeye, yellowfin, striped marlin, and swordfish.

In the western and central Pacific Ocean (WCPO), the Secretariat of the Pacific Community Oceanic Fisheries Program (SPC) conducts stock assessments on tropical tunas, as well as for South Pacific albacore, southwest Pacific swordfish, and striped marlin. In the North Pacific Ocean, the International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean (ISC) conducts similar stock assessments.

In 2022, stock assessments were completed for Western and Central Pacific Ocean skipjack tuna (Castillo-Jordan et al. 2022), Pacific bluefin tuna, (ISC 2022a), and North Pacific blue shark (ISC 2022b). Details of these stock assessments can be found in Section 2.6.7. This section also provides an overview of stock status in relation to overfishing and overfished reference points for species managed under this Pelagic FEP.

Figure ES-1 provides the current stock status for all species in the Pelagic FEP for which stock assessments have been completed.

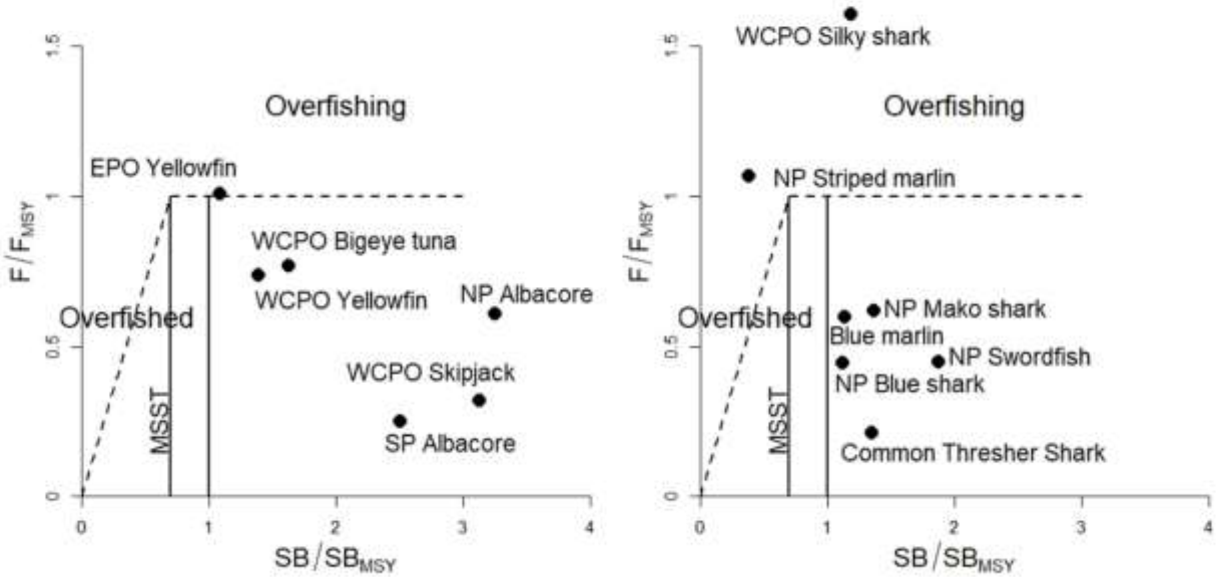


Figure ES-1. Specification of fishing mortality and biomass reference points in the Pelegic FEP and current stock status in the WCPO and EPO. Pacific Ocean bluefin tuna is not illustrated, but the recent stock assessment indicated overfishing is occurring and the stock is overfished

SUMMARY OF FISHERY DATA IN THE PACIFIC ISLAND REGION

Table ES-2. Summary of the total pelagic landings during 2022 in the Western Pacific and the percentage change between 2021 and 2022

Species	American Samoa		CNMI		Guam		Hawaii	
	Landings (lb)	% Change	Landings (lb)	% Change	Landings (lb)	% Change	Landings (lb)	% Change
Swordfish	5,669	-8.1	-	-	0	-	2,047,820	35.0
Blue marlin	104,196	37.1	0***	-100.0	8,700	-71.9	1,239,436	12.6
Striped marlin	3,990	-41.4	-	-	0	-	644,924	13.0
Other billfish*	3,858	0.3	3,449	-	1,046	-	322,324	-5.0
Mahimahi	12,826	447.9	58,049	91.8	94,491	202.5	775,422	3.4
Wahoo	25,826	-28.6	20,646	286.4	57,003	152.6	667,081	-43.2
Opah (moonfish)	938	-38.7	-	-	-	-	526,449	-37.7
Sharks (whole wt.)	0	-	0	-	0	-	9,873	-41.8
Albacore	2,365,584	28.4	-	-	0	-	456,745	-14.4
Bigeye tuna	41,818	-36.4	-	-	0	-	14,688,062	-8.9
Bluefin tuna	0	-100.0	-	-	-	-	3,290	58.3
Skipjack tuna	88,708	-31.3	132,152	-57.0	419,431	-37.0	460,050	-6.9
Yellowfin tuna	326,319	-31.3	14,224	-45.6	34,050	-63.3	7,124,349	2.2
Other pelagics**	1,828	-39.8	8,920	-45.0	15,116	0.4	600,087	3.1
Total	**2,981,560**	**12.6**	**237,440**	**-38.9**	**629,837**	**-26.6**	**29,565,913**	**-4.7**

Note: Total pelagic landings are based on commercial reports and/or creel surveys; % change based on 2020 landings relative to 2022 landings.

*Other billfish include black marlin, spearfish, and sailfish.

**Other pelagics include kawakawa, unknown tunas, pelagic fishes (dogtooth tuna, rainbow runner, barracudas), oilfish, and pomfret. Of these, only oilfish and pomfret are PMUS. While other tables in Chapter 2 excluded or separated out non-MUS, data could not accurately provide individual landings data for these species presented in this total landings table.

*** Tracking of marlin catches by pelagic fisheries in the CNMI is undergoing review to ensure that marlin species are properly identified for the purposes of monitoring fishery performance and reporting it in this annual SAFE report.

AMERICAN SAMOA

Pago Pago Harbor on the island of Tutuila is a regional base for the transshipment and processing of tuna taken by domestic fleets from other South Pacific nations, the distant-water longline fleets, and purse seine fleets. As the NMFS Pacific Island Region does not directly manage these fisheries, data on the purse seine and non-U.S. vessel landings are not included in this report.

Participation. The largest fishery in American Samoa directly managed as part of this FEP is the American Samoa longline fishery. The majority of these vessels are greater than 50 feet (ft), are required to fish beyond 50 nautical miles (nm) from shore, and sell the majority of their catch, primarily albacore, to the Pago Pago canneries. In 2022, there were 11 active longline vessels, all large (> 60 feet). Smaller longline vessels called *alias* (i.e., locally built, twin-hulled vessels about 30 ft long, powered by 40 horsepower gasoline outboard engines) can fish within 50 nm from shore, but due to the low participation in recent years, these data are confidential and can be reported only in combination with the large vessel fishery. Trolling is the next largest fishery with nine boats that landed pelagic species in 2022. Non-commercial pelagic fisheries in American Samoa are less common.

Landings. The estimated annual pelagic landings have varied widely, from 2.0 to over 6.1 million lb since 2013. The total estimated 2022 landings were approximately 3.0 million lb, which repsents an increase from 2021 but a continuation of the decline from 6.1 million lb in 2013 (Figure 4). Pelagic landings consist mainly of five tuna species including albacore, yellowfin, skipjack, mackerel, and bigeye, which made up over 95% of the total estimated landings when combined with other tuna species. Albacore made up 84% of the tuna species total estimated landings. Wahoo, blue marlin, swordfish, and mahimahi made up most of the non-tuna species landings.

Bycatch. There was no recorded bycatch for the troll fishery in 2022 (Table 14). In the longline fishery, around 0.7% of the tuna catch was released. Skipjack and yellowfin were the most released bycatch tuna species at 0.5 and 3.4%, respectively. Conversely, sharks, oilfish and pomfret had the highest release numbers of non-tunas, with nearly 100% of each species released (Table 6). In total, only 3.8% of all pelagic species caught by the longline fishery were released. Fish are released for various reasons including quality, handling and storage difficulties, and marketing problems.

Effort. There are currently 20 vessels known to be fishing in the waters of American Samoa according to federal logbooks collected. The 11 longline vessels that fished in 2022 deployed 1,219 sets (Table 5). The troll fishery conducted only 50 trips that landed pelagic species. Troll trips decreased by over 50%.

Catch Rate. The total pelagic catch rate by all longline vessels increased by 4.5 fish per 1,000 hooks in 2022 from the previous year. Non-tuna pelagic species had a consistent catch rate of 1.2 fish per 1,000 hooks. The longline catch rates for tuna species have fluctuated during the past decade ranging from 13.4 to nearly 21 fish per 1,000 hooks. Albacore catch rates increased this year by 5.4 to 14.6 fish per 1,000 hooks. The average catch per troll hour for all pelagic species decreased in 2022 to 22 lb/hour from 33 lb/hour in 2021.

Revenues. In 2022, the total longline fleet revenue (estimated landed value) was $3.19 million, and albacore composed a majority of the total landed value. Other main species included yellowfin tuna, bigeye tuna, skipjack tuna, and wahoo. The overall average fish price was $1.07 per pound in 2022. Albacore had an estimated price of $1.50 per pound, representing a decrease of $0.10 from 2021.

Protected Species Interactions. Protected species interactions are monitored in the American Samoa longline fishery with mandatory observer coverage targeting approximately 20% of all trips, however, coverage for 2020 was at 2.13% and for 2021 was at 4.65% due to impacts from the COVID-19 pandemic. In 2022, observer coverage was about 8% and data were no longer confidential. However, there were still very few protected species interactions observed.

CNMI

The CNMI's pelagic fisheries occur primarily from the island of Farallon de Medinilla south to the Island of Rota.

Participation. The number of fishers involved in CNMI's pelagic fishery has decreased since 2001, when there were 113 reporting commercial pelagic landings. In 2022, 92 fishers reported landing pelagic species, representing an increase of nearly 11% from the 83 fishers in 2021.

Landings. Skipjack tuna is the principal species landed, comprising neatly 56% of the total estimated pelagic landings in 2022 based on expanded creel survey data. Skipjack estimated landings decreased by 57% in 2022 to 132,152 lb, while total estimated landings also decreased by nearly 39% to 237,440 lb. Landings of mahimahi and wahoo ranked second and third by weight of pelagic species landings in 2022, respectively, at 58,049 lb and 20,646 lb. The amount of yellowfin tuna landed in 2022 decreased substantially from 2021 levels by over to 14,224 lb.

Effort. In 2022, the number of trips catching pelagic species from commercial receipt invoices decreased 16% from 2021 to 1,789 trips. However, the number of estimated trips from expanded creel survey data was relatively consistent at 2,973 trips. Total estimated trolling hours similarly decreased in 2022 by 17% to 14,427 hours. Average trip length has remained steady over the last decade, maintaining between 4.9 and 5.6 hours per trip and slightly decreasing in 2021 to 4.9, tied for the decadal low.

Catch Rate. In 2022, trolling catch rates decreased from 22.0 lb per trolling hour to 15.9 lb per trolling hour, a decrease compared to the 10-year average (21.7 lb/hr). The skipjack catch rate decreased to 9.2 lb per hour fished. This catch rate is 6.2 lb less than the 10-year average (15.4 lb/hr). Yellowfin catch rate decreased from 1.5 in 2021 to 1.0 lb per hour. The mahi mahi catch rate increased to 3.9 lb/hr in 2022, which is 0.1 lb/hr greater than the 10-year average.

Bycatch. Bycatch is not a significant issue in the CNMI, as fishermen retain their catch regardless of species, size, or condition. Based on creel survey interviews, only two fish were caught as bycatch in the trolling fisheries in 2020 leading up to 2022, both mahimahi.

Revenue. The total value of the pelagic fishery in 2022 was $721,579.40, which represented a 6.55% increase from the previous year ($677,239). The average price for all pelagic species was $3.08 in 2022, an increase of $0.66 from 2021.

Protected Species Interactions. There have not been any reported or observed interactions with protected species in the CNMI pelagic fisheries.

GUAM

Guam's pelagic fishery consists of small, primarily recreational, trolling boats that fish within the local waters of Guam's EEZ or the adjacent EEZ of the Northern Mariana Islands.

Participation. The number of boats involved in Guam's pelagic fishery gradually increased from 193 in 1983 to a high of 546 in 2021. There were 449 boats involved in Guam's pelagic fishery in 2022, a decrease of 17.7% from the all time high of 2021. The majority of the fishing boats are less than 10 m (33 ft) in length and are usually owner-operated by fishermen who earn a living outside of fishing. Most fishermen sell a portion of their catch, and it is difficult to make a distinction between recreational, subsistence, and commercial fishers. A small but economically significant segment (~5%) of the pelagic group is made up of marina-berthed charter boats that are operated primarily by full-time captains and crews. Data and graphs for non-charters, charters, and bycatch are represented in this report.

Landings. The estimated annual pelagic landings varies widely in the 42-year time series, ranging between 383,000 and 958,000 lb The average total catch has shown a slowly increasing trend over the reporting period. The 2022 total expanded pelagic landings were 629,837 lb, a decrease of 26.7% when compared with the catch from 2021. Tuna PMUS decreased 40.2%, while non-tuna PMUS increased 87.1%. Landings consisted primarily of five major species: mahimahi, wahoo, bonita or skipjack tuna, yellowfin tuna, and Pacific blue marlin, with skipjack comprising over 66.5% of total landings. Other minor species caught include rainbow runner, barracudas, and pomfrets. Sharks were also caught during 2022, with sharks noted in specific fishermen interviews conducted in 2022 regarding shark encounters (see bycatch below). However, these species were not encountered during offshore creel surveys and were not available for expansion for this year's report. Sharks are often discarded as bycatch. In addition to the above pelagic species, approximately half a dozen other species were landed incidentally this year.

There are wide year-to-year fluctuations in the estimated landings of the five major pelagic species. Landings for two of the five common species increased in 2022 from the previous year's levels. Skipjack decreased 37%, and yellowfin decreased by 63.3%. Wahoo catch increased 252%, mahimahi catch increased by 302%, and blue marlin decreased by 72%.

Effort. In 2022, the number of trolling trips decreased by 7.7% from 2021 levels to 9,895, and hours spent trolling similarly decreased by 14.3%.

In early 2010, the U.S. military began exercises in an area south and southeast of Guam designated W-517. W-517 is a special use airspace (approximately 14,000 nm2) that overlays deep open ocean approximately 50 miles south-southwest of Guam. Exercises in W-517 generally involve live fire and/or pyrotechnics. When W-517 is in use, a notice to mariners is issued, and vessels attempting to use the area are advised to be cautious of objects in the water and other small vessels. This discourages access to virtually all banks south of Guam, including Galvez, Santa Rosa, White Tuna, and other popular fishing areas. From 1982-2015, DAWR surveys recorded more than 2,930 trolling and bottom fishing trips to these southern banks, an average of more than 83 trips per year. The number of notices to mariners in 2021 was 80, equaling 80 closure days, down from 168 closure days in 2020. This impacted the number of fishing days south of Guam.

The small-boat bottomfish and trolling fishery in Guam relies on boat ramp access and FADs.

Recent activities to support the Guam fishery follow.

Catch Rate. Trolling catch rates (lb per hour fished) showed an decrease from 2021. Total CPUE decreased 14.6%. The two tuna species showed an decrease in CPUE from 2021 to 2022. Marlin showed in CPUE from 2021 to 2022. Mahi and wahoo CPUE increased from 2021 to 2022. The fluctuations in CPUE are possibly due to variability in the year-to-year abundance and availability of the stocks.

Bycatch. There is low bycatch in the charter fishery. In 2022, interview data indicated there was again a low bycatch rate; there were 72 fish reported as bycatch in 5,342 tallied fish caught, for a 1.34% rate. Bycatch occasionally occurs in the troll fishery including sharks, shark-bitten and undersized fish.

In 2022, fishers were asked if they experienced a shark interaction. There was a total of 802 interviews for boat-based fishing in 2022, with 95 of these inappropriate for determining shark interaction. Of the remaining 707 interviews, 267 reported interactions with sharks and 440 reported no interactions with sharks for a 37.7% positive rate for interviews where fishers were asked about shark interactions.

Revenues. Commercial data for Guam pelagic fisheries are non-disclosed due to confidentiality rules that prevent data derived from fewer than three sources to be reported. Because there were fewer than three vendors that reported sales of pelagic fish on Guam in 2020, 2021, and 2022, the data are not able to be presented in this report.

A majority of troll fishermen do not rely on the catch or selling of fish as their primary source of income. Previously, Guam law required the Government of Guam to provide locally caught fish to food services in government agencies, such as the Department of Education and Department of Corrections. In 2002, the Government of Guam began implementing cost-saving measures, including privatization of food services. The requirement that locally-caught fish be used for food services, while still a part of private contracts, is not being enforced. This has allowed private contractors to import cheaper foreign fish and reduced the sales of vendors selling locally caught fish. This represented a substantial portion of sales of locally caught pelagic fish. The decrease in commercial sales seen following 2002 may be, in part, due to this change.

Protected Species Interactions. There have not been any reported or observed interactions with protected species in the Guam pelagic fisheries.

HAWAII

Compared to the other regions, Hawaii has a diverse fishery sector which includes shallow- and deep-set longline, Main Hawaiian Islands (MHI) troll and handline, offshore handline, and the aku boat (pole and line) fisheries. The Hawaii longline fishery is by far the most important economically, accounting for nearly 90% of estimated ex-vessel value of the total commercial fish landings in the State. The MHI troll was the second largest fishery in Hawaii with 5.5% of the total value, followed by MHI handline, aku boat, offshore handline fisheries, and other gear types comprising the remainder. The pandemic had a large effect on participation, catch, and revenue in 2020 as the lockdown for public health safety to contain the spread of COVID-19 negatively impacted fishery-related businesses, but trends indicative of recovery may have been observed during 2021.

Participation. A total of 3,201 fishermen were licensed in 2022, including 1,873 (59%) who indicated that their primary fishing method and gear were intended to catch pelagic fish. This is a 1% increase in fishing licenses from the previous year. Most licenses that indicated pelagic fishing as their primary method were issued to longline fishermen (52%) and trollers (31%). The remainder was issued to ika-shibi and palu-ahi (handline) (17%).

Landings. Hawaii commercial fisheries caught and landed 29.6 million pounds of pelagic species in 2022, a decrease of 5% from the previous year. Although each fishery targets or intends to catch a particular pelagic species, a variety of other species were also caught. The deep-set longline fishery targeted bigeye and yellowfin tuna. This was the largest of all pelagic fisheries and its total catch comprised 82% (24.2 million pounds) of all pelagic fisheries. The shallow-set longline fishery targeted swordfish and its catch was 1.9 million pounds, or 6% of the total catch. The MHI troll fishery targeted tunas, marlins and other PMUS caught 1.8 million pounds or 6% of the total. The MHI handline fishery targeted yellowfin tuna while the offshore handline fishery targeted bigeye tuna. The MHI handline fishery accounted for 940,000 pounds (4% of the total). The offshore handline fishery was responsible for 454,000 pounds or less than 2% of the total catch.

The largest component of the pelagic catch was tunas, which comprised 77% of the total in 2022. Bigeye tuna alone accounted for 65% of the tunas and 50% of all the pelagic catch. Billfish catch made up 14% of the total catch in 2022. Swordfish was the largest of these, at 48% of the billfish and 7% of the total catch. Catches of other PMUS represented 9% of the total catch in 2022 with ono being the largest component at 30% of the other PMUS and 3% of the total catch.

Bycatch. A total of 104,013 fish were released by the deep-set longline fishery in 2022. PMUS sharks accounted for 86% of the deep-set longline bycatch. There is almost no market demand for sharks in Hawai’i. Of all shark species combined, 99.9% of the deep-set longline shark catch was released. Conversely, bycatch rate for the deep-set longline fishery was only 4% for targeted and incidentally caught pelagic species in 2022. A total of 7,554 fish were released by the shallow-set longline fishery in 2022. PMUS sharks accounted for 95% of the shallow-set longline bycatch. Of all shark species combined, 99.9% of the shallow-set longline shark catch was released. Conversely, bycatch rate for the shallow-set longline fishery was 3% for targeted and incidentally caught pelagic species in 2022. Since shallow-set longline trips are often longer than deep-set trips, the shallow-set sector conserves space for swordfish, which they target, and foregoes keeping other pelagic species due to their short shelf life.

Effort. There were 147 active Hawaii-permitted deep-set longline vessels in 2022, the same as the previous year. The number of deep-set trips was 1,531 along with 21,299 sets made in 2022. The number of hooks set by the deep-set longline fishery was 63.3 million hooks in 2022. The Hawaii-permitted shallow-set longline fishery operates mainly in the first half of the year. In 2022, 22 vessels completed 69 trips and made 857 sets, which was 5 vessels, 12 trips and 154 more sets than the previous year. The number of hooks set by this fishery also rose to 1.1 million in 2022, an increase over the record low observed in 2019. The number of days fished by MHI troll fishers has been trending lower from its peak in 2013, with 1,166 fishers logging 15,420 days fished around the MHI in 2022. There were 427 MHI handline fishers that fished 3,726 days in 2022, a slight increase from the lowest number of fishers and an improvement from the record low days fished in 2020. The offshore handline fishery only had 6 fishers and 188 days fished in 2022.

The deep-set longline fishery targets bigeye tuna and this species had higher nominal CPUE (2.7 fish per 1,000 hooks) compared to yellowfin tuna (1.3) but bigeye tuna has been on a downward trend from 2015 while yellowfin tuna CPUE has been higher than average for the past 6 years. Albacore CPUE was much lower at 0.2 in 2022. Blue marlin and striped marlin were incidental catches by the deep-set fishery were both at or at 0.3 fish per 1,000 hooks over the ten-year period. In contrast blue shark bycatch species with all fish logged as released yet its CPUE is third only to bigeye and yellowfin at 1.5 fish per 1,000 hooks. The Hawaii-permitted shallow-set longline fishery targets swordfish and had a CPUE of 8.9 fish, in 2022, up from a record low of 7.1 fish in 2021. Blue shark, a bycatch species for this fishery too, had a CPUE of 5.9 fish, same as the previous year. The MHI troll fishery CPUE for yellowfin tuna and blue marlin were both on a gradual upward trend. MHI troll CPUE for skipjack tuna, mahimahi and ono CPUE varied with no clear trend. MHI handline CPUE for yellowfin showed a strong, consistent upward pattern from 2019. Albacore and bigeye tuna CPUE were not only much lower than yellowfin tuna but below their respective long-term CPUEs. Bigeye tuna CPUE for the offshore handline fishery reached a record CPUE in 2022. Yellowfin tuna CPUE in this fishery was often a magnitude lower and variable over the past ten years.

Fish Size. With the exception of bigeye tuna, ono and moonfish the average weight for the remaining pelagic species were below their respective long-term average weight in the deep-set longline fishery. Bigeye tuna caught in the deep-set fishery was 83 pounds in 2022, 3 pounds above the long-term average. All billfish species caught by this fishery were below their 10-year average weight while other PMUS species were close to long-term mean weights. The mean size of swordfish was 130 pounds in 2022, much lower from the 10-year average weight. The pattern of average weight for tunas, billfish and other PMUS in by the shallow-set longline fishery was similar to fish size in the deep-set longline fishery. Swordfish caught by the shallow-set longline fishery was 169 pounds, below the 10-year average weight. In general, the average weight of most fish caught by the shallow-set longline fishery is higher than fish caught by the deep-set longline fishery. In general, the average weight for fish caught by the troll and handline fisheries was above their long-term averages. However, the average weight of blue marlin, swordfish and mahimahi were lower in 2022.

Revenue. The total revenue from Hawai'i's pelagic fisheries was $129.8 million in 2022. This was a decrease of 2% from the previous year. The strong revenue in 2022 is again attributed to the continued recovery from the COVID pandemic. Bigeye tuna and yellowfin tuna represented 57% and 22% of the total pelagic revenue, respectively in 2022. The deep-set longline revenue was $106.4 million in 2022. This fishery represented 82% of the total revenue for pelagic fish in Hawai'i. The shallow-set longline fishery almost doubled to $9.7 million and accounted for 7% of the revenue in 2022. Most of the increase in shallow-set revenue is from more vessels landing in Hawaii instead of off-loading in California. The MHI troll revenue was $7.0 million or 5% of the total in 2022. The MHI handline fishery increased to $4.1 million (3%). The offshore handline fishery was $1.5 million in 2022 and exhibited the largest increase of the small boat fisheries.

Protected Species Interactions. Protected species interactions are monitored in the Hawaii-based longline fishery with mandatory observer coverage at 100% for shallow-set vessels and a target of a minimum of 20% for deep-set vessels; however, observer coverage in the deep-set longline fishery in 2020 and 2021 was 15.25% and 17.84%, respectively, due to impacts related to pandemic restrictions. In the shallow-set longline fishery, annual monitoring of turtle interactions now occurs via trip limits. In 2022, one trip reached leatherback limit (2 interactions) and returned to port; no trips reached loggerhead limit (5). Additionally, the Pelagic Plan Team recommended forming a working group to initiate a detailed review of fishery performance under the trip limits and prepare a report for the May 2024 Plan Team meeting. Further, in the shallow-set fishery, trends of interactions with the black-footed albatross has been increasing over time. An analysis of oceanographic factors and fishery distribution has been identified as a need to better understand this trend, and the tori line study is currently underway to improve mitigation measures for the fishery. In the deep-set longline fishery, olive ridley and black-footed albatross interactions have decreased over the last two to three years after four to five years of higher interaction values. Prior analyses showed that higher interactions were likely driven by oceanographic factors. Additionally, the Pelagic Plan Team formed a working group to consider incorporating reporting requirements derived from the recent Biological Opinion for the fishery in future iterations of the annual SAFE report.

OCEANIC AND CLIMATE INDICATORS

In an effort to improve ecosystem-based fishery management, the Council is utilizing a conceptual model that allows for the application of data from specific climate change indicators that may affect marine systems and ultimately the productivity or catchability of managed stocks. While the indicators that the Council monitors may change as the Council continues to improve ecosystem-based management, this 2022 report provides information on the following list of climate and oceanic indicators being tracked:

- Atmospheric Concentration of Carbon Dioxide (CO_2)
- Oceanic pH (at Station ALOHA)
- Oceanic Niño Index (ONI)
- Pacific Decadal Oscillation (PDO)
- Tropical Cyclones
- Sea Surface Temperature
- Temperature at 200 – 300 m Depth
- Ocean Color (Chlorophyll-*a* concentration)
- North Pacific Subtropical Front (STF)/Transition Zone Chlorophyll Front (TZCF)
- Estimated Median Phytoplankton Size
- Fish Community Size Structure
- Bigeye Tuna Weight-Per-Unit-Effort
- Bigeye Tuna Recruitment Index
- Bigeye Tuna Catch Rate Forecast

Section 3.5.2 provides a description of each of these indicators, a 2022 snapshot of the current conditions accompanied by time series data, and a rationale for how these data may progress ecosystem-based fishery management.

ESSENTIAL FISH HABITAT

NS2 requires that the Council review and revise EFH provisions periodically and to report on this review as part of the annual SAFE report process, with a complete review conducted as recommended by the Secretary at least once every five years. No pelagic EFH reviews were completed in 2022. Non-fishing and cumulative impact components were reviewed from 2016 through 2017 (Minton 2017), and a habitat review for crustaceans in Guam and Hawaii was completed in 2019. The Council expects to amend the EFH for Hawaii precious corals in 2022.

MARINE PLANNING

In 2016, the Council approved a new FEP objective to "consider the implications of spatial management arrangements in Council decision-making". To monitor implementation of this objective, the 2022 annual SAFE report includes the Council's spatially based fishing restrictions (or marine managed areas, MMAs), the goals associated with them, and the most recent evaluation. In addition, to meet EFH and National Environmental Policy Act (NEPA) mandates, this annual SAFE report monitors activities of interest to the Council that may contribute to cumulative impact. This includes observing fishing and non-fishing activities and facilities, including aquaculture operations, alternative energy facilities, and military training and testing activities.

1 INTRODUCTION

The Fishery Management Plan (FMP) for Pelagic Fisheries of the Western Pacific Region was implemented by the National Oceanic and Atmospheric Administration's (NOAA) National Marine Fisheries Service (NMFS) on March 23, 1987. The Western Pacific Regional Fishery Management Council (WPRFMC; the Council) developed the FMP to manage the pelagic resources under the authority of the Magnuson Fishery Conservation and Management Act of 1976 (MSA) and that occur in the United States (U.S.) Exclusive Economic Zone (EEZ) around American Samoa, the Commonwealth of the Northern Mariana Islands (CNMI), Guam, Hawaii, and the U.S. possessions in the Western Pacific Region (i.e., Johnston Atoll, Kingman Reef, Palmyra Atoll, and Jarvis, Howland, Baker, Midway, and Wake Islands). In 2010, the Council and NMFS implemented the Fishery Ecosystem Plan (FEP) for the U.S. Pacific Island Pelagic Fisheries (Pelagic FEP), which includes management measures and strives to integrate vital ecosystem elements important to decision-making, including social, cultural, and economic dimensions, protected species, habitat considerations, climate change effects, and the implications to fisheries from various spatial uses of the marine environment.

For more information regarding the FEP's objectives, past amendments, and other information, refer to the Pelagic FEP found on Council website and regulations at 50 CFR 665.

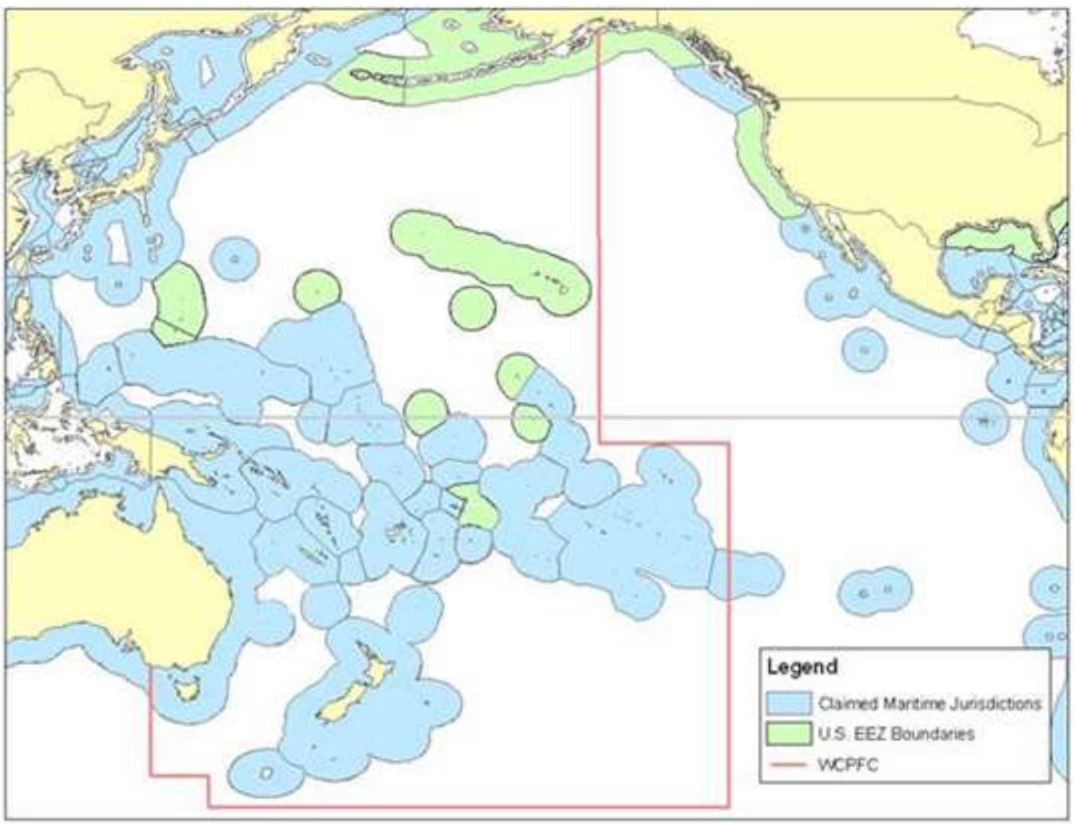
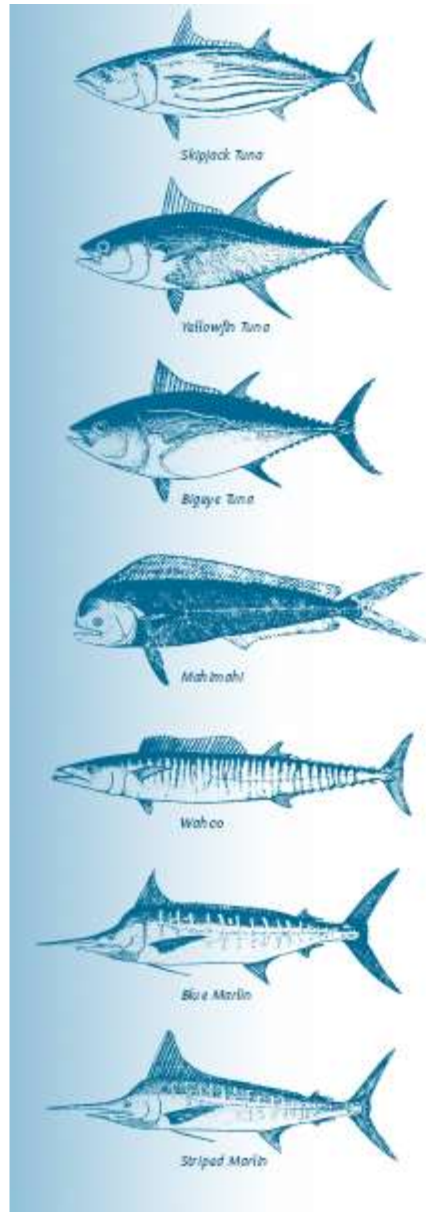


Figure 1. Map of the Western Pacific region

1.1 BACKGROUND TO THE SAFE REPORT

Following the Pelagic FEP requirements, the Council has been generating annual reports that assist the Council and NMFS in assessing the status of the stocks, fisheries, and effectiveness of the management regime. In July 2013, NMFS issued a final rule (78 FR 43066) that revised National Standard 2 (NS2) guidelines to manage fisheries using of the best scientific information available (BSIA) and clarify the content and purpose of the Stock Assessment and Fishery Evaluation (SAFE) Report. In 2015, the Council, in partnership with NMFS Pacific Islands Fisheries Science Center (PIFSC), local fishery resource management agencies, and the NMFS Pacific Islands Regional Office (PIRO), agreed to revise and expand the contents of future annual reports to include the range of ecosystem elements described above. This year marks the seventh iteration of the SAFE report that combines the requirements of reporting for the FEP with those required under NS2 guidelines.



1.2 PELAGIC MUS LIST

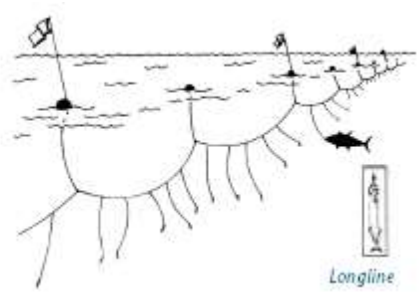
The management unit species (MUS) managed under the Pelagic FEP include large pelagic species such as tunas (tribe Thunnini), billfishes (Istiophoridae and Xiphiidae), and other harvested species with distribution straddling domestic and international waters. The MUS excludes some scombrids found predominantly near land, such as little bonitos (tribe Sardini, e.g., dogtooth tuna, *Gymnosarda unicolor*). Although they are sometimes caught by the FEP-managed fisheries and reported herein, the MUS also exclude all jacks (Carangidae, e.g., rainbow runner, *Elagatis bipinnulata*), all barracudas (Sphyraenidae), all sharks except the following nine species: pelagic thresher shark (*Alopias pelagicus*), bigeye thresher shark (*Alopias superciliosus*), common thresher shark (*Alopias vulpinus*), silky shark (*Carcharhinus falciformis*), oceanic whitetip shark, (*Carcharhinus longimanus*), blue shark (*Prionace glauca*), shortfin mako shark (*Isurus oxyrinchus*), longfin mako shark (*Isurus paucus*), salmon shark (*Lamna ditropis*), and squid (class Cephalopoda) except those listed in Table 1. Although caught frequently, most shark MUS are discarded alive and with fins attached in U.S. fisheries managed under the FEP. Shark finning is illegal in U.S. fisheries.

Table 1. Names of U.S. Pacific Island pelagic management unit species

English Common Name	Scientific Name	Samoan or AS local	Hawaiian or HI local	Chamorroan or Guam local	S. Carolinian or CNMI local	N. Carolinian or CNMI local
Mahimahi (dolphinfishes)	*Coryphaena* spp.	Masimasi	Mahimahi	Botague	Sopor	Habwur
Wahoo	*Acanthocybium solandri*	Paala	Ono	Toson	Ngaal	Ngaal
Indo-Pacific blue marlin Black marlin	*Makaira mazara* *Makaira indica*	Sa'ula	A'u, Kajiki	Batto'	Taghalaar	Taghalaar
Striped marlin	*Tetrapturus audax*		Nairagi			
Shortbill spearfish	*Tetrapturus angustirostris*	Sa'ula	Hebi	Spearfish		
Swordfish	*Xiphias gladius*	Sa'ula malie	A'u kū, Broadbill, Shutome	Swordfish	Taghalaar	Taghalaar
Sailfish	*Istiophorus platypterus*	Sa'ula	A'u lepe	Guihan layak	Taghalaar	Taghalaar
Pelagic thresher shark Bigeye thresher shark Common thresher shark Silky shark Oceanic whitetip shark Blue shark Shortfin mako shark Longfin mako shark Salmon shark	*Alopias pelagicus* *Alopias superciliosus* *Alopias vulpinus* *Carcharhinus falciformis* *Carcharhinus longimanus* *Prionace glauca* *Isurus oxyrinchus* *Isurus paucus* *Lamna ditropis*	Malie	Mano	Halu'u	Paaw	Paaw
Albacore	*Thunnus alalunga*	Apakoa	'Ahi palaha, Tombo	Albacore	Angaraap	Hangaraap
Bigeye tuna	*Thunnus obesus*	Asiasi, To'uo	'Ahi po'onui, Mabachi	Bigeye tuna	Toghu, Sangir	Toghu, Sangir
Yellowfin tuna	*Thunnus albacares*	Asiasi, To'uo	'Ahi shibi	'Ahi, Shibi	Yellowfin tuna	Toghu
Northern bluefin tuna	*Thunnus thynnus*		Maguro			
Skipjack tuna	*Katsuwonus pelamis*	Atu, Faolua, Ga'oga	Aku	Bunita	Angaraap	Hangaraap
Kawakawa	*Euthynnus affinis*	Atualo, Kavalau	Kawakawa	Kawakawa	Asilay	Hailuway
Moonfish	*Lampris* spp	Koko	Opah		Ligehrigher	Ligehrigher
Oilfish family	Gempylidae	Palu talatala	Walu, Escolar		Tekiniipek	Tekiniipek
Pomfret	Family Bramidae	Manifi moana	Monchong			
Other tuna relatives	*Auxis* spp, *Scomber* spp; *Allothunus* spp	(various)	Ke'o ke'o, saba (various)	(various)	(various)	(various)
Neon flying squid Diamondback squid Purple flying squid	*Ommastrephes bartamii* *Thysanoteuthis rhombus* *Sthenoteuthis oualaniensis*		Squid, ika Squid, ika Squid, ika			

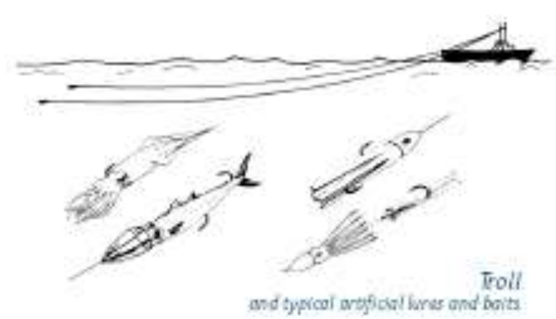
1.3 SUMMARY OF PELAGIC FISHERIES AND GEAR TYPES MANAGED UNDER THE FEP

U.S. pelagic fisheries in the Western Pacific Region are, with the exception of purse seining, primarily variations of hook-and-line fishing. These include longlining, trolling, handlining, and pole-and-line fishing. The U.S. purse-seine fishery is managed under an international convention and is therefore not discussed in this report. In addition, while the U.S. fleet of albacore trollers, based at West Coast ports, occasionally operates in the Western Pacific, this fishery is not directly managed by the Council, and is also not described in this report.



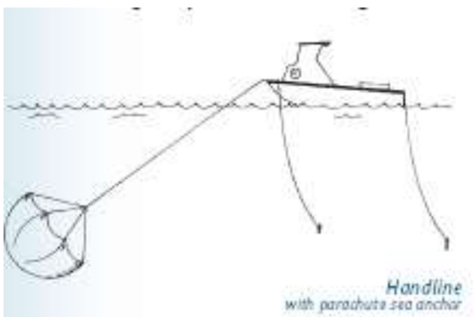
U.S. longline vessels in the Western Pacific Region are based primarily in Hawaii and American Samoa, although Hawaii-based vessels targeting swordfish and bigeye tuna have also fished seasonally out of California. The Hawaii fishery, with 147 active vessels, targets a range of species, with vessels setting shallow longlines to catch swordfish or fishing deep to maximize catches of bigeye tuna. Catches by the Hawaii fleet also include yellowfin tuna, mahimahi, wahoo, blue and striped marlins, opah (moonfish) and monchong (pomfret). The Hawaii fishery does not freeze its catch, which is sold to the fresh fish and sashimi markets in Hawaii, Japan, and the U.S. mainland.

The American Samoa longline fleet fishes almost exclusively for albacore, which is landed at the cannery in American Samoa. Pelagic landings consist primarily of four tuna species: albacore, yellowfin, bigeye, and skipjack. The pelagic species wahoo, blue marlin, and mahimahi comprise most of the non-tuna landings.



Trolling and, to lesser extent, handline fishing for pelagic species are the largest commercial fisheries in terms of participation, although they catch a relatively modest volume of fish annually compared to longline and purse seine gears. Troll and handline catches are dominated by yellowfin tuna in Hawaii, skipjack tuna in Guam and the CNMI, and skipjack and yellowfin tuna in American Samoa. Other commonly caught troll catches include mahimahi, wahoo, and blue marlin. Most of the troll and handline landings are made by Hawaii vessels.

Troll fishing for pelagic species is the most common recreational (i.e., non-commercial) fishery in the islands of the Western Pacific region. The definition of recreational fishing, however, continues to be problematic in a region where many fishermen who are fishing primarily for recreation may sell their fish to cover their expenses.



The Western and Central Pacific Ocean (WCPO) supports the world's largest tuna fishery, with around with at a total tuna catch of over 3.3 million mt of fish annually. Most of the catch is taken by fleets of longliners and purse seiners from countries such as Japan, Taiwan, United States (including the U.S. purse seine fleet), Korea and China; however, around a third of purse seine vessels operating in the WCPO are flagged to Pacific Island countries and these fleets are growing. Small scale artisanal longlining is also conducted in Pacific Island countries like Samoa.

Fishing has been a way of life for millennia across the Pacific Island Region. Each of the archipelagos within this region have a rich and fascinating history, where fishing maintains a critical part in the cultural identity and health of the people. Today, fishing is both a modern enterprise, sustaining an important industry and providing fresh seafood to all of the region's inhabitants, as well as an important pastime that maintains connections to the surrounding environment.

1.3.1 AMERICAN SAMOA

The islands of American Samoa are an area of modest productivity relative to areas to the north and west. The region is traversed by two main currents: the southern branch of the westward-flowing South Equatorial Current from June to October and the eastward-flowing South Equatorial Counter Current from November to April. Surface temperatures vary between 27° and 29° C and are highest from January to April. The upper limit of the thermocline in ocean areas is relatively shallow (27° C isotherm at 100 m depth, approximately 328 ft) but the thermocline itself is diffuse (lower boundary at 300 m depth, approximately 984 ft).

1.3.1.1 TRADITIONAL AND HISTORICAL PELAGIC FISHERIES

The pelagic fishery in American Samoa is and has been an important component of the American Samoan domestic economy. American Samoan dependence on fishing undoubtedly goes back as far as the peopled history of the islands of the Samoan archipelago, about 3,500 years ago. Many aspects of the culture have changed in contemporary times, but American Samoans have retained a traditional social system that continues to strongly influence and depend upon the culture of fishing. Centered around an extended family (*'aiga*) and allegiance to a hierarchy of chiefs (*matai*), this system is rooted in the economics and politics of communally-held village land. It has effectively resisted Euro-American colonial influence and has contributed to a contemporary cultural resiliency unique in the Pacific Island Region.

American Samoa is a landing and canning port for the U.S. purse seine fishery for skipjack and yellowfin tuna, with the largest catch of all U.S. pelagic fisheries in the region. The U.S. longline fishery for South Pacific albacore is conducted primarily in the American Samoa EEZ and comprises the second-largest of the U.S. longline fisheries in the FEP (after Hawaii). The ecosystem based fishery management approach to regulation under the MSA has focused on the socioeconomics of allocating catch and access to EEZ areas by fleet sectors and creating domestic regulations to monitor and mitigate longline fishery impacts to sea turtles and other protected species. American Samoa is a participating U.S. territory in the Western and Central Pacific Fisheries Commission (WCPFC), which status exempts it from certain WCPFC measures so as not to restrict responsible fishery development. The Western and Central Pacific Fisheries Commission (WCPFC) establishes conservation and management measures that NMFS implements under its authorities, including the MSA.

Prior to the mid-1990s, the pelagic fishery was largely a troll fishery. Horizontal longlining was introduced to the territory by Western Samoan fishermen in 1995. Local fishers have found longlining worthwhile as they land more with less effort and use less gasoline for trips. Initially the vessels used for longlining were "alias", locally built, twin-hulled (wood with fiberglass or aluminum) vessels about 30 ft. long, powered by 40 horsepower gasoline outboard engines. Larger monohull vessels capable of longer multi-day trips began joining the longline fleet soon after the alias. The number of alias participating in the fishery decreased to below three by 1995 and due to confidentiality requirements cannot be directly reported. Landings from these vessels are added to the total landings. The number of commercial troll vessels has also declined.

Vessels longer than 50 ft are restricted from fishing within 50 nm of Tutuila, Manu‘a, Swains Island and Rose Atoll (see Section 3.6 for details). Albacore is the primary species caught longlining, with the bulk of the longline catch sold to the Pago Pago canneries. Remaining catch is sold to stores, restaurants, and local residents or donated for customary trade or traditional functions. Pago Pago Harbor on the island of Tutuila is a regional base for the transshipment and processing of tuna taken by domestic fleets from other South Pacific nations, distant-water longline fleets, and purse seine fleets. Purse seine vessels land skipjack, yellowfin and other tunas, and a small portion of albacore.

1.3.1.2 CURRENT PELAGIC FISHERIES

The small-scale longline fishery is nearly defunct. Most participants in the small-scale domestic longline fishery were indigenous American Samoans with vessels under 50 ft in length, of which the remaining vessels are *alia* boats under 40 ft in length. The motivation for American Samoa’s commercial fishermen to shift from troll or handline gear to longline gear in the mid-1990s was the fishing success of 28-foot alia catamarans that engaged in longline fishing in the EEZ around Independent Samoa. Following this example, the fishermen in American Samoa deployed a short monofilament longline, with an average of 350 hooks per set, from a hand-powered reel. An estimated 90 percent of the crews working in the American Samoa small-scale alia longline fleet were from Independent Samoa. Like the conventional monohull longline fishery (see below) the predominant catch from the small-scale fishery has been albacore, which is marketed to the local tuna canneries.

American Samoa’s domestic longline fishery expanded rapidly in 2001. Much of the growth was due to the entry of monohull vessels larger than 50 ft in length. The number of permitted longline vessels in this sector increased from seven in 2000 to 38 by 2003. Of these, five permits for vessels between 50.1 ft – 70 ft, and five permits for vessels larger than 70 ft were believed to be held by indigenous American Samoans as of March 21, 2002. Economic barriers have prevented more substantial indigenous participation in the large-scale sector of the longline fishery. The lack of capital appears to be the primary constraint to substantial indigenous participation in this sector. In 2022, there were 11 active longline vessels. Poor economic conditions have plagued the large vessel fleet for several years and coupled with impacts from the COVID-19 pandemic, the lowest effort and catch was observed in 2020 since the start of the fishery. Both effort and catch slightly rebounded in 2021, and CPUE for albacore was greatly increased in 2022.

While the smallest (≤40 ft) vessels average 350 hooks per set, vessels over 50 ft can set five to six times more hooks and have a greater fishing ranges and capacity for storing fish (from eight to 40 mt on a larger vessel as compared to less than two mt on a small-scale vessel). Larger vessels are also outfitted with hydraulically-powered reels to set and haul mainline, as well as modern electronic equipment for navigation, communications and fish finding. Most are presently being operated to freeze albacore onboard, rather than to land chilled fish.

From October 1985 to the present, catch and effort data in American Samoa troll and handline fisheries have been collected through a creel survey that includes subsistence and recreational fishing, as well as commercial fishing. However, differentiating commercial fishing from non-commercial activity has been difficult, and there have been recent focuses on non-target longline catches that are sold to the local community instead of the cannery.

Recreational fishing underwent a renaissance in American Samoa with the establishment of the Pago Pago Game Fishing Association (PPGFA), founded in 2003 by a group of recreational anglers. The motivation to form the PPGFA was the desire to host regular fishing competitions. Recreational fishing vessels range from 10 ft single engine dinghies to 35 ft twin diesel engine cabin cruisers. The PPGFA has annually hosted international tournaments over the past 15 years, including the Steinlager I‘a Lapo‘a Game Fishing Tournament (a qualifying event for the International Game Fish Association’s Offshore World Championship in Cabo San Lucas, Mexico). The recreational vessels use anchored fish aggregating devices (FADs) extensively, and, during tournaments, venture to the various outer banks which include the South Bank (35 miles south), North East Bank (35 miles northeast), South East bank (37 miles southeast), 2% bank (29 miles east-southeast), and East Bank (24 miles east).

There was no full-time regular charter fishery in American Samoa similar to those in Hawaii or Guam prior to 2015, however, Pago Pago Marine Charters began operating a full-time charter fishery since then.

Estimates of the volume and value of recreational fishing in American Samoa are not precise. A volume approximation of boat based recreational fishing is generated in this annual report based on the annual sampling of catches, conducted by the American Samoa Department of Marine and Wildlife Resources (DMWR) and provided to NMFS PIFSC Fisheries Research and Monitoring Division (FRMD). While boat-based recreational catches were as high as over 46,000 lb in the 2000s, total non-commercial catch was estimated to be over 97,000 lb in 2019. It is likely that non-commercial fishing data in recent years have been affected by impacts associated with the COVID-19 pandemic.

While no permits have been issued to date, non-commercial fishing and recreational charter fishing is permitted within the Rose Atoll Marine National Monument. These permits are available only to community residents of American Samoa or charter businesses established legally under the laws of American Samoa.

1.3.2 COMMONWEALTH OF THE NORTHERN MARIANAS ISLANDS

Generally, the major surface current affecting the Mariana Archipelago is the North Equatorial Current, which flows westward through the archipelago, however, the Subtropical Counter Current affects the Northern Islands and generally flows in an easterly direction. Depending on the season, sea surface temperatures near the Northern Mariana Islands vary between 80.9° – 84.9° Fahrenheit. The mixed layer extends to between depths of 300 – 400 ft.

1.3.2.1 TRADITIONAL AND HISTORICAL PELAGIC FISHERIES

Fishery resources have played a central role in shaping the social, cultural, and economic fabric of the CNMI. The aboriginal peoples indigenous to these islands relied on seafood as their principal source of protein and developed exceptional fishing skills. Later immigrants to the islands from East and Southeast Asia also possessed a strong fishing tradition. Under the MSA, the CNMI is defined as a fishing community.

1.3.2.2 CURRENT PELAGIC FISHERIES

The CNMI's pelagic fisheries occur mainly from the island of Farallon de Medinilla (FDM) south to the island of Rota. Trolling is the primary fishing method utilized in the pelagic fishery. The pelagic fishing fleet consists mostly of vessels less than 24 ft in length, which usually have a limited 20-mile travel radius from Saipan. There were an estimated 2,973 trolling trips in 2022, representing a decrease of over 3% from 2021.

The primary target and most marketable species for the pelagic fleet is skipjack tuna (approximately 56% of 2022 landings). Schools of skipjack tuna have historically been common in nearshore waters, providing an opportunity to catch numerous fish with a minimum of travel time and fuel costs. Skipjack is readily consumed by the local populace and restaurants, primarily as sashimi. Yellowfin tuna and mahimahi are also easily marketable, but seasonal, species. During their seasonal runs, these fish are usually found close to shore and provide easy targets for the local fishermen. In addition to the economic advantages of being nearshore and their relative ease of capture, these species are widely accepted by all ethnic groups, which has kept market demand fairly high.

In late 2007, Crystal Seas became the first established longline fishing company in the CNMI to begin its operation out of the island of Rota. However, by 2009, Crystal Seas had become Pacific Seafood and relocated its operation to Saipan. In 2011, there were four licensed longline fishing vessels stationed in the CNMI, but these vessels found it difficult to market their catch and did not perform well. By 2014, there were no active longliners in the CNMI, although a few of the original vessels were experimenting with other types of fishing with limited success.

1.3.3 GUAM

1.3.3.1 TRADITIONAL AND HISTORICAL PELAGIC FISHERIES

Fishing in Guam continues to be important not only in terms of contributing to the subsistence needs of the Chamorro people, but also in terms of preserving their history and identity. Fishing assists in perpetuating traditional knowledge of marine resources and maritime heritage of the Chamorro culture.

1.3.3.2 CURRENT PELAGIC FISHERIES

Pelagic fishing vessels based in Guam are classified into two general groups: (1) distant-water purse seiners and longliners that fish outside Guam's EEZ and transship through the island; and (2) small, primarily recreational, trolling boats that are either towed to boat launch sites or berthed in marinas and fish only within local waters within Guam's EEZ or on some occasions in the adjacent EEZ of the Northern Mariana Islands. This annual report primarily covers the local, Guam-based, small-boat pelagic fishery.

Landings from Guam fisheries primarily consist of five major species: mahimahi (*Coryphaena hippurus*), wahoo (*Acanthocybium solandri*), skipjack tuna (*Katsuwonus pelamis*), yellowfin tuna (*Thunnus albacares*), and Pacific blue marlin (*Makaira mazara*). Other minor pelagic species caught include rainbow runner (*Elagatis bipinnulatus*), great barracuda (*Sphyraena barracuda*), kawakawa (*Euthynnus affinis*), dogtooth tuna (*Gymnosarda unicolor*), double-lined mackerel (*Grammatorcynus bilineatus*), oilfish (*Ruvettus pretiosus*), and three less common species of barracuda.

The number of boats involved in Guam's pelagic or open ocean fishery has gradually increased from about 200 vessels in 1982. There were 449 boats active in Guam's domestic pelagic fishery in 2022. A majority of the fishing boats are less than 10 m (33 ft) in length and are usually owner-operated by fishermen who earn a living outside of fishing. Most fishermen sell a portion of their catch, and it is difficult to make a distinction between recreational, subsistence, and commercial fishers. A small, but significant, segment of Guam's pelagic fishery is made up of marina-berthed charter boats that are operated primarily by full-time captains and crews.

1.3.4 HAWAII

The archipelago's position in the Pacific Ocean lies within the clockwise rotating North Pacific Subtropical Gyre, extending from the northern portion of the North Equatorial Current into the region south of the Subtropical High, where the water moves eastward in the North Pacific Current. At the pass between the Main Hawaiian Islands (MHI) and the Northwestern Hawaiian Islands (NWHI), there is often a westward flow from the region of Kauai along the lee side of the lower NWHI. This flow, the North Hawaiian Ridge Current, is extremely variable and can also be absent at times. The analysis of 10 years of shipboard acoustic Doppler current profiler data collected by the NOAA Ship *Townsend Cromwell* shows mean flow through the ridge between Oahu and Nihoa, and extending to a depth of 200 m.

Embedded in the mean east-to-west flow are an abundance of mesoscale eddies created from a mixture of wind, current, and sea floor interactions. The eddies, which can rotate either clockwise or counterclockwise, have important biological impacts. For example, eddies create vertical fluxes, with regions of divergence (i.e., upwelling) where the thermocline shoals and deep nutrients are pumped into surface waters enhancing phytoplankton production, and also regions of convergence (i.e., downwelling) where the thermocline deepens. Sea surface temperatures around the Hawaiian Archipelago experience seasonal variability, but generally vary between 18° - 28° C (64° - 82° F) with colder waters occurring more often in the NWHI.

A significant source of inter-annual physical and biological variation around Hawaii are El Niño and La Niña events. During an El Niño, the normal easterly trade winds weaken, resulting in a weakening of the westward equatorial surface current and a deepening of the thermocline in the central and eastern equatorial Pacific. Water in the central and eastern equatorial Pacific becomes warmer and more vertically stratified with a substantial drop in surface chlorophyll.

Physical and biological oceanographic changes have also been observed on decadal time scales. These low frequency changes, termed regime shifts, can impact the entire ocean ecosystem. Recent regime shifts in the North Pacific have occurred in 1976 and 1989, with both physical and biological (including fishery) impacts. In the late 1980s, an ecosystem shift from high carrying capacity to low carrying capacity occurred in the NWHI. The shift was associated with the weakening of the Aleutian Low Pressure System (North Pacific) and the Subtropical Counter Current. The ecosystem effects of this shift were observed in lower nutrient and productivity levels and decreased abundance of numerous species in the NWHI including the spiny lobster, the Hawaiian monk seal, various reef fish, the red-footed booby, and the red-tailed tropic bird.

1.3.4.1 TRADITIONAL AND HISTORICAL PELAGIC FISHERIES

In old Hawaii, fishing in nearshore waters (from the shoreline to the edges of the reefs and where there happens to be no reef, to a distance of nearly a mile from the beach) was regulated by the chiefs and closed seasons were determined by the life history of specific organisms. Areas known as nurseries were not used for fishing. This understanding of natural forces has been captured in the Hawaiian moon calendar, which incorporates the tides and seasons to explain the cycles of scarcity and abundance and provide guidance on what activities should occur at what times of the year. Deep sea fishing (beyond the reefs) was available and open to everyone and conducted based on annual/seasonal weather conditions. Those who fished in the deep ocean sought out these fishing grounds and kept them secret (Kahaulelio 2006). Fish caught in the deep sea included skipjack (aku), dolphinfish (mahimahi), billfish (aʻu), tuna (ahi), and other pelagics.

1.3.4.2 CURRENT PELAGIC FISHERIES

Hawaii's pelagic fisheries, which include longlining, MHI troll and handline, offshore handline, and the aku boat (pole and line) fisheries, are the State's largest and most valuable fishery sector. The target species are tunas and billfish, but a variety of other species are also important. Collectively, these pelagic fisheries harvested approximately 30.4 million lb of commercial landings with a total ex-vessel value of $80.2 million in 2020. The deep-set longline fishery was the largest of all commercial pelagic fisheries in Hawaii and represented 89% of the total commercial pelagic catch and ex-vessel revenue. The MHI troll was the second largest fishery in Hawaii and accounted for 5% of the catch and revenue. The shallow-set longline, MHI handline, aku boat, offshore handline fisheries, and other gear types made up the remainder.

The largest component of the pelagic catch was tunas, which comprised 77% of the total in 2022. Bigeye tuna alone accounted for 65% of the tunas and 50% of all the pelagic catch. Billfish catch made up 14% of the total catch in 2022. Swordfish was the largest of these, at 48% of the billfish and 7% of the total catch. Catches of other PMUS represented 9% of the total catch in 2022 with ono being the largest component at 30% of the other PMUS and 3% of the total catch.

The Hawaii longline fishery is by far the most important economically, with the deep-set fishery sector accounting for about 82% percent of the estimated ex-vessel value of the total commercial fish landings in the State in 2022. In 2017, it is estimated that the commercial fishing and seafood industries in Hawaii generated $900.6 million in sales, $262 million in income, and $402.2 million in value-added impacts while supporting 9,827 full- and part-time jobs (NMFS 2021a). In 2018, these industries supported 8,086 full- and part-time jobs and generated $776.2 million in sales, $233.4 million in income, and $343.6 million in value-added impacts (NMFS 2021b). More recently, in 2019, 7,693 jobs were supported by the industries, which generated $786 million in sales, $229.5 million in income, and $340.9 million in value-added impacts (NMFS 2022).

Recreational fisheries are also extremely important in the State of Hawaii economically, socially, and culturally. The total estimated pelagic recreational fisheries production in 2020 was nearly 14.5 million lb. The number of small vessels in Hawaii declined to approximately 11,000 in 2018 since a peak of over 16,000 vessels in 2008. Boat-based anglers took 632,088 fishing trips in 2019, with only 7,744 designated charter vessel trips. Although unsold or not entering the typical commercial channels for fish sales, the total estimated value of the recreational catch was approximately $20 million in 2018 based on an average of $3.00/lb provided by PIFSC FRMD.

1.3.5 PACIFIC REMOTE ISLAND AREA

Baker Island lies within the westward flowing South Equatorial Current. Baker Island also experiences an eastward flowing Equatorial Undercurrent that causes upwelling of nutrient and plankton rich waters on the west side of the island (Brainard et al. 2005). Sea surface temperatures of pelagic EEZ waters around Baker Island are often near 30° C. Although the depth of the mixed layer in the pelagic waters around Baker Island is seasonally variable, the average mixed layer depth is around 100 m.

Howland Island lies within the margins of the eastward flowing North Equatorial Counter Current and the margins of the westward flowing South Equatorial Current. Sea surface temperatures of pelagic EEZ waters around Baker Island are often near 30° C. Although the depth of the mixed layer in the pelagic waters around Howland Island is seasonally variable, the average mixed layer depth is around 70 m – 90 m.

Jarvis Island lies within the South Equatorial Current which runs in a westerly direction. Sea surface temperatures of pelagic EEZ waters around Jarvis Island are often 28°- 30° C. Although depth of the mixed layer in the pelagic waters around Jarvis Island is seasonally variable, the average mixed layer depth is around 80 m.

Palmyra Atoll and Kingman Reef lie in the North Equatorial Counter-current, which flow in a west to east direction. Sea surface temperatures of pelagic EEZ waters around Palmyra Atoll are often 27°- 30° C. Although the depth of the mixed layer in the pelagic waters around Kingman Reef is seasonally variable, the average mixed layer depth is around 80 m.

Sea surface temperatures of pelagic EEZ waters around Johnston Atoll are often 27°- 30° C. Although the depth of the mixed layer in the pelagic waters around Johnston Atoll is seasonally variable, the average mixed layer depth is around 80 m.

Sea surface temperatures of pelagic EEZ waters around Wake Island are often 27°- 30° C. Although the depth of the mixed layer in the pelagic waters around Wake Atoll is seasonally variable, the average mixed layer depth is around 80 m.

1.3.5.1 TRADITIONAL AND HISTORICAL PELAGIC FISHERIES

As many tropical pelagic species (e.g., skipjack tuna) are highly migratory, the fishing fleets targeting them often travel great distances. Although the EEZ waters around Johnston Atoll and Palmyra Atoll are over 750 nm and 1000 nm (respectively) away from Honolulu, the Hawaii longline fleet does seasonally fish in those areas. For example, the EEZ around Palmyra is visited by Hawaii-based longline vessels targeting yellowfin tuna, whereas at Johnston Atoll, albacore is often caught in greater numbers than yellowfin or bigeye tuna. Similarly, the U.S. purse seine fleet also targets pelagic species (primarily skipjack tuna) in the EEZs around some Pacific Remote Island Area (PRIA), specifically, the equatorial areas of Howland, Baker, and Jarvis Islands. The combined amount of fish harvested from these areas from the U.S. purse seine on average is less than five percent of their total annual harvest.

1.3.5.2 CURRENT PELAGIC FISHERIES

The U.S. Fish and Wildlife Service (USFWS) prohibits fishing within the Howland Island, Jarvis Island, and Baker Island National Wildlife Refuge boundaries. Currently, Jarvis Island, Howland Island, and Baker Island are uninhabited. The USFWS manages Johnston Atoll as a National Wildlife Refuge but does allow some recreational fishing within the Refuge boundary.

1.4 ADMINISTRATIVE AND REGULATORY ACTIONS

This section describes NMFS management actions for the pelagic fisheries in the Pacific Islands Region over the course of 2022.

On March 24, 2022, NMFS is issued an experimental fishing permit (EFP) to the Hawaii Longline Association (HLA) to evaluate the risk of seabird interactions in the Hawaii shallow-set longline fishery when setting fishing gear one hour before and one hour after local sunset and using tori lines instead of blue-dyed bait and strategic offal discharge as seabird mitigation measures (87 FR 15383). The intent of the EFP is to conduct a preliminary evaluation of alternative methods of discouraging seabird interactions while providing operational flexibility during setting in the shallow-set longline fishery. The permit is valid until September 24, 2023, or for a maximum of 80 fishing sets, whichever occurs first, unless revoked, suspended, or modified.

On April 13, 2022, NMFS issued temporary specifications to extend the effective date of Western and Central Pacific Fisheries Commission (WCPFC) intersessional decisions related to the COVID-19 pandemic on purse seine observer coverage and at-sea transshipment observers (87 FR 21812).

On April 28, 2022, NMFS published a final rule (87 FR 25153) to prohibit the use of wire leaders in the Hawaii deep-set longline fishery and require the removal of fishing gear from any oceanic whitetip shark caught in the region's domestic longline fisheries. The rule is intended to increase post-hooking survival of oceanic whitetip sharks. The rule became effective on May 31, 2022.

On August 29, 2022, NMFS announced a valid specified fishing agreement between American Samoa and the HLA (87 FR 52704). The agreement allocated up to 1,500 metric tons (t) of American Samoa's 2022 bigeye tuna limit to U.S. longline fishing vessels identified in the agreement. The agreement supports the long-term sustainability of fishery resources of the U.S. Pacific Islands and fisheries development in American Samoa. The specified agreement was valid as of July 20, 2022. The start date for attributing 2022 bigeye tuna catch to American Samoa under the agreement was August 25, 2022.

On December 7, 2022, NMFS announced a valid specified fishing agreement between the CNMI and the HLA (87 FR 74991). The agreement allocated up to 1,500 metric tons of the CNMI's 2022 bigeye tuna limit to U.S. longline fishing vessels identified in the agreement. The agreement supports the long-term sustainability of fishery resources of the U.S. Pacific Islands and fisheries development in the CNMI. The specified agreement was valid as of July 20, 2022. The start date for attributing 2022 bigeye tuna catch to the CNMI under the agreement was November 21, 2022.

1.5 TOTAL PELAGIC LANDINGS IN THE WESTERN PACIFIC REGION FOR ALL FISHERIES

A summary of the 2022 total pelagic landings in the Western Pacific and the change between 2021 and 2022 are shown in Table 2.

Table 2. Total pelagic landings (lb) in the Western Pacific Region in 2022 and percent change from the previous year

Species	American Samoa			CNMI			Guam			Hawaii		
	2021 lb	2022 lb	% Change	2021 lb	2022 lb	% Change	2021 lb	2022 lb	% Change	2021 lb	2022 lb	% Change
Swordfish	6,169	5,669	-8.1	-	-	-	0	0	-	1,516,976	2,047,820	35.0
Blue marlin	76,001	104,196	37.1	3,020	0	-100.0	30,967	8,700	-71.9	1,100,716	1,239,436	12.6
Striped marlin	6,811	3,990	-41.4	-	-	-	0	0	-	570,807	644,924	13.0
Other billfish*	3,847	3,858	0.3	0	3,449	-	0	1,046	-	339,428	322,324	-5.0
Mahimahi	2,341	12,826	447.9	30,264	58,049	91.8	31,235	94,491	202.5	750,266	775,422	3.4
Wahoo	36,184	25,826	-28.6	5,343	20,646	286.4	22,567	57,003	152.6	1,173,932	667,081	-43.2
Opah (moonfish)	1,531	938	-38.7	-	-	-	-	-	-	844,990	526,449	-37.7
Sharks (whole wt.)	0	0	-	0	0	-	0	0	-	16,973	9,873	-41.8
Albacore	1,842,039	2,365,584	28.4	-	-	-	0	0	-	533,800	456,745	-14.4
Bigeye tuna	65,789	41,818	-36.4	-	-	-	0	0	-	16,129,069	14,688,062	-8.9
Bluefin tuna	238	0	-100.0	-	-	-	-	-	-	2,079	3,290	58.3
Skipjack tuna	129,118	88,708	-31.3	307,492	132,152	-57.0	665,717	419,431	-37.0	494,100	460,050	-6.9
Yellowfin tuna	475,028	326,319	-31.3	26,144	14,224	-45.6	92,834	34,050	-63.3	6,970,137	7,124,349	2.2
Other pelagics**	3,035	1,828	-39.8	16,229	8,920	-45.0	15,052	15,116	0.4	581,864	600,087	3.1
Total	2,648,131	2,981,560	12.6	388,492	237,440	-38.9	858,372	629,837	-26.6	31,025,137	29,565,913	-4.7

Note: Total Pelagic Landings based on commercial reports and/or creel surveys. % change based on 2021 landings relative to 2022 landings. Hawaii data reflect commercial reports only.

*Other billfish include black marlin, spearfish, and sailfish.

**Other pelagics include: kawakawa, unknown tunas, pelagic fishes (dogtooth tuna, rainbow runner, barracudas), oilfish, and pomfret. Of these, only kawakawa, unknown tunas, oilfish and pomfret are Pelagic MUS. While other tables in Chapter 2 excluded or separated out non-MUS, data could not accurately provide individual landings data for these species presented in this total landings table.

1.6 PLAN TEAM RECOMMENDATIONS

At its May 2023 meeting, the Pelagic Plan Team:

1. Recommended the FDCRC to discuss and recommend increasing staff capacity and retention for the territorial fishery agencies.
2. Recommended PIFSC to look at the effect of protected species (prioritizing loggerhead sea turtles and leatherback sea turtles) population trends on predicted interactions and impacts of climate/environmental drivers.
3. Recommended that the Council form a working group including Pelagic Plan Team members T. Todd Jones, Rob Ahrens, Lynn Rassell, Melissa Snover, Russell Ito, and Council staff, to initiate a detailed review of fishery performance under the loggerhead and leatherback turtle trip interaction limits in the Hawaii shallow-set longline fishery including data since implementation of the trip limits in September 2020 through the 2022-2023 fishing season. The working group should take into account loggerhead and leatherback turtle interaction patterns as they relate to oceanographic factors, potential effect of population trends on interaction trends, and industry feedback received at the November 2022 EBFM Spatial Decision Making Workshop. The working group should provide a report to the Pelagic Plan Team at the May 2024 meeting.
4. Recommended that PIFSC SEES continue to pursue funding to conduct cost-earnings surveys at their regular five-year intervals to better inform socioeconomic data summaries.
5. Recommended the Action Team to prioritize analyzing regulations for multi-year longline bigeye tuna catch and allocations to have a single unified agreement between U.S. vessels and Territories, noting the complexities of tracking attributions of fishing vessels to territorial allocations and RFMO requirements of charter arrangements being singular.
6. Recommended that the Council request NOAA, in its evaluation of the Pacific Remote Island Area sanctuary designation, to evaluate the holistic impacts of prohibiting tuna fishing 50 to 200 nm of the island areas and that resuming sustainable fishing be made an objective in the designation.
7. Endorsed Pelagic Research Plan Priorities to be:
    - Improving knowledge on life history, stock structure, distributions, and connectivity of pelagic management unit species throughout Pacific
    - Understanding causality of fishery performance for Western Pacific Region pelagic fisheries, including incidentally caught species
    - Effects of spatial closures and large-scale marine protected areas on fisheries, island communities, and population dynamics on target and non-target species
    - Mitigation of depredation and development of deterrents to reduce depredation in U.S. Pacific Island fisheries.
    - Advancing ecosystem-based fisheries management
    - Impact of pelagic fisheries on sustaining community resiliency; and recommends Council staff to deliver a draft plan to the June 2023 SSC and Council.

2 DATA MODULES

2.1 AMERICAN SAMOA

2.1.1 DATA SOURCES

This report contains the most recently available information on American Samoa's pelagic fisheries, as compiled from data generated by the Department of Marine and Wildlife Resources (DMWR) through a program established in conjunction with the National Marine Fisheries Service (NMFS) Pacific Islands Fisheries Science Center (PIFSC) and supported in part through funding from the Interjurisdictional Fisheries Act (IFA). Purse seine and non-U.S. vessel landings are not included in this module but are discussed in general in the International module (see Section 2.6).

Prior to 1985, only commercial landings were monitored. From October 1985 to the present, data have been collected through the Tutuila and Manu‘a creel survey program to include subsistence, recreational, as well as commercial fishing. Surveyors have noted that fishermen may not accurately report the number of fish released at sea, although the troll fishery in American Samoa has not been known to release fish. However, the Pago Pago Gamefishing Association, a recreational troll fishery, catches and releases blue marlin.

In September 1990, a commercial purchase system (i.e., receipt book) was instituted requiring all businesses that buy fish commercially in American Samoa, with an exception for the canneries, to submit a copy of their purchase receipts to the DMWR. In January 1996, NMFS implemented a federal longline logbook system. All longline fishermen are required to obtain a federal permit and to submit logs containing detailed data on each of their sets and the resulting catch, including the number of hooks set and number of fish released as bycatch. Confidentiality requirements prohibit providing a breakdown of the catch or effort from alia and monohull longline vessels in recent years. Changes to the data collection and analysis methodology have occurred periodically and are described in previous annual reports. No changes to the data collection or analysis were made in 2020, except that the number of vendors participating in the commercial purchase system decreased.

Participation (i.e., number of boats) is determined through both logbook entries and creel interviews. Effort (i.e., number of trips, hooks) is determined by direct reporting for longline trips, but is indirectly calculated for trolling trips, based on total pounds landed (reported), and average hourly catch rate and duration for trip (from creel interviews). Since 2009 (the year of the tsunami), only the longline logbook database has been useful in determining the number of active boats. Prior to that, DMWR's boat-based creel survey data were also used to assess whether or not longline vessels were active to include information from alia longline vessels that did not frequent the canneries and exclude alias that exclusively conducted bottomfish fishing and/or trolling.

DMWR implemented a fuel subsidy program from 2015 to 2018 that required DMWR to meet fishers at a designated time and location for mandatory surveys in order to receive fuel subsidies. This extended the creel survey schedule and detracted from the random sampling design at other times of the day. The fuel was dispensed to vessel owners, including those who rent their vessels to fishermen. The new program caused changes in fishing behavior that may have impacted catch estimates. Generally, more fuel was used and there were longer and more frequent trips, but otherwise, catch per unit effort (CPUE) and species composition were not affected. There was an increase in the number of trolling trips and trip length that may have affected the relative amount of pelagic species in the catch.

Average weight (pounds) per fish is calculated directly from creel-weighed fish sampled over the year. In the past, cannery fish weight was determined based on a length to weight conversion from cannery sampling data, since longline boats have been landing their catches gilled and gutted since 1999. However, the cannery sampling program was discontinued in 2015, so those average weight data are no longer available. There is no cannery sampling data available since 2016. Therefore, PIFSC used proxies to estimate the weight and value of fish landings for the longline fishery in American Samoa.

For estimated weights, the current summaries are based on the best available average weight data for 2020, which is from DMWR's creel surveys. It should be noted that the weight of fish from the small boats is somewhat smaller than fish caught on the larger oceangoing vessels, contributing to a somewhat lower weight estimate for the fishery. Over the course of 2016, the Pacific Island Fisheries Science Center (PIFSC) Fisheries Research and Monitoring Division’s (FRMD) International Fisheries Program (IFP) began estimating the average weight of fish kept for the longline fishery from observer data. This alternative source provides trip-level average weights for vessels with observers. These weights will be more representative of the longline fishery, but they will not be available for trips that do not carry observers. The protocol for handling unobserved trips is being developed by IFP, which will provide the data for this report in future years, but the information is not yet available. The information will be provided in the Regional Fishery Management Organization (RFMO) report for US Pacific longline fisheries.

Another item lost with the discontinuation of the longline cannery sampling program by the Pacific Island Regional Office (PIRO) in Pago Pago was data on the proportion of longline fish (by species) sold to the cannery versus local market and village/take home (given, not sold). While the cannery buys a much higher volume of fish, their prices are low. The lesser amount of fish sold to the markets and local restaurants garners a higher price. Another portion of the catch is given away or taken home. In the absence of a cannery sampling program in 2016, PIFSC had to apply a number of estimates. For the top five cannery species (albacore, skipjack, yellowfin and big eye tuna and wahoo) the assumption of 100% sold to the cannery was applied. For other species also previously sampled at the cannery, for which a large percentage are not sold, proxy values from previous years were applied. The net result of using lower average weights (from creel surveys) and lower percentages sold to the market (or sold period) is likely to be responsible in part for a decrease in estimated weight and value of the catch sold.

Total landings data cover all fish caught and brought back to shore, whether it enters the commercial market or not. Commercial landings cover the portion of the total landings that was sold both to the canneries and other smaller local business. The difference between total landings and commercial landings is assumed to be the recreational/subsistence component of the fishery.

This module was prepared by DMWR and PIFSC Fisheries Research and Monitoring Division (FRMD) and was reviewed by the Pelagic Plan Team (PPT), Scientific and Statistical Committee (SSC), and the Western Pacific Regional Fishery Management Council (WPRFMC; the Council).

2.1.2 SUMMARY OF AMERICAN SAMOAN PELAGIC FISHERY

Landings. The estimated annual pelagic landings have varied from 2.0 to 6.1 million lb between 2013 and 2022. The 2022 landings were approximately 2.98 million pounds, which is slightly up from 2.6 million lb in 2021. There also has been a steady increase since 2020 (Figure 4). Pelagic landings consist mainly of four tuna species (albacore, yellowfin, skipjack, and bigeye), which, when combined with other tuna species, made up 95% of the total landings. Albacore made up 84% of the tuna species in 2022. Blue marlin, wahoo and mahimahi make up most of the non-tuna species landings.

Longline Effort. There were 11 vessels known to be fishing in the waters of American Samoa in 2022, one less than in 2021 and the same number in 2020 according to the PIRO Sustainable Fisheries Division permit program. The vessel size classes have been changed from four to two: small (< 40 feet) and large vessels (> 60 feet). There were 11 active large vessels and no active small vessels in 2022. There have been zero active small longline vessels since 2020. The 11 vessels that fished in 2022 made 42 trips (averaging 3.8 trips/vessel), deployed 1,219 sets, (110 sets/vessel) using 2.6 million hooks and 0 lightsticks (Table 5). All other fishing effort indicators indicate a declining longline fishery: the number of boats were the same in 2022 and 2021 but still low; the number hooks set increased from 2021 but still an all-time low; the number of sets; and the number of longline sets decreased from 2021 and is an all-time low. All fishing effort indicators also indicate a declining trolling fishery. The number of boats which was 9 in 2022 increased from 5 in 2021 on a long-term decline since 2014. The number of troll trips precipitously declined from 100 in 2021 to 50 in 2022 and the lowest since 2013. There were 205 effective trolling hours in 2022, which is the lowest since 2013. A certain degree of the decline in 2022 can be attributed to the fisheries impact of COVID-19 social restrictions.

Longline CPUE. The total pelagic catch rate by all longline vessels increased by 4.5 fish/1,000 hooks in 2022 to 19.1 fish/1,000 hooks, an increase of 34% and below average CPUE of 20 fish/1,000 hooks reported since 2006. The tuna catch rate by longliners also increased by 4.5 fish/1,000 hooks in 2021 to 17.9 fish/1,000 hooks and the highest catch rate since 2013 (17.9 fish/1,000 hooks in 2015 and 2022). The catch rate for albacore increased by 5.4 fish/1,000 hooks in 2022 to 14.6 fish/1,000 hooks. This is the highest catch rate since 2013, slightly lower than in 2012 and 2009 (4.8 fish/1,000 hooks) but still lower than the highest records of 18.4 fish/1,000 hooks in 2006 and 2007.

Lb-Per-Hour Trolling. Trolling catch rates decreased in 2022 (22 lb/hr) from 2021 (33 lb/hr) that had been previously increasing since 2017 (16 lb/hr; Figure 19). Trolling catch rates have fluctuated with peak in 2016 (45 lb/hr). The catch rates for skipjack decreased to 18.16 lb/hr in 2022 from 25.39 lb/hr in 2021 but still on an increasing trend since 2017 (4 lb/hr). The catch rates for yellowfin precipitously declined to 0.09 lb/hr in 2022 from 6.10 lb/hr in 2021 and on a decreasing trend since 2016 (17.8 lb/hr) (Figure 20).

Fish Size. Since the last year of available data from the cannery sampling program was 2015 average weight-per-fish are no longer presented in this report. Average albacore weight ranged from 38 to 40 lb from 2010 to 2015. However, the boat-based creel surveys recorded a size range of 35 to 38 lb from 2013 to 2020. Yellowfin and bigeye tuna weight per fish from the cannery sampling program seemed to decline from 2011 to 2015, at 57 to 39 lb and 54 to 38 lb, respectively.

Revenues. In 2022, the total longline fleet revenue (estimated landed value) was $3.19 million, and albacore composed a majority of the total landed value. Other main species included yellowfin tuna, bigeye tuna, skipjack tuna, and wahoo. The overall average fish price was $1.07 per pound in 2022. Albacore had an adjusted price of $1.50 per pound, representing a decrease of $0.10 from 2021. See the Socioeconomics (Section 3.2) module for additional data on American Samoa pelagic fisheries.

Bycatch. There was no recorded bycatch for the troll fishery in 2022 (Table 14). In the longline fishery, around 0.7% of the tuna catch was released. Skipjack and yellowfin were the most released bycatch tuna species at 0.5 and 3.4%, respectively. Conversely, sharks, oilfish and pomfret had the highest release numbers of non-tunas, with nearly 100% of each species released (Table 6). In total, only 3.8% of all pelagic species caught by the longline fishery were released. Fish are released for various reasons including quality, handling and storage difficulties, and marketing problems.

2.1.3 PLAN TEAM RECOMMENDATIONS

There were no Plan Team recommendations relevant to the American Samoa data module of the annual SAFE report.

2.1.4 OVERVIEW OF PARTICIPATION – ALL FISHERIES

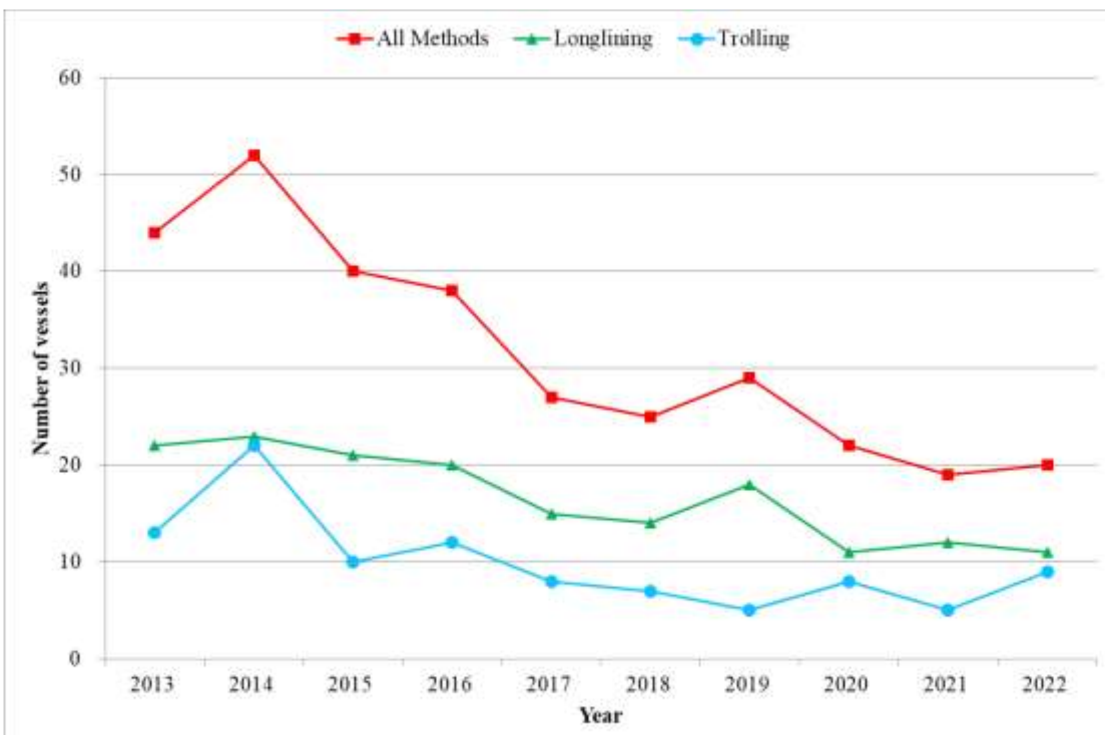


Figure 2. Number of boats landing any pelagic species in American Samoa by longlining, trolling, and all methods

Supporting data shown in Table A-2.

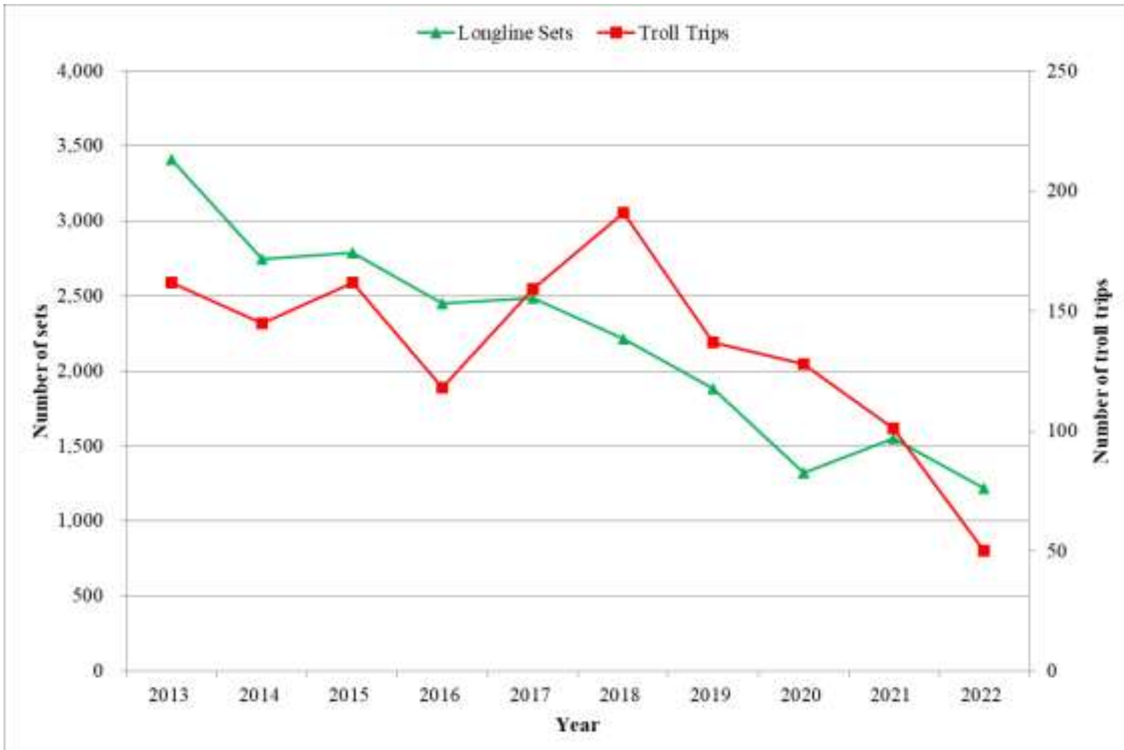


Figure 3. Number of fishing trips and sets for pelagic species in American Samoa
Supporting data shown in Table A-3.

2.1.5 OVERVIEW OF LANDINGS – ALL FISHERIES

Table 3. Estimated total landings (lb) of pelagic species in American Samoa by gear in 2022

Species	Longline Pounds	Troll Pounds	Other Pounds	Total Pounds
Skipjack tuna	84,974	3,734	0	88,708
Albacore tuna	2,365,584	0	0	2,365,584
Yellowfin tuna	326,301	19	0	326,319
Kawakawa	0	16	0	16
Bigeye tuna	41,818	0	0	41,818
Bluefin tuna	0	0	0	0
Tunas (unknown)	0	0	0	0
TUNAS TOTAL	**2,818,677**	**3,769**	**0**	**2,822,445**
Mahimahi	12,247	578	0	12,826
Black marlin	0	0	0	0
Blue marlin	104,196	0	0	104,196
Striped marlin	3,990	0	0	3,990
Wahoo	25,826	0	0	25,826
Swordfish	5,669	0	0	5,669
Sailfish	1,418	48	0	1,466

Species	Longline Pounds	Troll Pounds	Other Pounds	Total Pounds
Spearfish	2,392	0	0	2,392
Moonfish	938	0	0	938
Oilfish	303	0	0	303
Pomfret	431	0	0	431
Pelagic thresher shark	0	0	0	0
Thresher shark	0	0	0	0
Shark (unknown pelagic)	0	0	0	0
Snake mackerel	0	0	0	0
Bigeye thresher shark	0	0	0	0
Silky shark	0	0	0	0
White tip oceanic shark	0	0	0	0
Blue shark	0	0	0	0
Shortfin mako shark	0	0	0	0
Longfin mako shark	0	0	0	0
Billfishes (unknown)	0	0	0	0
NON-TUNA PMUS TOTAL	**157,410**	**626**	**0**	**158,037**
Pelagic fishes (unknown)	0	0	0	0
Double-lined mackerel	0	0	0	0
Mackerel	0	0	0	0
Long-jawed mackerel	0	0	0	0
Barracudas	918	0	0	918
Great barracuda	0	0	0	0
Small barracudas	0	63	0	63
Rainbow runner	0	6	0	6
Dogtooth tuna	0	79	12	91
OTHER PELAGICS TOTAL	**918**	**148**	**12**	**1,078**
TOTAL PELAGICS	**2,977,005**	**4,543**	**12**	**2,981,560**

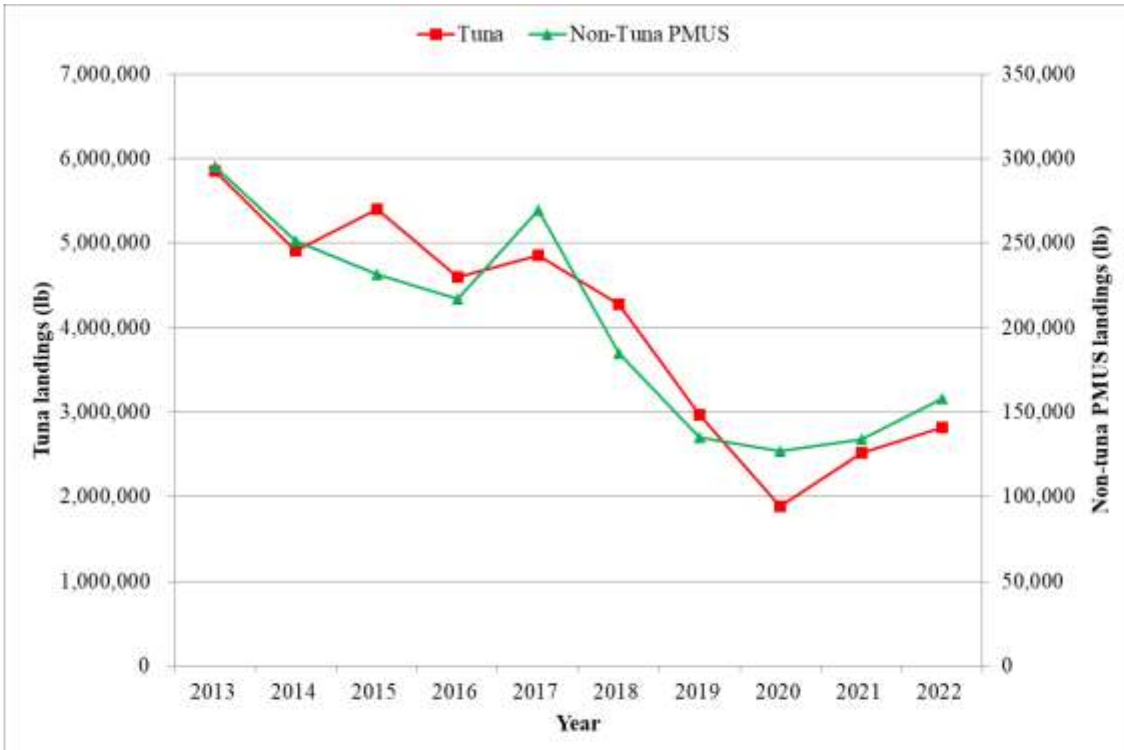


Figure 4. Total estimated landings of tuna and non-tuna PMUS in American Samoa
Supporting data shown in Table A-4.

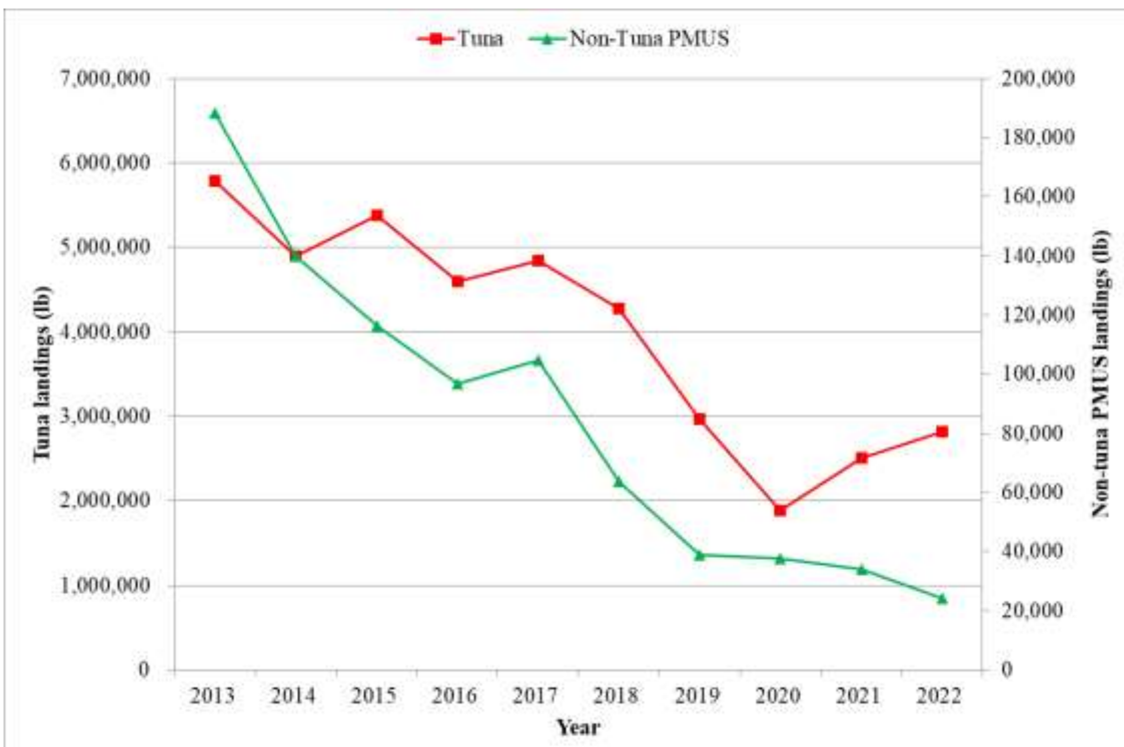


Figure 5. Commercial landings of tuna and non-tuna PMUS in American Samoa
Supporting data shown in Table A-5.

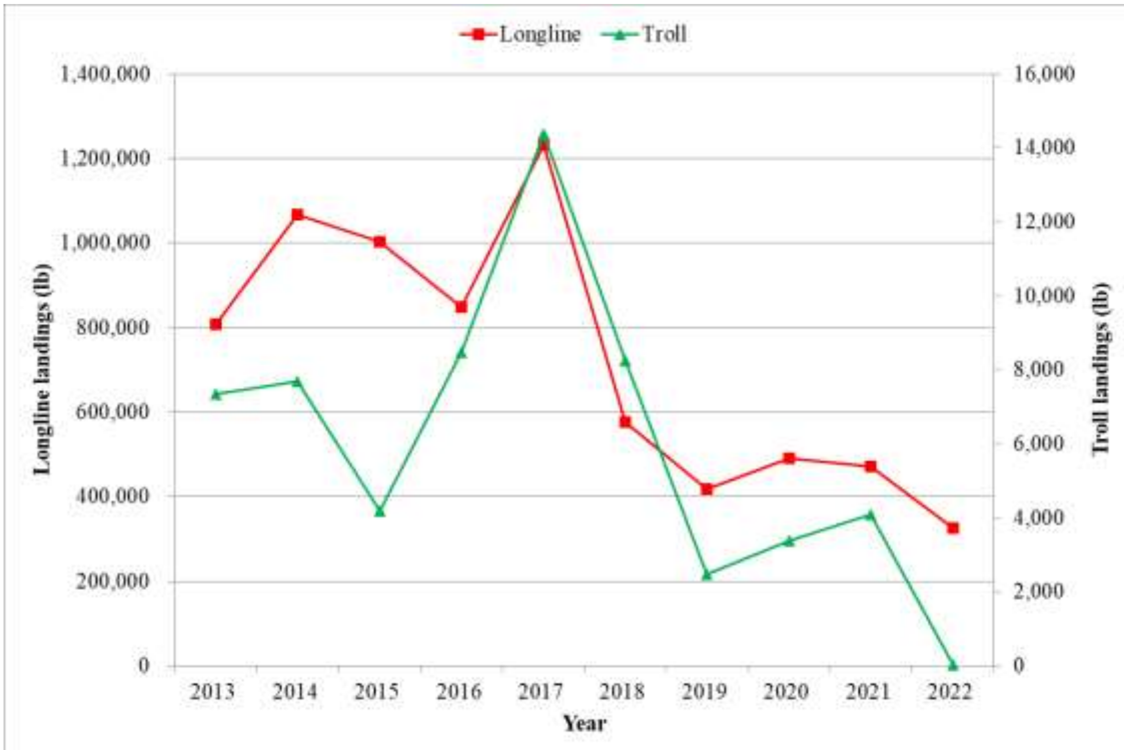


Figure 6. Total estimated landings of yellowfin tuna in American Samoa

Supporting data shown in Table A-6.

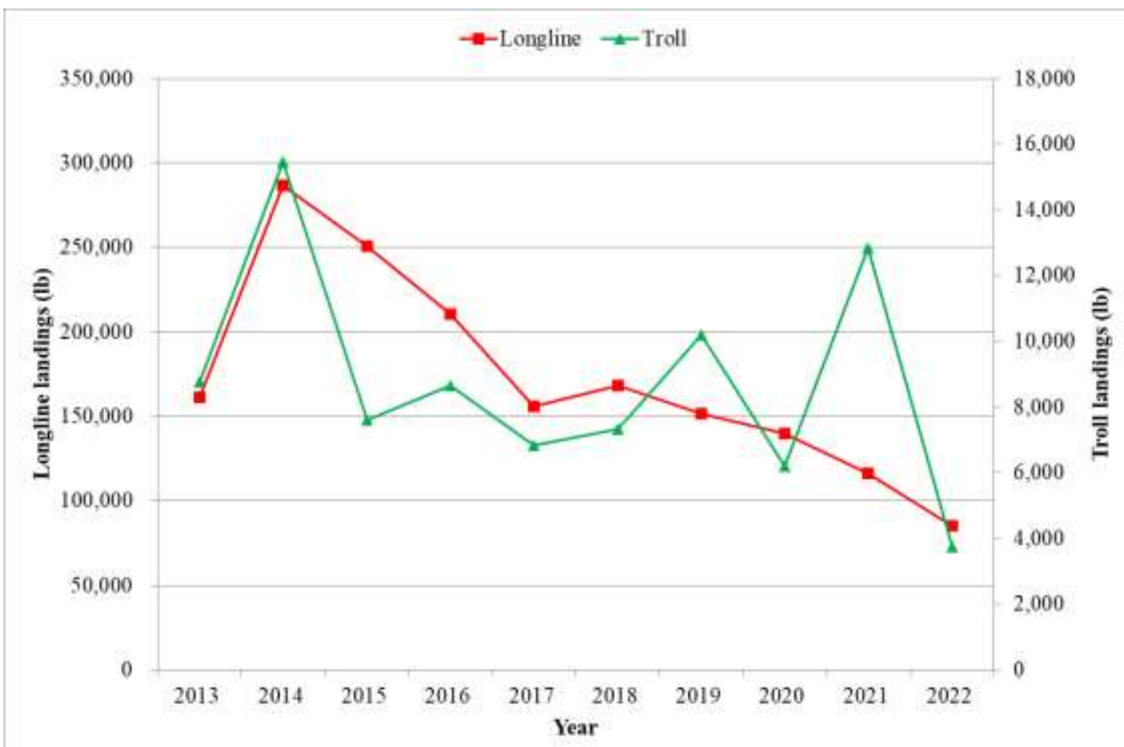


Figure 7. Total estimated landings of skipjack tuna in American Samoa

Supporting data shown in Table A-7.

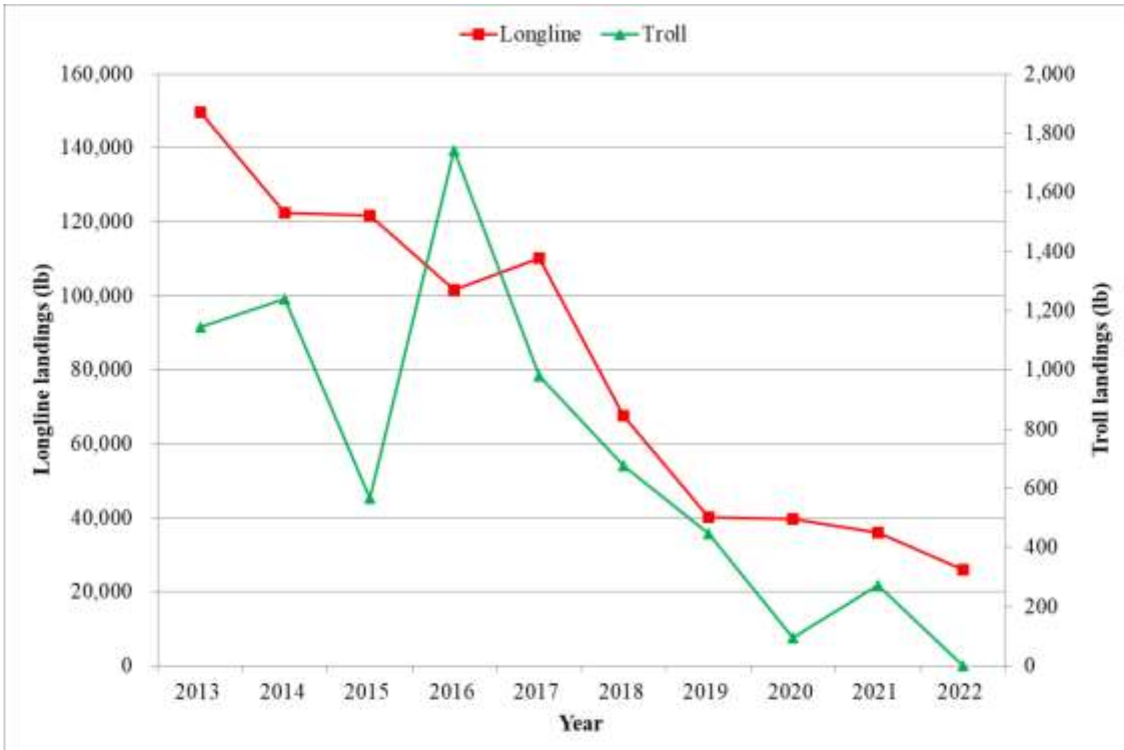


Figure 8. Total estimated landings of wahoo in American Samoa

Note: An unrepresentative amount of wahoo was caught by trolling one day in 2016. Supporting data shown in Table A-8.

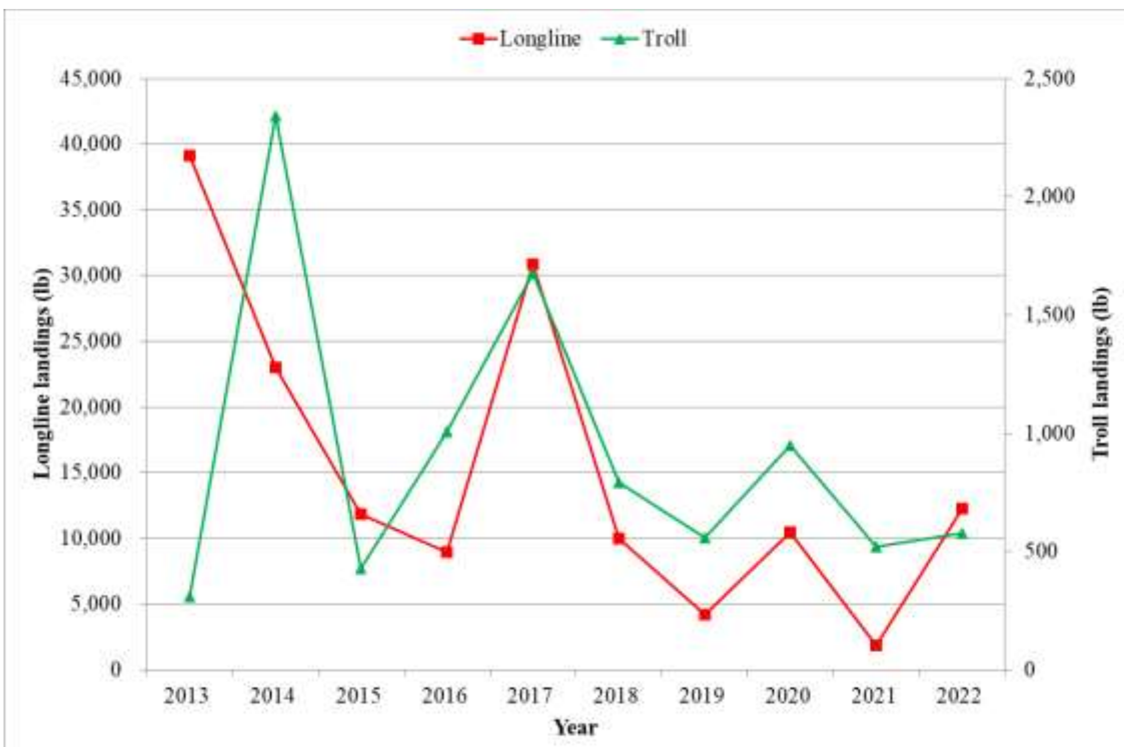


Figure 9. Total estimated landings of mahimahi in American Samoa

Supporting data shown in Table A-9.

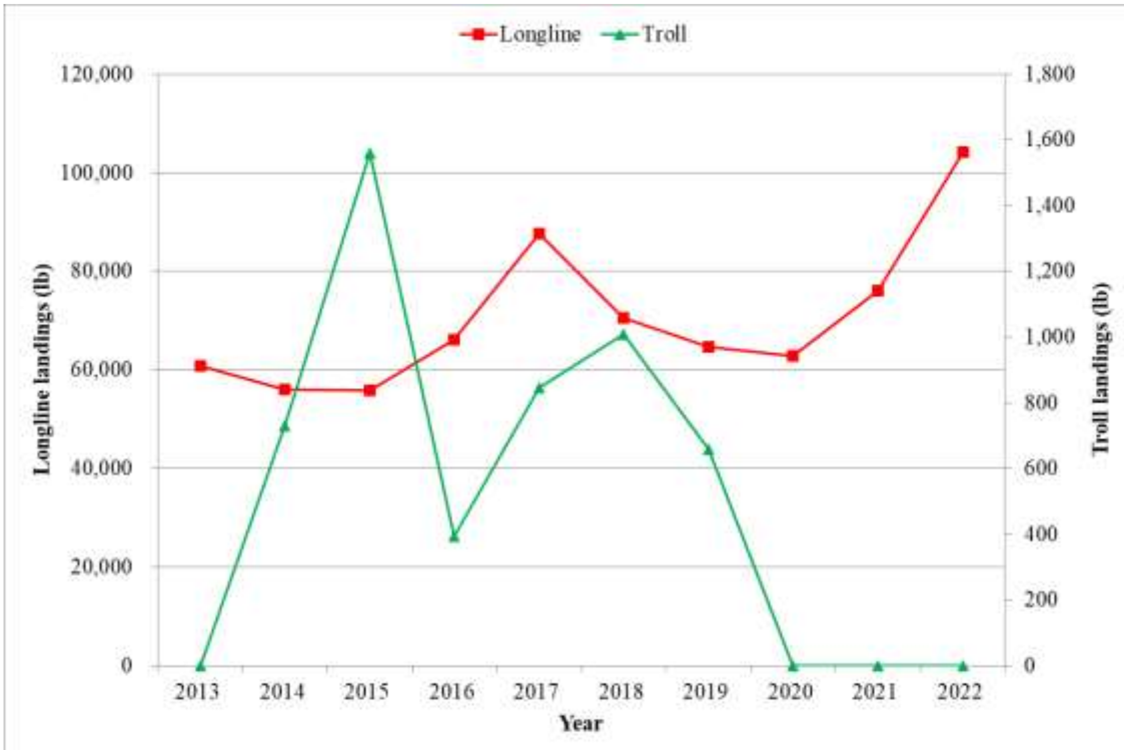


Figure 10. Total estimated landings of blue marlin in American Samoa

Supporting data shown in Table A-10.

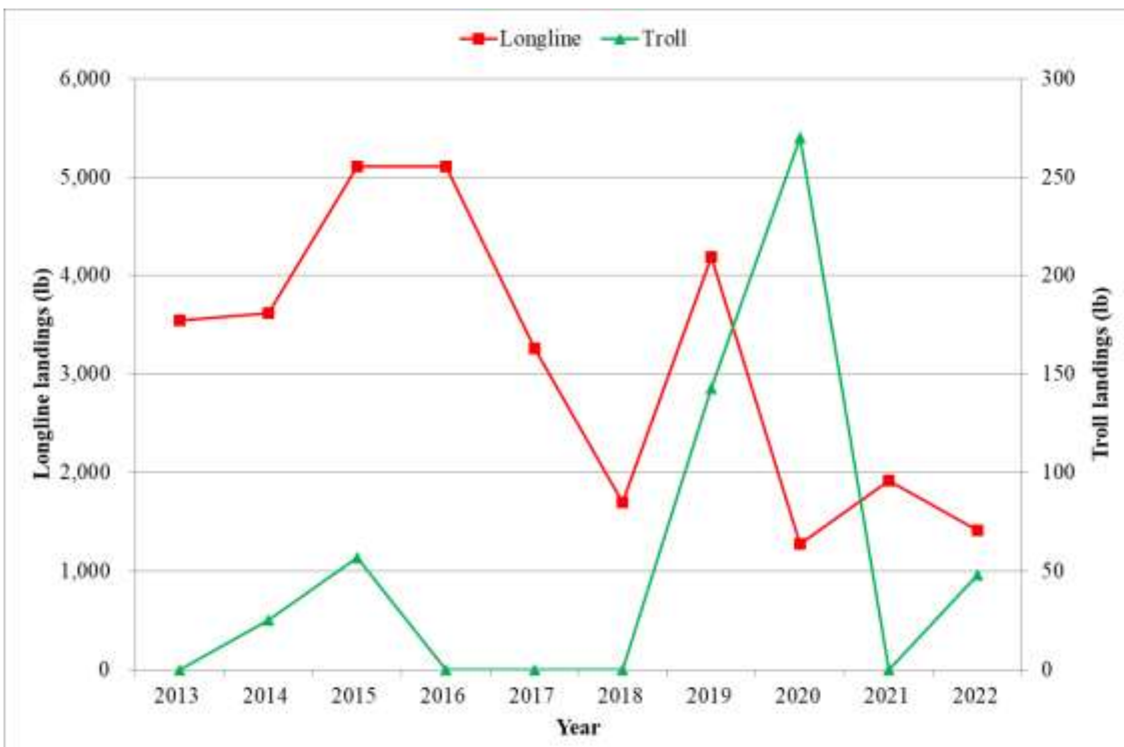


Figure 11. Total estimated landings of sailfish in American Samoa

Supporting data shown in Table A-11.

2.1.6 AMERICAN SAMOA LONGLINE PARTICIPATION, EFFORT, LANDINGS, BYCATCH, AND CPUE

Table 4. Number of permitted and active longline fishing vessels by size class in American Samoa

Year	Small Vessel Permits	Small Vessel Active	Large Vessel Permits	Large Vessel Active
2013	10	1	37	21
2014	18	2	44	21
2015	12	3	46	18
2016	11	2	39	18
2017	10	1	38	14
2018	13	1	43	13
2019	8	3	42	15
2020	7	1	40	10
2021	5	0	39	11
2022	5	0	39	11

Notes: These data are used for Figure 12 that follows. The "small" size class includes alia vessels, whereas the "large" size class typically includes larger monohull vessels fishing in the Southern Pacific Ocean. Dual-permitted vessels are included. These designations shifted from Classes A through D to Small and Large due to Amendment 9 to the Pelagic FEP (86 FR 55743, October 7, 2021) that reduced the original four size classes to the two presented here.

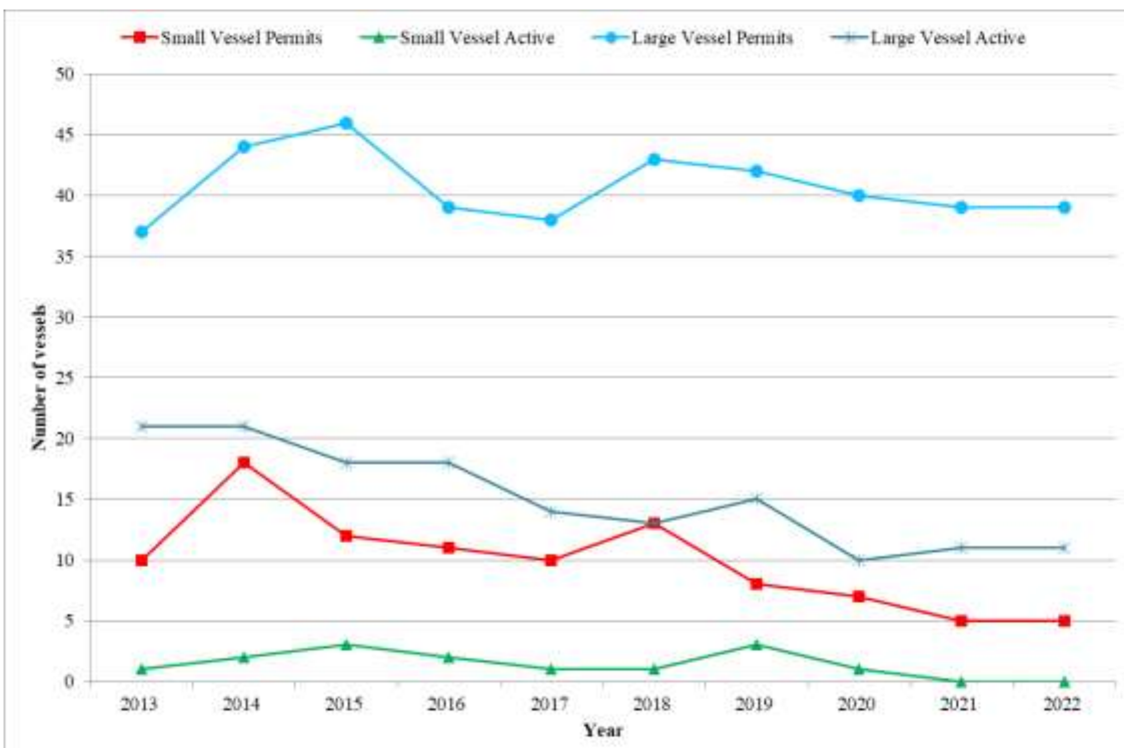


Figure 12. Number of active longline fishing vessels in American Samoa by size classes: Small (0-50 ft) and Large (> 51 ft)

Table 5. Longline effort by American Samoa vessels during 2022

Effort Type	All Vessels
Boats	11
Trips	42
Sets	1,219
Hooks (Thousands)	3,613
Lightsticks	0

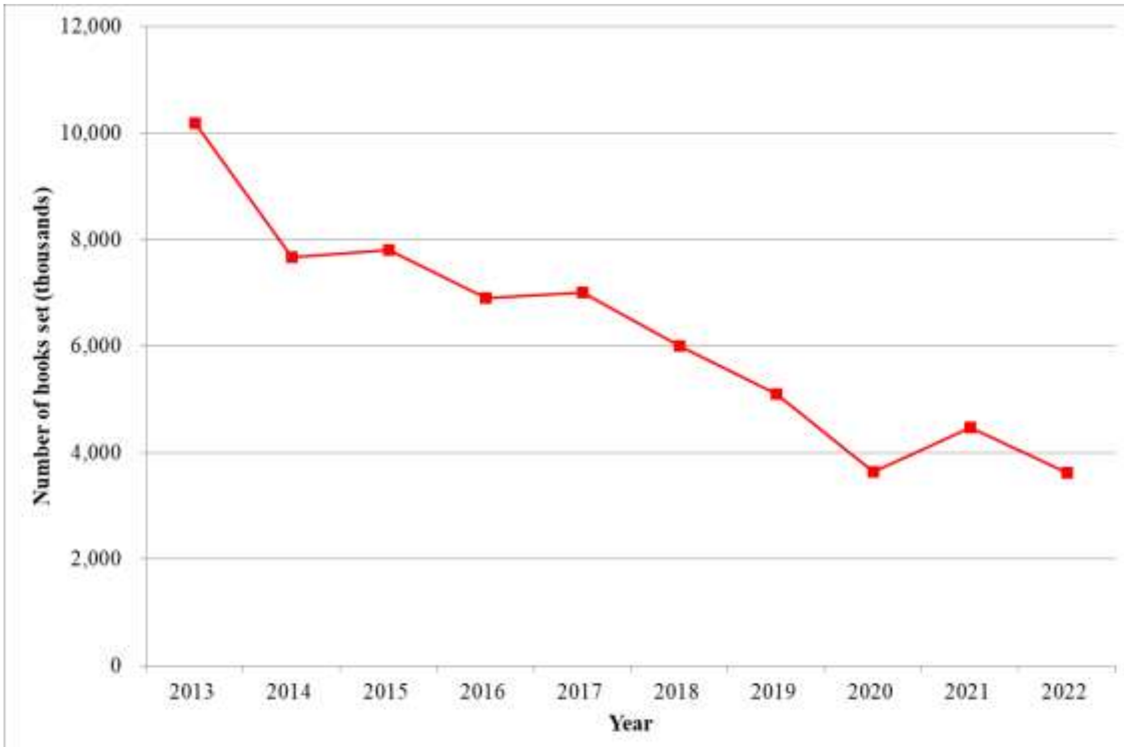


Figure 13. Number of longline hooks set from federal logbook data in American Samoa
Supporting data shown in Table A-12.

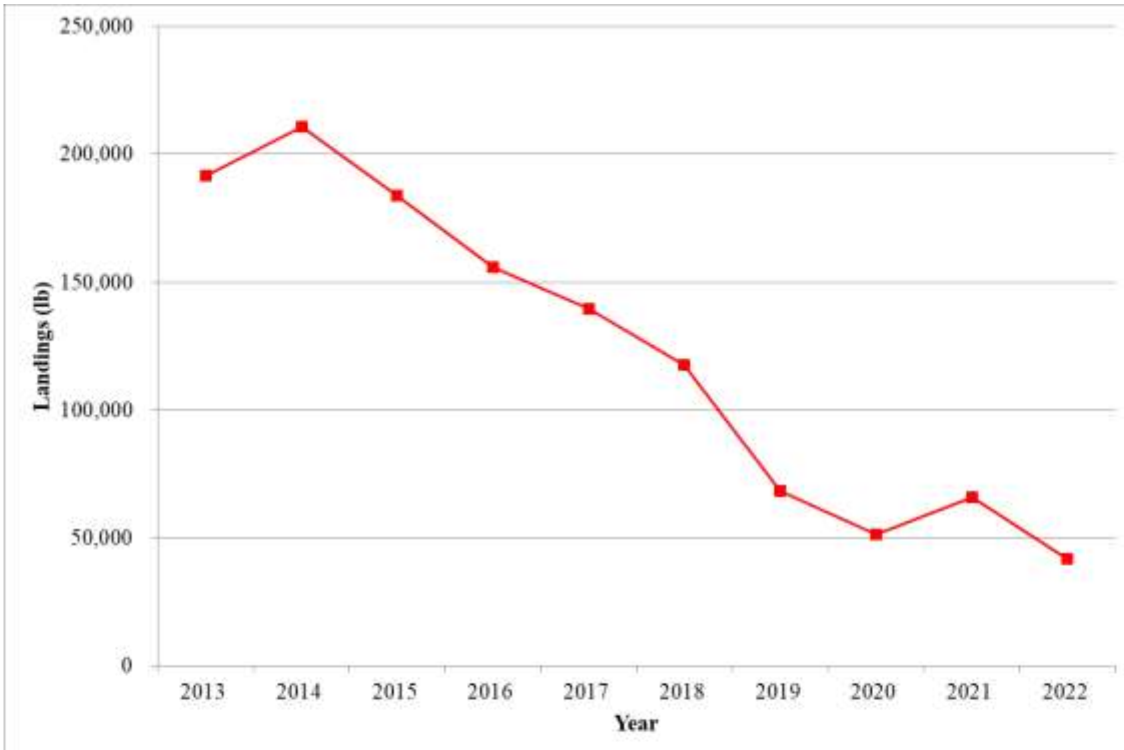


Figure 14. Total estimated landings of bigeye by longlining in American Samoa
Supporting data shown in Table A-13.

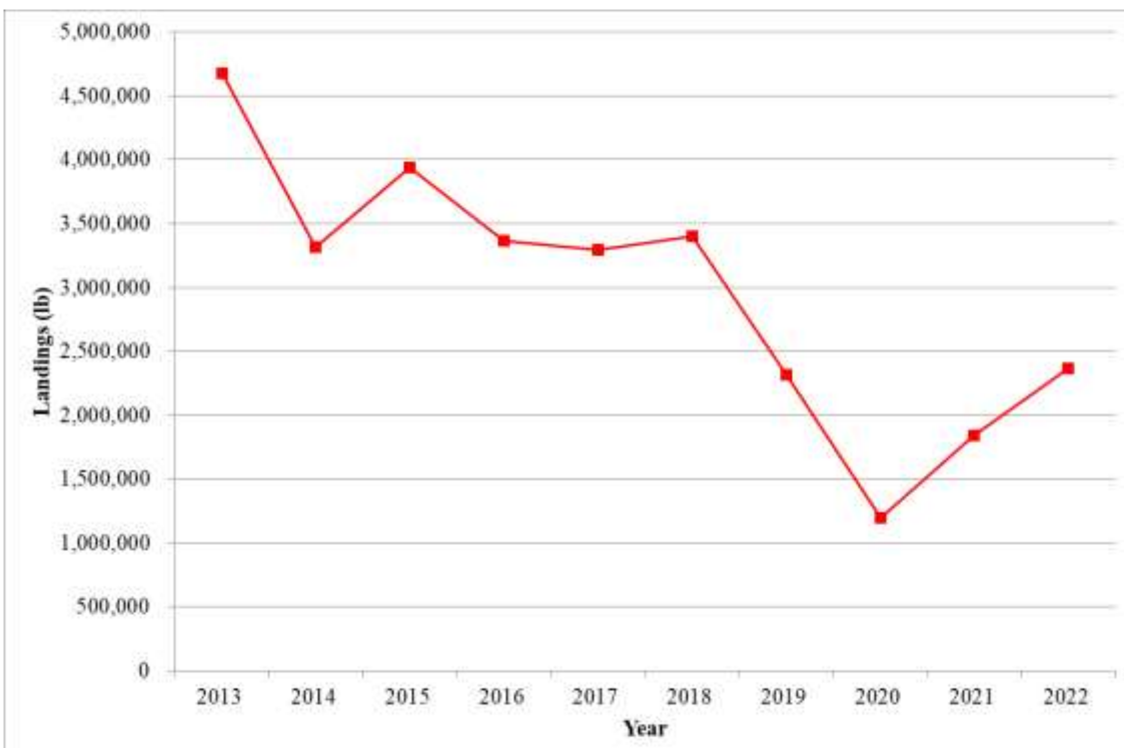


Figure 15. Total estimated landings of albacore by longlining in American Samoa
Supporting data shown in Table A-14.

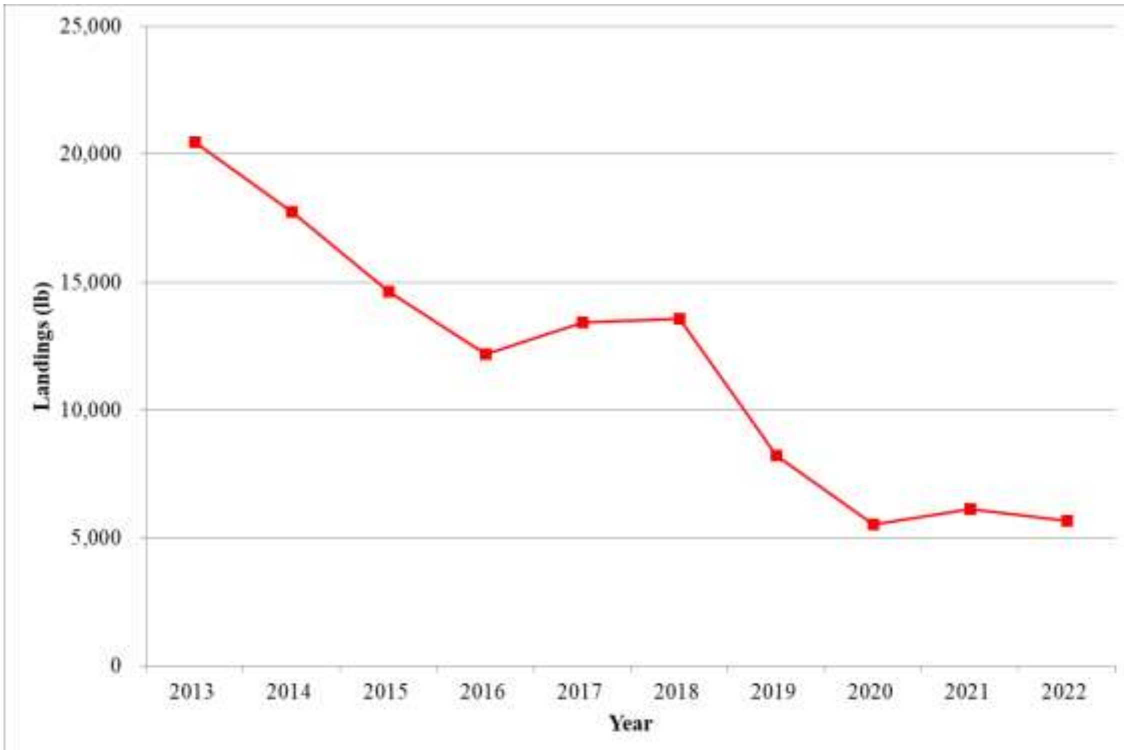


Figure 16. Total estimated landings of swordfish by longlining in American Samoa
Supporting data shown in Table A-15.

Table 6. Number of fish kept, released, and percent released for all American Samoa longline vessels from federal logbook data in 2022

Species	Number Kept	Number Released	Total Caught	Percent Released
Skipjack tuna	5,071	28	5,099	0.5
Albacore tuna	52,691	183	52,874	0.3
Yellowfin tuna	5,622	198	5,820	3.4
Kawakawa	0	0	0	0.0
Bigeye tuna	914	58	972	6.0
Bluefin tuna	0	0	0	0.0
Tunas (unknown)	0	0	0	0.0
TUNAS TOTAL	**64,298**	**467**	**64,765**	**0.7**
Mahimahi	579	12	591	2.0
Black marlin	0	0	0	0.0
Blue marlin	803	29	832	3.5
Striped marlin	58	1	59	1.7
Wahoo	1,015	13	1,028	1.3
Swordfish	51	36	87	41.4
Sailfish	20	4	24	16.7

Species	Number Kept	Number Released	Total Caught	Percent Released
Spearfish	52	13	65	20.0
Moonfish	19	2	21	9.5
Oilfish	16	438	454	96.5
Pomfret	49	313	362	86.5
Pelagic thresher shark	0	0	0	0.0
Thresher shark	0	81	81	100.0
Shark (unknown pelagic)	0	2	2	100.0
Snake mackerel	0	0	0	0.0
Bigeye thresher shark	0	0	0	0.0
Silky shark	0	309	309	100.0
White tip oceanic shark	0	74	74	100.0
Blue shark	0	800	800	100.0
Shortfin mako shark	0	50	50	100.0
Longfin mako shark	0	0	0	0.0
Billfishes (unknown)	0	0	0	0.0
NON-TUNA PMUS TOTAL	**2,662**	**2,177**	**4,839**	**45.0**
Pelagic fishes (unknown)	0	0	0	0.0
Double-lined mackerel	0	0	0	0.0
Mackerel	0	0	0	0.0
Long-jawed Mackerel	0	0	0	0.0
Barracudas	78	1	79	1.3
Great barracuda	0	0	0	0.0
Small barracudas	0	0	0	0.0
Rainbow runner	0	0	0	0.0
Dogtooth tuna	0	0	0	0.0
OTHER PELAGICS TOTAL	**78**	**1**	**79**	**1.3**
TOTAL PELAGICS	**67,038**	**2,645**	**69,683**	**3.8**

Table 7. Total estimated bycatch in number of fish for the top 10 bycatch species from the Pacific Islands Region Observer Program for the American Samoa longline fishery. The top 10 species comprised 79.26% of total bycatch in 2021.

Species	2016	2017	2018	2019	2020	2021
Pelagic Stingray	19,459	16,306	8,156	11,908	8,395	8,259
Escolar	7,756	7,773	5,567	5,094	5,540	5,517
Longfin Escolar	8,820	9,652	5,605	6,609	5,037	4,788
Longnose Lancetfish	6,228	5,881	5,482	4,991	4,063	3,913
Blue Shark	4,490	4,224	3,359	2,681	2,958	2,721
Slender Mola	1,327	2,595	1,648	193	2,210	2,074
Snake Mackerel	1,049	1,026	1,183	1,689	1,568	1,502
Skipjack Tuna	781	830	867	1,196	1,510	1,366
Yellowfin Tuna	1,873	1,702	1,345	1,180	1,476	1,363
Unidentified Tuna	1,340	1,595	1,326	824	1,473	1,313

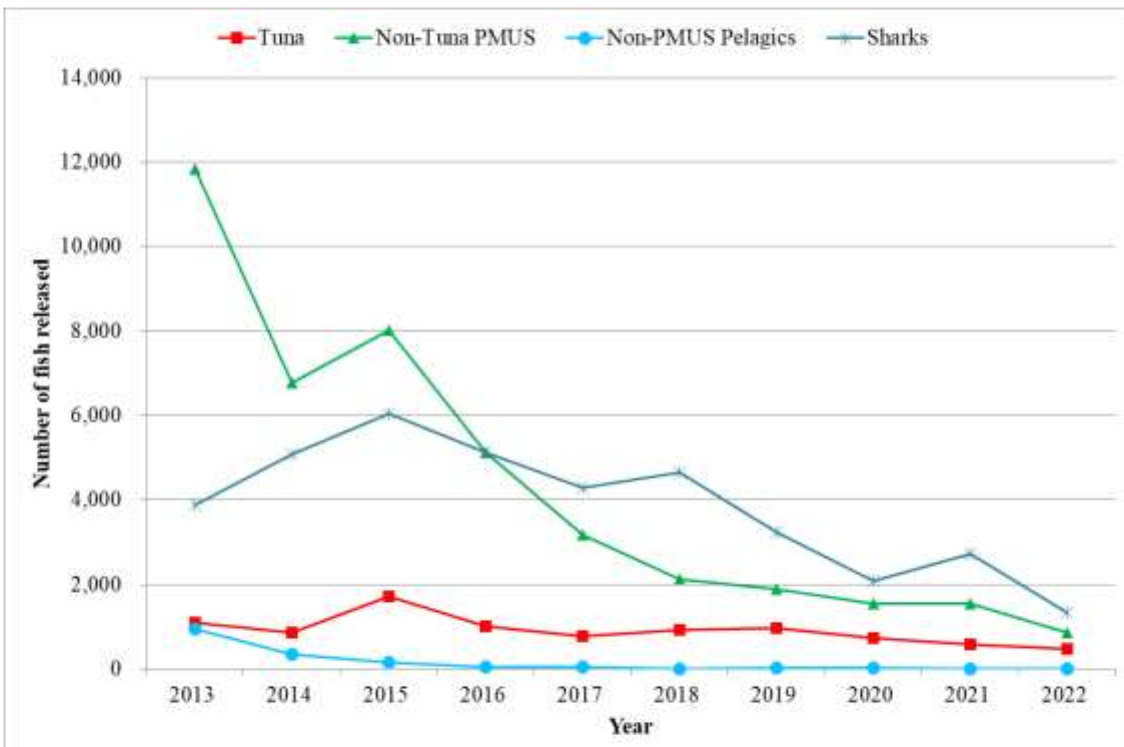


Figure 17. Number of fish released by longline vessels in American Samoa
Supporting data shown in Table A-16.

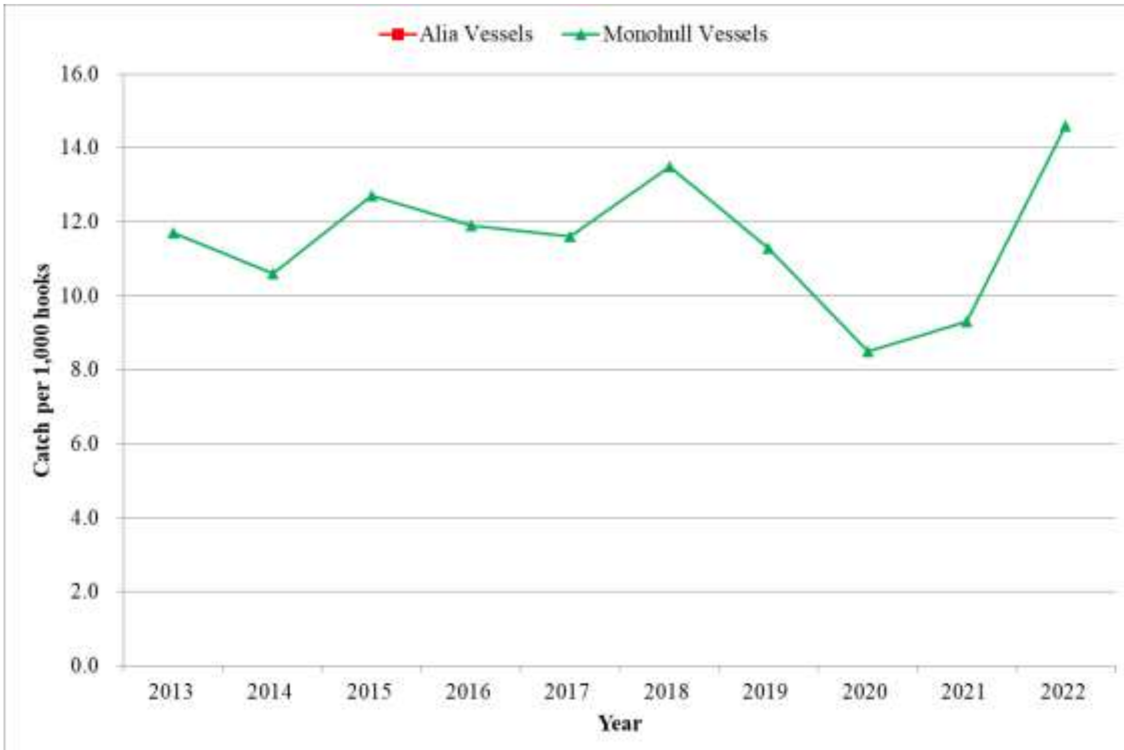


Figure 18. Albacore catch per 1,000 hooks by monohull vessels from longline logbook data in American Samoa

Note: Fewer than three alias reported, so alias are not included. Supporting data shown in Table A-17.

Table 8. Catch per 1,000 hooks for alia vessels in American Samoa from 1996 to 1998

Species	Alia 1996	Alia 1997	Alia 1998
Skipjack tuna	0.1	1.2	3.7
Albacore tuna	40.6	32.8	26.6
Yellowfin tuna	6.5	2.7	2.2
Bigeye tuna	1.3	0.3	0.3
TUNAS TOTAL	**48.5**	**37.0**	**32.8**
Mahimahi	2.3	2.2	1.7
Blue marlin	0.9	0.7	0.5
Wahoo	0.8	0.9	2.2
Swordfish	0.0	0.1	0.0
Sailfish	0.2	0.2	0.1
NON-TUNA PMUS TOTAL	**4.2**	**4.3**	**4.6**
Pelagic fishes (unknown)	0.0	0.0	0.2
OTHER PELAGICS TOTAL	**0.0**	**0.0**	**0.2**
TOTAL PELAGICS	**52.7**	**41.3**	**37.6**

Table 9. Catch per 1,000 hooks for two types of longline vessels in American Samoa from 1999 to 2002

Species	Alia 1999	Monohull 1999	Alia 2000	Monohull 2000	Alia 2001	Monohull 2001	Alia 2002	Monohull 2002
Skipjack tuna	5.0	4.5	2.0	1.7	3.1	2.1	6.0	4.9
Albacore tuna	18.8	14.8	19.8	28.0	27.3	32.9	17.2	25.8
Yellowfin tuna	6.7	2.1	6.2	3.1	3.3	1.4	7.1	1.3
Bigeye tuna	0.7	0.5	0.4	1.0	0.6	1.0	0.6	0.9
TUNAS TOTAL	**31.2**	**21.9**	**28.4**	**33.8**	**34.3**	**37.4**	**30.9**	**32.9**
Mahimahi	2.2	0.3	1.7	0.4	3.4	0.5	4.0	0.6
Black marlin	0.2	0.1	0.1	0.1	0.1	0.0	0.0	0.0
Blue marlin	0.5	0.1	0.5	0.2	0.4	0.2	0.2	0.3
Striped marlin	0.0	0.2	0.1	0.3	0.0	0.1	0.1	0.0
Wahoo	2.1	1.2	1.2	1.0	1.5	0.6	2.7	1.0
Swordfish	0.0	0.1	0.0	0.0	0.1	0.0	0.1	0.0
Sailfish	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.0
Spearfish	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0
Moonfish	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1
Oilfish	0.0	0.6	0.0	0.1	0.0	0.2	0.0	0.5
Pomfret	0.0	0.2	0.0	0.1	0.0	0.1	0.0	0.1
NON-TUNA PMUS TOTAL	**5.1**	**3.1**	**3.7**	**2.5**	**5.6**	**1.8**	**7.3**	**2.6**
Barracudas	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
OTHER PELAGICS TOTAL	**0.3**	**0.2**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.4**
TOTAL PELAGICS	**36.6**	**25.2**	**32.1**	**36.3**	**39.9**	**39.2**	**38.2**	**35.9**

Table 10. Catch per 1,000 hooks for two types of longline vessels in American Samoa from 2003 to 2005

Species	Alia 2003	Monohull 2003	Alia 2004	Monohull 2004	Alia 2005	Monohull 2005
Skipjack tuna	4.7	2.9	3.0	3.9	1.0	2.7
Albacore tuna	17.3	16.4	13.7	12.9	10.3	17.4
Yellowfin tuna	5.9	2.0	8.8	3.2	7.0	2.6
Bigeye tuna	1.6	1.1	0.8	1.3	1.0	0.9
TUNAS TOTAL	**29.5**	**22.4**	**26.3**	**21.3**	**19.3**	**23.6**
Mahimahi	2.2	0.4	2.1	0.2	2.0	0.3
Blue marlin	0.2	0.2	0.1	0.2	0.2	0.2

Species	Alia 2003	Monohull 2003	Alia 2004	Monohull 2004	Alia 2005	Monohull 2005
Striped marlin	0.0	0.0	0.1	0.0	0.1	0.0
Wahoo	1.8	1.1	3.0	1.6	2.3	1.4
Swordfish	0.1	0.0	0.1	0.0	0.1	0.0
Sailfish	0.1	0.0	0.0	0.1	0.1	0.1
Spearfish	0.1	0.0	0.0	0.1	0.0	0.0
Moonfish	0.1	0.1	0.1	0.1	0.1	0.1
Oilfish	0.3	0.5	0.0	0.7	0.0	0.3
Pomfret	0.1	0.1	0.0	0.1	0.0	0.1
NON-TUNA PMUS TOTAL	**5.0**	**2.4**	**5.5**	**3.1**	**4.9**	**2.5**
Pelagic fishes (unknown)	0.2	0.2	0.0	0.1	0.0	0.1
OTHER PELAGICS TOTAL	**0.2**	**0.2**	**0.0**	**0.1**	**0.0**	**0.1**
TOTAL PELAGICS	**34.7**	**25.0**	**31.8**	**24.5**	**24.2**	**26.2**

Table 11. Catch per 1,000 hooks for all types of longline vessels in American Samoa from 2006 to 2011

Species	All Vessels 2006	All Vessels 2007	All Vessels 2008	All Vessels 2009	All Vessels 2010	All Vessels 2011
Skipjack tuna	3.2	2.3	2.4	2.3	2.4	2.5
Albacore tuna	18.4	18.4	14.2	14.8	17.4	12.1
Yellowfin tuna	1.6	1.9	1.0	1.1	1.8	2.0
Bigeye tuna	0.9	0.9	0.5	0.6	0.8	0.7
TUNAS TOTAL	**24.1**	**23.5**	**18.1**	**18.8**	**22.4**	**17.3**
Mahimahi	0.4	0.1	0.1	0.2	0.1	0.1
Blue marlin	0.2	0.2	0.2	0.2	0.2	0.2
Wahoo	1.5	1.0	0.7	1.0	1.0	0.9
Swordfish	0.1	0.0	0.0	0.0	0.0	0.0
Sailfish	0.1	0.0	0.0	0.0	0.0	0.0
Spearfish	0.1	0.0	0.1	0.1	0.1	0.1
Oilfish	0.5	0.5	0.4	0.5	0.6	0.6
Pomfret	0.0	0.1	0.1	0.1	0.1	0.1
NON-TUNA PMUS TOTAL	**2.9**	**2.2**	**2.0**	**2.5**	**2.5**	**2.4**
Pelagic fishes (unknown)	0.0	0.0	0.0	0.0	0.1	0.0
OTHER PELAGICS TOTAL	**0.0**	**0.0**	**0.0**	**0.0**	**0.1**	**0.0**
TOTAL PELAGICS	**27.0**	**25.7**	**20.1**	**21.3**	**25.0**	**19.7**

Table 12. Catch per 1,000 hooks for all types of longline vessels from 2013 to 2017

Species	All Vessels 2012	All Vessels 2013	All Vessels 2014	All Vessels 2015	All Vessels 2016	All Vessels 2017
Skipjack tuna	4.3	1.1	2.5	2.0	2.0	1.5
Albacore tuna	14.8	11.7	10.6	12.7	11.9	11.5
Yellowfin tuna	1.2	1.9	2.5	2.6	2.6	3.6
Bigeye tuna	0.6	0.4	0.7	0.6	0.5	0.4
TUNAS TOTAL	**20.9**	**15.1**	**16.3**	**17.9**	**17.0**	**17.0**
Mahimahi	0.1	0.2	0.2	0.1	0.1	0.2
Blue marlin	0.1	0.1	0.1	0.1	0.1	0.1
Wahoo	0.7	0.7	0.7	0.7	0.7	0.7
Spearfish	0.1	0.1	0.1	0.1	0.0	0.0
Moonfish	0.1	0.0	0.0	0.0	0.0	0.0
Oilfish	0.8	0.7	0.6	0.8	0.6	0.3
Pomfret	0.1	0.1	0.1	0.1	0.1	0.1
Thresher shark	0.0	0.0	0.0	0.0	0.1	0.1
Silky shark	0.0	0.0	0.1	0.1	0.1	0.1
White tip oceanic shark	0.1	0.1	0.1	0.1	0.1	0.1
Blue shark	0.4	0.2	0.4	0.5	0.5	0.4
Shortfin mako shark	0.0	0.0	0.0	0.1	0.0	0.0
NON-TUNA PMUS TOTAL	**2.5**	**2.2**	**2.4**	**2.7**	**2.4**	**2.1**
Pelagic fishes (unknown)	0.1	0.1	0.0	0.0	0.0	0.0
OTHER PELAGICS TOTAL	**0.1**	**0.1**	**0.0**	**0.0**	**0.0**	0.0
TOTAL PELAGICS	**23.5**	**17.4**	**18.7**	**20.6**	**19.4**	**19.1**

Table 13. Catch/1,000 hooks for all types of longline vessels in American Samoa from 2018 to 2022

Species	All Vessels 2018	All Vessels 2019	All Vessels 2020	All Vessels 2021	All Vessels 2022
Skipjack tuna	1.8	2.3	2.6	1.5	1.4
Albacore tuna	13.5	11.6	8.5	9.2	14.6
Yellowfin tuna	1.7	1.9	2.7	2.4	1.6
Bigeye tuna	0.4	0.4	0.3	0.3	0.3
TUNAS TOTAL	**17.4**	**16.2**	**14.1**	**13.4**	**17.9**
Mahimahi	0.1	0.0	0.1	0.0	0.2
Blue marlin	0.1	0.1	0.1	0.1	0.2
Wahoo	0.5	0.4	0.4	0.3	0.3

Species	All Vessels 2018	All Vessels 2019	All Vessels 2020	All Vessels 2021	All Vessels 2022
Oilfish	0.3	0.2	0.3	0.2	0.1
Pomfret	0.0	0.1	0.1	0.1	0.1
Thresher shark	0.1	0.0	0.0	0.0	0.0
Silky shark	0.1	0.1	0.2	0.1	0.1
White tip oceanic shark	0.1	0.1	0.1	0.1	0.0
Blue shark	0.5	0.3	0.3	0.3	0.2
NON-TUNA PMUS TOTAL	**1.8**	**1.3**	**1.6**	**1.2**	**1.2**
TOTAL PELAGICS	**19.2**	**17.5**	**15.7**	**14.6**	**19.1**

2.1.7 AMERICAN SAMOA TROLLING BYCATCH AND CPUE

Data for participation, effort, landings, and revenue are found in previous sections of this chapter. Statistics summarizing bycatch for American Samoa trolling are shown in Table 14.

Table 14. American Samoa trolling bycatch summary (released fish)

Year	Number Release	Percent Release	Number Kept	Number Caught	Charter
2013	0	0.0	1,896	1,896	F
2014	0	0.0	2,789	2,789	F
2015	0	0.0	616	616	F
2016	0	0.0	1,374	1,374	F
2017	0	0.0	915	915	F
2018	0	0.0	743	743	F
2019	0	0.0	640	640	F
2020	0	0.0	465	465	F
2021	0	0.0	601	601	F
2022	0	0.0	132	132	F

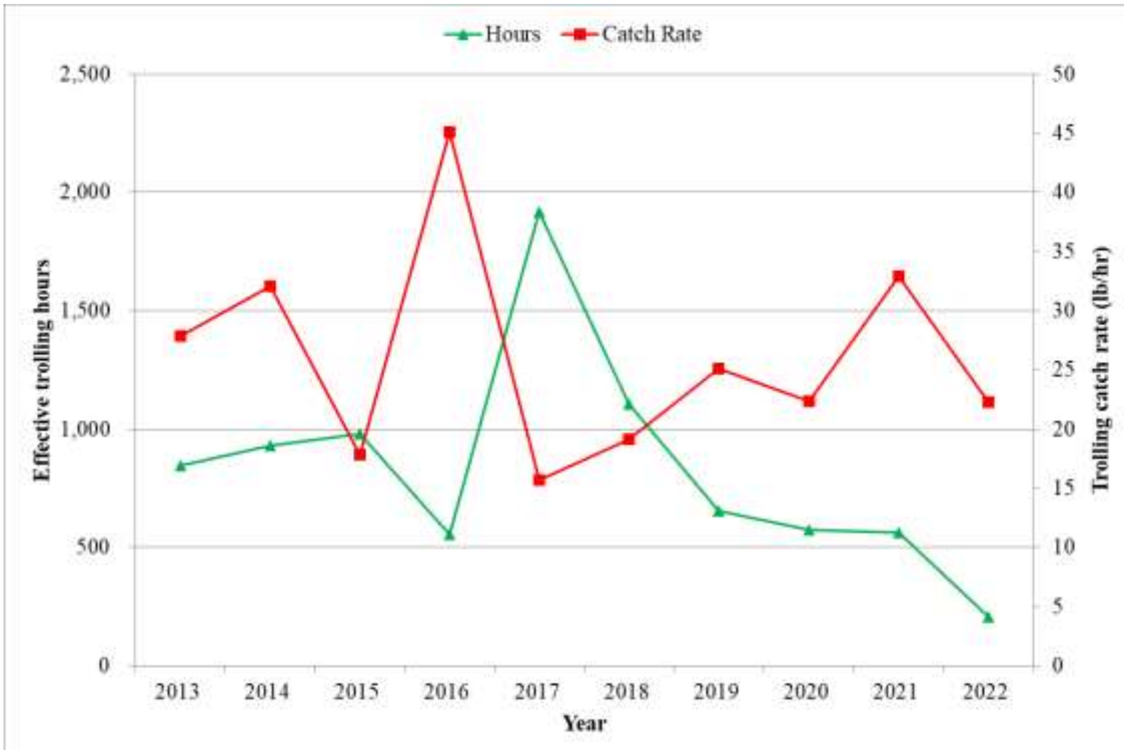


Figure 19. Catch-per-hour for trolling and number of trolling hours in American Samoa
Supporting data shown in Table A-18.

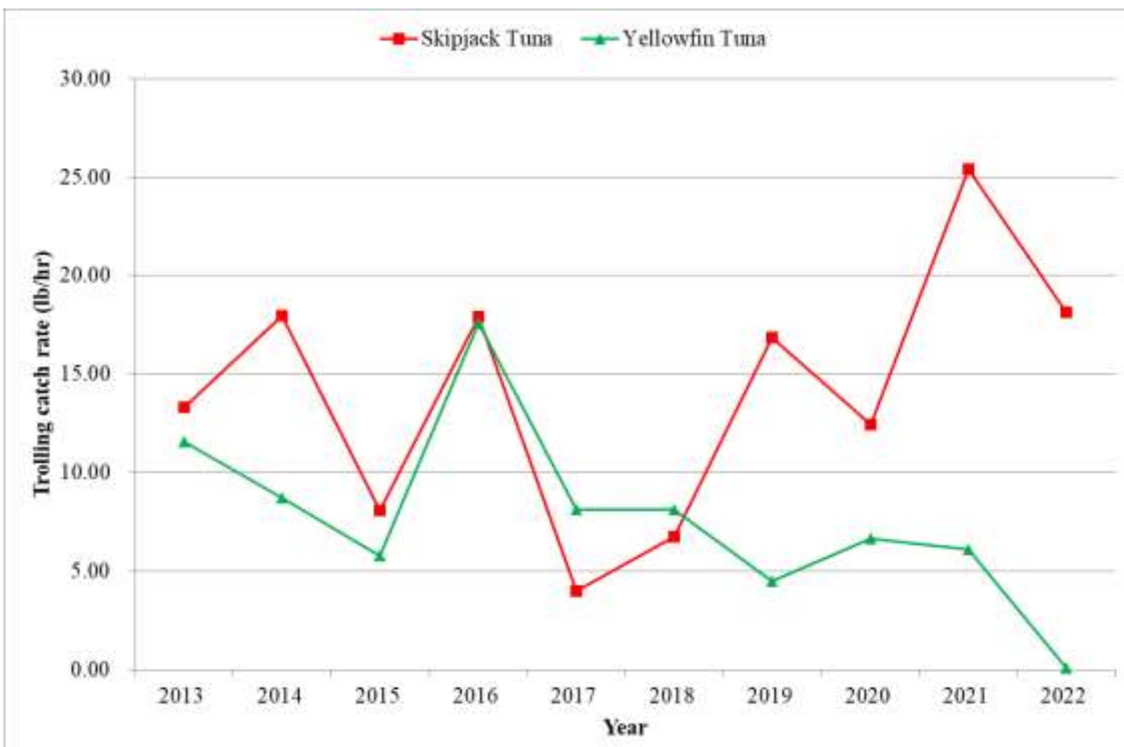


Figure 20. Trolling CPUE for skipjack and yellowfin tuna in American Samoa
Supporting data shown in Table A-19.

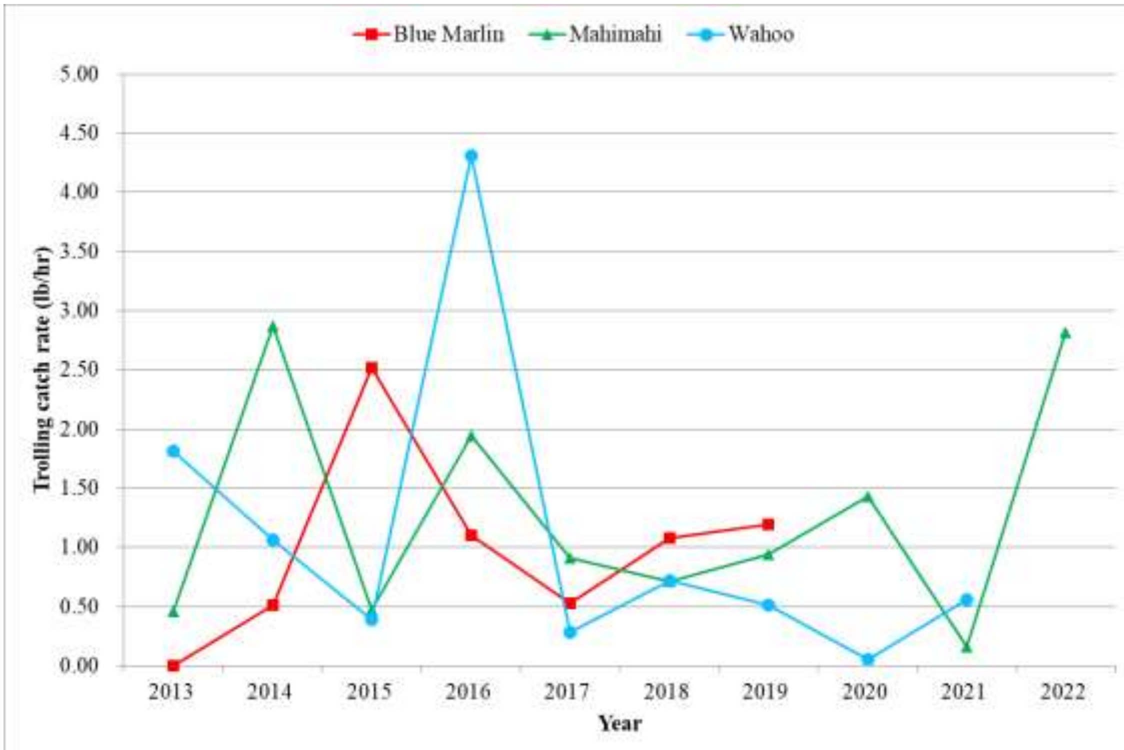


Figure 21. Trolling CPUE for blue marlin, mahimahi, and wahoo in American Samoa

Supporting data shown in Table A-20.

2.2 COMMONWEALTH OF THE NORTHERN MARIANA ISLANDS

2.2.1 DATA SOURCES

This fishery is characterized by the Commonwealth of the Northern Mariana Islands (CNMI) Department of Lands and Natural Resources, Division of Fish and Wildlife (DFW), using data from its commercial receipt invoice database and the boat-based creel survey. The commercial purchase data collection system is dependent upon first-level purchasers of local fresh fish to accurately record all fish purchases by species categories on specially designed invoices. DFW staff routinely distributes and collects invoice books from participating local fish purchasers on Saipan. This is a mandatory data collection program that includes purchasers at fish markets, stores, restaurants, and hotels, as well as roadside vendors ("fish-mobiles").

Currently, DFW's commercial purchase data collection system and the boat-based creel survey are documenting landings only on the island of Saipan. Although the Saipan commercial purchase data collection system has been in operation since the mid-1970s, only data collected since 1983 are considered accurate enough to be used. It is believed that the commercial purchase data includes about 50-60% of commercial landings for pelagic species on Saipan, based on the following estimates. In addition to unreported fish sales by official vendors (10-20%), there is also a subsistence fishery on Saipan, which profits by selling a small portion of the catch to cover fishing expenses. Some fishermen sell their catch by going door to door. This commercial catch comprises about 30% of unreported commercial landings, since it is not sold to fish purchasers participating in the invoice book program. Combined with the 10-20% of data from official commercial fish purchasers (fish markets/restaurants/hotel) that DFW is unable to capture for a variety of reasons (e.g., no forms returned, vendors missed, nonparticipation), an estimated 40-50% of total commercial sales may not be included in the commercial purchase data reported for Saipan.

In addition to commercial purchase data, the boat-based creel survey has been continuously implemented since April 2000. Creel data only analyzes fishing activity on the island of Saipan, as there are no boat-based creel survey programs for Tinian or Rota, presently.

One of DFW's goals is to expand the data collection program to the islands of Tinian and Rota; however, securing long term funding is challenging. Pilot boat-based creel surveys were conducted on Tinian and Rota, though these data are incomplete and not included in this report. These creel survey efforts were mainly focused on shore-based fisheries. The Rota pilot study with over a year and a half of data collection did not collect enough pelagic data to warrant analysis in the project report.

The Saipan creel survey targets both charter and non-charter vessels. DFW staff conducted 51 survey days in 2022 (see Table A-21). DFW staff recorded 107 boat log trips and 84 interviews in 2022. A decrease in surveys and interviews in 2022 was due to fueling issues that caused temporary suspension in boat-based creel surveys from mid-October to late November. Charter trips were not captured in 2022 due to the interrupted tourism market by the global pandemic, inflation, and staffing shortage. In January, there were only four key staff; one Data Officer and three technicians (2 under WPacFIN and 1 under WSFR). From February to mid-July, an additional technician was recruited as a temporary hire. In August, an employee had resigned, leaving the section with three key staff, of which only two had absolute advantage in work output. In October, the Division hired one additional employee under WPacFIN. Charter surveys were resumed in April 2023.

A 365-day annual expansion is run for each calendar year of DFW boat-based creel survey data to produce catch and effort estimates for the pelagic fishery, while avoiding over-estimating landings due to seasonal runs of pelagic species. This report does not include any data from longline vessels.

Percent species composition is calculated by weight for the sampled catch (raw interview data) for each method and applied to the pounds landed to produce catch estimates by species for the expansion period. CPUE data are calculated from the total annual landings of each fishery divided by the total number of hours spent fishing (gear in use), or by trip assuming that a trip is one day in length. Bycatch data are not expanded to the level of estimated annual trips and are reported as a direct summary of raw interview data. Some tables include landings of non-PMUS that may not be included in other tables in this report. This artifact of the reporting method results in a slight difference in the total landings and other values within a single table and between tables in this section.

2.2.2 SUMMARY OF CNMI PELAGIC FISHERIES

The number of interviews conducted for the creel surveys decreased in 2022 compared to 2021. Landings and effort data are adjusted for the creel data, while no adjustment was made for the commercial receipt data. As such, the landings and effort creel data are more accurate estimates than the commercial receipt data.

Landings. Skipjack tuna is the principal species landed, comprising 55.6% of the entire pelagic landings in 2022 based on creel survey data. Skipjack commercial landings decreased from 238,068 lbs in 2021 to 172,079.60 lbs in 2022.

Landings of mahimahi and yellowfin tuna ranked second and third by weight of commercial landings during 2022. There were 11,217.30 lbs of yellowfin commercial landings in 2022. Commercial data reported 33,112.50 lbs of mahimahi. Mahimahi commercial landings continued to decrease since 2013 with 2016 at its lowest. Skipjack tuna are easily caught in nearshore waters throughout the year. Based on creel survey data for 2022, mahimahi landings were the most abundant between January through March, as well as in December.

Effort. The number of boats involved in CNMI's pelagic fishery has been steadily decreasing from 2001, when there were 113 fishermen reporting commercial pelagic landings, to 2015 when there were 12. In 2022, there was an increase of fishermen who were landing pelagic species based on commercial receipt invoices (92). In 2022, there was a decrease in fishing vessels and fishing trips. The number of trips, based on both the commercial data receipts and the creel survey, have been variable since the late 1990s. Based on the creel surveys, there was a slight decrease in the number of trolling trips and trolling hours for non-charter pelagic fishing, from 3,072 trips in 2021 to 2,973 trips in 2022. Additionally, trolling hours per trip decreased from 5.7 hours in 2021 to 4.9 hours in 2022. Charter fishing has resumed since the COVID-19 pandemic, but the exact date of when it started is still unknown. Charter surveys re-initiated in April 2023.

Boat Ramps. There are several boat ramps in the CNMI, most of which are found on Saipan. The main boat ramp used for the largest boats transported via trailer is located at the Smiling

Cove Marina on Saipan. A convenience and transient dock are available for fishermen as well as slips that can be rented for long term boat storage. There are small boat ramps further north on Saipan in Tanapag and Lower Base. The Tanapag boat ramp is frequently used for small fishing and recreational vessels. The Lower Base boat ramp is used by 20-30 ft commercial tourism operators during the day, but at night is a common launching point for subsistence fishermen with small (8-12 ft) vessels. In Garapan, Fishing Base has a small boat ramp that is used by tourism operators, recreational boaters, subsistence fishermen, and commercial fishermen. In the south, the boat ramp at Sugar Dock was used by commercial fishermen, tourism operators, recreational boaters, and subsistence fishermen but due to the dock's collapse in 2014, the ramp hasn't been used often. Furthermore, Sugar Dock was once a port of interest for creel surveys but due to its lack of activity, DFW Data Section switched it out with DFW Ramp (August 2022). Sugar Dock is frequently covered in sand by beach erosion from further north in the lagoon and must be dredged periodically. Once in a while, people still use Sugar Dock as a loading or unloading site for transporting goods from other islands.

Weather. Weather conditions in 2022 roughly followed traditional seasonal patterns. There were no typhoons recorded in 2022. Based on information collected by the National Weather Service Forecast Office in Tiyan, Guam, the CNMI experienced near average amounts of precipitation (68.6 inches annually) and at least 10 high surf advisories in 2022.

Fish Aggregating Devices (FADs). No FAD systems were deployed in 2022. Currently there are no active FADs around Saipan and Rota, with only one still active near Tinian (GG). FAD deployments have been delayed since 2022 due to vessel deficiencies. A FAD off of Rota was active for 2022, but broke away this past January 2023.

CPUE. In 2022, trolling catch rates decreased from 22.0 lb per trolling hour to 15.9 lb per trolling hour, a decrease compared to the 10-year average (21.7 lb/hr). The skipjack catch rate decreased to 9.2 lb per hour fished. This catch rate is 6.2 lb less than the 10-year average (15.4 lb/hr). Yellowfin catch rate decreased from 1.5 in 2021 to 1.0 lb per hour. The mahi mahi catch rate increased to 3.9 lb/hr in 2022, which is 0.1 lb/hr greater than the 10-year average.

Revenue. The total value of the pelagic fishery in 2022 was $721,579.40, which represented a 6.55% increase from the previous year ($677,239). The average price for all pelagic species was $3.08 in 2022, an increase of $0.66 from 2021.

Bycatch. Bycatch is not a significant issue in the CNMI, as fishermen retain their catch regardless of species, size, or condition. Based on creel survey interviews, only two fish were caught as bycatch in the trolling fisheries in 2020 leading up to 2022.

2.2.3 PLAN TEAM RECOMMENDATIONS

There were no Plan Team recommendations relevant to the CNMI data module of the annual SAFE report.

2.2.4 OVERVIEW OF PARTICIPATION AND EFFORT

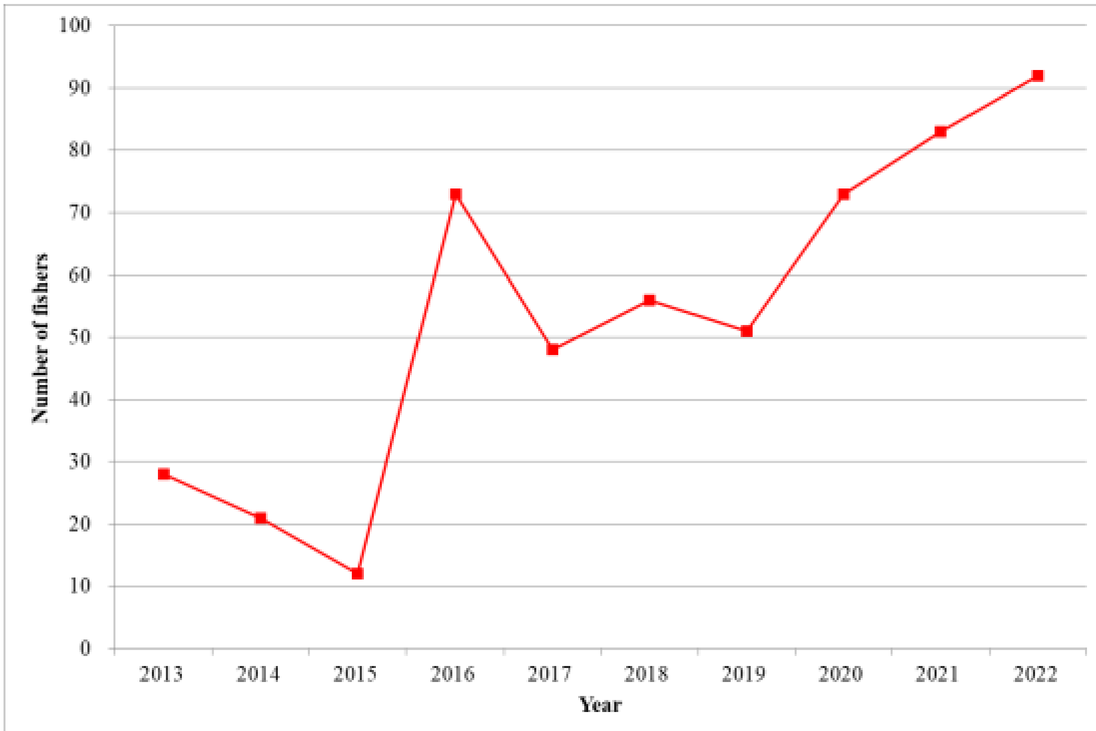


Figure 22. Number of fishers with commercial pelagic landings in the CNMI

Due to reporting methods, this number includes duplicate counts. Supporting data shown in Table A-22.

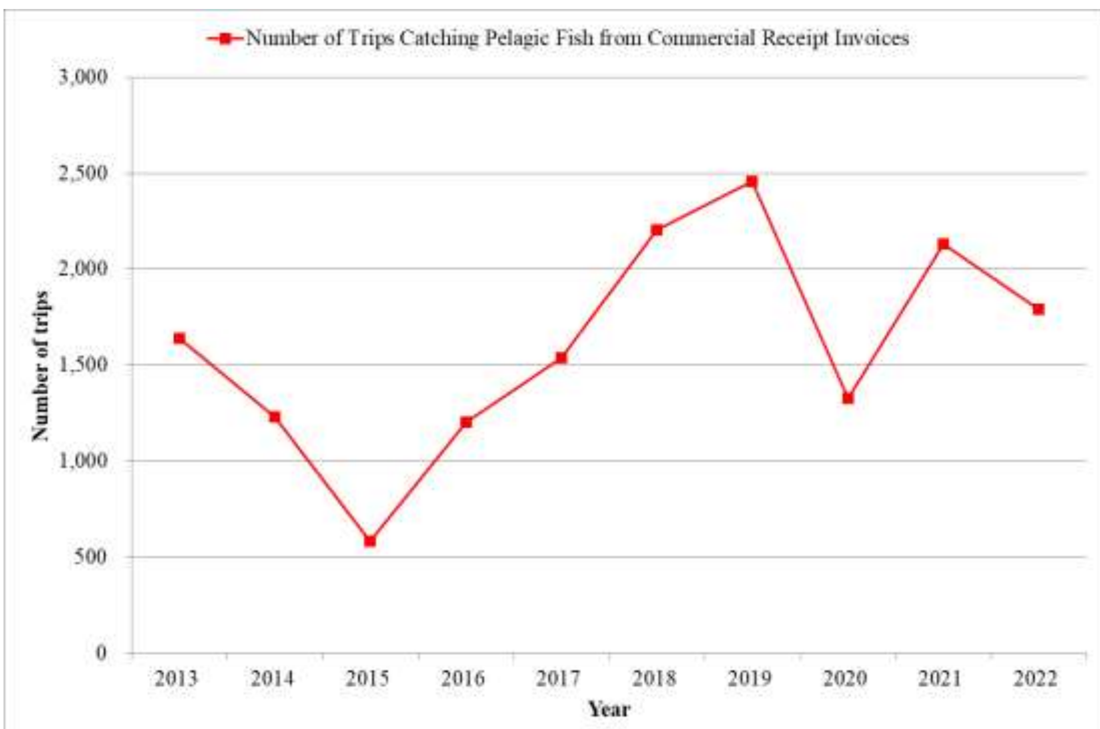


Figure 23. Number of trips with commercial pelagic landings in the CNMI

Supporting data shown in Table A-23.

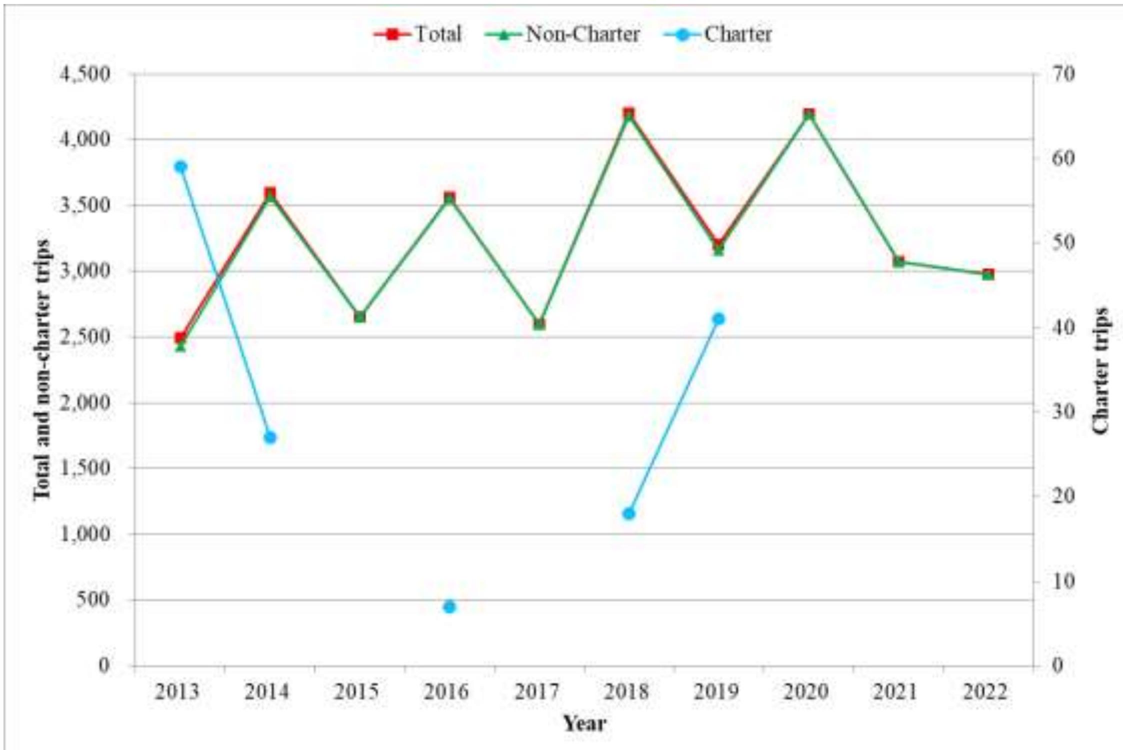


Figure 24. Estimated number of trolling trips from boat-based creel surveys in the CNMI
Supporting data shown in Table A-24.

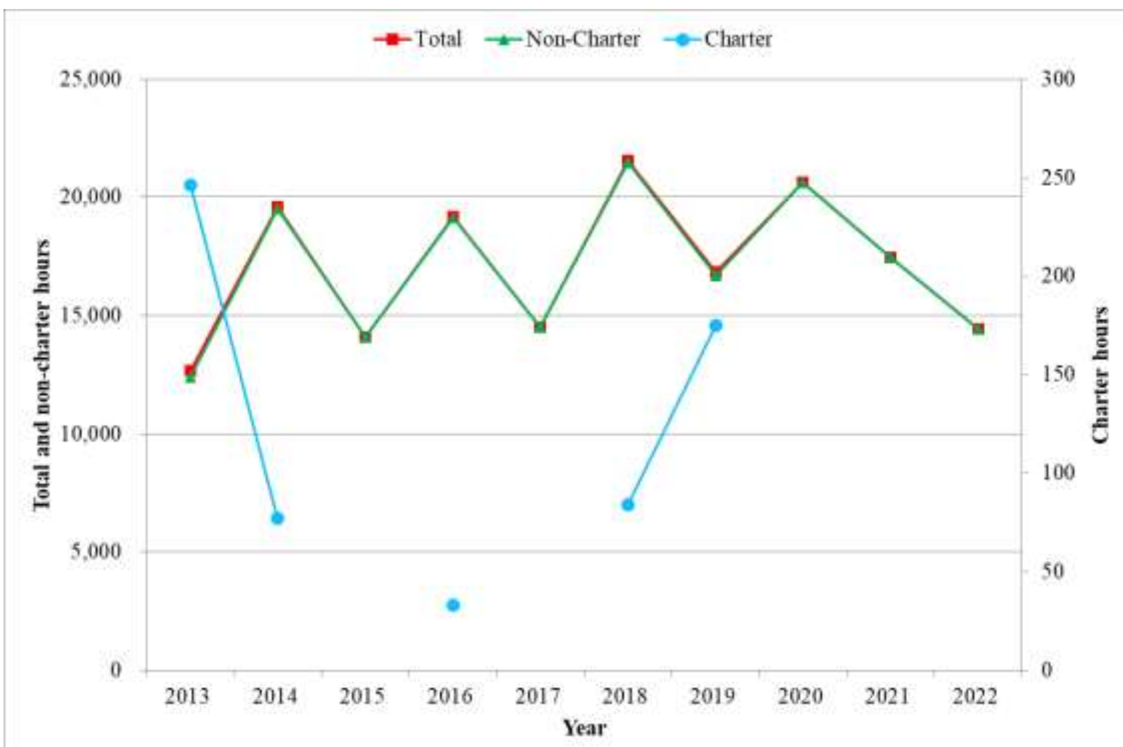


Figure 25. Estimated number of trolling hours from boat-based creel surveys in the CNMI
Supporting data shown in Table A-25.

Figure 26. Estimated average troll trip length from boat-based creel surveys in the CNMI
Supporting data shown in Table A-26.

2.2.5 OVERVIEW OF LANDINGS

Table 15. Pelagic species composition of boat-based creel survey total estimated catch (lb) in the CNMI in 2022

Species	Total Landings	Non-Charter	Charter
Skipjack Tuna	132,152	132,152	0
Yellowfin Tuna	14,224	14,224	0
Saba (Kawakawa)	2,607	2,607	0
Tunas (Misc.)	0	0	0
Tunas Total	**148,983**	**148,983**	**0**
Mahimahi	58,049	58,049	0
Wahoo	20,646	20,646	0
Blue Marlin	0	0	0
Sailfish	3,449	3,449	0
Spearfish	0	0	0
Sharks	0	0	0
Sickle Pomfret	169	169	0
Non-Tuna PMUS Total	**82,313**	**82,313**	**0**
Dogtooth Tuna	3,986	3,986	0

Species	Total Landings	Non-Charter	Charter
Rainbow Runner	629	629	0
Barracuda	1,529	1,529	0
Troll Fish (Misc.)	0	0	0
Other Pelagics Total	**6,144**	**6,144**	**0**
Total Pelagics	**237,440**	**237,440**	**0**

Note: Total pelagic landings may be greater than the sum of the individual species due to an artifact in reporting process, where the difference accounts for non-PMUS reported as part of the creel surveys.

Table 16. Commercial pelagic landings (lb), revenue ($), and average price ($) in the CNMI in 2022

Species	Pounds	Value	Average Price
Skipjack Tuna	172,079.6	520,514.8	3.02
Yellowfin Tuna	11,217.3	39,480.4	3.52
Saba (Kawakawa)	2,411.3	7,126.0	2.96
Tunas (Misc.)	310.0	820.0	2.65
Tunas Total and Average Price	**186,018.2**	**567,941.2**	**3.05**
Mahimahi	33,112.5	104,921.3	3.17
Wahoo	7,356.4	23,884.6	3.25
Blue Marlin	1,638.4	5,020.8	3.06
Sailfish	96.9	242.2	2.50
Sickle Pomfret	577.7	1,875.9	3.25
Non-Tuna PMUS Total and Average Price	**42,781.7**	**135,944.7**	**3.18**
Dogtooth Tuna	3,701.8	12,036.0	3.25
Rainbow Runner	1,319.3	4,892.5	3.71
Barracuda	97.5	243.8	2.50
Troll Fish (misc.)	173.8	521.3	3.00
Other Pelagics Total and Average Price	**5,292.3**	**17,693.5**	**3.34**
Pelagics Total and Average Price	**234,092.3**	**721,579.4**	**3.08**

Note: Total pelagic landings may be greater than the sum of the individual species due to an artifact in reporting process, where the difference accounts for non-PMUS reported as part of the creel survey.

Table 17. Bycatch summary for pelagic fisheries in the CNMI

Year	Number Release	Percent Release	Number Kept	Number Caught	Charter
2013	0	0.0	3,418	3,418	F
2014	0	0.0	2,413	2,413	F
2015	0	0.0	2,573	2,573	F
2016	0	0.0	1,667	1,667	F

Year	Number Release	Percent Release	Number Kept	Number Caught	Charter
2017	0	0.0	2,214	2,214	F
2018	0	0.0	1,761	1,761	F
2019	0	0.0	1,270	1,270	F
2020	2*	0.1	1,929	1,931	F
2021	0	0.0	2,600	2,600	F
2022	0	0.0	1,021	1,021	F
2013	0	0.0	33	33	T
2014	0	0.0	15	15	T
2015	0	0.0	17	17	T
2016	0	0.0	59	59	T
2017	0	0.0	4	4	T
2018	0	0.0	67	67	T
2019	0	0.0	74	74	T
2020	0	0.0	112	112	T

* Both individuals released were mahimahi.

Note: Bycatch information is calculated from raw interview creel survey data and represents the percent of fish caught or percent of interviews with bycatch.

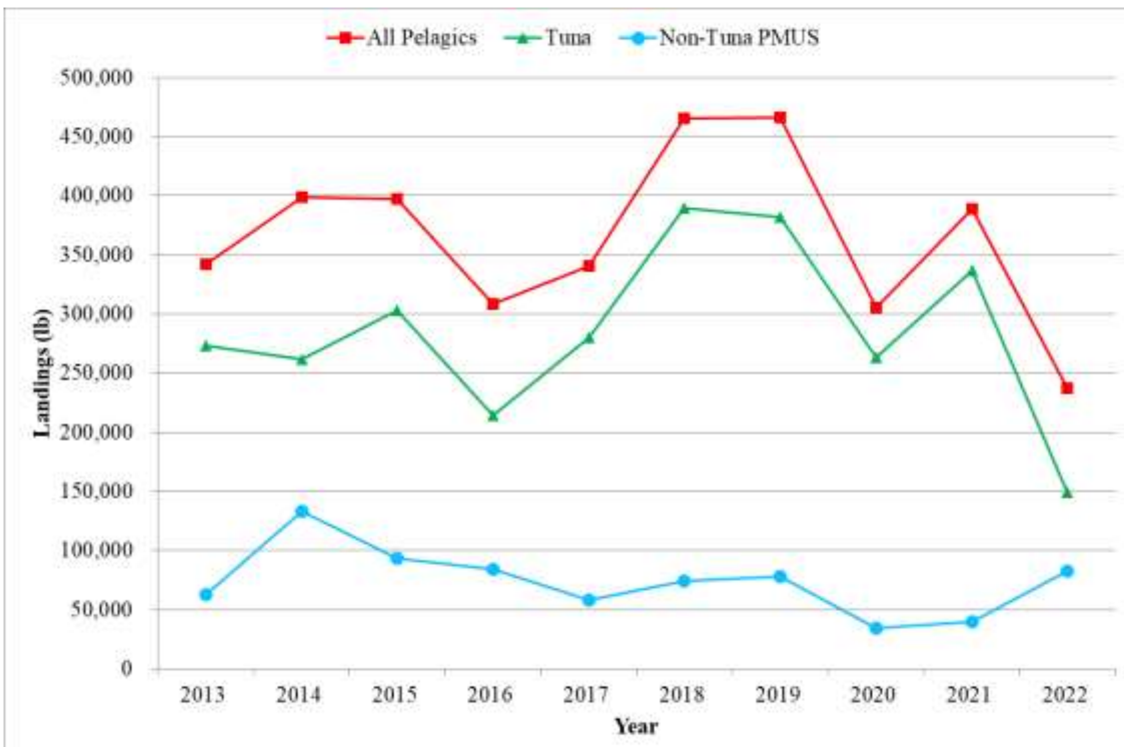


Figure 27. Total estimated catch for all pelagics, tuna PMUS, and non-tuna PMUS from boat-based creel surveys in the CNMI

Supporting data shown in Table A-27.

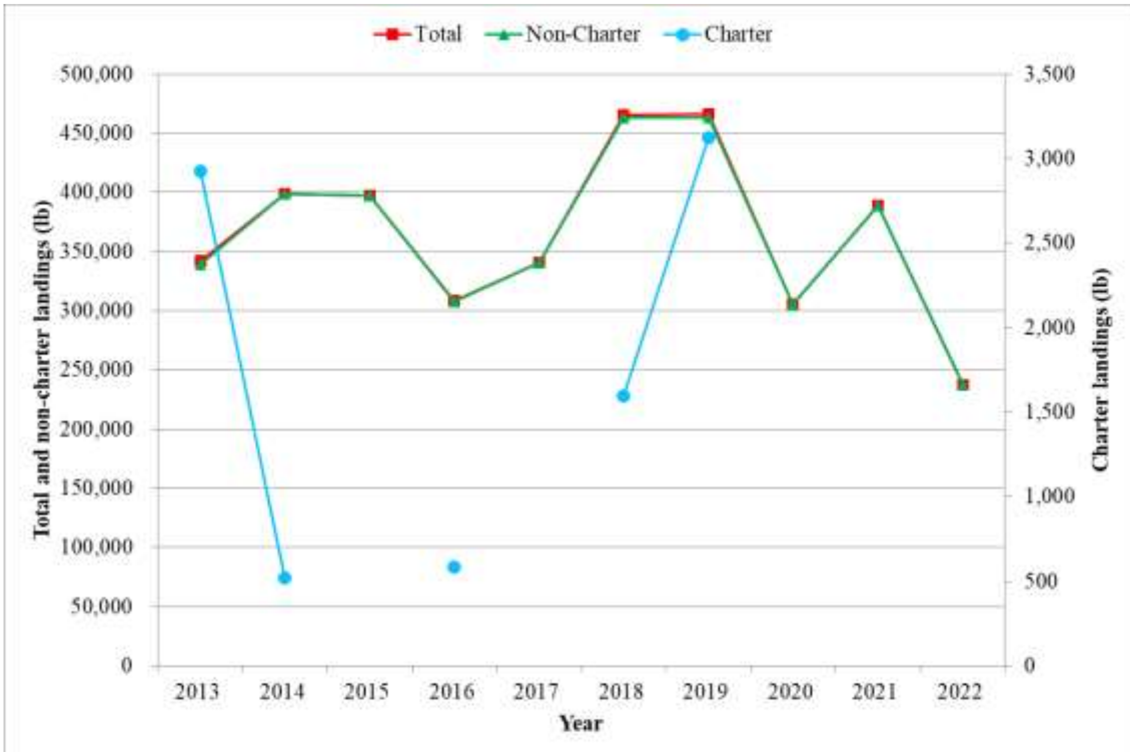


Figure 28. Total estimated catch for all pelagics in the CNMI

Supporting data shown in Table A-28.

Figure 29. Total estimated catch for tuna PMUS in the CNMI

Supporting data shown in Table A-29.

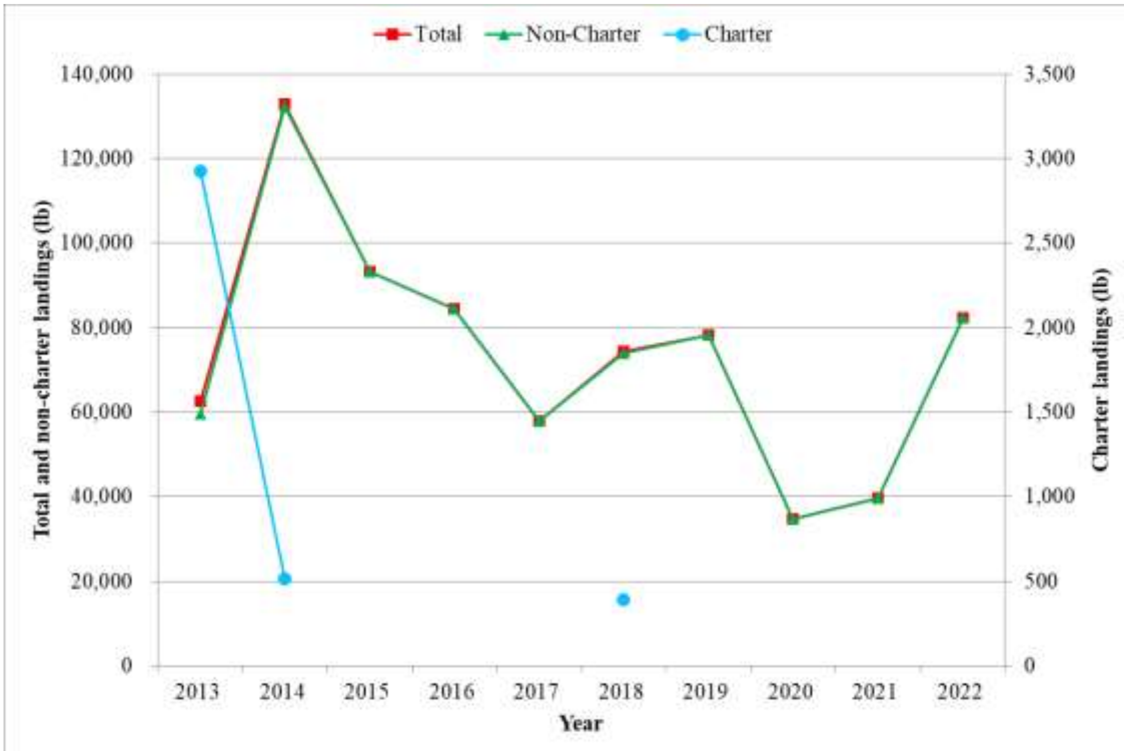


Figure 30. Total estimated catch for non-tuna PMUS in the CNMI

Supporting data shown in Table A-30.

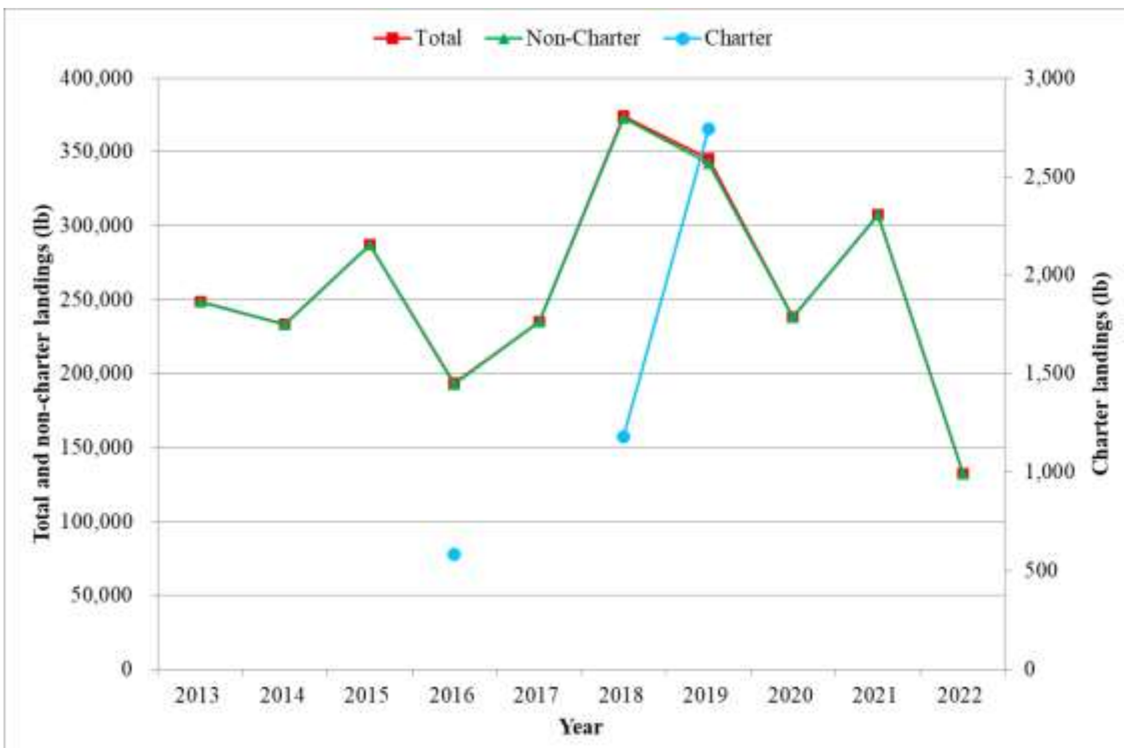


Figure 31. Total estimated catch for skipjack tuna in the CNMI

Supporting data shown in Table A-31.

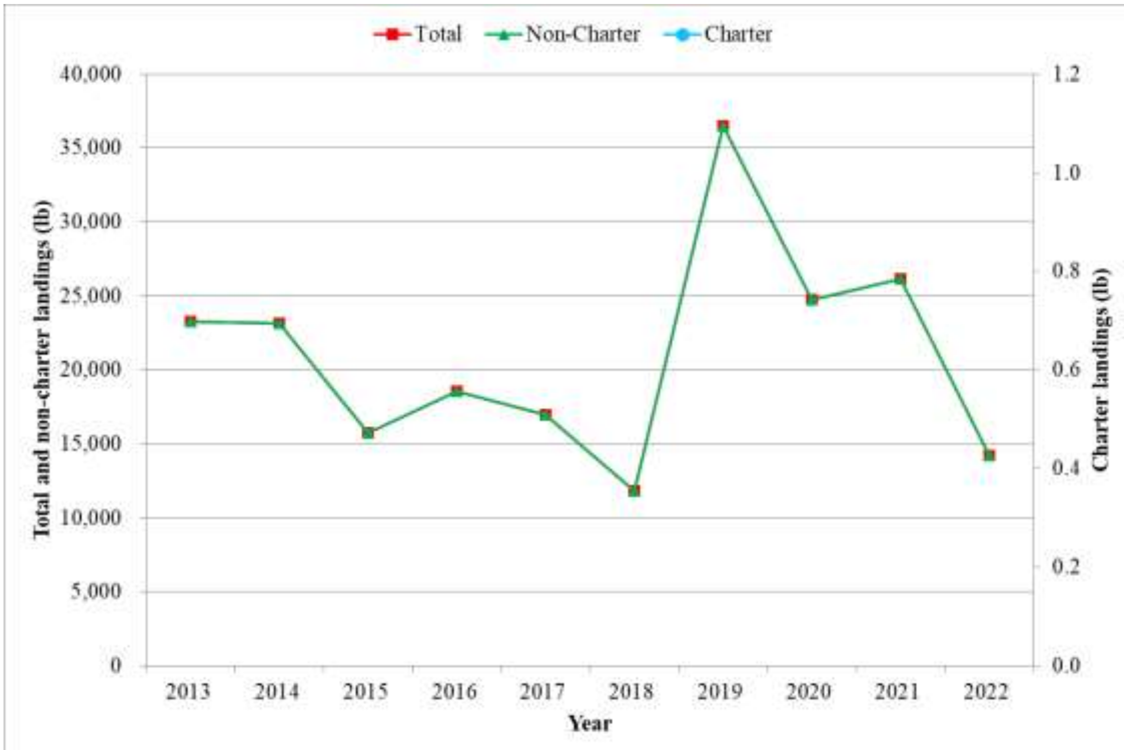


Figure 32. Total estimated catch for yellowfin tuna in the CNMI

Supporting data shown in Table A-32.

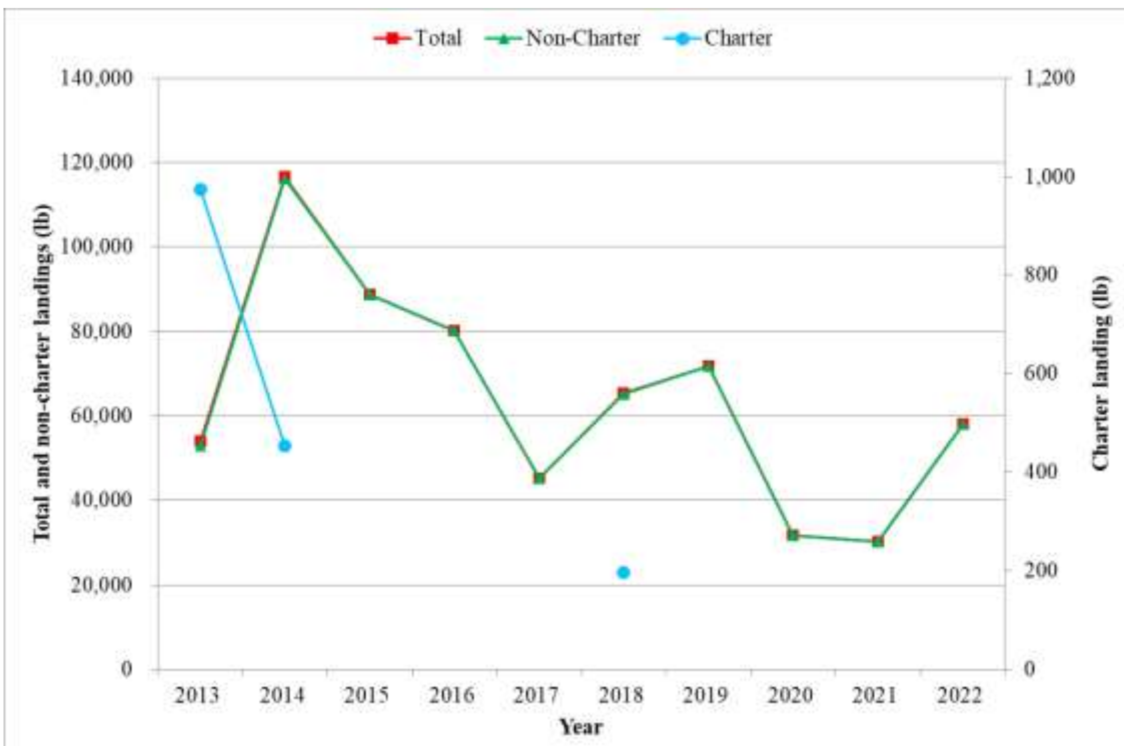


Figure 33. Total estimated catch for mahimahi in the CNMI

Supporting data shown in Table A-33.

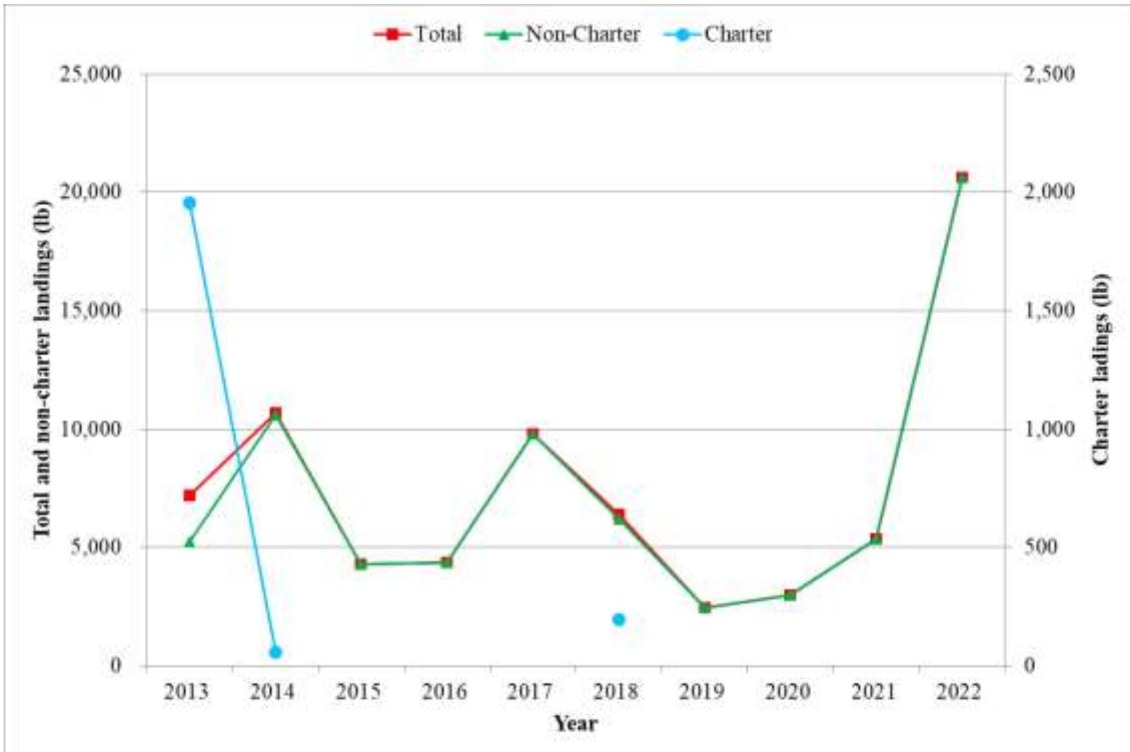


Figure 34. Total estimated catch for wahoo in the CNMI

Supporting data shown in Table A-34.

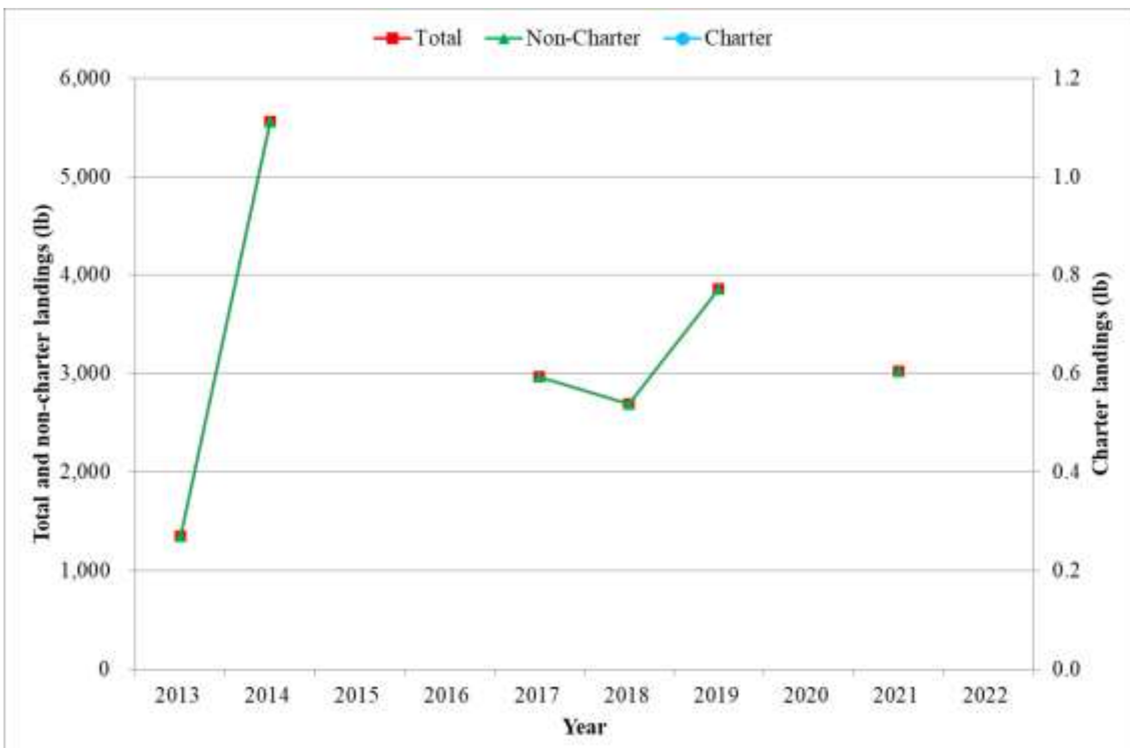


Figure 35. Total estimated catch for blue marlin in the CNMI

Supporting data shown in Table A-35.

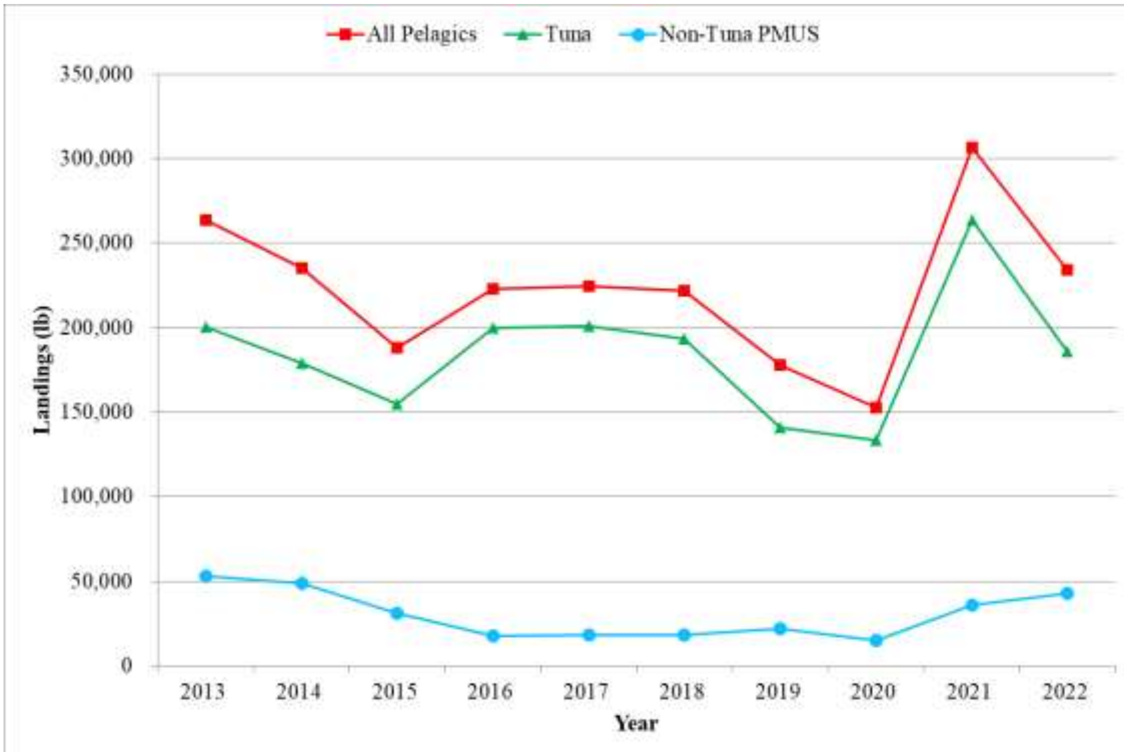


Figure 36. Commercial purchase landings for all pelagics, tuna PMUS, and non-tuna PMUS in the CNMI

Supporting data shown in Table A-36.

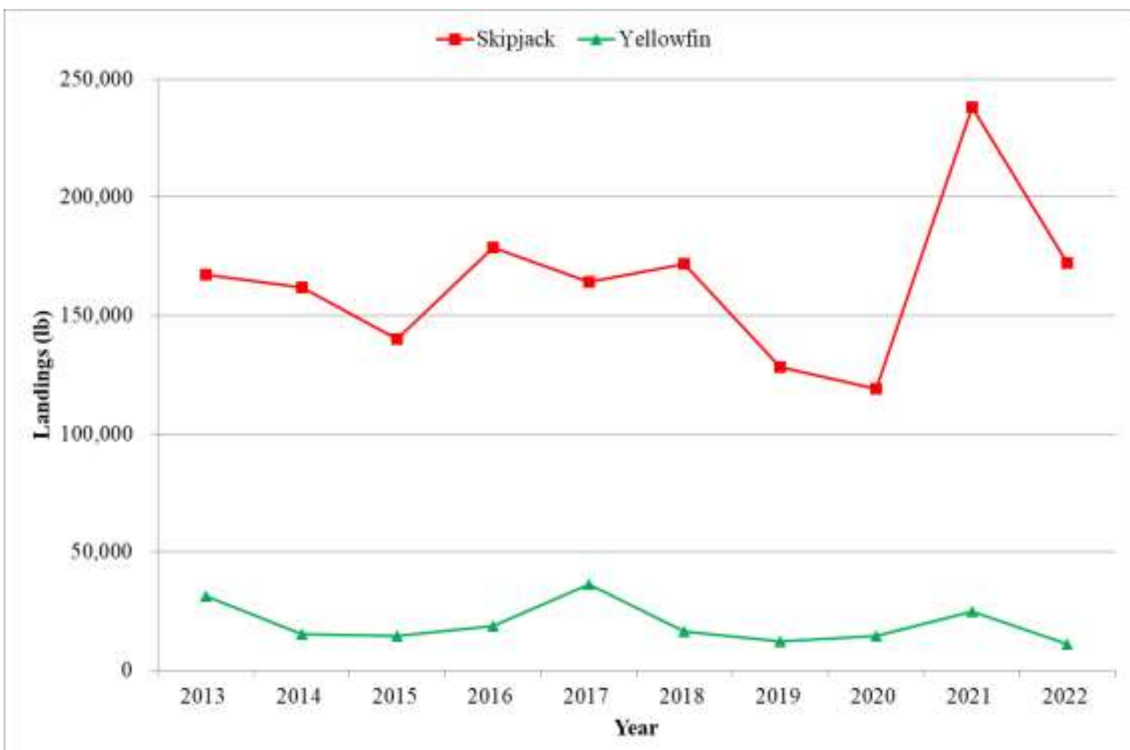


Figure 37. Commercial purchase landings for skipjack and yellowfin tunas in the CNMI

Supporting data shown in Table A-37.

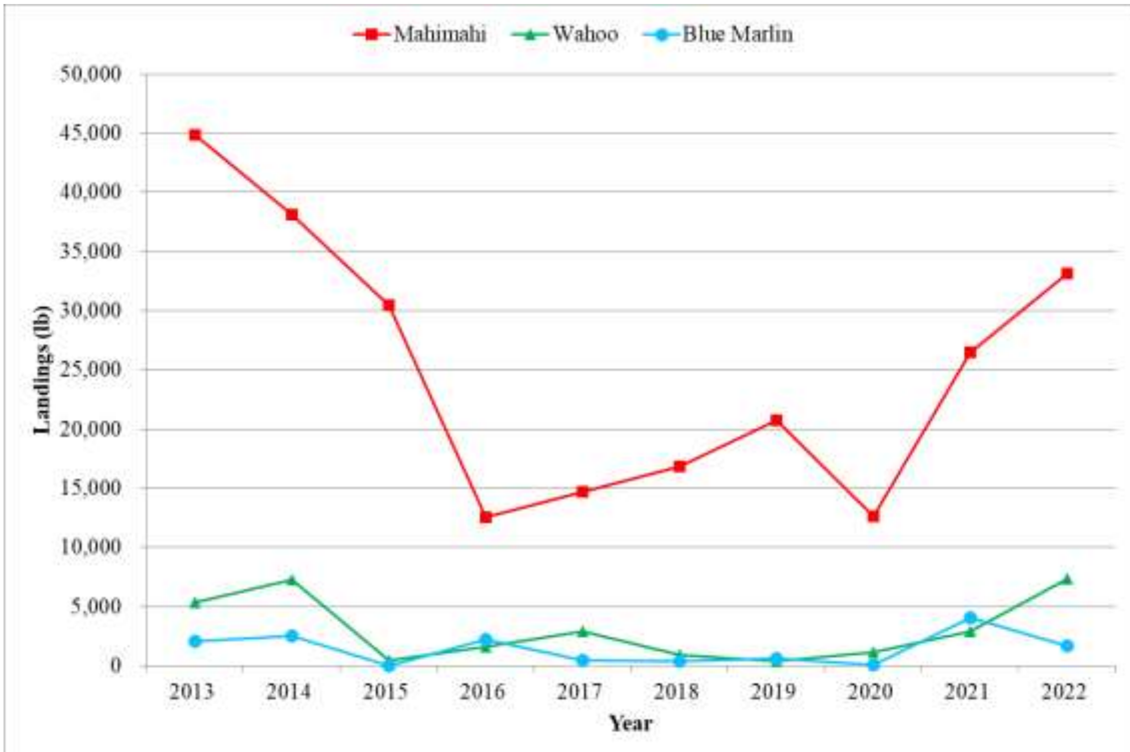


Figure 38. Commercial purchase landings for mahimahi, wahoo, and blue marlin in the CNMI

Supporting data shown in Table A-38.

2.2.6 OVERVIEW OF CATCH PER UNIT EFFORT ‑ ALL FISHERIES

This section provides catch rates for the five main species landed by trolling. “Pounds per hour trolled” is determined from creel survey interviews and includes charter and non-charter sectors, while “pounds per trip” is determined from commercial invoice receipts.

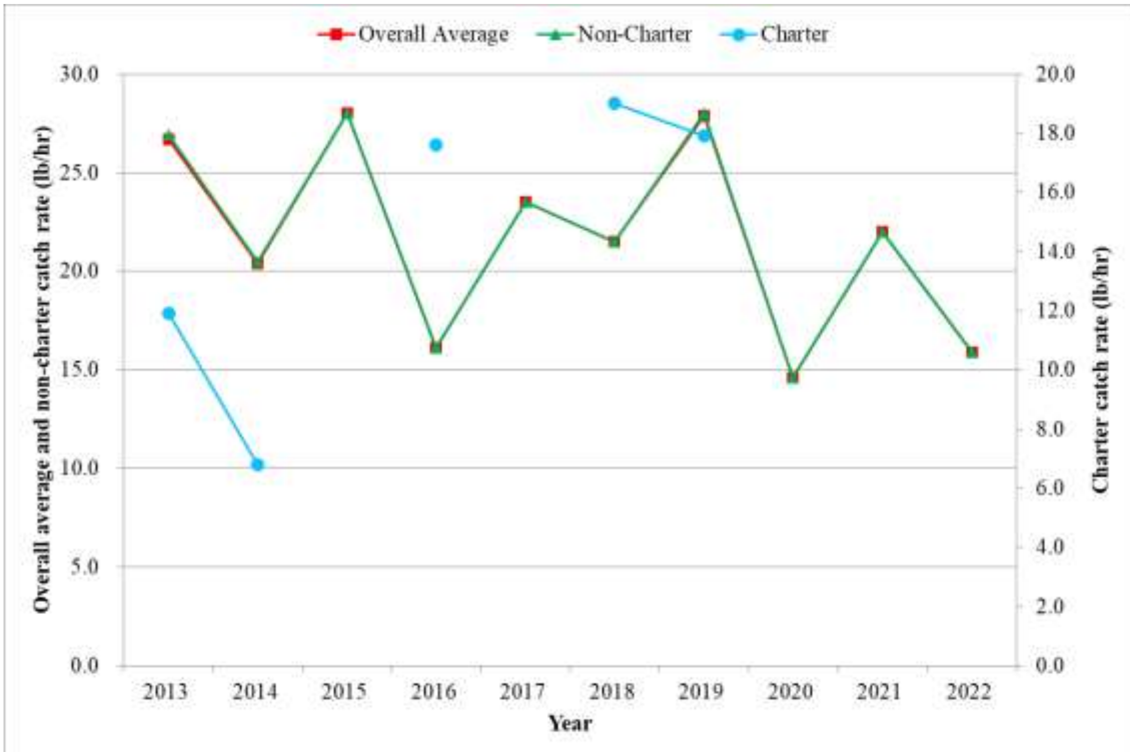


Figure 39. Estimated total trolling catch rates (lb/hr) in the CNMI

Supporting data shown in Table A-39.

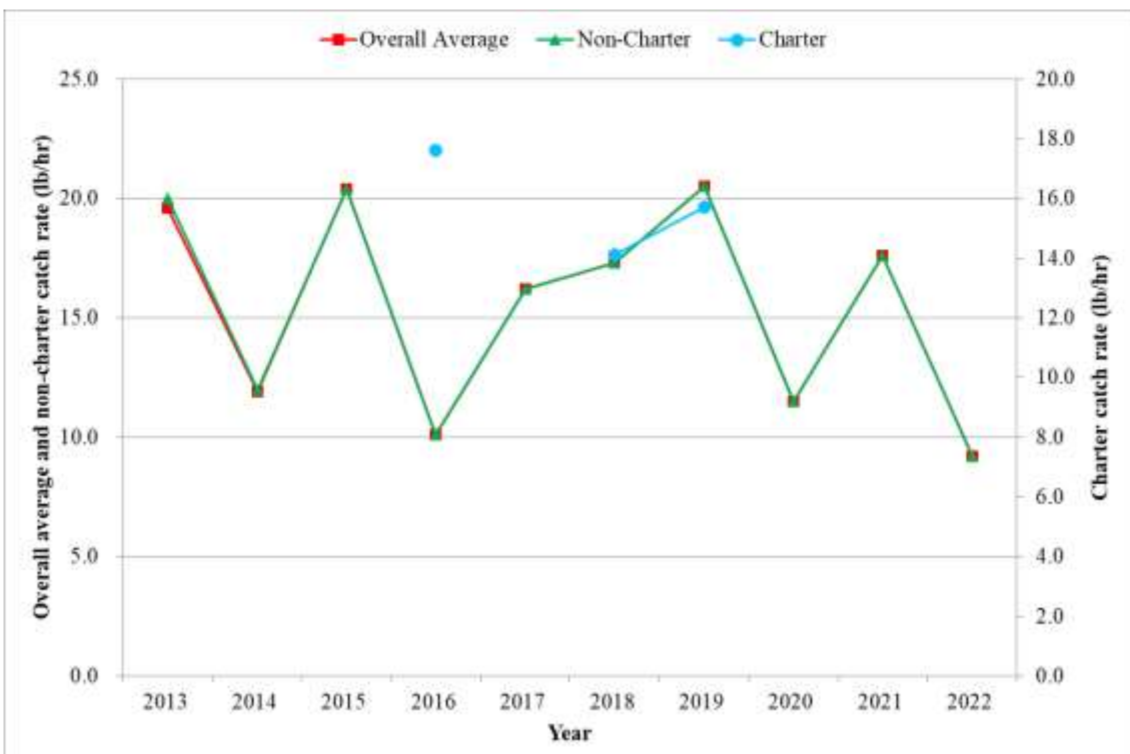


Figure 40. Estimated trolling catch rates (lb/hr) for skipjack tuna in the CNMI

Supporting data shown in Table A-40.

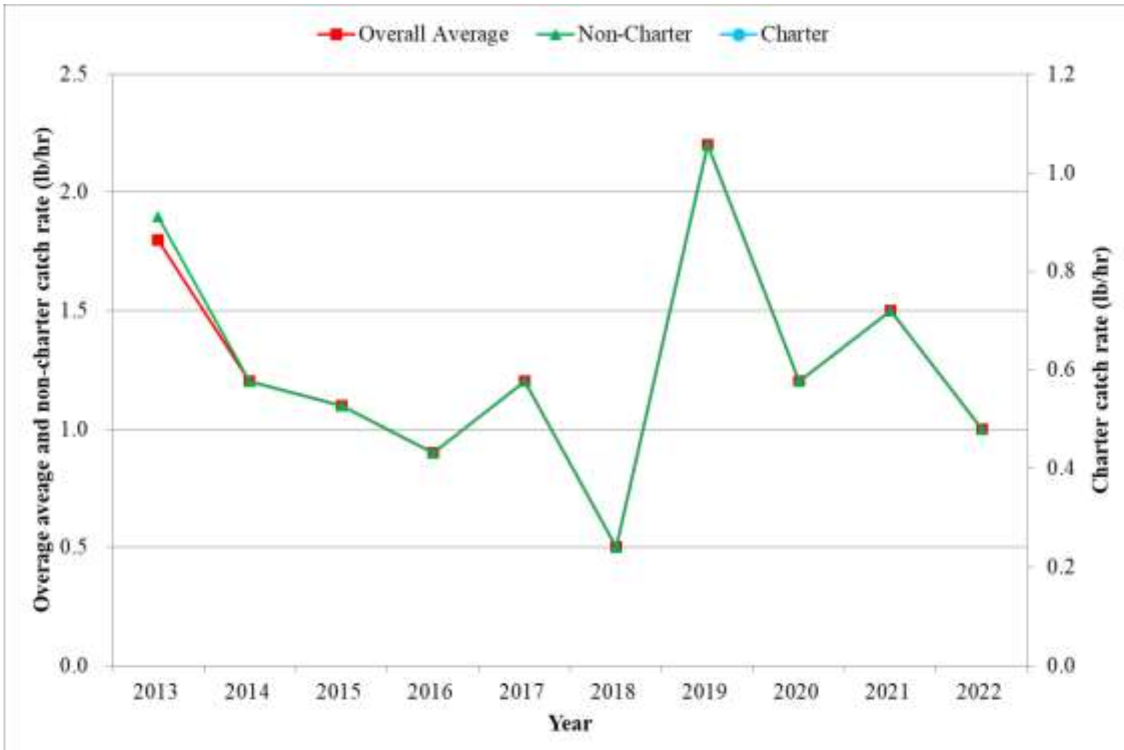


Figure 41. Estimated trolling catch rates (lb/hr) for yellowfin tuna in the CNMI

Supporting data shown in Table A-41.

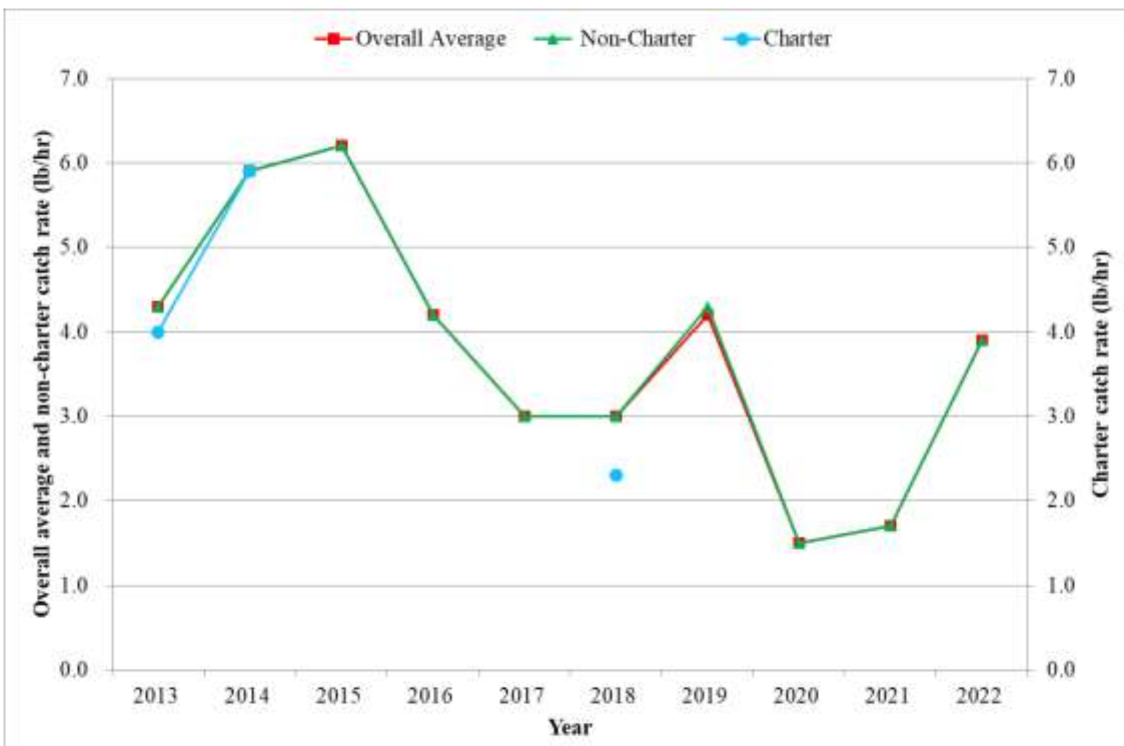


Figure 42. Estimated trolling catch rates (lb/hr) for mahimahi in the CNMI

Supporting data shown in Table A-42.

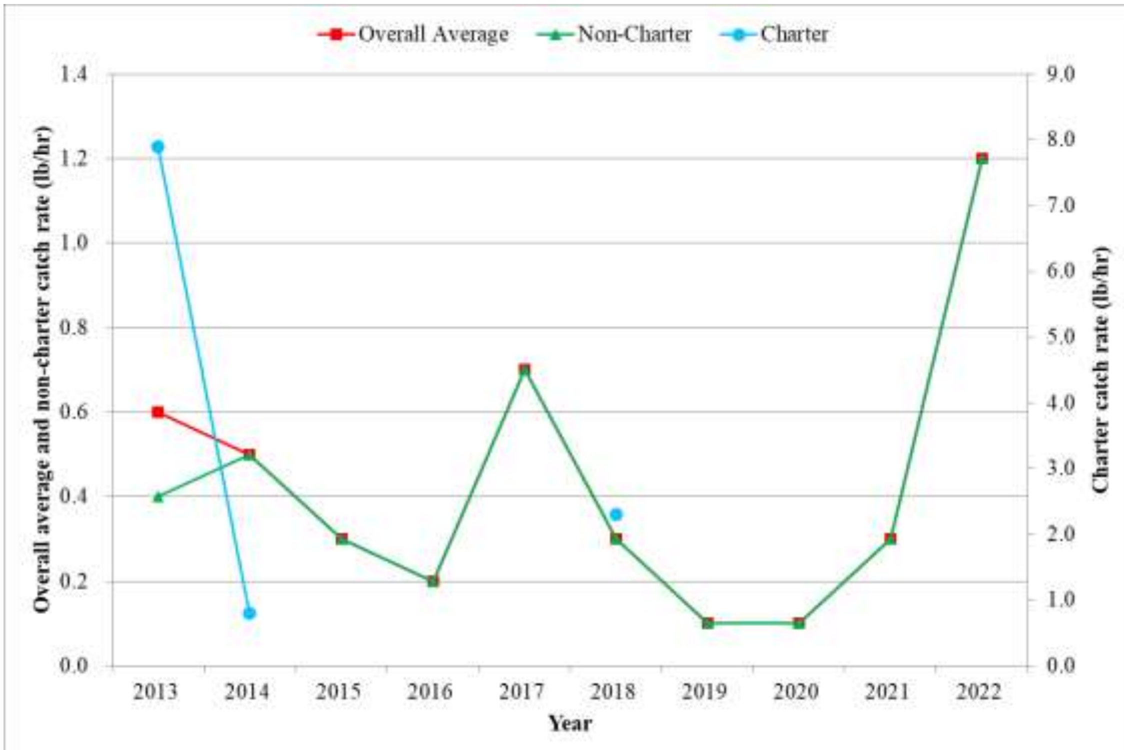


Figure 43. Estimated trolling catch rates (lb/hr) for wahoo in the CNMI

Supporting data shown in Table A-43.

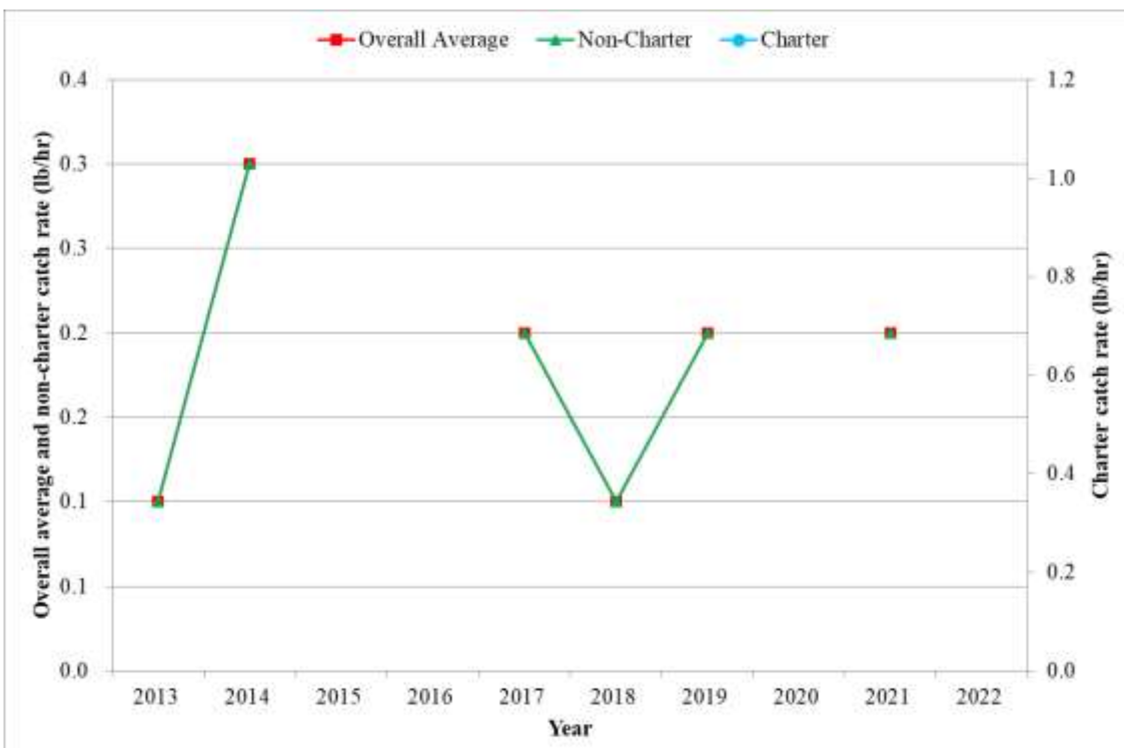


Figure 44. Estimated trolling catch rates (lb/hr) for blue marlin in the CNMI

Supporting data shown in Table A-44.

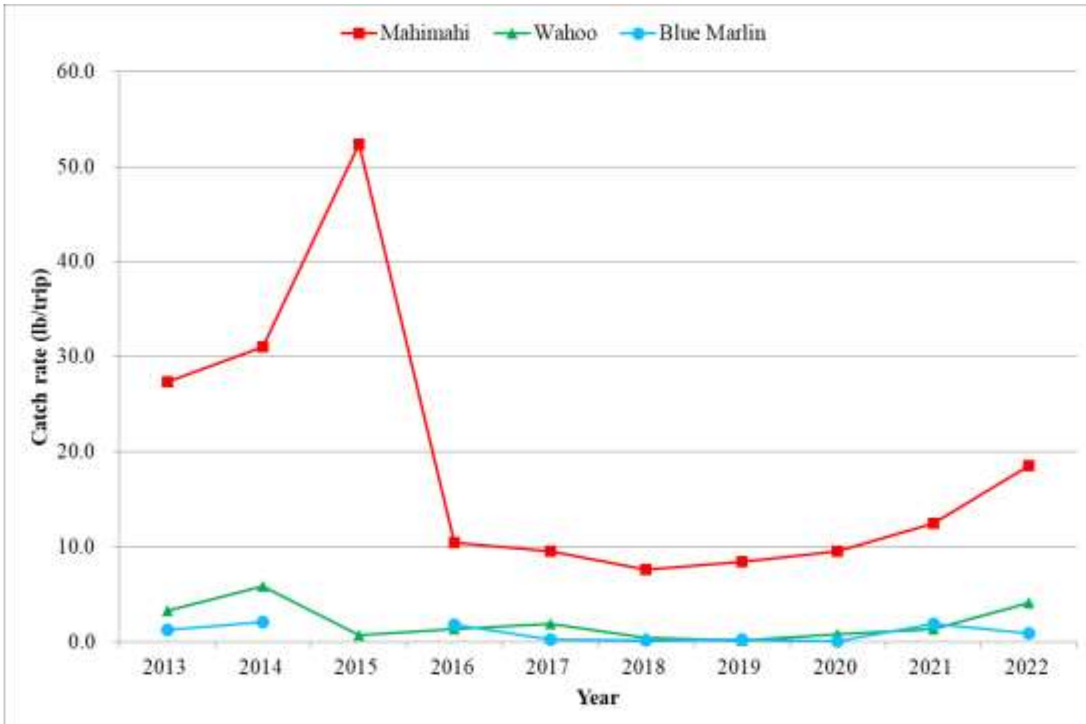


Figure 45. Estimated trolling catch rates (lb/trip) for mahimahi, wahoo, and blue marlin in the CNMI

Supporting data shown in Table A-45.

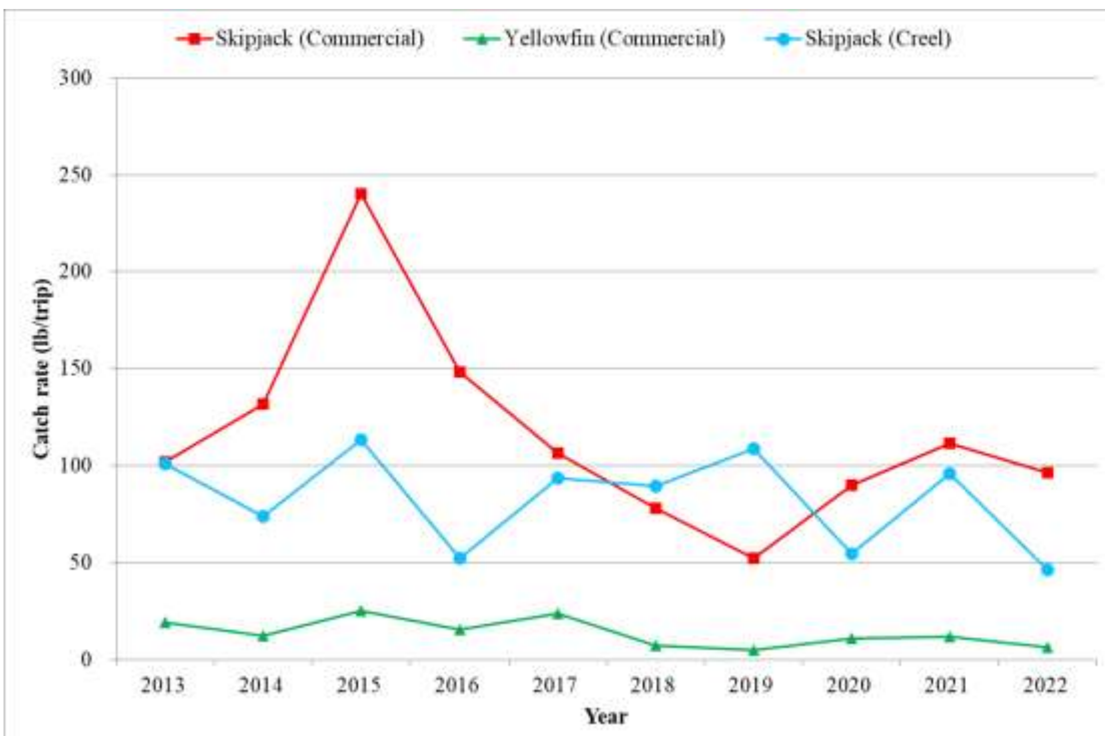


Figure 46. Estimated trolling catch rates (lb/trip) for skipjack and yellowfin tuna in the CNMI

Supporting data shown in Table A-46.

2.3 GUAM

2.3.1 DATA SOURCES

This report contains the most recently available information on Guam's pelagic fisheries, as compiled from data generated by the Division of Aquatic and Wildlife Resources (DAWR) through a program established in conjunction with PIFSC and the WPRFMC. Data are gathered through the offshore creel survey data program. In the past 10 years, DAWR staff have logged between 90 and 97 survey days annually (see Table A-47). The number of trips logged in boat logs has varied from 498 to 1,147 during that period, with the number of interviews slightly greater than half of that year's total trips. In 2022, DAWR completed 96 of 96 scheduled survey days, documented 949 trips and conducted 568 interviews.. Participation, total landings, effort, CPUE, and bycatch are generated from the creel survey. Using the DAWR computerized data expansion system files (with the assistance of NMFS to avoid over-estimating seasonal pelagic species), a 365-day quarterly expansion of survey data is run for each calendar year to produce catch and effort estimates for the pelagic fishery. Commercial landings, revenue, and price per pound data are obtained from the PIFSC-sponsored commercial landings system through the commercial receipt book. Transshipment landings data are obtained from the Bureau of Statistics and Plans. All transshipment through Guam ceased as of December 31, 2020.

DAWR has added three biologists in the past 12 months, which should help address chronic manpower shortages of the past. DAWR staff biologists continue to oversee several projects simultaneously, while providing on-going training to ensure the high quality of data being collected by all staff. All fisheries staff are trained to identify the most commonly caught fish to the species level. New staff are mentored by biologists and senior technicians in the field before conducting creel surveys on their own.

Total commercial landings are estimated by summing the weight fields in the commercial landings database from the principal fish wholesalers in Guam and then multiplying by an estimated percent coverage expansion factor. The annual expansion factor (described above) is subjectively created based on the available information in a given year including: an analysis of the "disposition of catch" data available from the DAWR offshore creel survey, an evaluation of the fishermen in the fishery and their entry/exit patterns, general "dock side" knowledge of the fishery and the status of the marketing conditions and structure, the overall number of records in the database, and a certain measure of best guesses.

2.3.2 SUMMARY OF GUAM PELAGIC FISHERIES

Landings. The estimated annual pelagic landings varies widely in the 42-year time series, ranging between 383,000 and 958,000 lb The average total catch has shown a slowly increasing trend over the reporting period. The 2022 total expanded pelagic landings were 629,837 lb, a decrease of 26.7% when compared with the catch from 2021. Tuna PMUS decreased 40.2%, while non-tuna PMUS increased 87.1%. Landings consisted primarily of five major species: mahimahi, wahoo, bonita or skipjack tuna, yellowfin tuna, and Pacific blue marlin, with skipjack comprising over 66.5% of total landings. Other minor species caught include rainbow runner, barracudas, and pomfrets. Sharks were also caught during 2022, with sharks noted in specific fishermen interviews conducted in 2022 regarding shark encounters (see bycatch below). However, these species were not encountered during offshore creel surveys and were not available for expansion for this year's report. Sharks are often discarded as bycatch. In addition to the above pelagic species, approximately half a dozen other species were landed incidentally this year.

There are wide year-to-year fluctuations in the estimated landings of the five major pelagic species. Landings for two of the five common species increased in 2022 from the previous year's levels. Skipjack decreased 37%, and yellowfin decreased by 63.3%. Wahoo catch increased 252%, mahimahi catch increased by 302%, and blue marlin decreased by 72%.

Effort. The number of boats involved in Guam's pelagic fishery gradually increased from 193 in 1983 to a high of 546 in 2021. There were 449 boats involved in Guam's pelagic fishery in 2022, a decrease of 17.7% from the all time high of 2021. The majority of the fishing boats are less than 10 m (33 ft) in length and are usually owner-operated by fishermen who earn a living outside of fishing. Most fishermen sell a portion of their catch, and it is difficult to make a distinction between recreational, subsistence, and commercial fishers. A small but economically significant segment (~5%) of the pelagic group is made up of marina-berthed charter boats that are operated primarily by full-time captains and crews. Data and graphs for non-charters, charters, and bycatch are represented in this report.

In early 2010, the U.S. military began exercises in an area south and southeast of Guam designated W-517. W-517 is a special use airspace (approximately 14,000 nm^2) that overlays deep open ocean approximately 50 miles south-southwest of Guam. Exercises in W-517 generally involve live fire and/or pyrotechnics. When W-517 is in use, a notice to mariners is issued, and vessels attempting to use the area are advised to be cautious of objects in the water and other small vessels. This discourages access to virtually all banks south of Guam, including Galvez, Santa Rosa, White Tuna, and other popular fishing areas. From 1995 to 2009, DAWR surveys recorded an annual average of 13.5 weekday trips to the south, and 31 weekend trips to the south, for a total of 44.5 trips per year. Since 2010, DAWR surveys have recorded an annual average of 6.7 weekday trips to the south, and 19.8 weekend trips to the south, for an average of 26.5 trips per year, a decrease of 40.5% per year. As the majority of NTMs for W-517 cover weekdays, the decrease in weekday trips is greater, 50.4%.

The small-boat bottomfish and trolling fishery in Guam relies on boat ramp access and FADs. Recent activities to support the Guam fishery follow.

On Guam, the makeshift ramp at Ylig Bay was eliminated in 2010. Widening of the main road on the southeast coast of Guam will cause removal of the ramp. In December 2006, a new launch ramp and facility was opened in Acfayan Bay, located in the village on Inarajan on the southeast coast of Guam. Monitoring of this ramp for pelagic fishing activity began at the start of 2007. In early 2007, this facility was damaged by heavy surf and has yet to be repaired. Monitoring of this ramp is currently on hold until the ramp is repaired. The current financial situation in Guam makes it unlikely this ramp will be repaired in the near future. DAWR staff are meeting with landowners and Department of Public Works officials to develop a new boat launching facility in Talofofo Bay on the east side of Guam, and land ownership may determine final placement.

CPUE. Trolling catch rates (lb per hour fished) showed an decrease from 2021. Total CPUE decreased 14.6%. The two tuna species showed an decrease in CPUE from 2021 to 2022. Marlin showed in CPUE from 2021 to 2022. Mahi and wahoo CPUE increased from 2021 to

2022. The fluctuations in CPUE are possibly due to variability in the year-to-year abundance and availability of the stocks.

Revenues. Commercial data for Guam pelagic fisheries are non-disclosed due to confidentiality rules that prevent data derived from fewer than three sources to be reported. Because there were fewer than three vendors that reported sales of pelagic fish on Guam in 2020, 2021, and 2022, the data are not able to be presented in this report.

A majority of troll fishermen do not rely on the catch or selling of fish as their primary source of income. Previously, Guam law required the Government of Guam to provide locally caught fish to food services in government agencies, such as Department of Education and Department of Corrections. In 2002, the Government of Guam began implementing cost-saving measures, including privatization of food services. The requirement that locally-caught fish be used for food services, while still a part of private contracts, is not being enforced. This has allowed private contractors to import cheaper foreign fish and reduced the sales of vendors selling locally caught fish. This represented a substantial portion of sales of locally caught pelagic fish. The decrease in commercial sales seen following 2002 may be, in part, due to this change.

Bycatch. There is low bycatch in the charter fishery. In 2022, interview data indicated there was again a low bycatch rate; there were 72 fish reported as bycatch in 5,342 tallied fish caught, for a 1.34% rate. Bycatch occasionally occurs in the troll fishery including sharks, shark-bitten and undersized fish.

In 2022, fishers were asked if they experienced a shark interaction. There was a total of 802 interviews for boat-based fishing in 2022, with 95 of these inappropriate for determining shark interaction. Of the remaining 707 interviews, 267 reported interactions with sharks and 440 reported no interactions with sharks for a 37.7% positive rate for interviews where fishers were asked about shark interactions.

2.3.3 PLAN TEAM RECOMMENDATIONS

There were no Plan Team recommendations relevant to the Guam data module of the annual SAFE report.

2.3.4 OVERVIEW OF PARTICIPATION

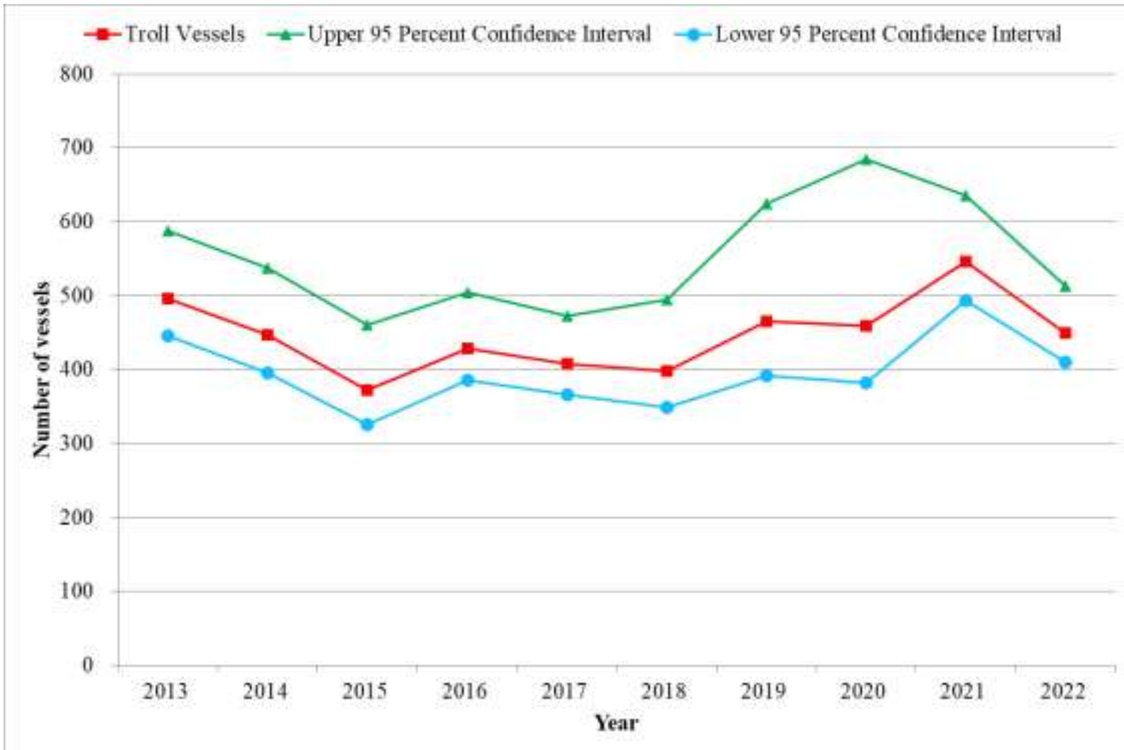


Figure 47. Total estimated number of vessels in Guam pelagic fisheries

Supporting data shown in Table A-48.

2.3.5 OVERVIEW OF TOTAL AND REPORTED COMMERCIAL LANDINGS

Table 18. Total estimated, non-charter, and charter landings (lb) for Guam in 2022

Species	Total Landings	Non-Charter	Charter
Skipjack Tuna	419,431	414,935	4,496
Yellowfin Tuna	34,050	33,909	141
Kawakawa	395	395	0
Albacore	0	0	0
Bigeye Tuna	0	0	0
Other Tuna PMUS	0	0	0
TUNAS Total	**453,876**	**449,239**	**4,637**
Mahimahi	94,491	86,651	7,840
Wahoo	57,003	55,434	1,569
Blue Marlin	8,700	6,818	1,882
Black Marlin	0	0	0
Striped Marlin	0	0	0
Sailfish	1,046	682	364

Species	Total Landings	Non-Charter	Charter
Shortbill Spearfish	0	0	0
Swordfish	0	0	0
Oceanic Sharks	0	0	0
Pomfrets	4,428	4,428	0
Oilfish	0	0	0
NON-TUNA PMUS Total	**165,668**	**154,013**	**11,655**
Dogtooth Tuna	1,476	1,442	34
Rainbow Runner	3,073	2,702	371
Barracudas	5,687	4,985	702
Double-lined Mackerel	57	57	0
Misc. Troll Fish	0	0	0
OTHER PELAGICS Total	**10,293**	**9,186**	**1,107**
TOTAL PELAGICS	**629,837**	**612,438**	**17,399**

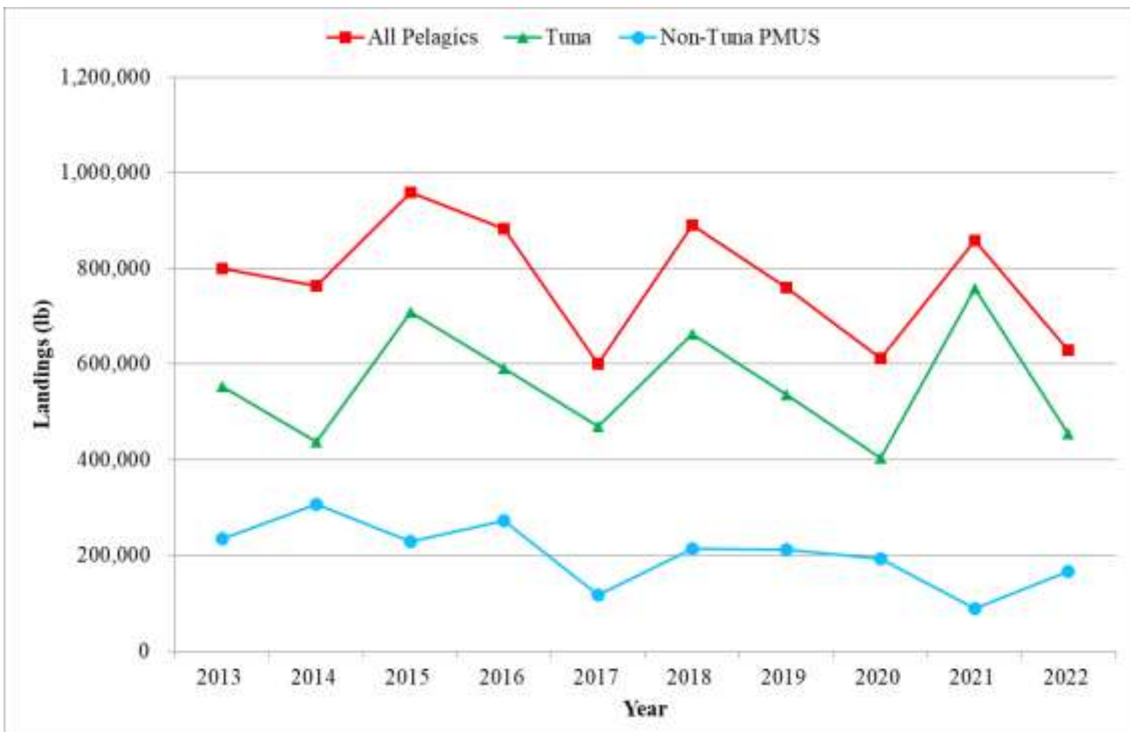


Figure 48. Total estimated landings for all pelagics, tuna PMUS, and non-tuna PMUS from boat-based creel surveys in Guam

Supporting data shown in Table A-49.

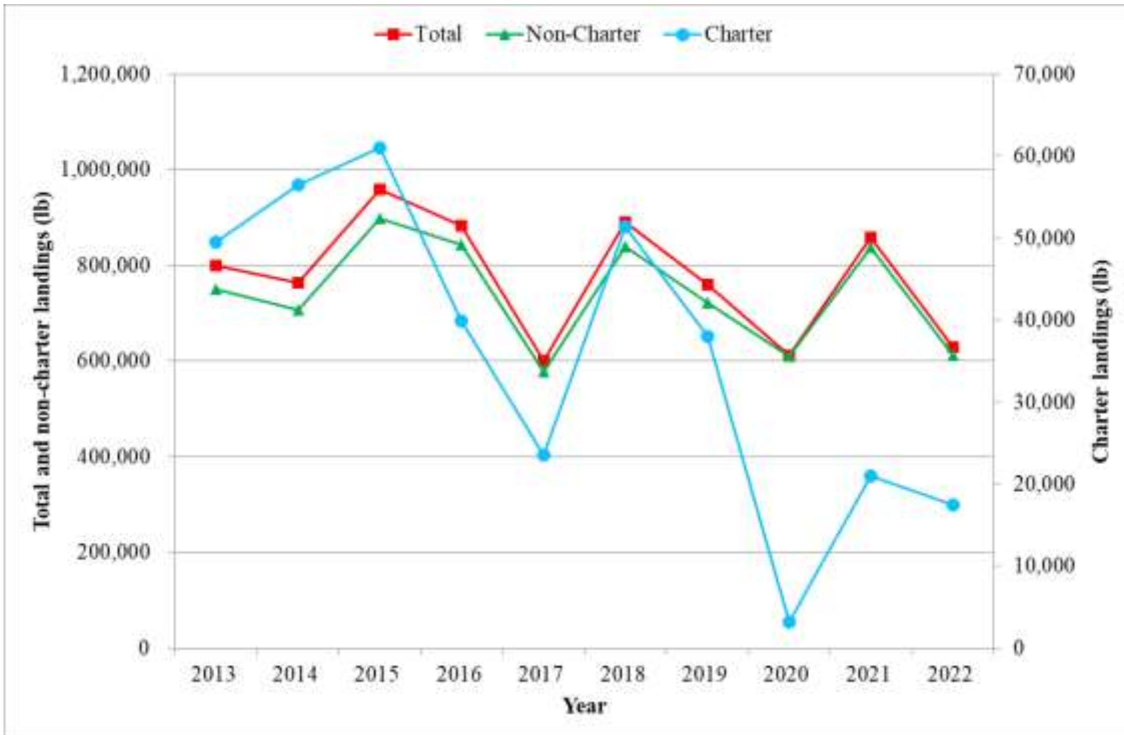


Figure 49. Total estimated landings for all pelagics in Guam

Supporting data shown in Table A-50.

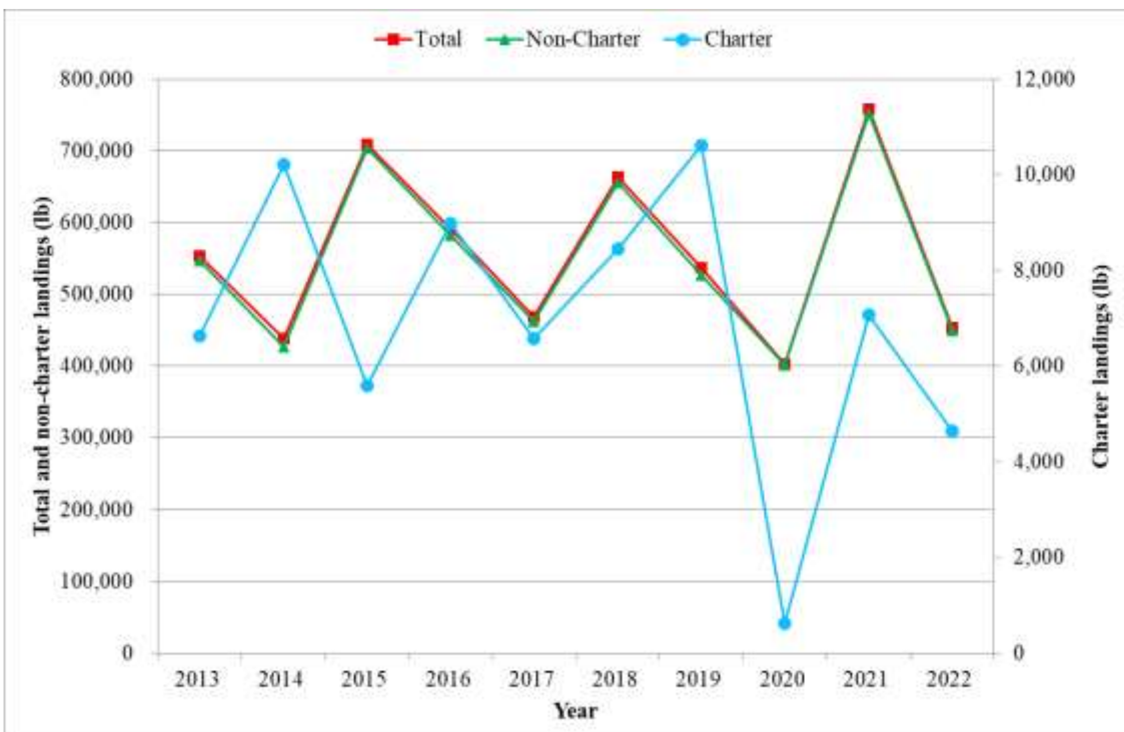


Figure 50. Total estimated landings for tuna PMUS in Guam

Supporting data shown in Table A-51.

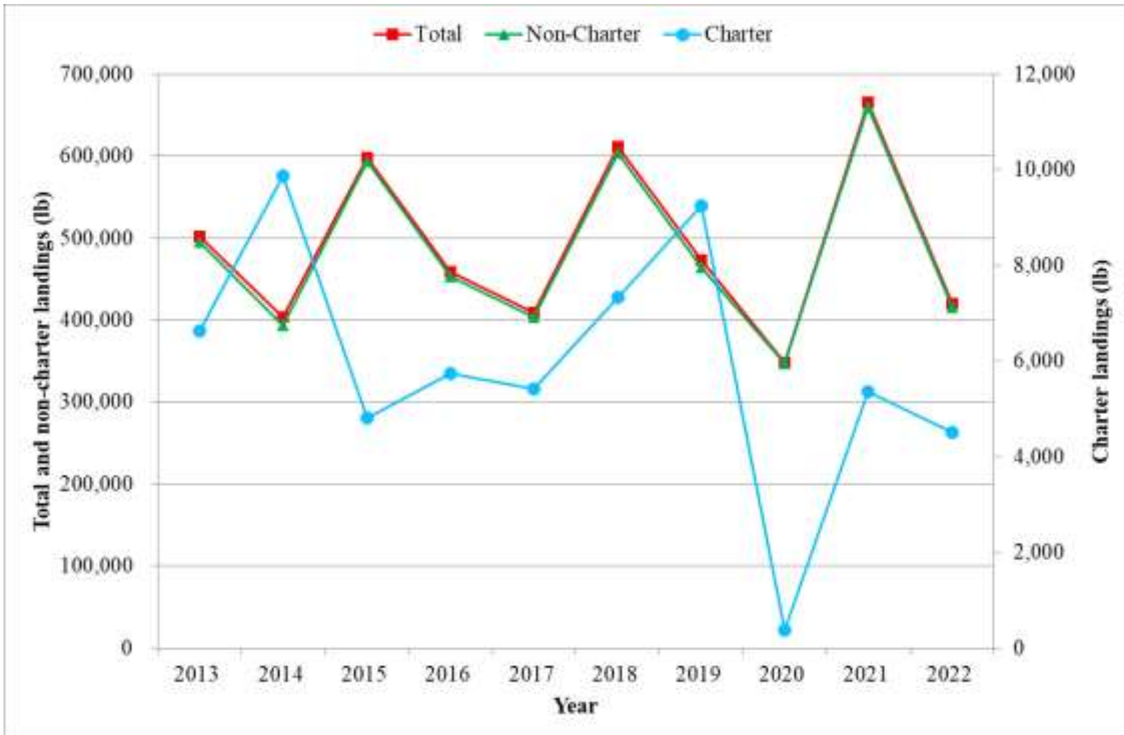


Figure 51. Total estimated landings for skipjack tuna in Guam

Supporting data shown in Table A-52.

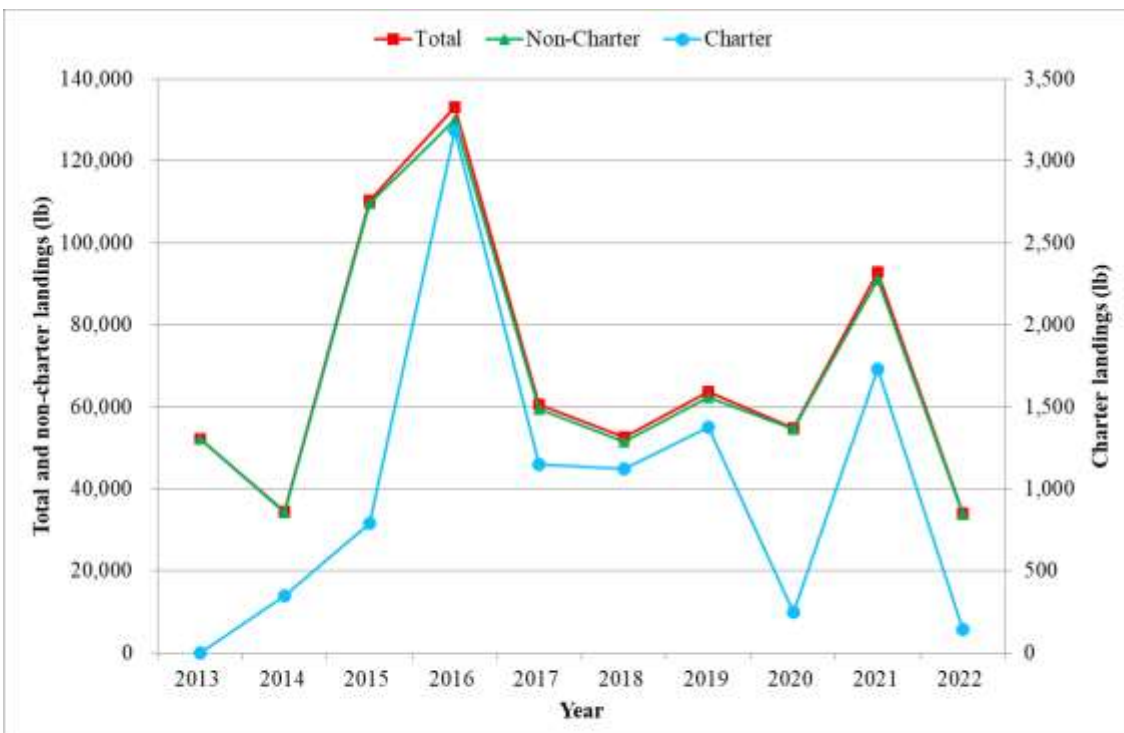


Figure 52. Total estimated landings for yellowfin tuna in Guam

Supporting data shown in Table A-53.

Figure 53. Total estimated landings for non-tuna PMUS in Guam

Supporting data shown in Table A-54.

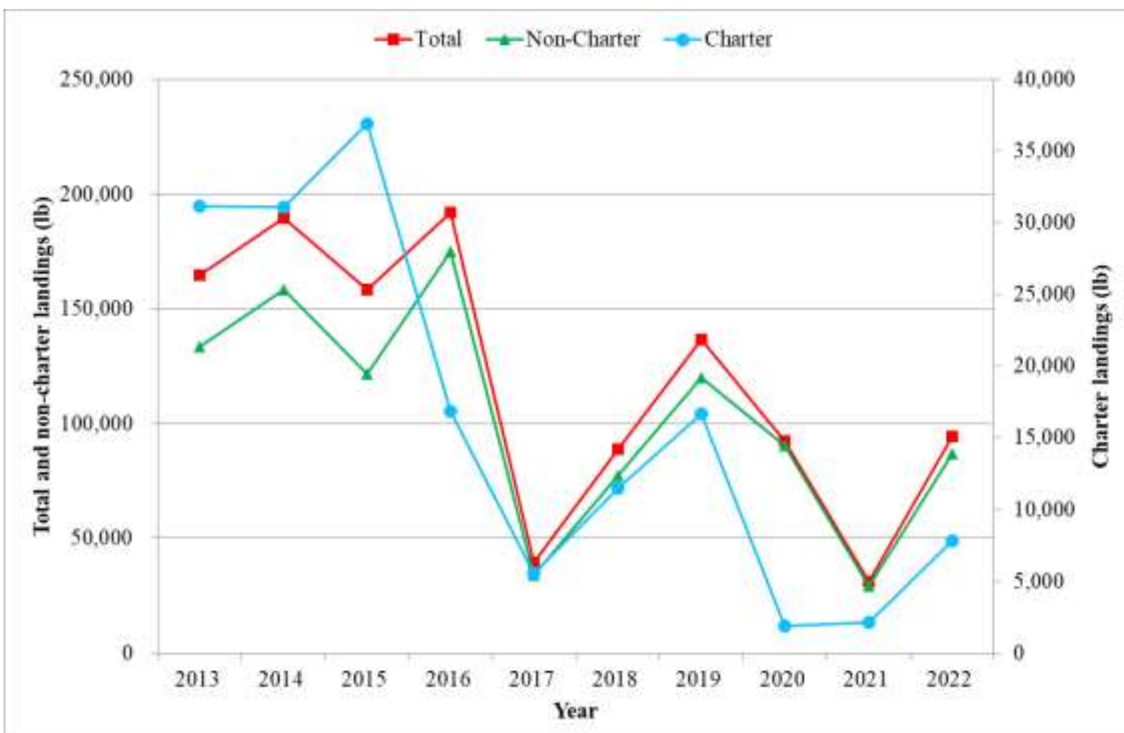


Figure 54. Total estimated landings for mahimahi in Guam

Supporting data shown in Table A-55.

Figure 55. Total estimated landings for wahoo in Guam

Supporting data shown in Table A-56.

Figure 56. Total estimated landings for blue marlin in Guam

Supporting data shown in Table A-57.

Table 19. Bycatch summary for pelagic trolling fisheries in Guam

Year	Number Release	Percent Release	Number Kept	Number Caught	Charter
2013	28	0.4	6,731	6,759	F
2014	21	0.4	5,320	5,341	F
2015	0	0.0	6,807	6,807	F
2016	0	0.0	8,867	8,867	F
2017	0	0.0	6,369	6,369	F
2018	2	0.0	7,987	7,989	F
2019	150	2.0	7,334	7,484	F
2020	4	0.1	3,218	3,222	F
2021	14	0.2	7,785	7,799	F
2022	72	1.2	5,769	5,841	F
2013	0	0.0	258	258	T
2014	0	0.0	496	496	T
2015	0	0.0	444	444	T
2016	6	1.6	369	375	T
2017	0	0.0	231	231	T
2018	0	0.0	284	284	T
2019	0	0.0	315	315	T
2020	0	0.0	40	40	T
2021	0	0.0	174	174	T
2022	0	0.0	130	130	T

Table 20. Bycatch species summary for pelagic trolling fisheries in Guam

Year	Species	Number Release	Percent Release	Number Kept	Number Caught	Charter
2013	Rainbow Runner	1	3.0	32	33	F
2013	Skipjack Tuna	21	0.4	5,474	5,495	F
2013	Yellowfin Tuna	6	1.6	373	379	F
2014	Barracudas	1	2.6	38	39	F
2014	Skipjack Tuna	19	0.5	3,914	3,933	F
2014	Yellowfin Tuna	1	0.4	271	272	F
2018	Wahoo	1	0.2	568	569	F
2018	Yellowfin Tuna	1	0.3	343	344	F
2019	Skipjack Tuna	148	2.5	5,862	6,010	F
2019	Yellowfin Tuna	2	0.4	531	533	F
2020	Mahimahi	4	1.9	204	208	F
2021	Skipjack Tuna	10	0.2	6,724	6,734	F
2021	Yellowfin Tuna	4	0.5	775	779	F

Year	Species	Number Release	Percent Release	Number Kept	Number Caught	Charter
2022	Blue Marlin	1	11.1	8	9	F
2022	Mahimahi	6	2.9	200	206	F

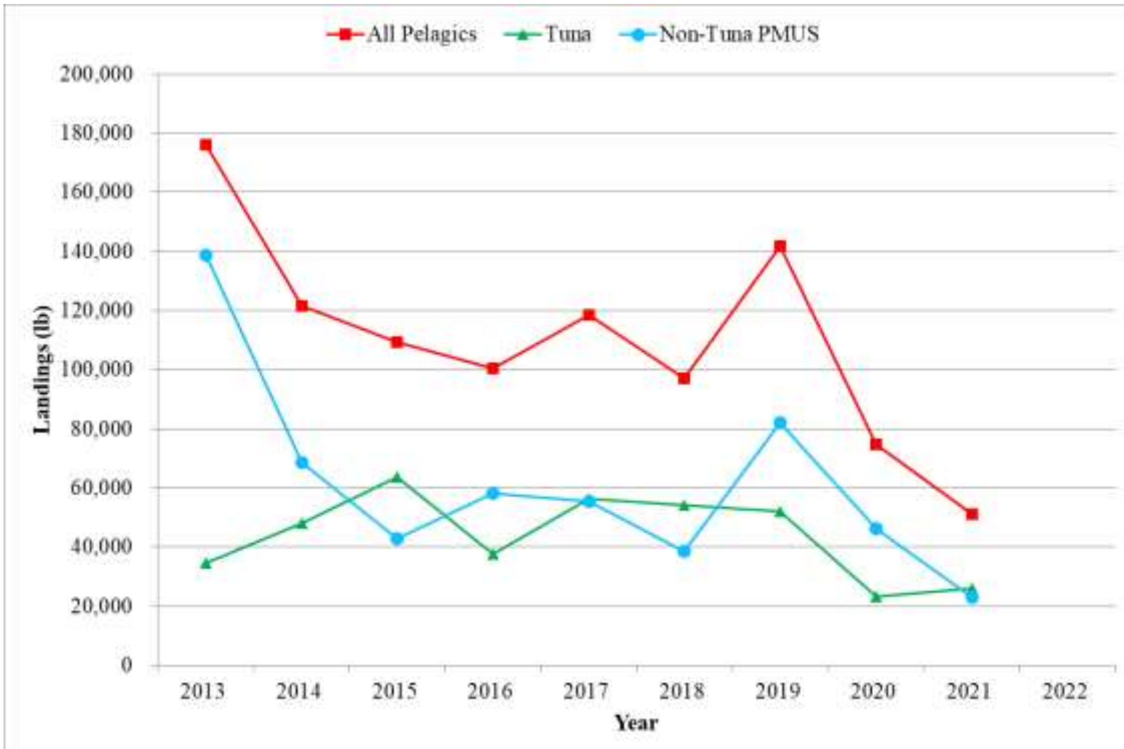


Figure 57. Commercial purchase landings for all pelagics, tuna PMUS, and non-tuna PMUS in Guam

Supporting data shown in Table A-58.

2.3.6 OVERVIEW OF EFFORT AND CPUE

Figure 58. Estimated number of trolling trips from boat-based creel surveys in Guam
Supporting data shown in Table A-59.

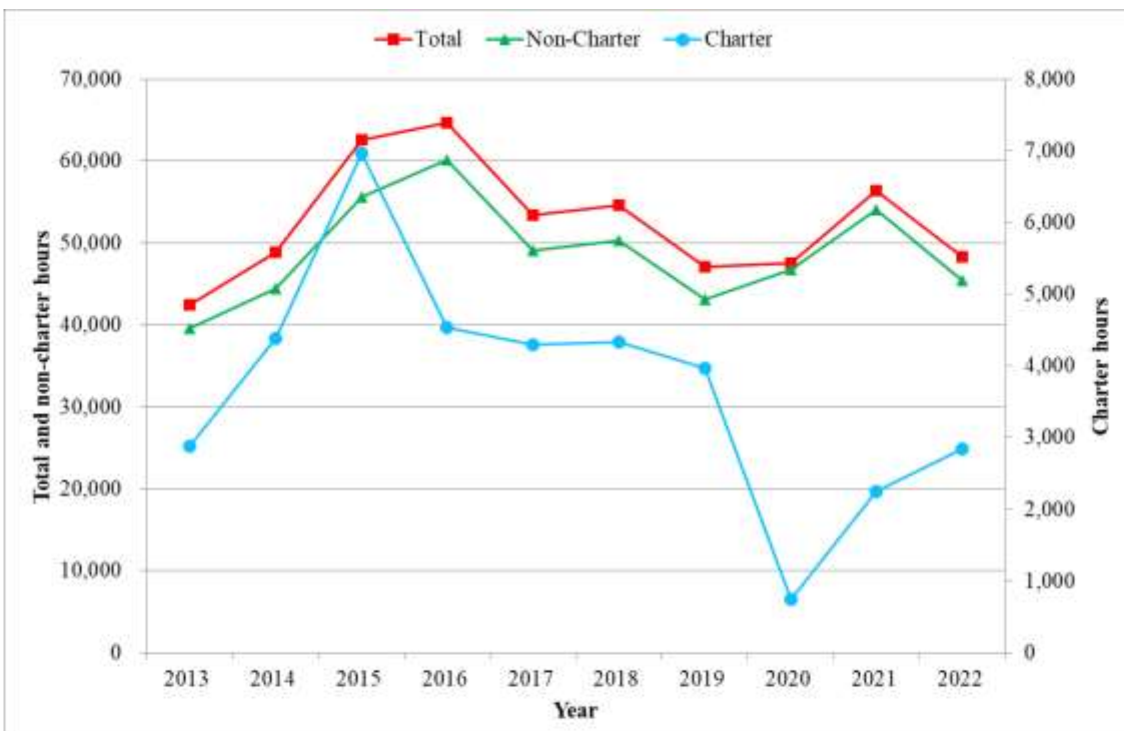


Figure 59. Estimated number of trolling hours from boat-based creel surveys in Guam
Supporting data shown in Table A-60.

Figure 60. Estimated fishing trip length (hr/trip) from boat-based creel surveys in Guam

Supporting data shown in Table A-61.

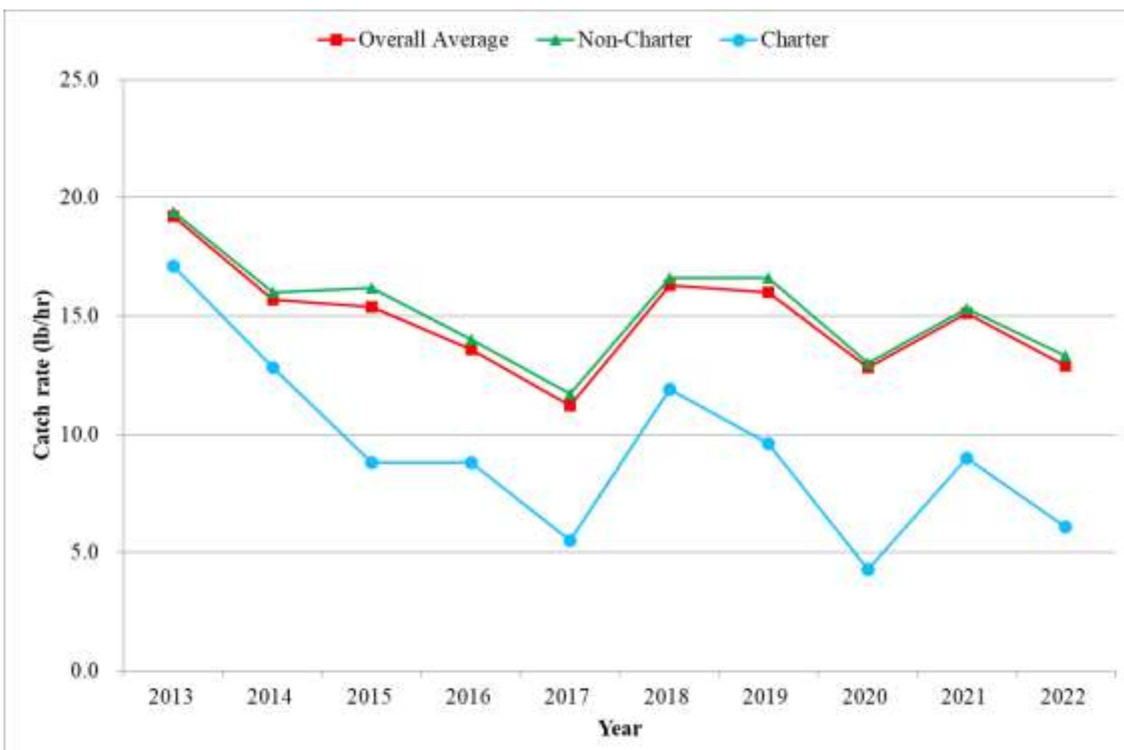


Figure 61. Estimated total trolling catch rates (lb/hr) in Guam

Supporting data shown in Table A-62.

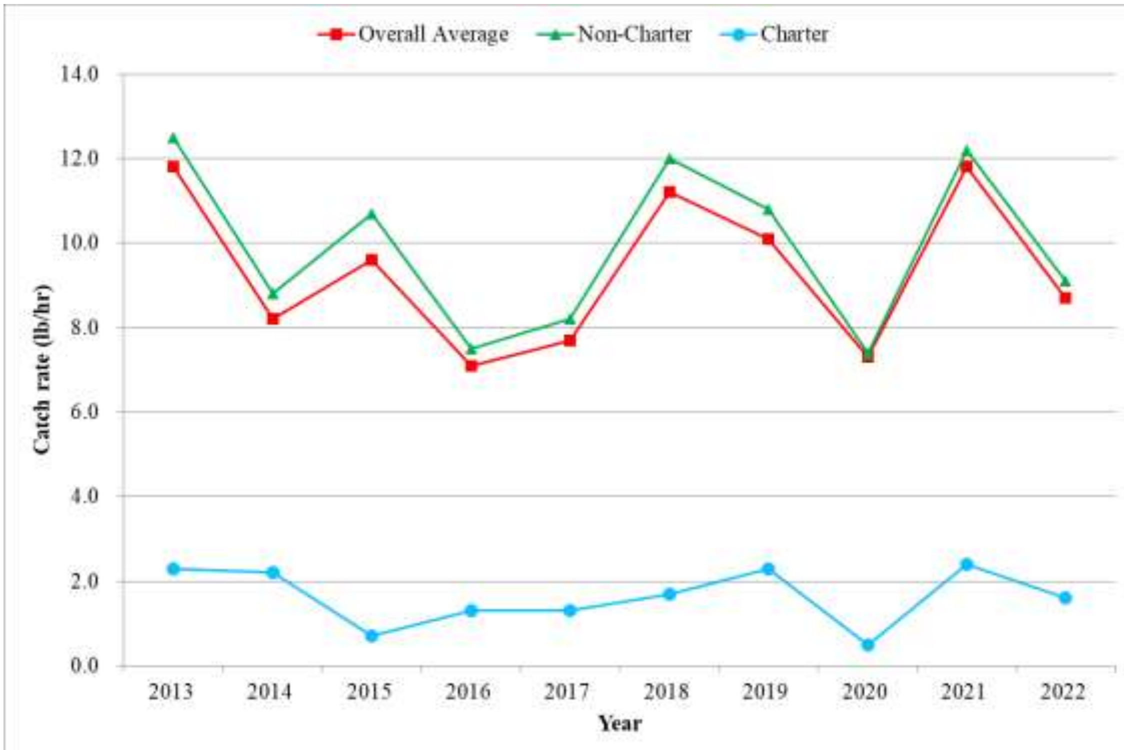


Figure 62. Estimated trolling catch rates (lb/hr) for skipjack tuna in Guam

Supporting data shown in Table A-63.

Figure 63. Estimated trolling catch rates (lb/hr) for yellowfin tuna in Guam

Supporting data shown in Table A-64.

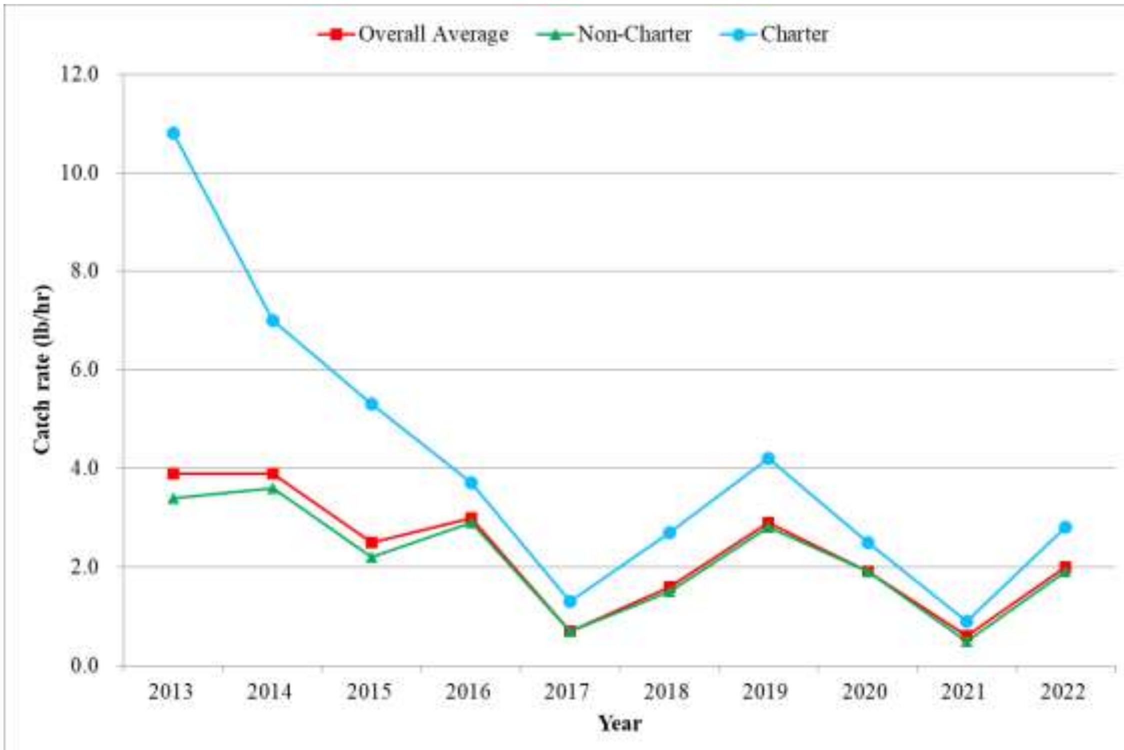


Figure 64. Estimated trolling catch rates (lb/hr) for mahimahi in Guam

Supporting data shown in Table A-65.

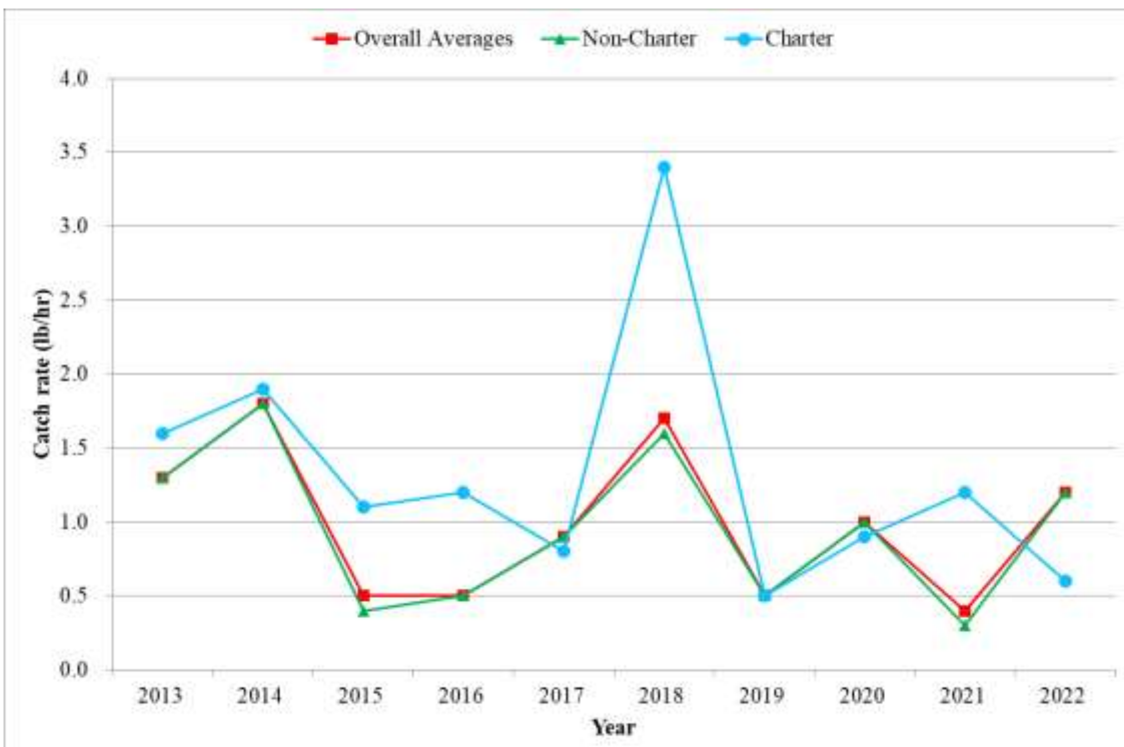


Figure 65. Estimated trolling catch rates (lb/hr) for wahoo in Guam

Supporting data shown in Table A-66.

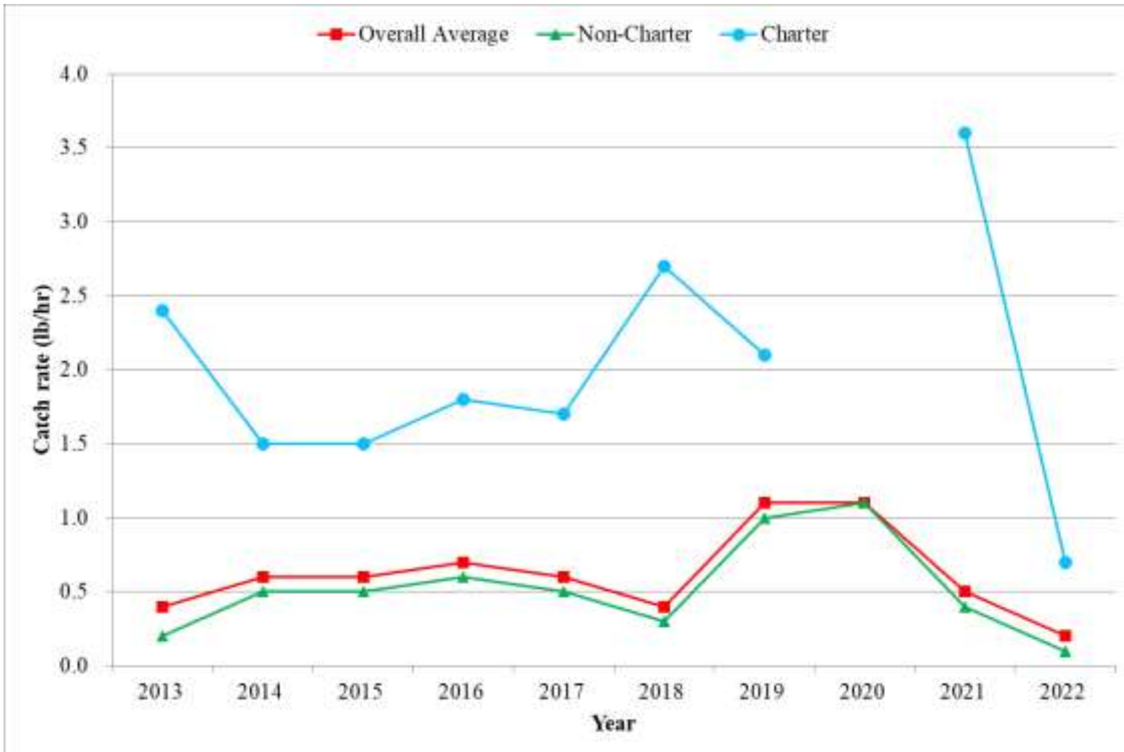


Figure 66. Estimated trolling catch rates (lb/hr) for blue marlin in Guam

Supporting data shown in Table A-67.

2.4 HAWAII

2.4.1 DATA SOURCES

This report contains the most recently available information on Hawaii's commercial pelagic fisheries, as compiled from four data sources: The State of Hawaii's Division of Aquatic Resources (HDAR) Commercial Marine License data (CML), Commercial Fishing Report data (Fishing Report), HDAR Commercial Marine Dealer's Report data (Dealer), and NMFS, Pacific Islands Fisheries Science Center's (PIFSC) longline logbook data.

Any fisherman who takes marine species for commercial purposes is required by HDAR to have a CML and submit a monthly catch report. An exception to this rule is that should a fishing trip occur on a boat, only one person per vessel is required to submit a catch report. This person is usually, but not necessarily, the captain. Crew members do not ordinarily submit catch reports. HDAR asks fishermen to identify their primary fishing gear or method on the CML at time of licensing. This does not preclude fishermen from using other gears or methods. Data sources and estimation procedures are described below.

The Hawaii-permitted Longline Fishery: The federal longline logbook system was implemented in December 1990 and it is the main source of the data used to determine longline vessel activity, effort, fish catches and catch-per-unit-effort (CPUE). Logbook data have detailed operational information and catch in number of fish. Longline vessel operators are required to declare whether they will be making a deep-set or shallow-set trip prior to their departure. A deep-set is defined as a set with 15 or more hooks between floats as opposed to a shallow-set that is characterized by setting less than 15 hooks between floats.

Number of fish caught by Hawaii-permitted longline fishery is a sum of the number of fish kept and released whereas the calculation of weight for longline catch only includes the number of fish kept. Another important data set is the HDAR Commercial Dealer data. Dealer data dates back to 1990 with electronic submission beginning in mid-1999. Revenue, average weight and average price are derived from the Dealer data.

The logbook and Dealer data were used to calculate the weight of longline catch. Longline purchases in the Dealer data was identified and separated out by matching longline trips based on a specific vessel name and its return to port date in the logbook data with the corresponding vessel name and purchase date(s) in the Dealer data. The general procedure of estimating longline catch for each species was done by first calculating an average weight by dividing the longline Dealer data "LBS BOUGHT" by the "NO. BOUGHT". This average weight was multiplied by the total number kept from the longline logbook data to estimate the total weigh of catch kept. Revenue was the simple sum of "AMOUNT PAID" from the Dealer data based on longline trips which were matched with logbook data. Swordfish are processed at sea and landed headed and gutted. Tunas and mahimahi that weighed more than 20 lb and marlins greater than 40 lb must be gilled and gutted prior to sale. A conversion factor is applied to processed fish to estimate whole weight. Average weight statistics were calculated separately for the deep-set and shallow-set longline fisheries. Each species needed a minimum of 20 samples within a month of each RFMO area, i.e., WCPO or EPO, in order to calculate a mean weight. If this criterion was not met, the time strata was increased to a quarter, year or multi-year period until there were enough samples to calculate a mean weight. Some species which were landed in low numbers needed to be aggregated to a multi-year period. Consequently, their respective annual mean weights are the same from year to year or repeat over time. Additional caveats to interpretation of logbook catch include billfish misidentifications that can bias some billfish species catch (Walsh et al. 2005). The PIFSC Stock Assessment Program works to correct billfish catch (Sculley 2021), however challenges integrating corrected billfish catch into the annua SAFE report preclude their inclusion.

Catch and effort summaries in this Module were based on RFMO standards and business rules. Longline catch and efforts statistics in this Module consists of U.S. longline fisheries in the North Pacific Ocean, attributions from CNMI, Guam and American Samoa in the North Pacific Ocean. Longline vessels operating from California were also included in this report to satisfy RFMO data reporting and NOAA confidentiality standards. Most of these vessels had Hawaii limited-entry permits. The only exception to summaries using RFMO standards was catch and effort statistics using boundaries within or outside of U.S. EEZs. Since there were substantial differences in operational characteristics and catch between the deep-set longline fishery targeting tunas and the shallow-set longline fishery targeting swordfish, separate summaries were provided for each longline fishery.

Main Hawaiian Islands (MHI) Troll Fishery: Catch and effort by the MHI troll fishery was defined as using a combination of pelagic species, gear and area codes from the HDAR Fishing Report data. The HDAR codes for the MHI troll fishery includes summaries of PMUS caught by Miscellaneous Trolling Methods (gear code 6), Lure Trolling (61), Bait Trolling (62), Stick Trolling (63), Casting, Light Tackle, Spinners or Whipping (10) and Hybrid Methods (97) in HDAR statistical areas 100 through 642. These are areas that begin from the shoreline out to 20 minute squares around the islands of Hawaii, Maui, Kaho'olawe, Lana'i, Moloka'i, O'ahu, Kaua'i and Ni'ihau.

MHI Handline Fishery: The MHI handline fishery includes PMUS caught by Deep Sea or Bottom Handline Methods (HDAR gear code 3), Inshore Handline or Cowrie Shell (Tako) Methods (4), Kaka line (5), Ika-Shibi (8), Palu-Ahi, Drop Stone or Make Dog Methods (9), Drifting Pelagic Handline Methods (35) and Floatline Methods (91) in HDAR statistical areas 100 to 642 except areas 175, 176, and 181.

Offshore Handline Fishery: The offshore handline fishery includes PMUS caught by Ika-Shibi (HDAR gear code 8), Palu-Ahi, Drop Stone or Make Dog Methods (9), Drifting Pelagic Handline Methods (35), Miscellaneous Trolling Methods (6), Lure Trolling (61), and Hybrid Methods (97) in Areas 15217 (NOAA Weather Buoy W4), 15717 (NOAA Weather Buoy W2), 15815, 15818 (Cross Seamount) , 16019 (NOAA Weather Buoy W3), 16223 (NOAA Weather Buoy W1), 175, 176, 181, 804, 807, 816, 817, 825, 839, 842, 892, 893, 894, 898, 900, 901, 15416, 15417, 15423, 15523, 15718, 15918, 15819, and 16221. This fishery also includes pelagic species caught by Deep Sea or Bottom Handline Methods (3) in Area 16223.

Other Gear: This category represents pelagic species caught by methods or in areas other than those methods mentioned above. Catch and revenue from this category is primarily composed of PMUS caught by the aku boat fishery, fishers trolling in areas outside of the MHI (the distant water albacore troll fishery) or PMUS caught close to shore by diving, spearfishing, squidding, or netting inside of the MHI.

Calculations: Pelagic catch by the MHI troll, MHI handline, offshore handline, and other gear were calculated by summing "LBS LANDED" from the HDAR Fishing Report data based on the gear and area codes used to define each gear type. The percent of catch for each pelagic species was calculated from the "LBS LANDED" by the MHI troll, MHI handline offshore handline and other gear and used to estimate the "LBS SOLD" and revenue of each fishery.

Catch in the HDAR Dealer data, referred to as "LBS BOUGHT", by each fishery was not clearly differentiated however, "LBS BOUGHT" by the longline and aku boat fisheries were identified by CML numbers and/or vessel names and kept separate from the "non-longline & non-aku boat" Dealer data. This remaining "LBS BOUGHT" along with the "AMOUNT PAID" from Dealer data for the "non-longline and non-aku boat" fisheries was used to calculate average weight, revenue and average price for the MHI troll, MHI handline, offshore handline fisheries and other gear category. "LBS BOUGHT" from this Dealer data was summed on a species specific basis. The percent of catch calculated from the HDAR Fishing Report "LBS LANDED" for each species and by each fishery was used in conjunction with total "LBS BOUGHT" from the HDAR Dealer data to apportion "LBS BOUGHT" and "AMOUNT PAID" or revenue accordingly to each respective fishery. This process was repeated on a monthly basis to account for the seasonality of catch and variability of activity for each fishery. Revenue and average price are inflation-adjusted by the Honolulu Consumer Price Index (CPI).

2.4.2 SUMMARY OF HAWAII PELAGIC FISHERIES

The following is a summary of effort, catch, CPUE, size of fish, revenue and bycatch for the main pelagic fisheries (deep-set and shallow-set longline, MHI troll, MHI handline, and offshore handline). With COVID-19 restrictions lifted, the business environment improving and number of visitors reaching pre-pandemic levels, fisheries have also appeared to have recovered in 2022. Total catch was lower than the long-term average but ex-revenue was above average in 2022. With La Nina last year there were only 10 hurricanes in the Pacific Ocean, most which dissipated in the eastern Pacific Ocean, four which developed into major hurricanes and one which came close to Hawaii. The Pacific Missile Range Facility (PMRF) issued 10 Notice of Hazardous Operation in 2022, each which cover a period of time and area boundaries which could possibly affect fishing area for longline vessels.

Participation. A total of 3,201 fishermen were licensed in 2022, including 1,873 (59%) who indicated that their primary fishing method and gear were intended to catch pelagic fish. This is a 1% increase in fishing licenses from the previous year. Most licenses that indicated pelagic fishing as their primary method were issued to longline fishermen (52%) and trollers (31%). The remainder was issued to ika-shibi and palu-ahi (handline) (17%).

Catch. Hawaii commercial fisheries caught and landed 29.6 million pounds of pelagic species in 2022, a decrease of 5% from the previous year. Although each fishery targets or intends to catch a particular pelagic species, a variety of other species were also caught. The deep-set longline fishery targeted bigeye and yellowfin tuna. This was the largest of all pelagic fisheries and its total catch comprised 82% (24.2 million pounds) of all pelagic fisheries. The shallow-set longline fishery targeted swordfish and its catch was 1.9 million pounds, or 6% of the total catch. The MHI troll fishery targeted tunas, marlins and other

PMUS caught 1.8 million pounds or 6% of the total. The MHI handline fishery targeted yellowfin tuna while the offshore handline fishery targeted bigeye tuna. The MHI handline fishery accounted for 940,000 pounds (4% of the total). The offshore handline fishery was responsible for 454,000 pounds or less than 2% of the total catch.

The largest component of the pelagic catch was tunas, which comprised 77% of the total in 2022. Bigeye tuna alone accounted for 65% of the tunas and 50% of all the pelagic catch. Billfish catch made up 14% of the total catch in 2022. Swordfish was the largest of these, at 48% of the billfish and 7% of the total catch. Catches of other PMUS represented 9% of the total catch in 2022 with ono being the largest component at 30% of the other PMUS and 3% of the total catch.

Effort. There were 147 active Hawaii-permitted deep-set longline vessels in 2022, the same as the previous year. The number of deep-set trips was 1,531 along with 21,299 sets made in 2022. The number of hooks set by the deep-set longline fishery was 63.3 million hooks in 2022. The Hawaii-permitted shallow-set longline fishery operates mainly in the first half of the year. In 2022, 22 vessels completed 69 trips and made 857 sets, which was 5 vessels, 12 trips and 154 more sets than the previous year. The number of hooks set by this fishery also rose to 1.1 million in 2022, an increase over the record low observed in 2019. The number of days fished by MHI troll fishers has been trending lower from its peak in 2013, with 1,166 fishers logging 15,420 days fished around the MHI in 2022. There were 427 MHI handline fishers that fished 3,726 days in 2022, a slight increase from the lowest number of fishers and an improvement from the record low days fished in 2020. The offshore handline fishery only had 6 fishers and 188 days fished in 2022.

CPUE. The deep-set longline fishery targets bigeye tuna and this species had higher nominal CPUE (2.7 fish per 1,000 hooks) compared to yellowfin tuna (1.3) but bigeye tuna has been on a downward trend from 2015 while yellowfin tuna CPUE has been higher than average for the past 6 years. Albacore CPUE was much lower at 0.2 in 2022. Blue marlin and striped marlin were incidental catches by the deep-set fishery were both at or at 0.3 fish per 1,000 hooks over the ten-year period. In contrast blue shark bycatch species with all fish logged as released yet its CPUE is third only to bigeye and yellowfin at 1.5 fish per 1,000 hooks. The Hawaii-permitted shallow-set longline fishery targets swordfish and had a CPUE of 8.9 fish, in 2022, up from a record low of 7.1 fish in 2021. Blue shark, a bycatch species for this fishery too, had a CPUE of 5.9 fish, same as the previous year. The MHI troll fishery CPUE for yellowfin tuna and blue marlin were both on a gradual upward trend. MHI troll CPUE for skipjack tuna, mahimahi and ono CPUE varied with no clear trend. MHI handline CPUE for yellowfin showed a strong, consistent upward pattern from 2019. Albacore and bigeye tuna CPUE were not only much lower than yellowfin tuna but below their respective long-term CPUEs. Bigeye tuna CPUE for the offshore handline fishery reached a record CPUE in 2022. Yellowfin tuna CPUE in this fishery was often a magnitude lower and variable over the past ten years.

Fish Size. With the exception of bigeye tuna, ono and moonfish the average weight for the remaining pelagic species were below their respective long-term average weight in the deep-set longline fishery. Bigeye tuna caught in the deep-set fishery was 83 pounds in 2022, 3 pounds above the long-term average. All billfish species caught by this fishery were below their 10-year average weight while other PMUS species were close to long-term mean weights. The mean size of swordfish was 130 pounds in 2022, much lower from the 10-year average weight. The pattern of average weight for tunas, billfish and other PMUS in by the shallow-set longline fishery was similar to fish size in the deep-set longline fishery. Swordfish caught by the shallow-set longline fishery was 169 pounds, below the 10-year average weight. In general, the average weight of most fish caught by the shallow-set longline fishery is higher than fish caught by the deep-set longline fishery. In general, the average weight for fish caught by the troll and handline fisheries was above their long-term averages. However, the average weight of blue marlin, swordfish and mahimahi were lower in 2022.

Revenue. The total revenue from Hawai'i's pelagic fisheries was $129.8 million in 2022. This was a decrease of 2% from the previous year. The strong revenue in 2022 is again attributed to the continued recovery from the COVID pandemic. Bigeye tuna and yellowfin tuna represented 57% and 22% of the total pelagic revenue, respectively in 2022. The deep-set longline revenue was $106.4 million in 2022. This fishery represented 82% of the total revenue for pelagic fish in Hawai'i. The shallow-set longline fishery almost doubled to $9.7 million and accounted for 7% of the revenue in 2022. Most of the increase in shallow-set revenue is from more vessels landing in Hawaii instead of off-loading in California. The MHI troll revenue was $7.0 million or 5% of the total in 2022. The MHI handline fishery increased to $4.1 million (3%). The offshore handline fishery was $1.5 million in 2022 and exhibited the largest increase of the small boat fisheries.

Bycatch. A total of 104,013 fish were released by the deep-set longline fishery in 2022. PMUS sharks accounted for 86% of the deep-set longline bycatch. There is almost no market demand for sharks in Hawai'i. Of all shark species combined, 99.9% of the deep-set longline shark catch was released. Conversely, bycatch rate for the deep-set longline fishery was only 4% for targeted and incidentally caught pelagic species in 2022. A total of 7,554 fish were released by the shallow-set longline fishery in 2022. PMUS sharks accounted for 95% of the shallow-set longline bycatch. Of all shark species combined, 99.9% of the shallow-set longline shark catch was released. Conversely, bycatch rate for the shallow-set longline fishery was 3% for targeted and incidentally caught pelagic species in 2022. Since shallow-set longline trips are often longer than deep-set trips, the shallow-set sector conserves space for swordfish, which they target, and foregoes keeping other pelagic species due to their short shelf life.

2.4.3 PLAN TEAM RECOMMENDATIONS

While there were no recommendations by the Pelagic Plan Team specific to the Hawaii module of the annual SAFE report, there were several relevant work items:

- Hawaii DAR to work with the PIFSC Fisheries Research and Monitoring Division (FRMD) to assume responsibility for Hawaii pelagic small boat fishery data summaries presented in the annual SAFE report and at the Pelagic Plan Team meeting.
- PIFSC FRMD to work with Hawaii DAR on data issues regarding inconsistencies between catch reports and dealer reports to ensure that these deficiencies do not perpetuate further errors downstream.
- Council staff to work with the established Plan Team working group to incorporate the new bycatch summaries for Hawaii's pelagic small boat fisheries into the annual SAFE report.

2.4.4 OVERVIEW OF PARTICIPATION – ALL FISHERIES

Table 21. Number of HDAR Commercial Marine Licenses

	Number of licenses	
Primary Fishing Method	**2021**	**2022**
Trolling	607	574
Longline	928	957
Ika Shibi & Palu Ahi	329	334
Aku Boat (Pole and Line)	7	8
Total Pelagic	1,871	1,873
Total All Methods	3,265	3,201

2.4.5 OVERVIEW OF LANDINGS AND ECONOMIC DATA

Table 22. Hawaii commercial pelagic catch, revenue, and price by species

	2021			2022		
Species	**Catch (1,000 lbs)**	**Ex-vessel revenue ($1,000)**	**Average price ($/lb)**	**Catch (1,000 lbs)**	**Ex-vessel revenue ($1,000)**	**Average price ($/lb)**
Tuna PMUS						
Albacore	534	$664	$1.71	457	$650	$2.07
Bigeye tuna	16,129	$79,365	$5.23	14,688	$73,645	$5.09
Bluefin tuna	2	$22	$6.56	3	$36	$7.51
Skipjack tuna	494	$596	$2.12	460	$861	$2.85
Yellowfin tuna	6,970	$29,132	$4.38	7,124	$28,197	$4.24
Other tunas	5	$36	$4.43	3	$5	$3.70
Tuna PMUS subtotal	**24,134**	**$109,814**	**$4.88**	**22,736**	**$103,394**	**$4.76**
Billfish PMUS						
Swordfish	1,517	$6,282	$4.26	2,048	$10,337	$4.87
Blue marlin	1,101	$2,356	$2.64	1,239	$2,356	$2.70
Spearfish (hebi)	304	$588	$1.85	296	$638	$2.15
Striped marlin	571	$1,799	$2.70	645	$2,313	$2.86
Other marlins	35	$80	$2.65	27	$76	$2.35
Billfish PMUS subtotal	**3,528**	**$11,105**	**$3.28**	**4,255**	**$15,720**	**$3.80**
Other PMUS						
Mahimahi	750	$3,438	$4.73	775	$3,164	$4.28
Ono (wahoo)	1,174	$4,262	$3.73	667	$3,135	$4.69
Opah (moonfish)	845	$1,913	$4.18	526	$1,683	$5.18
Oilfish	162	$186	$1.17	164	$200	$1.14
Pomfrets (monchong)	409	$2,356	$5.22	429	$2,542	$5.40
PMUS Sharks	17	$0	$0.00	10	$0	$0.00
Other PMUS subtotal	**3,357**	**$12,156**	**$4.14**	**2,572**	**$10,723**	**$4.51**
Other pelagics	**6**	**$8**	**$1.72**	**4**	**$5**	**$1.44**
Total pelagics	**31,025**	**$133,084**	**$4.62**	**29,566**	**$129,842**	**$4.60**

Table 23. Hawaii commercial pelagic catch, revenue, and price by fishery

Fishery	2021 Catch (1,000 lbs)	2021 Ex-vessel revenue ($1,000)	2021 Average price ($/lb)	2022 Catch (1,000 lbs)	2022 Ex-vessel revenue ($1,000)	2022 Average price ($/lb)
Deep-set longline	26,808	$116,306	$4.68	24,229	$106,362	$4.66
Shallow-set longline	1,264	$5,120	$4.16	1,873	$9,679	$4.75
MHI trolling	1,829	$7,055	$4.51	1,762	$7,040	$4.46
MHI handline	685	$3,017	$4.48	940	$4,109	$4.43
Offshore handline	257	$887	$2.99	454	$1,494	$2.86
Other gear	180	$700	$3.66	309	$1,157	$3.48
Total	**31,025**	**$133,084**	**$4.62**	**29,566**	**$129,842**	**$4.60**

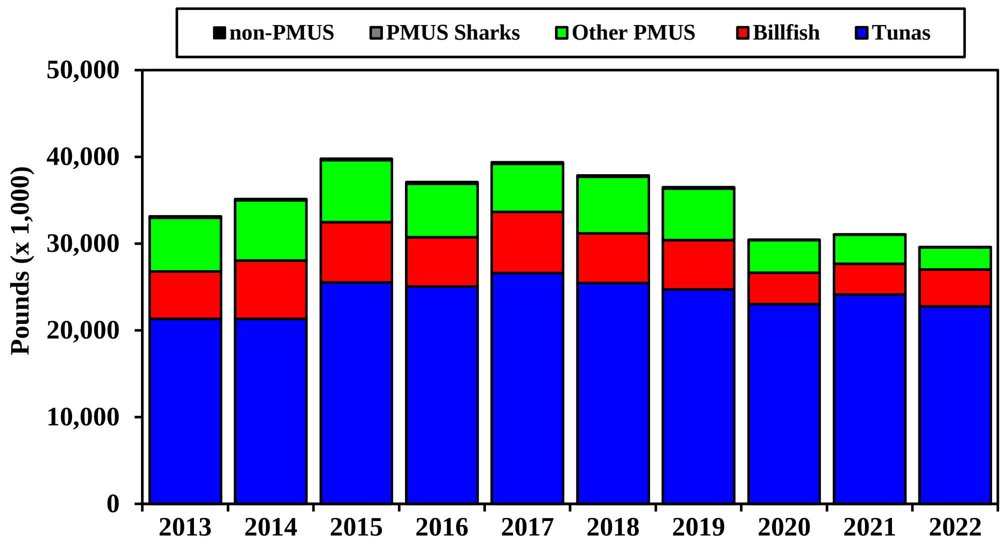


Figure 67. Hawaii commercial tuna, billfish, other PMUS and PMUS shark catch
Supporting data shown in Table A-68.

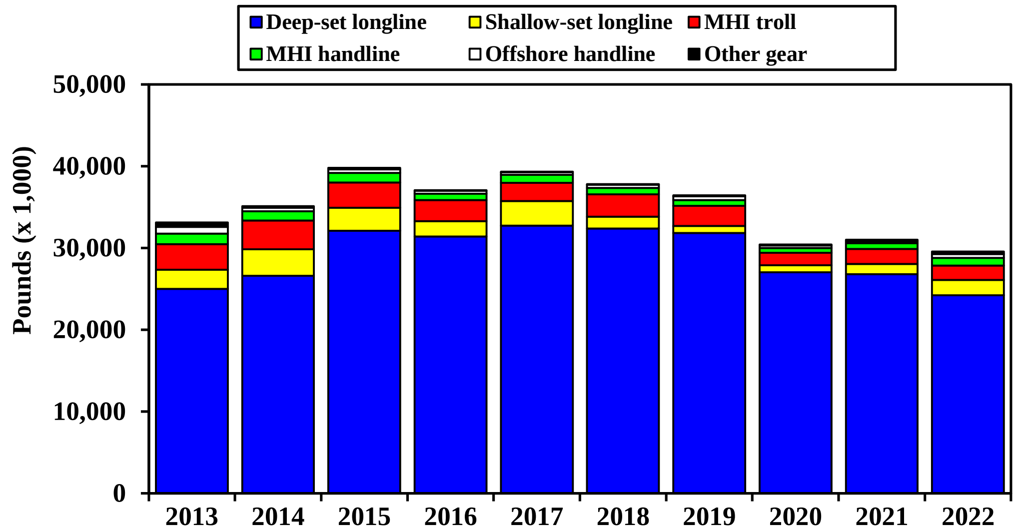


Figure 68. Total commercial pelagic catch by gear type

Supporting data shown in Table A-69.

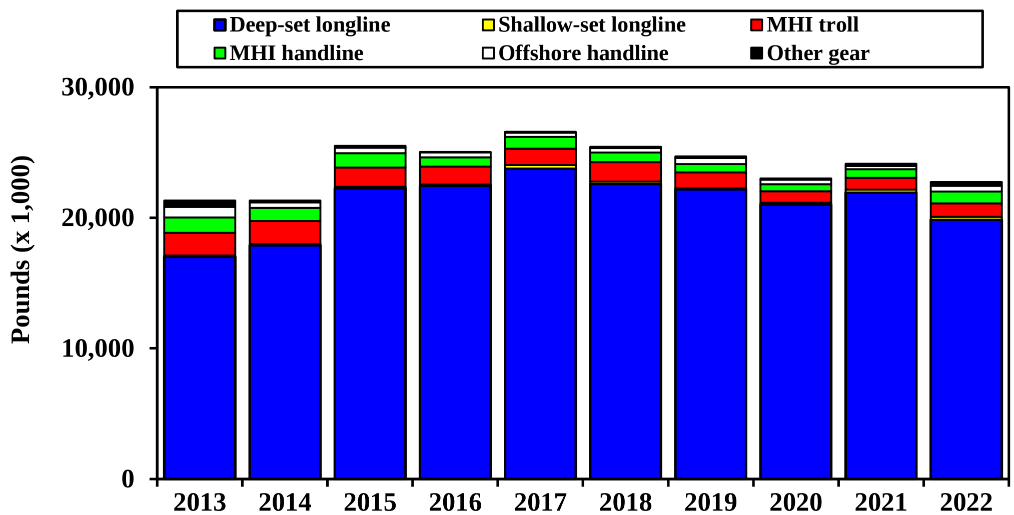


Figure 69. Hawaii commercial tuna catch by gear type

Supporting data shown in Table A-70.

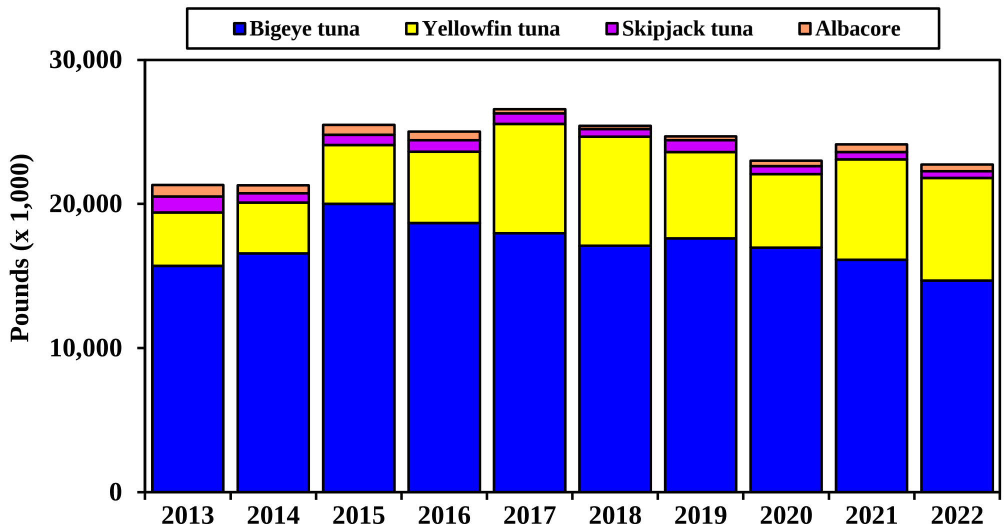


Figure 70. Species composition of tuna catch

Supporting data shown in Table A-71.

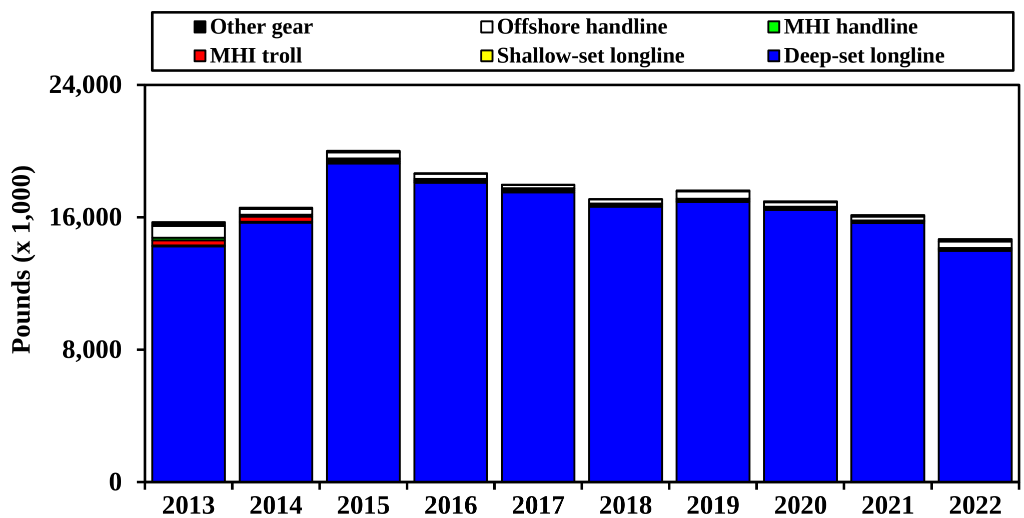


Figure 71. Hawaii bigeye tuna catch by gear type

Supporting data shown in Table A-72.

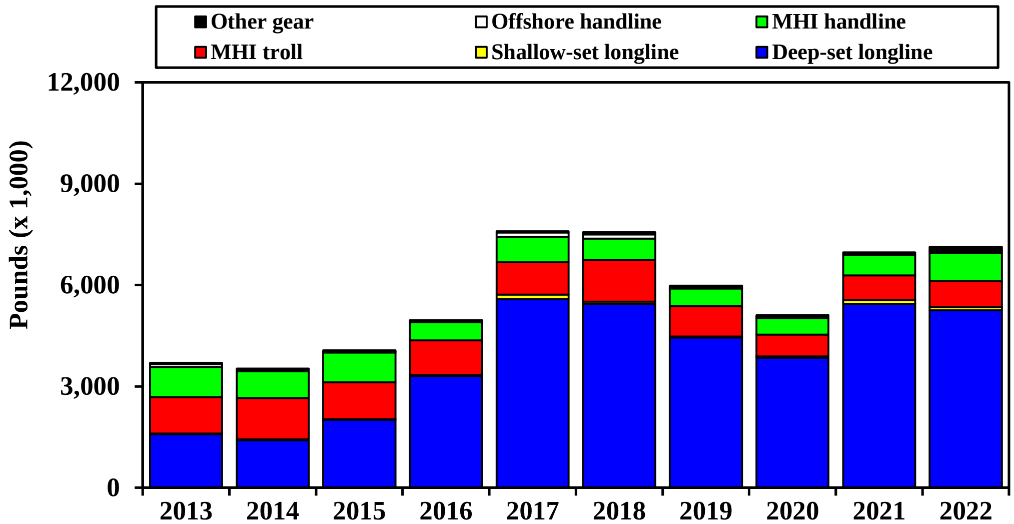


Figure 72. Hawaii yellowfin tuna catch by gear type

Supporting data shown in Table A-73.

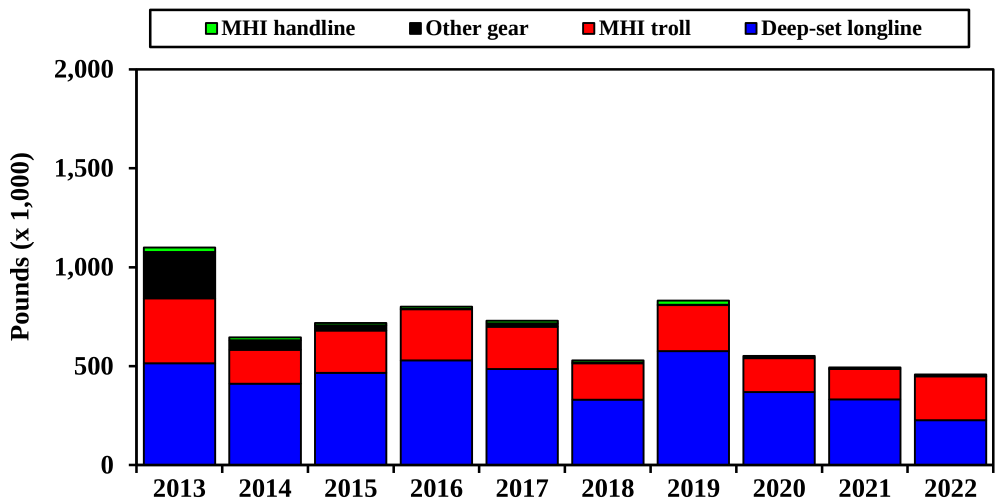


Figure 73. Hawaii skipjack tuna catch by gear type

Supporting data shown in Table A-74.

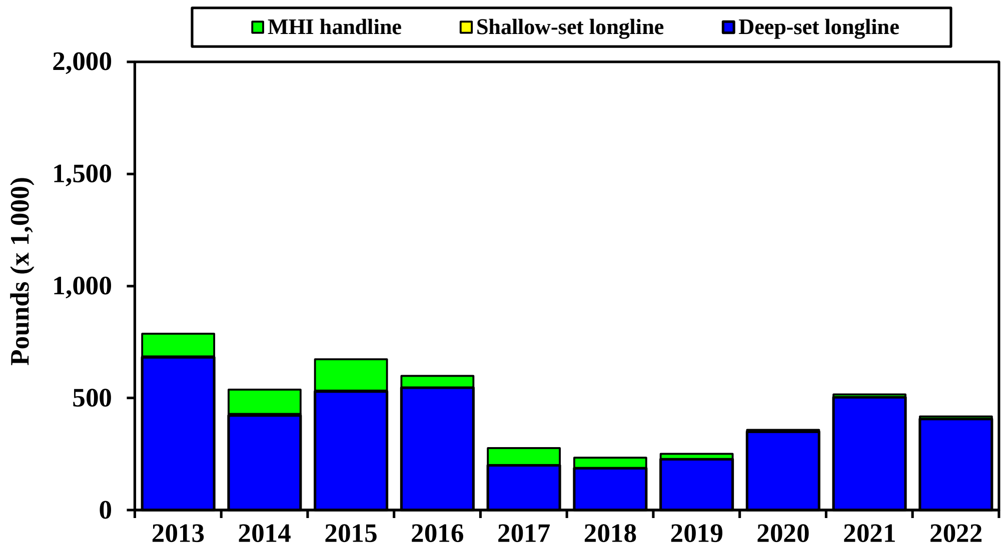


Figure 74. Hawaii albacore catch by gear type

Supporting data shown in Table A-75.

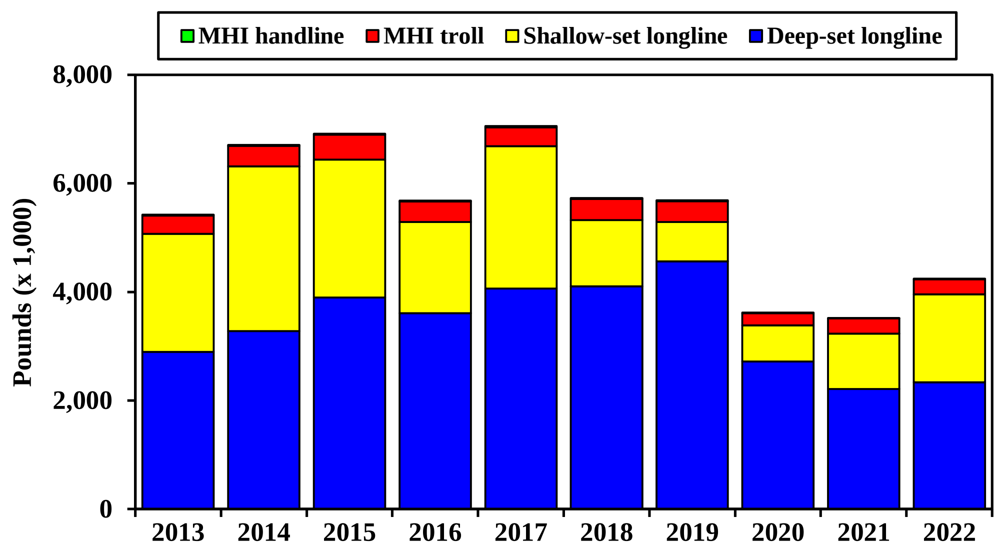


Figure 75. Hawaii commercial billfish catch by gear type

Supporting data shown in Table A-76.

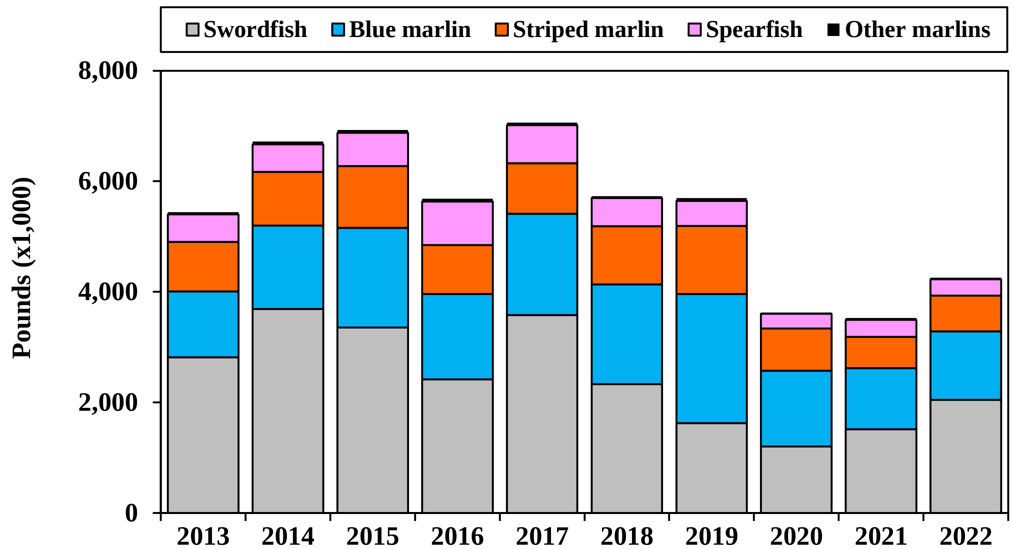


Figure 76. Species composition of billfish catch

Supporting data shown in Table A-77.

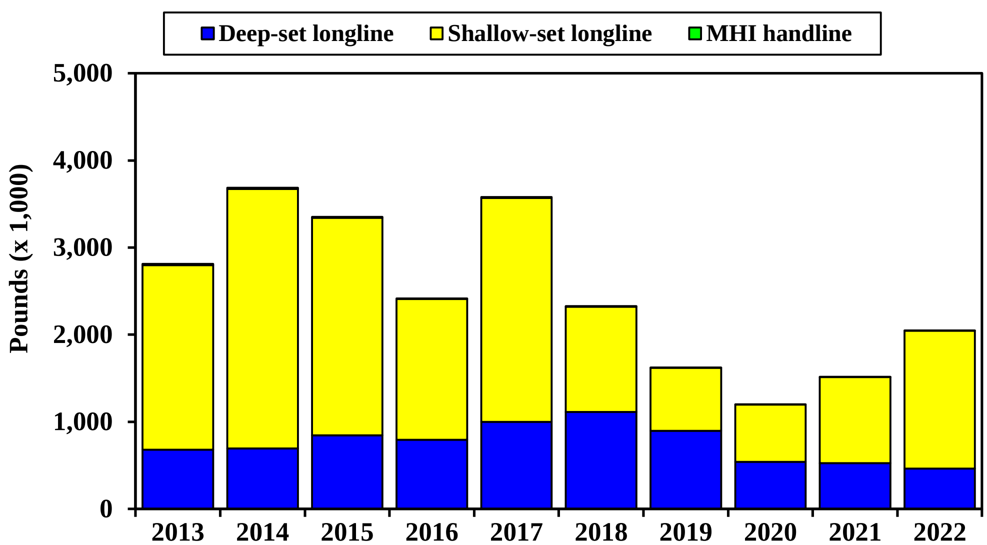


Figure 77. Hawaii swordfish catch by gear type

Supporting data shown in Table A-78.

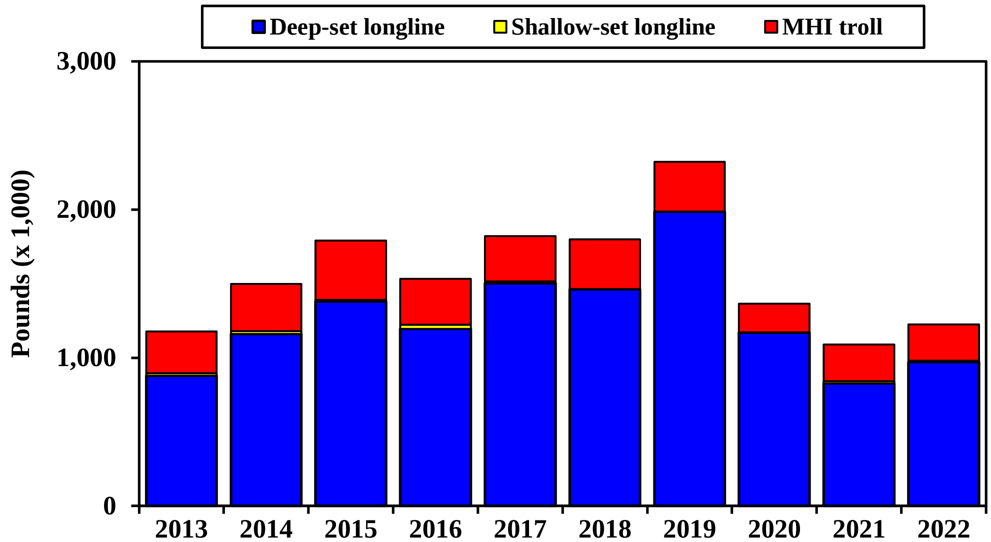


Figure 78. Hawaii blue marlin catch by gear type

Supporting data shown in Table A-79.

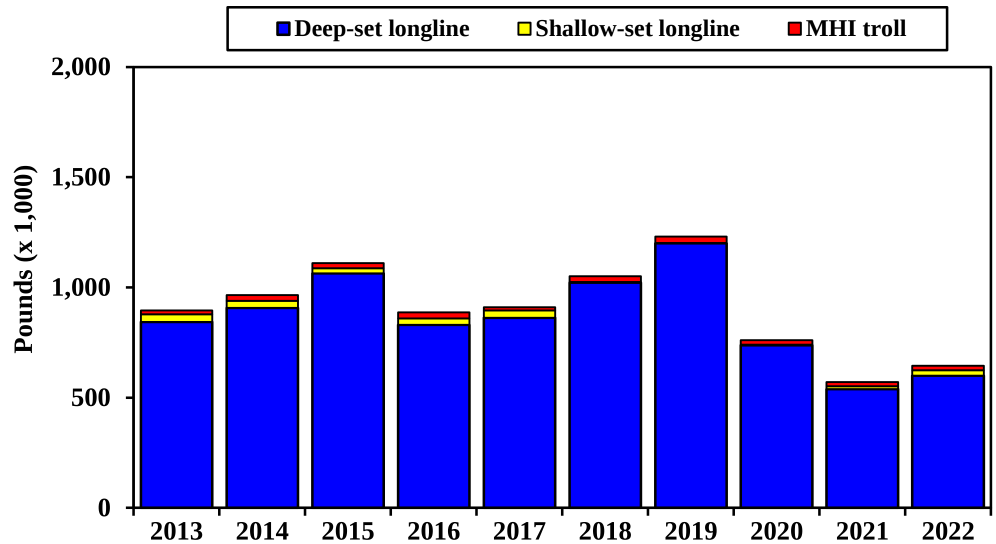


Figure 79. Hawaii striped marlin catch by gear type

Supporting data shown in Table A-80.

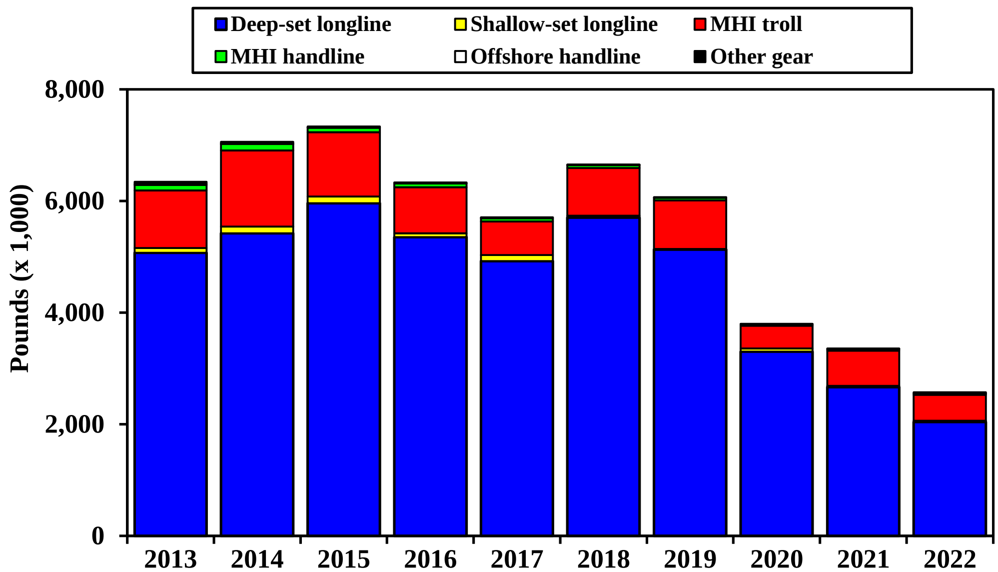


Figure 80. Hawaii commercial catch of other PMUS by gear type

Supporting data shown in Table A-81.

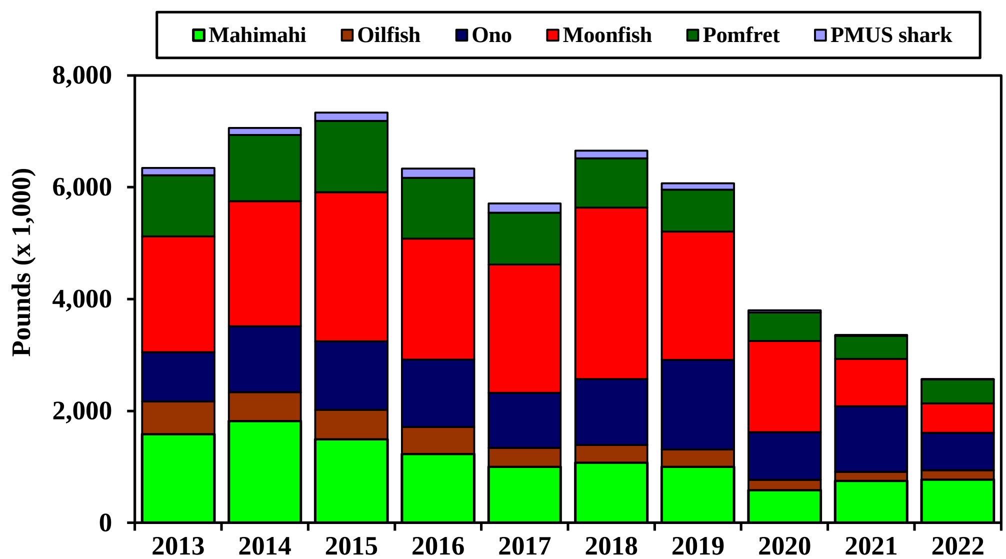


Figure 81. Species composition of other PMUS catch

Supporting data shown in Table A-82.

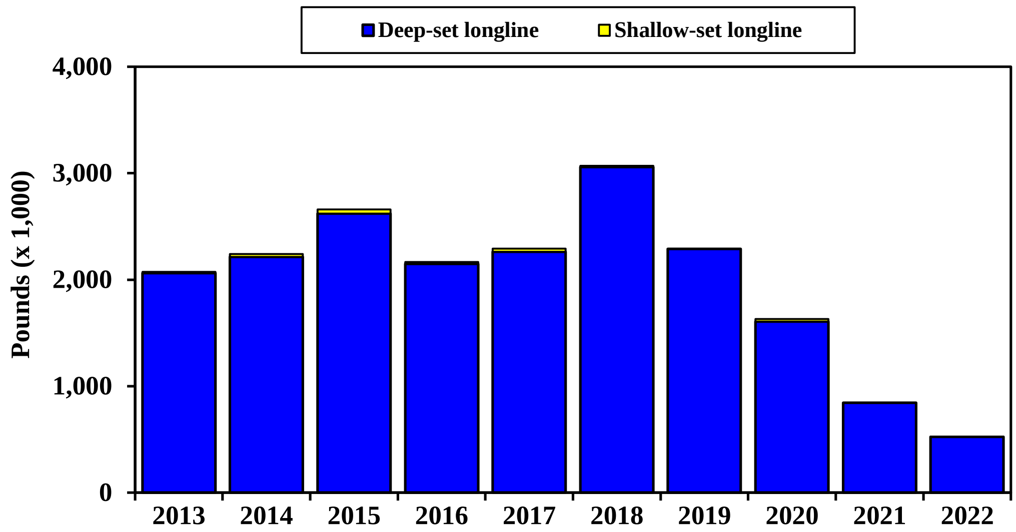


Figure 82. Hawaii moonfish catch by gear type

Supporting data shown in Table A-83.

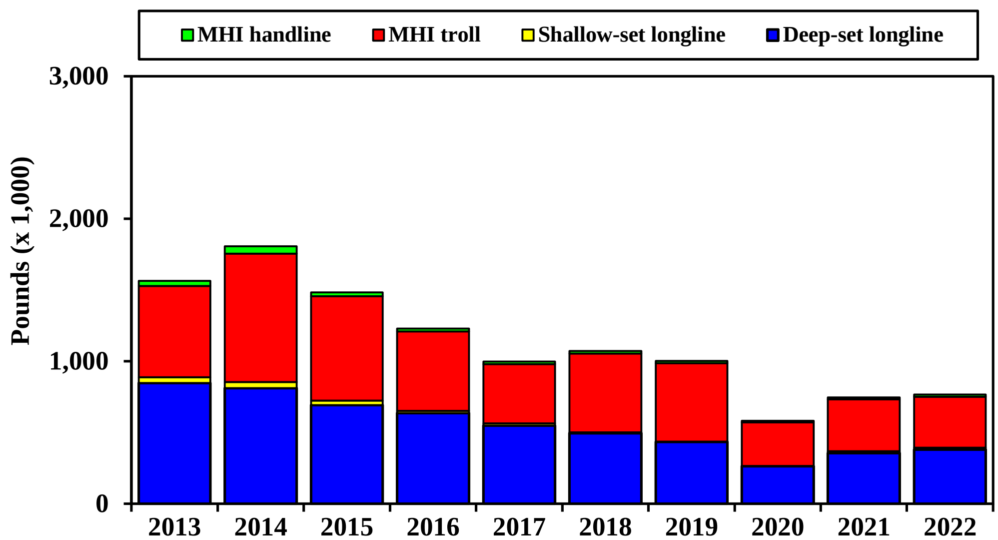


Figure 83. Hawaii mahimahi catch by gear type

Supporting data shown in Table A-84.

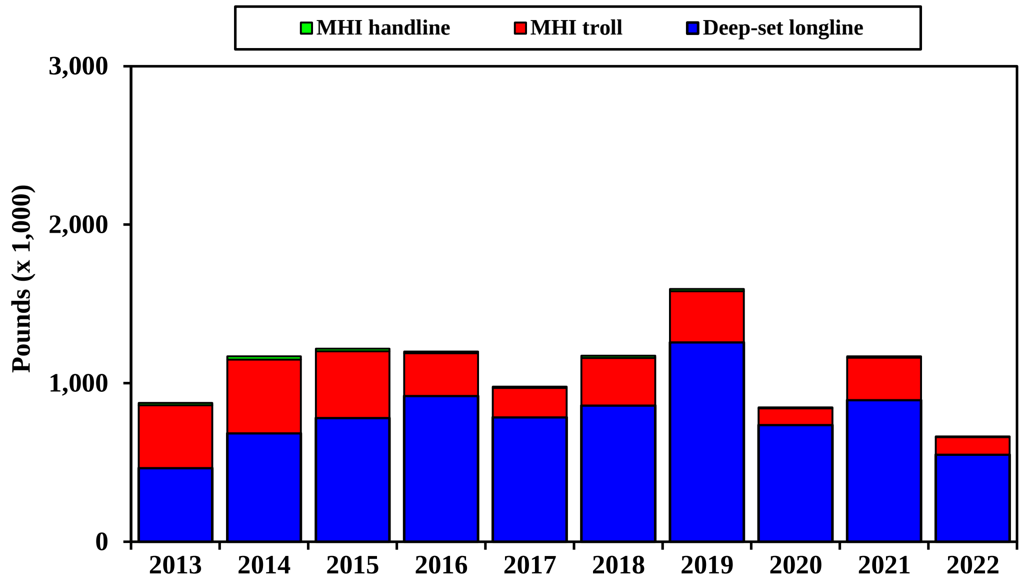


Figure 84. Hawaii ono (wahoo) catch by gear type

Supporting data shown in Table A-85.

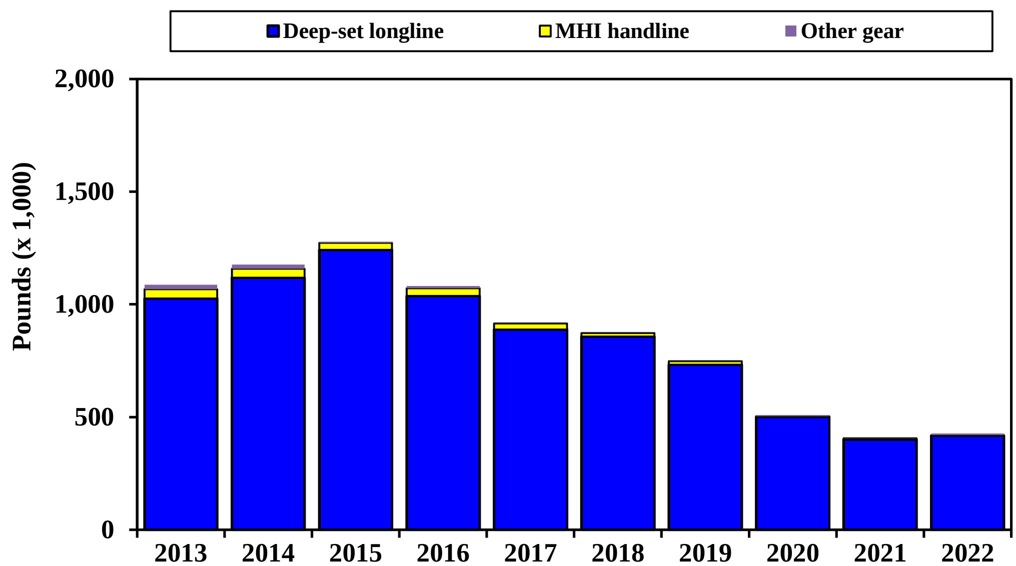


Figure 85. Hawaii pomfret catch by gear type

Supporting data shown in Table A-86.

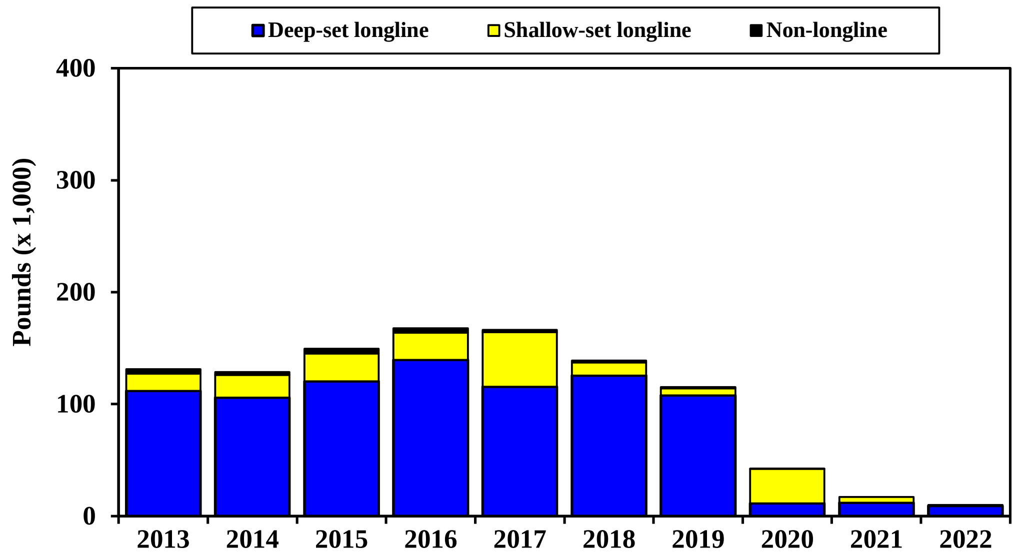


Figure 86. Hawaii PMUS shark catch by gear type

Supporting data shown in Table A-87.

2.4.6 HAWAII DEEP-SET LONGLINE FISHERY EFFORT, LANDINGS. REVENUE, AND CPUE

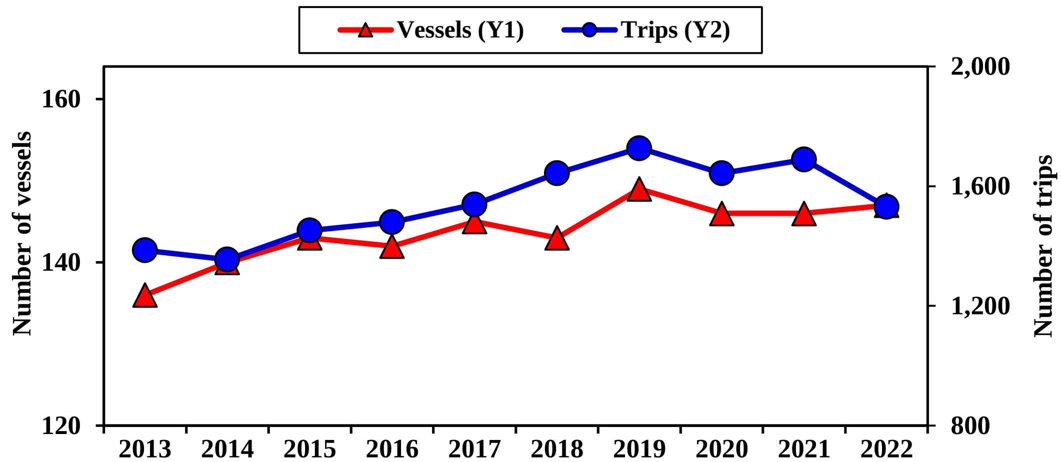


Figure 87. Number of Hawaii-permitted deep-set longline vessels and trips
Supporting data shown in Table A-88.

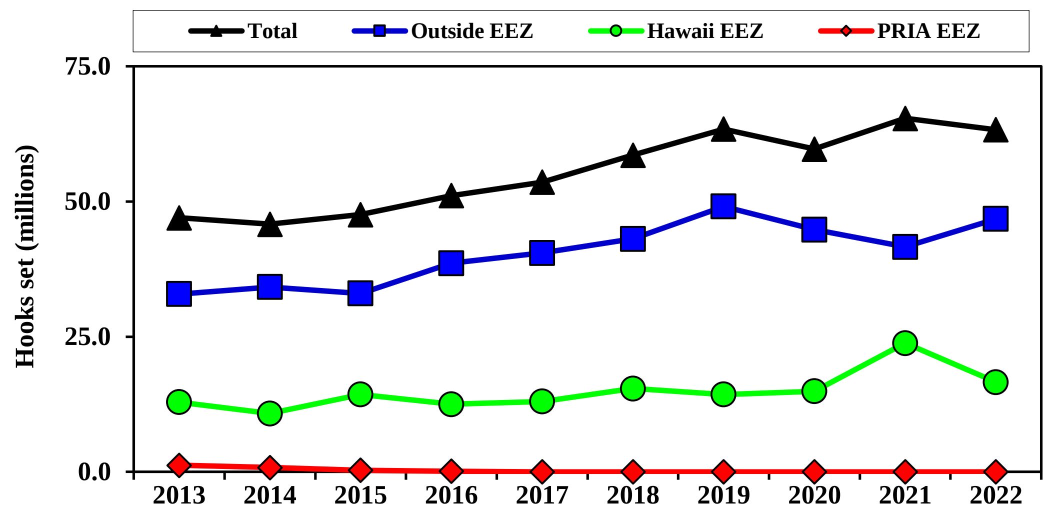


Figure 88. Number of hooks set by the Hawaii-permitted deep-set longline fishery
Supporting data shown in Table A-89.

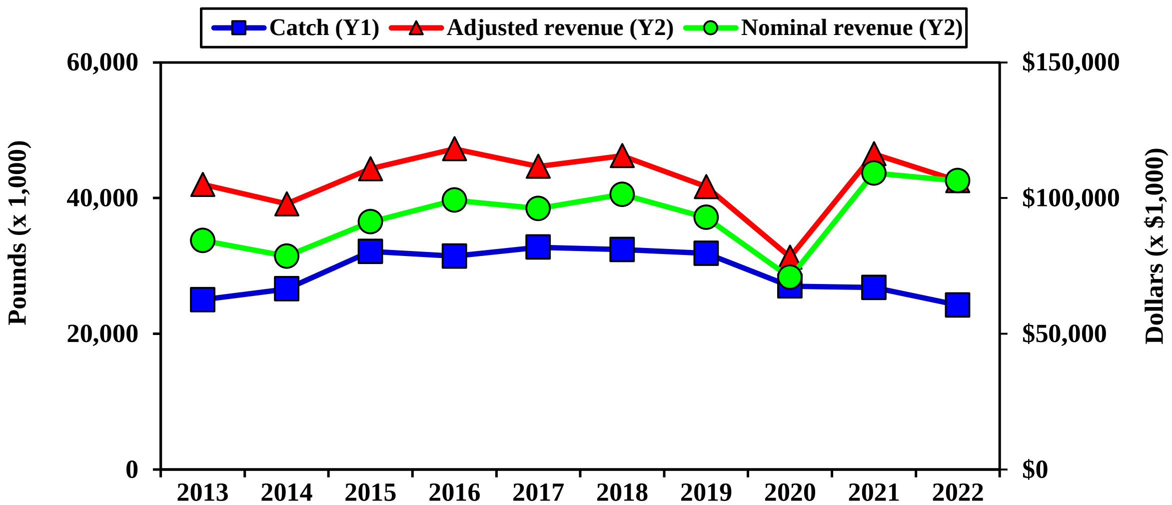


Figure 89. Catch and revenue for the Hawaii-permitted deep-set longline fishery

Supporting data shown in Table A-90.

Table 24. Hawaii-permitted deep-set longline catch (number of fish) by area

Year	Tunas			Billfish				Other PMUS				PMUS sharks
	Bigeye tuna	Yellowfin tuna	Albacore	Swordfish	Blue marlin	Striped marlin	Spearfish	Mahimahi	Ono (Wahoo)	Moonfish	Pomfrets	
Hawaii+PRIAs EEZ												
2013	49,139	7,702	3,461	922	1,177	5,644	5,439	16,726	2,912	2,963	11,051	20,770
2014	43,441	5,199	1,764	866	1,036	5,020	4,248	8,899	4,090	2,172	10,921	20,533
2015	60,987	11,842	3,089	1,324	2,561	5,945	7,087	15,360	6,388	2,754	21,960	25,395
2016	44,704	13,438	1,656	1,233	1,773	3,881	7,189	9,092	5,722	2,323	15,746	23,520
2017	52,275	24,333	277	822	2,296	4,311	5,507	8,843	5,126	1,794	12,699	27,666
2018	46,397	19,626	292	1,619	2,916	5,387	5,034	10,219	7,205	2,637	13,077	26,592
2019	39,571	12,176	167	1,126	3,859	5,735	3,747	6,073	8,203	2,142	13,209	30,233
2020	41,830	13,801	75	761	2,387	3,178	2,603	4,691	5,243	1,234	9,548	30,443
2021	58,682	26,606	516	1,267	2,522	4,087	5,066	6,449	11,004	777	9,486	37,446
2022	35,328	20,446	650	761	1,725	3,284	3,472	5,751	3,783	478	6,006	22,328
Outside EEZ												
2013	140,016	10,590	9,836	3,230	2,563	6,715	8,954	59,109	10,654	20,386	64,966	34,093
2014	170,261	11,406	6,756	3,604	4,475	9,558	11,348	61,365	18,296	23,564	69,311	51,058
2015	167,550	15,745	7,072	4,048	4,868	7,155	10,707	44,946	18,337	26,593	75,363	59,757
2016	175,867	32,820	8,197	3,870	4,444	7,700	16,828	39,397	24,440	22,029	65,864	65,377
2017	172,039	55,283	3,831	4,751	5,720	8,705	15,161	37,297	20,279	22,999	55,005	71,282
2018	172,662	42,106	3,363	4,492	4,642	10,340	10,443	33,912	24,090	30,548	42,870	76,087
2019	181,754	49,999	4,177	3,775	9,066	14,734	12,548	31,700	36,311	22,844	39,891	95,520
2020	165,302	40,594	8,461	3,102	5,790	9,600	7,372	17,258	19,118	15,372	26,529	87,844
2021	128,269	54,688	12,031	2,846	3,725	5,559	6,505	23,376	21,740	7,564	24,637	76,551
2022	136,096	63,519	10,888	2,865	5,384	7,848	7,559	29,990	13,717	4,476	25,675	66,728
All areas												
2013	193,603	19,234	14,733	4,264	3,941	12,530	14,875	76,801	14,349	23,465	78,485	56,827
2014	217,823	17,226	8,962	4,580	5,695	14,804	15,838	70,730	23,136	25,783	82,066	72,871
2015	229,943	27,684	10,207	5,397	7,515	13,121	17,853	60,380	24,899	29,349	97,455	86,116
2016	221,149	46,470	9,853	5,118	6,261	11,588	24,027	48,494	30,217	24,352	81,690	89,091
2017	224,391	79,620	4,108	5,576	8,018	13,019	20,668	46,146	25,426	24,794	67,736	98,986
2018	219,072	61,758	3,655	6,114	7,560	15,727	15,477	44,138	31,303	33,185	55,949	102,799
2019	221,344	62,177	4,344	4,901	12,926	20,469	16,296	37,779	44,546	24,986	53,102	125,811
2020	207,132	54,395	8,536	3,863	8,177	12,778	9,975	21,949	24,361	16,606	36,077	118,287
2021	186,963	81,301	12,547	4,113	6,247	9,646	11,573	29,825	32,750	8,341	34,125	114,058
2022	171,447	83,969	11,538	3,629	7,109	11,133	11,031	35,752	17,501	4,955	31,683	89,062

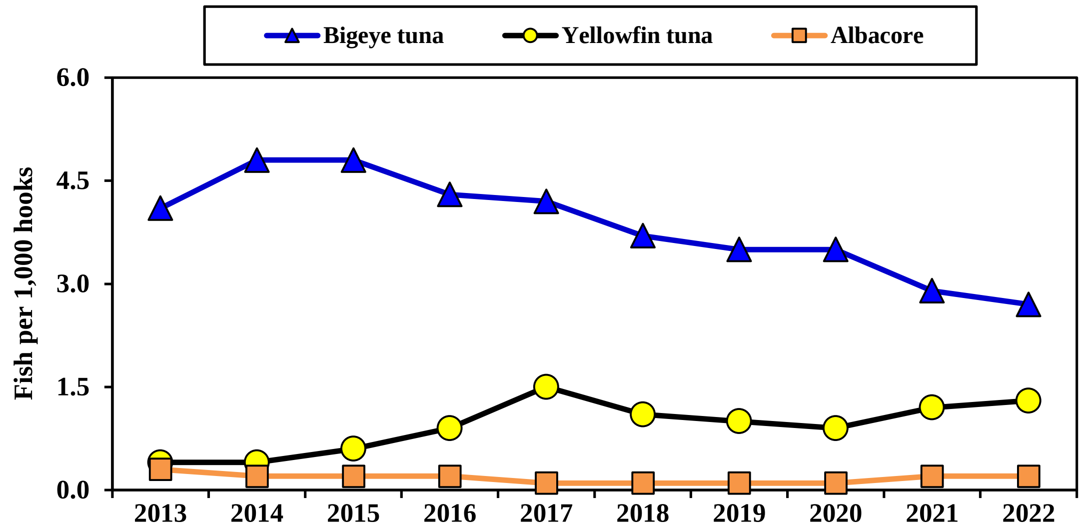


Figure 90. Tuna CPUE for the Hawaii-permitted deep-set longline fishery
Supporting data shown in Table A-91.

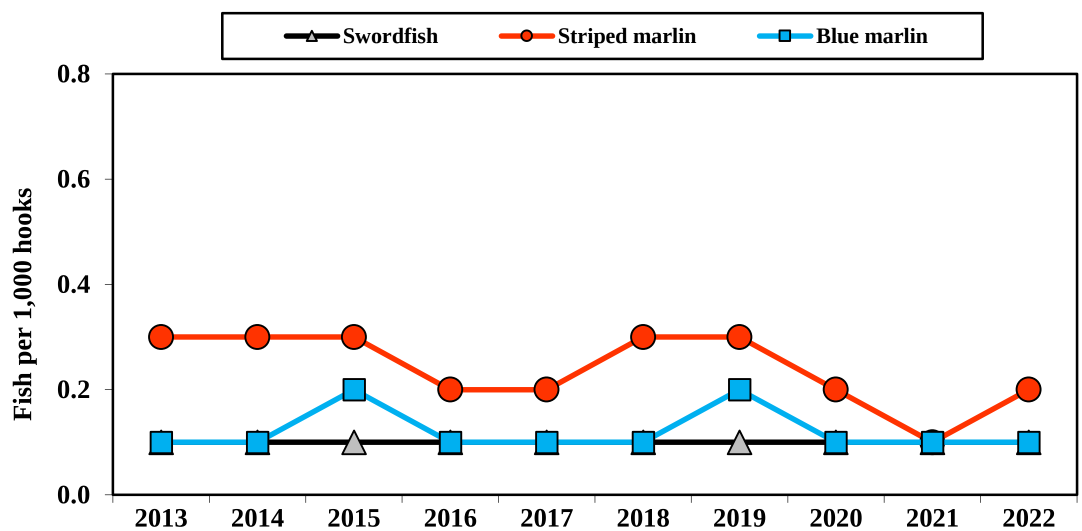


Figure 91. Billfish CPUE for the Hawaii-permitted deep-set longline fishery
Supporting data shown in Table A-92.

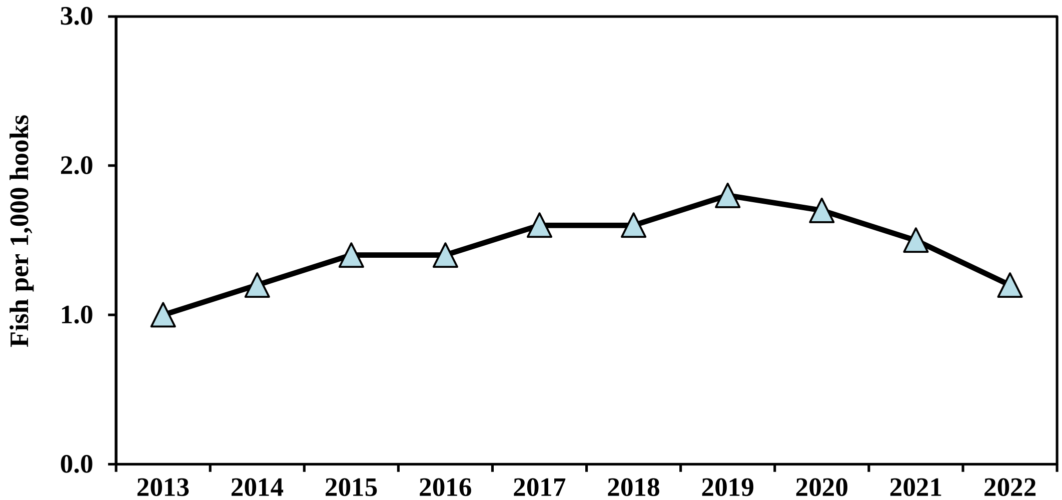


Figure 92. Blue shark CPUE for the Hawaii-permitted deep-set longline fishery

Supporting data shown in Table A-93.

Table 25. Total estimated bycatch in number of fish for the top 10 bycatch species from the Pacific Islands Region Observer Program for the Hawaii deep-set longline fishery. The top 10 species comprised 92.3% of total bycatch in 2021.

Species	2016	2017	2018	2019	2020	2021	Average	SD
Lancetfish, Longnose	229,791	230,048	309,551	275,802	288,339	217,244	258,462.5	37,766.9
Shark, Blue	102,250	123,166	119,306	134,067	139,284	124,209	123,713.7	12,886.3
Snake Mackerel	110,655	120,432	79,308	49,481	43,862	67,877	78,602.5	31,456.5
Escolar	37,860	35,052	44,873	47,973	50,556	53,089	44,900.5	7,142.0
Shark, Bigeye Thresher	11,639	9,551	6,519	10,399	9,754	13,313	10,195.8	2,279.1
Tuna, Bigeye	20,723	20,800	24,053	19,481	20,596	12,360	19,668.8	3,896.8
Tuna, Yellowfin	5,615	9,455	5,201	7,434	6,138	10,804	7,441.2	2,254.6
Pomfret, Dagger	6,464	7,443	8,188	8,929	5,667	9,450	7,690.2	1,451.7
Stingray, Pelagic	6,958	6,608	7,234	10,949	9,357	8,526	8,272.0	1,672.2
Tuna, Unidentified	5,731	6,337	5,164	6,855	4,097	5,052	5,539.3	986.2

Table 26. Released catch, retained catch, and total catch for the Hawaii-permitted deep-set longline fishery in 2022

	Deep-set longline fishery			
	Released catch	**Percent released**	**Retained catch**	**Total Catch**
Tuna				
Albacore	647	5.6	10,891	11,538
Bigeye tuna	2,563	1.5	168,884	171,447
Bluefin tuna	1	9.1	10	11
Skipjack tuna	160	1.3	12,426	12,586
Yellowfin tuna	1,842	2.2	82,127	83,969
Other tunas	0	-	0	0
Tuna PMUS Subtotal	**5,213**	**1.9**	**274,338**	**279,551**
Billfish				
Swordfish	73	2.0	3,556	3,629
Blue marlin	41	0.6	7,068	7,109
Striped marlin	157	1.4	10,976	11,133
Shortbill spearfish	243	2.2	10,788	11,031
Other billfishes	9	2.0	444	453
Billfish PMUS Subtotal	523	1.6	32,832	33,355
Other PMUS				
Mahimahi	558	1.6	35,194	35,752
Wahoo	95	0.5	17,406	17,501
Moonfish	4	0.1	4,951	4,955
Oilfish	1,827	18.9	7,837	9,664
Pomfret	405	1.3	31,278	31,683
Other PMUS Subtotal	**2,889**	**2.9**	**96,666**	**99,555**
Non-PMUS fish	**6,130**	**97.6**	**151**	**6,281**
Total non-shark	**14,755**	**3.5**	**403,987**	**418,742**
PMUS Sharks				
Blue shark	78,643	100.0	0	78,643
Mako sharks	1,568	98.8	19	1,587
Thresher sharks	8,184	99.6	31	8,215
Oceanic whitetip shark	384	100.0	0	384
Silky shark	233	100.0	0	233
Shark PMUS Subtotal	**89,012**	**99.9**	**50**	**89,062**
Non-PMUS sharks	**246**	**99.6**	**1**	**247**
Grand Total	**104,013**	**20.5**	**404,038**	**508,051**

Table 27. Average weight (lb) of the catch by the Hawaii-permitted deep-set longline fishery

Hawaii-permitted deep-set longline fishery																		
	Tunas					Billfish						Other PMUS					Sharks	
YEAR	Bigeye tuna	Yellowfin tuna	Albacore	Skipjack tuna	Bluefin Tuna	Swordfish	Striped marlin	Blue marlin	Spearfish	Sailfish	Black marlin	Mahimahi	Ono (Wahoo)	Moonfish	Pomfrets	Oilfish	Mako shark	Thresher shark
2013	75	84	47	16	240	184	68	225	31	62	180	11	33	89	13	18	196	173
2014	73	84	50	17	-	158	62	205	30	58	258	12	30	89	14	17	201	214
2015	85	74	52	18	240	165	81	185	33	59	219	12	31	91	13	18	195	219
2016	83	73	55	17	254	165	73	196	31	51	242	13	31	88	13	19	179	183
2017	79	72	49	19	254	190	67	188	32	63	286	12	31	92	13	20	181	200
2018	78	89	52	19	277	189	66	197	32	64	185	11	28	93	15	22	182	184
2019	78	74	53	18	269	189	60	156	28	29	182	12	28	92	14	22	190	190
2020	81	71	41	18	246	145	58	144	26	36	247	12	30	99	14	23	184	183
2021	84	69	39	19	233	129	56	134	26	42	149	12	27	102	12	21	184	183
2022	83	64	37	18	245	130	55	137	26	46	133	11	32	106	13	20	184	183
Average	**79.9**	**75.4**	**47.5**	**17.9**	**250.9**	**164.4**	**64.6**	**176.7**	**29.5**	**51.0**	**208.1**	**11.8**	**30.1**	**94.1**	**13.4**	**20.0**	**187.6**	**191.2**
SD	**4.0**	**7.8**	**6.3**	**1.0**	**14.3**	**23.8**	**8.1**	**31.6**	**2.8**	**12.3**	**50.0**	**0.6**	**1.9**	**6.1**	**0.8**	**2.0**	**7.4**	**15.0**

2.4.7 HAWAII SHALLOW-SET LONGLINE FISHERY EFFORT, LANDINGS. REVENUE, AND CPUE

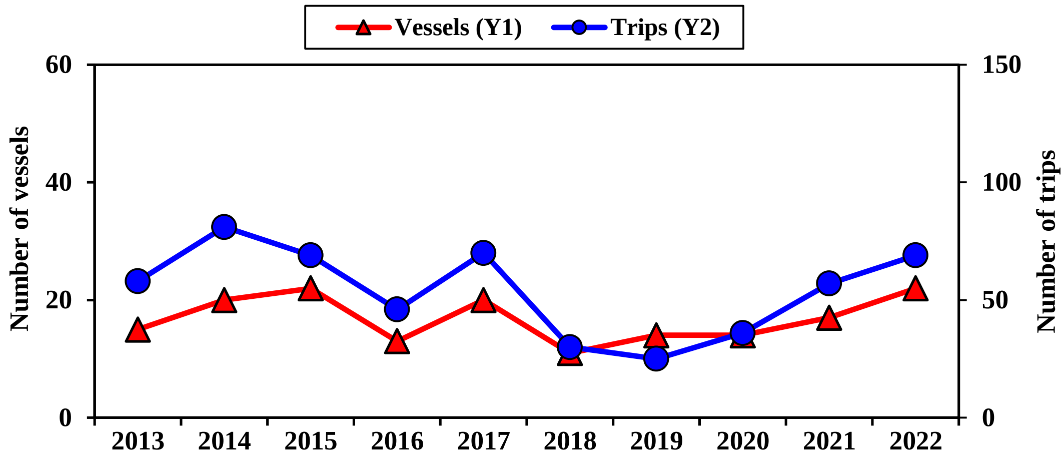


Figure 93. Number of Hawaii-permitted shallow-set longline vessels and trips
Supporting data shown in Table A-94.

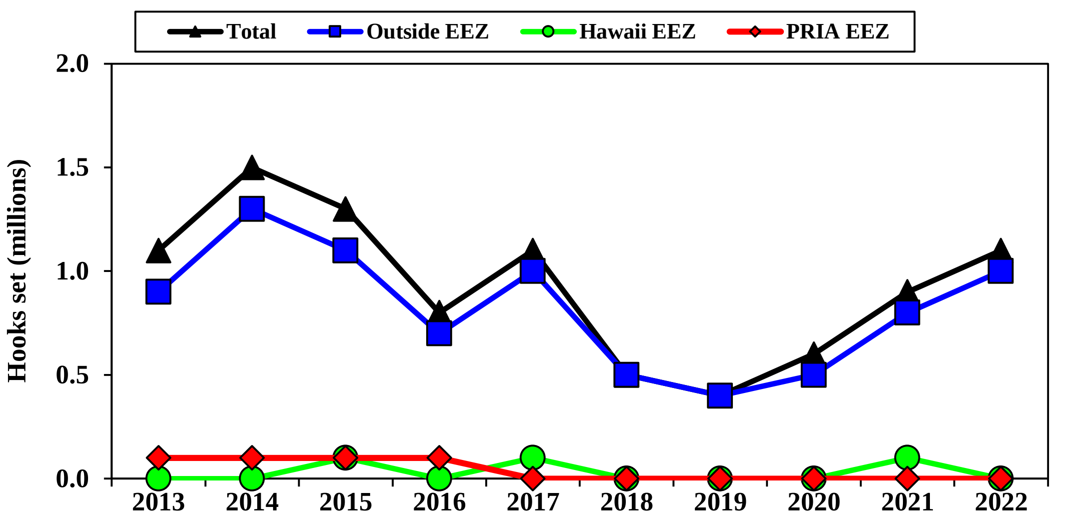


Figure 94. Number of hooks set by the Hawaii-permitted shallow-set longline fishery
Supporting data shown in Table A-95.

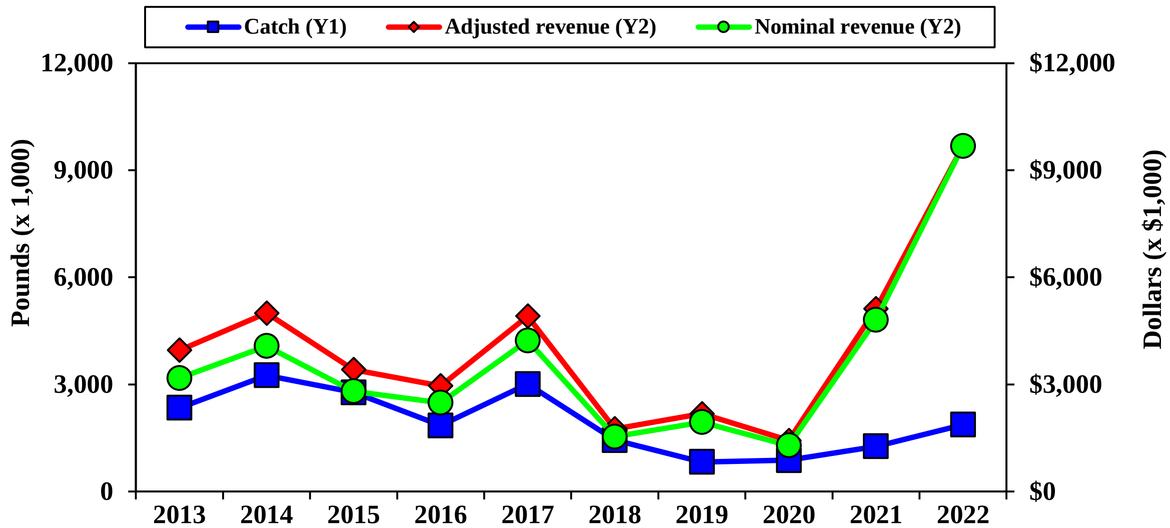


Figure 95. Catch and revenue for the Hawaii-permitted shallow-set longline fishery

Supporting data shown in Table A-96.

Table 28. Hawaii-permitted shallow-set longline catch (number of fish) by area

Year	Tunas			Billfish				Other PMUS				PMUS sharks
	Bigeye tuna	Yellowfin tuna	Albacore	Swordfish	Blue marlin	Striped marlin	Spearfish	Mahimahi	Ono (Wahoo)	Moonfish	Pomfrets	
Hawaii+PRIA EEZ												
2013	93	76	5	1,507	43	298	32	1,679	8	0	3	819
2014	27	57	1	1,689	54	137	37	968	19	0	4	1,280
2015	40	36	1	2,001	23	111	40	804	5	0	3	1,537
2016	20	47	5	1,157	68	104	45	69	19	0	2	1,142
2017	12	31	1	779	32	88	38	38	10	0	2	580
2018	12	11	0	58	1	1	0	12	1	0	0	22
2019												
2020												
2021	100	94	0	424	41	69	65	34	23	4	36	482
2022	7	51	0	185	13	33	10	13	3	1	0	247
Outside EEZ												
2013	359	126	556	9,222	20	92	84	1,995	22	241	129	5,442
2014	810	124	662	13,646	21	231	134	3,321	25	515	228	10,173
2015	1,305	103	305	12,988	26	155	66	1,822	11	645	121	12,489
2016	921	254	54	8,573	27	225	115	1,065	20	271	16	10,737
2017	1,518	1,522	286	13,141	26	323	122	1,263	64	431	37	10,268
2018	1,279	767	137	6,052	4	61	44	627	25	172	24	2,887
2019	874	331	81	3,435	0	12	18	247	3	31	5	3,195
2020	1,099	456	356	4,374	7	23	24	229	9	300	12	6,605
2021	873	1,067	626	6,074	50	123	38	1,218	38	20	1	5,733
2022	947	1,016	1,395	9,426	36	355	52	1,488	32	28	6	6,896
All areas												
2013	452	202	561	10,729	63	390	116	3,674	30	241	132	6,261
2014	837	181	664	15,449	75	368	171	4,289	44	535	233	11,632
2015	1,345	139	306	14,989	49	266	106	2,626	16	645	124	14,026
2016	941	301	59	9,730	95	329	160	1,134	39	271	18	11,879
2017	1,530	1,553	287	13,928	58	411	160	1,301	74	431	39	10,852
2018	1,291	778	137	6,110	5	62	44	639	26	172	24	2,909
2019	874	331	81	3,435	0	12	18	247	3	31	5	3,195
2020	1,114	497	356	4,594	23	30	26	241	12	302	12	7,012
2021	973	1,161	626	6,498	91	192	103	1,252	61	24	37	6,215
2022	954	1,067	1,395	9,611	49	388	62	1,501	35	29	6	7,143

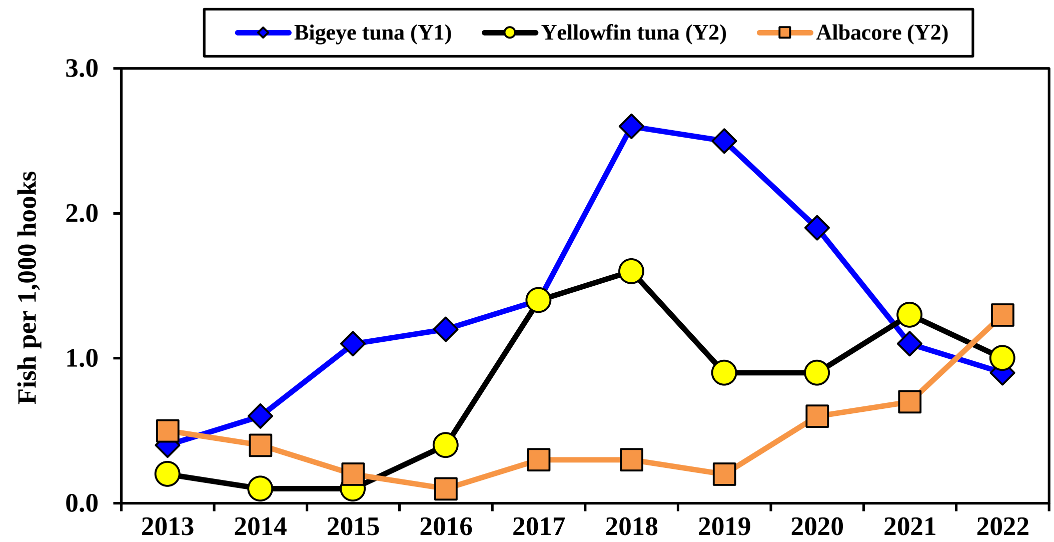


Figure 96. Tuna CPUE for the Hawaii-permitted shallow-set longline fishery
Supporting data shown in Table A-97.

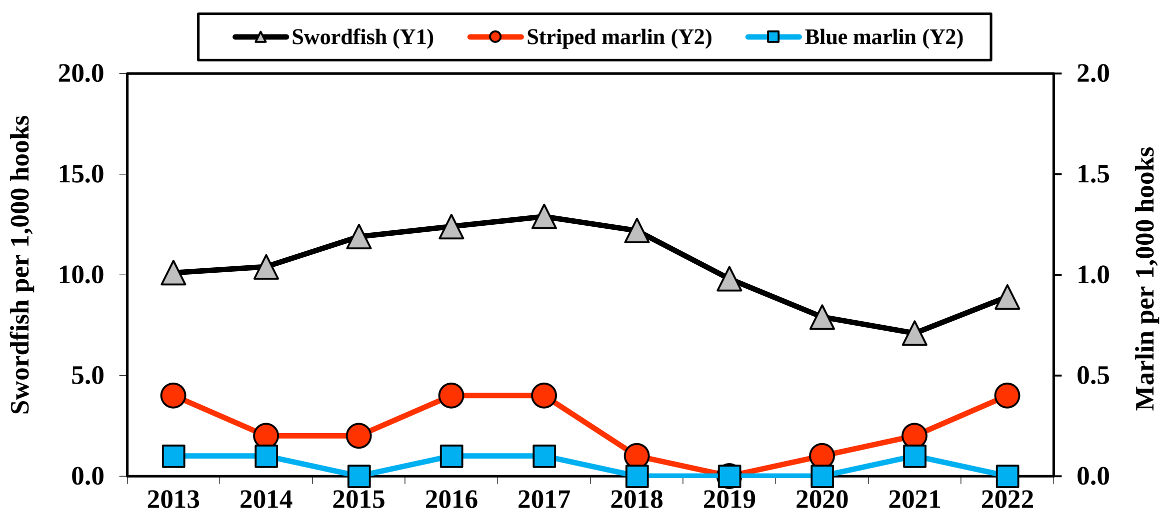


Figure 97. Billfish CPUE for the Hawaii-permitted shallow-set longline fishery
Supporting data shown in Table A-98.

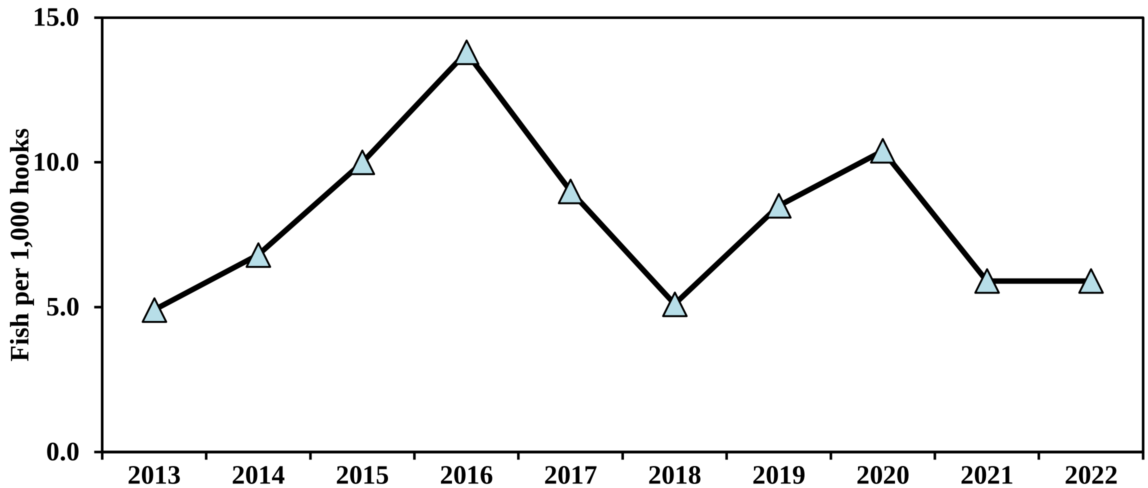


Figure 98. Blue shark CPUE for the Hawaii-permitted shallow-set longline fishery

Supporting data shown in Table A-99.

Table 29. Total estimated bycatch in number of fish for the top 10 bycatch species from the Pacific Islands Region Observer Program for the Hawaii shallow-set longline fishery. The top 10 species comprised 95.5% of total bycatch in 2021.

Species	2016	2017	2018	2019	2020	2021	Average	S.D.
Shark, Blue	11,853	10,102	4,115	4,225	6,949	6,446	7,281.7	3,131.5
Lancetfish, Longnose	1,784	2,728	1,211	1,232	1,268	2,480	1,783.8	674.5
Shark, Shortfin Mako	968	1,085	537	298	1,151	808	807.8	332.7
Escolar	459	765	150	122	152	521	361.5	262.2
Swordfish	1,049	1,419	735	254	251	499	701.2	465.0
Oilfish	171	327	114	57	248	219	189.3	96.7
Stingray, Pelagic	245	284	440	82	328	171	258.3	124.4
Snake Mackerel	315	638	62	16	31	98	193.3	243.6
Tuna, Bigeye	121	278	153	55	77	79	127.2	81.9
Dolphinfish	83	107	34	18	20	75	56.2	37.2

Table 30. Released catch, retained catch, and total catch for the Hawaii-permitted shallow-set longline fishery in 2022

	Shallow-set longline fishery			
	Released catch	**Percent released**	**Retained catch**	**Total Catch**
Tuna				
Albacore	19	1.4	1,376	1,395
Bigeye tuna	7	0.7	947	954
Bluefin tuna	0	0.0	4	4
Skipjack tuna	0	0.0	31	31
Yellowfin tuna	12	1.1	1,055	1,067
Other tunas	0	-	0	0
Tuna PMUS Subtotal	**38**	**1.1**	**3,413**	**3,451**
Billfish				
Swordfish	262	2.7	9,349	9,611
Blue marlin	0	0.0	49	49
Striped marlin	3	0.8	385	388
Shortbill spearfish	0	0.0	62	62
Other billfishes	1	8.3	11	12
Billfish PMUS Subtotal	**266**	**2.6**	**9,856**	**10,122**
Other PMUS				
Mahimahi	3	0.2	1,498	1,501
Wahoo	0	0.0	35	35
Moonfish	2	6.9	27	29
Oilfish	96	42.3	131	227
Pomfret	2	33.3	4	6
Other PMUS Subtotal	**103**	**5.7**	**1,695**	**1,798**
Non-PMUS fish	**3**	**23.1**	**10**	**13**
Total non-shark	**410**	**2.7**	**14,974**	**15,384**
PMUS Sharks				
Blue shark	6,355	100.0	0	6,355
Mako sharks	709	99.4	4	713
Thresher sharks	44	100.0	0	44
Oceanic whitetip shark	26	100.0	0	26
Silky shark	5	100.0	0	5
Shark PMUS Subtotal	**7,139**	**99.9**	**4**	**7,143**
Non-PMUS sharks	**5**	**100.0**	**0**	**5**
Grand Total	**7,554**	**33.5**	**14,978**	**22,532**

Table 31. Average weight (lb) of the catch by the Hawaii-permitted shallow-set longline fisheries

Hawaii-permitted shallow-set longline fishery																		
	Tunas					Billfish						Other PMUS					Sharks	
Year	Bigeye tuna	Yellowfin tuna	Albacore	Skipjack tuna	Bluefin Tuna	Swordfish	Striped marlin	Blue marlin	Spearfish	Sailfish	Black marlin	Mahimahi	Ono (Wahoo)	Moonfish	Pomfrets	Oilfish	Mako shark	Thresher shark
2013	107	111	27	17	187	216	92	281	34	-	-	12	42	82	15	23	177	-
2014	87	131	24	14	268	212	91	278	36	51	-	12	42	71	16	24	202	243
2015	79	120	22	16	-	184	97	292	37	51	-	12	39	76	13	22	150	243
2016	86	103	34	16	-	179	97	304	39	51	-	14	33	83	13	21	215	243
2017	98	94	35	18	187	200	102	259	39	51	-	12	36	83	14	20	179	243
2018	89	98	36	15	187	214	94	412	36	-	-	10	39	84	14	25	184	243
2019	72	92	35	17	-	217	126	-	35	51	-	9	39	83	16	22	165	-
2020	90	76	28	18	187	148	89	160	34	-	-	12	36	83	17	19	175	243
2021	95	101	34	19	225	160	76	177	25	51	-	10	32	84	17	20	175	243
2022	106	92	28	18	210	169	65	182	26	42	-	9	35	80	12	29	175	-
Average	**90.9**	**101.8**	**30.3**	**16.8**	**207.3**	**189.9**	**92.9**	**260.6**	**34.1**	**49.7**	---	**11.2**	**37.3**	**80.9**	**14.7**	**22.5**	**179.7**	**243.0**
SD	**11.0**	**15.6**	**5.1**	**1.5**	**30.7**	**25.4**	**16.0**	**78.9**	**4.9**	**3.4**	---	**1.6**	**3.5**	**4.2**	**1.8**	**3.0**	**18.1**	**0.0**

2.4.8 MHI TROLL FISHERY EFFORT, LANDINGS, REVENUE, AND CPUE

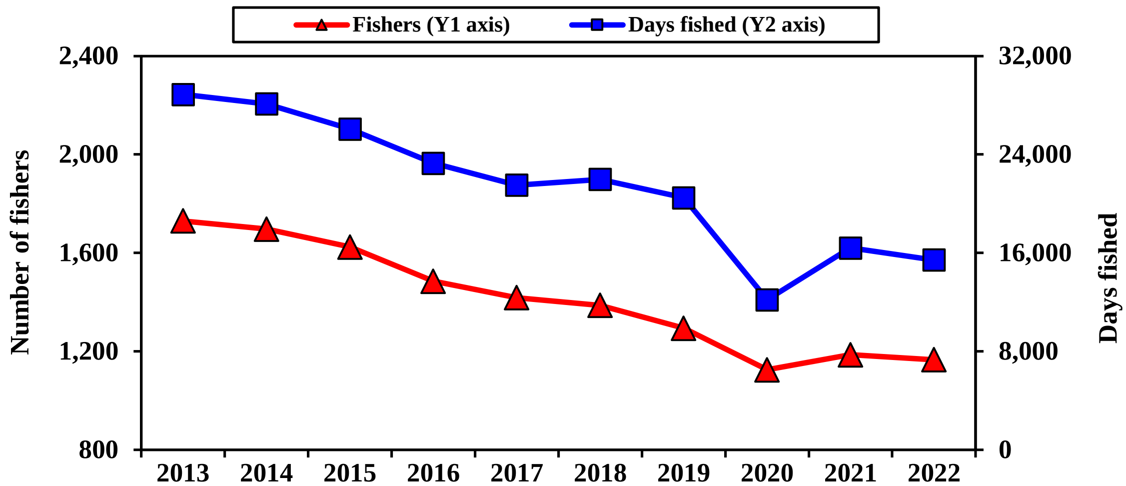


Figure 99. Number of MHI troll fishers and days fished

Supporting data shown in Table A-100.

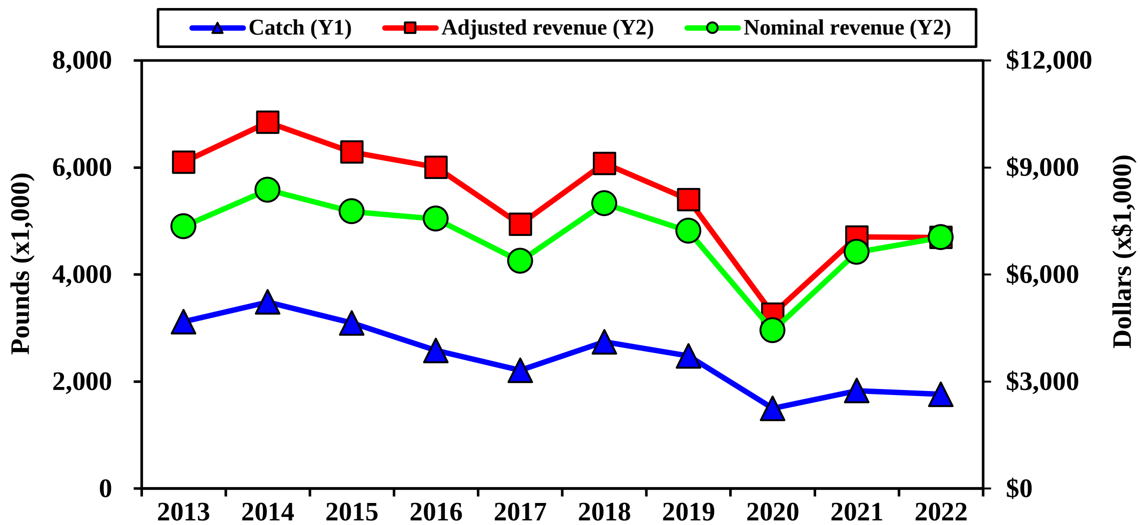


Figure 100. Catch and revenue for the MHI troll fishery

Supporting data shown in Table A-101.

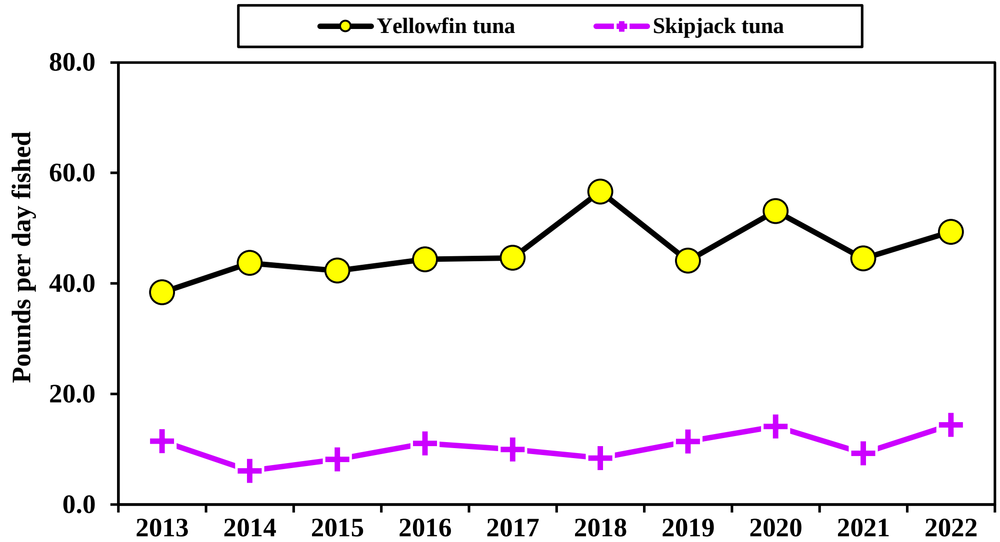


Figure 101. Tuna CPUE for the MHI troll fishery

Supporting data shown in Table A-102.

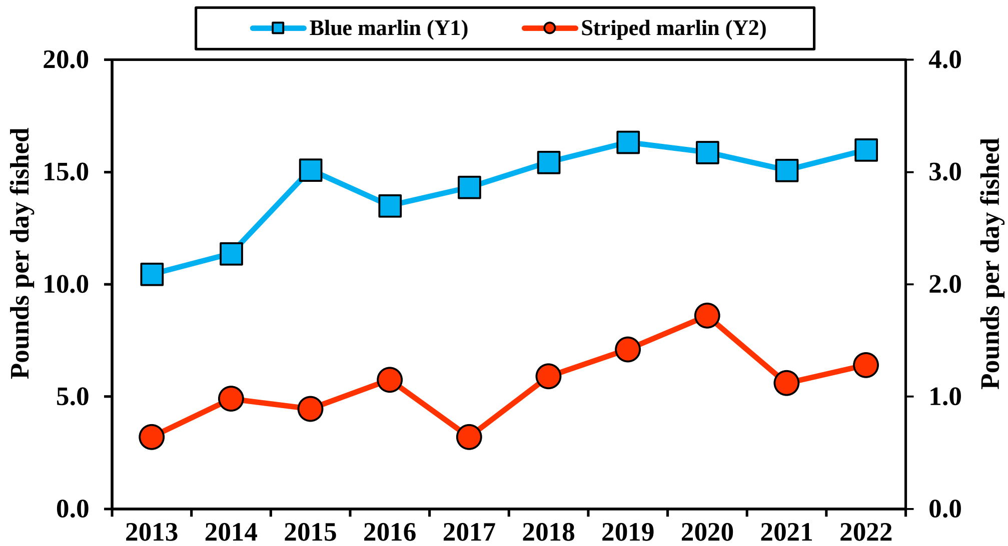


Figure 102. Marlin CPUE for the MHI troll fishery

Supporting data shown in Table A-103.

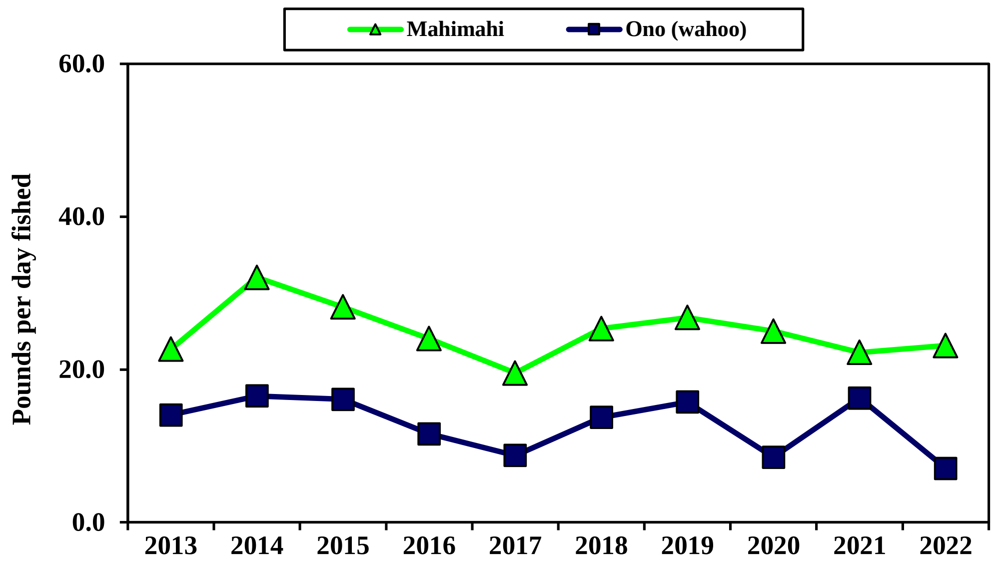


Figure 103. Mahimahi and Ono CPUE for the MHI troll fishery

Supporting data shown in Table A-104.

2.4.9 MHI HANDLINE FISHERY EFFORT, LANDINGS, REVENUE, AND CPUE

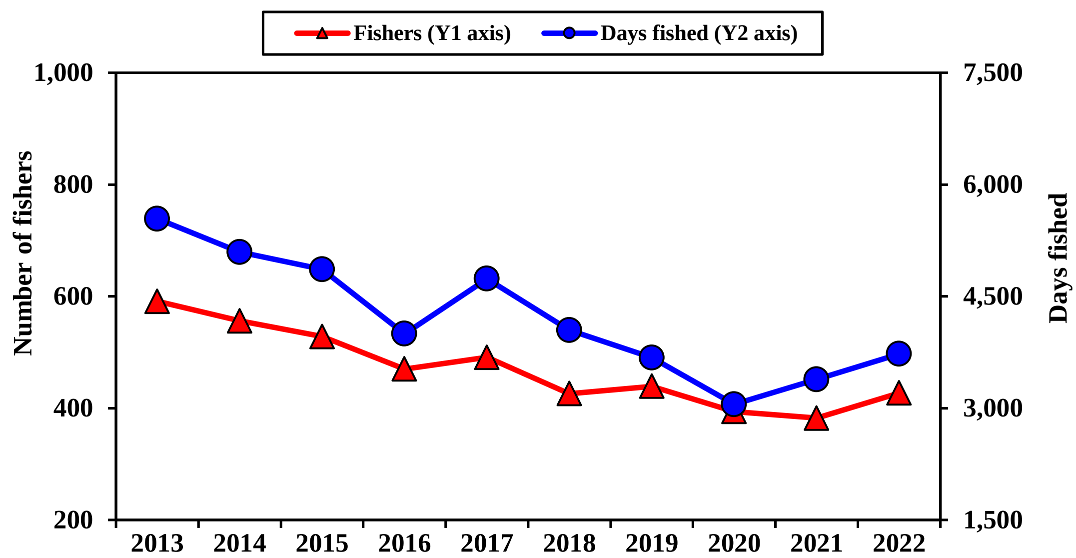


Figure 104. Number of MHI handline fishers and days fished

Supporting data shown in Table A-105.

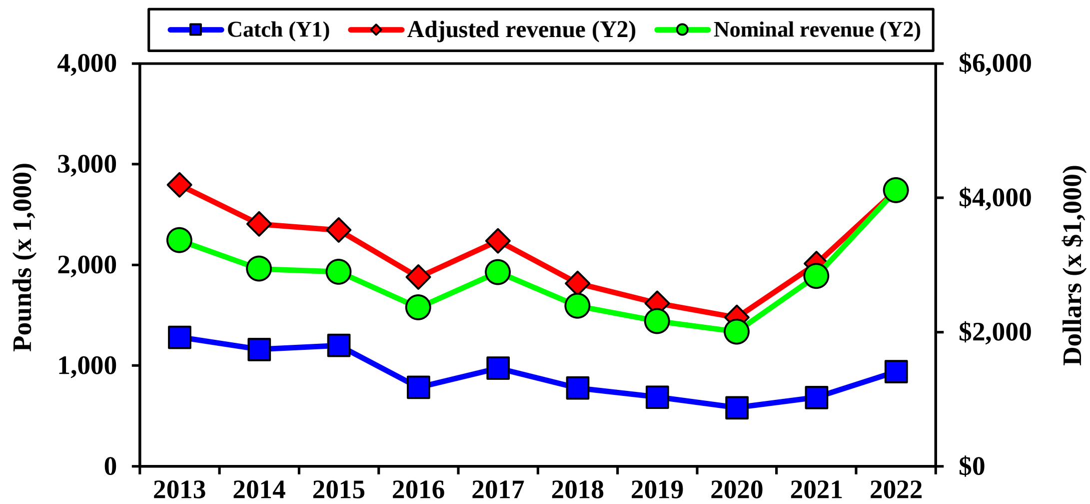


Figure 105. Catch and revenue for the MHI handline fishery

Supporting data shown in Table A-106.

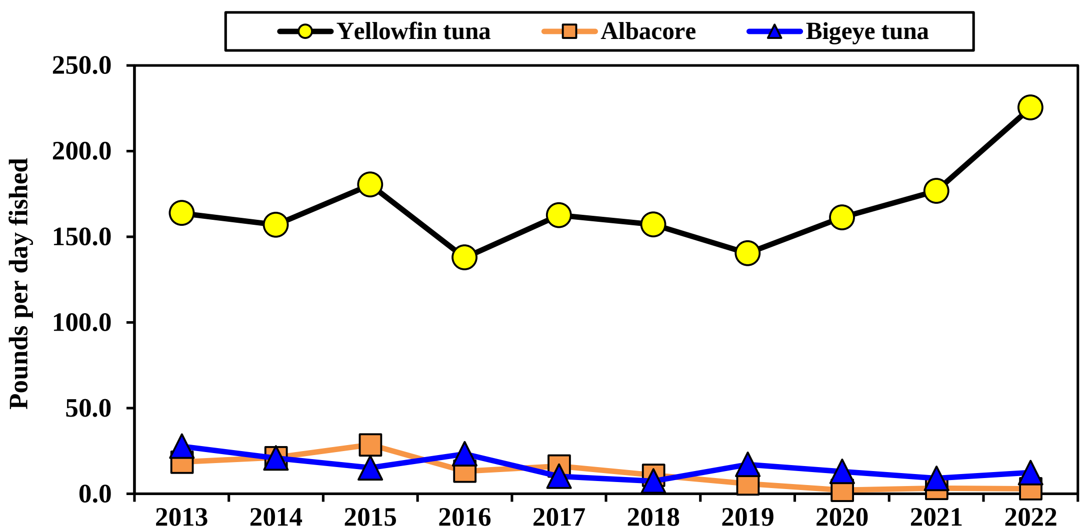


Figure 106. Tuna CPUE for the MHI handline fishery

Supporting data shown in Table A-107.

2.4.10 OFFSHORE HANDLINE FISHERY EFFORT, LANDINGS, REVENUE, AND CPUE

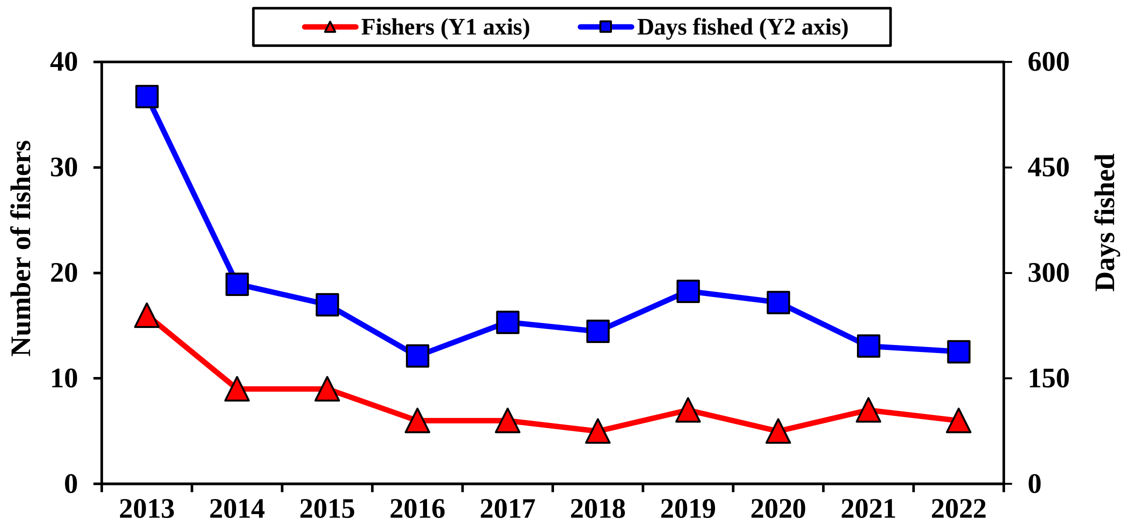


Figure 107. Number of offshore handline fishers and days fished

Supporting data shown in Table A-108.

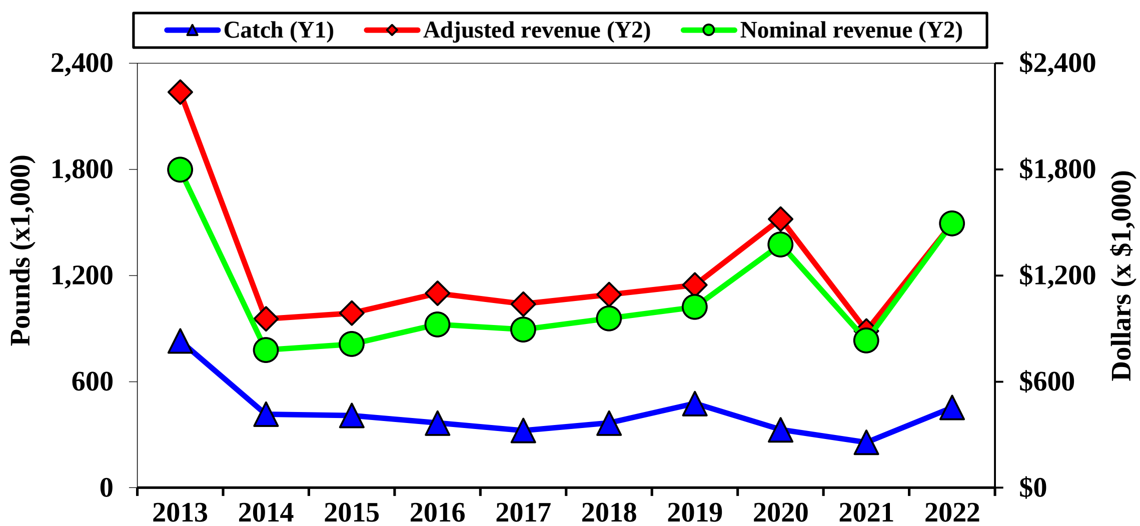


Figure 108. Catch and revenue for the offshore tuna handline fishery

Supporting data shown in Table A-109.

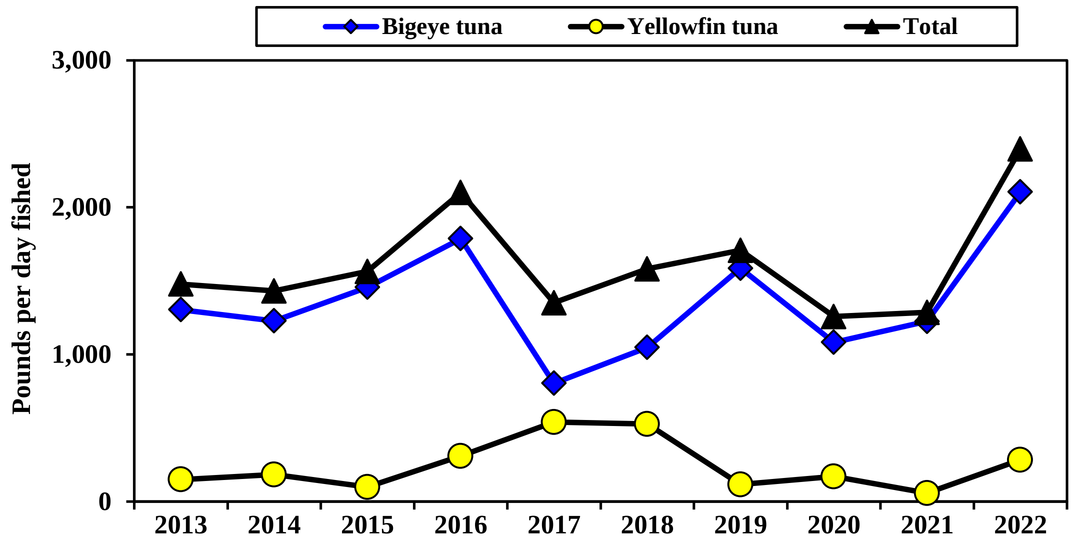


Figure 109. Tuna CPUE for the offshore tuna handline fishery

Supporting data shown in Table A-110.

Table 32. Average weight (lb) of the catch by the Hawaii troll and handline fisheries

	Tunas				Billfish			Other PMUS	
Year	Albacore	Bigeye tuna	Skipjack tuna	Yellowfin tuna	Blue marlin	Striped marlin	Swordfish	Mahimahi	Ono (wahoo)
2013	46.1	23.9	8.6	35.2	257.3	64.7	101.2	12.3	23.9
2014	43.8	24.1	6.7	34.5	245.4	49.5	118.9	12.3	22.0
2015	44.1	21.5	8.1	33.9	170.5	72.9	96.4	13.2	21.7
2016	47.7	20.9	8.4	33.7	145.1	63.1	117.0	12.0	23.0
2017	53.0	24.1	9.1	42.9	175.1	73.7	121.4	11.0	23.1
2018	52.5	25.4	7.9	45.2	193.2	66.6	110.6	11.8	20.5
2019	54.5	22.8	8.9	33.0	150.8	62.2	129.8	12.7	21.0
2020	55.3	25.9	11.8	39.8	124.5	46.3	159.3	12.3	21.8
2021	58.2	26.1	10.1	31.7	151.0	79.2	107.9	12.7	22.1
2022	57.4	29.7	11.4	49.0	164.1	66.9	103.1	11.8	24.4
Average	**51.2**	**24.4**	**9.1**	**37.9**	**177.7**	**64.5**	**116.6**	**12.2**	**22.3**
SD	**5.4**	**2.5**	**1.6**	**5.9**	**43.1**	**10.2**	**18.1**	**0.6**	**1.2**

2.4.11 PELAGIC SMALL BOAT FISHERY BYCATCH SUMMARIES

CML holders are required to report all fishing activity regardless of whether the marine life is ultimately kept. Bycatch is reported at the species or species group level along with count (pieces), gear, reporting grid number and other trip details. Fishers are not required to report bycatch in weight.

2.4.11.1 FISHERY DEFINITIONS

Fishery definitions included in Section 2.4.1 were created to account for all landings of pelagic species. Because pelagic species are occasionally caught incidentally or misreported in fisheries that do not target them directly, fishery definitions were intentionally kept broad, e.g., the deep-sea handline, a gear used primarily to target bottomfish, was included in the MHI pelagic handline fishery definition to account for pelagic species incidentally caught by the gear and/or catch of species like pomfrets which the gear is occasionally used to target. When accounting for bycatch this presents an issue as the typically non-pelagic fisheries included in these definitions tend to have relatively high bycatch that is otherwise non-pelagic and may mischaracterize bycatch in pelagic fisheries. Fishery definitions as they pertain to bycatch have been modified to herein to remove such non-pelagic fisheries and therefore differ from those used to define catch. Specifically, the gear “Casting, Light Tackle, Spinners or Whipping” was removed from MHI Troll Fishery definition and “Deep Sea or

2.4.11.2 BYCATCH SUMMARIES

Over 50% of the reported bycatch for the MHI troll fishery in 2022 was comprised of blue marlin and yellowfin tuna (Reported bycatch for the MHI handline fishery is led by its two primary targets: yellowfin and bigeye tuna (Table 34). Again, both species have a three-pound minimum size for commercial sale imposed by the State of Hawaii that results in releases of undersized fish. Other top bycatch species for this fishery are reflective of common pelagic catch and other species such as jacks and bottomfish that are occasionally caught incidentally. Several species, namely palani, 'ōpelu, and akule likely appear pelagic handline catch due to misreporting of gear, potentially on mixed-gear trips. The majority of the data in Table 34 is withheld due to confidentiality rules, specifically that less than three CML holders reported catch of the species in a given year. Though bycatch in this pelagic fishery relative to overall catch is thought to be low, underreporting is almost certainly occurring.

Bycatch for other pelagic fisheries including the offshore handline and offshore troll fisheries are not reported here due to the data confidentiality rules. Both of these fisheries are extremely small in terms of participation compared with the MHI trolling and handline fisheries. Bycatch data for the offshore troll and handline fisheries will be presented in future reports as confidentiality rules allow.
Table 33). High releases of blue marlin and other billfish are due in part to charter fishing operations in which all captains and crews involved are required to hold CMLs. Sport fishing charter trips, especially those fishing the waters off West Hawai‘i Island, often fish for billifish as a primary target though a large number are released. The State of Hawaii has a three-pound minimum size limit on the commercial sale of ahi (yellowfin and bigeye tuna). High releases of yellowfin tuna, an otherwise commercially valuable and sought after food

fish, may be due to undersized fish being discarded. Other top bycatch species for the MHI troll fishery are characteristic of this fishery and include both typically high-value species such as mahimahi, aku, and ono that may be released because they are not at a marketable size as well as other species such kāhala, kākū, and miscellaneous sharks that have low market value. Small inshore species such as menpachi, 'āweoweo, and halalū were likely misreported while on a mixed-gear trip, e.g., trolling and inshore handline. Though bycatch QA/QC methodologies are being introduced, DAR currently does not scrutinize bycatch data to the same degree of catch data resulting in such species being included.

Reported bycatch for the MHI handline fishery is led by its two primary targets: yellowfin and bigeye tuna (Table 34). Again, both species have a three-pound minimum size for commercial sale imposed by the State of Hawaii that results in releases of undersized fish. Other top bycatch species for this fishery are reflective of common pelagic catch and other species such as jacks and bottomfish that are occasionally caught incidentally. Several species, namely palani, 'ōpelu, and akule likely appear pelagic handline catch due to misreporting of gear, potentially on mixed-gear trips. The majority of the data in Table 34 is withheld due to confidentiality rules, specifically that less than three CML holders reported catch of the species in a given year. Though bycatch in this pelagic fishery relative to overall catch is thought to be low, underreporting is almost certainly occurring.

Bycatch for other pelagic fisheries including the offshore handline and offshore troll fisheries are not reported here due to the data confidentiality rules. Both of these fisheries are extremely small in terms of participation compared with the MHI trolling and handline fisheries. Bycatch data for the offshore troll and handline fisheries will be presented in future reports as confidentiality rules allow.

Table 33. Total reported commercial bycatch (number of individuals) from the MHI troll fishery for fishing years 2013-2022

Species	**2022**	**2021**	**2020**	**2019**	**2018**	**2017**	**2016**	**2015**	**2014**	**2013**
Makaira mazara or *Makaira nigricans*; Blue Marlin	518	497	386	1167	949	651	681	1269	797	598
Thunnus albacares; Yellowfin Tuna	332	586	615	780	551	497	835	1240	1593	899
Katsuwonus pelamis; Aku	248	224	187	124	151	193	417	411	711	652
Coryphaena hippurus; Mahimahi	155	146	197	213	216	282	248	427	623	530
Seriola dumerili; Kāhala	91	87	53	94	100	92	59			
Kajikia audax; Striped Marlin	48	21	38	101	54		64	75	149	66
Sphyraena barracuda; Kākū	36		26	37				58		
Euthynnus affinis; Kawakawa	30							202	437	
Tetrapturus angustirostris; Shortbill Spearfish	30	30		77	146	181	280	180	159	227
Selachii (infraclass); Shark (Misc.)	29	21								
Acanthocybium solandri; Ono		49	20	56	66	60			51	92
Thunnus obesus; Bigeye Tuna		28	36	110			148	170	394	314

Caranx ignobilis; White Pāpio/Ulua			27				59	55		
Myripristis spp.; Menpachi					n.d.	n.d.	n.d.			n.d.
Heteropriacanthus cruentatus; 'Āweoweo					n.d.	n.d.				n.d.
Selar crumenophthalmus (juvenile); Halalū						n.d.				
Caranx melampygus; 'Ōmilu									47	
Percent of all Bycatch	*96*	*97*	*95*	*94*	*66*	*57*	*87*	*96*	*97*	*87*

Note: n.d. = non-disclosed due to data confidentiality rules; the species presented in this table represent the ten species most frequently released in each year over the past ten years.

Table 34. Total reported commercial bycatch (number of individuals) from the MHI handline fishery for fishing years 2013-2022

Species	**2022**	**2021**	**2020**	**2019**	**2018**	**2017**	**2016**	**2015**	**2014**	**2013**
Thunnus albacares; Yellowfin Tuna	148	246	118	183	261	168	283	434	476	519
Thunnus obesus; Bigeye Tuna	n.d.	13	n.d.	46	n.d.	92	34	40	63	120
Katsuwonus pelamis; Aku	31	n.d.	n.d.	n.d.	n.d.	13	20	44	58	42
Elagatis bipinnulata; Kamanu	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	26	n.d.	n.d.	n.d.
Coryphaena hippurus; Mahimahi	12	n.d.	n.d.	44	13	23	n.d.	n.d.	47	n.d.
Belonidae (family); 'Aha	n.d.	n.d.			n.d.					
Selachii (infraclass); Shark (Misc.)	n.d.	n.d.	n.d.			n.d.				
Seriola dumerili; Kāhala	n.d.		12	n.d.	20		7	n.d.		
Acanthurus dussumieri; Palani	n.d.									
Caranx ignobilis; White Pāpio/Ulua	n.d.									
Acanthocybium solandri; Ono		n.d.	n.d.	n.d.	21	n.d.	28	n.d.	n.d.	n.d.
Sphyraena barracuda; Kākū		n.d.								
Alopias vulpinus; Thresher Shark		n.d.							4	
Pristipomoides filamentosus; 'Opakapaka			n.d.							
Decapterus macarellus; 'Ōpelu			n.d.							
Euthynnus affinis; Kawakawa				n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	
Carcharhinus longimanus or *Triaenodon obesus*				n.d.				5		5
Balistidae (family); Humuhumu				n.d.						n.d.
Caranx melampygus; 'Ōmilu					n.d.					
Thunnus alalunga; Tombo						15			n.d.	
Prionace glauca; Blue Shark						n.d.				
Selar crumenophthalmus; Akule							n.d.	n.d.		

Species	**2022**	**2021**	**2020**	**2019**	**2018**	**2017**	**2016**	**2015**	**2014**	**2013**
Carangidae (family); Pāpio, Ulua (Misc.)							n.d.			
Xiphias gladius; Broadbill Swordfish									n.d.	
Gempylus serpens; Hāuliuli										n.d.
Caranx sexfasciatus; Sasa										n.d.
Percent of all Bycatch	*68*	*66*	*65*	*59*	*65*	*78*	*88*	*75*	*88*	*84*

Note: n.d. = non-disclosed due to data confidentiality rules; the species presented in this table represent the ten species most frequently released in each year over the past ten years.

2.5 NON-COMMERCIAL PELAGIC FISHERIES

2.5.1 OVERVIEW OF NON-COMMERCIAL PELAGIC FISHERIES

Fishing, either for subsistence, sustenance, or recreation continues to be an important activity throughout the Western Pacific region in its four major populated island areas: Hawaii, American Samoa, Guam, and the CNMI. These non-commercial fisheries are important in island communities that depend on fish and other marine organisms as one of its few local sources of protein. This section was not updated in the 2021 or 2022 report in preparation of a revised section in the 2023 annual SAFE report, consistent with recommendations by the Council's Pelagic Plan Team.

In Hawaii, non-commercial shoreline fishing was more popular than boat-based fishing up to and after World War 2. Boat-based fishing during this period referred primarily to fishing from traditional canoes (Glazier 1999). All fishing was greatly constrained during World War 2 through time and area restrictions, which effectively stopped commercial fishing and confined non-commercial fishing to inshore areas (Brock 1947). Following World War 2, the advent of better fishing equipment, new small boat hulls, and marine inboard and outboard engines led to a growth in small vessel-based non-commercial fishing.

A major period of expansion of small vessel non-commercial fishing occurred between the late 1950s and early 1970s through the introduction of fiberglass technology to Hawaii and the further refinement of marine inboard and outboard engines. By the early 1960s there were an estimated 5,300 small boats in the State being used for non-commercial fishing. By the 1980s, the number of non-commercial craft had risen to almost 13,000 vessels, and this number increased further to about 15,000 vessels in the 1990s. There are many fishing clubs in Hawaii, and a variety of different recreational fishing tournaments organized by both clubs and independent tournament organizers. Hawaii also hosts between 150 and 200 boat-based fishing tournaments, about 30 of which are considered major international competitions. This level of interest in recreational fishing is sufficient to support local fishing magazines, *Hawaii Fishing News* and *Lawai'a*, with articles about local recreational fishing, as well as several recreational fishing television programs.

Elsewhere in the Western Pacific region, non-commercial fishing is less structured. In Guam, fishing clubs have been founded along ethnic lines by Japanese and Korean residents. These clubs had memberships of 10 to 15 people along with their families. Four such clubs were founded in Guam over the past 20 years, but none lasted for more than a 2 to 3 years (Gerry Davis, NMFS PIRO, pers. comm.). There was also a Guam Boating Association, comprised of mostly fishermen, with several hundred members. This organization functioned as a fishing club for about 10 years before disbanding. Some school groups and the boy scouts have formed fishing clubs focused on rod and reel fishing, and there is still one spearfishing club (Marianas Underwater Fishing Federation) that is active. There are also some limited fishing tournaments in Guam, including a fishing derby for children organized by the DAWR.

Every summer in Guam, the fishing community gathers to partake in several fishing derbies and the *Gupot Y Peskadot* (i.e., Fishermen's Festival). This includes several fishing competitions such as the Kid's Fishing Derby, In-Shore Tournament (rod and reel), Spearfishing Challenge and Guam Marianas International Fishing Derby (trolling).

There are a few fishing clubs in the in the Northern Mariana Islands. The Saipan Fishermen's Association (SFA) has been in existence since 1985 and is the sponsor of the annual Saipan International Fishing Tournament usually held in August or September. The SFA also developed a "Tasi to Table" Youth Fishing Club, which provides fishing experiences and training to high school students. One spearfishing club, the Marianas Apnea Spearfishing Club, was founded in 2007 and continues to instill traditional cultural fishing skills among the people of the CNMI to encourage sustainable fishing.

Levine and Allen (2009) provided an overview of fisheries in American Samoa, including subsistence and recreational fisheries. Citing a survey conducted in American Samoa by Kilarski et al. (2006), Levine and Allen (2009) noted that approximately half of the respondents stated that they fished for recreation, with 71 percent of these individuals fishing once a week or less. Fishermen also fished infrequently for cultural purposes, although cultural, subsistence, and recreational fishing categories were difficult to discern as one fishing outing could be motivated by any combination of the three reasons.

Boat-based recreational fishing in American Samoa has been influenced primarily by fishing clubs and fishing tournaments. Tournament fishing for pelagic species began in American Samoa in the 1970s, and between 1974 and 1998, a total of 64 fishing tournaments were held (Tulafono 2001). Most of the boats that participated were *alia* catamarans and small skiffs. Catches from tournaments were often sold, as most of the entrants were local small-scale commercial fishermen. In 1996, three days of tournament fishing contributed about one percent of the total domestic landings. Typically, seven to 14 local boats carrying a total of 55 to 70 fishermen participated in each tournament, which were held two to five times per year (Craig et al. 1993).

Most tournament participants operated 28-foot *alia* vessels, the same vessels that engage in the small-scale longline fishery. With more emphasis on commercial longline fishing since 1996, interest in the tournaments waned (Tulafono 2001) and pelagic fishing effort shifted markedly from trolling to longlining. Catch-and-release recreational fishing is virtually non-existent in American Samoa. Landing fish to meet cultural obligations is of such high importance such that releasing fish would generally be considered a failure to meet these responsibilities (Tulafono 2001). Nevertheless, some pelagic fishermen who fish for subsistence release fish that are in excess of their subsistence needs.

Most of the non-commercial boat-based fishing is done by the Pago Pago Game Fishing Association (PPGFA), which was founded in 2003 to host regular fishing competitions. The PPGFA has annually hosted international tournaments with fishermen from neighboring Samoa and Cook Islands attending. The non-commercial vessels extensively use anchored FADs, and venture to the various outer banks such as the South Bank (35 miles), North East Bank (40 miles NE), South East bank (37 miles SE), Two Percent Bank (40 miles), and East Bank (24 miles East) during tournaments. The PPGFA plays host to the Steinlager *I'a Lapo'a* Game Fishing Tournament, which is a qualifying event for the International Game Fish Association's Offshore World Championship. There is no full-time regular charter fishery in American Samoa similar to those in Hawaii, CNMI, or Guam. However, Pago Pago Marine Charters does include fishing charters among the services it offers.

There is also some non-commercial fishing activity within portions of the PRIA, namely at Midway, Wake Island, and Palmyra Atoll. There are no resident populations at Howland Island, Baker Island, Johnston Atoll, or Jarvis Island, and fishing activity at these locations is likely minimal. There was a tourist facility at Midway until 2002, which operated a charter boat fishery targeting primarily pelagic fish. The company operated five vessels for charter fishing, consisting of three 22 to 26 foot catamarans for lagoon and nearshore fishing operations and two 38 foot sportfishing vessels used for blue water trolling. In addition, there were approximately seven small vessels maintained and used by Midway residents for non-commercial fishing. Of these seven, three vessels engaged primarily in offshore trolling for PMUS including yellowfin tuna, wahoo, and marlin. All vessels fishing at Midway were required to file a float plan prior to a fishing trip and complete the “Midway Sports Fishing Boat Trip Log” upon completion of each trip. The U.S. Fish and Wildlife Service was responsible for compiling these catch data.

At Palmyra Atoll, an island privately owned by The Nature Conservancy, small boats are operated within the lagoon for trolling. There are several craft used for non-commercial fishing at the military base on Wake Island, including two landing craft and two small vessels.

2.5.2 NON-COMMERCIAL CATCH AND EFFORT

Estimates of non-commercial catch are summarized and provided in Table 33. Data on total catch and trips are reported in each island area’s respective module and non-commercial catch and trips were either calculated by subtracting the commercial catch or by utilizing data from NMFS PIFSC on the boat-based creel survey estimates for commercial versus non-commercial portions of landings.

Both Hawaii and American Samoa have large total pelagic catch due to the inclusion of longline landings, which results in non-commercial catch being proportionally minor for American Samoa. Additionally, non-commercial catch estimates for American Samoa were anomalously low in 2020, possibly due to the COVID-19 pandemic impacting survey sampling. Conversely, non-commercial catch for Hawaii in 2020 was relatively high while total pelagic catch was slightly lower than normal due to the impacts of COVID-19 on commercial pelagic fisheries. In comparison, CNMI and Guam both have a higher percentage of non-commercial fishing than American Samoa. This difference between island areas is to be expected, as both Hawaii and American Samoa have larger markets to which they can supply fish (i.e., hotels, restaurants, exports, and the cannery).

Table 33. Summary of estimated non-commercial landings by island area in 2020

Island Area	Total Pelagic Catch (lb)	Total Trips	Non-Commercial Catch (lb)	Non-Commercial Fishing Trips	Non-Commercial % of Total Catch
American Samoa	1,892,277	221	32	6	> 0.01%
CNMI	689,136	9,481	23,862	3,747	3.46%
Guam	614,633	9,200	69,899	6,089	11.37%
Hawaii	30,399,157	760,174	14,537,548	743,859	47.8%

Source: NMFS PIFSC, WPacFIN, State of Hawaii DAR and HMRFS, MRIP.

Charter fishing data are provided in each of the island areas' respective modules and are summarized in Table 34. Data for Hawaii is provided by the State of Hawaii Commercial Marine License reporting system. There is no charter data from American Samoa available. For species-specific charter information (landings, trips, CPUE, etc.), please refer to the individual island area sections.

Overall, charter fishing in the region primarily target the same pelagic species in each island area utilizing primarily trolling gear. Charter fishing in Hawaii is more focused on catching blue marlin, which in 2004 formed about 50 percent of the total annual charter vessel catch by weight. An increase in catch and release effort of marlins in the industry that has grown since 2004 and, coupled with the lower price per pound received for marlins, outside forces such as the Billfish Conservation Act that reduced the ability for fishermen to export marlin and marlin products outside of Hawaii may be the reason. In 2020, Hawaii's charter industry took 1,257 trips and kept 134,889 lb of fish. Both trips and catch were down nearly 75 percent from previous years due mainly to the inability to fish during much of the COVID-19 pandemic due to stay-at-home orders and the lack of tourism. Guam's charter industry has slightly expanded but is subject to the availability of military and visitors, and, thus, it has waxed and waned with the tourism industry. The COVID-19 pandemic in 2020 showed this impact with charter landings, effort, and trips all being well below 2019 values. In CNMI, charter fishing was nonexistent as the pandemic eliminated tourism, the sole source of charter fishing, resulting in no charter catch in 2020.

Table 34. Summary of charter fishing in the Western Pacific region in 2020

Island Area	Catch (lb)	Effort (Trips)	CPUE (lb/trip)	Principal Species
CNMI	0	1	0	skipjack tuna, mahimahi, wahoo, yellowfin tuna
Guam	3,167	202	15.68	mahimahi, skipjack tuna, blue marlin, wahoo, yellowfin tuna
Hawaii	134,889.5	1,257	107.31	Yellowfin tuna, blue marlin, mahimahi, ono, aku

Source: NMFS PIFSC, WPacFIN, State of Hawaii CML database.

Hawaii is the only island area in the region that has a specific non-commercial fishing data collection program through the Hawaii Marine Recreational Fishing Survey (HMRFS). This collaborative project between the State of Hawaii and NMFS Office of Science and Technology is part of the nationwide Marine Recreational Information Program (MRIP) used by NMFS to estimate recreational catches in most of the coastal states of the U.S. For more information on HMRFS data collection, see https://dlnr.hawaii.gov/dar/fishing/hmrfs/.

Table 35 provides summaries of the non-commercial, boat-based catch between 2013 and 2020 for pelagic fish in Hawaii. Non-commercial catches of pelagic fish were higher in 2020 than 2019 and above the mean for the time series. The species composition of the catch in 2020 was predominantly yellowfin tuna as in past years, followed by skipjack tuna, mahimahi, blue marlin, wahoo, and striped marlin (Figure 110). The species composition of the catch in 2020 was predominantly yellowfin tuna as in past years, followed by skipjack tuna, mahimahi, blue marlin, wahoo, and striped marlin (Figure 110). CPUE, measured in pounds per angler trip, in 2020 had a similar species composition, and every species had a CPUE of less than 10 lb/angler trip that year except for yellowfin tuna at 11.16 lb/trip (Figure

111). The number of estimated boat-based angler trips was slightly up in 2020 from 2019 at 743,859 angler trips and remains well above the average for the time series (Figure 112).

Table 35. Estimated non-commercial boat-based pelagic catch in Hawaii from 2013 to 2020

Year	Catch (lb)	Change from previous year
2013	14,245,945	+1,915,307 (+16%)
2014	10,833,018	-3,412,927 (-24%)
2015	13,065,927	+2,232,909 (+21%)
2016	6,572,343	-6,493,584 (-50%)
2017	6,308,217	-264,126 (-4%)
2018	20,876,569	+14,568,352 (+231%)
2019	12,785,507	-8,091,062 (-38.76%)
2020	14,537,548	+1,752,041 (+13.7%)
AVG	**12,395,079**	---

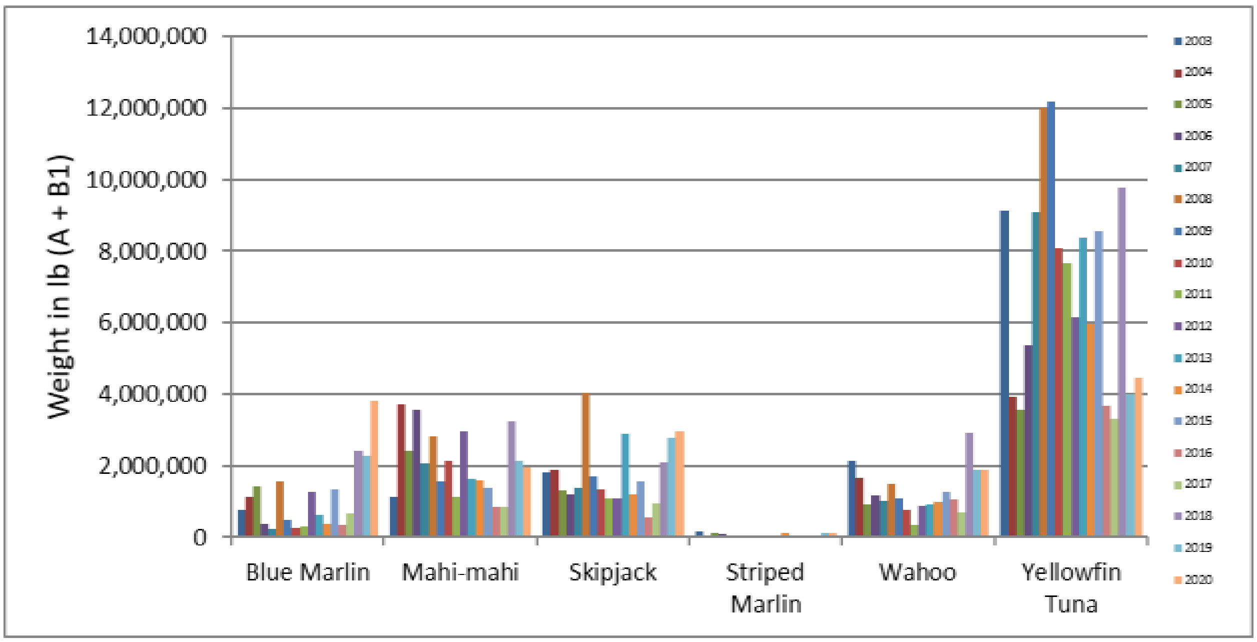


Figure 110. Non-commercial catch (lb) in Hawaii by species from 2003 to 2020

Note: Weight estimates were missing for the catch in some waves (wave = two-month period), but the number of fish could be estimated from interview data that lacked corresponding weight measurements. The weight estimates for these estimated fish numbers were imputed by using average weight from other waves in the year. If there were no mean weight estimates for a whole year, the estimate of mean weight from the previous year was used.

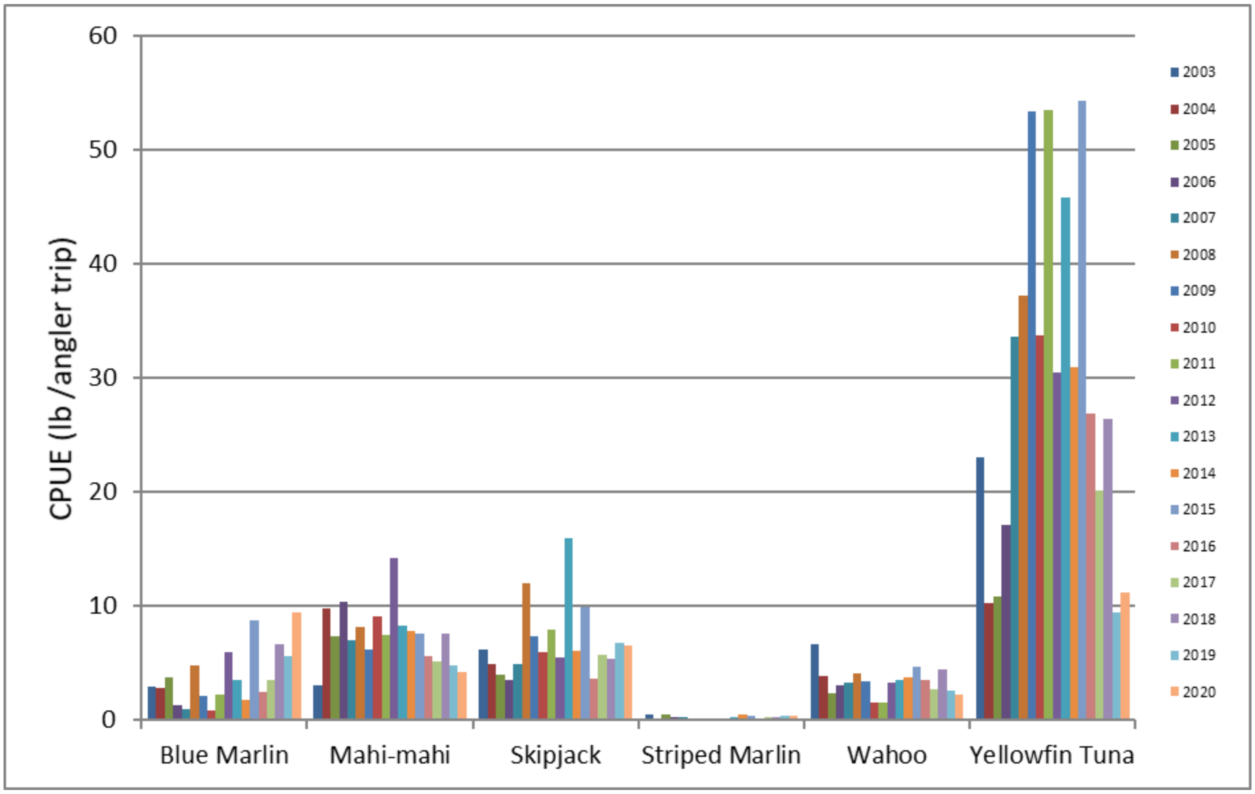


Figure 111. Non-commercial CPUE (lb/angler trip) in Hawaii by species from 2003 to 2020

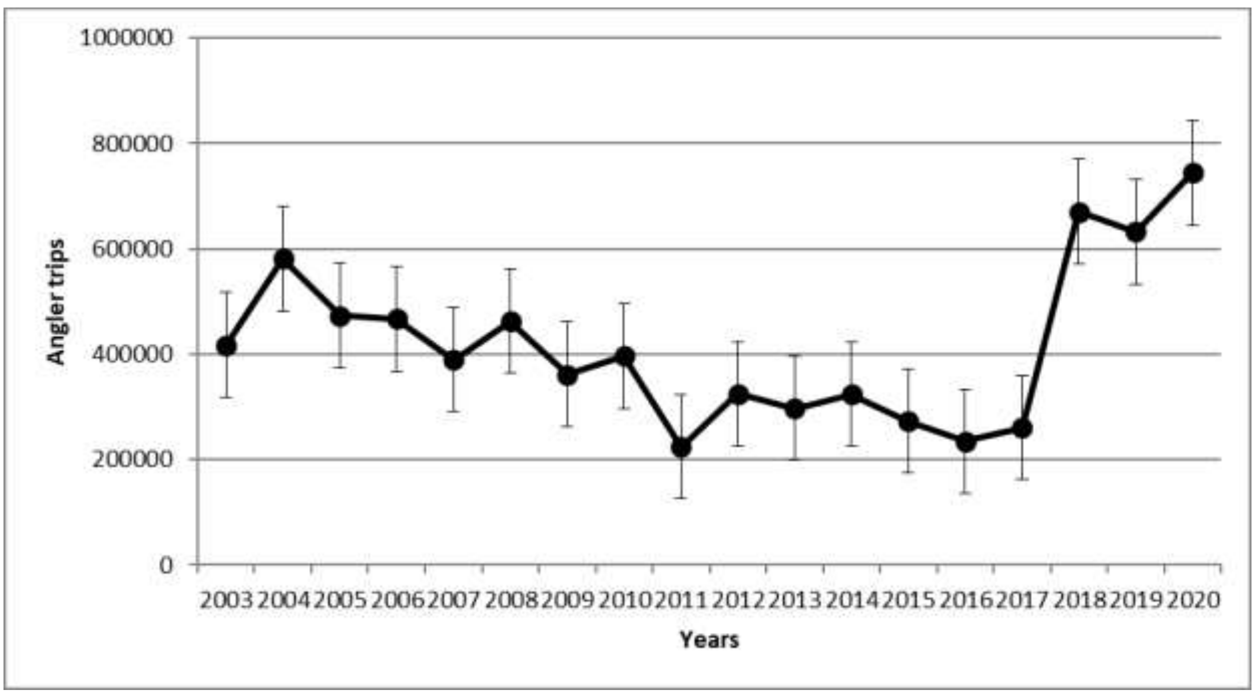


Figure 112. Estimated angler trips in the Hawaii non-commercial fishery from 2003 to 2020

2.6 INTERNATIONAL

2.6.1 INTRODUCTION

The U.S Pacific Island EEZs managed by the Council are surrounded by large and diverse fisheries targeting pelagic species. The International Module contains reported catches of pelagic species in the entire Pacific Ocean by fleets of Pacific Island nations and distant water fishing nations and information for a SAFE report that includes the most recent assessment information in relation to status determination criteria. Fishery trends in the entire Pacific Ocean are illustrated for the purse seine, longline and pole-and-line fisheries. The tables of this section show the catches of pelagic MUS by U.S. longline (Hawaii and California-based) and U.S. territorial longline fisheries in the Western and Central Pacific Fisheries Commission (WCPFC) Convention Area from 2018-2022, as reported by NMFS to the WCPFC. The catches for 2022 are preliminary.

Table 44 through Table 46 provide the U.S. longline landings as submitted to the WCPFC and Inter-American Tropical Tuna Commission (IATTC).

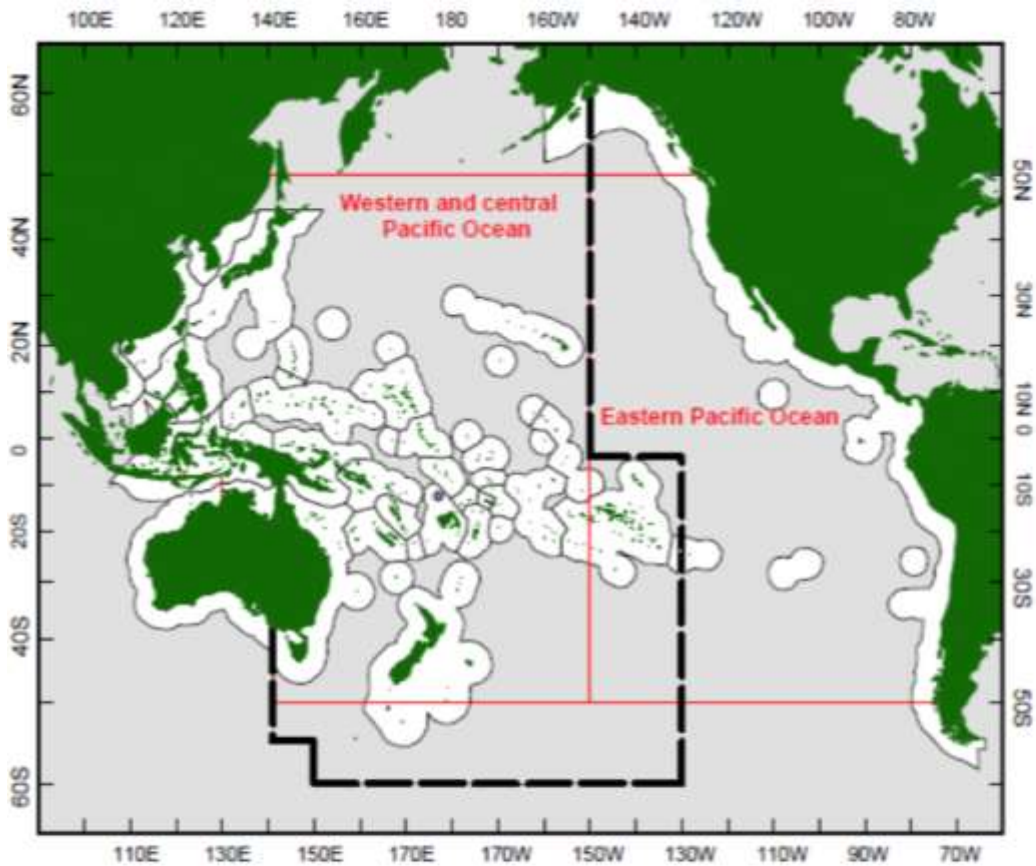


Figure 113. The Western and Central Pacific Ocean, Eastern Pacific Ocean and the WCPFC Convention Area (WCP–CA) [in dashed lines])

2.6.2 DATA SOURCES

The data sources for the international module of the annual SAFE report are obtained from the various literature of the WCPFC, the IATTC, and the International Scientific Committee for Tuna and Tuna-like species (ISC). These references can be found in Section 5. Additional sources of data include the U.S. data submissions to the WCPFC and IATTC documented in this module.

2.6.3 PLAN TEAM RECOMMENDATIONS

There were no recommendations for the International module by the Pelagic Plan Team for the 2022 annual SAFE report to be forwarded to the Council, only work items to Pelagic Plan Team members on improvements to other modules.

2.6.4 SUMMARY OF FISHERIES

This section presents the total catch of tuna species in the Pacific Ocean as reported to the Pacific Community (PC) from all member countries. Table 38 and Figure 114 depict the combined catch of all fisheries, while the following subsections present fishery specific data for the three main fisheries: purse seine, longline, and pole-and-line.

Table 38. Estimated annual catch (mt) of tuna species in the Pacific Ocean

Year	Albacore	Bigeye	Skipjack	Yellowfin	Total
2012	181,609	269,535	2,001,883	838,293	3,291,320
2013	175,643	243,627	2,106,861	811,623	3,337,754
2014	162,971	260,928	2,248,280	867,743	3,539,922
2015	155,110	250,282	2,118,867	849,259	3,373,518
2016	126,953	249,087	2,127,260	915,382	3,418,682
2017	151,899	232,958	1,935,840	936,873	3,257,570
2018	137,543	245,827	2,133,155	953,881	3,470,406
2019	143,530	227,566	2,385,974	935,555	3,692,625
2020	113,437	252,578	2,016,127	962,476	3,344,618
2021	111,656	222,013	1,950,558	1,034,496	3,318,723
Average	146,035	245,440	2,102,481	910,558	3,404,514
STD deviation	24,113	14,665	138,201	68,211	131,933

Source: PC (2022).

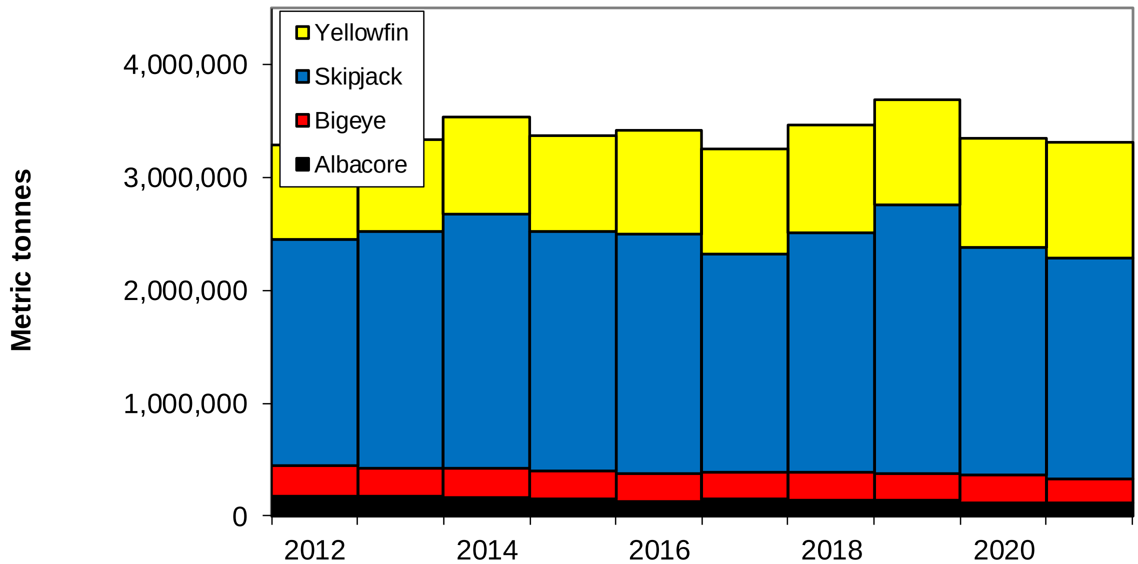


Figure 114. Estimated total annual catch of tuna species in the Pacific Ocean
Source: PC (2022).

2.6.4.1 PURSE SEINE FISHERY IN THE WCPFC

Source: WCPFC-SC18-2022 GN-WP-01

Vessels: The majority of the historic WCP–CA purse seine catch has come from the four main Distant Water Fishing Nation (DWFN) fleets – Japan, Korea, Chinese-Taipei and USA, which combined numbered 163 vessels in 1992, but declined to a low of 111 vessels in 2006 (due to reductions in the US fleet), before some rebound in recent years (up to 129 vessels in 2017 and 124 vessels in 2020). The Pacific Islands fleets have gradually increased in numbers over the past two decades to a level of 142 vessels in 2021. The remainder of the purse seine fishery includes several fleets which entered the WCPFC tropical fishery during the 2000s (e.g., China, Ecuador, El Salvador, New Zealand, and Spain).

The total number of purse seine vessels was relatively stable over the period 1990-2006 (in the range of 180–220 vessels), but thence until 2014, the number of vessels gradually increased, attaining a record level of 308 vessels in 2015, before steadily declining since (to 267 vessels in 2020). Further declines occurred in 2020 and 2021 with a significant reduction in vessels from one component of the US purse seine fleet.

The provisional 2021 purse seine catch of 1,740,370 mt was the lowest catch since 2011, and around 360,000 mt lower than the record catch in 2019 (2,101,405 mt). The 2021 purse seine skipjack catch (1,254,022 mt: 72% of the catch) was a clear drop of around 440,000 mt on the record in 2019 (~1,700,000 mt). The 2021 purse seine catch for yellowfin tuna (405,915 mt; 23% of the total purse seine tuna catch) was around 95,000 mt lower than the record catch in 2017 (501,109 mt) but still amongst the highest annual catches for this fishery. The provisional catch estimate for bigeye tuna for 2021 (79,167 mt) was the highest since 2014 and a clear increase on the relatively low purse seine bigeye tuna catch in 2019 (49,958 mt). The increased bigeye tuna catches in both 2020 and 2021 appears to be related to a higher number of associated sets in conjunction with La Nina conditions.

Despite the FAD closure for certain periods in each year since 2010, drifting FAD sets remain an important fishing strategy, particularly to the east of 160°E. The relatively high proportion of unassociated sets in the eastern areas (e.g. Gilbert Islands) was a feature of the fishery in 2015–2016 (i.e. corresponding to El Niño conditions). The move to ENSO-neutral conditions, then weak La Niña during 2017 into early 2018 resulted in more effort in the area west of 160°E compared to recent years, and a higher use of drifting FADs in the area east of 160°E. By late 2018, weak El Niño conditions presided over the fishery and relatively high catches were taken in the eastern tropical areas, in and adjacent to the waters of Tokelau and the Phoenix Group. El Niño conditions continued into 2019 with purse seine effort extending further to the east compared to recent years and very good catches were taken in a few concentrated areas of the eastern tropical waters. The La Niña conditions experienced in 2020 and 2021 resulted in a general westward shift of fishing effort compared to 2019.

In general, the distribution of effort for most fleets in 2021 is similar to 2020 activities, no doubt related to the prevailing (La Niña) conditions in both years. The US fleet typically fishes in the more eastern areas as was the case during 2020 with effort extended into the Gilberts, Phoenix and Line Islands, the Cook Islands, Tokelau and the adjacent eastern high seas areas with increasingly less effort west of 160°E; during 2021, the US fleet fished even further east, in the Line Group and the high seas areas north of the Cook Islands and French Polynesian EEZs. The difference in areas fished by the non-Pacific islands' fleets (Figures 3.4.2–3.4.5) is related to the areas they have access to and perhaps also related to fishing strategy (e.g., use of traditional fishing grounds, e.g. FSM, PNG and the Solomon Islands by the Japan fleet).

Table 39. Total reported purse seine catch (mt) of skipjack, yellowfin, and bigeye tuna in the Pacific Ocean

Year	Skipjack	Yellowfin	Bigeye	Total
2012	1,639,189	596,199	142,654	2,378,042
2013	1,754,271	590,836	133,891	2,478,998
2014	1,878,005	613,970	141,875	2,633,850
2015	1,722,044	563,285	123,883	2,409,212
2016	1,713,933	650,823	130,787	2,495,543
2017	1,588,071	711,486	133,783	2,433,340
2018	1,738,252	621,186	138,817	2,498,255
2019	2,043,578	580,485	119,181	2,743,244
2020	1,700,197	620,375	151,824	2,472,396
2021	1,652,329	683,445	134,111	2,469,885
Average	1,742,987	623,209	135,081	2,501,277
STD Deviation	131,166	46,518	9,419	108,914

Source: PC (2022) and IATTC (2022).

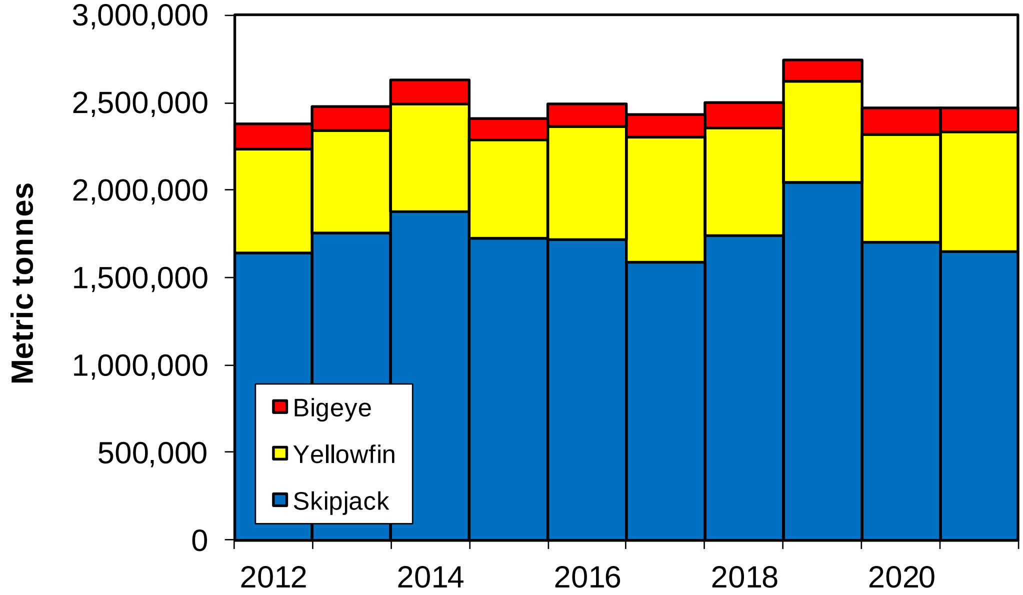


Figure 115. Total purse seine catch of skipjack, yellowfin, and bigeye tuna in the Pacific Ocean

Source: PC (2022) and IATTC (2022).

2.6.4.2 LONGLINE FISHERIES IN THE WCPFC

Source: WCPFC-SC18-2022 GN-WP-01

The longline fishery now accounts for only 8–10% of the total WCP–CA catch (OFP, 2021), but approaches the much larger purse seine catch in landed value. It provides the longest time series of catch estimates for the WCP– CA, with estimates available since the early 1950s. The total number of vessels involved in the fishery generally fluctuated between 3,000 and 6,000 for the period 1970–2004, although for some distant-water fleets, vessels operating in areas beyond the WCP–CA could not be separated out and more representative vessel numbers for WCP–CA have only become available in recent years. Total longline vessel numbers have slowly declined over the past 15 years, with the provisional estimate of 1,543 vessels in 2021 showing a 57% drop on vessel numbers in 2005 and a 9% drop on 2019 vessel numbers, mainly due to a decline in the category of non Pacific Islands domestic fleets, but also no doubt due to the impacts of COVID-19.

The fishery involves two main types of operation:

- Large (typically >250 gross registered tonnes [GRT]) distant-water freezer vessels which undertake long voyages (months) and operate over large areas of the region. These vessels may target either tropical (yellowfin, bigeye tuna) or subtropical (albacore) species. Voluntary reduction in vessel numbers by at least one fleet has occurred in recent years;
- Smaller (typically <100 GRT) offshore vessels which are usually domestically based, undertaking trips less than one month, with ice or chill capacity, and serving fresh or air-freight sashimi markets, or albacore canneries. There are several foreign offshore fleets based in Pacific Island countries.

The following broad categories of longline fishery, based on type of operation, area fished and target species, are currently active in the WCP–CA:

- South Pacific offshore albacore fishery comprises Pacific-Islands domestic "offshore" vessels, such as those from American Samoa, Cook Islands, Fiji, French Polynesia, Kiribati, New Caledonia, PNG, Samoa, Solomon Islands, Tonga, Tuvalu and Vanuatu; these fleets mainly operate in subtropical waters, with albacore the main species taken. Two new entrants, Tuvalu and Wallis & Futuna, joined this category during 2011, although the latter fleet has not fished recently. Vessel numbers have stabilized in recent years, but they may also vary depending on charter arrangements.
- Tropical offshore bigeye/yellowfin-target fishery includes "offshore" sashimi longliners from Chinese-Taipei, based in Micronesia, Guam, Philippines and mainland Chinese vessels based in Micronesia, and domestic fleets based in Indonesia, Micronesian countries, Philippines, PNG, the Solomon Islands and Vietnam.
- Tropical distant-water bigeye/yellowfin-target fishery comprises "distant-water" vessels from Japan, Korea, Chinese-Taipei, mainland China and Vanuatu. These vessels primarily operate in the eastern tropical waters of the WCP–CA (and into the EPO), targeting bigeye and yellowfin tuna for the frozen sashimi market.
- South Pacific distant-water albacore fishery comprises "distant-water" vessels from Chinese-Taipei, mainland China and Vanuatu operating in the south Pacific, generally below 20°S, targeting albacore tuna destined for canneries.
- Domestic fisheries in the sub-tropical and temperate WCP–CA comprise vessels targeting different species within the same fleet depending on market, season and/or area. These fleets include the domestic fisheries of Australia, Japan, New Zealand and Hawai'i. For example, the Hawaiian longline fleet has a component that targets swordfish and another that targets bigeye tuna.
- South Pacific distant-water swordfish fishery is a relatively new fishery and comprises "distant-water" vessels from Spain and Portugal (one vessel started fishing in 2011).
- North Pacific distant-water albacore and swordfish fisheries mainly comprise "distant-water" vessels from Japan (swordfish and albacore), Chinese-Taipei (albacore only) and Vanuatu (albacore only).

Catch: The provisional WCP–CA longline catch (191,666 mt) for 2021 is the lowest catch since 1993 at this stage, acknowledging the negative impacts due to COVID-19 but also that coverage of available 2021 data is not yet complete. The COVID-19 restrictions played a role in the distribution of 2021 effort in the longline fishery, with clear declines in effort in both the south Pacific Albacore fishery and in the tropical longline fishery. The *La Niña* conditions during 2020 and 2021 may also have contributed to lower catches in the longline fishery, although further investigation would be required to confirm this hypothesis.

The WCP–CA albacore longline catch (66,475 mt – 35%) for 2021 was the lowest since 1996, and nearly 40,000 mt lower than the record of 106,142 mt attained in 2010. The provisional bigeye catch (49,511 mt – 26%) for 2021 was the lowest since 1983, and well down on the bigeye catch levels experienced in the 2000s (e.g. the 2004 longline bigeye catch was 99,709 mt). The yellowfin catch for 2021 (71,847 mt – 37%), as in 2020, was a significant drop on the high catch level in 2019 (106,279 mt).

The distant-water fleet dynamics have continued to evolve in recent years, with catches down from record levels in the mid-2000s initially due to a reduction in vessel numbers, although vessel numbers for some fleets appear to be on the rise again in recent years, but with variation in areas fished and target species. The Japanese distant water and offshore longline fleets have experienced a substantial decline in both bigeye catches (from 20,725 mt in 2004 to 1,524 mt in 2021) and vessel numbers (366 in 2004 to 71 in 2021). The Chinese-Taipei distant-water longline fleet bigeye catch declined from 16,888 mt in 2004 to 3,667 mt in 2021, mainly related to a substantial drop in vessel numbers (137 vessels in 2004 reduced to 85 vessels in 2021). The Korean distant-water longline fleet experienced some decline in bigeye and yellowfin catches since the period of highest catches 15–20 years ago in line with a reduction in vessel numbers – from 184 vessels active in 2002 reduced to 94 vessels in 2021.

In contrast, the China longline fleet catches of albacore tuna have been amongst the highest ever in recent years (this fleet caught on average 20,000–25,000 mt of albacore tuna in the WCP-CA in recent years, although the 2021 albacore tuna catch was 16,076 mt).

With domestic fleet sizes continuing to increase as foreign-offshore and distant-water fleets decrease, this evolution in fleet dynamics no doubt has some effect on the species composition of the catch. For example, the increase in effort by the Pacific Islands domestic fleets has primarily been in albacore fisheries, although this had been balanced to some extent by the switch to targeting bigeye tuna (from albacore) by certain vessels in the distant-water Chinese-Taipei fleet almost a decade ago. More detail on individual fleet activities during recent years is available in the WCPFC–SC18 National Fisheries Reports.

Fleet distribution: Effort by the large-vessel, distant-water fleets of Japan, Korea and Chinese-Taipei accounts for most of the effort, but there has been some reduction in vessel numbers in some fleets over the past decade. Effort is widespread as sectors of these fleets target bigeye and yellowfin for the frozen sashimi market in central and eastern tropical waters, and albacore for canning in the more temperate waters, mainly in international waters.

Activity by the foreign-offshore fleets from Japan, mainland China and Chinese-Taipei is restricted to tropical waters, targeting bigeye and yellowfin for the fresh sashimi market; these fleets have limited overlap with the distant-water fleets. The substantial "offshore" effort in the west of the region is primarily by the Indonesian, Chinese-Taipei and Vietnamese domestic fleets targeting yellowfin and bigeye (the latter now predominantly using the handline gear). The growth in domestic fleets targeting albacore tuna in the South Pacific over the past decade has been noted; the most prominent fleets in this category are the Cook Islands, Samoa, Fiji, French Polynesia, Solomon Islands (when chartering arrangements are active), Tonga and Vanuatu fleets.

Table 40. Total reported longline catch (mt) of PMUS in the Pacific Ocean

Year	Albacore	Yellowfin	Bigeye	Striped Marlin	Black Marlin	Blue Marlin	Swordfish	Total
2012	122,167	100,620	120,138	6,469	2,007	18,262	43,570	413,233
2013	117,437	88,129	101,807	5,881	1,820	20,037	41,032	376,143
2014	108,978	109,024	110,774	5,625	2,201	20,982	39,422	397,006
2015	112,161	115,012	114,921	5,268	2,522	20,231	44,691	414,806
2016	92,514	101,677	98,618	4,335	1,313	18,598	42,056	359,111
2017	116,876	96,707	93,486	4,411	1,138	16,454	38,103	367,175
2018	102,436	110,195	98,618	4,321	1,245	15,774	40,117	372,706
2019	107,067	117,327	97,015	4,872	1,161	14,393	34,514	376,349
2020	87,568	87,017	84,261	4,923	1,513	11,145	36,027	312,454
2021	89,574	86,664	68,303	4,953	1,345	10,172	35,354	296,365
Average	105,678	101,237	98,794	5,106	1,627	16,605	39,489	368,535
STD deviation	12,300	11,533	15,058	712	484	3,765	3,478	38,773

Source: SPC (2022) and IATTC (2022).

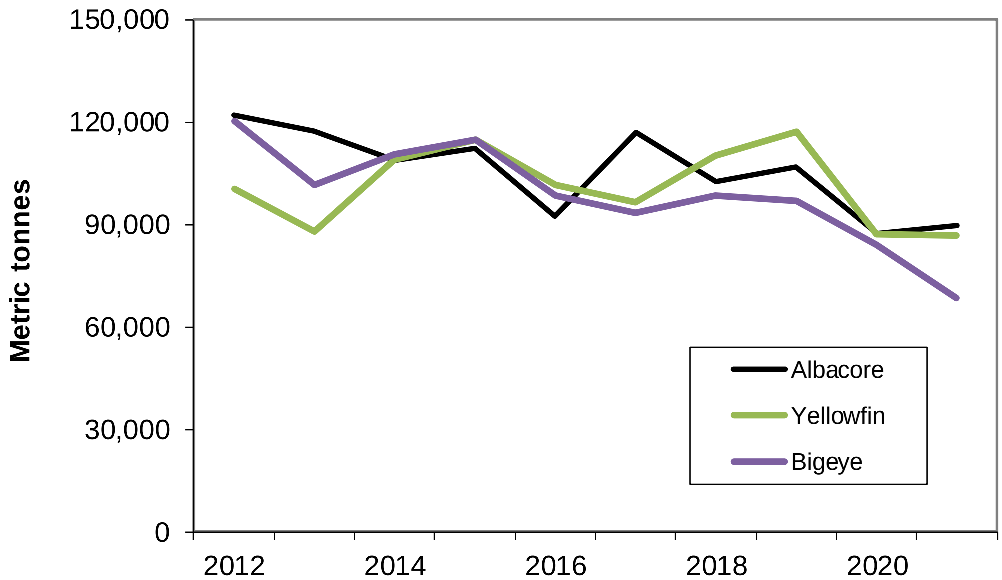


Figure 116. Reported longline tuna catches in the Pacific Ocean

Source: PC (2022) and IATTC (2022).

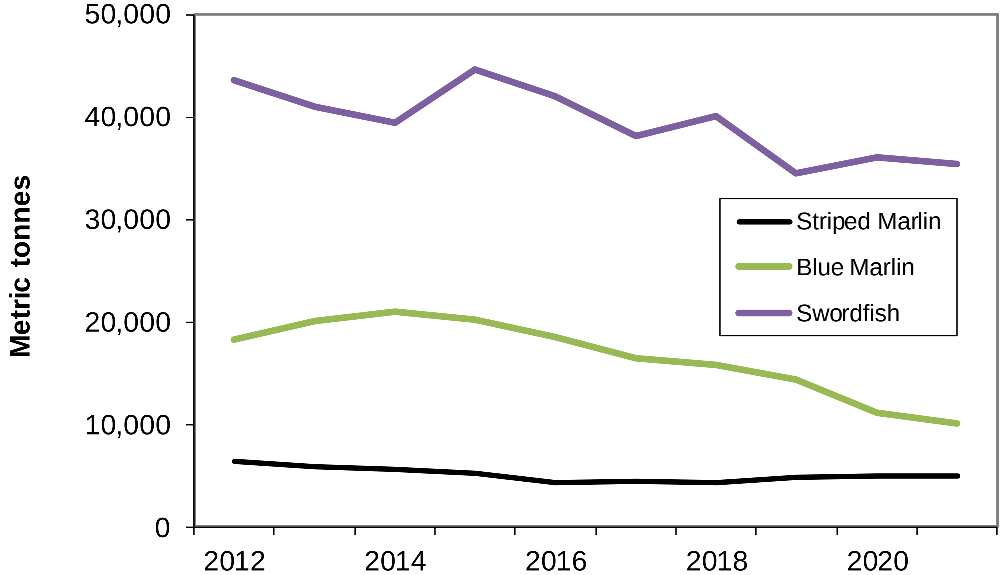


Figure 117. Reported longline billfish catches in the Pacific Ocean
Source: SPC (2022) and IATTC (2022).

2.6.4.3 POLE-AND-LINE FISHERY IN THE WCPFC

Source: WCPFC-SC18-2022 GN-WP-01

Vessels: Economic factors and technological advances in the purse seine fishery (primarily targeting the same species, skipjack) have resulted in a gradual decline in the number of vessels in the pole-and-line fishery and in the annual pole-and-line catch during the past 15–20 years. The gradual reduction in numbers of vessels has occurred in all pole-and-line fleets over the past decade. Pacific Island domestic fleets have declined in recent years – fisheries formerly operating in Fiji, Palau and Papua New Guinea are no longer active, only one vessel is now operating (occasionally) in Kiribati, and fishing activity in the Solomon Islands fishery during the 2000s was reduced substantially from the level experienced during the 1990s. Several vessels continue to fish in Hawai'i, and the French Polynesian *bonitier* fleet remains active (30 vessels in 2021), but an increasing number of vessels have turned to longline fishing. Vessel and catches from Indonesian pole-and-line fleet have also declined over recent years. There is continued interest in pole-and-line fish associated with certification/ecolabelling.

Catch: The provisional 2021 pole-and-line catch (123,528 mt) was lower than the 2020 catch (200,345 mt) and at this stage, the lowest annual catch since the early-1960s, due to reduced catches in both the Japanese and the Indonesian fisheries, although 2021 estimates are provisional at this stage. Skipjack accounts for the majority of the catch (~70-83% in recent years, but typically more than 85% of the total catch in tropical areas) and albacore (5– 10% in recent years) is taken by the Japanese coastal and offshore fleets in the temperate waters of the north Pacific. Yellowfin tuna (recently 10–15%) and a small component of bigeye tuna (1–4%) make up the remainder of the catch. There are only four pole and-line fleets currently active in the WCPO (French Polynesia, Japan, Indonesia and Solomon Islands). Japanese distant-water and offshore fleets (67,910 mt in 2021), and the

Indonesian fleets (54,204 mt in 2021), account for nearly all of the WCP–CA pole-and-line catch (99% in 2021). The catches by the Japanese distant-water and offshore fleets in recent years have been the lowest for several decades and this is no doubt related to the continued reduction in vessel numbers (although the vessel numbers have been stable at around 75-80 over the past 5 years). The Solomon Islands fleet recovered from low catch levels experienced in the early 2000s (only 2,773 mt in 2000 due to civil unrest) to reach a level of 10,448 mt in 2003. This fleet ceased operating in 2009 but resumed fishing in 2011 with catches generally around 1,000 mt (1,200 mt in 2021 from 4 vessels).

Fleet distribution: The WCP–CA pole-and-line fishery has several components:

- the year-round tropical skipjack fishery, mainly involving the domestic fleets of Indonesia, Solomon Islands and French Polynesia, and the distant water fleet of Japan
- seasonal sub-tropical skipjack fisheries in the domestic (home) waters of Japan, Australia, Hawaii, and Fiji
- a seasonal albacore/skipjack fishery east of Japan (largely an extension of the Japan home-water fishery).

Table 41. Total reported pole-and-line catch (mt) of skipjack in the Pacific Ocean

Year	Catch
2012	170,841
2013	169,189
2014	148,851
2015	151,317
2016	156,603
2017	123,466
2018	183,935
2019	158,225
2020	159,440
2021	146,840
Average	156,871
STD deviation	16,328

Source: PC (2022).

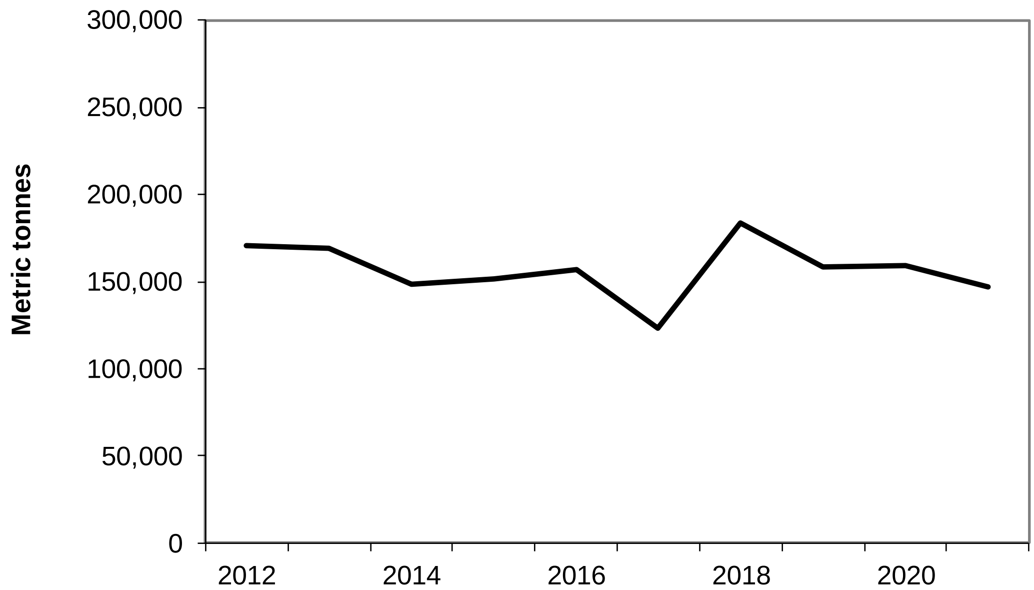


Figure 118. Reported pole-and-line catch (mt) in the Pacific Ocean

Source: PC (2022).

2.6.5 STATUS OF THE STOCKS

National Standard 1 of the MSA requires that conservation and management measures prevent overfishing while achieving, on a continual basis, the optimum yield from each fishery for the U.S. fishing industry. NMFS advisory guidelines for National Standard 1 require the Council to evaluate and describe in their fishery management plans, the criteria for determining if a stock is subject to overfishing, and when a stock is overfished, or approaching a condition of becoming overfished. This section briefly summarizes the status determination criteria (SDC) for pelagic MUS described in the Pelagic FEP, the stock status relative to the SDC, and lists the stock assessments completed since the last SAFE report.

2.6.5.1 DESCRIPTION OF OVERFISHED STATUS DETERMINATION CRITERIA

For all PMUS, the Council adopted a maximum sustainable yield (MSY) control rule shown in Figure 119. The Pelagic FEP uses minimum stock size threshold (MSST) as the SDC for an overfished determination, and a stock is considered overfished when its biomass (B) has declined below the MSST. The MSST is determined based on the natural mortality (M) of the stock and the biomass at MSY (B_{MSY}). Specifically, MSST = cB_{MSY}, where c is the greater of 0.5, or 1 minus the natural mortality rate (M). Expressed as a ratio, a stock is overfished when $B_{year}/B_{MSY} < 1\text{-}M$ or 0.50, whichever is greater. To illustrate these specifications of the MSST, for a stock with a natural mortality rate of 0.2, MSST would be set at $0.8B_{MSY}$, and the stock would be overfished if $B_{year}/B_{MSY} < 0.8$. For a stock with a natural mortality rate greater than 0.5, MSST cannot be set below $0.5B_{MSY}$, and the stock would be overfished if $B_{year}/B_{MSY} < 0.5$.

The Council has also adopted a warning reference point, B_{FLAG}, set equal to B_{MSY} to provide a trigger for consideration of management action before a stock's biomass reaches the MSST.

A stock is approaching an overfished condition when there is more than a 50 percent chance that the biomass will decline below the MSST within two years.

It is important to note that NMFS National Standard 1 guidelines at 50 CFR 665.310(e)(1)(i)(C) defines B_{MSY} as the long-term average size of the stock measured in terms of spawning biomass (SB) or other appropriate measure of the stock's reproductive potential that would be achieved by fishing at B_{MSY}. Thus, whenever available, NMFS will use estimates of SB in determining the status of a stock. When estimates of SB are not available, NMFS may use estimates of total biomass (B), or other reasonable proxies for determining stock status.

2.6.5.2 OVERFISHING SDC

The Pelagic FEP uses maximum fishing mortality threshold (MFMT) as the SDC for overfishing. Specifically, overfishing occurs when fishing mortality (F) is greater than the fishing mortality rate that results in MSY (F_{MSY}). Expressed as a ratio, the MFMT is exceeded and a stock is subject to overfishing when $F/F_{MSY} > 1.0$. However, for a stock where biomass has declined below MSST, the default MSY control rule requires the MFMT to be reduced linearly below F_{MSY} to allow for rebuilding of the stock.

It is also important to note that all finfish managed under the Pelagic FEP are also managed under the international agreements governing the WCPFC and/or the IATTC to which the U.S. is a party. Additionally, both the WCPFC and IATTC have adopted criteria for overfishing and overfished for certain species that differ from those described above. Pursuant to Section 304(e)(1), for those fisheries managed under a fishery management plan or international agreement, NMFS shall determine the status of a stock using the criteria specified in the plan, or the agreement. For the purpose of stock status determinations, NMFS will determine stock status of Pelagic MUS using the SDC described in the Pelagic FEP.

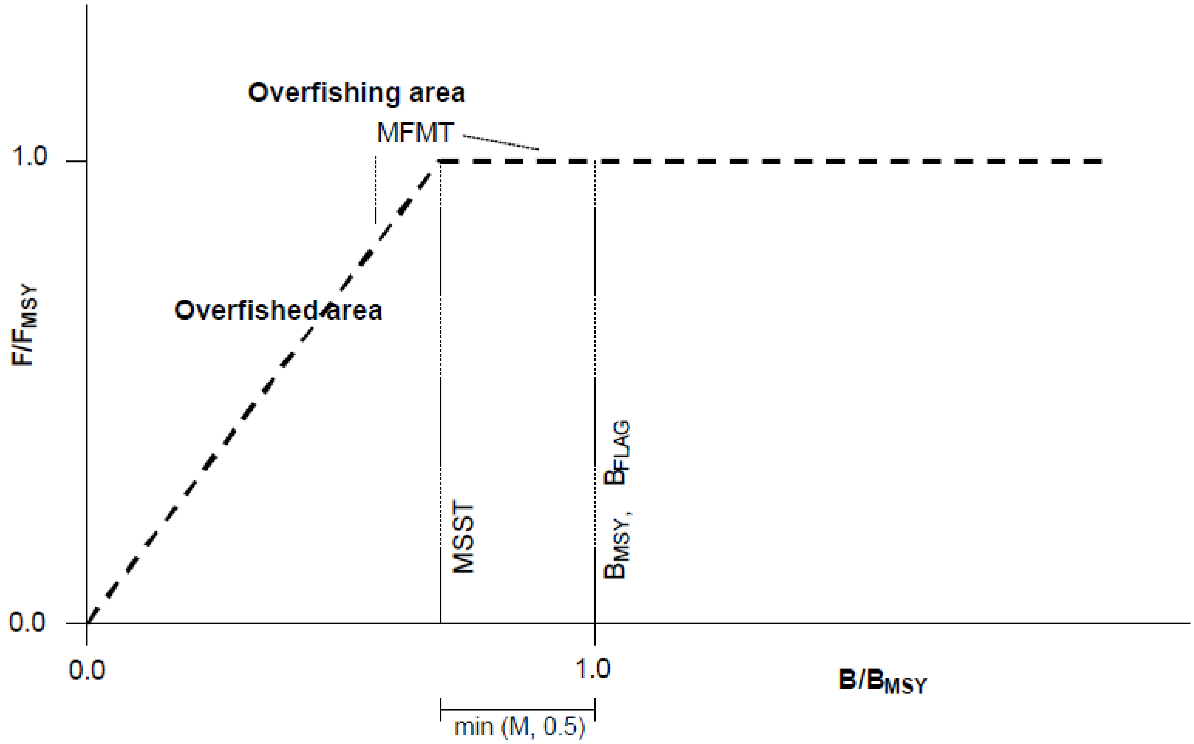


Figure 119. MSY control rule and reference points for pelagic MUS

2.6.6 INFORMATION ON OFL, ABC, AND ACL

Because pelagic squid have an annual life cycle, and all pelagic finfish are subject to management under the international agreements governing the WCPFC and/or the IATTC, all pelagic MUS are excepted from annual catch limit (ACL) and accountability measure requirements of section 303(a)(15) of the MSA, and related reference points. However, this statutory exception does not preclude the Council from specifying ACLs and related reference points for pelagic MUS using the ACL process described in the Pelagic FEP, if the Council deems such specifications are necessary to meet the objectives of the plan.

2.6.7 STOCK ASSESSMENTS COMPLETED SINCE THE LAST PELAGIC SAFE REPORT

Stock status is most reliably determined from stock assessments that integrate fishery and life history information across the range of the stock. For Pelagic MUS, most stock assessments are conducted by several international organizations. In the EPO, IATTC staff conduct stock assessments mainly for tropical tunas (bigeye and yellowfin) and some billfish (striped marlin, swordfish). These assessments are presented to the Scientific Advisory Committee of the IATTC and then to the full IATTC plenary. Assessments for IATTC managed stocks may be accessed on the IATTC meeting webpage.

In the WCPO, the Pacific Community's Oceanic Fisheries Program (OFP-SPC) conducts stock assessments as the science provider to the WCPFC. Like the IATTC, the PC-OFP generally focuses on the tropical tunas, but also conduct stock assessments for South Pacific albacore and southwest Pacific swordfish and striped marlin. In the North Pacific Ocean, the

ISC for Tuna and Tuna-like Species in the North Pacific Ocean conducts stock assessments specifically for the WCPFC Northern Committee. These assessments are presented to the Scientific Committee of the WCPFC and then to the full WCPFC plenary. Assessments for WCPFC managed stocks may be accessed on the WCPFC meeting webpage.

Table 42 summarizes the stock assessments for pelagic MUS completed or scheduled for completion between 2017 and 2022.

Table 42. Schedule of completed stock assessments for WPRFMC PMUS

Management Unit Species	Year Completed	Management Unit Species	Year Completed
Albacore (S. Pacific)	2021	Swordfish (N. Pacific)	2018
Albacore (N. Pacific)	2020	Wahoo	
Other tuna relatives (*Auxis* sp.)		Yellowfin Tuna (WCPO)	2020
(*allothunnus* sp., *Scomber* sp.)		Kawakawa	
Bigeye Tuna (WCPO)	2020	**Bluefin Tuna (Pacific)**	**2022**
Black Marlin		Common Thresher Shark	
Blue Marlin	2021	Pelagic Thresher Shark	
Mahimahi		Bigeye Thresher Shark	2017 - risk assessment
Oilfishes		Shortfin Mako Shark	2018
Opah		Longfin Mako Shark	
Pomfrets		**Blue Shark (N. Pacific)**	**2022**
Sailfish		Silky Shark	2018
Shortbill Spearfish		Oceanic Whitetip Shark	2019
Skipjack Tuna (WCPO)	**2022**	Salmon Shark	
Striped Marlin (N. Pacific)	2019	Squid	

The following pages include links to the most recent stock assessments and assessment results completed in 2022, including descriptions provided in the WCPFC SC18 Summary Report. For more information on stock assessments and assessment results completed prior to 2021, please see the past pelagic annual SAFE reports.

2.6.7.1 SKIPJACK TUNA

Stock assessment: Castillo Jordan et al. (2022).

Link: https://meetings.wcpfc.int/node/16242.

a. Stock status and trends

SC18 noted that the total catch in 2021 was 1,547,945t, a 10% decrease from 2020 and a 14% decrease from the 2016-2020 average. Purse seine catch in 2021 (1,254,022t) was a 11% decrease from 2020 and a 13% decrease from the 2016-2020 average. Pole and line catch (97,908t) was a 39% decrease from 2020 and a 37% decrease from the 2016-2020 average catch. Catch by other gears totalled 192,182t and was a 25% increase from 2020 and 5% decrease from the average catch in 2016-2020.

SC18 adopted the 2022 assessment and a structural uncertainty grid was used to develop management advice which included axes for tag mixing (three options), growth (two options) and steepness (three options), resulting in 18 models (Table SKJ-01). All models within the grid were equally weighted. The assessment grid of models estimated that the overall median recent spawning depletion ($SB_{recent}/SB_{F=0}$) is 0.51 (80^{th} percentile 0.43-0.64), which is close to the interim target reference point (TRP) of 0.50 (CMM 2021-01). No grid models were below the limit reference point (LRP) of 0.20 $SB_{F=0}$. The median of F_{recent}/F_{MSY} was 0.32 (80^{th} percentile 0.18-0.45) (Table SKJ-02). The 2022 stock assessment of skipjack tuna for the WCPO, indicated that according to WCPFC reference points the stock is not overfished, nor undergoing overfishing.

Catches of skipjack tuna in the WCPO have increased from approximately 250,000 metric tonnes in the late 1970s to a peak catch of approximately 2,000,000 metric tonnes in 2019; catches have dropped from 2019 to 2021 (Figure SKJ-02). Catches are dominated by purse seine fisheries in equatorial regions 6, 7, and 8, and purse seine and other gears in region 5 (Figure SKJ-03). Catches are dominated by pole-and-line in the northern regions 1–4 and continue to be low compared to those in the equatorial regions (Figures SKJ-03 and SKJ-04). The spawning potential and total biomass, while showing variability over time, do not show sustained long-term declining trends (Figures SKJ-05 and SKJ-08). In contrast, the trajectory of spawning potential depletion ($SB/SB_{F=0}$) shows a long-term trend towards a more depleted status (Figure SKJ-09). The spawning potential depletion trajectory was largely driven by the model estimates of increased levels of unfished spawning potential over time which are in turn driven by the model estimates of increasing recruitment over time (Figure SKJ-05). The model estimated increased recruitment over time to account for the increased catches in the face of a relatively stable biomass that is partly informed by several long-term stable CPUE indices of abundance (i.e., pole-and-line fishery indices) within the assessment. However, it is noted that spawning potential, recruitment and total biomass are estimated to have declined since around 2010 (Figure SKJ-05).

Fishing mortality continues to increase over time for the adult and juvenile components of the stock, with fishing mortality being consistently higher for adults (Figure SKJ-06).

Fishery impact analyses show that the purse seine fisheries continue to dominate the impact in the equatorial regions 6, 7, and 8, with similar impacts by the ‘associated’ and ‘unassociated’ components, except for region 8 where ‘associated’ fishing appears to have more impact (Figure SKJ-07). Fishery impacts in region 5 are dominated by purse seine and other gears, and in regions 1-4, by pole-and-line, but with increasing impact of purse seine over time (Figure SKJ-07).

The influences of the structural uncertainty grid axes on key management quantities are shown in Figure SKJ-10. Tag mixing assumptions that applied longer tag mixing periods, and the externally estimated growth curve, resulted in more optimistic estimates of spawning potential depletion and spawning potential and lower fishing mortality.

Majuro and Kobe plots summarising stock status for the 18 models in the structural uncertainty grid are included for the ‘latest’ (2021, Figure SKJ-11) and ‘recent’ periods (2018-2021, Figure SKJ-12). These plots show that the stock status estimates across the 18 models are all within the zones indicating that the stock is not overfished nor undergoing overfishing.

The assessment provided a range of diagnostic analyses derived from the diagnostic model that indicated conflict between tag and CPUE data and instability in the convergence minima. Despite this, the model showed low retrospective bias and the important spawning potential depletion management quantities were robust to the differences in model convergence.

However, as noted by several CCMs, data conflicts and the instability in model convergence minima require follow-up work and should be improved.

SC18 noted that the skipjack assessment continues to show that the stock is currently moderately exploited and the level of fishing mortality is sustainable.

SC18 noted that the stock was assessed to be above the adopted LRP and fished at rates below F_{MSY} with 100% probability. Therefore, the skipjack stock is not overfished, nor subject to overfishing. At the same time, it was also noted that fishing mortality is continuously increasing for both adult and juvenile stages while the estimated spawning potential has shown a declining trend since the mid to late 2000s, and spawning potential depletion reached a historically low level in recent years.

SC18 noted that levels of fishing mortality and depletion differ between regions, and that fishery impact was highest in the tropical region (Regions 5, 6, 7 and 8 in the stock assessment model), mainly due to the purse seine fisheries in the equatorial Pacific and the "other" fisheries within the Western Pacific.

b. Management advice and implications

SC18 did not achieve a consensus on the management advice for skipjack tuna in the WCPO.

2.6.7.2 BLUEFIN TUNA

Stock assessment: ISC (2022a).

Link: https://isc.fra.go.jp/pdf/ISC22/ISC22_ANNEX06_Report_of_the_PBFWG_Workshop_Dec2021.pdf.

a. Stock status and trends

SC18 welcomed successful completion of an updated Pacific bluefin tuna (PBF) stock assessment and noted the following stock status and conservation information provided by ISC.

SC18 noted the following stock status from ISC:

PBF spawning stock biomass (SSB) has gradually increased in the last 10 years, and the rate of increase is accelerating. These biomass increases coincide with a decline in fishing mortality, particularly for fish aged 0 to 3, over the last decade. The latest (2020) SSB is estimated to be10.2% of SSB_0.

1) No biomass-based limit or target reference points have been adopted for PBF, but the PBF stock is overfished relative to the potential biomass-based reference points (20%SSB_0) adopted for other tuna species by the IATTC and WCPFC. On the other hand, SSB reached its initial rebuilding target (SSB_{MED} = 6.3%SSB_0) in 2019, 5 years earlier than originally anticipated by the RFMOs.
2) No fishing mortality-based reference points have been adopted for PBF by the IATTC and WCPFC. The recent (2018-2020) $F_{\%SPR}$ is estimated to produce a fishing intensity of 30.7%SPR and is below the level corresponding to overfishing for many F-based reference points proposed for tuna species

(Table PBF2), including SPR20%.

SC18 noted that while the gradual improvement of the Pacific bluefin tuna stock is a step in the right direction, it must be remembered that the current spawning biomass of the stock is only 10.2% of the unfished level. This is well below the LRP of 20% adopted for the key tuna species in WCPFC and suggests the Pacific bluefin tuna stock remains overfished relative to the LRP of key tuna species.

SC18 noted some CCMs encourage a precautionary approach towards the management of Pacific bluefin tuna until such time as the second rebuilding target is met, especially as the stock assessment and projection results are based on certain assumptions, including those on future recruitment, that may not always be met.

SC18 supported the continued monitoring of recruitment and spawning stock biomass, and research on a recruitment index for the stock assessment given the uncertainty in future recruitment and the influence of recruitment on stock biomass, as well as the impact of changes in fishing operations due to management changes.

b. Management advice and implications

SC18 noted that the updated stock assessment presented at SC18 indicates that the stock is likely recovering as planned or possibly faster, which suggests that the measures incorporated in CMM 2021-02 appear to be working as intended.

SC18 recommended that the Commission exercise a precautionary approach, and noted that the PBF stock is still in a depleted state (10.2% of SSB_0) when it considers any revisions to the current CMM. Consideration of any increases to the catch limit needs to be weighted against reducing the probability of recovering to the second rebuilding target.

SC18 further welcomed ISC's effort on further investigation of structural uncertainty to incorporate it in future management advice.

SC18 noted the following management information from ISC:

After the steady decline in SSB from 1996 to the historically low level in 2010, the PBF stock has started recovering, and recovery has been more rapid in recent years, consistent with the implementation of stringent management measures. The 2020 SSB was above the initial rebuilding target but remains below the second rebuilding target adopted by the WCPFC and IATTC. However, stock recovery is occurring at a faster rate than anticipated by managers when the Harvest Strategy to foster rebuilding (WCPFC HS 2017-02) was implemented in 2014. The fishing mortality ($F_{\%SPR}$) in 2018-2020 has been reduced to a level producing 30.7%SPR, the lowest observed in the time series. Based on these findings, the following information on the conservation of the Pacific bluefin tuna stock is provided:

1. The PBF stock is recovering from the historically low biomass in 2010 and has exceeded the initial rebuilding target ($SSB_{MED1952-2014}$) five years earlier than expected. The rate of recovery is increasing and under all projection scenarios evaluated, it is very likely the second rebuilding target (20%SSB_0 with 60% probability) will be achieved (probabilities > 90%) by 2029 (Table PBF-3). The risk of SSB falling below the historical lowest observed SSB at least once in 10 years is

negligible.

2. The projection results show that increases in catches are possible without affecting the attainment of the second rebuilding objective. Increases in catch should consider both the rebuilding rate and the distribution of catch between small and large fish.
3. The projection results assume that the CMMs are fully implemented and are based on certain biological and other assumptions. For example, these future projection results do not contain assumptions about discard mortality. Although the impact of discards on SSB is small compared to other fisheries, discards should be considered in future harvest scenarios.
4. Given the uncertainty in future recruitment and the influence of recruitment on stock biomass as well as the impact of changes in fishing operations due to the management, monitoring recruitment and SSB should continue and research on a recruitment index for the stock assessment should be pursued.
5. The results of projections from sensitivity models with lower productivity assumptions show that this conservation information is robust to uncertainty in stock productivity.

2.6.7.3 NORTH PACIFIC BLUE SHARK

Stock assessment: ISC (2022).

Link:
https://isc.fra.go.jp/pdf/ISC22/ISC22_ANNEX12_Stock_Assessment_for_Blue_Shark.pdf.

a. Stock status and trends

SC18 thanked ISC for the updated stock assessment for North Pacific blue shark and noted the following conclusions on the stock status provided by ISC.

Target and limit reference points have not yet been established for pelagic sharks in the Pacific Ocean by either the WCPFC or the IATTC. Stock status was reported in relation to MSY-based reference points. The following information on the status of North Pacific BSH was provided.

The median of the annual spawning stock biomass (SSB) from the model ensemble had a steadily decreasing trend until 1992 and slightly increased until recent years. The median of the annual F from the model ensemble gradually increased in the late 1970s and 1980s and suddenly dropped around 1990, which slightly preceded the high-seas drift gillnet fishing ban, after which it has been slightly decreasing. The median of the annual age-0 recruitment estimates from the model ensemble appeared relatively stable with a slightly decreasing trend over the assessment period except for 1988, which shows a large pulse. The historical trajectories of stock status from the model ensemble revealed that North Pacific BSH had experienced some level of depletion and overfishing in previous years, showing that the trajectories moved through the overfishing zone, overfished and overfishing zone, and overfished zone in the Kobe plots relative to MSY reference points. However, in the last two decades, median estimates of the stock condition returned into the not overfished and not overfishing zone.

Based on these findings, the following information on the status of the North Pacific BSH is provided:

1) Median female SSB in 2020 was estimated to be 1.170 of SSB_{MSY} (80^{th} percentile, 0.570 - 1.776) and is likely (63.5% probability) not in an overfished condition relative to MSY-based reference points.
2) Recent annual F ($F_{2017-2019}$) is estimated to be below F_{MSY} and overfishing of the stock is very likely (91.9% probability) not occurring relative to MSY-based reference points.
3) The base case model results show that there is a 61.9% joint probability that NPO BSH stock is not in an overfished condition and that overfishing is not occurring relative to MSY based reference points.

SC18 noted that the current assessment is an improvement over the previous assessment and supports the model ensemble approach taken in the 2022 stock assessment as a more comprehensive way of characterizing structural uncertainty in stock status. However, SC18 noted that the model ensemble did not consider some key uncertainties, in particular natural mortality or stock-recruitment steepness and SC18 recommended a more thorough use of the model ensemble approach is recommended to better represent uncertainty for future assessments.

b. Management advice and implications

SC18 noted the following conservation information from ISC.

Stock projections of biomass and catch of NPO BSH from 2020 to 2030 were performed assuming four different harvest policies: $F_{current}$ (2017-2019), F_{MSY}, $F_{current}$+20%, and $F_{current}$-20% and evaluated relative to MSY-based reference points. Based on these findings, the following conservation information is provided:

1) Future projections in three of the four harvest scenarios ($F_{current}$ (2017-2019), $F_{current}$+20%, and $F_{current}$-20%) showed that median SSB in the North Pacific Ocean will likely (>50 probability) increase; the F_{MSY} harvest scenario led to a decrease in median SSB.
2) Median estimated SSB of BSH in the North Pacific Ocean will likely (>50 probability) remain above SSB_{MSY} in the next ten years for all scenarios except F_{MSY}; harvesting at F_{MSY} decreases SSB below SSB_{MSY} (Figure E5).
3) There remain some uncertainties in the time series based on the quality (observer vs. logbook) and timespans of catch and relative abundance indices, limited size composition data for several fisheries, the potential for additional catch not accounted for in the assessment, and uncertainty regarding life history parameters. Continued improvements in the monitoring of BSH catches, including recording the size and sex of sharks retained and discarded for all fisheries, as well as continued research into the biology, ecology, and spatial structure of BSH in the North Pacific Ocean are recommended.

SC18 noted that recent estimated recruitment was below the average level from the Beverton-Holt stock recruit relationship, and that if these low recruitments persist into the future then the projection results could be overly optimistic.

Table 43. Estimates of stock status in relation to overfishing and overfished reference points for WPFMC PMUS

Stock	Overfishing reference point	Is overfishing occurring?	Approaching Overfishing (2 yr)	Overfished reference point	Is the stock overfished?	Approaching Overfished (2 yr)	Assessment results[1]	Natural mortality[2]	MSST
Skipjack Tuna (WCPO)	$F_{2017-2020}/F_{MSY}$=0.32	No	No	$SB_{2018-2022}/SB_{MSY}$=3.12, $SB_{2018-2021}/SB_{F=0}$=0.52	No	No	Castillo et al. (2022), SC18 report	>0.5 yr-1	0.5 SB_{MSY}
Skipjack Tuna (EPO)	NA	NA	NA	NA	NA	NA	Maunder (2018)	NA	NA
Yellowfin Tuna (WCPO)	$F_{2014-2017}/F_{MSY}$=0.37	No	No	SB_{2018}/SB_{MSY}=2.43, $SB_{2018}/SB_{F=0}$=0.54	No	No	Vincent et al. (2020)	0.8-1.6 yr^{-1}	0.5 SB_{MSY}
Yellowfin Tuna (EPO)	F/F_{MSY}=1.01	Yes, because F>MFMT	Not applicable	$SB_{2015-2017}/SB_{MSY}$=1.08, $B_{2015-2017}/B_{MSY}$=1.35	No	No	Minte-Vera et al. (2018)	0.2-0.7 yr^{-1}	0.5 B_{MSY}
Albacore (S. Pacific)	$F_{2015-2018}/F_{MSY}$=0.25	No	No	SB_{2019}/SB_{MSY}=2.50 $SB_{2019}/SB_{F=0}$=0.37	No	No	Castillo Jordan et al. (2021)	0.2-0.4 yr^{-1}	0.6 SB_{MSY}
Albacore (N. Pacific)	$F_{2015-2017}/F_{MSY}$=0.60	No	No	$SB_{2015-2017}/SB_{F=0}$=0.43	No	No	ISC (2020)	0.4 yr^{-1}	0.6 B_{MSY}
Bigeye Tuna (WCPO)	$F_{2014-2017}/F_{MSY}$=0.74	No	No	SB_{2018}/SB_{MSY}=1.70, $SB_{2018}/SB_{F=0}$=0.38	No, because SSB>MSST	No	Ducharme-Barth et al. (2020)	0.4 yr^{-1}	0.6 SB_{MSY}
Bigeye Tuna (EPO)	$F_{2015-2017}/F_{MSY}$=1.15	Yes, because F>MFMT	Not applicable	$SB_{2015-2017}/SB_{MSY}$=1.02, $B_{2012-2015}/B_{MSY}$=0.91	No, because SSB>MSST	Not applicable	Xu et al. (2018)	0.1-0.25 yr^{-1}	~0.75 B_{MSY}
Pacific Bluefin Tuna	F is 30.7% SPR	No	Not applicable	$SB_{2019}/SB_{F=0}$=0.102	Yes, because SSB<MSST	Not applicable	ISC (2022)	0.25-1.6 yr-1	~0.75 B_{MSY}
Blue Marlin (Pacific)	$F_{2017-2019}/F_{MSY}$=0.6	No	Unknown	$SB_{2017-2019}/SB_{MSY}$=1.13	No	Unknown	ISC (2021)	0.22-0.42 yr^{-1}	~0.7 SB_{MSY}
Swordfish (WCNPO)	$F_{2013-2015}/F_{MSY}$=0.45	No	Unknown	SB_{2016}/SB_{MSY}=1.87	No	Unknown	ISC (2018a)	0.3 yr^{-1}	0.7 B_{MSY}
Swordfish (EPO)	F_{2012}/F_{MSY} = 1.11	Yes, because F > MFMT	Not applicable	SB_{2012}/SB_{MSY} =1.87	No	Unknown	ISC (2014)	0.35 yr^{-1}	0.65 B_{MSY}
Striped Marlin WC (N. Pacific)	$F_{2015-2017}/F_{MSY}$=1.07	Yes, because F>MFMT	Not applicable	SB_{2017}/SB_{MSY}=0.38	Yes, because SSB_{2017}<MSST	Not applicable	ISC (2019)	0.4 yr^{-1}	0.6 SB_{MSY}

Stock	Overfishing reference point	Is overfishing occurring?	Approaching Overfishing (2 yr)	Overfished reference point	Is the stock overfished?	Approaching Overfished (2 yr)	Assessment results[1]	Natural mortality[2]	MSST
Striped Marlin (NEPO)	Not provided in assessment	No	No	$SB_{2009}/SB_{MSY}=1.5$	No	Unknown	Hinton and Maunder (2011)	0.5 yr^{-1}	0.5 B_{MSY}
Blue Shark (N. Pacific)[2]	$F_{2017-2019}/F_{MSY}=0.445$	No	Unknown	$SB_{2020}/SB_{MSY}=1.17$	No	Unknown	ISC (2022)	0.145-0.785 yr-1	~0.8 SB_{MSY}
Oceanic white-tip shark (WCPO)[3]	$F_{2016}/F_{MSY}=3.30$	Yes	Not applicable	$SB_{2016}/SB_{MSY}=0.11$	Yes	Not applicable	Tremblay-Boyer et al. (2019), SC15 Report	0.18 yr^{-1}	0.82 B_{MSY}
Silky shark (WCPO)[3]	$F_{2016}/F_{MSY}=1.61$	Yes	Not applicable	$SB_{2016}/SB_{MSY}=1.18$	No	Unknown	Clarke et al. (2018), SC14 Report	0.18 yr^{-1}	0.82 B_{MSY}
Silky Shark (EPO)[3]	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Lennert-Cody et al. (2018)	Unknown	Unknown
Longfin mako shark (N. Pacific)	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Shortfin mako shark (N. Pacific)	$F_{2013-2015}/F_{MSY}=0.62$	No	Unknown	$SB_{2016}/SB_{MSY}=1.36$	No	Unknown	ISC (2018b)	0.128 yr^{-1}	0.872 B_{MSY}
Common thresher shark (N. Pacific)	$F/F_{MSY}=0.21$	No	Unknown	$SB/SB_{MSY}=1.3$	No	Unknown	Teo et al. (2018)	0.04 yr^{-1}	0.96 B_{MSY}
Bigeye thresher shark (N. Pacific)	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Pelagic thresher shark (N. Pacific)	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Salmon shark (N. Pacific)	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Mahimahi (Pacific)	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Wahoo (Pacific)	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown

Stock	Overfishing reference point	Is overfishing occurring?	Approaching Overfishing (2 yr)	Overfished reference point	Is the stock overfished?	Approaching Overfished (2 yr)	Assessment results[1]	Natural mortality[2]	MSST
Opah (Pacific)	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Pomfret (family Bramidae, W. Pacific)	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Black marlin (Pacific)	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Shortbill spearfish (Pacific)	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Sailfish (Pacific)	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Kawakawa (Pacific)	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Oilfish (family Gempylidae, Pacific)	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Other tuna relatives (*Auxis* spp., *Allothunnus* spp., and *Scomber* spp, Pacific)	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Squids (Pacific)	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown

[1]For some WCPO stocks, the Scientific Committee of the WCPFC may adjust the weighting of the structural uncertainty grid, based on scientific uncertainty, used to derive median limit reference points. For these stocks, the reference to the SC meeting report at which the weighting decision was made is provided in addition to the stock assessment report reference.
[2]Estimates based on Boggs et al. (2000) or assumed in the assessments.
[3]As of this publication, NMFS has not yet determined that this stock assessment is the best scientific information available for the purposes of stock status determination.

2.6.8 U.S. LONGLINE LANDINGS REPORTED TO WCPFC AND IATTC FOR 2022

The tables of this section show the catches of pelagic MUS by U.S. longline (Hawaii and California-based) and U.S. territorial longline fisheries in the WCPFC Convention Area from 2018-2022, as reported by NMFS to the WCPFC in 2023. The catches for 2022 are preliminary.

Table 44. U.S. and territorial longline catch (mt) by species in the WCPFC Statistical Area, 2018-2022

	U.S. in North Pacific Ocean					CNMI in North Pacific Ocean					Guam in North Pacific Ocean					American Samoa in North Pacific Ocean					American Samoa in South Pacific Ocean					Total				
	2022	2021	2020	2019	2018	2022	2021	2020	2019	2018	2022	2021	2020	2019	2018	2022	2021	2020	2019	2018	2022	2021	2020	2019	2018	2022	2021	2020	2019	2018
Vessels	142	137	135	138	136	119	131	119	128	121	0	0	0	0	0	133	24	122	127	113	11	12	11	18	14	153	150	146	156	151
Species																														
Albacore, NPO	108	105	48	88	59											22	30	8	12	11						129	135	57	101	70
Albacore, SPO																					1,073	835	542	1,050	1,542	1,073	835	542	1,050	1,542
Bigeye tuna	3,237	3,748	3,546	3,459	3,393	544	1,500	925	999	993						1,546	405	1,563	1,514	798	19	30	23	31	53	5,346	5,683	6,058	6,003	5,236
Pacific bluefin tuna	1	1	0	1	0																				1	1	1	1	2	1
Skipjack tuna	84	130	124	198	105											10	15	16	28	15	39	53	63	69	76	133	198	203	295	196
Yellowfin tuna	1,969	2,021	1,199	1,556	1,868											184	274	160	220	209	148	214	222	189	261	2,301	2,509	1,581	1,965	2,339
Other tuna	0	0	0	0	0																									
TOTAL TUNA	**5,399**	**6,005**	**4,918**	**5,302**	**5,425**	**544**	**1,500**	**925**	**999**	**993**						**1,762**	**725**	**1,747**	**1,774**	**1,034**	**1,278**	**1,132**	**851**	**1,339**	**1,934**	**8,984**	**9,362**	**8,442**	**9,415**	**9,384**
Black marlin																														
Blue marlin	351	332	440	747	529											52	31	44	83	38	47	34	28	29	32	450	397	513	860	598
Sailfish	8	9	5	12	9											1	1	1	2	1	1	1	1	2	1	9	11	7	16	11
Spearfish	111	110	94	154	171											8	10	11	16	15	1	1	0	2	1	120	121	105	173	187
Striped marlin, NPO	230	196	241	397	332											25	30	47	62	44						255	226	288	458	375
Striped marlin, SPO																					2	3	2	2	1	2	3	2	2	1
Other marlins	0	1	1	0	1																					0	1	1	0	1
Swordfish, NPO	735	528	266	510	590											26	39	40	44	41						760	567	306	555	631
Swordfish, SPO	0	0	0	0	0																3	3	3	4	6	3	3	3	4	6
TOTAL BILLFISH	**1,436**	**1,177**	**1,047**	**1,821**	**1,631**											**111**	**111**	**143**	**208**	**138**	**53**	**42**	**33**	**39**	**41**	**1,600**	**1,329**	**1,223**	**2,068**	**1,811**
Blue shark																									3					3
Mako shark	1	1	2	32	36											0	0	0	3	5	0	0	0	0	0	1	1	2	35	42
Thresher	2	1	1	4	2											0	1	0	1	0	0	0	0	1	1	2	1	1	5	2
Other sharks																														
Oceanic whitetip shark																														
Silky shark																														
Hammerhead shark																														
Tiger shark																														
Porbeagle																														
TOTAL SHARKS	**3**	**1**	**3**	**36**	**38**											**0**	**1**	**0**	**3**	**5**	**0**	**0**	**0**	**1**	**4**	**3**	**2**	**3**	**40**	**47**
Mahimahi	129	109	75	123	155											14	18	11	20	14	6	1	5	2	5	149	128	92	145	174
Moonfish	80	109	198	368	390											12	26	40	59	58	0	1	1	1	1	92	136	238	428	449
Oilfish	57	52	55	89	98											7	6	8	15	14	0	0	0	0	0	64	58	63	103	112
Pomfret	138	132	157	246	265											17	18	23	29	32	0	0	0	0	0	155	150	181	275	298
Wahoo	194	314	239	401	264											25	41	35	60	34	12	16	18	18	31	231	371	292	479	329
Other fish	1	2	1	1	4											0	0	0	1	0	0	1	0	0	0	2	3	2	2	5
TOTAL OTHER	**600**	**718**	**726**	**1,228**	**1,178**											**74**	**109**	**118**	**184**	**153**	**18**	**19**	**24**	**21**	**37**	**692**	**846**	**867**	**1,433**	**1,367**
GEAR TOTAL	**7,437**	**7,901**	**6,694**	**8,387**	**8,272**	**544**	**1,500**	**925**	**999**	**993**						**1,946**	**945**	**2,008**	**2,169**	**1,329**	**1,350**	**1,193**	**908**	**1,400**	**2,016**	**11,278**	**11,539**	**10,535**	**12,955**	**12,610**

Table 45. U.S. longline catch (mt) by species in the North Pacific Ocean, 2018-2022

	U.S. (ISC)				
	2022	**2021**	**2020**	**2019**	**2018**
Vessels	147	146	147	149	143
Species					
Albacore, North Pacific	201	226	156	104	87
Albacore, South Pacific					
Bigeye tuna	6,374	7,039	7,445	7,692	7,591
Pacific bluefin tuna	1	1	2	2	1
Skipjack tuna	103	153	168	261	150
Yellowfin tuna	2,427	2,501	1,733	2,029	2,500
Other tuna					
TOTAL TUNA	**9,107**	**9,920**	**9,504**	**10,088**	**10,327**
Black marlin					
Blue marlin	444	382	531	901	664
Sailfish	9	12	7	18	13
Spearfish	130	132	116	199	219
Striped marlin, North Pacific	283	247	336	545	465
Striped marlin, South Pacific					
Other marlins		1	2	1	1
Swordfish, North Pacific	927	684	543	734	1,052
Swordfish, South Pacific					
TOTAL BILLFISH	**1,793**	**1,459**	**1,534**	**2,398**	**2,414**
Blue shark					
Mako shark	2	5	16	47	60
Thresher	3	3	3	5	2
Other sharks					
Oceanic whitetip shark					
Silky shark					
Hammerhead shark					
Tiger shark					

	U.S. (ISC)				
	2022	**2021**	**2020**	**2019**	**2018**
Porbeagle					
TOTAL SHARKS	**5**	**8**	**19**	**52**	**62**
Mahimahi	178	166	119	198	227
Moonfish	239	385	740	1,039	1,392
Oilfish	75	74	83	140	143
Pomfret	189	182	227	332	389
Wahoo	250	406	334	571	390
Other fish	1	2	2	2	4
TOTAL OTHER	**932**	**1,214**	**1,505**	**2,281**	**2,545**
GEAR TOTAL	**11,837**	**12,601**	**12,563**	**14,819**	**15,348**

Table 46. U.S. longline catch (mt) by species in the Eastern Pacific Ocean, 2018-2022

	All U.S. vessels					**U.S. vessels ≥ 24 m**					**U.S. vessels ≤ 24 m**				
	2022	**2021**	**2020**	**2019**	**2018**	**2022**	**2021**	**2020**	**2019**	**2018**	**2022**	**2021**	**2020**	**2019**	**2018**
Vessels	108	112	121	126	121	22	23	27	30	30	86	89	94	96	91
Albacore, North Pacific	72	90	100	4	17	15	20	16	1	3	57	71	84	3	13
Albacore, South Pacific															
Bigeye tuna	1,047	1,386	1,410	1,720	2,408	178	357	332	507	524	869	1,029	1,078	1,212	1,883
Pacific bluefin tuna			1					1							
Skipjack tuna	8	8	28	35	30	1	2	4	9	9	7	5	24	26	21
Yellowfin tuna	274	205	374	254	422	41	51	82	75	99	233	155	292	179	323
Other tuna															
TOTAL TUNA	**1,402**	**1,690**	**1,913**	**2,013**	**2,876**	**236**	**430**	**435**	**593**	**635**	**1,166**	**1,260**	**1,478**	**1,420**	**2,241**
Black marlin															
Blue marlin	41	19	47	71	98	7	3	6	16	11	35	16	41	55	87
Sailfish	1	2	1	4	3	-	1	-	1	1	1	1	1	2	2
Spearfish	11	13	11	28	32	2	4	2	7	7	9	9	9	21	25
Striped marlin, North Pacific	28	21	48	87	90	3	6	11	23	15	24	15	37	64	74
Striped marlin, South															

	All U.S. vessels					U.S. vessels ≥ 24 m					U.S. vessels ≤ 24 m				
	2022	**2021**	**2020**	**2019**	**2018**	**2022**	**2021**	**2020**	**2019**	**2018**	**2022**	**2021**	**2020**	**2019**	**2018**
Pacific															
Other marlins				1					1						
Swordfish, North Pacific	167	117	237	179	422	96	90	194	110	215	71	27	43	69	207
Swordfish, South Pacific															
TOTAL BILLFISH	**247**	**172**	**345**	**369**	**644**	**108**	**103**	**213**	**158**	**249**	**140**	**68**	**132**	**211**	**395**
Blue shark															
Mako shark	1	5	14	12	19	1	4	13	8	11		1	1	4	8
Thresher	1	1	2			1	1	1							
Other sharks															
Oceanic whitetip shark															
Silky shark															
Hammerhead shark															
Tiger shark															
Porbeagle															
TOTAL SHARKS	**2**	**6**	**16**	**13**	**19**	**2**	**5**	**14**	**9**	**11**		**1**	**2**	**4**	**8**
Mahimahi	35	39	32	55	57	6	9	6	14	11	29	29	26	41	46
Moonfish	147	249	502	612	944	25	54	116	196	258	122	195	386	416	686
Oilfish	11	16	20	36	30	2	4	6	10	9	8	12	15	26	22
Pomfret	34	32	47	57	91	5	8	8	17	30	29	24	38	40	61
Wahoo	31	51	60	110	91	4	12	12	33	22	28	39	48	77	69
Other fish		1					1								
TOTAL OTHER	**259**	**387**	**662**	**870**	**1,215**	**42**	**88**	**149**	**270**	**331**	**216**	**300**	**513**	**600**	**884**
GEAR TOTAL	**1,909**	**2,255**	**2,936**	**3,264**	**4,754**	**388**	**626**	**811**	**1,029**	**1,226**	**1,522**	**1,629**	**2,125**	**2,235**	**3,528**

3 FISHERY ECOSYSTEMS

3.1 FISHER OBSERVATIONS

Hawaii fishermen Clay Tam and Roy Morioka started the fisher observations initiative in 2020 to add traditional and local ecological knowledge, and on-the-water observations to complement fishery-dependent data sources in the annual SAFE reports. Fisher observations from 2021 can be found in the pelagic and the respective archipelagic reports (WPRFMC 2022a; WPRFMC 2022b; WPRFMC 2022c; WPRFMC 2022d).

In 2021, the Council collected fisher observations for pelagic fisheries during quarterly advisory panel meetings for Hawaiʻi, American Samoa, Guam, and the CNMI. Input collected at these meetings was limited to Advisory Panel members. The Council also convened two meetings dedicated to fisher observations in February 2022 – one for Guam and the CNMI on February 23, 2022 and one for Hawaiʻi on February 24, 2022. There was no American Samoa fisher observations meeting in 2022 to cover 2021 due to COVID-19. The Guam and CNMI, and Hawaiʻi annual fisher observations meetings included some Advisory Panel members, but also included individuals from the fishing community in those areas. The full results from these two fisher observations meetings are available as PIFSC data reports (Ayers et al. 2022a; Ayers et al. 2022b).

Fisher observations for pelagic species were collected during quarterly Advisory Panel meetings for each of the respective jurisdictions. Annual fisher observation meetings were held for American Samoa, Guam and CNMI, and Hawaiʻi in 2023 to cover 2022. Data from these meetings will be published as PIFSC data reports. Pelagic fisher observations from 2022 will begin with a summary of fisher observations collected during the 2022 quarterly advisory panel meetings, separated by island area/jurisdiction, then followed by a summary of pelagic management unit species data collected from the fisher observations meetings.

3.1.1 INFORMATION FROM ADVISORY PANEL MEETINGS

3.1.1.1 AMERICAN SAMOA

From April to June, COVID-19 lockdowns and associated mandates limited fishing activity and pelagic fishing trips. Another reported that the community members from Manuʻa and the American Samoa Longline fleet reported good fishing in the second quarter of 2022. From July to September, rough weather reduced effort by smaller recreational and alia vessels. The albacore season was good for the longline fleet despite increases in food costs and decreases in fish prices. According to Tautai o Samoa Longline and Fishing Association, only one vessel was able to go jigging and reported high costs to outfit the vessel with fishing gear. The association would like to get more vessels to jig for albacore. The raft closure started in the summer, but they expect more vessels to return in October. Purse seiners are fishing in the east and the cannery has been purchasing fish from foreign-flagged purse seine vessels.

3.1.1.2 CNMI

From April to June, CNMI AP members reported an abundance of sharks, with some even hitting vessels. Many FADs have been lost. Another AP member reported seeing just one FAD west of Tinian, the ‘FF’ buoy. The individual noted seabirds attacking lures rather than fish, with some birds going after squid and mahimahi lures. A strange occurrence not seen before by these fishers. Fuel prices continued to increase, with diesel fuel prices reaching $9-10 per gallon on

Tinian. Military activities are increasing, but the main issue in the CNMI are the high fuel prices. One AP member felt that Saipan needs another boat ramp for fishing. Fishing base is full of activity every weekend. The crowding, along with weekend community events discourage fishing vessels from launching.

Fishers on Tinian are still waiting on the floating marina on Tinian to be finished. The Tinian Marina held its groundbreaking ceremony and the new marina will be paved. Another AP member noted that fuel prices continue to rise, but fish prices remain the same. From July to September, an AP member on Tinian caught the largest Marlin ever caught by a Tinian fisher, which weighed in at 772.5 pounds. Wahoo catches on Tinian have been good, with an average weight around 25 pounds.

A Rota fisher reported catching small tuna, all weighing two pounds or less and also reported that wahoo were not as active as they are around the more Northern Mariana Islands. Fuel prices on Rota dropped to $6.90 per gallon, which is still very expensive. Another fisher reported that it was difficult to find seabirds. It's unusual to find schools of fish not accompanied by seabirds. Sharks have been active, but one fisher reported fishing for 4 hours with no shark sightings or depredation.

3.1.1.3 GUAM

From January to March, AP members noted small runs of bonito. The cost of diesel increased 25 cents to $7.25 per gallon, with regular unleaded at $6.39 and Premium at $6.79. AP members hope that upcoming tournaments will bring more fish, but added that it will be unlikely without any FADs. From March to June, one AP member reported few fish being caught. When calm waters prevailed, few fishing seabirds were observed and few skipjack tuna were caught. Strange weather and strong winds were also noted during the second quarter of 2022. One fisher reported catching a small mahimahi and wahoo during a recent fishing trip. The mahimahi weighed in during the Greg D. Perez fishing tournament were small, with a 3.2 pound fish placing third overall. Since Guam had not assessed any fines and did not enter into a specified fishing arrangement with Hawai‘i longliners for additional bigeye tuna quota [such arrangements fund sustainable fishing and fisheries development for participating U.S. territories], there has not been funding for the Guam Marine Conservation Plan. The AP felt that the Council should explore additional means to fund the plan.

3.1.1.4 HAWAII

3.1.1.4.1 Hawaii Island

From January to March, fishers expect ono, but they have not been observed by AP members. Fishers have been finding ‘ahi instead. From April to June, one AP member reported a decrease in fishing trips due to the high cost of fuel, ice, and boat maintenance. Fishers noted an increase in ika abundance along with spotted dolphin. Fuel prices increased in Hilo and 100 pound ‘ahis were biting. Only small marlin and mahimahi being caught on the Hilo side, but fishers did find some nice ono (30 pounder). Ika shibi fishers did well with ono during a recent overnight trip. From July-September, fishing and fish prices were steady, with high fuel prices increasing fishing costs. Hilo fishers observed a bloom of tuna eggs spanning over to Maui on the flight to Oahu. The bloom usually occurs in July and is late. Fishers also reported good mahimahi fishing.

3.1.1.4.2 Kauai

From January to March, AP members noted that FAD buoy ‘KK’ has disappeared. From April to June, tuna catches began to improve. Despite improved fishing conditions, AP members reported that fishers are being more selective about going fishing due to higher fuel prices. Fishers also noted more otaru coming up, an abundance of akule, ‘oama coming in, an abundance of nehu, large bird aggregations, and the water boiling with fish off of the north shore. West side fishers noted more fish piles coming close, good fishing and good prices. Fuel prices approached $6 per gallon, which limited fishing trips.

3.1.1.4.3 Maui

From January to March, Maui fishers reported sustained high fuel prices. Tuna fishing improved in the Spring, from April to June. Maui Co-op fishers caught tuna, but reported high fuel prices. From July-September, fishers observed an abundance of tuna, and mahimahi. One fisherman caught 25 pieces of otaru.

3.1.1.4.4 Oahu

From January to March, AP members observed a strong mango and avocado bloom which usually means a good year for fishing. During the first quarter of 2022, the small boat fishery have experienced a strong ‘ahi bite. The longline catch has been low in this quarter, but the prices have remained near $5-$6 per pound. Increased swordfish catches have been absorbed by local and domestic markets.

Another AP member noted that the ‘ahi have been jumping just like the 1980s and noted the strong correlation with the strong avocado bloom. Other AP members agreed that there a lot of small to medium-sized ‘ahi around. Another member noted that this year has seen an early mango bloom which is often associated with an abundance of ‘ahi and otaru. In terms of FADs, O‘ahu AP members noted that FAD ‘X’ north of O‘ahu is gone. From April to June fishers observed an abundance of mahimahi. They reported a moderate ‘ahi catch that was offset by high fuel and maintenance costs. An AP member said they observed a slowdown in fishing, but fishers were still finding big ‘ahi, nearing 100 pounds. Another AP member reported that the Hawai‘i longline catch has been higher relative to recent months with moderate demand. From July to September more aku and otaru were seen offshore and a bloom of mū [Bigeye emperor, *Monotaxis grandoculis*] off of O‘ahu’s north shore.

3.1.2 INFORMATION FROM THE AMERICAN SAMOA ANNUAL SUMMIT

From 6-8pm Samoa Standard Time on February 14, 2023, the Council convened a fisher observations meeting with American Samoa Advisory Panel members and other members of the American Samoa fishing community. The meeting included 8 American Samoa fishers with remote attendance by 4 Council staff and 1 PIFSC social scientist. Advisory Panel members reached via their social networks to the American Samoa fishing community to invite fishers to attend the meeting and contribute to 2022 fisher observations. Advisory panel members often have experience in multiple gear types, many years of fishing experience, and are well-informed of fishery changes. For the 2022 American Samoa fisher observations meeting, they tried to secure participation and gather data from current or past ‘highliners’ with different fishery specializations, including individuals on small ‘alia’ vessels that target pelagic species. Highliners have more fishery knowledge than less experienced fishers and thus may offer deeper insights.

Just as in 2021, the focus of the 2022 meeting was to describe notable fishery events, changes in timing of fisheries events, issues the council should pay attention to, including drivers of changes. Discussions were based upon a streamlined interview guide developed by Roy Morioka and Zach Yamada. Although the interview guide was streamlined from the previous year, it did not substantially change participant responses. Participants were asked follow up questions as needed related to different social, economic, ecological, and management (SEEM) aspects of the fishery to facilitate their use in fisheries science and management. These four SEEM categories comprise a qualitative construct which have been used to complement the quantitative P* construct and process, and provide additional guidance when setting annual catch limits, although the process has never been applied to pelagic management unit species (Hospital et al. 2019).

The American Samoa fisher observations meeting was not recorded, but PIFSC staff along with Council staff took detailed notes during the meeting and captured attendee quotes as close to verbatim as possible and captured all main ideas shared by meeting attendees. Main ideas were categorized topically using the SEEM categories, then into additional sub-categories to provide further detail on fisher observations from American Samoa fishers in 2022. Below, their observations of pelagic fisheries are separated and described using the SEEM categories.

3.1.2.1 SOCIAL

COVID-19 continued to impact American Samoa fishers. Meeting attendees referenced the slow rollout of COVID relief and CARES Act funds. They also conveyed the need to upgrade American Samoa fishing infrastructure, such as adding more boat slips, upgrading longline docks, and replacing Fish Aggregating Devices (FADs). There was good turnout for their pelagic species fishing tournament and the fishing was productive with over 50 masi caught over two days, along with good catches of yellowfin tuna and marlin.

3.1.2.2 ECONOMIC

Several fishers referenced the alia program, a program in which local fishers receive government assistance to purchase an alia fishing vessel. Another mentioned a Super alia program, which was announced 6-7 years ago, but is still in development. One attendee reported that ice availability is an issue for alia fishers, which may decrease market demand due to spoilage of catch.

3.1.2.3 ECOLOGICAL (BIOLOGICAL AND PHYSICAL/OCEANOGRAPHIC)

American Samoa fishers indicated that 2022 was a good year for pelagic species. One fisher reported a strong masi run in August and September, catching 6-12 masi per trip. Good catches of yellowfin tuna and marlin were also referenced, including one fisher that caught a 168 pound yellowfin. Shark depredation remains an issue, and may be increasing each year. Fishers also reported severe weather that limited fishing trips. One fisher reported that an earthquake may have caused yellowfin and aku to move closer to shore, where fishers were catching larger size classes of fish. Fishers also noted very warm water temperatures throughout the year.

3.1.2.4 MANAGEMENT UNCERTAINTY

Fishers lamented the lack of support for the Council's Catchit Logit app to record catches and expressed apprehension over the uncertainty surrounding Biden Administration's 30x30 plan implementation.

3.1.3 INFORMATION FROM THE GUAM AND CNMI ANNUAL SUMMIT

On February 7, 2023 from 6:00-8:00pm Chamorro Standard Time, the Council convened a fisher observations meeting with advisory panel members from Guam and the CNMI, along with other members of fishing communities in the archipelago. Hawai‘i fishermen Clay Tam and Roy Morioka convened and facilitated the meeting and it was attended by 9 Guam fishers and 11 CNMI fishers, along with 4 Council staff, and 2 PIFSC staff. The focus of the meeting was the same as the American Samoa meeting and discussions/follow-up questions were based on the same revised interview guide developed by Roy Morioka and Zach Yamada.

The Guam and CNMI fisher observations meeting was not recorded, but PIFSC staff along with Council staff took detailed notes in the same manner as the American Samoa meeting. Main ideas were categorized topically using the SEEM categories, then into additional sub-categories to provide further detail on fisher observations from Guam and CNMI fishers in 2022. Below, their observations of pelagic fisheries are separated and described using the SEEM categories.

3.1.3.1 SOCIAL

In Guam, fishers described around 30 new boats entering the fishery from Saipan. They also detailed the loss of Fish Aggregating Devices (FADs), crowding and thefts at boat ramps, fishers transitioning trolling reels to electric, and customary exchange of fish in the community.

In the CNMI, fishers also reported losing FADs, a marina upgrade, and nearly 30 boats exiting the fishery, that were delivered to Guam. They also described ongoing military exercises that interfered with fishing activity and reduce fishing effort.

3.1.3.2 ECONOMIC

Guam fishers reported that fuel costs remained high and fish prices were down due to excess supply of fish, particularly pelagic species like mahimahi, which made it difficult to get fair market prices.

CNMI fishers reported challenging market conditions, as noted in previous social research in fishing community profiles (Allen and Amesbury 2012; Ayers 2018). Fishers did find markets for their catch or consumed them at home. Fuel costs, normally high in the Marianas, climbed as high as $7.29/gallon in 2022

3.1.3.3 ECOLOGICAL (BIOLOGICAL AND PHYSICAL/OCEANOGRAPHIC)

A majority of Guam fishers reported good fishing for pelagic species in 2022, both in terms of amount and size of fish for marlin, aku/bonito, and dogtooth tuna. Mahimahi was particularly abundant. Some fishers posited that it could be part of a 5-7 year cycle. In terms of phenology, wahoo showed up later in the year than usual. Guam fishers noted stronger winds and weather, which inhibited fishing trips. They also observed cooler water temperatures and abnormal currents that ran opposite the prevailing direction.

CNMI fishers also reported a strong mahimahi year in 2022 and larger numbers of wahoo. Shark depredation remains an issue around Tinian and Goat island. CNMI fishers also reported rougher water due to prevailing weather and wind patterns, cooler water temperatures, and stronger currents. One fisher noted a lot of fishing debris in the water around CNMI waters.

3.1.3.4 MANAGEMENT UNCERTAINTY

There were no comments from fishers pertaining to management uncertainty.

3.1.4 INFORMATION FROM THE HAWAII ANNUAL SUMMIT

On February 8, 2023 from 6:30-8:30pm Hawaiʻi Standard Time, the Council convened a fisher observations meeting with advisory panel members from Hawaiʻi, along with other members of the fishing community. Hawaiʻi fishermen Clay Tam and Roy Morioka convened and facilitated the meeting and it was attended by 18 Hawaiʻi fishers or fisher representatives, including 8 from Oʻahu, 5 from Hawaiʻi Island, and 1 each from Kauaʻi and Maui. Council staff, staff from the Hawaiʻi Division of Aquatic Resources, and 3 PIFSC staff also attended. The focus of the meeting was the same as the American Samoa, and Guam and CNMI meetings. The interview guide, notetaking, and analysis process was also the same. Below, 2022 Hawaiʻi fisher observations of pelagic fisheries are separated and described using the SEEM categories.

3.1.4.1 SOCIAL

In 2022, customary exchange remained an important social and cultural component of Hawaiʻi pelagic fisheries. Fishers reported fishing infrastructure challenges such as crowded boat ramps in Hilo, the loss of a charter weigh-in station and tags for billfish in Kailua-Kona, maintenance or replacements needed on Fish Aggregating Devices (FADs), safety issues for fishers unfamiliar with navigation channels in Kawaihae, and conflicts associated with private FADs (PFADs) offshore. The boat ramp crowding and infrastructure needs affected access for pelagic fishing trips, and the FADs and PFADs affected fishing trips targeting pelagic species. Changes in social networks included older fishers exiting the fishery and newer, less experienced fishers replacing them. COVID-19 continued to affect fishing operations, making it difficult to find crew at times and potentially making remote fishing spots more crowded.

3.1.4.2 ECONOMIC

Economic conditions were mixed, with most Oʻahu fishers reporting good market conditions for pelagic species like mahimahi, monchong, and ono due to their closer proximity to the United Fishing Agency Auction in Honolulu. Fuel prices were up for most of the year, as were prices for bait, tackle, and ice, with a slight decrease in fuel prices observed late in the year. Fewer tuna imports may have helped secure better market prices for Hawaiʻi-caught fish.

3.1.4.3 ECOLOGICAL (BIOLOGICAL AND PHYSICAL/OCEANOGRAPHIC)

Fishers reported greater abundance and availability of pelagic species with a few exceptions. One being Hawaiʻi island fisheries, where aku was more difficult to find and in smaller size classes when located. Hilo trollers also reported a poor season off of their side of the island. Sharks continued to depredate catch during fishing trips. Oʻahu fishers reported few issues with currents, but Kona fishers observed a change in currents due to La Niña and/or increases in easterly wind days. The change in current has negatively affected fishing in west Hawaiʻi. Winds were up and down with extended periods of both strong and light winds.

3.1.4.4 MANAGEMENT UNCERTAINTY

The comments related to management uncertainty dealt with the lack of data collection from unsold fish caught by Kona fishing charters, and the need for Hawaiʻi fishing communities to share the importance of fishing.

3.2 SOCIOECONOMICS

The socioeconomics section outlines the pertinent economic, social, and community information available for assessing the performance of Fishery Ecosystem Plan (FEP) management measures for the Pelagic Fisheries (WPRFMC 2009d). This section meets the objective "Support Fishing Communities" adopted at the 165th Council meeting; specifically, it identifies the various social and economic groups and their interconnections within the region's fishing communities. The section begins with an overview of the socioeconomic context for the region, and then provides a summary of relevant general studies and data for each jurisdiction, followed by summaries of relevant studies and data for each specific fishery within the jurisdiction.

In 1996, the Magnuson-Stevens Fishery Conservation and Management Act's (MSA) National Standard 8 (NS8) specified that conservation and management measures take into account the importance of fishery resources to fishing communities. In doing so, the measures would ensure the community's sustained participation in fisheries and minimize associated adverse economic impacts provided that these considerations do not compromise local conservation. Unlike other regions of the United States, the settlement of the Western Pacific region was intimately tied to the sea (Figure 120), which is reflected in local culture, customs, and traditions.

Figure 120. Settlement of the Pacific Islands[1]

[1] Source: Wikimedia Commons, https://commons.wikimedia.org/wiki/File:Polynesian_Migration.svg.

Polynesian voyagers relied on the ocean and marine resources on their long voyages in search of new islands, as well as in sustaining established island communities. Today, the population of the region also represents many Asian cultures from Pacific Rim countries, which hold similar significance for many marine resources. Thus, fishing and seafood are integral ways of life in the local community. This is reflected in the amount of seafood eaten in the region in comparison with the rest of the United States, as well as in the language, customs, ceremonies, and community events of the region. Because fishing is such an integral part of the culture, it is difficult to discern commercial from non-commercial fishing, with many trips involving multiple motivations and multiple uses of the catch landed. While economics are an important consideration, fishermen report other motivations (e.g., customary exchange) as being equally important, if not more so. Due to changing economies and westernization, recruitment of younger fishermen has become a concern for the sustainability of fishing and fishing traditions in the region. During the COVID-19 pandemic, the diversification of the fisheries in the region and their ability to adapt to shift from a national and global economy to a local one played a vital role in supporting local food systems, nutrition, food security, and community social cohesion (Kleiber et al. 2022, Smith et al. 2022).

3.2.1 RESPONSE TO PREVIOUS COUNCIL RECOMMENDATIONS

At its 190th meeting held via web conference and in Hagatña, Guam, and Garapan, Saipan, CNMI in March 2022, the Council directed staff to work with the Advisory Panels on restructuring fishermen's observation meetings and reports. PIFSC social scientists continued to assist the AP chairs, participating in organizational sessions, serving as note-takers, and providing synthesis reports.

At its 191st meeting held via web conference and in Honolulu, HI in June 2022, the Council directed staff to continue developing options for fishing regulations in the Papahānaumokuākea Marine Expansion Area. PIFSC social scientists have reviewed noncommercial fishing laws, policies, and regulations, and served as subject matter experts to assist the Council in developing potential alternatives for discussion.

At its 192nd meeting held via web conference and in Honolulu, HI in September 2022, the Council directed staff to develop a process for improving noncommercial data collection. Council members noted the importance of including non-fish species or species of concern. PIFSC social scientists are reviewing noncommercial fishing concepts in policy documents and peer-reviewed literature. This analysis identified core data needs for a more comprehensive understanding of noncommercial fishing as well as potential categories for data collection. PIFSC social scientists are also examining cultural prioritization of marine taxa. Publications on both of these topics are expected in 2023.

Also at its 192nd meeting, regarding the proposal to expand the PRIMNM, the Council requested NMFS assist the territories on a scientific and economic evaluation of the proposal, including unintended consequences to American Samoa fisheries. PIFSC staff have developed an analysis of the economic contributions from commercial fisheries to the American Samoa economy and this report should be published in 2023.

Also at its 192nd meeting, the Council requested PIFSC report on recent information on market prices and trends to better understand underlying market dynamics and targeting in the Hawai‘i longline fishery. PIFSC has offered to prepare, upon request, a market snapshot report to present alongside the midyear and annual Hawai‘i Longline Fishery Report at future SSC and Council meetings, as a complement to these recurring reports provided by our Fisheries Reporting and Bycatch Program.

Also at its 192nd meeting, the Council requested PIFSC to work with vessel owners to infer socioeconomic impacts of the LVPA (and the recent exemption of large vessels) and inform trends in fishery participation. In 2021, PIFSC conducted an American Sāmoa small boat fishery cost-earning survey to better understand the economic, social, and cultural characteristics of small boat fishing in American Sāmoa. In total, 37 surveys were completed with respondents from Tutuila (76%) and the Manu'a Islands (24%). In an open ended question, Do you have any suggestions for how American Samoa’s fisheries should be managed or topics that you feel need further study, approximately 11% of surveys received expressed concerns that specifically reference the LVPA exemption of large vessels negatively impacting small boat fishery performance, while 14% desired more local government authority over fisheries management. In considering general trends in fishery participation, 22% of respondents felt that fewer people will fish for pelagic species in the coming year. PIFSC expects to publish the results of this survey in 2023, and therefore these results are preliminary at this time.

Also at its 192nd meeting, the Council directed staff to incorporate scenario planning for extreme environmental events into EBFM-related planning. PIFSC, PIRO, and Council staff initiated a contract and began coordinating a training to build scenario planning capacity, which would be held in early 2023.

At its 193rd meeting held via web conference and in Honolulu, HI in December 2022 the Council requested NMFS staff to work with SSC members to evaluate the impacts of large static closed areas in the Pacific Islands Region (including the Marine National Monuments) on target and non-target species, to address the SSC’s concerns about a lack of reproducibility of findings by a recent paper published in *Science*, and also evaluate socioeconomic impacts. PIFSC staff conducted further analysis, and found the results presented in the 2022 *Science* paper, “Spillover benefits from the world’s largest fully protected MPA” are reproducible following the approach presented in the paper. There are questions as to the suitability of the approach taken, with the main statistical concerns related to the data transformation and the choice of underlying statistical distribution of the data used. The approach assumed an underlying Gaussian distribution and even with the transformation applied in the paper, the distribution of scaled catch rates is not well described by a Gaussian distribution. Assuming an incorrect form of the underlying distribution of the data can bias results. Using the approach taken, the overall effect of the spillover benefit is around 0.75 yellowfin tuna per 1,000 hooks close to the Monument, decreasing by 0.25 yellowfin tuna per 1,000 hooks per 100 nautical miles away from the monument. The effects are less for bigeye tuna. Further work could be done to understand the effect of the assumed statistical distribution, but is currently not planned.

3.2.2 SOCIAL AND CULTURAL ELEMENTS

3.2.2.1 EQUITY AND ENVIRONMENTAL JUSTICE

NOAA Fisheries equity and environmental justice (EEJ) goals are to 1) Prioritize identification, equitable treatment, and meaningful involvement of underserved communities, 2) Provide equitable delivery of services and 3) Prioritize EEJ in our mandated and mission work with demonstrable progress.

NOAA Fisheries commitment to EEJ is particularly relevant to the Pacific Islands Region. While every community is a fishing community in the Pacific Islands Region, there are specific features of these communities that can create barriers to EEJ. While some are shared across the region such as comparatively smaller populations and geographic isolation for NOAA Fisheries headquarters, others are specific to the cultural and political context of each archipelago, territory and commonwealth.

In this first year of adding EEJ to the SAFE report we will report a synthesis of feedback from partners and communities collected in informal listening sessions conducted in 2022.

Going forward we will work to further develop this section to highlight the social and cultural impacts of fisheries science and management and highlight the EEJ issues specific to pelagic fisheries.

3.2.2.1.1 2022 Listening Sessions

EEJ themes for pelagic fisheries were extracted from feedback in 2022 listening sessions that were relevant to pelagic fisheries.

3.2.2.1.2 Key EEJ themes

- The remote location of the U.S. Pacific territories creates logistical challenges that aren't accounted for in many U.S. standards, many of which impact the territorial pelagic fisheries.
- There is frustration with closure of federal waters to fishing, creating a barrier to local access to pelagic fisheries.

3.2.2.2 AMERICAN SAMOA

3.2.2.2.1 Introduction

As described in Chapter 1, fishing has played a crucial role in American Samoan culture and society since the Samoan archipelago was populated. An overview of American Samoa history, culture, geography, and relationship with the U.S. is described in Section 1.3 of the American Samoa FEP (WPRFMC 2009a). Over the past decade, a number of studies have synthesized more specifics about the role of fishing and marine resources in American Samoa, as well as information about the people who engage in the fisheries or use of fishery resources (Armstrong et al. 2011; Grace-McCaskey 2015; Kleiber and Leong 2018; Levine and Allen 2009; Richmond and Levine 2012). These studies describe the importance of marine resources in cultural, economic, and subsistence aspects of Samoan village life. Fishing was held in high esteem in traditional Samoan culture, with proficiency in fishing bringing high social status; fishing activities were featured prominently in Samoan mythology as well. The basic units of Samoan social structure are the family and village, with the family as the central unit. The village leadership would decide, according to season, what sort of community fishing should take place. The tautai, or master fishermen of the village, were key decision makers who were awarded higher status than others when it came to matters of fishing (even those that might otherwise outrank him). Village-level systems of governance and resource tenure are still largely intact, and Samoan cultural systems and representation are formally incorporated into the Territorial Government. Reciprocity is emphasized over individual accumulation. Gifts of food (especially fish and other marine resources) mark every occasion and help maintain Samoan social structure to this day.

Recent studies have found that American Samoa is ethnically and culturally very homogeneous (Levine et al. 2016; Richmond and Levine 2012). Polynesians account for the vast majority of the territory's people (93%). The primary language spoken at home is Samoan (91%), although English is often spoken in school and business settings. Contemporary American Samoan culture is characterized by a combination of traditional Samoan values and systems of social organization, as well as the strong influence of Christianity. Maintaining *fa'a Samoa*, or "the Samoan way", was considered a priority under the territorial constitution. Given the cultural homogeneity, nearly everyone in American Samoa accepts and complies with Samoan traditions of land and resource tenure.

However, over the last half century or more, fishing has become less prominent as a central and organizing community force. Through this time, modern fishing gears and new technologies were introduced, tuna canneries became a major economic force in Pago Pago, the population more than tripled, and the gradual but continuous introduction of Western cultural norms and practices altered locals' relationship with the sea. While many traditions and village-based systems of governance have been maintained, the islands have experienced a shift from a subsistence-oriented economy, where sharing of fish catch was extremely important, to a cash-based economy, where fishing is often viewed as a more commercial venture.

A recent study by Levine et al. (2016) found that American Samoans still consume seafood frequently, with 78% of respondents stating that they eat fish or seafood at least once a week. Most American Samoans purchase seafood from stores or restaurants, with 65% of survey respondents listing this as their first or second choice for obtaining seafood. Other common means for obtaining fish include markets and roadside vendors (45%) and fish caught by household members (37%). This corroborates Levine and Allen's (2009) observation that American Samoans largely rely on, and in many cases prefer, store-bought food to locally-caught fish, with the majority of fish consumed in American Samoa imported from Samoa.

The introduction of outboard engines and other technology in the 1950s and 1960s allowed American Samoan boats to go farther and faster, but also made it necessary for boat owners and operators to sell a portion of their catch to pay for fuel and engine maintenance. The disruption of other traditional values, as well as the introduction of a cash economy based primarily on government jobs and cannery employment, also decreased reliance on traditional, subsistence fishing and allowed commercial fishing to develop on the islands (Levine and Allen, 2009).

Unlike other areas within the Western Pacific region, American Samoa also experienced the development of domestic industrial-scale fisheries, including tuna processing, transshipment, and home port industries. This is due to the excellent harbor at Pago Pago, 390,000 km^2 of surrounding exclusive economic zone (EEZ), and certain special provisions of U.S. law that allowed the development of the fish processing industry. For example, the territory is exempt from the Nicholson Act, which prohibits foreign ships from landing their catches in U.S. ports, and American Samoan products with less than 50 percent market value from foreign sources enter the U.S. duty free.

The two most important economic sectors are the American Samoa Government (ASG), which receives income and capital subsidies from the Federal Government and tuna canning. According to the last published Statistical Yearbook (American Samoa Government 2022), main imports include fish brought in for processing. Exports are primarily canned tuna and associated products. In 2019, domestic exports from American Samoa amounted to $353,215,000, of which $351, 470,000 (over 99%) was from canned tuna (American Samoa Government 2022). Private businesses and commerce comprise a third sector. Unlike some of its South Pacific neighbors, American Samoa has never had a robust tourist industry.

In 2020, the ASG employed 6,614 people (40% of total employment; American Samoa Government 2022), and the private sector employed 7,424 people (Figure 121). Supporting data for Figure 121 are provided in Table A-111. The canneries employed 2,361 people, which is 14% of the total people employed in the territory. Ancillary businesses involved in re-provisioning the fishing fleet generate a significant number of jobs and income for local residents.

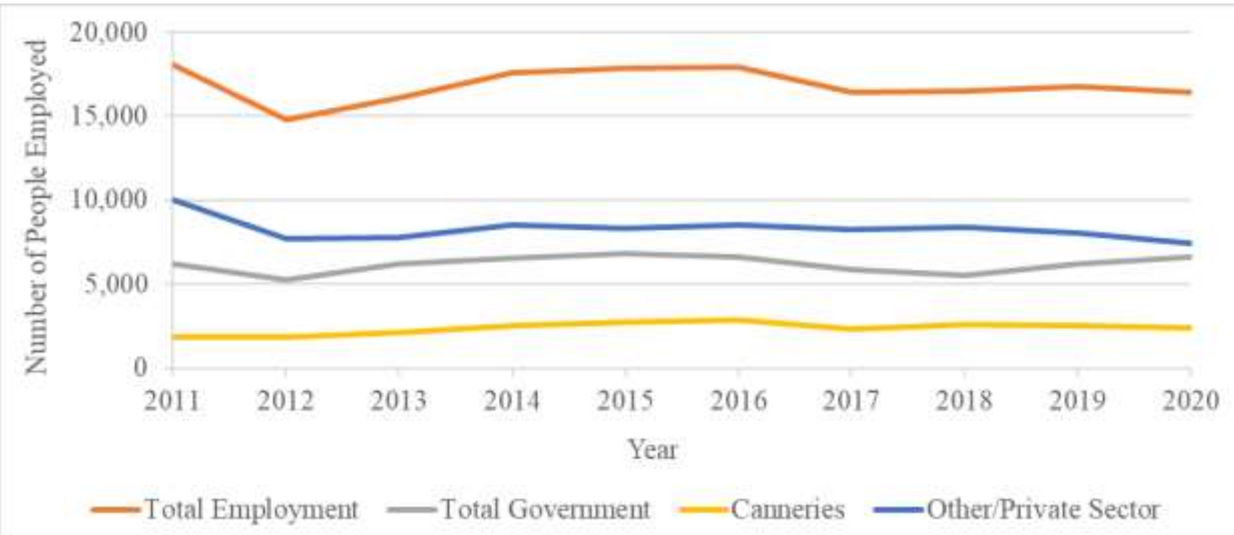


Figure 121. American Samoa Employment Estimates from 2011-2020[1]

[1] Source: American Samoa Government (2022).

The canneries have been operating since 1954, represent the largest private-sector source of employment in the region, and, until recently, were the principal industry in the territory. Although as many as 90% of cannery workers are not American Samoa citizens, the canneries play a large role in the American Samoa economy (e.g., via delivery of goods or services to tuna processors and expenditures and buying patterns of cannery workers). Trends in world trade, specifically reductions in tariffs, have been reducing the competitive advantage of American Samoa's duty-free access to the U.S. canned tuna market, and the viability of the canneries has been uncertain for nearly a decade. In 2009, the Chicken of the Sea cannery closed, resulting in a loss of approximately 2,000 jobs. It was bought by Tri Marine International, which invested $70 million in rebuilding and expansion before reopening in 2015. In October 2016, StarKist Co. suspended operations due to lack of fish, partly because of the Effort Limit Area for Purse Seine (ELAPS) closures (Pacific Islands Report 2016). That same month, Tri Marine International announced that it would suspend production indefinitely in December 2016 (Honolulu Star Advertiser 2016). There are currently no plans to reopen (Pacific Islands Report 2017). Starkist Samoa is currently the only cannery operating in American Samoa and is the largest private employer with about 2,000 workers.

Even before Tri Marine International's closure, American Samoa's economy was identified as being in a highly transitional state that should be monitored closely (McCaskey 2015). It will be important to monitor any changes and developments related to the tuna industry, given the historically close connection between the tuna canneries, employment levels, population trends, and the economic welfare of the territory. It is also possible that increased federal aid in recent years has masked the full extent of the economic recession.

Members of the American Samoa fishing community had also expressed concerns about the impact of National Marine Sanctuary of American Samoa (NMSAS) expansion in 2012 and management of the Rose Atoll Marine National Monument, which was established in 2009. In both of these cases, the local communities have been concerned about the impacts on fishing practices as well as broader social and cultural issues, such as traditional marine tenure and the ability of villages to manage their own resources.

In 2017, understanding the relationship of pelagic fisheries with cultural fishing practices took on a greater focus. During the peak of longline landings in 2002, NMFS created a Large Vessel Prohibited Area (LVPA) to prevent gear conflicts and catch competition between large and small vessels, as well as to preserve opportunities for fishing by American Samoa's small boat ("alia") fleet (NOAA 2017). Since 2002, both large and small vessels have experienced declining catch rates, fish prices, and increasing fuel and operating costs. In 2016, NMFS published an exemption to the LVPA rule to allow large U.S. vessels holding a federal American Samoa longline limited entry permit to fish in portions of the LVPA (NOAA 2016). NMFS and the Council were then sued by the American Samoa Government, who claimed that the 1900 and 1904 Deeds of Cession were not considered in the rulemaking process. The U.S. District Court ruled in favor of American Samoa in March 2017, requiring NMFS to preserve American Samoan cultural fishing practices as part of their obligations to the Deeds of Cession. A study examining dimensions of cultural fishing for the small and large longline fleets found that these fisheries play an important role in maintaining cultural practices, primarily through sharing of catch (Kleiber and Leong 2018). The Council took action to provide a four-year exemption for vessels permitted under the American Samoa Longline Limited Entry permit, which reduced the area closed to large vessels from 25.5 to 11.5%. In September 2020 the Ninth Circuit Court of Appeals reversed the District Court decision in favor of NMFS. In February 2021, the ASG appealed to the Supreme Court of the United States, but the writ of certiorari was denied June 21, 2021. NMFS published the original 2016 LVPA exemption as a final rule, effective July 6, 2021.

3.2.2.2.2 People Who Fish

Few studies have been conducted that include demographics or other information about people who fish in American Samoa. Information at the fishery level will be reported in the fishery specific sections below. Qualitative research has resulted in some general observations about trends in fishing by American Samoans.

One household survey by Levine et al. (2016) found that over half of residents participate in fishing or gathering of marine resources. Approximately 15% reported fishing once a week or more and over 30% of households stated that they engaged in fishing or gathering at least once a month. Commercial fishing is very uncommon in American Samoa, with only 3% of those who fish stated that they frequently did so to sell their catch and 62% never selling their catch. More commonly, people fish to feed themselves and their family or to give to extended friends, family, pastors, and village leaders.

While fishing and marine resources are universally considered to be important aspects of *fa'a Samoa*, limited income has made American Samoans less inclined to engage in strenuous fishing activities when food imports are relatively more available (Levine and Allen 2009). Only a small number of American Samoans engage in boat-based or commercial fishing. Although unemployment in the territory has increased, the percentage of individuals participating in subsistence activities (including fishing for food or home use) decreased between 2000 and 2013 (Grace McCaskey 2015). However, a large number of island residents have been employed by the canneries in Pago Pago, which facilitated the availability of low-cost fish for many residents and ensured that the livelihood of American Samoans is still tightly tied to fishing activities.

As described in the FEP, American Samoans have been discouraged from working on foreign longline vessels delivering tuna to the canneries for a number of reasons, including harsh working conditions, low wages, and long fishing trips. While American Samoans prefer employment on the U.S. purse seine vessels, the capital-intensive nature of purse seine operations limits the number of job opportunities for locals in that sector.

Local fishermen have indicated an interest in participating in the more lucrative overseas markets for fresh fish. However, they are limited by inadequate shore-side ice and cold storage facilities, as well as infrequent and expensive air transportation.

As noted by Levine and Allen (2009), the trend of decreasing reliance on local fish as a food source is reflective of a society that has been undergoing a shift from a subsistence-oriented economy to a cash economy. Changes such as a decrease in leisure time, a shift in dietary preferences towards store-bought foods, a preference to buy fish at the market rather than expend effort in fishing, and an increased availability of inexpensive imported reef fish from Western Samoa and Tonga are also likely contributing to decreasing rates of subsistence fishing in the region (Richmond and Levine 2012).

3.2.2.2.3 American Samoa Longline

The American Samoa longline fishery only includes landings in American Samoa by American Samoa longline permitted vessels, it does not include the bigeye landings in Hawaii by the dual (Hawaii and American Samoa) permitted vessels. The American Samoa longline fishery is a limited entry fishery with a maximum of 60 permits. Under the limited access program, NMFS issued a total of 60 initial longline limited entry permits starting from 2005 to qualified candidates. The American Samoa longline limited entry permit is required for anyone using longline gear to fish for pelagic species within the EEZ around America Samoa or anyone landing or transshipping pelagic species in American Samoa that were caught within the EEZ around American Samoa. The total active permits (vessels) fishing in the South Pacific Ocean and landed in American Samoa in 2016 was 20. The American Samoa longline permit may be used to fish and land catch with longline gear in the EEZ around Guam, the CNMI, and the Pacific Remote Island Area (PRIA). It may not, however, be used to fish with longline gear in the Hawaii EEZ.

The American Samoa longline fishery faces many challenges in recent years. A cost-earnings study conducted in 2009 had already indicated a thin profit margin and significant economic challenges encountered by the longline fleet (Arita and Pan 2013). Pan (2015) also observed that at the end of 2013, the majority of the vessels in the American Samoa fleet were tied up at dock, and 18 vessels posted "For Sale" signs. They noted that the collapse of the fishery seemed inevitable due to the poor economic performance resulting from the continuous decline in catch per unit effort, increases in fuel prices, and a sharp drop in albacore prices in 2013. The small-scale alia fleet has been greatly reduced in recent years.

3.2.2.2.4 American Samoa Trolling

According to Levine and Allen (2009), until 1995, boat-based fishing in was primarily trolling and bottomfish handlining, with the pelagic fishery in American Samoa being largely troll-based. In 1996, the majority of trolling fishermen converted their alias to longlining, especially larger commercial trollers, although some continued to troll occasionally. Consequently, the alia fishery has experienced a decline in its catch and effort. In 1996, seven of the 35 trolling vessels rarely sold catch; their captains primarily fished for recreation on weekends, holidays, or competed in fishing tournaments. By 2001, longlining became the dominant fishing method in American Samoa and the number of trolling boats, and their total catch dropped dramatically. Nevertheless, alia longlining has dropped dramatically since then. The landings and revenue by alia longline are not included in this section but are included in the American Samoa longline section.

3.2.2.3 CNMI

3.2.2.3.1 Introduction

An overview of CNMI history, culture, geography, and relationship with the U.S. is described in Section 1.3 of the FEP for the Mariana Archipelago (WPRFMC 2009c). The CNMI is situated at the northern end of the archipelago. Over the past decade, a number of studies have synthesized more specifics about the role of fishing and marine resources across CNMI, as well as information about the people who engage in the fisheries or use fishery resources.

The ancestors of the indigenous Chamorros first arrived in the Mariana Archipelago around 3,500 years ago and relied on seafood as their principal source of protein (see Chapter 1, Allen and Amesbury 2012; Grace McCaskey 2014). Similar to other archipelagos in the Western Pacific, fish and marine resources have played a central role in shaping the social, cultural, and economic fabric of CNMI that continues today. They fished for both reef and pelagic species, collected mollusks and other invertebrates, and caught sea turtles. The occupation of CNMI by foreign nations dramatically changed the island's ecosystems, reshaped communities, and disrupted fishing traditions. In the 17th and 18th centuries, Spanish colonizers destroyed the Chamorros' seagoing canoes, suppressed offshore fishing practices, and relocated populations from their traditional home. CNMI was briefly occupied by Germany from 1899 to the beginning of World War 2. During World War 2, CNMI was occupied by the Japanese military, and then was captured by the United States. Throughout this time, fishing remained an important activity. Later immigrants to the islands from East and Southeast Asia also possessed a strong fishing tradition. Today, only Saipan, Rota, and Tinian are permanently inhabited, with 90% of the population on the island of Saipan. Although the CNMI has transitioned to a tourism-based economy, fishing still plays an important cultural role and serves as a reliable source of local food (Ayers 2018).

3.2.2.3.2 People Who Fish

Allen and Amesbury (2012) summarized results of studies that demonstrated the sociocultural importance of fishing to Saipan residents. In a 2005 study, most of the active or commercial fishermen who responded to the survey had fished more than 10 years. They most often participated in snorkel spear fishing at night (participated in by 73% of the fishermen) and snorkel spear fishing during daytime (58% of the fishermen), followed by hook-and-line less than 100 ft. deep (36%), trolling (21%) cast net (talaya; 14%) hook-and-line more than 100 ft. deep (9%), trapping (octopus, crabs, etc.; 19%), foraging the reef (8%); 18% said they participated in one or more other techniques. Less than a third (30%) said they owned a boat. Their primary reasons for fishing were social and cultural, including that they just really like fishing (32%), they need the fish to feed their family (23%), giving catch to family and friends strengthened social bonds (13%), their family has always fished (12%), and it strengthens bonds with their children/family (6%). Only 4% said they needed the money from the fish they sold. Other motivations included strengthening the bond with their fellow fishermen, fishing to catch fish for fiestas/parties, and seasonal fishing for manahak, ti‘ao, and i‘e (2% each).

The fishermen reported fishing an average of 71 days a year, with 26% going once every 2 to 3 days and 24% fishing once every 2 weeks. They also reported a decrease in their amount of fishing over time, fishing an average of 93 days a year 10 years ago. Saipan reef fish were the most frequently caught species (caught by 54% of the fishermen), followed by shallow-water bottomfish (23%) and reef invertebrates such as octopus, shellfish, and crabs (14%).

As in other parts of the region, much of their catch was consumed by themselves and immediate family (70%), with another 20% consumed by extended family and friends. Only 8% of the catch was sold. Only 18 respondents identified themselves as commercial fishermen. They reported a median monthly income of ~$200 from fishing, with an average of just over $1,000 per month. Costs exceeded sales for almost every income category of fishermen, suggesting that for most fishing is not a profitable business and that they sell their catch to recover some of the costs.

While fish remains an important part of the local diet and an integral part of the people’s history and culture, adaptation to and integration with a more westernized lifestyle appears to have changed people’s diets on Saipan. Nearly half (45%) of the survey respondents reported eating “somewhat less fish” than they did 10 years ago, although the majority still ate fish between 1 and 3 times a week. The majority also purchased their fish from a store or restaurant (40%) while 31% purchase fish from roadside vendors. Less common was acquiring fish from an extended relative/friend (13%) or their own catch (11%). Most of the fish consumed came from the U.S. mainland (41%), while the next most important source was from inside Saipan’s reef (31%), deep water or pelagic fish caught off Saipan (23%) or imported from other Pacific islands such as Chuuk (10%).

Few other surveys have been conducted on fishing in general in CNMI. A household survey conducted in 2012 found that 37% of respondents said they or someone else in their household was a fisherman (Kotowicz and Allen 2015). Respondents from fishing households tended to be younger, have lower education levels, and have a higher rate of unemployment than respondents from non-fishing households.

The designation of the Marianas Trench Marine National Monument (“the Monument”) in 2009 has resulted in concerns about loss of fishing access (Richmond and Kotowicz 2015; Kotowicz and Richmond 2013; Kotowicz and Allen 2015; and Kotowicz et al. 2017). Despite long distance, high cost, and inconvenience, travel to the areas now protected by the Monument were rare but culturally significant events, and fishing was an essential component. While CNMI residents generally supported designation of the monument, awareness was low (Kotowicz et al. 2017). In addition, fishing households showed higher awareness of the Monument but were less likely to strongly support it.

3.2.2.3.3 CNMI Trolling

While proportionally few residents own a boat, more than 400 vessels were registered in the CNMI small boat fleet between 2010 and 2011 (Allen and Amesbury 2012). More than 200 of the vessels were active and operating in CNMI waters, and more than 100 of the vessels were involved in fishing activities. However, estimates of active vessels have declined in recent years. The active small boat fleet targets tunas, other small pelagics (through trolling), and bottomfish, although with the increases in the price of gas, pelagic fishing has dropped off somewhat. The fish are marketed locally, given away to family and friends, or used for ceremonial purposes such as parties, culturally significant fiestas, and each village's patron saint's day.

On Saipan, fisheries managers estimated the active small boat fleet at approximately 100 vessels in 2010 and 2011, but it is likely that active vessels have declined in recent years. Full-time commercial fishing is primarily conducted by ethnic nonindigenous minorities, namely Filipino residents (who fish primarily as independent owners and/or operators) and recent immigrants from the Federated States of Micronesia (who are primarily employed for wages). Chamorro and Carolinians, in contrast, primarily fish for recreational and subsistence purposes, selling catch to recoup costs. A few vessel owner operators are considered "Pescadores", a term used to refer to fishermen who provide fish for important community and familial events. Pescadores customarily provide 100-200 lb of reef fish for cooked dishes and pelagic species for kelaguen (i.e., a raw fish dish) for community and family celebrations. The system of seafood distribution underwent significant changes from approximately 2000-2010 with the establishment of large seafood vendors. In contrast to individual fishermen/vendors who only market their own catch, large vendors typically own and operate a number of vessels and purchase catch from independent fishermen to sell, which is reportedly depressing prices. In addition, increases in fuel prices, low market prices for fish, and downturns in the domestic economy have led to a general decline in participation in this fishery since 2000, with respect to numbers of fishermen, trips, landings, and seafood purchasers. The Saipan Fishermen's Association (SFA) is a nonprofit organization established in 1985 that holds annual fishing derbies and participated in community involvement projects, such as beach cleanup.

On Tinian, estimates of fleet size range from 15 to 20 vessels in 2010 and 2011. An estimated 1 to 3 fishermen fished consistently with the primary intent of selling fish. Respondents suggested that fishing and eating of fish was more habitual, rather than geared toward a particular event. Increasing fuel prices have reportedly led to the decline in number of active fishermen, and fishermen frequently sell fish to cover fuel costs. Three restaurants and two stores in Tinian purchase fish, although fishermen also sell house to house and commonly have an established clientele. A few charter boats serve tourist clientele; however, they do not land much catch and even trolling trips serve more as photo opportunities. Charter boats are reportedly owned by nonlocal residents and target tourists from their country of origin (Japan, China, or Korea).

On Rota, fishermen target pelagic species when in season, and fish for bottomfish the rest of the year. Like on the other islands, the number and activity of fishermen have declined as a result of increased fuel prices. Family members will often make requests for certain kinds of fish, but they will also contribute money to purchase fuel for a fishing trip. In addition, fishermen will often check demand with local restaurants, based on fuel prices. In 2010-2011, fishermen sold catch to three restaurants, or to neighbors and friends within the community (door to door or from a cooler on the roadside). One general store sold fish caught by a family member, who fishes specifically to sell. Rota holds one fishing derby in celebration of San Francisco, the saint of their island.

A survey of the small boat fleet was also conducted in 2011 (Hospital and Beavers 2014). On average, respondents were 41 years old and had been boat fishing for an average of 15 years, providing evidence of a deep tradition of boat fishing in the CNMI. They were more likely to identify themselves as Chamorro relative to the general population of the CNMI, although they were equally likely to have been born in the CNMI. In general, small boat fishermen were more educated than the general population and of comparable affluence. Pelagic trolling as the most popular gear type, followed by deep water bottomfish fishing, shallow-water bottomfish, and spear fishing. Most (71%) fishermen reported fishing at a Fish Aggregating Device (FAD) during the past 12 months, and on nearly 22% of their fishing trips. A high degree of seasonal fishing effort was reported across most subgroups of the fleet, although fishermen on Tinian and Rota were more likely to fish year-round.

Hospital and Beavers (2014) found that a majority of fishermen (74%) reported selling at least a portion of their catch in the past 12 months. However, less than half (43%) of survey respondents indicated that they could always sell all the fish that they wanted. A significant percentage of fish caught was consumed at home (28%) or given away to relatives, friends, or for cultural events (38%), reflecting the strong family and social connections associated with fishing in the CNMI. Approximately 29% of fish catch was sold, with the remaining catch either released (2%) or exchanged for goods and services (3%). Even fishermen who regularly sell fish still retain approximately 22% of their catch for home consumption and participation in traditional fish-sharing networks and customary exchange. Additionally, 86% of respondents considered the pelagic fish they catch to be an important source of food. These findings validate the importance of fishing in building and maintaining social and community networks, perpetuating fishing traditions, and providing fish to local communities as a source of food security.

Fishing in the CNMI is a social activity; only 3% of fishermen reported to fish alone, while 70% reported that their boat is used without them on occasion. In addition, the majority of fishermen (57%) agreed that as a fisherman, they are respected by the greater community. While nearly a third of respondents were neutral (27%) and some were hesitant to express an opinion or simply did not know (13%), the study found that very few (3%) felt that they were not respected by the community.

Overall, the CNMI small boat fisheries are a complex mix of subsistence, cultural, recreational, and quasi-commercial fishermen whose fishing behaviors provide evidence of the importance of fishing to the people of the CNMI. For nearly all fishery participants, the social and cultural motivations for fishing far outweigh any economic prospects. Nearly all fishermen supplement their income with other jobs and are predominantly subsistence fishermen, selling occasionally to recover trip expenses.

3.2.2.4 GUAM

3.2.2.4.1 Introduction

An overview of Guam's history, culture, geography, and relationship with the U.S. is described in Section 1.3 of the Fishery Ecosystem Plan for the Mariana Archipelago (WPRFMC 2009c). Guam is the largest and southernmost island of the archipelago. It is also the largest and most heavily populated island in Micronesia. Over the past decade, a number of studies have synthesized more specifics about the role of fishing and marine resources across Guam, as well as information about the people who engage in the fisheries or use fishery resources.

The ancestors of the indigenous Chamorros first arrived in the Marianas around 3,500 years ago and were expert fishermen and seafarers, relying on seafood as their principal source of protein (Allen and Bartram 2008; Grace-McCaskey 2014; Hospital and Beavers 2012). They fished on the high seas in large sailing canoes (proas) and used numerous methods to catch reef and bottomfish from boats Similar to other archipelagos in the Western Pacific, fish and marine resources have played a central role in shaping the social, cultural, and economic fabric of Guam that continues today. Chamorros fished for both reef and pelagic species, collected mollusks and other invertebrates, and caught sea turtles.

The occupation of Guam by foreign nations dramatically changed the island's ecosystems, reshaped communities, and disrupted fishing traditions. In the 17th and 18th centuries, Spanish colonizers destroyed the Chamorros' seagoing canoes, suppressed offshore fishing practices, and relocated populations from their traditional home. Following the Spanish-American War in 1898, the U.S. Navy took control of Guam, until it was occupied by Japan from 1941 to 1944. Guam became a U.S. territory in 1950, and the U.S. military is currently in the process of building up an even greater presence on the island. Throughout this time, fishing has remained an important activity, although by the beginning of the American period in 1898, the indigenous inhabitants had lost many of their seafaring and fishing skills and even the native names of many of the offshore species. Later immigrants to the islands from East and Southeast Asia also possessed a strong fishing tradition. In 2000, for Guam's population that identified as a single ethnicity 37% were Chamorro, followed by 32% Asian (about 80% of whom were Filipino), 17% other Pacific Islander, 7% white and 1% black. Despite rapid socioeconomic change, households still reflect the traditional pattern of extended families with multigenerational clustering of relatives, especially in Guam's southern villages. Social occasions such as neighborhood parties, wedding and baptismal parties, wakes and funerals, and especially the village fiestas that follow the religious celebrations of village patron saints all require large quantities of fish and other traditional foods, reflecting the role of fish in maintaining social ties and cultural identities. Sometimes fish are also sold to earn money to buy gifts for friends and relatives on important Catholic religious occasions such as novenas, births and christenings, and other holidays.

Since the late 1970s, Guam's most important commercial fisheries activity has been its role as a major regional fish transshipment center and resupply base for domestic and foreign tuna fishing fleets. Services provided include fueling, provisioning, unloading, air and sea transshipment, net and vessel repairs, crew repatriation, medical care, and warehousing. Among Guam's advantages as a home port are well-developed and highly efficient port facilities in Apra Harbor; an availability of relatively low-cost vessel fuel; a well-established marine supply/repair industry; and recreational amenities for crew shore leave. In addition, the territory is exempt from the Nicholson Act, which prohibits foreign ships from landing their catches in U.S. ports. Initially, the majority of vessels calling in Apra Harbor to discharge frozen tuna for transshipment were Japanese purse seine boats and carrier vessels. In the late 1980s, Guam became an important port for Japanese and Taiwanese longline fleets, but port calls have steadily declined and the transshipment volume has also declined accordingly. By the early 1990s, an air transshipment operation was also established in Guam. Fresh tuna was flown into Guam from the Federated States of Micronesia and elsewhere on air cargo planes and out of Guam to the Japanese market on wide-body passenger planes. Further, vessels from Japan and Taiwan also landed directly into

Guam where their fish was packed and transshipped by air to Japan. A second air transshipment operation began in the mid-1990s; it was transporting to Europe fish that did not meet Japanese sashimi market standards, but this has since ceased operations. Moreover, the entire transshipment industry has contracted markedly with only a few operators still making transshipments to Japan. Annual volumes of tuna transshipped of between 2007 and 2011 averages about 3,400 mt, with a 2012 estimate of 2,222 mt, compared to over 12,000 mt at the peak of operations between 1995 and 2001. As early as 2006, it was noted that the Port of Guam had lost much of its competitive advantage compared to alternative transshipment locations in the western Pacific and elsewhere, a trend that may not be reversible.

Otherwise, commercial fisheries have a relatively minor contribution to Guam's economy; the social and cultural importance of fisheries in Guam dwarfs their commercial value. Nearly all Guam domestic fishermen hold jobs outside the fishery, with fishing typically supplementing family subsistence. High value is placed on sharing one's fish catch with relatives and friends, and this social obligation extends to part-time and full-time commercial fishermen alike. A 2005 survey of Guam households found that nearly one-quarter (24 percent) of the fish consumed was caught by the respondent or an immediate family member, and an additional 14 percent was caught by a friend or extended family member (Allen and Bartram 2008). However, a little more than half (51%) of the fish consumed was purchased at a store or restaurant and 9% was purchased at a flea market or from a roadside stand. The same study found that annual seafood consumption in Guam is estimated to be about 60 lb per capita, with approximately 43% imported from the U.S.

The Westernization of Guam, particularly since World War II, not only resulted in a transition from a subsistence to wage-based economy but also contributed to dramatic changes in eating patterns, including lower seafood consumption. Indeed, recent years have seen steady declines in the market demand for fresh local fish across Guam (Hospital and Beavers 2012). While some families continue to supplement their diet by fishing and farming, no existing communities are completely dependent on local fishing as a source of food. A household survey conducted in 2016 found that only 29% of respondents participate in fishing (NCRMP 2016a).

As recently as the early 1970s, relatively few people in Guam fished offshore, because boats and deep-sea fishing equipment were prohibitively expensive (Allen and Bartram 2008). During the economic boom from the late 1980s through most of the 1990s, Guam developed a small boat fishery that conducts trolling and bottomfish fishing, mostly within 30 miles of shore.

The Guam Fishermen's Cooperative Association (GFCA) plays an important role in preserving important fishing traditions. It began operations in 1976 and was incorporated in 1977. In 2006, its membership included 164 full-time and part-time fishermen from every district in Guam, and it processed and marketed approximately 80% of the local commercial catch. In addition, it plays a role in fisheries data collection, marine education and training, and fisheries conservation and management. The GFCA strives to provide benefits not just to fishermen but to residents throughout Guam, benefitting the broader Guam community. It utilizes a Hazard Analysis and Critical Control Point (HACCP) system to ensure safe seafood, and tests fish for potential toxins or whenever requested by the Guam Department of Health and Sanitation. It has also become a focal point for community activities such as the Guam Marianas International Fishing Derby, cooking competitions, the Guam Fishermen's Festival, dissemination of educational materials on marine resources, vessel safety and seafood preparation, public meetings on resource management issues, and communications via radio base to relay information and coordinate rescues. It also has adopted a policy of purchasing local origin products that benefits 40 small businesses in Guam, regularly donates seafood for village functions and charitable activities, and provides assistance to victims of periodic typhoons with emergency supplies of ice and fuel. In addition, the GFCA has become a voice for Guam fishermen in the policy arena to ensure that concerns of fishermen are incorporated into issues such as the military buildup.

Fishing in Guam continues to be important not only in contributing to the subsistence needs of the Chamorro and other residents but in preserving their histories and identities. Knowledge of how fish are distributed and consumed locally is crucial to understanding the social and cultural significance of fishing in Guam.

3.2.2.4.2 People Who Fish

Few studies have been conducted on fishing in Guam in general. A household survey conducted in 2012 found that 35% of respondents said they or someone else in their household was a fisherman (Kotowicz and Allen 2015). Respondents from fishing households tended to have lower education levels and have a higher rate of unemployment than respondents from non-fishing households.

A few studies have targeted pelagic fishermen or the small boat fleet. While these boats also engage in bottomfish fishing and reef fishing, the primary pelagic fishing method is trolling, thus, results of these studies will be reported in the Guam Troll section.

3.2.2.4.3 Guam Trolling

As noted in Chapter 1, Guam's primary pelagic fishing method is trolling. While the majority of trolling activity is non-commercial, pelagic fish catch from troll fisheries historically account for about 80 percent of the island's boat-based fisheries commercial harvest. In addition, Guam's charter fishing fleet is considered a commercial fleet and trolls for pelagic fish. In 1998, the charter fleet attracted approximately 3% of visitors to Guam and consisted of about 12 core boats.

In 2001, pelagic fishers were interviewed to develop a profile of contemporary demographic and sociological characteristics of Guam's pelagic fishers (for full report see Rubenstein, 2001). Their study was designed to capture a representative sample of the majority of pelagic fishers and included 97 respondents. Of these, all but two were men, and neither of the two women were Pacific Islanders, reflecting the strong cultural values in Micronesia that discourage women from involvement in pelagic fishing. With respect to ethnic distribution of fishers, indigenous Chamorros reflected the general population of Guam (41%). Micronesians were over-represented, forming nearly 18% of the fishing population, but only about 6% of the general population, as were Euro-Americans, comprising 27% of the fishing population but only about 18% of the general population. Asians were under-represented; 7% of the pelagic fishing population was Filipino versus nearly 23% of the general population. Other Asian nationalities accounted for 3% of the pelagic fishing population versus 13% of the general population. Respondents were significantly more affluent than the general population on average, although there was a wide range of variation. Almost three quarters (72%) of respondents either owned or co-owned a boat. While trolling was the most common method of fishing (occurring on 70% of trips), many fishers also reported both trolling and bottomfish fishing on the same trip.

There were three main motivations for fishing. The predominant motivation (65%) emphasized personal enjoyment, and a number of respondents within this category (especially Chamorros and other Micronesians) emphasized the sense of cultural identity they derive from fishing. A second motivation (18%) was consumption of fish for family subsistence, and the final motivation (16%) was income. However, more than half (51%) identified multiple motivations. In addition, nearly all fishers (96%) reported regularly giving fish to family (36%), friends (13%), or both (47%). Most (53%) said they did not give fish to people other than family and close friends; of those who did occasionally, the main recipients were church fiestas (32%) and other church events or organizations (20%), reflecting Guam's long and well-entrenched Catholic tradition.

More than half of the respondents (58%) reported that they sell portions of their catches, although again with multiple motivations. People who sold fish one to four times per month (53%) were mostly seeking to recover some of the cost of fishing and boat ownership, whereas those who sold fish eight or more times per month (36%) were more likely selling to make a profit. The majority of fishers (69%) earned less than $500 monthly from fish sales. A number reported that infrequent fish sales subsidize the cost of fishing equipment and boats, a common theme in the Western Pacific region. There were 22% of respondents who earned more than $1,000 per month, relying heavily on fishing for their income.

In 2011, another survey was conducted of the small boat fleet, which found similar patterns (Hospital and Beavers, 2012). On average, fishermen responding to the survey were 44 years old and reported to have been boat fishing for an average of 20 years. Respondents were also more educated and more affluent than the general population. The majority of respondents described themselves as Chamorro (72%) followed by white (23%) with relatively small proportions of Filipinos (6%), Micronesians (6%), other ethnicities (5%), and Carolinians (1%). While the percentage of Micronesians was lower than in the 2001 study, the researchers noted that efforts to engage Filipinos and Micronesians were less successful than the investigators had hoped. As in the previous study, there was considerable evidence of co-ownership and sharing of fishing vessels. In addition, fishermen reported the use of multiple gear types, with pelagic trolling as the most popular gear type followed by shallow-water bottomfish fishing and deepwater bottomfish fishing. Almost all (96%) fishermen reported fishing at a Fish Aggregating Device (FAD) during the past 12 months, and on nearly half (53%) of their fishing trips. Fishing for bottomfish and reef fish was highly seasonal compared to pelagics; whereas over half of the survey respondents (54%) fished all year for pelagics, only 16% fished year-round for bottomfish and reef fish.

A larger proportion of fishermen reported selling at least a portion of their fish (70%) than in the 2001 study, and 82% of could always sell all the fish that they wanted to sell. However, nearly 30% reported that they had not sold any fish in the past 12 months, and nobody reported selling all the fish they caught. Instead, cost recovery was cited as the primary motivation for the sale of fish, with fish sales contributing very little to personal income for the majority (59%). In fact, 64% of fishermen reporting the sale of fish earned fishing revenues of less than $1000, which would not cover overall trip expenditures for the year. Sale of pelagic fish contributes to nearly 67% of fishing income, with another 20% from bottomfish revenues, and the rest from reef fish.

While respondents sold approximately 24% of their total catch, 29% was consumed at home, while 42% was given away. The remaining catch was either released (2%) or exchanged for goods and services (3%). This diversity of catch disposition extends to fishermen who regularly sell fish, as they still retain approximately 30% of their catch for home consumption and participation in traditional fish-sharing networks and customary exchange. Additionally, 78% consider the pelagic fish they catch to be an important source of food, 79% for bottomfish, and

85% for reef fish. These findings validate the importance of fishing in terms of building and maintaining social and community networks, perpetuating fishing traditions, and providing food security to local communities.

Like with CNMI, fishing in Guam is a social activity. Only 7% of fishermen reported fishing alone, and 45% reported that their boat is used without them on occasion. In addition, 61% reported to be a member of a fishing club, association, or group. The majority of fishermen (60%) also agreed that as a fisherman, they are respected by the Guam community. Very few felt that they were not respected by the community.

There was also an open-ended portion of the survey that asked for comments. The two most prevalent themes were that of a rising population and rising fuel costs. Many believed that the expanding population would increase the demand for fish and number of fishermen, yet at the same time, others noted that fuel costs and economic considerations could restrict fishing. In addition, there was concern about the designation of Marianas Trench Marine National Monument (the Monument), especially since respondents felt that the Marine Preserve Areas established in 1997 had already displaced them from their traditional fishing grounds. Military exercises also affected fishing trips. Other studies have also documented concerns about fishing access related to the designation of the Monument (see Richmond and Kotowicz 2015; Kotowicz and Richmond 2013; and Kotowicz and Allen 2015). Despite long distance, high cost, and inconvenience, travel to the areas now protected by the Monument were rare but culturally significant events, and fishing was an essential component.

Similar to CNMI, Guam’s small boat fisheries are a complex mix of subsistence, cultural, recreational, and quasi-commercial fishermen whose fishing behaviors provide evidence of the importance of fishing to the island of Guam. For nearly all fishery participants, the social and cultural motivations for fishing far outweigh any economic prospects. Nearly all fishermen supplement their income with other jobs and are predominantly subsistence fishermen, selling occasionally to recover trip expenses.

3.2.2.5 HAWAII

3.2.2.5.1 Introduction

The geography and overall history of the Hawaiian Archipelago, including indigenous culture and current demographics and description of fishing communities is described in section 1.3 of the Fishery Ecosystem Plan for the Hawaii Archipelago (WPRFMC 2009b). Over the past decade, a number of studies have synthesized more specifics about the role of fishing and marine resources across the Hawaiian archipelago, as well as information about the people who engaging in the fisheries or use fishery resources.

As described in Chapter 1, a number of studies have outlined the importance of fishing for Hawaiian communities through history (e.g., Geslani et al. 2012; Richmond and Levine 2012). Traditional Native Hawaiian subsistence relied heavily on fishing, trapping shellfish, and collecting seaweed to supplement land-based diets. Native Hawaiians also maintained fishponds, some of which date back thousands of years are still used today. The Native Hawaiian land and marine tenure system, known as ahupuaʻa-based management, divided the islands into large parcels called moku, which are reflected in modern political boundaries (Census County Districts).

Immigrants from many other countries with high seafood consumption and cultural ties to fishing and the ocean came to work on the plantations around the turn of the 20th Century, establishing in Hawaii large populations of Chinese, Japanese, Koreans, Filipinos, and Portuguese, among others. In 1985, the Compact of Free Association also encouraged a large Micronesian population to migrate to Hawaii. According to the 2020 Census, the State of Hawaii's population is almost 1.5 million. Ethnically, it has the highest percentage of Asian Americans (37.2%) and Multiracial Americans (25.3%) and the lowest percentage of White Americans (22.9%) of all states. Approximately 27% of the population identifies as Native Hawaiian or part Native Hawaiian. Tourism from many of these Asian countries also increases the demand for fresh, high-quality seafood, especially sushi, sashimi, and related raw fish products such as poke.

Today, fishing continues to play a central role in the local Hawaiian culture, diet, and economy. In 2012, an estimated 486,000 people were employed in marine-related businesses in Hawaii, with the level of commercial fishing-related employment well above the national average (Richmond et al. 2015). The Fisheries Economics of the United States 2019 report found that the commercial fishing and seafood industry in Hawaii (including the commercial harvest sector, seafood processors and dealers, seafood wholesalers and distributors, importers, and seafood retailers) generated $786 million in sales impacts and approximately 7,693 full and part-time jobs that year (NMFS 2022). It is estimated that recreational anglers took 3.5 million fishing trips, with $400 million in sales impacts and 2,911 full- and part-time jobs were generated by recreational fishing activities in the State during 2019. Similarly, the 2011 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation (USFWS 2011) estimated that 157 thousand people over 16 years old participated in saltwater angling in Hawaii in 2011. They fished approximately 1.9 million days, with an average of 12 days per angler. This study estimated that fishing-related expenditures totaled $203 million, with each angler spending an average of $651 on trip-related costs. These numbers are not significantly different from those reported on the 2006 and 2001 national surveys. Due to changes in data availability NMFS does not currently report recreational angler participation at the State level.

Seafood consumption in Hawaii is estimated at approximately two to three times higher than the entire U.S., and Hawaii consumes more fresh and frozen finfish while shellfish and processed seafood is consumed more across the entire U.S. (see Geslani et al. 2010 and Davidson et al. 2012 for review). In addition, studies have shown that seafood is eaten frequently, at least once a week by most, and at least once a month by almost all respondents (NCRMP 2016b). Fresh seafood is the most popular type of seafood purchased, and while most is purchased at markets or restaurants, a sizeable amount is reported as caught by friends, neighbors, or extended family (NCRMP 2016b; Davidson et al. 2012).

At the same time, local supply is inadequate in meeting the high seafood demand. In 2010, 75% of all seafood consumed in the State of Hawaii was imported from either the U.S. mainland or foreign markets, and the rise in imported fish has influenced the price of local catch (Arita et al. 2011; Hospital et al. 2011). In addition, rising costs of fuel and other expenses have made it more difficult to recover trip costs (Hospital et al. 2011). A majority of commercial fishermen report selling their fish simply to recover these costs, not necessarily to make income (Hospital et al. 2011). Many describe the importance of sharing fish as a part of maintaining relationships within family or other networks as being more important than earning income from fishing (Calhoun et al. 2020).

Pelagic fish play a large role in seafood consumption, with Hawaii residents regularly consuming substantial amounts of fresh bigeye and yellowfin tuna as ‘ahi poke (bite-sized cubes of seasoned raw tuna) and ‘ahi sashimi (sliced raw tuna). ‘Ahi is also a significant part of cultural celebrations, especially during the holiday period from late November (Thanksgiving) through late January to mid-February (Chinese New Year). Changes in bigeye regulations can have far-reaching effects not only on Hawaii's fishing community but also on the general population (Richmond et al. 2015). While most of the fresh tuna consumed in Hawaii is supplied by the local industry, market observations suggest that imported tuna is becoming more commonplace to meet local demands (Pan 2014). However, on average, only 18% of tuna consumed is imported (Dombrow et al. 2022).

Examination of the seascape of compliance across the US Pacific Island region found, that while the literature highlights the importance of enforcement, local experts emphasized barriers of capacity, governance process, and the lack of data. This suggests that non-instrumental and governance approaches can complement enforcement and should be part of an integrated compliance approach both in the region (Ayers and Leong 2020).

3.2.2.5.2 People Who Fish

Hawaii includes a mix of commercial, non-commercial, and subsistence characteristics across fisheries. Pelagic fish are caught not only by the industrial-scale Hawaii longline fishery, but also by small boat fishermen. The longline fishery will be addressed in the following section. Within the small boat fleet, there is a nearly continuous gradation from the full-time and part-time commercial fleet to the charter and personal recreation fleets. A single boat (and trip) will often utilize multiple gear types and target fish from multiple fisheries. Thus, other than the longline fishery, the other fisheries are typically not studied individually. Rather, studies have typically been conducted based on ability to reach potential respondents. Studies have targeted fishermen via State of Hawaii Commercial Marine Licenses (CMLs; Chan and Pan 2017; Madge et al. 2016), shoreline and boat ramp intercepts (Hospital et al. 2011; Madge et al. 2016), and vessel and angler registries (Madge et al. 2016).

The Hawaii small boat pelagic fleet was studied in 2007-2008 (hereafter, referred to as the 2008 study), following a design last used in 1997 (Hospital et al. 2011). This work was updated in 2014 by Chan and Pan (2017). Both studies found that the small boat pelagic fleet is predominantly owner-operated and a male dominated activity (98% of respondents were male in both studies). The ethnic composition was predominantly Asian (45% in 2008, 41% in 2014) and White (23% in 2008, 26% in 2014), which is similar to the State population as a whole. In 2014, proportionally more Native Hawaiians and Pacific Islanders responded to the survey than are represented in the general population (18% vs. 10%). In addition, the majority of respondents had a household income above $50,000 (75% in 2008, 69% in 2014).

These studies also asked respondents to classify themselves based on categories ranging from commercial to non-commercial. In 2014, 7% identified as full-time commercial, 51% identified as part-time commercial, 27% identified as recreational expense where they sold some catch to offset fishing expenses, 11% as purely recreational, 3% as subsistence, and 1% as cultural. Different activities were then compared based on self-classification.

As previously mentioned, the Hawaii small boat pelagic fishery is a mixed-gear fishery. In 2008, 47% of respondents reported using more than one gear type, predominantly trolling (for pelagic fish) and handline (for bottomfish). In 2014, 65% of respondents reported trolling as their most common gear, while 16% indicated bottomfish handline, and 12% stated pelagic handline was their most commonly used gear. Trolling was more commonly used by recreational fishermen whereas pelagic handline and bottomfish gears were more commonly used by commercial fishermen. The 2014 study also asked about species composition of catch. While 93% of the respondents reporting landing pelagic fish in the past 12 months, about half of respondents also reported they caught and landed bottomfish or reef fish. Only 7% of survey respondents did not catch any pelagic fish in the past 12 months. Thus, the small boat fleet includes not only a mixture of gear types, but also targets both pelagic and insular fish stocks.

Both studies also examined how fishermen self-identified vs. their commercial and non-commercial activities. In both cases, many people who considered themselves recreational, subsistence, or cultural fishers still sold fish. In 2008, 42% of fishermen self-classified as commercial fishermen, yet 60% of respondents reported selling fish in the past 12 months. In addition, just over 30% of fishermen who self-classified as recreational reported selling fish in the past year. Results for the 2014 study are shown in Table 47.

Table 47. Catch disposition by fisherman self-classification, from Chan and Pan (2017)

	Number of respondents (n)	Caught and released (%)	Given away (%)	Consumed at home (%)	Sold (%)
All Respondents	738	5.6	13.9	15.4	65.0
By Fisherman Classification…					
Full-time commercial	55	6.2	9.4	11.6	72.8
Part-time commercial	369	5.2	12.9	14.4	67.5
Recreational expense	200	6.7	19.8	21.7	51.8
Purely recreational	78	5.4	37.3	29.6	27.6
Subsistence	24	1.9	20.7	31.0	46.5
Cultural	8	4.0	36.8	22.5	36.7

In 2014, the average value of fish sold by all respondents was approximately $8,500. Full-time commercial fishermen reported the highest value of fish sold ($35,528 annually and $558 per trip), part-time commercial fishermen reported $8,391 annually and $245 per trip, cultural fishermen $3,900 annually and $150 per trip, recreational expenses fishermen $2,690 annually and $95 per trip, subsistence fishermen $1,905 annually and $79 per trip, and purely recreational fishermen reported selling close to $1,000 annually ($58 per trip). While income from fish selling served as an important source of personal income for full-time commercial fishermen, the majority of fishermen reported selling fish to cover trip expenses, not necessarily to make a profit; few fishermen reported substantial, if any, profits from fishing. In the 2008 study, respondents expressed concern about their ability to cover trip costs, noting that trip costs continued to increase from year to year, but fish prices remained relatively flat.

The 2008 study was also the first attempt to quantify the scale of unsold fish that was shared within community networks. Approximately 38% of pelagic fish caught by commercial fishermen was not sold, 97% of survey respondents indicated they participated in fish sharing networks with friends and relatives, and more than 62% considered the fish they catch as an important food source for their family. Community networks were also present in the outlets where fish were sold, which included the United Fishing Agency (UFA) auction in Honolulu, dealers/wholesalers, markets/stores, restaurants, roadside, but also sales to friends, neighbors, and coworkers. The 2014 study also documented 27% of sales to friends, neighbors, or coworkers and corroborated the importance of giving away fish for all self-classification categories. In addition, 17% of respondents (who all held CMLs) sold no fish in the past 12 months.

Taken together, the results from these studies suggest a disconnect between the disposition of Hawaii fishermen and public perception of their fishing activity relative to current regulatory frameworks. The small boat fleet is extremely heterogeneous with respect to gear type, target species, and catch disposition, while regulations attempt to treat each separately with clear distinctions between commercial and recreational activities. In addition to providing income, the Hawaii small boat fleet serves many vital nonmarket functions, including building social and community networks, perpetuating fishing traditions, and providing fish to local communities.

A survey was also conducted on the attitudes and preferences of Hawaii non-commercial fishers (see Madge et al. 2016). Nearly all survey respondents were male (96%). Their average age was 53, and, on average, they had engaged in non-commercial saltwater fishing in Hawaii for 31 years. The majority had household income equal to or greater than $60,000, reported high levels of education, and reflected a large racial diversity (primarily various Asian ethnicities and White). They primarily fished via private motorboat (61%), followed by shore, including beach, pier, and bridge (38%). Offshore trolling and whipping/casting, and free-dive spearfishing were the most frequent gears reported as "always" used, and a majority of respondents reported using multiple gears on a single fishing trip.

As with the small boat fleet, even though this study targeted "non-commercial fishermen", 9% reported that their primary motivation for fishing was to sell some catch to recover trip expenses. However, the primary motivation for the majority (51%) was purely for recreational purposes (only for sport or pleasure). A total of 78% of respondents indicated they "always" or "often" share catch with family and friends, and only 35% indicated they "never" supply fish for community/cultural events. Fishing for home/personal consumption was the most important trip catch outcome (36% rated it "extremely important"), followed by catching enough fish to be able to share with friends and family (20%). Thirty-six percent indicated that their catch was extremely or very important to their regular diet. Thus, similar to the small boat fleet, non-commercial fishermen demonstrate mixed motivations that include commercial activities. They also play an important role in providing fish via social and community networks, even though they report their primary motivation as fishing only for sport or pleasure.

NMFS and the Hawaii DAR have been collecting information on recreational fishing in Hawaii, administered through the Hawaii Marine Recreational Fishing Survey (HMRFS; see Allen and Bartlett 2008; Ma and Ogawa 2016). The program collected data from 1979-1981, but not from 1982-2000, and then began annual data collection again in 2001. A dual survey approach is currently used. A telephone survey of a random sample of households determines how many have done any fishing in the ocean, their mode of fishing, methods used, and effort. The telephone survey component will be discontinued after 2017 due to declining land line coverage. Concurrently, surveyors conduct in-person intercept surveys at boat launch ramps, small boat harbors, and shoreline fishing sites. Fisher county of residence and zip code are regularly collected in the intercept surveys but has not yet been compared to the composition of the general public. As observed in the other surveys, this program documented wide range of gears used to catch a variety of both pelagic and insular fish. The majority of trips from the onsite interviews were from "pure recreational fishermen" (defined as people who do not sell their catch), with an average of almost 60% to over 80% depending on year and island. However, they also noted that in Hawaii the divisions between commercial, non-commercial, or recreational are not clearly defined, and results suggested that the majority of catch for some categories of fishermen may be consumed by themselves or given away, further reinforcing common themes from other studies.

3.2.2.5.3 Hawaii Longline

The Hawaii longline fishery (HLF) is the dominant commercial fishery in the Hawaiian Islands and is described in detail in Richmond et al. (2015). It operates out of the port of Honolulu, and in 2018 there were 142 active vessels. The majority of longline fish is sold at the Honolulu fish auction, modeled after the Tsukiji auction in Tokyo, where dealers bid on individual fish. Over 40 dealers representing a variety of different market strategies regularly purchase fish at the auction. Many dealers represent locally-owned small businesses. Additional businesses connected to the bigeye fishery include processors, airline and shipping companies, ice distributors, gear stores, restaurants, and retail outlets.

Owners and operators of Hawaii's longline vessels comprise three main ethnic groups: Korean-American (K-A), Vietnamese-American (V-A), and Euro-American (E-A) (Allen and Gough 2007); and the crew is predominantly Filipino (Allen and Gough, 2006). Unlike the broader Asian-American population in Hawaii, most HLF K-A and V-A fishers are first generation immigrants and speak limited English. E-A fishers largely consist of individuals from the mainland U.S. whose native language is English. The fishery is considered well regulated, although there are concerns about growing social and economic impacts from increased competition and regulation. Social network analysis revealed that fishers interacted more within ethnic groups than across ethnic groups. V-A fishers reported the most cross-scale linkages, whereas K-A fishers reported only one tie to an industry leader outside their community (Barnes-Mauthe et al. 2013). This indicates that the interests of K-A fishers may not be adequately represented in the management and policy arena. It also supports previous research that suggests the three ethnic communities should not be assumed to utilize the same fishing practices, exhibit the same attitudes toward fishery management and regulations, or display the same level of trust across groups. According to Kalberg and Pan (2015), The V-A group had the highest number of active vessels in 2012 (n=70), while the E-A had 44 active vessels, and K-A had 15. In addition, on average each vessel had more foreign crew than U.S. crew members.

An economic model documented some of the major changes to the fishery's role in the local economy, based on 2005 data (Arita et al. 2011). These included rising fuel costs, a steady rise in foreign crewmembers, and weakening profits. From 2003-2004, a study was conducted on Filipino crew members in the longline fleet (Allen and Gough 2006). Filipino crew sampled ranged from 21 to 52 years of age in 2003; the average age was 37, and 55% were older than 36. A total of 89% had completed high school, nearly 30% also completed an associate or trade school degree (often focused on maritime studies), an additional 16% completed at least some college coursework, and 5% completed college studies. In many cases, they had received more formal education than the captains or owners for whom they were working in Hawaii. Crew were responsible for an average of five dependents, and all respondents indicated that their households depended heavily on the Hawaii longline industry for income, with 63% relying on the fishery as their sole source of income. Many had an extensive background in commercial fishing, with an average of 11 years of experience. In comparison, only 25% of respondents reported more than 5 years total involvement in seafaring in a 2004 study of overall seafarers. While there are a number of challenges to obtaining foreign laborers for employment on Hawaii longline vessels, they are often willing to work for less money and earn more money as a crew member than they would in their home country. Crew must reside on the vessel and do not receive a 'shore pass' to leave the pier area. However, many developed strong social networks and a number of Hawaii-based Filipinos developed businesses in the pier area to serve crew needs. The average annual income of a Hawaii-longline crew member was well over double the average earned in the Philippines; even the lowest paid crew members earned 62% more than the family average for the Philippines and did not have to pay for food or housing while living on the longline vessel. Nearly 70% reported high or very high levels of job satisfaction while nearly 80% reported a reasonable income and no problem with their workload or living conditions.

In 2010, the bigeye tuna fishery experienced the first extended closure of the western and central Pacific Ocean (WCPO) to U.S. longliners from the State of Hawaii. Richmond et al. (2015) monitored the socioeconomic impacts of this closure to examine how the bigeye fishery community (including fishermen, a large fish auction, dealers, processors, retailers, consumers, and support industries) perceived and were affected by the constraints of the 40-day closure over the holiday season. During the closure period, they found a reduced supply and quality of bigeye landed, an increase in price for high quality fish, and longer distances traveled to fish in rougher waters. These factors resulted in increased stress and in some cases lost revenue for individuals and businesses connected to the fishery. Different stakeholder groups responded differently to the closure, with fish dealers among those most affected. Some dealers chose to purchase high quality tuna despite abnormally high prices and sell at a loss to maintain relationships with their customers. During the closure, U.S. boats could continue to fish for bigeye in the Eastern Pacific Ocean and foreign and dual permitted vessels could still fish in the WCPO, which mitigated some of the impacts to the fishery. U.S. legislation and federal rules that have prevented subsequent closures of the fishery have since been put in place.

Frozen tuna treated with carbon monoxide to enhance color has appeared in Hawaii markets since the late 1990s. It is often labeled as "Tasteless Smoke" and is sold in markets in thawed form, which is similar in appearance to fresh 'ahi poke. The price of Tasteless Smoke tuna is lower than the price of fresh tuna landed by local vessels. During the closure, imported products were available in retail markets and the price in the retail market stayed consistent, suggesting that local and imported products are substitutes and that imports increase quickly to meet demand when local landings are low (Pan 2014). However, conversation with multiple dealers suggested that only a few dealers increased their reliance on imports during the closure (Richmond et al. 2015).

In the fall of 2016, concerns about the working conditions of foreign crewmembers garnered national media attention. In response, the Hawaii Longline Association commissioned a follow-up study, based on the methodology developed by Allen and Gough (2006), and conducted by one of the same researchers (see Gough 2016). Many of the same crew members were interviewed in both 2006 and 2016 due to high retention in the fleet. The study interviewed crew from 75% of Hawaii longline vessels on crew recruitment and fees, on board conditions and access, pay structure, medical care, document retention on board, and grievance mechanisms. There were no indications of foreign crew employed against their will, nor were there records of respondents who wished to return to their country of origin but were unable to do so; trends reported did not reflect forced labor or human trafficking. While no exploitation was reported, the study also identified potential operational flaws that could result in exploitation of foreign crew. It also suggested recommendations to improve those systems to reduce industry vulnerability to scrutiny, including safeguards for both crew and vessel owners.

On August 26, 2016, a Presidential proclamation expanded the Papahānaumokuākea Marine National Monument to include the majority of the United States Exclusive Economic Zone surrounding the Hawaiian Islands, which would largely affect the longline fleet. An internal report noted the potential for differential impacts (e.g., based on target species, vessel size, or ethnicity; see PIFSC 2017). For example, the shallow-set fishery appears to have nominally higher share of catch, effort, and revenues from the Northwest Hawaiian Islands, compared to the deep-set fishery. Multiple evaluations of the effects from the Monument expansion were published in 2020 (Chan 2020; Lynham et al. 2020).

3.2.2.5.4 Hawaii Trolling

Trolling was one of the gear types included in the 2014 Small Boat Survey (Chan and Pan 2017). Fisher demographics and catch disposition were summarized in Chapter 2. Most small boat fishermen trolled, with 65% of respondents stating that trolling was their most commonly used gear. Approximately half of their trips occurred in State waters, and half in federal waters. A higher percentage of those who identified troll as their most commonly used gear reported using only a single gear (35%) in comparison to respondents who most commonly used other gear types. However, a larger percentage (45%) reported using two types of gear. Trolling was more commonly used by fishermen who self-identified as recreational, although respondents spanned all response categories (full-time commercial, part-time commercial, recreational expense, purely recreational, subsistence, and cultural). This finding corroborates the observation that the troll fishery has a significant cultural and subsistence role in Hawaii's fishing communities (Markrich and Hawkins 2016).

3.2.2.5.5 Hawaii Pelagic Handline

Pelagic handline was one of the gear types included in the 2014 Small Boat Survey (Chan and Pan 2017). Fisher demographics and catch disposition were summarized in Chapter 2. Only 12% of respondents stated that pelagic handline was their most commonly used gear. A larger percentage of their fishing trips occurred in State waters (62%) vs. federal waters (38%). In comparison to respondents who most commonly used other gear types, those who identified pelagic handline as their most commonly used gear reported the lowest percentage of single gear use (8%). They predominantly reported using two types of gear (49%). Pelagic handline was most commonly used by fishermen who self-identified as commercial, although respondents spanned all response categories (full-time commercial, part-time commercial, recreational expense, purely recreational, subsistence, and cultural). This finding corroborates the observation that the pelagic handline fishery has a significant cultural and subsistence role in Hawaii's fishing communities (Markrich and Hawkins 2016).

3.2.2.5.6 Offshore Handline

Pelagic offshore handline was one of the gear types included in the 2014 Small Boat Survey (Chan and Pan 2017) and fisher demographics and catch disposition on the offshore handline were available in Chan and Pan (2019b).

3.2.2.5.7 Other Gears (including Aku Boat/Pole and Line)

This category represents pelagic species caught by methods or in areas other than those methods of longline, MHI troll and handline, and offshore handline. There is currently no socioeconomics information specific to this group of fisheries. Aku boat was included in the group. Fishers trolling in areas outside of the MHI (the distant water albacore troll fishery) or PMUS caught close to shore by diving, spearfishing, squidding, or netting inside of the MHI are also included in this category.

3.2.3 ECONOMIC PERFORMANCE OF MAIN COMMERCIAL FISHERIES

3.2.3.1 AMERICAN SAMOA

3.2.3.1.1 American Samoa Longline

3.2.3.1.1.1 Commercial Participation, Landings, Revenue, and Prices

The American Samoa longline fishery includes large longline vessels and small longline vessels (alia boats). Alia longline fishing has experienced declining trends in participation over the years, and no alia vessels participated in fishing activities in 2021 or 2022. There was only one active alia vessel longline vessel in 2020. In 2022, all 11 active longline vessels that actively fished in American Samoa EEZ were mid- or large-size vessels (i.e., 50 feet or larger). The American Samoa longline fishery mainly targets albacore, which differs from the Hawaii longline fishery targeting bigeye tuna and swordfish. The American Samoa longline fishery, especially the large vessels, sell the majority of their catch to the local cannery. The species sold to the local cannery includes four tuna species, albacore, yellowfin, bigeye, and skipjack, and one non-tuna species, wahoo.

In 2022, the total fleet revenue (i.e., estimated landed value sold to cannery) was $2.98 million from 3.19 million pounds of landings. Albacore composed over 90% of the total landed value (compared to 80% in 2021) and the revenue from the other four primary species (yellowfin, bigeye, skipjack, and wahoo) comprised the remaining 10% of revenue in 2022. The higher proportion of albacore in 2022 was likely due to the high albacore CPUE. Swordfish and some wahoo landings may be sold in non-cannery markets, but no detailed commercial data are available to describe this behavior. Wahoo was one of the five species that canneries accepted. Traditionally, most all wahoo harvested by American Samoa longline are sold to the canneries. In recent years, fishers indicated they have sold more wahoo to local markets instead of the cannery since local markets pay a higher price for wahoo. However, we used cannery price to estimate the total commercial landings of wahoo and assumed all wahoo were sold to canneries because the portion and price that sold to local markets for wahoo are not available.

Figure 122 presents the trends of commercial landings and revenue (for cannery only) from 2003-2022. Revenue presented here represents only the revenue from sale to the cannery. Supporting data for Figure 122 are provided in Table A-112. In general, American Samoa longline landings and revenue have been declining since 2003. Commercial landings in 2022 were up 13% compared to 2021. Revenue increased 20% in 2022 due to higher albacore price and CPUE.

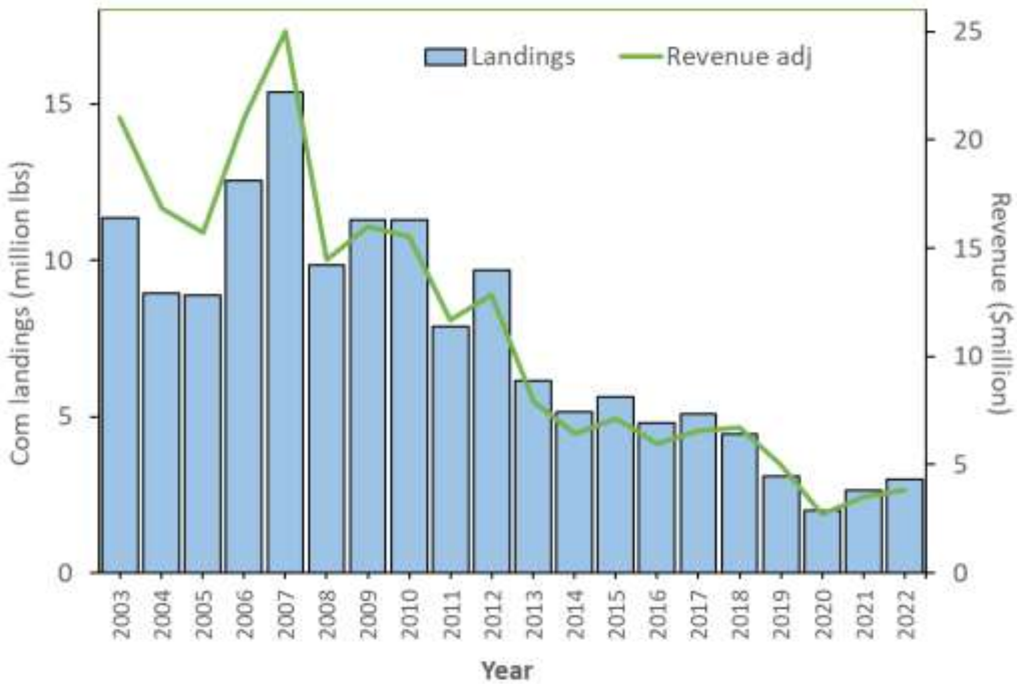


Figure 122. Commercial landings and revenues of the American Samoa longline fishery (adjusted to 2022 dollars)[1]

[1] Data source: Pacific Islands Fisheries Science Center: Fishery Economic Performance Measures (Tier 1 indicators). https://inport.nmfs.noaa.gov/inport/item/46097.

Fish price data for the five main species harvested by American Samoa longline have been collected through annual in-person interviews with owners or agents of the fishery since 2012. Fish price information was collected through a collaborative effort between PIFSC and the PIRO observer program. Challenges were posed during 2020 and 2021 during the pandemic period, as travel restrictions were in place and no in-person interviews with local fishermen were able to be conducted.

Trends in albacore price from 2012 to 2022 are presented in Figure 123. Supporting data for Figure 123 are presented in Table A-113. The albacore price was at its lowest in 2013, dropping from its second highest peak in 2012. The albacore price increased substantially in 2018 because the American Samoa-based US longline fleet secured certification from the Marine Stewardship Council (MSC) and Starkist Co., which led to the higher albacore price with an additional $200 per metric ton provided for vessels that fish exclusively in the US EEZ around American Samoa. The nominal average albacore price in 2019 reached a historical high of $1.61 per pound (whole weight), or $3,542 per metric ton. However, the adjusted price decreased again from 2020 to 2021. The nominal price in 2022 was slightly higher at $1.50 per pound in 2022 versus $1.46 per pound in 2021. Table A-113 also shows the average fish price of all species sold to canneries.

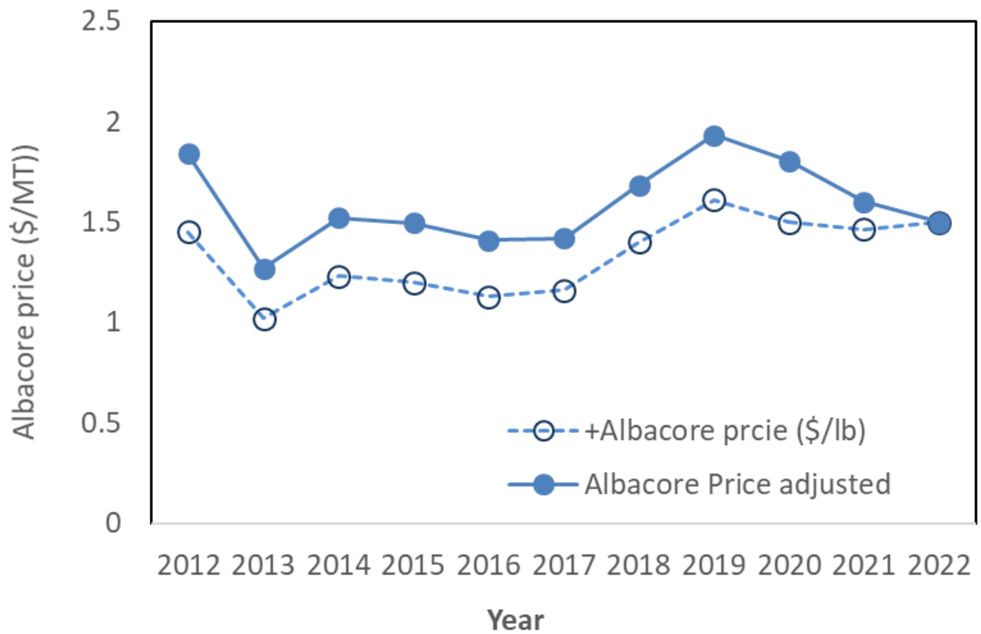


Figure 123. Albacore whole-weight price as reported by American Samoan fishers (adjusted to 2022 dollars)[1]

[1] Data source: PIFSC Continuous Economic Data Collection Program (Pan 2018).

3.2.3.1.1.2 Fishing Costs

The American Samoa longline continuous economic data collection program started in 2006, the same time as PIRO started their observer program in the fishery (Pan 2018 and Pan 2019). Fisher participation in the economic data collection program is voluntary. Similar to the Hawaii longline fisheries' continuous economic data collection program, the American Samoa continuous economic data collection obtains information on the fishery via a form requesting data on 10 variable cost items common to American Samoa longline trip expenditures, excluding labor costs. For the main cost items, including diesel fuel, engine oil, and bait, information is collected on unit price, quantity used, and total cost. For other items, such as gear, provisions, and communications, information is collected on total cost only. It was often difficult for observers to collect trip cost data when vessels were operated by hired captains. In an effort to increase the number of observations for the economic data collection program, PIFSC economists began to supplement observer data by traveling to American Samoa to conduct in-person interviews of owners or agents starting in 2012. The details of the data collection program are described in a NOAA technical memorandum (Pan 2018).

Although cost data from 2020 and 2021 were not available because there were no in-person surveys conducted during these two years due to pandemic-related travel restrictions, the data gap were able to fill out during the 2023 in person survey with fishermen (owners or agents). Therefore, cost and net revenue data for the entire data series 2006-2022 are presented with updated information of 2020 and 2021 trip cost data. Data prior to 2006 were not available since trip cost data collection did not begin until 2006. While cost per trip data were collected**,** we present the cost per set (not per trip) to show the change across years, as the variation in trip length is considerable across years and cost per set could better reflect cost changes for this fishery.

Figure 124 shows the cost structure for an average American Samoa longline trip in 2022, while Figure 125 presents the trends in costs per set for 2006 to 2022. Fuel usually comprises about 50% of trip costs, but in 2022, the percentage increased to 61% from 51% in the previous year. The proportion of fuel costs to total trip costs was relatively low in 2016, 2017, and 2021 compared to other years due to lower fuel prices. Thus, the total fishing costs (per set) were also relatively lower for those years. The cost per set in 2022 was a historical high as shown in Figure 125 due to the high fuel price in 2022 of $4.02, compared with $2.27 in 2021.

The data supporting Figure 125 are presented in Table A-114. Using the average cost per set can be a better index to examine the cost trend across years because the average trip length (total trip days) for the American Samoa longline fleet varies substantially.

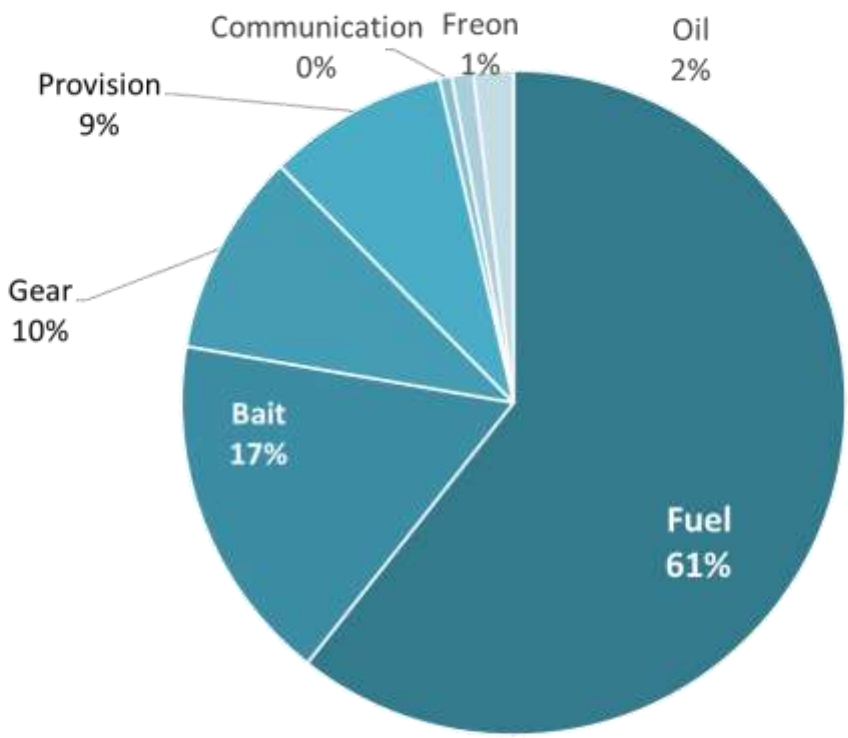


Figure 124. The cost structure for an average American Samoa longline trip in 2022[1]

[1] Data source: PIFSC Continuous Economic Data Collection Program (Pan 2018).

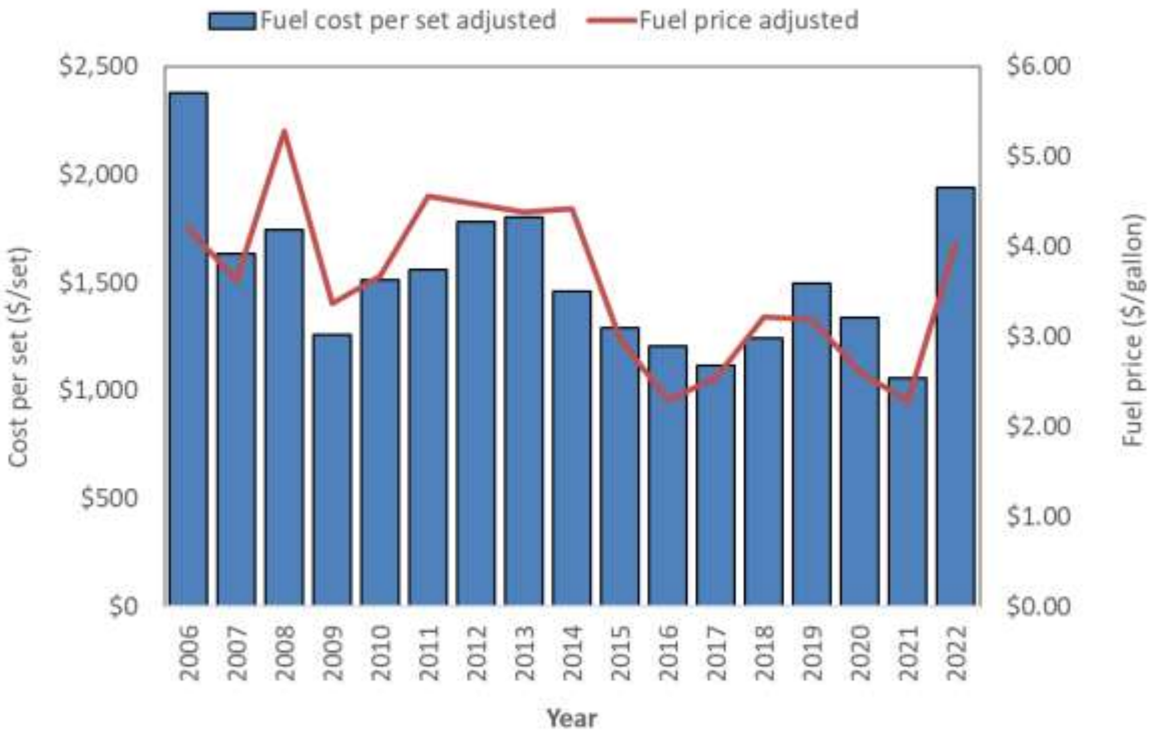


Figure 125. Costs per set[1] for the American Samoa Longline Fishery (not including labor cost and fixed costs) adjusted to 2022 dollars[2]

[1] Data source: PIFSC Continuous Economic Data Collection Program (Pan 2018).

3.2.3.1.1.3 Economic Performance Indicators

The continuous economic data collection program allows for the monitoring of variation in fishing costs over time. Compiling the revenue with cost and effort data, it is possible to measure the economic performance in terms of net revenue and monitor changes over time.

Figure 126 presents trends in net revenue per set for the period from 2006 to 2022. The data supporting Figure 126 are provided in Table A-114. Using the average net revenue per set can be a better index than the average net revenue per trip to present the revenue and cost trends because the average trip length (i.e., in total trip days) for the American Samoa longline fleet has varied substantially over the years. Figure 126 shows a downward trend in the economic performance (in net revenue per set) from 2006 to 2013 but also indicates a recovery since 2014 and continued improvement through 2019. However, net revenue per set decreased again in 2020. The economic performance per set improved in 2022 due to higher albacore CPUE.

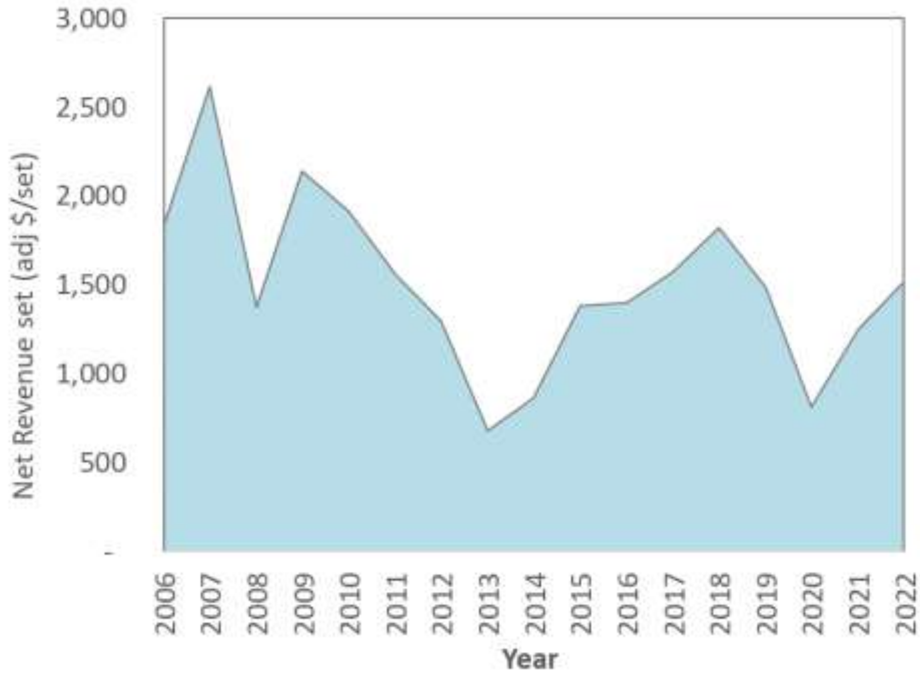


Figure 126. Net revenue per set for the American Samoa longline fishery (adjusted to 2022 dollars)[1]

[1] Data source: PIFSC economic data collection program (Pan 2018).

In addition to the measurement of the net revenue, NOAA Fisheries has established a national set of economic performance indicators to monitor the economic health of the nation's fisheries (Brinson et al. 2015). The PIFSC Socioeconomics Program has used this framework to evaluate select regional fisheries; specifically, the American Samoa Longline, Hawaii Longline, and Main Hawaiian Islands (MHI) Deep 7 bottomfish fisheries. These indicators include metrics related to catch, effort, and revenues. For the American Samoa longline fishery, this section will present revenue performance metrics of (a) total revenue per day at sea, (b) annual revenue per vessel, and (c) Gini coefficient (while b and c are both shown in the same figure) of annual revenue per vessel.

The Gini coefficient (value 0 to 1) measures the equality of the distribution of revenue among active vessels in the fishery. A value of zero represents a perfectly equal distribution of revenue amongst these vessels, whereas a value of one represents a perfectly unequal distribution, in the case that a single vessel earns all of the revenue. Data on aggregate revenue from species in fishery per-day-at-sea and revenue per vessel calculation (for Gini coefficient) are from Pacific Islands Fisheries Science Center, data run for the Fishery Economic Performance Measures (Tier 1 indicators).

Trends in fishery revenue per day are shown Figure 127, while the trends in revenue per vessel and distribution among vessels (i.e., the Gini coefficient) are shown in Figure 128. The revenue is presented in nominal terms to be consistent with the national Tier 1 measure. Supporting data are provided in Table A-115. The revenue per fishing day has been steady in nominal value but shows a decreasing trend in adjusted values. The change in revenue per vessel over time was greater than per fishing day. Revenue per vessel was at its peak in 2008 but has experienced a decreasing trend since then; it increased in 2018 and 2019 but declined again in 2020 and 2021.

The revenue per vessel increased slightly in 2022, reflecting higher CPUE and fish price. The Gini coefficient decreased in 2022 compared to 2021, indicating that the variation of revenue received by individual vessels in the fleet was relatively lower in 2022. The Gini coefficient was relatively variable over time, especially compared to the Hawaii longline fishery.

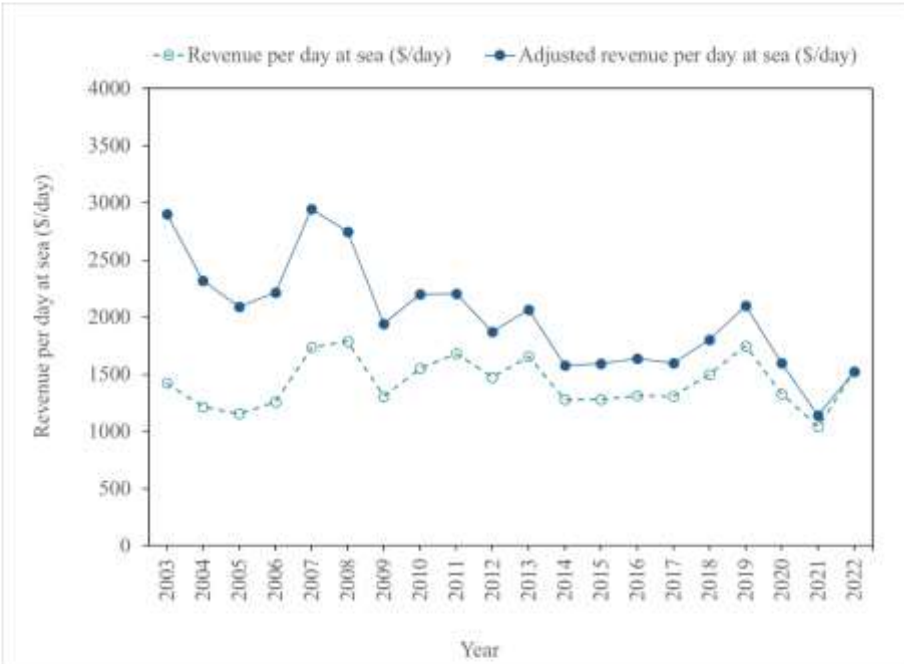


Figure 127. Revenue per-day-at-sea for the American Samoa longline fishery[1]

[1] Data sourced from the Pacific Islands Fisheries Science Center: Fishery Economic Performance Measures (Tier 1 indicators). https://inport.nmfs.noaa.gov/inport/item/46097.

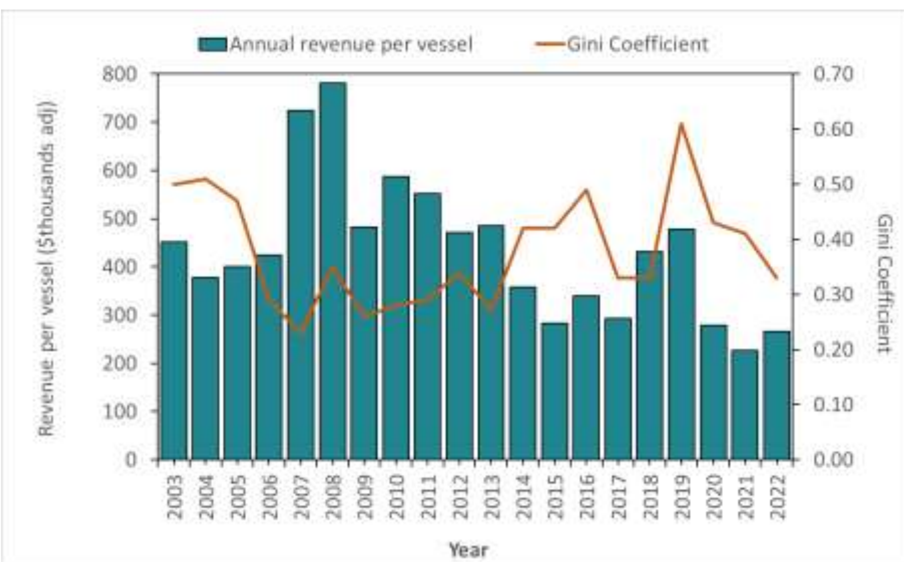


Figure 128. Revenue distribution (revenue per vessel and Gini coefficient) for the American Samoa longline fishery[1]

[1] Data sourced from the Pacific Islands Fisheries Science Center: Fishery Economic Performance Measures (Tier 1 indicators). https://inport.nmfs.noaa.gov/inport/item/46097.

3.2.3.1.2 American Samoa Trolling

3.2.3.1.2.1 Commercial Participation, Landings, Revenue, and Prices

This section describes trends in commercial participation, landings, revenue, and price for the American Samoa troll fishery. The PMUS harvested by alia longliners are not included in this section as alia fishing is included with longlining despite the small size of vessels. Figure 129 presents the trends of revenue and pounds sold for the troll fishery from 2003 to 2022, and Figure 130 presents the trend in price for PMUS sold by the trollers during this period. Supporting data for Figure 129 and Figure 130 are presented in Table A-116. There were six years of commercial landings and revenue data during the 20-year period that were confidential and not presented due to fewer than vendors submitting commercial receipts to the data collection program. In 2020, PMUS pounds sold and revenue by trolling (including trolling from mixed gear trips) were the lowest over the past decade at less than 2,000 lb (valued at $6,440), down from 13,892 lb in 2019. Commercial landings and revenue in 2021 and 2022 decreased, as total landings of PMUS were relatively low for these two years. On average, the PMUS commercial landings have been 17% of total PMUS landings for the non-longline fisheries.

It is worth noting that the data for pounds caught and pounds sold are collected by two different data collection methods. The data for pounds sold were collected through "Commercial Sales Receipt Books" Program, while the data for pounds caught were collected through Boat-based and Shore-based creel surveys and expanded to an estimated total. The coverage rates of two data collection methods may change independently across individual years. Therefore, the two time-series may not move coherently with each other. For example, the low percentage of pounds sold compared to pounds caught could be due to the low coverage of dealer participation in the Commercial Receipt Books Program. In addition, the data summary for PMUS in socioeconomic module is based on the PMUS species defined in the Ecosystem Management Plan and the raw dataset frozen on March 15, 2022.

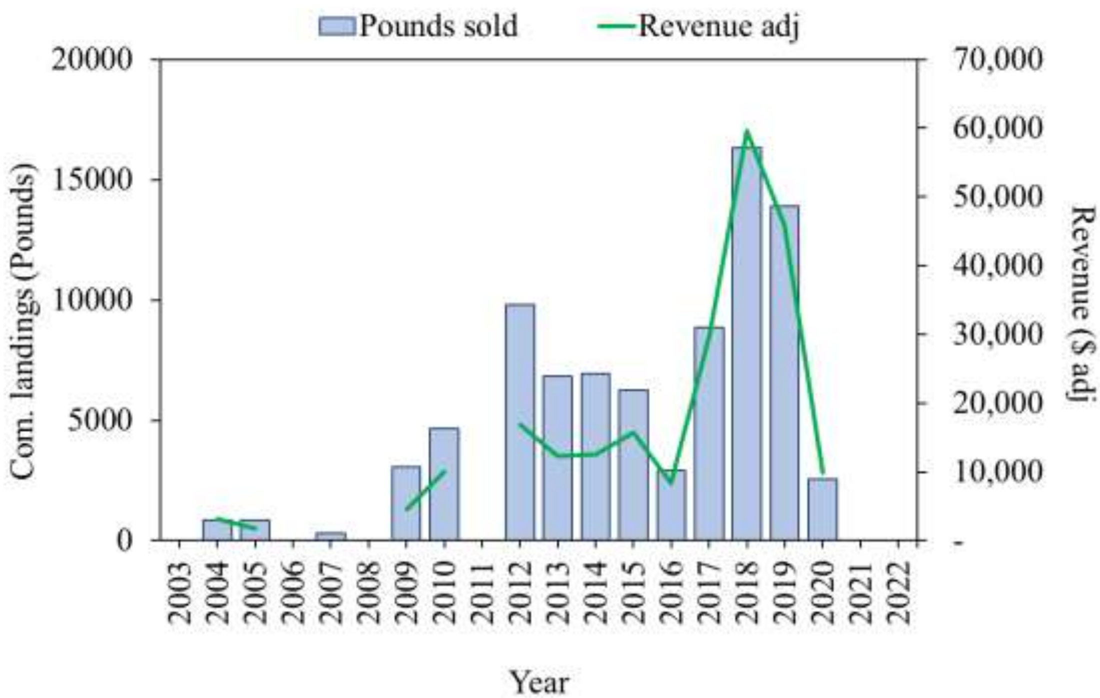


Figure 129. PMUS pounds sold and revenue for trolling (adjusted to 2022 dollars)[1]

[1] Data sourced from the Pacific Islands Fisheries Science Center WPacFIN.

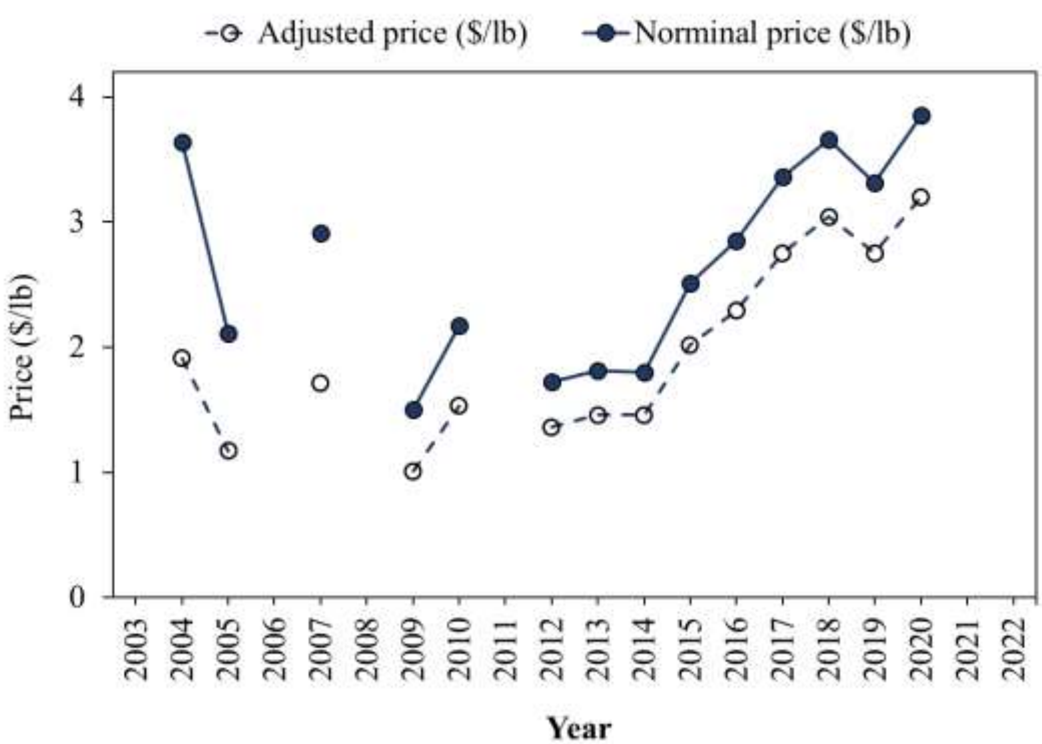


Figure 130. Adjusted and nominal price of PMUS sold by trolling gear (adjusted to 2022 dollars)[1]

[1] Data sourced from the Pacific Islands Fisheries Science Center. Sale data from 2021-22 are not available.

3.2.3.1.2.2 Fishing Costs

Since 2009, PIFSC economists have maintained a continuous small boat economic data collection program in American Samoa through collaboration with the PIFSC Fisheries Research and Monitoring Division (FRMD). The economic data collection gathers fishing expenditure data for boat-based reef fish, bottomfish, and pelagic fishing trips on an ongoing basis. Data for fishing trip expenses include gallons of fuel used, price per gallon of fuel, cost of ice used, cost of bait & chum used, cost of fishing gear lost, and the engine type of the boat. These economic data are collected from same subset of fishing trips as the boat-based creel survey carried out by the local fisheries management agencies and PIFSC FRMD.

Figure 131 presents the average costs for American Samoa troll trips from 2009 to 2022 (adjusted to 2022 dollars). Supporting data for Figure 131 are presented in Table A-117. In general, the fishing costs of an average troll trip slightly declined during the period of 2011 to 2016, mainly as a result of decreased fuel costs. Since 2017, fuel costs have risen primarily due to fuel price increases. Trip costs in 2022 went down mainly due to fuel usage per trip decreasing even as fuel prices increased.

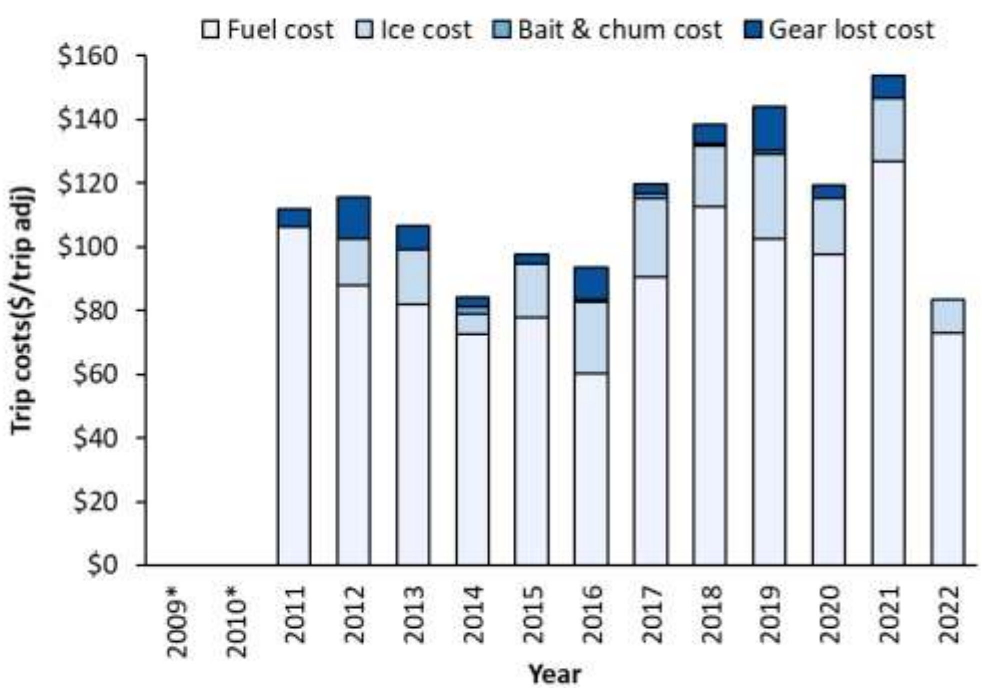


Figure 131. Average costs for American Samoa trolling trips from (adjusted to 2022 dollars)[1]

[1] Data sourced from Chan and Pan (2019a). * Confidential data.

3.2.3.2 CNMI

3.2.3.2.1 CNMI Trolling

3.2.3.2.1.1 Commercial Participation, Landings, Revenue, and Prices

This section presents the pounds sold, revenue, and price for all PMUS in the CNMI by all gears. Unlike American Samoa, the data for pounds sold by gear are not available for the CNMI. Figure 132 and Figure 133 present the trends of total pounds sold and revenue for all PMUS in the CNMI from 2003 to 2022. Supporting data for these two figures are presented in Table A-118.

Pelagic fishing is an important commercial fishery in the CNMI. Nearly half a million pounds of pelagic species are landed annually, and about 50% of landed pelagic fish were sold to markets from 2003 to 2022 based on the commercial receipts. In 2022, about 99% of total PMUS landed were sold, which is much higher than in previous years. The high ratio of commercial landings to total landings in 2021 and 2022 is likely a result of improvements in the implementation of the commercial data collection program. In the CNMI, a mandatory reporting program was implemented in 2019 and follow-up outreach efforts have resulted in increased vendor reporting participation, as 37 out of 42 vendors reported in 2021. The average pelagic fish price has increased since 2007 gradually, and fish price increased from $2.53 in 2021 to $3.08 in 2022, a 22% increase adjusting for inflation.

It is worth noting that the data for pounds caught and pounds sold are collected by two different data collection methods. The data for pounds sold were collected through "Commercial Sales Receipt Books" Program and expanded to an estimated total. While the data for pounds caught were collected through Boat-based and Shore-based creel surveys. Both data series are generated from an expansion algorithm built on a non-census data collection program, and the survey coverage rates of two data collection methods may change independently in individual years. Therefore, the two time-series may not move coherently with each other. For example, the low percentage of pounds sold compared to pounds caught could be due to the low coverage of dealer participations in the Commercial Receipt Books Program or vice versa.

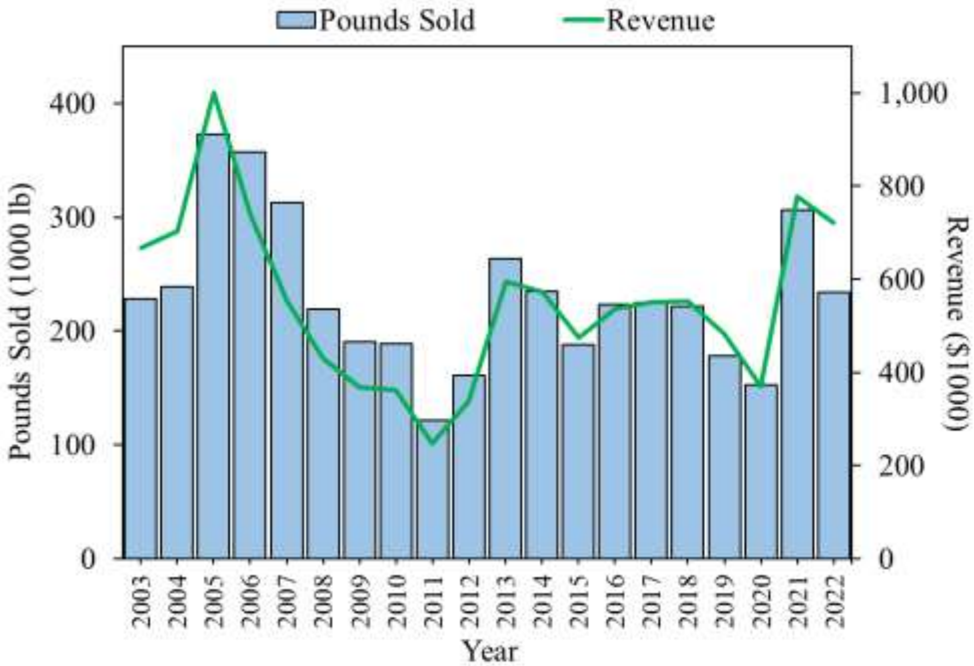


Figure 132. Total PMUS annual pounds sold and revenues in the CNMI for all gears (adjusted to 2022 dollars)[1]

[1] CNMI CPI information was not available since 2016, so we assumed there were no changes for adjustments.

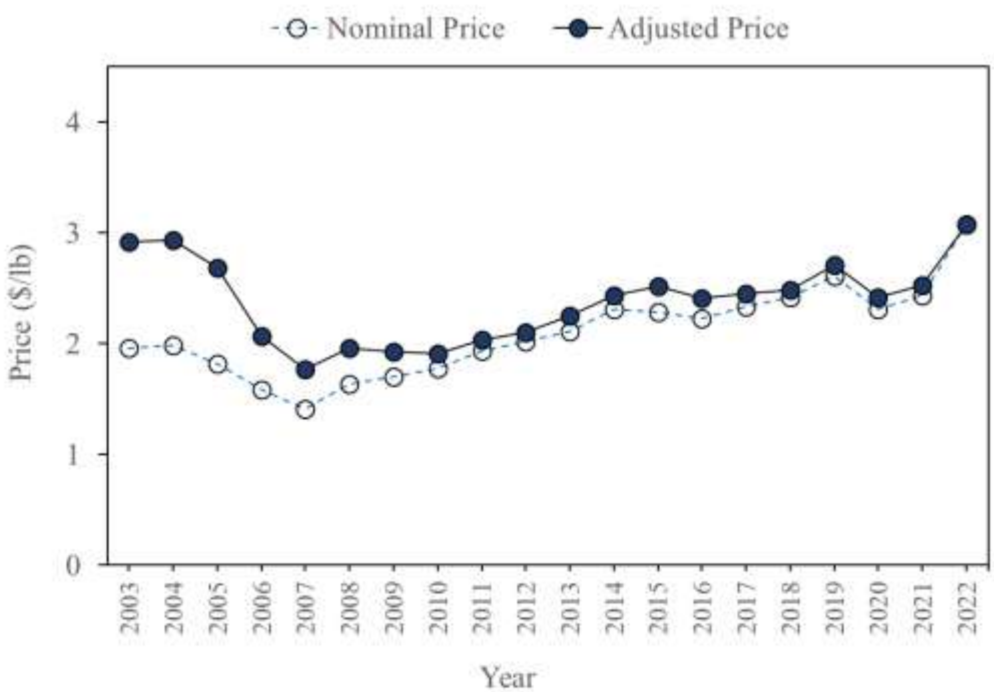


Figure 133. Real and nominal prices of PMUS for fish sold in the CNMI from all gears[1]

[1] Data sourced from the PIFSC FRMD.

3.2.3.2.1.2 Fishing Costs

Since 2009 the PIFSC Socioeconomics Program has maintained a continuous economic data collection program in Saipan through collaboration with the PIFSC FRMD. The economic data collection program gathers fishing expenditure data for boat-based reef fish, bottomfish, and pelagic fishing trips on an ongoing basis. Data for fishing trip expenses include gallons of fuel used, price per gallon of fuel, cost of ice used, cost of bait & chum used, cost of fishing gear lost, and the engine type of the boat. These economic data are collected from same subset of fishing trips as the boat-based creel survey carried out by the local fisheries management agencies and PIFSC FRMD.

Figure 134 presents the average trip costs for CNMI troll trips from 2009 to 2022 (adjusted to 2022 dollars). In general, the costs of trolling trips had small changes across years. Costs moved up and down mainly related to changes in fuel costs. In 2022, the average cost of trolling trips was around $101, $3 higher than 2022. Fuel cost is the main component of the trolling trip costs. Supporting data for Figure 134 is presented in Table A-119.

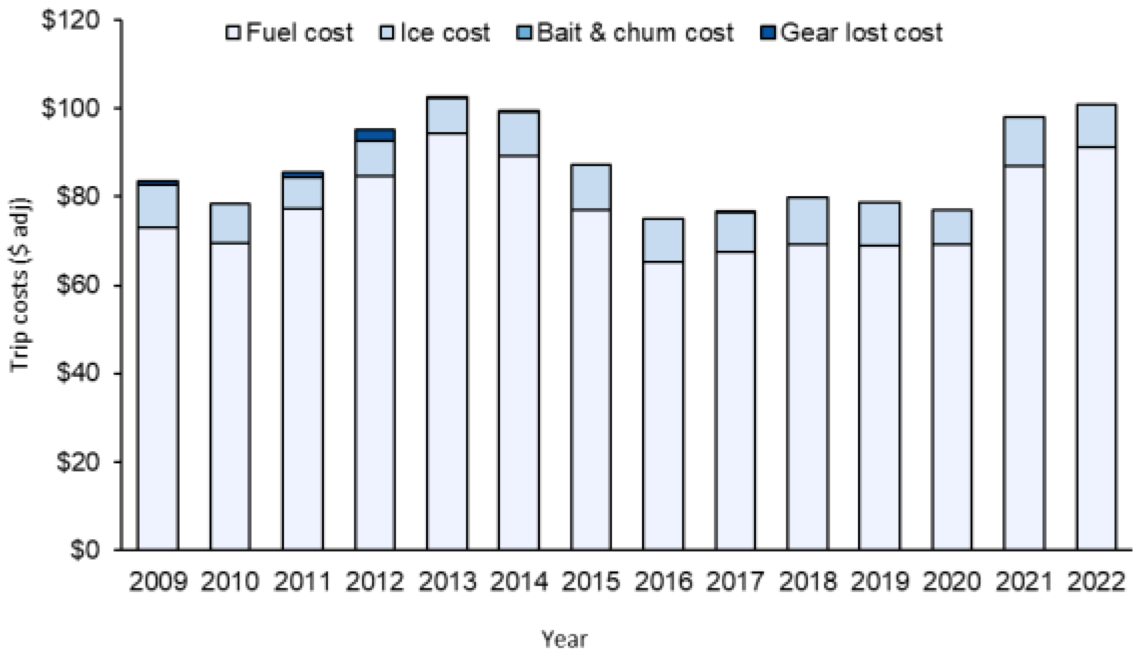


Figure 134. Average cost for CNMI trolling trips (adjusted to 2022 dollars)[1]

[1] Data sourced from PIFSC Continuous Cost Data Collection Program (Chan and Pan 2019a). Trip cost data collection began in 2009.

3.2.3.3 GUAM

3.2.3.3.1 Guam Trolling

3.2.3.3.2 Commercial Participation, Landings, Revenue, and Prices

This section describes trends in commercial landings, revenue, and price of PMUS in Guam. Figure 135 presents the trends of pounds sold and revenue for PMUS in Guam fisheries and Figure 136 presents the trend of PMUS price during 2003 to 2022. Supporting data for Figure 135 and Figure 136 are shown in Table A-120.

Pelagic fishing is an important fishery in Guam. The average annual total pounds landed has been around 668,000 lb over the past 20 years, with 141,744 lb of commercial landings. Figure 135 shows only 15 years of commercial landings and revenue between 2003 and 2022 because the data for the other years were confidential when there were fewer than three reporting vendors. For the 15 years presented, the average pounds sold were 22% of the total pounds landed annually. The average price (inflation adjusted) of all PMUS was relatively flat over the 15 years at $2.66/lb on average, while the nominal price showed slowly increase over time.

It should be noted that the data for pounds caught and pounds sold are collected by two different data collection methods. The data for pounds sold were collected through "Commercial Sales Receipt Books" Program, while the data for pounds caught were collected through Boat-based and Shore-based creel surveys. Both data series are generated from an expansion algorithm built on a non-census data collection program, and the survey coverage rates of two data collection methods may change independently in individual years. Therefore, the two time-series may not move coherently with each other. For example, the low percentage of pounds sold compared to pounds caught could be due to the low coverage of dealer participations in the Commercial Receipt Books Program, or vice versa.

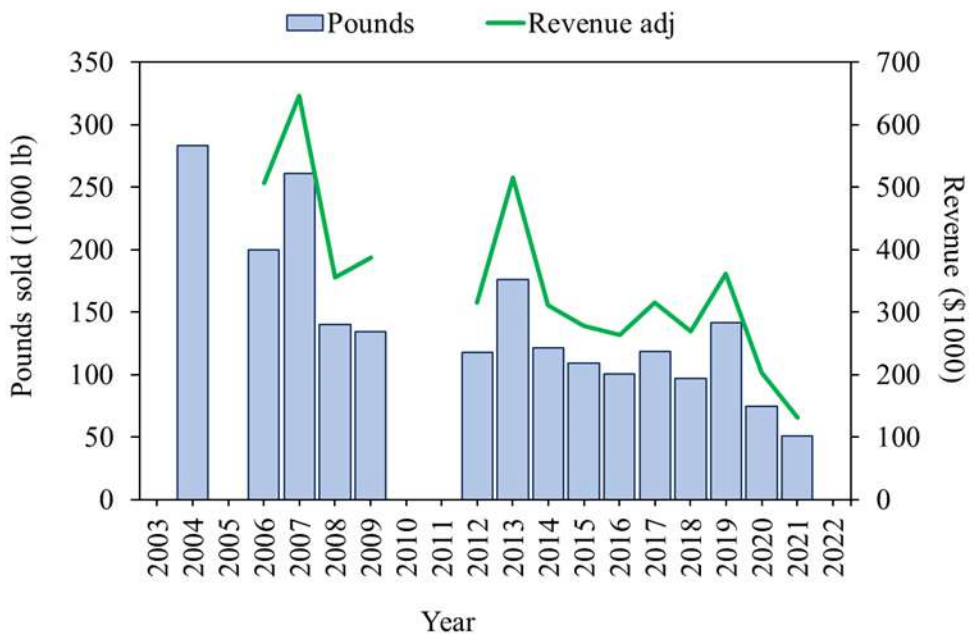


Figure 135. Total PMUS annual pounds sold and revenue in Guam (adjusted to 2022 dollars)[1]

[1] Data sourced from PIFSC FRMD.

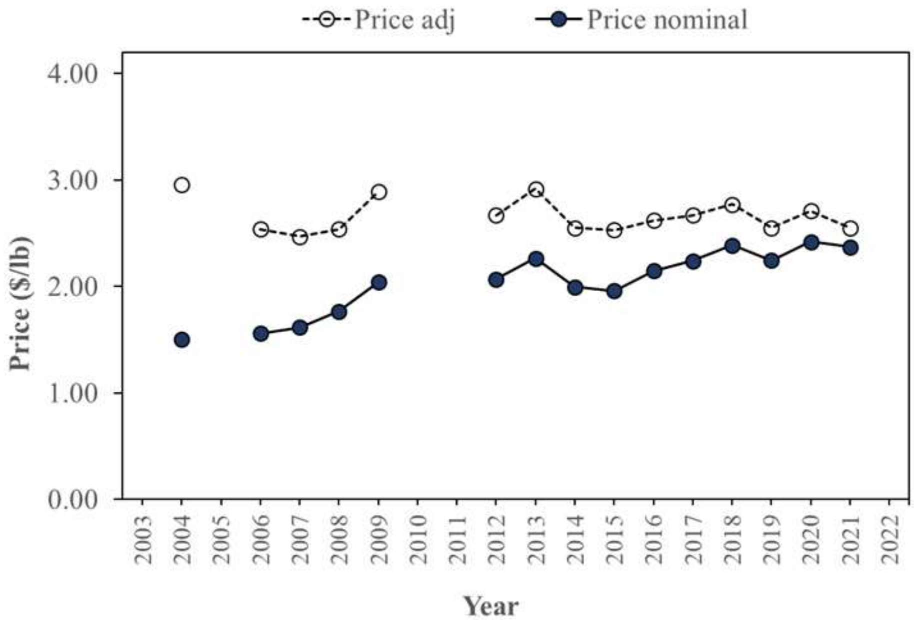


Figure 136. The real and nominal prices of PMUS sold by all gears in Guam[1]

[1]Data sourced from PIFSC FRMD.

3.2.3.3.3 Fishing Costs

Since 2011, the PIFSC Socioeconomics Program has maintained a continuous economic data collection program on Guam through collaboration with PIFSC FRMD. The economic data collection gathers fishing expenditure data for boat-based reef fish, bottomfish, and pelagic fishing trips on an ongoing basis. Data for fishing trip expenses include gallons of fuel used, price per gallon of fuel, cost of ice used, cost of bait & chum used, cost of fishing gear lost, and the engine type of the boat. These economic data are collected from same subset of fishing trips as the boat-based creel survey carried out by the local fisheries management agencies and PIFSC FRMD.

Figure 137 shows the trend of costs for trolling trips in Guam from 2011 to 2022. Costs tend to move up and down over time mainly due to changes in fuel costs. The average cost of trolling trips in 2022 was $92 in Guam, $17 less than the previous year. However, the total fuel cost was higher than the previous year due to a higher fuel price in 2022. Supporting data for Figure 137 are presented in Table A-121.

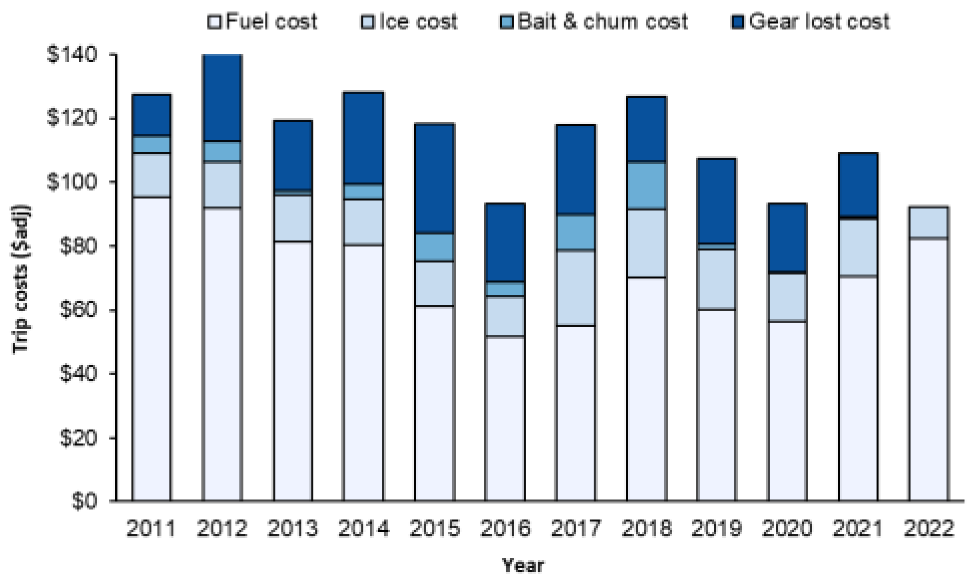


Figure 137. Average cost for Guam troll trips (adjusted to 2022 dollars)[1]

[1] Data sourced from the Pacific Islands Fisheries Science Center (Chan and Pan 2019a).

3.2.3.4 HAWAII

3.2.3.4.1 Hawaii Longline

3.2.3.4.1.1 Commercial Participation, Landings, Revenue, and Prices

The Hawaii permitted longline fishery conducts two types of fishing to target the bigeye tuna (deep-set) and swordfish (shallow-set) by setting the fishing gear at different depths in the water column. Most of the vessels only target tuna while some vessels switch between these two types of fishing depending on the season. The majority of the catches by the Hawaii permitted longline vessels were landed and sold in Honolulu, while some of catches were landed and sold on the West Coast of the US Mainland. For the period from 2003 to 2020 for which landings and revenue data are available, the fish landed and sold on the West Coast increased gradually since 2008 and stabilized from 2009 to 2020. Based on the West Coast dealers' reports, an average of $5.3 million in revenue (2.3 million pounds sold) was generated annually from West Coast during the years from 2015 to 2020, and the average annual revenue sold in Hawaii was $94 million (26 million pounds sold). However, the data of commercial landings for the West Coast were not available in 2021 and 2022. Due to the concerns of incomplete market reports, the total commercial landings and revenue trend of the Hawaii longline presented in Figure 138 were generated only from total pounds kept, value, and the fish price from Hawaii dealers.

The total active number of vessels landing fish in 2022 was 144, with one additional vessel compared to the 2021. The fleet generated total revenues sold in Hawaii markets (revenue generated from HDAR dealer reports) as presented in Figure 138, which only included the total revenue generated from HDAR dealer reports. The pounds sold in Hawaii markets reported from the HDAR dealers only accounted for 97% of the total estimated value of the total pelagic landings (estimated by the pounds kept from fishermen's report in 2022 assuming all pounds caught were landed and sold) by the entire fleet. In general, the total revenue of the Hawaii permitted longline fleet showed an upward trend for the period of 2012 to 2017 but has seen declines since 2018, particularly in 2020. In 2021, the fleet revenue increased to a historical high ($111 million), mainly due to higher fish prices in 2021 while commercial landings in 2021 were at the level similar to 2020. The total pounds sold in the Hawaii market was 22 million pounds valued at $111 million. The fish prices in 2021 increased from $3.42/lb in 2020 to $5.00/lb in 2021. In 2022, total commercial landings were 2% lower than 2021, but total revenue was similar to the 2021. Supporting data of Figure 138 are presented in Table A-122.

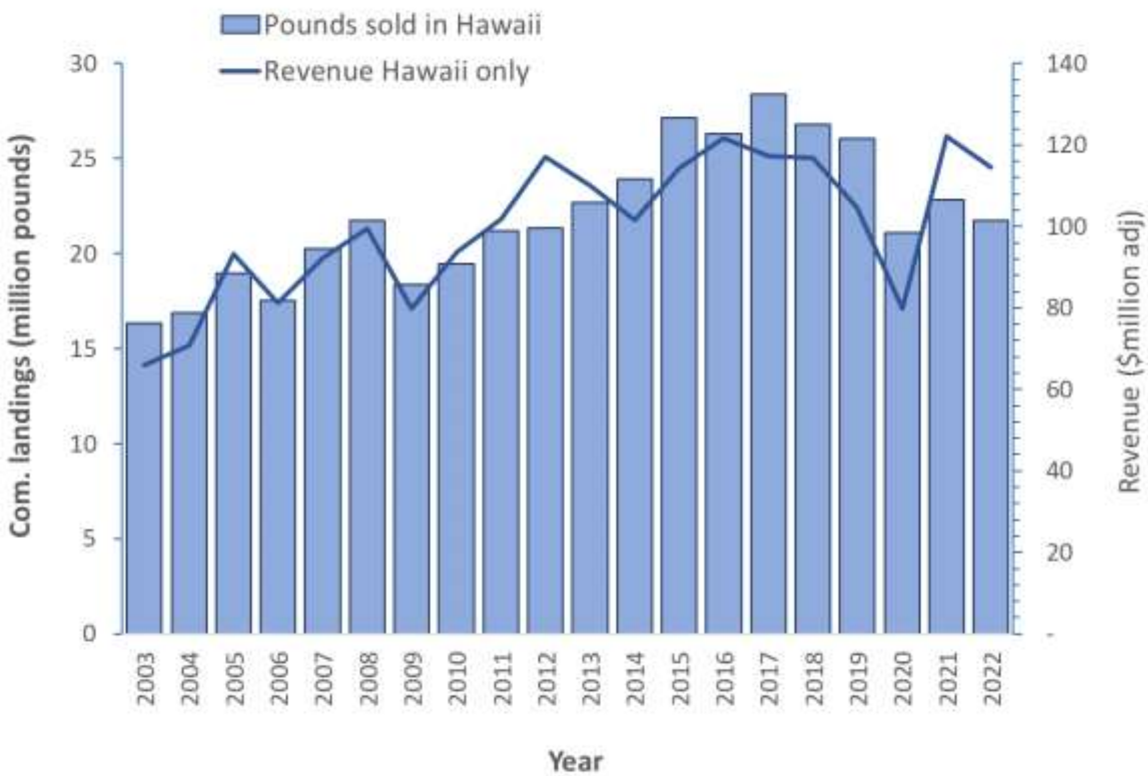


Figure 138. Commercial landings and revenue of Hawaii-permitted longline fleet (landed in Hawaii markets; adjusted to 2022 dollars)[1]

[1] Source: Pacific Islands Fisheries Science Center, Tier 1 indicators data request.

Figure 139 shows the trends of the revenue composition (based on the estimated total value, instead of sold revenue in Hawaii market) from the main species (bigeye, swordfish, and yellowfin) and others from 2003 to 2022, and Figure 140 shows the price trends for bigeye, swordfish, and yellowfin for the same period. Supporting data for Figure 139 and Figure 140 are presented in Table A-123 and Table A-124, respectively.

It can be observed that bigeye tuna comprised the majority of fishery revenue for the longline fleet during 2003 to 2022. Revenue from yellowfin tuna has grown in recent years while revenue from swordfish had declined since 2012, but the percentage of revenue from swordfish went up again in 2021 and 2022. In 2022, bigeye tuna comprised 61% of revenue for Hawaii permitted longline vessels, followed by yellowfin tuna at 18%, swordfish at 14%, and other species at 17% of the total Hawaii longline revenue, while the 20-year averages were 65%, 10%, and 13%, respectively. Fish prices have fluctuated in general and the prices of the three species converged on each other. The price of bigeye tuna peaked in 2012 and has decreased since then but increased significantly in 2021. Yellowfin tuna price has varied over time, peaking in 2013 and declined thereafter. However, yellowfin tuna price went up considerably in 2018, approaching bigeye tuna prices. In 2022, the nominal prices of all the three main species went up, with swordfish price increasing more than bigeye and yellowfin. In 2022, swordfish price exceeded yellowfin price.

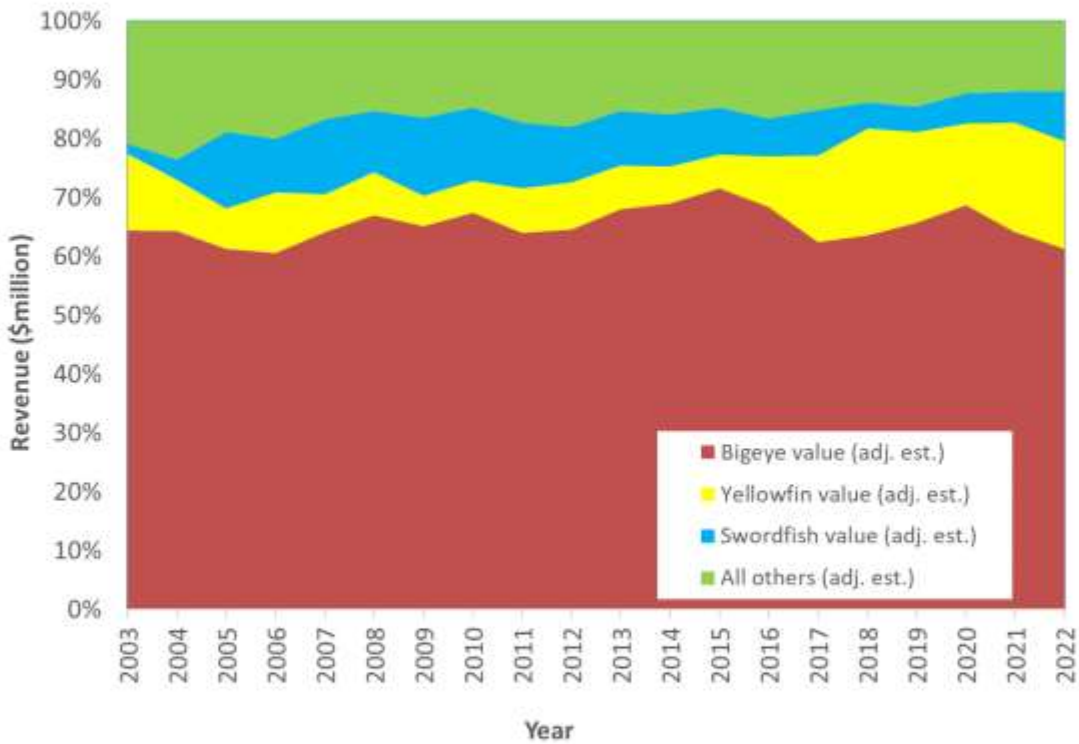


Figure 139. Trends in Hawaii longline revenue species composition[1]

[1] Data Source: Pacific Islands Fisheries Science Center, Tier 1 data request.

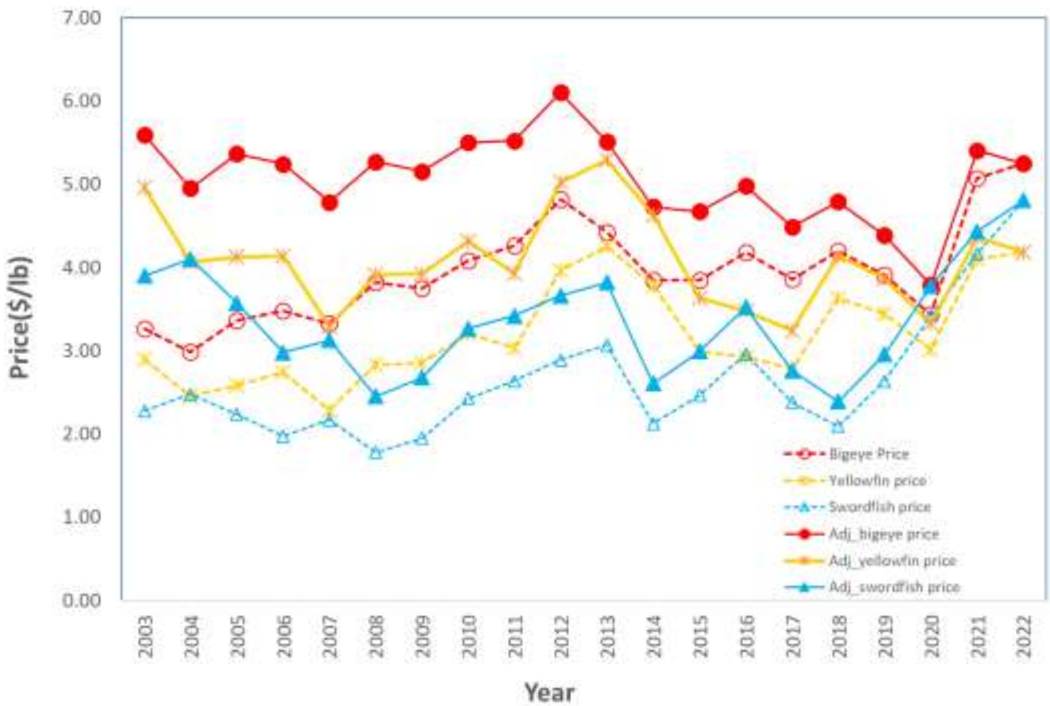


Figure 140. Price trends of nominal and adjusted of three main species (bigeye tuna, yellowfin tuna, and swordfish)[1]

[1] Source: Pacific Islands Fisheries Science Center, Tier 1 data request**.**

3.2.3.4.1.2 Fishing Costs

The Economic Cost Data Collection Program for the Hawaii longline fishery was the first to establish continuous (routine) trip expenditure collection in the Pacific Islands Region. The program was implemented in August 2004 through cross-agency collaboration by the PIFSC Economics Program and the NOAA Observer Program managed by PIRO (Pan 2018 and Pan 2019). Before the establishment of these programs, trip-level economic information on the fisheries was limited primarily to the dockside value of landed fish. Data on fishing expenses were obtained intermittently through one-time surveys conducted roughly every five years (Hamilton et al. 1996; O'Malley and Pooley 2002; Kalberg and Pan 2016). The continuous economic data collection program has provided important trend data to track changes in economic performance for the Hawaii longline fishery on a continuous basis.

The continuous data collection form is comprised of eight cost items commonly arising in Hawaii longline trips, but it excludes labor costs. Non-labor cost items collected include diesel fuel, engine oil, bait, ice, as well as total costs for gear replacement, provisions, and communications. The form requests unit price, quantity used, and total costs of fuel, bait, and oil usage. In addition, the total number of crew members, and the subset who are not United States nationals, is collected for both tuna and swordfish trips. Survey forms are produced and available in first languages (i.e., English, Korean, and Vietnamese) to ease survey burden.

The project is designed to collect data from all observed trips. Observers conduct interviews with the captains on board while returning to port or when a trip is completed. The participation of fishers in the economic data survey is voluntary. Observers accompany 100% of the Hawaii-based shallow-set longline trips (targeting swordfish) and about 20% of the deep-set trips (targeting bigeye tuna). Since the economic data collection project was implemented in August 2004, the average response rate based on observed trips has been around 60%. The data collection program would not succeed without the generous support of vessel owners and operators. A detailed description of the continuous data collection program can be found in a NOAA technical memorandum (Pan 2018).

This report presents trip-level fishing costs for each type of longline trip since shallow-set (swordfish) trips often have a longer trip length compared to deep-set (bigeye tuna) trips. The data series of trip costs and net revenue data have been presented in the annual SAFE report from 2005 to present, as the first full-year's data were available beginning in 2005. Average swordfish trip costs generally are higher than a tuna trip because the trip length of a swordfish trip is longer than a tuna trip. The average trip length for swordfish trips was 31 days per trip during the period of 2005 to 2022, while it was 22 days for tuna trips. A decreasing trend in trip length for swordfish trips has been observed over recent years. The average trip length of 26 days per trip in 2022 was considerably lower than the 18-year average (i.e., 31 days). The average tuna trip length has been relatively steady over the 18-year period.

In terms of cost structure in 2022, fuel cost accounts for the largest share of total fishing trip costs (i.e., non-labor items) for both tuna and swordfish trips. Figure 141 and Figure 142 show the cost structures of an average tuna and swordfish trip, respectively, in 2022. In 2022, fuel cost was the leading item of trip costs, comprising 57% of the tuna trip costs, considerably higher than that in 2021 (49%). Bait was the second largest item making up 23% of tuna trip costs. Fuel and bait costs together made up over 80% of the trip costs for tuna fishing. For swordfish trips, the cost of fuel also made up 57% of swordfish trip costs, higher than 2021 (49%), while bait cost made up 17% of total swordfish trip costs. The cost of the lightstick gear is unique to swordfish fishing, and it made up 8% of the total trip costs of swordfish trips in 2022. Supporting data for Figure 141 and Figure 142 are presented in Table A-125 and Table A-126.

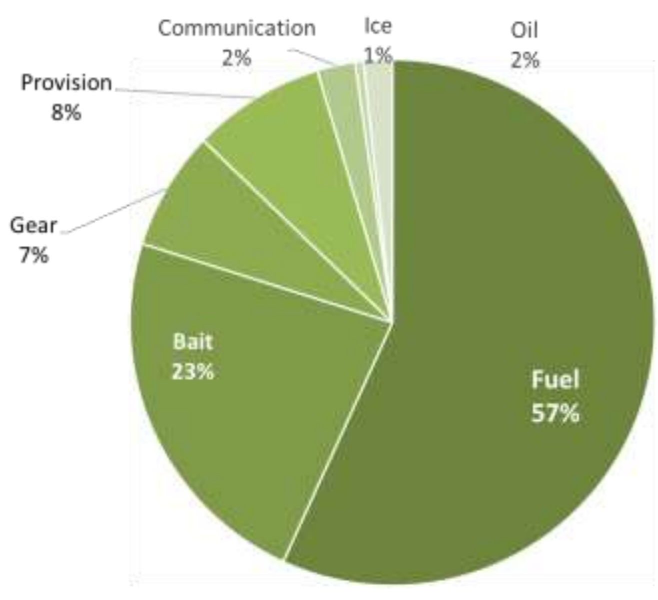


Figure 141. The cost structure of an average deep-set fishing trip[1]

[1] Data source: PIFSC continuous economic data collection program (Pan 2018).

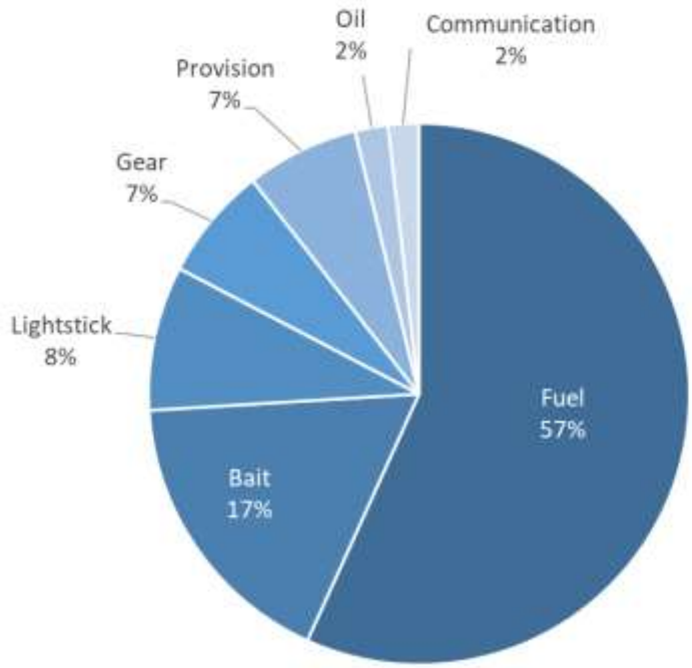


Figure 142. The cost structure of an average shallow-set fishing trip[1]

[1] Data source: PIFSC continuous economic data collection program (Pan 2018).

Figure 143 and Figure 144 show the trends of average trip costs for tuna and swordfish trips, respectively, in the Hawaii longline fishery for the 2005-2022 period. Supporting data for Figure 143 and Figure 144 are presented in Table A-125 and Table A-126. The average trip costs for both trip types differ, and swordfish trips (i.e., with longer trip lengths) cost more than tuna trips. In 2022, the average trip cost for swordfish trips was $44,905 while it was $33,923 for tuna trips. They shared a similar trend during the period of 2012 to 2018, but trip costs for swordfish trips have shown a decreasing trend in recent years (2019-2021), while the trip costs for tuna trips appears steady.

Considering trends, the cost of tuna trips peaked in 2012, while swordfish trip costs peaked in 2011 with elevated values persisting into 2012. Costs of tuna trips trended downward until 2015 and have been relatively stable since then. Swordfish trip costs also decreased after 2012, but swordfish trip costs decreased to a greater extent than tuna trips. The shorter trip length of swordfish trips might have contributed to the decrease in fuel costs and total trip costs for swordfish trips. In 2022, both tuna trip costs and swordfish trip costs were higher than 2021, mainly due to increases in fuel costs.

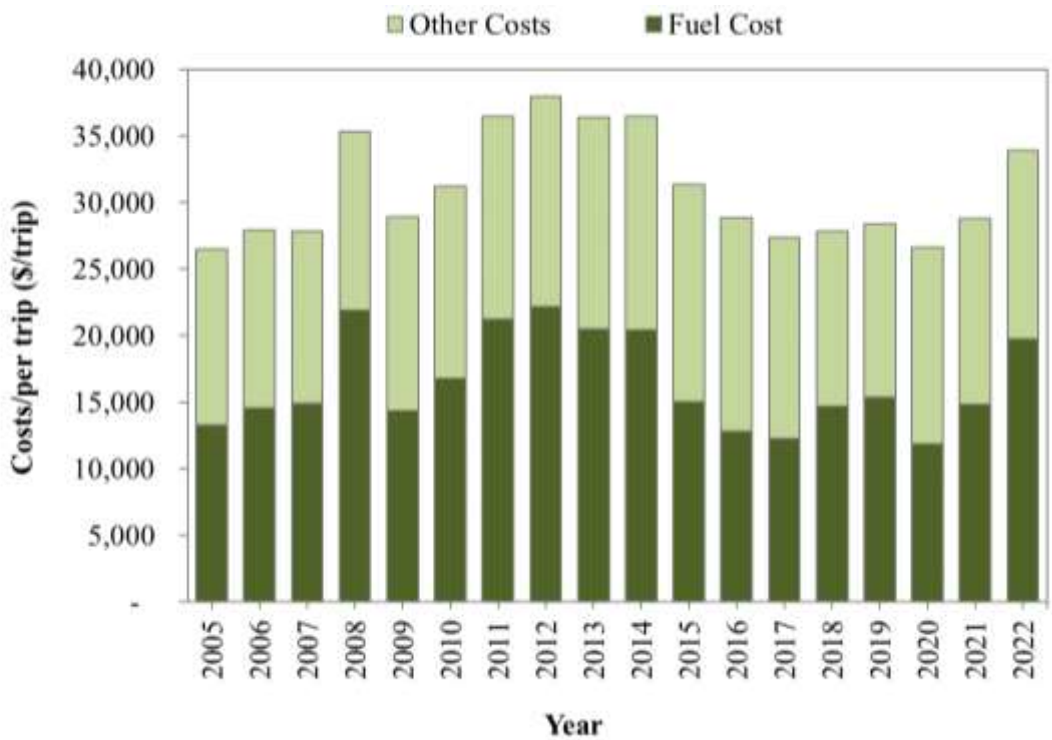


Figure 143. Average trip costs for Hawaii longline deep-set fishing (adjusted to 2022 dollars)[1]

[1] Data source: PIFSC continuous economic data collection program (Pan 2018).

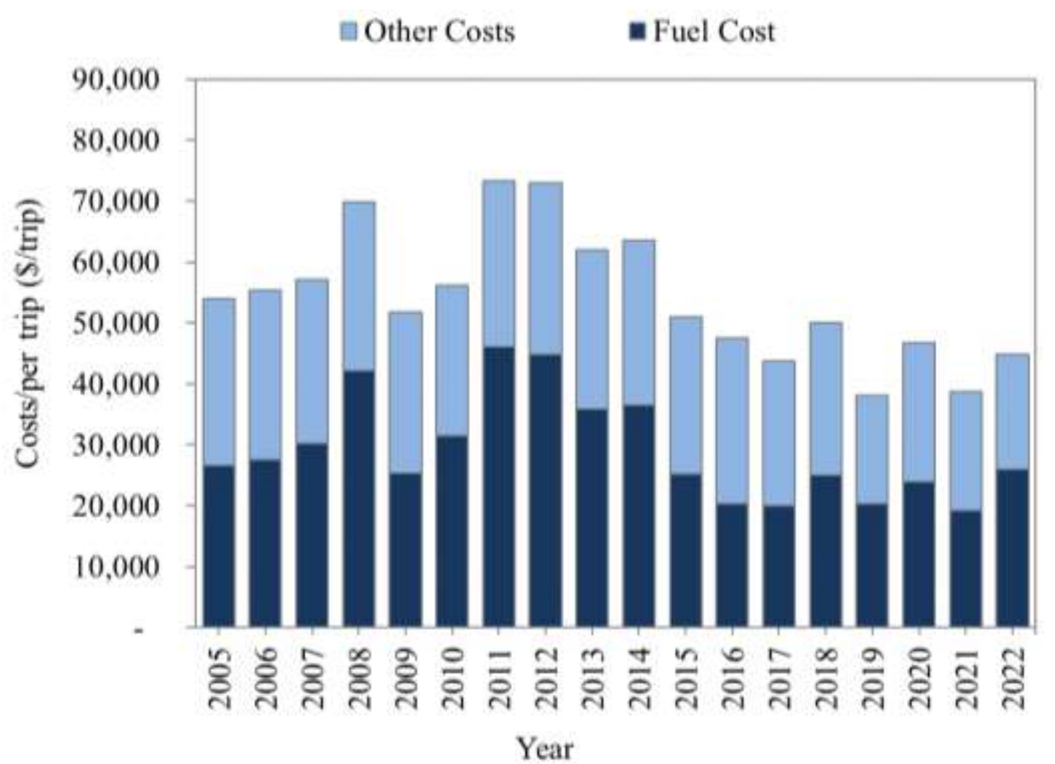


Figure 144. Average trip costs for Hawaii longline shallow-set fishing (adjusted to 2022 dollars)[1]

[1] Data source: PIFSC continuous economic data collection program (Pan 2018).

3.2.3.4.1.3 Economic Performance Indicators

The continuous economic data collection program allows for the monitoring of trends in fishing cost over time (Pan 2018). Compiling revenue data with cost and effort data allows for the measurement of the economic performance in terms of trip net revenue. Figure 145 and Figure 146 present the trends of trip net revenues for two trip types for the period of 2012 to 2021. Supporting data for Figure 145 and Figure 146 are presented in Table A-127 and Table A-128, respectively. The net revenue of tuna (i.e., deep-set) fishing varied across years and peaked in 2016. However, tuna trip net revenue was in a downward trend after 2016, and it was near a historical low in 2020 considering the period of 2005-2021. In 2022, the net revenue decreased slightly compared to 2021 ($41,566 vs. $44,283 per trip). The net trip revenue for swordfish trips was high from 2016 to 2019, but trip net revenue was at a lower level in 2020 and 2021 compared to the period of 2016 to 2019. The average trip net revenue for swordfish trips went up slightly in 2021 and increased considerably in 2022. The net revenue increased in 2022 mainly due to a higher CPUE of swordfish as well as increase fish price for the year.

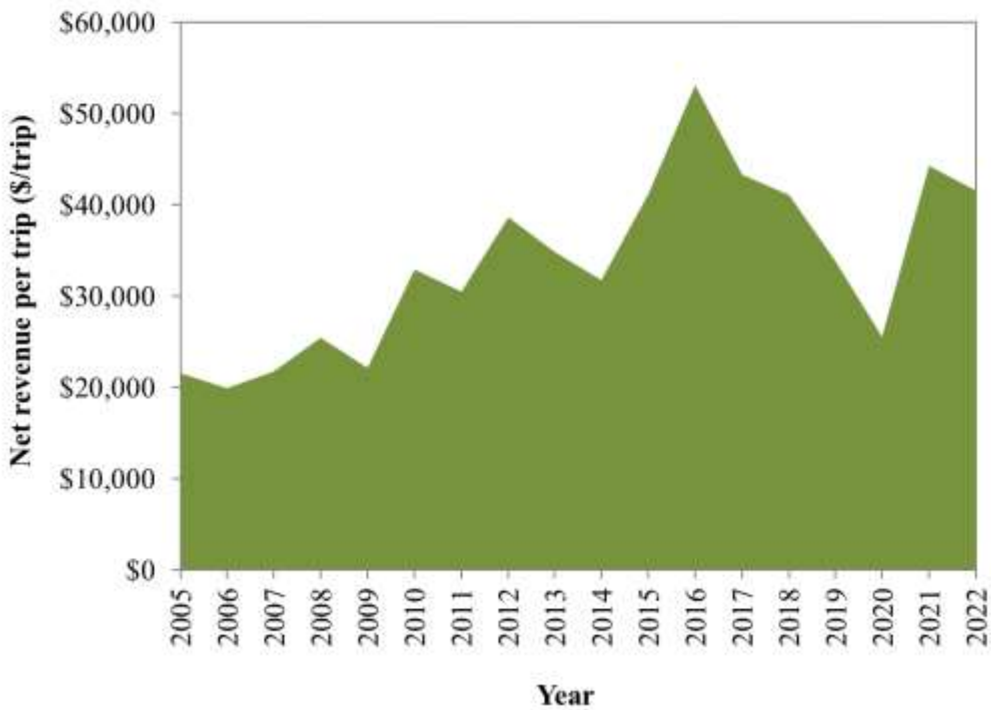


Figure 145. Average net revenue per trip for Hawaii longline deep-set trips (adjusted to 2022 dollars)[1]

[1] Data source: PIFSC continuous economic data collection program (Pan 2018).

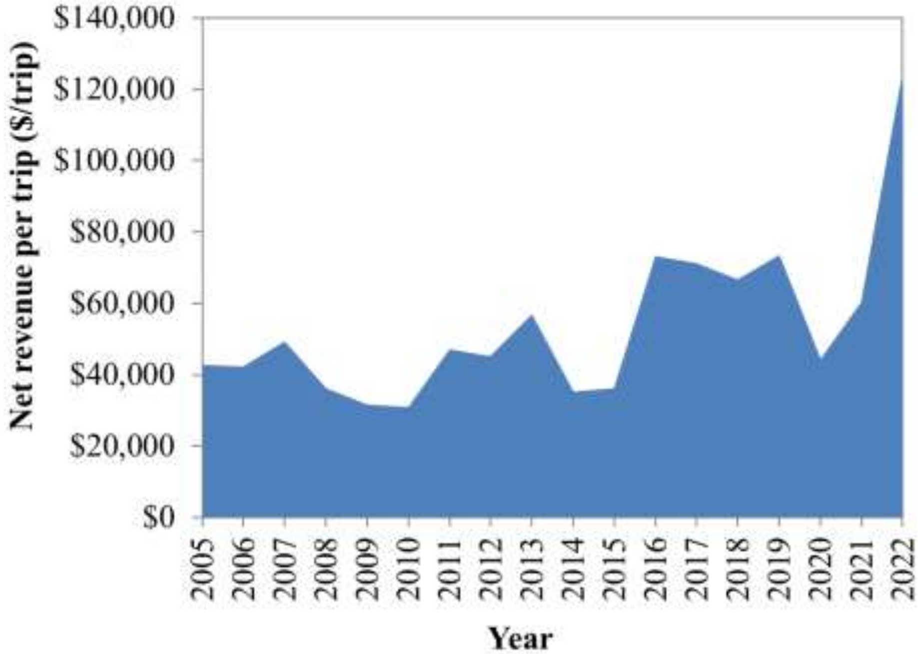


Figure 146. Average net revenue per trip for Hawaii longline shallow-set trips (adjusted to 2022 dollars)[1]

[1] Data source: PIFSC continuous economic data collection program (Pan 2018).

In addition to the measurement of the net revenue, NOAA Fisheries has established a national set of economic performance indicators to monitor the economic health of the nation's fisheries (Brinson et al. 2015). The PIFSC SEES Program has used this framework to evaluate select regional fisheries; specifically, the American Samoa Longline, Hawaii Longline, and Main Hawaiian Islands (MHI) Deep 7 bottomfish fisheries. These indicators include metrics related to catch, effort, and revenue. For the American Samoa longline fishery, this section presents revenue performance metrics of the total revenue per day at sea, annual revenue per vessel, and the Gini coefficient based on individual vessels.

The Gini coefficient measures the equality of the distribution of revenue among active vessels in the fishery. A value of zero represents a perfectly equal distribution of revenue amongst these vessels, whereas a value of one represents a perfectly unequal distribution, in the case that a single vessel earns all of the revenue. Data on aggregate revenue from species in fishery per-day-at-sea and revenue per vessel calculation (for Gini coefficient) are sourced from PIFSC FRMD. Figure 147 and Figure 148 present the revenue per-day-at-sea, revenue per vessel, and the Gini coefficient for the Hawaii longline fisheries during the period of 2003 to 2022. Supporting data for Figure 147 and Figure 148 are presented in Table A-129.

One of the economic performance indicators, revenue per-day-at-sea for the Hawaii longline fishery, presents an upward trend through 2016 that has declined since then, while the revenue per-day-at-sea was at its lowest in 2020. It increased notably in 2021, and 2022 was at a similar level as 2021. Another economic performance indicator, revenue per vessel, held relatively steady from 2003-2022 with a slowly increasing trend through 2018. The revenue per vessel dropped notably in 2020 but seemingly recovered in 2021 and 2022. The income distribution (i.e., Gini coefficient in terms of revenue per vessel) among vessels is relatively stable over the same period but low (0.22) in 2022, which indicates that the variation of revenue received by individual vessels was small across the fleet.

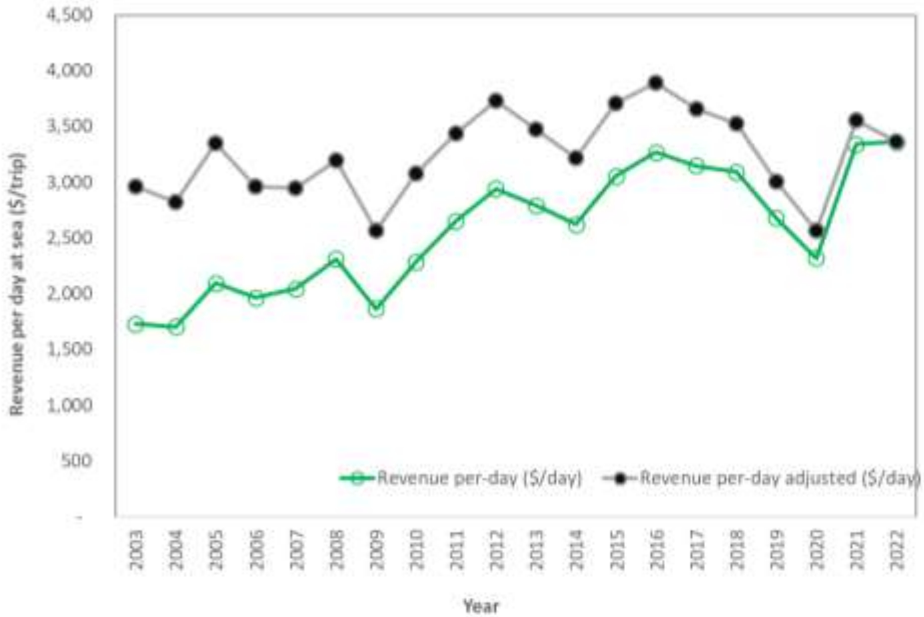


Figure 147**.** Revenue per-day-at-sea for Hawaii longline (adjusted to 2022 dollars)[1]

[1] Data Source: Pacific Islands Fisheries Science Center, Tier 1 indicators data request.

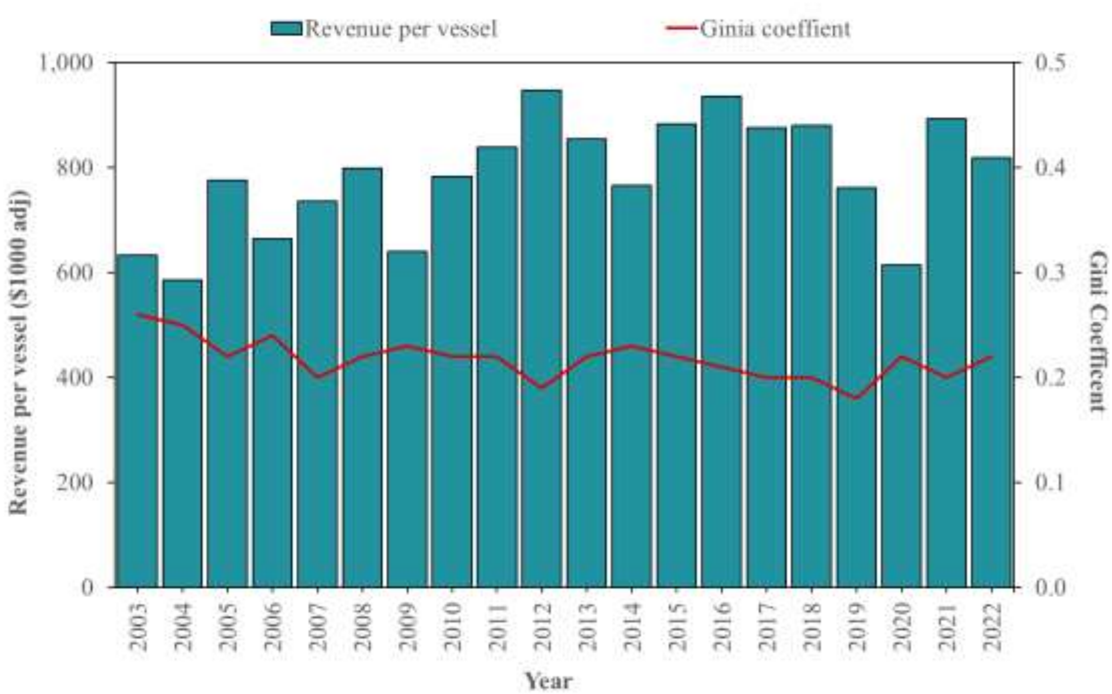


Figure 148. Revenue per vessel and Gini coefficient for the Hawaii longline fisheries[1] (adjusted to 2022 dollars)[2]

[1] Revenue per vessel includes the estimation of revenue landed on the West Coast.

[2] Source: Pacific Islands Fisheries Science Center, Tier 1 indicators data request

3.2.3.4.2 Overview of the Hawaii Non-Longline Gears for PMUS

In addition to the Hawaii permitted longline vessels, there are the smaller scale fisheries, such as the MHI troll, MHI handline, offshore handline, aku boats (i.e., pole and line), among other gears, that harvest PMUS and sell to the Hawaii markets. The following figures present an overview of these various gears in terms of pounds sold, revenue, price, and participants. Aku boats were not included in “other gears” because the fishery has been declining and the number of active vessels has been less than three since 2010. In terms of participants in the fisheries, Figure 149 presents the total fishers participating in these non-longline fisheries, including the total number of fishers who reported PMUS caught in fishers reports and the total number of fishers who reported PMUS sold in the dealer reports. The number of fishers has experienced a downward trend since 2013 and decreased considerably in 2020 with 191 fewer fishers than 2019. In 2021, the number of fishers increased by 44, and 2022 had a similar number as 2021 that was still lower than 2019. The number of fishers with fish sold decreased to a greater extent in 2020 with 361 fewer than 2019. The value increased slightly in 2021 and 2022 but is still less than 2019.

Including pelagic fish landed and sold in the Hawaii markets from all gear types (including longline), the total revenue generated from Hawaii’s pelagic fisheries sold in Hawaii markets was $128 million in 2022, a historical high. The Hawaii non-longline fisheries contributed 11% of the total PMUS revenue in 2022. Among the non-longline gears, trolling is the leading fishing gear in terms of PMUS pounds sold and revenue (i.e., 5% to the total), followed by MHI handline gear (i.e., 2% to the total). Among the total revenue of the non-longline gears, the MHI troll was the leading sector with $7.04 million revenue or 51% of total revenue generated by non-longline gears in 2022 (not including aku boat due to confidential data). The MHI handline fishery followed at $4.1 million (30%). The offshore handline fishery was worth $1.5 million (11%) in 2022. There has been a sharp decline in aku boat fishing during the reporting period and detailed figures are not reported due to confidentiality considerations. Figure 150 presents the trend of commercial landings by different non-longline gears, and Figure 151 presents the trend of commercial revenue by non-longline gears. Both commercial landings and revenue peaked in 2004 and have declined since then (except for a small lift in 2018). Compared to the estimated landings reported from fishers’ reports, 82% of PMUS caught were sold during the period of 2003-2022 but was 92% in 2022. Both total PMUS landings (pounds kept) and commercial landings (pounds sold) increased in 2022 compared to 2021 but were lower than 2019. Supporting data for the Figure 150 and Figure 151 are presented in Table A-130 and Table A-131, respectively.

Figure 152 presents the price trends of PMUS harvested and sold by different gears, 2003-2022 (adjusted to 2022 dollars). Dealer data do not record gear types, so the prices by species by gear were estimated by assuming that the gear distributions of fish sold in the dealers reports by species were the same as in fishers’ reports. Thus, the prices by species by gear presented here may not reflect the actual price differences among gears for the same species. The estimated price data by species by gear are presented in Figure 152. In general, pelagic fish price went down slightly in 2022 for all gear types, while all prices had increased in 2021. Supporting data for Figure 152 are presented in Table A-132. Figure 153 presents the fishing trip costs by the three main small boat gears for pelagic fishing.

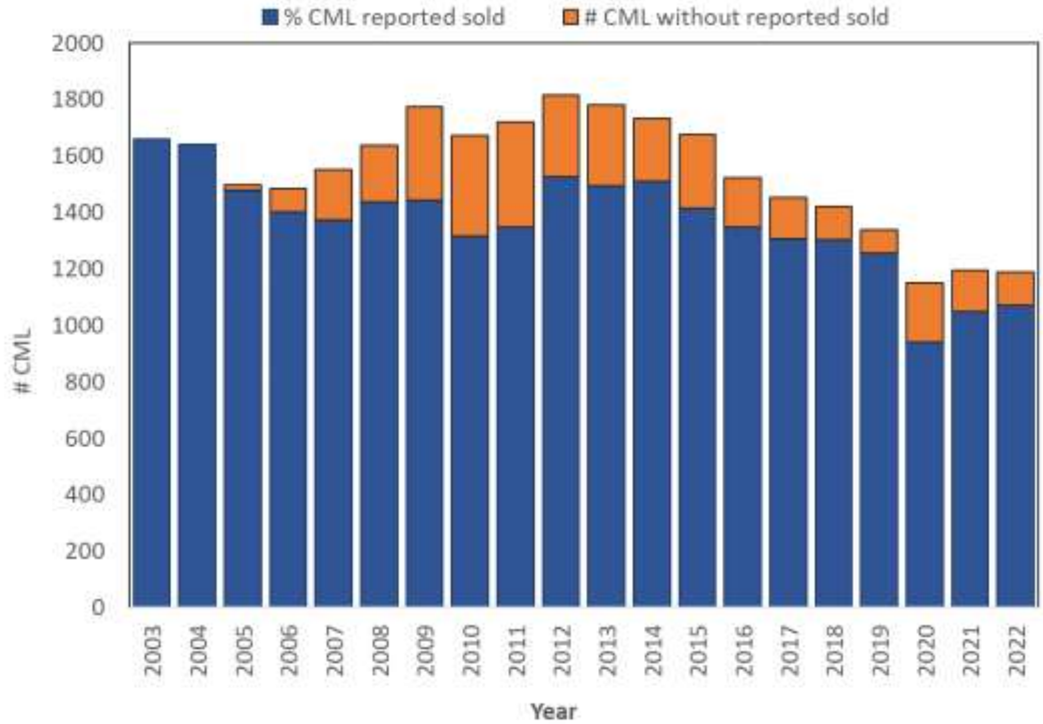


Figure 149. Total number of licensed fishers participating in small scale (i.e., non-longline) PMUS fisheries[1]

[1] Data sourced from PIFSC Pelagic Module data request.

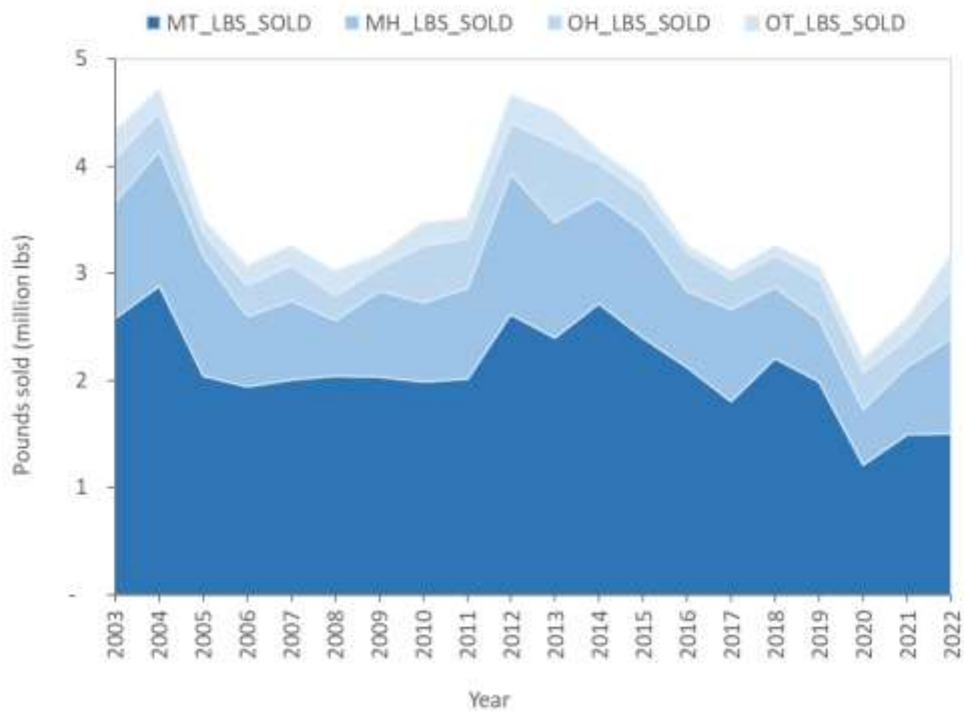


Figure 150. Total pounds sold of MHI commercial non-longline gears[1]

[1] Data sourced from PIFSC Pelagic Module data request.

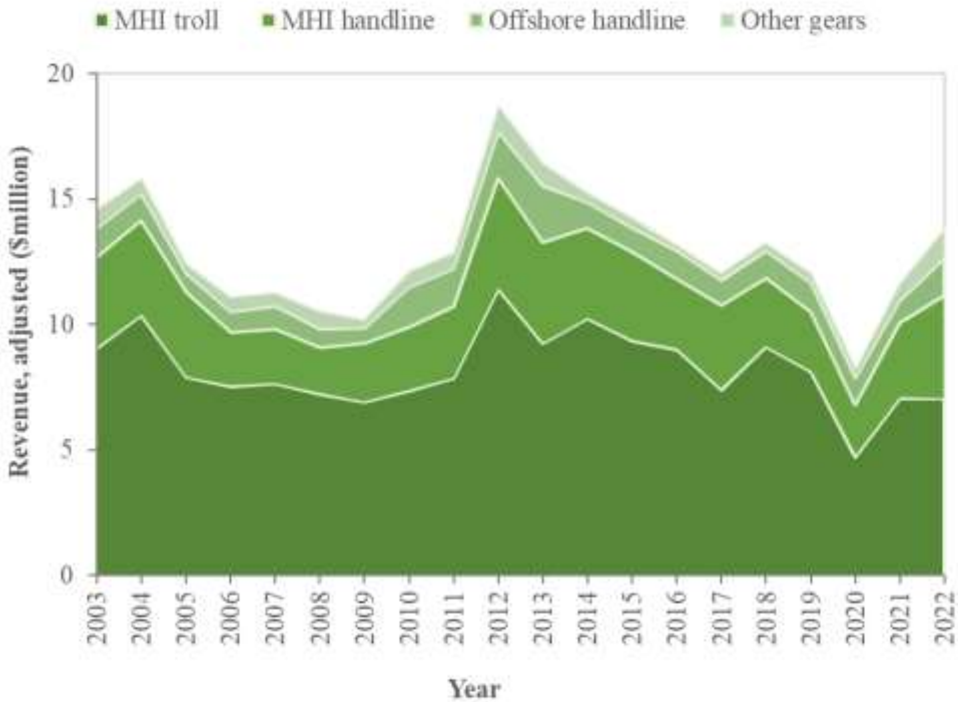


Figure 151. Revenue of non-longline gears (adjusted to 2022 dollars)[1]

[1] Data sourced from the PIFSC Pelagic Module data request.

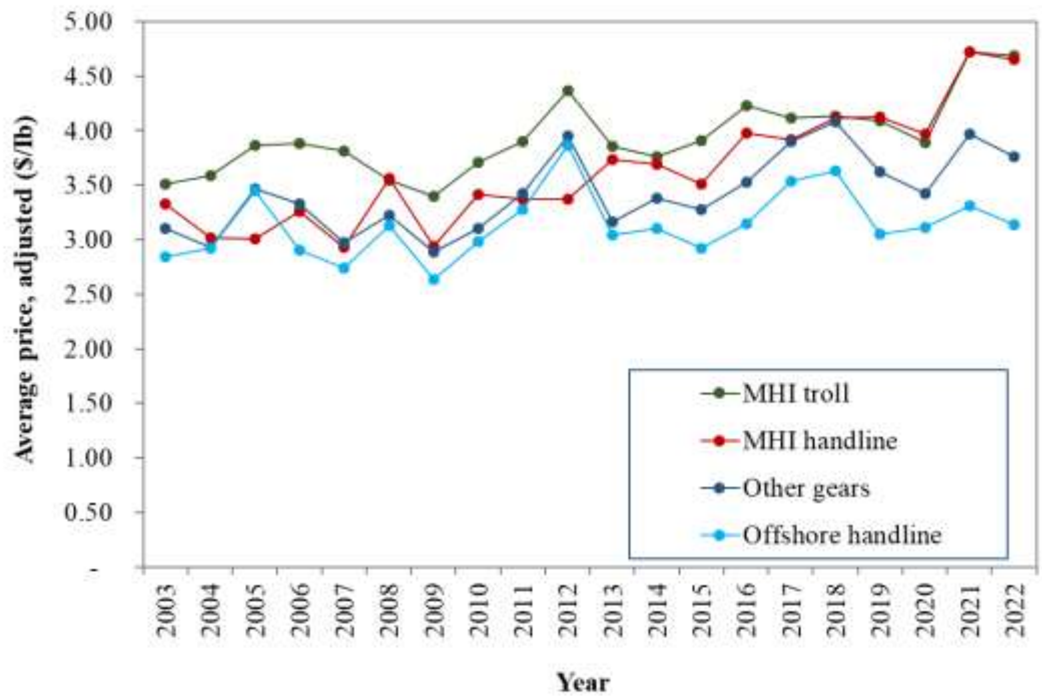


Figure 152. Price trends of PMUS by different gears (adjusted to 2022 dollars)[1]

[1] Data sourced from the PIFSCE Pelagic Module data request. Longline price included for reference.

3.2.3.4.2.1 Fishing Costs

There is no continuous cost data collection program established for the non-longline PMUS fisheries in Hawaii. Past periodic research has documented the costs of pelagic small boat fishing in Hawaii; both trip expenditure and annual fishing expenditures (i.e., fixed costs) are provided in the literature (Hamilton and Huffman, 1998; Hospital et al. 2011; Chan and Pan 2017; Chan 2022). The trip costs by gear type, collected in 2014 and 2021 studies (Chan and Pan 2017 and Chan 2022), are presented in Figure 153.

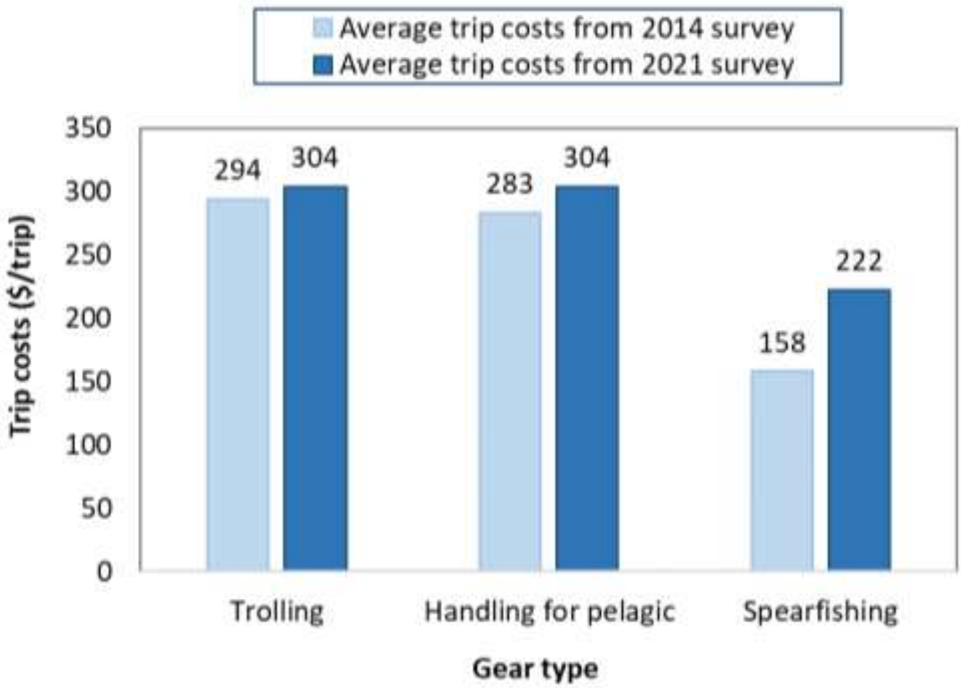


Figure 153. Fishing trip cost by gear type in 2014 and 2021[1]

[1] Data sourced from a 2014 and 2021 Hawaii small boat survey (Chan and Pan 2017 and Chan 2022; https://www.fisheries.noaa.gov/science-blog/hawaii-small-boat-survey-2021-summary)

3.2.3.4.3 Hawaii Trolling

3.2.3.4.3.1 Commercial Participation, Landings, Revenue, and Prices

This section describes trends in commercial participation, landings, revenues, and prices for the Hawaii troll fishery. Figure 154 presents the pounds sold and revenue (adjusted to 2022 dollars) for the MHI troll fishery from 2003-2022. Supporting data of Figure 154 are presented in Table A-130 and Table A-131. Among the non-longline gears, the Hawaii troll fishery landed the largest amount of pelagic fish. The commercial revenue from Hawaii troll fishery peaked in 2012 with revenue of over $10 million (adjusted to 2022 dollars) from 2.6 million pounds sold, while commercial landings peaked in 2014. Since then, both commercial landings and revenue have experienced a declining trend. Total commercial landings and revenue from the troll fishery in 2020 was only 61% and 59%, respectively, of 2019 values, likely due to impact of the pandemic. Landings and revenue increased in 2021 and stayed at similar level in 2022, but these values were still much lower than the 2019 level. Price information is available in Figure 152.

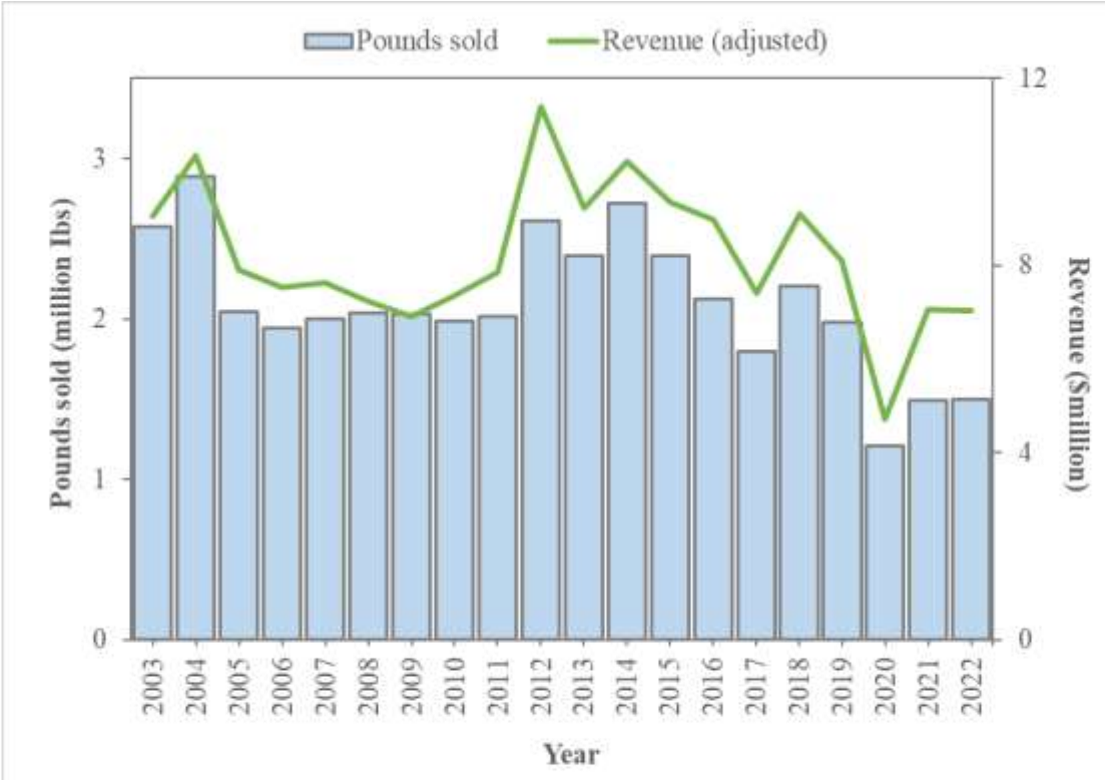


Figure 154. The pounds sold and revenue for the MHI troll (adjusted to 2022 dollars)[1]

[1] Data sourced from the PIFSC Pelagic Module data request.

3.2.3.4.3.2 Fishing Costs

There are no continuous cost data collection program established for the non-longline PMUS fisheries in Hawaii. Past periodic research has documented the costs of pelagic small boat fishing in Hawaii; both trip expenditure and annual fishing expenditures (fixed costs) are provided in the literature (Hamilton and Huffman 1997; Hospital et al. 2011; Chan and Pan 2017; Chan 2022). The most updated cost data for a Hawaii trolling trip are presented in Figure 153.

3.2.3.4.4 Hawaii Pelagic Handline

3.2.3.4.4.1 Commercial Participation, Landings, Revenue, and Prices

This section describes trends in commercial participation, landings, revenues, and prices for the Hawaii pelagic handline fishery. Figure 155 presents the pounds sold and revenue (adjusted to 2022 dollars) for the MHI handline fishery from 2003-2022. Supporting data for Figure 155 can be found in Table A-130 and Table A-131. The landings and revenue from the Hawaii handline fishery peaked in 2012 with 1.3 million pounds sold, valued at over $4 million (adjusted in 2022 dollars), before experiencing a general declining trend since 2013. Both revenue and commercial landings of Hawaii handline continued declining in 2020 but increased in 2021 and increased more significantly in 2022. Price information is available in Figure 152.

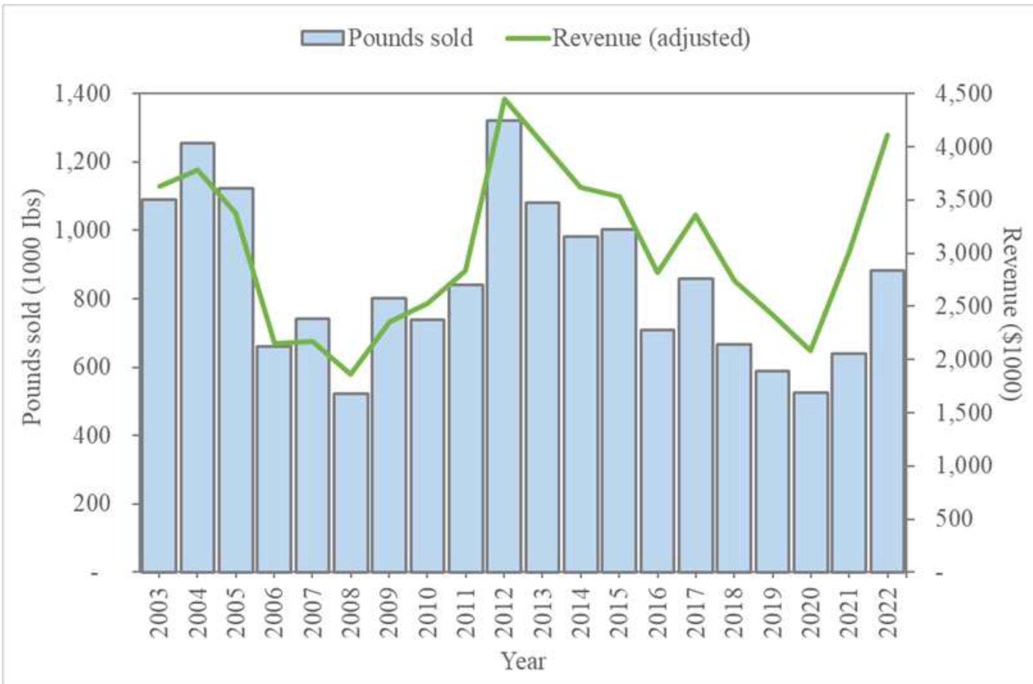


Figure 155. Pounds sold and revenue for MHI handline (adjusted to 2022 dollars)[1]

[1] Data sourced from the PIFSC Pelagic Module data request.

3.2.3.4.4.2 Fishing Costs

There is no continuous cost data collection program established for the non-longline PMUS fisheries in Hawaii. Past periodical research has documented the costs of pelagic small boat fishing in Hawaii; both trip expenditure and annual fishing expenditures (fixed costs) are provided in the literature (Hamilton and Huffman 1997; Hospital et al. 2011; Chan and Pan 2017; Chan 2022). The most recent cost data for MHI handline trips are presented Figure 153.

3.2.3.4.5 Offshore Handline

3.2.3.4.5.1 Commercial Participation, Landings, Revenue, and Prices

This section describes trends in pounds sold and revenues for the Hawaii offshore handline fishery. Figure 156 presents the pounds sold and revenue (adjusted to 2022 dollars) of the offshore handline, 2003-2022. Supporting data for Figure 156 can be found in Table A-130 and Table A-131. The offshore handline fishery seems stable in most of the years during the period of 2003-2022, except that the pounds sold and revenue jumped up considerably in 2013. The offshore handline in 2022 went up considerably in both landings and revenue, but lower than the historical high in 2013. Price information is available in Figure 152.

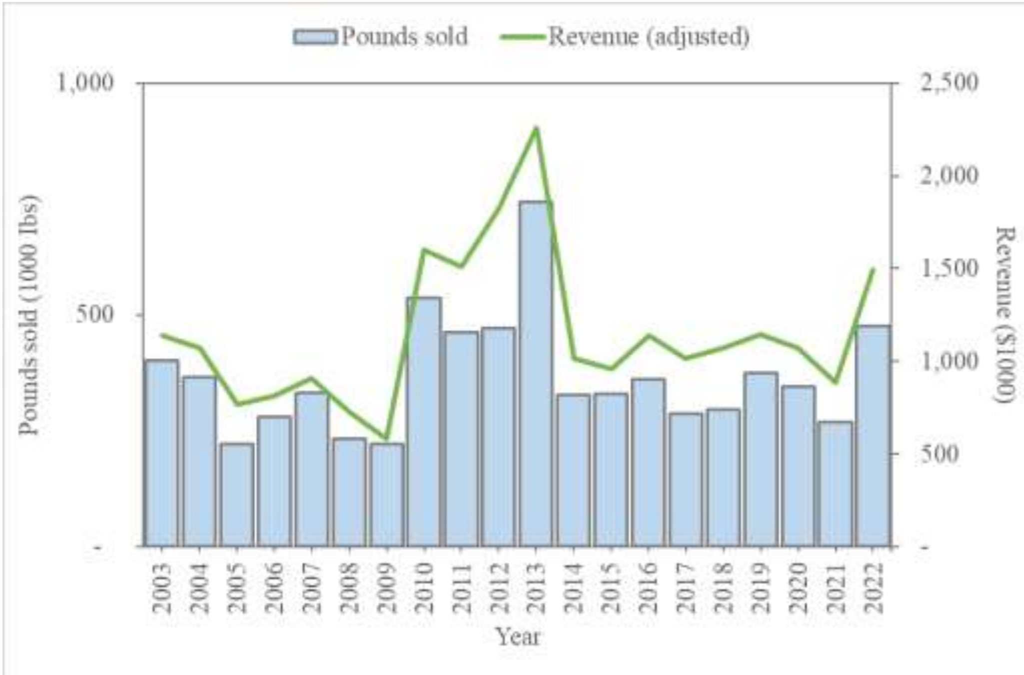


Figure 156. The pounds sold and revenue for the offshore handline (adjusted to 2022 dollars)[1]

[1] Data sourced from the PIFSC Pelagic Module data request.

3.2.3.4.5.2 Fishing Costs

Fishing costs for offshore handline were first studied in the 2014 Hawaii small boat survey (Chan and Pan 2019b). Fishing trip costs were collected from the 2014 Hawaii small boat survey (Chan and Pan 2017). Fishermen were asked their fishing trip costs for the most common and second most common gear types they used in the past 12 months and the survey provides information on the variable costs incurred during the operation of vessel including boat fuel, truck fuel, oil, ice, bait, food and beverage, daily maintenance and repair, and other. However, the 2021 survey did not receive any updated cost information on the offshore handline.

3.2.3.4.6 Other Gears (Including Aku Boat/Pole and Line)

3.2.3.4.6.1 Commercial Participation, Landings, Revenue, and Prices

This section will describe trends in commercial pounds sold and revenues for the "other gears". Figure 157 presents the pounds sold and revenue (adjusted to 2022 dollars) of the other gears 2003-2022 (excluding aku boats because data are confidential from 2019 to 2022 and the dramatic changes from $1 million revenue in 2023 to $4000 in 2018) during the reporting period). Supporting data for Figure 157 can be found in Table A-130 and Table A-131. After a period of continuous declines, the commercial landings and revenue from the other-gear-group (excluding Aku fishing) has risen slowly since 2017. In 2022, the revenue generated from the other fisheries 2022 went up considerably.

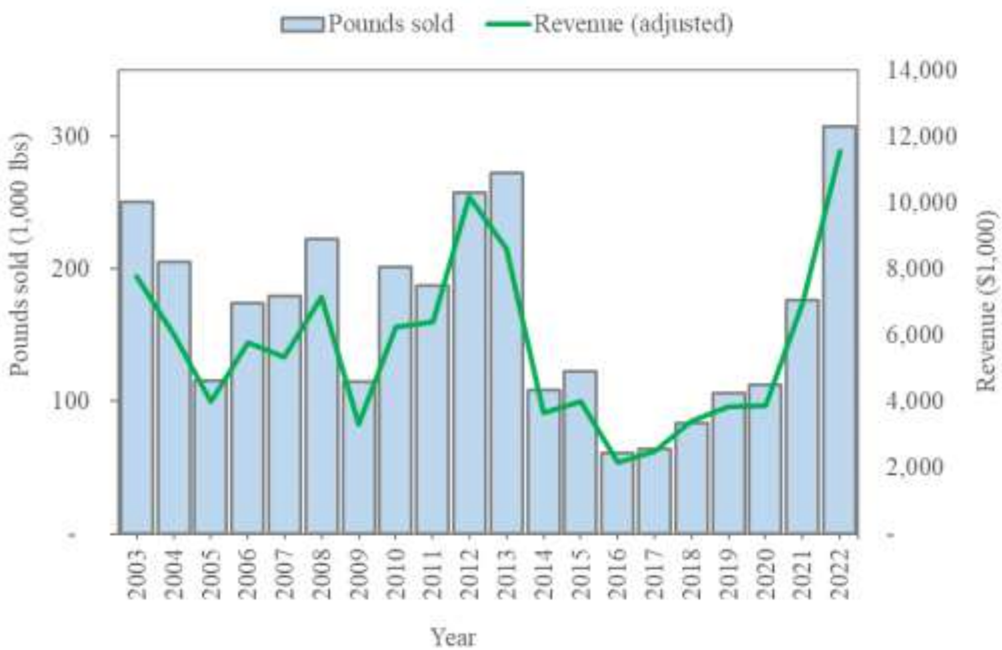


Figure 157. The pounds sold and revenue for all other gears (excluding aku-boat; adjusted to 2022 dollars)[1]

[1] Data sourced from the PIFSC Pelagic Module data request.

3.2.3.4.6.2 Fishing Costs

Fishing cost data for the other presented gears were not available at the time of publication.

3.2.4 ONGOING RESEARCH AND INFORMATION COLLECTION

Each year, the PIFSC reports on the status of economic data collections for select regional commercial fisheries. This supports a national economic data monitoring effort known as the Commercial Fishing Economic Assessment Index (CFEAI). Details on the CFEAI and access to data from other regions is available at: https://www.st.nmfs.noaa.gov/data-and-tools/CFEAI-RFEAI/.

The table below represents the most recent data available for CFEAI metrics for select regional commercial fisheries for 2022. Entries for Pelagic fisheries are bolded in red. These values represent the most recent year of data for key economic data monitoring parameters (fishing revenues, operating costs, and fixed costs). The assessment column indicates the most recent publication year for specific economic assessments (returns above operating cost, profit), where available.

Table 48. Pacific Islands Region 2022 Commercial Fishing Economic Assessment Index

	2022 Projected CFEAI				
	2022 Reporting Year (e.g. 1/2022-12/2022)				
	Data			Assessment	
Pacific Islands Fisheries	Fishing Revenue Most Recent Year	Operating Cost Most Recent Year	Fixed Cost Most Recent Year	Returns Above Operating Costs (Quasi Rent) Assessment Most Recent Year	Profit Assessment Most Recent Year
HI Longline	**2022**	**2022**	**2013**	**2022**	**2016**
ASam Longline	**2022**	**2022**	**2016**	**2022**	**2019**
HI Offshore Handline	**2022**	**2014**	**2014**	**2019**	**2019**
HI Small Boat (pelagic)	**2022**	**2021**	**2021**	**2017**	**2019**
HI Small Boat (bottomfish)	2022	2021	2021	2017	2019
HI Small Boat (reef)	2022	2021	2021	2017	2019
Guam Small boat	**2022**	**2022**	**2019**	**2019**	
CNMI Small boat	**2022**	**2022**	**2019**	**2019**	
ASam Small boat	**2022**	**2022**	**2021**	**2019**	

PIFSC also generates projections for upcoming fiscal years, and the table below provides the projected CFEAI report for 2022 (*all projected activities and analyses are subject to funding*). Based on early projections PIFSC intends to maintain ongoing economic data collections for the Hawaii and American Samoa longline fisheries (Pan 2018) and small boat fisheries in American Samoa, Guam and the CNMI (Chan and Pan 2019a) during 2022.

Table 49. Pacific Islands Region 2023 Commercial Fishing Economic Assessment Index

	2023 CFEAI				
	2023 Reporting Year (e.g. 1/2023-12/2023)				
	Data			Assessment	
Pacific Islands Fisheries	Fishing Revenue Most Recent Year	Operating Cost Most Recent Year	Fixed Cost Most Recent Year	Returns Above Operating Costs (Quasi Rent) Assessment Most Recent Year	Profit Assessment Most Recent Year
HI Longline	**2023**	**2023**	**2023**	**2023**	**2016**
ASam Longline	**2023**	**2023**	**2016**	**2023**	**2019**
HI Offshore Handline	**2023**	**2014**	**2014**	**2019**	**2019**
HI Small Boat (pelagic)	**2023**	**2021**	**2021**	**2023**	**2023**
HI Small Boat (bottomfish)	2023	2021	2021	2023	2023
HI Small Boat (reef)	2023	2021	2021	2023	2023
Guam Small boat	**2023**	**2023**	**2019**	**2019**	
CNMI Small boat	**2023**	**2023**	**2019**	**2019**	
ASam Small boat	**2023**	**2023**	**2021**	**2019**	

PIFSC fielded an update to the Hawaii small boat cost earnings survey (Chan and Pan 2017; Hospital et al. 2011) during calendar year 2021 (Chan 2022). This survey will provide updated information on operating costs and fixed costs for the Hawaii pelagic small boat fisheries, as well as numerous elements related to fishing behavior, market participation, and fishery demographics. PIFSC intends final survey results to be published during 2023.

A cost-earnings survey of the American Samoa small boat fishery was completed during 2021. This survey will provide updated data on fishing revenues, operating costs, and fixed costs, as well as numerous elements related to fishing behavior, market participation, and fishery demographics for American Samoa boat-based fisheries. PIFSC intends final survey results to be published during 2023.

PIFSC completed a cost-earnings survey of small boat fisheries in Guam and the CNMI during 2018-2019 to serve as an update to the previous 2011 cost-earnings survey (Hospital and Beavers 2012, 2014). This 2018-2019 survey collected data on fishing revenues, operating costs, and fixed costs, as well as numerous elements related to fishing behavior, market participation, and fishery demographics. Efforts to complete the analysis of the 2018-2019 cost-earnings have been delayed due to staff departures coupled with COVID-19 monitoring requirements and PIFSC intends final survey results to be published during 2023.

Plans to field an update to the Hawaii longline cost earnings survey (Kalberg and Pan 2016) during 2021 have been postponed to 2023, on account of ongoing pandemic restrictions. This survey will ultimately provide updated information on fixed costs, labor costs, and allow for a more in depth analysis of economic performance for the fleet.

PIFSC will continue to collect and monitor annual community social indicators (Kleiber et al. 2018; Hospital and Leong 2021) for Hawaii fishing communities, in accordance with a national project to describe and evaluate community well-being in terms of environmental justice, economic vulnerability, and gentrification pressure (https://www.fisheries.noaa.gov/national/socioeconomics/social-indicators-coastal-communities).

Community social indicators have also been generated for American Samoa, the CNMI and Guam (Kleiber et al. 2018). However, indicators in the Western Pacific rely solely on decennial Census data and cannot be updated until 2020 Census data becomes available, likely during 2023.

3.2.5 RELEVANT PIFSC ECONOMICS AND HUMAN DIMENSIONS PUBLICATIONS: 2022

Publication	**MSRA priority**
Ayers AL, Leong K. 2022. Focusing on the human dimensions to reduce protected species bycatch. Fisheries Research, Volume 254: 106432. https://doi.org/10.1016/j.fishres.2022.106432	PS1.4.2 PS1.4.5 PS2.4.2
Ayers A, Leong K, Hospital J, Tam C, Morioka R. 2022. Guam & CNMI fisher observations data summary and analysis. Pacific Islands Fisheries Science Center, PIFSC Data Report, DR-22-26, 17 p. https://doi.org/10.25923/wmv2-y197	HC3.1.1 HC3.1.3 HC1.1.7
Ayers A, Leong K, Hospital J, Tam C, Morioka R. 2022. Hawai'i fisher observations data summary and analysis. Pacific Islands Fisheries Science Center, PIFSC Data Report, DR-22-27, 23 p. https://doi.org/10.25923/aepb-m302	HC3.1.1 HC3.1.3 HC1.1.7
Dombrow C, Rollins E, Sweeney J, Hospital J. 2022. Hawaiʻi Pelagic Fisheries Market Analysis. U.S. Dept. of Commerce, NOAA Technical Memorandum NOAA-TM-NMFS-PIFSC-127, 72 p. https://doi.org/10.25923/nb9m-2x97	HC1.1.3
Freitag A, Blake S, Clay PM, Haynie AC, Kelble C, Jepson M, Kasperski S,	HC2.1.2

Leong KM, Moss JH, Regan SD. 2022. Scale matters - Relating Wetland Loss and Commercial Fishing Activity in Louisiana across Spatial Scales. Nature and Culture, 17(2), 144-169. https://doi.org/10.3167/nc.2022.170202	HC3.1.3
Kleiber D, Iwane M, Kamikawa K, Leong K, Hospital J. 2022. Pacific Islands Region Fisheries and COVID-19: Impacts and adaptations. U.S. Dept. of Commerce, NOAA Technical Memorandum NOAA-TM-NMFS-PIFSC-130, 36 p. https://doi.org/10.25923/2fpm-c128	HC2.2.4
Smith SL, Cook S, Golden A, Iwane MA, Kleiber D, Leong KM, Mastitski A, Richmond L, Szymkowiak M, Wise S. 2022. Review of adaptations of U.S. commercial fisheries in response to the COVID-19 pandemic using the Resist-Accept-Direct (RAD) framework. Fisheries Management and Ecology. 1-17. https://doi.org/10.1111/fme.12567	HC2.2.4

3.3 PROTECTED SPECIES

This section of the report summarizes information on protected species interactions in fisheries managed under the Pelagic FEP. Protected species covered in this report include sea turtles, seabirds, marine mammals, elasmobranchs, and corals. Most of these species are protected under the Endangered Species Act (ESA), Marine Mammal Protection Act (MMPA), and/or the Migratory Bird Treaty Act (MBTA). A list of protected species found in or near waters where fisheries managed under the Pelagic FEP operate and a list of critical habitat designations in the Pacific Ocean are included in Appendix B.

3.3.1 HAWAII SHALLOW-SET LONGLINE FISHERY

3.3.1.1 INDICATORS FOR MONITORING PROTECTED SPECIES INTERACTIONS AND EFFECTIVENESS OF MANAGEMENT MEASURES IN THE HAWAII SHALLOW-SET LONGLINE FISHERY

This report monitors the status of protected species interactions in the Hawaii shallow-set longline fishery using the following indicators:

- General interaction trends over time
- Effectiveness of FEP conservation measures
- Take levels compared to the incidental take statement (ITS) levels under the ESA
- Take levels compared to marine mammal Potential Biological Removals (PBRs), where applicable

Details of these indicators are discussed below.

3.3.1.1.1 Conservation Measures

The Pelagic FEP includes a number of conservation measures to mitigate seabird and sea turtle interactions in the shallow-set longline fishery. These measures include the following:

- Longline vessel owners/operators are required to adhere to regulations for safe handling and release of sea turtles and seabirds.
- Longline vessel owners/operators must have on board the vessel all required turtle handling/dehooking gear specified in regulations.
- Longline vessel owners/operators are required to remove trailing gear from oceanic whitetip sharks and cut the line as close to the hook as possible.
- Longline vessel owners/operators can choose between side-setting or stern-setting longline gear with additional regulatory specifications to reduce seabird interactions (e.g., night-setting, blue-dyed bait, weighted branch lines, strategic offal discards, using a “bird curtain”).
- When shallow-set longline fishing north of the Equator:
    - Use 18/0 or larger circle hooks with no more than 10° offset.
    - Use mackerel-type bait.
    - Vessel owners and operators required to annually attend protected species workshop
    - Closure for remainder of year when fishery reaches annual interaction limits (“hard caps”). Since September 17, 2020, the fishery has operated under a hard

cap of 16 leatherback turtles and no hard cap for loggerhead turtles (see Section 3.3.1.3.2, this report)
- o Effective September 17, 2020, vessels required to return to port when an individual trip interaction limit of 5 loggerhead turtles or 2 leatherback turtles is reached, with additional requirements if the vessel reaches the same trip limit for the second time in a calendar year (see Section 3.3.1.3.2 of this report)

3.3.1.1.2 ESA Consultations

Two valid Biological Opinions document the effects of the shallow-set fishery on ESA listed species. On January 6, 2012, the U.S. Fish and Wildlife Service issued a Biological Opinion on the effects of the Hawaii deep-set and shallow-set longline fisheries on ESA-listed seabirds (USFWS 2012). The USFWS concluded that the shallow-set fishery would not jeopardize the short-tailed albatross and included an incidental take statement of one short-tailed albatross interaction every five years. To date the fishery has not interacted with any short-tailed albatross.

On June 26, 2019, NMFS issued a biological opinion on the effects of the shallow-set fishery on ESA-listed marine species (NMFS 2019). In total, 49 listed resources comprised of 40 listed species and nine critical habitat designations occur within the area the shallow-set fishery operates and were analyzed in the 2019 Biological Opinion. These also include listed fish, marine invertebrates, and other critical habitat in vessel transiting areas of the shallow-set fishery primarily in California (Long Beach, San Francisco, and San Diego).

NMFS concluded that the continued authorization of the fishery is not likely to jeopardize the continued existence of any of the following: endangered North Pacific loggerhead sea turtle distinct population segment (DPS); endangered leatherback sea turtle; endangered Mexico breeding population of olive ridley sea turtle, and threatened (other) populations of olive ridley sea turtle; threatened Eastern Pacific green sea turtle DPS; threatened Central North Pacific green sea turtle DPS; threatened East Indian-West Pacific green sea turtle DPS; endangered Central West Pacific green sea turtle DPS; threatened Southwest Pacific green sea turtle DPS; endangered Central South Pacific green sea turtle DPS; threatened oceanic whitetip shark; threatened giant manta ray; and threatened Guadalupe fur seal.

In its 2019 Biological Opinion, NMFS issued an ITS for the loggerhead, leatherback, green, olive ridley, Guadalupe fur seal, oceanic whitetip shark, and giant manta ray, which were derived from interaction predictions generated by McCracken (2018) using a Bayesian inferential approach (Table 51). These predictions are based on observer data from 2005-2017 for all species, except for loggerheads (2005-2018) where more recent data were available.

Additionally, the 2019 Biological Opinion concluded that the shallow-set fishery may affect, but is not likely to adversely affect the following: hawksbill sea turtle; MHI insular false killer whale DPS; Mexico and Central America humpback whale DPSs; fin whale; blue whale; North Pacific right whale; sei whale; sperm whale; Eastern Pacific scalloped hammerhead shark DPS; and listed fish and invertebrate species common to transiting areas off the coast of California (Central California coast coho salmon, Central Valley spring-run Chinook salmon, Sacramento River winter-run Chinook salmon, Central California coast steelhead, California coast steelhead, Southern North American green sturgeon, Black abalone, and White abalone).

The 2019 Biological Opinion also concluded that the shallow-set fishery is not likely to adversely modify designated critical habitat for the following: leatherback sea turtle; Hawaiian monk seal; MHI insular false killer whale; Steller sea lion; and critical habitat for listed fish and invertebrate species common to transiting areas off the coast of California (Central California coast coho salmon, Sacramento River winter-run Chinook salmon, California coast steelhead, Southern North American green sturgeon, and Black abalone).

Table 50. Summary of ESA consultations for the Hawaii shallow-set longline fishery

Species or DPS	Consultation Date	Consultation Type[a]	Outcome[b]
Loggerhead turtle, North Pacific DPS	2019-06-26	BiOp	LAA, non-jeopardy
Leatherback turtle	2019-06-26	BiOp	LAA, non-jeopardy
Olive ridley turtle	2019-06-26	BiOp	LAA, non-jeopardy
Green turtle	2019-06-26	BiOp	LAA, non-jeopardy
Hawksbill turtle	2019-06-26	BiOp	NLAA
False killer whale, MHI insular DPS	2019-06-26	BiOp	NLAA
Fin whale	2019-06-26	BiOp	NLAA
Blue whale	2019-06-26	BiOp	NLAA
North Pacific right whale	2019-06-26	BiOp	NLAA
Sei whale	2019-06-26	BiOp	NLAA
Sperm whale	2019-06-26	BiOp	NLAA
Hawaiian monk seal	2019-06-26	BiOp	NLAA
Guadalupe fur seal	2019-06-26	BiOp	LAA, non-jeopardy
Scalloped hammerhead shark, Eastern Pacific DPS	2019-06-26	BiOp	NLAA
Oceanic whitetip shark	2019-06-26	BiOp	LAA, non-jeopardy
Giant manta ray	2019-06-26	BiOp	LAA, non-jeopardy
Listed fish and invertebrate species[c]	2019-06-26	BiOp	NLAA
Short-tailed albatross	2012-01-06	BiOp (FWS)	LAA, non-jeopardy
Critical Habitat	**Consultation Date**	**Consultation Type[a]**	**Outcome[b]**
Hawaiian monk seal	2019-06-26	BiOp	NLAA
False killer whale, MHI insular DPS	2019-06-26	BiOp	NLAA
Leatherback turtle	2019-06-26	BiOp	NLAA
Steller sea lion	2019-06-26	BiOp	NLAA
Listed fish and invertebrate species[d]	2019-06-26	BiOp	NLAA

[a] BiOp = Biological Opinion; LOC = Letter of Concurrence.
[b] LAA = likely to adversely affect; NLAA = not likely to adversely affect.
[c] Listed fish and invertebrate species = Central California coast coho salmon, Central Valley spring-run Chinook salmon, Sacramento River winter-run Chinook salmon, Central California coast steelhead, California coast steelhead, Southern North American green sturgeon, Black abalone, and White abalone.
[d] Listed fish and invertebrate species = Central California coast coho salmon, Sacramento River winter-run Chinook salmon, California coast steelhead, Southern North American green sturgeon, and Black abalone.

Table 51. Summary of Incidental Take Statements (ITS) for the Hawaii shallow-set longline fishery

Species	ITS Time Period	Takes	Mortalities	Source BiOp
Loggerhead turtle (North Pacific DPS)	1-year	36	6	NMFS (2019)
Leatherback turtle	1-year	21	3	NMFS (2019)
Olive ridley turtle	1-year	5	1	NMFS (2019)
Green turtle	1-year	5	1	NMFS (2019)
Oceanic whitetip shark	1-year	102	32	NMFS (2019)
Giant manta ray	1-year	13	4	NMFS (2019)
Guadalupe fur seal	1-year	11	9	NMFS (2019)
Short-tailed albatross	5-year	1 injury or death		USFWS (2012)

3.3.1.1.3 Non-ESA Marine Mammals

Fishery impacts to marine mammal stocks are primarily assessed and monitored through the Stock Assessment Reports (SARs) prepared pursuant to the MMPA. The SARs include detailed information on these species' geographic range, abundance, potential biological removal (PBR) estimates, bycatch estimates, and status. The most recent SARs are available online at: https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-stock-assessment-reports-region.

The Hawaii shallow-set longline fishery is a Category II under the MMPA 2023 List of Fisheries (LOF; 88 FR 16899, March 21, 2023), meaning that this fishery has occasional incidental mortality and serious injuries of marine mammals. The 2023 LOF lists the following marine mammal stocks that are incidentally killed or injured in this fishery:[3]

- Bottlenose dolphin, HI Pelagic stock
- False killer whale, HI Pelagic stock
- Fin whale, HI stock
- Guadalupe fur seal
- Humpback whale, Central North Pacific stock
- Risso's dolphin, HI stock
- Striped dolphin, HI stock

Most bycatch estimates in the SARs are based on the most recently available 5-year period, but there is a data lag of at least two years due to the SAR review process. This annual report focuses on available long-term interaction trends and summarizes relevant information from the most recent SAR.

[3] This fishery is listed in the LOF under Commercial Fisheries in the Pacific Ocean and Commercial Fisheries on the High Seas. Stocks from both lists are included here.

3.3.1.2 DATA SOURCE FOR MONITORING PROTECTED SPECIES INTERACTIONS IN THE HAWAII SHALLOW-SET LONGLINE FISHERY

Protected species interactions in the Hawaii longline fishery have been monitored through mandatory observer coverage since 1994. Observer coverage in the Hawaii longline fishery was between 3 and 5 percent from 1994 through 1999 and increased to 10 percent in 2000. Since 2004, the shallow-set component of the Hawaii longline fishery has had 100 percent observer coverage.

NMFS uses the date of the interaction for tracking interactions against the ITS and the shallow-set longline sea turtle hard caps, while the PIRO Observer Program Quarterly and Annual Reports through 2020 summarized interaction data by vessel arrival dates. As a result, the annual number of interactions counting toward the ITS and hard caps may differ from the numbers reported on the historical Observer Program Quarterly and Annual Reports. Starting in 2021, the PIRO Observer Program Quarterly and Annual Reports began summarizing interaction data by haul begin dates (proxy for interaction date). This report presents sea turtle interactions summarized by vessel arrival date (Table 52) and by interaction date (Table 53) for the Hawaii shallow-set longline fishery. For the remainder of species and fisheries, the annual observed interactions are based on vessel arrival date.

In 2006 and 2019, the shallow-set longline fishery closed in March, and in 2018 the fishery closed in May (see Section 3.3.1.3.2, this report). Due to these early closures in first and second quarters, data for these years are not representative of typical fishing years and should be interpreted with caution.

3.3.1.3 SEA TURTLE INTERACTIONS IN THE HAWAII SHALLOW-SET LONGLINE FISHERY

Table 52 summarizes the incidental take data of sea turtles from 2004 to 2022 in the Hawaii shallow-set longline fishery summarized by vessel arrival date in accordance with the Observer Program. Additionally,

Table 53 summarizes the sea turtle interaction data based on interaction date to allow comparison with the hard caps. The incidental take data in this section were compiled from the PIRO Observer Program Annual Status Reports as well as unpublished observer data and are for monitoring purposes. Since there is full observer coverage for this fishery, all sea turtle interactions have been documented. Many of these interactions have been examined further by PIFSC, and updated information necessary for any data analyses is available from PIFSC. The incidental take data for the fourth quarter of 2007 were combined with 2008 data due to vessel confidentiality rules.

Based on the vessel arrival date (Table 53), nearly all sea turtles observed in the Hawaii shallow-set longline fishery from 2004 to 2022 were released alive, with the exception of three total loggerhead turtles released dead in 2018 and 2020, and one olive ridley turtle released dead in 2019. Additionally, one loggerhead in 2013 was entangled in marine debris that was entangled with fishing gear and NMFS did not count this turtle towards the annual shallow-set interaction limit. One unidentified hard shell in 2013 was classified by NMFS as a loggerhead per protocol and was counted towards the annual shallow-set interaction limit for loggerheads. The highest interaction rates involved both leatherback and loggerhead turtles, whereas interactions with greens, olive ridleys, and unidentified hard shell turtles were much less frequent.

The observed number of sea turtle takes per year has been variable for green, olive ridley, leatherback, and unidentified hard shell turtles. Higher numbers of interactions with loggerhead turtles were observed starting in late 2017. In total, 21, 33, and 20 loggerhead turtles were observed in 2017, 2018, 2019, respectively, based on interaction date summary (Table 53). The fishery was closed May-December 2018 due to a stipulated settlement, and March-December 2019 due to reaching the loggerhead hard cap, thus interaction rate data for these years are not directly comparable to other years in which the fishery operated throughout the year. Loggerhead turtle interactions in 2020 were lower than the previous three years, although shallow-set effort in 2020 was not reflective of a typical fishing year due to 1) the shallow-set vessels voluntarily reducing effort in the first quarter after majority of the 2020 loggerhead turtle interactions were observed in January; and 2) impacts from the COVID-19 pandemic especially in second quarter. Additional discussion regarding the higher number of loggerhead turtle interactions observed since 2017 is provided in Section 3.3.1.3.2, and a summary of an analysis evaluating the experimental oceanographic TurtleWatch product is provided in Section 4.1.

Table 52. Observed takes, mortalities (M), and takes per fishing effort (1,000 hooks) for sea turtles in the Hawaii shallow-set longline fishery based on vessel arrival date associated with Pacific Islands Regional Observer Program annual reports, 2004-2022[a]

Year	Observer Coverage (%)	Sets	Hooks	Green		Leatherback		Loggerhead		Olive ridley		Unidentified hard shell	
				Takes	Takes/ 1,000 hooks	Takes	Takes/ 1,000 hooks	Takes (M)	Takes/ 1,000 hooks	Takes (M)	Takes/ 1,000 hooks	Takes	Takes/ 1,000 hooks
2004	100	88	76,750	0	0.000	1	0.013	1	0.013	0	0.000	0	0.000
2005	100	1,604	1,328,806	0	0.000	8	0.006	10	0.008	0	0.000	0	0.000
2006	100	939	745,125	0	0.000	2	0.003	17[b]	0.023	0	0.000	2[c]	0.003
2007[d]	100	1,496	1,292,036	0	0.000	5	0.004	15	0.012	1	0.001	0	0.000
2008	100	1,487	1,350,127	1	0.001	2	0.001	0	0.000	2	0.001	0	0.000
2009	100	1,833	1,767,128	1	0.001	9	0.005	3	0.002	0	0.000	0	0.000
2010	100	1,879	1,828,529	0	0.000	7	0.004	5	0.003	0	0.000	0	0.000
2011	100	1,579	1,611,395	4	0.002	17	0.011	14	0.009	0	0.000	0	0.000
2012	100	1,307	1,418,843	0	0.000	7[e]	0.005	5	0.004	0	0.000	0	0.000
2013	100	912	1,000,084	0	0.000	6	0.007	5[f]	0.005	0	0.000	1[g]	0.001
2014	100	1,349	1,509,727	1	0.001	19	0.013	13	0.009	1	0.001	1	0.001
2015	100	1,178	1,286,628	0	0.000	6	0.005	15	0.012	1	0.001	0	0.000
2016	100	778	849,681	0	0.000	5	0.006	16	0.019	0	0.000	0	0.000
2017	100	973	1,051,426	2	0.002	4	0.004	16	0.015	4	0.004	0	0.000
2018	100	476	546,371	1	0.002	6	0.011	38(2)	0.070	1	0.002	0	0.000
2019	100	312	374,487	0	0.000	0	0.000	20	0.053	2(1)	0.006	0	0.000
2020	100	455	588,481	0	0.000	2	0.003	15(1)	0.026	0	0.000	0	0.000
2021	100	763	972,692	1	0.001	3	0.003	16	0.016	2	0.002	1	0.001
2022	100	945	1,219,202	0	0.000	8	0.007	23	0.019	2	0.002	0	0.000

[a] Take data are based on vessel arrival dates.

[b] The released conditions of two loggerheads were unknown.

[c] The released condition of one unidentified hard shell turtle was unknown.

[d] Due to vessel confidentiality rules, data for the fourth quarter in 2007 are combined with data for 2008. Take data for 2007 reflect those from first, second and third quarters.

[e] The released condition of one leatherback was unknown.

[f] One injured loggerhead was entangled in marine debris, which became entangled with fishing gear. This loggerhead did not count toward the annual shallow-set interaction limit but is included in this table.

[g] One turtle listed as an unidentified hard shell sea turtle in the Observer Program Status Report is being classified as a loggerhead per protocol for the shallow-set interaction limit and will count toward the annual shallow-set limit.

Sources: 2004-2020 PIRO Observer Program Annual and Quarterly Status Reports; PIRO Sustainable Fisheries Division unpublished data.

Table 53. Observed takes, mortalities (M), and takes per fishing effort (1,000 hooks) for sea turtles in the Hawaii shallow-set longline fishery based on interaction date for comparison with the shallow-set sea turtle hard caps, 2004-2022[a]

Year	Observer Coverage (%)	Sets	Hooks	Green		Leatherback		Loggerhead		Olive ridley		Unidentified hard shell	
				Takes	Takes/ 1,000 hooks	Takes	Takes/ 1,000 hooks	Takes (M)	Takes/ 1,000 hooks	Takes (M)	Takes/ 1,000 hooks	Takes	Takes/ 1,000 hooks
2004	100	135	115,718	0	0.000	1	0.009	1	0.009	0	0.000	0	0.000
2005	100	1646	1,358,247	0	0.000	8	0.006	10	0.009	0	0.000	0	0.000
2006	100	850	676,716	0	0.000	2	0.003	17[b]	0.022	0	0.000	2[c]	0.003
2007[d]	100	1569	1,353,761	0	0.000	5	0.004	15	0.011	1	0.001	0	0.000
2008	100	1595	1,460,042	1	0.001	2	0.001	0	0.000	2	0.001	0	0.000
2009	100	1761	1,694,550	1	0.001	9	0.005	3	0.002	0	0.000	0	0.000
2010	100	1872	1,835,182	0	0.000	8	0.004	7	0.004	0	0.000	0	0.000
2011	100	1474	1,505,467	4	0.003	16	0.011	12	0.008	0	0.000	0	0.000
2012	100	1364	1,476,969	0	0.000	7[e]	0.005	6	0.004	0	0.000	0	0.000
2013	100	962	1,074,909	0	0.000	10	0.009	6[f]	0.006	0	0.000	1[g]	0.001
2014	100	1338	1,470,683	1	0.001	16	0.011	14	0.010	1	0.001	1	0.001
2015	100	1156	1,274,805	0	0.000	5	0.004	13	0.011	1	0.001	0	0.000
2016	100	727	796,165	0	0.000	5	0.006	15	0.019	0	0.000	0	0.000
2017	100	1005	1,083,216	2	0.002	4	0.004	21(1)	0.019	4	0.004	0	0.000
2018	100	420	486,013	1	0.002	6	0.012	33(1)	0.068	1	0.002	0	0.000
2019	100	314	374,487	0	0.000	0	0.000	20	0.053	2(1)	0.005	0	0.000
2020	100	479	624,579	0	0.000	2	0.003	15(1)	0.024	0	0.000	0	0.000
2021	100	804	1,026,373	1	0.001	3	0.003	19	0.019	2	0.002	1	0.001
2022	100	971	1,242,997	0	0.000	11	0.009	24	0.019	2	0.002	0	0.000

[a] Take data based on interaction dates. Set and hook data based on haul begin date as a proxy for interaction date.
[b] The released conditions of two loggerheads were unknown.
[c] The released condition of one unidentified hard shell turtle was unknown.
[d] Due to vessel confidentiality rules, data for the fourth quarter in 2007 are combined with data for 2008. Take data for 2007 reflect those from first, second and third quarters.
[e] The released condition of one leatherback was unknown.
[f] One injured loggerhead was entangled in marine debris, which became entangled with fishing gear. This loggerhead will not count toward the annual shallow-set interaction limit but is included in this table.
[g] One turtle listed as an unidentified hard shell sea turtle in the Observer Program Status Report is being classified as a loggerhead per protocol for the shallow-set interaction limit and will count toward the annual shallow-set limit.
Sources: PIRO Sustainable Fisheries Division unpublished data.

3.3.1.3.1 Comparison of Interactions with ITS

Due to a fishery closure in March 2019, the Hawaii shallow-set longline fishery in 2019 operated solely under the ITSs in the 2012 Biological Opinion (NMFS 2012). The ITS from the June 26, 2019 Biological Opinion took effect in January 2020 when the fishery reopened.

Under the 2019 Biological Opinion, NMFS will monitor the ITSs for the Hawaii shallow-set longline fishery annually starting in January 2020 to track incidental take. NMFS uses the date of the interaction for tracking sea turtle interactions against the ITS (Table 54), regardless of when the vessel returns to port. NMFS uses the post-hooking mortality criteria (Ryder et al. 2006) to estimate sea turtle mortality rates.

Table 54. Observed interactions and estimated total mortality (M) (using Ryder et al. 2006) of sea turtles in the Hawaii shallow-set longline fishery compared to the 1-year ITS in the 2019 Biological Opinion[a]

Species	1-year ITS Interactions (M)	Interactions (M)		
		2020	2021	2022
Green turtle	5(1)	0(0)	1(0)	0(0)
Leatherback turtle	21(3)	2(1)	3(1)	11(3)
Loggerhead turtle (North Pacific DPS)	36(6)	15(2)	20(4)[b]	24(5)
Olive ridley turtle	5(1)	0(0)	2(0)	2(1)

[a] Takes are counted based on interaction date.
[b] Includes one unidentified turtle.

3.3.1.3.2 Effectiveness of FEP Conservation Measures

Management measures in the Hawaii shallow-set longline fishery have been effective in reducing the number of sea turtle interactions. The introduction of sea turtle bycatch reduction measures for the fishery in 2004, such as switching from J-hooks to circle hooks, and from squid bait to mackerel bait, resulted in an 89% decrease in sea turtle interactions in 2004-2006 compared to interactions observed in 1994 through 2002 (Gilman et al. 2007). A more recent analysis, including observer data through 2014, show that these mitigation measures continue to be effective with reductions in leatherback and loggerhead turtle interaction rates of 84% and 95%, respectively, for the post-regulation period (Swimmer et al. 2017). The rate of deeply hooked sea turtles, which is thought to result in higher mortality levels, also declined after those measures were implemented (Gilman et al. 2007).

From 2012 to 2018, the fishery did not reach the annual hard cap for either leatherback or loggerhead turtles (26 and 34, respectively, based on the 2012 Biological Opinion ITSs). The Hawaii shallow-set longline fishery was closed in May 2018 pursuant to a settlement agreement. At the time of the closure, the fishery had 33 loggerhead interactions (Table 53), thus the fishery was closed prior to reaching the annual hard cap limit of 34 turtles. From 2004 to 2012, the shallow-set fishery operated under hard caps of 17 loggerhead turtles and 16 leatherback turtles (except in 2010 when the loggerhead hard cap was 46 under Pelagic FEP Amendment 18; later returned to 17 loggerheads due to litigation). The fishery reached the loggerhead hard cap in 2006 and the leatherback hard cap in 2011 (Table 53). Due to the 2018 stipulated settlement agreement, the hard cap limit of 17 loggerhead turtles was reinstated based on the 2004 Biological Opinion when the fishery reopened on January 1, 2019, and remained in place until

September 17, 2020. In 2019, the fishery closed on March 19 due to reaching the loggerhead hard cap limit of 17[4], and the fishery reopened on January 1, 2020.

In 2017–2019, loggerhead turtle interactions in the Hawaii shallow-set longline fishery were higher than levels previously observed since the fishery reopened in 2004. A total of 21 loggerhead interactions were observed in 2017, 33 loggerhead interactions observed from January 2018 to the fishery closure in May, and 20 loggerhead interactions observed from January 2019 to the fishery closure in March. The increase in loggerhead interactions may be explained by the high reproductive output at their source nesting beaches in Japan. Loggerhead turtle nest counts increased nearly an order of magnitude from 1997 to 2014. The high levels of nesting likely resulted in higher hatchling production. Most of the loggerhead turtles observed interacting with the Hawaii shallow-set longline fishery in 2017 and 2018 were in the range of 40 to 60 cm straight carapace length, which is estimated to be approximately 3 to 10 years in age and consistent with the period of high nesting in Japan.

In response to the higher number of loggerhead turtle interactions in the shallow-set fishery, the Council in 2018 developed management measures to provide managers and fishery participants with the necessary tools to respond to and mitigate fluctuations in loggerhead and leatherback turtle interactions, and to ensure a continued supply of fresh swordfish to U.S. markets, consistent with the conservation needs of these sea turtles. At its 179th Meeting in August 2019, the Council took final action to amend the Pelagic FEP to modify sea turtle mitigation measures for the shallow-set fishery, incorporating provisions required under the 2019 Biological Opinion Reasonable and Prudent Measures (RPMs) and Terms and Conditions 1a and 1b. Specifically, the Council recommended 1) setting an annual fleet-wide hard cap limit on the number of leatherback turtle interactions at 16, consistent with RPMs and Terms and Conditions 1a under the 2019 Biological Opinion; 2) not setting an annual fleet-wide hard cap limit on the number of North Pacific loggerhead turtle interactions; and 3) establishing individual trip interaction limits for loggerhead and leatherback turtles for the shallow-set fishery, consistent with RPMs and Terms and Conditions 1b under the 2019 Biological Opinion. NMFS published the Notice of Availability for Amendment 10 on January 23, 2020 (85 FR 3889) and the proposed rule on February 4, 2020 (85 FR 6131). Amendment 10 became effective on April 22, 2020, and the regulations implementing the amendment became effective on September 17, 2020 (85 FR 57988).

As part of the final action for Amendment 10, the Council recommended an annual review of the fishery's performance under the trip interaction limits in the Annual SAFE Report. Table 55 shows the distribution of the shallow-set vessels' interactions with loggerhead and leatherback turtle interactions from January 1 – December 31, 2022. The current limits are five loggerhead turtle interactions per trip or two leatherback turtle interactions per trip. In 2022, one trip reached the leatherback trip limit.

[4] The actual observed number of interactions for 2019 was 20 loggerhead turtles due to the fishery having multiple observed interactions on the day the hard cap was reached.

Table 55. Number of shallow-set longline trips by the number of loggerhead and leatherback turtle interactions per trip, January 1 – December 31, 2022. The total number of trips in this period was 75

Loggerhead turtles		Leatherback turtles	
Number of turtles per trip	Number of trips[a]	Number of turtles per trip	Number of trips
0	61	0	65
1	6	1	9
2	6	2	1
3	2	≥3	0
≥4	0	--	--

[a] Number of trips based on haul begin date.

3.3.1.4 MARINE MAMMAL INTERACTIONS IN THE HAWAII SHALLOW-SET LONGLINE FISHERY

Table 56 through Table 60 summarize the incidental take data of marine mammals from 2004 to 2022 in the Hawaii shallow-set longline fishery. Since there is full observer coverage for this fishery, all marine mammal interactions are documented. The incidental take data in this section were compiled from the PIRO Observer Program Annual Status Reports and are for monitoring purposes. Reported interactions listed in these tables reflect all observed interactions, including mortalities, serious injuries, and non-serious injuries. Refer to the most recent SARs for mortality and serious injury estimates and stock-specific estimates of interactions. Many of these interactions have been further examined by NMFS, and updated information necessary for any data analyses is available from PIFSC. The incidental take data for the fourth quarter of 2007 were combined with 2008 data due to vessel confidentiality rules.

The majority of observed cetacean interactions and all mortalities during this time period involved small dolphin species (Table 56). Of these species, Risso's dolphins had the highest rate of interactions over time, followed by bottlenose dolphins, striped dolphins, common dolphins, and rough-toothed dolphins with a single take. Marine mammals grouped as small whales (Table 57) and large whales (Table 58) had comparatively lower rates of interactions than most small dolphin species. Small and large whales with observed interactions since 2004 include false killer whale, Blainville's beaked whale, pygmy sperm whale, unidentified *Kogia* species, ginkgo-tooth beaked whale, Bryde's whale, humpback whale, and fin whale. Observed interactions with unidentified cetaceans are shown in Table 59.

Interactions with pinnipeds, including Northern elephant seals, Guadalupe fur seals, and unidentified pinniped species have been occasionally observed since 2013 (Table 60). All pinniped interactions were observed outside of the EEZ off of California, while fishing under the Hawaii longline limited entry permit. In 2022, two Guadalupe fur seals and one unidentified pinniped were observed.

Most of the pinniped interactions to date have occurred in the fourth quarter in areas east of 130 degrees west. Effort in this quarter has increased since 2012, which likely partially explains the increase in pinniped interactions. However, demographic and oceanographic influences may also be playing a role in the increase in interactions, particularly for Guadalupe fur seals. The rebound of this species from near extinction has resulted in an increase in both the overall number of seals and their spatial extent, as they reoccupy the northern portion of their historic migration range (e.g., D'Agnese et al. 2020). Further, foraging studies have indicated that during anomalous warming events in the northeastern Pacific, such as those that occurred between 2014 and 2016, Guadalupe fur seals expand their foraging areas to the north and offshore (Amador-Capitanachi et al. 2020). These conditions may have also precipitated the Unusual Mortality Event, which has involved the stranding of over 700 predominantly young Guadalupe fur seals along the US West Coast between 2015 and 2021.[5] Although the marine heatwave of 2014-2016 was the largest and longest on record since monitoring began in 1982, the second and third largest events occurred in 2020 and 2019, respectively.[6] The marine heatwave of 2022 was the fourth largest and second longest on record, suggesting a northward and offshore shift in the distribution of Guadalupe fur seals and other pinnipeds as in other anomalously warm years. The occurrence of Guadalupe fur seal interactions in 2022 is thus not surprising, especially combined with the level of fishing effort east of 130 degrees west. In 2021, there was limited fishing effort east of this longitude and no pinniped interactions, even though the marine heatwave of 2021 was the seventh largest on record, suggesting a dynamic relationship between oceanographic conditions and fishing effort is likely driving pinniped interactions in this fishery.

[5] https://www.fisheries.noaa.gov/national/marine-life-distress/2015-2021-guadalupe-fur-seal-unusual-mortality-event-california

[6] https://www.integratedecosystemassessment.noaa.gov/regions/california-current/california-current-marine-heatwave-tracker-blobtracker

Table 56. Observed takes, mortalities (M), and takes per fishing effort (1,000 hooks) for dolphins in the Hawaii shallow-set longline fishery, 2004-2022[a]

Year	Observer Coverage (%)	Sets	Hooks	Bottlenose dolphin		Risso's dolphin		Rough-toothed dolphin		Short-beaked common dolphin		Striped dolphin	
				Takes (M)	Takes/ 1,000 hooks	Takes (M)	Takes/ 1,000 hooks	Takes (M)	Takes/ 1,000 hooks	Takes (M)	Takes/ 1,000 hooks	Takes (M)	Takes/ 1,000 hooks
2004	100	88	76,750	0	0.000	0	0.000	0	0.000	0	0.000	0	0.000
2005	100	1,604	1,328,806	0	0.000	1	0.001	0	0.000	0	0.000	0	0.000
2006	100	939	745,125	1	0.001	2(1)	0.003	0	0.000	0	0.000	0	0.000
2007[b]	100	1,496	1,292,036	3	0.002	3	0.002	0	0.000	0	0.000	0	0.000
2008	100	1,487	1,350,127	0	0.000	4(1)	0.003	0	0.000	0	0.000	1	0.001
2009	100	1,833	1,767,128	0	0.000	3	0.002	0	0.000	0	0.000	0	0.000
2010	100	1,879	1,828,529	2	0.001	7(1)	0.004	0	0.000	0	0.000	2(1)	0.001
2011	100	1,579	1,611,395	2	0.001	4	0.002	0	0.000	1[c]	0.001	0	0.000
2012	100	1,307	1,418,843	1	0.001	0	0.000	0	0.000	0	0.000	1	0.001
2013	100	912	1,000,084	2(1)	0.002	3	0.003	1(1)	0.001	0	0.000	0	0.000
2014	100	1,349	1,509,727	4	0.003	6(2)	0.004	0	0.000	1	0.001	2	0.001
2015	100	1,178	1,286,628	2	0.002	3(2)	0.002	0	0.000	0	0.000	0	0.000
2016	100	778	849,681	1	0.001	2	0.002	0	0.000	0	0.000	1	0.001
2017	100	973	1,051,426	0	0.000	2	0.002	0	0.000	0	0.000	1	0.001
2018	100	476	546,371	1	0.002	2	0.004	0	0.000	0	0.000	0	0.000
2019	100	312	374,487	0	0.000	0	0.000	0	0.000	0	0.000	0	0.000
2020	100	455	588,481	0	0.000	0	0.000	0	0.000	0	0.000	0	0.000
2021	100	763	972,692	0	0.000	0	0.000	0	0.000	0	0.000	0	0.000
2022	100	945	1,219,202	1	0.000	2	0.002	0	0.000	0	0.000	0	0.000

[a] Take data are based on vessel arrival dates.
[b] Due to vessel confidentiality rules, data for the fourth quarter in 2007 are combined with data for 2008. Take data for 2007 reflect those from first, second and third quarters.
[c] Animal is identified as only a common dolphin in the Observer Program Status Report.
Source: 2004-2020 PIRO Observer Program Annual and Quarterly Status Reports, PIRO Sustainable Fisheries Division unpublished data.

Table 57. Observed takes, mortalities (M), and takes per fishing effort (1,000 hooks) for small whales in the Hawaii shallow-set longline fishery, 2004-2022[a]

Year	Obs. Cov. (%)	Sets	Hooks	Blainville's beaked whale		False killer whale		*Kogia* spp.		Pygmy sperm whale		Ginkgo-toothed beaked whale	
				Takes (M)	Takes/ 1,000 hooks	Takes (M)	Takes/ 1,000 hooks	Takes (M)	Takes/ 1,000 hooks	Takes (M)	Takes/ 1,000 hooks	Takes (M)	Takes/ 1,000 hooks
2004	100	88	76,750	0	0.000	0	0.000	0	0.000	0	0.000	0	0.000
2005	100	1,604	1,328,806	0	0.000	0	0.000	0	0.000	0	0.000	0	0.000
2006	100	939	745,125	0	0.000	0	0.000	0	0.000	0	0.000	0	0.000
2007[b]	100	1,496	1,292,036	0	0.000	0	0.000	0	0.000	0	0.000	0	0.000
2008	100	1,487	1,350,127	0	0.000	1	0.001	1	0.001	1	0.001	0	0.000
2009	100	1,833	1,767,128	0	0.000	1	0.001	0	0.000	0	0.000	0	0.000
2010	100	1,879	1,828,529	0	0.000	0	0.000	0	0.000	0	0.000	0	0.000
2011	100	1,579	1,611,395	1	0.001	1	0.001	0	0.000	0	0.000	0	0.000
2012	100	1,307	1,418,843	0	0.000	1	0.001	0	0.000	0	0.000	0	0.000
2013	100	912	1,000,084	0	0.000	0	0.000	0	0.000	0	0.000	0	0.000
2014	100	1,349	1,509,727	0	0.000	1	0.001	0	0.000	0	0.000	0	0.000
2015	100	1,178	1,286,628	0	0.000	0	0.000	0	0.000	0	0.000	1	0.001
2016	100	778	849,681	0	0.000	0	0.000	0	0.000	0	0.000	0	0.000
2017	100	973	1,051,426	0	0.000	0	0.000	0	0.000	0	0.000	0	0.000
2018	100	476	546,371	0	0.000	0	0.000	0	0.000	0	0.000	0	0.000
2019	100	312	374,487	0	0.000	0	0.000	0	0.000	0	0.000	0	0.000
2020	100	455	588,481	0	0.000	1	0.002	0	0.000	0	0.000	0	0.000
2021	100	763	972,692	0	0.000	0	0.000	0	0.000	0	0.000	0	0.000
2022	100	945	1,219,202	0	0.000	0	0.000	0	0.000	0	0.000	0	0.000

[a] Take data are based on vessel arrival dates.

[b] Due to vessel confidentiality rules, data for the fourth quarter in 2007 are combined with data for 2008. Take data for 2007 reflect those from first, second and third quarters.

Source: 2004-2020 PIRO Observer Program Annual and Quarterly Status Reports; PIRO Sustainable Fisheries Division unpublished data.

Table 58. Observed takes, mortalities (M), and takes per fishing effort (1,000 hooks) for large whales in the Hawaii shallow-set longline fishery, 2004-2022[a]

Year	Observer Coverage (%)	Sets	Hooks	Bryde's whale		Humpback whale		Fin whale	
				Takes (M)	Takes/1,000 hooks	Takes (M)	Takes/1,000 hooks	Takes (M)	Takes/1,000 hooks
2004	100	88	76,750	0	0.000	0	0.000	0	0.000
2005	100	1,604	1,328,806	1	0.001	0	0.000	0	0.000
2006	100	939	745,125	0	0.000	1	0.001	0	0.000
2007[b]	100	1,496	1,292,036	0	0.000	0	0.000	0	0.000
2008	100	1,487	1,350,127	0	0.000	1	0.001	0	0.000
2009	100	1,833	1,767,128	0	0.000	0	0.000	0	0.000
2010	100	1,879	1,828,529	0	0.000	0	0.000	0	0.000
2011	100	1,579	1,611,395	0	0.000	1	0.001	0	0.000
2012	100	1,307	1,418,843	0	0.000	0	0.000	0	0.000
2013	100	912	1,000,084	0	0.000	0	0.000	0	0.000
2014	100	1,349	1,509,727	0	0.000	0	0.000	0	0.000
2015	100	1,178	1,286,628	0	0.000	1	0.001	1	0.001
2016	100	778	849,681	0	0.000	0	0.000	0	0.000
2017	100	973	1,051,426	0	0.000	0	0.000	0	0.000
2018	100	476	546,371	0	0.000	0	0.000	0	0.000
2019	100	312	374,487	0	0.000	0	0.000	0	0.000
2020	100	455	588,481	0	0.000	0	0.000	0	0.000
2021	100	763	972,692	0	0.000	0	0.000	0	0.000
2022	100	945	1,219,202	0	0.000	0	0.000	0	0.000

[a] Take data are based on vessel arrival dates.
[b] Due to vessel confidentiality rules, data for the fourth quarter in 2007 are combined with data for 2008. Take data for 2007 reflect those from first, second and third quarters.
Source: 2004-2020 PIRO Observer Program Annual and Quarterly Status Reports; PIRO Sustainable Fisheries Division unpublished data.

Table 59. Observed takes, mortalities (M), and takes per fishing effort (1,000 hooks) for unidentified dolphins, beaked whales, whales, and cetaceans in the Hawaii shallow-set longline fishery, 2004-2022[a]

Year	Obs. Cov. (%)	Sets	Hooks	Unidentified dolphin[b]		Unidentified beaked whale		Unidentified whale[b]		Unidentified cetacean[b]	
				Takes (M)	Takes/ 1,000 hooks	Takes (M)	Takes/ 1,000 hooks	Takes (M)	Takes/ 1,000 hooks	Takes (M)	Takes/ 1,000 hooks
2004	100	88	76,750	0	0.000	0	0.000	0	0.000	0	0.000
2005	100	1,604	1,328,806	0	0.000	0	0.000	1	0.001	0	0.000
2006	100	939	745,125	0	0.000	0	0.000	0	0.000	0	0.000
2007[c]	100	1,496	1,292,036	0	0.000	0	0.000	0	0.000	0	0.000
2008	100	1,487	1,350,127	0	0.000	0	0.000	1	0.001	0	0.000
2009	100	1,833	1,767,128	0	0.000	0	0.000	1	0.001	0	0.000
2010	100	1,879	1,828,529	1	0.001	0	0.000	0	0.000	0	0.000
2011	100	1,579	1,611,395	0	0.000	1	0.001	0	0.000	2	0.001
2012	100	1,307	1,418,843	0	0.000	0	0.000	0	0.000	1	0.001
2013	100	912	1,000,084	0	0.000	2	0.002	0	0.000	0	0.000
2014	100	1,349	1,509,727	0	0.000	0	0.000	0	0.000	0	0.000
2015	100	1,178	1,286,628	0	0.000	0	0.000	0	0.000	0	0.000
2016	100	778	849,681	0	0.000	0	0.000	0	0.000	0	0.000
2017	100	973	1,051,426	0	0.000	0	0.000	0	0.000	0	0.000
2018	100	476	546,371	0	0.000	0	0.000	0	0.000	0	0.000
2019	100	312	374,487	0	0.000	0	0.000	0	0.000	0	0.000
2020	100	455	588,481	0	0.000	0	0.000	0	0.000	0	0.000
2021	100	763	972,692	0	0.000	1	0.001	0	0.000	0	0.000
2022	100	945	1,219,202	0	0.000	1	0.001	0	0.000	0	0.000

[a] Take data are based on vessel arrival dates.
[b] Unidentified species identification based on PIRO Observer Program classifications. Unidentified cetacean refers to a marine mammal not including pinnipeds (seal or sea lion); unidentified whale refers to a large whale; unidentified dolphin refers to a small cetacean with a visible beak; and unidentified beaked whale refers to an animal in the Ziphiidae family. Further classifications based on observer description, sketches, photos, and videos may be available from the PIFSC.
[c] Due to vessel confidentiality rules, data for the fourth quarter in 2007 are combined with data for 2008. Take data for 2007 reflect those from first, second and third quarters.

Source: 2004-2020 PIRO Observer Program Annual and Quarterly Status Reports; PIRO Sustainable Fisheries Division unpublished data.

Table 60. Observed takes, mortalities (M), and takes per fishing effort (1,000 hooks) for pinnipeds in the Hawaii shallow-set longline fishery, 2004-2022[a]

Year	Obs. Cov. (%)	Sets	Hooks	Northern elephant seal		Guadalupe fur seal		Unidentified pinniped		Unidentified sea lion		Unidentified seal		Unidentified fur seal	
				Takes (M)	Takes/ 1,000 hooks	Takes (M)	Takes/ 1,000 hooks	Takes (M)	Takes/ 1,000 hooks	Takes (M)	Takes/ 1,000 hooks	Takes (M)	Takes/ 1,000 hooks	Takes (M)	Takes/ 1,000 hooks
2004	100	88	76,750	0	0.000	0	0.000	0	0.000	0	0.000	0	0.000	0	0.000
2005	100	1,604	1,328,806	0	0.000	0	0.000	0	0.000	0	0.000	0	0.000	0	0.000
2006	100	939	745,125	0	0.000	0	0.000	0	0.000	0	0.000	0	0.000	0	0.000
2007[b]	100	1,496	1,292,036	0	0.000	0	0.000	0	0.000	0	0.000	0	0.000	0	0.000
2008	100	1,487	1,350,127	0	0.000	0	0.000	0	0.000	0	0.000	0	0.000	0	0.000
2009	100	1,833	1,767,128	0	0.000	0	0.000	0	0.000	0	0.000	0	0.000	0	0.000
2010	100	1,879	1,828,529	0	0.000	0	0.000	0	0.000	0	0.000	0	0.000	0	0.000
2011	100	1,579	1,611,395	0	0.000	0	0.000	0	0.000	0	0.000	0	0.000	0	0.000
2012	100	1,307	1,418,843	0	0.000	0	0.000	0	0.000	0	0.000	0	0.000	0	0.000
2013	100	912	1,000,084	1	0.001	0	0.000	0	0.000	0	0.000	0	0.000	0	0.000
2014	100	1,349	1,509,727	1	0.001	0	0.000	0	0.000	1	0.001	0	0.000	0	0.000
2015	100	1,178	1,286,628	0	0.000	0	0.000	3[c]	0.002	2[c]	0.002	0	0.000	0	0.000
2016	100	778	849,681	0	0.000	1	0.001	0	0.000	0	0.000	0	0.000	0	0.000
2017	100	973	1,051,426	0	0.000	3[c]	0.003	0	0.000	0	0.000	0	0.000	0	0.000
2018	100	476	446,371	0	0.000	0	0.000	0	0.000	0	0.000	0	0.000	0	0.000
2019	100	312	374,487	0	0.000	0	0.000	0	0.000	0	0.000	1	0.003	0	0.000
2020	100	455	588,481	0	0.000	7	0.012	0	0.000	0	0.000	0	0.000	2	0.003
2021	100	763	972,692	0	0.000	0	0.000	0	0.000	0	0.000	0	0.000	0	0.000
2022	100	945	1,219,202	0	0.000	2(1)	0.002	1	0.001	0	0.000	0	0.000	0	0.000

[a] Take data are based on vessel arrival dates.
[b] Due to vessel confidentiality rules, data for the fourth quarter in 2007 are combined with data for 2008. Take data for 2007 reflect those from first, second and third quarters.
[c] The interactions with these pinnipeds and sea lions occurred off the California coast, outside the EEZ, while fishing under the Hawaii Longline Permit.
Source: 2004-2020 PIRO Observer Program Annual and Quarterly Status Reports; PIRO Sustainable Fisheries Division unpublished data.

3.3.1.4.1 Comparison of Interactions with ITS

The 2019 Biological Opinion includes a 1-year ITS of 11 interactions and 9 mortalities with the Guadalupe fur seal. NMFS will monitor the ITSs for the Hawaii shallow-set longline fishery annually starting in January 2020 to track incidental take. NMFS uses the date of the interaction for tracking pinniped interactions against the ITS (Table 61) regardless of when the vessel returns to port. Prior to 2021, NMFS counted interactions based on vessel arrival dates in the PIRO Observer Program Quarterly and Annual Reports. For this reason, the number of annual interactions counted against an ITS may vary from those reported on the Observer Program's quarterly and annual reports. For the purpose of ITS tracking, NMFS uses the mortality rate estimate of 0.80 from the 2019 Biological Opinion to estimate the Guadalupe fur seal mortalities.

Table 61. Observed interactions and estimated total mortalities (M) of Guadalupe fur seals in the Hawaii shallow-set longline fishery compared to the 1-year ITS in the 2019 Biological Opinion[a]

Species	1-year ITS Interactions (M)	Interactions (M)		
		2020	2021	2022
Guadalupe fur seal	11(9)	7(6)	0(0)	2(2)
Unidentified fur seal[b]	N/A	2(2)	0(0)	0(0)
Unidentified pinniped	N/A	0(0)	0(0)	1(1)

[a] Takes are counted based on interaction date.
[b] Unidentified fur seal interactions are also tracked as the ITS was based on interaction data that included unidentified pinniped species that may have been Guadalupe fur seals.

3.3.1.4.2 Comparison of Interactions with PBR under the MMPA

Marine mammal takes against the PBR are monitored through the SARs. A summary of the current mean annual M&SI and the PBR for stocks relevant to the Hawaii shallow-set longline fishery is presented in Table 62. The PBR of a stock reflects only marine mammals of that stock observed within the EEZ around Hawaii, with the exception of the Central North Pacific stock of humpback whales for which PBR applies to the entire stock. The mean annual M&SI specified in the SARs includes only interactions determined as mortalities and serious injuries; it does not include interactions classified as non-serious injuries.

For marine mammal stocks where the PBR is available, the mean annual M&SI for the shallow-set longline fishery inside the EEZ around Hawaii is well below the corresponding PBR in the time period covered by the current SAR (Table 62).

Table 62. Summary of mean annual mortality and serious injury (M&SI) and potential biological removal (PBR) by marine mammal stocks with observed interactions in the Hawaii shallow-set longline fishery

Stock	Years Included in 2021 SARs	Outside EEZ[a]	Inside EEZ	
		Mean Annual M&SI	Mean Annual M&SI	PBR (Inside EEZ only)[c]
Bottlenose dolphin, HI Pelagic	2014-2018	2	0	undetermined
Risso's dolphin, HI	2014-2018	2.8	0	61
Rough-toothed dolphin, HI	2014-2018	0	0	548
Striped dolphin, HI	2014-2018	0.5	0	291
Blainville's beaked whale, HI	2014-2018	0	0	5.6
False killer whale, HI Pelagic	2015-2019	0.0	0	16
Short-finned pilot whale, HI	2014-2018	0	0	87
Kogia spp. whale (Pygmy or dwarf sperm whale), HI	2014-2018	Pygmy = 0 Dwarf = 0	Pygmy = 0 Dwarf = 0	Pygmy = 257 Dwarf = undetermined
Humpback whale, Central North Pacific	2014-2018	0		83[b]
Fin whale, HI	2014-2018	0	0	0.2
Guadalupe fur seal, CA	2013-2017	0.4		1,062[b]

[a] PBR estimates are not available for portions of the stock outside of the U.S EEZ around Hawaii, except for the Central North Pacific stock of humpback whales for which PBR applies to the entire stock.

[b] PBR and M&SI for the Central North Pacific stock for humpback whales and Guadalupe fur sealsapply to the entire stock.
[c] PBR estimates for Hawaii stocks are only available for portions of the stock within the U.S. EEZ around Hawaii.
Source: Final 2021 Marine Mammal SARs.

3.3.1.5 SEABIRD INTERACTIONS IN THE HAWAII SHALLOW-SET LONGLINE FISHERY

Table 63 summarizes the incidental take data of seabirds from 2004 to 2022 in the Hawaii shallow-set longline fishery. Since there is full observer coverage for this fishery, the interactions in Table 63 represent fishery-wide totals.

Interaction data provided here may vary slightly from other sources depending on how interactions were reported (date of trip departure or arrival, set date, or haul date in any given year). The incidental take data in this section were compiled from the PIRO Observer Program Annual Status Reports and are for monitoring purposes. Many of these interactions have been further examined by NMFS, and updated information necessary for any data analyses is available from NMFS.

NMFS annually publishes the report Seabird Interactions and Mitigation Efforts in Hawaii Longline Fisheries (Seabird Annual Report), which includes verified numbers of seabird interactions and information on fishing regulations and effort, interaction rates, and band recovery data for seabirds caught in the shallow-set and deep-set fisheries. Recent reports are available at: https://www.fisheries.noaa.gov/pacific-islands/bycatch/seabird-interactions-pelagic-longline-fishery.

The majority of observed interactions and all mortalities during this time period involved Laysan albatrosses and black-footed albatrosses. The fishery has also had a small number of interactions with shearwaters and a northern fulmar, all of which were released injured, and one interaction with an unidentified gull that was released dead. NMFS identified the shearwaters as sooty shearwaters (NMFS 2016). There have been no observed takes of short-tailed albatrosses by this fishery.

Table 63 shows an increase in takes of black-footed albatrosses 2008 through 2017. Black-footed albatross takes from 2018 to 2020 were lower, which may be explained by temporal patterns in interactions. In typical years, the majority of black-footed albatross interactions occur in the second quarter (April-June), but there was lower than average or no fishing effort in that quarter in 2018 through 2020. The shallow-set longline fishery was closed May-December 2018 and March-December 2019 and had limited effort in the second quarter in 2020 due to the COVID-19 pandemic. Laysan albatross interactions were also low in 2017-2018. Interaction rate data for 2018-2020 are therefore not directly comparable to other years in which the fishery operated throughout the year. In 2022, black-footed albatross interactions returned to expected levels with the fishery operating year-round, and had higher number of interactions than 2017. Laysan albatross interactions have been relatively more stable.

In the process of developing a regulatory amendment to modify seabird mitigation measures in the Hawaii deep-set longline fishery (see Section 3.3.2.5), the Council at the 185th meeting in March 2021 considered options for modifying the shallow-set longline fishery seabird mitigation measures. Based on input from its advisory bodies and industry representatives and because conditions differ in the shallow-set longline fishery as compared to the deep-set longline fishery, the Council recommended additional research under an Experimental Fishing Permit (EFP) and development of an appropriate combination of mitigation measures for the shallow-set longline fishery. The Council placed high priority on identifying a combination of mitigation measures that maintain effectiveness of seabird deterrence during dusk compared to the existing night-setting suite of measures, to provide operational flexibility in starting the setting operations before sunset.

NMFS received an EFP application from the Hawaii Longline Association in November 2021 to conduct a pilot study of tori lines with gear setting starting at dusk, and the Council at its 189th meeting in December 2021 recommended the issuance of the EFP. NMFS issued the EFP on March 24, 2022, and the study was initiated in 2022.

3.3.1.5.1 Comparison of Interactions with ITS

The short-tailed albatross ITS in the USFWS 2012 Biological Opinion for the Hawaii longline fishery is 1 incidental take every 5 years in the shallow-set fishery. Exceeding this number will lead to reinitiating consultation of the impact of this fishery on the species. Since there have been no observed takes of short-tailed albatrosses in the fishery, the ITS has not been exceeded as of the end of 2022.

Table 63. Observed takes, mortalities (M), and takes per fishing effort (1,000 hooks) for seabirds in the Hawaii shallow-set longline fishery, 2004-2022[a]

Year	Obs. Cov. (%)	Sets	Hooks	Laysan Albatross		Black-footed Albatross		Northern fulmar		Unidentified shearwater		Unidentified gull		Short-tailed Albatross
				Takes (M)	Takes/ 1,000 hooks	Takes (M)	Takes/ 1,000 hooks	Takes (M)	Takes/ 1,000 hooks	Takes (M)	Takes/ 1,000 hooks	Takes (M)	Takes/ 1,000 hooks	Takes (M)
2004	100	88	76,750	1	0.013	0	0.000	0	0.000	0	0.000	0	0.000	0
2005	100	1,604	1,328,806	62(18)	0.047	7(4)	0.005	0	0.000	0	0.000	0	0.000	0
2006	100	939	745,125	8(3)	0.011	3(3)	0.004	0	0.000	0	0.000	0	0.000	0
2007[b]	100	1,496	1,292,036	39(6)	0.030	8(2)	0.006	0	0.000	0	0.000	0	0.000	0
2008	100	1,487	1,350,127	33(11)	0.024	6(4)	0.004	0	0.000	0	0.000	0	0.000	0
2009	100	1,833	1,767,128	81(17)	0.046	29(7)	0.016	0	0.000	1[c]	0.001	0	0.000	0
2010	100	1,879	1,828,529	40(7)	0.022	39(11)	0.021	1	0.001	0	0.000	0	0.000	0
2011	100	1,579	1,611,395	49(10)	0.030	19(5)	0.012	0	0.000	0	0.000	0	0.000	0
2012	100	1,307	1,418,843	61(11)	0.043	37(10)	0.026	0	0.000	0	0.000	0	0.000	0
2013	100	912	1,000,084	46(10)	0.046	28(17)	0.028	0	0.000	2[c]	0.002	0	0.000	0
2014	100	1,349	1,509,727	36(2)	0.024	29(14)	0.019	0	0.000	1[c]	0.001	0	0.000	0
2015	100	1,178	1,286,628	45(6)	0.035	41(10)	0.032	0	0.000	0	0.000	0	0.000	0
2016	100	778	849,681	26(3)	0.031	40(12)	0.047	0	0.000	0	0.000	0	0.000	0
2017	100	973	1,051,426	6(1)	0.007	51(20)	0.049	0	0.000	0	0.000	1	0.001	0
2018	100	476	546,371	2	0.004	9(2)	0.017	0	0.000	0	0.000	0	0.000	0
2019	100	312	374,487	15(3)	0.040	19(5)	0.051	0	0.000	0	0.000	0	0.000	0
2020	100	455	588,481	26(0)	0.044	5(0)	0.009	1	0.001	0	0.000	0	0.000	0
2021	100	763	972,692	10(1)	0.010	45(11)	0.046	0	0.000	0	0.000	0	0.000	0
2022	100	945	1,219,202	36(5)	0.030	69(20)	0.057	0	0.000	0	0.000	0	0.000	0

[a] Take data are based on vessel arrival dates.
[b] Due to vessel confidentiality rules, data for the fourth quarter in 2007 are combined with data for 2008. Take data for 2007 reflect those from first, second and third quarters.
[c] These birds were later identified as sooty shearwaters in the NMFS Seabird Annual Report.
Source: 2004-2020 PIRO Observer Program Annual and Quarterly Status Reports; PIRO Sustainable Fisheries Division unpublished data.

3.3.1.6 ELASMOBRANCH INTERACTIONS IN THE HAWAII SHALLOW-SET LONGLINE FISHERY

Oceanic whitetip sharks constitute the majority of the interactions. Observed oceanic whitetip shark interactions were substantially lower in 2004, 2006, 2018, and 2019 likely due to fishery closures. Spatial distribution of shallow-set fishing effort primarily overlaps with oceanic whitetip shark distribution (south of 30°N) in the summer months (May-June). Most of the oceanic whitetip sharks that are caught in the shallow-set fishery are released alive. Interactions in 2022 were the highest observed since 2011. Although it is premature to derive any theories on the factors driving the higher interaction rates, one possibility is the potential for increased spatial overlap of oceanic whitetip habitat with fishing effort due to warming oceans. Higher interaction rates may also be the result of potential increases in population density in the region because of international management measures prohibiting retention of the species through IATTC since 2011 and WCPFC since 2013 (WCPFC measure implemented under U.S. regulations in 2015), but these require further investigation.

Giant manta ray interactions with this fishery are rare. There were no observed interactions with scalloped hammerheads in the shallow-set fishery since 2004. Furthermore, there have been no recorded or observed take of scalloped hammerhead sharks in the range of the Eastern Pacific DPS in the shallow-set fishery. Based on the known range and likely occurrence for the Eastern Pacific DPS, it is unlikely that these sharks occur in the area where shallow-set fishing occurs.

Table 64 summarizes the incidental take data of ESA-listed elasmobranchs from 2004 to 2022 in the Hawaii shallow-set longline fishery.

Oceanic whitetip sharks constitute the majority of the interactions. Observed oceanic whitetip shark interactions were substantially lower in 2004, 2006, 2018, and 2019 likely due to fishery closures. Spatial distribution of shallow-set fishing effort primarily overlaps with oceanic whitetip shark distribution (south of 30°N) in the summer months (May-June). Most of the oceanic whitetip sharks that are caught in the shallow-set fishery are released alive. Interactions in 2022 were the highest observed since 2011. Although it is premature to derive any theories on the factors driving the higher interaction rates, one possibility is the potential for increased spatial overlap of oceanic whitetip habitat with fishing effort due to warming oceans. Higher interaction rates may also be the result of potential increases in population density in the region because of international management measures prohibiting retention of the species through IATTC since 2011 and WCPFC since 2013 (WCPFC measure implemented under U.S. regulations in 2015), but these require further investigation.

Giant manta ray interactions with this fishery are rare. There were no observed interactions with scalloped hammerheads in the shallow-set fishery since 2004. Furthermore, there have been no recorded or observed take of scalloped hammerhead sharks in the range of the Eastern Pacific DPS in the shallow-set fishery. Based on the known range and likely occurrence for the Eastern Pacific DPS, it is unlikely that these sharks occur in the area where shallow-set fishing occurs.

Table 64. Observed and estimated interactions with elasmobranchs in the Hawaii shallow-set longline fishery, 2004-2022[a]

Year	Obs. Cov. (%)	Sets	Hooks	Scalloped hammerhead shark		Oceanic whitetip shark		Giant manta ray	
				Takes (M[b])	Takes/ 1,000 hooks	Takes (M[b])	Takes/ 1,000 hooks	Takes (M)	Takes/ 1,000 hooks
2004	100	88	76,750	0	0.0000	3	0.0391	0	0.0000
2005	100	1,604	1,328,806	0	0.0000	348(32)	0.2619	0	0.0000
2006	100	939	745,125	0	0.0000	1	0.0013	0	0.0000
2007	100	1,496	1,292,036	0	0.0000	98(7)	0.0758	5(2)	0.0039
2008	100	1,487	1,350,127	0	0.0000	47(8)	0.0348	0	0.0000
2009	100	1,833	1,767,128	0	0.0000	54(14)	0.0306	0	0.0000
2010	100	1,879	1,828,529	0	0.0000	90(17)	0.0492	6	0.0027
2011	100	1,579	1,611,395	0	0.0000	78(9)	0.0484	3(2)	0.0031
2012	100	1,307	1,418,843	0	0.0000	24(2)	0.0169	0	0.0000
2013	100	912	1,000,084	0	0.0000	27(2)	0.0270	0	0.0000
2014	100	1,349	1,509,727	0	0.0000	21(3)	0.0139	1	0.0033
2015	100	1,178	1,286,628	0	0.0000	22(2)	0.0171	0	0.0000
2016	100	778	849,681	0	0.0000	32(3)	0.0377	0	0.0000
2017	100	973	1,051,426	0	0.0000	29(1)	0.0276	2	0.0048
2018	100	476	546,371	0	0.0000	1	0.0018	0	0.0000
2019	100	312	374,487	0	0.0000	0	0.0000	0	0.0000
2020	100	455	588,481	0	0.0000	13(1)	0.0221	0	0.0000
2021	100	763	972,692	0	0.0000	45(6)	0.0463	0	0.0000
2022	100	945	1,219,202	0	0.0000	54(7)	0.0443	3	0.0025

[a] Take data are based on vessel arrival dates.
[b] Mortality numbers include sharks that were released dead or retained (prior to applicable prohibition on retention).
Source: PIRO Sustainable Fisheries Division unpublished data.

3.3.1.6.1 Comparison of Interactions with ITS

An ITS is not required to provide protective coverage for oceanic whitetip sharks and giant manta rays because there are no take prohibitions under ESA section 4(d) for these species. However, the 2019 Biological Opinion includes 1-year ITSs for oceanic whitetip sharks and giant manta rays to serve as a check on the no-jeopardy conclusion by providing a reinitiation trigger if the level of take analyzed in the Biological Opinion is exceeded.

NMFS will monitor the ITSs for the Hawaii shallow-set longline fishery annually starting in January 2020 to track incidental take. NMFS uses the date of the interaction (begin haul date) for tracking elasmobranch interactions against the ITS (Table 65) regardless of when the vessel returns to port. Prior to 2021, NMFS counted sea turtle interactions based on vessel arrival dates the PIRO Observer Program Quarterly and Annual Reports. For this reason, the number of annual interactions counted against an ITS may vary from those reported on the Observer Program's quarterly and annual reports. For the purpose of ITS tracking, NMFS uses the mortality rate estimates of 0.19 for oceanic whitetip sharks and 0.41 for large rays from the 2019 Biological Opinion to estimate mortalities.

Table 65. Observed interactions and estimated total mortalities (M) of oceanic whitetip shark and giant manta ray in the Hawaii shallow-set longline fishery compared to the 1-year ITS in the 2019 Biological Opinion[a]

Species	1-year ITS Interactions (M)	Interactions (M[c])		
		2020	2021	2022
Oceanic whitetip shark	102(32)	13 (5)	45(13)	54(16)
Giant manta ray	13(4)	0(0)	0(0)	3(1)
Manta/Mobula[b]		1(0)	4(2)	0

[a] Takes are counted based on begin haul date.
[b] Manta/mobula interactions are also tracked as the ITS for giant manta ray was based on interaction data that included rays classified as manta/mobula in the observer record that may have been giant manta rays.
[c] Mortality rates are from the 2019 Biological Opinion and are based on 2004-2018 interaction data.

3.3.2 HAWAII DEEP-SET LONGLINE FISHERY

3.3.2.1 INDICATORS FOR MONITORING PROTECTED SPECIES INTERACTIONS AND EFFECTIVENESS OF MANAGEMENT MEASURES IN THE HAWAII DEEP-SET LONGLINE FISHERY

In this annual report, the Council monitors protected species interactions in the Hawaii deep-set longline fishery using the following indicators:

- General interaction trends over time
- Effectiveness of FEP conservation measures
- Take levels compared to the incidental take statement levels under ESA
- Take levels compared to marine mammal PBRs, where applicable

3.3.2.1.1 Conservation Measures

The Pelagic FEP includes a number of conservation measures to mitigate seabird and sea turtle interactions in the deep-set longline fishery. These measures include the following:

- Longline vessel owners/operators are required to adhere to regulations for safe handling and release of sea turtles and seabirds.
- Longline vessel owners/operators must have on board the vessel all required turtle handling/dehooking gear specified in regulations.
- Longline vessel owners/operators are required to remove trailing gear from oceanic whitetip sharks and cut the line as close to the hook as possible.
- Deep-set fishing operations north of 23º N latitude are required to comply with seabird mitigation regulations, which include choosing between side-setting or stern-setting longline gear with additional regulatory specifications (e.g., blue-dyed bait, weighted branch lines, strategic offal discards, using a “bird curtain”).
- Vessel owners and operators are required to annually attend a protected species workshop.
- When deep-set longline fishing, the use of wire leaders is prohibited.

The following regulatory amendment to the Pelagic FEP that affect conservation measures for the Hawaii deep-set longline fishery is undergoing rulemaking and was not implemented during the 2022 calendar year:

- Replace blue-dyed thawed bait and strategic offal discharge measures required for stern-setting deep-set longline vessels with a new tori line requirement (Council final action in December 2021; see Section 3.3.2.5) of this report for more information.

3.3.2.1.2 ESA Consultations

During 2022, the Hawaii deep-set longline fishery was covered under a NMFS Biological Opinion dated September 19, 2014 (NMFS 2014) and associated supplements. NMFS concluded in the 2014 Biological Opinion that the fishery is not likely to jeopardize four sea turtle species (North Pacific DPS loggerhead, leatherback, olive ridley and green turtles), three marine mammal species (humpback whale, sperm whale and MHI insular DPS false killer whale) and the Indo-West Pacific DPS of scalloped hammerhead sharks, and not likely to adversely affect hawksbill turtles, four marine mammal species (blue, North Pacific right and sei whale, and Hawaiian monk seal) and the Eastern Pacific DPS of scalloped hammerhead sharks (Oceanic whitetip sharks constitute the majority of the interactions. Observed oceanic whitetip shark interactions were substantially lower in 2004, 2006, 2018, and 2019 likely due to fishery closures. Spatial distribution of shallow-set fishing effort primarily overlaps with oceanic whitetip shark distribution (south of 30°N) in the summer months (May-June). Most of the oceanic whitetip sharks that are caught in the shallow-set fishery are released alive. Interactions in 2022 were the highest observed since 2011. Although it is premature to derive any theories on the factors driving the higher interaction rates, one possibility is the potential for increased spatial overlap of oceanic whitetip habitat with fishing effort due to warming oceans. Higher interaction rates may also be the result of potential increases in population density in the region because of international management measures prohibiting retention of the species through IATTC since 2011 and WCPFC since 2013 (WCPFC measure implemented under U.S. regulations in 2015), but these require further investigation.

Giant manta ray interactions with this fishery are rare. There were no observed interactions with scalloped hammerheads in the shallow-set fishery since 2004. Furthermore, there have been no recorded or observed take of scalloped hammerhead sharks in the range of the Eastern Pacific DPS in the shallow-set fishery. Based on the known range and likely occurrence for the Eastern Pacific DPS, it is unlikely that these sharks occur in the area where shallow-set fishing occurs.

Table 64). The humpback whale Hawaii DPS was delisted under the ESA in 2016, so interactions are no longer monitored against the ITS. A USFWS Biological Opinion dated January 6, 2012, also concluded that the fishery is not likely to jeopardize short-tailed albatrosses (USFWS 2012). An additional informal consultation dated September 16, 2015 concluded that the fishery is not likely to adversely affect fin whales or Hawaiian monk seal critical habitat. In 2017, NMFS completed a Supplement to the 2014 Biological Opinion for green, loggerhead, and olive ridley sea turtles due to exceedance of the ITS for these three species (NMFS 2017).

NMFS and USFWS have issued ITSs for species included in the Biological Opinions and determined not to jeopardize the species (Table 67). Exceedance of the 3-year or 5-year ITSs requires reinitiation of consultation on the fishery under the ESA. The ITSs for green turtle and loggerhead turtles were exceeded in 2015 and the ITS for olive ridley turtles was exceeded during the first quarter of 2016, and reconsultation was completed on March 24, 2017.

On October 4, 2018, NMFS reinitiated ESA Section 7 consultation for the deep-set fishery for all ESA-listed species under NMFS jurisdiction occurring in the action area due to three re-initiation triggers: listing of the oceanic whitetip shark and giant manta ray; designation of MHI insular false killer whale critical habitat; and exceeding the ITS for East Pacific green sea turtle DPS in mid-2018. On October 4, 2018, NMFS determined that the conduct of the fishery during the period of consultation will not violate ESA Sections 7(a)(2) and 7(d) (updated April 15, 2020, December 18, 2020, November 17, 2021, and January 11, 2023).

On September 28, 2022, NMFS issued a Supplemental Biological Opinion to the 2014 Biological Opinion for the two new listed species, and concluded that the deep-set fishery is not likely to jeopardize the continued existence of the oceanic whitetip shark and giant manta ray.

On May 18, 2023, NMFS issued a Biological Opinion covering all applicable ESA-listed species, which concluded that the fishery is not likely to jeopardize the following species: giant manta ray; Indo-West Pacific scalloped hammerhead shark; oceanic whitetip shark; Central North Pacific, East Indian-West Pacific, East Pacific, Southwest Pacific, Central West Pacific and Central South Pacific green sea turtles; leatherback sea turtles; North Pacific loggerhead sea turtles; olive ridley sea turtles, sperm whale, and main Hawaiian Islands insular false killer whale. The new ITSs took effect when the new Biological Opinion was signed, thus did not apply in 2022.

Table 66. Summary of ESA consultations for the Hawaii deep-set longline fishery

Species	Consultation Date	Consultation Type[a]	Outcome[b]
Loggerhead turtle, North Pacific DPS	2017-03-24	BiOp[c]	LAA, non-jeopardy
Leatherback turtle	2014-09-19	BiOp	LAA, non-jeopardy
Olive ridley turtle, Endangered Mexico and threatened eastern Pacific populations	2017-03-24	BiOp[c]	LAA, non-jeopardy
Olive ridley turtle, Threatened western Pacific population	2017-03-24	BiOp[c]	LAA, non-jeopardy
Green turtle, East Pacific DPS	2017-03-24	BiOp[c]	LAA, non-jeopardy
Green turtle, Central North Pacific DPS	2017-03-24	BiOp[c]	LAA, non-jeopardy
Green turtle, East Indian-West Pacific DPS	2017-03-24	BiOp[c]	LAA, non-jeopardy
Green turtle, Southwest Pacific DPS	2017-03-24	BiOp[c]	LAA, non-jeopardy
Green turtle, Central West Pacific DPS	2017-03-24	BiOp[c]	LAA, non-jeopardy
Green turtle, Central South Pacific DPS	2017-03-24	BiOp[c]	LAA, non-jeopardy
Hawksbill turtle	2014-09-19	BiOp	NLAA
False killer whale, MHI insular DPS	2014-09-19	BiOp	LAA, non-jeopardy
Fin whale	2015-09-16	LOC	NLAA
Blue whale	2014-09-19	BiOp	NLAA
North Pacific right whale	2014-09-19	BiOp	NLAA
Sei whale	2014-09-19	BiOp	NLAA

Species	Consultation Date	Consultation Type[a]	Outcome[b]
Sperm whale	2014-09-19	BiOp	LAA, non-jeopardy
Hawaiian monk seal	2014-09-19	BiOp	NLAA
Scalloped hammerhead shark, Eastern Pacific DPS	2014-09-19	BiOp	NLAA
Scalloped hammerhead shark, Indo-West Pacific DPS	2014-09-19	BiOp	LAA, non-jeopardy
Oceanic whitetip shark	2022-09-28	BiOpc	LAA, non-jeopardy
Giant manta ray	2022-09-28	BiOpc	LAA, non-jeopardy
Short-tailed albatross	2012-01-06	BiOp (FWS)	LAA, non-jeopardy
Critical Habitat: Hawaiian monk seal	2015-09-16	LOC	NLAA

[a] BiOp = Biological Opinion; LOC = Letter of Concurrence.
[b] LAA = likely to adversely affect; NLAA = not likely to adversely affect.
[c] Supplement to the 2014 BiOp.

Table 67. Summary of ITSs for the Hawaii deep-set longline fishery

Species	ITS Time Period	Takes	Mortalities	Source BiOp
Loggerhead turtle, North Pacific DPS	3-year	18	13	NMFS 2017
Leatherback turtle	3-year	72	27	NMFS 2014
Olive ridley turtle, Endangered Mexico and threatened eastern Pacific populations	3-year	144	134	NMFS 2017
Olive ridley turtle, Threatened western pacific population	3-year	42	40	NMFS 2017
Green turtle, East Pacific DPS	3-year	12	12	NMFS 2017
Green turtle, Central North Pacific DPS	3-year	6	6	NMFS 2017
Green turtle, East Indian-West Pacific DPS	3-year	6	6	NMFS 2017
Green turtle, Southwest Pacific DPS	3-year	6	6	NMFS 2017
Green turtle, Central West Pacific DPS	3-year	3	3	NMFS 2017
Green turtle, Central South Pacific DPS	3-year	3	3	NMFS 2017
Sperm whale	3-year	9	6	NMFS 2014
False killer whale (MHI insular DPS)	3-year	1	0.74	NMFS 2014
Scalloped hammerhead shark (Indo-West Pacific DPS)[a]	3-year	6	3	NMFS 2014
Oceanic whitetip sharka	5-year running sum	6,336		NMFS 2022
Giant manta raya	5-year running sum	144		NMFS 2022
Short-tailed albatross	5-year	2 injuries or deaths		USFWS 2012

[a] An ITS is not required for the Indo-West Pacific DPS of scalloped hammerhead sharks due to the lack of take prohibition under ESA section 4(d), but NMFS included an ITS to serve as a check on the no-jeopardy conclusion by providing a reinitiation trigger.

3.3.2.1.3 Non-ESA Marine Mammals

Fishery impacts to marine mammal stocks are primarily assessed and monitored through the SARs prepared pursuant to the MMPA. The SARs include detailed information on these species' geographic range, abundance, PBR estimates, bycatch estimates, and status. The most recent SARs are available online at: https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-stock-assessment-reports-region.

The Hawaii deep-set longline fishery is a Category I fishery under the MMPA 2023 LOF (88 FR 16899, March 21, 2023), meaning that NMFS has determined that this fishery has frequent incidental mortality and serious injuries of marine mammals. The 2023 LOF lists the following marine mammal stocks that are incidentally killed or injured in this fishery:[7]

- Bottlenose dolphin, HI Pelagic stock
- False killer whale, MHI Insular stock (also ESA-listed)
- False killer whale, HI Pelagic stock
- False killer whale, NWHI stock
- *Kogia* spp. (Pygmy or dwarf sperm whale), HI stock
- Risso's dolphin, HI stock
- Rough-toothed dolphin, HI stock
- Short-finned pilot whale, HI stock
- Striped dolphin, HI stock

Most bycatch estimates in the SARs are based on the most recently available 5-year period, but there is a data lag of approximately 2 years due to the SAR review process. This annual report focuses on available long-term interaction trends and summarizes relevant information from the most recent SAR.

3.3.2.2 DATA SOURCE FOR MONITORING PROTECTED SPECIES INTERACTIONS IN THE HAWAII DEEP-SET LONGLINE FISHERY

Protected species interactions in the Hawaii longline fishery have been monitored through mandatory observer coverage since 1994. Observer coverage in the Hawaii longline fishery was between 3 and 5 percent from 1994 through 1999, increased to 10 percent in 2000, then to 20 percent in 2001.

In response to the emerging COVID-19 crisis, and to ensure the safety and protect the health of fishermen, observers, and others, NMFS issued an emergency action on March 27, 2020 (85 FR 17285), to provide the authority, on a case-by-case basis, to waive observer coverage. This action was extended on September 21, 2020 (85 FR 59199) and again on March 29, 2021 (86 FR 16307). Under this emergency action, a NMFS Regional Administrator, Office Director, or Science Center Director had the ability to waive observer coverage requirements if:

- Local, state, or national governments, or private companies or organizations that deploy observers pursuant to NMFS regulations, restrict travel or otherwise issue COVID-19-related social control guidance, or requirement(s) addressing COVID-19-related concerns, such that it is inconsistent with the requirement(s) or not recommended to place an observer(s); or

- No qualified observer(s) are available for placement due to health, safety, or training issues related to COVID-19.

[7] This fishery is listed in the LOF under Commercial Fisheries in the Pacific Ocean and Commercial Fisheries on the High Seas. Stocks from both lists are included here.

The PIRO Regional Administrator granted waivers on a case-by-case basis consistent with the emergency rule resulting in reduced annual coverage for the Hawaii deep-set longline fishery for 2020 and 2021 at 15.25% and 17.84% respectively. Observer coverage was also variable in 2020 ranging from 7.7% to 18.2% in a quarter. While 2021 saw an improved coverage rate and less coverage variability (14.3% to 21.1% in a quarter), fleet-wide interaction estimates for 2021 may still have greater uncertainty than usual. Annual observer coverage rate returned to 20.2% in 2022.

This report summarizes protected species interactions in the Hawaii deep-set longline fishery since 2002, when separate reporting by deep-set and shallow-set components of the longline fishery began. Annual observed interactions are tallied based on vessel arrival date (rather than interaction date) for the purposes of this report for consistency with the methods used to estimate the annual total interactions. Comparison of annual incidental takes within a year to the ITSs are based on the interaction date rather than the vessel arrival date, consistent with the 2014 BiOp and associated supplements. Annual summary data presented in this report may differ from those in the PIRO Observer Program Quarterly and Annual Reports, which began summarizing interaction data by haul begin dates (proxy for interaction date) in 2021.

3.3.2.3 SEA TURTLE INTERACTIONS IN THE HAWAII DEEP-SET LONGLINE FISHERY

Table 68 summarizes the incidental take data of sea turtles from 2002 to 2022 in the Hawaii deep-set longline fishery. The incidental take data in this section were compiled from the PIRO Observer Program Annual Status Reports and are for monitoring purposes. Many of these interactions have been further examined by NMFS, and updated information necessary for any data analyses is available from PIFSC. Observed take data are expanded to represent the estimated number of incidental takes for the entire fishery by PIFSC (referred to in this document as "McCracken estimates (ME)"). When ME are not available, a standard expansion factor estimate is used (EF Est. = 100 / % observer coverage * # takes).

Observed sea turtle takes year to year were variable. The most commonly observed sea turtle species being olive ridley sea turtles, whereas interactions with leatherbacks, greens, and loggerheads were much less frequent.

Preliminary results from an analysis conducted by PIFSC and presented to the Scientific and Statistical Committee at its 122nd Meeting in March 2016 showed that leatherback interactions in 2014 were significantly higher than levels expected from previous years (2007-2013). The higher level of interactions in 2014 was considered in the 2014 Biological Opinion, which concluded that the fishery is not likely to jeopardize leatherback turtles. Leatherback interactions, since the 2014 Biological Opinion, remain below the ITS of 72 interactions over three years. The Council at its 165th Meeting in March 2016 recommended continued monitoring of the interactions and further analysis to evaluate patterns of leatherback interactions in the Hawaii deep-set longline fishery. Leatherback turtle interactions in 2017-2019 were lower than 2014-2015.

The highest number of observed olive ridley interactions occurred in 2016 with 31 takes. This was followed by three years of high olive ridley interactions with 26, 18, and 29 interactions in 2017, 2018, and 2019, respectively. Interactions in 2020-2022 were within the range observed prior to 2016. Due to the depth of the deep-set longline gear, most of the interactions result in mortalities. The higher level of olive ridley turtle interactions was considered in the 2017 Supplement to the 2014 Biological Opinion, which analyzed impacts with data through the second quarter of 2016 (25 of the 31 interactions occurred in the first two quarters). The 2017 Supplement to the 2014 Biological Opinion concluded that the fishery is not likely to jeopardize olive ridley turtles after considering this higher level of interactions. The Council's Protected Species Advisory Committee at its March 2017 meeting discussed the olive ridley turtle interaction trend and recommended evaluation of the increasing trend in conjunction with the previously recommended effort to evaluate ecosystem factors influencing bycatch in the longline fishery. This recommendation led to a collaborative ecosystem-based fisheries management project between Council, PIFSC, PIRO and University of Florida to develop a protected species ensemble random forest (PSERF) model. Additional information on this effort is included in Section 4.1.

Top variables for defining olive ridley turtle interaction determined using the PSERF model indicate an influence of mean wind direction and shows that SW-W-NW winds seem to have higher probability of interactions than normal. Eddy-based features such as Okubo-Weiss (negative values indicate vorticity dominated regions e.g., eddies), eddy kinetic energy (positive values indicate high eddy activity) and current speed also seems to have higher than average probability of interactions. Together, these seem to indicate that features that result in higher turtle movement rates (wind, currents) or aggregate turtles (eddies) increase the probability of interactions with olive ridley turtles. Aggregate mean characteristics from the fishing sets indicate that for sets from 2015-2019, higher eddy activity, higher current speeds, and winds blowing from the west-southwest increased whereas these conditions waned after 2020.

Table 68. Observed takes, mortalities (M), takes per fishing effort (1,000 hooks), and estimated annual takes using expansion factor estimates and ME for sea turtles in the Hawaii deep-set longline fishery, 2002-2022[a]

Year	Obs. Cov. (%)	Sets	Hooks	Green				Leatherback				Loggerhead				Olive ridley				Unidentified hard shell		
				Observed Takes (M)	Observed Takes/ 1,000 hooks	EF Est.	ME	Observed Takes (M)	Observed Takes/ 1,000 hooks	EF Est.	ME	Observed Takes (M)	Observed Takes/ 1,000 hooks	EF Est.	ME	Observed Takes (M)	Observed Takes/ 1,000 hooks	EF Est.	ME	Observed Takes (M)	Observed Takes/ 1,000 hooks	ME
2002	24.6	3,523	6,786,303	1(1)	0.0001	-	3	2	0.0003	-	5	4(1)	0.0006	-	17	7(7)	0.0010	-	31	0	0.0000	-
2003	22.2	3,204	6,442,221	0	0.0000	-	0	1(1)	0.0002	-	4	0	0.0000	-	0	3(3)	0.0005	-	14	0	0.0000	-
2004	24.6	3,958	7,900,681	1(1)	0.0001	-	5	3	0.0004	-	15	0	0.0000	-	0	13(13)	0.0016	-	46	0	0.0000	-
2005	26.1	4,602	9,360,671	0	0.0000	-	0	1	0.0001	-	4	0	0.0000	-	0	4(4)	0.0004	-	16	0	0.0000	-
2006	21.2	3,605	7,540,286	2(2)	0.0003	-	6	2(2)	0.0003	-	9	0	0.0000	-	0	11(10)	0.0015	-	54	0	0.0000	-
2007	20.1	3,506	7,620,083	0	0.0000	-	0	2	0.0003	-	4	1(1)	0.0001	-	7	7(7)	0.0009	-	26	0	0.0000	-
2008	21.7	3,915	8,775,951	0	0.0000	-	0	1	0.0001	-	11	0	0.0000	-	0	3(3)	0.0003	-	18	0	0.0000	-
2009	20.6	3,520	7,877,861	0	0.0000	-	0	1(1)	0.0001	-	4	0	0.0000	-	0	4(4)	0.0005	-	18	0	0.0000	-
2010	21.1	3,580	8,184,127	1(1)	0.0001	-	1	1(1)	0.0001	-	6	1(1)	0.0001	-	6	4(3)[b]	0.0005	-	10	0	0.0000	-
2011	20.3	3,540	8,260,092	1(1)	0.0001	-	5	3	0.0004	-	14	0	0.0000	-	0	7(6)	0.0008	-	36	0	0.0000	-
2012	20.4	3,659	8,768,728	0	0.0000	-	0	1(1)	0.0001	-	6	0	0.0000	-	0	6(6)	0.0007	-	34	0	0.0000	-
2013	20.4	3,830	9,278,133	1(1)	0.0001	-	5	3	0.0003	-	15	2(2)	0.0002	-	11	9(9)	0.0010	-	42	0	0.0000	-
2014	20.8	3,831	9,608,244	3(3)	0.0003	-	16	7(2)	0.0007	-	38	0	0.0000	-	0	8(7)	0.0008	-	50	0	0.0000	-
2015	20.6	3,728	9,393,234	1(1)	0.0001	-	4	4(2)	0.0004	-	18	2(2)	0.0002	-	9	13(12)	0.0014	-	69	0	0.0000	-
2016	20.1	3,880	9,872,439	1(1)	0.0001	-	5	3(1)	0.0003	-	15	2(1)	0.0002	-	7	31(28)	0.0031	-	162	1(1)	0.0001	5
2017	20.4	3,832	10,148,195	3(1)	0.0003	-	18	0	0.0000	-	0	3	0.0003	-	12	26(23)	0.0026	-	119	0	0.0000	-
2018	20.4	4,332	11,751,144	3(3)	0.0003	-	17	2	0.0002	-	12	1(1)	0.0001	-	4	18(16)	0.0015	-	96	0	0.0000	-
2019	20.5	4,697	12,948,077	2(2)	0.0002	-	12	3	0.0002	-	14	0	0.0000	-	0	29(28)	0.0022	-	138	0	0.0000	-
2020	15.25	3,131	8,738,011	2(2)	0.0002	-	13	4	0.0005	-	31	3(1)	0.0003	-	19	11(9)	0.0013	-	79	0	0.0000	-
2021	17.84	3,972	11,454,331	3(3)	0.0003	-	17	1	0.0001	-	8	1	0.0001	-	5	7(5)	0.0006	-	46	0	0.0000	-
2022	20.22	4,314	12,473,293	1(1)	0.0001	-	6	5	0.0004	-	24	3	0.0002	-	19	10(8)	0.0008	-	49	0	0.0000	-

[a] Take data are based on vessel arrival dates.

[b] One olive ridley turtle interaction (released injured) occurred inside the American Samoa EEZ. This interaction was included in the Observer Program Annual Report for the Hawaii deep-set fishery because the vessel departed Honolulu under the Hawaii longline permit.

Sources: Take data—2002-2020 PIRO Observer Program Annual and Quarterly Status Reports, PIRO Sustainable Fisheries Division unpublished data. Expansion estimates for 2002-2003, NMFS 2005.
ME—McCracken, 2005; McCracken, 2006; McCracken, 2007; McCracken, 2008; McCracken, 2009; McCracken, 2010; McCracken, 2011b; McCracken, 2012; McCracken, 2013; McCracken, 2014; McCracken 2017c, McCracken 2017d, McCracken 2019b, McCracken 2019d, McCracken and Cooper 2020a, McCracken and Cooper (in review).

3.3.2.3.1 Comparison of Interactions with ITS

The Hawaii deep-set longline fishery operates under the 3-year ITS in the 2014 Biological Opinion for leatherback sea turtles, and in the 2017 Supplement to the 2014 Biological Opinion for all other sea turtle species (Table 69). NMFS began monitoring the 2014 Biological Opinion ITS in Quarter 3 of 2014 and the 2017 Supplement to the 2014 Biological Opinion ITS in Quarter 3 of 2016 and uses a rolling 3-year period to track incidental take. NMFS always uses the interaction date for tracking sea turtle interactions against the ITS, regardless of vessel arrival date. Prior to 2021, NMFS in its PIRO Observer Program Quarterly and Annual Reports counted sea turtle interactions based on vessel arrival dates. For this reason, the number of quarterly or annual sea turtle interactions counted against an ITS may vary from those reported on the Observer Program's quarterly and annual reports. NMFS uses post-hooking mortality criteria (Ryder et al. 2006) to calculate sea turtle mortality rates.

Unlike the Hawaii shallow-set longline fishery, the deep-set fishery does not have hard caps and the ITS triggers reinitiation of consultation when exceeded. The ITSs for green and olive ridley turtles were exceeded in 2018. On October 4, 2018, NMFS reinitiated consultation for the deep-set fishery due in part to exceeding the ITS for the east Pacific green turtle DPS. Since the October 4, 2018, reinitiation, the deep-set fishery has also exceeded the ITS for the North Pacific loggerhead turtle and eastern and western Pacific populations of olive ridley turtle. NMFS has since updated its analysis under ESA Sections 7(a)(2) and 7(d).

Table 69. Estimated total interactions (extrapolated using quarterly observer coverage) and total mortalities (M) (using Ryder et al. 2006) of sea turtles in the Hawaii deep-set longline fishery compared to the 3-year ITS in the 2014 Biological Opinion and in the 2017 Supplement to the 2014 Biological Opinion[a]

2014 BiOp				
Species	3-year ITS Interactions (M)	Estimated Total Interactions and Mortalities Interactions (M)		
		2018-2020	2019-2021	2020-2022
Leatherback turtle	72(27)	57(21.55)	53(19.77)	62.61(22.60)
2017 Supp. BiOp				
Species[b]	3-year ITS Interactions (M)	Estimated Total Interactions and Mortalities Interactions (M)		
		2018-2020	2019-2021	2020-2022
Green turtle	-	-	-	-
East Pacific DPS (70%)	12(12)	22.4(21.35)	29.4(28.08)	25.17(24.1)
Central North Pacific DPS (12%)	6(6)	3.84(3.66)	5.04(4.81)	4.31(4.13)
East Indian-west Pacific DPS (8%)	6(6)	2.56(2.44)	3.36(3.21)	2.88((2.75)
Southwest Pacific DPS (7%)	6(6)	2.24(2.14)	2.94(2.81)	2.52(2.41)
Central West Pacific DPS (1%)	3(3)	0.32(0.31)	0.42(0.40)	0.36(0.34)
Central South Pacific DPS (1%)	3(3)	0.32(0.31)	0.42(0.40)	0.36(0.34)
Loggerhead turtle	18(13)	23(14.89)	24(14.52)	41.35(22.87)
Olive ridley turtle	-	-	-	-
Endangered Mexico and threatened eastern Pacific populations (77%)	141(134)	241.01(228.80)	202.51(190.43)	137.10(129.59)
Threatened western Pacific populations (23%)	42(40)	71.99(68.34)	60.49(56.88)	40.95(38.71)

[a] Takes are counted based on interaction date.

[b] These species exceeded their ITSs in 2016, and interactions beginning the third quarter of 2016 count against their new ITSs (NMFS 2017).

3.3.2.4 MARINE MAMMAL INTERACTIONS IN THE HAWAII DEEP-SET LONGLINE FISHERY

Table 70 through Table 75 summarize the incidental take data of marine mammals from 2002 to 2022 in the Hawaii deep-set longline fishery. The incidental take data in this section were compiled from the PIRO Observer Program Annual Status Reports and are for monitoring purposes. Reported interactions listed in these tables reflect all observed interactions, including mortalities, serious injuries, and non-serious injuries. Refer to the most recent SARs for mortality and serious injury estimates and stock-specific abundance estimates and geographic range. Many of these interactions have been further examined, and updated information necessary for any data analyses is available from PIFSC. Observed take data are expanded to represent the estimated number of annual incidental takes for the entire fishery by PIFSC (referred to in this document as “ME”). When ME are not available, a standard expansion factor estimate is listed in the table (EF Est. = 100 / % observer coverage * # takes).

The majority of observed interactions and all observed mortalities since 2002 involved dolphin and small whale species. False killer whales also had the highest interaction rate over the entire 2002-2022 period, with the highest number of observed interactions occurring in 2019. Short-finned pilot whales, bottlenose dolphins, Risso's dolphins, and rough-toothed dolphins are also occasionally observed, but in 2022, only one Risso's dolphin interaction was observed and none observed of the other species. Rough-tooth dolphin interactions were notably higher in 2020 compared to past years, but no contributing factors are readily apparent, with interactions closer to baseline levels for 2021 and none observed in 2022. Very few interactions were observed with striped dolphins, pantropical spotted dolphins, Blainville's beaked whales, pygmy killer whales, and *Kogia* spp. whales. Interactions with marine mammals grouped as large whales were also rare, with observed interactions recorded with humpback whales and one sperm whale in 2011 (Table 72). Observed interactions with unidentified cetacean groups are shown in Table 73. In 2022, there were two observed unidentified cetacean interactions.

In response to the false killer whale interactions and Southern Exclusion Zone (SEZ) closures in recent years (see also Section 3.3.2.4.2), the Council at its 190th meeting in March 2022 recommended analysis of interaction and depredation patterns through 2021, including estimating economic impacts from depredation, as well as the effect of SEZ closure on fishing effort and false killer whale interactions.

Table 70. Observed takes, mortalities (M), takes per fishing effort (1,000 hooks), and estimated annual takes using expansion factor estimates and ME for dolphins in the Hawaii deep-set longline fishery, 2002-2022[a]

Year	Obs. Cov. (%)	Sets	Hooks	Bottlenose dolphin				Pantropical spotted dolphin				Rough-toothed dolphin				Risso's dolphin				Striped dolphin			
				Observed				Observed				Observed				Observed				Observed			
				Takes (M)	Takes/ 1,000 hooks	EF Est.	ME	Takes (M)	Takes/ 1,000 hooks	EF Est.	ME	Takes (M)	Takes/ 1,000 hooks	EF Est.	ME	Takes (M)	Takes/ 1,000 hooks	EF Est.	ME	Takes (M)	Takes/ 1,000 hooks	EF Est.	ME
2002	24.6	3,523	6,786,303	0	0.0000	0	-	0	0.0000	0	-	0	0.0000	0	-	0	0.0000	0	-	0	0.0000	0	-
2003	22.2	3,204	6,442,221	1(1)	0.0002	5	-	0	0.0000	0	-	0	0.0000	0	-	0	0.0000	0	-	0	0.0000	0	-
2004	24.6	3,958	7,900,681	0	0.0000	-	0	0	0.0000	-	0	0	0.0000	0	-	0	0.0000	-	0	0	0.0000	0	-
2005	26.1	4,602	9,360,671	0	0.0000	-	0	0	0.0000	-	0	0	0.0000	0	-	1	0.0001	-	3	0	0.0000	0	-
2006	21.2	3,605	7,540,286	1	0.0001	-	1	0	0.0000	-	0	0	0.0000	0	-	2	0.0003	-	5	1(1)	0.0001	-	6
2007	20.1	3,506	7,620,083	0	0.0000	-	0	0	0.0000	-	0	0	0.0000	0	-	1(1)	0.0001	-	3	0	0.0000	-	0
2008	21.7	3,915	8,775,951	0	0.0000	-	0	1(1)	0.0001	-	3	0	0.0000	0	-	1	0.0001	-	2	0	0.0000	-	0
2009	20.6	3,520	7,877,861	1	0.0001	-	5	0	0.0000	-	0	0	0.0000	0	-	0	0.0000	-	0	0	0.0000	-	0
2010	21.1	3,580	8,184,127	1	0.0001	-	4	0	0.0000	-	0	0	0.0000	-	0	1	0.0001	-	3	0	0.0000	-	0
2011	20.3	3,540	8,260,092	0	0.0000	-	0	0	0.0000	-	0	0	0.0000	-	0	0	0.0000	-	0	1(1)	0.0001	-	4
2012	20.4	3,659	8,768,728	0	0.0000	-	0	0	0.0000	-	0	0	0.0000	-	0	0	0.0000	-	0	0	0.0000	-	0
2013	20.4	3,830	9,278,133	2(1)	0.0002	-	11	0	0.0000	-	0	1(1)	0.0001	-	5	0	0.0000	-	0	0	0.0000	-	0
2014	20.8	3,831	9,608,244	0	0.0000	-	0	0	0.0000	-	0	0	0.0000	-	0	0	0.0000	-	0	0	0.0000	-	0
2015	20.6	3,728	9,393,234	0	0.0000	-	0	0	0.0000	-	0	0	0.0000	-	0	2(1)	0.0002	-	10	0[b]	0.0000	-	4[b]
2016	20.1	3,880	9,872,439	1	0.0001	-	5	0	0.0000	-	0	1(1)	0.0001	-	5	0	0.0000	-	0	0	0.0000	-	0
2017	20.4	3,832	10,148,195	1	0.0001	-	7	0	0.0000	-	0	0	0.0000	-	0	1	0.0001	-	5	0	0.0000	-	0
2018	20.4	4,332	11,751,144	1	0.0001	-	3	0	0.0000	-	0	0	0.0000	-	0	0	0.0000	-	0	0	0.0000	-	0
2019	20.5	4,697	12,948,077	0	0.0000	-	0	0	0.0000	-	0	1	0.0001	-	4	1(1)	0.0001	-	7	0	0.0000	-	0
2020	15.25	3,131	8,738,011	1	0.0001	-	10	0	0.0000	-	0	5(2)	0.0006	-	29	2	0.0002	-	16	0	0.0000	-	0
2021	17.84	3,972	11,454,331	3	0.0003	17	-	0	0.0000	0	-	2(1)	0.0002	11	-	0	0.0000	0	-	0	0.0000	0	-
2022	20.22	4,314	12,473,293	0	0.0000	0	-	0	0.0000	0	-	0	0.0000	0	-	1	0.0001	5	-	0	0.0000	0	-

[a] Take data are based on vessel arrival dates.
[b] One unidentified dolphin was later identified as a striped dolphin but is listed as an unidentified dolphin in the 2015 Annual Observer Report.
Source: Take data—2002-2020 PIRO Observer Program Annual and Quarterly Status Reports, PIRO Sustainable Fisheries Division unpublished data.
ME—McCracken, 2005; McCracken, 2006; McCracken, 2011a; McCracken, 2016; McCracken, 2017b; McCracken 2019c, McCracken and Cooper 2022c.

Table 71. Observed takes, mortalities (M), takes per fishing effort (1,000 hooks), and estimated annual takes using expansion factor estimates and ME for small whales in the Hawaii deep-set longline fishery, 2002-2022[a]

Year	Obs. Cov. (%)	Sets	Hooks	Blainville's beaked whale				False killer whale				*Kogia* spp.				Pygmy killer whale				Short-finned pilot whale			
				Observed		EF Est.	ME	Observed		EF Est.	ME	Observed		EF Est.	ME	Observed		EF Est.	ME	Observed		EF Est.	ME
				Takes (M)	Takes/ 1,000 hooks			Takes (M)	Takes/ 1,000 hooks			Takes (M)	Takes/ 1,000 hooks			Takes (M)	Takes/ 1,000 hooks			Takes (M)	Takes/ 1,000 hooks		
2002	24.6	3,523	6,786,303	1(1)	0.0001	4	-	5	0.0007	20	-	0	0.0000	0	-	0	0.0000	0	-	0	0.0000	0	-
2003	22.2	3,204	6,442,221	0	0.0000	0	-	2	0.0003	9	-	0	0.0000	0	-	0	0.0000	0	-	0	0.0000	0	-
2004	24.6	3,958	7,900,681	0	0.0000	-	0	6(1)	0.0008	-	28	0	0.0000	0	-	0	0.0000	0	-	1	0.0001	-	3
2005	26.1	4,602	9,360,671	1	0.0001	-	6	2(1)	0.0002	-	6	0	0.0000	0	-	0	0.0000	0	-	1	0.0001	-	6
2006	21.2	3,605	7,540,286	0	0.0000	-	0	4	0.0005	-	17	0	0.0000	0	-	0	0.0000	0	-	2	0.0003	-	6
2007	20.1	3,506	7,620,083	0	0.0000	-	0	4	0.0005	-	15	0	0.0000	0	-	0	0.0000	0	-	1	0.0001	-	2
2008	21.7	3,915	8,775,951	0	0.0000	-	0	3	0.0003	-	11	0	0.0000	0	-	0	0.0000	0	-	3	0.0003	-	5
2009	20.6	3,520	7,877,861	0	0.0000	-	0	10(1)	0.0013	-	55	0	0.0000	0	-	0	0.0000	0	-	0	0.0000	-	0
2010	21.1	3,580	8,184,127	0	0.0000	-	0	4	0.0005	-	19	0	0.0000	-	0	0	0.0000	-	0	0	0.0000	-	0
2011	20.3	3,540	8,260,092	0	0.0000	-	0	3	0.0004	-	10	0	0.0000	-	0	0	0.0000	-	0	0	0.0000	-	0
2012	20.4	3,659	8,768,728	0	0.0000	-	0	3	0.0003	-	15	0	0.0000	-	0	0	0.0000	-	0	0	0.0000	-	0
2013	20.4	3,830	9,278,133	0	0.0000	-	0	4	0.0004	-	22	0	0.0000	-	0	1(1)	0.0001	-	5	1(1)	0.0001	-	4
2014	20.8	3,831	9,608,244	0	0.0000	-	0	11	0.0011	-	55	1	0.0001	-	10	0	0.0000	-	0	0	0.0000	-	0
2015	20.6	3,728	9,393,234	0	0.0000	-	0	5(1)	0.0005	-	21	0	0.0000	-	0	0	0.0000	-	0	1	0.0001	-	4
2016	20.1	3,880	9,872,439	0	0.0000	-	0	7	0.0007	-	39	0	0.0000	-	0	0	0.0000	-	0	0	0.0000	-	0
2017	20.4	3,832	10,148,195	0	0.0000	-	0	8(2)	0.0008	-	45	0	0.0000	-	0	0	0.0000	-	0	0	0.0000	-	0
2018	20.4	4,332	11,751,144	0	0.0000	-	0	12	0.0010	-	49	0	0.0000	-	0	0	0.0000	-	0	0	0.0000	-	0
2019	20.5	4,697	12,948,077	0	0.0000	-	0	15(3)	0.0012	-	75	0	0.0000	-	0	0	0.0000	-	0	0	0.0000	-	0
2020	15.25	3,131	8,738,011	0	0.0000	-	0	4	0.0005	-	22	1	0.0001	-	4	0	0.0000	-	0	0	0.0000	-	0
2021	17.84	3,972	11,454,331	0	0.0000	0	-	15(2)	0.0013	84	-	0	0.0000	0	-	0	0.0000	0	-	1	0.0000	6	-
2022	20.22	4,314	12,473,293	0	0.0000	0	-	7	0.0006	35	-	0	0.0000	0	-	0	0.0000	0	-	0	0.0000	0	-

[a] Take data are based on vessel arrival dates.

Source: Take data—2002-2020 PIRO Observer Program Annual and Quarterly Status Reports, PIRO Sustainable Fisheries Division unpublished data

ME—McCracken, 2005; McCracken, 2006; McCracken, 2011a; McCracken, 2016; McCracken, 2017b; McCracken 2019c, McCracken and Cooper 2022c.

Table 72. Observed takes, takes per fishing effort (1,000 hooks), and estimated annual takes using expansion factor estimates and ME for large whales in the Hawaii deep-set longline fishery, 2002-2022[a]

Year	Obs. Cov. (%)	Sets	Hooks	Humpback whale				Sperm whale			
				Observed		EF Est.	ME	Observed		EF Est.	ME
				Takes	Takes/1,000 hooks			Takes	Takes/1,000 hooks		
2002	24.6	3,523	6,786,303	1	0.0001	4	-	0	0.0000	0	-
2003	22.2	3,204	6,442,221	0	0.0000	0	-	0	0.0000	0	-
2004	24.6	3,958	7,900,681	1	0.0001	-	6	0	0.0000	-	0
2005	26.1	4,602	9,360,671	0	0.0000	-	0	0	0.0000	-	0
2006	21.2	3,605	7,540,286	0	0.0000	-	0	0	0.0000	0	-
2007	20.1	3,506	7,620,083	0	0.0000	-	0	0	0.0000	0	-
2008	21.7	3,915	8,775,951	0	0.0000	-	0	0	0.0000	0	-
2009	20.6	3,520	7,877,861	0	0.0000	-	0	0	0.0000	0	-
2010	21.1	3,580	8,184,127	0	0.0000	-	0	0	0.0000	-	0
2011	20.3	3,540	8,260,092	0	0.0000	-	0	1	0.0001	-	6
2012	20.4	3,659	8,768,728	0	0.0000	-	0	0	0.0000	-	0
2013	20.4	3,830	9,278,133	0	0.0000	-	0	0	0.0000	-	0
2014	20.8	3,831	9,608,244	1	0.0001	-	5	0	0.0000	-	0
2015	20.6	3,728	9,393,234	0	0.0000	-	0	0	0.0000	-	0
2016	20.1	3,880	9,872,439	0	0.0000	-	0	0	0.0000	-	0
2017	20.4	3,832	10,148,195	0	0.0000	-	0	0	0.0000	-	0
2018	20.4	4,332	11,751,144	0	0.0000	-	0	0	0.0000	-	0
2019	20.5	4,697	12,948,077	0	0.0000	-	0	0	0.0000	-	0
2020	15.25	3,131	8,738,011	0	0.0000	-	0	0	0.0000	-	0
2021	17.84	3,972	11,454,331	0	0.0000	0	-	0	0.0000	0	-
2022	20.22	4,314	12,473,293	0	0.0000	0	-	0	0.0000	0	-

[a] Take data are based on vessel arrival dates.
Source: Take data—2002-2020 PIRO Observer Program Annual and Quarterly Status Reports, PIRO Sustainable Fisheries Division unpublished data.
ME—McCracken, 2005; McCracken, 2006; McCracken, 2011a; McCracken, 2016; McCracken, 2017b; McCracken 2019c; McCracken and Cooper 2022c.

Table 73. Observed takes, takes per fishing effort (1,000 hooks), and estimated annual takes using expansion factor estimates for unidentified species of cetaceans in the Hawaii deep-set longline fishery, 2002-2022[a]

Year	Obs. Cov. (%)	Sets	Hooks	Unidentified cetacean[b]			Unidentified whale[b]			Unidentified dolphin[b]			Unidentified beaked whale[b]		
				Observed		EF Est.	Observed		EF Est.	Observed		EF Est.	Observed		EF Est.
				Takes	Takes/ 1,000 hooks		Takes	Takes/ 1,000 hooks		Takes	Takes/ 1,000 hooks		Takes	Takes/ 1,000 hooks	
2002	24.6	3,523	6,786,303	2	0.0003	8	0	0.0000	0	0	0.0000	0	0	0.0000	0
2003	22.2	3,204	6,442,221	1	0.0002	5	1	0.0002	5	0	0.0000	0	0	0.0000	0
2004	24.6	3,958	7,900,681	0	0.0000	0	0	0.0000	0	0	0.0000	0	0	0.0000	0
2005	26.1	4,602	9,360,671	1	0.0001	4	0	0.0000	0	0	0.0000	0	0	0.0000	0
2006	21.2	3,605	7,540,286	0	0.0000	0	2	0.0003	9	2	0.0003	9	0	0.0000	0
2007	20.1	3,506	7,620,083	1	0.0001	5	0	0.0000	0	1	0.0001	5	0	0.0000	0
2008	21.7	3,915	8,775,951	2	0.0002	9	2	0.0002	9	0	0.0000	0	0	0.0000	0
2009	20.6	3,520	7,877,861	0	0.0000	0	3	0.0004	15	0	0.0000	0	0	0.0000	0
2010	21.1	3,580	8,184,127	0	0.0000	0	3	0.0004	14	0	0.0000	0	0	0.0000	0
2011	20.3	3,540	8,260,092	2	0.0002	10	0	0.0000	0	0	0.0000	0	0	0.0000	0
2012	20.4	3,659	8,768,728	2	0.0002	10	0	0.0000	0	0	0.0000	0	0	0.0000	0
2013	20.4	3,830	9,278,133	2	0.0002	10	0	0.0000	0	0	0.0000	0	0	0.0000	0
2014	20.8	3,831	9,608,244	2	0.0002	10	0	0.0000	0	0	0.0000	0	0	0.0000	0
2015	20.6	3,728	9,393,234	1	0.0001	5	0	0.0000	0	1[c]	0.0001	5	0	0.0000	0
2016	20.1	3,880	9,872,439	2	0.0002	10	0	0.0000	0	0	0.0000	0	1	0.0001	5
2017	20.4	3,832	10,148,195	4	0.0004	20	0	0.0000	0	0	0.0000	0	0	0.0000	0
2018	20.4	4,332	11,751,144	4	0.0003	20	0	0.0000	0	0	0.0000	0	0	0.0000	0
2019	20.5	4,697	12,948,077	3	0.0002	15	0	0.0000	0	0	0.0000	0	1	0.0001	5
2020	15.3	3,131	8,738,011	4	0.0005	26	0	0.0000	0	0	0.0000	0	1	0.0001	7
2021	17.8	3,972	11,454,331	4(1)	0.0003	22	0	0.0000	0	0	0.0000	0	0	0.0000	0
2022	20.22	4,314	12,473,293	2	0.0002	10	0	0.0000	0	0	0.0000	0	0	0.0000	0

[a] Take data are based on vessel arrival dates.
[b] Unidentified species identification based on PIRO Observer Program classifications. Unidentified cetacean refers to a marine mammal not including pinnipeds (seal or sea lion); unidentified whale refers to a large whale; unidentified dolphin refers to a small cetacean with a visible beak; and unidentified beaked whale refers to an animal in the Ziphiidae family. Further classifications based on observer description, sketches, photos, and videos may be available from the Pacific Islands Fisheries Science Center.
[c] This dolphin was later identified as a striped dolphin but is listed as an unidentified dolphin in the 2015 Annual Observer Report.
Source: Take data—2002-2020 PIRO Observer Program Annual and Quarterly Status Reports, PIRO Sustainable Fisheries Division unpublished data.

3.3.2.4.1 Comparison of Interactions with ITS

The Hawaii deep-set longline fishery operates under the 3-year ITS in the 2014 Biological Opinion for all marine mammals protected under the ESA, which includes sperm whales and the MHI insular DPS of false killer whales (Table 74). NMFS began monitoring the Hawaii deep-set longline fishery ITS in Quarter 3 of 2014 and uses a rolling 3-year period to track incidental take. NMFS always uses the interaction date for tracking marine mammal interactions against the ITS, regardless of vessel arrival date. In the PIRO Observer Program Quarterly and Annual Reports, NMFS bases the percent observer coverage on vessel departures, and bases the marine mammal interactions on vessel arrival dates. For this reason, the number of quarterly or annual marine mammal interactions counted against an ITS may vary from those reported in the Observer Program's quarterly and annual reports. NMFS uses M&SI determinations under the MMPA to calculate marine mammal mortality rates. Takes for these species are still under the 3-year ITS at this time.

On September 8, 2016, NMFS issued a final rule identifying 14 distinct population segments (DPS) of the humpback whale under the ESA (81 FR 62260). Under this final rule, the Hawaii DPS is not listed, so interactions are no longer being monitored against the ITS. Humpback whale interactions will continue to be monitored against the PBR in this report.

On October 4, 2018, NMFS reinitiated ESA Section 7 consultation for the deep-set fishery for all ESA-listed species under NMFS jurisdiction occurring in the action area. NMFS determined that the conduct of the fishery during the period of consultation will not violate ESA Sections 7(a)(2) and 7(d). Until NMFS completes the Section 7 consultation and issues a new biological opinion, the 2014 BiOp as supplemented (2017) remains valid for all species and critical habitat considered in the 2014 BiOp as supplemented. Since the October 4, 2018 reinitiation, the deep-set fishery has not exceeded the ITS for the sperm or MHI insular false killer whale.

Table 74. Estimated total interactions (extrapolated using quarterly observer coverage) and total mortalities (M) of cetaceans in the Hawaii deep-set longline fishery compared to the 3-year ITS in the 2014 Biological Opinion[a]

Species	3-year ITS Interactions (M)	3-year Monitoring Period Interactions (M)			
		2017-2019	2018-2020	2019-2021	2020-2022
Sperm whale	9(3)	0	0	0	0
MHI insular false killer whale	1(0.74)	2017: 0.07 (0.05) 2018: 0.10 (0.09) 2019: Data not yet available.	2018: 0.10 (0.09) 2019-2020: Data not yet available.	2019-2021: Data not yet available.	2020-2022: Data not yet available.

[a] Takes are counted based on interaction date.

3.3.2.4.2 Comparison of Interactions with PBR under the MMPA

Marine mammal takes against the PBR are monitored through the SARs. A summary of the current mean estimated annual M&SI and the PBR for stocks relevant to the Hawaii deep-set longline fishery is presented in Table 75. The PBR of a stock reflects only marine mammals of that stock observed within the EEZ around Hawaii, with the exception of the Central North Pacific stock of humpback whales for which PBR applies to the entire stock. The mean estimated annual M&SI specified in the SARs includes only interactions determined as mortalities and serious injuries and not interactions classified as non-serious injuries.

For most marine mammal stocks where the PBR is available, the number of observed takes of marine mammal species in the deep-set longline fishery inside the EEZ around Hawaii is well below the PBR in the time period covered by the most current SAR (Table 75).

The M&SI interactions inside the Hawaii EEZ for the HI Pelagic stock of false killer whales previously exceeded the PBR for this stock. A False Killer Whale Take Reduction Team was formed in 2010 pursuant to the MMPA to address incidental takes of false killer whales in the Hawaii-permitted longline fisheries. NMFS implemented the False Killer Whale Take Reduction Plan in 2012. The objective of the plan is to reduce mortality and serious injury of false killer whales in the Hawaii-permitted longline fisheries.

Monitoring of false killer whale interactions in the MHI Insular and HI Pelagic stocks is ongoing under the False Killer Whale Take Reduction Plan. The M&SI interactions inside the Hawaii EEZ for the HI Pelagic stock for 2015 to 2019 was 9.8 in the latest SAR, which is below this stock's PBR (Table 75). Updated information provided to the False Killer Whale Take Reduction Team in 2022 indicated that the M&SI interactions inside the Hawaii EEZ for the HI Pelagic Stock was 17 for the 2017-2021 period, which was above PBR (NMFS unpublished data).

On July 24, 2018, the Southern Exclusion Zone (SEZ) was closed pursuant to the False Killer Whale Take Reduction Plan following two false killer whale interactions within the EEZ resulting in a M&SI (83 FR 33848). The SEZ was closed for the remainder of the year and was reopened on January 1, 2019. On February 22, 2019, the SEZ closed from reaching the closure trigger (84 FR 5356), and was reopened on August 25, 2020, after at least one of the reopening criteria defined in the Take Reduction Plan implementing regulations was met (85 FR 50959). In 2021, the revised SEZ trigger of four M&SI was met, but SEZ did not close because the fourth interaction was not confirmed until January 2022 when the timeframe for closing the SEZ in 2021 had passed (87 FR 12941). The SEZ trigger was not met in 2022.

Table 75. Mean estimated annual M&SI and PBR by marine mammal stocks with observed interactions in the Hawaii deep-set longline fishery

Stock	Years Included in 2020 SAR and Draft 2021 SAR	Outside EEZ[a]	Inside EEZ[b]	
		Mean Estimated Annual M&SI	Mean Estimated Annual M&SI	PBR (Inside EEZ only)
Bottlenose dolphin, HI Pelagic	2014-2018	3.0	0	undetermined
Pantropical spotted dolphin, HI Pelagic	2014-2018	0	0	265
Rough-toothed dolphin, HI	2014-2018	1.0	0	548
Risso's dolphin, HI	2014-2018	2.9	0	61
Striped dolphin, HI	2014-2018	0.4	0	291
Blainville's beaked whale, HI	2014-2018	0	0	5.6
False killer whale, MHI Insular	2015-2019	N/A	0.0	0.3
False killer whale, HI Pelagic	2015-2019	28.8	9.8	16
False killer whale, NWHI	2015-2019	N/A	0.1	1.4
False killer whale, Palmyra Atoll	2006-2010	N/A	0.3	6.4
Kogia spp. whale (Pygmy or dwarf sperm whale), HI	2014-2018	Pygmy = 0 Dwarf = 0	Pygmy = 0 Dwarf = 0	Pygmy = 257 Dwarf = undetermined
Pygmy killer whale, HI	2014-2018	0	1.1	56
Short-finned pilot whale, HI	2014-2018	1.4	0.9	87
Humpback whale, Central North Pacific	2014-2018	0.9		83[c]
Sperm whale, HI	2014-2018	0	0	18

[a] PBR estimates are not available for portions of the stock outside of the U.S. EEZ around Hawaii, except for the Central North Pacific stock of humpback whales for which PBR applies to the entire stock.
[b] PBR estimates are only available for portions of the stock within the U.S. EEZ around Hawaii.
[c] PBR for the Central North Pacific stock for humpback whales apply to the entire stock.
Source: Final 2021 Marine Mammal SARs.

3.3.2.5 SEABIRD INTERACTIONS IN THE HAWAII DEEP-SET LONGLINE FISHERY

The incidental take data in this section were compiled from the PIRO Observer Program Annual Status Reports and are for monitoring purposes. Many of these interactions have been further examined by NMFS, and updated information necessary for any data analyses is available from NMFS. Observed take data are expanded to represent the estimated number of annual incidental takes for the entire fishery by PIFSC (hereafter "ME"). When ME are not available, a standard expansion factor estimate is listed in the table (EF Est. = 100 / % observer coverage * # takes).

Interaction data provided here may vary slightly from other sources depending on how interactions were reported (date of trip departure or arrival, set date, or haul date in a given year). NMFS annually publishes the report *Seabird Interactions and Mitigation Efforts in Hawaii Longline Fisheries* (Seabird Annual Report), which includes verified numbers of seabird interactions and information on fishing regulations and effort, interaction rates, and band recovery data for seabirds caught in the shallow-set and deep-set fisheries. Recent reports are available at: https://www.fisheries.noaa.gov/pacific-islands/bycatch/seabird-interactions-pelagic-longline-fishery.

Table 76 and Table 77 summarize the incidental take data of seabirds from 2002 to 2022 in the Hawaii deep-set longline fishery. The most common observed interactions during this time period involved black-footed albatrosses and Laysan albatrosses. Additional takes of unidentified shearwaters, sooty shearwaters, brown boobies, red-footed boobies, unidentified gulls, unidentified albatross, and unidentified seabirds have been observed. Most of the unidentified shearwaters have been identified as sooty shearwaters (NMFS 2016). There have been no observed takes of short-tailed albatrosses by this fishery.

Interactions with black-footed albatrosses since 2015 have been substantially higher compared to previous years with the highest number observed in 2018. From 2019 to 2022, the observed number of black-footed albatross interactions has declined every year. Expanded annual estimated takes for other seabird species suggested a high degree of variability from year to year. Interactions with sooty shearwaters and boobies are relatively infrequent.

Results from an analysis of seabird interaction rates in the Hawaii deep-set longline fishery (Gilman et al. 2016) were presented to the Protected Species Advisory Committee and Pelagic Plan Team in 2016. The analysis included data from October 2004 to May 2014. Results indicate that seabird interaction rates significantly increased as annual mean multivariate ENSO index values increased, meaning that decreasing ocean productivity may have contributed to the increasing trend in seabird catch rates. The analysis also showed a significant increasing trend in the number of albatrosses attending vessels, which may also be contributing to the increasing seabird catch rates. Both side setting and blue-dyed bait significantly reduced the seabird catch rate compared to stern setting and untreated bait, respectively. Of two options for meeting regulatory requirements, side setting had a significantly lower seabird catch rate than blue-dyed bait.

The Council, at its 166th Meeting in June 2016, directed the Plan Team and the Protected Species Advisory Committee to continue monitoring interactions through the SAFE to detect any future changes in albatross interactions that may be attributed to fishing operations. The Council noted that current seabird measures implemented in the Hawaii longline fishery are effective and recent increase in seabird captures are driven by non-fishery factors at this time. The Council additionally recommended research to be conducted, as appropriate, on at-sea foraging behavior of albatross species to improve understanding of interaction rates in the Hawaii longline fisheries.

In response to the Council recommendation, a seabird workshop was convened in November 2017. The objectives of the workshop were to: 1) review recent increased albatross interactions in the Hawaii longline fishery; 2) explore possible factors responsible for this increase; 3) evaluate albatross population impacts; and 4) provide input for future data collection, analysis, and models. Information presented at the workshop strongly suggested that El Niño Southern Oscillation (ENSO) and Pacific Decadal Oscillation (PDO) influence albatross distribution by affecting wind patterns and ocean productivity. In years of positive ENSO and PDO, albatross distributions and longline fishing effort overlap more closely, resulting in increased albatross interaction rates. (Wren et al. 2019; Hyrenback et al. 2021) The workshop also identified albatross population dynamics, mesoscale oceanographic processes, and increased albatross attraction to vessels as other factors that may influence interaction rates. A black-footed albatross population model indicated that the recent increase in albatross interactions is unlikely to significantly affect population growth as long as the increase is limited to the Hawaii longline fishery or is episodic. Next steps include filling a variety of data gaps in order to build an Integrated Population Model (IPM).

At its 173rd Meeting, the Council directed staff to conduct a seabird workshop to review seabird mitigation requirements and the best scientific information available for Hawaii's pelagic longline fisheries, considering operational aspects of the fisheries, seasonal and spatial distributions of seabird interactions, alternative bycatch mitigation measures and findings from cost-benefit analyses. Identified priority mitigation measures suitable for the Hawaii longline fishery, potential changes to seabird measures, and research needs to inform future changes to seabird measures (Gilman and Ishizaki 2018). Specifically, workshop participants identified deterrents such as tori lines (also called streamer lines or bird scaring lines) and towed buoys, which are currently not required in the Hawaii longline fishery, to be a high priority for further research and development. Conversely, workshop participants identified blue-dyed bait as a candidate for removal from Hawaii's seabird requirements because of concerns with efficacy and practicality. Participants discussed that the requirement for using blue-dyed bait was intended to be used for squid bait but currently only fish are used for bait in both Hawaii longline fisheries, and that blue-dyed fish bait may also be less effective at mitigating seabird catch risk than blue-dyed squid bait. Industry members who participated in the workshop indicated that blue-dyed bait is not favored by fishermen as the dye is messy and thawing of bait reduces retention on hooks. Additionally, recent analysis of observer data indicate that side-setting is more effective than blue-dyed bait in the Hawaii deep-set longline fishery. The workshop also identified the importance of training and outreach, in light of possible captain effects showing higher interactions by a smaller number of captains in the fleet.

The Council at its 174th Meeting in October 2018 received a report of the September 2018 Workshop and recommended: 1) enhancing outreach and training efforts to ensure proper application of existing seabird mitigation measure requirements; 2) NMFS provide support for research and development for alternative measures with potential to replace blue-dyed bait, with high priority placed on identifying suitable designs for tori lines; and 3) encourage submission of Experimental Fishing Permit applications for testing alternative measures without the use of blue-dyed bait to allow comparison of measure effectiveness with and without blue-dyed bait.

The Council additionally directed staff to prepare a discussion paper for the March 2019 Council Meeting to evaluate the effect of potential removal of blue-dyed bait without additional replacement measures on seabird interaction rates.

The Council, at its 176th meeting held in March 2019, endorsed additional strategies for identifying alternative measures and improving seabird measure effectiveness for the Hawaii deep-set longline fishery including addressing captain effects through strategic outreach, identifying tori line designs suitable for the Hawaii fishery, encouraging trials for making minor modifications to existing required measures, and progressing international bycatch assessments for North Pacific albatross species. In 2020, a cooperative research project by the Council, NMFS and the Hawaii Longline Association was completed. The project conducted 1) demonstration and trial of tori lines in the Hawaii longline fishery to inform minimum standards specific to this fishery, and 2) field trials of tori lines to collect data on operational practicality and effectiveness in using tori lines under commercial fishing operations. The results from the study indicate that tori lines are effective in reducing albatross contacts and attempts on baited hooks when used in conjunction with existing seabird bycatch mitigation measures in the Hawaii deep-set longline fishery. Specifically, the results indicate that albatrosses contacts are about 3 times less likely, and attempts about 2 times less likely when tori lines are used (Gilman et al. 2021).

The Council at its 183rd meeting in September 2020 recommended additional at-sea trials for winter 2020/spring 2021 to test tori line efficacy without the use of blue-dyed bait when fishing north of 23N under an Experimental Fishing Permit (EFP) to inform development of options for revising mitigation measures. The Council at its 183rd Meeting 2020 also directed staff to develop an options paper to consider inclusion of tori lines in the seabird mitigation measures, including an option to allow the use of tori lines without blue-dyed bait. The Council at its 184th Meeting reviewed the options paper, and recommended development of a regulatory amendment to evaluate options for allowing the use of tori lines in lieu of blue-dyed bait and removing the strategic offal discharge requirement in the DSLL fishery. The Council also indicated its intent to schedule further action on the DSLL fishery when the results of an ongoing Experimental Fishing Permit (EFP) study are available later in 2021.

NMFS received an EFP application from the Hawaii Longline Association in November 2020, and the Council at its 184th Meeting in December 2020 recommended the issuance of the EFP. NMFS issued the EFP on January 27, 2021. Field trials for the EFP study were conducted from February to June 2021. The results of the study were presented at the 187th Council meeting. The results showed that albatross attempts are 1.5 times less likely, contacts are 4 times less likely, and captures 14 times less likely on tori line sets compared to blue-dyed bait sets (Chaloupka et al. 2021).

The Council at the 187th Meeting in September 2021 considered initial action on the regulatory amendment, and recommended as preliminary preferred alternatives 1) replacing blue-dyed bait with tori line; and 2) removing strategic offal discard from the regulatory requirement, with the addition to include best practices training on offal management as part of the required annual protected species workshop. The Council directed staff to consider a contingency that would allow vessels to continue fishing if a tori pole breaks during a trip. Additionally, the Council directed staff to work with the Action Team to develop the necessary documentation including draft regulations for consideration of final action at the December 2021 meeting.

The Council at its 189th Meeting on December 7-9, 2021, took final action and recommended regulatory amendments under the Pelagic FEP to improve the overall operational practicality and mitigation efficacy of required measures for the Hawaii deep-set longline fishery. Specifically, the Council recommended replacing blue-dyed thawed bait and strategic offal discharge measures required for stern-setting deep-set longline vessels with a new tori line requirement. In lieu of a regulatory requirement for a strategic offal discharge measure, the Council recommended implementing best practices training on offal management as part of the annual protected species workshop, based on the best practices as presented, or any update thereof. The Council additionally recommended tori line regulatory specifications.

3.3.2.5.1 Comparison of Interactions with ITS

The short-tailed albatross ITS in the USFWS 2012 Biological Opinion for the Hawaii longline fishery is two incidental takes every five years in the deep-set fishery. Exceeding this number will lead to reinitiating consultation of the impact of this fishery on the species. Since there have been no observed takes of short-tailed albatrosses in the fishery, the ITS has not been exceeded as of the end of 2022.

Table 76. Observed takes, mortalities (M), takes per fishing effort (sets and 1,000 hooks), and estimated annual takes using expansion factor estimates and ME for albatross species in the Hawaii deep-set longline fishery, 2002-2022[a]

Year	Obs. Cov. (%)	Sets	Hooks	Laysan albatross				Black-footed albatross				Unidentified albatross				Short-tailed albatross
				Observed		EF Est.	ME	Observed		EF Est.	ME	Observed		EF Est.	ME	Observed
				Takes (M)	Takes/ 1,000 hooks			Takes (M)	Takes/ 1,000 hooks			Takes (M)	Takes/1,000 hooks			Takes (M)
2002	24.6	3,523	6,786,303	16(13)	0.0024	65	-	18(17)	0.0027	73	-	0	0.0000	-	-	0
2003	22.2	3,204	6,442,221	44(44)	0.0068	198	-	24(23)	0.0037	108	-	0	0.0000	-	-	0
2004	24.6	3,958	7,900,681	2(2)	0.0003	-	10	4(4)	0.0005	-	16	0	0.0000	-	-	0
2005	26.1	4,602	9,360,671	6(6)	0.0006	-	43	12(12)	0.0013	-	82	0	0.0000	-	-	0
2006	21.2	3,605	7,540,286	1(1)	0.0001	-	7	17(17)	0.0023	-	70	0	0.0000	-	-	0
2007	20.1	3,506	7,620,083	7(7)	0.0009	-	44	14(14)	0.0018	-	77	0	0.0000	-	-	0
2008[d]	21.7	3,915	8,775,951	14(13)	0.0016	-	55	34(33)	0.0039	-	118	0	0.0000	-	-	0
2009	20.6	3,520	7,877,861	18(18)	0.0023	-	60	23(23)	0.0029	-	110	0	0.0000	-	-	0
2010	21.1	3,580	8,184,127	39(38)	0.0048	-	155	17(17)	0.0021	-	65	0	0.0000	-	-	0
2011	20.3	3,540	8,260,092	32(31)	0.0039	-	187	13(12)	0.0016	-	73	0	0.0000	-	-	0
2012	20.4	3,659	8,768,728	30(25)	0.0034	-	136	35(35)	0.0040	-	167	0	0.0000	-	-	0
2013	20.4	3,830	9,278,133	48(46)	0.0052	-	236	50(47)	0.0054	-	257	0	0.0000	-	-	0
2014	20.8	3,831	9,608,244	13(10)	0.0014	-	77	32(29)	0.0033	-	175	0	0.0000	-	-	0
2015	20.6	3,728	9,393,234	24(22)	0.0026	-	119	107(92)	0.0114	-	541	0	0.0000	-	-	0
2016	20.1	3,880	9,872,439	34(32)	0.0034	-	166	104(99)	0.0105	-	485	1(1)	0.0003	-	7	0
2017	20.4	3,832	10,148,195	38(38)	0.0037	-	226	97(85)	0.0096	-	471	0	0.0000	0	-	0
2018	20.4	4,332	11,751,144	33(29)	0.0028	-	157	194(168)	0.0165	-	931	0	0.0000	0	-	0
2019	20.5	4,697	12,948,077	45(44)	0.0035	-	231	146(139)	0.0113	-	767	0	0.0000	0	-	0
2020	15.25	3,131	8,738,011	59(55)	0.0068	-	315	96(87)	0.0110	-	590	0	0.0000	0	-	0
2021	17.84	3,972	11,454,331	38(35)	0.0033	-	244	87(80)	0.0076	-	536	0	0.0000	0	-	0
2022	20.22	4,314	12,473,293	56(56)	0.0045	-	366	47(45)	0.0038	-	269	0	0.0000	0	-	0

[a] Take data are based on vessel arrival dates.
Source: Take data—2002-2019 PIRO Observer Program Annual and Quarterly Status Reports, PIRO Sustainable Fisheries Division unpublished data.
ME—McCracken, 2005; McCracken, 2006; McCracken, 2007; McCracken, 2008; McCracken, 2009; McCracken, 2010; McCracken, 2011b; McCracken, 2012; McCracken, 2013; McCracken, 2014; McCracken, 2017c; McCracken, 2017d; McCracken 2019d; McCracken and Cooper 2020b; McCracken and Cooper 2022a; McCracken and Cooper (in review).

Table 77. Observed takes, mortalities (M), takes per fishing effort (sets and 1,000 hooks), and estimated annual takes using expansion factor estimates and ME for other seabird species in the Hawaii deep-set longline fishery, 2002-2022[a]

Year	Obs. Cov. (%)	Sets	Hooks	Booby species				Sooty shearwater			Unidentified shearwater				Unidentified gull			
				Observed				Observed			Observed				Observed			
				Takes (M)	Takes/ 1,000 hooks	EF Est.	ME	Takes (M)	Takes/ 1,000 hooks	EF Est.	Takes (M)	Takes/ 1,000 hooks	EF Est.	ME	Takes (M)	Takes/ 1,000 hooks	EF Est.	ME
2002	24.6	3,523	6,786,303	0	0.0000	0	-	0	0.0000	0	0	0.0000	0	-	0	0.0000	-	-
2003	22.2	3,204	6,442,221	0	0.0000	0	-	0	0.0000	0	0	0.0000	0	-	0	0.0000	-	-
2004	24.6	3,958	7,900,681	0	0.0000	0	-	0	0.0000	0	2(2)	0.0003	8	-	0	0.0000	-	-
2005	26.1	4,602	9,360,671	1(1)[b]	0.0001	4	-	0	0.0000	0	0	0.0000	0	-	0	0.0000	-	-
2006	21.2	3,605	7,540,286	0	0.0000	0	-	3(3)	0.0004	14	2(2)[c]	0.0003	9	-	0	0.0000	-	-
2007	20.1	3,506	7,620,083	0	0.0000	0	-	0	0.0000	0	0	0.0000	0	-	0	0.0000	-	-
2008[d]	21.7	3,915	8,775,951	1[e]	0.0001	-	4	0	0.0000	0	14(14)[c]	0.0016	-	62	0	0.0000	-	-
2009	20.6	3,520	7,877,861	0	0.0000	-	0	0	0.0000	0	4(4)[c]	0.0005	-	24	0	0.0000	-	-
2010	21.1	3,580	8,184,127	0	0.0000	-	0	0	0.0000	0	1(1)[c]	0.0001	-	0	0	0.0000	-	-
2011	20.3	3,540	8,260,092	0	0.0000	-	0	0	0.0000	0	3(3)[c]	0.0004	-	19	0	0.0000	-	-
2012	20.4	3,659	8,768,728	0	0.0000	-	0	1(1)	0.0001	5	6(6)[c]	0.0007	-	36	0	0.0000	-	-
2013	20.4	3,830	9,278,133	0	0.0000	-	0	0	0.0000	0	8(8)[c]	0.0009	-	43	0	0.0000	-	-
2014	20.8	3,831	9,608,244	0	0.0000	-	0	0	0.0000	0	1(1)[c]	0.0001	-	7	0	0.0000	-	-
2015	20.6	3,728	9,393,234	1(1)[g]	0.0001	-	6	5(4)	0.0005	5	0	0.0000	-	21[f]	0	0.0000	-	-
2016	20.1	3,880	9,872,439	2(1)[g]	0.0002	-	12	4(4)	0.0004	20	0	0.0000	0	-	0	0.0000	-	-
2017	20.4	3,832	10,148,195	0	0.0000	-	0	0	0.0000	0	0	0.0000	-	0	1	0.0001	-	6
2018	20.4	4,332	11,751,144	2(2)[h]	0.0002	-	11	0	0.0000	0	10(10)	0.0009	-	40	0	0.0000	-	0
2019	20.5	4,697	12,948,077	1(1)[i]	0.0001	-	4	0	0.0000	0	0	0.0000	-	0	0	0.0000	-	0
2020	15.25	3,131	8,738,011	1(1)[j]	0.0001	-	5	1(1)	0.0001	7	0	0.0000	-	0	0	0.0000	-	0
2021	17.84	3,972	11,454,331	0	0.0000	0	-	0	0.0000	-	2	0.0000	-	9	0	0.0000	0	-
2022	20.22	4,314	12,473,293	1(1)j	0.0001	-	6	0	0.0000	0	0	0.0000	0	-	0	0.0000	0	-

[a] Take data are based on vessel arrival dates.
[b] This animal was identified as a brown booby on the 2005 PIRO Observer Program Annual and Quarterly Status reports.
[c] These were later identified as sooty shearwaters in NMFS Seabird Interactions and Mitigation Efforts in Hawaii Longline Fisheries (Seabird Annual Report).
[d] One *unidentified seabird* was released injured in the second quarter of 2008 (takes/1,000 hooks < 0.001, ME = 2).
[e] This animal was identified as a red-footed booby on the 2008 PIRO Observer Program Annual and Quarterly Status reports.
[f] These birds were identified as sooty shearwaters in the 2015 PIRO Observer Program Annual and Quarterly Status reports.
[g] These birds were identified as red-footed boobies in the 2015 and 2016 PIRO Observer Program Annual and Quarterly Status reports.
[h]One of the booby species was identified as a red-footed booby and one was identified as a brown booby on the 2018 PIRO Observer Program Annual and Quarterly Status reports.
[I] This animal was identified as a brown booby in the 2019 PIRO Observer Program Annual and Quarterly Status reports.
[j] This animal was identified as a brown booby in the unpublished observer data.
Source: Take data—2002-2020 PIRO Observer Program Annual and Quarterly Status Reports, PIRO Sustainable Fisheries Division unpublished data.
ME—McCracken, 2005; McCracken, 2006; McCracken, 2007; McCracken, 2008; McCracken, 2009; McCracken, 2010; McCracken, 2011b; McCracken, 2012; McCracken, 2013; McCracken, 2014; McCracken, 2017c; McCracken, 2017d; McCracken 2019d; McCracken and Cooper 2020b, McCracken and Cooper 2022a, McCracken and Cooper (in review).

3.3.2.6 ELASMOBRANCH INTERACTIONS IN THE HAWAII DEEP-SET LONGLINE FISHERY

Table 78 summarizes the incidental take data for the Indo-west Pacific DPS of scalloped hammerhead sharks, oceanic whitetip sharks, and giant manta rays in the Hawaii deep-set longline fishery. The most common observed interactions from 2004 to 2022 were of oceanic whitetip sharks, with giant manta rays observed infrequently. Three observed interactions with the Indo-west Pacific DPS of scalloped hammerhead shark have been recorded since 2004. Observed take data are expanded to represent the estimated number of annual incidental takes for the entire fishery by PIFSC (referred to in this document as "ME"). When ME are not available, a standard expansion factor estimate is listed in the table (EF Est. = 100 / % observer coverage * # takes).

The scalloped hammerhead shark data only include interactions that occurred within the range of the Indo-west Pacific DPS of scalloped hammerhead sharks, and do not include interactions occurred within the range of the Central Pacific DPS, which is not listed under the ESA. Giant manta rays were listed under the ESA on January 22, 2018 (83 FR 2916), and oceanic whitetip sharks were listed on January 30, 2018 (83 FR 4153).

In an effort to reduce impacts to oceanic whitetip sharks in the Hawaii deep-set longline fishery, the Hawaii Longline Association (HLA) announced in late 2020 that its members, comprising more than 90% of the Hawaii deep-set longline fleet of approximately 146 active vessels, would voluntarily switch from wire to monofilament leaders. At the 186th meeting in June 2021, the Council recommended that wire leaders be prohibited in the Hawaii deep-set fishery, along with the requirement to remove trailing gear in all longline fisheries operating under the Pelagic FEP. The proposed rule for this regulatory amendment was published on January 19, 2022 (87 FR 2742) and the final rule published on April 28, 2022 (87 FR 25153) with an effective date of May 31, 2022.

Table 78. Observed takes, mortalities (M), takes per fishing effort (sets and 1,000 hooks), and estimated annual takes using expansion factor estimates and ME for ESA-listed elasmobranch species in the Hawaii deep-set longline fishery, 2004-2022[a]

Year	Obs. Cov. (%)	Sets	Hooks	Scalloped hammerhead shark				Oceanic whitetip shark				Giant manta ray			
				Observed		EF Est.	ME	Observed		EF Est.	ME	Observed		EF Est.	ME
				Takes (M[b])	Takes/ 1,000 hooks			Takes (M[b])	Takes/ 1,000 hooks			Takes (M[b])	Takes/ 1,000 hooks		
2004	24.6	3,958	7,900,681	2	0.0003	-	6	434(101)	0.0549	-	2,938	1	0.0001	-	3
2005	26.1	4,602	9,360,671	0	0.0000	-	0	341(80)	0.0364	-	1,282	2	0.0002	-	7
2006	21.2	3,605	7,540,286	0	0.0000	-	0	331(78)	0.0439	-	1,346	2(1)	0.0003	-	11
2007	20.1	3,506	7,620,083	1	0.0001	-	7	262(72)	0.0344	-	1,341	2	0.0003	-	5
2008	21.7	3,915	8,775,951	0	0.0000	-	0	144(36)	0.0164	-	741	2	0.0002	-	10
2009	20.6	3,520	7,877,861	0	0.0000	-	0	244(55)	0.0310	-	1,236	4	0.0005	-	23
2010	21.1	3,580	8,184,127	0	0.0000	-	0	253(44)	0.0309	-	1,198	17(1)	0.0021	-	95
2011	20.3	3,540	8,260,092	0	0.0000	-	0	225(43)	0.0272	-	1,176	1	0.0001	-	5
2012	20.4	3,659	8,768,728	0	0.0000	-	0	172(38)	0.0196	-	878	2	0.0002	-	11
2013	20.4	3,830	9,278,133	0	0.0000	-	0	196(36)	0.0211	-	973	1	0.0001	-	5
2014	20.8	3,831	9,608,244	0	0.0000	-	0	374(68)	0.0389	-	1,670	3	0.0003	-	11
2015	20.6	3,728	9,393,234	0	0.0000	-	0	531(139)	0.0565	-	2,654	2	0.0002	-	10
2016	20.1	3,880	9,872,439	0	0.0000	-	0	423(123)	0.0428	-	2,188	4	0.0004	-	22
2017	20.4	3,832	10,148,195	0	0.0000	-	0	242(57)	0.0238	-	1,257	0	0.0000	-	0
2018	20.4	4,332	11,751,144	0	0.0000	-	0	224(62)	0.0191	-	1,092	1	0.0001	-	3
2019	20.5	4,697	12,948,077	0	0.0000	-	0	435(99)	0.0336	-	2,125	0	0.0000	-	0
2020	15.25	3,131	8,738,011	0	0.0000	0	-	302(83)	0.0346	-	1,959	1	0.0001	-	7
2021	17.84	3,972	11,454,331	0	0.0000	0	-	522(103)	0.0456	-	3,084	2(2)	0.0002	-	11
2022	20.22	4,314	12,473,293	0	0.0000	-	0	480(130)	0.0385	-	2,362	0	0.0000	-	0

[a] Take data are based on vessel arrival dates.
[b] Mortality numbers include animals that were released dead, finned (prior to passage of the Shark Conservation Act of 2010), and kept.
Source: NMFS 2014 (2004-2013), PIRO Sustainable Fisheries Division unpublished data (2014-2018), McCracken 2019b; McCracken and Cooper 2020a; McCracken and Cooper 2021b.

3.3.2.6.1 Comparison of Interactions with ITS

An ITS is not required to provide protective coverage for the ESA listed elasmobranchs including the Indo-west Pacific scalloped hammerhead shark DPS, the oceanic whitetip shark, or the giant manta ray, because there are no take prohibitions under ESA section 4(d) for these species. However, ITS were included for these species in their relevant Biological Opinions to serve as a check on the no-jeopardy conclusions by providing a reinitiation trigger.

For the Indo-west Pacific scalloped hammerhead DPS, NMFS included an ITS of 6 interactions over a three-year period in the 2014 Biological Opinion (NMFS 2014). NMFS uses a rolling three-year period to track incidental take. NMFS counts takes for the Indo-west Pacific DPS of scalloped hammerhead shark based on the end of haul incidental take date. NMFS uses data from condition at time of release to calculate shark mortality rates. Interactions since 2017 are monitored against this ITS, and there has been no observed interaction with this DPS through the end of 2022.

On September 28, 2022, NMFS issued a no-jeopardy supplemental biological opinion on the agency's authorization of the Hawaii deep-set longline fishery (NMFS 2022). The 2022 Supplement addresses the Hawaii deep-set longline fishery's impacts to oceanic whitetip sharks and giant manta rays and concluded that the authorization of the deep-set longline fishery as currently managed is not likely to jeopardize their continued existence. NMFS included in this supplement, ITSs of 6,336 interactions with the oceanic whitetip shark and 144 interactions with the giant manta ray over a five-year running period (Table 79). Exceeding either of these numbers over 5 consecutive years will lead to reinitiating consultation of the impact of this fishery on these species.

Table 79. Estimated total interactions (extrapolated using quarterly observer coverage) of oceanic whitetip sharks and giant manta rays in the Hawaii deep-set longline fishery compared to the 5-year running sum ITS in the 2022 Supplement to the 2014 Biological Opinion[a]

Species	5-year Running Sum ITS	Estimated Total Interactions in 2022
Oceanic whitetip shark	6,336	2,291
Giant manta ray	144	0
Manta/Mobula[b]		27

[a] Take data are based on haul dates.

[b] 20% of manta/mobula interactions are also tracked as the ITS for giant manta ray was based on interaction data that included rays classified as manta/mobula in the observer record that may have been giant manta rays

3.3.2.6.2 Effectiveness of FEP Conservation Measures

In June 2021, the Council recommended a regulatory amendment that would prohibit wire leaders in the Hawaii deep-set fishery and require removal of trailing gear for oceanic whitetip sharks in all longline fisheries operating under the Pelagic FEP. The rule change took effect in May 2022.

During 2021, the Hawaii deep-set longline fleet initiated the voluntary transition from wire to monofilament nylon leaders. Figure 158 shows the monthly proportion of leader material used for observed sets, with most of the vessels using monofilament nylon leaders by December 2021.

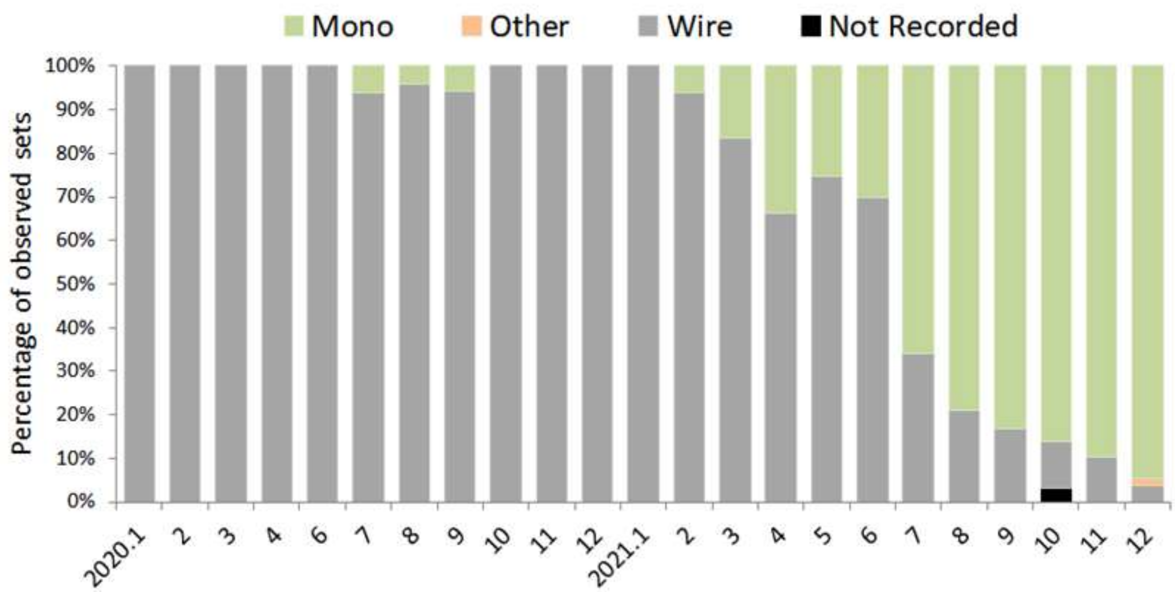


Figure 158. Leader material (based on observed sets) used in the Hawaii deep-set longline fishery by month before and during the voluntary transition period (2020–2021)

3.3.3 AMERICAN SAMOA LONGLINE FISHERY

3.3.3.1 INDICATORS FOR MONITORING PROTECTED SPECIES INTERACTIONS AND EFFECTIVENESS OF MANAGEMENT MEASURES IN THE AMERICAN SAMOA LONGLINE FISHERY

In this annual report, the Council monitors protected species interactions in the American Samoa longline fishery using the following indicators:

- General interaction trends over time
- Effectiveness of FEP conservation measures
- Take levels compared to the incidental take statement levels under ESA
- Take levels compared to marine mammal PBRs, where applicable

Details of these indicators are discussed below.

3.3.3.1.1 FEP Conservation Measures

The Pelagic FEP includes conservation measures to mitigate sea turtle interactions in the American Samoa longline fishery. These measures include the following:

- Longline vessel owners/operators are required to adhere to regulations for safe handling and release of sea turtles and seabirds.
- Longline vessel owners/operators must have on board the vessel all required turtle handling/dehooking gear specified in regulations.
- Longline vessel owners/operators are required to remove trailing gear from oceanic whitetip sharks and cut the line as close to the hook as possible.

- Longline vessel owners/operators are required to annually complete a protected species workshop.
- Owners and operators of vessels longer than 40 ft (12.2 m) must use longline gear that meet the following requirements:
    - Each float line must be at least 30 m long.
    - At least 15 branch lines must be attached to the mainline between any two float lines attached to the mainline.
    - Each branch line must be at least 10 m long.
    - No branch line may be attached to the mainline closer than 70 m to any float line.

Additionally, the American Samoa longline fishery has had observer coverage since 2006.

3.3.3.1.2 ESA Consultations

During 2022, the American Samoa longline fishery was covered under a NMFS Biological Opinion dated October 30, 2015 (NMFS 2015) and associated supplements. NMFS concluded in the 2015 Biological Opinion that the fishery is not likely to jeopardize five sea turtle species (South Pacific DPS loggerhead, leatherback, olive ridley, green and hawksbill turtles) and the Indo-West Pacific DPS of scalloped hammerhead sharks, and not likely to adversely affect six species of reef-building corals (Table 80). The 2015 Biological Opinion also included a Conference Opinion for the green turtle DPSs and an ITS, which became effective at the time of the final listing in 2016 (81 FR 20058, April 5, 2016). Several informal consultations conducted by NMFS and USFWS have concluded that the fishery is not likely to adversely affect two marine mammal species (humpback and sperm whale) or the Newell's shearwater. NMFS has also determined that the fishery has no effect on three marine mammal species (fin, blue, and sei whale) or three petrel species (Chatham, Fiji, and magenta petrel).

NMFS and USFWS have issued ITSs for species with a non-jeopardy determination in the Biological Opinions (Table 81). Exceeding the three-year ITSs requires reinitiation of consultation on the fishery under the ESA.

On April 3, 2019, NMFS reinitiated ESA Section 7 consultation for the American Samoa deep-set fishery for all ESA-listed species under NMFS jurisdiction occurring in the action area due to several re-initiation triggers: listing of the oceanic whitetip shark, giant manta ray, and chambered nautilus; and exceeding the ITS for the east Indian west Pacific, southwest Pacific, central South Pacific, and east Pacific green sea turtle DPS; hawksbill; and olive ridley sea turtles in 2018. On April 3, 2019, May 6, 2020, July 13, 2021, August 29, 2022, NMFS determined that the conduct of the fishery during the period of consultation will not violate ESA Sections 7(a)(2) and 7(d).

On October 27, 2022, NMFS issued a Supplemental Biological Opinion to the 2015 Biological Opinion for the two new listed species, and concluded that the deep-set fishery is not likely to jeopardize the continued existence of the oceanic whitetip shark and giant manta ray.

On May 15, 2023, NMFS issued a Biological Opinion covering all applicable ESA-listed species, which concluded that the fishery is not likely to jeopardize the following species: Leatherback sea turtle, green sea turtles in the East Pacific, East Indian-West Pacific, Southwest Pacific, Central West Pacific and Central South Pacific; olive ridley sea turtles; hawksbill sea turtles, oceanic whitetip sharks, Indo-West Pacific scalloped hammerhead sharks, and giant manta ray. The new ITSs took effect when the new Biological Opinion was signed, thus did not apply in 2022.

Table 80. Summary of ESA consultations for the American Samoa longline fishery

Species	Consultation Date	Consultation Type[a]	Outcome[b]
Loggerhead turtle, South Pacific DPS	2015-10-30	BiOp	LAA, non-jeopardy
Leatherback turtle	2015-10-30	BiOp	LAA, non-jeopardy
Olive ridley turtle	2015-10-30	BiOp	LAA, non-jeopardy
Green turtle, Central South Pacific DPS	2015-10-30	BiOp	LAA, non-jeopardy
Green turtle, Southwest Pacific DPS	2015-10-30	BiOp	LAA, non-jeopardy
Green turtle, East Pacific DPS	2015-10-30	BiOp	LAA, non-jeopardy
Green turtle, Central West Pacific DPS	2015-10-30	BiOp	LAA, non-jeopardy
Green turtle, East Indian-West Pacific DPS	2015-10-30	BiOp	LAA, non-jeopardy
Hawksbill turtle	2015-10-30	BiOp	LAA, non-jeopardy
Humpback whale	2010-07-27	LOC	NLAA
Fin whale	2010-05-12	No Effects Memo	No effect
Blue whale	2010-05-12	No Effects Memo	No effect
Sei whale	2010-05-12	No Effects Memo	No effect
Sperm whale	2010-07-27	LOC	NLAA
Scalloped hammerhead shark, Indo-West Pacific DPS	2015-10-30	BiOp	LAA, non-jeopardy
Oceanic whitetip shark	2022-10-27	BiOpc	LAA, non-jeopardy
Giant manta ray	2022-10-27	BiOpc	LAA, non-jeopardy
Reef-building corals	2015-10-30	BiOp	NLAA
Newell's shearwater	2011-05-19	LOC (FWS)	NLAA
Chatham petrel	2011-07-29	No Effects Memo	No effect
Fiji petrel	2011-07-29	No Effects Memo	No effect
Magenta petrel	2011-07-29	No Effects Memo	No effect

[a] BiOp = Biological Opinion; LOC = Letter of Concurrence.
[b] LAA = likely to adversely affect; NLAA = not likely to adversely affect.
[c] Supplement to the 2015 BiOp.

Table 81. Summary of ITSs for the American Samoa longline fishery

Species	ITS Time Period	Takes	Mortalities	Source BiOp
Loggerhead turtle, South Pacific DPS	3-year	6	3	NMFS 2015
Leatherback turtle	3-year	69	49	NMFS 2015
Olive ridley turtle	3-year	33	10	NMFS 2015
Green turtle, Central South Pacific DPS[a]	3-year	30	27	NMFS 2015
Green turtle, Southwest Pacific DPS[a]	3-year	20	17.82	NMFS 2015
Green turtle, East Pacific DPS[a]	3-year	7	6.48	NMFS 2015
Green turtle, Central West Pacific DPS[a]	3-year	2	1.62	NMFS 2015
Green turtle, East Indian-West Pacific DPS[a]	3-year	1	1.08	NMFS 2015
Hawksbill turtle	3-year	6	3	NMFS 2015
Scalloped hammerhead shark, Indo-West Pacific DPS[b]	3-year	36	12	NMFS 2015
Oceanic whitetip shark	5-year running sum	3,520		NMFS 2022
Giant manta ray	5-year running sum	57		NMFS 2022

[a] The green turtle DPS-specific ITSs became effective in May 2016 when the DPS listings were finalized.
[b] An ITS is not required for the Indo-West Pacific DPS of scalloped hammerhead sharks, oceanic whitetip sharks and giant manta ray due to the lack of take prohibition under ESA section 4(d), but NMFS included an ITS to serve as a check on the no-jeopardy conclusion by providing a re-initiation trigger.

3.3.3.1.3 Non-ESA Marine Mammals

Fishery impacts to marine mammal stocks are primarily assessed and monitored through the SARs prepared pursuant to the MMPA. The SARs include detailed information on these species' geographic range, abundance, PBR estimates, bycatch estimates, and status. The most recent SARs are available online at https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-stock-assessment-reports-region.

The American Samoa longline fishery is a Category II under the MMPA 2023 LOF (88 FR 16899, March 21, 2023), meaning that this fishery has occasional incidental mortality and serious injuries of marine mammals. The 2023 LOF lists the following marine mammal stocks that are incidentally killed or injured in this fishery:

- False killer whale, American Samoa stock
- Rough-toothed dolphin, American Samoa stock
- Short-finned pilot whale, unknown stock
- Stiped dolphin, unknown stock

Most bycatch estimates in the SARs are based on the most recently available 5-year period, but there is a data lag of approximately two years due to the SAR review process. This annual report focuses on available long-term interaction trends and summarizes relevant information from the most recent SAR.

3.3.3.2 DATA SOURCE FOR MONITORING PROTECTED SPECIES INTERACTIONS IN THE AMERICAN SAMOA LONGLINE FISHERY

Protected species interactions in the American Samoa longline fishery have been monitored through mandatory observer coverage since 2006. Observer coverage in the fishery ranged between 6 and 8 percent from 2006-2009, increased to 25 percent in 2010 and 33 percent in 2011. Coverage ranged between 15-22 percent in 2012-2019.

In response to the emerging COVID-19 crisis, and to ensure the safety and protect the health of fishermen, observers, and others, NMFS issued an emergency action on March 27, 2020 (85 FR 17285), to provide the authority, on a case-by-case basis, to waive observer coverage. This action was extended on September 21, 2020 (85 FR 59199) and again on March 29, 2021 (86 FR 16307). Under this emergency action, a NMFS Regional Administrator, Office Director, or Science Center Director had the ability to waive observer coverage requirements if:

- Local, state, or national governments, or private companies or organizations that deploy observers pursuant to NMFS regulations, restrict travel or otherwise issue COVID-19-related social control guidance, or requirement(s) addressing COVID-19-related concerns, such that it is inconsistent with the requirement(s) or not recommended to place an observer(s); or
- No qualified observer(s) are available for placement due to health, safety, or training issues related to COVID-19.

The PIRO Regional Administrator granted waivers on a case-by-case basis consistent with the emergency rule resulting in reduced coverage for the American Samoa longline fishery for 2020 at 2.13%, for 2021 at 4.65%, and for 2022 at 8.70%. Observer coverage remained below pre-COVID-19 rates in 2022 for this fishery due to the logistics and costs of deploying observers in American Samoa. NMFS is looking into designing a program that would allow for easier hire of local observers to increase coverage rates.

This report summarizes protected species interactions in the American Samoa longline fishery since 2006. Data for 2020 and 2021 are not reported due to data confidentiality rules associated with the low observer coverage. Annual observed interactions are tallied based on vessel arrival date (rather than interaction date) for the purposes of this report for consistency with the methods used to estimate the annual total interactions. Comparison of annual incidental takes within a year to the ITSs are based on the interaction date rather than the vessel arrival date, consistent with the 2015 Biological Opinion and associated supplements. Annual summary data presented in this report may differ from those in the PIRO Observer Program Quarterly and Annual Reports, which began summarizing interaction data by haul begin dates (proxy for interaction date) in 2021.

3.3.3.3 SEA TURTLE INTERACTIONS IN THE AMERICAN SAMOA LONGLINE FISHERY

Table 82 summarizes the incidental take data of sea turtles from 2006 to 2022 in the American Samoa longline fishery. The incidental take data in this section were compiled from the PIRO Observer Program Annual Status Reports and are for monitoring purposes. Many of these interactions have been further examined by NMFS, and updated information necessary for any data analyses is available from PIFSC. Observed take data are expanded to represent the estimated number of incidental takes for the entire fishery by PIFSC (referred to in this document as “McCracken estimates (ME)”). When ME are not available, a standard expansion factor estimate is used (EF Est. = 100 / % observer coverage * # takes). PIFSC generated estimated number of interactions for 2020-2021 based on observer data from 2012-2020 (McCracken and Cooper 2022a, 2022e).

Between 2006 and 2019, the PIRO Observer Program reported interactions with green, leatherback, olive ridley, and hawksbill sea turtles, but no observed interactions were reported with loggerhead sea turtles. The highest observed interaction rate involved green sea turtles, whereas interactions with leatherbacks, olive ridleys, and hawksbills were less frequent. 2020 and 2021 data cannot be reported due to confidentiality rules.

Green sea turtle takes were variable year to year, ranging between 0-11 observed takes (0-50 expanded annual estimated takes). From 2016 to 2019, four annual interactions per year with green turtles were observed, all of which resulted in mortalities. The interaction rate in 2018 was the highest since 2006. At its 170th Meeting in June 2017, the Council recommended evaluation of the effectiveness of the 2011 green turtle measure that required gear configuration to set hooks below 100 meters in the American Samoa longline fishery. PIFSC in response indicated they do not recommend evaluation at that time due to the low statistical power. At its 173rd Meeting in June 2018, the Council recommended PIFSC conduct an economic cost-benefit analysis on the use of large circle hooks in the American Samoa longline fishery to determine whether modifying the green turtle mitigation measures in the fishery may contribute to further reductions in interactions in the fishery without significant negative impacts on fishery operations and revenue. In response, PIFSC conducted a feasibility assessment for conducting a cost-benefit analysis, which indicated that a detailed analysis is not likely to provide new information beyond what is known from the Council-funded large circle hook study (Curran and Beverly 2012) due to data limitations (Raynor 2018).

All leatherback, olive ridley, and hawksbill sea turtle interactions were observed after 2010, with hawksbill interactions first occurring in 2016. Observer coverage was relatively low in 2006-2009 when interactions with these species were not observed (average observer coverage = 10.8%) compared to 2010-2019 (above 15%). Since leatherback, olive ridley, and hawksbill interactions with this fishery are relatively uncommon, it is possible the recent occurrence of interactions after 2010 is due to higher observer coverage as opposed to a true increase in interactions in the fishery.

Table 82. Observed takes, mortalities (M), takes per fishing effort (1,000 hooks), estimated annual takes using expansion factor estimates and ME for sea turtles in the American Samoa longline fishery, 2006-2022[a]

Year	Obs. Cov. (%)	Sets	Hooks	Green				Leatherback				Olive ridley				Hawksbill			
				Observed		EF Est.	ME	Observed		EF Est.	ME	Observed		EF Est .	ME	Observed		EF Est.	ME
				Takes (M)	Takes/ 1,000 hooks			Takes (M)	Takes/ 1,000 hooks			Takes (M)	Takes/ 1,000 hooks			Takes (M)	Takes/ 1,000 hooks		
2006	8.1	287	797,221	3(3)	0.0038	37	-	0	0.0000	0	-	0	0.0000	0	-	0	0.0000	-	-
2007	7.1	410	1,255,329	1(1)	0.0008	14	-	0	0.0000	0	-	0	0.0000	0	-	0	0.0000	-	-
2008	6.4	379	1,194,096	1(1)	0.0008	16	-	0	0.0000	0	-	0	0.0000	0	-	0	0.0000	-	-
2009	7.7	306	880,612	3(3)	0.0034	39	-	0	0.0000	0	-	0	0.0000	0	-	0	0.0000	-	-
2010	25.0	798	2,301,396	6(5)	0.0026	-	50	0	0.0000	-	0	0	0.0000	-	0	0	0.0000	-	-
2011	33.3	1,257	3,605,897	11(10)	0.0031	-	32	2(1)	0.0006	-	4	1	0.0003	-	4	0	0.0000	-	-
2012	19.8	662	1,880,525	0	0.0000	-	0	1	0.0005	-	6	1(1)	0.0005	-	6	0	0.0000	-	-
2013	19.4	585	1,690,962	2(2)	0.0012	-	19	2(1)	0.0012	-	13	1	0.0006	-	4	0	0.0000	-	-
2014	19.4	565	1,490,416	2(2)	0.0013	-	17	0	0.0000	-	4	2	0.0013	-	5	0	0.0000	-	-
2015	22.0	504	1,441,706	0	0.0000	-	0	3(3)	0.0021	-	22	1	0.0007	-	6	0	0.0000	-	-
2016	19.4	424	1,179,532	4(4)	0.0034	-	17	1(1)	0.0008	-	3	3(3)	0.0025	-	12	1(1)	0.0008	-	4
2017	20.0	447	1,271,803	4(4)	0.0031	-	22	1	0.0008	-	3	2(2)	0.0016	-	12	0	0.0000	-	3
2018	17.5	276	732,476	4(4)	0.0055	-	20	1	0.0014	-	5	2(2)	0.0027	-	11	2(2)	0.0027	-	5
2019	15.7	380	1,087,860	4(4)	0.0037	-	26	1(1)	0.0009	-	7	3(3)	0.0028	-	29	0	0.0000	-	0
2020	2.13	*	*	*	*	*	11	*	*	*	7	*	*	*	6	*	*	*	2
2021	4.65	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
2022	8.70	90	260,768	0	0.0000	-	4	0	0.0000	-	2	1(1)	0.0038	-	8	0	0.0000	-	0

[a] Take data are based on vessel arrival dates.
*2020 and 2021 data are not reported due to confidentiality rules.
Source: Take data—2006-2020 PIRO Observer Program Annual and Quarterly Status Reports
ME—McCracken, 2015; McCracken, 2017a; McCracken 2019a; McCracken 2020b; McCracken and Cooper 2022a; McCracken and Cooper 2022e.

3.3.3.3.1 Comparison of Interactions with ITS

NMFS completed a Biological Opinion for the American Samoa longline fishery on October 30, 2015. The Biological Opinion includes data through June 30, 2015. NMFS began monitoring the American Samoa longline fishery ITS in the third quarter of 2015 and uses a rolling three-year period to track incidental take (Table 83). This table was not updated for the 2020 report due to data confidentiality. NMFS always uses the date of the interaction for tracking sea turtle interactions against the ITS, regardless of when the vessel returns to port. In the PIRO Observer Program Quarterly and Annual Reports, NMFS bases the percent observer coverage on vessel departures and bases sea turtle interactions on vessel arrivals. For this reason, the number of quarterly or annual interactions counted against an ITS may vary from those reported on the Observer Program's quarterly and annual reports. NMFS uses post-hooking mortality criteria (Ryder et al. 2006) to calculate sea turtle mortality rates.

On April 3, 2019, NMFS reinitiated ESA Section 7 consultation for the American Samoa deep-set fishery for all ESA-listed species under NMFS jurisdiction occurring in the action area due in part to exceeding the ITS for the east Indian west Pacific, southwest Pacific, central South Pacific, and east Pacific green sea turtle DPS, hawksbill turtle, and olive ridley turtles in 2018. NMFS determined that the conduct of the fishery during the period of consultation will not violate ESA Sections 7(a)(2) and 7(d).

Table 83. Estimated total interactions[a] (extrapolated using quarterly observer coverage) and total mortality (M) (using Ryder et al. 2006) of sea turtles in the American Samoa longline fishery compared to the 3-year Incidental Take Statement (ITS) in the 2015 Biological Opinion

Species	3-year ITS Interactions (M)	Estimated Total Interactions and Mortalities Interactions (M) [b,c]			
		2017-2019	2018-2020	2019-2021	2020-2022
Green turtle	60(54)	68(64.64)	46(43.72)	47(44.72)	21(20.28)
Central South Pacific DPS	30(27)	34(32.32)	23(21.86)	23.5(22.36)	10.5(10.14)
Southwest Pacific DPS	20(17.82)	22.44(21.33)	15.18(14.43)	15.51(14.76)	6.93(6.69)
East Pacific DPS	7(6.48)	8.16(7.76)	5.52(5.25)	5.64(5.37)	2.52(2.43)
Central West Pacific DPS	2(1.62)	2.04(1.94)	1.38(1.31)	1.41(1.34)	0.63(0.61)
East Indian-West Pacific DPS	1(1.08)	1.36(1.29)	0.92(0.87)	0.94(0.89)	0.42(0.41)
Leatherback turtle	69(49)	15(10.28)	12(8.29)	20(13.6)	13(8.62)
Olive ridley turtle	33(10)	43(32.92)	31(23.72)	33(24.6)	18(13.58)
Loggerhead turtle	6(3)	0	0	0	0
Hawksbill turtle	6(3)	8(8)	5(5)	4(4.0)	4 (4.0)

[a] Takes are counted based on interaction date.
[b] The green turtle DPS-specific ITSs became effective in May 2016 when the DPS listings were finalized.
[c] Estimated total interactions for the green turtle DPSs are prorated based on the estimated proportion of each green turtle DPS indicated in the 2015 BiOp (NMFS 2015).
[d] Estimated total interactions for 2021 were calculated using the number of observed interactions multiplied by the expansion factor.

3.3.3.4 MARINE MAMMAL INTERACTIONS IN THE AMERICAN SAMOA LONGLINE FISHERY

Table 84 summarizes the incidental take data of marine mammals from 2006 to 2022 in the American Samoa longline fishery. The incidental take data in this section were compiled from the PIRO Observer Program Annual Status Reports and are for monitoring purposes. Reported interactions listed in these tables reflect all observed interactions, including mortalities, serious injuries, and non-serious injuries. Refer to the most recent SARs for mortality and serious injury estimates and stock-specific abundance estimates and geographic range. Many of these interactions have been further examined by NMFS, and updated information necessary for any data analyses is available from PIFSC. Observed take data were expanded to represent the estimated number of incidental takes for the entire fishery using a standard expansion factor estimate (EF Est. = 100 / % observer coverage * # takes). PIFSC generated estimated number of interactions for 2020-2021 based on observer data from 2012-2020 (McCracken and Cooper 2022b, 2022g), and the logbook and observer data were also used to derive the 2021 estimates (McCracken and Cooper 2022g).

Observed marine mammal interactions with the American Samoa longline fishery between 2006 and 2019 were relatively infrequent with only one striped dolphin interactions in 2019. False killer whales had the highest interaction rate over this period, followed by rough-toothed dolphins, Cuvier's beaked whales, short-finned pilot whales, and 2 unidentified cetaceans. Between 2006 and 2022, there were 6 years of no observed marine mammal interactions with this fishery (2006, 2007, 2009, 2010, 2012, and 2022).

3.3.3.4.1 Comparison of Interactions with PBR under the MMPA

SARs are only available for four species of marine mammals for which stocks have been identified around American Samoa (humpback whale, false killer whale, rough-toothed dolphin, and spinner dolphin). PBR comparisons with estimates of mortality and serious injury are not available for American Samoa stocks of marine mammals due to the lack of abundance estimates.

Table 84. Observed takes, mortalities (M), takes per fishing effort (1,000 hooks), and estimated annual takes using expansion factor estimates for marine mammals in the American Samoa longline fishery, 2006-2022[a]

Year	Obs. Cov. (%)	Sets	Hooks	Cuvier's beaked whale			False killer whale				Rough-toothed dolphin				Short-finned pilot whale			Striped dolphin				Unidentified cetacean		
				Observed			Observed				Observed				Observed			Observed				Observed		
				Takes (M)	Takes/ 1,000 hooks	EF Est.	Takes (M)	Takes/ 1,000 hooks	EF Est.	ME	Takes (M)	Takes/ 1,000 hooks	EF Est.	ME	Takes (M)	Takes/ 1,000 hooks	EF Est.	Takes (M)	Takes/ 1,000 hooks	EF Est.	ME	Takes (M)	Takes/ 1,000 hooks	EF Est.
2006	8.1	287	797,221	0	0.0000	0	0	0.0000	0	-	0	0.0000	0	-	0	0.0000	0	0	0.0000	0	-	0	0.0000	0
2007	7.1	410	1,255,329	0	0.0000	0	0	0.0000	0	-	0	0.0000	0	-	0	0.0000	0	0	0.0000	0	-	0	0.0000	0
2008	6.4	379	1,194,096	0	0.0000	0	2(1)	0.0017	31	-	1	0.0008	16	-	0	0.0000	0	0	0.0000	0	-	0	0.0000	0
2009	7.7	306	880,612	0	0.0000	0	0	0.0000	0	-	0	0.0000	0	-	0	0.0000	0	0	0.0000	0	-	0	0.0000	0
2010	25.0	798	2,301,396	0	0.0000	0	0	0.0000	0	-	0	0.0000	0	-	0	0.0000	0	0	0.0000	0	-	0	0.0000	0
2011	33.3	1,257	3,605,897	1(1)	0.0003	3	3	0.0008	9	-	5	0.0014	15	-	0	0.0000	0	0	0.0000	0	-	2	0.0006	6
2012	19.8	662	1,880,525	0	0.0000	0	0	0.0000	0	-	0	0.0000	0	-	0	0.0000	0	0	0.0000	0	-	0	0.0000	0
2013	19.4	585	1,690,962	0	0.0000	0	1	0.0006	5	-	1(1)	0.0006	5	-	0	0.0000	0	0	0.0000	0	-	0	0.0000	0
2014	19.4	565	1,490,416	0	0.0000	0	0	0.0000	0	-	0	0.0000	0	-	1	0.0007	5	0	0.0000	0	-	0	0.0000	0
2015	22.0	504	1,441,706	0	0.0000	0	2(1)	0.0014	-	5	0	0.0000	-	0	0	0.0000	0	0	0.0000	-	0	0	0.0000	0
2016	19.4	424	1,179,532	0	0.0000	0	2	0.0017	-	10	2(2)	0.0017	-	10	0	0.0000	0	0	0.0000	-	0	0	0.0000	0
2017	20.0	447	1,271,803	0	0.0000	0	1	0.0008	-	6	1	0.0008	-	4	0	0.0000	0	0	0.0000	-	0	0	0.0000	0
2018	17.5	276	732,476	0	0.0000	0	1	0.0014	-	5	1(1)	0.0014	-	3	0	0.0000	0	0	0.0000	-	2	0	0.0000	0
2019	15.7	380	1,087,860	0	0.0000	0	0	0.0000	-	0	0	0.0000	-	0	0	0.0000	0	1	0.0009	-	5	0	0.0000	0
2020	2.13	*	*	*	*	*	1	*	-	5	1	*	-	3	0	*	-	0	0	*	-	0	*	*
2021	4.65	*	*	*	*	*	*	*	*		*	*	*		*	*	*		*	*	*		*	*
2022	8.70	90	260,768	0	0.0000	0	0	0.0000	0	-	0	0.0000	0	-	0	0.0000	0	-	0	0.0000	0	-	0	0.0000

[a] Take data are based on vessel arrival dates.

*2020 and 2021 data are not reported due to confidentiality rules.

Source: 2006-2020 PIRO Observer Program Annual and Quarterly Status Reports and unpublished observer data; McCracken 2020a; McCracken and Cooper 2022b; McCracken and Cooper 2022g.

3.3.3.5 SEABIRD INTERACTIONS IN THE AMERICAN SAMOA LONGLINE FISHERY

Table 85 summarizes the incidental take data of seabirds from 2006 to 2022 in the American Samoa longline fishery. The incidental take data in this section were compiled from the PIRO Observer Program Annual Status Reports and are for monitoring purposes. Many of these interactions have been further examined by NMFS, and updated information necessary for any data analyses is available from PIFSC. Observed take data are expanded to represent the estimated number of annual incidental takes for the entire fishery by PIFSC (referred to in this document as McCracken Estimates, or “ME”). When ME are not available, a standard expansion factor estimate is listed in the table (EF Est. = 100 / % observer coverage * # takes). 2020-2021 data cannot be reported due to confidentiality rules. PIFSC generated estimated number of interactions for 2020-2021 based on observer data from 2012-2020 (McCracken and Cooper 2022a, 2022e).

Observed seabird interactions with the American Samoa longline fishery between 2006 and 2022 were uncommon, including interactions with two unidentified shearwaters and one frigatebird. Additionally, the observer program report for 2015 included 13 observed interactions with black-footed albatrosses that occurred in the North Pacific with vessels departing American Samoa and landing in California. There was one unidentified shearwater was observed in 2019, and no other observed seabird interactions from 2016-2022.

Table 85. Observed takes, mortalities (M), takes per fishing effort (1,000 hooks), and estimated annual takes using expansion factor estimates and ME for seabirds in the American Samoa longline fishery, 2006-2022[a]

Year	Obs. Cov. (%)	Sets	Hooks	Black-footed Albatross				Unidentified shearwater				Unidentified frigatebird			
				Observed		EF Est.	ME	Observed		EF Est.	ME	Observed		EF Est.	ME
				Takes (M)	Takes/ 1,000 hooks			Takes (M)	Takes/ 1,000 hooks			Takes (M)	Takes/ 1,000 hooks		
2006	8.1	287	797,221	0	0.0000	0	-	0	0.0000	0	-	0	0.0000	0	-
2007	7.1	410	1,255,329	0	0.0000	0	-	1(1)	0.0008	14	-	0	0.0000	0	-
2008	6.4	379	1,194,096	0	0.0000	0	-	0	0.0000	0	-	0	0.0000	0	-
2009	7.7	306	880,612	0	0.0000	0	-	0	0.0000	0	-	0	0.0000	0	-
2010	25.0	798	2,301,396	0	0.0000	0	-	0	0.0000	-	0	0	0.0000	-	0
2011	33.3	1,257	3,605,897	0	0.0000	0	-	1(1)	0.0003	-	2	0	0.0000	-	0
2012	19.8	662	1,880,525	0	0.0000	0	-	0	0.0000	-	0	0	0.0000	-	0
2013	19.4	585	1,690,962	0	0.0000	0	-	0	0.0000	-	0	1(1)	0.0006	-	5
2014	19.4	565	1,490,416	0	0.0000	-	0	0	0.0000	0	-	0	0.0000	-	0
2015	22.0	504	1,441,706	13(13)[b]	0.0090	-	13	0	0.0000	0	-	0	0.0000	-	0
2016	19.4	424	1,179,532	0	0.0000	0		0	0.0000	-	0	0	0.0000	0	-
2017	20.0	447	1,271,803	0	0.0000	0	-	0	0.0000	-	0	0	0.0000	0	-
2018	17.5	276	732,476	0	0.0000	0	-	0	0.0000	-	0	0	0.0000	0	-
2019	15.7	380	1,087,860	0	0.0000	0	-	1(1)	0.0009	-	7	0	0.0000	0	-
2020	2.13	*	*	*	*	*	0	*	*	*	1	*	*	*	1
2021	4.65	*	*	*	*	*	0	*	*	*	1	*	*	*	1
2022	8.70	90	260,768	0	0.0000	0	-	0	0.0000	-	0	0	0.0000	-	0

[a] Take data are based on vessel arrival dates.
[b] These seabird interactions occurred in the North Pacific by vessels departing American Samoa and landing in California.
*2020 data are not reported due to confidentiality rules.
Source: 2006-2019 PIRO Observer Program Annual and Quarterly Status Reports
ME—McCracken, 2015a; McCracken, 2017a; McCracken 2020b; McCracken and Cooper 2022a.

3.3.3.6 ELASMOBRANCH INTERACTIONS IN THE AMERICAN SAMOA LONGLINE FISHERY

Table 86 summarizes the incidental take data for the Indo-west Pacific DPS scalloped hammerhead sharks, oceanic whitetip sharks, and giant manta rays in the American Samoa longline fishery. Giant manta rays were listed under the ESA on January 22, 2018 (83 FR 2916), and oceanic whitetip sharks were listed on January 30, 2018 (83 FR 4153). On April 3, 2019, NMFS reinitiated consultation for the American Samoa longline fishery and determined that the conduct of the fishery during the period of consultation will not violate ESA Sections 7(a)(2) and 7(d). 2020 and 2021 data cannot be reported due to confidentiality rules. PIFSC generated estimated number of interactions for 2020-2021 based on observer data from 2012-2020 (McCracken and Cooper 2022a, 2022d).

Observed interactions with oceanic whitetip sharks are most common in the American Samoa longline fishery from 2006 to 2019. Scalloped hammerheads and giant manta rays are observed less frequently. There have been no observed takes of giant manta rays since 2014.

Table 86. Observed and estimated total elasmobranch interactions with the American Samoa longline fishery for 2006-2022[a]

Year	Obs. Cov. (%)	Sets	Hooks	Scalloped hammerhead				Oceanic whitetip				Giant manta ray			
				Observed		EF Est.	ME	Observed		EF Est.	ME	Observed		EF Est.	ME
				Takes (M [b])	Takes/ 1,000 hooks			Takes (M [b])	Takes/ 1,000 hooks			Takes (M)	Takes/ 1,000 hooks		
2006	8.1	287	797,221	1(1)	0.0013	12	-	46(11)	0.0577	568	-	0	0.0000	0	-
2007	7.1	410	1,255,329	1	0.0008	14	-	62(18)	0.0494	873	-	0	0.0000	0	-
2008	6.4	379	1,194,096	0	0.0000	0	-	48(17)	0.0402	750	-	0	0.0000	0	-
2009	7.7	306	880,612	0	0.0000	0	-	45(13)	0.0511	584	-	1	0.0011	13	-
2010	25	798	2,301,396	4(1)	0.0017	-	17	130(37)	0.0565	-	1,176	3	0.0013	-	11
2011	33.3	1,257	3,605,897	2(1)	0.0006	-	7	116(44)	0.0322	-	319	3	0.0008	-	11
2012	19.8	662	1,880,525	0	0.0000	-	0	71(26)	0.0378	-	470	3	0.0016	-	29
2013	19.4	585	1,690,962	0	0.0000	-	0	88(15)	0.0520	-	407	2	0.0012	-	8
2014	19.4	565	1,490,416	1	0.0007	-	6	104(37)	0.0698	-	464	1	0.0007	-	2
2015	22.0	504	1,441,706	1(1)	0.0007	-	3	168(59)	0.1165	-	827	0	0.0000	-	3
2016	19.4	424	1,179,532	1	0.0008	-	8	197(70)	0.1670	-	788	0	0.0000	-	0
2017	20.0	447	1,271,803	1	0.0008	-	7	63(22)	0.0495	-	484	0	0.0000	-	0
2018	17.5	276	732,476	3	0.0041	-	8	108(39)	0.1474	-	513	0	0.0000	0	-
2019	15.7	380	1,087,860	0	0.0000	-	0	140(51)	0.1287	-	870	0	0.0000	0	-
2020	2.13	*	*	*	*	*	4	*	*	*	469	*	*	*	3
2021	4.65	*	*	*	*	*	3	*	*	*	467	*	*	*	3
2022	8.70	90	260,768	0	0.0000	-	2	25(8)	0.0959	-	355	0	0.0000	-	3

[a] Take data are based on vessel arrival dates.
[b] Mortality numbers include sharks that were released dead, finned (prior to the passage of the Shark Conservation Act of 2010), and kept.
*2020 data are not reported due to confidentiality rules.
Source: 2006-2019 PIRO Observer Program Annual and Quarterly Status Reports and unpublished observer data; McCracken 2015a; McCracken 2017a, McCracken 2019a; McCracken 2020b; McCracken and Cooper 2022a.

3.3.3.6.1 Comparison of Interactions with ITS

An ITS is not required to provide protective coverage for the ESA listed elasmobranchs including the Indo-west Pacific scalloped hammerhead shark DPS, the oceanic whitetip shark, or the giant manta ray, because there are no take prohibitions under ESA section 4(d) for these species. However, ITS were included for these species in their relevant Biological Opinions to serve as a check on the no-jeopardy conclusions by providing a reinitiation trigger.

For the Indo-west Pacific scalloped hammerhead shark DPS, NMFS included an ITS of 36 interactions over a three-year period in the 2015 Biological Opinion. NMFS uses a rolling three-year period to track incidental take against this ITS (Table 87). NMFS counts takes for the Indo-west Pacific DPS of scalloped hammerhead sharks based on the end of haul incidental take date.

On October 27, 2022, NMFS issued a no-jeopardy supplemental biological opinion on the agency's authorization of the American Samoa longline fishery. The 2022 Supplement addresses the American Samoa longline fishery's impacts to oceanic whitetip sharks and giant manta rays and concluded that the authorization of the deep-set longline fishery as currently managed is not likely to jeopardize their continued existence. NMFS included in this supplement, ITSs of 3,520 interactions with the oceanic whitetip shark and 57 interactions with the giant manta ray over a five-year running period (Table 87). Exceeding either of these numbers over 5 consecutive years will lead to reinitiating consultation of the impact of this fishery on these species.

Table 87. Estimated total interactions (extrapolated using quarterly observer coverage) of oceanic whitetip sharks and giant manta rays in the American Samoa longline fishery compared to the 5-year running sum ITS in the 2022 Supplement to the 2015 Biological Opinion[a]

2015 BiOp		
Species	**3-year ITS**	**Estimated Total Interactions 2020-2022**
Scalloped hammerhead shark, Indo-West Pacific DPS	36	7
2022 Supp. BiOp		
Species	**5-year Running Sum ITS**	**Estimated Total Interactions in 2022**
Oceanic whitetip shark	3,520	190
Giant manta ray	57	0
Manta/Mobula[b]		1

[a] Take data are based on haul dates.
[b] 20% of manta/mobula interactions are also tracked as the ITS for giant manta ray was based on interaction data that included rays classified as manta/mobula in the observer record that may have been giant manta rays

3.3.4 HAWAII TROLL FISHERY

3.3.4.1 INDICATORS FOR MONITORING PROTECTED SPECIES INTERACTIONS IN THE HAWAII TROLL FISHERY

In this report, the Council monitors protected species interactions in the Hawaii troll fishery using proxy indicators such as fishing effort and changes in gear types as this fishery does not have observer coverage.

3.3.4.1.1 Conservation Measures

The Hawaii troll fishery has not had reported interactions with protected species, and no specific regulations are in place to mitigate protected species interactions. The Pacific Pelagic FEP requires any vessel fishing under the FEP to comply with sea turtle handling and release regulations.

3.3.4.1.2 ESA Consultations

In a Biological Opinion completed on September 1, 2009 for the troll and handline fisheries in the western Pacific region, NMFS concluded that these fisheries are not likely to jeopardize the continued existence of green turtles and included an ITS of four animals killed per year from collisions with troll and handline fishing vessels (NMFS 2009). The Biological Opinion also concluded that the fisheries are not likely to adversely affect all other protected species in the region. NMFS also determined on October 6, 2014 that fisheries managed under the Pelagic FEP have no effects on ESA-listed reef-building corals.

3.3.4.1.3 Non-ESA Marine Mammals

The MMPA requires NMFS to annually publish a LOF that classifies commercial fisheries in one of three categories based on the level of mortality and serious injury of marine mammals associated with that fishery. According to the 2023 LOF (88 FR 16899, March 21, 2023), the Hawaii troll fishery (HI troll) is classified as a Category III fishery (i.e., a remote likelihood of or no known incidental mortality and serious injury of marine mammals). The 2023 LOF lists the following marine mammal stock that may be incidentally killed or injured in this fishery:

- Pantropical spotted dolphin, HI stock

While NMFS lists Pantropical spotted dolphin as potentially interacting with the Hawaii troll fishery in the LOF, there is a lack of direct evidence of serious injury or mortality in this fishery (78 FR 23708, April 22, 2013).

3.3.4.2 STATUS OF PROTECTED SPECIES INTERACTIONS IN THE HAWAII TROLL FISHERY

NMFS has determined that the Hawaii troll fishery operating under the Pacific Pelagic FEP is not likely to jeopardize green sea turtles and not likely to adversely affect other ESA-listed sea turtles, marine mammals, seabirds, scalloped hammerhead shark, and non ESA-listed marine mammals, and has no effects on ESA-listed reef-building corals. The Hawaii troll fishery has minimal interactions with these protected species.

The ITS in the 2009 Biological Opinion estimates four green turtle mortalities annually in the troll and handline fisheries in the western Pacific region. There have not been any reported or observed collisions of troll and handline vessels with green turtles, and data are not available to attribute stranded turtle mortality source to troll and handline vessels.

Based on fishing effort and other characteristics described in Chapter 2, no notable changes have been observed in the fishery. There is no other information to indicate that impacts to protected species from this fishery have changed in recent years.

3.3.5 MHI HANDLINE FISHERY

3.3.5.1 INDICATORS FOR MONITORING PROTECTED SPECIES INTERACTIONS IN THE MHI HANDLINE FISHERY

In this report, the Council monitors protected species interactions in the MHI handline fishery using proxy indicators such as fishing effort and changes in gear types as this fishery does not have observer coverage.

3.3.5.1.1 Conservation Measures

The MHI handline fishery has not had reported interactions with protected species, and no specific regulations are in place to mitigate protected species interactions. The Pacific Pelagic FEP requires any vessel fishing under the FEP to comply with sea turtle handling and release regulations.

3.3.5.1.2 ESA Consultations

In a Biological Opinion completed on September 1, 2009 for the troll and handline fisheries in the western Pacific region, NMFS concluded that these fisheries are not likely to jeopardize the continued existence of green turtles and included an ITS of four animals killed per year from collisions with troll and handline fishing vessels (NMFS 2009). The Biological Opinion also concluded that the fisheries are not likely to adversely affect all other protected species in the region. NMFS also determined on October 16, 2014 that fisheries managed under the Pelagic FEP have no effects on ESA-listed reef-building corals.

3.3.5.1.3 Non-ESA Marine Mammals

The MMPA requires NMFS to annually publish an LOF that classifies commercial fisheries in one of three categories based on the level of mortality and serious injury of marine mammals associated with that fishery. According to the 2023 LOF (88 FR 16899, March 21, 2023), the MHI handline (HI pelagic handline) fishery is classified as a Category III fishery (i.e., a remote likelihood of or no known incidental mortality and serious injury of marine mammals).

3.3.5.2 STATUS OF PROTECTED SPECIES INTERACTIONS IN THE MHI HANDLINE FISHERY

NMFS has determined that the MHI handline fishery operating under the Pacific Pelagic FEP is not likely to jeopardize green sea turtles and not likely to adversely affect other ESA-listed sea turtles, marine mammals, seabirds, scalloped hammerhead shark, and non ESA-listed marine mammals, and has no effects on ESA-listed reef-building corals. The MHI handline fishery has minimal interactions with these protected species.

The ITS in the 2009 Biological Opinion estimates four green turtle mortalities annually in the troll and handline fisheries in the western Pacific region. There have not been any reported or observed collisions of troll and handline vessels with green turtles, and data are not available to attribute stranded turtle mortality source to troll and handline vessels.

Based on fishing effort and other characteristics described in Chapter 2, no notable changes have been observed in the fishery. There is no other information to indicate that impacts to protected species from this fishery have changed in recent years.

3.3.6 HAWAII OFFSHORE HANDLINE FISHERY

3.3.6.1 INDICATORS FOR MONITORING PROTECTED SPECIES INTERACTIONS IN THE HAWAII OFFSHORE HANDLINE FISHERY

In this report, the Council monitors protected species interactions in the Hawaii offshore handline fishery using proxy indicators such as fishing effort and changes in gear types as this fishery does not have observer coverage.

3.3.6.1.1 Conservation Measures

The Hawaii offshore handline fishery has not had reported interactions with protected species, and no specific regulations are in place to mitigate protected species interactions. The Pacific Pelagic FEP requires any vessel fishing under the FEP to comply with sea turtle handling and release regulations.

3.3.6.1.2 ESA Consultations

In a Biological Opinion completed on September 1, 2009 for the troll and handline fisheries in the Western Pacific region, NMFS concluded that these fisheries are not likely to jeopardize the continued existence of green turtles and included an ITS of four animals killed per year from collisions with troll and handline fishing vessels. The Biological Opinion also concluded that the fisheries are not likely to adversely affect all other protected species in the region. NMFS also determined on October 16, 2014 that fisheries managed under the Pelagic FEP have no effects on ESA-listed reef-building corals.

3.3.6.1.3 Non-ESA Marine Mammals

The MMPA requires NMFS to annually publish an LOF that classifies commercial fisheries in one of three categories based on the level of mortality and serious injury of marine mammals associated with that fishery. According to the 2023 LOF (88 FR 16899, March 21, 2023), the Hawaii offshore handline (HI pelagic handline) fishery is classified as a Category III fishery (i.e., a remote likelihood of or no known incidental mortality and serious injury of marine mammals).

3.3.6.2 STATUS OF PROTECTED SPECIES INTERACTIONS IN THE HAWAII OFFSHORE HANDLINE FISHERY

NMFS has determined that the Hawaii offshore handline fishery operating under the Pacific Pelagic FEP is not likely to jeopardize green sea turtles and not likely to adversely affect other ESA-listed sea turtles, marine mammals, seabirds, scalloped hammerhead shark, and non ESA-listed marine mammals, and have no effects on ESA-listed reef-building corals. The Hawaii offshore handline fishery has minimal interactions with these protected species.

The ITS in the 2009 Biological Opinion estimates four green turtle mortalities annually in the troll and handline fisheries in the western Pacific region. There have not been any reported or observed collisions of troll and handline vessels with green turtles, and data are not available to attribute stranded turtle mortality source to troll and handline vessels.

Based on fishing effort and other characteristics described in Chapter 2, no notable changes have been observed in the fishery. There is no other information to indicate that impacts to protected species from this fishery have changed in recent years.

3.3.7 AMERICAN SAMOA, GUAM, AND CNMI TROLL FISHERY

3.3.7.1 INDICATORS FOR MONITORING PROTECTED SPECIES INTERACTIONS IN THE AMERICAN SAMOA, GUAM AND CNMI TROLL FISHERY

In this report, the Council monitors protected species interactions in the American Samoa, Guam, and CNMI troll fisheries using proxy indicators such as fishing effort and changes in gear types as these fisheries do not have observer coverage.

Details of these indicators are discussed in the sections below.

3.3.7.1.1 Conservation Measures

The American Samoa, Guam, and CNMI fisheries have not had reported interactions with protected species, and no specific regulations are in place to mitigate protected species interactions. The Pacific Pelagic FEP requires any vessel fishing under the FEP to comply with sea turtle handling and release regulations.

3.3.7.1.2 ESA Consultations

In a Biological Opinion completed on September 1, 2009 for the troll and handline fisheries in the Western Pacific region, NMFS concluded that these fisheries are not likely to jeopardize the continued existence of green turtles and included an ITS of four animals killed per year from collisions with troll and handline fishing vessels. The Biological Opinion also concluded that the fisheries are not likely to adversely affect all other protected species in the region. NMFS also determined on October 16, 2014 that fisheries managed under the Pelagic FEP have no effects on ESA-listed reef-building corals.

3.3.7.1.3 Non-ESA Marine Mammals

The MMPA requires NMFS to annually publish an LOF that classifies commercial fisheries in one of three categories based on the level of mortality and serious injury of marine mammals associated with that fishery. According to the 2023 LOF (88 FR 16899, March 21, 2023), troll fisheries in American Samoa, Guam and CNMI are classified as Category III fisheries (i.e., a remote likelihood of or no known incidental mortality and serious injury of marine mammals).

3.3.7.2 STATUS OF PROTECTED SPECIES INTERACTIONS IN THE AMERICAN SAMOA, GUAM AND CNMI TROLL FISHERY

NMFS has determined that the American Samoa, Guam, and CNMI fisheries operating under the Pacific Pelagic FEP are not likely to jeopardize green sea turtles and not likely to adversely affect other ESA-listed sea turtles, marine mammals, seabirds, scalloped hammerhead shark, and non ESA-listed marine mammals, and have no effects on ESA-listed reef-building corals. The American Samoa, Guam, and CNMI fisheries likely have minimal interactions with these protected species.

The ITS in the 2009 Biological Opinion estimates four green turtle mortalities annually in the troll and handline fisheries in the western Pacific region. There have not been any reported or observed collisions of troll and handline vessels with green turtles, and data are not available to attribute stranded turtle mortality source to troll and handline vessels.

Based on fishing effort and other characteristics described in Chapter 2, no notable changes have been observed in the American Samoa, Guam, and CNMI troll fisheries. There is no other information to indicate that impacts to protected species from these fisheries have changed in recent years.

3.3.8 IDENTIFICATION OF EMERGING ISSUES

Oceanic whitetip sharks were listed under the ESA in 2018. This species is incidentally captured in the Hawaii and American Samoa longline fisheries. Observed interaction data have been added to this report. RFMO conservation measures implemented in the U.S. domestic fisheries has required non-retention of oceanic whitetip sharks since 2011 in the IATTC area and 2015 in the WCPFC area. Additionally, the Cooperative Institute for Marine and Atmospheric Research and the Hawaii Institute of Marine Biology is conducted a study to assess the post-release survivorship of five species of sharks including the oceanic whitetip shark released alive in the Hawaii and American Samoa longline fishery.

In the study (Hutchinson et al. 2021), PIFSC researchers worked with observer programs and fishermen to quantify post release mortality rates of blue (BSH), bigeye thresher (BTH), shortfin mako (SMA), oceanic whitetip (OCS), and silky sharks (FAL) that are incidentally captured in the Hawaii deep-set (HiDS) and OCS and FAL in the American Samoa (AS) tuna target longline fisheries, using pop-off archival satellite tags (PAT). This study also assessed the effects that standard shark bycatch handling and discard practices utilized in these fisheries may have on the post release fate of discarded sharks that are alive at haul back of the longline gear. Observers trained in the project methods collected shark condition and handling data on 19,all incidental elasmobranchs captured during the study. Tagging was not conducted on Hawaii shallow-set (HISS) trips targeting swordfish. The handling and damage data recorded by trained observers indicated that most of the five species of sharks considered in this study were released by cutting the line. Followed by; gear removal with jaw damage, gear removal with no damage to the shark, gear removal with removal of part of the shark (e.g., lobe of tail on tail-hooked BTH). A small proportion of these sharks escaped the gear on their own. Other handling methods that were observed included the use of a dehooker and a drag line. The length and composition of the trailing gear was also recorded by observers and varied by fishery and by species. The HIDS fishery left the greatest amount of trailing gear on sharks, where sharks were released with an average of 8.75 m, ranging in length from 1.0–25.0 m, typically composed of a stainless-steel hook, 0.5 m of braided wire leader, a 45-gram weighted swivel, and monofilament branchline. Sharks released by cutting the line in American Samoa were released with an average of 2.98 m of trailing gear which is composed of a stainless-steel hook to an all monofilament line ranging in length from 1.0–10.0 m.

A proportional hazard model was implemented in a Bayesian framework to understand the impacts of several factors (fishery, condition at the vessel, handling and discard methods, approximate fork length, length of trailing gear) associated with the fishery interaction on survival. The baseline hazard was assumed to vary by species and tag deployment period. Of the species caught and tagged in the HIDS fishery, BSH had the lowest survival rate, followed by BTH, OCS, and SMA at their mean interaction conditions. For the species caught in the ASLL fishery, OCS had a lower survival rate than FAL at their mean interaction conditions. The only species tagged in both fisheries, OCS, had lower survival in the ASLL fishery than the HIDS fishery. The most influential factors reducing survival rates post release were; catch condition where injured animals had higher mortality rates, handling methods that either damaged the jaw or removed part of the tail (thresher sharks only), the amount of trailing gear left on an animal, tail hooking (thresher sharks only) and wire leader material. Additional details regarding the preliminary results of this study are available in Hutchinson et al. (2021). Currently, analysis is ongoing to incorporate data from tags deployed after 2019 and final results are forthcoming.

Currently, genetic samples are being taken from large Mobulids captured in the Hawaii longline fishery to help elucidate species identification issues, interaction rates, and eventually, population structure for the giant manta ray. To date, 24 samples have been collected and 15 of those samples have been analyzed for species identification. To date, species collected include *M. mobular/japanica*, *M. thurstoni*, *M. tarapacana*; none were *M. birostris*. More samples are needed for a larger sample size.

Previous efforts to understand the spatial relationships of loggerhead turtles and the Hawaii shallow-set longline fishery have included data generated from satellite tags deployed on both captive-reared turtles, and turtles incidentally caught in the fishery. Given captive-reared turtles may not be representative of the size or locations of turtles interacting with the modern Hawaii shallow-set longline fishery, efforts have been underway since 2020 to increase the sample size of satellite tags deployed on incidentally caught turtles. A total of 41 satellite tags were deployed between February 2020 and March 2023 on post-hooked loggerheads, and additional tags will be deployed in coming years.

A power-assisted device that will be affixed to an extendable pole is currently being developed to enable longline observers (on deck) to attach satellite tags to leatherback turtles (still in the water). Doing so will generate urgently needed spatial ecology information on the species that can inform models and management decision making.

Potential interactions between Hawaii non-longline pelagic fisheries and cetaceans have been identified and are summarized in the most recent marine mammal SARs. Available information does not identify which type of fisheries may be causing injury to cetaceans nor the extent to which the cetacean populations may be impacted by such injuries. New information on this subject published in 2016 that are not included in the current SARs are summarized below.

Potential interactions between Hawaii non-longline pelagic fisheries and cetaceans have been identified and are summarized in the most recent marine mammal SARs. Available information does not identify which type of fisheries may be causing injury to cetaceans nor the extent to which the cetacean populations may be impacted by such injuries. New information on this subject published in 2016 that are not included in the current SARs are summarized below.

Madge, L., 2016. Exploratory study of interactions between cetaceans and small-boat fishing operations in the Main Hawaiian Islands (MHI). Pacific Islands Fisheries Science Center, Administrative Report H-16-07, 37 p. doi:10.7289/V5/AR-PIFSC-H-16-07.

Summary: The exploratory study was aimed at improving the understanding of fishery-cetacean interactions in the main Hawaiian Islands through interviews with small-boat fishermen on Oahu and the Big Island. The study highlighted that there is considerable uncertainty in species identification by fishermen of false killer whales and other odontocetes categorized as blackfish, and respondents generally reported avoiding interactions by leaving the fishing area when a blackfish is observed. The results of this study cannot be used to estimate frequency or assess the distribution of interactions due to the small sample size and non-random sampling method.

Table 88 summarizes current candidate ESA species, recent listing status, and post-listing activity (critical habitat designation and recovery plan development). Impacts from FEP-managed fisheries on any new listings and critical habitat designations will be considered in future versions of this report.

Table 88. Status of ESA listing, status reviews, critical habitat and recovery plan for species occurring in the Pelagic FEP region

Species		**Listing/Petition Response Process**			**Post-Listing Activity**	
Common Name	**Scientific Name**	**90-day Finding**	**12-month Finding / Proposed Rule**	**Final Rule**	**Critical Habitat**	**Recovery Plan**
Oceanic whitetip shark	*Carcharhinus longimanus*	Positive (81 FR 1376, 1/12/2016)	Positive, threatened (81 FR 96304, 12/29/2016)	Listed as threatened (83 FR 4153, 1/30/18)	Designation not prudent; no areas within US jurisdiction that meet definition of critical habitat (85 FR 12898, 3/5/2020)	Draft Recovery Plan published January 25, 2023 (88 FR 4817)

Species		Listing/Petition Response Process			Post-Listing Activity	
Common Name	Scientific Name	90-day Finding	12-month Finding / Proposed Rule	Final Rule	Critical Habitat	Recovery Plan
Chambered nautilus	*Nautilus pompilius*	Positive (81 FR 58895, 8/26/2016)	Positive, threatened (82 FR 48948, 10/23/17)	Listed as threatened (83 FR 48876, 09/28/2018)	Designation not prudent; no areas within US jurisdiction that meet definition of critical habitat (85 FR 5197, 01/29/2020)	TBA
Giant manta ray	*Manta birostris*	Positive (81 FR 8874, 2/23/2016)	Positive, threatened (82 FR 3694, 1/12/2017)	Listed as threatened (83 FR 2916, 1/22/18)	Designation not prudent; no areas within US jurisdiction that meet definition of critical habitat (84 FR 66652, 12/5/2019)	In development, Recovery outline published 12/4/19 to serve as interim guidance until full recovery plan is developed.
Shortfin mako shark	*Isurus oxyrinchus*	Positive (86 FR 19863), 4/15/2021	Not warranted (87 FR 68236, 11/14/2022)	N/A	N/A	N/A
Corals	N/A	Positive for 82 species (75 FR 6616, 2/10/2010)	Positive for 66 species (77 FR 73219, 12/7/2012)	20 species listed as threatened (79 FR 53851, 9/10/2014)	Critical habitat proposed (85 FR 76262, 11/27/2021), comment period extended through 5/26/2021 (86 FR 16325)	In development, interim recovery outline in place, recovery workshops convened in May 2021.
Cauliflower coral	*Pocillopora meandrina*	Positive (83 FR 47592, 9/20/2018)	Not warranted (85 FR 40480, 7/6/20)	N/A	N/A	N/A
False killer whale (MHI Insular DPS)	*Pseudorca crassidens*	Positive (75 FR 316, 1/5/2010)	Positive, endangered (75 FR 70169, 11/17/2010)	Listed as endangered (77 FR 70915, 11/28/2012)	Designated in waters from the 45 m depth contour to the 3,200 m depth contour around the MHI from Niihau east to Hawaii (83 FR 35062, 07/24/2018)	Final Recovery Plan published November 3, 2021 (85 FR 60615)
Green sea turtle	*Chelonia mydas*	Positive (77 FR 45571, 8/1/2012)	Identification of 11 DPSs, endangered and threatened (80 FR 15271, 3/23/2015)	11 DPSs listed as endangered and threatened (81 FR 20057, 4/6/2016)	In development, proposal expected summer 2023	TBA

Species		Listing/Petition Response Process			Post-Listing Activity	
Common Name	Scientific Name	90-day Finding	12-month Finding / Proposed Rule	Final Rule	Critical Habitat	Recovery Plan
Loggerhead sea turtle (North Pacific DPS)	*Caretta caretta*	Positive (72 FR 64585, 11/16/2007)	9 DPSs listed as endangered and threatened (76 FR 15932, 03/22/2011)	9 DPSs listed as endangered and threatened (76 FR 58867, 10/24/2011)	Designated for Atlantic Ocean and Gulf of Mexico DPSs (79 FR 39855, 08/11/2014)	In development; 5-year status review published on 4/7/2020

3.3.9 IDENTIFICATION OF RESEARCH, DATA, AND ASSESSMENT NEEDS

The following research, data and assessment needs for pelagic fisheries were identified by the Council's Plan Team:

- Identify zones to develop a regional look at environmental and oceanographic factors for area outside of the EEZ that may focus on areas of high-interactions. Develop metrics to characterize environmental data, effort, and bycatch rates at these regional scales (e.g. leatherback, olive ridley, albatrosses, elasmobranchs);
- Generate data on the spatial ecology, as well as post-hooking behaviors and survival rates for leatherback turtles interacting with the SSLL and DSLL fisheries;
- Ecosystem considerations on catch and bycatch in the DSLL fishery (e.g., bigeye tuna, albatrosses, leatherback, and olive ridley turtles) and SSLL fishery (e.g., black-footed albatross) as they relate to environmental and ecological drivers of changing species distribution and aggregation;
- Improve observer data collection for elasmobranchs in longline fisheries to record release condition, handling, trailing gear, size and sex;
- Improve data collection for oceanic whitetip shark capture data in non-longline pelagic fisheries;
- Conduct genetic and telemetry research to improve understanding of population structure and movement patterns for listed elasmobranchs;
- Estimates of post release survival for incidental protected species;
- Improve observer data collection for bite-offs; and
- Build species distribution models (SDM) for protected species using existing telemetry data to assess how a changing ocean may affect the availability of preferred habitat and how this might impact fishery vulnerability under future climate change projections.

3.4 CLIMATE AND OCEANIC INDICATORS

Over the past few years, the Council has incorporated climate change into the overall management of the fisheries over which it has jurisdiction. This 2022 annual SAFE report includes a now standard section on indicators of climate and oceanic conditions in the Western Pacific Region. These indicators reflect both global climate variability and change, as well as trends in local oceanographic conditions.

The section begins with a brief summary of the state of the ocean and climate in 2022. This is followed by a list of all selected indicators. These indicators are then examined through summaries focused on natural climate variability and on anthropogenic climate change. Information on the background of these indicators, their development over time, and ongoing research needs can be found at the end of this section.

3.4.1 INDICATORS AT A GLANCE

Based on the information provided by the indicators in this chapter, long-term climate trends persisted in the Western Pacific region in 2022. Modes of interannual climate variability (e.g., ENSO, PDO) remained in negative phases. Hurricane activity and storm energy were below average. The atmospheric concentration of carbon dioxide continued to increase, ocean acidification intensified, and sea surface temperatures continued to rise. Chlorophyll concentrations at the ocean's surface exhibited no long-term trend, but the median size of phytoplankton has declined slightly over the past 25 years. Both the Subtropical Frontal Zone and the Transition Zone Chlorophyll Front were north of average across much of the longline fishing grounds. Temperatures at 200–300 m below the surface were average. Both bigeye tuna and swordfish had size distributions similar to last year, though no long-term trend is evident. Neither bigeye tuna weight-per-unit-effort nor the bigeye tuna recruitment index suggest there will be a pulse of increased recruitment or catch rates in the next few years. The bigeye tuna catch rate forecast suggests that catch will be fairly steady over the next four years.

3.4.2 SELECTED INDICATORS

The primary goal for selecting the indicators used in this report is to provide fisheries-related communities, resource managers, and businesses with a climate-related situational awareness. In this context, indictors were selected to:

- Be fisheries relevant and informative;
- Build intuition about current conditions in light of a changing climate;
- Provide historical context; and
- Allow for recognition of patterns and trends.

In this context, this section includes the following climate and oceanic indicators:

- Atmospheric concentration of carbon dioxide (CO_2)
- Oceanic pH at Station ALOHA;
- El Niño – Southern Oscillation (ENSO);
- Pacific Decadal Oscillation (PDO);
- Tropical cyclones;
- Sea surface temperature (SST);

- Ocean temperature at 200-300 m depth;
- Ocean color;
- North Pacific Subtropical Front (STF) and Transition Zone Chlorophyll Front (TZCF);
- Estimated median phytoplankton size
- Fish community size structure;
- Bigeye tuna weight-per-unit-effort;
- Bigeye tuna recruitment index; and
- Bigeye tuna catch rate forecast.

3.4.2.1 NATURAL CLIMATE VARIABILITY SUMMARY

The ocean and climate indicators described in this chapter can be used to understand the effects of natural climate variability. The relationship between these indicators is illustrated in Figure 159.

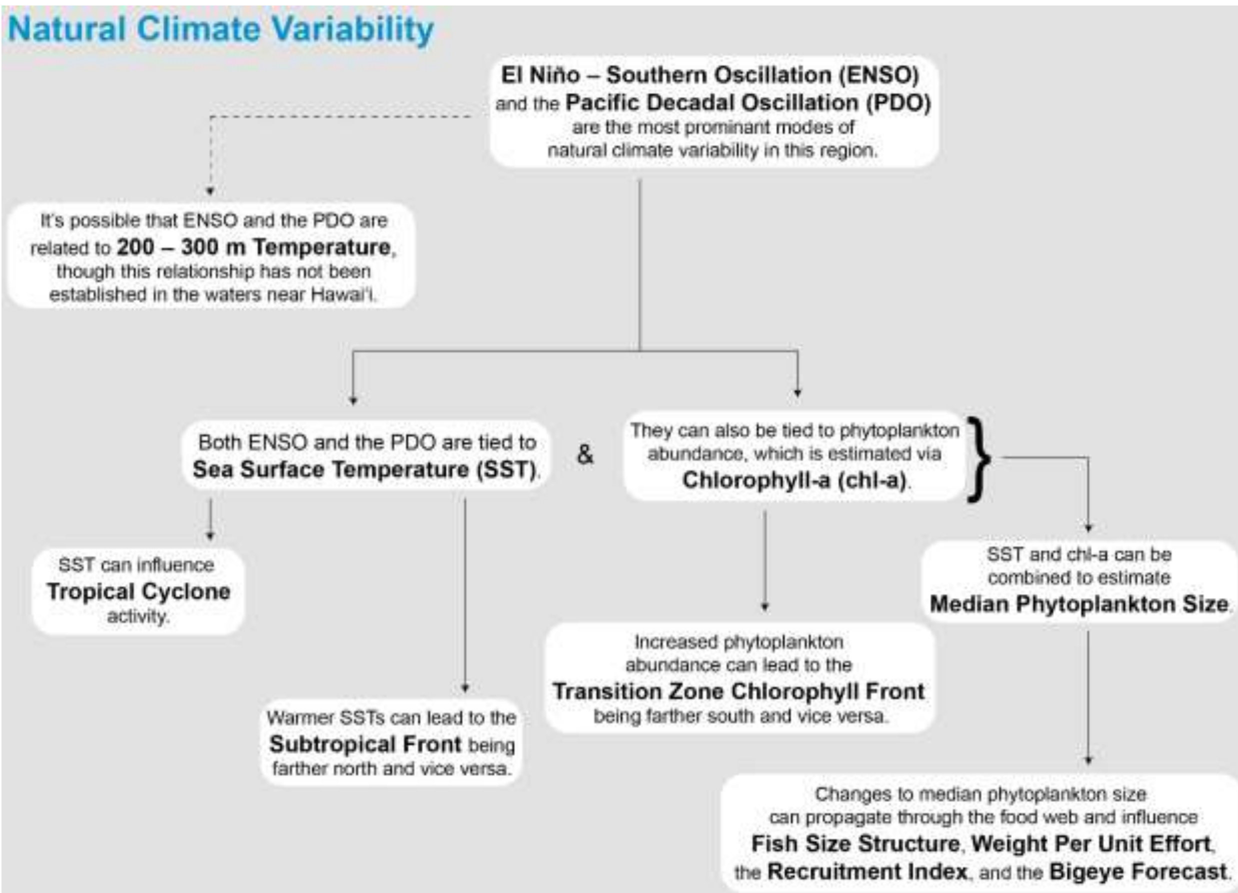


Figure 159. Schematic diagram illustrating the relationships between the ocean and climate indicators from the perspective of natural climate variability

The El Niño – Southern Oscillation (ENSO) and the Pacific Decadal Oscillation (PDO) are the most prominent modes of natural climate variability in the North Pacific. ENSO cycles are known to impact Pacific fisheries including tuna fisheries. The Oceanic Niño Index (ONI) is a measure of ENSO phase that focuses on ocean temperature, which has the most direct effect on these fisheries.

Both ENSO and the PDO are associated with interannual changes in sea surface temperature (SST), which is one of the most directly observable existing measures for tracking ocean temperature. Natural variability in SST impacts the marine ecosystem and pelagic fisheries. For example, higher SSTs can lead to the subtropical front being farther north and vice versa, which in turn affects the distance fishers may need to travel to reach longline fishing grounds. Changes in SST can also influence the number, location, strength, and seasonal timing of tropical cyclones.

ENSO and the PDO are also associated with interannual changes in phytoplankton abundance, which is observed through ocean color and estimated via chlorophyll-a (chl-a). Phytoplankton are the foundational food source for the species targeted by the region's longline fishery. Changes in phytoplankton abundance have the potential to impact fish abundance, size, and catch. Increased phytoplankton abundance can lead to the transition zone chlorophyll front (TZCF) being farther south and vice versa, and changes in the location of this front particularly impact Hawai‘i's swordfish fishery.

SST and chl-a can be combined to estimate median phytoplankton size. Changes to median phytoplankton can propagate through the food web and influence fish size structure, weight-per-unit-effort, and the bigeye tuna recruitment index. Furthermore, the recruitment index can be combined with median phytoplankton size to forecast bigeye tuna catch rates up to four years in advance.

It is possible that natural climate variability influences temperatures at 200–300 m below the surface where the bigeye fishery sets their hooks. However, this relationship has yet to be established.

Understanding the effects of natural climate variability, like ENSO and the PDO, on the ocean, marine ecosystems, and regional fisheries is an active area of research.

3.4.2.2 ANTHROPOGENIC CLIMATE CHANGE SUMMARY

The ocean and climate indicators described in this chapter can be used to understand the effects of anthropogenic climate change. The relationship between these indicators is illustrated in Figure 160.

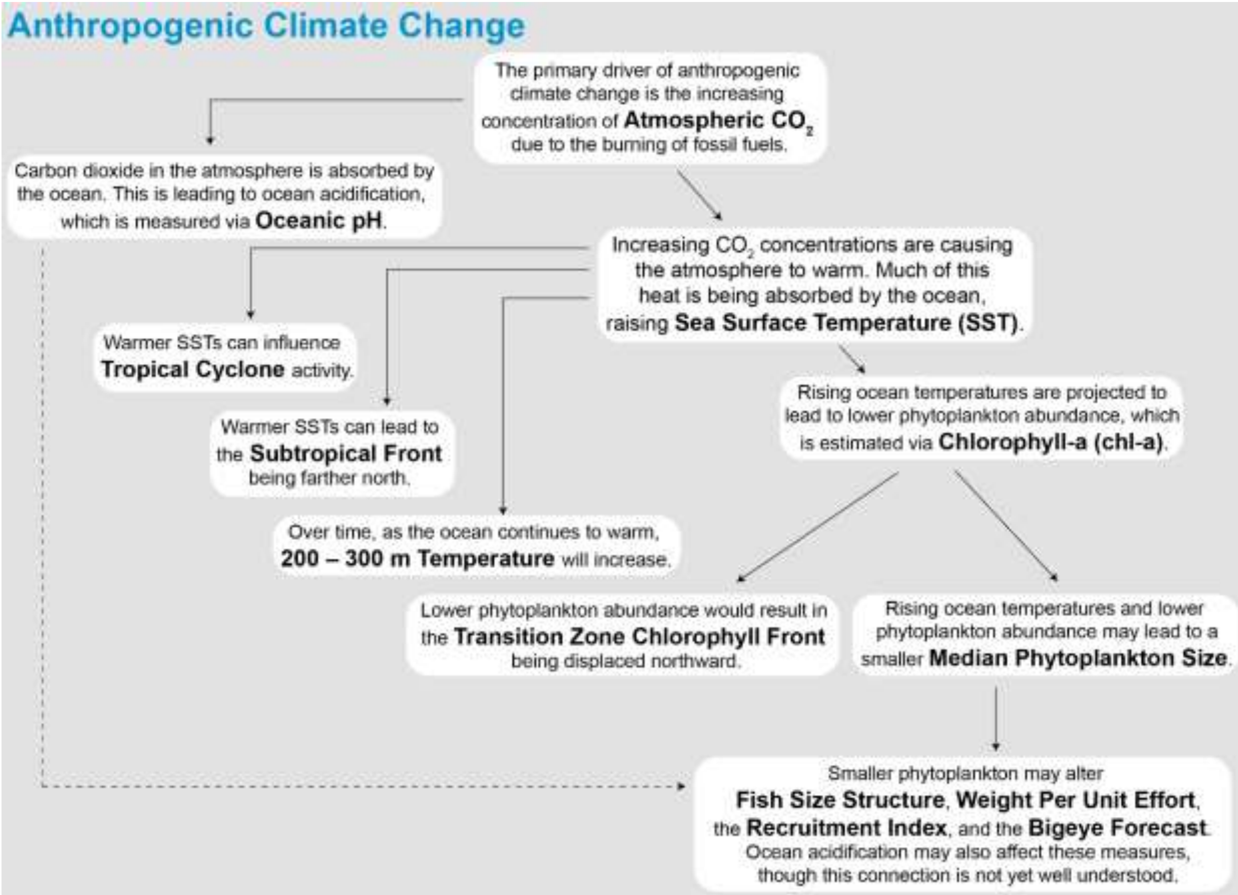


Figure 160. Schematic diagram illustrating the relationships between the ocean and climate indicators from the perspective of anthropogenic climate change

The primary driver of anthropogenic (human-caused) climate change is the increasing concentration of atmospheric carbon dioxide, CO_2, due to the burning of fossil fuels. Therefore, atmospheric CO_2 serves as a measure of what human activity has already done to affect the climate system through greenhouse gas emissions. The concentration of atmospheric CO_2, and, in turn, its warming influence, is increasing more quickly over time.

Carbon dioxide in the atmosphere is absorbed by the ocean. This leads to ocean acidification, which is measured via pH. Therefore, oceanic pH is a measure of how greenhouse gas emissions have already impacted the ocean. Increasing ocean acidification limits the ability of marine organisms to build shells and other hard structures. Prey for commercially valuable fish are already being negatively affected by increasing ocean acidification.

Increasing carbon dioxide concentrations cause the atmosphere to warm. Much of this heat is then absorbed by the ocean, raising sea surface temperature (SST). SST is another measure of how greenhouse gas emissions are already impacting the ocean.

Rising sea surface temperatures may affect the number, strength, duration, track, and seasonal timing of tropical cyclones. The Accumulated Cyclone Energy index, or ACE Index, accounts for both the strength and duration of storms.

Over time, rising sea surface temperatures will warm deeper ocean waters. Changes in ocean temperature will affect tuna, and in turn, potentially their catchability. For example, fish may move to deeper waters or their habitat could be compressed geographically or vertically. Temperatures at 200–300 meters below the ocean's surface reflect those at the mid-range of depths targeted by the deep-set bigeye tuna fishery. Bigeye tuna have preferred thermal habitat, generally staying within waters between 8–14 ºC while they are at depth.

Rising ocean temperatures are projected to lead to lower phytoplankton abundance, which is observed through ocean color and estimated via chlorophyll-a (chl-a). Combined, rising ocean temperatures and lower phytoplankton abundance may lead to smaller median phytoplankton sizes. Smaller phytoplankton may alter fish size structure, weight-per-unit-effort, and the bigeye tuna recruitment index. Median phytoplankton size can be combined with the bigeye recruitment index to forecast catch rates.

Understanding the effects of anthropogenic climate change on the ocean, marine ecosystems, and regional fisheries is an active area of research.

3.4.2.3 ATMOSPHERIC CONCENTRATION OF CARBON DIOXIDE AT MAUNA LOA

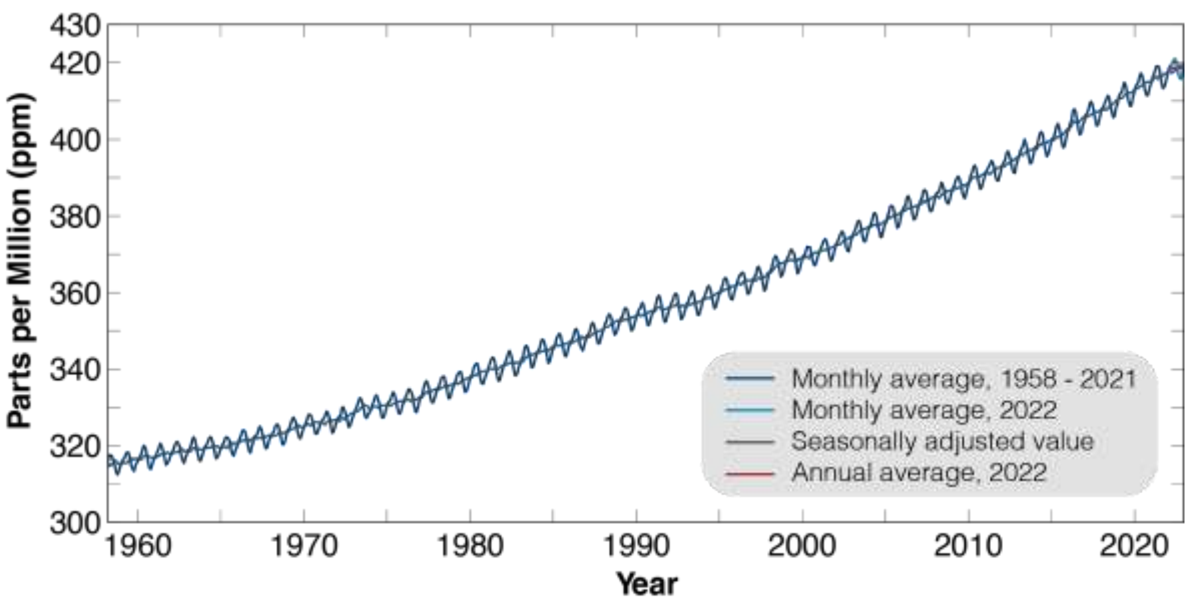


Figure 161. The concentration of atmospheric carbon dioxide at Mauna Loa Observatory on the island of Hawaii

Rationale: Atmospheric carbon dioxide is a measure of what human activity has already done to affect the climate system through greenhouse gas emissions. It provides quantitative information in a simplified, standardized format that decision makers can easily understand. This indicator demonstrates that the concentration (and, in turn, warming influence) of greenhouse gases in the atmosphere has increased substantially over the last several decades.

Status: Atmospheric CO_2 is increasing exponentially. This means that atmospheric CO_2 is increasing more quickly over time. In 2022, the annual mean concentration of CO_2 was 418.56 ppm. This is the highest annual value recorded. This year also saw the highest monthly value, which was 420.99 ppm. In 1959, the first year full of the time series, the atmospheric concentration of CO_2 was 316 ppm. The annual mean passed 350 ppm in 1988, and 400 ppm in 2015.

Description: Monthly mean atmospheric carbon dioxide (CO_2) at Mauna Loa Observatory, Hawai‘i in parts per million (ppm) from March 1958 to present. The observed increase in monthly average carbon dioxide concentration is primarily due to CO_2 emissions from fossil fuel burning. Carbon dioxide remains in the atmosphere for a very long time, and emissions from any location mix throughout the atmosphere in approximately one year. The annual variations at Mauna Loa, Hawai‘i are due to the seasonal imbalance between the photosynthesis and respiration of terrestrial plants. During the summer growing season, photosynthesis exceeds respiration, and CO_2 is removed from the atmosphere. In the winter (outside the growing season), respiration exceeds photosynthesis, and CO_2 is returned to the atmosphere. The seasonal cycle is strongest in the northern hemisphere because of its larger land mass.

Timeframe: Annual, monthly.

Region/Location: Mauna Loa, Hawaii, but representative of global atmospheric carbon dioxide concentration.

Measurement Platform: *In-situ* station.

Data available at: https://gml.noaa.gov/ccgg/trends/data.html.

Sourced from: Keeling et al. (1976), Thoning et al. (1989), and NOAA (2023a). Graphics produced in part using Stawitz (2022).

3.4.2.4 OCEANIC PH

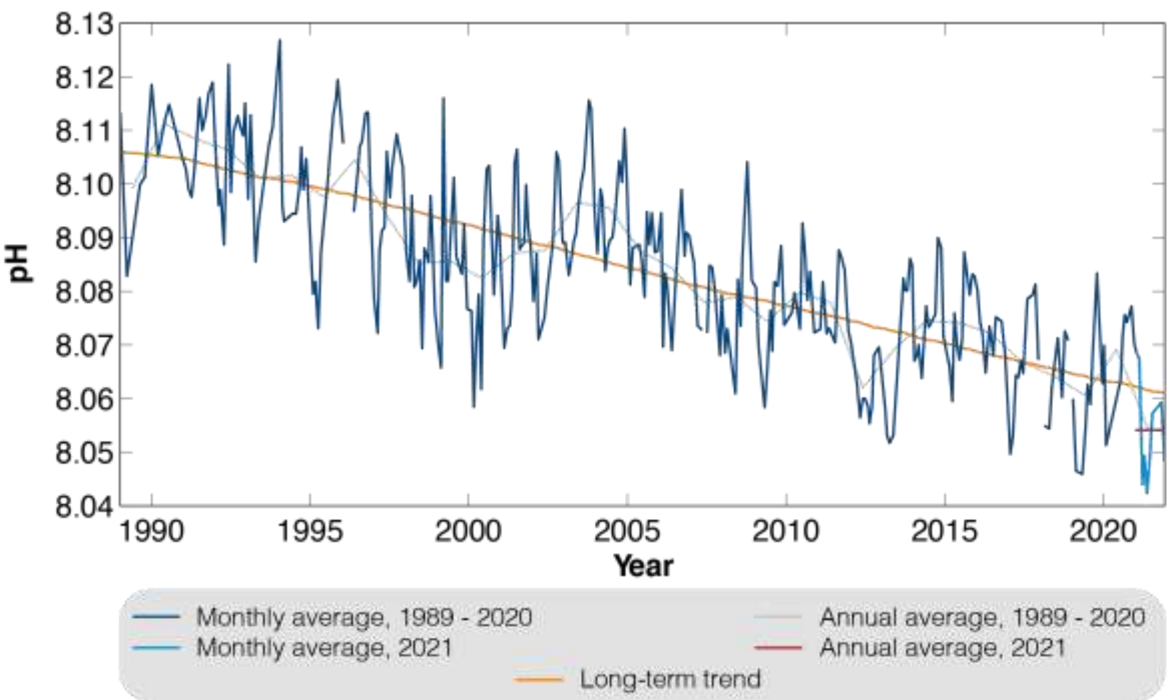


Figure 162. Time series and long-term trend of oceanic pH measured at Station ALOHA

Rationale: Oceanic pH is a measure of how greenhouse gas emissions have already impacted the ocean. This indicator demonstrates that oceanic pH has decreased significantly over the past several decades (i.e., the ocean has become more acidic). Increasing ocean acidification limits the ability of marine organisms to build shells and other calcareous structures. Recent research has shown that pelagic organisms such as pteropods and other prey for commercially valuable fish species are already being negatively impacted by increasing acidification (Feely et al. 2016). The full impact of ocean acidification on the pelagic food web is an area of active research (Fabry et al. 2008).

Status: The ocean is roughly 10.9% more acidic than it was 30 years ago at the start of this time series. Over this time, pH has declined by 0.045 at a constant rate. In 2021, the most recent year for which data are available, the average pH was 8.05. Additionally, for the 6th year, small variations seen over the course of the year are outside the range seen in the first year of the time series. The highest pH value reported for the most recent year (8.069) is lower than the lowest pH value reported in the first year of the time series (8.083).

Description: Trends in surface (5 m) pH at Station ALOHA, north of Oahu (22.75°N, 158°W), collected by the Hawaiʻi Ocean Time Series (HOT) from October 1988 to 2021 (2022 data are not yet available). Oceanic pH is a measure of ocean acidity, which increases as the ocean absorbs carbon dioxide from the atmosphere. Lower pH values represent greater acidity. Oceanic pH is calculated from total alkalinity (TA) and dissolved inorganic carbon (DIC). Total alkalinity represents the ocean's capacity to resist acidification as it absorbs CO_2 and the amount of CO_2 absorbed is captured through measurements of DIC. The multi-decadal time series at Station ALOHA represents the best available documentation of the significant downward trend in oceanic pH since the time series began in 1988. Oceanic pH varies over both time and space, though the conditions at Station ALOHA are considered broadly representative of those across the Western and Central Pacific's pelagic fishing grounds.

Timeframe: Monthly.

Region/Location: Station ALOHA: 22.75°N, 158°W.

Measurement Platform: *In-situ* station.

Data available at: https://hahana.soest.hawaii.edu/hot/hot-dogs/bseries.html.

Sourced from: Fabry et al. (2008), Feely et al. (2016), and the Hawaiʻi Ocean Time Series as described in Karl and Lukas (1996) and on its website (HOT 2023) using the methodology provided by Zeebe and Wolf-Gladrow (2001). Graphics produced in part using Stawitz (2022).

3.4.2.5 EL NIÑO – SOUTHERN OSCILLATION

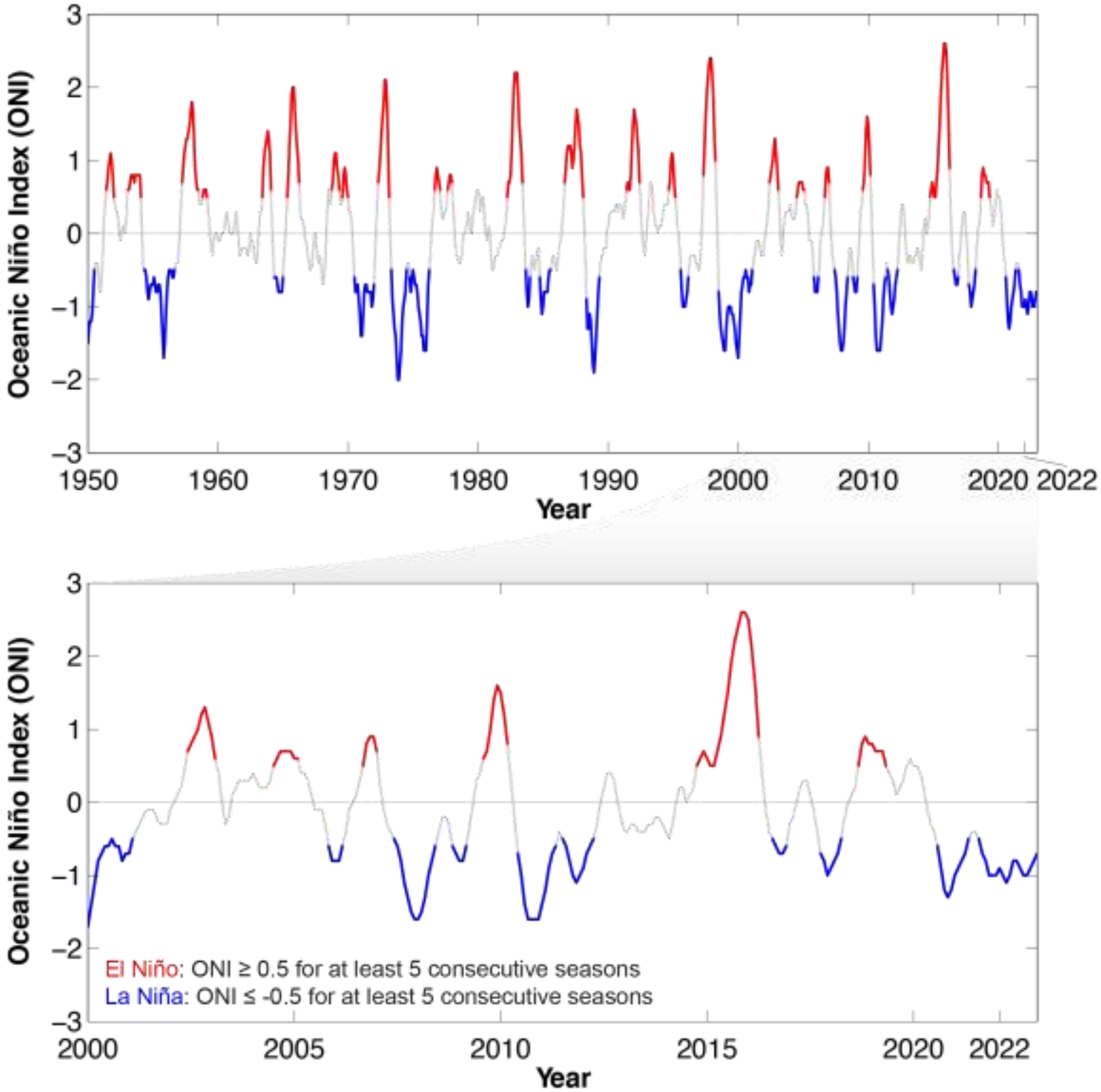


Figure 163. Oceanic Niño Index from 1950-2022 (top) and 2000–2022 (bottom) with El Niño periods in red and La Niña periods in blue

Rationale: The El Niño – Southern Oscillation (ENSO) cycle is known to have impacts on Pacific fisheries including tuna fisheries. The ONI focuses on ocean temperature, which has the most direct effect on these fisheries.

Status: The Oceanic Niño Index (ONI) indicated La Niña conditions throughout 2022. In 2022, the ONI ranged from -1.06 to -0.81. This is within the range of values observed previously in the time series.

Description: The three-month running mean (referred to as a season) of satellite remotely-sensed sea surface temperature (SST) anomalies in the Niño 3.4 region (5°S – 5°N, 120° – 170°W). The Oceanic Niño Index (ONI) is a measure of the El Niño – Southern Oscillation (ENSO) phase.

Warm and cool phases, termed El Niño and La Niña respectively, are based in part on an ONI threshold of ± 0.5 °C being met for a minimum of five consecutive overlapping seasons. Additional atmospheric indices are needed to confirm an El Niño or La Niña event, as the ENSO is a coupled ocean-atmosphere phenomenon. The atmospheric half of ENSO is measured using the Southern Oscillation Index.

Timeframe: Every three months.

Region/Location: Niño 3.4 region, 5°S – 5°N, 120° – 170°W.

Measurement Platform: *In-situ* station, satellite, model.

Data available at: https://www.cpc.ncep.noaa.gov/data/indices/oni.ascii.txt.

Sourced from NOAA CPC (2023).

3.4.2.6 PACIFIC DECADAL OSCILLATION

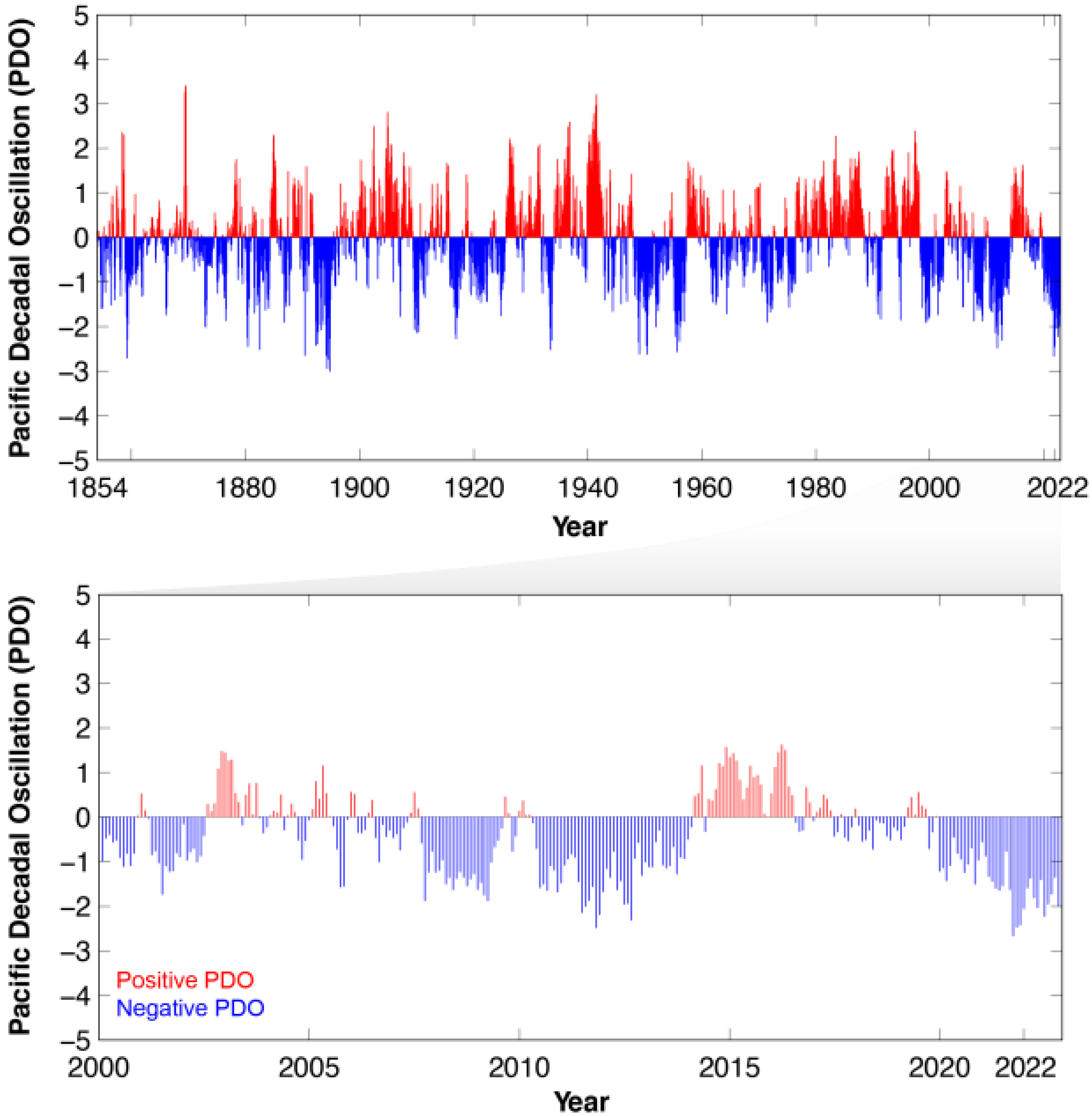


Figure 164. Pacific Decadal Oscillation from 1854–2022(top) and 2000–2022 (bottom) with positive warm periods in red and negative cool periods in blue

Rationale: The Pacific Decadal Oscillation (PDO) was initially named by fisheries scientist Steven Hare in 1996 while researching connections between Alaska salmon production cycles and Pacific climate. Like ENSO, the PDO reflects changes between periods of persistently warm or persistently cool ocean temperatures, but over a period of 20 to 30 years (versus six to 18 months for ENSO events). The climatic fingerprints of the PDO are most visible in the Northeastern Pacific, but secondary signatures exist in the tropics.

Status: The PDO was negative in 2022. The index ranged from -2.22 to -1.35 over the course of the year. This is within the range of values observed previously in the time series.

Description: The PDO is often described as a long-lived El Niño-like pattern of Pacific climate variability. As seen with the better-known ENSO, extremes in the PDO pattern are marked by widespread variations in the Pacific Basin and the North American climate. In parallel with the ENSO phenomenon, the extreme cases of the PDO have been classified as either warm or cool, as defined by ocean temperature anomalies in the northeast and tropical Pacific Ocean. When SST is below average in the [central] North Pacific and warm along the North American coast, and when sea level pressures are below average in the North Pacific, the PDO has a positive value. When the climate patterns are reversed, with warm SST anomalies in the interior and cool SST anomalies along the North American coast, or above average sea level pressures over the North Pacific, the PDO has a negative value. Description inserted from NOAA (2022b).

Timeframe: Annual, monthly.

Region/Location: Pacific Basin north of 20°N.

Measurement Platform: *In-situ* station, satellite, model.

Data available at: https://psl.noaa.gov/pdo/.

Sourced from: NOAA (2023b), Mantua (1997), and Newman (2016).

3.4.2.7 TROPICAL CYCLONES

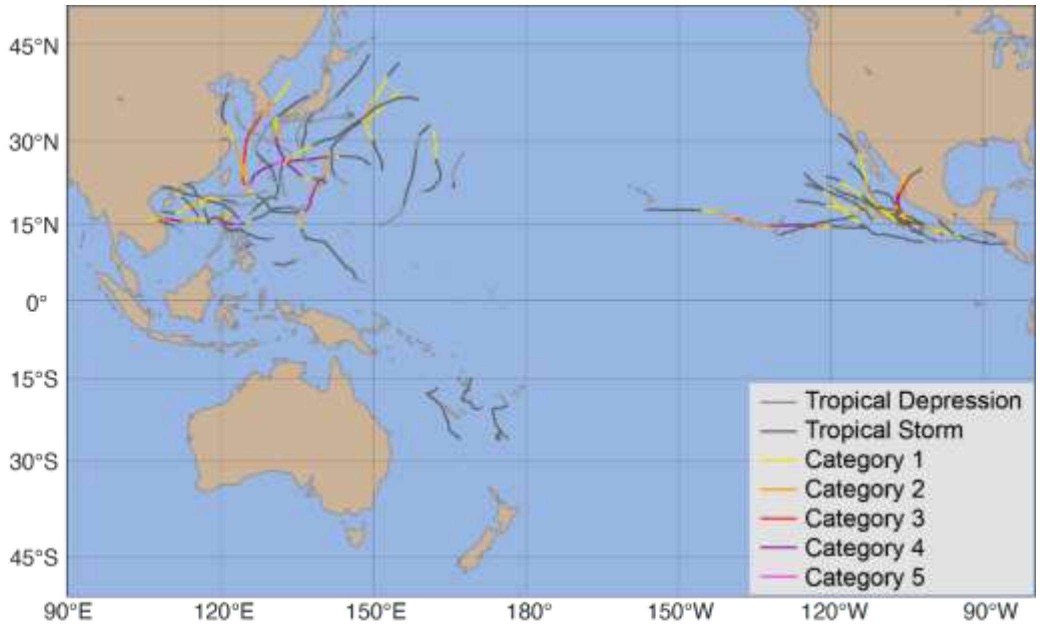


Figure 165. 2022 Pacific basin tropical cyclone tracks

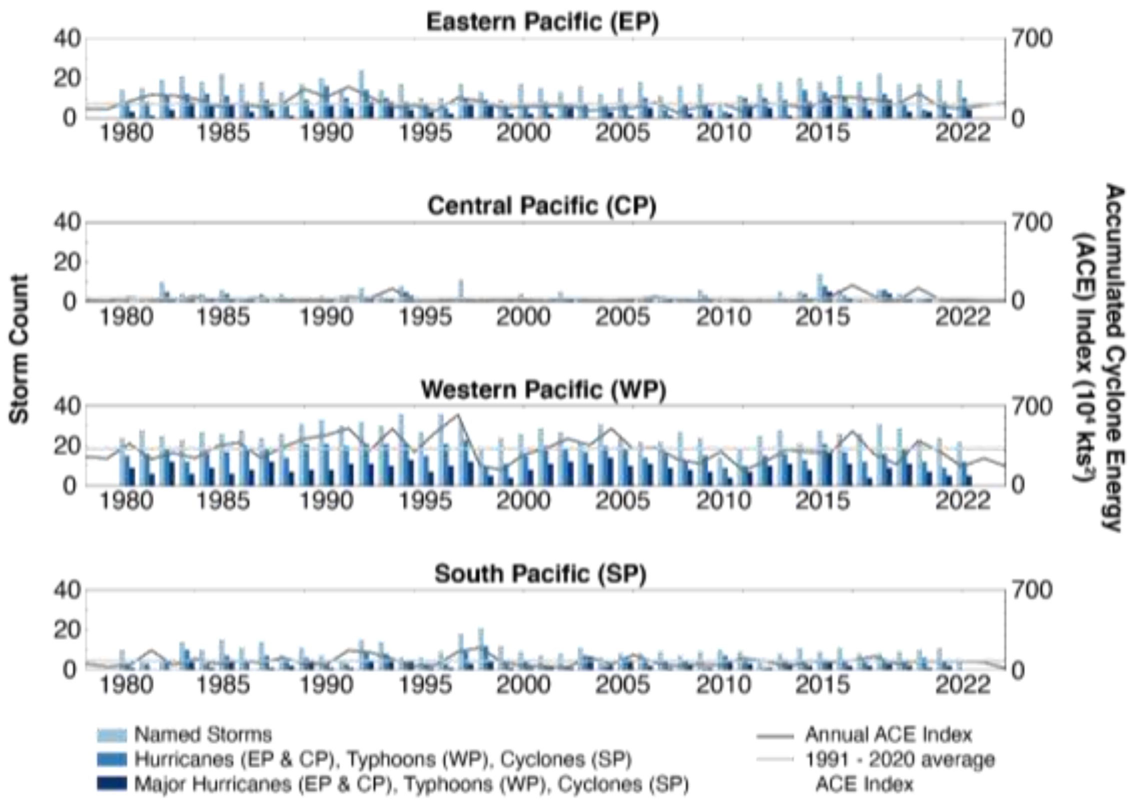


Figure 166. Storm counts (bars) and Accumulated Cyclone Energy (ACE) index values (lines) in each region of the Pacific. Both annual ACE index (black lines) and 1981 – 2020 average ACE index (grey lines) are shown

Rationale: The effects of tropical cyclones are numerous and well known. At sea, storms disrupt and endanger shipping traffic as well as fishing effort and safety. The Hawaiʻi longline fishery, for example, has had serious problems with vessels dodging storms at sea, delayed departures, and inability to make it safely back to Honolulu because of bad weather. When cyclones encounter land, their intense rains and high winds can cause severe property damage, loss of life, soil erosion, and flooding. Associated storm surge, the large volume of ocean water pushed toward shore by cyclones' strong winds, can cause severe flooding and destruction.

Status:

Eastern North Pacific. Tropical cyclone activity was near normal in the Eastern Pacific in 2022. There were 19 named storms, 10 of which were hurricanes. There were 4 major hurricanes (category 3 or higher), which is also near normal. The Accumulated Cyclone Energy (ACE) was near the 1991–2020 average. After four straight years of named storms forming in the Eastern Pacific in November (which is unusually high), conditions returned to normal this November with no storms, named or otherwise. Portions of this summary inserted from https://www.ncei.noaa.gov/access/monitoring/monthly-report/tropical-cyclones/202211.

Central North Pacific. Central Pacific tropical cyclone activity was below the 1991–2020 average in 2022. There was 1 named storm, which reached hurricane status, and no major hurricanes. A weakened Hurricane Darby entered the Central Pacific in July, passing south of the Island of Hawaiʻi as a tropical depression. On average (1991–2020), the central Pacific sees four named storms, two hurricanes, and one major hurricane each year. The 2022 ACE index was about ten percent of the 1991–2020 average. Portions of this summary inserted from https://www.ncei.noaa.gov/access/monitoring/monthly-report/tropical-cyclones/202207.

Western North Pacific. Tropical cyclone activity got off to a slow but strong start in the Western Pacific, with no storms occurring until Super Typhoon Malakas formed in April. The season overall saw below normal activity for the third year in a row. Tropical cyclone activity was below the 1991–2020 average in 2022. The 22 named storms, 12 typhoons, and 5 major typhoons were all below average (1991–2020), as was the ACE. Portions of the summary inserted from https://www.ncei.noaa.gov/access/monitoring/monthly-report/tropical-cyclones/202203, https://www.ncei.noaa.gov/access/monitoring/monthly-report/tropical-cyclones/202204, and https://www.ncei.noaa.gov/access/monitoring/monthly-report/tropical-cyclones/202213.

South Pacific. South Pacific tropical cyclone activity was below average in 2022. There were 4 named storms, none of which became cyclones or major cyclones. The 2022 ACE was also below the 1991–2020 average. Portions of the summary inserted from https://www.ncei.noaa.gov/access/monitoring/monthly-report/tropical-cyclones/202213.

Description: This indicator uses historical data from the NOAA National Climate Data Center (NCDC) International Best Track Archive for Climate Stewardship to track the number of tropical cyclones in the western, central, eastern, and southern Pacific basins. This indicator also monitors the Accumulated Cyclone Energy (ACE) Index and the Power Dissipation Index which are two ways of monitoring the frequency, strength, and duration of tropical cyclones based on wind speed measurements.

The annual frequency of storms passing through each basin is tracked and Figure 166 shows the representative breakdown of Saffir-Simpson hurricane categories.

Every cyclone has an ACE Index value, which is a number based on the maximum wind speed measured at six-hourly intervals over the entire time that the cyclone is classified as at least a tropical storm (wind speed of at least 34 knots; 39 mph). Therefore, a storm's ACE Index value accounts for both strength and duration. Figure 166 shows the ACE values for each hurricane/typhoon season and has a horizontal line representing the average annual ACE value.

Timeframe: Annual.

Region/Location:

Eastern North Pacific: east of 140° W, north of the equator.

Central North Pacific: 180° - 140° W, north of the equator.

Western North Pacific: west of 180°, north of the equator.

South Pacific: south of the equator.

Measurement Platform: Satellite.

Data available at: https://www.ncei.noaa.gov/data/international-best-track-archive-for-climate-stewardship-ibtracs/v04r00/access/csv.

Sourced from: Knapp et al. (2010), Knapp et al. (2018), and NOAA (2023c).

3.4.2.8 SEA SURFACE TEMPERATURE (SST)

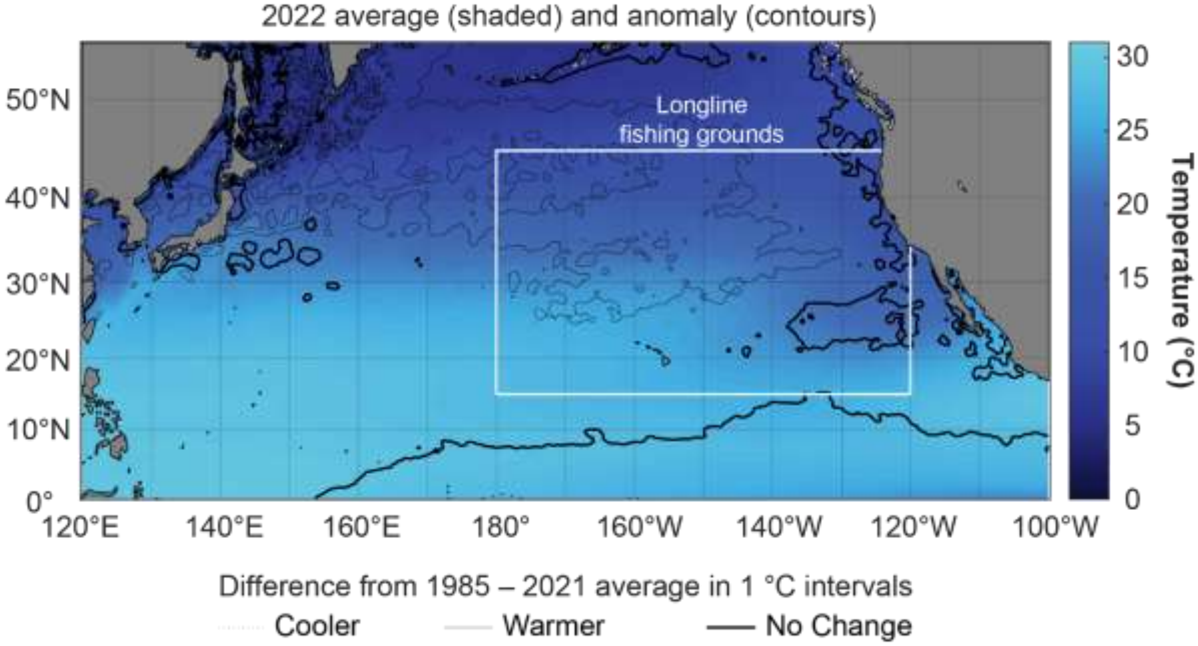


Figure 167. Average 2022 sea surface temperature (shaded) and the difference from the 1985–2021 average (contoured). The white rectangle identifies the area targeted by Hawaii's longline fisheries. SST is averaged over this area for the time series shown in Figure 168 and Figure 169

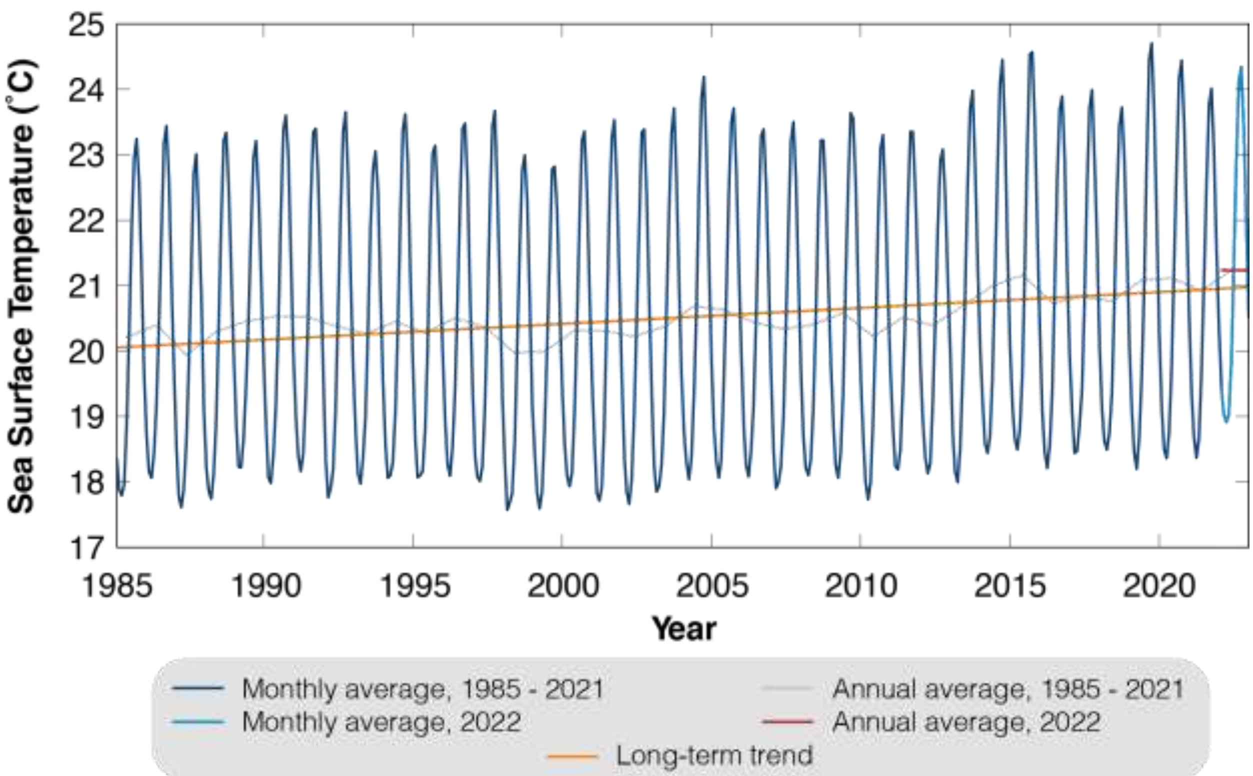


Figure 168. Time series of monthly average sea surface temperature over the longline fishing grounds outlined in Figure 167

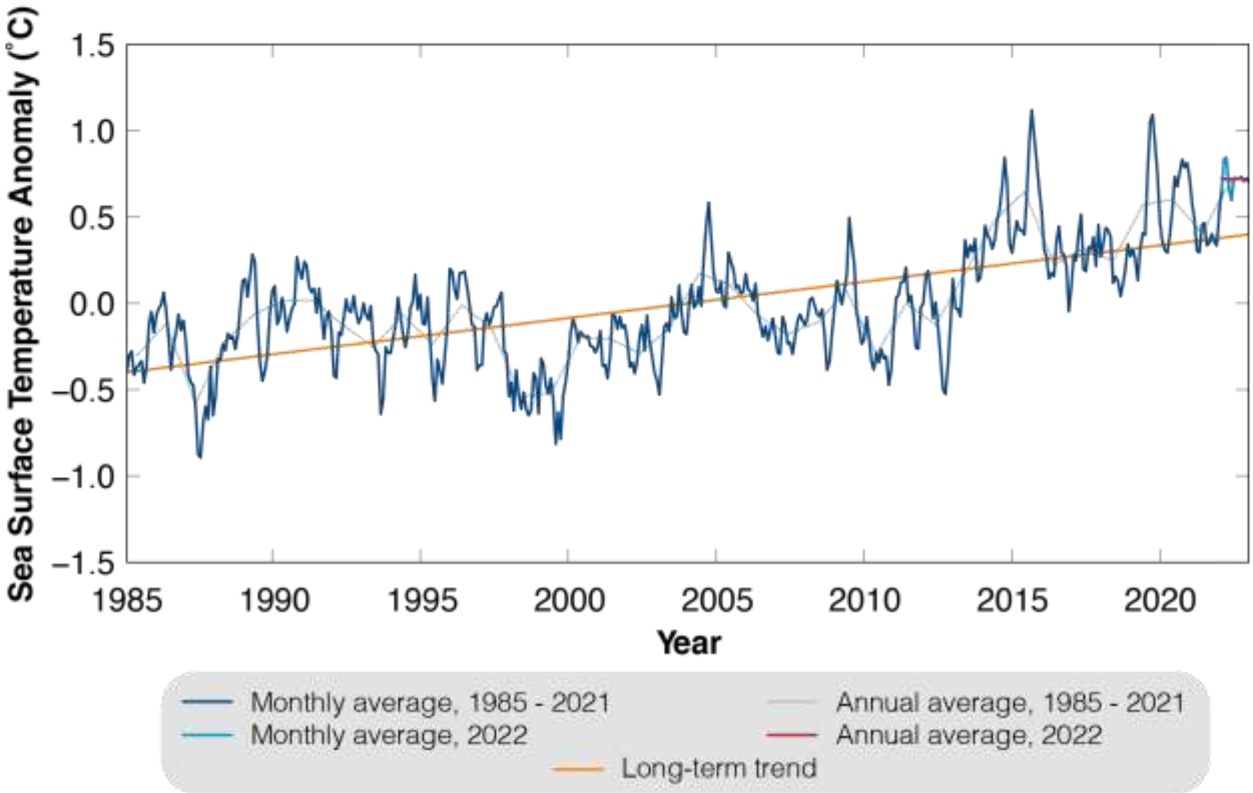


Figure 169. Time series of monthly average sea surface temperature anomaly over the longline fishing grounds outlined in Figure 167

Rationale: Sea surface temperature (SST) is one of the most directly observable existing measures for tracking increasing ocean temperatures. SST varies in response to natural climate cycles such as the El Niño – Southern Oscillation (ENSO) and is rising as a result of anthropogenic climate change. Both short-term variability and long-term trends in SST impact the marine ecosystem. Understanding the mechanisms through which organisms are impacted and the time scales of these impacts is an area of active research.

Status: Annual mean SST was 21.2 ºC in 2022. Over the period of record, SST across the longline fishing grounds has increased by 0.9 ºC and the monthly SST anomaly increased by 0.8 ºC, both at a rate of roughly 0.02 ºC yr^{-1}. Monthly SST values in 2022 ranged from 18.9–24.3 ºC, within the range of temperatures experienced over the past several decades (17.6–24.7 ºC). Overall, SST was above the long-term average across most of the Hawai‘i longline region in 2022. The exception to this was a patch of slightly cooler waters in the southeastern corner of the fishing grounds where very little fishing takes place and the waters of the California Current where the fishery does not operate.

Description: Satellite remotely sensed monthly sea surface temperature (SST) is averaged across the Hawai‘i-based longline fishing grounds (15° – 45°N, 180° – 120°W). A time series of monthly mean SST averaged over the Hawai‘i longline region is presented. Additionally, spatial climatologies and anomalies are shown. CoralTemp data are used to calculate this indicator.

Timeframe: Monthly.

Region/Location: Hawaii longline region: 15° – 45°N, 180° – 120°W.

Measurement Platform: Satellite.

Data available at: https://oceanwatch.pifsc.noaa.gov/erddap/griddap/CRW_sst_v3_1_monthly.

Sourced from: NOAA OceanWatch (2023a). Graphics produced in part using Stawitz (2022).

3.4.2.9 TEMPERATURE AT 300 M DEPTH

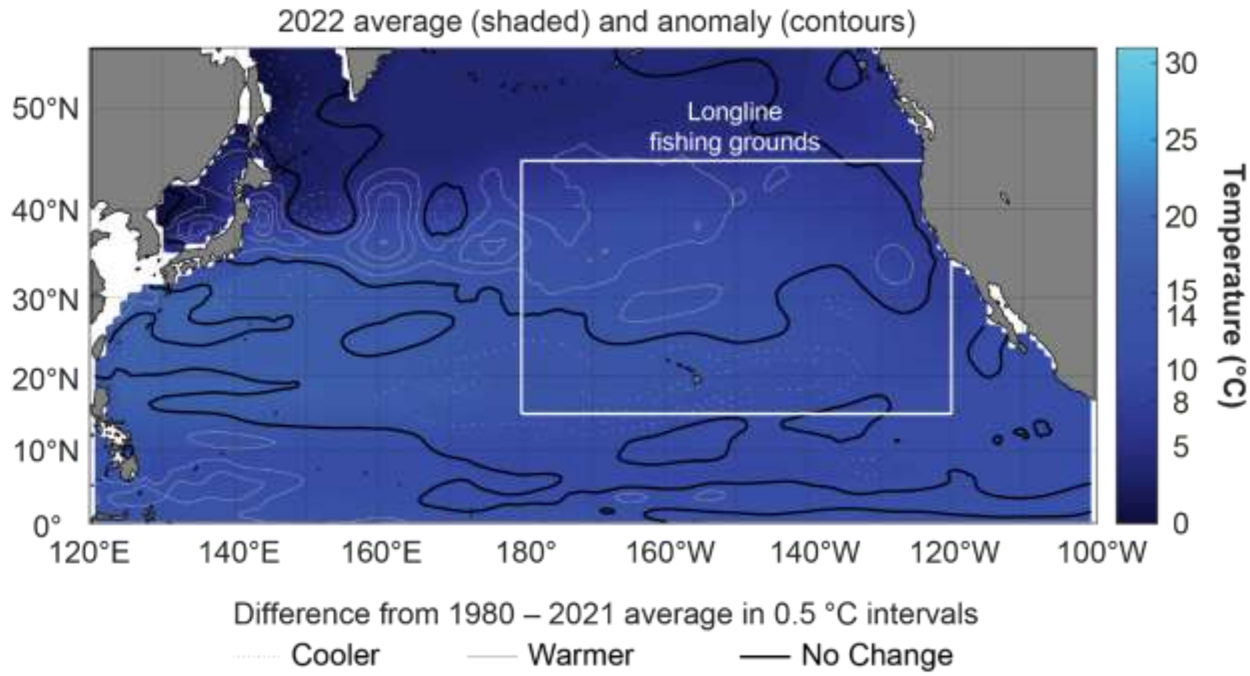


Figure 170. Average temperatures at 200 – 300 m depth in 2022 (shaded) and the difference from the 1980 – 2021 average (contoured). The white rectangle identifies the area targeted by Hawaii's longline fisheries. Temperatures is averaged over this area for the time series shown in Figure 171

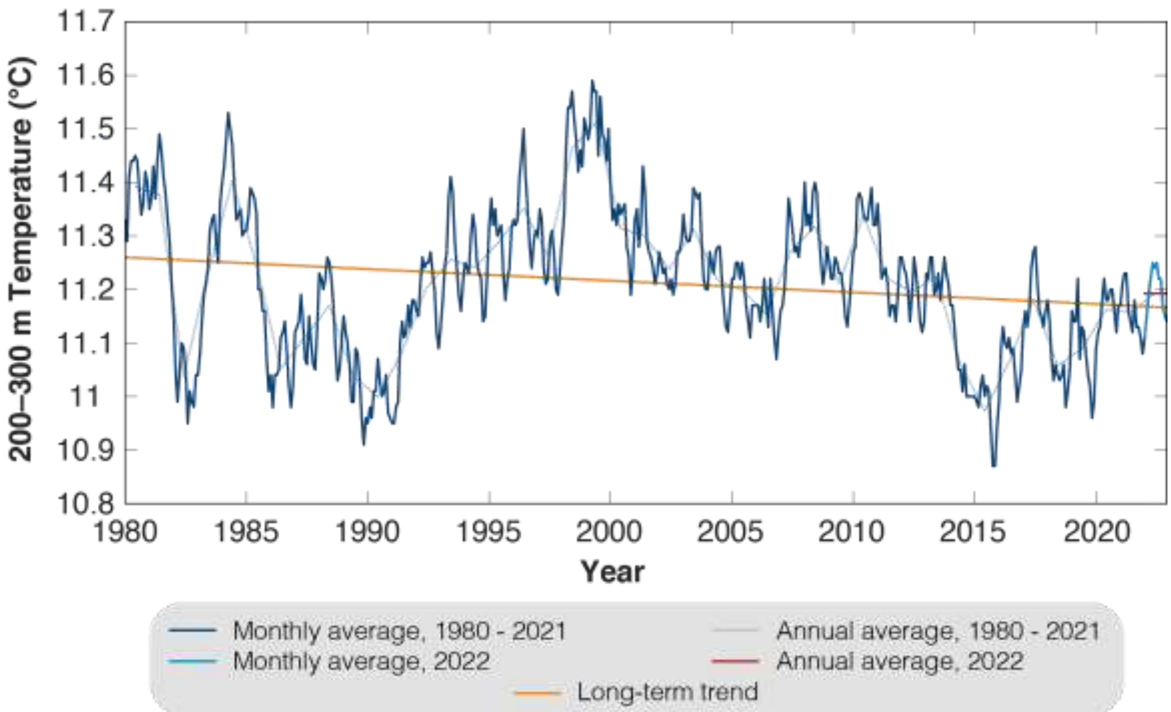


Figure 171. Time series of monthly 200 – 300 m temperatures over the longline fishing grounds outlined in Figure 170

Rationale: The temperature at 200–300 m reflects the temperature in the mid-range of depths targeted by the deep-set bigeye tuna fishery. Bigeye have preferred thermal habitat, generally staying within temperatures ranging from 8–14 °C while they are at depth (Howell et al. 2010). Changes in ocean temperature at depth will impact tuna, and in turn, potentially impact their catchability. Understanding the drivers of sub-surface temperature trends and their ecosystem impacts is an area of active research.

Status: In 2022, 200–300 m temperatures ranged from 11.11–11.25 °C with an average value of 11.19 °C. These temperatures are within the range of temperatures experienced over the past several decades (10.87–11.59 °C) and are within the bounds of bigeye tuna's preferred deep daytime thermal habitat (8–14 °C). Over the period of record (1980–2022), 200–300 m temperatures have declined by -0.09 °C. The spatial pattern of temperature anomalies was mixed with temperatures at depth around the main Hawaiian Islands roughly 0.5–1 °C below average, and temperatures north of about 30°N 0–0.5 °C above average.

Description: Ocean temperature at 200–300 m depth is averaged across the Hawai'i-based longline fishing grounds (15° – 45°N, 180° – 120°W). Global Ocean Data Assimilation System (GODAS) data are used. GODAS incorporates global ocean data from moorings, expendable bathythermographs (XBTs), and Argo floats.

Timeframe: Annual, monthly.

Region/Location: Hawaii longline region: 15° – 45°N, 180° – 120°W.

Measurement Platform: *In-situ* sensors, model.

Sourced from: NOAA (2023d) and APDRC (2023). Graphics produced in part using Stawitz (2022).

3.4.2.10 OCEAN COLOR

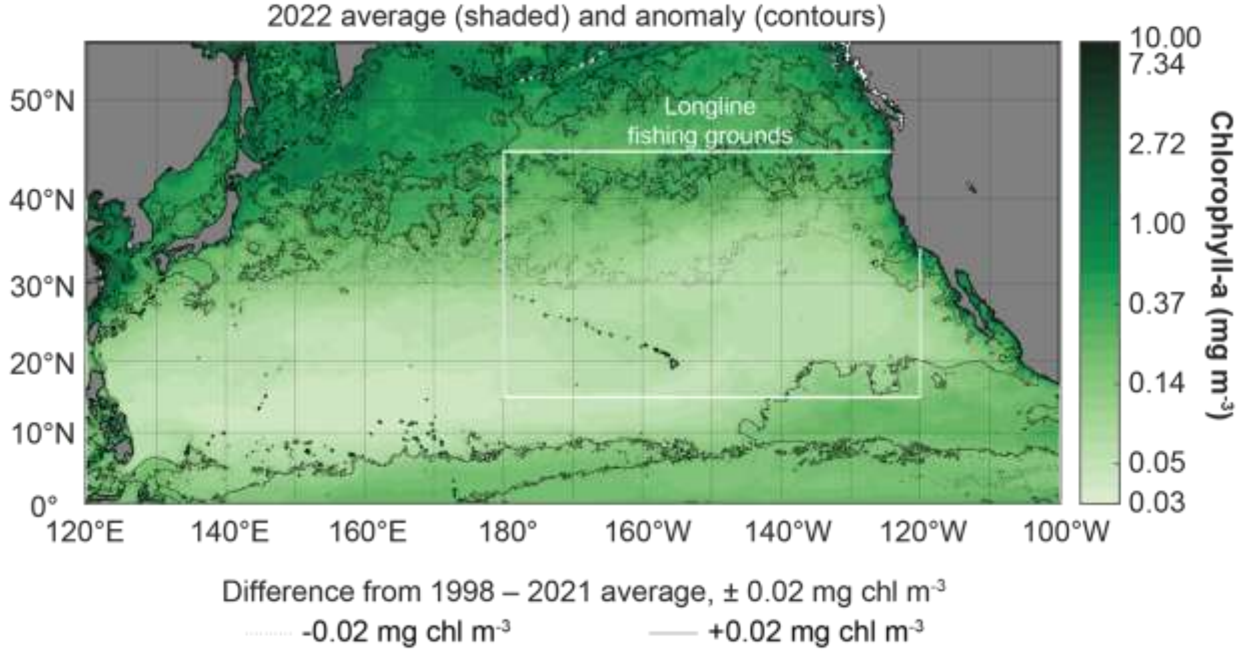


Figure 172. Average chlorophyll-a concentration in 2022 (shaded) and the difference from the 1998–2021 average (contoured). The white rectangle identifies the area targeted by Hawai‘i’s longline fisheries. Chlorophyll-a is averaged over this area for the time series shown in Figure 173 and Figure 174

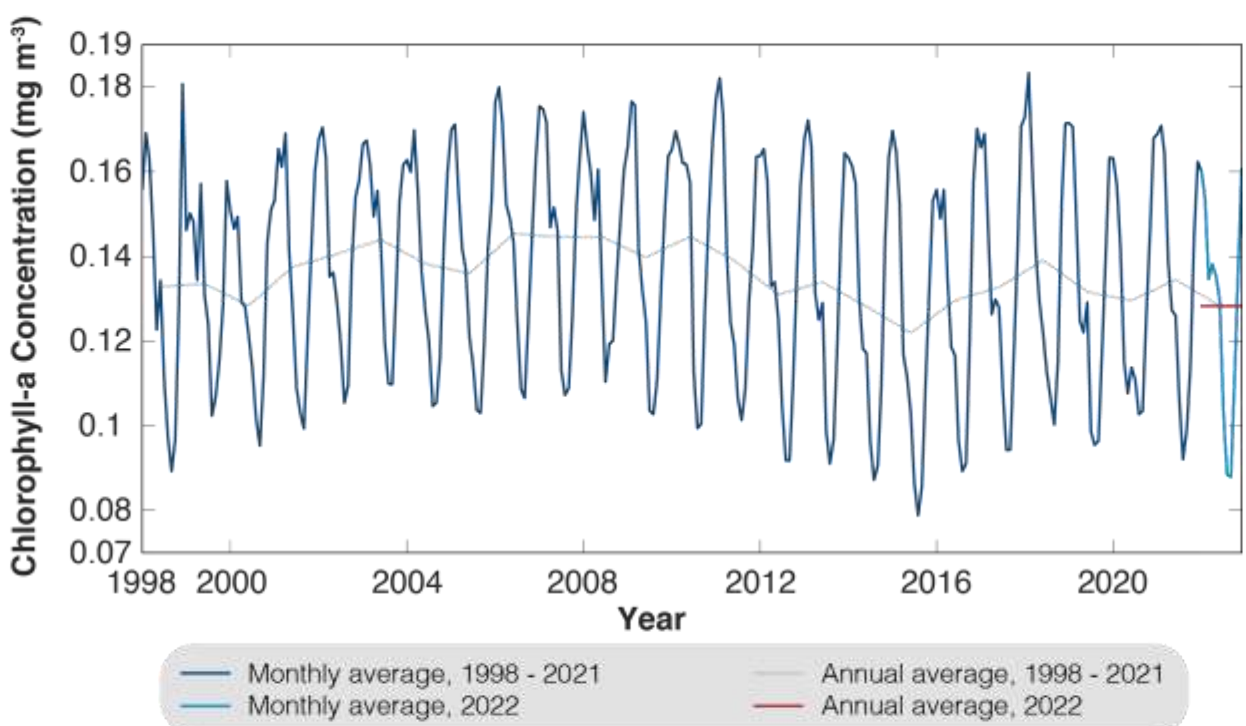


Figure 173. Time series of monthly average chlorophyll concentration over the longline fishing grounds outlined in Figure 174

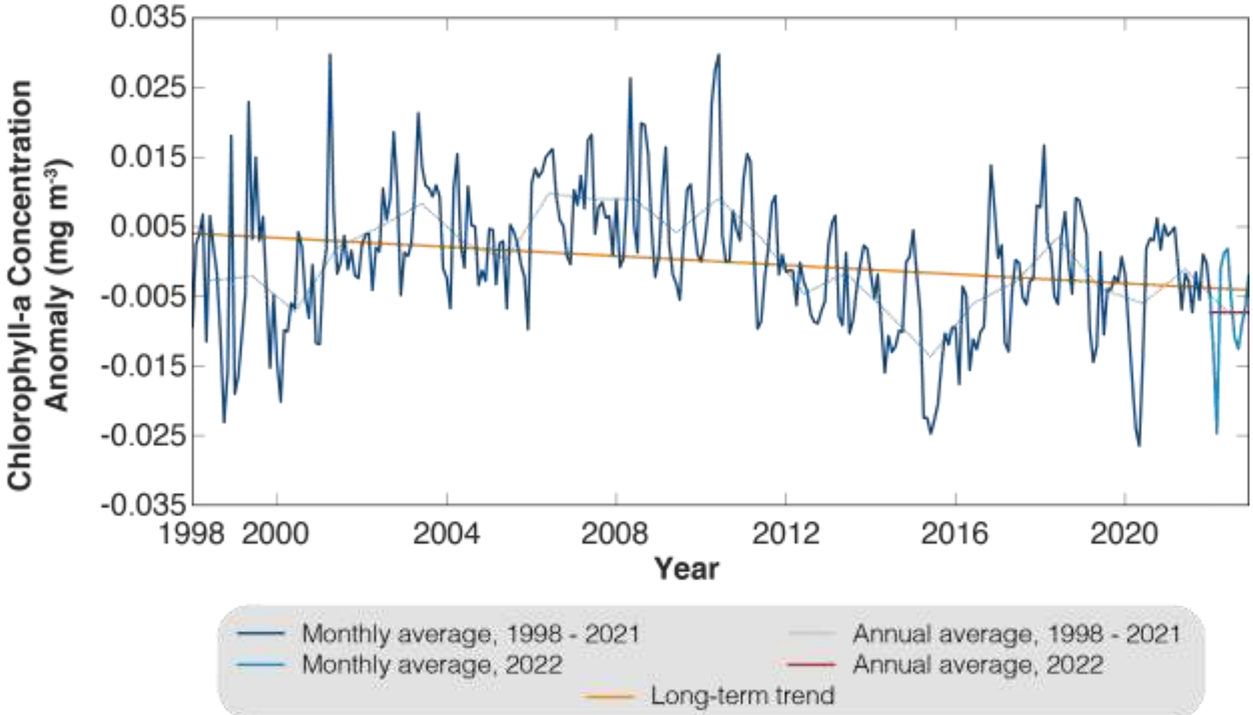


Figure 174. Time series of monthly average chlorophyll concentration anomaly over the longline fishing grounds outlined in Figure 173

Rationale: Phytoplankton are the foundational food source for the fishery. Changes in phytoplankton abundance have been linked to both natural climate variability and anthropogenic climate change. These changes have the potential to impact fish abundance, size, and catch.

Status: The mean monthly chlorophyll concentration was 0.13 mg chl m^{-3} in 2022. Monthly mean chlorophyll concentrations ranged from 0.088–0.16 mg chl m^{-3}, which was within the range of values observed during the previous years of the time series (0.079–0.18 mg chl m^{-3}). There has been no significant trend in monthly average chlorophyll concentration over the time period, however chlorophyll anomalies have declined by 0.008. Chlorophyll concentrations were fairly average across the southern portion of the longline fishing grounds and a little below average north of 30 - 35°N.

Description: Satellite remotely sensed ocean color is used to determine chlorophyll concentrations in the pelagic surface ocean. A time series of median monthly chlorophyll-a concentrations averaged over the Hawai‘i longline region is presented. Additionally, spatial climatologies and anomalies are shown. European Space Agency (ESA) Climate Change Initiative (CCI) data are used for this indicator (Sathyendranath et al. 2018).

Timeframe: Monthly

Region/Location: Hawaii longline region: 5° – 45°N, 180° – 120°W

Measurement Platform: Satellite

Sourced from: NOAA OceanWatch (2023b) and Sathyendranath et al. (2018). Graphics produced in part using Stawitz (2022).

3.4.2.11 NORTH PACIFIC SUBTROPICAL FRONT (STF) AND TRANSITION ZONE CHLOROPHYLL FRONT (TZCF)

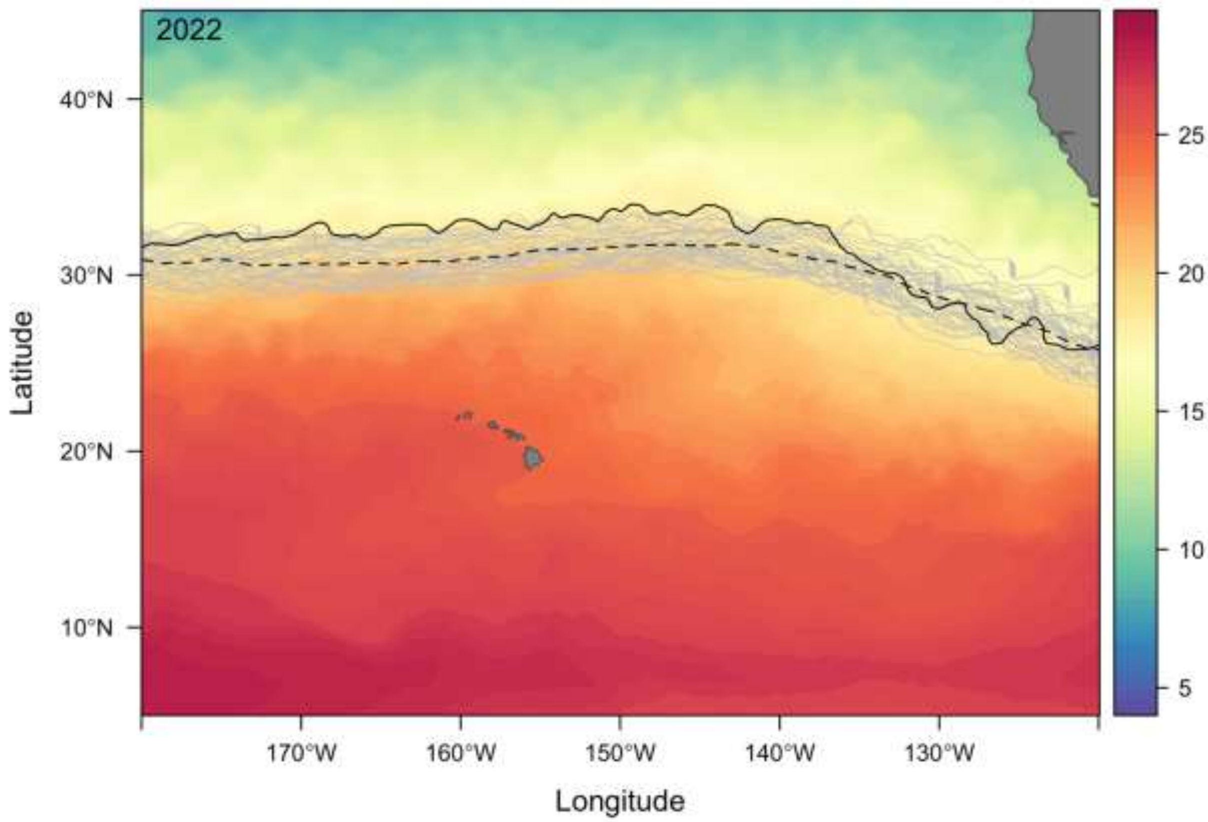


Figure 175. Average position of the subtropical front (STF) in 2022 (solid black line), over the long-term average (dotted line), locations from previous years (solid grey lines), and ocean temperatures for the first quarter of 2022 (shaded). The long-term average for the STF spans 1985–2021

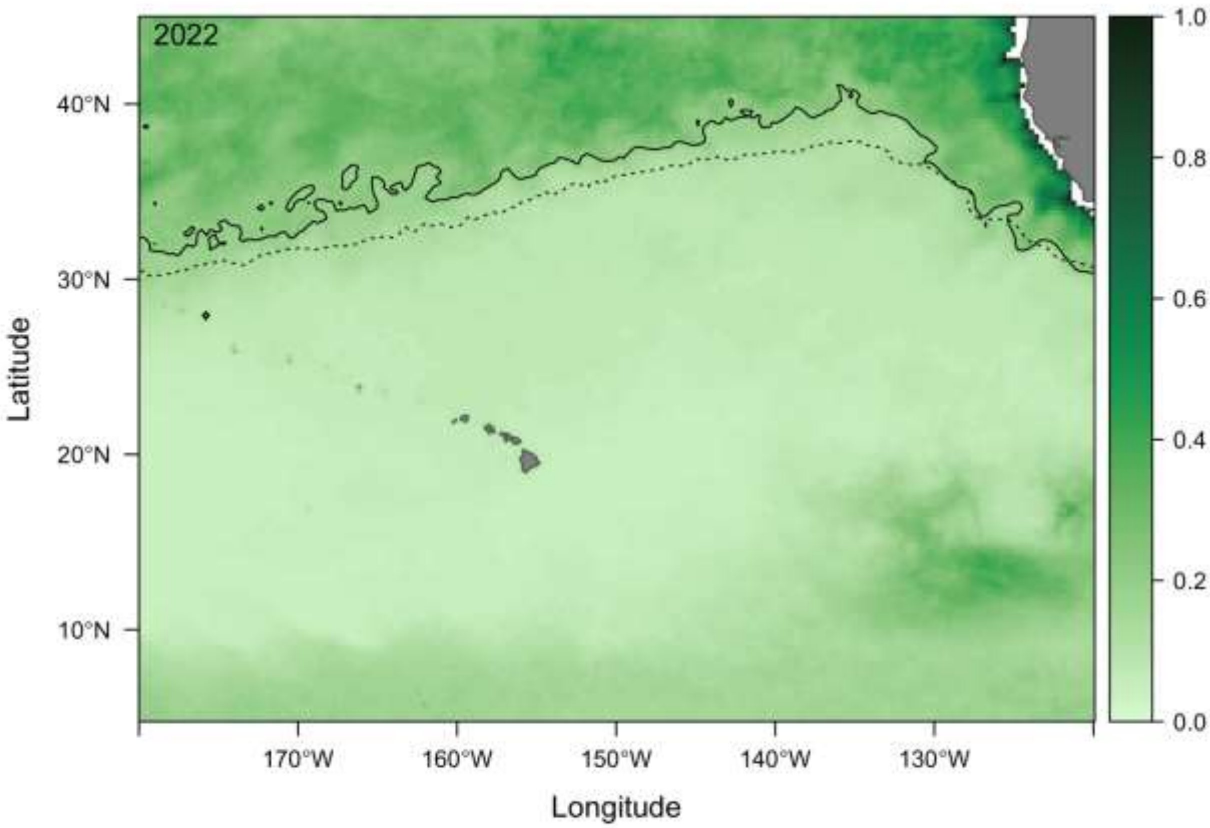


Figure 176. Average position of the transition zone chlorophyll front (TZCF) in 2022 (solid black line) over a long-term average (dotted black line) and ocean color for the first quarter of 2022 (shaded). The long-term average for the TZCF spans 1998–2021

Rationale: The STF is targeted by the swordfish fishery. Additionally, both the STF and TZCF are used as migration and foraging corridors by both commercially valuable and protected species. Northward displacement of the frontal zone can increase the distance fishing vessels must travel to set their gear. This can, in turn, increase operational expenses. The positions of the fronts vary in response to natural climate variations. Long-term northward displacement of the frontal zone may also result from anthropogenic climate change.

Status: During the first quarter of 2022, the STF was north of average and near its northernmost position across much of the fishing grounds west of 135°W, and roughly average east of 135°W. The TZCF was also north of average west of about 135°W and at its average latitude east of 135°W.

Description: The subtropical front (STF) is marked by the 18 °C sea surface temperature (SST) isotherm and the transition zone chlorophyll front (TZCF) by the 0.2 mg chl-a m^{-3} isopleth (Bograd et al. 2004; Polovina et al. 2001). They roughly mark the northern boundary of the North Pacific subtropical gyre as well as the northern extent of the Hawai‘i-based longline fishery. Both fronts migrate meridionally on a seasonal basis and their positions are impacted by the phase of the El Niño – Southern Oscillation (ENSO). Due to significant seasonal variation, the climatology and anomaly (2022) are presented for the first quarter of the year only. The STF is determined from CoralTemp data (see SST indicator) and the TZCF is determined from ESA CCI data (see Section 0).

Timeframe: Annual, seasonal

Region: Hawaii longline region: 5° – 45°N, 180° – 120°W

Measurement Platform: Satellite

Data available at: https://oceanwatch.pifsc.noaa.gov/erddap/griddap/CRW_sst_v3_1_monthly and https://oceanwatch.pifsc.noaa.gov/erddap/griddap/esa-cci-chla-monthly-v5-0.

Sourced from: Bograd et al. (2004), Polovina et al. (2001), and NOAA OceanWatch (2023a; 2023b).

3.4.2.12 ESTIMATED MEDIAN PHYTOPLANKTON SIZE

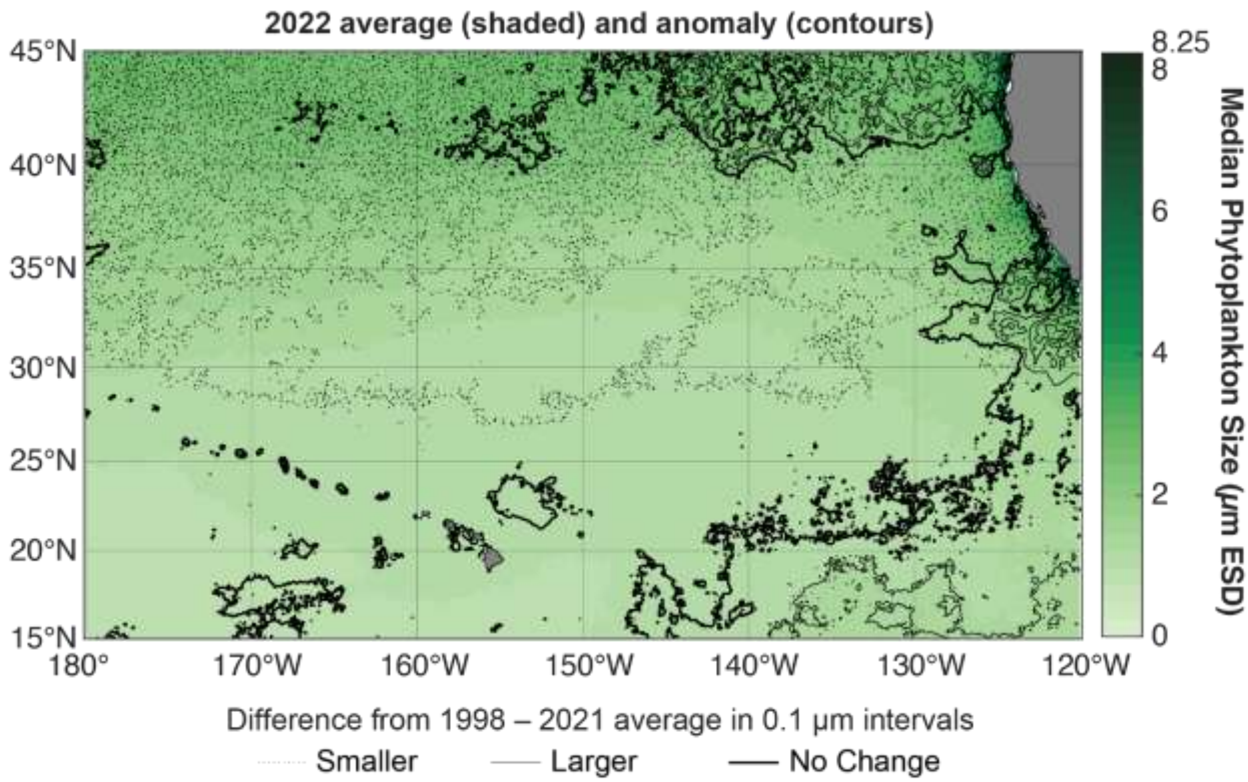


Figure 177. Average estimated median phytoplankton size in 2022 (shaded) and the difference from the 1998–2021 average (contoured) across the area targeted by Hawaii's longline fisheries

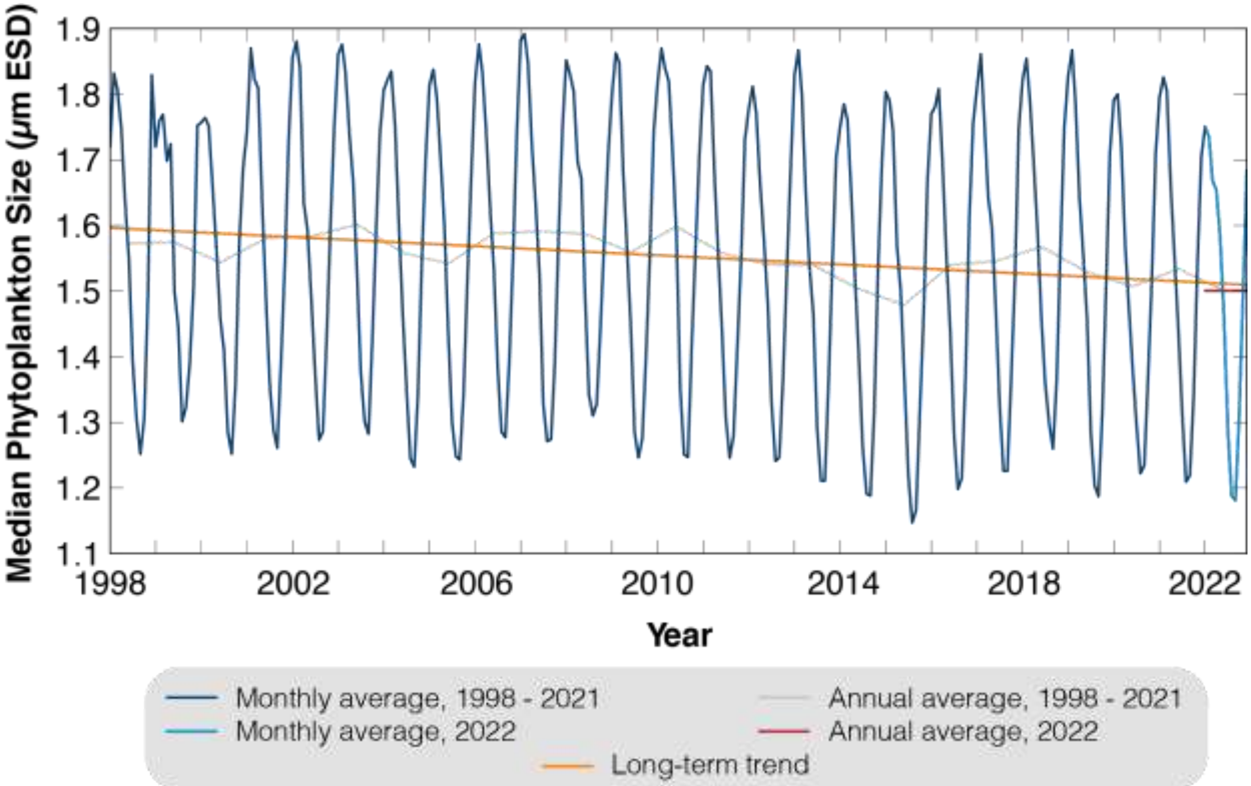


Figure 178. Time series of monthly median phytoplankton size over the longline fishing grounds shown in Figure 177

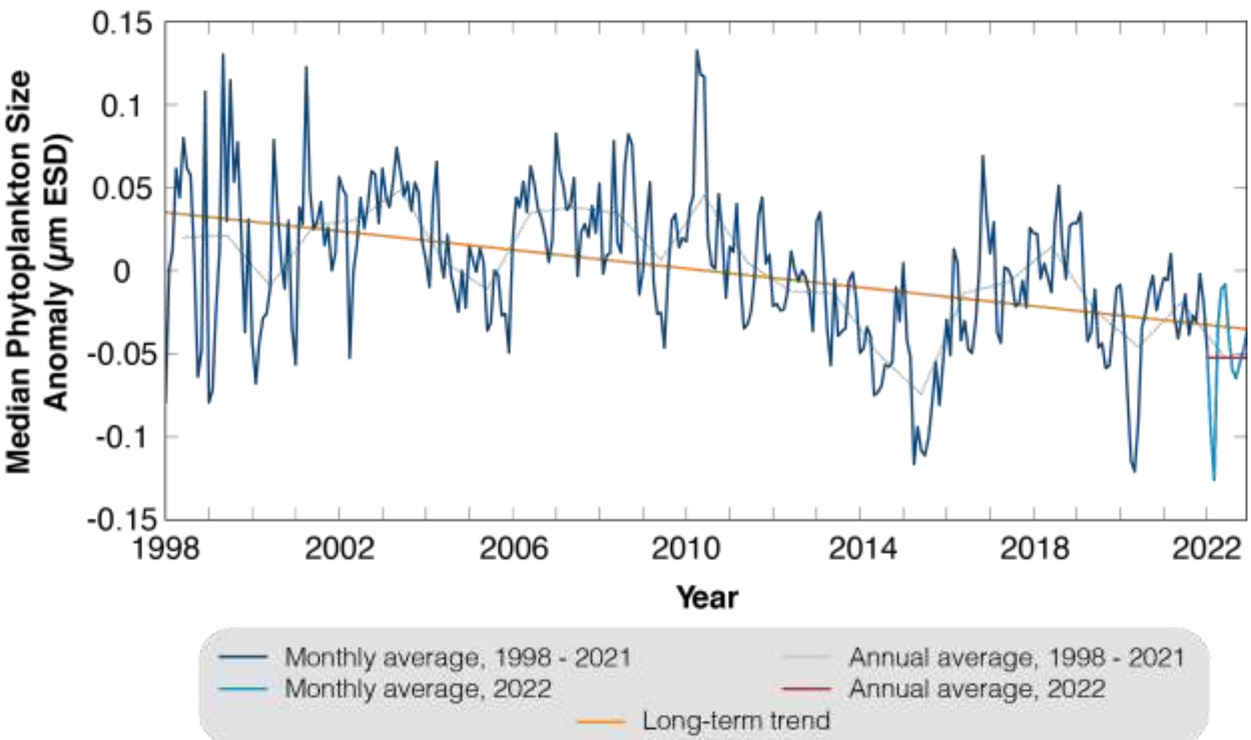


Figure 179. Time series of monthly median phytoplankton size anomaly over the longline fishing grounds shown in Figure 177

Rationale: Phytoplankton are the base of the food web and their abundance influences the food available to all higher trophic levels from zooplankton through tuna and billfish. Some studies project that climate change will result in both fewer and smaller phytoplankton. This would reduce the food available to all members of the food web. Understanding trends in phytoplankton abundance and size structure, how they are influenced by oceanographic conditions, and how they influence fish abundance and size structure are areas of active research.

Status: The mean monthly phytoplankton cell size was 1.5 μm Equivalent Spherical Diameter (ESD) in 2022. Monthly mean cell size ranged from 1.18–1.75 μm ESD during the year, within the range of values observed over the period of record (1.15–1.89 μm ESD). Over the period of record, there has been weakly significant decline in monthly median phytoplankton size. Over the time series, median phytoplankton size has declined by 0.087 μm ESD, or by -5.4%. The monthly anomaly has declined as well, by -0.07 μm ESD. Average estimated median phytoplankton size was below average across much of the fishing grounds.

Description: Median phytoplankton cell size can be estimated from satellite remotely sensed SST and ocean color (Barnes et al. 2011). A time series of monthly median phytoplankton cell size averaged over the Hawai‘i longline region is presented, as well as a time series of anomalies. NOAA CoralTemp (see SST indicator) and ESA CCI data (see ocean color indicator) are used to calculate median phytoplankton cell size.

Timeframe: Monthly

Region: Hawaii longline region: 15° – 45°N, 180° – 120°W

Measurement Platform: Satellite

Data available at: https://oceanwatch.pifsc.noaa.gov/erddap/griddap/CRW_sst_v3_1_monthly and https://oceanwatch.pifsc.noaa.gov/erddap/griddap/esa-cci-chla-monthly-v5-0

Sourced from: Barnes et al. (2011) and NOAA OceanWatch (2023a; 2023b). Graphics produced in part using Stawitz (2022).

3.4.2.13 FISH COMMUNITY SIZE STRUCTURE

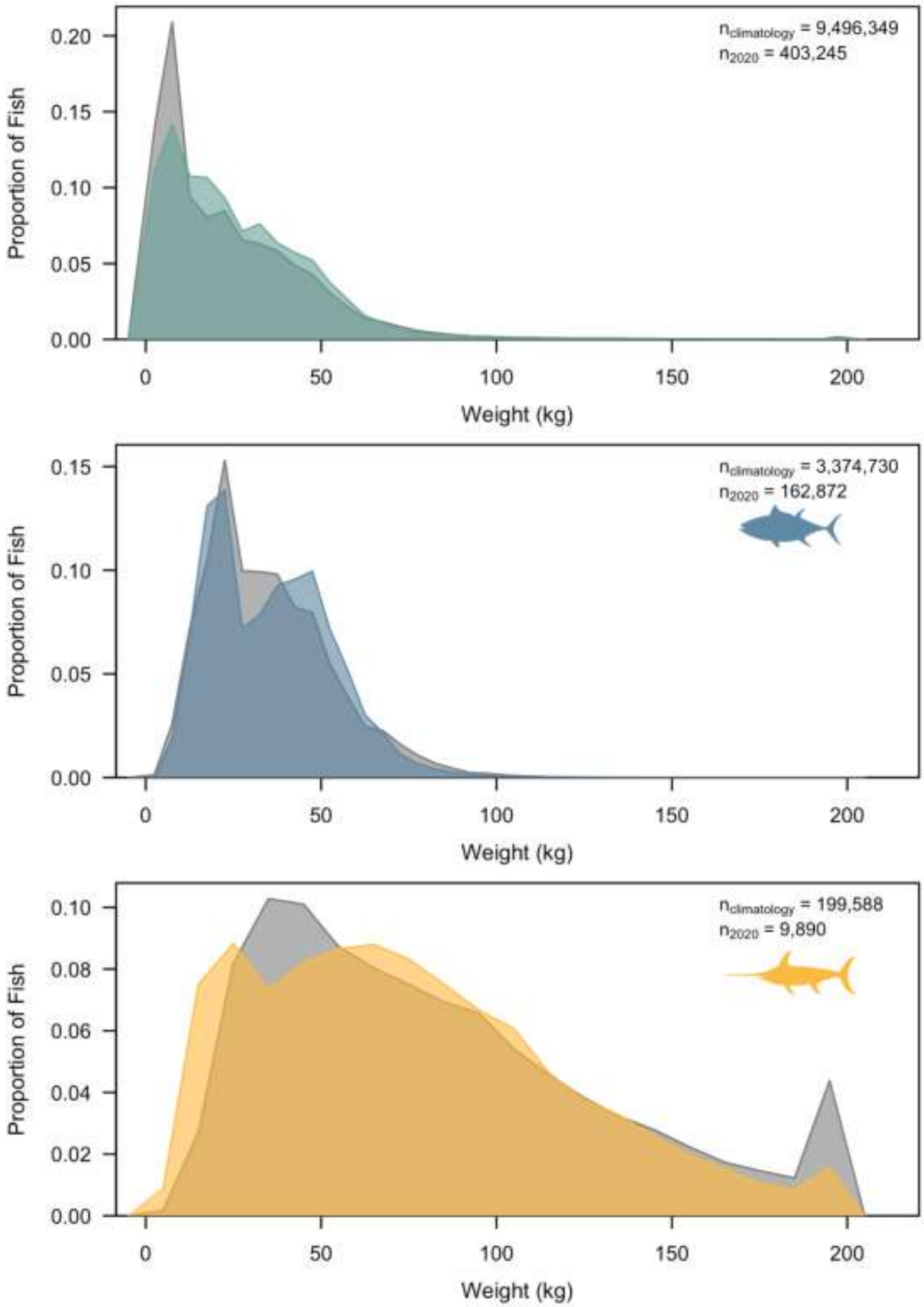


Figure 180. The climatological (2000 – 2021; grey) and 2022 (color) distribution of weights for all fish (top), bigeye tuna from deep sets (middle), and swordfish from shallow sets (bottom)

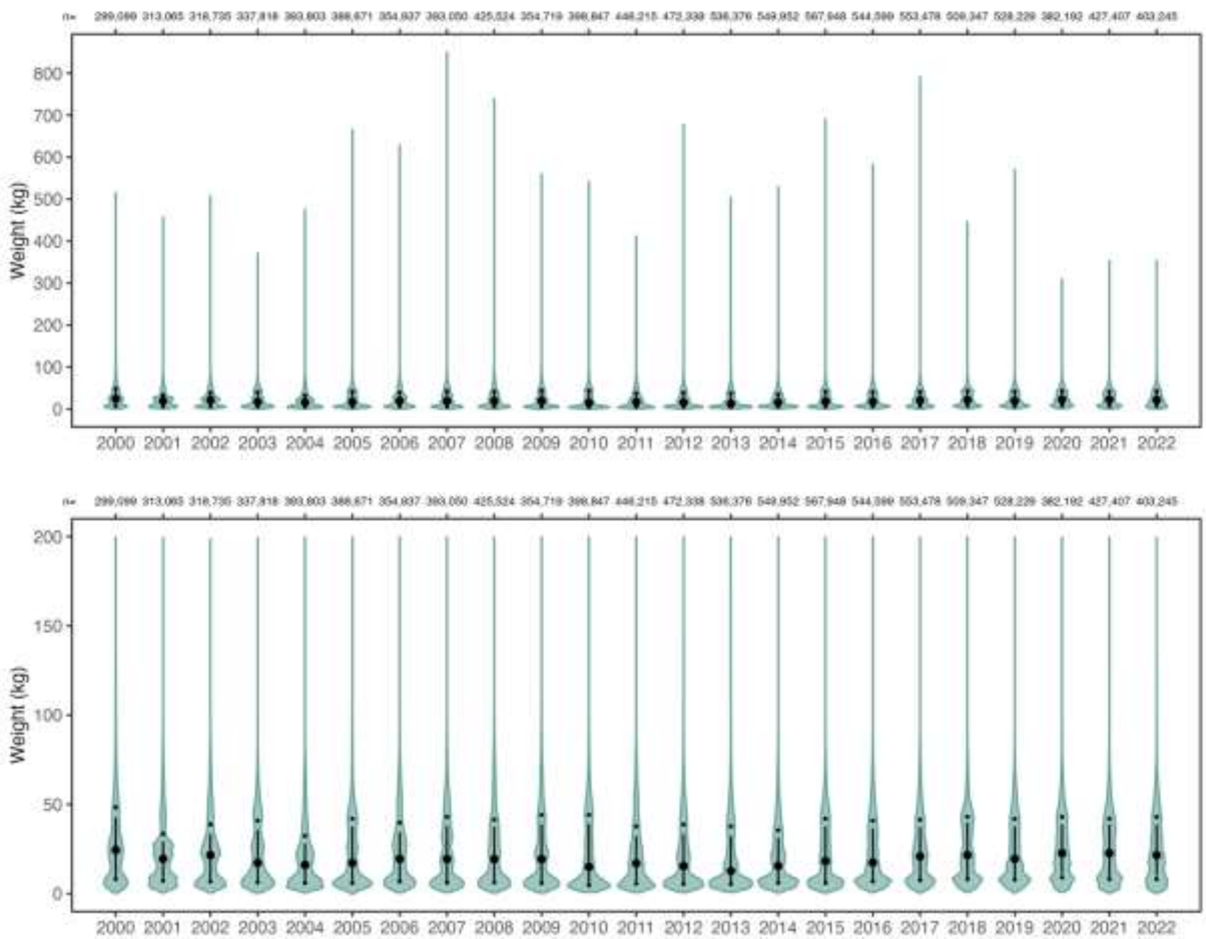


Figure 181. The annual distribution of weights of all fish, showing the full range of weights (top) and truncated to better demonstrate the distribution of the majority of weights (bottom) with large circles denoting median weight, black lines showing the range of the middle 50% of fish, small circles denoting the 20th and 80th percentiles of the weight distributions, and width of shading proportional to the number of fish of a given weight

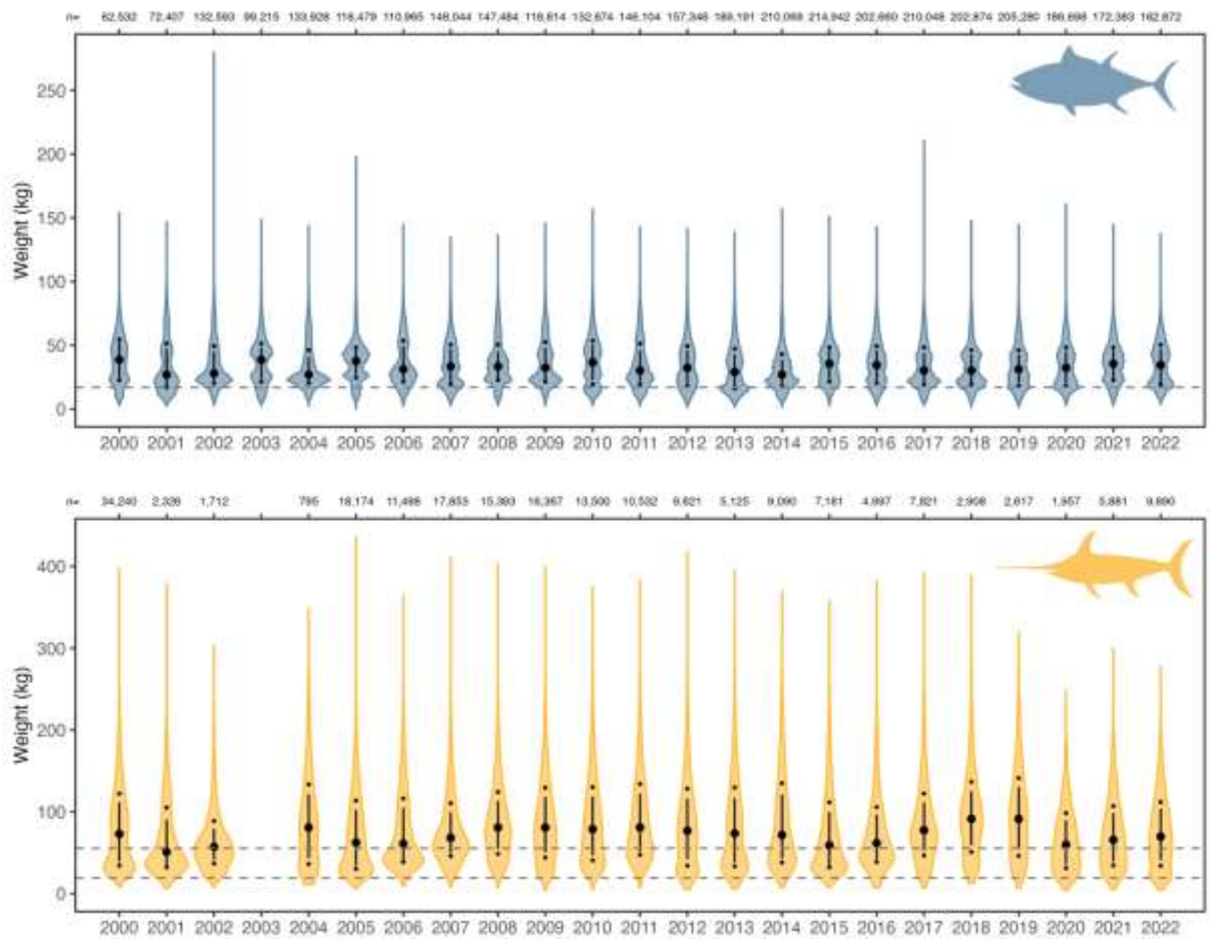


Figure 182. The annual distribution of weights of bigeye tuna from deep sets (top) and swordfish from shallow sets (bottom), with large circles denoting median weight, black lines showing the range of the middle 50% of fish, small circles denoting the 20th and 80th percentiles of the weight distributions, and width of shading proportional to the number of fish of a given weight. Horizontal dashed lines denote the weight corresponding to L_{50} for bigeye tuna (17 kg; Farley et al. 2018), female swordfish (55.5 kg; Kapur et al. 2017), and male swordfish (19.4 kg, Kapur et al. 2017)

Rationale: Fish size can be impacted by a number of factors, including climate. Currently, the degree to which the fishery's target species are impacted by climate, and the scale at which these impacts may occur, is largely unknown. Ongoing collection of size structure data is necessary for detecting trends in community size structure and attributing causes of these trends. Understanding trends in fish size structure and how oceanographic conditions influence these trends is an area of active research.

Status: For the longline fishery as a whole, fish were slightly larger than average in 2022, with a lower proportion of fish smaller than about 15 kg. Bigeye tuna had a more bimodal size distribution than average in 2022 and swordfish were slightly larger than the previous year on average.

Description: The weight of individual fish moving through the Honolulu auction is available from 2000 through the present. Using these weights, community size structure is presented. A standardized pooled climatological distribution is presented, as is the 2022 distribution. Similar distributions for target species (bigeye tuna and swordfish) are also presented. Annual time series of pooled target species weights are presented as violin plots. Bigeye weights are from deep sets (≥ 15 hooks per float) only. Swordfish weights are from shallow sets (< 15 hooks per float) only. The Honolulu auction reports weights for gilled and gutted fish. A conversion factor is used to calculate the whole fish weights used for this indicator (Langley et al. 2006).

Timeframe: Annual.

Region: Hawaii-based longline fishing grounds.

Measurement Platform: *In-situ* measurement.

Sourced from: Farley et al. (2018), HDAR Measurement Platform, and Langley et al. (2006).

3.4.2.14 BIGEYE WEIGHT-PER-UNIT-EFFORT

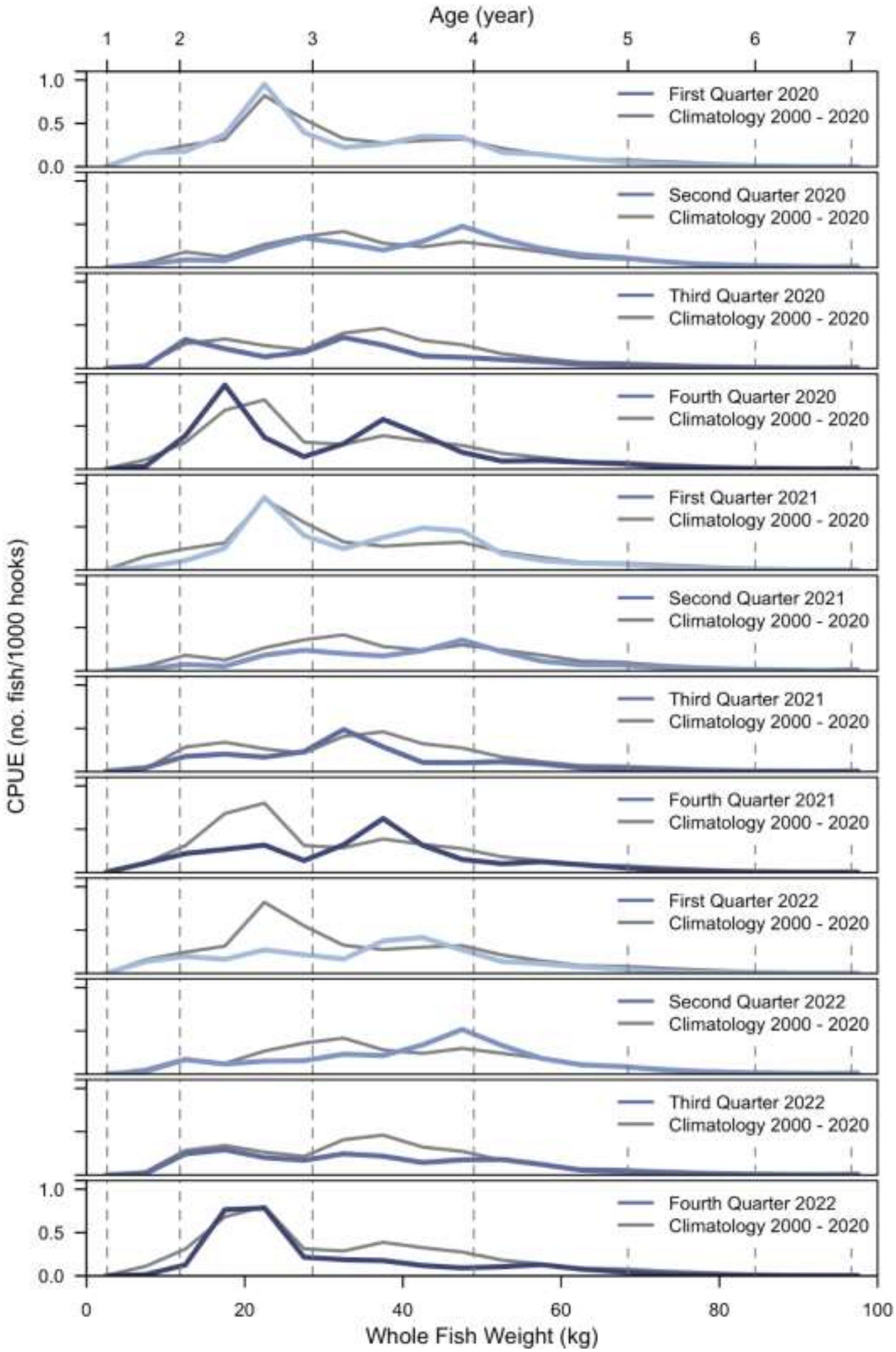


Figure 183. Quarterly deep-set bigeye tuna weight per unit effort for 2020–2022 (color) and the climatological average (2000–2020)

Rationale: Tracking the progression of growing size classes through time can provide a strong indication of recruitment pulses. The timing of these pulses is not yet well understood, particularly in terms of how they relate to climatic influences such as interannual variability. Improving this understanding could lead to the ability to project future yields and is an area of active research.

Status: No above-average peaks in two-year-old bigeye CPUE were observed in 2021 or 2022, suggesting that there will not be a peak in the CPUE of four- and five-year-old bigeye in 2023 and 2024.

Description: Quarterly time series of bigeye weight-per-unit-effort (WPUE) in hooks set is presented for the previous two years. Fish weights are those of bigeye tuna received at the Honolulu auction. The Honolulu auction reports weights for gilled and gutted fish. A conversion factor is used to calculate the whole fish weights used for this indicator (Langley et al. 2006). Note the quarterly (colored) and climatological (grey) distributions of bigeye tuna weight-per-unit-effort in Figure 183. Bigeye weights are from sets using ≥ 15 hooks per float.

Timeframe: Quarterly.

Region: Hawaii-based longline fishing grounds.

Measurement Platform: *In-situ* measurement.

Sourced from: HDAR and Langley et al. (2006).

3.4.2.15 BIGEYE RECRUITMENT INDEX

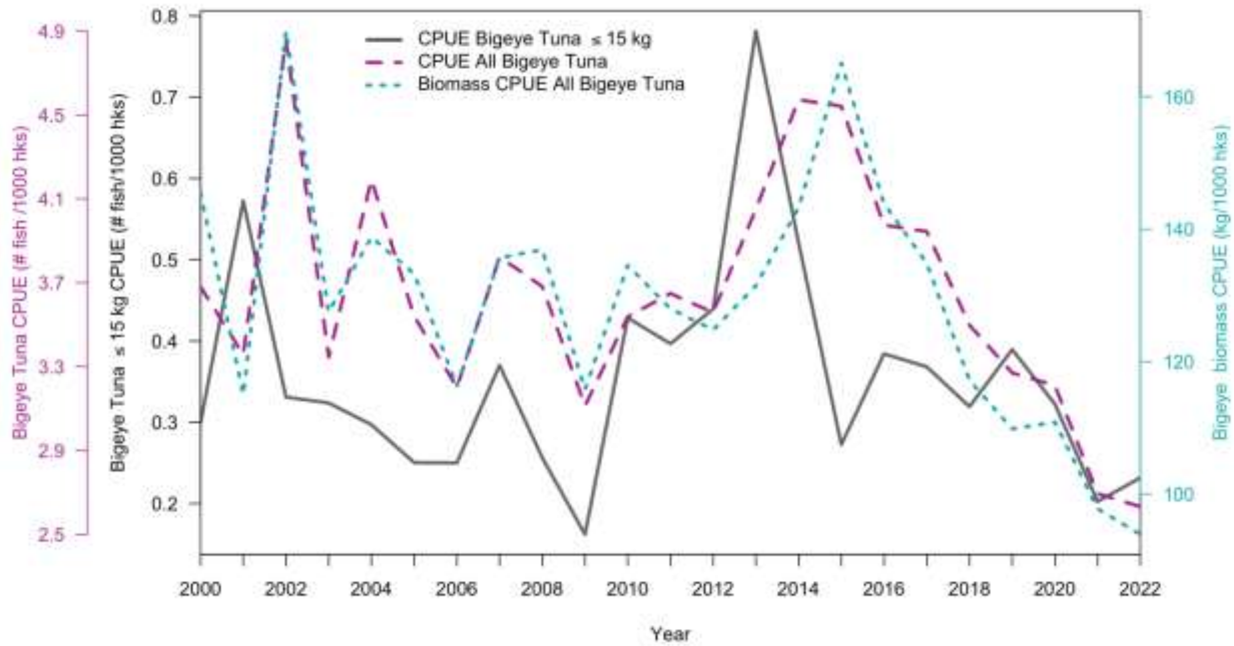


Figure 184. Annual CPUE of bigeye tuna ≤ 15 kg (grey solid line), CPUE of all bigeye tuna (pink dashed line), and biomass CPUE (blue dotted line) from 2000 – 2022, all from deep sets

Rationale: Catch rates of small bigeye tuna (≤ 15 kg) peak two years prior to peaks in catch rates (CPUE) and biomass (weight-per-unit-effort), indicating a recruitment pulse and allowing for predictions regarding increases in total catch rates of the fishery. The timing of these pulses is not yet well understood, particularly in terms of how they relate to climate impacts such as interannual variability. Improving this understanding could lead to the ability to project future yields and is an area of active research.

Status: In 2022, the CPUE of bigeye ≤ 15 kg was 0.23 fish per 1,000 hooks set. This is within the range observed over the last 21 years (0.16–0.78 fish per 1,000 hooks set) and at this time does not appear indicative of a strong recruitment pulse such as was seen in 2001 or 2013.

Description: Time series of small (≤ 15 kg) and total bigeye tuna catch-per-unit-effort (hooks set) and weight-per-unit-effort (hooks set) for all bigeye tuna is presented. Fish weights are those of bigeye tuna received at the Honolulu auction. The Honolulu auction reports weights for gilled and gutted fish. A conversion factor is used to calculate the whole fish weights used for this indicator (Langley et al. 2006).

Timeframe: Annual.

Region: Hawaii-based longline fishing grounds.

Measurement Platform: Model-derived.

Sourced from: HDAR and Langley et al. (2006).

3.4.2.16 BIGEYE TUNA CATCH RATE FORECAST

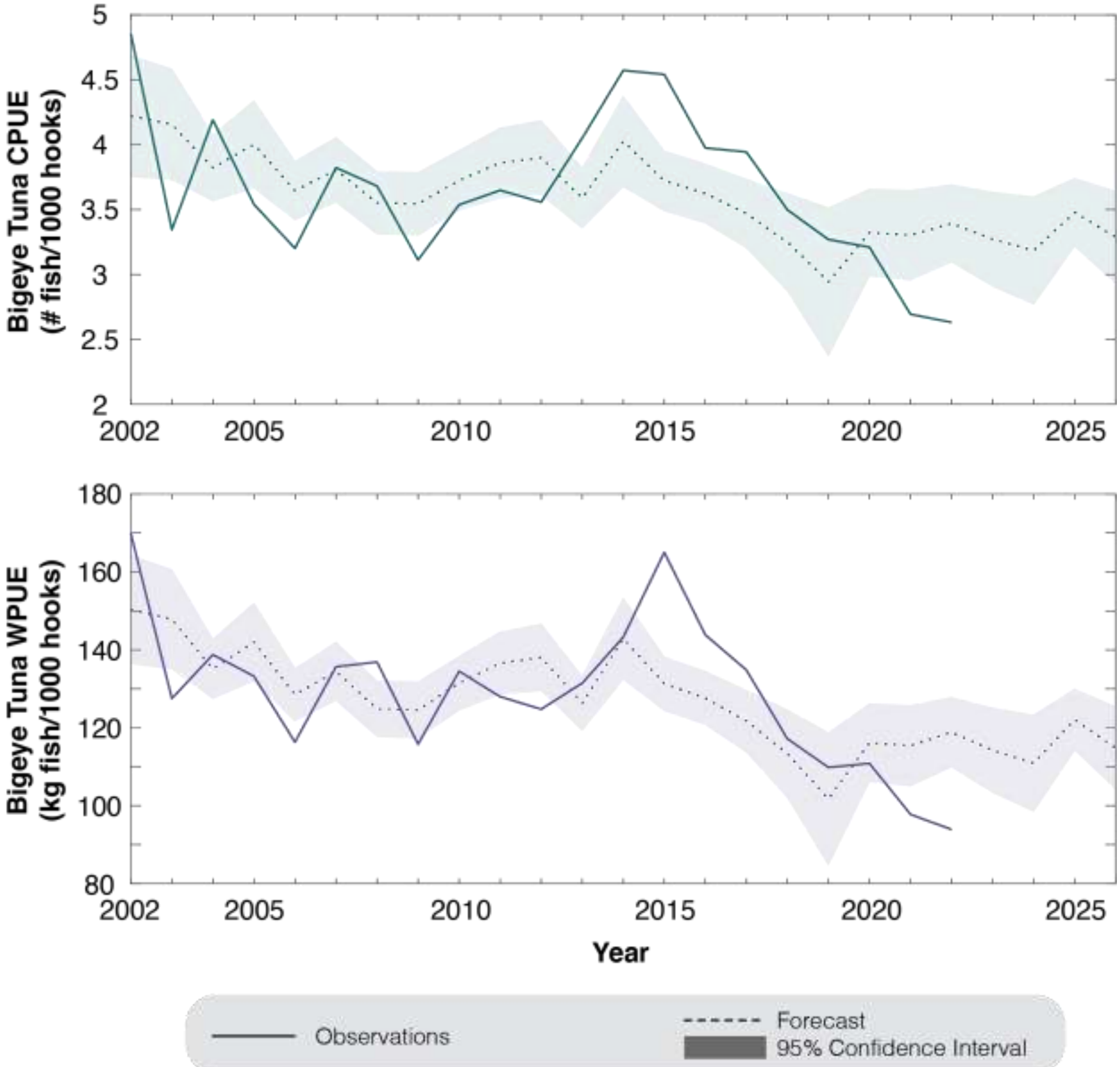


Figure 185. Annual observed (solid lines) and forecast (dotted lines) CPUE (upper panel; green) and WPUE (lower panel; purple) of bigeye tuna from deep sets. The forecasts' 95% confidence intervals are shaded

Rationale: Recent work has shown that average phytoplankton size can be used to predict bigeye tuna catch rates up to four years in advance (Woodworth-Jefcoats and Wren 2020). The hypothesized mechanism behind this relationship is that larger phytoplankton are indicative of higher quality food for the zooplankton upon which larval and juvenile bigeye tuna prey. With higher quality prey available, more bigeye tuna survive into adulthood and recruit to the fishery.

Status: The catch rate forecasts suggest that catch rates will be fairly steady over the next four years.

Description: Time series of observed bigeye tuna CPUE and WPUE are presented together with the annual forecast values and their associated 95% confidence interval. The forecast is based on a linear regression between four-year-lagged median phytoplankton size and both CPUE and WPUE (individual).

Timeframe: Annual.

Region: Hawaii-based longline fishing grounds (0° – 40°N, 180° – 150°W and 15° – 36°N, 150° – 125°W).

Measurement Platform: Model-derived from satellite remotely sensed data.

Sourced from: HDAR, Langley et al. (2006), NOAA OceanWatch (2023c), and Woodworth-Jefcoats and Wren (2020). Graphics produced in part using Stawitz (2022).

3.4.3 BACKGROUND AND RATIONALE FOR INDICATORS

The reasons for the Council's decision to provide and maintain an evolving discussion of climate conditions as an integral and continuous consideration in their deliberations, decisions, and reports are numerous:

- Emerging scientific and community understanding of the impacts of changing climate conditions on fishery resources, the ecosystems that sustain those resources, and the communities that depend upon them;
- Recent Federal Directives including the 2010 implementation of a National Ocean Policy that identified Resiliency and Adaptation to Climate Change and Ocean Acidification as one of nine National priorities as well as the development of a Climate Science Strategy by NMFS in 2015 and the subsequent development of the Pacific Islands Regional Action Plan for climate science; and
- The Council's own engagement with NOAA as well as jurisdictional fishery management agencies in American Samoa, CNMI, Guam, and Hawaii as well as fishing industry representatives and local communities in those jurisdictions.

In 2013, the Council began restructuring its Marine Protected Area/Coastal and Marine Spatial Planning Committee to include a focus on climate change, and the committee was renamed as the Marine Planning and Climate Change (MPCC) Committee. In 2015, based on recommendations from the committee, the Council adopted its Marine Planning and Climate Change Policy and Action Plan, which provided guidance to the Council on implementing climate change measures, including climate change research and data needs. The revised Pelagic Fisheries Ecosystem Plan (FEP; February 2016) included a discussion on climate change data and research as well as a new objective (Objective 9) that states the Council should consider the implications of climate change in decision-making, with the following sub-objectives:

1. To identify and prioritize research that examines the effects of climate change on Council-managed fisheries and fishing communities.
2. To ensure climate change considerations are incorporated into the analysis of management alternatives.
3. To monitor climate change related variables via the Council's Annual Reports.
4. To engage in climate change outreach with U.S. Pacific Islands communities.

Beginning with the 2015 report, the Council and its partners began providing continuing descriptions of changes in a series of climate and oceanic indicators.

This annual report focuses previous years' efforts by refining existing indicators and improving communication of their relevance and status. Future reports will include additional indicators as the information becomes available and their relevance to the development, evaluation, and revision of the FEPs becomes clearer. Working with national and jurisdictional partners, the Council will make all datasets used in the preparation of this and future reports available and easily accessible.

3.4.4 RESPONSE TO PREVIOUS COUNCIL RECOMMENDATIONS

At its 182nd meeting in June 2020, the Council requested the Pelagic Plan Team to look at South Pacific albacore indicators, provide more information on spatial catches within the region including American Samoa, and investigate ecosystem drivers for inclusion in the Annual SAFE Report. Preliminary information was explored and presented at the Pelagic Plan Team meeting in May 2021.

At its 170th meeting from June 20-22, 2017, the Council directed staff to support the development of community training and outreach materials and activities on climate change. In addition, the Council directed staff to coordinate a "train-the-trainers" workshop that includes NOAA scientists who presented at the 6th Marine Planning and Climate Change Committee (MPCCC) meeting and the MPCCC committee members in preparation for community workshops on climate and fisheries. The Council and NOAA partnered to deliver the workshops in the fall of 2017 to the MPCCC members in Hawaii (with the Hawaii Regional Ecosystem Advisory Committee), as well as American Samoa, Guam, and the CNMI (with their respective Advisory Panel groups). Feedback from workshop participants has been incorporated into this year's climate and oceanic indicator section. To prepare for community outreach, Guam-based MPCCC members conducted a climate change survey and shared the results with the MPCCC at its 7th meeting on April 10th and 11th, 2018. The Council also directed staff to explore funding avenues to support the development of additional oceanic and climate indicators, such as wind and extratropical storms. These indicators were added to this module by corresponding Plan Team members in 2018.

Prior to holding its 8th meeting, the MPCCC was disbanded in early 2019, re-allocating its responsibilities among its members already on other committees or teams, such as the Fishery Ecosystem Plan Teams.

3.4.5 CONCEPTUAL MODEL

In developing this chapter, the Council relied on a number of recent reports conducted in the context of the U.S. National Climate Assessment including, most notably, the 2012 Pacific Islands Regional Climate Assessment and the Ocean and Coasts chapter of the 2014 report on a Pilot Indicator System prepared by the National Climate Assessment and Development Advisory Committee (NCADAC).

The Advisory Committee Report presented a possible conceptual framework designed to illustrate how climate factors can connect to and interact with other ecosystem components to impact ocean and coastal ecosystems and human communities. The Council adapted this model with considerations relevant to the fishery resources of the Western Pacific Region:

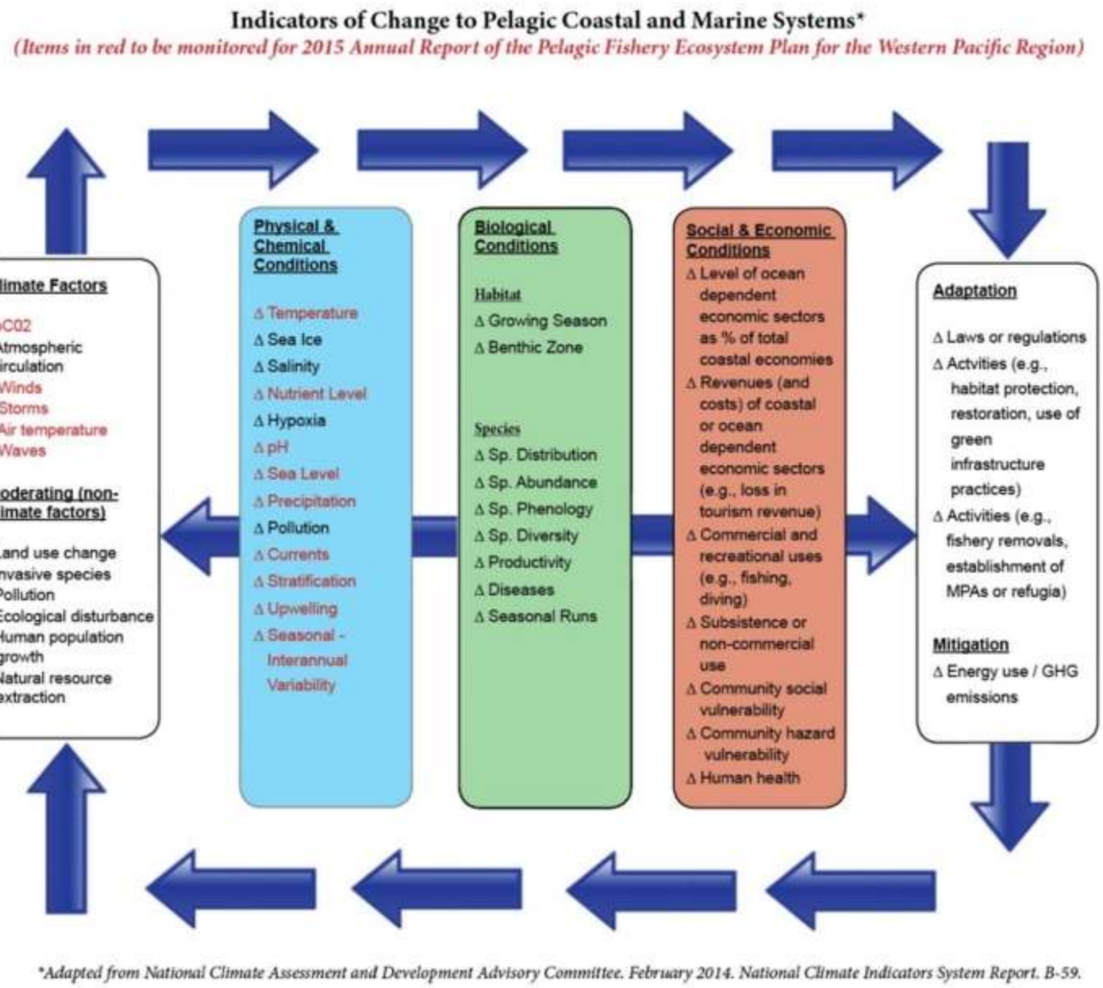


Figure 186. Indicators of change of pelagic coastal and marine systems; conceptual model

As described in the 2014 NCADAC report, the conceptual model presents a "simplified representation of climate and non-climate stressors in coastal and marine ecosystems." For the purposes of this Annual Report, the modified Conceptual Model allows the Council and its partners to identify indicators of interest to be monitored on a continuing basis in coming years. The indicators shown in red were considered for inclusion in the annual SAFE reports, though the final list of indicators varied somewhat. Other indicators will be added over time as data become available and an understanding of the causal chain from stressors to impacts emerges.

The Council also hopes that this Conceptual Model can provide a guide for future monitoring and research. This guide will ideally enable the Council and its partners to move forward from observations and correlations to understanding the specific nature of interactions, and to develop capabilities to predict future changes of importance in the developing, evaluating, and adapting of FEPs in the Western Pacific region.

3.4.6 OBSERVATIONAL AND RESEARCH NEEDS

Through preparation of this and previous Pelagic annual SAFE reports, the Council has identified a number of observational and research needs that, if addressed, would improve the information content of future Climate and Oceanic Indicators section. This information would provide fishery managers, the fishing industry, and community stakeholders with better understanding and predictive capacity that is vital to sustaining a resilient and vibrant fishery in the Western Pacific. These observational and research needs are to:

- Emphasize the importance of continuing the climate and ocean indicators used in this report so that a consistent, long-term record can be maintained and interpreted;
- Develop agreements among stakeholders and research partners to ensure the sustainability, availability, and accessibility of climate and ocean indicators, associated datasets, and analytical methods used in this and future reports;
- Improve monitoring and understanding of the impacts of changes in ocean temperature, pH and ocean acidity, ocean oxygen content and hypoxia, and sea level rise through active collaboration by all fishery stakeholders and research partners;
- Develop, test, and provide access to additional climate and ocean indicators that can improve the Pelagic Conceptual Model;
- Investigate the connections between climate variables and other indicators in the Pelagic Conceptual Model to improve understanding of changes in physical, chemical, biological, and socio-economic processes and their interactions in the regional ecosystem;
- Develop predictive models that can be used for scenario planning to account for unexpected changes and uncertainties in the regional ecosystem and fisheries;
- Foster applied research in ecosystem modeling to better describe current conditions and to better anticipate the future under alternative projections of climate and ocean change including changes in expected human benefits and their variability;
- Improve understanding of the connections between the Pacific Decadal Oscillation (PDO) and fisheries ecosystems beyond the North Pacific;
- Improve understanding of mahimahi and swordfish size in relation to the location and orientation of the transition zone chlorophyll front (TZCF);
- Explore the connections between sea surface conditions, stratification, and mixing;
- Identify the biological implications of tropical cyclones;
- Research cultural knowledge and practices for adapting to past climate changes and investigate how they might contribute to future climate adaptation; and
- Explore additional and/or alternative climate and ocean indicators that may have important effects of pelagic fisheries systems including:
    - Ocean currents and anomalies;
    - Eddy kinetic energy (EKE);
    - Near-surface wind velocity and anomalies;
    - Wave forcing and anomalies;
    - Oceanic nutrient concentration;
    - South Pacific convergence zones targeted by swordfish;
    - Standardized fish community size structure data for gear types, including the troll fishery for yellowfin and blue marlin;

- Estimates of phytoplankton abundance and size from satellite remotely-sensed sea surface temperature (SST) and ocean color measurements;
- Additional spatial coverage for the international purse seine fishery and the American Samoa longline fishery;
- Time series of species richness and diversity from catch data which could potentially provide insight into how the ecosystem is responding to physical climate influences; and
- Socio-economic indicators of effects of a changing climate on fishing communities and businesses.

3.5 ESSENTIAL FISH HABITAT

3.5.1 INTRODUCTION

Per requirements of the Magnuson-Stevens Fishery Conservation and Management Act (MSA; 50 CFR § 600.815), Essential Fish Habitat (EFH) information for all Pelagic Management Unit Species (MUS) is found in the Pelagic Fishery Ecosystem Plan (FEP). The EFH Final Rule requires that the Council review and revise EFH provisions periodically and report on this review as part of the annual Stock Assessment and Fishery Evaluation (SAFE) report, with a complete review conducted as recommended by the Secretary, but at least once every five years.
The habitat objective of the FEP is to refine EFH and minimize impacts to EFH, with the following sub-objectives:

- Review EFH and Habitat Areas of Particular Concern (HAPC) designations every five years and update such designations based on the best available scientific information, when available.
- Identify and prioritize research to assess adverse impacts to EFH and HAPC from fishing (including aquaculture) and non-fishing activities, including, but not limited to, activities that introduce land-based pollution into the coastal environment.

Pelagic EFH information was not updated during preparation of 2022 SAFE report, except for Section 3.5.5. Non-fishing impacts to pelagic EFH were reviewed in the past as part of the Council's omnibus review of non-fishing effects on EFH. The Council's support of non-fishing activities research is monitored through the program plan and five-year research priorities, not the annual SAFE report.

3.5.2 RESPONSE TO PREVIOUS COUNCIL RECOMMENDATIONS

There were no Council recommendations for the EFH section of the Pelagic annual SAFE report in 2022.

3.5.3 HABITAT USE BY MUS AND TRENDS IN HABITAT CONDITION

The geographic extent of EFH for PMUS in the Western Pacific region is the shoreline to the edge of the exclusive economic zone (EEZ; 64 FR 19067, April 19, 1999). Egg/larval PMUS EFH is the water column to a depth of 200 m, while juvenile/adult PMUS EFH is designated to 1000 m. HAPC is designated to a depth of 1,000 m above seamounts and banks with summits shallower than 2,000 m.

Because the habitat is the water column, the Climate and Oceanic Indicators section (Section 3.4) provides data and trends relevant to pelagic EFH, including oceanic pH, the ONI PDO, tropical cyclones, North Pacific oligotrophic area, ocean color, and subtropical front/transition zone chlorophyll front indicators. Future SAFE reports may provide further interpretation of these indicators as they relate to EFH.

3.5.4 REPORT ON REVIEW OF EFH INFORMATION

No pelagic EFH reviews were completed in 2022.

3.5.5 RESEARCH NEEDS AND ONGOING PROJECTS

The Council previously identified pelagic scientific data needs to address the EFH provisions more effectively in the FEP. This section includes active research and data collection initiatives to address these needs. Many recent research cruises have been cancelled due to the COVID-19 pandemic, so data needed to move these projects forward have generally not been collected.

Research continues at PIFSC to enhance understanding of open-ocean habitats and ecosystem processes through improved utility of climate and oceanographic information. Specific research efforts continue on determining the distribution of feeding and spawning habitats and their response to anthropogenic climate change, as well as the influence of natural climate variability (e.g., ENSO) on the distribution of suitable habitat for bigeye tuna (BET).

The BET Initiative is a collection of projects that looks to utilize telemetry data to describe BET thermal and spatial habitat, identify imminent spawners among longline catch to shed light on where in the Hawaii longline fishery spawning occurs, explore the distribution of feeding and spawning habitat and responses to anthropogenic climate change, and examine the effect of large-scale climate variability to better understand shifts in catch rates and locations.

Currently, BET research almost exclusively uses satellite and/or modeled data (with much less frequent use of sparse *in situ* observations for environmental data). Additional telemetry data would improve the models, especially with respect to species distribution. At present, commercial catch data is used exclusively for fish distribution models. There is a need for better models, and the furtherance of dynamic habitat delineation is dependent on more *in situ* data and regular scientific sampling.

PIFSC is also researching the effect of large-scale variability on longline and purse seine tuna species CPUE in the Equatorial Pacific. Results of this research would tie into the BET Initiative, as it can provide information on possible links between the North Pacific and the Equatorial Pacific CPUE and BET population structure. One of the main management questions is whether the North Pacific stock is a separate stock or individuals that spawn in the equatorial region and migrate north.

At Cross Seamount, PIFSC scientists are looking at the distribution and relative abundance of micronekton (i.e., BET forage) in the seamount environment, and the distribution and relative biomass of juvenile BET in the seamount environment. This research can lead to an assessment of how juvenile BET abundance is reflected in the North Pacific pelagic environment (i.e., fishing grounds), possibly providing a route to fisheries independent data for stock assessments. PIFSC is also characterizing micronekton at the Transition Zone Chlorophyl Front (TZCF), a critical migratory route and foraging ground for top predators (e.g., tunas, billfish, and protected species) that feed on micronekton.

PIFSC has recently developed the Protected Species Ensemble Random Forest (PSERF) model, which is a habitat-based framework to describe Hawaii- and American Samoa-based longline interactions with protected species, utilizing olive ridley sea turtles (*Lepidochelys olivacea*) as a case study. Ongoing work includes updating Hawaii deep-set and shallow-set longline fishery data sets for the most recent years and adding oceanographic features derived from weekly products, including eddy kinetic energy, Okubo-Weiss parameters, and Ekman pumping to define mesoscale features. Distribution models are being developed for all species in the Hawaii deep-set, Hawaii shallow-set, and American Samoa longline fisheries, and will be rerun with more recent data and features. More robust habitat delineation and possible dynamic ocean management based on models using weekly products could facilitate timely updates for areas of high protected species encounter probabilities.

3.6 MARINE PLANNING

3.6.1 INTRODUCTION

Marine planning is a science-based management tool being utilized regionally, nationally, and globally to identify and address issues of multiple human uses, ecosystem health and cumulative impacts in the coastal and ocean environment. The Council's efforts to formalize incorporation of marine planning in its actions began in response to Executive Order 13547, Stewardship of the Ocean, Our Coasts, and the Great Lakes. Executive Order 13158, Marine Protected Areas (MPAs), proposes that agencies strengthen the management, protection, and conservation of existing MPAs, develop a national system of MPAs representing diverse ecosystems, and avoid causing harm to MPAs through federal activities. MPAs, or marine managed areas (MMAs) are one tool used in fisheries management and marine planning.

At its 165th meeting in March 2016, in Honolulu, Hawaii, the Council approved the following objective for the FEPs: Consider the Implications of Spatial Management Arrangements in Council Decision-making. The following sub-objectives apply:

a. Identify and prioritize research that examines the positive and negative consequences of areas that restrict or prohibit fishing to fisheries, fishery ecosystems, and fishermen, such as the Bottomfish Fishing Restricted Areas, military installations, NWHI restrictions, and Marine Life Conservation Districts.
b. Establish effective spatially-based fishing zones.
c. Consider modifying or removing spatial-based fishing restrictions that are no longer necessary or effective in meeting their management objectives.
d. As needed, periodically evaluate the management effectiveness of existing spatial-based fishing zones in federal waters.

In order to monitor implementation of this objective, this annual report includes the Council's spatially-based fishing restrictions or MMAs, the goals associated with those, and the most recent evaluation. Council research needs are identified and prioritized through the 5 Year Research Priorities and other processes and are not tracked in this report.

To meet the EFH and National Environmental Policy Act (NEPA) mandates, this annual SAFE report tracks activities that occur in the ocean that are of interest to the Council and incidents or facilities that may contribute to cumulative impact. While the Council is not responsible for NEPA compliance, monitoring the environmental effects of ocean activities for the FEP's EFH cumulative impacts section is duplicative of the agency's NEPA requirement, and therefore, this report can provide material or suggest resources to meet both mandates.

3.6.2 RESPONSE TO PREVIOUS COUNCIL RECOMMENDATIONS

There are no standing Council recommendations indicating review deadlines for Pelagic MMAs.

At its 147th meeting in March 2010, the Council recommended a no-take area from 0–12 nm around Rose Atoll Marine National Monument (MNM) with the Council to review the no-take regulations after three years. The most recent review took place in 2013, with the subsequent review previously scheduled for 2016. PIRO received no requests for non-commercial permits to fish within the Rose Atoll MNM. Further, inquiries in American Samoa showed that there was no indication that the 12 nm closure around Rose Atoll MNM has been limiting fishing. The Pelagic Plan Team deferred decision on Rose Atoll in May 2017. At its 172nd meeting in March 2018, the Council requested that NOAA and USFWS provide a report to the Council at its following meeting to review resultant benefits to fish populations, protected species, and coral reef, deep-slope, and pelagic ecosystems from the establishment of the Rose MNM. USFWS presented this report to the Council at its 173rd meeting in June 2018, from which no Council recommendations were generated.

At its 162nd meeting in March 2015, the Council recommended a regulatory amendment for the temporary exemption to the Large Vessel Protected Area (LVPA) by American Samoa longline limited entry permitted vessels greater than 50 ft in length. The Council would review the LVPA exemption on an annual basis. In 2016, NMFS published a final rule that allowed large, federally-permitted U.S. longline vessels to fish in specific areas of the LVPA (81 FR 5619, February 3, 2016). In July 2016, American Samoa sued NMFS and the Council in the Hawaii Federal District Court, claiming that NMFS did not consider the 1900 and 1904 Deeds of Cession with respect to the protection of the cultural fishing rights of the people of American Samoa. In 2017, the Hawaii Federal District Court deemed the final rule invalid and ordered NMFS to vacate the LVPA exemption rule (82 FR 43908, September 20, 2017).

At its 173rd meeting in June 2018, regarding the LVPA applicable to the American Samoa limited entry vessels, the Council recognized the LVPA rule has led to disagreement within the American Samoa fishing community and was the subject of litigation. The Council noted that the court decision requires the consideration and protection of American Samoa cultural fishing. To this end, the Council requested PIFSC conduct research on American Samoa cultural fishing practices to facilitate understanding and potential impacts of opening some restricted fishing areas within the U.S. EEZ for American Samoa vessels that primarily target albacore. PIFSC presented the results of this research at the Council's 172nd meeting in March 2018, which indicated that all fishing in American Samoa has cultural importance because catch from all locally-based fishing sectors flows into the American Samoa community for cultural purposes. The Council also recommended a regulatory amendment to provide a four-year exemption for vessels permitted under the American Samoa longline limited entry program to fish within the LVPA seaward of 12 nm around Tutuila, 12 nm around Manua, 12 nm around Swains, and 2 nm around the offshore banks, and recommended annual monitoring of the American Samoa longline and troll catch rates, small vessel participation, and local fisheries development.

NMFS appealed Hawaii Federal District Court's 2017 decision that invalidated the 2016 LVPA reduction to the U.S. Ninth Circuit Court of Appeals. Oral arguments were in February 2020 in Honolulu, Hawaii, and the decision was reversed in a September 2020 ruling.

At its 184th meeting in December 2020, the Council directed staff to monitor the fishing operation and fishery performance of the American Samoa longline and alia fisheries and report back to the Council at its September 2021 meeting. Council staff provided this presentation to the Council as scheduled. On July 9, 2021, NMFS published a final rule reimplementing the 2016 regulations that the Council submitted to NMFS (86 FR 36239).

3.6.3 MARINE MANAGED AREAS

Council-established MMAs are shown in Figure 187, and are compiled in Table 89.

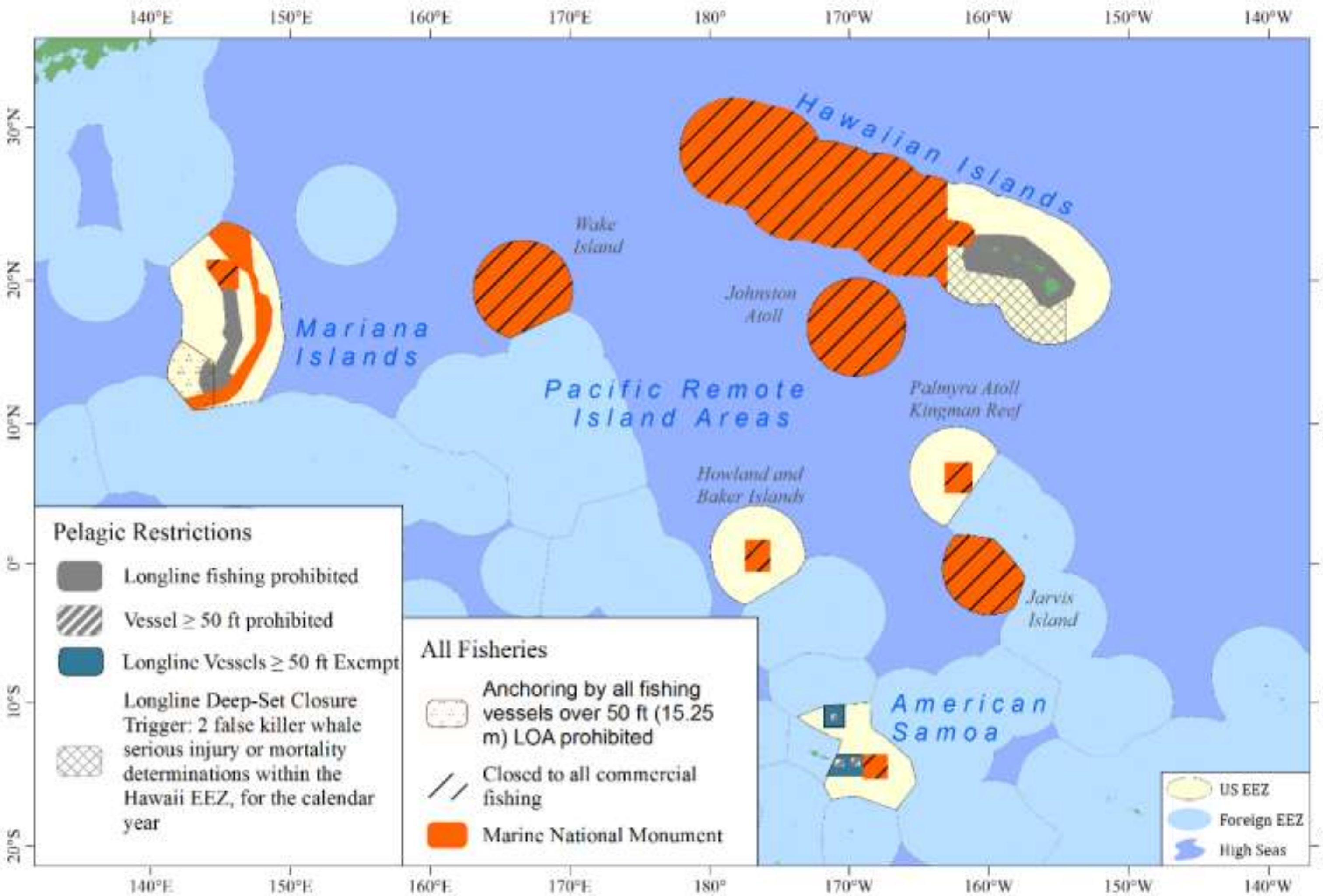


Figure 187. Regulated Fishing Areas of the Western Pacific Region

Table 89. MMAs established under FEPs from 50 CFR § 665

Name	FEP	Island(s)	50 CFR /FR /Amendment Reference	Marine Area (km²)	Fishing Restriction	Goals	Most Recent Evaluation	Review Deadline
Pelagic Restrictions								
NWHI Longline Protected Species Zone	Pelagic (Hawaii)	NWHI	665.806(a)(1) 56 FR 52214 76 FR 37287 Pelagic FMP Am. 3	351,514.00	Longline fishing prohibited	Prevent longline interaction with monk seals.	1991	-
MHI Longline Prohibited Area	Pelagic (Hawaii)	MHI	665.806(a)(2) 57 FR 7661 77 FR 71286 Pelagic FMP Am. 5	248,682.38	Longline fishing prohibited	Prevent gear conflicts between longline vessels and troll/handline vessels.	1992	-
Guam Longline Prohibited Area	Pelagic (Marianas)	Guam	665.806(a)(3) 57 FR 7661 Pelagic FMP Am. 5	50,192.88	Longline fishing prohibited	Prevent gear conflicts between longline vessels and troll/handline vessels.	1992	-
CNMI Longline Prohibited Area	Pelagic (Marianas)	Mariana Archipelago	665.806(a)(4) 76 FR 37287 Pelagic FEP Am. 3	88,112.68	Longline fishing prohibited	Reduce potential for nearshore localized fish depletion from longline fishing, and to limit catch competition and gear conflicts between the CNMI-based longline and trolling fleets.	2011	-

Name	FEP	Island(s)	50 CFR /FR /Amendment Reference	Marine Area (km²)	Fishing Restriction	Goals	Most Recent Evaluation	Review Deadline
Large Vessel Prohibited Area	Pelagic (American Samoa)	Tutuila, Manu'a, and Rose Atoll	665.806 (b)(1) 81 FR 5619 82 FR 43908	74,857.32	Vessels ≥ 50 ft. prohibited	Prevent gear conflict with smaller alia vessels; longline vessels >50 ft. exempted from 12 to 50 nm to improve the viability of the American Samoa longline fishery and achieve optimum yield from the fishery while preventing overfishing.	Jan 29, 2016	-
Large Vessel Prohibited Area	Pelagic (American Samoa)	Swains Island	665.806 (b)(1) 81 FR 5619 82 FR 43908 Pelagic FEP	28,352.17	Vessels ≥ 50 ft. prohibited	Prevent gear conflict with smaller alia vessels; longline vessels over 50 ft. exempted between 12 and 50 nm due to improve the viability of the American Samoa longline fishery and achieve optimum yield from the fishery while preventing overfishing.	Jan 29, 2016	-
Other Restrictions								
Howland Island No-Take Marine Protected Area (MPA)/PRI Marine National Monument	PRIA/ Pelagic	Howland Island	665.599 and 665.799(a)(1) 69 FR 8336 Coral Reef Ecosystem Fishery Management Plan (FMP) 78 FR 32996 PRIA FEP Am. 2	-	All Take Prohibited	Minimize adverse human impacts on coral reef resources; commercial fishing prohibited within 12 nautical miles (nm).	2013	-

Name	FEP	Island(s)	50 CFR /FR /Amendment Reference	Marine Area (km^2)	Fishing Restriction	Goals	Most Recent Evaluation	Review Deadline
Jarvis Island No-Take MPA/PRI Marine National Monument	PRIA/ Pelagic	Jarvis Island	665.599 and 665.799(a)(1) 69 FR 8336 Coral Reef Ecosystem FMP 78 FR 32996 PRIA FEP Am. 2	-	All Take Prohibited	Minimize adverse human impacts on coral reef resources; commercial fishing prohibited within 12 nmi.	2013	-
Baker Island No-Take MPA/PRI Marine National Monument	PRIA/ Pelagic	Baker Island	665.599 and 665.799(a)(1) 69 FR 8336 Coral Reef Ecosystem FMP 78 FR 32996 PRIA FEP Am. 2	-	All Take Prohibited	Minimize adverse human impacts on coral reef resources; commercial fishing prohibited within 12 nmi.	2013	-
Rose Atoll No-Take MPA/Rose Atoll Marine National Monument	American Samoa Archipelago/ Pelagic	Rose Atoll	665.99 and 665.799(a)(2) 69 FR 8336 Coral Reef Ecosystem FMP 78 FR 32996 American Samoa FEP Am. 3	-	All Take Prohibited	Minimize adverse human impacts on coral reef resources; commercial fishing prohibited within 12 nmi.	June 3, 2013	June 3, 2016
Kingman Reef No-Take MPA/PRI Marine National Monument	PRIA/Pelagic	Kingman Reef	665.599 and 665.799(a)(1) 69 FR 8336 Coral Reef Ecosystem FMP 78 FR 32996 PRIA FEP Am. 2	-	All Take Prohibited	Minimize adverse human impacts on coral reef resources; all fishing prohibited within 12 nmi.	2013	-

Name	FEP	Island(s)	50 CFR /FR /Amendment Reference	Marine Area (km²)	Fishing Restriction	Goals	Most Recent Evaluation	Review Deadline
Guam No Anchor Zone	Mariana Archipelago	Guam	665.399 69 FR 8336 Coral Reef Ecosystem FMP	138,992.51	Anchoring by all fishing vessels ≥ 50 ft. prohibited on the offshore southern banks located in the U.S. EEZ off Guam	Minimize adverse human impacts on coral reef resources.	2004	-
Johnston Atoll Low-Use MPA/PRI Marine National Monument	PRIA/ Pelagic	Johnston Atoll	69 FR 8336 Coral Reef Ecosystem FMP 78 FR 32996 PRIA FEP Am. 2	-	Special Permit Only	Minimize adverse human impacts on coral reef resources; superseded by prohibiting fishing within 12 nm in Am. 2.	2013	-
Palmyra Atoll Low-Use MPAs/PRI Marine National Monument	PRIA/ Pelagic	Palmyra Atoll	69 FR 8336 Coral Reef Ecosystem FMP 78 FR 32996 PRIA FEP Am. 2	-	Special Permit Only	Minimize adverse human impacts on coral reef resources; superseded by prohibiting fishing within 12 nm in Am. 2.	2013	-
Wake Island Low-Use MPA/PRI Marine National Monument	PRIA/Pelagic	Wake Island	69 FR 8336 Coral Reef Ecosystem FMP 78 FR 32996 PRIA FEP Am. 2	-	Special Permit Only	Minimize adverse human impacts on coral reef resources; superseded by prohibiting fishing within 12 nm in Am. 2.	2013	-

3.6.4 ACTIVITIES AND FACILITIES OCCURRING IN THE WESTERN PACIFIC REGION

In the Western Pacific Region, fisheries compete with other activities for access to and use of fishing grounds. These activities include, but are not limited to, military bases and training activities, commercial shipping, recreational activities, and off-shore energy projects. Between the Bureau of Ocean Energy Management (BOEM), the U.S. Army Corps of Engineers (USACE), and NMFS, most permits for offshore energy and aquaculture development, dredging, or mooring projects that occur in the waters of the U.S. are captured. Department of Defense (DOD) activities are assessed in environmental impact statements (EIS) on a five-year cycle and are available through the *Federal Register*. Due to the sheer volume of ocean activities and the annual frequency of this report, only major activities on multi-year planning cycles or those permitted by NMFS Sustainable Fisheries Division are tracked in this report. Activities which are no longer reasonably foreseeable or have been replaced with another planning activity are removed from the report, though they may occur in previous reports.

3.6.4.1 AQUACULTURE FACILITIES

Hawaii has one offshore aquaculture facility operating in federal waters that was owned by Ocean Era (formerly Kampachi Farms), but the associated Special Coral Reef Ecosystem Fishing Permit (SCREFP) been transferred to Forever Oceans (see Table 90). Additionally, the Final Programmatic Environmental Impact Statement (PEIS) for an aquaculture management program in the Pacific Islands was published in 2022. Relatedly, the State of Hawaii is interested in developing a pre-permitted demonstration/pilot area for offshore aquaculture technologies at their NELHA facility.

Table 90. Offshore aquaculture facilities near Hawaii

Name	Size	Location	Species	Status
Forever Oceans, transferred from Ocean Era (formerly Kampachi Farms)	Shape: Cylindrical Height: 33 ft. Diameter: 39 ft. Volume: 36,600 ft^3	5.5 nautical miles (nm) west of Keauhou Bay and 7 nm south-southwest of Kailua Bay, off the west coast of Hawaii Island (19°33' N, 156° 04' W). Mooring scope is 10,400-foot radius.	*Seriola rivoliana*	On July 6, 2016, NMFS authorized SCREFP for culture and harvest of 30,000 kampachi over two years on July 6, 2016. Array broke loose from mooring and net pen sank in 12,000 feet of water on Dec. 12, 2016. The mooring was redeployed under guidance from the U.S. Army Corps of Engineers (USACE) in late 2018 and stocked with a cohort of 10,000 fish in early 2019. On March 30, 2017, NMFS authorized transfer of the two-year SCREFP from Ocean Era to Forever Oceans. Forever Oceans' most recent SCREFP expired in December 2021, and there are currently no ongoing, in-water operations.

3.6.4.2 ALTERNATIVE ENERGY FACILITIES

There are no alternative energy facilities in territorial or federal waters, proposed or existing, in American Samoa, Guam, the CNMI, or the PRIA.

Hawaii previously had four proposed wind energy facilities in federal waters through BOEM. On June 24, 2016, BOEM published a "Call for Information and Nominations" to seek additional nominations from companies interested in commercial wind energy leases within the Call Area offshore Hawaii, and pursued public comment on site conditions, resources, and existing uses of the area associated with BOEM's wind energy development authorization process (BOEM 2017). However, these projects were disengaged in 2018. In December 2020, BOEM put out a new call for recommendations on environmental studies regarding offshore wind facilities, and the Hawaii State Energy Office is facilitating and providing input on studies that could be conducted to mitigate impacts on various resources, including aquatic. In October 2021, the National Renewable Energy Laboratory published a study providing estimates of the Levelized Cost of Energy of offshore wind in the region surrounding Oahu and investigates related topics relevant to planning for offshore wind (Shields et al. 2021). There are several alternative energy projects also being tracked in this report (Table 91).

Table 91. Alternative Energy Facilities and Development in the Western Pacific region

Name	Type	Location	Impact to Fisheries	Stage of Development	Source
Makai Ocean Engineering, Inc., Natural Energy Laboratory of Hawaii Authority (NELHA)	120 kW Ocean Thermal Energy Conversion (OTEC) Test Site/ 1 MW OTEC Test Site	Ke'ahole, North Kona, West Hawaii	Intake	120 kW OTEC operational; Final EA for 1 MW OTEC Site using existing infrastructure submitted July 2012 and lease negotiations being finalized; HEPA Exemption List memo Dec. 27, 2016.	NELHA Energy Projects Final Environmental Assessment, NELHA, July 2012
Honolulu Sea Water Air Conditioning (SWAC)	SWAC	4 miles S of Kaka'ako, Oahu	Benthic impacts; intake	USACE Record of Decision (ROD) signed in 2015. In 2018, HSWAC and the State of Hawaii finalized an agreement to provide seawater air conditioning for eight State buildings. Construction was planned to start in late 2019 or, but the operation was shut down in late 2020 due to increasing costs.	Honolulu SWAC Press Room Final Environmental Assessment, June 2014
Marine Corps Base Hawaii Wave Energy Test Site (WETS)	Shallow- and Deep-Water Wave Energy	1, 2 and 2.5 km N of Mokapu, Oahu	Hazard to navigation	Shallow and deepwater wave energy units operational in mid-2015. In 2021, deployments were planned for the C-Power 2 kW SeaRay, the Oscilla Triton-C, and the Ocean Energy 500 kW OE35.	Final Environmental Assessment, NAVFAC PAC, January 2014 Tethys The Maritime Executive

3.6.4.3 MILITARY TRAINING AND TESTING ACTIVITIES AND IMPACTS

Major activities occurring in waters of the Western Pacific region by the DOD are summarized in Table 92.

Table 92. DOD major activities in the Western Pacific region

Action	Description	Phase	Impacts
Guam and CNMI Military Relocation SEIS	Relocate Marines to Guam and build a cantonment/family housing unit on Finegayan/Andersen Air Force Base, a live-fire individual training range complex at the Ritidian Unit of the Guam National Wildlife Refuge.	Record of Decision (ROD) published August 29, 2015 after release of Final SEIS on July 18, 2015 (80 FR 55838). Lawsuit filed for segmentation and range of reasonable alternatives under NEPA. The case was lost in 2018 when a judge from the District Court of CNMI stated that the Guam buildup and proposed training in the CNMI are not connected actions. The case was appealed, and the US Court of Appeals for the Ninth Circuit affirmed the District Court's dismissal in 2020. Marine Corps Base Camp Blaz was activated on October 1, 2020. The US Army Corps of Engineers published a final rule on Oct. 8, 2021, amending regulations to establish a danger zone in the Pacific Ocean adjacent to the Mason Live-Fire Training Range Complex at Camp Blaz.	Surface danger zone established at Ritidian – access restricted during training. Northern District Wastewater Treatment Plant will significantly impact nearshore water quality until it is upgraded.
Mariana Islands Training and Testing – Supplemental	The supplement to the 2015 Final EIS/OEIS was prepared to support ongoing and future activities conducted at sea and on Farallon de Medinilla (FDM) beyond 2020. New information, including an updated acoustic effects model, updated marine mammal density data, and evolving and emergent BSIA, were used to update the MITT.	The MITT Final Supplemental EIS/OEIS was released in June 2020. ROD published on August 7, 2020 to continue training and testing activities in the study area (85 FR 47952). Meetings are ongoing to discuss FDM research activities and exercises. Meetings were previously held to discuss the Integrated Natural Resources Management Plan and plans for future surveys around FDM. In July 2020, NMFS implemented regulations regarding to the incidental take of marine mammals in the MITT area (85 FR 46302).	Access and habitat impact similar to previously analyzed activities in the 2015 EIS/OEIS (80 FR 46525).
Rim of the Pacific (RIMPAC) Exercise	Multinational, sea control/power projection fleet exercise that has been performed biennially for currently headquartered in Pearl Harbor, Hawaii. RIMPAC exercise locations are present throughout the State of Hawaii.	RIMPAC Programmatic EA developed in 2002 and a Supplemental Programmatic EA was finalized in 2006 (71 FR 31170). Biennial exercises continue through the present, with the most recent occurring in August 2020 as an at-sea-only event. RIMPAC will occur again in Summer 2022 and will be more traditional.	Programmatic Environmental Assessment, June 2002 U.S. Pacific Fleet
Hawaii-Southern California Training and Testing (HSTT)	Increase naval testing and training activities, including the use of active sonar and explosives.	Record of Decision available in December 2018 to conduct training and testing activities as identified in Alternative 1 of the HSTT Final EIS/OEIS published in October 2018 (83 FR 66255). NMFS implemented regulations regarding to the incidental take of marine mammals in the HSTT area in July 2020 (85 FR 41780).	The 2018 HSTT EIS/OEIS predicts impacts to access and habitat impact similar to previous analysis in the 2013 HSTT EIS/OEIS.
Long Range Strike Weapon Systems	Conduct operational evaluations of Long Range Strike weapons and other munitions as part of Long Range Strike WSEP operations at the	Comment period closed Feb. 6, 2017, and final rule on Aug. 22, 2017, for NMFS authorization to take marine mammals	Access – closures during training.

Action	Description	Phase	Impacts
Evaluation Program (WSEP)	Pacific Missile Range Facility at Kauai, Hawaii.	incidental to conducting munitions testing for their Long-Range Strike Weapons Systems Evaluation Program (LRS WSEP) over the course of five years, from August 21, 2017 through August 22, 2022 (82 FR 1702; 82 FR 39684).	Final Environmental Assessment, October 2016 NMFS Biological Opinion, August 2017
Naval Special Operations Training in the State of Hawaii	Small-unit maritime training activities for naval special operations personnel.	Draft EA released in October 2018. Public comment period through Dec. 10, 2018 was extended to Jan. 7, 2019. Final EA released May 2021.	Access. Draft Environmental Assessment, 2018
CNMI Joint Military Training	Establish unit and combined level training ranges on Tinian and Pagan.	Revised Draft EIS was expected in late 2018 or early 2019, but there is no new information on the EIS status. Lawsuit filed for segmentation and range of reasonable alternatives under NEPA. DOJ asked U.S. District Court for the NMI to dismiss the plaintiff's complaint with prejudice to prevent refiling. The case was lost in 2018 after a judge from the district court of CNMI agreed with the military that the Guam buildup and proposed training in the CNMI are not connected actions. The case was appealed, and the U.S. Court of Appeals for the Ninth Circuit affirmed the District Court's dismissal in 2020. Several meetings have been held with DFW and military officials to discuss relevant natural resource, land use, and social concerns regarding the proposed activities and prompted the reconsideration of proposed alternatives.	Significant access and habitat impacts around Tinian and Pagan.
Garapan Anchorage	Military Pre-Positioned Ships anchor and transit.	Expired Memorandum of Understanding with the CNMI Government. As of 2021, a new MOU had not been signed.	Access, invasive species, unmitigated damage to reefs.
Farallon de Medinilla	Restricted airspace covering the island to 12 nm radius to conduct military training scenarios using air-to-ground ordnance delivery, naval gunfire, lasers, and special operations training.	Final rule published March 13, 2017, effective June 22, 2017, designating a new area, R-2701A, that surrounds existing R-2701, encompassing airspace between a 3 nm radius and 12 nm radius of FDM (82 FR 13389). Proposed surface danger zone to 12 nmi. Meetings with military officials established that the 12 nm radius is closed when exercises are being conducted, but a 3 nm closure would instead be in effect year-round when exercises are not being conducted. Damage to submerged lands and fisheries to be included within consultation establishing continued US interest in the island and compensation to the CNMI (Report to the President on 902 Consultations 2017)	Access – to fishing grounds and transit to fishing grounds – and damage to submerged lands.
Tinian Divert Infrastructure Improvements, Marianas	Improvements to airport and seaport (improving roads, installing fuel line) in CNMI for expanding mission requirements in Western Pacific.	ROD for Tinian Divert Infrastructure Improvements published in 2016 (81 FR 92791). The USAF has published a NOI to prepare a SEIS for the proposed Tinian	Adverse impacts to EFH minimal; access near Port of Tinian fuel transfer facility affected.

Action	Description	Phase	Impacts
		Divert Infrastructure Improvements. The NOI began the public scoping process for the SEIS, which ended on May 31, 2018. Substantive comments received during the public scoping period were taken into consideration during preparation of the Draft SEIS. The USAF published a Notice of Availability (NOA) for the Draft SEIS on May 17, 2019. The NOA began the public review period for the Draft SEIS, which ended on July 1, 2019. Substantive comments received during the public review period were taken into consideration during preparation of the Final SEIS, which had an NOA published in July 2020 (85 FR 43580). Ground was broken on the Tinian Divert airfield on Feb. 22, 2022, which is expected to be completed by Oct. 9, 2025.	Access and transit to fishing grounds.

In addition to the Department of Defense activities detailed in Table 92, the U.S. military proposed the development of a small arms firing range near the shoreline in northwest Tinian. Several concerns were brought to the military regarding the proposed firing range, including issues with fishing access in the associated spatial closure area, issues with access to dive sites in the area, issues with the increased distance that boaters would have to travel to transit between Tinian and Saipan, and issues regarding boater safety due to having to travel further west from Tinian and losing access to the calmer waters nearshore (Tenorio, pers. comm., April 4, 2022).

In early 2010, the U.S. military began exercises in an area south and southeast of Guam designated W-517. W-517 is a special use airspace (approximately 14,000 nm^2) that overlays deep open ocean approximately 50 miles south-southwest of Guam. Exercises in W-517 generally involve live fire and/or pyrotechnics. When an offshore area such as W-517 is in use for training or testing exercises by the U.S. military, a notice to mariners (NTM) is issued, and vessels attempting to use the area are advised to be cautious of objects in the water and other small vessels. This discourages access to virtually all banks south of Guam, including Galvez, Santa Rosa, White Tuna, and other popular fishing areas. NTMs from the military regarding these exercises and the number of days affected for Guam and the CNMI are included in Table 93. The warning areas for which NTMs are issued are presented in Figure 188. No data are presented for 2022 because the U.S. military stopped issuing detailed information via NTMs.

Table 93. Notices to mariners for military exercises in the Mariana Archipelago from 2013-2021

Year	Location	Number of Notices to Mariners Issued	Number of Days Affected
2013	FDM	45	159
	W-517	24	54
2014	FDM	38	145
	W-517	24	49

Year	Location	Number of Notices to Mariners Issued	Number of Days Affected
2015	FDM	37	164
	W-517	33	87
2016	FDM	35	142
	W-517	50	139
	W-11	N/A	N/A
	W-12	N/A	N/A
2017	FDM	56	191
	W-517	46	119
	W-12	2	5
	W-11	N/A	N/A
2018	FDM	38	150
	W-517	49	107
	W-12	6	13
	W-11	1	1
2019	FDM	39	165
	W-517	27	65
	W-12	3	22
	W-11	6	27
	W-13	15	37
2020	FDM	17	62
	W-517	12	26
	W-12	5	10
	W-11	3	8
	W-13	15	62
2021*	FDM	N/A	49
	W-517	N/A	80
	W-12	N/A	32
	W-11	N/A	41
	W-13	N/A	63

*Data for 2021 are incomplete. The number of notices to mariners is not able to be reported for 2021 due to changes in how the Department of Defense presents aggregate NTM data. Additionally, military departments did not issue NTMs from August to December of 2021, so the presented data are from January to July 2021.

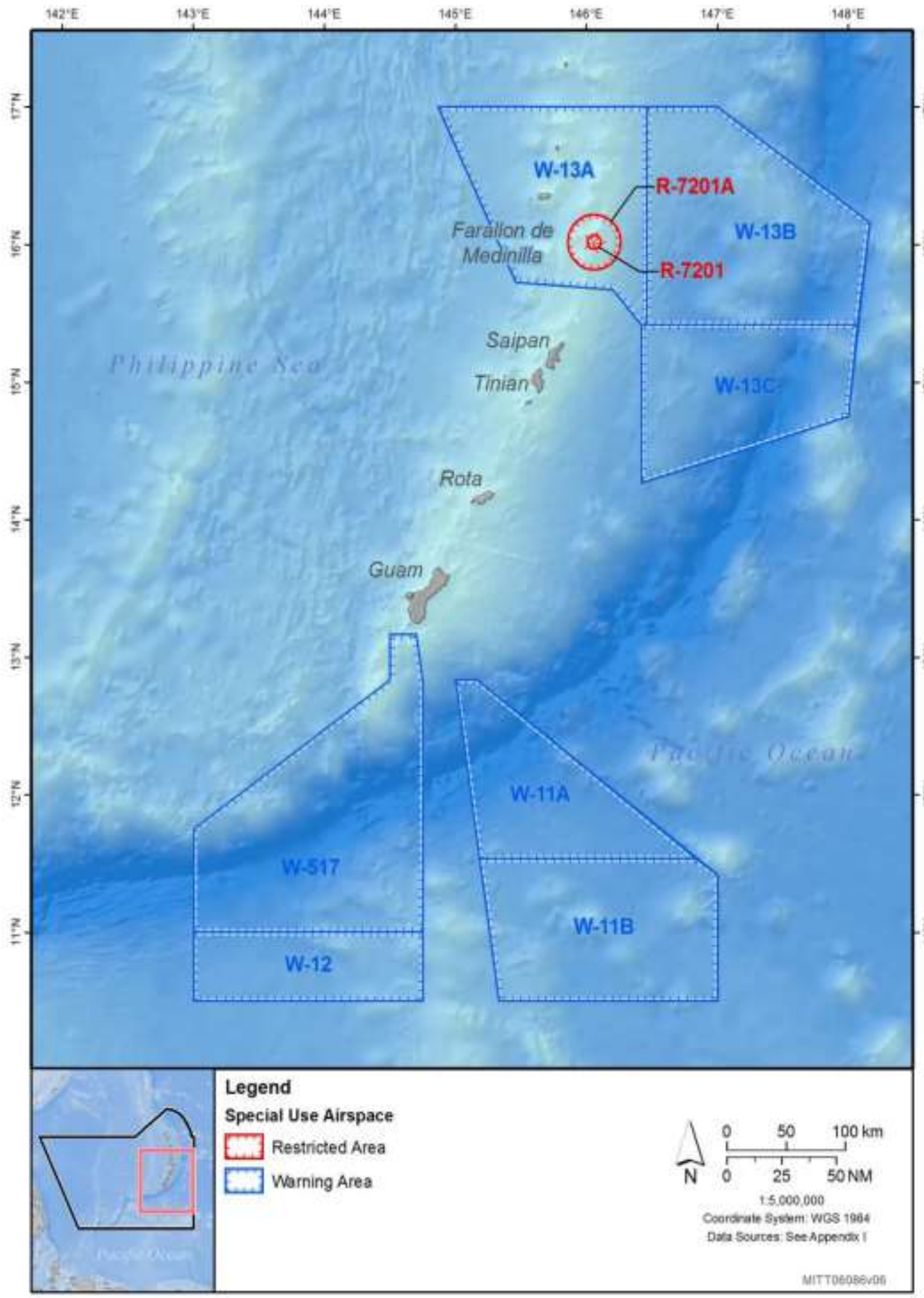


Figure 188. Map showing Warning Areas around the Mariana Archipelago

3.6.5 ADDITIONAL CONSIDERATIONS

3.6.5.1 AMERICAN SAMOA

3.6.5.1.1 Spatial planning Tools

In June 2018, President Trump signed the EO 13840 *Regarding the Ocean Policy to Advance Economic, Security, and Environmental Interests of the United States*, which established a policy focused on public access to marine data and information and requires federal agencies to 1) coordinate activities regarding ocean-related matters and 2) facilitate the coordination and collaboration of ocean-related matters with governments and ocean stakeholders. To that end, the American Samoa Coastal and Marine Spatial Planning Data Portal was created by Marine Cadastre to share information and data for coastal and marine spatial planning in American Samoa.

3.6.5.1.2 Fish Aggregating Devices (FADs)

There are usually five FADs active in the waters around American Samoa in recent years: four around Tutuila and one near Manua. In 2021, however, only two fish aggregating devices (FADs) were active, FADs B and E (Figure 189).

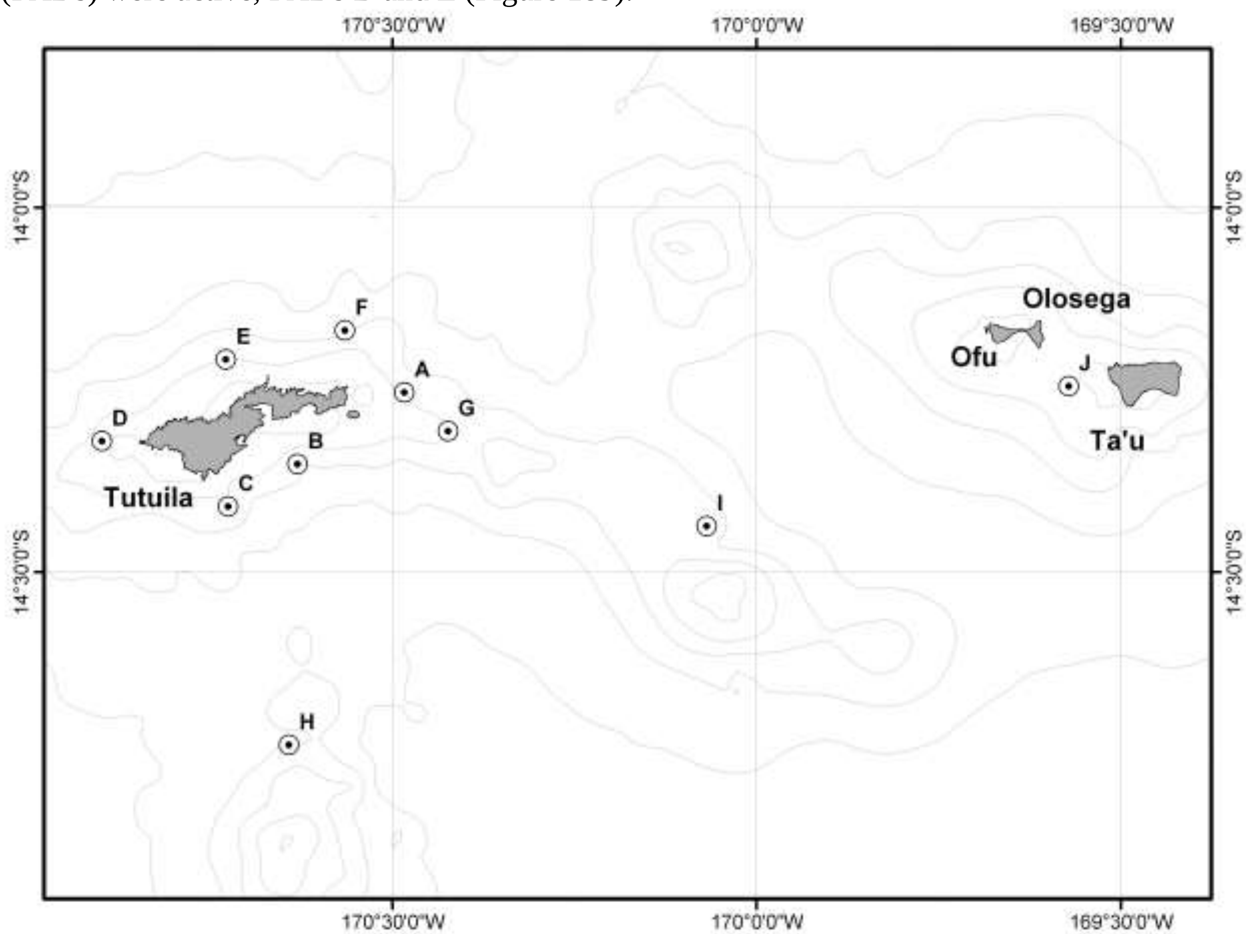


Figure 189. Present or planned locations of FADs in deep water around American Samoa in 2020 (Source: DMWR)

Two other FADs have been lost in recent years, FADs A and C; however, there are plans to deploy FADs C, G, and J in the near future. American Samoa recently received three new FADs sent from New Zealand to replace lost FADs, though the shipment had been delayed due to complications associated with COVID-19 shipping restrictions in Australia and New Zealand. The American Samoa DMWR also resurveyed three potential FAD sites around Tutuila, noting some discrepancies in the depth.

3.6.5.2 CNMI

3.6.5.2.1 Spatial Planning Initiatives

Spatial planning has occurred in CNMI in Saipan Lagoon. CNMI Division of Coastal Resources Management developed the Saipan Lagoon Use Management Plan, which was updated in 2017 and has an associated mapping tool.

3.6.5.2.2 FADs

As of early 2022, there are six FAD systems active within waters of the CNMI: KK, JJ, II, HH, FF, and DE. The CNMI DFW is planning on conducting another site assessment in the near future to verify reports from fishers of missing FADs. Additionally, DFW is currently acquiring materials to construct replacement FADs, including ropes, shackles, swivels, and anchors; procurement of solar navigational lights and buoys is ongoing. DFW plans to secure a FAD deployment contract once all the materials have been obtained and the systems have been prepared. Relatedly, DFW participated in a meeting with fishers to discuss the FAD program and consider options to reconfigure site locations around the islands of Saipan, Tinian, and Rota in the future (Tenorio, pers. comm. April 5, 2022). A map of the FADs is provided in Figure 190.

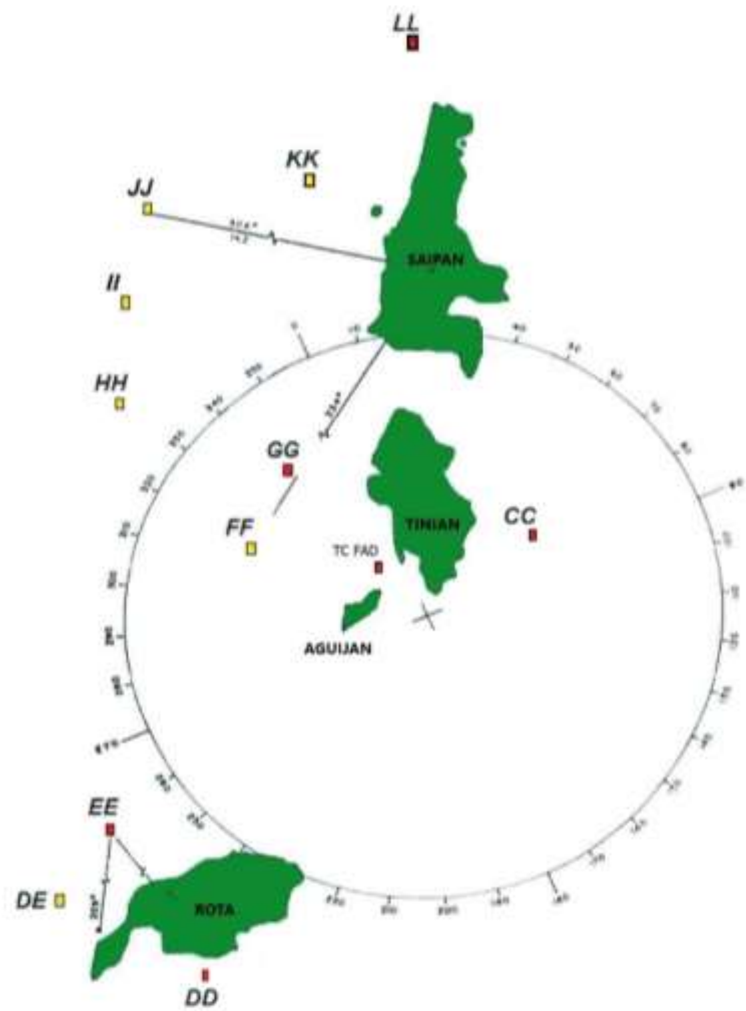


Figure 190. Map of FAD locations around the CNMI. Yellow depicts present FADs, and red depicts missing FADs as of the beginning of April 2022 (Source: DFW)

3.6.5.2.3 Mariana Trench National Marine Sanctuary Nomination – Five-Year Review

On January 21, 2022, the NOAA Office of National Marine Sanctuaries (ONMS) began facilitation of a review of the nomination for the Mariana Trench National Marine Sanctuary (NMS) at the five-year interval by requesting written and oral comments (87 FR 3284). On March 10, 2022, the NOAA OMNS extended the public comment period by an additional 45 days through April 25, 2022 (87 FR13709). ONMS will review information to its 11 evaluation criteria for inclusion in the inventory of nominations, emphasizing any new information about the significance of the area's natural or cultural resources, changes to any threats to these resources, and any updates to the management framework of the area. The original nominating parties for the NMS were Pew Charitable Trusts and Friends of the Marianas Trench, which will also have an opportunity to provide input on relevant information. Following information gathering and internal analysis, NOAA will make a final determination on whether or not the Mariana Trench NMS nomination will remain in the inventory for another five-year period.

The potential development of an NMS for the Mariana Trench is an issue of debate for residents of the Mariana Archipelago. The Marianas Trench Marine National Monument (MTMNM) already exists in the area, and the creation of an NMS would have the potential to further restrict fishing access or limit the potential for fisheries development within the EEZ around the CNMI. Regarding the nomination of the Mariana Trench NMS, concerns have been raised about the potential to expand the NMS beyond the boundaries of the MTMNM, the expansion of fishing restrictions to the water column within the Trench Unit of the MTMNM, and the current lack of community support and public confusion surrounding the nomination letter submitted by Friends of the Marianas Trench (Tenorio, pers. comm., April 4, 2022

3.6.5.3 GUAM

3.6.5.3.1 FADs

In Guam, as of 2020, there were five active FADs: Number 2, Umatac, Facpi 2, Cocos, and Agat Bay (Figure 191). DAWR is also in possession of three other FADs to be deployed in the near future in addition to a community-based FAD via the GFCA. These FADs will be deployed once the deployment contract is finalized. DAWR is also planning to experiment with two new FAD designs as well as procure three FADs under the existing design pending a purchase order from the Guam Department of Agriculture.

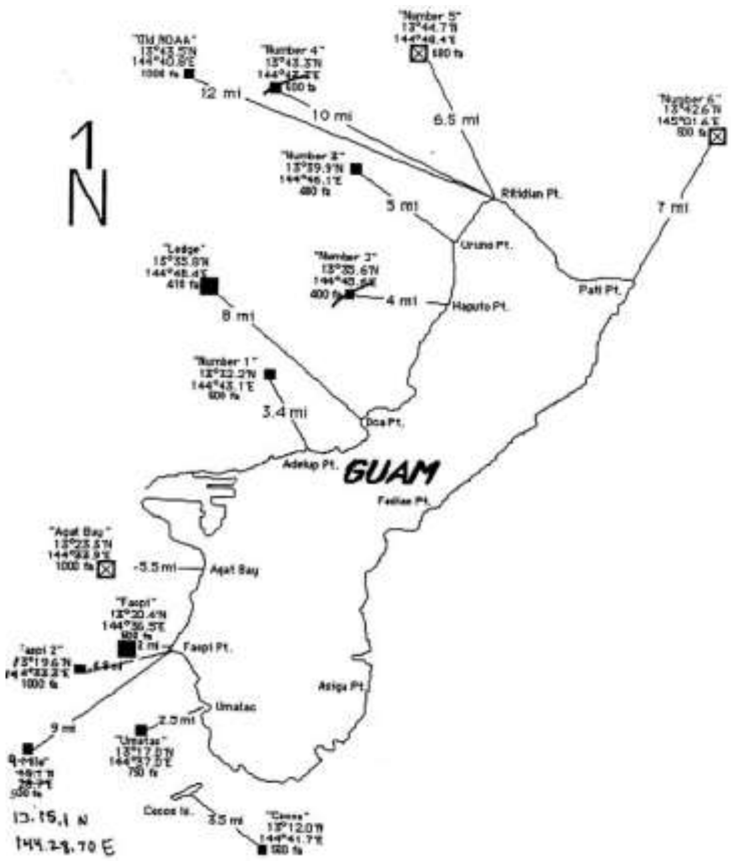


Figure 191. Map of FAD locations around Guam (Source: DAWR)

3.6.5.4 HAWAII

3.6.5.4.1 Spatial Planning Initiatives

The State of Hawaii has several initiatives ongoing, including its 30x30 Initiative and its Ocean Resource Management Plan, which was most recently updated in 2020 (Hawaii Office of

Planning 2020). Interested parties are encouraged to provide input to and track the progress of these plans.

3.6.5.4.2 Bottomfish Restricted Fishing Areas (BRFAs)

In 1997, in response to a federal stock assessment indicating that certain species of the MHI bottomfish stock complex were in danger of being overfished, DAR developed a bottomfish management plan, which included the creation of 19 bottomfish restricted fishing areas (BRFAs) where bottomfish fishing was prohibited. These BRFAs were enacted in 1998. The MHI BRFAs are situated in both State and federal waters. Upon review in 2005, it was determined that the BRFA system did not protect an adequate amount of preferred habitat for bottomfish, so a new system was created in 2007 with 12 BRFAs (Figure 192) with the objective of reducing fishing mortality of MHI bottomfish stocks, rebuilding bottomfish populations on habitats within the BRFAs, and improving bottomfish populations in adjacent fishing areas (Drazen et al. 2014). In 2019, four of the 12 BRFAs were opened: BRFA C (Poipu, Kauai), BRFA F (Penguin Banks), BRFA J (Hana, Maui), and BRFA L (Leleiwi, Hawaii Island) (Figure 192).

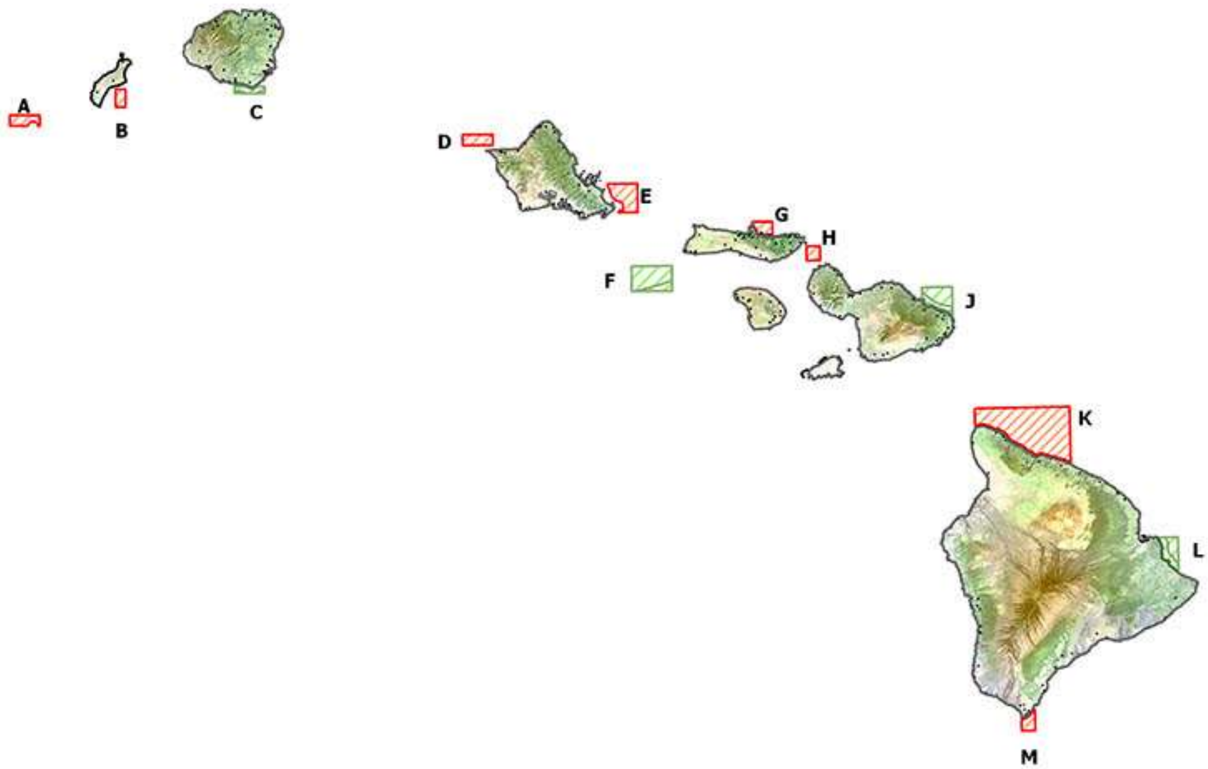


Figure 192. Map of the 12 BRFAs around the MHI; green boxes indicate those areas were opened to bottomfish fishing in 2019 and red boxes indicate areas that remained closed to bottomfish fishing at this time. All BRFAs are now open (from DAR 2021)

On February 25, 2022, the Hawaii Board of Land and Natural Resources (BLNR) approved the reopening of all BRFAs such that registered bottomfish vessels are now allowed to fish for Deep-7 bottomfish in all previously closed BRFAs. During deliberations, representatives from DAR suggested that, because the Deep-7 bottomfish complex is being fished at sustainable levels according to the 2021 stock assessment update (Syslo et al. 2021), DAR is comfortable in taking an adaptive management approach to co-management of the Hawaii bottomfish fishery by opening the BRFAs and relying on other existing conservation and management measures to sustain the fishery.

3.6.5.4.3 FADs

The State of Hawaii FAD program is run by the Hawaii Institute of Marine Biology, SOEST, University of Hawaii in cooperation with DAR. FADs attract schools of tuna, mahimahi, ono, billfish, and other pelagic fishes so that fisher can easily locate and catch these species, as it is known that pelagic fish tend to aggregate around floating objects (Hawaii Sea Grant). The FADs utilized around the MHI are typically surface FADs anchored using a catenary mooring method and have an average life expectancy of three to four years (Figure 193; Hawaii Sea Grant). There are currently 54 FADs monitored and maintained throughout the MHI, with 17 around the Big Island (Figure 194), 14 around Maui (Figure 195), 14 around Oahu (Figure 196), and nine around Kauai (Figure 197). Over the course 2021, there were 13 FADs reported as missing, four FADs recovered, and seven deployed. As of March 22, 2022, two of the 17 FADs around the Big Island, six of the 14 FADs around Maui, eight of the 14 FADs around Oahu, and four of the nine FADs around Kauai were not active (Figure 194 through Figure 197). Additionally, there were two FADs, one near Maui and the other near the Big Island, that were discontinued.

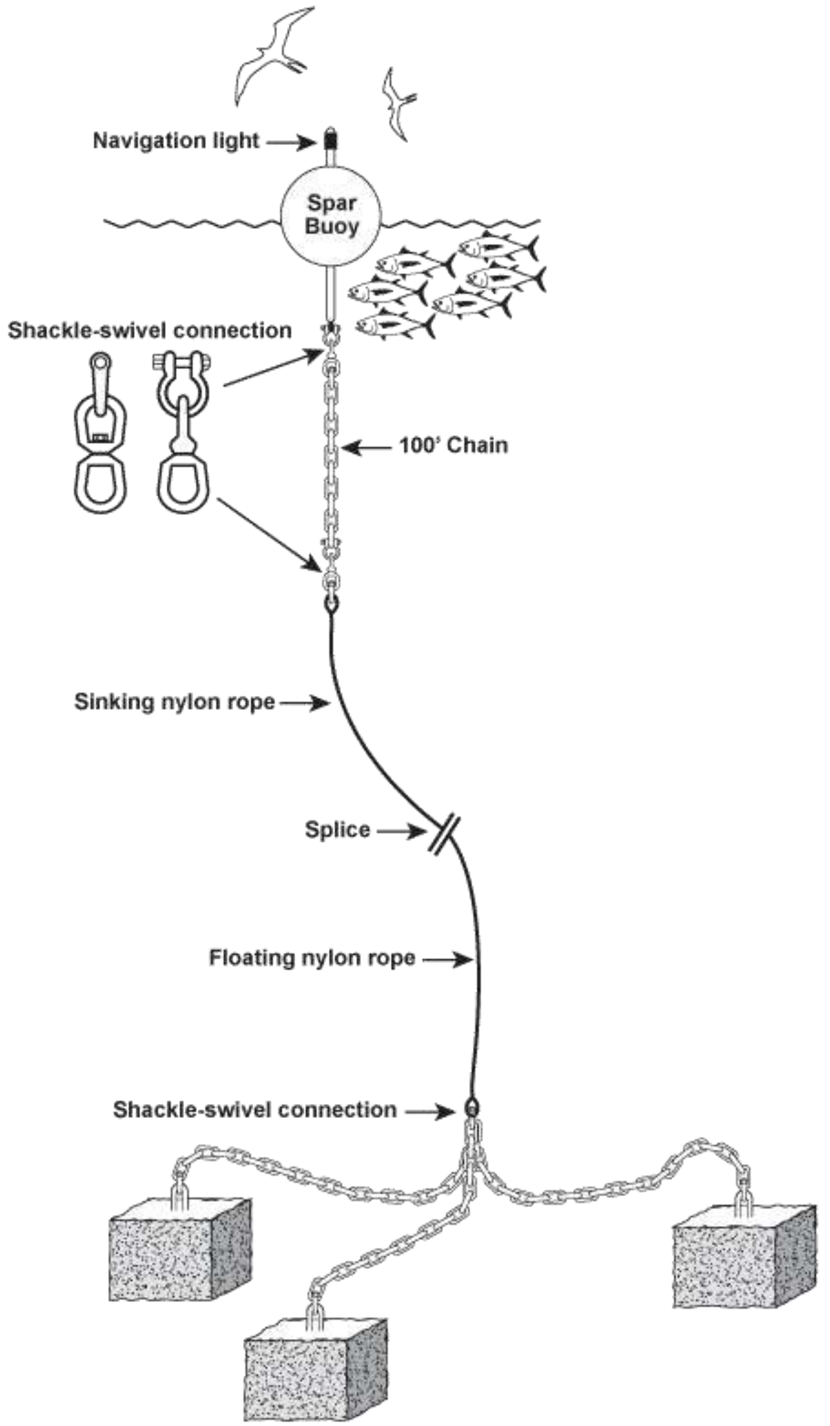


Figure 193. Diagram of the typical arrangement of FADs around the MHI (from Hawaii Sea Grant)

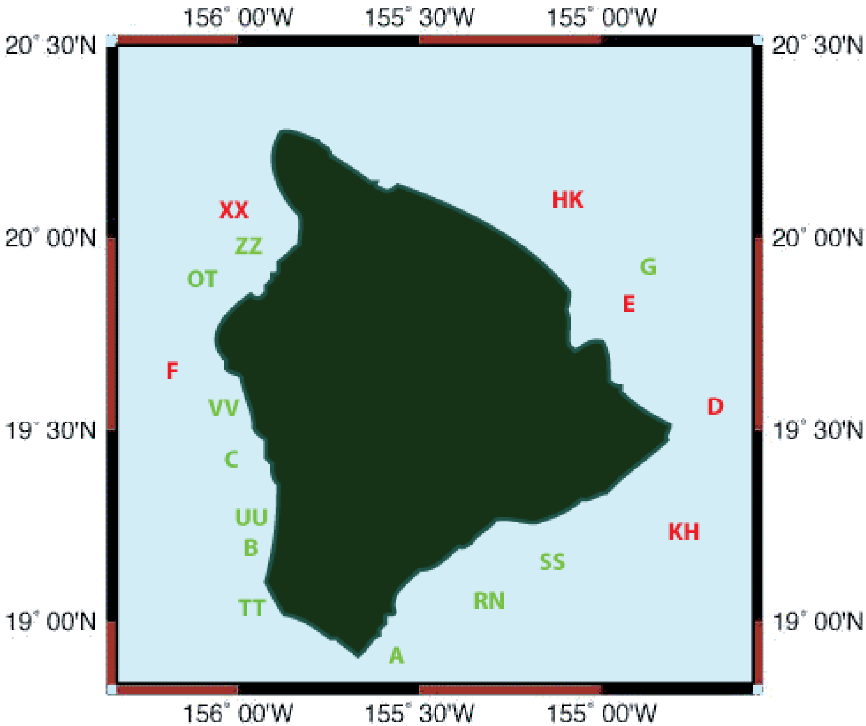


Figure 194. Map of FADs in the waters around the Big Island; red letters indicate a FAD that is known to be missing, and green letters indicate an active FAD (as of March 22, 2022, from Hawaii Sea Grant)

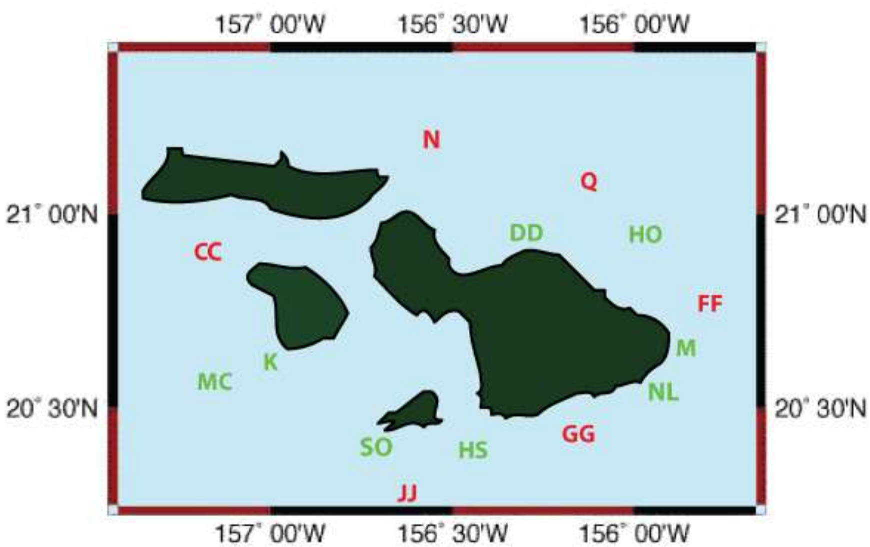


Figure 195. Map of FADs in the waters around Maui; red letters indicate a FAD that is known to be missing, and green letters indicate an active FAD (as of March 22, 2022, from Hawaii Sea Grant)

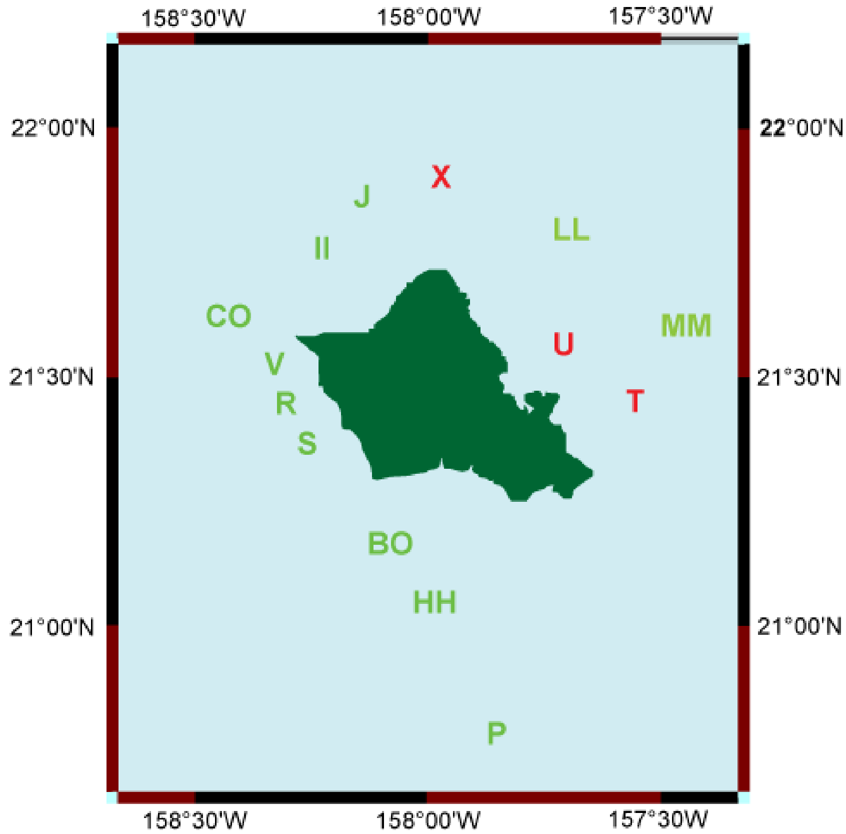


Figure 196. Map of FADs in the waters around Oahu; red letters indicate a FAD that is known to be missing, and green letters indicate an active FAD (as of March 22, 2022, from Hawaii Sea Grant)

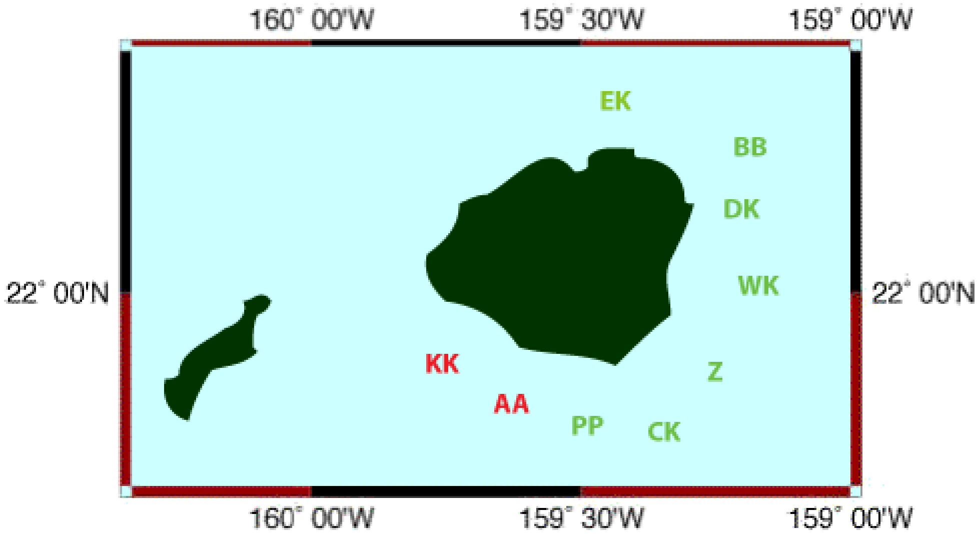


Figure 197. Map of FADs in the waters around Kauai; red letters indicate a FAD that is known to be missing, and green letters indicate an active FAD that has been recently deployed (as of March 22, 2022, from Hawaii Sea Grant)

4 DATA INTEGRATION

This chapter intends to advance ecosystem-based fishery management of Western Pacific pelagic fisheries by examining the fisheries in the context of marine ecosystems. The Council convened a two-day workshop on November 30 to December 1, 2016, to identify content for this chapter. The pelagic fisheries group suggested this chapter focus on three topical issues: 1) bycatch (with a focus on protected species factors that may influence interaction rates; 2) a socioeconomics section examining fishery performance in two areas: attrition in American Samoa longline fleet and the decline of shallow-set longline swordfish fishery; and 3) the projected decrease in oceanic productivity with implications for management issues, including a discussion of factors influencing significant changes in the CPUE of target species. The chapter used to include a section on influences of black-footed albatross interaction rates in the Hawaii longline fishery, but this has since been moved to the Protected Species section of the report and replaced with a summary of the Ecosystem-Based Fisheries Management project for impact assessments of protected species. As of the 2019 report, abstracts from recent publications relevant to data integration for pelagic fisheries are included in this chapter.

In 2019, the Pelagic Fishery Ecosystem Plan Team recommended work items for this chapter, such as directing Council staff and PIRO Sustainable Fisheries Division (SFD) to update the SAFE report data integration section with regularity and to include notable changes or issues pertinent to the FEP as a guide for adaptive management. The Plan Team also noted that Council staff should work with PIRO SFD to review thematic priorities that were previously identified in the Data Integration Workshop going forward. These work items were briefly discussed at the 2020 Pelagic Fishery Ecosystem Plan Team meeting to better determine a path forward, but at the 2021 Plan Team meeting, the efforts were discontinued. This section will continue to be updated by Council staff as resources and information allow.

4.1 ECOSYSTEM-BASED FISHERIES MANAGEMENT PROJECT FOR PORTECTED SPECIES IMPACTS ASSESSMENT FOR HAWAII AND AMERICAN SAMOA LONGLINE FISHERIES

In response to olive ridley turtle interaction trends observed in the Hawaii deep-set longline fishery (see Section 3.3.2.3) the Council’s Protected Species Advisory Committee at its March 2017 meeting recommended evaluation of the increasing trend in conjunction with the previously recommended effort to evaluate ecosystem factors influencing bycatch in the longline fishery. Following this recommendation, the Council and NMFS implemented the ecosystem-based fisheries management (EBFM) project for protected species impacts assessment for the Hawaii and American Samoa longline fishery. The project is a collaboration between PIFSC, Council, PIRO and University of Florida.

In the first year of the initiative, the team developed methodologies to associate the spatiotemporal patterns of olive ridley turtle interactions with the Hawaii deep-set fishery primarily targeting bigeye tuna with static and dynamic environmental characteristics. However, the project quickly expanded looking not only across marine turtle species within the fisheries but across taxa as well. The project resulted in the development of a data compilation workflow linking the observer dataset with NOAA and other related oceanographic data products for the Hawaii deep-set observer data set as well as the shallow-set observer data. The resulting data sets were used to develop an Ensemble Random Forest model (Siders et al. 2020) to (i) predict the probability of fishery interactions with protected species including target and non-target catch; (ii) defining critical areas of interaction using quantile contouring over a range of temporal time frames; (iii) assessed the number of sets and interactions within the contours; and (iv) developing covariate response curves using Accumulated Local Effects.

The team summarized the first year's effort into a publication in the Endangered Species Research journal. The primary purposes of this publication were to test the model performance of the developed Ensemble Random Forests model against other existing approaches to handle rare events (e.g., bycatch), to demonstrate its performance on case studies of ESA-listed and protected species, and to Ensemble Random Forests as an intuitive extension of the Random Forest algorithm to handle rare event bias. Through simulation, the team showed Ensemble Random Forests outperforms Random Forest with and without down-sampling as well as the synthetic minority over-sampling technique from highly class imbalanced to balanced datasets. The team found spatial covariance greatly impacts Ensemble Random Forests perceived performance as shown through simulation and case studies. For cases studies from the Hawaii deep-set longline fishery, giant manta ray (*Mobula birostris* syn. *Manta birostris*) and scalloped hammerhead (*Sphyrna lewini*) had high spatial covariance in their presences and high model test performance while false killer whale (*Pseudorca crassidens*) had low spatial covariance and low model test performance. Overall, the team found Ensemble Random Forests have four advantages: 1) reduced successive partitioning effects; 2) prediction uncertainty propagation; 3) better accounting of interacting variables through balancing; and 4) minimization of false positives as the majority of Random Forest within the ensemble vote correctly. Regarding the ESA-listed and protected species case studies, the team found the giant manta ray's highest probability of interaction with the Hawaii deep-set fishery was concentrated around the main Hawaiian islands as well as between 170-160ºW and 10-15ºN, the scalloped hammerhead's probability of interaction was more diffuse but still concentrated around the main Hawaiian islands as well as throughout 170-155ºW and 10-17ºN, and the false killer whale's probability of interaction was the most diffuse but highest northeast of the main Hawaiian islands.

In 2020, the team conducted an evaluation of the experimental oceanographic TurtleWatch product (Siders et al. 2023). The team focused on the 1ºC band originally set by Howell et al. (2008) and five aspects of the TurtleWatch product: (i) does the TurtleWatch 17.5-18.5ºC band hold up with additional satellite telemetry information on loggerhead sea turtle locations; (ii) when are loggerhead sea turtles in the TurtleWatch 17.5-18.5ºC band over the course of a year; (iii) when do the Hawaii shallow-set longline fishery (SSLL) locations and the loggerhead sea turtle locations overlap; (iv) do fisher avoid the band as the hard cap of loggerhead sea turtle fishery interactions is approached. To answer these questions, the team used an expanded set of the satellite telemetry locations of tagged loggerhead sea turtles from the original analysis and PIRO Observer Program fisheries-dependent monitoring SSLL set locations. Using the oceanographic extraction subroutine developed in previous EBFM activities, the team matched sea surface temperature (SST) with the tag and fishery locations.

(i & ii) The team found that the original band holds up well with additional data for locations of fishery interactions in quarter 1 (January–March) and quarter 4 (October–December) (Figure 198). In quarter 1, tagged turtles were in colder water than the TurtleWatch band (SST < 17.5ºC). In quarter 2, tagged turtles were in the TurtleWatch band while quarter 3 they were warmer than the band (SST > 18.5ºC). In quarter 4, the tagged turtles, fishing locations, and interactions all strongly overlapped with the TurtleWatch band (Figure 198).

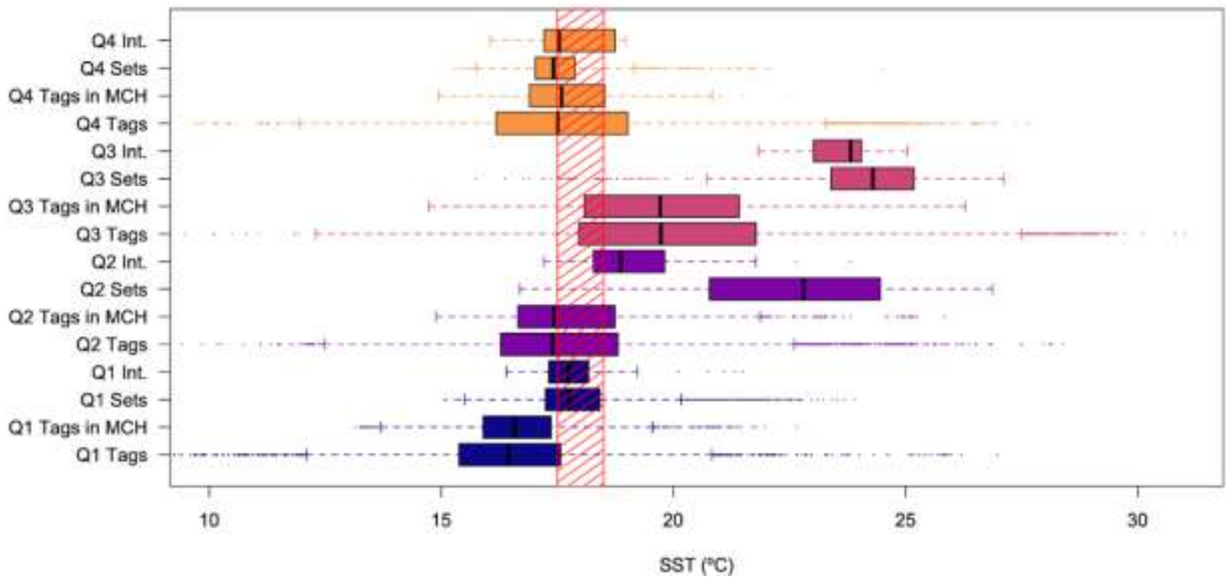


Figure 198. Quarterly sea surface temperature distribution of telemetered sea turtles (Tags), of telemetered sea turtles in the minimum convex hull of the Hawaii shallow-set longline sets (Tags in MCH), the shallow-set fishery sets (Sets), and the interactions between loggerheads and the shallow-set fishery (Interactions) relative to the 1º TurtleWatch band (17.5-18.5ºC), the red hash.

(iii) As the vast majority of these turtles were released in the western Pacific, the number of telemetry locations in the area of the shallow-set fishery peaked at about a third of all locations in a given quarter. For each quarter, we visualized and calculated the overlap between the turtle location for each quarter (Figure 198). The team showed that in the quarters with more loggerhead interactions (quarters 1 and 4), there is little avoidance of the TurtleWatch band and many of the interactions come from within the band. Interestingly, sets in quarter 4 are likely to get more turtles per set than quarter 1. Sets with interactions in quarter 2 come from early in the quarter before the fishery has pushed to warmer SST. Overall, the team found that the overlap between the fishery and the turtles is driven by changing in latitudes over the course of the year (Figure 199). In quarter 1 and quarter 4, both the turtles and the fishery are in the same latitudinal band. In quarter 2, the fishery moves farther south (lower latitudes) while the turtles move farther north over quarter 2 and 3. In quarter 3, the fishery pushes north again and by quarter 4 ends up overlapping with the turtle locations again.

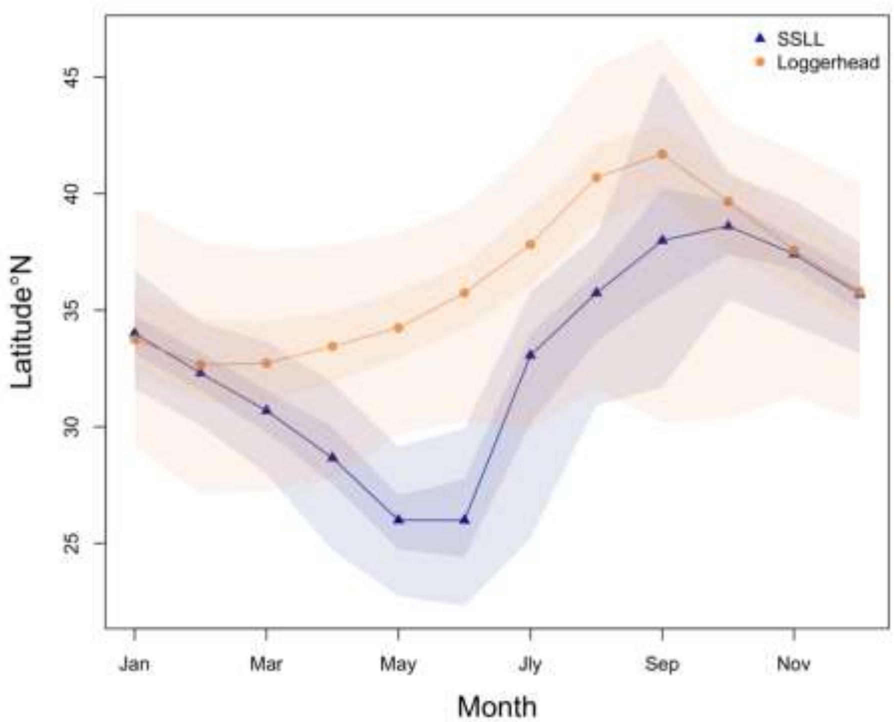


Figure 199. Latitudinal overlap between the Hawaii shallow-set longline fishery (blue triangles) and the loggerhead locations (orange circles). The line is the mean, the darker shading is the 50%, and the lighter shading is the 95%.

(iv) The team evaluated some aspects of fisher behavior garnered from the fishery locations only. The mean distance to the TurtleWatch band was calculated and whether fishers were avoiding the band as the percent of the loggerhead hard cap was filled was assessed. The team saw no indication of avoidance behavior except in 2018, when the hard cap was reached in early quarter 2, rather than in late quarter 1 as in other years, and the majority of the fishery had moved to warmer SSTs than the turtles frequent.

Overall, the team concluded that the TurtleWatch experimental product was still valid for quarters 1 and 4 for the location of shallow-set fishery interactions with loggerhead sea turtles. The location of tagged sea turtles in quarter 1 suggests that if fishers were to set in cooler waters than they do now, more interactions could occur as the overlap with the distribution of loggerhead sea turtles increases. Additionally, quarter 4 had the highest interaction rates but some of the lowest fishing effort. The team noted that if effort were to increase in quarter 4, there is likely to be an increase in loggerhead sea turtle interactions. Quarter 2 and 3 offer the least chance of encountering loggerhead sea turtles. From the historic fishing location information, fishers did not appear to use the TurtleWatch product to avoid loggerhead sea turtle interactions. Further analysis following the 2019 regulatory change from the fishery hard cap to trip interaction limits (see Section 3.3.1.3.2) will offer an opportunity to explore the change in fisher behavior.

In November 2022, the Council, PIFSC and the University of Florida convened a workshop with representatives from the Hawaii Longline Association (HLA), Hawaii SSLL fishery, and PIRO to discuss a case study evaluating the effects of spatial decision making by fishery participants on the protected species interactions and catch of target species.[8] The case study focused on scenarios of SSLL fishers avoiding loggerhead sea turtles in the first or fourth quarter of the year either by using the TurtleWatch product (based on 17.5–18.5ºC sea surface temperature band) or areas identified by the Protected Species Ensemble Random Forests (PSERF) model based on the probability of loggerhead interactions. The workshop provided an overview of the spatial tool developed to do the evaluation, highlighted where industry feedback from an initial session with HLA/SSLL participants was used in the model, and presented the evaluation results.

The spatial tool consisted of four submodels: 1) PSERF models of the probability of interactions with loggerhead and leatherback sea turtles with the SSLL fishery; 2) a spatiotemporal model of fishery effort; 3) a spatiotemporal model of fishery Swordfish catch-per-unit-effort (CPUE); 4) an avoidance area design model using the TurtleWatch product or the PSERF models' outputs. These were then used to predict the fishery effort, CPUE, protected species interaction distribution, and avoidance areas for the months in quarters 1 and 4 in 2019–2021. A fifth submodel redistributed fishing effort out of avoidance areas.

The model results were summarized as the amount of effort that would need to avoid one of the spatial avoidance areas, the percent change in swordfish catch, the change in the number of loggerhead sea turtle interactions, and the change in the number of leatherback sea turtle interactions from avoidance. The tool identified that no matter how the avoidance area was defined, there was a strong chance that avoiding loggerhead interactions by the SSLL fishery would result in increasing the leatherback interactions in at least one of the months in quarters 1 and 4. The TurtleWatch-defined avoidance area resulted in the highest increase in leatherback interactions per loggerhead interaction avoided.

Workshop participants discussed the results of the submodels of the spatial tool and concluded that most of the submodels did a decent job of capturing the environmental covariates important for determining where fishing effort, CPUE, and protected species interactions occurred. As the models did not account for size of swordfish in the catch and other market drivers (secondary species, spatial variation in catch quality, competition), participants discussed at length how market forces influence the decision making of SSLL fishers. As the spatial tool identified a strong inverse tradeoff between avoiding loggerhead interactions and increasing leatherback interactions, participants discussed alternative solutions to avoiding protected species interactions. These encompassed discussions on vessel-to-vessel communication and information sharing amongst the fleet on interaction hotspots, training of new fishery participants on best practices to avoid protected species, and dissemination of avoidance areas or model-generated protected species hotspots to vessels at sea. Further discussions centered on what incentivizes fishers with a focus on how the market and market forces interact with swordfish behavior to constrain fishers' spatial and temporal decision making. The rest of the discussions considered applications of the spatial tool to the Hawaii deep-set longline (DSLL) fishery, the time and information needed to apply the tool, and potential species or spatial scenarios to test.

[8] Report of the Ecosystem Based Fishery Management Workshop: Exploring the effect of spatial decision making by fishers in the Hawaii shallow-set longline fishery. Available online at: https://www.wpcouncil.org/wp-content/uploads/2021/10/09.A1-EBFM-SSLL-Turtle-Model-Workshop-Report.pdf.

4.2 ATTRITION IN LONGLINE FLEETS

4.2.1 AMERICAN SAMOA LONGLINE

A downward trend of economic returns to the American Samoa longline fishery for the period of 2007 to 2013 has been observed in a recent economic study (Pan et al. 2017). This decline continues based on results from ongoing Pacific Islands Fisheries Science Center (PIFSC) Socioeconomics Program economic data collection and performance indicator monitoring programs. Based on data from a 2009 cost-earnings study on the fishery researchers found that the economic performance of the American Samoa longline fleet is highly sensitive to changes in albacore price, fuel prices, and the CPUE of albacore (Pan et al. 2017). The fishery was hit hard in 2013, when all three of these elements trended in the wrong direction, resulting in negative impacts to profit (Pan 2015). In early 2014, the majority of vessels in the American Samoa longline fleet were tied up at the docks in Pago Pago, and according to the *Samoa News*, "For Sale" signs had been posted on close to 20 (of the 22) active vessels[9].

Based on the analyses, the situation in 2013 was clearly associated with poor economic performance resulting from: (a) a continuous decline in albacore CPUE, (b) increasing fuel price, (c) a sharp drop in market prices for albacore, and (d) a baseline of limited profit margins resulting from a long term downward trend of net return since 2007 (Pan 2015). The previous cost-earnings study indicated that the fleet in 2009 operations was barely profitable where the albacore CPUE was at 14.8 fish per 1,000 hooks, the fuel price was at $2.53 (adjusted to 2013 value), and the market price for the albacore species was $1.00/lb. ($2,200 per mt). However, in 2013, the CPUE for albacore fell to 11.9 fish per 1,000 hooks (versus 14.8 in 2009) and the fuel price increased to $3.20 per gallon (versus $2.53 in 2009, adjusted to 2013 value). The albacore price in 2013 was similar to the 2009 level but it was a sharp drop compared to the price of $1.47/lb. in the previous year (2012). Thus, these changes yielded extensive losses across the fleet in 2013.

It is worth noting that the continuing decline of the American Samoa longline fishery during this period was not an isolated event but was a part of a region-wide economic collapse of the South Pacific albacore fishery. According to a report of the SPC Fisheries Newsletter #142 (September to December 2013), domestic fishing fleets targeting primarily albacore in Pacific Island Countries and Territories (PICTs) had reported difficulties in maintaining profitability in recent years, probably facing the challenges in fuel price rise, and albacore CPUE and price decline[10]. Ongoing PIFSC Socioeconomics Program economic monitoring programs will allow researchers to provide timely updates on future changes in economic performance for the American Samoa longline fishery.

4.2.2 HAWAII LONGLINE: SHALLOW-SET FISHERY

Gear configuration for Hawaii longline vessels is rather flexible as operations can easily be adjusted to change target species between swordfish or tuna fishing trips. Tuna fishing (deep-set fishery) has shown steady increases in both effort (hooks) and catch over the past two decades, while swordfish fishing (shallow-set fishery) has experienced a steady downward trend during

[9] http://www.samoanews.com/tri-marine-says-local-longline-fleet-vital-economy

[10] http://www.spc.int/coastfish/publications/bulletins/419-spc-fisheries-newsletter-142.html

the same period (Pan 2014). Since its closure and reopening in the early 2000s, the shallow set fishery has yet to recover even halfway to levels during its historical peak in the early 1990s.

Diminishing economic performance of shallow-set fishing may have contributed to the overall decline of the shallow set fishery, in addition to regulatory measures in controlling sea turtle interactions within the fishery. The Pacific Islands Fisheries Science Center (PIFSC) Socioeconomics Program economic data collection has documented declining net returns to the fishery during the period of 2005-2016, while the average net revenue for tuna trips has generally increased over the same period of time (Pan 2018).

Trends in swordfish and tuna trip costs have been similar over the years; however, swordfish trip revenues have fluctuated widely over the years unlike the relatively steady increase in tuna trip revenue over time (see Chapter 2). As a result, the average net revenue of swordfish trips moved up and down during 2005 to 2014. Prior to 2008, the average net revenue of a tuna trip was less than 50% of the average net revenue of a swordfish trip. In 2014, the level of the average tuna trip net revenue, $32,100, was much closer to the level of the average swordfish trip net revenue, $33,446. Yet, a swordfish trip usually lasts longer than a tuna trip, so the average net returns per day at sea for a swordfish trip are lower than for a tuna trip. Thus, tuna fishing seems to have an increasing comparative advantage over swordfish fishing in terms of trip-level economic returns. Without improved economic performance for swordfish fishing, there may not be much economic incentive to increase fishing effort for swordfish in the future.

Economic performance of longline fishing is the combined effect of many factors, but the key factors that determine the net revenue of Hawaii longline fishing may include: a) prices of target species, b) CPUE of the target species, c) fuel prices, and d) regulatory effects.

4.2.2.1 WEAKENED SWORDFISH MARKET

The weakened swordfish market has been a disincentive for Hawaii fishermen to re-engage in the swordfish fishery in recent years. Unlike bigeye tuna, which is mainly consumed in Hawaii's local market, the majority of the swordfish landed in Hawaii and used to be exported to the U.S. mainland where it competed with imports from other nations and the Atlantic. Concern over mercury contamination could have possibly contributed to decreased demand as well. In early 1990, bigeye and swordfish ex-vessel prices in the Hawaii market were similar at around $4.50 per pound. From 1994 to 2009, swordfish prices declined while bigeye prices have held relatively stable. In recent years, the price differential between these two species has increased. For example, in 2008 the ex-vessel price of bigeye tuna was $4.12 per pound while the ex-vessel price of swordfish was only $2.08 per pound.

4.2.2.2 CPUE DECLINES FOR SWORDFISH TRIPS

Swordfish CPUE was high at the beginning of the time series, being above 15 fish per 1,000 hooks in the years of 2005, 2006, and 2007. It has decreased since 2007, dropping to its lowest in 2010 with only 10 fish per 1,000 hooks. The swordfish CPUE has slightly increased and then remained unchanged in recent years. Bigeye CPUE, on the other hand, shows a different trend; it was quite steady from 2005 to 2012, and has increased continuously in the last four years from 3.8 fish per 1,000 hooks in 2012 to approximately 4.5 fish per 1,000 hooks in 2015.

4.2.2.3 FUEL PRICES

While the two types of fisheries face the same fuel market, trip costs, revenues, and subsequent net revenues can vary across the deep-set and shallow-set fisheries. As previously stated, PIFSC

Socioeconomics Program economic data collection programs have documented declining net returns to the swordfish fishery during the period from 2005 to 2014, while the average net revenue for tuna trips has generally increased over the same period of time (Pan 2018).

4.2.2.4 SUDDEN CLOSURES DURING FISHING SEASON

Due to hitting the sea turtle caps, the fishery experienced closures in 2006 and 2011, respectively. The sudden closures had interrupted the normal fishing trip cycle and might have resulted in economic loss to the fishermen as a fishing trip had to be ended no matter if the catch was fully loaded as planned. In the case of 2006, the closure brought back all the swordfish fishing vessels to port, flooding the swordfish market, which in turn constrained air shipping capacity and limited local consumption.

4.2.3 FACTORS AFFECTING CPUE OF TARGET SPECIES

The work of PIFSC researchers in spatial and temporal changes in Hawaii longline fishery catch and their potential for forecasting future fishery performance are excerpted below from the briefing document provided for the 124th meeting of the Council's Scientific and Statistical Committee (SSC). Authors include Phoebe Woodworth-Jefcoats, Johanna Wren, Jeff Drazen and Jeff Polovina[11]. Additional explanatory text was provided by Phoebe Woodworth-Jefcoats (pers. comm.)

A comprehensive examination of the spatial and temporal trends in the Hawaii-based longline fishery over the past 20 years was conducted using three fisheries-dependent data sets: logbook (1995-2016), observer (2006-2016), and dealer (2000-2016) data. Logbook data completed by fishermen provides catch, effort, and catch location data of landed species for all vessels in the fleet, while observer data provides lengths of every third fish caught, including discards, but only ~20% of vessels have an observer on board. Dealer data provides weight of all fish sold at the Honolulu Fish Auction and can be matched with logbook data for each vessel trip.

[11] Factors behind the recent rise in bigeye CPUE in the Hawaii longline fishery. Documented submitted for Western Pacific Fishery Regional Management Council 124th Scientific and Statistical Committee Meeting, October 4 to October 6, 2016, Honolulu, Hawaii, 4 p.

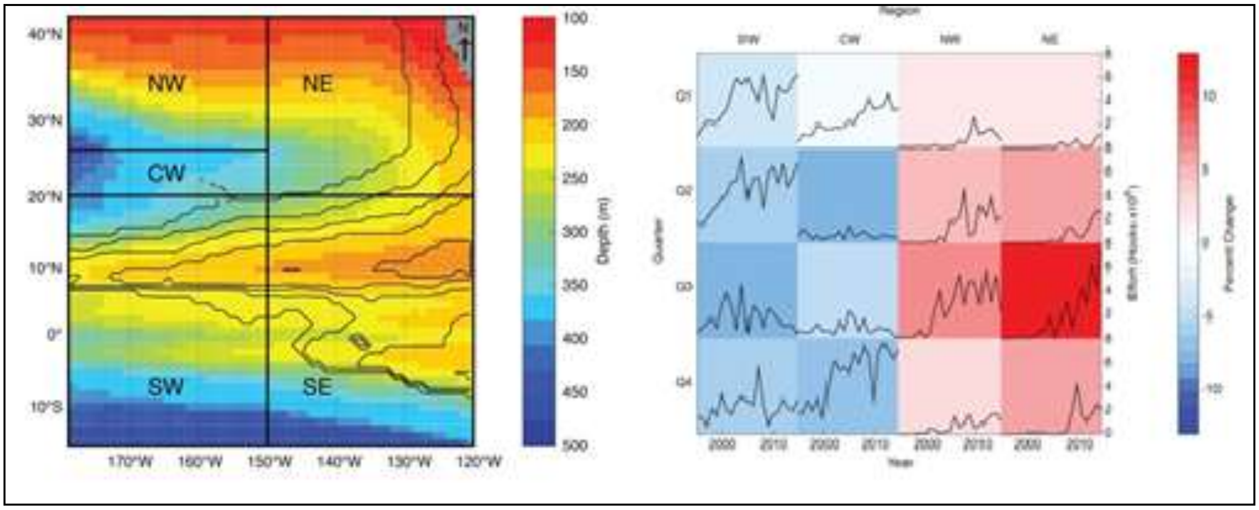


Figure 200. Left: Map depicting the five regions by which the fishery is examined overlaid on the climatological (1995-2015) median depth of preferred thermal habitat

Note: (8 – 14 °C, shaded) and the depth of the 1 mL/L oxygen threshold (contoured every 100 m from 100 to 500 m, with stippling where the depth is less than 100 m). Right: The difference between the proportion of total annual effort set in each region and quarter from the beginning (1995 – 1997 mean) to the end (2013 – 2015 mean) of the time series is shaded. Total annual effort in each region and quarter is plotted in black. Note: nearly no effort is deployed in the SE region.

The deep-set longline fishery, which targets bigeye tuna, has expanded considerably over the past two decades. Not only has total effort increased from nearly 8.4 million hooks set in 1995 to over 47 million hooks set in 2015, but the spatial footprint of the fishery has expanded as well. At the beginning of the time series, nearly all (97%) of Hawaii's deep-set effort was set in the fishery's core operating area south of 26°N and west of 150°W, whereas in 2015 over 40% of the deep-set effort was set either north or east of these bounds. This expansion is most prominent in the third quarter of the year (Figure 200).

The marked northeastward expansion of the fishery appears to have several drivers. First, it is possible that waters closer to Hawaii were unable to support an increase in effort due to both Hawaii-based and international effort. Waters northeast of Hawaii had little to no international competition. Second, bigeye catch rates within the fishery's core operating area are lowest in the third quarter of the year. However, during this quarter catch rates are still high in waters to the northeast of Hawaii. Finally, preferred bigeye thermal habitat and oxygen levels overlap most completely with deep-set gear in waters to the northeast of Hawaii (Figure 200). This overlap could act to increase bigeye's catchability, and in turn catch rates, in northeastern waters. The fishery expanded spatially in the third quarter in response to low target catch rates. In waters to the northeast of Hawaii the fleet faced little competition and found a particularly efficient fishing ground due to its local oceanography.

One consequence of the fishery's spatiotemporal expansion has been an increase in the amount of lancetfish caught. Lancetfish have no commercial value and all catches are discarded. Lancetfish catch rates are highest north of 26°N and in the third quarter. Thus, the fishery is deploying more effort both in the region where lancetfish are most commonly caught and at the time when catch rates are highest. This has resulted in lancetfish catches exceeding bigeye catches for the past decade (Figure 201).

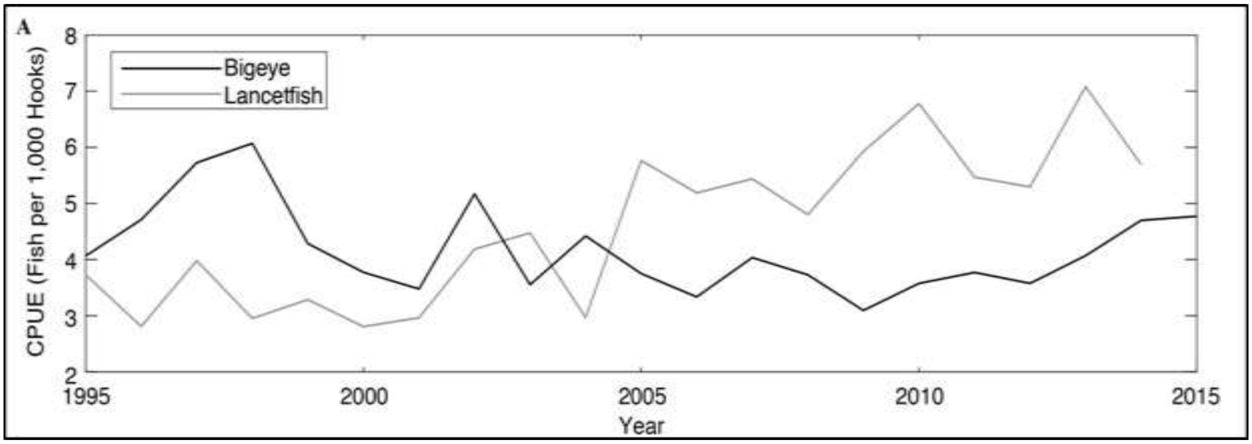


Figure 201. Annual deep-set bigeye tuna (black) and lancetfish (gray) CPUE

Trends in productivity and catch rates in the fishery over the past decades may be caused by spatiotemporal changes in the fishery itself, changes in the stock, or both. In order to better understand these trends A General Additive Models (GAM) was built to analyze time series of mean weight, catch per unit effort (CPUE, in number of fish caught per 1000 hooks) and weight per unit effort (WPUE, in kg caught per 1000 hooks). The GAM a llowed researchers to tease apart trends caused by changes in the stock from those caused by changes in seasonality and geographic location of the fishery. Over the past 16 years, mean weights of commercially important fish in the Hawaii- based longline fishery have declined 10%.

This is in part due to a decline in mean weight by five out of the eleven most commonly caught species, and partly due to a change in species composition of the catch. Smaller fishes, such as pomfrets and walu, are becoming more common while larger fishes, such as opah and striped marlin, make up a lesser proportion of the total catch (Figure 202A). Because more small fish, and more small fish species are caught, the productivity of the fishery (WPUE) declined by 53% since 2000, but the shift in area and seasonality of fishing effort helped maintain productivity in the fishery (Figure 202C).

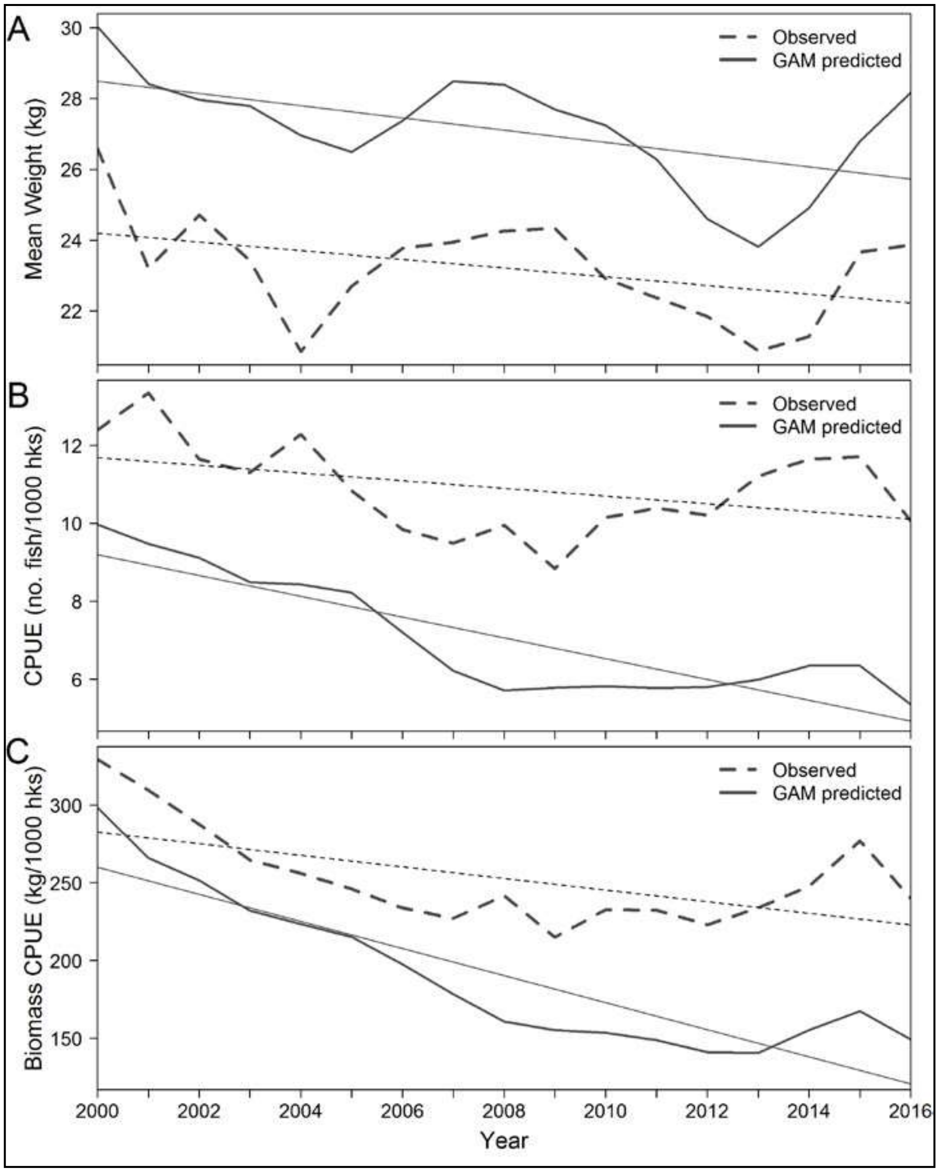


Figure 202. Mean weight (A), catch per unit effort (B), and weight per unit effort (WPUE) for all fish in the Hawaii-based longline fishery from dealer provided data.

Note: The dashed lines show the annual values from the dealer data with a linear trend line, and the solid line shows the GAM predicted annual values with linear trend lines.

CPUE has increased slowly since 2008, but when accounting for the increase in effort and geographic shift of the fishery, CPUE has remained stable. The recent peaks in both CPUE and WPUE are largely due to a strong recruitment pulse of bigeye tuna entering the fishery in the third quarter of 2013. This recruitment pulse in the fishery can be followed through 2016, where it provides an increase in first CPUE then WPUE. A recruitment index could be generated for bigeye tuna that provides a forecast of fishery performance. A peak in small bigeye tuna (<=15kg) is an indication that there will be an increase in CPUE and WPUE in the following two years (Figure 203).

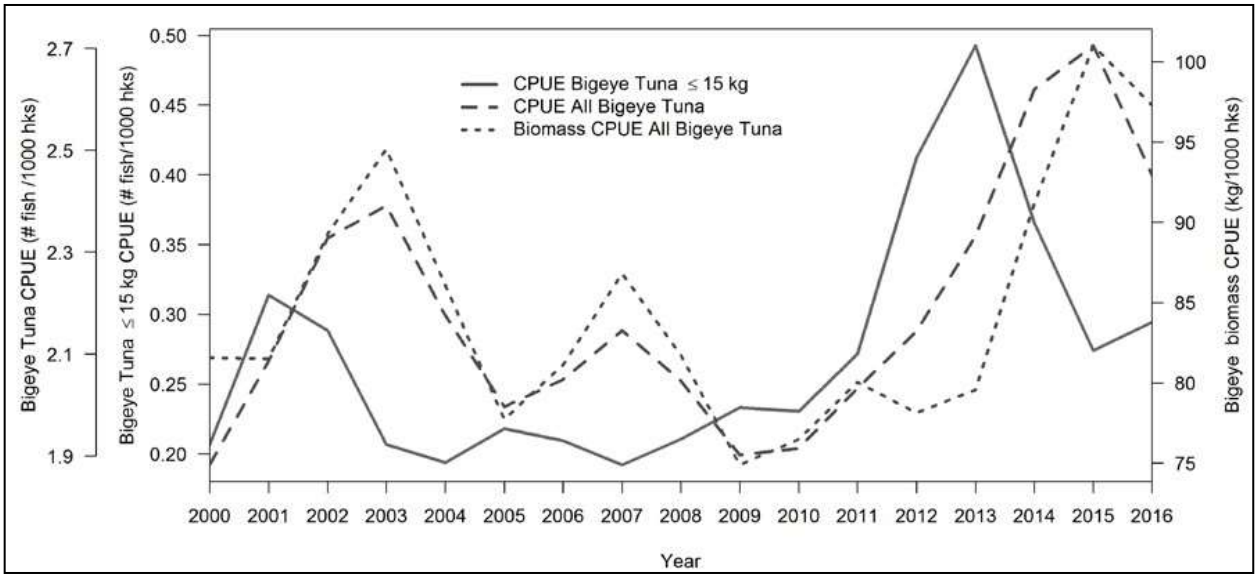


Figure 203. Temporally- and spatially-adjusted annual catch per 1000 hooks

Note: (CPUE; dashed line), and biomass per 1000 hooks (WPUE) for all bigeye tuna and bigeye tuna 15 kg or less (solid line) from the GAM from 2000-2016.

Additional reading on the influence of environmental impacts on tuna populations can be found in Lehodey et al. (2010) and Lehodey et al. (2013).

4.3 ABSTRACTS FROM RECENT RELEVANT STUDIES

In this section, abstracts publications in 2022 and relevant to data integration are compiled. Collecting the abstracts of these articles is intended to further the goal of this section being used to guide adaptive management.

Arostegui MC, Gaube, P, Woodworth-Jefcoats PA, et al. 2022. Anticyclonic eddies aggregate pelagic predators in a subtropical gyre. Nature (2022) https://doi.org/10.1038/s41586-022-05162-6.

Ocean eddies are coherent, rotating features that can modulate pelagic ecosystems across many trophic levels. These mesoscale features, which are ubiquitous at mid-latitudes1, may increase productivity of nutrient-poor regions, accumulate prey and modulate habitat conditions in the water column. However, in nutrient-poor subtropical gyres—the largest marine biome—the role of eddies in modulating behaviour throughout the pelagic predator community remains unknown despite predictions for these gyres to expand and pelagic predators to become increasingly important for food security. Using a large-scale fishery dataset in the North Pacific Subtropical Gyre, we show a pervasive pattern of increased pelagic predator catch inside anticyclonic eddies relative to cyclones and non-eddy areas. Our results indicate that increased mesopelagic prey abundance in anticyclone cores may be attracting diverse predators, forming ecological hotspots where these predators aggregate and exhibit increased abundance. In this energetically quiescent gyre, we expect that isolated mesoscale features (and the habitat conditions in them) exhibit primacy over peripheral submesoscale dynamics in structuring the foraging opportunities of pelagic predators. Our finding that eddies influence coupling of epi- to mesopelagic communities corroborates the growing evidence that deep scattering layer organisms are vital prey for a suite of commercially important predator species and, thus, provide valuable ecosystem services.

Asner GP, Vaughn NR, Martin RE, Foo SA, Heckler J, Neilson BJ, Gove JM. 2022. Mapped coral mortality and refugia in an archipelago-scale marine heat wave. Proceedings of the National Academy of Sciences. 119(19) https://doi.org/10.1073/pnas.2123331119.

Corals are a major habitat-building life-form on tropical reefs that support a quarter of all species in the ocean and provide ecosystem services to millions of people. Marine heat waves continue to threaten and shape reef ecosystems by killing individual coral colonies and reducing their diversity. However, marine heat waves are spatially and temporally heterogeneous, and so too are the environmental and biological factors mediating coral resilience during and following thermal events. This combination results in highly variable outcomes at both the coral bleaching and mortality stages of every event. This, in turn, impedes the assessment of changing reef-scale patterns of thermal tolerance or places of resistance known as reef refugia. We developed a large-scale, high-resolution coral mortality monitoring capability based on airborne imaging spectroscopy and applied it to a major marine heat wave in the Hawaiian Islands. While water depth and thermal stress strongly mediated coral mortality, relative coral loss was also inversely correlated with preheat-wave coral cover, suggesting the existence of coral refugia. Subsequent mapping analyses indicated that potential reef refugia underwent up to 40% lower coral mortality compared with neighboring reefs, despite similar thermal stress. A combination of human and environmental factors, particularly coastal development and sedimentation levels, differentiated resilient reefs from other more vulnerable reefs. Our findings highlight the role that coral mortality mapping, rather than bleaching monitoring, can play for targeted conservation that protects more surviving corals in our changing climate.

Boland RC, Hyrenbach KD, DeMartini EE, Parrish FA, Rooney JJ. 2022. Quantifying mesophotic fish assemblages of Hawai`i`s Au`au channel: associations with benthic habitats and depth. Frontiers in Marine Science. Volume 8:1990. https://doi.org/10.3389/fmars.2021.785308.

Mesophotic reefs (30–150 m) occur in the tropics and subtropics at depths beyond most scientific diving, thereby making conventional surveys challenging. Towed cameras, submersibles, and mixed-gas divers were used to survey the mesophotic reef fish assemblages and benthic substrates of the Au‘au Channel, between the Hawaiian Islands of Maui and Lāna‘i. Non-parametric multivariate analysis: Non-metric Multidimensional Scaling (NMDS), Hierarchical Cluster Analysis (HCA), Multi-Response Permutation Procedure (MRPP), and Indicator Species Analysis (ISA) were used to determine the association of mesophotic reef fish species with benthic substrates and depth. Between 53 and 115-m depths, 82 species and 10 genera of fish were observed together with 10 types of benthic substrate. Eight species of fish (*Apolemichthys arcuatus*, *Centropyge potteri*, *Chaetodon kleinii*, *Chromis leucura*, *Chromis verater*, *Forcipiger* sp., *Naso hexacanthus*, and *Parupeneus multifasciatus*) were positively associated with increasing depth, *Leptoseris* sp. coral cover, and hard-bottom cover, and one species (*Oxycheilinus bimaculatus*) of fish was positively associated with increasing *Halimeda* sp. algae cover. Fish assemblages associated with rubble were not significantly different from those associated with sand, *Montipora* coral beds and *Leptoseris* coral beds, but were distinct from fish assemblages associated with hard bottom. The patterns in the data suggested two depth assemblages, one “upper mesophotic” between 53 and 95 m and the other deeper, possibly part of a “lower mesophotic” assemblage between 96 and 115 m at the edge of the rariphotic and bottomfish complex.

Domokos R. 2022. Seamount effects on micronekton at a subtropical central Pacific seamount. Deep Sea Research Part I: Oceanographic Research Papers, Volume 186: 103829. https://doi.org/10.1016/j.dsr.2022.103829.

Seamounts are globally ubiquitous features with potential for increased biodiversity and biomass, including those of economically important fish. Although their ecological and economical importance is well known, the mechanisms for supporting seamount-associated communities are not well understood. In this study, the effects of an intermediate depth seamount (Cross Seamount) on the micronekton communities, forage for economically important bigeye tuna, are investigated. Relative biomass and composition estimates were calculated from multi-frequency active acoustic data from surveys over 3 years. Mean micronekton biomass was significantly higher than in the ambient environment and its composition differed over the flanks and plateau of Cross Seamount. The effects of the seamount extended ~3.5 km away from the plateau's edge, possibly further below 400 m depth at the flanks. Micronekton occupied the water column from the surface to the 400 m deep plateau with dense aggregations immediately over the bottom at night. During the day, these micronekton migrated both horizontally and downward, occupying depths of 500–700 m, preferably along the upstream flank of the seamount. Descending micronekton from near-surface waters appeared to be temporarily blocked by the topography before swimming below the plateau at the flanks. Mechanisms supporting the increase in micronekton biomass are uncertain, although hydrographic data support topographic trapping of zooplankton and the existence of transient or semi-permanent Taylor caps.

Giddens J, Kobayashi DR, Mukai GNM, Asher J, Birkeland C, Fitchett M, Hixon MA, Hutchinson M, Mundy BC, O'Malley JM, Sabater M Scott M, Stahl J, Toonen R, Trianni

M, Woodworth-Jefcoats PA, Wren JLK, Nelson M. 2022. Assessing the vulnerability of marine life to climate change in the Pacific Islands region. PLoS One,17(7):e0270930. https://doi.org/10.1371/journal.pone.0270930.

Our changing climate poses growing challenges for effective management of marine life, ocean ecosystems, and human communities. Which species are most vulnerable to climate change, and where should management focus efforts to reduce these risks? To address these questions, the National Oceanic and Atmospheric Administration (NOAA) Fisheries Climate Science Strategy called for vulnerability assessments in each of NOAA's ocean regions. The Pacific Islands Vulnerability Assessment (PIVA) project assessed the susceptibility of 83 marine species to the impacts of climate change projected to 2055. In a standard Rapid Vulnerability Assessment framework, this project applied expert knowledge, literature review, and climate projection models to synthesize the best available science towards answering these questions. Here we: (1) provide a relative climate vulnerability ranking across species; (2) identify key attributes and factors that drive vulnerability; and (3) identify critical data gaps in understanding climate change impacts to marine life. The invertebrate group was ranked most vulnerable and pelagic and coastal groups not associated with coral reefs were ranked least vulnerable. Sea surface temperature, ocean acidification, and oxygen concentration were the main exposure drivers of vulnerability. Early Life History Survival and Settlement Requirements was the most data deficient of the sensitivity attributes considered in the assessment. The sensitivity of many coral reef fishes ranged between Low and Moderate, which is likely underestimated given that reef species depend on a biogenic habitat that is extremely threatened by climate change. The standard assessment methodology originally developed in the Northeast US, did not capture the additional complexity of the Pacific region, such as the diversity, varied horizontal and vertical distributions, extent of coral reef habitats, the degree of dependence on vulnerable habitat, and wide range of taxa, including data-poor species. Within these limitations, this project identified research needs to sustain marine life in a changing climate.

Gulland FMD, Baker JD, Howe M, LaBrecque E, Leach L, Moore SE, Reeves RR, Thomas PO. 2022. A review of climate change effects on marine mammals in United States waters: Past predictions, observed impacts, current research and conservation imperatives. Climate Change Ecology. Volume 3: 100054. https://doi.org/10.1016/j.ecochg.2022.100054.

We consider the current evidence of climate change effects on marine mammals that occur in U.S. waters relative to past predictions. Compelling cases of such effects have been documented, though few studies have confirmed population-level impacts on abundance or vital rates. While many of the observed effects had been predicted, some unforeseen and relatively acute consequences have also been documented. Effects often occur when climate-induced alterations are superimposed upon marine mammals' ecological (e.g., predator-prey) relationships or coincident human activities. As they were unanticipated, some of the unpredicted effects of climate change have strained the ability of existing conservation and management systems to respond effectively. The literature is replete with cases suggestive of climate change impacts on marine mammals, but which remain unconfirmed. This uncertainty is partially explained by insufficient research and monitoring designed to reveal the connections. Detecting and mitigating the impacts of climate change will require some realignment of research and monitoring priorities, coupled with rapid and flexible management that includes both conventional and novel conservation interventions.

Hall R, Parke M. 2022. PIFSC-PIRO ecosystem-based fisheries management workshop April 6-7, 2021 final report. Pacific Islands Fisheries Science Center, PIFSC Administrative Report, H-22-02, 42 p. https://doi.org/10.25923/5f6x-sk11.

NOAA Fisheries strives to maintain and build productive and sustainable fisheries and healthy marine and aquatic ecosystems, as well as to protect threatened and endangered species, through use of an ecosystem-based approach to science and management. To further our goal of implementing ecosystem-based fisheries management (EBFM) in the Pacific Islands region, NOAA Fisheries Pacific Islands Fisheries Science Center (PIFSC) and Pacific Islands Regional Office (PIRO) held an EBFM Workshop on April 6 & 7, 2021.

Huntington B, Vargas-Angel B, Couch CS, Barkley HC, Abecassis M. 2022. Oceanic productivity and high-frequency temperature variability -not human habitation- supports calcifier abundance on central Pacific coral reefs. Frontiers in Marine Science. 9:1075972. https://doi.org/10.3389/fmars.2022.1075972.

Past research has demonstrated how local-scale human impacts—including reduced water quality, overfishing, and eutrophication—adversely affect coral reefs. More recently, global-scale shifts in ocean conditions arising from climate change have been shown to impact coral reefs. Here, we surveyed benthic reef communities at 34 U.S.-affiliated Pacific islands spanning a gradient of oceanic productivity, temperature, and human habitation. We re-evaluated patterns reported for these islands from the early 2000s in which uninhabited reefs were dominated by calcifiers (coral and crustose coralline algae) and thought to be more resilient to global change. Using contemporary data collected nearly two decades later, our analyses indicate this projection was not realized. Calcifiers are no longer the dominant benthic group at uninhabited islands. Calcifier coverage now averages 26.9% ± 3.9 SE on uninhabited islands (compared to 45.18% in the early 2000s). We then asked whether oceanic productivity, past sea surface temperatures (SST), or acute heat stress supersede the impacts of human habitation on benthic cover. Indeed, we found variation in benthic cover was best explained not by human population densities, but by remotely sensed metrics of chlorophyll-*a*, SST, and island-scale estimates of herbivorous fish biomass. Specifically, higher coral and CCA cover was observed in more productive waters with greater biomass of herbivores, while turf cover increased with daily SST variability and reduced herbivore biomass. Interestingly, coral cover was positively correlated with daily variation in SST but negatively correlated with monthly variation. Surprisingly, metrics of acute heat stress were not correlated with benthic cover. Our results reveal that human habitation is no longer a primary correlate of calcifier cover on central Pacific island reefs, and highlight the addition of oceanic productivity and high-frequency SST variability to the list of factors supporting reef builder abundance.

Huntington B, Weible R, Halperin A, et al. 2022. Early successional trajectory of benthic community in an uninhabited reef system three years after mass coral bleaching. Coral Reefs (2022) https://doi.org/10.1007/s00338-022-02246-7.

Severe thermal stress events occurring on the backdrop of globally warming oceans can result in mass coral mortality. Tracking the ability of a reef community to return to pre-disturbance composition is important to inform the likelihood of recovery or the need for active management to conserve these ecosystems. Here, we quantified annual, temporal changes in the benthic communities for the three years following mass coral mortality at Jarvis Island—an uninhabited island in the Pacific Remote Islands Marine National Monument. While Jarvis experienced catastrophic coral mortality in 2015 due to heat stress resulting from the 2015/16 El Niño, significant annual shifts were documented in the benthic community in the three years post-disturbance. Macroalgal and turf dominance of the benthos was temporary—likely reflecting the high biomass of herbivorous reef fishes post-bleaching—giving way to calcifiers such as crustose coralline algae and *Halimeda*, which may facilitate rather than impede coral recovery. By 2018, indications of recovery were detectable in the coral community itself as juvenile densities increased and stress-tolerant genera, such as *Pavona*, exceeded their pre-disturbance densities. However, densities of *Montipora* and *Pocillopora* remain low, suggesting recovery will be slow for these formerly dominant taxa. Collectively, the assemblage and taxon-specific shifts observed in the benthic and coral community support cautious optimism for the potential recovery of Jarvis Island's coral reefs to their pre-disturbance state. Continued monitoring will be essential to assess whether reassembly is achieved before further climate-related disturbance events affect this reef system.

Iwane M, Hospital J. 2022. Hawai'i fishing communities' vulnerability to climate change: Climate vulnerable species and adaptive capacity. U.S. Dept. of Commerce, NOAA Technical Memorandum NOAA-TM-NMFS-PIFSC-136, 34 p. https://doi.org/10.25923/4vvb-pv29.

In this report, we propose a framework that could be useful to select candidate communities from the main Hawaiian Islands for future qualitative research on the vulnerability of fishing communities to climate change. We adopted the IPCC framework (2001) that defines climate change vulnerability as a function of sensitivity (S), exposure (E), and adaptive capacity (AC). We tested and finalized community selection criteria based on available quantitative data and CSVIs relevant to MHI communities' social and climate change vulnerability.

Kinney MJ, Carvalho F, Kai M, Semba Y, Liu KM, Tsai WP, Leonardo CGJ, Horacio HA, Daniel CCL, Teo SLH. 2022. Cluster analysis used to re-examine fleet definitions of North Pacific fisheries with spatiotemporal consideration of blue shark size and sex data. Pacific Islands Fisheries Science Center, PIFSC Working Paper, WP-22-001, 18 p. https://doi.org/10.25923/zet2-sk13.

This study looked at re-examining the North Pacific fleets that have been used for previous assessments of blue shark by investigating the size and sex composition data from observer records, port and scientific samples in greater detail. Our goal is to provide information that can be used by the ISC shark working group to more appropriately define fleet structure for the assessment based on size and sexual composition of the catch. Ultimately, refining fleet structure within the model with greater consideration for the spatiotemporal characteristics of blue shark catch may help reduce model misspecification in future assessments. We analyzed nearly 600,000 individual records of blue shark size and sex information divided across 240 5 x 5° grid cells covering the North Pacific. A clustering approach was taken to discern areas with related size and sex compositions. Results suggested four distinct clusters, where Clusters 1 and 4 (made up primarily of smaller immature animals) predominate in the catch at higher latitudes (north of ~25°N), especially in the eastern and western edges of the North Pacific (waters nearer the coasts). While Cluster 2 (mature males and females) and Cluster 3 (mostly males, both mature and immature) predominate in a band from ~ 20°N to near the equator. During fall and winter (seasons 1 and 4) this band of mature animals expands north in central Pacific waters, loosely around Hawaii, as high up as ~40°N. We suggest that this work, along with several other studies carried out by various members of the ISC shark working group over the years, be used to better define the fleets used in future assessments of blue sharks in the North Pacific

Kleiber D, Iwane M, Kamikawa K, Leong K, Hospital J. 2022. Pacific Islands Region Fisheries and COVID-19: Impacts and adaptations. U.S. Dept. of Commerce, NOAA Technical Memorandum NOAA-TM-NMFS-PIFSC-130, 36 p. https://doi.org/10.25923/2fpm-c128.

The Pacific Islands Region has experienced a number of unique risks from COVID-19, and the measures put in place to stop its spread. In this report, we detail the impacts of COVID-19 on the Pacific Islands Region fisheries from March 2020 to February 2021, and highlight the adaptations made by the diverse fishers, marketers, and fishing communities of this region. We gathered information from different sources, including publicly available statistics, news reports, government rules, as well as short open-ended phone interviews.

Lisi P, Hogan J.D, Holt G, Moody K, Wren J, Kobayashi D, Blum M, McIntyre P. 2022. Stream and ocean hydrodynamics mediate partial migration strategies in an amphidromous Hawaiian goby. Ecology, e3800. https://doi.org/10.1002/ecy.3800.

Partial migration strategies, in which some individuals migrate but others do not, are widely observed in populations of migratory animals. Such patterns could arise via variation in migratory behaviors made by individual animals, via genetic variation in migratory predisposition, or simply by variation in migration opportunities mediated by environmental conditions. Here we use spatiotemporal variation in partial migration across populations of an amphidromous Hawaiian goby to test whether stream or ocean conditions favor completing its life cycle entirely within freshwater streams rather than undergoing an oceanic larval migration. Across 35 watersheds, microchemical analysis of otoliths revealed that most adult *Awaous stamineus* were freshwater residents (62% of n = 316 in 2009, 83% of n = 274 in 2011), but we found considerable variation among watersheds. We then tested the hypothesis that the prevalence of freshwater residency increases with the stability of stream flows and decreases with the availability of dispersal pathways arising from ocean hydrodynamics. We found that streams with low variation of daily discharge were home to a higher incidence of freshwater residents in each survey year. The magnitude of the shift in freshwater residency between survey years was positively associated with predicted interannual variability in the success of larval settlement in streams on each island based on passive drift in ocean currents. We built on these findings by developing a theoretical model of goby life history to further evaluate whether mediation of migration outcomes by stream and ocean hydrodynamics could be sufficient to explain the range of partial migration frequency observed across populations. The model illustrates that the proportion of larvae entering the ocean and differential survival of freshwater-resident versus ocean-going larvae are plausible mechanisms for range-wide shifts in migration strategies. Thus, we propose that hydrologic variation in both ocean and stream environments contributes to spatiotemporal variation in the prevalence of migration phenotypes in *A. stamineus*. Our empirical and theoretical results suggest that the capacity for partial migration could enhance the persistence of metapopulations of diadromous fish when confronted with variable ocean and stream conditions.

Mazur MD, Tanaka KR, Shank B, Chang J, Hodgson CT, Reardon KM, Friedland KD, Chen Y. 2022. Incorporating spatial heterogeneity and environmental impacts into stock-

recruitment relationships for Gulf of Maine lobster. ICES Journal of Marine Science.0:1-11. https://doi.org/10.1093/icesjms/fsab266.

Functional stock-recruitment relationships (SRRs) are often difficult to quantify and can differ over space. Additionally, climate change adds to the complexity of recruitment dynamics. This paper's aim was to incorporate spatial heterogeneity and environmental effects on productivity in SRRs with American lobster in the Gulf of Maine (GOM) as a case study. GOM lobster recruitment has substantially increased since the mid-2000s, due to improved survival rates of pre-recruits and increased spawning stock biomass (SSB). GOM bottom water temperatures have increased at a rate of 0.2ºC per decade, which caused lobster settlement area to expand and improved survival rates. We first estimated local SSB using bottom trawl survey data and a geostatistical model. Using estimated SSB, recruitment data from a ventless trap survey, and an interpolated bottom water temperature field, we developed modified Ricker stock-recruitment models accounting for spatial heterogeneity and temperature impacts with varying coefficient generalized additive models. Results showed that temperature significantly impacted recruitment. Changes in temperature mediated productivity differed between the eastern and western GOM. Our study demonstrated that the incorporation of spatial heterogeneity and environmental effects impacts our understanding of SRRs. These methods can be applied to other species to understand recruitment dynamics influenced by climate change.

Panelo J, Wiegner TN, Colbert SL, Goldberg S, Abaya LM, Conklin E, Couch C, Falinski K, Gove J, Watson L, Wiggins C. 2022. Spatial distribution and sources of nutrients at two coastal developments in South Kohala, Hawai'i. Marine Pollution Bulletin. Volume 174:113143. https://doi.org/10.1016/j.marpolbul.2021.113143.

Nutrient sources to coastal waters with coral reefs are not well-characterized. This study documented spatial distributions of nutrients within coastal waters along two developments with coral reefs, and identified nutrient sources through nutrient mixing plots, $\delta^{15}N$ measurements in macroalgal tissue, and NO_3^- stable isotope mixing models. Nutrients decreased from fresh groundwaters to offshore waters, with some surface waters higher in concentrations than benthic ones. Conservative and non-conservative mixing between fresh and ocean waters occurred, the latter suggestive of local nutrient sources and biological removal. $\delta^{15}N$ in macroalgal tissue and NO_3^- concurred that fresh groundwater, ocean water, and fertilizers were dominant nutrient sources. Benthic salinity and $NO_3^- + NO_2^-$ concentrations illustrated that submarine groundwater discharge delivered nutrients to reefs in pulses ranging from minutes to days. Information generated from this study is imperative for developing management actions to improve water quality and make coral reefs more resilient to stressors.

Smith J, Halperin A, Barkley H. 2022. A 'perfect storm' of cumulative and acute heat stress, and a warming trend, lead to bleaching events in Tutuila, American Samoa. U.S. Dept. of Commerce, NOAA Technical Memorandum NOAA-TM-NMFS-PIFSC-129, 52 p. https://doi.org/10.25923/yphg-pq04.

To better understand vertical thermal structure of reefs at depth and identify predictors of mass bleaching events using high frequency time series data, we used long-term (2012–2018) in situ temperature data collected at multiple reefs and depths around the island of Tutuila in American Samoa. Located in the central South Pacific, Tutuila is 1 of 5 volcanic islands and 2 atolls that comprise American Samoa. Lying just a few kilometers from shore, Tutuila contains shallow fringing reefs and a deep offshore bank (Birkeland et al. 2008). American Samoa experienced severe bleaching in 1994, 2003, 2015 and 2017 (Coward et al. 2020). The objectives of our study are to (1) conduct a time series analysis on in situ temperature data (2012–2018) and calculate heating metrics and (2) determine whether heating metrics predicted coral bleaching prevalence during the 2015 bleaching event.

Tanaka KR, Schmidt AL, Kindinger TL, Whitney JL, Samson JC. 2022. Spatiotemporal assessment of *Aprion virescens* density in shallow main Hawaiian Islands waters, 2010-2019. U.S. Dept. of Commerce, NOAA Technical Memorandum NOAA-TM-NMFS-PIFSC-132, 33 p. https://doi.org/10.25923/f24q-k056.

The Magnuson-Stevens Fishery Conservation and Management Act of 1996 directs regional fishery management councils and the National Marine Fisheries Service (NMFS) to identify and describe "essential fish habitat (EFH)" for all federally managed species to ensure conservation and sustainable management of living marine resources. This report summarizes the statistically-derived density patterns of *Aprion virescens* in shallow coastal waters of the main Hawaiian Islands (MHIs) from 2010 to 2019.

Tanaka KR, Van Houtan KS. 2022. The recent normalization of historical marine heat extremes. PLOS Climate. 1(2): e0000007. https://doi.org/10.1371/journal.pclm.0000007.

Climate change exposes marine ecosystems to extreme conditions with increasing frequency. Capitalizing on the global reconstruction of sea surface temperature (SST) records from 1870-present, we present a centennial-scale index of extreme marine heat within a coherent and comparable statistical framework. A spatially ($1° \times 1°$) and temporally (monthly) resolved index of the normalized historical extreme marine heat events was expressed as a fraction of a year that exceeds a locally determined, monthly varying 98th percentile of SST gradients derived from the first 50 years of climatological records (1870–1919). For the year 2019, our index reports that 57% of the global ocean surface recorded extreme heat, which was comparatively rare (approximately 2%) during the period of the second industrial revolution. Significant increases in the extent of extreme marine events over the past century resulted in many local climates to have shifted out of their historical SST bounds across many economically and ecologically important marine regions. For the global ocean, 2014 was the first year to exceed the 50% threshold of extreme heat thereby becoming "normal", with the South Atlantic (1998) and Indian (2007) basins crossing this barrier earlier. By focusing on heat extremes, we provide an alternative framework that may help better contextualize the dramatic changes currently occurring in marine systems.

Winston M, Oliver T, Couch C, Donovan MK, Asner GP, et al. 2022. Coral taxonomy and local stressors drive bleaching prevalence across the Hawaiian Archipelago in 2019. PLOS ONE 17(9): e0269068. https://doi.org/10.1371/journal.pone.0269068.

The Hawaiian Archipelago experienced a moderate bleaching event in 2019—the third major bleaching event over a 6-year period to impact the islands. In response, the Hawaiʻi Coral Bleaching Collaborative (HCBC) conducted 2,177 coral bleaching surveys across the Hawaiian Archipelago. The HCBC was established to coordinate bleaching monitoring efforts across the state between academic institutions, non-governmental organizations, and governmental agencies to facilitate data sharing and provide management recommendations. In 2019, the goals of this unique partnership were to: 1) assess the spatial and temporal patterns of thermal stress; 2) examine taxa-level patterns in bleaching susceptibility; 3) quantify spatial variation in bleaching extent; 4) compare 2019 patterns to those of prior bleaching events; 5) identify predictors of bleaching in 2019; and 6) explore site-specific management strategies to mitigate future bleaching events. Both acute thermal stress and bleaching in 2019 were less severe overall compared to the last major marine heatwave events in 2014 and 2015. Bleaching observed was highly site- and taxon-specific, driven by the susceptibility of remaining coral assemblages whose structure was likely shaped by previous bleaching and subsequent mortality. A suite of environmental and anthropogenic predictors was significantly correlated with observed bleaching in 2019. Acute environmental stressors, such as temperature and surface light, were equally important as previous conditions (e.g. historical thermal stress and historical bleaching) in accounting for variation in bleaching during the 2019 event. We found little evidence for acclimation by reefs to thermal stress in the main Hawaiian Islands. Moreover, our findings illustrate how detrimental effects of local anthropogenic stressors, such as tourism and urban run-off, may be exacerbated under high thermal stress. In light of the forecasted increase in severity and frequency of bleaching events, future mitigation of both local and global stressors is a high priority for the future of corals in Hawai‘i.

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APPENDIX A: SUPPORTING DATA TABLES FOR FIGURES IN CHAPTER 2 AND SECTION 3.1

Table **Page**

TABLES FOR SECTION 2.1: AMERICAN SAMOA

Table A-1. Summary of creel survey boat-based sampling effort

Year	Sample Days	Trolling Interviews	Troll Trips Sampled	Expanded # of Trips	Percent of Trolling Trips Surveyed
2013	259	73	73	119	61.3
2014	237	97	111	124	89.5
2015	220	51	53	103	51.5
2016	196	44	44	77	57.1
2017	199	41	43	132	32.6
2018	207	59	59	162	36.4
2019	211	49	49	116	42.2
2020	228	43	43	79	54.4
2021	201	26	26	86	30.2
2022	164	15	15	50	30.0

Table A-2. Supporting Data for Figure 2

Year	Boats Landing Pelagics (All Methods)	Boats Landing Pelagics (Longline)	Boats Landing Pelagics (Troll)
2013	44	22	13
2014	52	23	22
2015	40	21	10
2016	38	20	12
2017	27	15	8
2018	25	14	7
2019	29	18	5
2020	22	11	8
2021	19	12	5
2022	20	11	9
Average	**32**	**17**	**10**
Standard Deviation	**11**	**5**	**5**

Table A-3. Supporting Data for Figure 3

Year	**Troll Trips**	**Longline Sets**
2013	162	3,411
2014	145	2,748
2015	162	2,786
2016	118	2,451
2017	159	2,488
2018	191	2,213
2019	137	1,882
2020	128	1,322
2021	101	1,552
2022	50	1,219
Average	**135**	**2,207**
Standard Deviation	**39**	**708**

Table A-4. Supporting Data for Figure 4

Year	**Total Pounds Landed - Tuna**	**Total Pounds Landed - Non-Tuna PMUS**
2013	5,855,624	295,415
2014	4,908,415	251,065
2015	5,401,420	231,205
2016	4,601,298	217,186
2017	4,851,383	269,547
2018	4,279,765	184,972
2019	2,965,882	134,912
2020	1,887,156	126,679
2021	2,512,481	133,642
2022	2,822,445	158,037
Average	**4,008,587**	**200,266**
Standard Deviation	**1,355,210**	**61,300**

Table A-5. Supporting Data for Figure 5

Year	**Commercial Landings (lb) - Tuna**	**Commercial Landings (lb) - Non-Tuna PMUS**
2013	5,783,775	188,237
2014	4,895,560	139,857
2015	5,380,023	116,355
2016	4,593,671	96,634
2017	4,842,676	104,657
2018	4,273,435	63,636
2019	2,962,774	38,782
2020	1,883,833	37,492
2021	2,509,499	34,080
2022	2,820,772	24,110
Average	**3,994,602**	**84,384**
Standard Deviation	**1,341,290**	**54,076**

Table A-6. Supporting Data for Figure 6

Year	**Estimated Yellowfin Longline Landings (lb)**	**Estimated Yellowfin Trolling Landings (lb)**
2013	808,271	7,354
2014	1,067,483	7,687
2015	1,003,907	4,189
2016	848,926	8,482
2017	1,233,124	14,367
2018	575,768	8,242
2019	417,262	2,476
2020	490,527	3,385
2021	470,931	4,097
2022	326,301	19
Average	**724,250**	**6,030**
Standard Deviation	**311,095**	**4,052**

Table A-7. Supporting Data for Figure 7

Year	Estimated Skipjack Longline Landings (lb)	Estimated Skipjack Trolling Landings (lb)
2013	161,136	8,753
2014	286,397	15,448
2015	250,832	7,610
2016	210,451	8,661
2017	155,788	6,842
2018	168,457	7,317
2019	151,372	10,189
2020	139,867	6,194
2021	116,265	12,853
2022	84,974	3,734
Average	**172,554**	**8,760**
Standard Deviation	**60,835**	**3,374**

Table A-8. Supporting Data for Figure 8

Year	Estimated Wahoo Longline Landings (lb)	Estimated Wahoo Trolling Landings (lb)
2013	149,619	1,144
2014	122,384	1,241
2015	121,750	567
2016	101,693	1,742
2017	110,322	981
2018	67,510	676
2019	40,231	447
2020	39,577	93
2021	35,913	271
2022	25,826	0
Average	**81,483**	**716**
Standard Deviation	**44,727**	**555**

Table A-9. Supporting Data for Figure 9

Year	Estimated Mahimahi Longline Landings (lb)	Estimated Mahimahi Trolling Landings (lb)
2013	39,140	310
2014	23,037	2,344
2015	11,822	430
2016	8,969	1,008
2017	30,883	1,678
2018	10,007	792
2019	4,163	557
2020	10,494	949
2021	1,819	521
2022	12,247	578
Average	**15,258**	**917**
Standard Deviation	**11,969**	**637**

Table A-10. Supporting Data for Figure 10

Year	Blue Marlin Longline Landings (lb)	Blue Marlin Trolling Landings (lb)
2013	60,795	0
2014	55,941	731
2015	55,836	1,561
2016	66,073	395
2017	87,684	847
2018	70,536	1,009
2019	64,672	657
2020	62,800	0
2021	76,001	0
2022	104,196	0
Average	**70,453**	**520**
Standard Deviation	**15,257**	**536**

Table A-11. Supporting Data for Figure 11

Year	Sailfish Longline Landings (lb)	Sailfish Trolling Landings (lb)
2013	3,546	0
2014	3,616	25
2015	5,106	57
2016	5,106	0
2017	3,262	0
2018	1,702	0
2019	4,184	143
2020	1,276	270
2021	1,915	0
2022	1,418	48
Average	**3,113**	**54**
Standard Deviation	**1,462**	**88**

Table A-12. Supporting Data for Figure 13

Year	Longline Hooks Set
2013	10,184
2014	7,667
2015	7,806
2016	6,909
2017	7,009
2018	6,010
2019	5,104
2020	3,646
2021	4,474
2022	3,613
Average	**6,242**
Standard Deviation	**2,086**

Table A-13. Supporting Data for Figure 14

Year	Bigeye Tuna Longline Landings (lb)
2013	191,554
2014	210,869
2015	183,849
2016	155,842
2017	139,424
2018	117,516
2019	68,305
2020	51,213
2021	65,789
2022	41,818
Average	**122,618**
Standard Deviation	**62,813**

Table A-14. Supporting Data for Figure 15

Year	Albacore Longline Landings (lb)
2013	4,673,320
2014	3,313,856
2015	3,937,366
2016	3,367,685
2017	3,296,463
2018	3,400,628
2019	2,315,559
2020	1,195,281
2021	1,842,039
2022	2,365,584
Average	**2,970,778**
Standard Deviation	**1,033,926**

Table A-15. Supporting Data for Figure 16

Year	Swordfish Longline Landings (lb)
2013	20,474
2014	17,736
2015	14,615
2016	12,194
2017	13,438
2018	13,561
2019	8,210
2020	5,529
2021	6,127
2022	5,669
Average	**11,755**
Standard Deviation	**5,231**

Table A-16. Supporting Data for Figure 17

Year	Releases - Tunas	Releases - Non-Tuna PMUS	Releases - Other Pelagics	Releases - Sharks
2013	1,095	11,838	936	3,878
2014	846	6,762	342	5,067
2015	1,722	8,025	156	6,043
2016	996	5,116	33	5,131
2017	767	3,170	49	4,282
2018	910	2,120	5	4,642
2019	962	1,893	16	3,234
2020	727	1,541	27	2,077
2021	577	1,544	4	2,718
2022	467	861	1	1,316
Average	**907**	**4,287**	**157**	**3,839**
Standard Deviation	**345**	**3,594**	**294**	**1,490**

Table A-17. Supporting Data for Figure 18

Year	Alia Catch (Individuals) per 1,000 Hooks	Monohull Catch (Individuals) per 1,000 Hooks
2013	n.d.	11.7
2014	n.d.	10.6
2015	n.d.	12.7
2016	n.d.	11.9
2017	n.d.	11.6
2018	n.d.	13.5
2019	n.d.	11.3
2020	n.d.	8.5
2021	n.d.	9.3
2022	n.d.	14.6
Average	**n.d.**	**11.6**
Standard Deviation	**n.d.**	**1.8**

Table A-18. Supporting Data for Figure 19

Year	Troll Catch (lb) Per Hour	Effective Troll Hours
2013	28	845
2014	32	930
2015	18	980
2016	45	553
2017	16	1,918
2018	19	1,104
2019	25	653
2020	22	574
2021	33	561
2022	22	205
Average	**26**	**832**
Standard Deviation	**9**	**463**

Table A-19. Supporting Data for Figure 20

Year	Troll Catch Rate (lb/hr) - Skipjack	Troll Catch Rate (lb/hr) - Yellowfin
2013	13.33	11.59
2014	17.97	8.72
2015	8.08	5.79
2016	17.90	17.58
2017	4.00	8.12
2018	6.75	8.11
2019	16.87	4.49
2020	12.46	6.65
2021	25.39	6.10
2022	18.16	0.09
Average	**14.09**	**7.72**
Standard Deviation	**6.47**	**4.59**

Table A-20. Supporting Data for Figure 21

Year	Troll Catch Rate (lb/hr) – Blue Marlin	Troll Catch Rate (lb/hr) - Mahimahi	Troll Catch Rate (lb/hr) - Wahoo
2013		0.46	1.81
2014	0.51	2.87	1.06
2015	2.52	0.47	0.39
2016	1.10	1.94	4.31
2017	0.53	0.91	0.28
2018	1.08	0.71	0.72
2019	1.19	0.94	0.51
2020		1.43	0.05
2021		0.16	0.56
2022		2.82	
Average	**1.16**	**1.27**	**1.08**
Standard Deviation	**0.73**	**0.97**	**1.32**

TABLES FOR SECTION 2.2: COMMONWEALTH OF THE NORTHERN MARIANA ISLANDS

Table A-21. Boat-based Survey Statistics (raw data), CNMI

Year	Survey Days	Trips in Boat Log	Charter Trips	Non-Charter Trips	Total Interviews	Charter Interviews	Non-Charter Interviews
2013	72	163	2	161	149	2	147
2014	71	155	2	153	144	4	140
2015	57	110	1	109	102	1	101
2016	65	115	4	111	100	4	96
2017	66	121	7	114	109	3	106
2018	54	124	3	121	108	4	104
2019	33	65	1	64	58	4	54
2020	58	112	1	111	119	5	114
2021	69	138	0	138	129	0	129
2022	51	107	0	107	84	0	84

Table A-22. Supporting Data for Figure 22

Year	Number of Fishers Landing Pelagic Species from Commercial Receipt Invoices
2013	28
2014	21
2015	12
2016	73
2017	48
2018	56
2019	51
2020	73
2021	83
2022	92
Average	**54**
Standard Deviation	**27**

Table A-23. Supporting Data for Figure 23

Year	Number of Trips Catching Pelagic Fish from Commercial Receipt Invoices
2013	1,640
2014	1,229
2015	582
2016	1,205
2017	1,540
2018	2,204
2019	2,457
2020	1,325
2021	2,132
2022	1,789
Average	**1,610**
Standard Deviation	**561**

Table A-24. Supporting Data for Figure 24

Year	Estimated Total Troll Trips	Estimated Troll Trips - Non-Charter	Estimated Troll Trips - Charter
2013	2,492	2,434	59
2014	3,595	3,568	27
2015	2,654	2,654	0
2016	3,563	3,556	7
2017	2,599	2,599	0
2018	4,203	4,185	18
2019	3,202	3,161	41
2020	4,193	4,193	0
2021	3,072	3,072	0
2022	2,973	2,973	0
Average	**3,255**	**3,240**	**15**
Standard Deviation	**622**	**625**	**21**

Table A-25. Supporting Data for Figure 25

Year	**Estimated Troll Hours - Total**	**Estimated Troll Hours - Non-Charter**	**Estimated Troll Hours -Charter**
2013	12,658	12,413	246
2014	19,598	19,522	77
2015	14,084	14,084	0
2016	19,158	19,125	33
2017	14,498	14,498	0
2018	21,562	21,477	84
2019	16,841	16,667	175
2020	20,631	20,631	0
2021	17,460	17,460	0
2022	14,427	14,427	0
Average	**17,092**	**17,030**	**62**
Standard Deviation	**3,087**	**3,106**	**87**

Table A-26. Supporting Data for Figure 26

Year	**Estimated Troll Hours per Trip**	**Estimated Troll Hours per Trip - Non-Charter**	**Estimated Troll Hours per Trip - Charter**
2013	5.1	5.1	4.2
2014	5.5	5.5	2.9
2015	5.3	5.3	0.0
2016	5.4	5.4	4.7
2017	5.6	5.6	0.0
2018	5.1	5.1	4.7
2019	5.3	5.3	4.3
2020	4.9	4.9	0.0
2021	5.7	5.7	0.0
2022	4.9	4.9	0.0
Average	**5.3**	**5.3**	**2.1**
Standard Deviation	**0.3**	**0.3**	**2.2**

Table A-27. Supporting Data for Figure 27

Year	Estimated Total Landings (lb) - All Pelagics	Estimated Total Landings (lb) - Tuna PMUS	Estimated Total Landings (lb) - Non-Tuna PMUS
2013	341,891	273,137	62,507
2014	398,939	262,061	132,820
2015	397,551	303,201	93,167
2016	308,531	214,112	84,480
2017	340,871	280,241	57,876
2018	465,009	389,288	74,354
2019	466,269	381,645	78,218
2020	305,252	262,905	34,604
2021	388,492	336,427	39,606
2022	237,440	148,983	82,313
Average	**365,025**	**285,200**	**73,995**
Standard Deviation	**72,393**	**72,950**	**28,188**

Table A-28. Supporting Data for Figure 28

Year	Estimated Total Landings (lb) - All Pelagics	Estimated Total Landings (lb) - Non-Charter	Estimated Total Landings (lb) - Charter
2013	341,891	338,964	2,928
2014	398,939	398,418	521
2015	397,551	397,551	0
2016	308,531	307,950	581
2017	340,871	340,871	0
2018	465,009	463,410	1,598
2019	466,269	463,144	3,125
2020	305,252	305,252	0
2021	388,492	388,492	0
2022	237,440	237,440	0
Average	**365,025**	**364,149**	**875**
Standard Deviation	**72,393**	**71,797**	**1,240**

Table A-29. Supporting Data for Figure 29

Year	Estimated Landings (lb) - Tuna PMUS	Estimated Landings (lb) - Non-Charter	Estimated Landings (lb) - Charter
2013	273,137	273,137	0
2014	262,061	262,061	0
2015	303,201	303,201	0
2016	214,112	213,531	581
2017	280,241	280,241	0
2018	389,288	388,105	1,182
2019	381,645	378,904	2,741
2020	262,905	262,905	0
2021	336,427	336,427	0
2022	148,983	148,983	0
Average	**285,200**	**284,750**	**450**
Standard Deviation	**72,950**	**72,426**	**896**

Table A-30. Supporting Data for Figure 30

Year	Estimated Landings (lb) - Non-Tuna PMUS	Estimated Landings (lb) - Non-Charter	Estimated Landings (lb) - Charter
2013	62,507	59,580	2,928
2014	132,820	132,308	512
2015	93,167	93,167	0
2016	84,480	84,480	0
2017	57,876	57,876	0
2018	74,354	73,962	392
2019	78,218	78,218	0
2020	34,604	34,604	0
2021	39,606	39,606	0
2022	82,313	82,313	0
Average	**73,995**	**73,611**	**383**
Standard Deviation	**28,188**	**28,216**	**914**

Table A-31. Supporting Data for Figure 31

Year	Estimated Total Landings (lb) - Skipjack	Estimated Total Landings (lb) - Non-Charter	Estimated Total Landings (lb) - Charter
2013	248,672	248,672	0
2014	233,474	233,474	0
2015	287,173	287,173	0
2016	193,697	193,116	581
2017	235,065	235,065	0
2018	374,373	373,190	1,182
2019	345,172	342,431	2,741
2020	238,094	238,094	0
2021	307,492	307,492	0
2022	132,152	132,152	0
Average	**259,536**	**259,086**	**450**
Standard Deviation	**71,494**	**70,981**	**896**

Table A-32. Supporting Data for Figure 32

Year	Estimated Total Landings (lb) - Yellowfin	Estimated Total Landings (lb) - Non-Charter	Estimated Total Landings (lb) - Charter
2013	23,278	23,278	0
2014	23,149	23,149	0
2015	15,760	15,760	0
2016	18,535	18,535	0
2017	16,968	16,968	0
2018	11,787	11,787	0
2019	36,473	36,473	0
2020	24,756	24,756	0
2021	26,144	26,144	0
2022	14,224	14,224	0
Average	**21,107**	**21,107**	**0**
Standard Deviation	**7,228**	**7,228**	**0**

Table A-33. Supporting Data for Figure 33

Year	Estimated Total Landings (lb) - Mahimahi	Estimated Total Landings (lb) - Non-Charter	Estimated Total Landings (lb) - Charter
2013	53,907	52,934	974
2014	116,586	116,132	454
2015	88,799	88,799	0
2016	80,072	80,072	0
2017	45,099	45,099	0
2018	65,266	65,070	196
2019	71,791	71,791	0
2020	31,629	31,629	0
2021	30,264	30,264	0
2022	58,049	58,049	0
Average	**64,146**	**63,984**	**162**
Standard Deviation	**26,627**	**26,571**	**321**

Table A-34. Supporting Data for Figure 34

Year	Estimated Total Landings (lb) - Wahoo	Estimated Total Landings (lb) - Non-Charter	Estimated Total Landings (lb) - Charter
2013	7,177	5,223	1,954
2014	10,673	10,615	58
2015	4,264	4,264	0
2016	4,351	4,351	0
2017	9,811	9,811	0
2018	6,400	6,204	196
2019	2,448	2,448	0
2020	2,975	2,975	0
2021	5,343	5,343	0
2022	20,646	20,646	0
Average	**7,409**	**7,188**	**221**
Standard Deviation	**5,380**	**5,424**	**612**

Table A-35. Supporting Data for Figure 35

Year	Estimated Total Landings (lb) - Blue Marlin	Estimated Total Landings (lb) - Non-Charter	Estimated Total Landings (lb) - Charter
2013	1,347	1,347	0
2014	5,561	5,561	0
2015	0	0	0
2016	0	0	0
2017	2,966	2,966	0
2018	2,688	2,688	0
2019	3,855	3,855	0
2020	0	0	0
2021	3,020	3,020	0
2022	0	0	0
Average	**1,944**	**1,944**	**0**
Standard Deviation	**1,971**	**1,971**	**0**

Table A-36. Supporting Data for Figure 36

Year	Estimated Total Landings (lb) - All Pelagics	Estimated Total Landings (lb) - Tuna PMUS	Estimated Total Landings (lb) - Non-Tuna PMUS
2013	263,497	200,294	52,950
2014	235,104	178,712	48,467
2015	188,300	154,658	30,893
2016	223,004	199,620	17,387
2017	224,531	201,111	18,392
2018	221,714	193,130	18,294
2019	177,957	140,716	22,044
2020	152,599	133,411	14,841
2021	306,547	263,410	35,746
2022	234,128	186,018	42,818
Average	**222,738**	**185,108**	**30,183**
Standard Deviation	**43,567**	**37,275**	**14,101**

Table A-37. Supporting Data for Figure 37

Year	Commercial Purchase Landings (lb) - Skipjack	Commercial Purchase Landings (lb) - Yellowfin
2013	167,050	31,278
2014	161,798	15,102
2015	139,873	14,636
2016	178,815	18,725
2017	164,196	36,500
2018	171,856	16,345
2019	128,027	12,283
2020	119,044	14,341
2021	238,068	24,892
2022	172,080	11,217
Average	**164,081**	**19,532**
Standard Deviation	**32,904**	**8,548**

Table A-38. Supporting Data for Figure 38

Year	Commercial Purchase Landings (lb) - Mahimahi	Commercial Purchase Landings (lb) - Wahoo	Commercial Purchase Landings (lb) - Blue Marlin
2013	44,889	5,345	2,091
2014	38,095	7,262	2,547
2015	30,465	428	0
2016	12,582	1,603	2,198
2017	14,715	2,894	440
2018	16,839	943	374
2019	20,724	336	604
2020	12,627	1,114	94
2021	26,517	2,869	4,071
2022	33,112	7,356	1,638
Average	**25,057**	**3,015**	**1,406**
Standard Deviation	**11,367**	**2,710**	**1,329**

Table A-39. Supporting Data for Figure 39

Year	Troll Overall Average Catch Rate (lb/hr)	Troll Catch Rate (lb/hr) - Non-Charter	Troll Catch Rate (lb/hr) - Charter
2013	26.7	26.9	11.9
2014	20.4	20.5	6.8
2015	28.0	28.0	
2016	16.1	16.1	17.6
2017	23.5	23.5	
2018	21.5	21.5	19.0
2019	27.9	28.0	17.9
2020	14.6	14.6	
2021	22.0	22.0	
2022	15.9	15.9	
Average	**21.7**	**21.7**	**14.6**
Standard Deviation	**5.0**	**5.0**	**5.2**

Table A-40. Supporting Data for Figure 40

Year	Troll Overall Average Catch Rate (lb/hr) - Skipjack	Troll Catch Rate (lb/hr) - Non-Charter	Troll Catch Rate (lb/hr) - Charter
2013	19.6	20.0	
2014	11.9	12.0	
2015	20.4	20.4	
2016	10.1	10.1	17.6
2017	16.2	16.2	
2018	17.3	17.3	14.1
2019	20.5	20.5	15.7
2020	11.5	11.5	
2021	17.6	17.6	
2022	9.2	9.2	
Average	**15.4**	**15.5**	**15.8**
Standard Deviation	**4.4**	**4.4**	**1.8**

Table A-41. Supporting Data for Figure 41

Year	Troll Overall Average Catch Rate (lb/hr) - Yellowfin	Troll Catch Rate (lb/hr) - Non-Charter	Troll Catch Rate (lb/hr) - Charter
2013	1.8	1.9	
2014	1.2	1.2	
2015	1.1	1.1	
2016	0.9	0.9	
2017	1.2	1.2	
2018	0.5	0.5	
2019	2.2	2.2	
2020	1.2	1.2	
2021	1.5	1.5	
2022	1.0	1.0	
Average	**1.3**	**1.3**	
Standard Deviation	**0.5**	**0.5**	

Table A-42. Supporting Data for Figure 42

Year	Troll Overall Average Catch Rate (lb/hr) - Mahimahi	Troll Catch Rate (lb/hr) - Non-Charter	Troll Catch Rate (lb/hr) - Charter
2013	4.3	4.3	4.0
2014	5.9	5.9	5.9
2015	6.2	6.2	
2016	4.2	4.2	
2017	3.0	3.0	
2018	3.0	3.0	2.3
2019	4.2	4.3	
2020	1.5	1.5	
2021	1.7	1.7	
2022	3.9	3.9	
Average	**3.8**	**3.8**	**4.1**
Standard Deviation	**1.6**	**1.6**	**1.8**

Table A-43. Supporting Data for Figure 43

Year	Troll Overall Average Catch Rate (lb/hr) - Wahoo	Troll Catch Rate (lb/hr) - Non-Charter	Troll Catch Rate (lb/hr) - Charter
2013	0.6	0.4	7.9
2014	0.5	0.5	0.8
2015	0.3	0.3	
2016	0.2	0.2	
2017	0.7	0.7	
2018	0.3	0.3	2.3
2019	0.1	0.1	
2020	0.1	0.1	
2021	0.3	0.3	
2022	1.2	1.2	
Average	**0.4**	**0.4**	**3.7**
Standard Deviation	**0.3**	**0.3**	**3.7**

Table A-44. Supporting Data for Figure 44

Year	Troll Overall Average Catch Rate (lb/hr) – Blue Marlin	Troll Catch Rate (lb/hr) - Non-Charter	Troll Catch Rate (lb/hr) - Charter
2013	0.1	0.1	
2014	0.3	0.3	
2015			
2016			
2017	0.2	0.2	
2018	0.1	0.1	
2019	0.2	0.2	
2020			
2021	0.2	0.2	
2022			
Average	**0.2**	**0.2**	
Standard Deviation	**0.1**	**0.1**	

Table A-45. Supporting Data for Figure 45

Year	Troll Catch Rate (lb/trip) - Mahimahi	Troll Catch Rate (lb/trip) - Wahoo	Troll Catch Rate (lb/trip) - Blue Marlin
2013	27.4	3.3	1.3
2014	31.0	5.9	2.1
2015	52.4	0.7	
2016	10.4	1.3	1.8
2017	9.6	1.9	0.3
2018	7.6	0.4	0.2
2019	8.4	0.1	0.3
2020	9.5	0.8	0.1
2021	12.4	1.4	1.9
2022	18.5	4.1	0.9
Average	**18.7**	**2.0**	**1.0**
Standard Deviation	**14.4**	**1.9**	**0.8**

Table A-46. Supporting Data for Figure 46

Year	Troll Catch Rate (lb/trip) - Skipjack	Troll Catch Rate (lb/trip) - Yellowfin	Troll Catch Rate (lb/trip) - Skipjack (Creel)
2013	102	19	101
2014	132	12	74
2015	240	25	114
2016	148	16	52
2017	107	24	94
2018	78	7	89
2019	52	5	109
2020	90	11	54
2021	112	12	96
2022	96	6	47
Average	**116**	**14**	**83**
Standard Deviation	**51**	**7**	**25**

TABLES FOR SECTION 2.3: GUAM

Table A-47. Numbers of Trips and Interviews for Creel Trolling Method, Guam

Year	Survey Days	Trips in Boat Log	Interviews
2013	96	799	456
2014	90	964	511
2015	97	904	540
2016	93	1,147	728
2017	92	1,018	643
2018	89	979	652
2019	93	930	620
2020	96	981	243
2021	96	1,101	676
2022	97	949	568

Table A-48. Supporting Data for Figure 47

Year	Estimated Troll Boats	Upper 95 Percent	Lower 95 Percent
2013	496	588.0	446.0
2014	447	537.0	395.0
2015	372	460.0	326.0
2016	428	505.0	386.0
2017	408	473.0	366.0
2018	398	495.0	349.0
2019	465	624.0	392.0
2020	459	685.0	382.0
2021	546	635.0	493.0
2022	449	513.0	410.0
Average	**447**	**552**	**395**
Standard Deviation	**50**	**77**	**48**

Table A-49. Supporting Data for Figure 48

Year	Estimated Total Landings (lb) - All Pelagic	Estimated Total Landings (lb) - Tuna PMUS	Estimated Total Landings (lb) - Non-Tuna PMUS
2013	799,483	554,062	235,590
2014	764,151	437,871	307,092
2015	959,906	709,521	228,207
2016	883,583	591,599	273,533
2017	600,826	469,153	117,938
2018	891,748	663,817	214,168
2019	759,653	537,064	211,095
2020	612,672	402,664	192,467
2021	858,372	758,641	88,545
2022	629,837	453,876	165,668
Average	**776,023**	**557,827**	**203,430**
Standard Deviation	**127,045**	**121,697**	**66,279**

Table A-50. Supporting Data for Figure 49

Year	Estimated Total Landings (lb) - Pelagic	Estimated Total Landings (lb) - Non-Charter	Estimated Total Landings (lb) - Charter
2013	799,483	749,955	49,529
2014	764,151	707,659	56,491
2015	959,906	898,827	61,081
2016	883,583	843,726	39,858
2017	600,826	577,287	23,539
2018	891,748	840,306	51,444
2019	759,653	721,615	38,034
2020	612,672	609,506	3,167
2021	858,372	837,411	20,962
2022	629,837	612,438	17,399
Average	**776,023**	**739,873**	**36,150**
Standard Deviation	**127,045**	**113,917**	**19,133**

Table A-51. Supporting Data for Figure 50

Year	Estimated Landings (lb) - Tuna PMUS	Estimated Landings (lb) - Non-Charter	Estimated Landings (lb) - Charter
2013	554,062	547,430	6,633
2014	437,871	427,658	10,213
2015	709,521	703,930	5,591
2016	591,599	582,607	8,992
2017	469,153	462,585	6,568
2018	663,817	655,356	8,461
2019	537,064	526,439	10,625
2020	402,664	402,039	625
2021	758,641	751,563	7,078
2022	453,876	449,239	4,637
Average	**557,827**	**550,885**	**6,942**
Standard Deviation	**121,697**	**120,965**	**2,945**

Table A-52. Supporting Data for Figure 51

Year	Estimated Total Landings (lb) - Skipjack	Estimated Total Landings (lb) - Non-Charter	Estimated Total Landings (lb) - Charter
2013	501,465	494,833	6,633
2014	403,139	393,270	9,868
2015	598,507	593,703	4,804
2016	458,312	452,579	5,733
2017	408,491	403,074	5,417
2018	610,751	603,412	7,339
2019	473,405	464,156	9,249
2020	347,793	347,417	376
2021	665,717	660,368	5,349
2022	419,431	414,935	4,496
Average	**488,701**	**482,775**	**5,926**
Standard Deviation	**104,359**	**103,864**	**2,663**

Table A-53. Supporting Data for Figure 52

Year	Estimated Total Landings (lb) - Yellowfin	Estimated Total Landings (lb) - Non-Charter	Estimated Total Landings (lb) - Charter
2013	52,183	52,183	0
2014	34,492	34,148	345
2015	110,459	109,672	787
2016	133,210	130,028	3,182
2017	60,541	59,390	1,151
2018	52,555	51,433	1,122
2019	63,621	62,245	1,376
2020	54,871	54,622	249
2021	92,834	91,105	1,729
2022	34,050	33,909	141
Average	**68,882**	**67,874**	**1,008**
Standard Deviation	**32,788**	**32,036**	**957**

Table A-54. Supporting Data for Figure 53

Year	Estimated Total Landings Non-Tuna (lb) - PMUS	Estimated Total Landings (lb) - Non-Charter	Estimated Total Landings (lb) - Charter
2013	235,590	193,026	42,564
2014	307,092	260,949	46,142
2015	228,207	173,272	54,936
2016	273,533	243,237	30,296
2017	117,938	101,582	16,356
2018	214,168	171,742	42,427
2019	211,095	183,877	27,215
2020	192,467	189,926	2,542
2021	88,545	74,934	13,612
2022	165,668	154,013	11,655
Average	**203,430**	**174,656**	**28,775**
Standard Deviation	**66,279**	**56,299**	**17,425**

Table A-55. Supporting Data for Figure 54

Year	Estimated Total Landings (lb) - Mahimahi	Estimated Total Landings (lb) - Non-Charter	Estimated Total Landings (lb) - Charter
2013	164,550	133,376	31,174
2014	189,444	158,333	31,110
2015	158,536	121,621	36,915
2016	191,940	175,089	16,851
2017	39,505	33,950	5,555
2018	88,817	77,314	11,503
2019	136,665	119,970	16,694
2020	92,283	90,418	1,865
2021	31,235	29,117	2,118
2022	94,491	86,651	7,840
Average	**118,747**	**102,584**	**16,163**
Standard Deviation	**58,195**	**48,450**	**12,847**

Table A-56. Supporting Data for Figure 55

Year	Estimated Total Landings (lb) - Wahoo	Estimated Total Landings (lb) - Non-Charter	Estimated Total Landings (lb) - Charter
2013	54,202	49,646	4,556
2014	88,394	80,074	8,320
2015	31,457	23,955	7,502
2016	34,240	28,860	5,380
2017	46,985	43,437	3,548
2018	96,035	81,248	14,787
2019	23,707	21,669	2,037
2020	46,262	45,586	677
2021	22,567	19,144	3,423
2022	57,003	55,434	1,569
Average	**50,085**	**44,905**	**5,180**
Standard Deviation	**25,208**	**22,592**	**4,176**

Table A-57. Supporting Data for Figure 56

Year	Estimated Total Landings (lb) - Blue Marlin	Estimated Total Landings (lb) - Non-Charter	Estimated Total Landings (lb) - Charter
2013	15,050	8,216	6,834
2014	29,241	22,529	6,712
2015	37,509	26,992	10,518
2016	44,954	36,889	8,065
2017	31,253	24,000	7,253
2018	24,516	12,754	11,763
2019	49,973	41,512	8,460
2020	50,846	50,846	0
2021	30,967	22,897	8,071
2022	8,700	6,818	1,882
Average	**32,301**	**25,345**	**6,956**
Standard Deviation	**14,027**	**14,370**	**3,572**

Table A-58. Supporting Data for Figure 57

Year	Estimated Commercial Landings (lb) - All Pelagic	Estimated Commercial Landings (lb) - Tuna PMUS	Estimated Commercial Landings (lb) - Non-Tuna PMUS
2013	176,108	34,509	138,555
2014	121,632	48,148	68,668
2015	109,395	63,677	42,794
2016	100,551	37,560	58,031
2017	118,457	56,455	55,434
2018	97,019	54,112	38,655
2019	141,756	52,020	82,100
2020	74,702	23,355	46,328
2021	51,033	25,997	22,905
2022	n.d.	n.d.	n.d.
Average	**110,073**	**43,981**	**61,497**
Standard Deviation	**36,343**	**14,177**	**33,641**

Table A-59. Supporting Data for Figure 58

Year	Estimated Troll Trips	Estimated Troll Trips - Non-Charter	Estimated Troll Trips - Charter
2013	8,100	7,182	918
2014	9,803	8,495	1,308
2015	9,223	8,000	1,223
2016	11,680	10,344	1,336
2017	10,302	9,083	1,219
2018	10,760	9,323	1,437
2019	9,249	8,016	1,233
2020	9,218	9,016	202
2021	10,719	10,106	614
2022	9,895	9,107	788
Average	**9,895**	**8,867**	**1,028**
Standard Deviation	**1,019**	**972**	**392**

Table A-60. Supporting Data for Figure 59

Year	Estimated Troll Hours - Total	Estimated Troll Hours - Non-Charter	Estimated Troll Hours -Charter
2013	42,438	39,554	2,885
2014	48,889	44,501	4,388
2015	62,568	55,600	6,968
2016	64,671	60,141	4,530
2017	53,390	49,092	4,298
2018	54,617	50,289	4,328
2019	47,101	43,135	3,966
2020	47,516	46,778	738
2021	56,373	54,125	2,248
2022	48,297	45,461	2,836
Average	**52,586**	**48,868**	**3,719**
Standard Deviation	**7,115**	**6,296**	**1,665**

Table A-61. Supporting Data for Figure 60

Year	Estimated Troll Hours per Trip – Overall Average	Estimated Troll Hours per Trip - Non-Charter	Estimated Troll Hours per Trip - Charter
2013	5.2	5.5	3.1
2014	5.0	5.2	3.4
2015	6.8	7.0	5.7
2016	5.5	5.8	3.4
2017	5.2	5.4	3.5
2018	5.1	5.4	3.0
2019	5.1	5.4	3.2
2020	5.2	5.2	3.7
2021	5.3	5.4	3.7
2022	4.9	5.0	3.6
Average	**5.3**	**5.5**	**3.6**
Standard Deviation	**0.5**	**0.6**	**0.8**

Table A-62. Supporting Data for Figure 61

Year	Troll Catch Rate (lb/hr) - Overall Average	Troll Catch Rate (lb/hr) - Non-Charter	Troll Catch Rate (lb/hr) - Charter
2013	19.2	19.4	17.1
2014	15.7	16.0	12.8
2015	15.4	16.2	8.8
2016	13.6	14.0	8.8
2017	11.2	11.7	5.5
2018	16.3	16.6	11.9
2019	16.0	16.6	9.6
2020	12.8	13.0	4.3
2021	15.1	15.3	9.0
2022	12.9	13.3	6.1
Average	**14.8**	**15.2**	**9.4**
Standard Deviation	**2.3**	**2.2**	**3.8**

Table A-63. Supporting Data for Figure 62

Year	Troll Catch Rate (lb/hr) - Skipjack	Troll Catch Rate (lb/hr) - Non-Charter	Troll Catch Rate (lb/hr) - Charter
2013	11.8	12.5	2.3
2014	8.2	8.8	2.2
2015	9.6	10.7	0.7
2016	7.1	7.5	1.3
2017	7.7	8.2	1.3
2018	11.2	12.0	1.7
2019	10.1	10.8	2.3
2020	7.3	7.4	0.5
2021	11.8	12.2	2.4
2022	8.7	9.1	1.6
Average	**9.4**	**9.9**	**1.6**
Standard Deviation	**1.8**	**2.0**	**0.7**

Table A-64. Supporting Data for Figure 63

Year	Troll Catch Rate (lb/hr) - Yellowfin Tuna	Troll Catch Rate (lb/hr) - Non-Charter	Troll Catch Rate (lb/hr) - Charter
2013	1.2	1.3	
2014	0.7	0.8	0.1
2015	1.8	2.0	0.1
2016	2.1	2.2	0.7
2017	1.1	1.2	0.3
2018	1.0	1.0	0.3
2019	1.4	1.4	0.3
2020	1.2	1.2	0.3
2021	1.6	1.7	0.8
2022	0.7	0.7	
Average	**1.3**	**1.4**	**0.4**
Standard Deviation	**0.5**	**0.5**	**0.3**

Table A-65. Supporting Data for Figure 64

Year	Troll Catch Rate (lb/hr) - Mahimahi	Troll Catch Rate (lb/hr) - Non-Charter	Troll Catch Rate (lb/hr) - Charter
2013	3.9	3.4	10.8
2014	3.9	3.6	7.0
2015	2.5	2.2	5.3
2016	3.0	2.9	3.7
2017	0.7	0.7	1.3
2018	1.6	1.5	2.7
2019	2.9	2.8	4.2
2020	1.9	1.9	2.5
2021	0.6	0.5	0.9
2022	2.0	1.9	2.8
Average	**2.3**	**2.1**	**4.1**
Standard Deviation	**1.2**	**1.1**	**3.0**

Table A-66. Supporting Data for Figure 65

Year	Troll Catch Rate (lb/hr) - Wahoo	Troll Catch Rate (lb/hr) - Non-Charter	Troll Catch Rate (lb/hr) - Charter
2013	1.3	1.3	1.6
2014	1.8	1.8	1.9
2015	0.5	0.4	1.1
2016	0.5	0.5	1.2
2017	0.9	0.9	0.8
2018	1.7	1.6	3.4
2019	0.5	0.5	0.5
2020	1.0	1.0	0.9
2021	0.4	0.3	1.2
2022	1.2	1.2	0.6
Average	**1.0**	**1.0**	**1.3**
Standard Deviation	**0.5**	**0.5**	**0.8**

Table A-67. Supporting Data for Figure 66

Year	Troll Catch Rate (lb/hr) - Blue Marlin	Troll Catch Rate (lb/hr) - Non-Charter	Troll Catch Rate (lb/hr) - Charter
2013	0.4	0.2	2.4
2014	0.6	0.5	1.5
2015	0.6	0.5	1.5
2016	0.7	0.6	1.8
2017	0.6	0.5	1.7
2018	0.4	0.3	2.7
2019	1.1	1.0	2.1
2020	1.1	1.1	
2021	0.5	0.4	3.6
2022	0.2	0.1	0.7
Average	**0.6**	**0.5**	**2.0**
Standard Deviation	**0.3**	**0.3**	**0.8**

TABLES FOR SECTION 2.4: HAWAII

Table A-68. Supporting Data for Figure 67

	Hawaii pelagic catch (1,000 pounds)					
Year	Tunas	Billfish	Other PMUS	PMUS Sharks	non-PMUS	Total
2013	21,321	5,440	6,215	131	25	33,133
2014	21,317	6,721	6,932	129	18	35,116
2015	25,515	6,928	7,186	150	23	39,802
2016	25,038	5,687	6,167	168	24	37,083
2017	26,584	7,060	5,543	166	11	39,364
2018	25,439	5,732	6,515	139	12	37,838
2019	24,696	5,697	5,955	115	5	36,468
2020	23,005	3,624	3,757	43	5	30,433
2021	24,134	3,528	3,340	17	6	31,025
2022	22,736	4,255	2,562	10	4	29,566
Average	**23,978.5**	**5,467.0**	**5,417.3**	**106.7**	**13.4**	**34,982.8**
SD	**1,813.0**	**1,292.8**	**1,611.0**	**60.4**	**8.6**	**3,746.7**

Table A-69. Supporting Data for Figure 68

	Hawaii pelagic total catch (1,000 pounds)						
Year	Deep-set longline	Shallow-set longline	MHI troll	MHI handline	Offshore handline	Other gear	Total
2013	25,006	2,345	3,117	1,282	831	550	33,133
2014	26,615	3,255	3,486	1,161	416	182	35,116
2015	32,136	2,778	3,094	1,200	409	184	39,802
2016	31,434	1,849	2,582	785	366	67	37,083
2017	32,760	3,007	2,209	975	323	89	39,364
2018	32,410	1,438	2,743	778	366	104	37,838
2019	31,865	829	2,479	687	477	132	36,468
2020	27,035	875	1,498	582	328	113	30,433
2021	26,808	1,264	1,829	685	257	180	31,025
2022	24,229	1,873	1,762	940	454	309	29,566
Average	**29,030.0**	**1,951.4**	**2,479.9**	**907.7**	**422.8**	**191.2**	**34,982.8**
SD	**3,379.4**	**870.7**	**654.2**	**243.1**	**157.7**	**143.8**	**3,746.7**

Table A-70. Supporting Data for Figure 69

	Hawaii tuna catch by gear type (1,000 pounds)						
Year	**Deep-set longline**	**Shallow-set longline**	**MHI troll**	**MHI handline**	**Offshore handline**	**Other gear**	**Total**
2013	17,019	82	1,745	1,166	810	499	21,321
2014	17,898	101	1,743	1,026	403	145	21,317
2015	22,255	123	1,473	1,106	400	157	25,515
2016	22,450	106	1,368	703	362	48	25,038
2017	23,768	274	1,253	899	310	80	26,584
2018	22,588	188	1,494	717	358	94	25,439
2019	22,167	93	1,220	626	469	120	24,696
2020	21,012	151	864	552	324	102	23,005
2021	21,931	220	915	650	252	166	24,134
2022	19,845	236	1,014	907	450	283	22,736
Average	**21,093.4**	**157.5**	**1,308.9**	**835.2**	**413.9**	**169.6**	**23,978.5**
SD	**2,180.9**	**67.9**	**315.2**	**215.8**	**153.6**	**132.4**	**1,813.0**

Table A-71. Supporting Data for Figure 70

	Hawaii tuna catch (1,000 pounds)						
Year	**Bigeye tuna**	**Yellowfin tuna**	**Skipjack tuna**	**Albacore**	**Bluefin tuna**	**Other tunas**	**Total**
2013	15,699	3,698	1,109	803	1	11	21,321
2014	16,564	3,522	648	552	1	30	21,317
2015	20,009	4,068	722	679	0	36	25,515
2016	18,663	4,956	801	602	1	14	25,038
2017	17,955	7,596	732	287	3	11	26,584
2018	17,093	7,567	530	239	1	10	25,439
2019	17,612	5,982	832	255	4	10	24,696
2020	16,968	5,108	554	366	3	6	23,005
2021	16,129	6,970	494	534	2	5	24,134
2022	14,688	7,124	460	457	3	3	22,736
Average	**17,138.0**	**5,659.2**	**688.3**	**477.4**	**2.0**	**13.6**	**23,978.5**
SD	**1,524.3**	**1,602.0**	**196.7**	**190.6**	**1.3**	**10.9**	**1,813.0**

Table A-72. Supporting Data for Figure 71

	Hawaii bigeye tuna catch (1,000 pounds)						
Year	Deep-set longline	Shallow-set longline	MHI troll	MHI handline	Offshore handline	Other gear	Total
2013	14,240	45	326	147	719	222	15,699
2014	15,657	65	315	105	348	75	16,564
2015	19,248	99	129	74	373	87	20,009
2016	18,070	75	75	93	310	40	18,663
2017	17,498	126	81	48	185	17	17,955
2018	16,635	108	59	30	244	17	17,093
2019	16,916	60	77	63	435	62	17,612
2020	16,445	102	41	40	279	61	16,968
2021	15,653	88	28	31	240	89	16,129
2022	13,956	99	28	46	396	163	14,688
Average	**16,431.6**	**86.7**	**115.8**	**67.8**	**352.8**	**83.2**	**17,138.0**
SD	**1,638.6**	**25.2**	**111.9**	**37.7**	**150.2**	**64.5**	**1,524.3**

Table A-73. Supporting Data for Figure 72

	Hawaii yellowfin tuna catch (1,000 pounds)						
Year	Deep-set longline	Shallow-set longline	MHI troll	MHI handline	Offshore handline	Other gear	Total
2013	1,582	22	1,078	894	82	40	3,698
2014	1,407	24	1,224	795	53	21	3,522
2015	2,012	17	1,095	878	25	41	4,068
2016	3,304	29	1,024	542	51	5	4,956
2017	5,581	137	951	758	124	45	7,596
2018	5,437	75	1,240	628	114	73	7,567
2019	4,445	30	903	516	32	57	5,982
2020	3,845	39	647	492	44	41	5,108
2021	5,441	113	730	598	11	77	6,970
2022	5,254	97	761	840	53	119	7,124
Average	**3,830.8**	**58.3**	**965.2**	**694.1**	**58.9**	**51.9**	**5,659.2**
SD	**1,671.9**	**43.8**	**204.8**	**155.7**	**37.0**	**31.9**	**1,602.0**

Table A-74. Supporting Data for Figure 73

Year	Hawaii skipjack tuna catch (1,000 pounds) Deep-set longline	Shallow-set longline	MHI troll	MHI handline	Offshore handline	Other gear	Total
2013	515	0	328	22	9	235	1,109
2014	411	0	172	15	3	48	648
2015	467	1	213	11	2	28	722
2016	529	0	258	11	0	3	801
2017	485	1	214	13	0	18	732
2018	329	0	185	12	0	4	530
2019	576	0	232	21	2	1	832
2020	369	0	172	11	1	0	554
2021	333	1	152	8	0	1	494
2022	226	1	222	9	1	1	460
Average	**424.1**	**0.5**	**214.7**	**13.2**	**1.9**	**33.8**	**688.3**
SD	**109.3**	**0.4**	**51.2**	**4.8**	**2.5**	**72.4**	**196.7**

Table A-75. Supporting Data for Figure 74

Year	Hawaii albacore catch (1,000 pounds) Deep-set longline	Shallow-set longline	MHI troll	MHI handline	Offshore handline	Other gear	Total
2013	682	14	4	101	0	2	803
2014	423	12	7	108	0	1	552
2015	529	7	4	139	0	0	679
2016	546	2	2	52	0	0	602
2017	200	9	1	76	1	0	287
2018	187	5	3	44	0	0	239
2019	227	3	2	22	1	0	255
2020	350	9	1	7	0	0	366
2021	503	18	2	11	0	0	534
2022	406	38	2	11	0	0	457
Average	**405.2**	**11.6**	**2.6**	**57.2**	**0.3**	**0.5**	**477.4**
SD	**165.3**	**10.5**	**1.9**	**47.0**	**0.4**	**0.8**	**190.6**

Table A-76. Supporting Data for Figure 75

	Hawaii billfish catch (1,000 lbs)						
Year	**Deep-set longline**	**Shallow-set longline**	**MHI troll**	**MHI handline**	**Offshore handline**	**Other gear**	**Total**
2013	2,895	2,177	334	18	5	10	5,440
2014	3,282	3,033	373	21	6	6	6,721
2015	3,898	2,539	462	16	4	9	6,928
2016	3,608	1,677	382	15	1	3	5,687
2017	4,059	2,625	349	20	4	3	7,060
2018	4,106	1,216	392	13	1	4	5,732
2019	4,564	723	385	15	3	6	5,697
2020	2,720	665	224	9	2	4	3,624
2021	2,210	1,020	282	7	3	6	3,528
2022	2,338	1,616	281	8	1	9	4,255
Average	**3,368.2**	**1,729.0**	**346.5**	**14.4**	**2.9**	**6.0**	**5,467.0**
SD	**805.9**	**835.7**	**68.5**	**4.7**	**1.6**	**2.6**	**1,292.8**

Table A-77. Supporting Data for Figure 76

	Hawaii billfish catch (1,000 lbs)					
Year	**Swordfish**	**Blue marlin**	**Striped marlin**	**Spearfish**	**Other marlins**	**Total**
2013	2,816	1,190	898	497	39	5,440
2014	3,690	1,511	967	501	52	6,721
2015	3,356	1,804	1,112	605	50	6,928
2016	2,418	1,542	887	784	56	5,687
2017	3,582	1,833	910	688	46	7,060
2018	2,329	1,808	1,052	504	39	5,732
2019	1,626	2,337	1,231	453	50	5,697
2020	1,202	1,373	762	262	24	3,624
2021	1,517	1,101	571	304	35	3,528
2022	2,048	1,239	645	296	27	4,255
Average	**2,458.5**	**1,573.9**	**903.5**	**489.5**	**41.8**	**5,467.0**
SD	**885.6**	**378.0**	**204.1**	**171.5**	**10.9**	**1,292.8**

Table A-78. Supporting Data for Figure 77

	Swordfish catch (1,000 lbs)						
Year	**Deep-set longline**	**Shallow-set longline**	**MHI troll**	**MHI handline**	**Offshore handline**	**Other gear**	**Total**
2013	677	2,120	1	14	1	2	2,816
2014	694	2,978	2	15	0	1	3,690
2015	843	2,500	2	11	0	1	3,356
2016	794	1,615	0	9	0	1	2,418
2017	998	2,570	1	13	1	0	3,582
2018	1,111	1,210	1	6	0	1	2,329
2019	898	720	1	7	0	1	1,626
2020	538	659	0	4	0	1	1,202
2021	524	989	1	3	0	1	1,517
2022	464	1,580	1	2	0	1	2,048
Average	**754.0**	**1,694.0**	**1.0**	**8.3**	**0.3**	**0.9**	**2,458.5**
SD	**213.5**	**817.8**	**0.7**	**4.7**	**0.3**	**0.6**	**885.6**

Table A-79. Supporting Data for Figure 78

	Blue marlin catch (1,000 lbs)						
Year	**Deep-set longline**	**Shallow-set longline**	**MHI troll**	**MHI handline**	**Offshore handline**	**Other gear**	**Total**
2013	879	17	282	4	3	6	1,190
2014	1,160	19	318	4	5	4	1,511
2015	1,380	12	399	5	3	6	1,804
2016	1,194	28	311	5	1	2	1,542
2017	1,502	14	306	6	2	2	1,833
2018	1,463	1	336	6	0	2	1,808
2019	1,987	0	334	8	2	5	2,337
2020	1,168	3	193	4	2	2	1,373
2021	827	15	247	5	2	4	1,101
2022	970	9	247	6	1	7	1,239
Average	**1,253.1**	**11.8**	**297.3**	**5.4**	**2.2**	**4.0**	**1,573.9**
SD	**346.7**	**8.8**	**57.7**	**1.3**	**1.3**	**1.8**	**378.0**

Table A-80. Supporting Data for Figure 79

Year	Deep-set longline	Shallow-set longline	MHI troll	MHI handline	Offshore handline	Other gear	Total
	Striped marlin catch (1,000 lbs)						
2013	843	35	18	0	0	1	898
2014	908	31	27	1	0	0	967
2015	1,064	24	23	0	0	1	1,112
2016	831	29	27	1	0	0	887
2017	861	34	14	0	0	0	910
2018	1,021	4	26	0	0	1	1,052
2019	1,200	1	29	0	0	1	1,231
2020	738	2	21	0	0	1	762
2021	538	13	18	0	0	1	571
2022	599	25	20	0	0	1	645
Average	**860.4**	**19.8**	**22.2**	**0.2**	**0.2**	**0.7**	**903.5**
SD	**203.7**	**13.5**	**4.9**	**0.3**	**0.1**	**0.4**	**204.1**

Table A-81. Supporting Data for Figure 80

Year	Deep-set longline	Shallow-set longline	MHI troll	MHI handline	Offshore handline	Other gear	Total
	Catch of other PMUS by gear type (1,000 lbs)						
2013	5,071	86	1,036	97	16	40	6,346
2014	5,421	121	1,367	114	7	30	7,061
2015	5,964	116	1,155	78	4	18	7,336
2016	5,356	67	828	66	3	15	6,335
2017	4,926	108	603	56	10	7	5,709
2018	5,706	34	855	48	7	6	6,654
2019	5,129	12	872	46	5	5	6,070
2020	3,300	60	409	21	2	7	3,799
2021	2,664	24	632	27	2	8	3,357
2022	2,041	21	466	24	2	17	2,572
Average	**4,557.8**	**64.8**	**822.3**	**57.7**	**5.9**	**15.3**	**5,524.0**
SD	**1,370.7**	**41.3**	**305.3**	**31.2**	**4.4**	**11.7**	**1,665.7**

Table A-82. Supporting Data for Figure 81

	Catch of other PMUS by species (1,000 lbs)						
Year	**Mahimahi**	**Moonfish**	**Oilfish**	**Ono**	**Pomfret**	**PMUS shark**	**Total**
2013	1,588	2,073	580	883	1,091	131	6,346
2014	1,819	2,242	516	1,176	1,179	129	7,061
2015	1,495	2,662	528	1,223	1,278	150	7,336
2016	1,232	2,166	481	1,204	1,084	168	6,335
2017	1,003	2,293	338	984	925	166	5,709
2018	1,077	3,070	315	1,176	878	139	6,654
2019	1,005	2,292	308	1,599	751	115	6,070
2020	585	1,629	184	850	509	43	3,799
2021	750	845	162	1,174	409	17	3,357
2022	775	526	164	667	429	10	2,572
Average	**1,132.9**	**1,979.9**	**357.6**	**1,093.6**	**853.3**	**106.7**	**5,524.0**
SD	**398.6**	**780.6**	**159.6**	**258.7**	**317.8**	**60.4**	**1,665.7**

Table A-83. Supporting Data for Figure 82

	Moonfish catch (1,000 lbs)			
Year	**Deep-set longline**	**Shallow-set longline**	**Other gear**	**Total**
2013	2,063	10	0	2,073
2014	2,213	28	0	2,242
2015	2,622	39	1	2,661
2016	2,148	19	0	2,166
2017	2,261	32	0	2,293
2018	3,057	13	0	3,070
2019	2,289	3	0	2,292
2020	1,606	23	0	1,629
2021	843	2	0	845
2022	524	2	0	526
Average	**1,962.6**	**17.2**	**0.1**	**1,979.8**
SD	**773.5**	**13.4**	**0.2**	**780.6**

Table A-84. Supporting Data for Figure 83

	Mahimahi catch (1,000 lbs)						
Year	**Deep-set longline**	**Shallow-set longline**	**MHI troll**	**MHI handline**	**Offshore handline**	**Other gear**	**Total**
2013	846	43	639	37	12	11	1,588
2014	810	45	901	52	5	7	1,819
2015	692	30	734	27	2	9	1,495
2016	636	16	558	19	1	3	1,232
2017	548	15	416	18	1	3	1,003
2018	495	6	553	18	1	3	1,077
2019	434	2	549	17	2	1	1,005
2020	262	3	305	12	1	2	585
2021	355	12	365	14	1	3	750
2022	380	13	357	16	1	8	775
Average	**545.8**	**18.5**	**537.6**	**23.0**	**2.9**	**5.1**	**1,132.9**
SD	**196.9**	**15.5**	**186.4**	**12.5**	**3.4**	**3.5**	**398.6**

Table A-85. Supporting Data for Figure 84

	Ono catch (1,000 lbs)						
Year	**Deep-set longline**	**Shallow-set longline**	**MHI troll**	**MHI handline**	**Offshore handline**	**Other gear**	**Total**
2013	464	1	396	16	2	4	883
2014	684	2	465	20	1	5	1,176
2015	781	1	421	17	1	3	1,223
2016	920	1	269	11	0	2	1,204
2017	784	3	186	9	1	2	984
2018	859	1	301	13	0	1	1,176
2019	1,259	0	322	14	2	2	1,599
2020	738	0	104	7	1	1	850
2021	894	2	267	8	1	2	1,174
2022	550	1	109	5	0	1	667
Average	**793.2**	**1.2**	**284.0**	**11.9**	**0.9**	**2.4**	**1,093.6**
SD	**218.5**	**0.7**	**124.2**	**4.8**	**0.6**	**1.3**	**258.7**

Table A-86. Supporting Data for Figure 85

Year	Pomfret catch (1,000 lbs)					
	Deep-set longline	**Shallow-set longline**	**MHI handline**	**Offshore handline**	**Other gear**	**Total**
2013	1,027	1	41	2	20	1,091
2014	1,118	2	41	1	18	1,179
2015	1,242	1	31	1	4	1,278
2016	1,038	0	34	2	10	1,084
2017	888	0	28	7	1	925
2018	857	0	16	5	1	878
2019	732	0	15	2	2	751
2020	501	0	3	0	4	509
2021	400	1	5	0	3	409
2022	417	0	3	1	7	429
Average	**822.1**	**0.7**	**21.6**	**2.0**	**6.9**	**853.2**
SD	**300.1**	**0.7**	**15.2**	**2.3**	**6.9**	**317.8**

Table A-87. Supporting Data for Figure 86

Year	PMUS shark catch (1,000 lbs)			
	Deep-set longline	**Shallow-set longline**	**Non-longline**	**Total**
2013	112	15	4	131
2014	106	20	3	129
2015	120	25	4	150
2016	140	24	4	168
2017	116	49	2	166
2018	126	12	2	139
2019	108	6	1	115
2020	11	31	0	43
2021	12	5	0	17
2022	9	1	0	10
Average	**85.9**	**18.8**	**2.0**	**106.7**
SD	**52.7**	**14.3**	**1.7**	**60.4**

Table A-88. Supporting Data for Figure 87

Year	Deep-set longline		
	Vessels	Trips	Sets
2013	136	1,386	18,803
2014	140	1,355	17,831
2015	143	1,452	18,519
2016	142	1,480	19,391
2017	145	1,539	19,674
2018	143	1,643	21,012
2019	149	1,727	22,318
2020	146	1,643	20,784
2021	146	1,689	22,175
2022	147	1,531	21,299
Average	**143.7**	**1,544.5**	**20,180.6**
SD	**3.8**	**128.0**	**1560.3**

Table A-89. Supporting Data for Figure 88

Year	Number of deep-set hooks by area (millions)			
	Outside EEZ	Hawaii EEZ	PRIA EEZ	Total
2013	32.9	12.9	1.2	47.0
2014	34.2	10.8	0.8	45.8
2015	33.0	14.3	0.3	47.6
2016	38.6	12.5	0.1	51.1
2017	40.5	13.0	0.0	53.6
2018	43.1	15.4	0.0	58.6
2019	49.1	14.3	0.0	63.4
2020	44.8	14.9	0.0	59.7
2021	41.6	23.8	0.0	65.4
2022	46.8	16.6	0.0	63.3
Average	**40.46**	**14.85**	**0.24**	**55.55**
SD	**5.75**	**3.55**	**0.42**	**7.46**

Table A-90. Supporting Data for Figure 89

Year	Catch (1,000 lbs)	Adjusted revenue ($1,000)	Nominal revenue ($1,000)	Honolulu CPI
2013	25,006	$105,029	$84,376	253.9
2014	26,615	$97,860	$78,617	257.6
2015	32,136	$110,835	$91,229	260.2
2016	31,434	$118,182	$99,190	265.3
2017	32,760	$111,710	$96,137	272.0
2018	32,410	$115,595	$101,332	277.1
2019	31,865	$104,237	$92,862	281.6
2020	27,035	$78,265	$70,820	286.0
2021	26,808	$116,306	$109,219	296.8
2022	24,229	$106,362	$106,362	316.1
Average	**29,030.0**	**$106,437.9**	**$93,014.6**	
SD	**3,379.4**	**$11,739.7**	**$12,181.6**	

Table A-91. Supporting Data for Figure 90

Year	Deep-set longline CPUE (fish per 1,000 hooks)		
	Bigeye tuna	Yellowfin tuna	Albacore
2013	4.1	0.4	0.3
2014	4.8	0.4	0.2
2015	4.8	0.6	0.2
2016	4.3	0.9	0.2
2017	4.2	1.5	0.1
2018	3.7	1.1	0.1
2019	3.5	1.0	0.1
2020	3.5	0.9	0.1
2021	2.9	1.2	0.2
2022	2.7	1.3	0.2
Average	**3.85**	**0.93**	**0.17**
SD	**0.72**	**0.37**	**0.07**

Table A-92. Supporting Data for Figure 91

Year	Deep-set longline CPUE (fish per 1,000 hooks)		
	Swordfish	Striped marlin	Blue marlin
2013	0.1	0.3	0.1
2014	0.1	0.3	0.1
2015	0.1	0.3	0.2
2016	0.1	0.2	0.1
2017	0.1	0.2	0.1
2018	0.1	0.3	0.1
2019	0.1	0.3	0.2
2020	0.1	0.2	0.1
2021	0.1	0.1	0.1
2022	0.1	0.2	0.1
Average	**0.10**	**0.24**	**0.12**
SD	**0.00**	**0.07**	**0.04**

Table A-93. Supporting Data for Figure 92

Year	Deep-set CPUE (fish per 1000 hooks)
	Blue shark
2013	1.0
2014	1.2
2015	1.4
2016	1.4
2017	1.6
2018	1.6
2019	1.8
2020	1.7
2021	1.5
2022	1.2
Average	1.44
SD	0.25

Table A-94. Supporting Data for Figure 93

	Shallow-set longline		
Year	**Vessels**	**Trips**	**Sets**
2013	15	58	962
2014	20	81	1,338
2015	22	69	1,130
2016	13	46	727
2017	20	70	994
2018	11	30	420
2019	14	25	284
2020	14	36	461
2021	17	57	703
2022	22	69	857
Average	**16.8**	**54.1**	**787.6**
SD	**4.0**	**19.0**	**334.0**

Table A-95. Supporting Data for Figure 94

	Number of hooks set by area (milions)			
Year	**Outside EEZ**	**Hawaii EEZ**	**PRIA EEZ**	**Total**
2013	0.9	0.0	0.1	1.1
2014	1.3	0.0	0.1	1.5
2015	1.1	0.1	0.1	1.3
2016	0.7	0.0	0.1	0.8
2017	1.0	0.1	0.0	1.1
2018	0.5	0.0	0.0	0.5
2019	0.4	0.0	0.0	0.4
2020	0.5	0.0	0.0	0.6
2021	0.8	0.1	0.0	0.9
2022	1.0	0.0	0.0	1.1
Average	**0.82**	**0.03**	**0.04**	**0.93**
SD	**0.29**	**0.05**	**0.05**	**0.36**

Table A-96. Supporting Data for Figure 95

Year	Catch (1,000 lbs)	Adjusted revenue ($1,000)	Nominal revenue ($1,000)	Honolulu CPI
2013	2,345	$3,958	$3,180	253.9
2014	3,255	$4,999	$4,074	257.6
2015	2,778	$3,414	$2,810	260.2
2016	1,849	$2,961	$2,486	265.3
2017	3,007	$4,915	$4,230	272.0
2018	1,438	$1,755	$1,538	277.1
2019	829	$2,180	$1,942	281.6
2020	875	$1,429	$1,293	286.0
2021	1,264	$5,120	$4,808	296.8
2022	1,873	$9,679	$9,679	316.1
Average	**1,951.4**	**$4,040.9**	**$3,603.9**	
SD	**870.7**	**$2,397.2**	**$2,436.0**	

Table A-97. Supporting Data for Figure 96

	Shallow-set longline CPUE (fish per 1,000 hooks)		
Year	Bigeye tuna	Yellowfin tuna	Albacore
2013	0.4	0.2	0.5
2014	0.6	0.1	0.4
2015	1.1	0.1	0.2
2016	1.2	0.4	0.1
2017	1.4	1.4	0.3
2018	2.6	1.6	0.3
2019	2.5	0.9	0.2
2020	1.9	0.9	0.6
2021	1.1	1.3	0.7
2022	0.9	1.0	1.3
Average	**1.37**	**0.79**	**0.46**
SD	**0.75**	**0.56**	**0.35**

Table A-98. Supporting Data for Figure 97

	Shallow-set longline CPUE (fish per 1,000 hooks)		
Year	**Swordfish**	**Striped marlin**	**Blue marlin**
2013	10.1	0.4	0.1
2014	10.4	0.2	0.1
2015	11.9	0.2	0.0
2016	12.4	0.4	0.1
2017	12.9	0.4	0.1
2018	12.2	0.1	0.0
2019	9.8	0.0	0.0
2020	7.9	0.1	0.0
2021	7.1	0.2	0.1
2022	8.9	0.4	0.0
Average	**10.36**	**0.24**	**0.05**
SD	**1.99**	**0.15**	**0.05**

Table A-99. Supporting Data for Figure 98

	Shallow-set CPUE (fish per 1000 hooks)
Year	**Blue shark**
2013	4.9
2014	6.8
2015	10.0
2016	13.8
2017	9.0
2018	5.1
2019	8.5
2020	10.4
2021	5.9
2022	5.9
Average	**8.03**
SD	**2.85**

Table A-100. Supporting Data for Figure 99

Year	Fishers	Days fished
2013	1,730	28,880
2014	1,697	28,114
2015	1,624	26,070
2016	1,485	23,295
2017	1,418	21,502
2018	1,387	21,975
2019	1,294	20,479
2020	1,125	12,188
2021	1,186	16,406
2022	1,166	15,420
Average	**1,411.2**	**21,432.9**
SD	**221.4**	**5,509.3**

Table A-101. Supporting Data for Figure 100

Year	Catch (1,000 lbs)	Adjusted revenue ($1,000)	Nominal revenue ($1,000)	Honolulu CPI
2013	3,117	$9,149	$7,350	253.9
2014	3,486	$10,269	$8,368	257.6
2015	3,094	$9,432	$7,763	260.2
2016	2,582	$9,005	$7,558	265.3
2017	2,209	$7,406	$6,374	272.0
2018	2,743	$9,116	$7,991	277.1
2019	2,479	$8,102	$7,218	281.6
2020	1,498	$4,894	$4,429	286.0
2021	1,829	$7,055	$6,625	296.8
2022	1,762	$7,040	$7,040	316.1
Average	**2,479.9**	**$8,146.8**	**$7,071.7**	
SD	**654.2**	**$1,576.9**	**$1,106.2**	

Table A-102. Supporting Data for Figure 101

MHI troll tuna CPUE (pounds per day fished)		
Year	Yellowfin tuna	Skipjack tuna
2013	38.4	11.5
2014	43.7	6.1
2015	42.3	8.2
2016	44.4	11.1
2017	44.6	10.0
2018	56.6	8.4
2019	44.1	11.4
2020	53.1	14.1
2021	44.5	9.3
2022	49.4	14.4
Average	**46.11**	**10.45**
SD	**5.39**	**2.61**

MHI troll tuna CPUE (pounds per hour fished)		
Year	Yellowfin tuna	Skipjack tuna
2013	5.8	1.73
2014	6.6	0.91
2015	6.5	1.25
2016	6.8	1.71
2017	7.0	1.55
2018	8.6	1.27
2019	6.8	1.75
2020	7.9	2.10
2021	6.7	1.38
2022	7.3	2.13
Average	**6.97**	**1.58**
SD	**0.78**	**0.39**

Table A-103. Supporting Data for Figure 102

MHI troll marlin CPUE (pounds per day fished)		
Year	Blue marlin	Striped marlin
2013	10.5	0.6
2014	11.4	1.0
2015	15.1	0.9
2016	13.5	1.2
2017	14.3	0.6
2018	15.4	1.2
2019	16.3	1.4
2020	15.9	1.7
2021	15.1	1.1
2022	16.0	1.3
Average	**14.35**	**1.10**
SD	**2.00**	**0.34**

MHI troll marlin CPUE (pounds per hour fished)		
Year	Blue marlin	Striped marlin
2013	1.6	0.1
2014	1.7	0.2
2015	2.3	0.1
2016	2.1	0.2
2017	2.2	0.1
2018	2.3	0.2
2019	2.5	0.2
2020	2.4	0.3
2021	2.3	0.2
2022	2.4	0.2
Average	**2.17**	**0.17**
SD	**0.30**	**0.05**

Table A-104. Supporting Data for Figure 103

MHI troll mahimahi and ono CPUE (pounds per day fished)		
Year	Mahimahi	Ono (wahoo)
2013	22.7	14.1
2014	32.1	16.6
2015	28.2	16.1
2016	24.1	11.6
2017	19.6	8.8
2018	25.4	13.8
2019	26.8	15.8
2020	25.0	8.5
2021	22.2	16.3
2022	23.1	7.1
Average	**24.91**	**12.84**
SD	**3.50**	**3.61**

MHI troll mahimahi and ono CPUE (pounds per hour fished)		
Year	Mahimahi	Ono (wahoo)
2013	3.4	2.1
2014	4.8	2.5
2015	4.3	2.5
2016	3.7	1.8
2017	3.0	1.4
2018	3.8	2.1
2019	4.1	2.4
2020	3.7	1.3
2021	3.3	2.4
2022	3.4	1.0
Average	**3.77**	**1.94**
SD	**0.53**	**0.55**

Table A-105. Supporting Data for Figure 104

Year	Fishers	Days fished
2013	591	5,540
2014	556	5,094
2015	528	4,862
2016	470	3,996
2017	491	4,735
2018	426	4,047
2019	439	3,677
2020	394	3,051
2021	382	3,385
2022	427	3,726
Average	**470.4**	**4,211.3**
SD	**70.0**	**807.3**

Table A-106. Supporting Data for Figure 105

Year	Catch (1,000 lbs)	Adjusted revenue ($1,000)	Nominal revenue ($1,000)	Honolulu CPI
2013	1,282	$4,190	$3,366	253.9
2014	1,161	$3,608	$2,940	257.6
2015	1,200	$3,518	$2,896	260.2
2016	785	$2,817	$2,364	265.3
2017	975	$3,358	$2,890	272.0
2018	778	$2,724	$2,388	277.1
2019	687	$2,427	$2,162	281.6
2020	582	$2,215	$2,005	286.0
2021	685	$3,017	$2,833	296.8
2022	940	$4,109	$4,109	316.1
Average	**907.7**	**$3,198.3**	**$2,795.3**	
SD	**243.1**	**$672.6**	**$621.0**	

Table A-107. Supporting Data for Figure 106

	MHI handline CPUE (pounds per day fished)			
Year	Yellowfin tuna	Albacore	Bigeye tuna	Total
2013	163.8	18.6	27.9	210.3
2014	157.0	21.2	20.9	199.2
2015	180.4	28.7	15.3	224.3
2016	137.8	13.3	23.4	174.6
2017	162.6	16.3	10.3	189.2
2018	157.2	11.0	7.5	175.7
2019	140.4	6.0	17.2	163.6
2020	161.3	2.2	13.1	176.6
2021	176.8	3.3	9.0	189.1
2022	225.3	3.0	12.4	240.8
Average	**166.27**	**12.36**	**15.70**	**194.33**
SD	**24.69**	**8.92**	**6.62**	**24.47**

	MHI handline CPUE (pounds per hour fished)			
Year	Yellowfin tuna	Albacore	Bigeye tuna	Total
2013	22.5	2.6	3.8	28.9
2014	21.7	2.9	2.9	27.5
2015	26.4	4.2	2.2	32.9
2016	20.3	2.0	3.5	25.7
2017	22.3	2.2	1.4	25.9
2018	23.4	1.6	1.1	26.2
2019	21.5	0.9	2.6	25.0
2020	24.0	0.3	1.9	26.3
2021	26.3	0.5	1.4	28.2
2022	32.1	0.4	1.8	34.3
Average	**24.05**	**1.77**	**2.26**	**28.08**
SD	**3.46**	**1.26**	**0.92**	**3.15**

Table A-108. Supporting Data for Figure 107

Year	Fishers	Days fished
2013	16	551
2014	9	284
2015	9	255
2016	6	182
2017	6	230
2018	5	217
2019	7	274
2020	5	258
2021	7	196
2022	6	188
Average	**7.6**	**263.5**
SD	**3.3**	**107.2**

Table A-109. Supporting Data for Figure 108

Year	Catch (1,000 lbs)	Adjusted revenue ($1,000)	Nominal revenue ($1,000)	Honolulu CPI
2013	831	$2,238	$1,798	253.9
2014	416	$955	$778	257.6
2015	409	$987	$812	260.2
2016	366	$1,100	$923	265.3
2017	323	$1,039	$894	272.0
2018	366	$1,093	$958	277.1
2019	477	$1,147	$1,021	281.6
2020	328	$1,520	$1,375	286.0
2021	257	$887	$833	296.8
2022	454	$1,494	$1,494	316.1
Average	**419.4**	**$1,218.2**	**$1,043.6**	

Table A-110. Supporting Data for Figure 109

	Offshore handline CPUE (pounds per day fished)			
Year	**Bigeye tuna**	**Yellowfin tuna**	**Mahimahi**	**Total**
2013	1,305	150	23	1,478
2014	1,228	183	20	1,431
2015	1,457	99	9	1,564
2016	1,788	309	3	2,100
2017	805	540	6	1,351
2018	1,048	527	7	1,582
2019	1,586	116	6	1,708
2020	1,083	170	5	1,257
2021	1,225	57	4	1,286
2022	2,105	284	8	2,396
Average	**1,280.4**	**238.9**	**9.3**	**1,528.7**
SD	**297.4**	**181.0**	**7.2**	**259.5**

TABLES FOR SECTION 3.3: SOCIOECONOMICS

Table A-111. Supporting Data for Figure 121

Labor force status	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Total Employment	16,990	14,108	18,862	18,028	14,806	16,089	17,565	17,853	17,930	16,408
Total Government	6,035	6,004	6,782	6,177	5,258	6,198	6,556	6,804	6,585	5,849
Canneries	4,861	1,562	1,553	1,815	1,827	2,108	2,500	2,759	2,843	2,312
Other/Private Sector	6,094	6,542	10,527	10,036	7,721	7,783	8,509	8,290	8,502	8,247

Table A-112. Data for Figure 122

Year	Total Landings	Revenue	Revenue Adj.	Fish Price ($/lb Nominal)	Fish Price ($/lb Adjusted)	CPI Adjuster
2003	11.36	10.31	21.01	0.91	1.85	2.037
2004	8.94	8.84	16.83	0.99	1.88	1.905
2005	8.88	8.68	15.72	0.98	1.77	1.811
2006	12.53	11.96	21.03	0.95	1.68	1.758

Year	Total Landings	Revenue	Revenue Adj.	Fish Price ($/lb Nominal)	Fish Price ($/lb Adjusted)	CPI Adjuster
2007	15.37	14.76	25.04	0.96	1.63	1.696
2008	9.84	9.41	14.45	0.96	1.47	1.535
2009	11.27	10.76	15.99	0.95	1.42	1.486
2010	11.28	10.95	15.53	0.97	1.38	1.418
2011	7.86	8.92	11.69	1.13	1.49	1.311
2012	9.69	10.14	12.86	1.05	1.33	1.269
2013	6.13	6.38	7.94	1.04	1.29	1.245
2014	5.14	5.21	6.44	1.01	1.25	1.236
2015	5.62	5.71	7.12	1.02	1.27	1.247
2016	4.80	4.78	5.97	1.00	1.24	1.248
2017	5.10	5.38	6.58	1.06	1.29	1.223
2018	4.45	5.58	6.71	1.25	1.51	1.203
2019	3.09	4.17	5.01	1.35	1.62	1.201
2020	2.00	2.27	2.74	1.14	1.37	1.203
2021	2.63	3.19	3.50	1.21	1.33	1.097
2022	2.98	3.82	3.82	1.28	1.28	1

Data source: Pacific Islands Fisheries Science Center: Fishery Economic Performance Measures (Tier 1 indicators). https://inport.nmfs.noaa.gov/inport/item/46097.

Table A-113. Supporting Data for Figure 123

Year	Albacore Price ($/MT)	Albacore Price adj ($/lb)	Yellowfin Price adj ($/lb)	Bigeye Price adj ($/lb)	Skipjack Price adj ($/lb)	Wahoo Price adj ($/lb)	CPI Adjuster
2012	3,193	1.84	0.80	0.36	0.79	0.76	1.269
2013	2,254	1.27	0.88	0.43	0.74	0.81	1.245
2014	2,707	1.52	0.60	0.53	0.51	0.51	1.236
2015	2,651	1.50	0.62	0.54	0.57	0.53	1.247
2016	2,498	1.41	0.66	0.55	0.57	0.55	1.248
2017	2,559	1.42	0.88	0.80	0.79	0.79	1.223
2018	3,086	1.68	0.72	0.82	0.63	0.63	1.203
2019	3,542	1.93	0.61	0.53	0.52	1.09	1.201
2020	3,306	1.80	0.59	0.50	0.50	1.36	1.203
2021	3,212	1.60	0.64	0.54	0.54	1.36	1.097
2022	3,305	1.50	0.73	0.64	0.64	1.36	1

Table A-114. Supporting Data for Figure 124, Figure 125, and Figure 126

Year	Total costs per trip ($)	Costs per set ($)	Costs per set (adj)	Revenue per set	Revenue per set ($ adjusted)	Net Rev per set	Net Rev per set (adj)	CPI Adjustor
2006	31,468	1,353	2,379	2,400	4,218	1,046	1,839	1.758
2007	45,253	963	1,633	2,506	4,250	1,543	2,617	1.696
2008	43,881	1,138	1,747	2,036	3,125	897	1,378	1.535
2009	32,942	848	1,260	2,288	3,399	1,440	2,139	1.486
2010	29,815	1,065	1,510	2,416	3,426	1,351	1,916	1.418
2011	30,916	1,189	1,559	2,378	3,117	1,189	1,558	1.311
2012	46,832	1,403	1,780	2,424	3,076	1,021	1,296	1.269
2013	50,792	1,448	1,801	1,993	2,480	546	679	1.244
2014	43,106	1,181	1,460	1,877	2,320	696	860	1.236
2015	42,468	1,034	1,289	2,143	2,672	1,109	1,384	1.247
2016	34,148	967	1,207	2,090	2,609	1,123	1,402	1.248
2017	34,223	913	1,116	2,195	2,684	1,282	1,568	1.223
2018	30,515	1,034	1,244	2,547	3,064	1,512	1,819	1.203
2019	44,728	1,246	1,496	2,481	2,979	1,235	1,483	1.201
2020	35,944	1,112	1,337	1,787	2,149	675	812	1.203
2021	38,803	964	1,058	2,099	2,303	1,135	1,245	1.097
2022	45,879	1,942	1,942	3,455	3,455	1,513	1,513	1

Table A-115. Supporting Data for Figure 127 and Figure 128

Year	Total Revenue per Sea Day	Total Revenue per Sea Day ($ Adjusted)	Total Revenue per Vessel	Total Revenue per Vessel ($ Adjusted)	Gini Coefficient	CPI Adjuster
2003	1,425	2,902	221,496	451,187	0.50	2.037
2004	1,218	2,319	198,339	377,835	0.51	1.905
2005	1,155	2,091	220,885	400,023	0.47	1.811
2006	1,260	2,215	241,063	423,789	0.29	1.758
2007	1,737	2,946	427,137	724,424	0.23	1.696
2008	1,790	2,747	509,034	781,368	0.35	1.535
2009	1,306	1,941	324,571	482,313	0.26	1.486
2010	1,553	2,202	413,787	586,750	0.28	1.418
2011	1,682	2,205	421,250	552,258	0.29	1.311
2012	1,476	1,873	371,547	471,493	0.34	1.269
2013	1,658	2,065	389,816	485,321	0.27	1.245
2014	1,279	1,581	289,848	358,252	0.42	1.236

2015	1,279	1,595	226,442	282,373	0.42	1.247
2016	1,314	1,640	271,891	339,320	0.49	1.248
2017	1,309	1,601	239,035	292,340	0.33	1.223
2018	1,501	1,805	358,431	431,192	0.33	1.203
2019	1,749	2,101	398,419	478,501	0.61	1.201
2020	1,329	1,598	231,925	279,005	0.43	1.203
2021	1,041	1,142	206,761	226,816	0.41	1.097
2022	1,526	1,526	265,646	265,646	0.33	1

Table A-116. Supporting Data for Figure 129 and Figure 130

Year	Est. pounds caught (lb)	Est. pounds sold (lb)	% sold	Est. revenue ($)	Est. revenue ($ adj.)	Fish price ($)	Fish price ($ adj.)	CPI Adjuster
2003	64,056	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	2.037
2004	58,689	864	1%	1,651	3,145	1.91	3.64	1.905
2005	39,558	850	2%	991	1,795	1.17	2.11	1.811
2006	56,065	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	1.758
2007	38,860	310	1%	531	901	1.71	2.91	1.696
2008	79,378	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	1.535
2009	24,854	3,044	12%	3,069	4,561	1.01	1.5	1.486
2010	17,044	4,648	27%	7,104	10,066	1.53	2.17	1.417
2011	71,797	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	1.311
2012	51,069	9,800	19%	13,294	16,870	1.36	1.72	1.269
2013	45,930	6,827	15%	9,936	12,360	1.46	1.81	1.244
2014	59,623	6,946	12%	10,128	12,518	1.46	1.8	1.236
2015	34,971	6,240	18%	12,577	15,684	2.02	2.51	1.247
2016	40,617	2,919	7%	6,670	8,324	2.29	2.85	1.248
2017	30,148	8,863	29%	24,353	29,784	2.75	3.36	1.223
2018	21,152	16,314	77%	49,597	59,665	3.04	3.66	1.203
2019	16,367	13,892	85%	38,246	45,933	2.75	3.31	1.201
2020	20,703	2,566	12%	8,204	9,869	3.20	3.85	1.203
2021	18,472	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	1.097
2022	9,098	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	1

Table A-117. Supporting Data for Figure 131

Year	Total trip costs ($)	Total cost adj. ($)	Fuel cost adj. ($)	Ice cost adj. ($)	Bait cost adj. ($)	Gear lost adj. ($)	Fuel price adj. ($/gal)	CPI Adjuster
2011	85	112	106	0	0.00	5.74	5.63	1.311

2012	91	116	88	15	0.00	13.05	5.43	1.269
2013	86	107	82	17	0.00	7.54	5.26	1.245
2014	68	84	73	6	2.35	2.75	2.65	1.236
2015	78	98	78	17	0.00	2.70	2.73	1.247
2016	75	94	60	23	0.83	9.95	2.88	1.248
2017	98	120	91	25	1.30	3.26	2.87	1.223
2018	115	138	113	19	0.86	5.82	3.64	1.203
2019	120	144	103	26	1.06	13.78	3.67	1.201
2020	99	120	98	18	0.00	4.14	3.77	1.203
2021	140	154	127	20	0.00	6.97	3.78	1.097
2022	84	84	73	11	0.00	0.00	4.15	1

Table A-118. Supporting Data for Figure 132 and Figure 133

Year	Est. pounds caught (lb.)	Est. pounds sold (lb.)	Est. revenue ($)	Est. revenue ($ adj.)	% of pounds sold	Fish price ($)	Fish price ($ adj.)	CPI Adjuster
2003	733,629	228,416	447,647	666,994	31%	1.96	2.92	1.490
2004	609,526	239,007	476,543	703,853	39%	1.99	2.94	1.477
2005	576,576	372,375	678,773	1,000,512	65%	1.82	2.69	1.474
2006	611,151	356,706	568,872	739,534	58%	1.59	2.07	1.300
2007	615,271	312,554	439,953	553,901	51%	1.41	1.77	1.259
2008	604,672	219,187	359,427	430,593	36%	1.64	1.96	1.198
2009	378,230	190,796	323,778	368,136	50%	1.70	1.93	1.137
2010	535,875	188,906	335,518	361,688	35%	1.78	1.91	1.078
2011	349,389	121,118	234,444	246,870	35%	1.94	2.04	1.053
2012	481,069	160,883	324,934	338,581	33%	2.02	2.10	1.042
2013	341,891	263,497	555,686	594,028	77%	2.11	2.25	1.069
2014	398,939	235,104	542,205	573,110	59%	2.31	2.44	1.057
2015	397,551	188,299	431,039	475,005	47%	2.29	2.52	1.102
2016	308,531	223,004	497,524	537,326	72%	2.23	2.41	1.080
2017	340,870	224,531	524,317	550,009	66%	2.34	2.45	1.049
2018	465,007	221,714	535,533	552,134	48%	2.42	2.49	1.031
2019	466,269	177,957	464,101	483,129	38%	2.61	2.71	1.041
2020	305,251	152,540	352,544	369,819	50%	2.31	2.42	1.049
2021	388,492	306,420	747,474	776,625	79%	2.44	2.53	1.039
2022	237,441	234,092	721,579	721,579	99%	3.08	3.08	1

Table A-119. Supporting Data for Figure 134

Year	Total trip costs ($)	Total cost adj. ($)	Fuel cost adj. ($)	Ice cost adj. ($)	Bait cost adj. ($)	Gear lost adj. ($)	Fuel price adj. ($/gal)	CPI Adjuster
2009	73	84	73	10	0.00	0.88	3.80	1.137
2010	73	78	70	9	0	0	4.14	1.078
2011	81	86	77	7	0.00	1.24	4.86	1.053
2012	91	95	85	8	0.00	2.41	5.23	1.042
2013	96	102	94	8	0.08	0.00	5.33	1.069
2014	94	99	89	10	0.06	0.00	5.23	1.057
2015	79	87	77	10	0.00	0.00	4.47	1.102
2016	69	75	65	10	0.00	0.00	3.86	1.080
2017	73	76	68	9	0.00	0.20	4.13	1.049
2018	77	80	69	11	0.00	0.00	4.27	1.031
2019	76	79	69	10	0.00	0.00	4.10	1.041
2020	73	77	69	8	0.00	0.00	3.84	1.049
2021	94	98	87	11	0.00	0.00	4.89	1.039
2022	101	101	91	10	0.00	0.00	5.49	1

Table A-120. Supporting Data for Figure 135 and Figure 136

Year	Est. pounds caught (lb.)	Est. pounds sold (lb.)	Est. revenue ($)	Est. revenue ($ adj.)	% of pounds sold	Fish price ($)	Fish price ($ adj.)	CPI Adjuster
2003	517,491	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	2.083
2004	698,610	283,395	427,504	839,191	41%	1.51	2.96	1.963
2005	300,643	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	1.823
2006	516,279	199,352	310,625	507,250	39%	1.56	2.54	1.633
2007	561,524	261,002	422,143	645,457	46%	1.62	2.47	1.529
2008	550,717	139,670	246,769	355,347	25%	1.77	2.54	1.44
2009	721,525	134,044	273,618	387,443	19%	2.04	2.89	1.416
2010	738,036	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	1.376
2011	591,947	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	1.332
2012	397,776	118,038	244,382	315,497	30%	2.07	2.67	1.291
2013	799,482	176,108	398,716	514,742	22%	2.26	2.92	1.291
2014	764,150	121,632	242,719	310,681	16%	2.00	2.55	1.280
2015	959,906	109,395	214,560	277,212	11%	1.96	2.53	1.292
2016	883,582	100,551	216,029	263,339	11%	2.15	2.62	1.219
2017	600,826	118,457	265,559	315,749	20%	2.24	2.67	1.189

Year	Est. pounds caught (lb.)	Est. pounds sold (lb.)	Est. revenue ($)	Est. revenue ($ adj.)	% of pounds sold	Fish price ($)	Fish price ($ adj.)	CPI Adjuster
2018	891,746	97,019	231,632	268,461	11%	2.39	2.77	1.159
2019	759,651	141,756	318,008	361,893	19%	2.24	2.55	1.138
2020	612,671	74,702	180,840	202,360	12%	2.42	2.71	1.119
2021	858,369	51,033	120,945	130,378	6%	2	3	1.078
2022	629,837	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	1

Table A-121. Supporting Data for Figure 137

Year	Total trip costs ($)	Total cost adj. ($)	Fuel cost adj. ($)	Ice cost adj. ($)	Bait cost adj. ($)	Gear lost adj. ($)	Fuel price adj. ($/gal)	CPI Adjuster
2011	96	127	95	14	5.52	13.08	6.08	1.329
2012	112	145	92	14	6.23	31.97	6.19	1.289
2013	92	119	81	15	1.12	21.95	6.15	1.289
2014	100	128	80	14	4.84	28.76	5.98	1.279
2015	91	118	61	14	8.85	34.10	4.93	1.291
2016	76	93	52	13	4.56	24.48	4.34	1.219
2017	99	118	55	24	11.18	27.97	4.55	1.189
2018	109	127	70	22	14.51	20.50	4.78	1.159
2019	94	107	60	19	1.70	26.84	4.65	1.139
2020	83	93	57	15	0.50	21.37	4.19	1.119
2021	101	109	71	18	0.48	19.81	4.72	1.078
2022	92	92	82	10	0.00	0.00	5.13	1

Table A-122. Supporting Data for Figure 138

Year	Estimated total landings (million lb)	Estimated total value ($ million)	Pounds sold in Hawaii markets (million lb)	Revenue from Hawaii markets ($ million)	Revenue adjusted (millions)	Price ($/lb)	Price adjusted ($/lb)	CPI Adjuster
2003	17.58	40.21	16.33	38.54	66.02	2.29	3.92	1.713
2004	18.61	44.50	16.87	44.50	73.77	2.39	3.96	1.658
2005	23.37	60.62	18.96	60.62	96.88	2.59	4.15	1.598
2006	21.47	55.85	17.55	55.85	84.28	2.60	3.93	1.509
2007	24.75	65.84	20.27	65.84	94.80	2.66	3.83	1.44

Year	Estimated total landings (million lb)	Estimated total value ($ million)	Pounds sold in Hawaii markets (million lb)	Revenue from Hawaii markets ($ million)	Revenue adjusted (millions)	Price ($/lb)	Price adjusted ($/lb)	CPI Adjuster
2008	26.86	74.54	21.76	74.54	102.94	2.77	3.83	1.381
2009	22.14	59.10	18.38	59.10	81.20	2.67	3.67	1.374
2010	23.79	72.12	19.47	72.12	97.07	3.03	4.08	1.346
2011	26.51	83.33	21.17	83.33	108.08	3.14	4.08	1.297
2012	26.12	96.46	21.33	96.46	122.21	3.69	4.68	1.267
2013	27.28	92.59	22.66	92.59	115.28	3.39	4.23	1.245
2014	29.80	87.31	23.93	87.31	107.13	2.93	3.59	1.227
2015	34.40	102.44	27.12	102.44	124.46	2.98	3.62	1.215
2016	33.14	110.68	26.32	110.68	131.81	3.34	3.98	1.191
2017	35.60	108.48	28.37	108.48	126.06	3.05	3.54	1.162
2018	33.57	109.44	26.80	109.44	124.87	3.26	3.72	1.141
2019	32.13	99.05	26.03	99.05	111.14	3.08	3.46	1.122
2020	26.84	80.07	21.11	80.07	88.48	2.98	3.30	1.105
2021	27.10	119.77	22.82	119.77	127.56	4.42	4.71	1.065
2022	25.43	117.82	21.75	117.82	117.82	4.63	4.63	1

Data source: Pacific Islands Fisheries Science Center: Fishery Economic Performance Measures (Tier 1 indicators). https://inport.nmfs.noaa.gov/inport/item/46097.

Table A-123. Supporting Data for Figure 139

Year	Total revenue ($million)	Bigeye revenue ($million)	Yellowfin revenue ($million)	Swordfish revenue ($million)	Others Revenue ($million)	% bigeye	% yellowfin	% swordfish	% others
2003	40,206,394	25,867,486	5,229,913	688,623	8,420,372	64%	13%	2%	21%
2004	44,495,720	28,611,612	3,877,632	1,529,800	10,476,677	64%	9%	3%	24%
2005	60,622,926	37,166,905	4,120,645	7,877,437	11,457,938	61%	7%	13%	19%
2006	55,853,742	33,857,353	5,731,074	5,084,768	11,180,547	61%	10%	9%	20%
2007	65,835,772	42,208,056	4,272,917	8,298,317	11,056,482	64%	6%	13%	17%
2008	74,537,264	49,877,959	5,479,032	7,792,301	11,387,972	67%	7%	10%	15%
2009	59,095,670	38,515,167	3,001,797	7,840,792	9,737,914	65%	5%	13%	16%
2010	72,120,632	48,635,042	3,923,402	8,948,693	10,613,495	67%	5%	12%	15%
2011	83,330,475	53,366,379	6,271,548	9,265,500	14,427,049	64%	8%	11%	17%
2012	96,459,498	62,223,867	7,731,132	9,049,944	17,454,555	65%	8%	9%	18%
2013	92,594,422	62,979,020	6,793,581	8,574,965	14,246,856	68%	7%	9%	15%
2014	87,313,949	60,271,041	5,388,558	7,796,655	13,857,695	69%	6%	9%	16%
2015	102,439,890	73,242,543	5,850,355	8,216,373	15,130,619	71%	6%	8%	15%
2016	110,675,624	75,641,255	9,542,693	7,118,299	18,373,377	68%	9%	6%	17%

Year	Total revenue ($million)	Bigeye revenue ($million)	Yellowfin revenue ($million)	Swordfish revenue ($million)	Others Revenue ($million)	% bigeye	% yellowfin	% swordfish	% others
2017	108,482,532	67,678,779	15,901,494	8,476,775	16,425,484	62%	15%	8%	15%
2018	109,436,602	69,528,643	19,846,193	4,854,514	15,207,251	64%	18%	4%	14%
2019	99,051,238	65,067,355	15,282,634	4,239,370	14,461,878	66%	15%	4%	15%
2020	80,068,411	55,043,150	11,098,050	4,060,091	9,867,121	69%	14%	5%	12%
2021	119,771,693	76,808,382	22,240,926	6,253,326	14,469,060	64%	19%	5%	12%
2022	117,821,092	72,119,277	21,648,346	9,797,328	14,256,140	61%	18%	8%	12%

Table A-124. Supporting Data for Figure 140

Year	Bigeye price	Bigeye price adj.	Yellowfin price	Yellowfin price adj.	Swordfish price	Swordfish price adj.	CPI Adjuster
2003	3.27	5.59	2.90	4.96	2.28	3.90	1.713
2004	2.99	4.95	2.45	4.06	2.47	4.10	1.658
2005	3.36	5.37	2.58	4.13	2.24	3.57	1.598
2006	3.48	5.24	2.74	4.14	1.97	2.98	1.509
2007	3.32	4.79	2.28	3.29	2.17	3.12	1.44
2008	3.82	5.27	2.83	3.91	1.78	2.45	1.381
2009	3.75	5.15	2.85	3.92	1.95	2.68	1.374
2010	4.08	5.50	3.21	4.32	2.43	3.26	1.346
2011	4.26	5.52	3.03	3.93	2.63	3.42	1.297
2012	4.82	6.10	3.96	5.02	2.89	3.66	1.267
2013	4.43	5.51	4.25	5.29	3.07	3.82	1.245
2014	3.85	4.73	3.77	4.63	2.12	2.61	1.227
2015	3.85	4.67	2.99	3.63	2.46	2.99	1.215
2016	4.18	4.98	2.92	3.48	2.96	3.52	1.191
2017	3.86	4.49	2.79	3.24	2.38	2.76	1.162
2018	4.20	4.79	3.63	4.14	2.09	2.39	1.141
2019	3.91	4.39	3.45	3.87	2.64	2.96	1.122
2020	3.43	3.79	3.01	3.32	3.42	3.78	1.105
2021	5.07	5.40	4.10	4.36	4.16	4.43	1.065
2022	5.25	5.25	4.18	4.18	4.81	4.81	1

Data source: Pacific Islands Fisheries Science Center pelagic module data request.

Table A-125. Supporting Data for Figure 143

Year	Total trip costs (adj $)	Fuel Cost ($ adj)	Other costs ($ adj)	Trip days	CPI Adjustor
2005	26,495	13,314	13,182	19	1.598
2006	27,905	14,582	13,324	20	1.509
2007	27,851	14,936	12,915	21	1.440
2008	35,353	21,948	13,406	22	1.381
2009	28,932	14,365	14,568	24	1.374
2010	31,232	16,817	14,415	24	1.346
2011	36,470	21,258	15,211	23	1.298
2012	37,987	22,180	15,807	23	1.267
2013	36,402	20,522	15,880	23	1.245
2014	36,503	20,434	16,069	23	1.227
2015	31,342	15,067	16,275	22	1.215
2016	28,872	12,824	16,047	22	1.191
2017	27,531	12,263	15,123	21	1.162
2018	29,129	14,677	13,175	21	1.141
2019	29,059	15,364	13,055	22	1.123
2020	26,645	11,865	14,781	21	1.105
2021	28,796	14,827	13,969	21	1.065
2022	33,923	19,771	14,152	23	1

Table A-126. Supporting Data for Figure 144

Year	Total trip costs ($ adj)	Fuel Cost ($ adj)	Other costs ($ adj)	trip days	CPI Adjustor
2005	53,965	26,596	27,369	28	1.598
2006	55,417	27,630	27,787	31	1.509
2007	57,159	30,167	26,992	33	1.440
2008	69,826	42,195	27,630	33	1.381
2009	51,686	25,430	26,256	32	1.374
2010	56,201	31,445	24,756	33	1.346
2011	73,347	46,114	27,233	33	1.298
2012	73,010	44,790	28,219	35	1.267
2013	61,925	35,881	26,044	31	1.245
2014	63,595	36,591	27,004	32	1.227
2015	50,989	25,181	25,808	33	1.215
2016	47,535	20,404	27,131	31	1.191

2017	43,673	20,055	23,617	27	1.162
2018	49,508	25,005	24,980	33	1.141
2019	38,990	20,315	17,775	27	1.123
2020	46,779	23,901	22,878	28	1.105
2021	38,656	19,180	19,476	25	1.065
2022	44,905	26,060	18,845	26	1

Table A-127. Supporting Data for Figure 145

Year	Trip costs ($)	Trip costs ($ adjusted)	Revenue ($)	Net revenue ($ adjusted)	CPI Adjuster
2005	16,580	38,162	21,581	34,487	1.598
2006	18,493	38,443	19,950	30,105	1.509
2007	19,341	41,099	21,758	31,332	1.440
2008	25,600	51,084	25,484	35,193	1.381
2009	21,057	43,216	22,159	30,447	1.374
2010	23,204	56,194	32,990	44,405	1.346
2011	28,097	58,598	30,501	39,590	1.298
2012	29,981	68,629	38,647	48,966	1.267
2013	29,239	64,165	34,926	43,483	1.245
2014	29,750	61,565	31,815	39,037	1.227
2015	25,796	67,022	41,226	50,090	1.215
2016	24,242	77,368	53,126	63,273	1.191
2017	23,692	67,065	43,372	50,399	1.162
2018	25,529	66,676	41,146	46,948	1.141
2019	25,876	59,779	33,903	38,073	1.123
2020	24,113	49,706	25,592	28,279	1.105
2021	27,039	71,322	44,283	47,161	1.065
2022	33,923	75,489	41,566	41,566	1

Table A-128. Supporting Data for Figure 146

Year	Trip costs ($)	Trip costs adjusted ($)	Revenue ($)	Net revenue adjusted ($)	CPI Adjuster
2005	33,770	35,815	42,502	67,918	1.598
2006	36,724	44,495	42,116	63,553	1.509
2007	39,694	33,844	49,153	70,780	1.440

Year	Trip costs ($)	Trip costs adjusted ($)	Revenue ($)	Net revenue adjusted ($)	CPI Adjuster
2008	50,562	40,593	36,147	49,919	1.381
2009	37,617	29,622	31,565	43,370	1.374
2010	41,754	38,383	30,846	41,519	1.346
2011	56,508	50,774	46,958	60,952	1.298
2012	57,624	48,538	44,944	56,944	1.267
2013	49,739	41,101	56,566	70,425	1.245
2014	51,829	38,714	35,141	43,118	1.227
2015	41,966	28,927	36,082	43,839	1.215
2016	39,912	37,562	73,066	87,022	1.191
2017	37,584	52,720	71,204	82,739	1.162
2018	43,390	73,529	66,473	75,846	1.141
2019	34,720	58,873	73,167	82,167	1.123
2020	42,334	71,177	43,940	48,554	1.105
2021	36,297	58,413	60,117	64,024	1.065
2022	44,905	88,561	123,178	123,178	1

Table A-129. Supporting Data for Figure 147 and Figure 148

Year	Revenue per-day at-sea ($/day)	Revenue per-day-at-sea adjusted ($/day)	Annual revenue per vessel ($)	Annual revenue per vessel adjusted ($)	Gini coefficient	CPI Adjuster
2003	1,729	2,961	368,866	631,867	0.26	1.713
2004	1,704	2,825	353,141	585,507	0.25	1.658
2005	2,096	3,349	484,983	775,003	0.22	1.598
2006	1,964	2,963	439,793	663,648	0.24	1.509
2007	2,045	2,945	510,355	734,911	0.20	1.44
2008	2,313	3,194	577,808	797,953	0.22	1.381
2009	1,866	2,564	465,320	639,350	0.23	1.374
2010	2,287	3,078	581,618	782,858	0.22	1.346
2011	2,652	3,439	645,973	837,827	0.22	1.297
2012	2,943	3,729	747,748	947,397	0.19	1.267
2013	2,792	3,476	685,885	853,926	0.22	1.245
2014	2,624	3,220	623,671	765,244	0.23	1.227
2015	3,056	3,712	726,524	882,727	0.22	1.215
2016	3,269	3,893	784,934	934,856	0.21	1.191

2017	3,147	3,657	753,351	875,394	0.20	1.162
2018	3,092	3,528	770,680	879,346	0.20	1.141
2019	2,679	3,006	678,433	761,202	0.18	1.122
2020	2,320	2,564	556,031	614,414	0.22	1.105
2021	3,341	3,558	837,564	892,006	0.20	1.065
2022	3,364	3,364	818,202	818,202	0.22	1

Table A-130. Supporting Data for Figure 149, Figure 150, Figure 154, Figure 155, Figure 156, and Figure 157

Year	Troll lb Kept	MHI Handline lb Kept	Offshore Handline lb Kept	Others lb Kept	Aku Boat lb Kept	Troll lb Sold	MHI Handline lb Sold	Offshore Handline lb Sold	Others lb Sold	Aku Boat lb Sold
2003	2,548,628	962,758	371,084	214,263	905,837	2,578,123	1,090,141	401,481	250,618	1,010,872
2004	3,182,537	1,186,050	480,686	248,461	636,909	2,885,469	1,255,683	366,463	205,258	655,161
2005	2,605,780	1,223,122	423,736	189,906	904,729	2,042,131	1,122,523	222,082	115,363	921,759
2006	2,590,508	801,476	502,765	273,090	630,590	1,942,533	660,212	280,570	173,794	655,735
2007	2,838,518	949,837	598,687	279,449	643,029	2,003,353	740,916	331,025	179,696	640,107
2008	2,976,988	686,237	325,433	293,628	702,193	2,037,864	522,670	232,856	222,178	696,977
2009	2,967,253	1,063,594	306,922	156,145	506,695	2,032,363	800,740	221,450	114,801	509,769
2010	2,857,486	929,717	615,316	235,169	114,320	1,985,285	738,725	537,959	201,618	113,525
2011	2,984,978	1,119,839	614,733	247,663	347,897	2,017,997	841,610	461,697	187,089	369,687
2012	3,672,150	1,609,266	590,123	322,838	109,563	2,612,743	1,320,311	472,479	257,351	109,364
2013	3,201,290	1,309,552	835,410	308,294	233,275	2,395,280	1,081,399	743,874	272,190	233,292
2014	3,490,512	1,167,585	417,010	132,028	47,648	2,720,280	981,747	327,058	108,530	56,390
2015	3,094,132	1,198,983	407,075	151,028	31,517	2,394,041	1,004,449	328,964	122,208	25,607
2016	2,594,388	795,355	386,290	65,349	1,521	2,125,306	707,736	361,983	61,195	478
2017	2,230,479	989,701	323,700	74,969	16,434	1,799,828	858,984	286,686	64,174	15,593
2018	2,755,065	786,965	349,723	99,810	4,019	2,203,546	667,591	295,765	83,424	3,922
2019	2,480,164	685,164	476,898	130,650	NULL	1,982,594	587,139	375,390	106,198	NULL
2020	1,497,197	582,480	328,425	112,824	NULL	1,208,545	524,585	344,764	112,562	NULL
2021	1,829,023	684,573	256,969	179,848	NULL	1,495,417	638,805	267,868	176,572	NULL
2022	1,761,684	940,181	453,846	309,001	NULL	1,502,843	882,858	476,338	307,616	NULL

Table A-131. Supporting Data for Figure 151, Figure 154, Figure 155, Figure 156, and Figure 157

Year	Troll Revenue	MHI Handline Revenue	Offshore Handline Revenue	Others Revenue	Aku Boat Revenue	Troll Adjusted Revenue	MHI Handline Adjusted Revenue	Offshore Handline Adjusted Revenue	Others Adjusted Revenue	Aku Boat Adjusted Revenue	CPI adjustor
2003	5,283,460	2,119,320	666,040	454,417	1,004,565	9,050,567	3,630,395	1,140,926	778,416	1,720,819	1.71
2004	6,249,787	2,282,403	645,728	363,090	861,060	10,362,146	3,784,224	1,070,617	602,003	1,427,637	1.66
2005	4,942,867	2,112,004	479,726	250,138	1,073,828	7,898,702	3,374,983	766,603	399,720	1,715,978	1.60
2006	4,995,421	1,425,473	539,284	383,226	878,864	7,538,090	2,151,038	813,780	578,288	1,326,206	1.51

2007	5,310,730	1,506,553	630,916	371,466	671,832	7,647,451	2,169,436	908,518	534,911	967,438	1.44
2008	5,234,010	1,348,929	527,932	518,735	866,873	7,228,168	1,862,871	729,073	716,373	1,197,152	1.38
2009	5,024,316	1,713,658	424,543	241,195	681,289	6,903,411	2,354,566	583,322	331,401	936,091	1.37
2010	5,465,395	1,876,576	1,191,546	464,922	210,682	7,356,422	2,525,871	1,603,820	625,785	283,577	1.35
2011	6,063,930	2,189,502	1,167,044	493,311	607,295	7,864,917	2,839,784	1,513,657	639,825	787,662	1.30
2012	9,000,679	3,510,958	1,441,714	802,107	230,235	11,403,860	4,448,383	1,826,651	1,016,270	291,708	1.27
2013	7,423,961	3,241,943	1,816,264	692,705	456,267	9,242,831	4,036,219	2,261,249	862,418	568,053	1.25
2014	8,342,685	2,950,764	826,835	298,684	102,352	10,236,475	3,620,588	1,014,526	366,485	125,586	1.23
2015	7,700,797	2,905,434	791,461	329,319	71,569	9,356,469	3,530,102	961,625	400,123	86,956	1.22
2016	7,550,122	2,364,861	956,080	181,293	1,035	8,992,196	2,816,550	1,138,692	215,920	1,233	1.19
2017	6,369,541	2,893,301	873,230	215,332	32,035	7,401,407	3,362,016	1,014,693	250,216	37,225	1.16
2018	7,989,348	2,406,115	941,238	298,541	12,768	9,115,846	2,745,377	1,073,952	340,636	14,568	1.14
2019	7,223,669	2,158,940	1,021,691	342,598	NULL	8,104,956	2,422,331	1,146,337	384,395	NULL	1.12
2020	4,259,225	1,883,736	970,351	349,183	NULL	4,706,444	2,081,528	1,072,238	385,847	NULL	1.11
2021	6,624,840	2,832,637	832,704	657,791	NULL	7,055,455	3,016,759	886,830	700,547	NULL	1.07
2022	7,040,001	4,108,970	1,494,323	1,156,468	NULL	7,040,001	4,108,970	1,494,323	1,156,468	NULL	1.00

Table A-132. Supporting Data for Figure 152

Year	MHI troll price ($/lb), adjusted	MHI handline price ($/lb), adjusted	Offshore price ($/lb), adjusted	Other gears price ($/lb), adjusted
2003	3.51	3.33	2.84	3.11
2004	3.59	3.01	2.92	2.93
2005	3.87	3.01	3.45	3.46
2006	3.88	3.26	2.90	3.33
2007	3.82	2.93	2.74	2.98
2008	3.55	3.56	3.13	3.22
2009	3.40	2.94	2.63	2.89
2010	3.71	3.42	2.98	3.10
2011	3.90	3.37	3.28	3.42
2012	4.36	3.37	3.87	3.95
2013	3.86	3.73	3.04	3.17
2014	3.76	3.69	3.10	3.38
2015	3.91	3.51	2.92	3.27
2016	4.23	3.98	3.15	3.53
2017	4.11	3.91	3.54	3.90
2018	4.14	4.11	3.63	4.08
2019	4.09	4.13	3.05	3.62
2020	3.89	3.97	3.11	3.43
2021	4.72	4.72	3.31	3.97
2022	4.68	4.65	3.14	3.76

APPENDIX B: LIST OF PROTECTED SPECIES AND DESIGNATED CRITICAL HABITAT

Table B-1. Protected species found or reasonably believed to be found near or in Hawaii shallow-set longline waters

Common Name	Scientific Name	ESA Listing Status	MMPA Status	Occurrence	References
Seabirds					
Laysan Albatross	*Phoebastria immutabilis*	Not Listed	N/A	Breeding visitor	Pyle & Pyle 2009
Black-Footed Albatross	*Phoebastria nigripes*	Not Listed	N/A	Breeding visitor	Pyle & Pyle 2009
Short-Tailed Albatross	*Phoebastria albatrus*	Endangered	N/A	Breeding visitor in the NWHI	35 FR 8495, 65 FR 46643, Pyle & Pyle 2009
Northern Fulmar	*Fulmarus glacialis*	Not Listed	N/A	Winter resident	Pyle & Pyle 2009
Kermadec Petrel	*Pterodroma neglecta*	Not Listed	N/A	Migrant	Pyle & Pyle 2009
Herald Petrel	*Pterodroma arminjoniana*	Not Listed	N/A	Migrant	Pyle & Pyle 2009
Murphy's Petrel	*Pterodroma ultima*	Not Listed	N/A	Migrant	Pyle & Pyle 2009
Mottled Petrel	*Pterodroma inexpectata*	Not Listed	N/A	Migrant	Pyle & Pyle 2009
Juan Fernandez Petrel	*Pterodroma externa*	Not Listed	N/A	Migrant	Pyle & Pyle 2009
Hawaiian Petrel	*Pterodroma sandwichensis (Pterodroma phaeopygia sandwichensis)*	Endangered	N/A	Breeding visitor in the MHI	32 FR 4001, Pyle & Pyle 2009
White-Necked Petrel	*Pterodroma cervicalis*	Not Listed	N/A	Migrant	Pyle & Pyle 2009
Bonin Petrel	*Pterodroma hypoleuca*	Not Listed	N/A	Breeding visitor in the NWHI	Pyle & Pyle 2009
Black-Winged Petrel	*Pterodroma nigripennis*	Not Listed	N/A	Migrant	Pyle & Pyle 2009
Cook Petrel	*Pterodroma cookii*	Not Listed	N/A	Migrant	Pyle & Pyle 2009
Stejneger Petrel	*Pterodroma longirostris*	Not Listed	N/A	Migrant	Pyle & Pyle 2009
Pycroft Petrel	*Pterodroma pycrofti*	Not Listed	N/A	Migrant	Pyle & Pyle 2009
Bulwer Petrel	*Bulweria bulwerii*	Not Listed	N/A	Breeding visitor	Pyle & Pyle 2009
Flesh-Footed Shearwater	*Ardenna carneipes*	Not Listed	N/A	Migrant	Pyle & Pyle 2009
Wedge-Tailed Shearwater	*Ardenna pacifica*	Not Listed	N/A	Breeding visitor	Pyle & Pyle 2009
Buller's Shearwater	*Ardenna bulleri*	Not Listed	N/A	Migrant	Pyle & Pyle 2009

Common Name	Scientific Name	ESA Listing Status	MMPA Status	Occurrence	References
Sooty Shearwater	*Ardenna grisea*	Not Listed	N/A	Migrant	Pyle & Pyle 2009
Short-Tailed Shearwater	*Ardenna tenuirostris*	Not Listed	N/A	Migrant	Pyle & Pyle 2009
Christmas Shearwater	*Puffinus nativitatis*	Not Listed	N/A	Breeding visitor	Pyle & Pyle 2009
Newell's Shearwater	*Puffinus newelli (Puffinus auricularis newelli)*	Threatened	N/A	Breeding visitor	40 FR 44149, Pyle & Pyle 2009
Wilson's Storm-Petrel	*Oceanites oceanicus*	Not Listed	N/A	Migrant	Pyle & Pyle 2009
Leach's Storm-Petrel	*Oceanodroma leucorhoa*	Not Listed	N/A	Winter resident	Pyle & Pyle 2009
Band-Rumped Storm-Petrel	*Oceanodroma castro*	Not Listed	N/A	Breeding visitor	Pyle & Pyle 2009
Tristram Storm-Petrel	*Oceanodroma tristrami*	Not Listed	N/A	Breeding visitor in the NWHI	Pyle & Pyle 2009
White-Tailed Tropicbird	*Phaethon lepturus*	Not Listed	N/A	Breeding visitor	Pyle & Pyle 2009
Red-Tailed Tropicbird	*Phaethon rubricauda*	Not Listed	N/A	Breeding visitor	Pyle & Pyle 2009
Masked Booby	*Sula dactylatra*	Not Listed	N/A	Breeding visitor	Pyle & Pyle 2009
Brown Booby	*Sula leucogaster*	Not Listed	N/A	Breeding visitor	Pyle & Pyle 2009
Red-Footed Booby	*Sula sula*	Not Listed	N/A	Breeding visitor	Pyle & Pyle 2009
Great Frigatebird	*Fregata minor*	Not Listed	N/A	Breeding visitor	Pyle & Pyle 2009
Lesser Frigatebird	*Fregata ariel*	Not Listed	N/A	Breeding visitor	Pyle & Pyle 2009
Laughing Gull	*Leucophaeus atricilla*	Not Listed	N/A	Winter resident in the MHI	Pyle & Pyle 2009
Franklin Gull	*Leucophaeus pipixcan*	Not Listed	N/A	Migrant	Pyle & Pyle 2009
Ring-Billed Gull	*Larus delawarensis*	Not Listed	N/A	Winter resident in the MHI	Pyle & Pyle 2009
Herring Gull	*Larus argentatus*	Not Listed	N/A	Winter resident in the NWHI	Pyle & Pyle 2009
Slaty-Backed Gull	*Larus schistisagus*	Not Listed	N/A	Winter resident in the NWHI	Pyle & Pyle 2009
Glaucous-Winged Gull	*Larus glaucescens*	Not Listed	N/A	Winter resident	Pyle & Pyle 2009
Brown Noddy	*Anous stolidus*	Not Listed	N/A	Breeding visitor	Pyle & Pyle 2009
Black Noddy	*Anous minutus*	Not Listed	N/A	Breeding visitor	Pyle & Pyle 2009
Blue-Gray Noddy	*Procelsterna cerulea*	Not Listed	N/A	Breeding visitor in the NWHI	Pyle & Pyle 2009
White Tern	*Gygis alba*	Not Listed	N/A	Breeding visitor	Pyle & Pyle 2009

Common Name	Scientific Name	ESA Listing Status	MMPA Status	Occurrence	References
Sooty Tern	*Onychoprion fuscatus*	Not Listed	N/A	Breeding visitor	Pyle & Pyle 2009
Gray-Backed Tern	*Onychoprion lunatus*	Not Listed	N/A	Breeding visitor	Pyle & Pyle 2009
Little Tern	*Sternula albifrons*	Not Listed	N/A	Breeding visitor in the NWHI	Pyle & Pyle 2009
Least Tern	*Sternula antillarum*	Not Listed	N/A	Breeding visitor in the NWHI	Pyle & Pyle 2009
Arctic Tern	*Sterna paradisaea*	Not Listed	N/A	Migrant	Pyle & Pyle 2009
South Polar Skua	*Stercorarius maccormicki*	Not Listed	N/A	Migrant	Pyle & Pyle 2009
Pomarine Jaeger	*Stercorarius pomarinus*	Not Listed	N/A	Winter resident in the MHI	Pyle & Pyle 2009
Parasitic Jaeger	*Stercorarius parasiticus*	Not Listed	N/A	Migrant	Pyle & Pyle 2009
Long-Tailed Jaeger	*Stercorarius longicaudus*	Not Listed	N/A	Migrant	Pyle & Pyle 2009
Sea turtles					
Green Sea Turtle	*Chelonia mydas*	Threatened (Central North Pacific DPS)	N/A	Most common turtle in the Hawaiian Islands, much more common in nearshore State waters (foraging grounds) than offshore federal waters. Most nesting occurs on French Frigate Shoals in the NWHI. Foraging and haul out in the MHI.	43 FR 32800, 81 FR 20057, Balazs et al. 1992, Kolinski et al. 2001
Green Sea Turtle	*Chelonia mydas*	Threatened (East Pacific DPS)	N/A	Nest primarily in Mexico and the Galapagos Islands. Little known about their pelagic range west of 90°W but may range as far as the Marshall Islands. Genetic testing confirmed that they are incidentally taken in the HI DSLL fishery.	43 FR 32800, 81 FR 20057, WPRFMC 2009, Cliffton et al. 1982, Karl & Bowen 1999
Hawksbill Sea Turtle	*Eretmochelys imbricata*	Endangered[a]	N/A	Small population foraging around Hawaii and low level nesting on Maui and Hawaii Islands. Occur worldwide in tropical and subtropical waters.	35 FR 8491, NMFS & USFWS 2007, Balazs et al. 1992, Katahira et al. 1994
Leatherback Sea Turtle	*Dermochelys coriacea*	Endangered[a]	N/A	Regularly sighted in offshore waters, especially at the southeastern end of the archipelago.	35 FR 8491, NMFS & USFWS 1997

Common Name	Scientific Name	ESA Listing Status	MMPA Status	Occurrence	References
Loggerhead Sea Turtle	*Caretta caretta*	Endangered (North Pacific DPS)	N/A	Rare in Hawaii. Found worldwide along continental shelves, bays, estuaries, and lagoons of tropical, subtropical, and temperate waters.	43 FR 32800, 76 FR 58868, Dodd 1990, Balazs 1979
Olive Ridley Sea Turtle	*Lepidochelys olivacea*	Threatened (Entire species, except for the breeding population on the Pacific coast of Mexico, which is listed as endangered)	N/A	Rare in Hawaii. Occurs worldwide in tropical and warm temperate ocean waters.	43 FR 32800, Pitman 1990, Balacz 1982
Marine mammals					
Blainville's Beaked Whale	*Mesoplodon densirostris*	Not Listed	Non-strategic	Found worldwide in tropical and temperate waters	Mead 1989
Blue Whale	*Balaenoptera musculus*	Endangered	Strategic	Acoustically recorded off of Oahu and Midway Atoll, small number of sightings around Hawaii. Considered extremely rare, generally occur in winter and summer.	35 FR 18319, Bradford et al. 2013, Northrop et al. 1971, Thompson & Friedl 1982, Stafford et al. 2001
Bottlenose Dolphin	*Tursiops truncatus*	Not Listed	Non-strategic	Distributed worldwide in tropical and warm-temperate waters. Pelagic stock distinct from island-associated stocks.	Perrin et al. 2009, Martien et al. 2012
Bryde's Whale	*Balaenoptera edeni*	Not Listed	Unknown	Distributed widely across tropical and warm-temperate Pacific Ocean.	Leatherwood et al. 1982
Common Dolphin	*Delphinus delphis*	Not Listed	N/A	Found worldwide in temperate and subtropical seas.	Perrin et al. 2009
Cuvier's Beaked Whale	*Ziphius cavirostris*	Not Listed	Non-strategic	Occur year round in Hawaiian waters.	McSweeney et al. 2007
Dall's Porpoise	*Phocoenoides dalli*	Not Listed	Non-strategic	Range across the entire north Pacific Ocean.	Hall 1979
Dwarf Sperm Whale	*Kogia sima*	Not Listed	Non-strategic	Most common in waters between 500 m and 1,000 m in depth. Found worldwide in tropical and warm-temperate waters.	Nagorsen 1985, Baird et al. 2013
False Killer Whale	*Pseudorca crassidens*	Not Listed	Non-strategic	Found worldwide in tropical and warm-temperate waters. Pelagic stock tracked to within 11 km of Hawaiian Islands.	Stacey et al. 1994, Baird et al. 2012, Bradford et al. 2015

Common Name	Scientific Name	ESA Listing Status	MMPA Status	Occurrence	References
Fin Whale	*Balaenoptera physalus*	Endangered	Strategic	Infrequent sightings in Hawaii waters. Considered rare in Hawaii, though may migrate into Hawaiian waters during fall/winter based on acoustic recordings.	35 FR 18319, Hamilton et al. 2009, Thompson & Friedl 1982
Fraser's Dolphin	*Lagenodelphis hosei*	Not Listed	Non-strategic	Found worldwide in tropical waters.	Perrin et al. 2009
Guadalupe Fur Seal	*Arctocephalus townsendi*	Threatened	Strategic	Extremely rare sightings. Little known about their pelagic distribution. Breed mainly on Isla Guadalupe, Mexico.	50 FR 51252, Gallo-Reynoso et al. 2008, Fleischer 1987
Hawaiian Monk Seal	*Neomonachus schauinslandi*	Endangered[a]	Strategic	Endemic tropical seal. Occurs throughout the archipelago. MHI population spends some time foraging in federal waters during the day.	41 FR 51611, Baker at al. 2011
Humpback Whale	*Megaptera novaeangliae*	Delisted Due to Recovery (Hawaii DPS)	Strategic	Migrate through the archipelago and breed during the winter. Common during winter months when they are generally found within the 100 m isobath.	35 FR 18319, 81 FR 62259, Childerhouse et al. 2008, Wolman & Jurasz 1976, Herman & Antinoja 1977, Rice & Wolman 1978
Killer Whale	*Orcinus orca*	Not Listed	Non-strategic	Rare in Hawaii. Prefer colder waters within 800 km of continents.	Mitchell 1975, Baird et al. 2006
Longman's Beaked Whale	*Indopacetus pacificus*	Not Listed	Non-strategic	Found in tropical waters from the eastern Pacific westward through the Indian Ocean to the eastern coast of Africa. Rare in Hawaii.	Dalebout 2003, Baird et al. 2013
Melon-Headed Whale	*Peponocephala electra*	Not Listed	Non-strategic	Found in tropical and warm-temperate waters worldwide, found primarily in equatorial waters. Uncommon in Hawaii.	Perryman et al. 1994, Barlow 2006, Bradford et al. 2013
Minke Whale	*Balaenoptera acutorostrata*	Not Listed	Non-strategic	Occur seasonally around Hawaii	Barlow 2003, Rankin & Barlow 2005
North Pacific Right Whale	*Eubalaena japonica*	Endangered[a]	Strategic	Extremely rare in Hawaii waters	35 FR 18319, 73 FR 12024, Rowntree et al. 1980, Herman et al. 1980

Common Name	Scientific Name	ESA Listing Status	MMPA Status	Occurrence	References
Northern Elephant Seal	*Mirounga angustirostris*	Not Listed	Non-strategic	Females migrate to central North Pacific to feed on pelagic prey.	Le Beouf et al. 2000
Northern Fur Seal	*Callorhinus ursinus*	Not Listed	Non-strategic	Occur throughout the North Pacific Ocean.	Gelatt et al. 2015
Pacific White-Sided Dolphin	*Lagenorhynchus obliquidens*	Not Listed	Non-strategic	Endemic to temperate waters of North Pacific Ocean. Occur both on the high seas and along continental margins.	Brownell et al. 1999
Pantropical Spotted Dolphin	*Stenella attenuata*	Not Listed	Non-strategic	Common and abundant throughout the Hawaiian archipelago. Pelagic stock occurs outside of insular stock areas (20 km for Oahu and 4-island stocks, 65 km for Hawaii Island stock).	Baird et al. 2013, Oleson et al. 2013
Pygmy Killer Whale	*Feresa attenuata*	Not Listed	Non-strategic	Small resident population in Hawaiian waters. Found worldwide in tropical and subtropical waters.	McSweeney et al. 2009, Ross & Leatherwood 1994
Pygmy Sperm Whale	*Kogia breviceps*	Not Listed	Non-strategic	Found worldwide in tropical and warm-temperate waters.	Caldwell & Caldwell 1989
Risso's Dolphin	*Grampus griseus*	Not Listed	Non-strategic	Found in tropical to warm-temperate waters worldwide.	Perrin et al. 2009
Rough-Toothed Dolphin	*Steno bredanensis*	Not Listed	Non-strategic	Found in tropical to warm-temperate waters worldwide. Occasionally found offshore of Hawaii.	Perrin et al. 2009, Baird et al. 2013, Barlow 2006, Bradford et al. 2013
Sei Whale	*Balaenoptera borealis*	Endangered	Strategic	Rare in Hawaii. Generally found in offshore temperate waters.	35 FR 18319, Barlow 2003, Bradford et al. 2013
Short-Finned Pilot Whale	*Globicephala macrorhynchus*	Not Listed	Non-strategic	Found in tropical to warm-temperate waters worldwide. Commonly observed around MHI and present around NWHI.	Shallenberger 1981, Baird et al. 2013, Bradford et al. 2013
Sperm Whale	*Physeter macrocephalus*	Endangered	Strategic	Found in tropical to polar waters worldwide, most abundant cetaceans in the region. Sighted off the NWHI and the MHI.	35 FR 18319, Rice 1960, Lee 1993, Barlow 2006, Mobley et al. 2000, Shallenberger 1981

Common Name	Scientific Name	ESA Listing Status	MMPA Status	Occurrence	References
Spinner Dolphin	*Stenella longirostris*	Not Listed	Non-strategic	Found worldwide in tropical and warm-temperate waters. Pelagic stock found outside of island-associated boundaries (10 nm).	Perrin et al. 2009
Striped Dolphin	*Stenella coeruleoalba*	Not Listed	Non-strategic	Found in tropical to warm-temperate waters throughout the world.	Perrin et al. 2009
Elasmobranchs					
Giant manta ray	*Manta birostris*	Threatened	N/A	Found worldwide in tropical, subtropical, and temperate waters. Commonly found in upwelling zones, oceanic island groups, offshore pinnacles and seamounts, and on shallow reefs.	Dewar et al. 2008, Marshall et al. 2009, Marshall et al. 2011.
Oceanic whitetip shark	*Carcharhinus longimanus*	Threatened	N/A	Found worldwide in open ocean waters from the surface to 152 m depth. It is most commonly found in waters > 20°C	Bonfil et al. 2008, Backus et al, 1956, Strasburg 1958, Compagno 1984
Scalloped hammerhead shark	*Sphyrna lewini*	Endangered (Eastern Pacific DPS)	N/A	Found in coastal areas from southern California to Peru.	Compagno 1984, Baum et al. 2007, Bester 2011
Scalloped hammerhead	*Sphyrna lewini*	Threatened (Indo-West Pacific DPS)	N/A	Occur over continental and insular shelves, and adjacent deep waters, but rarely found in waters < 22°C. Range from the intertidal and surface to depths up to 450–512 m.	Compagno 1984, Schulze-Haugen & Kohler 2003, Sanches 1991, Klimley 1993
Corals					
N/A	*Acropora globiceps*	Threatened	N/A	Not confirmed in Hawaii waters. Occur on upper reef slopes, reef flats, and adjacent habitats in depths ranging from 0 to 8 m	Veron 2014
N/A	*Acropora jacquelineae*	Threatened	N/A	Not confirmed in Hawaii waters. Found in numerous subtidal reef slope and back-reef habitats, including but not limited to, lower reef slopes, walls and ledges, mid-slopes, and upper reef slopes protected from wave action, and depth range is 10 to 35 m.	Veron 2014

Common Name	Scientific Name	ESA Listing Status	MMPA Status	Occurrence	References
N/A	*Acropora retusa*	Threatened	N/A	Not confirmed in Hawaii waters. Occur in shallow reef slope and back-reef areas, such as upper reef slopes, reef flats, and shallow lagoons, and depth range is 1 to 5 m.	Veron 2014
N/A	*Acropora speciosa*	Threatened	N/A	Not confirmed in Hawaii waters. Found in protected environments with clear water and high diversity of *Acropora* and steep slopes or deep, shaded waters. Depth range is 12 to 40 meters and have been found in mesophotic habitat (40-150 m).	Veron 2014
N/A	*Euphyllia paradivisa*	Threatened	N/A	Not confirmed in Hawaii waters. Found in environments protected from wave action on at least upper reef slopes, mid-slope terraces, and lagoons in depths ranging from 2 to 25 m depth.	Veron 2014
N/A	*Isopora crateriformis*	Threatened	N/A	Not confirmed in Hawaii waters. Found in shallow, high-wave energy environments, from low tide to at least 12 meters deep, and have been reported from mesophotic depths (less than 50 m depth).	Veron 2014
N/A	*Seriatopora aculeata*	Threatened	N/A	Not confirmed in Hawaii waters. Found in broad range of habitats including, but not limited to, upper reef slopes, mid-slope terraces, lower reef slopes, reef flats, and lagoons, and depth ranges from 3 to 40 m.	Veron 2014
Invertebrates					
Chambered nautilus	*Nautilus pompilius*	Threatened	N/A	Found in small, isolated populations throughout the Indo-Pacific on steep-sloped forereefs with sandy, silty, or muddy bottom substrates from depths of 100 m to 500 m.	83 FR 48948, CITES 2016

[a] These species have critical habitat designated under the ESA. See Table B-4.

Table B-2. Protected species found or reasonably believed to be found near or in Hawaii deep-set longline waters

Common Name	Scientific Name	ESA Listing Status	MMPA Status	Occurrence	References
Seabirds					
Laysan Albatross	*Phoebastria immutabilis*	Not Listed	N/A	Breeding visitor	Pyle & Pyle 2009
Black-Footed Albatross	*Phoebastria nigripes*	Not Listed	N/A	Breeding visitor	Pyle & Pyle 2009
Short-Tailed Albatross	*Phoebastria albatrus*	Endangered	N/A	Breeding visitor in the NWHI	35 FR 8495, 65 FR 46643, Pyle & Pyle 2009
Northern Fulmar	*Fulmarus glacialis*	Not Listed	N/A	Winter resident	Pyle & Pyle 2009
Kermadec Petrel	*Pterodroma neglecta*	Not Listed	N/A	Migrant	Pyle & Pyle 2009
Herald Petrel	*Pterodroma arminjoniana*	Not Listed	N/A	Migrant	Pyle & Pyle 2009
Murphy's Petrel	*Pterodroma ultima*	Not Listed	N/A	Migrant	Pyle & Pyle 2009
Mottled Petrel	*Pterodroma inexpectata*	Not Listed	N/A	Migrant	Pyle & Pyle 2009
Juan Fernandez Petrel	*Pterodroma externa*	Not Listed	N/A	Migrant	Pyle & Pyle 2009
Hawaiian Petrel	*Pterodroma sandwichensis (Pterodroma phaeopygia sandwichensis)*	Endangered	N/A	Breeding visitor in the MHI	32 FR 4001, Pyle & Pyle 2009
White-Necked Petrel	*Pterodroma cervicalis*	Not Listed	N/A	Migrant	Pyle & Pyle 2009
Bonin Petrel	*Pterodroma hypoleuca*	Not Listed	N/A	Breeding visitor in the NWHI	Pyle & Pyle 2009
Black-Winged Petrel	*Pterodroma nigripennis*	Not Listed	N/A	Migrant	Pyle & Pyle 2009
Cook Petrel	*Pterodroma cookii*	Not Listed	N/A	Migrant	Pyle & Pyle 2009
Stejneger Petrel	*Pterodroma longirostris*	Not Listed	N/A	Migrant	Pyle & Pyle 2009
Pycroft Petrel	*Pterodroma pycrofti*	Not Listed	N/A	Migrant	Pyle & Pyle 2009
Bulwer Petrel	*Bulweria bulwerii*	Not Listed	N/A	Breeding visitor	Pyle & Pyle 2009
Wedge-Tailed Shearwater	*Ardenna pacifica*	Not Listed	N/A	Breeding visitor	Pyle & Pyle 2009
Buller's Shearwater	*Ardenna bulleri*	Not Listed	N/A	Migrant	Pyle & Pyle 2009
Sooty Shearwater	*Ardenna grisea*	Not Listed	N/A	Migrant	Pyle & Pyle 2009
Short-Tailed Shearwater	*Ardenna tenuirostris*	Not Listed	N/A	Migrant	Pyle & Pyle 2009
Christmas Shearwater	*Puffinus nativitatis*	Not Listed	N/A	Breeding visitor	Pyle & Pyle 2009

Common Name	Scientific Name	ESA Listing Status	MMPA Status	Occurrence	References
Newell's Shearwater	*Puffinus newelli (Puffinus auricularis newelli)*	Threatened	N/A	Breeding visitor	40 FR 44149, Pyle & Pyle 2009
Wilson's Storm-Petrel	*Oceanites oceanicus*	Not Listed	N/A	Migrant	Pyle & Pyle 2009
Leach's Storm-Petrel	*Oceanodroma leucorhoa*	Not Listed	N/A	Winter resident	Pyle & Pyle 2009
Band-Rumped Storm-Petrel	*Oceanodroma castro*	Not Listed	N/A	Breeding visitor	Pyle & Pyle 2009
Tristram Storm-Petrel	*Oceanodroma tristrami*	Not Listed	N/A	Breeding visitor in the NWHI	Pyle & Pyle 2009
White-Tailed Tropicbird	*Phaethon lepturus*	Not Listed	N/A	Breeding visitor	Pyle & Pyle 2009
Red-Tailed Tropicbird	*Phaethon rubricauda*	Not Listed	N/A	Breeding visitor	Pyle & Pyle 2009
Masked Booby	*Sula dactylatra*	Not Listed	N/A	Breeding visitor	Pyle & Pyle 2009
Nazca Booby	*Sula granti*	Not Listed	N/A	Vagrant	Pyle & Pyle 2009
Brown Booby	*Sula leucogaster*	Not Listed	N/A	Breeding visitor	Pyle & Pyle 2009
Red-Footed Booby	*Sula*	Not Listed	N/A	Breeding visitor	Pyle & Pyle 2009
Great Frigatebird	*Fregata minor*	Not Listed	N/A	Breeding visitor	Pyle & Pyle 2009
Lesser Frigatebird	*Fregata ariel*	Not Listed	N/A	Breeding visitor	Pyle & Pyle 2009
Laughing Gull	*Leucophaeus atricilla*	Not Listed	N/A	Winter resident in the MHI	Pyle & Pyle 2009
Franklin Gull	*Leucophaeus pipixcan*	Not Listed	N/A	Migrant	Pyle & Pyle 2009
Ring-Billed Gull	*Larus delawarensis*	Not Listed	N/A	Winter resident in the MHI	Pyle & Pyle 2009
Herring Gull	*Larus argentatus*	Not Listed	N/A	Winter resident in the NWHI	Pyle & Pyle 2009
Slaty-Backed Gull	*Larus schistisagus*	Not Listed	N/A	Winter resident in the NWHI	Pyle & Pyle 2009
Glaucous-Winged Gull	*Larus glaucescens*	Not Listed	N/A	Winter resident	Pyle & Pyle 2009
Brown Noddy	*Anous stolidus*	Not Listed	N/A	Breeding visitor	Pyle & Pyle 2009
Black Noddy	*Anous minutus*	Not Listed	N/A	Breeding visitor	Pyle & Pyle 2009
Blue-Gray Noddy	*Procelsterna cerulea*	Not Listed	N/A	Breeding visitor in the NWHI	Pyle & Pyle 2009
White Tern	*Gygis alba*	Not Listed	N/A	Breeding visitor	Pyle & Pyle 2009
Sooty Tern	*Onychoprion fuscatus*	Not Listed	N/A	Breeding visitor	Pyle & Pyle 2009
Gray-Backed Tern	*Onychoprion lunatus*	Not Listed	N/A	Breeding visitor	Pyle & Pyle 2009

Common Name	Scientific Name	ESA Listing Status	MMPA Status	Occurrence	References
Little Tern	*Sternula albifrons*	Not Listed	N/A	Breeding visitor in the NWHI	Pyle & Pyle 2009
Least Tern	*Sternula antillarum*	Not Listed	N/A	Breeding visitor in the NWHI	Pyle & Pyle 2009
Arctic Tern	*Sterna paradisaea*	Not Listed	N/A	Migrant	Pyle & Pyle 2009
South Polar Skua	*Stercorarius maccormicki*	Not Listed	N/A	Migrant	Pyle & Pyle 2009
Pomarine Jaeger	*Stercorarius pomarinus*	Not Listed	N/A	Winter resident in the MHI	Pyle & Pyle 2009
Parasitic Jaeger	*Stercorarius parasiticus*	Not Listed	N/A	Migrant	Pyle & Pyle 2009
Long-Tailed Jaeger	*Stercorarius longicaudus*	Not Listed	N/A	Migrant	Pyle & Pyle 2009
Sea turtles					
Green Sea Turtle	*Chelonia mydas*	Threatened (Central North Pacific DPS)	N/A	Most common turtle in the Hawaiian Islands, much more common in nearshore State waters (foraging grounds) than offshore federal waters. Most nesting occurs on French Frigate Shoals in the NWHI. Foraging and haulout in the MHI.	43 FR 32800, 81 FR 20057, Balazs et al. 1992, Kolinski et al. 2001
Green Sea Turtle	*Chelonia mydas*	Threatened (East Pacific DPS)	N/A	Nest primarily in Mexico and the Galapagos Islands. Little known about their pelagic range west of 90°W but may range as far as the Marshall Islands. Genetic testing confirmed that they are incidentally taken in the HI DSLL fishery.	43 FR 32800, 81 FR 20057, WPRFMC 2009, Cliffton et al. 1982, Karl & Bowen 1999
Hawksbill Sea Turtle	*Eretmochelys imbricata*	Endangered[a]	N/A	Small population foraging around Hawaii and low level nesting on Maui and Hawaii Islands. Occur worldwide in tropical and subtropical waters.	35 FR 8491, NMFS & USFWS 2007, Balazs et al. 1992, Katahira et al. 1994
Leatherback Sea Turtle	*Dermochelys coriacea*	Endangered[a]	N/A	Regularly sighted in offshore waters, especially at the southeastern end of the archipelago.	35 FR 8491, NMFS & USFWS 1997
Loggerhead Sea Turtle	*Caretta*	Endangered (North Pacific DPS)	N/A	Rare in Hawaii. Found worldwide along continental shelves, bays, estuaries, and lagoons of tropical, subtropical, and temperate waters.	43 FR 32800, 76 FR 58868, Dodd 1990, Balazs 1979

Common Name	Scientific Name	ESA Listing Status	MMPA Status	Occurrence	References
Olive Ridley Sea Turtle	*Lepidochelys olivacea*	Threatened (Entire species, except for the breeding population on the Pacific coast of Mexico, which is listed as endangered)	N/A	Rare in Hawaii. Occurs worldwide in tropical and warm temperate ocean waters.	43 FR 32800, Pitman 1990, Balacz 1982
Marine mammals					
Blainville's Beaked Whale	*Mesoplodon densirostris*	Not Listed	Non-strategic	Found worldwide in tropical and temperate waters	Mead 1989
Blue Whale	*Balaenoptera musculus*	Endangered	Strategic	Acoustically recorded off of Oahu and Midway Atoll, small number of sightings around Hawaii. Considered extremely rare, generally occur in winter and summer.	35 FR 18319, Bradford et al. 2013, Northrop et al. 1971, Thompson & Friedl 1982, Stafford et al. 2001
Bottlenose Dolphin	*Tursiops truncatus*	Not Listed	Non-strategic	Distributed worldwide in tropical and warm-temperate waters. Pelagic stock distinct from island-associated stocks.	Perrin et al. 2009, Martien et al. 2012
Bryde's Whale	*Balaenoptera edeni*	Not Listed	Unknown	Distributed widely across tropical and warm-temperate Pacific Ocean.	Leatherwood et al. 1982
Common Dolphin	*Delphinus delphis*	Not Listed	N/A	Found worldwide in temperate and subtropical seas.	Perrin et al. 2009
Cuvier's Beaked Whale	*Ziphius cavirostris*	Not Listed	Non-strategic	Occur year round in Hawaiian waters.	McSweeney et al. 2007
Dall's Porpoise	*Phocoenoides dalli*	Not Listed	Non-strategic	Range across the entire north Pacific Ocean.	Hall 1979
Dwarf Sperm Whale	*Kogia sima*	Not Listed	Non-strategic	Most common in waters between 500 m and 1,000 m in depth. Found worldwide in tropical and warm-temperate waters.	Nagorsen 1985, Baird et al. 2013
False Killer Whale	*Pseudorca crassidens*	Not Listed	Non-strategic	Found worldwide in tropical and warm-temperate waters. Pelagic stock tracked to within 11 km of Hawaiian Islands.	Stacey et al. 1994, Baird et al. 2012, Bradford et al. 2015

Common Name	Scientific Name	ESA Listing Status	MMPA Status	Occurrence	References
Fin Whale	*Balaenoptera physalus*	Endangered	Strategic	Infrequent sightings in Hawaii waters. Considered rare in Hawaii, though may migrate into Hawaiian waters during fall/winter based on acoustic recordings.	35 FR 18319, Hamilton et al. 2009, Thompson & Friedl 1982
Fraser's Dolphin	*Lagenodelphis hosei*	Not Listed	Non-strategic	Found worldwide in tropical waters.	Perrin et al. 2009
Guadalupe Fur Seal	*Arctocephalus townsendi*	Threatened	Strategic	Rare sightings. Little known about their pelagic distribution. Breed mainly on Isla Guadalupe, Mexico.	50 FR 51252, Gallo-Reynoso et al. 2008, Fleischer 1987
Hawaiian Monk Seal	*Neomonachus schauinslandi*	Endangered[a]	Strategic	Endemic tropical seal. Occurs throughout the archipelago. MHI population spends some time foraging in federal waters during the day.	41 FR 51611, Baker at al. 2011
Humpback Whale	*Megaptera novaeangliae*	Delisted Due to Recovery (Hawaii DPS)	Strategic	Migrate through the archipelago and breed during the winter. Common during winter months when they are generally found within the 100 m isobath.	35 FR 18319, 81 FR 62259, Childerhouse et al. 2008, Wolman & Jurasz 1976, Herman & Antinoja 1977, Rice & Wolman 1978
Killer Whale	*Orcinus orca*	Not Listed	Non-strategic	Rare in Hawaii. Prefer colder waters within 800 km of continents.	Mitchell 1975, Baird et al. 2006
Longman's Beaked Whale	*Indopacetus pacificus*	Not Listed	Non-strategic	Found in tropical waters from the eastern Pacific westward through the Indian Ocean to the eastern coast of Africa. Rare in Hawaii.	Dalebout 2003, Baird et al. 2013
Melon-Headed Whale	*Peponocephala electra*	Not Listed	Non-strategic	Found in tropical and warm-temperate waters worldwide, found primarily in equatorial waters. Uncommon in Hawaii.	Perryman et al. 1994, Barlow 2006, Bradford et al. 2013
Minke Whale	*Balaenoptera acutorostrata*	Not Listed	Non-strategic	Occur seasonally around Hawaii	Barlow 2003, Rankin & Barlow 2005
North Pacific Right Whale	*Eubalaena japonica*	Endangered[a]	Strategic	Extremely rare in Hawaii waters	35 FR 18319, 73 FR 12024, Rowntree et al. 1980, Herman et al. 1980

Common Name	Scientific Name	ESA Listing Status	MMPA Status	Occurrence	References
Northern Elephant Seal	*Mirounga angustirostris*	Not Listed	Non-strategic	Females migrate to central North Pacific to feed on pelagic prey	Le Beouf et al. 2000
Northern Fur Seal	*Callorhinus ursinus*	Not Listed	Non-strategic	Range across the north Pacific Ocean.	Gelatt et al. 2015
Pacific White-Sided Dolphin	*Lagenorhynchus obliquidens*	Not Listed	Non-strategic	Endemic to temperate waters of North Pacific Ocean. Occur both on the high seas and along continental margins.	Brownell et al. 1999
Pantropical Spotted Dolphin	*Stenella attenuata*	Not Listed	Non-strategic	Common and abundant throughout the Hawaiian archipelago. Pelagic stock occurs outside of insular stock areas (20 km for Oahu and 4-island stocks, 65 km for Hawaii Island stock)	Baird et al. 2013, Oleson et al. 2013
Pygmy Killer Whale	*Feresa attenuata*	Not Listed	Non-strategic	Small resident population in Hawaiian waters. Found worldwide in tropical and subtropical waters.	McSweeney et al. 2009, Ross & Leatherwood 1994
Pygmy Sperm Whale	*Kogia breviceps*	Not Listed	Non-strategic	Found worldwide in tropical and warm-temperate waters.	Caldwell & Caldwell 1989
Risso's Dolphin	*Grampus griseus*	Not Listed	Non-strategic	Found in tropical to warm-temperate waters worldwide.	Perrin et al. 2009
Rough-Toothed Dolphin	*Steno bredanensis*	Not Listed	Non-strategic	Found in tropical to warm-temperate waters worldwide. Occasionally found offshore of Hawaii.	Perrin et al. 2009, Bradford et al. 2013, Barlow 2006, Baird et al. 2013
Sei Whale	*Balaenoptera borealis*	Endangered	Strategic	Rare in Hawaii. Generally found in offshore temperate waters.	35 FR 18319, Barlow 2003, Bradford et al. 2013
Short-Finned Pilot Whale	*Globicephala macrorhynchus*	Not Listed	Non-strategic	Found in tropical to warm-temperate waters worldwide. Commonly observed around MHI and present around NWHI.	Shallenberger 1981, Baird et al. 2013, Bradford et al. 2013
Sperm Whale	*Physeter macrocephalus*	Endangered	Strategic	Found in tropical to polar waters worldwide, most abundant cetaceans in the region. Sighted off the NWHI and the MHI.	35 FR 18319, Rice 1960, Lee 1993, Barlow 2006, Mobley et al. 2000, Shallenberger 1981

Common Name	Scientific Name	ESA Listing Status	MMPA Status	Occurrence	References
Spinner Dolphin	*Stenella longirostris*	Not Listed	Non-strategic	Found worldwide in tropical and warm-temperate waters. Pelagic stock found outside of island-associated boundaries (10 nm)	Perrin et al. 2009
Striped Dolphin	*Stenella coeruleoalba*	Not Listed	Non-strategic	Found in tropical to warm-temperate waters throughout the world	Perrin et al. 2009
Elasmobranchs					
Giant manta ray	*Manta birostris*	Threatened	N/A	Found worldwide in tropical, subtropical, and temperate waters. Commonly found in upwelling zones, oceanic island groups, offshore pinnacles and seamounts, and on shallow reefs.	Dewar et al. 2008, Marshall et al. 2009, Marshall et al. 2011.
Oceanic whitetip shark	*Carcharhinus longimanus*	Threatened	N/A	Found worldwide in open ocean waters from the surface to 152 m depth. It is most commonly found in waters > 20°C	Bonfil et al. 2008, Backus et al, 1956, Strasburg 1958, Compagno 1984
Scalloped hammerhead shark	*Sphyrna lewini*	Endangered (Eastern Pacific DPS)	N/A	Found in coastal areas from southern California to Peru.	Compagno 1984, Baum et al. 2007, Bester 2011
Scalloped hammerhead shark	*Sphyrna lewini*	Threatened (Indo-West Pacific DPS)	N/A	Occur over continental and insular shelves, and adjacent deep waters, but rarely found in waters < 22°C. Range from the intertidal and surface to depths up to 450–512 m.	Compagno 1984, Schulze-Haugen & Kohler 2003, Sanches 1991, Klimley 1993
Corals					
N/A	*Acropora globiceps*	Threatened	N/A	Occur on upper reef slopes, reef flats, and adjacent habitats in depths ranging from 0 to 8 m.	Veron 2014
N/A	*Acropora jacquelineae*	Threatened	N/A	Found in numerous subtidal reef slope and back-reef habitats, including but not limited to, lower reef slopes, walls and ledges, mid-slopes, and upper reef slopes protected from wave action, and depth range is 10 to 35 m.	Veron 2014

Common Name	Scientific Name	ESA Listing Status	MMPA Status	Occurrence	References
N/A	*Acropora retusa*	Threatened	N/A	Occur in shallow reef slope and back-reef areas, such as upper reef slopes, reef flats, and shallow lagoons, and depth range is 1 to 5 m.	Veron 2014
N/A	*Acropora speciosa*	Threatened	N/A	Found in protected environments with clear water and high diversity of *Acropora* and steep slopes or deep, shaded waters. Depth range is 12 to 40 meters, and it has been found in mesophotic habitat (40-150 m).	Veron 2014
N/A	*Euphyllia paradivisa*	Threatened	N/A	Found in environments protected from wave action on at least upper reef slopes, mid-slope terraces, and lagoons in depths ranging from 2 to 25 m depth.	Veron 2014
N/A	*Isopora crateriformis*	Threatened	N/A	Found in shallow, high-wave energy environments, from low tide to at least 12 m deep, and have been reported from mesophotic depths (less than 50 m depth).	Veron 2014
N/A	*Seriatopora aculeata*	Threatened	N/A	Found in broad range of habitats including, but not limited to, upper reef slopes, mid-slope terraces, lower reef slopes, reef flats, and lagoons, and depth ranges from 3 to 40 m.	Veron 2014
Invertebrates					
Chambered nautilus	*Nautilus pompilius*	Threatened	N/A	Found in small, isolated populations throughout the Indo-Pacific on steep-sloped forereefs with sandy, silty, or muddy bottom substrates from depths of 100 m to 500 m.	83 FR 48948, CITES 2016

[a] These species have critical habitat designated under the ESA. See Table B-4.

Table B-3. Protected species found or reasonably believed to be found near or in American Samoa longline waters

Common Name	Scientific Name	ESA Listing Status	MMPA Status	Occurrence	References
Seabirds					

Common Name	Scientific Name	ESA Listing Status	MMPA Status	Occurrence	References
Audubon's Shearwater	*Puffinus lherminieri*	Not Listed	N/A	Resident	Craig 2005
Black Noddy	*Anous minutus*	Not Listed	N/A	Resident	Craig 2005
Black-Naped Tern	*Sterna sumatrana*	Not Listed	N/A	Visitor	Craig 2005
Blue-Gray Noddy	*Procelsterna cerulea*	Not Listed	N/A	Resident	Craig 2005
Bridled Tern	*Onychoprion anaethetus*	Not Listed	N/A	Visitor	Craig 2005
Brown Booby	*Sula leucogaster*	Not Listed	N/A	Resident	Craig 2005
Brown Noddy	*Anous stolidus*	Not Listed	N/A	Resident	Craig 2005
Christmas Shearwater	*Puffinus nativitatis*	Not Listed	N/A	Resident?	Craig 2005
Collared Petrel	*Pterodroma brevipes*	Not Listed	N/A	Resident?	Craig 2005
White Tern	*Gygis alba*	Not Listed	N/A	Resident	Craig 2005
Greater Crested Tern	*Thalasseus bergii*	Not Listed	N/A	Visitor	Craig 2005
Gray-Backed Tern	*Onychoprion lunatus*	Not Listed	N/A	Resident	Craig 2005
Great Frigatebird	*Fregata minor*	Not Listed	N/A	Resident	Craig 2005
Herald Petrel	*Pterodroma heraldica*	Not Listed	N/A	Resident	Craig 2005
Laughing Gull	*Leucophaeus atricilla*	Not Listed	N/A	Visitor	Craig 2005
Lesser Frigatebird	*Fregata ariel*	Not Listed	N/A	Resident	Craig 2005
Masked Booby	*Sula dactylatra*	Not Listed	N/A	Resident	Craig 2005
Newell's Shearwater	*Puffinus auricularis newelli*	Threatened	N/A	Visitor	40 FR 44149, Craig 2005
Red-Footed Booby	*Sula*	Not Listed	N/A	Resident	Craig 2005
Red-Tailed Tropicbird	*Phaethon rubricauda*	Not Listed	N/A	Resident	Craig 2005
Short-Tailed Shearwater	*Ardenna tenuirostris*	Not Listed	N/A	Visitor	Craig 2005
Sooty Shearwater	*Ardenna grisea*	Not Listed	N/A	Visitor	Craig 2005
Sooty Tern	*Sterna fuscata*	Not Listed	N/A	Resident	Craig 2005
Tahiti Petrel	*Pterodroma rostrata*	Not Listed	N/A	Resident	Craig 2005
Wedge-Tailed Shearwater	*Ardenna pacifica*	Not Listed	N/A	Resident?	Craig 2005
White-Necked Petrel	*Pterodroma cervicalis*	Not Listed	N/A	Visitor	Craig 2005
White-Faced Storm-Petrel	*Pelagodroma marina*	Not Listed	N/A	Visitor	Craig 2005
White-Tailed Tropicbird	*Phaethon lepturus*	Not Listed	N/A	Resident	Craig 2005
White-Throated Storm-Petrel	*Nesofregetta fuliginosa*	Not Listed	N/A	Resident?	Craig 2005

Common Name	Scientific Name	ESA Listing Status	MMPA Status	Occurrence	References
Laysan Albatross	*Phoebastria immutabilis*	Not Listed	N/A	Breed mainly in Hawaii, and range across the North Pacific Ocean.	Causey 2008
Hawaiian Petrel	*Pterodroma sandwichensis (Pterodroma phaeopygia sandwichensis)*	Endangered	N/A	Breed in MHI, and range across the central Pacific Ocean.	32 FR 4001, Simons & Hodges 1998
Laysan Albatross	*Phoebastria immutabilis*	Not Listed	N/A	Breed mainly in Hawaii, and range across the North Pacific Ocean.	Causey 2009
Northern Fulmar	*Fulmarus glacialis*	Not Listed	N/A	Breed and range across North Pacific Ocean.	Hatch & Nettleship 2012
Short-Tailed Albatross	*Phoebastria albatrus*	Endangered	N/A	Breed in Japan and NWHI, and range across the North Pacific Ocean.	35 FR 8495, 65 FR 46643, BirdLife International 2017
Sea turtles					
Green Sea Turtle	*Chelonia mydas*	Endangered (Central South Pacific DPS)	N/A	Frequently seen. Nest at Rose Atoll in small numbers.	43 FR 32800, 81 FR 20057, Balacz 1994
Hawksbill Sea Turtle	*Eretmochelys imbricata*	Endangered[a]	N/A	Frequently seen. Nest at Rose Atoll, Swain's Island, and Tutuila.	35 FR 8491, NMFS & USFWS 2013, Tuato'o-Bartley et al. 1993
Leatherback Sea Turtle	*Dermochelys coriacea*	Endangered[a]	N/A	Very rare. One juvenile recovered dead in experimental longline fishing.	35 FR 8491, Grant 1994
Loggerhead Sea Turtle	*Caretta caretta*	Endangered (South Pacific DPS)	N/A	No known sightings. Found worldwide along continental shelves, bays, estuaries, and lagoons of tropical, subtropical, and temperate waters.	43 FR 32800, 76 FR 58868, Utzurrum 2002, Dodd 1990
Olive Ridley Sea Turtle	*Lepidochelys olivacea*	Threatened (Entire species, except for the endangered breeding population on the Pacific coast of Mexico)	N/A	Rare. Three known sightings.	43 FR 32800, Utzurrum 2002
Marine mammals					
Blainville's Beaked Whale	*Mesoplodon densirostris*	Not Listed	Non-strategic	Found worldwide in tropical and temperate waters	Mead 1989

Common Name	Scientific Name	ESA Listing Status	MMPA Status	Occurrence	References
Blue Whale	*Balaenoptera musculus*	Endangered	Strategic	No known sightings. Occur worldwide and are known to be found in the western South Pacific.	35 FR 18319, Olson et al. 2015
Bottlenose Dolphin	*Tursiops truncatus*	Not Listed	Non-strategic	Distributed worldwide in tropical and warm-temperate waters. Pelagic stock distinct from island-associated stocks.	Perrin et al. 2009, Martien et al. 2012
Bryde's Whale	*Balaenoptera edeni*	Not Listed	Unknown	Distributed widely across tropical and warm-temperate Pacific Ocean.	Leatherwood et al. 1982
Common Dolphin	*Delphinus delphis*	Not Listed	N/A	Found worldwide in temperate and subtropical seas.	Perrin et al. 2009
Cuvier's Beaked Whale	*Ziphius cavirostris*	Not Listed	Non-strategic	Occur worldwide.	Heyning 1989
Dwarf Sperm Whale	*Kogia sima*	Not Listed	Non-strategic	Found worldwide in tropical and warm-temperate waters.	Nagorsen 1985
False Killer Whale	*Pseudorca crassidens*	Not Listed	Unknown	Found in waters within the U.S. EEZ of A. Samoa	Bradford et al. 2015
Fin Whale	*Balaenoptera physalus*	Endangered	Strategic	No known sightings but reasonably expected to occur in A. Samoa. Found worldwide.	35 FR 18319, Hamilton et al. 2009
Fraser's Dolphin	*Lagenodelphis hosei*	Not Listed	Non-strategic	Found worldwide in tropical waters.	Perrin et al. 2009
Guadalupe Fur Seal	*Arctocephalus townsendi*	Threatened	Strategic	No known sightings. Little known about their pelagic distribution. Breed mainly on Isla Guadalupe, Mexico.	50 FR 51252, Gallo-Reynoso et al. 2008, Fleischer 1987
Humpback Whale	*Megaptera novaeangliae*	Delisted Due to Recovery (Oceania DPS)	Strategic	Migrate through the archipelago and breed during the winter in American Samoan waters.	35 FR 18319, 81 FR 62259, Garrigue et al. 2007, SPWRC 2008
Killer Whale	*Orcinus orca*	Not Listed	Non-strategic	Found worldwide. Prefer colder waters within 800 km of continents.	Leatherwood & Dalheim 1978, Mitchell 1975, Baird et al. 2006
Longman's Beaked Whale	*Indopacetus pacificus*	Not Listed	Non-strategic	Found in tropical waters from the eastern Pacific westward through the Indian Ocean to the eastern coast of Africa.	Dalebout 2003
Melon-Headed Whale	*Peponocephala electra*	Not Listed	Non-strategic	Found in tropical and warm-temperate waters worldwide, primarily found in equatorial waters.	Perryman et al. 1994

Common Name	Scientific Name	ESA Listing Status	MMPA Status	Occurrence	References
Minke Whale	*Balaenoptera acutorostrata*	Not Listed	Non-strategic	Uncommon in this region, usually seen over continental shelves in the Pacific Ocean.	Brueggeman et al. 1990
North Pacific Right Whale	*Eubalaena japonica*	Endangered[a]	Strategic	Extremely rare.	35 FR 18319, 73 FR 12024, Childerhouse et al. 2008, Wolman & Jurasz 1976, Herman & Antinoja 1977, Rice & Wolman 1978
Northern Elephant Seal	*Mirounga angustirostris*	Not Listed	Non-strategic	Females migrate to central North Pacific to feed on pelagic prey	Le Beouf et al. 2000
Pantropical Spotted Dolphin	*Stenella attenuata*	Not Listed	Non-strategic	Found in tropical and subtropical waters worldwide.	Perrin et al. 2009
Pygmy Killer Whale	*Feresa attenuata*	Not Listed	Non-strategic	Found in tropical and subtropical waters worldwide.	Ross & Leatherwood 1994
Pygmy Sperm Whale	*Kogia breviceps*	Not Listed	Non-strategic	Found worldwide in tropical and warm-temperate waters.	Caldwell & Caldwell 1989
Risso's Dolphin	*Grampus griseus*	Not Listed	Non-strategic	Found in tropical to warm-temperate waters worldwide.	Perrin et al. 2009
Rough-Toothed Dolphin	*Steno bredanensis*	Not Listed	Unknown	Found in tropical to warm-temperate waters worldwide. Common in A. Samoa waters.	Perrin et al. 2009, Craig 2005
Sei Whale	*Balaenoptera borealis*	Endangered	Strategic	Generally found in offshore temperate waters.	35 FR 18319, Barlow 2003, Bradford et al. 2013
Short-Finned Pilot Whale	*Globicephala macrorhynchus*	Not Listed	Non-strategic	Found in tropical to warm-temperate waters worldwide	Shallenberger 1981, Baird et al. 2013, Bradford et al. 2013
Sperm Whale	*Physeter macrocephalus*	Endangered	Strategic	Found in tropical to polar waters worldwide, most abundant cetaceans in the region.	35 FR 18319, Rice 1960, Barlow 2006, Lee 1993, Mobley et al. 2000, Shallenberger 1981
Spinner Dolphin	*Stenella longirostris*	Not Listed	Unknown	Common in American Samoa, found in waters with mean depth of 44 m.	Reeves et al. 1999, Johnston et al. 2008

Common Name	Scientific Name	ESA Listing Status	MMPA Status	Occurrence	References
Striped Dolphin	*Stenella coeruleoalba*	Not Listed	Non-strategic	Found in tropical to warm-temperate waters throughout the world	Perrin et al. 2009
Elasmobranchs					
Giant manta ray	*Manta birostris*	Threatened	N/A	Found worldwide in tropical, subtropical, and temperate waters. Commonly found in upwelling zones, oceanic island groups, offshore pinnacles and seamounts, and on shallow reefs.	Dewar et al. 2008, Marshall et al. 2009, Marshall et al. 2011.
Oceanic whitetip shark	*Carcharhinus longimanus*	Threatened	N/A	Found worldwide in open ocean waters from the surface to 152 m depth. It is most commonly found in waters > 20°C.	Bonfil et al. 2008, Backus et al, 1956, Strasburg 1958, Compagno 1984
Scalloped hammerhead shark	*Sphyrna lewini*	Threatened (Indo-West Pacific DPS)	N/A	Occur over continental and insular shelves, and adjacent deep waters, but rarely found in waters < 22°C. Range from the intertidal and surface to depths up to 450–512 m.	Compagno 1984, Schulze-Haugen & Kohler 2003, Sanches 1991, Klimley 1993
Corals					
N/A	*Acropora globiceps*	Threatened	N/A	Occur on upper reef slopes, reef flats, and adjacent habitats in depths from 0 to 8 m	Veron 2014
N/A	*Acropora jacquelineae*	Threatened	N/A	Found in numerous subtidal reef slope and back-reef habitats, including but not limited to, lower reef slopes, walls and ledges, mid-slopes, and upper reef slopes protected from wave action, and its depth range is 10 to 35 m.	Veron 2014
N/A	*Acropora retusa*	Threatened	N/A	Occur in shallow reef slope and back-reef areas, such as upper reef slopes, reef flats, and shallow lagoons. Depth range is 1 to 5 m.	Veron 2014
N/A	*Acropora speciosa*	Threatened	N/A	Found in protected environments with clear water and high diversity of Acropora and steep slopes or deep, shaded waters. Depth range is 12 to 40 meters and have been found in mesophotic habitat (40-150 m).	Veron 2014

Common Name	Scientific Name	ESA Listing Status	MMPA Status	Occurrence	References
N/A	*Euphyllia paradivisa*	Threatened	N/A	Found in environments protected from wave action on at least upper reef slopes, mid-slope terraces, and lagoons in depths ranging from 2 to 25 m depth.	Veron 2014
N/A	*Isopora crateriformis*	Threatened	N/A	Found in shallow, high-wave energy environments, from low tide to at least 12 meters deep, and have been reported from mesophotic depths (less than 50 m depth).	Veron 2014
Invertebrates					
Chambered nautilus	*Nautilus pompilius*	Threatened	N/A	Found in small, isolated populations throughout the Indo-Pacific on steep-sloped forereefs with sandy, silty, or muddy bottom substrates from depths of 100 m to 500 m.	83 FR 48948, CITES 2016

[a] These species have critical habitat designated under the ESA. See Table B-4.

Table B-4. ESA-listed species' critical habitat in the Pacific Ocean[a]

Common Name	Scientific Name	ESA Listing Status	Critical Habitat	References
Hawksbill Sea Turtle	*Eretmochelys imbricata*	Endangered	None in the Pacific Ocean.	63 FR 46693
Leatherback Sea Turtle	*Dermochelys coriacea*	Endangered	Approximately 16,910 square miles (43,798 square km) stretching along the California coast from Point Arena to Point Arguello east of the 3,000 meter depth contour; and 25,004 square miles (64,760 square km) stretching from Cape Flattery, Washington to Cape Blanco, Oregon east of the 2,000 meter depth contour.	77 FR 4170
Hawaiian Monk Seal	*Neomonachus schauinslandi*	Endangered	Ten areas in the Northwestern Hawaiian Islands (NWHI) and six in the main Hawaiian Islands (MHI). These areas contain one or a combination of habitat types: Preferred pupping and nursing areas, significant haul-out areas, and/or marine foraging areas, that will support conservation for the species.	53 FR 18988, 51 FR 16047, 80 FR 50925
North Pacific Right Whale	*Eubalaena japonica*	Endangered	Two specific areas are designated, one in the Gulf of Alaska and another in the Bering Sea, comprising a total of approximately 95,200 square kilometers (36,750 square miles) of marine habitat.	73 FR 19000, 71 FR 38277

[a] For maps of critical habitat, see https://www.fisheries.noaa.gov/national/endangered-species-conservation/critical-habitat.

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APPENDIX C: OBSERVER PROGRAM BYCATCH DATA

Table C-1. Total estimated bycatch in number of fish from the Pacific Islands Region Observer Program for the Hawaii deep-set longline fishery

Species	2016	2017	2018	2019	2020	2021
Lancetfish, Longnose	229,791	230,048	309,551	275,802	288,339	217,244
Lancetfish, Shortnose	5	0	16	9	9	5
Triggerfish, Rough	0	7	9	3	0	8
Triggerfish, Unidentified	0	0	0	0	0	0
Needle Fish, Gaping	0	0	0	0	0	0
Fanfishes	63	32	27	32	57	46
Pomfret, Bigtooth	0	0	0	0	0	0
Pomfret, Brama spp.	4,773	10,999	3,681	5,038	4,961	3,288
Pomfret, Dagger	6,464	7,443	8,188	8,929	5,667	9,450
Pomfret, Lustrous	62	92	131	115	66	225
Pomfret, Pacific	0	0	0	0	0	0
Pomfret, Rough	658	719	1,146	597	286	430
Pomfret, Sickle	2,284	1,845	1,488	1,510	1,337	1,525
Pomfret, Unidentified	290	258	306	294	113	165
Jack, Cottonmouth	5	10	0	0	14	5
Kahala, Unspecified (Amberjacks)	5	0	0	0	0	0
Pilotfish	NC	NC	NC	NC	6	0
Rainbow Runner	0	0	0	5	0	5
Yellowtail	0	0	0	0	0	0
Swallowers	122	115	288	336	258	67
Dolphinfish	5,277	4,428	5,177	4,896	2,505	3,092
Dolphinfish, Pompano	195	165	208	82	59	288
Flyingfish	0	0	4	0	0	0
Escolar	37,860	35,052	44,873	47,973	50,556	53,089
Escolar, Longfin	2,823	2,590	4,057	4,570	5,370	3,430
Escolar, Roudi's	414	338	301	510	253	268
Gemfish, Black	150	136	166	147	268	111
Oilfish	994	1,516	2,276	2,717	2,457	2,063
Snake Mackerel	110,655	120,432	79,308	49,481	43,862	67,877
Snake Mackerel, Unidentified	33	178	54	148	55	38
Billfish, Unidentified	499	498	628	1,298	454	275
Marlin, Black	0	0	0	0	0	0
Marlin, Blue	176	132	226	817	476	224
Marlin, Striped	878	772	1,243	2,781	1,186	536
Marlin, Unidentified	NC	NC	NC	NC	82	137
Sailfish	59	26	11	331	63	21
Spearfish, Shortbill	3,559	2,301	1,706	2,663	2,126	2,073

Species	2016	2017	2018	2019	2020	2021
Opah	963	721	1,885	1,315	932	144
Crestfish	184	130	133	82	72	45
Crestfish, Unicorn	NC	NC	NC	NC	8	8
Louvar	0	0	0	0	0	0
Mola, Common	148	86	151	183	114	165
Mola, Sharptail	91	133	51	59	55	33
Mola, Slender	1,480	692	630	196	226	19
Molas	NC	NC	NC	NC	16	0
Cigarfishes	49	58	48	80	48	54
Hammerjaw	415	255	290	468	420	71
Oarfish	0	0	0	0	6	0
Mackerel (incl. Chub, Spotted Chub)	0	0	0	0	0	0
Mackerel, Bullet	0	0	0	0	0	0
Tuna, Albacore	265	73	106	145	80	790
Tuna, Bigeye	20,723	20,800	24,053	19,481	20,596	12,360
Tuna, Bluefin	0	0	0	0	0	0
Tuna, Dogtooth	NC	NC	NC	NC	4	0
Tuna, Kawakawa	0	0	0	0	0	0
Tuna, Skipjack	5,502	5,559	2,585	4,366	2,833	3,074
Tuna, Southern Bluefin	NC	NC	NC	NC	0	0
Tuna, Unidentified	5,731	6,337	5,164	6,855	4,097	5,052
Tuna, Yellowfin	5,615	9,455	5,201	7,434	6,138	10,804
Wahoo	1,989	1,664	2,245	3,404	1,784	2,080
Barracuda, Great	271	197	210	204	433	233
Puffer, Pelagic	798	745	589	267	526	538
Puffer, Unidentified	42	32	48	51	101	63
Pufferfish, Porcupine	NC	NC	NC	NC	30	5
Ribbonfish, Scalloped	21	24	3	29	7	31
Ribbonfish, Tapertail	286	216	370	207	164	215
Ribbonfishes	NC	NC	NC	NC	0	8
Scabbardfish, Razorback	38	5	51	20	16	5
Scabbardfish, Unidentified	0	0	4	0	0	7
Bony Fish, Other Identified	37	35	58	54	29	27
Bony Fish, Unidentified	357	214	265	368	60	1,104
Swordfish	NA	4,282	3,851	2,228	2,495	1,485
Stingray, Pelagic	6,958	6,608	7,234	10,949	9,357	8,526
Manta Ray, Giant	22	0	3	0	7	11
Manta/Mobula	16	26	39	82	43	66
Mobula (Devil Ray)	120	121	86	218	76	251
Ray, Other Identified	0	0	0	0	0	0
Ray, Unidentified	4	7	14	0	6	26

Species	2016	2017	2018	2019	2020	2021
Shark, Bigeye Thresher	11,639	9,551	6,519	10,399	9,754	13,313
Shark, Common Thresher	0	6	0	6	23	29
Shark, Pelagic Thresher	1,403	47	135	212	132	158
Shark, Unid. Thresher	476	476	586	659	400	485
Shark, Bignose	0	5	5	0	0	0
Shark, Blacktip Reef	0	3	0	0	0	0
Shark, Blue	102,250	123,166	119,306	134,067	139,284	124,209
Shark, Galapagos	16	32	55	41	37	39
Shark, Oceanic White-Tip	2,188	1,257	1,092	2,125	1,959	3,084
Shark, Sandbar	20	50	26	28	17	39
Shark, Silky	2,538	1,417	1,071	1,831	959	1,419
Shark, Tiger	34	19	31	20	36	26
Shark, Cookie Cutter	24	3	31	5	21	15
Shark, Longfin Mako	228	124	251	212	340	193
Shark, Salmon	0	0	0	6	0	8
Shark, Shortfin Mako	6,205	8,184	8,834	7,362	7,052	4,678
Shark, Unid. Mako	42	79	95	171	82	36
Bigeye Sand Tiger Shark	0	24	21	22	31	18
Shark, Crocodile	2,132	3,449	2,009	3,206	1,994	1,704
Shark, Scalloped Hammerhead	0	5	0	0	0	0
Shark, Smooth Hammerhead	167	140	92	184	195	215
Shark, Unid. Hammerhead	44	14	49	32	43	49
Dogfish, Velvet	2,225	2,219	3,063	2,216	2,639	1,629
Shark, Other Identified	10	0	0	0	0	5
Shark, Unidentified	853	1,300	1,457	1,066	454	1,131

Note: Species that did not have a unique species code prior to 2020 are listed as "NC" for each year from 2016 to 2019.

Table C-2. Total estimated bycatch in number of fish from the Pacific Islands Region Observer Program for the Hawaii shallow-set longline fishery

Species	2016	2017	2018	2019	2020	2021
Lancetfish, Longnose	1,784	2,728	1,211	1,232	1,268	2,480
Lancetfish, Shortnose	0	0	0	0	0	0
Triggerfish, Rough	0	0	0	0	0	0
Triggerfish, Unidentified	0	0	0	0	0	0
Needle Fish, Gaping	0	0	0	0	0	0
Fanfishes	1	1	0	0	1	0
Pomfret, Bigtooth	0	0	0	0	0	0
Pomfret, Brama spp.	50	50	42	27	45	21
Pomfret, Dagger	11	13	5	2	3	21
Pomfret, Lustrous	0	1	0	0	1	0
Pomfret, Pacific	0	0	0	0	0	0
Pomfret, Rough	2	0	0	0	0	0

Species	2016	2017	2018	2019	2020	2021
Pomfret, Sickle	0	0	0	1	0	0
Pomfret, Unidentified	0	0	2	4	0	0
Jack, Cottonmouth	0	0	0	0	0	0
Kahala, Unspecified (Amberjacks)	0	0	0	0	0	0
Rainbow Runner	0	0	0	0	0	0
Yellowtail	0	0	0	0	0	0
Swallowers	0	0	0	0	0	0
Dolphinfish	83	107	34	18	20	75
Dolphinfish, Pompano	1	0	0	0	0	1
Flyingfish	0	0	0	0	0	0
Escolar	459	765	150	122	152	0
Escolar, Longfin	2	3	0	0	0	521
Escolar, Roudi's	0	0	0	0	0	2
Gemfish, Black	0	0	0	0	0	0
Oilfish	171	327	114	57	248	1
Snake Mackerel	315	638	62	16	31	219
Snake Mackerel, Unidentified	1	0	3	3	0	98
Billfish, Unidentified	6	4	2	2	3	0
Marlin, Black	0	0	0	0	0	10
Marlin, Blue	11	7	5	0	7	0
Marlin, Striped	55	81	44	6	31	7
Marlin, Unidentified	NC	NC	NC	NC	0	55
Sailfish	0	0	0	0	0	2
Spearfish, Shortbill	53	19	8	3	12	0
Opah	110	70	20	7	22	12
Crestfish	0	0	0	0	0	0
Crestfish, Unicorn	NC	NC	NC	NC	0	0
Louvar	0	0	0	0	0	0
Mola, Common	31	46	41	5	41	0
Mola, Sharptail	0	0	1	0	0	9
Mola, Slender	0	1	0	0	0	0
Molas	NC	NC	NC	NC	0	1
Cigarfishes	1	2	0	0	0	0
Hammerjaw	0	0	0	0	0	0
Mackerel (incl. Chub, Spotted Chub)	0	0	0	0	0	0
Mackerel, Bullet	0	0	0	0	0	0
Tuna, Albacore	5	28	6	1	51	0
Tuna, Bigeye	121	278	153	55	77	63
Tuna, Bluefin	0	0	0	0	0	79
Tuna, Dogtooth	NC	NC	NC	NC	0	0
Tuna, Kawakawa	0	0	0	0	0	0

Species	2016	2017	2018	2019	2020	2021
Tuna, Skipjack	3	2	1	4	0	0
Tuna, Unidentified	5	30	11	12	16	9
Tuna, Yellowfin	27	125	55	8	46	28
Wahoo	1	4	0	0	0	71
Barracuda, Great	0	0	0	0	0	2
Puffer, Pelagic	21	9	0	0	3	0
Puffer, Unidentified	0	0	0	0	0	9
Pufferfish, Porcupine	NC	NC	NC	NC	0	7
Ribbonfish, Scalloped	0	0	0	0	0	0
Ribbonfish, Tapertail	5	4	0	0	5	1
Ribbonfishes	NC	NC	NC	NC	0	0
Scabbardfish, Razorback	0	0	0	0	0	0
Scabbardfish, Unidentified	0	0	0	0	0	0
Bony Fish, Other Identified	2	0	1	1	0	0
Bony Fish, Unidentified	22	7	8	1	3	0
Swordfish	1,049	1,419	735	254	251	30
Stingray, Pelagic	245	284	440	82	328	499
Manta Ray, Giant	0	2	0	0	0	171
Manta/Mobula	3	4	0	0	1	0
Mobula (Devil Ray)	8	5	0	0	0	4
Ray, Other Identified	0	0	0	0	0	2
Ray, Unidentified	1	0	0	0	0	0
Shark, Bigeye Thresher	57	72	13	3	21	0
Shark, Common Thresher	3	3	0	2	2	58
Shark, Pelagic Thresher	0	0	0	0	0	0
Shark, Unid. Thresher	2	6	1	1	7	0
Shark, Gray Reef	0	0	0	0	0	7
Shark, Bignose	0	0	0	0	0	1
Shark, Blacktip Reef	0	0	0	0	0	0
Shark, Blue	11,853	10,102	4,115	4,225	6,949	0
Shark, Galapagos	0	0	0	0	1	6,446
Shark, Oceanic White-Tip	32	29	1	0	13	0
Shark, Sandbar	2	0	0	0	0	37
Shark, Silky	2	9	1	0	1	0
Shark, Tiger	0	1	0	0	0	8
Shark, Cookie Cutter	3	6	1	2	2	0
Shark, Longfin Mako	2	5	1	1	2	2
Shark, Salmon	6	2	1	5	3	1
Shark, Shortfin Mako	968	1,085	537	298	1,151	2
Shark, Unid. Mako	6	0	0	2	1	808
Bigeye Sand Tiger Shark	0	0	0	0	0	0
Shark, Crocodile	0	3	0	0	0	0

Species	2016	2017	2018	2019	2020	2021
Shark, Scalloped Hammerhead	0	0	0	0	0	2
Shark, Smooth Hammerhead	1	1	0	0	1	0
Shark, Unid. Hammerhead	1	0	0	0	0	3
Dogfish, Velvet	1	0	0	0	0	6
Shark, Other Identified	0	0	0	0	0	0
Shark, Unidentified	65	52	19	44	32	0

Note: Species that did not have a unique species code prior to 2020 are listed as "NC" for each year from 2016 to 2019.

Table C-3. Total estimated bycatch in number of fish from the Pacific Islands Region Observer Program for the American Samoa longline fishery

Species	2016	2017	2018	2019	2020	2021
Cardinalfish, Blackmouth	NC	NC	NC	NC	NA	NA
Lancetfish, Longnose	6,228	5,881	5,482	4,991	4,063	3,913
Lancetfish, Shortnose	9	11	3	13	3	4
Fanfishes	0	0	0	0	2	1
Pomfret, Dagger	141	203	151	344	85	85
Pomfret, Lustrous	27	22	23	20	28	27
Pomfret, Rough	4	6	16	24	8	8
Pomfret, Sickle	459	412	388	535	407	425
Pomfret, Brama spp.	193	191	112	232	145	135
Pomfret, Unidentified	4	3	0	0	1	0
Jack, Cottonmouth	5	16	13	0	5	5
Rainbow Runner	4	3	3	0	3	2
Yellowtail	0	3	3	0	1	1
Swallowers	3	0	0	0	1	0
Dolphinfish	64	100	106	18	163	147
Dolphinfish, Pompano	0	0	2	5	1	1
Soapfish, Goldenstripe	7	6	15	34	10	10
Escolar	7,756	7,773	5,567	5,094	5,540	5,517
Escolar, Longfin	8,820	9,652	5,605	6,609	5,037	4,788
Escolar, Roudi's	751	774	509	521	417	406
Gemfish, Black	82	41	23	31	57	54
Oilfish	516	586	567	718	485	498
Snake Mackerel	1,049	1,026	1,183	1,689	1,568	1,502
Snake Mackerel, Unidentified	18	15	0	0	3	2
Marlin, Blue	219	167	108	144	294	289
Marlin, Striped	167	160	44	279	131	121
Sailfish	204	124	93	163	98	97
Spearfish, Shortbill	262	316	210	447	423	390
Billfish, Unidentified	75	57	50	43	40	32
Opah	116	98	46	109	68	66
Crestfish	85	115	106	129	124	122

Species	2016	2017	2018	2019	2020	2021
Mola, Common	9	13	11	0	9	8
Mola, Sharptail	4	8	4	0	2	2
Mola, Slender	1,327	2,595	1,648	193	2,210	2,074
Cigarfishes	17	14	13	9	8	10
Hammerjaw	48	39	13	13	28	26
Tuna, Albacore	1,078	1,520	1,630	1,584	1,136	1,077
Tuna, Bigeye	656	476	736	564	830	778
Tuna, Skipjack	781	830	867	1,196	1,510	1,366
Tuna, Yellowfin	1,873	1,702	1,345	1,180	1,476	1,363
Wahoo	425	517	380	326	728	690
Tuna, Unidentified	1,340	1,595	1,326	824	1,473	1,313
Barracuda, Great	659	729	542	747	442	434
Puffer, Pelagic	4	15	23	27	12	11
Puffer, Unidentified	2	3	5	5	1	1
Ribbonfish, Tapertail	40	34	25	27	33	31
Scabbardfish, Razorback	13	16	20	16	14	13
Swordfish	367	257	199	706	211	260
Bony Fish, Other Identified	59	120	83	24	34	34
Bony Fish, Unidentified	104	10	15	58	31	34
Stingray, Pelagic	19,459	16,306	8,156	11,908	8,395	8,259
Manta Ray, Giant	0	0	0	0	3	3
Mobula (Devil Ray)	24	31	18	0	12	12
Manta/Mobula	7	6	8	24	4	5
Ray, Unidentified	9	4	0	0	2	2
Shark, Bigeye Thresher	196	254	253	148	159	158
Shark, Pelagic Thresher	4	11	12	0	3	3
Shark, Unid. Thresher	82	54	27	27	25	25
Shark, Blue	4,490	4,224	3,359	2,681	2,958	2,721
Shark, Galapagos	0	0	5	11	7	4
Shark, Oceanic White-Tip	788	484	513	870	469	467
Shark, Silky	1,874	1,695	1,212	1,840	1,227	1,238
Shark, Longfin Mako	21	20	19	47	24	20
Shark, Shortfin Mako	321	231	229	169	234	232
Shark, Unid. Mako	0	0	0	13	6	5
Shark, Crocodile	5	8	9	5	5	8
Shark, Scalloped Hammerhead	8	7	8	0	4	3
Shark, Smooth Hammerhead	0	0	5	9	2	2
Shark, Unid. Hammerhead	6	3	0	0	2	2
Dogfish, Velvet	2	0	0	0	4	4
Shark, Unidentified	56	35	133	96	62	57

Note: Species that did not have a unique species code prior to 2020 are listed as “NC” for each year from 2016 to 2019.

APPENDIX D: LIST OF PLAN TEAM MEMBERS

Member; Title	Plan Team Role
Donald Koybayashi; NMFS PIFSC	Chair; Habitat and Living Marine Resources
Réka Domokos; NMFS PIFSC	Ecosystems
Russell Ito; NMFS PIFSC	Pelagics
Ashley Tomita; NMFS PIFSC	Pelagics
Kirsten Leong; NMFS PIFSC	Human Dimensions
Emily Crigler; NMFS PIRO	Fisheries Policy
Michael Kinney; NMFS PIFSC	Life History
Minling Pan; NMFS PIFSC	Economics
T. Todd Jones; NMFS PIFSC	Protected Resources
Phoebe Woodworth-Jefcoats; NMFS PIFSC	Oceanography
Robert Ahrens; NMFS PIFSC	Management Strategy Evaluation
Valerie Post; NMFS PIRO	International Fisheries
Chelsea Young; NMFS PIRO	Protected Resources
Melissa Snover; NMFS PIRO	Protected Resources
Jenny Suter; NMFS PIFSC	Fisheries Research & Monitoring
Lynn Rassel, NMFS PIFSC	Observer Program
Jason Helyer; Hawaii DAR	Hawaii
Sean Felise; American Samoa DMWR	American Samoa
Domingo Ochavillo; American Samoa DMWR	American Samoa
Kelsey Lizama; CNMI DFW	CNMI
Nathan VanEe; CNMI DFW	CNMI
Brent Tibbatts; Guam DAWR	Guam
Frank Roberto; Guam DAWR	Guam
Bryan Ishida; Hawaii DAR	Ex-Officio
Felipe Carvalho; NMFS PIFSC	Ex-Officio

APPENDIX E: PELAGIC PLAN TEAM REPORT – MAY 2023

Consistent with direction from the Council's Pelagic Plan Team at its regular meeting in May 2023, the Pelagic Plan Team's meeting report is appended to this annual SAFE report to provide readers with important context regarding fishery performance trends that are not otherwise provided in the annual SAFE report. The Pelagic Plan Team report begins on the following page.