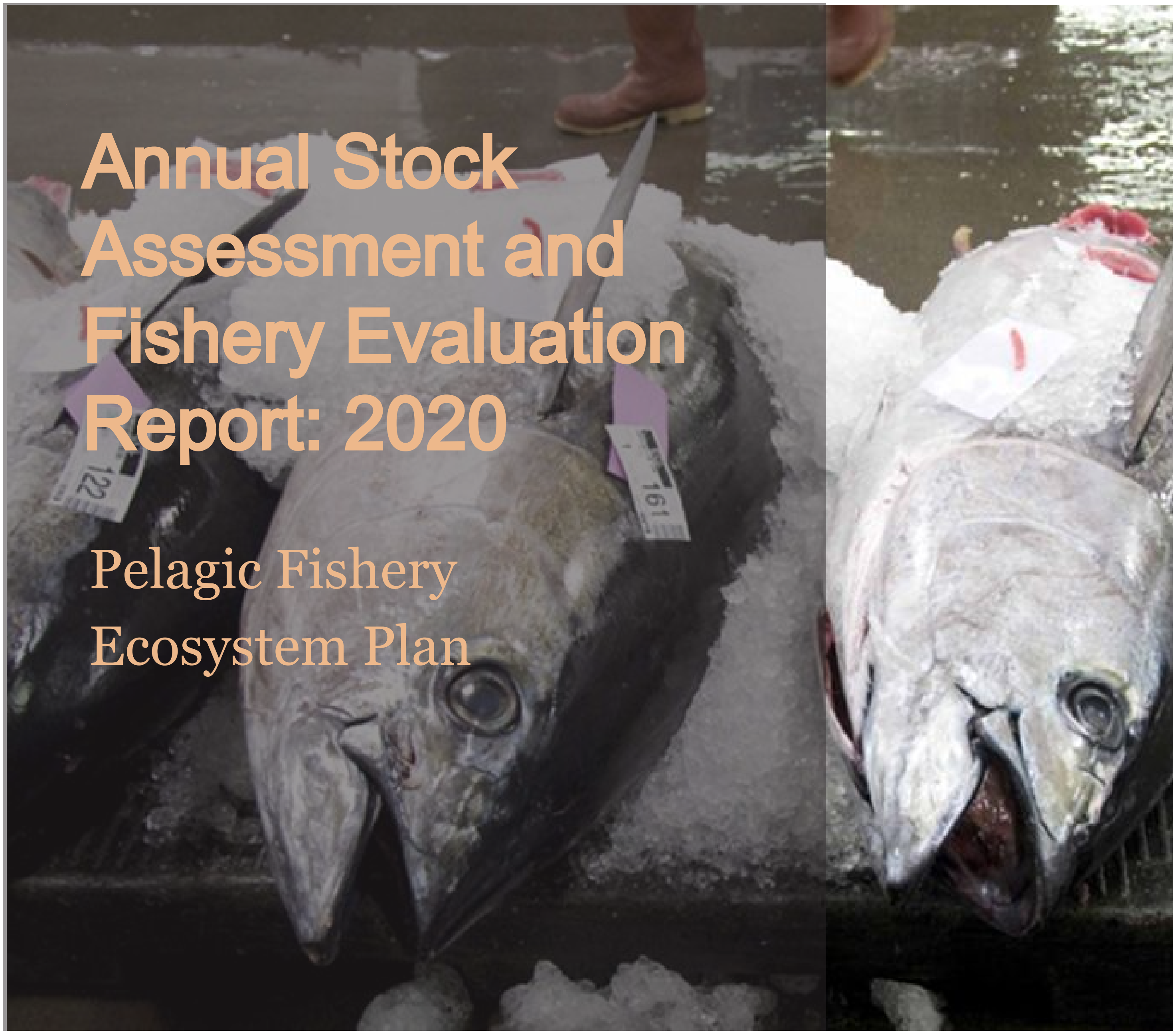

Annual Stock Assessment and Fishery Evaluation Report: 2020

Pelagic Fishery Ecosystem Plan

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Cover image: Taken by the WPRFMC at the Honolulu Fish Auction.

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Note: In 2020, there were notable impacts to fishery operations due to the 2019 novel coronavirus (COVID-19) outbreak. Impacts associated with the pandemic and its restrictions are described in Sections 2.1 through 2.4 and 3.1 through 3.3.

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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 caught in a fishery but discarded or released, except in a recreational fishery catch and release 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. 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
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 Areas (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 2020 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 5 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 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 (ISC) for Tuna and Tuna-like Species in the North Pacific Ocean conducts similar stock assessments.

In 2020, stock assessments were completed for the WCPO bigeye tuna (Ducharme-Barth et al. 2020), the WCPO yellowfin tuna (Vincent et al. 2020), North Pacific Ocean albacore (ISC 2020), and Pacific Ocean bluefin tuna (ISC 2020). 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.

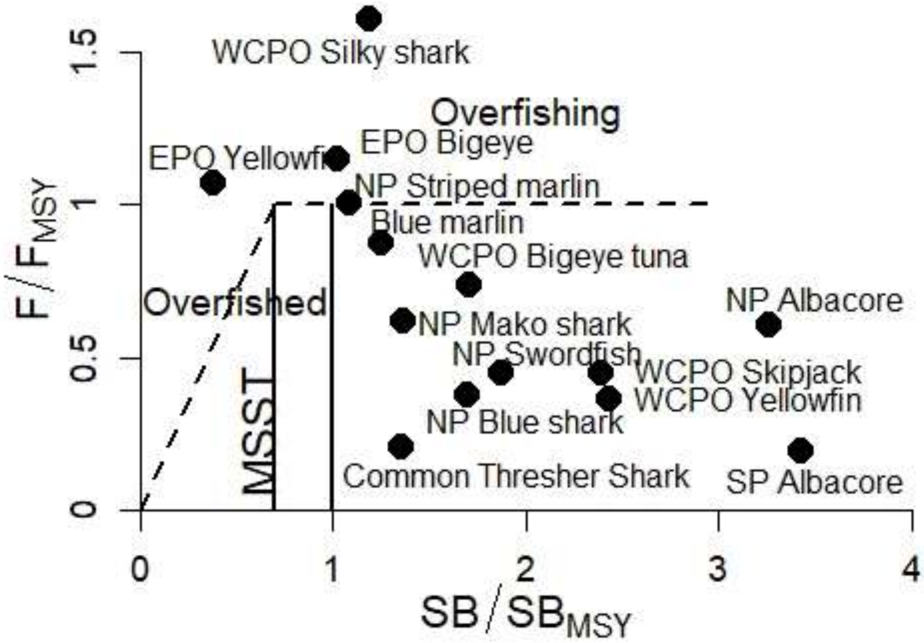


Figure ES-1. Specification of fishing mortality and biomass reference points in the Pelegic FEP and current stock status in the WCPO and EPO. Pacific Ocean bluefin tuna is not illustrated, but the recent stock assessment indicated overfishing is occurring and the stock is overfished

SUMMARY OF FISHERY DATA IN THE PACIFIC ISLAND REGION

Table ES-2. Summary of the total pelagic landings during 2020 in the Western Pacific and the percentage change between 2019 and 2020

Species	American Samoa		CNMI		Guam		Hawaii	
	Lbs.	% Change	Lbs.	% Change	Lbs.	% Change	Lbs.	% Change
Swordfish	4,945	-39.8	-	-	-	-	1,199,054	-26.2
Blue marlin	54,645	-16.6	0	-100.0	50,833	1.7	1,373,204	-41.2
Striped marlin	3,302	-5.9	-	-	-	-	762,178	-38.1
Other billfish*	2,090	-74.7	0	-	0	-100.0	286,252	-43.1
Mahimahi	10,727	120.0	71,564	-0.3	92,602	-32.2	580,028	-42.3
Wahoo	34,991	-14.3	6,549	167.5	46,920	97.9	849,256	-46.9
Opah (moonfish)	1,432	20.8	-	-	-	-	1,631,024	-28.8
Sharks (whole wt.)	90	-93.8	0	-	0	-	42,605	-63.0
Albacore	1,116,890	-51.8	-	-	-	-	366,231	43.5
Bigeye tuna	45,785	-31.2	-	-	-	-	16,951,895	-3.7
Bluefin tuna	238	-50.0	-	-	-	-	3,400	-9.7
Skipjack tuna	132,585	-19.3	537,399	55.7	348,466	-26.2	553,091	-33.6
Yellowfin tuna	482,700	14.8	55,944	53.4	54,962	-13.6	5,098,324	-14.8
Other pelagics**	1,857	-45.0	17,680	170.8	20,850	-9.0	702,613	-34.6
Total	1,892,277	-39.1	689,136	47.8	614,633	-19.1	30,399,157	-16.6

Note: Total pelagic landings are based on commercial reports and/or creel surveys; % change based on 2019 landings relative to 2020 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.

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-waters longline fleets, and purse seine fleets. As 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 2020, there were 11 active longline vessels, with seven vessels greater than 70 ft, three vessels between 50 and 70 ft, one vessel between 40 and 50 ft, and zero vessels shorter than 40 ft. Smaller longline vessels called alias (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, these data are confidential and are reported only as combined with the large vessel fishery. Trolling is the next largest fishery with eight boats that landed pelagic species in 2020. Non-commercial pelagic fisheries in American Samoa are less common.

Landings. The estimated annual pelagic landings have varied widely, from 1.9 to nearly 10 million lb since 2011. The total estimated 2020 landings were approximately 1.9 million lb, the lowest in the past decade, which contributes to the declining trend since recent peak landings in 2011 (Figure 4). Pelagic landings consist mainly of five tuna species including albacore, yellowfin, skipjack, mackerel, and bigeye, which made up over 99% of the total estimated landings when combined with other tuna species. Albacore made up 63% 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 2020 (Table 13). In the longline fishery, 1.2% of the tuna caught were released. Skipjack and yellowfin were the most released tuna species, while sharks and oilfish had the highest numbers of non-tuna released fish accounting for a 59% release of all non-tuna species. In total, only 7.6% of all pelagic species caught were released in 2020. Fish are released for various reasons including quality, handling and storage difficulties, and marketing problems. Investigation into the reasons for releasing pelagic species are recommended because of the high release rate for many non-tuna Pacific PMUS and releases of some tuna.

Effort. There are currently 22 vessels known to be fishing in the waters of American Samoa according to federal logbooks collected. The 11 longline vessels that fished in 2020 made 90 trips (average 8 trips/vessel), deployed 1,227 sets, (111 sets/vessel) using nearly 3.4 million hooks (Table 5). The troll fishery conducted 131 trips that landed pelagic species.

Catch Rate. The total pelagic catch rate by all longline vessels decreased by 1.8 fish per 1,000 hooks in 2020 from the previous year. Non-tuna pelagic species also had an increase in catch rate of 0.3 fish per 1,000 hooks. The longline catch rates for tuna species have fluctuated during the past decade ranging from 14 to nearly 21 fish per 1,000 hooks. Albacore catch rates also decreased this year by 3.1 to 8.5 fish per 1,000 hooks. Troll trips decreased by 22.5% and troll hours decreased by over 27% from their 2019 values. The average catch per troll hour for all pelagic species slightly decrease from the previous year to 21 lb/hour.

Revenue. In 2020, the total longline fleet revenue (estimated landed value) was $2.1 million, and albacore composed of over 62% of the total landed value. Other main species included yellowfin, bigeye, skipjack, and wahoo. The estimated value of the species landed were 15%, 1%, 3%, and 2%, respectively. Albacore had an estimated price of $1.50 per pound.

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% due to impacts from COVID-19. Thus, all protected species interaction data from observers aboard American Samoa longline vessels were confidential in 2020. Mitigation measures to reduce green turtle interactions in this fishery were implemented in 2011. From 2016 to 2019, four annual interactions per year with green turtles were observed, all of which resulted in mortalities. The interaction rate in 2019 was similar to 2016-2017 levels (0.003 takes/1,000 hooks) and lower than 2018. Observed marine mammal interactions with the American Samoa longline fishery are relatively infrequent, with only one striped dolphin interaction observed in 2019. Seabird interactions with the American Samoa longline fishery are infrequent, with one observed interaction with an unidentified shearwater observed in 2019. This report also includes observed interactions with Endangered Species Act (ESA)-listed elasmobranchs, for which there were 140 interactions with oceanic whitetip sharks in 2019, and infrequent interactions with the Indo-west Pacific distinct population segment (DPS) of scalloped hammerhead and giant manta rays. There have not been any reported or observed interactions with protected species in the American Samoa troll fishery.

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 boats involved in CNMI's pelagic fishery has been steadily decreasing since 2001, when there were 113 reporting commercial pelagic landings. In 2016, a decade-high 73 boats reported landings, a significant increase from 12 in the previous year. In 2020, 73 boats reported landing pelagic species, tied for the decadal high with 2016 and representing an increase of 32.9% from the 49 boats in 2019.

Landings. Skipjack tuna is the principal species landed, comprising 78% of the total estimated pelagic landings in 2020 based on expanded creel survey data. Skipjack estimated landings increased by 55.7% in 2020 to 537,399 lb, while total estimated landings also increased by 47.8% to 689,136 lbs. Landings of mahimahi and yellowfin tuna ranked second and third by weight of pelagic species landings in 2020 at 71,564 lb (0.3% increase from 2019) and 55,944 lb (53.4% increase from 2019), respectively. The amount of wahoo landed in 2020 substantially increase from 2019 levels by over 167% to 6,549 lb.

Effort. In 2020, the number of trips catching pelagic species from commercial receipt invoices decreased 46.7% from 2019 to 1,309 trips. The number of estimated trips from expanded creel survey data, however, increased 196% from 3,202 trips in 2019 to 9,481 trips in 2020. Total estimated trolling hours similarly increased in 2020 by 178% to 46,818 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 2020 to 4.9.

Catch Rate. Average trolling catch rates decreased over 48% from 27.9 lb per trolling hour in 2019 to 14.5 in 2020. The catch rate for skipjack, the primary target species in the CNMI, also decreased by over 44% from 20.5 lb per hour fished in 2019 to 11.4 lb per hour in 2020. Pounds caught per trip for skipjack, however, increased from 52 to 78. Yellowfin catch rate also decreased in 2020 from 2.2 lb per hour fished to 1.2 lb per hour. The mahimahi catch rate increased by 64% to 1.5 lb per hour fished in 2020, and there was also a decrease in the pounds caught per trip from 8.4 in 2019 to 7.6 in 2020.

Bycatch. Bycatch is not a significant issue in the CNMI, as fishermen typically retain their catch regardless of species, size, or condition. Based on creel survey interviews, two fish were released as bycatch in the trolling fisheries from the years 2011 to 2020, both mahimahi.

Revenue. The total value of the pelagic fishery in 2020 was $349,096, which represented a decrease of nearly 25% from the previous year. It was estimated that 22% of all pounds caught were sold, a smaller proportion than estimated in years prior to 2020. The average price for all pelagic species was $2.31 in 2020, a decrease of over 11% from 2019. The average price per pound for tuna slightly decreased from 2019 to 2020 to $2.52, ranging from $2.28 for wahoo to $2.49 for skipjack and $2.63 for yellowfin. Non-tuna PMUS had an average price per pound of $2.61.

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 496 in 2013. There were 459 boats involved in Guam's pelagic fishery in 2020, a decrease of 1% from 2019. 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 40-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 2020 total expanded pelagic landings were 614,633 lb, a decrease of 19.1% when compared with the 759,653 lb of catch from 2019. Tuna PMUS decreased 24.9%, while non-tuna PMUS decreased 8.3%. Landings consisted primarily of five major species: mahimahi, wahoo, bonita or skipjack tuna, yellowfin tuna, and Pacific blue marlin, with skipjack comprising over 57% of total landings. Other minor species caught include rainbow runner, barracudas, and pomfrets. Sharks were also caught during 2020, with sharks noted in specific fishermen interviews conducted in 2020 regarding shark encounters (see "bycatch" below). However, these species were not encountered during offshore creel surveys and were not available for expansion in 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 three of the five common species decreased in 2020 from the previous year's levels. Skipjack decreased 26.4%, and wahoo increased by 98%. Yellowfin tuna catch decreased 13.6%, mahimahi catch decreased by 32%, and blue marlin increased by 1.7%.

The amount of transshipped fish has ranged from 1,898 metric tonnes (mt) to 2,411 mt between 2010 and 2014. Transshipment data from 2015 to 2020 are confidential due to fewer than three transshipment reporting agents. All transshipment through Guam ceased as of December 31, 2020.

Effort. In 2020, the number of trolling trips decreased by 0.5% from 2019 levels, and hours spent trolling increased 0.76%. 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 1982-2015, Guam's Division of Aquatic Resources (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 2020 was 52, equaling 168 closure days, down from

316 closure days in 2019. This impacted the number of fishing days south of Guam.

Catch Rate. Trolling catch rates (lb per hour fished) showed a decrease from 2019. Total CPUE decreased 19%. All major troll species showed a drop in CPUE from 2019 to 2020 except for wahoo. The recording of lower rates is almost certainly due to low creel interview numbers due to COVID restrictions on government employees. 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 2020, limited interview data indicated there was again a low total bycatch rate; there was 4 fish reported as bycatch in 3,192 tallied fish caught, for a 0.1% rate. Bycatch occasionally occurs in the troll fishery including sharks, shark-bitten and undersized fish.

In 2020, fishers were asked if they experienced a shark interaction. There was a total of 360 interviews for boat based fishing in 2020, with 29 of these inappropriate for determining shark interaction. Of the remaining 331 interviews, 123 reported interactions with sharks and 208 reported no interactions with sharks for a 37% positive rate for interviews where fishers were asked about shark interactions.

Revenues. The price of PMUS sold by all gears in Guam during 2020 was $2.39 per pound. Commercial revenues decreased in 2020 to $164,411, down from $322,441 in 2019. Sales numbers were down for all species. This can be attributed to COVID shutdown measures, which included closure of stores and restaurants for much of 2020. This left fishermen with limited to no outlets to sell catch. 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 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 7% of the total value, followed by MHI handline, aku boat, offshore handline fisheries, and other gear types comprising the remainder. The COVID-19 pandemic had a large effect on participation, catch, and revenue in 2020. The lockdown for public health safety to contain the spread of COVID-19 negatively impacted fishery-related businesses.

Participation. A total of 3,014 fishermen were licensed in 2020, including 1,709 (57%) who indicated that their primary fishing method and gear were intended to catch pelagic fish. This is a 7% decrease in fishing licenses from the previous year. Most licenses that indicated pelagic fishing as their primary method were issued to longline fishermen (40%) and trollers (44%). The remainder was issued to ika shibi and palu ahi (handline) (16%).

Landings. Hawaii commercial fisheries caught and landed 30.4 million lb of pelagic species in 2020, a decrease of 17% 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 89% (27.1 million lb) of all pelagic fisheries. The shallow-set longline fishery targeted swordfish and its catch was 838,000 lb, or 3% of the total catch. The MHI troll fishery targeted tunas, marlins, and other PMUS, and caught 1.5 million lb or 5% of the total. The MHI handline fishery targeted yellowfin tuna while the offshore handline fishery targeted bigeye tuna. The MHI handline fishery accounted for 579,000 lb (2% of the total). The offshore handline fishery was responsible for 326,000 lb or 1% of the total catch.

The largest component of the pelagic catch was tunas, which comprised 76% of the total in 2019. Bigeye tuna alone accounted for 74% of the tunas and 56% of all the pelagic catch. Billfish catch made up 12% of the total catch in 2020. Blue marlin was the largest of these, at 38% of the billfish and 5% of the total catch. Catches of other PMUS represented 12% of the total catch in 2020 with moonfish being the largest component at 43% of the other PMUS and 5% of the total catch.

Bycatch. A total of 135,879 fish were released by the deep-set longline fishery in 2020. Sharks accounted for 87% of the deep-set longline bycatch. With the exception for mako and a few thresher sharks, there is no demand for other shark species in Hawaii. Of all shark species combined, 99.6% 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 2020. A total of 7,073 fish were released by the shallow-set longline fishery in 2020. Sharks accounted for 94% of the shallow-set longline bycatch. Of all shark species combined, 94% of the shallow-set longline shark catch was released. Conversely, bycatch rate for the shallow-set longline fishery was 6% for targeted and incidentally caught pelagic species in 2020. Since shallow-set longline trips are often longer than deep-set trips, the higher release rate by the shallow-set sector is to conserve space for swordfish and forego keeping other pelagic species due to their short shelf life.

Effort. There were 146 active Hawaii-permitted deep-set longline vessels in 2020, three less vessels than the previous year, with 149 deep-set vessels. The number of deep-set trips (1,644) and sets (20,758) were both below the record deep-set effort in 2019. The number of hooks set by the deep-set longline fishery was 59.7 million hooks in 2020. The Hawaii-permitted shallow-set longline fishery operates mainly in the first half of the year. In 2020, 14 vessels completed 34 trips and made 450 sets, which was above the record low effort for this segment of the fishery in 2019. The number of hooks set by this fishery also increased to 600,000 in 2020, an increase over the record low in 2019. The number of days fished by MHI troll fishers has been trending lower from its peak in 2012, with 1,122 fishers logging 12,119 days fished around the MHI in 2020. There were 392 MHI handline fishers that fished 3,017 days in 2020, both at their lowest levels in the previous 10-year period. The offshore handline fishery only had 5 fishers and 255 days fished in 2020.

Catch Rate. The deep-set longline fishery targets bigeye tuna and this species had higher CPUE (3.5 fish per 1,000 hooks) compared to yellowfin tuna (0.9) and albacore (0.1) in 2020. CPUE of blue marlin and striped marlin for the deep-set fishery were low (0.1 and 0.2 fish per 1,000 hooks, respectively), while the CPUE for blue shark, a bycatch species, is second only to bigeye at 1.7 fish per 1,000 hooks. The Hawaii-permitted shallow-set longline fishery targets swordfish and had a record low CPUE of 8.1 fish per 1,000 hooks in 2020. Blue shark, a bycatch species of this fishery, had the highest CPUE at 10.5 fish per 1,000 hooks. The MHI troll fishery CPUE for yellowfin tuna and marlins trended higher while skipjack tuna, mahimahi, and ono CPUE were relatively consistent. MHI handline CPUE for yellowfin, albacore, and bigeye tuna CPUE were steady over the past eight years. Bigeye tuna and yellowfin tuna CPUE for the offshore handline fishery showed considerable variability over the past five years.

Fish Size. The average weights for tunas, other PMUS, and PMUS sharks caught by the deep-set longline fishery were close to their respective long-term weights, while most of the billfish species were below their 10-year average weights in 2020. Bigeye tuna caught in the deep-set fishery were 81 lb in 2020, close to the long-term average. The size of swordfish was 145 lb in 2020, much lower from the 10-year average weight. Swordfish caught by the shallow-set longline fishery were 148 lb, well below the 10-year average. 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. The average weight for tunas caught by the troll and handline fisheries was above their long-term average in 2020. Troll and handline caught marlin were below their long-term mean weights.

Revenue. The total revenue from Hawaii's pelagic fisheries was $80.2 million in 2020, a decrease of 25% from the previous year, mainly attributed to the COVID-19 pandemic. Bigeye tuna and yellowfin tuna represented 66% and 17% of the total pelagic revenue, respectively, in 2020. The deep-set longline revenue was $71.5 million in 2020. This fishery represented 89% of the total revenue for pelagic fish in Hawaii. The shallow-set longline fishery decreased to $1.3 million and accounted for 2% of the revenue. The MHI troll revenue was $4.2 million or 5% of the total in 2020 and was followed by the MHI handline fishery at $1.9 million (2%). The offshore handline fishery was close to $1 million in 2020. The trend for revenue from the deep-set longline peaked in 2018 and decreased in the two most recent tears, dropping by 25% in 2020. Revenue for the shallow-set longline fishery trended lower and decreased to a record low in 2020. The revenue from the MHI troll and MHI handline were at decadal lows in 2020, while the offshore handline fishery has had steady revenue over the past seven years.

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. Both the shallow- and deep-set fisheries are required to adhere to a suite of conservation measures aimed at reducing seabird, sea turtle, marine mammal, and elasmobranch interactions.

In 2020, there were 455 sets and 588,481 hooks observed in the shallow-set fishery. Effort is higher than last year because the fishery closed in March 2019 due to the fishery reaching the loggerhead hard cap of 17 interactions. A new Biological Opinion for the shallow-set fishery was completed in June 2019 and concluded that the shallow-set fishery is not likely to adversely modify designated critical habitat for leatherback sea turtles, Hawaiian monk seals, MHI insular false killer whales, Steller sea lions, and critical habitat for listed fish and invertebrate species common to transiting areas off the coast of California. The shallow-set fishery had no observed interactions with dolphins, one observed interaction with a false killer whale, and nine observed interactions with fur seals in 2020. The level of mortality and serious injury for all marine mammal species was below the corresponding potential biological removal (PBR) determined in the Stock Assessment Reports (SARs) prepared under the Marine Mammal Protection Act (MMPA). Seabird and oceanic whitetip shark interactions in the shallow-set fishery in 2019 were relatively consistent with previous years.

Because the deep-set longline fishery operates under a 20% observer coverage requirement, an extrapolation is used to estimate total takes in the fishery. In 2020, there were 3,131 sets and 8,738,011 hooks observed in the deep-set fishery at 15.25% annual observer coverage. 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 incidental take statement (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 and December 18, 2020). Interactions with sea turtles were relatively consistent with previous years. Marine mammal interactions in 2020 included five interactions with a rough-toothed dolphin, two with a Risso’s dolphin, one with a bottlenose dolphin, four with false killer whales, and one with *Kogia* spp. Available data show that associated ITSs were not exceeded for ESA-listed marine mammals. The levels of mortality and serious injury for all marine mammal species were below the corresponding PBR determined in the SARs. Interactions with black-footed albatross have remained high since 2015 compared to years prior, and work is ongoing to field trial tori lines in the deep-set fishery.

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 2020 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 2020 snapshot of the current conditions, 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 2020. 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.

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 2020 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 that are covered by 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 (Johnston Atoll, Kingman Reef and Palmyra, 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.

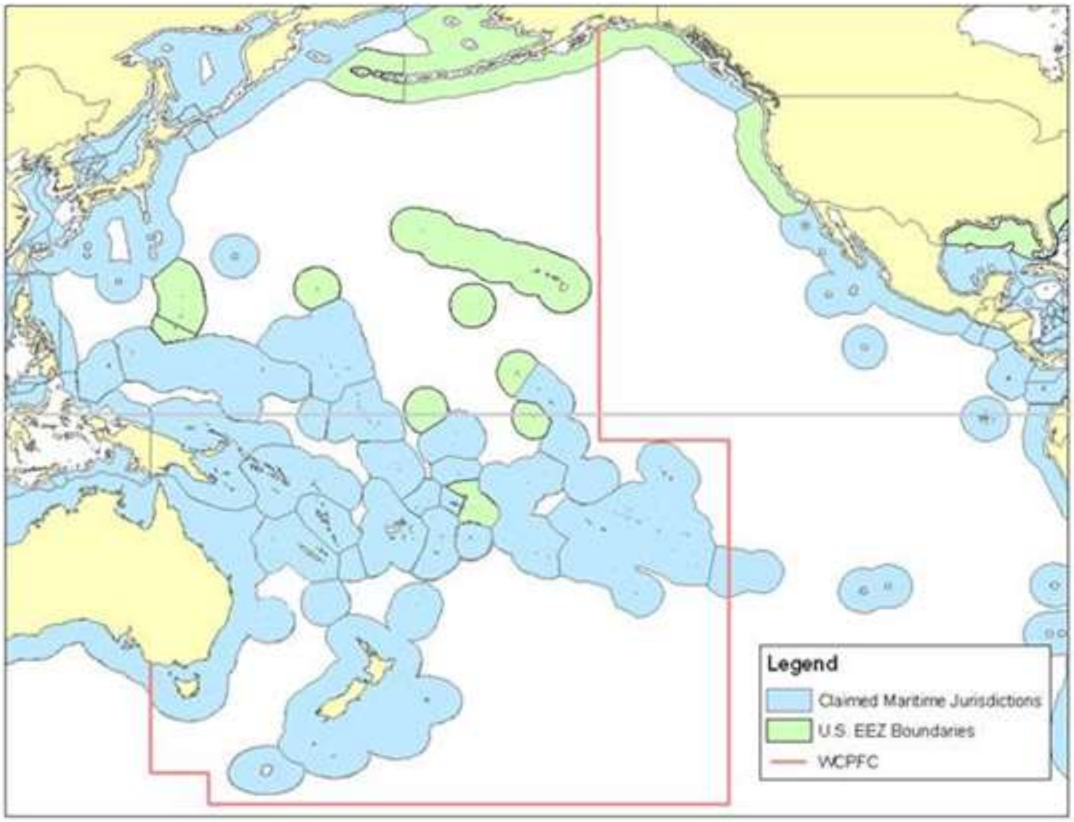
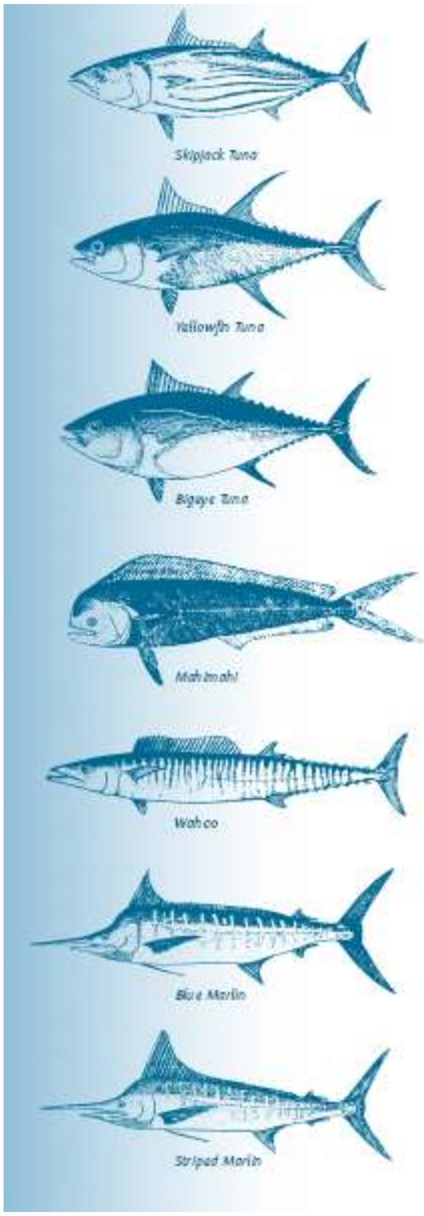


Figure 1. Map of the Western Pacific region

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 fifth 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

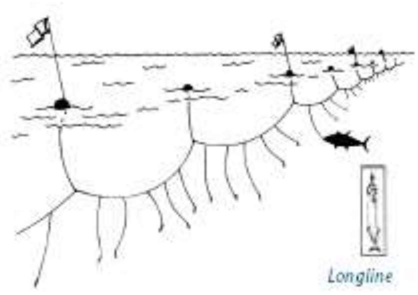
The management unit species (MUS) managed under the Pelagic FEP include large pelagic species such as tunas (tribe Thunnini), billfishes (Istiophoridae and Xiphiidae), and other harvested species with distribution straddling domestic and international waters. The MUS excludes some scombrids found predominantly 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	*Makaira mazara*	Sa’ula	A’u, Kajiki	Batto’	Taghalaar	Taghalaar
Black marlin	*Makaira indica*					
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	*Alopias pelagicus*	Malie	Mano	Halu’u	Paaw	Paaw
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*					
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	*Ommastrephes bartamii*		Squid, ika			
Diamondback squid	*Thysanoteuthis rhombus*		Squid, ika			
Purple flying squid	*Sthenoteuthis oualaniensis*		Squid, ika			

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

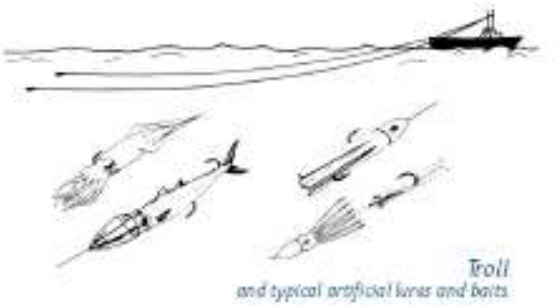
U.S. pelagic fisheries in the Western Pacific Region are, with the exception of purse seining, primarily variations of hook-and-line fishing. These include longlining, trolling, handlining, and pole-and-line fishing. The U.S. purse-seine fishery is managed under an international convention and is therefore 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 WPRFMC, and is also not described in this report.



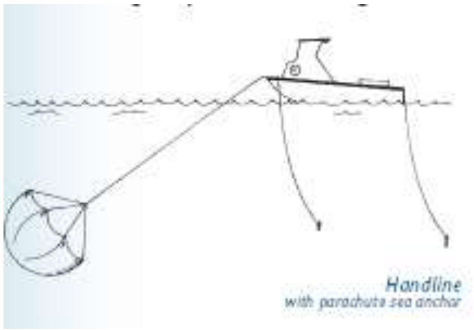
U.S. longline vessels in the Western Pacific Region are based primarily in Hawaii and American Samoa, although Hawaii-based vessels targeting swordfish and bigeye tuna have also fished seasonally out of California. The Hawaii fishery, with 146 active vessels, targets a range of species, with vessels 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, by 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, Manuʻa, Swains Island and Rose Atoll (see Section 3.7 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 2020, there were 11 active longline vessels. Poor economic conditions have plagued the large vessel feet 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.

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 troll fishing from non-commercial activity is difficult.

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 2020 was 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 9,481 trolling trips in 2020, representing a decadal high.

The primary target and most marketable species for the pelagic fleet is skipjack tuna (approximately 78% of 2020 commercial 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 459 boats active in Guam's domestic pelagic fishery in 2020. 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 (a‘u), 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 76% of the total in 2020. Bigeye tuna alone accounted for 74% of the tunas and 56% of all pelagic catch. Billfish catch made up 12% of the total catch in 2020. Blue marlin was the largest of these at 38% of the billfish and 5% of the total catch. Catches of other pelagic management unit species (PMUS) represented 12% of the total catch in 2020 with moonfish being the largest component at 43% of the other PMUS and 5% of the total catch.

The Hawaii longline fishery is by far the most important economically, accounting for about 89% percent of the estimated ex-vessel value of the total commercial fish landings in the State in 2020. In 2012, it is estimated that the commercial seafood industry in Hawaii generated sales impacts of $855 million and income impacts of $262 million while supporting approximately 11,000 full and part time jobs in the State of Hawaii. The commercial harvest sector generated 3,800 jobs, $196 million in sales, $71 million in income, and $102 million in value added impacts (NMFS 2014a). More recently, in 2016, it is estimated that the commercial fishing and seafood industry in Hawaii generated $867.1 million in sales impacts, $269.3 million in income impacts, $391.8 million in value added impacts, and 9,900 full-and part-time jobs. The commercial harvest sector generated 3,691 jobs, $205.7 million in sales, $75.1 million in income, and $108 million in value added impacts (NMFS 2018).

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 AREAS

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 Areas (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 the course of 2020.

On May 7, 2020, NMFS announced the approval of a three-year marine conservation plan (MCP) for the CNMI. The MCP describes CNMI fishery conservation and management objectives and projects that can be funded with revenue from the transfer of bigeye tuna allocations to U.S. longline fishing vessels under valid specified fishing agreements, and from fines and other penalties collected by CNMI for violations by foreign fishing vessels in the EEZ around CNMI.

On June 22, 2020, NMFS issued a final rule (85 FR 37376) for the area of overlap between the convention areas of the Inter-American Tropical Tuna Commission (IATTC) and the WCPFC. The rule revises the management regime for fishing vessels that target tunas and other highly migratory fish species so that all regulations implementing IATTC measures and a few regulations implementing WCPFC measures now apply in the area of overlapping jurisdiction.

On August 19, 2020, NMFS specified a 2020 limit of 2,000 mt of longline-caught bigeye tuna for each U.S. Pacific territory (American Samoa, Guam, and the CNMI). NMFS allowed each territory to allocate up to 1,500 mt to U.S. longline fishing vessels in a valid specified fishing agreement, but the overall allocation limit among all territories could not exceed 3,000 mt. The final specifications were effective August 17, 2020, through December 31, 2020.

On September 9, 2020, NMFS announced the approval of a three-year MCP for Guam (85 FR 55642). The MCP describes Guam fishery conservation and management objectives and projects that can be funded with revenue from the transfer of bigeye tuna allocations to U.S. longline fishing vessels under valid specified fishing agreements, and from fines and other penalties collected by Guam for violations by foreign fishing vessels in the EEZ around Guam.

On September 17, 2020, NMFS published a final rule (85 FR 57988) that implements Amendment 10 to the Fishery Ecosystem Plan for U.S. Pelagic Island Fisheries. The rule reduces the annual Hawaii shallow-set fishery fleet interaction limit (hard cap) for leatherback sea turtles from 26 to 16 and removes the hard cap for North Pacific loggerhead turtles (previously 17). This rule also establishes individual trip limits of two leatherback and five North Pacific loggerhead turtle interactions, with accountability measures for reaching a limit. This rule ensures compliance with the June 26, 2019, biological opinion and allows for a continued supply of fresh domestic swordfish to U.S. markets.

On October 7, 2020, NMFS announced (85 FR 63216) a valid specified fishing agreement that allocated up to 1,000 mt of the 2020 bigeye tuna limit for American Samoa to U.S. longline fishing vessels. The agreement was effective on September 6, 2020 and supports the long-term sustainability of fishery resources of the U.S. Pacific Islands, and fisheries development in American Samoa.

On October 15, 2020, NMFS announced (85 FR 65389) the approval of a three-year MCP for the PRIA and Hawaii. The PRIA includes the EEZ adjacent to Baker, Howland and Jarvis Islands, Johnston Atoll, Palmyra Atoll, Kingman Reef, Midway Island, and Wake Island. The MCP outlines conservation and management projects using funds from the Western Pacific Sustainable Fisheries Fund.

On November 23, 2020, NMFS announced (85 FR 74614) a valid specified fishing agreement that allocated up to 1,000 mt of the 2020 bigeye tuna limit for the CNMI to U.S. longline fishing vessels. The agreement, which was effective November 15, 2020, followed the prior American Samoa agreement that was projected to reach its 1,000 mt limit on November 22, 2020. These agreements support the long-term sustainability and development of fishery resources of the U.S. Pacific Islands.

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

A summary of the 2020 total pelagic landings in the Western Pacific and the change between 2019 and 2020 are shown in Table 2.

Table 2. Total pelagic landings (lb) in the Western Pacific Region in 2020 and percent change from the previous year

Species	American Samoa			CNMI			Guam			Hawaii		
	2019 lb	**2020 lb**	**% Change**	**2019 lb**	**2020 lb**	**% Change**	**2019 lb**	**2020 lb**	**% Change**	**2019 lb**	**2020 lb**	**% Change**
Swordfish	8,210	4,945	-39.8	-	-	-	-	-	-	1,625,550	1,199,054	-26.2
Blue marlin	65,506	54,645	-16.6	3,855	0	-100.0	49,973	50,833	1.7	2,337,302	1,373,204	-41.2
Striped marlin	3,509	3,302	-5.9	-	-	-	-	-	-	1,231,250	762,178	-38.1
Other billfish*	8,263	2,090	-74.7	0	0	-	1,459	0	-100.0	502,660	286,252	-43.1
Mahimahi	4,877	10,727	120.0	71,791	71,564	-0.3	136,665	92,602	-32.2	1,005,344	580,028	-42.3
Wahoo	40,832	34,991	-14.3	2,448	6,549	167.5	23,707	46,920	97.9	1,599,188	849,256	-46.9
Opah (moonfish)	1,185	1,432	20.8	-	-	-	-	-	-	2,291,791	1,631,024	-28.8
Sharks (whole wt.)	1,447	90	-93.8	0	0	-	0	0	-	115,222	42,605	-63.0
Albacore	2,315,559	1,116,890	-51.8	-	-	-	-	-	-	255,187	366,231	43.5
Bigeye tuna	66,547	45,785	-31.2	-	-	-	-	-	-	17,612,214	16,951,895	-3.7
Bluefin tuna	476	238	-50.0	-	-	-	-	-	-	3,765	3,400	-9.7
Skipjack tuna	164,330	132,585	-19.3	345,172	537,399	55.7	472,405	348,466	-26.2	832,482	553,091	-33.6
Yellowfin tuna	420,402	482,700	14.8	36,473	55,944	53.4	63,621	54,962	-13.6	5,982,494	5,098,324	-14.8
Other pelagics**	3,374	1,857	-45.0	6,530	17,680	170.8	22,921	20,850	-9.0	1,073,709	702,613	-34.6
Total	**3,104,812**	**1,892,277**	**-39.1**	**466,269**	**689,136**	**47.8**	**759,653**	**614,633**	**-19.1**	**36,468,157**	**30,399,157**	**-16.6**

Note: Total Pelagic Landings based on commercial reports and/or creel surveys. % change based on 2019 landings relative to 2020 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

Plan Team members agreed to carry out the following module improvements and action items for the Pelagic Annual SAFE Report:

1. Indicate annual estimates of non-longline fishing effort or catch that are anomalous (such as for CNMI in 2020 annual estimates of troll effort that varied significantly) and may be associated with uncertainty. This should also include means of characterizing uncertainty.
2. Given the lack of sampling for two three-month gaps that coincide with prevalence of two major PMUS, to reconcile annual estimates of PMUS in the Guam fishery data module for 2020 to either determine alternative means to estimate PMUS in Guam, or to conclude if 2020 estimates for certain PMUS in Guam are flagged as unreliable based on sampling issues.
3. Include a Fishery Observation section to the Pelagic Plan SAFE Report as a separate section within the Ecosystem chapter to be updated annually, independent from data modules, and explicitly noting source of information. This may include instances in which local knowledge and observations corroborate trends in available data sources in future years. This information should come from periodic check-ins with fishing communities and with the advisory panels.
4. PIFSC, state, and territory management agencies, and Council staff to work on determining local and external demands for incidental PMUS, such as mahimahi, and explore drivers impacting price per pound related to catch in non-longline and longline fisheries. This work should include consultation with Council advisory bodies and in concert with local knowledge provided in the new Fishery Observation section.
5. PIFSC Socioeconomics Program and Plan Team members to work with state and territorial management agencies in documenting the COVID impacts to the fishery performance, data collection, and fishing communities for inclusion in the new special COVID section within the 2020 annual SAFE report. The PIFSC Socioeconomic Program and Plan Team members are to determine feasibility of including such a section in the 2021 annual SAFE Report.

Regarding bycatch data tables in the pelagic annual SAFE report, the Pelagic Plan Team formed a Plan Team working group composed of PIRO, PIFSC, and Council staff to consider inclusion of longline bycatch data using observer data for future reports. The working group may identify priority species for generating expanded estimates from the prior year in time for the SAFE report and a list of species and species groupings for remaining fish bycatch to supplement the existing tables based on logbook data.

Regarding the development of the Non-Commercial module in the Annual SAFE report, the Pelagic Plan Team recommended the Council requests PIFSC analyze the fishery-dependent data: 1) total estimated creel catch minus commercial receipts for non-commercial catch and 2) expand the creel intended sold and unsold, to determine which approach could be used for the non-commercial estimates in the annual SAFE reports.

Regarding the Fishermen Observations section of the SAFE Report, the Pelagic Plan Team recommended that the Council consider directing its Social Science Planning Committee to work with the Advisory Panels to explore conducting periodic check-ins with the fishing communities to provide information for this section.

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 1.9 to 9.7 million lb between 2011 and 2020. The 2020 landings were approximately 1.9 million pounds, the lowest recorded and a continuation of the decline from 9.7 million lb in 2012 (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 63% of the tuna species in 2020. Wahoo, blue marlin, and swordfish 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 2020 according to the PIRO Sustainable Fisheries Division permit program. This was a decrease from 18 in 2019. The following number of vessels were active in each class: 7 Class D vessels (> 70 foot), 3 Class C (50 - 60 foot), 0 Class B vessels (40 - 50 foot) and 1 Class A (< 40 foot). The 11 vessels that fished in 2020 made 90 trips (averaging 8 trips/vessel), deployed 1,227 sets, (111 sets/vessel) using 3.4 million hooks and 0 lightsticks (Table 5). All other fishing effort indicators indicate a declining fishery: the number of boats further decreased in 2020 from 2019, the effort decreased (trips, sets, and hooks), and longline hooks set were an all-time low. A certain degree of the decline in 2020 can be attributed to the fisheries impact of COVID-19 social restrictions.

Longline CPUE. The total pelagic catch rate by all longline vessels decreased by 1.8 fish/1,000 hooks in 2020, a decline of 10% and the lowest CPUE reported since 1999. The tuna catch rate by longliners also decreased by 2.1 fish/1,000 hooks in 2020 to 14.1 fish/1,000 hooks after relatively stable catch rates from 2015 to 2018 (17.0 to 17.9 fish/1,000 hooks). The catch rate for albacore declined by 3.1 fish/1,000 hooks in 2020 to 8.5 fish/1,000 hooks. This is the lowest recorded catch rate for albacore since 1999.

Lb-Per-Hour Trolling. Trolling catch rates decreased slightly in 2020 (21 lb/hr) from 2019 (24 lb/hr) but had been previously increasing since 2017 (14 lb/hr; Figure 19). Trolling catch rates have fluctuated with peaks in 2011 to 2012 (52 lb/hr) and 2016 (43 lb/hr). The catch rates for skipjack decreased to 12 lb/hr in 2020 but increased for yellowfin relative to 2019 to 6 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 2020, the total longline fleet revenue (estimated landed value) was $2.1 million, and albacore composed of over 62% of the total landed value. Other main species included yellowfin, bigeye, skipjack, and wahoo. The estimated value of the species landed were 15%, 1%, 3%, and 2%, respectively. Albacore had an estimated price of $1.50 per pound. See the Socioeconomics (Section 3.3) section for additional data on American Samoa pelagic fisheries.

Bycatch. There was no recorded bycatch for the troll fishery in 2020 (Table 13). In the longline fishery, around 1.2% of the tuna catch was released. Skipjack and yellowfin were the most released bycatch tuna species at 1.6 and 1.4%, respectively. Conversely, sharks and oilfish had the highest release numbers of non-tunas, with nearly 100% of each species released (Table 6). In total, only 7.6% 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

Plan Team members agreed to carry out the following module improvements and action items for the Pelagic Annual SAFE Report:

1. Indicate annual estimates of non-longline fishing effort or catch that are anomalous (such as for CNMI in 2020 annual estimates of troll effort that varied significantly) and may be associated with uncertainty. This should also include means of characterizing uncertainty.

2.1.4 OVERVIEW OF PARTICIPATION – ALL FISHERIES

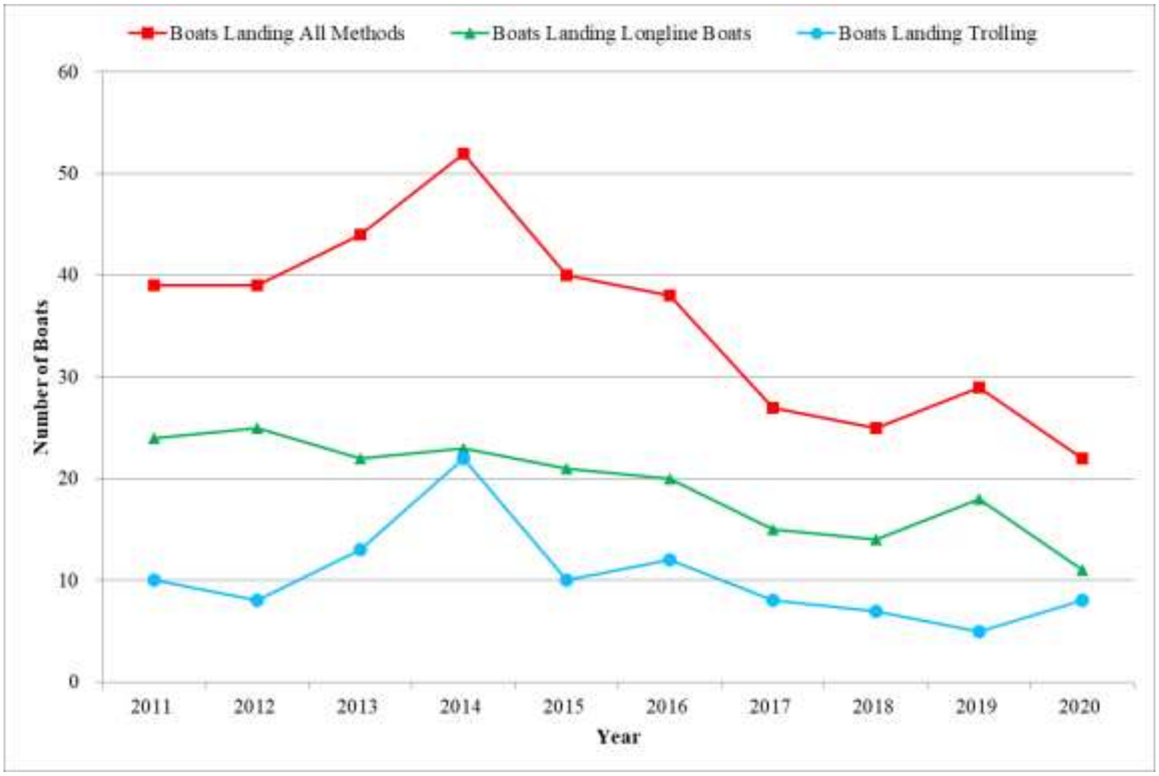


Figure 2. Number of boats landing any pelagic species in American Samoa by longlining, trolling, and all methods from 2011-2020

Supporting data shown in Table A-2.

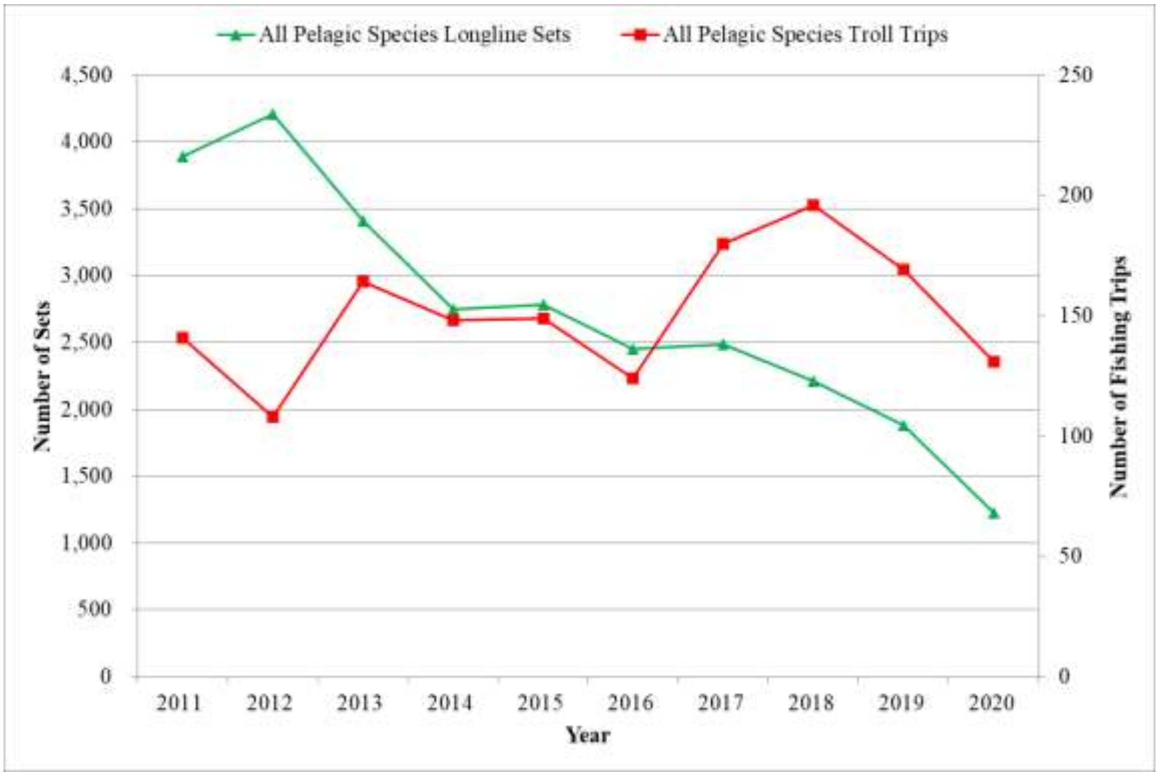


Figure 3. Number of fishing trips and sets for pelagic species in American Samoa from 2011-2020

Supporting data shown in Table A-3.

2.1.5 OVERVIEW OF LANDINGS – ALL FISHERIES

Table 3. 2020 estimated total landings (lb) of pelagic species in American Samoa by gear

Species	Longline Pounds	Troll Pounds	Other Pounds	Total Pounds
Skipjack tuna	126,168	6,417	0	132,585
Albacore tuna	1,116,890	0	0	1,116,890
Yellowfin tuna	479,374	3,327	0	482,700
Kawakawa	0	39	0	39
Bigeye tuna	45,389	396	0	45,785
Bluefin tuna	238	0	0	238
Tunas (unknown)	0	0	0	0
TUNAS TOTAL	**1,768,059**	**10,179**	**0**	**1,778,237**
Mahimahi	9,784	942	0	10,727
Black marlin	0	0	0	0
Blue marlin	54,645	0	0	54,645
Striped marlin	3,302	0	0	3,302
Wahoo	34,885	105	0	34,991

Species	Longline Pounds	Troll Pounds	Other Pounds	Total Pounds
Swordfish	4,945	0	0	4,945
Sailfish	1,205	287	0	1,492
Spearfish	598	0	0	598
Moonfish	1,432	0	0	1,432
Oilfish	76	0	0	76
Pomfret	194	0	0	194
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	90	0	0	90
Longfin mako shark	0	0	0	0
Billfishes (unknown)	0	0	0	0
NON-TUNA PMUS TOTAL	**111,156**	**1,334**	**0**	**112,492**
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	49	0	0	49
Great barracuda	0	0	364	364
Small barracudas	0	24	0	24
Rainbow runner	0	17	89	106
Dogtooth tuna	0	323	682	1,005
OTHER PELAGICS TOTAL	49	364	1,135	1,548
TOTAL PELAGICS	**1,879,264**	**11,877**	**1,135**	**1,892,277**

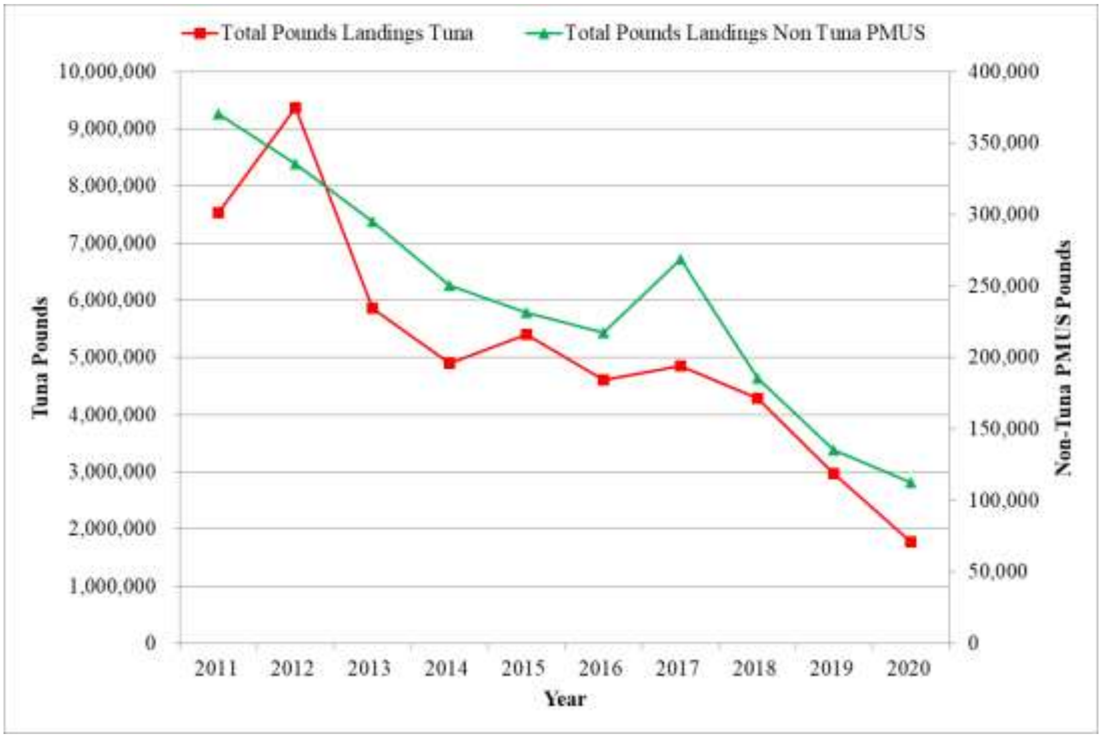


Figure 4. Total estimated landings of tuna and non-tuna PMUS in American Samoa from 2011-2020

Supporting data shown in Table A-4.

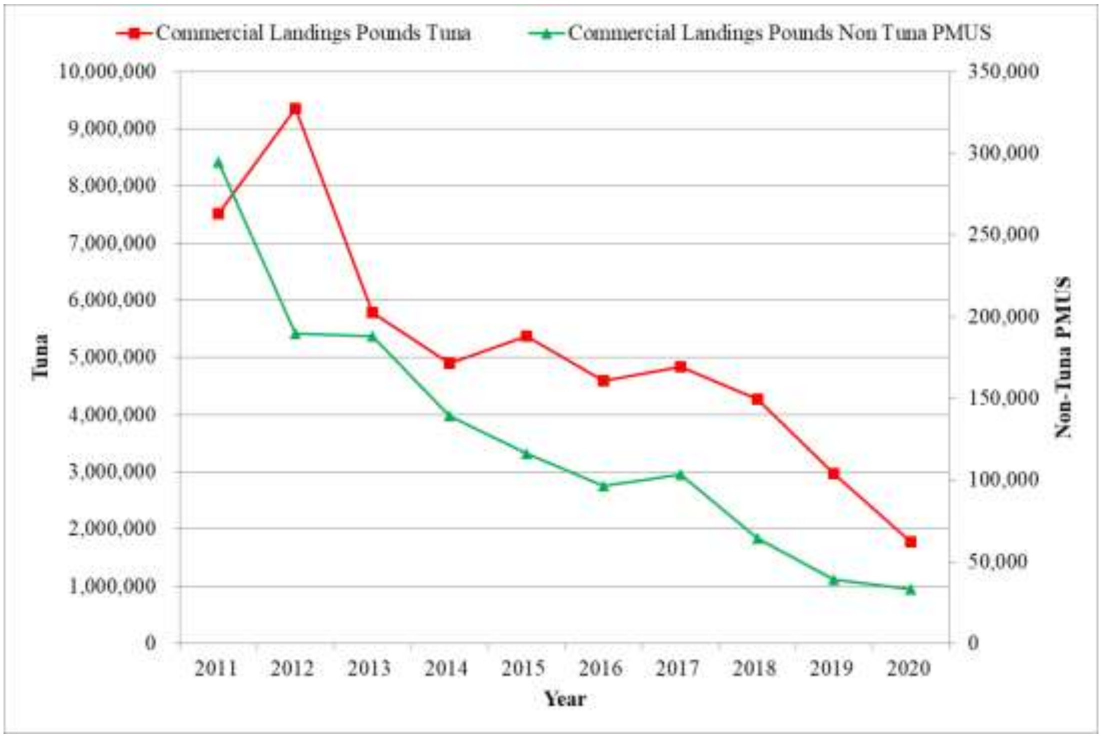


Figure 5. Commercial landings of tuna and non-tuna PMUS in American Samoa from 2011-2020

Supporting data shown in Table A-5.

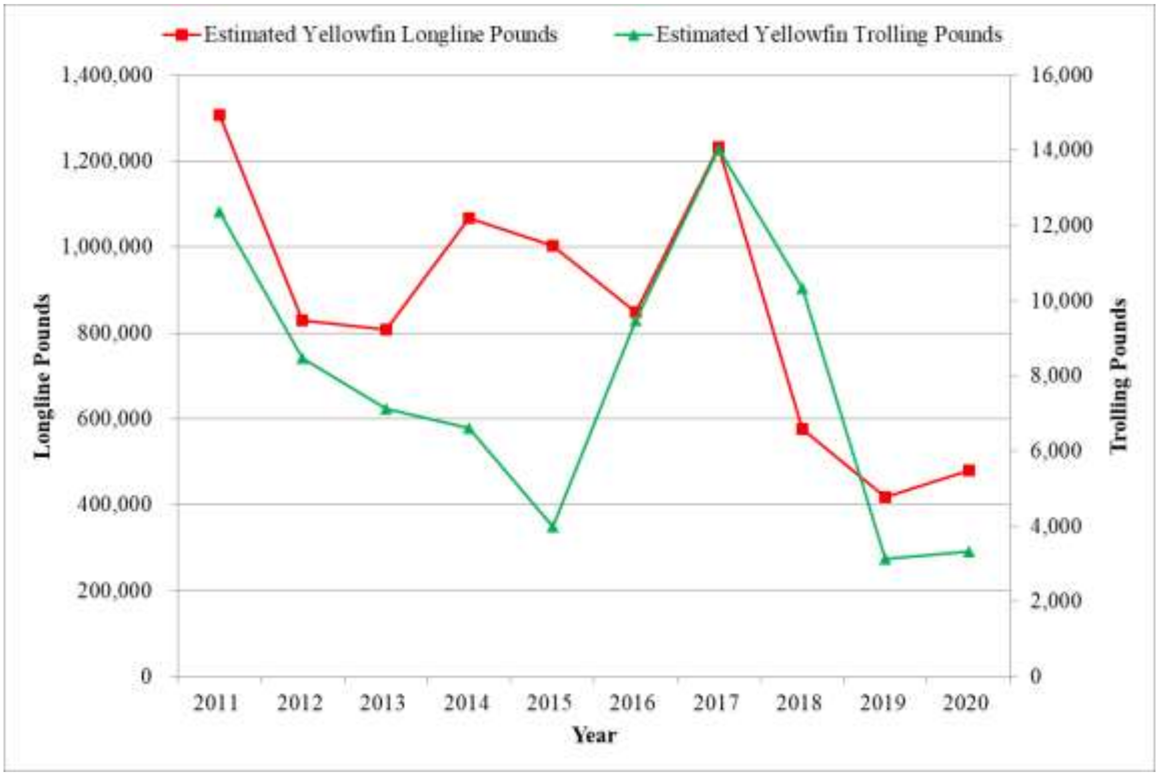


Figure 6. Total estimated landings of yellowfin tuna in American Samoa from 2011-2020
Supporting data shown in Table A-6.

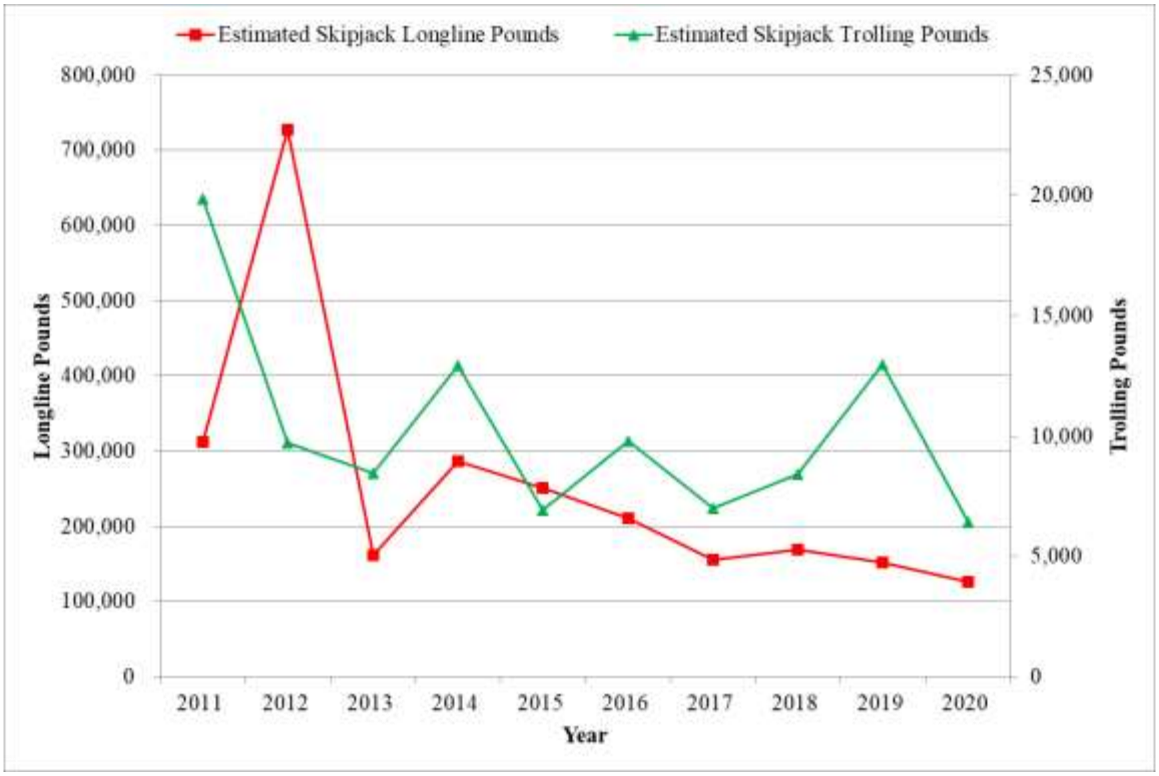


Figure 7. Total estimated landings of skipjack tuna in American Samoa from 2011-2020
Supporting data shown in Table A-7.

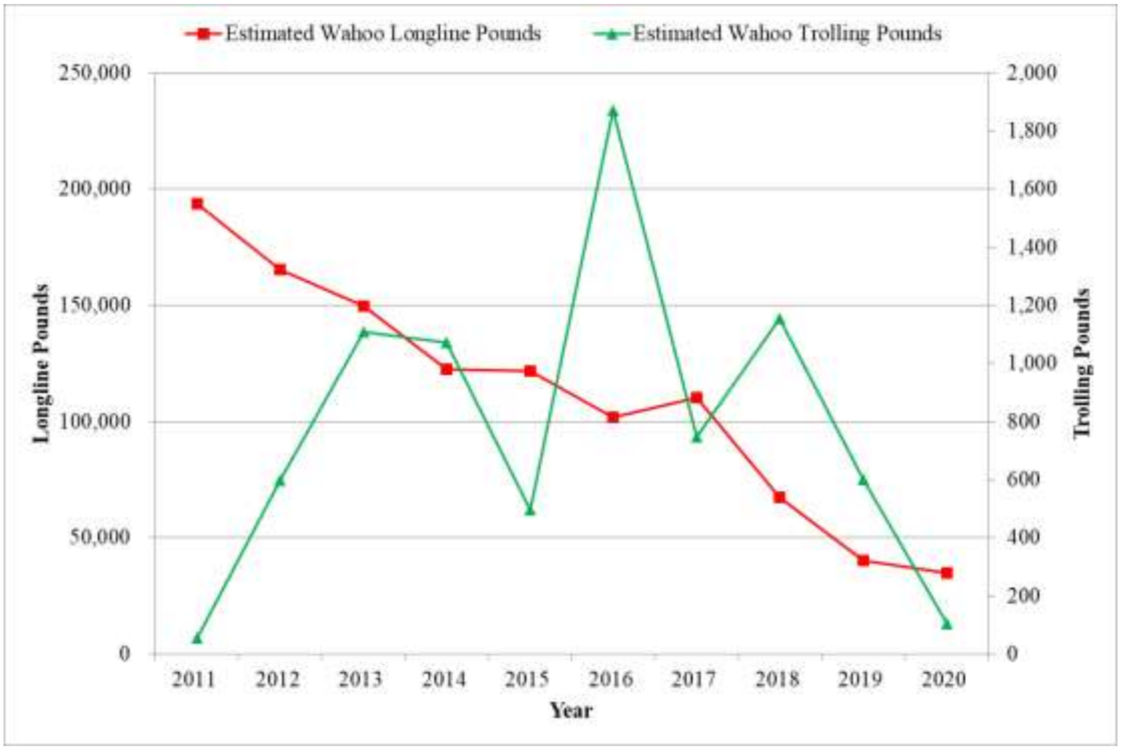


Figure 8. Total estimated landings of wahoo in American Samoa from 2011-2020

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

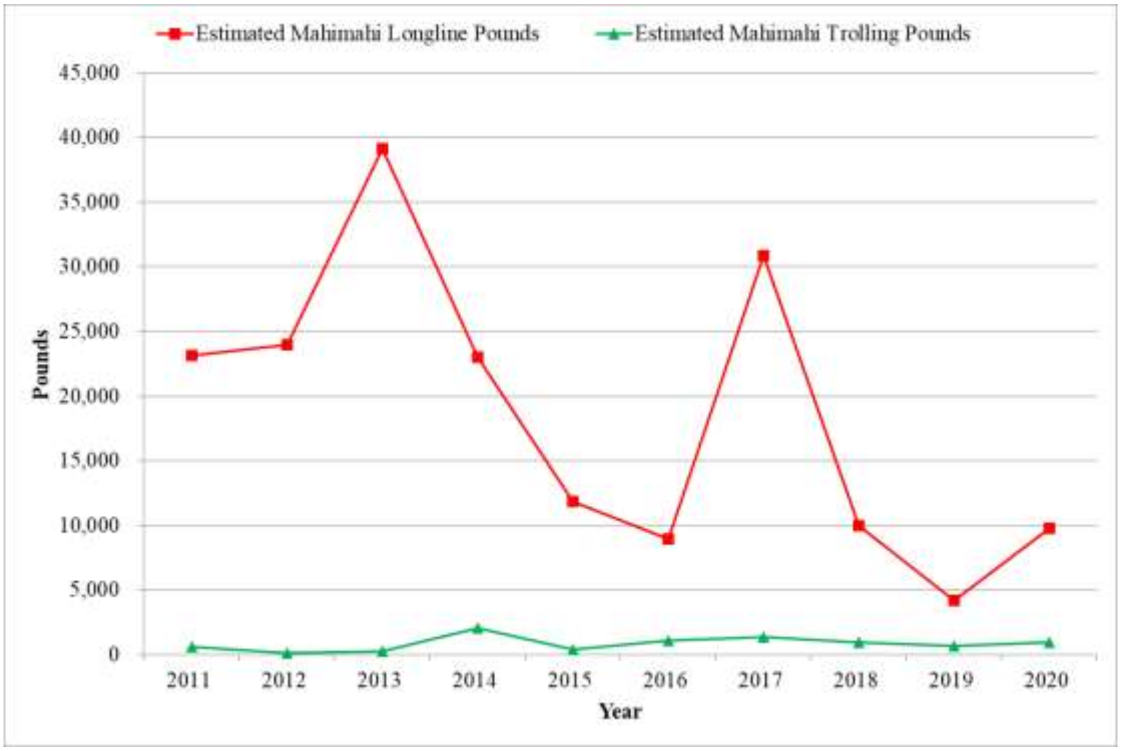


Figure 9. Total estimated landings of mahimahi in American Samoa from 2011-2020

Supporting data shown in Table A-9.

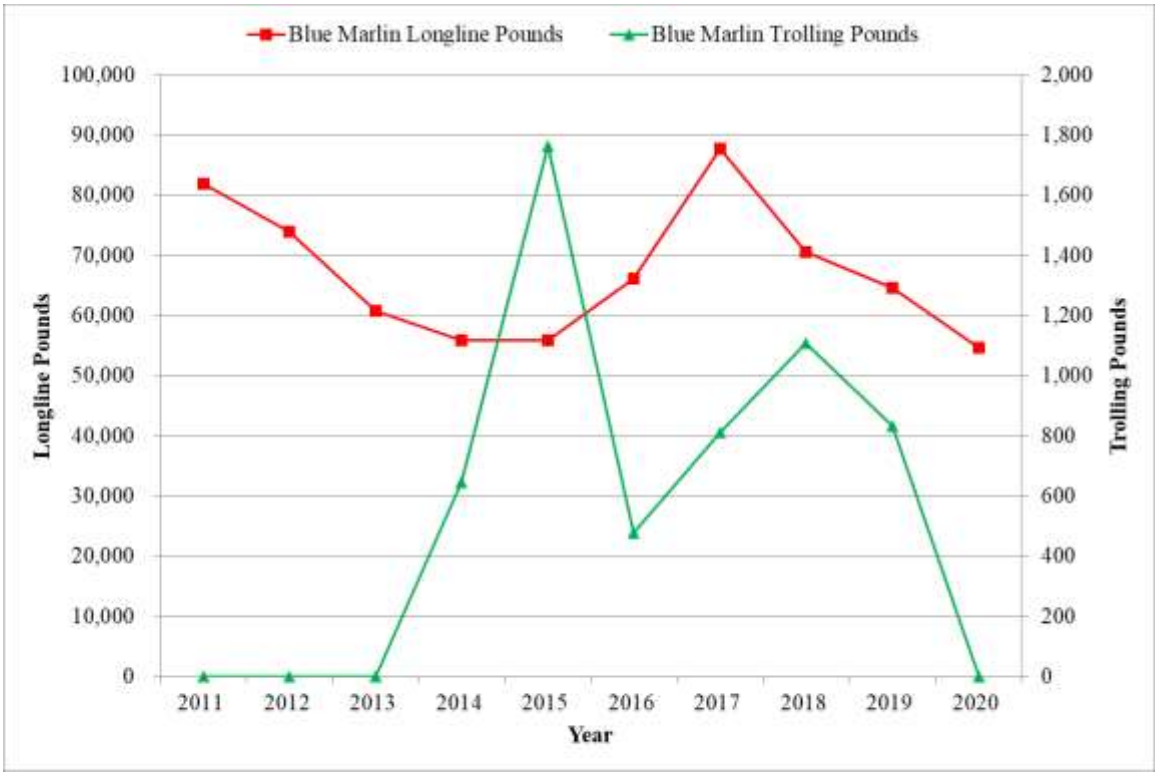


Figure 10. Total estimated landings of blue marlin in American Samoa from 2011-2020
Supporting data shown in Table A-10.

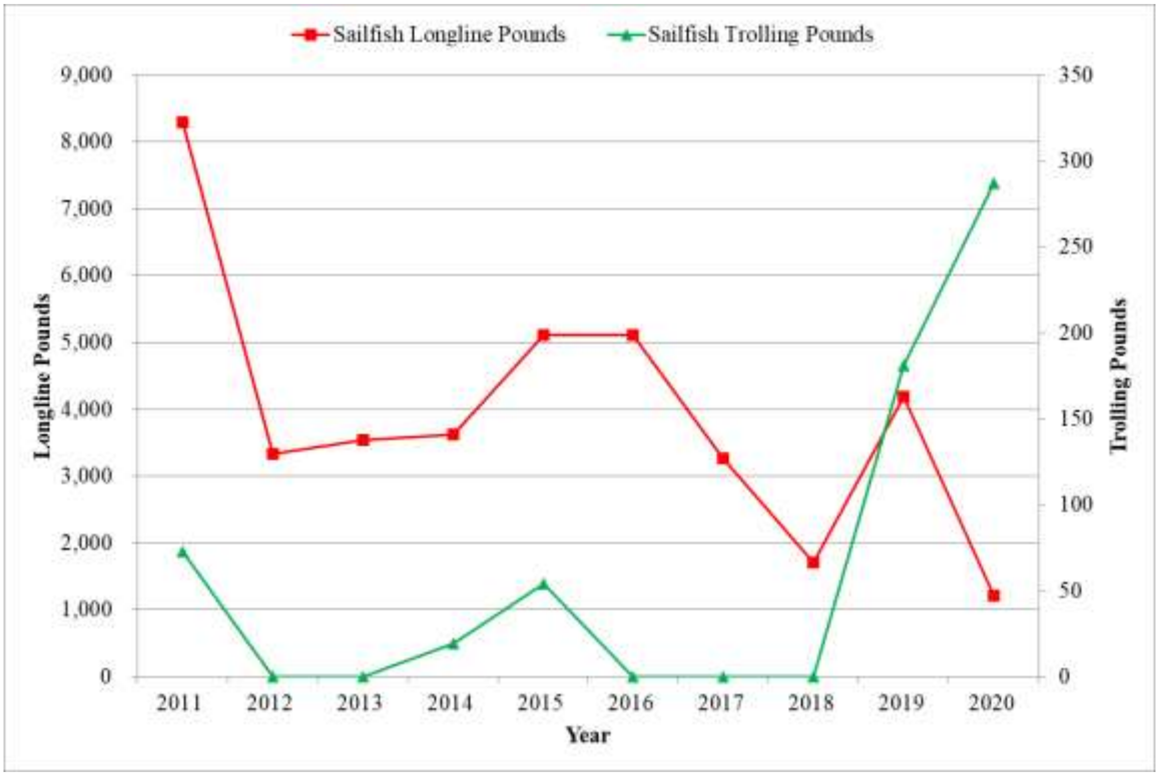


Figure 11. Total estimated landings of sailfish in American Samoa from 2011-2020
Supporting data shown in Table A-11.

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 from 2011-2020

Year	Class A Permits	Class A Active	Class B Permits	Class B Active	Class C Permits	Class C Active	Class D Permits	Class D Active
2011	12	1	1	0	12	8	27	15
2012	5	3	5	0	11	8	27	14
2013	5	1	5	0	11	7	26	14
2014	13	2	5	0	17	7	27	14
2015	7	3	5	0	12	6	34	12
2016	7	2	4	0	12	5	27	13
2017	7	1	3	0	11	5	27	9
2018	6	1	7	0	14	4	29	9
2019	4	3	4	0	13	5	29	10
2020	3	1	4	0	13	3	27	7

Note: These data are used for Figure 12 that follows. Classes A and B include alia vessels, whereas Classes C and D typically include larger monohull vessels fishing in the Southern Pacific Ocean. Dual-permitted vessels are included.

Figure 12. Number of active longline fishing vessels in American Samoa by size classes: A (< 40 ft.), B (40-50 feet), C (51-70 feet) and D (> 70 ft.) from 2011-2020

Table 5. Longline effort by American Samoa vessels during 2020

Effort Type	All Vessels
Boats	11
Trips	90
Sets	1,227
1000 Hooks	3,401
Lightsticks	0

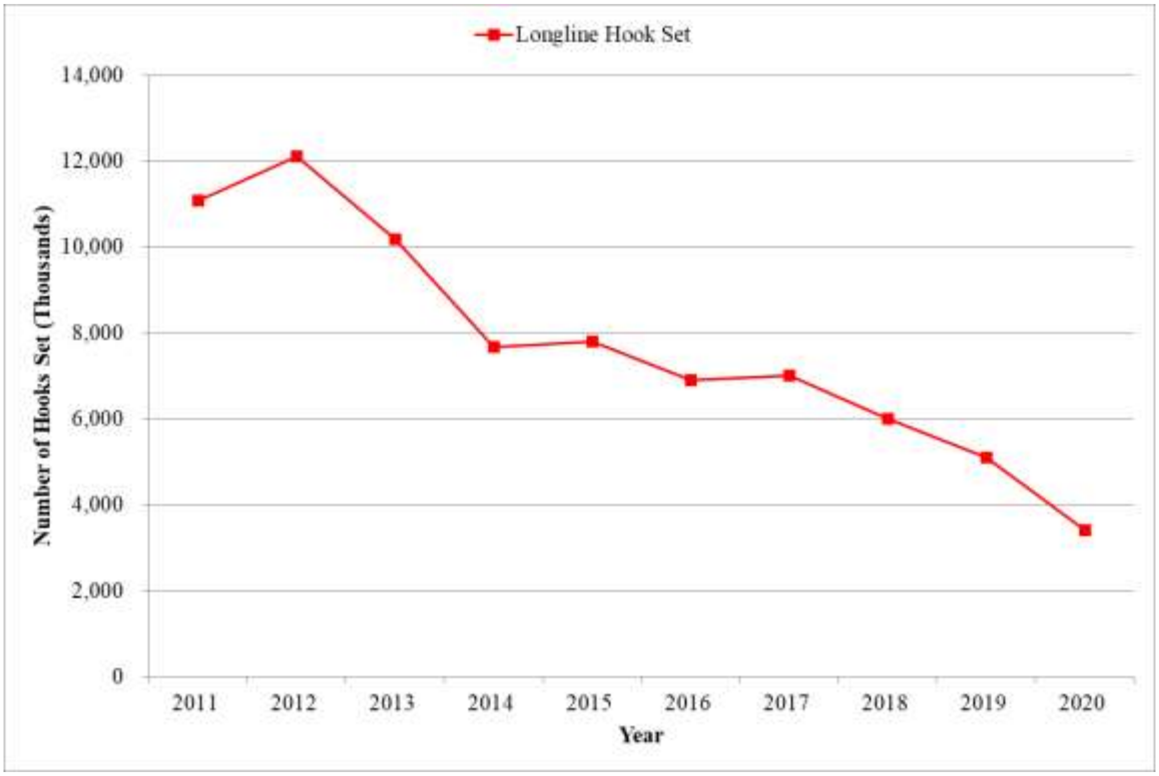


Figure 13. Thousands of longline hooks set from federal logbook data in American Samoa from 2011-2020

Supporting data shown in Table A-12.

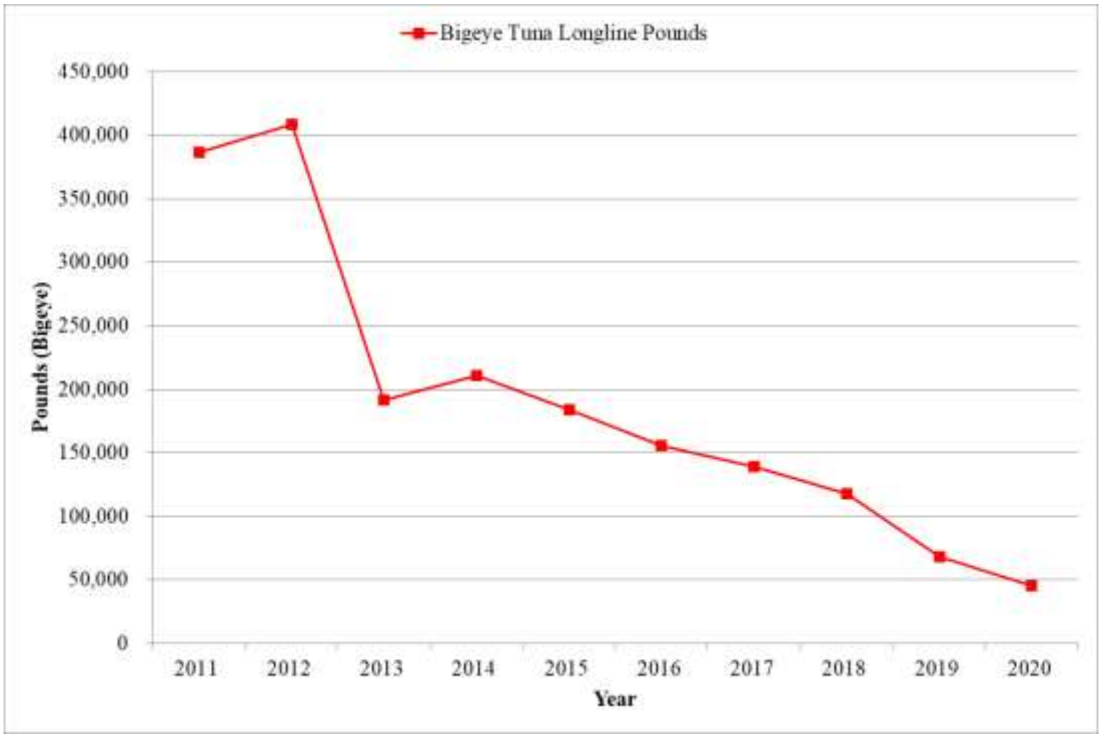


Figure 14. Total estimated landings of bigeye by longlining in American Samoa from 2011-2020

Supporting data shown in Table A-13. .

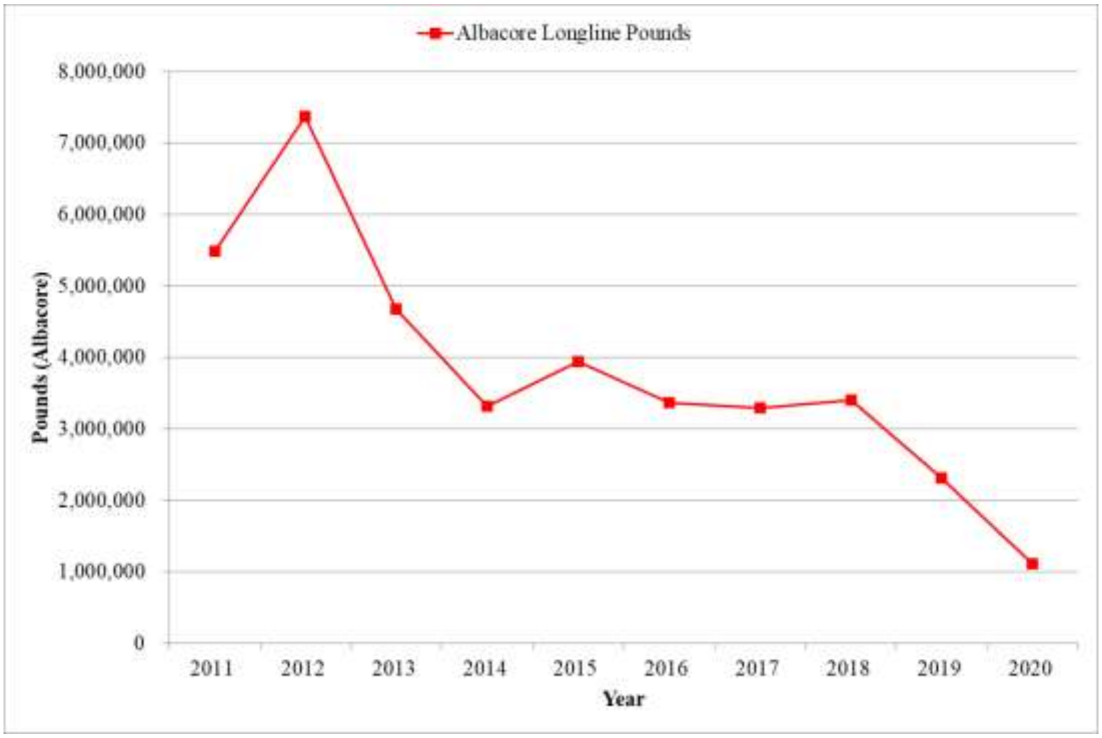


Figure 15. Total estimated landings of albacore by longlining in American Samoa from 2011-2020

Supporting data shown in Table A-14.

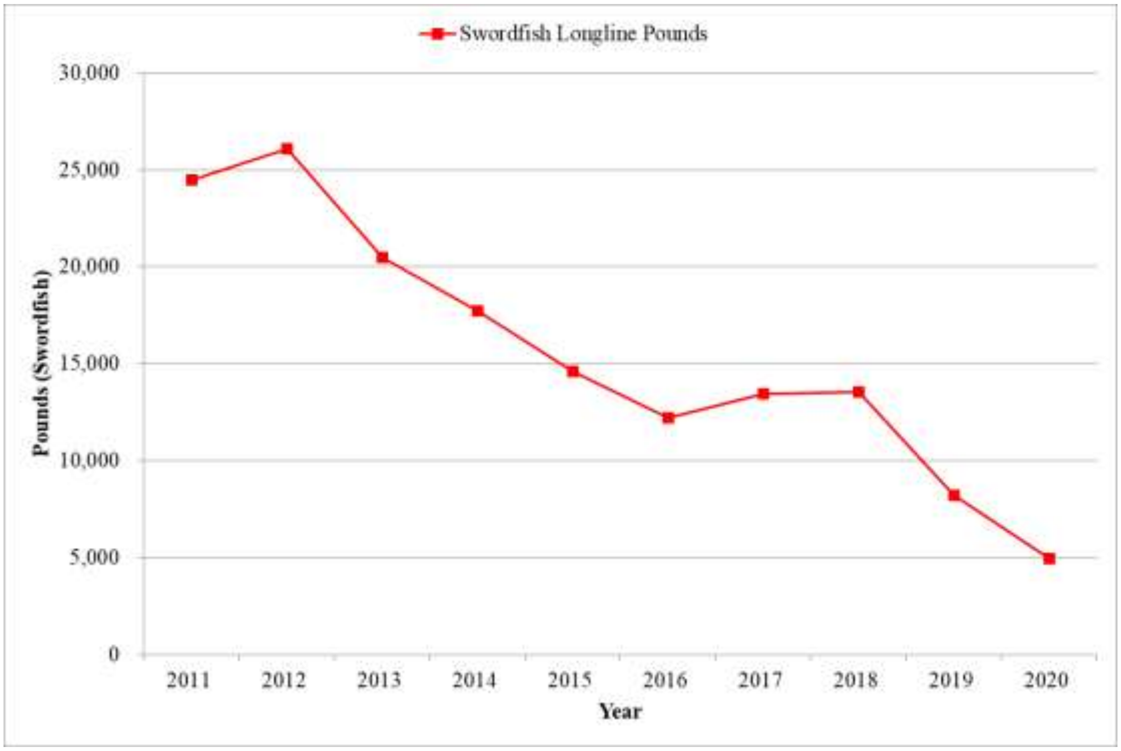


Figure 16. Total estimated landings of swordfish by longlining in American Samoa from 2011-2020

Supporting data shown in Table A-15.

Table 6. Number of fish kept, released, and percent released for all American Samoa longline vessels in 2020

Species	Number Kept	Number Released	Total Caught	Percent Released
Skipjack tuna	8,832	143	8,975	1.6
Albacore tuna	28,504	305	28,809	1.1
Yellowfin tuna	9,083	127	9,210	1.4
Kawakawa	0	0	0	0.0
Bigeye tuna	974	12	986	1.2
Bluefin tuna	1	0	1	0.0
Tunas (unknown)	0	0	0	0.0
TUNAS TOTAL	**47,394**	**587**	**47,981**	**1.2**
Mahimahi	457	9	466	1.9
Black marlin	0	0	0	0.0
Blue marlin	419	28	447	6.3
Striped marlin	48	0	48	0.0
Wahoo	1,361	37	1,398	2.6
Swordfish	45	44	89	49.4
Sailfish	17	34	51	66.7

Species	Number Kept	Number Released	Total Caught	Percent Released
Spearfish	13	122	135	90.4
Moonfish	29	4	33	12.1
Oilfish	4	993	997	99.6
Pomfret	22	224	246	91.1
Pelagic thresher shark	0	0	0	0.0
Thresher shark	0	77	77	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	536	536	100.0
White tip oceanic shark	0	391	391	100.0
Blue shark	0	899	899	100.0
Shortfin mako shark	1	87	88	98.9
Longfin mako shark	0	0	0	0.0
Billfishes (unknown)	0	0	0	0.0
NON-TUNA PMUS TOTAL	**2,416**	**3,487**	**5,903**	**59.1**
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	4	27	31	87.1
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	**4**	**27**	**31**	**87.1**
TOTAL PELAGICS	**49,814**	**4,101**	**53,915**	**7.6**

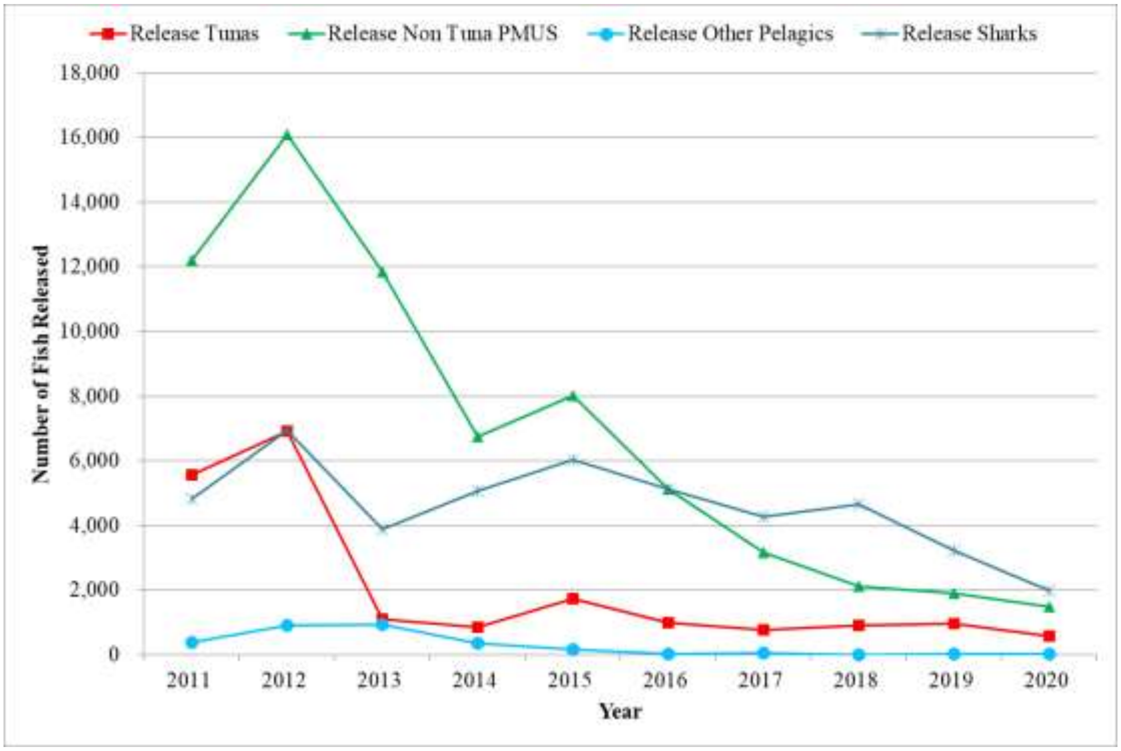


Figure 17. Number of fish released by longline vessels in American Samoa from 2011-2020

Supporting data shown in Table A-16.

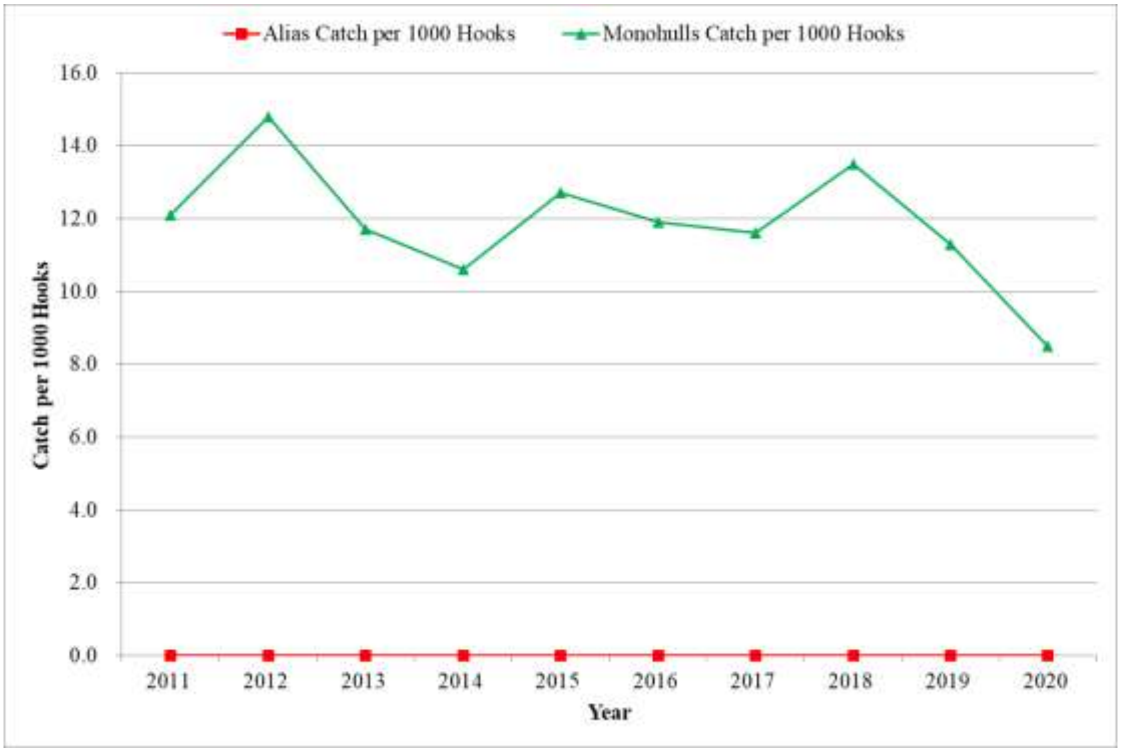


Figure 18. Albacore catch/1,000 hooks by monohull vessels from longline logbook data in American Samoa from 2011-2020

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

Table 7. Catch/1,000 hooks for alia vessels in American Samoa from 1996-1998

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 8. Catch/1,000 hooks for two types of longline vessels in American Samoa from 1999-2002

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

Species	Alia 1999	Monohull 1999	Alia 2000	Monohull 2000	Alia 2001	Monohull 2001	Alia 2002	Monohull 2002
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 9. Catch/1,000 hooks for two types of longline vessels in American Samoa from 2003-2005

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
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 10. Catch/1,000 hooks for all types of longline vessels in American Samoa from 2006-2011

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 11. Catch/1,000 hooks for all types of longline vessels from 2013-2017

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

Species	All Vessels 2012	All Vessels 2013	All Vessels 2014	All Vessels 2015	All Vessels 2016	All Vessels 2017
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 12. Catch/1,000 hooks for all types of longline vessels in American Samoa from 2018-2020

Species	All Vessels 2018	All Vessels 2019	All Vessels 2020
Skipjack tuna	1.8	2.3	2.6
Albacore tuna	13.5	11.6	8.5
Yellowfin tuna	1.7	1.9	2.7
Bigeye tuna	0.4	0.4	0.3
TUNAS TOTAL	**17.4**	**16.2**	**14.1**
Mahimahi	0.1	0.0	0.1
Blue marlin	0.1	0.1	0.1
Wahoo	0.5	0.4	0.4
Oilfish	0.3	0.2	0.3
Pomfret	0.0	0.1	0.1
Thresher shark	0.1	0.0	0.0
Silky shark	0.1	0.1	0.2
White tip oceanic shark	0.1	0.1	0.1
Blue shark	0.5	0.3	0.3
NON-TUNA PMUS TOTAL	**1.8**	**1.3**	**1.6**
TOTAL PELAGICS	**19.2**	**17.5**	**15.7**

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 13.

Table 13. American Samoa trolling bycatch summary (released fish) for 2011-2020

Year	Total Trips	Total Bycatch	Bycatch Charter	Bycatch Non Charter	Total Kept	Percent Bycatch
2011	112	0	0	0	1,836	0.0
2012	63	0	0	0	1,527	0.0
2013	128	0	0	0	1,899	0.0
2014	212	0	0	0	2,814	0.0
2015	99	0	0	0	667	0.0
2016	116	0	0	0	1,376	0.0
2017	95	0	0	0	915	0.0
2018	130	0	0	0	744	0.0
2019	96	0	0	0	648	0.0
2020	71	0	0	0	465	0.0

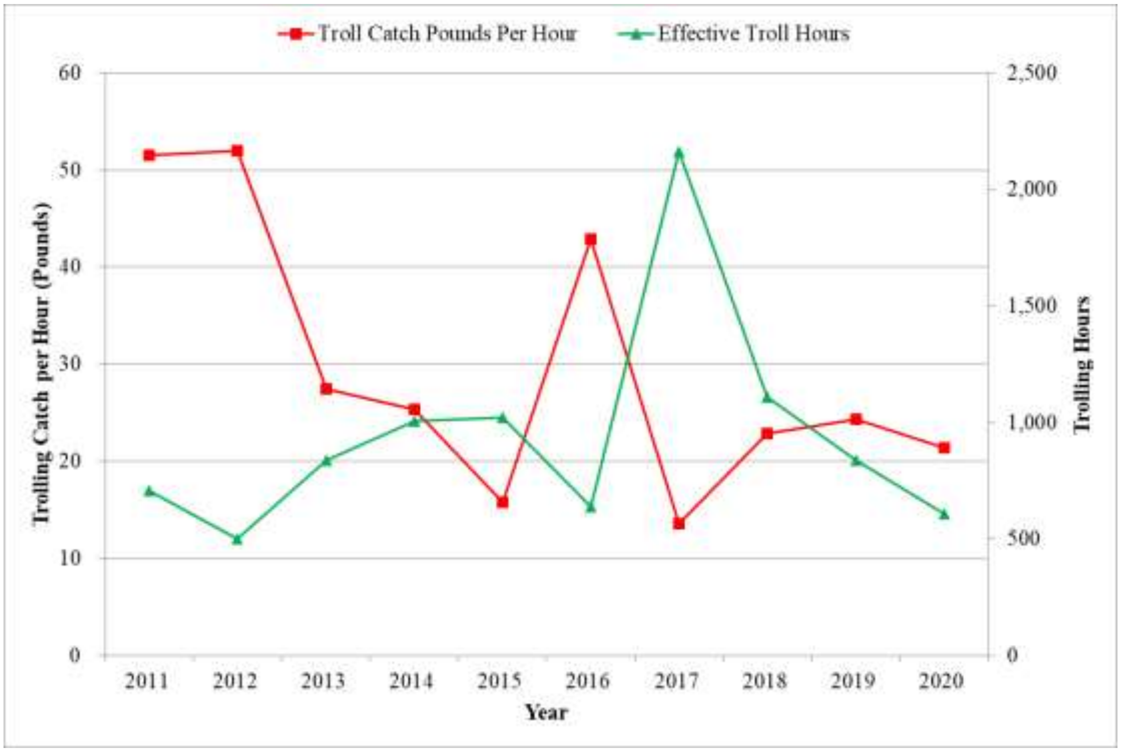


Figure 19. Catch-per-hour for trolling and number of trolling hours in American Samoa from 2011-2020

Supporting data shown in Table A-18.

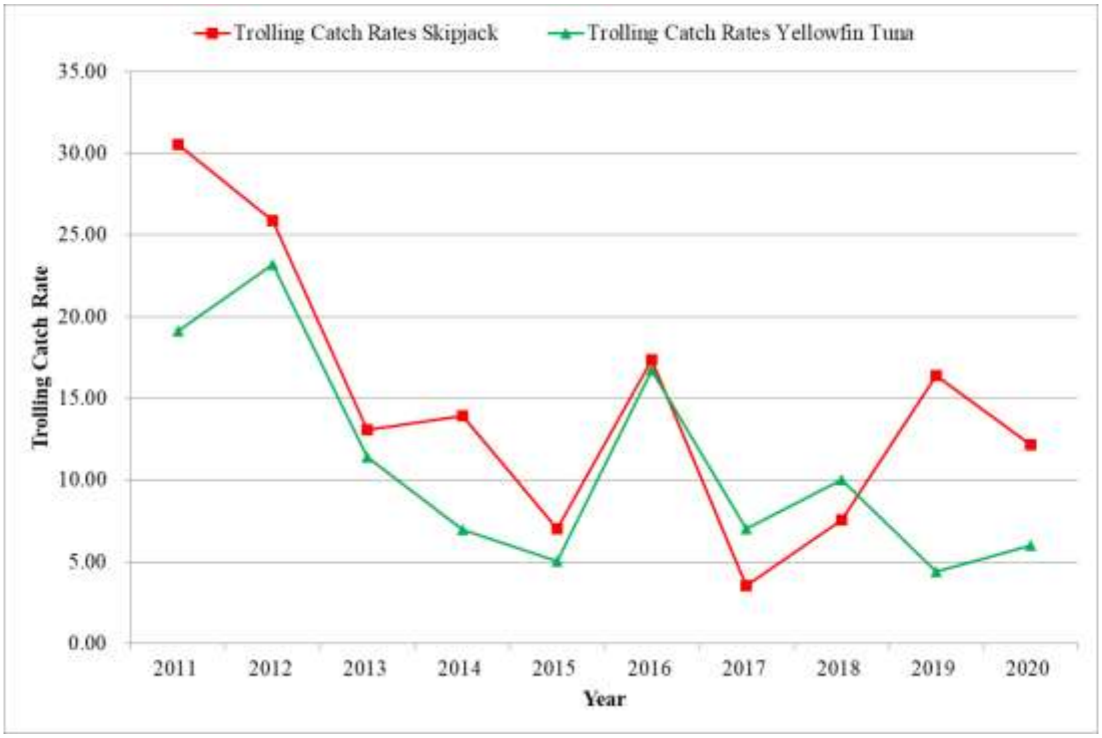


Figure 20. Trolling CPUE for skipjack and yellowfin tuna in American Samoa from 2011-2020

Supporting data shown in Table A-19.

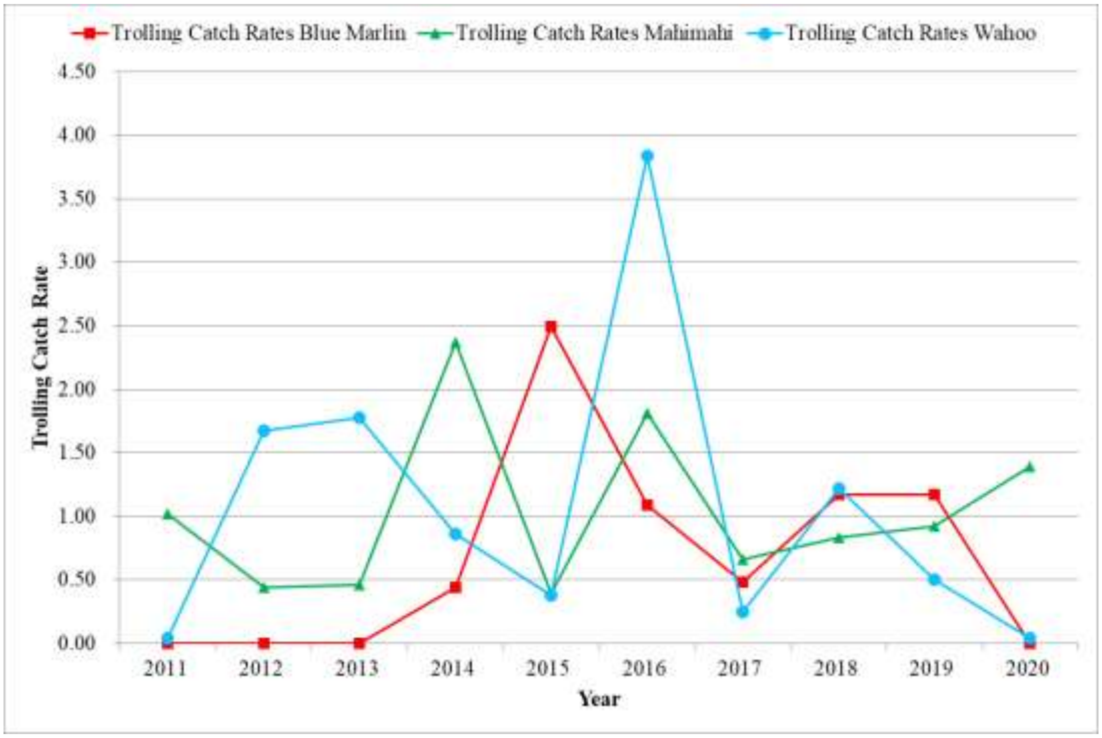


Figure 21. Trolling CPUE for blue marlin, mahimahi, and wahoo in American Samoa from 2011-2020

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 vendors) 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.

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 61 survey days in 2020 (see Table A-21). Total sampled trips in 2020 increased from 65 trips in 2019 to 112 in 2020, which is 9 trips fewer than the 10-year average. In 2020, DFW staff collected 119 interviews, which was a 9% greater than the 10-year average. A decrease in surveys and interviews in 2019 was due to a suspension in boat-based creel surveys from July to September. This interruption in surveys was due to a delay in the WPacFIN award. Only 1 charter trip was intercepted in 2020, but 5 interviews were conducted. 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.

Participation (i.e., number of fishermen) is determined by tallying unique fishermen as recorded on the commercial receipt invoice, while effort (i.e., number of trips) is assumed to equal the number of invoices submitted, assuming that all sales from a single trip are made on a single day. 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 increased in 2020 compared to 2019. 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 78% of the entire pelagic landings in 2020 based on creel survey data. Skipjack and total landings increased 36% (537,399 lb) and 32% (689,136 lb), respectively, from landings in 2019.

Landings of mahimahi and yellowfin tuna ranked second and third by weight of landings during 2020. Creel data estimated 71,564 lb of mahimahi, a 0.3% decrease from 2019. After three years (2014-2016) of high poundage of mahimahi landings and a moderate drop in 2017, landed pounds have increased the past three years. There were 55,944 lb of yellowfin landed in 2019, a 35% increase from the 2019 landings. Skipjack tuna are easily caught in nearshore waters throughout the year. Mahimahi is seasonal with peak catch usually from February through April, whereas yellowfin tuna season runs from April to September.

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 2016, there was a sharp increase of fishermen who were landing pelagic species based on commercial receipt invoices (73). Despite a decrease in the number of fishermen in the last two years, the number of fishermen in 2020 equaled the number of fishermen in 2016. The number of trips, based on both the commercial data receipts and the creel survey, have been variable since the late 1990s but had been increasing up until 2019. In 2020, the number of trips recorded by the commercial receipt invoices decreased dramatically by 47% from 2019. However, 9,481 trips were estimated from the creel surveys (a 196% increase from 2019). The differences in trips calculated from the commercial receipt invoices and the creel trip estimates are possibly due to an increase of subsistence fishing during the COVID-19 pandemic. Estimated charter trips decreased to zero due to the lack of tourism, which was affected by COVID-19. Total hours trolling in

2020 showed an increase of 178% from 2019 to 46,818 hours. Average trip length decreased slightly to 4.9 hours per trip.

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 Mariana 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 is used by commercial fishermen, tourism operators, recreational boaters, and subsistence fishermen. This boat ramp is frequently covered in sand by beach erosion from further north in the lagoon and must be dredged periodically. It is still used when the ramp is covered in sand as it is an important launching site. Sugar Dock has not been dredged in several years and is not used as much.

Weather. Weather and typhoon conditions followed traditional patterns. There were no typhoons recorded in 2020. Based on information collected by the National Weather Service Forecast Office in Tiyan, Guam, the CNMI experienced drought and zero high surf advisories in 2020.

Fish Aggregating Devices (FADs). A total of eleven FAD systems were deployed between the months of May through October 2020.

CPUE. In 2020, trolling catch rates decreased from 27.9 lb per trolling hour to 14.5 lbs per trolling hour, a level below the 10-year average (16.9 lb/hr). The skipjack catch rate decreased to 11.4 lb per hour fished. This catch rate is 4.3 lb less than the 10-year average (15.7 lb/hr). Yellowfin catch rate in decreased to 1.2 lb per hour. The mahimahi catch rate decreased to 1.5 lb/hr in, which is 2.3 lb/hr less than the 10-year average.

Revenue. The total value of the pelagic fishery in 2020 was $349,096, which represented a decrease of nearly 25% from the previous year. It was estimated that 22% of all pounds caught were sold, a smaller proportion than estimated in years prior to 2020. The average price for all pelagic species was $2.31 in 2020, a decrease of over 11% from 2019.

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, no fish were caught as bycatch in the trolling fisheries in the years 2007-2020.

2.2.3 PLAN TEAM RECOMMENDATIONS

Plan Team members agreed to carry out the following module improvements and action items for the Pelagic Annual SAFE Report:

1. Indicate annual estimates of non-longline fishing effort or catch that are anomalous (such as for CNMI in 2020 annual estimates of troll effort that varied significantly) and may be associated with uncertainty. This should also include means of characterizing uncertainty.

2.2.4 OVERVIEW OF PARTICIPATION AND EFFORT

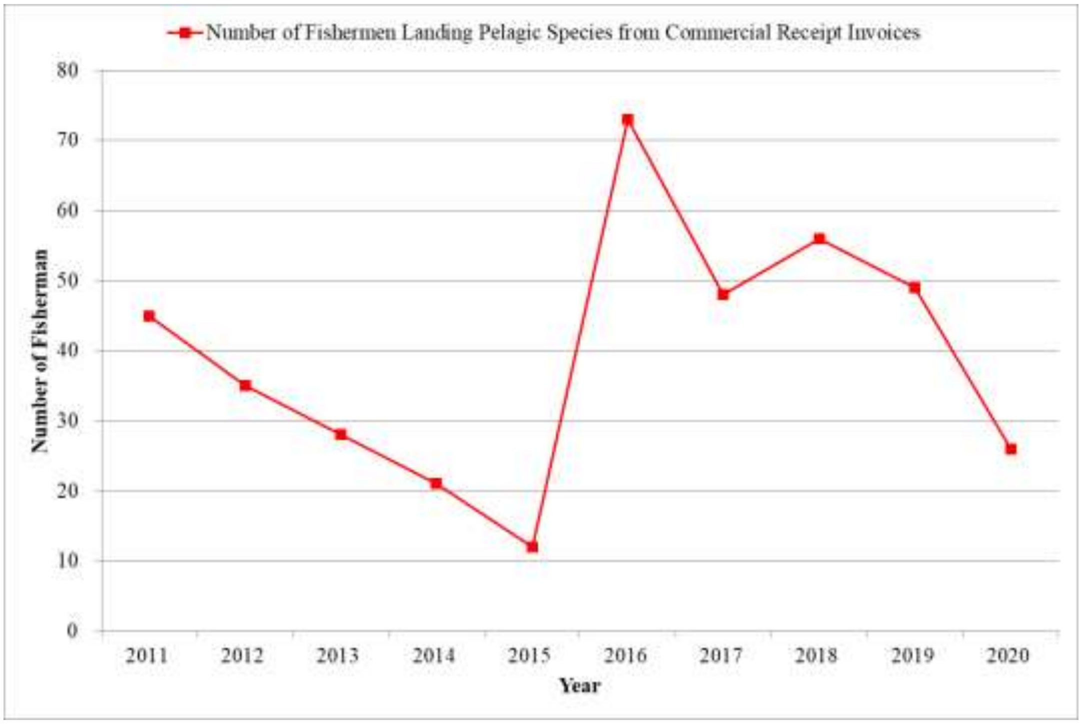


Figure 22. CNMI fishermen (boats) with commercial pelagic landings from 2011-2020

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

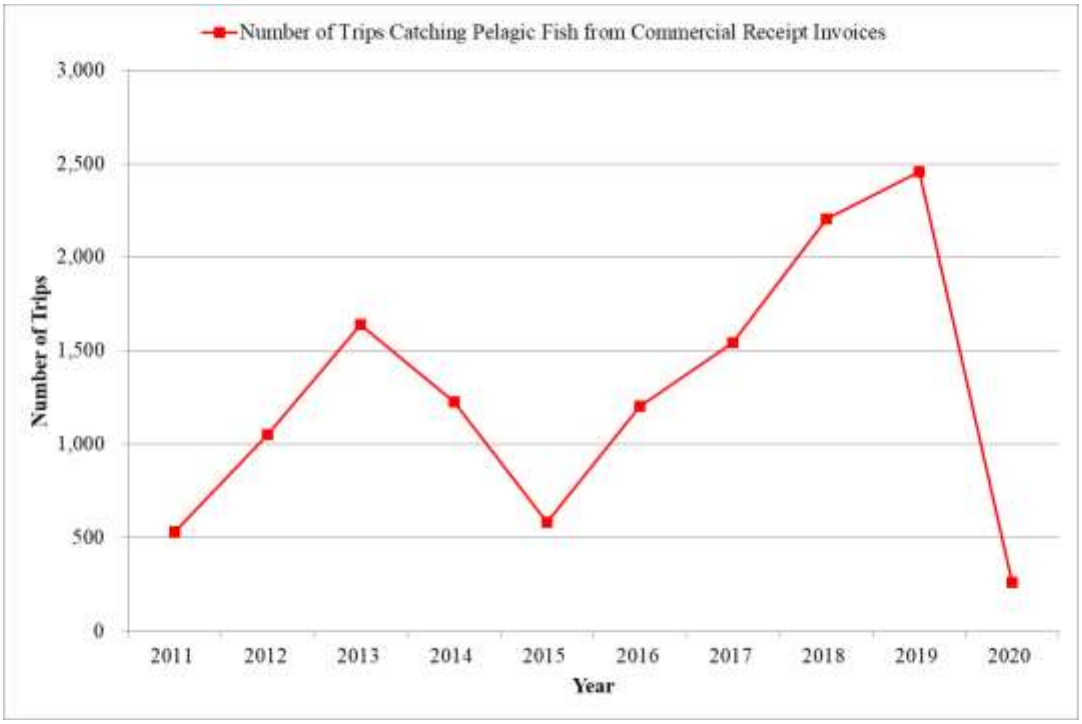


Figure 23. Number of trips catching pelagic fish from commercial receipt invoices from 2011-2020

Supporting data shown in Table A-23.

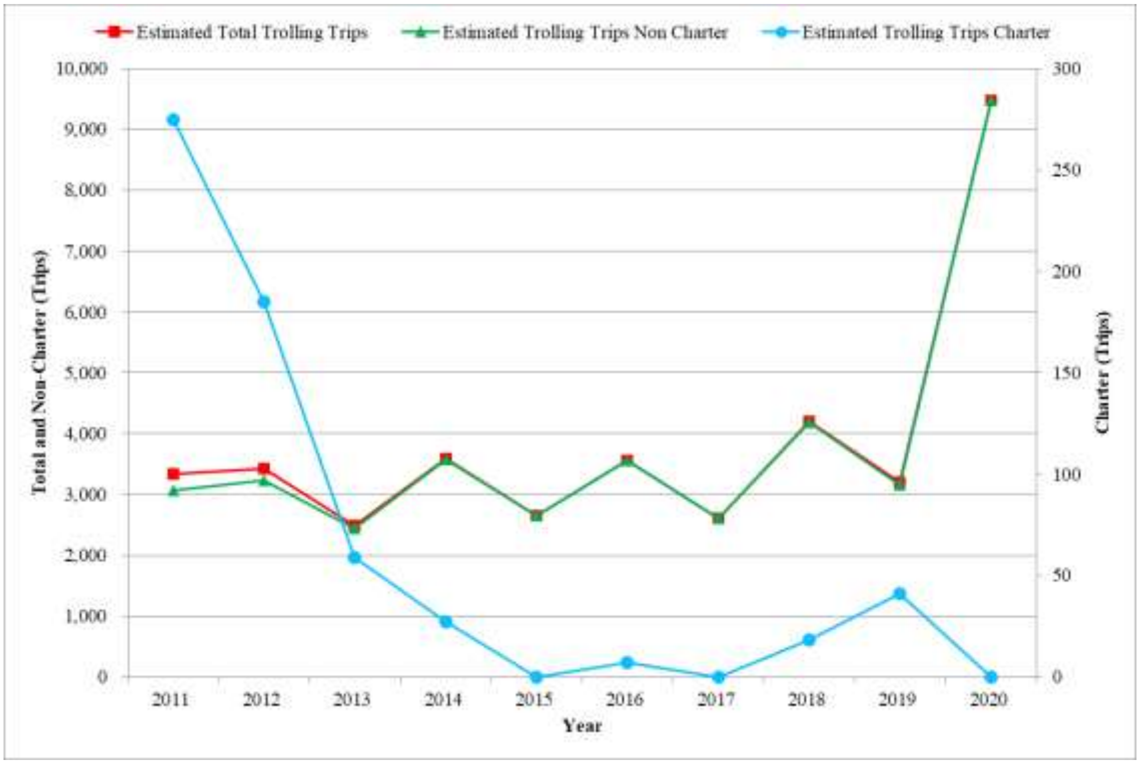


Figure 24. CNMI boat-based creel estimated number of trolling trips from 2011-2020

Supporting data shown in Table A-24.

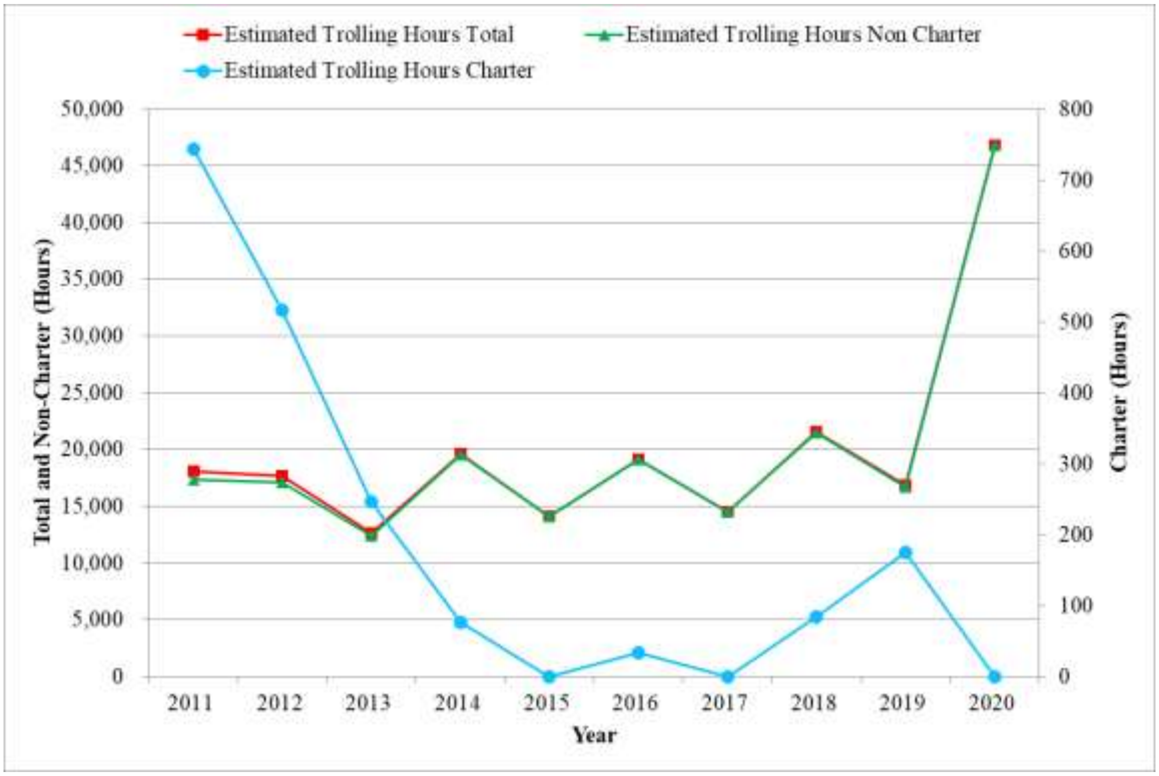


Figure 25. CNMI boat-based creel estimated number of trolling hours from 2011-2020

Supporting data shown in Table A-25.

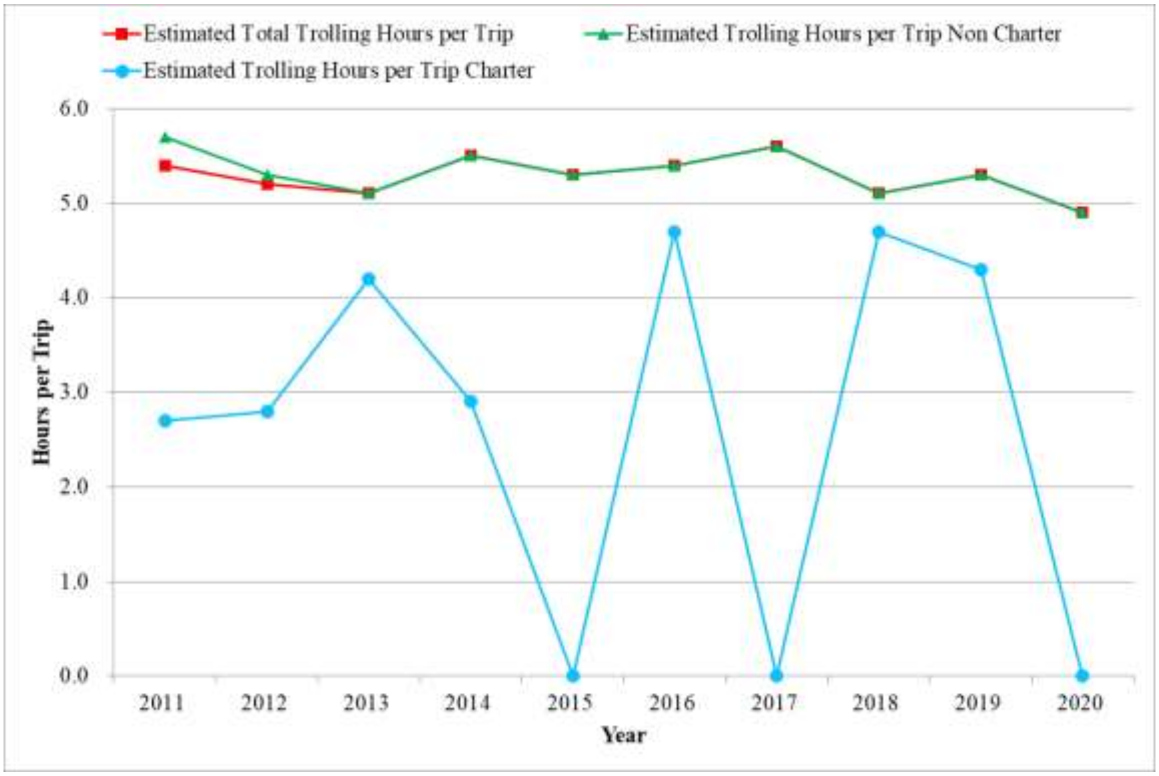


Figure 26. CNMI boat-based creel average trip length in hours per trip from 2011-2020

Supporting data shown in Table A-26.

2.2.5 OVERVIEW OF LANDINGS

Table 14. Pelagic species composition from creel surveys performed in the CNMI in 2020

Species	Total Landings	Non Charter	Charter
Skipjack Tuna	537,399	537,399	0
Yellowfin Tuna	55,944	55,944	0
Saba (Kawakawa)	120	120	0
Tunas (Misc.)	0	0	0
Tunas Total	**593,463**	**593,463**	**0**
Mahimahi	71,564	71,564	0
Wahoo	6,549	6,549	0
Blue Marlin	0	0	0
Sailfish	0	0	0
Spearfish	0	0	0
Sharks	0	0	0
Sickle Pomfret	0	0	0
Non-Tuna PMUS Total	**78,113**	**78,113**	**0**
Dogtooth Tuna	1,066	1,066	0

Species	Total Landings	Non Charter	Charter
Rainbow Runner	15,517	15,517	0
Barracuda	977	977	0
Troll Fish (Misc.)	0	0	0
Other Pelagics Total	**17,560**	**17,560**	**0**
Total Pelagics	**689,136**	**689,136**	**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 15. Commercial pelagic landings (lb.), revenues ($), and average prices ($) in the CNMI in 2020

Species	Pounds	Value	Average Price
Skipjack Tuna	25,918.0	64,433.4	2.49
Yellowfin Tuna	3,265.8	8,596.2	2.63
Tunas Total and Average Price	**29,183.8**	**73,029.5**	**2.50**
Mahimahi	4,049.7	10,252.3	2.53
Wahoo	70.7	161.3	2.28
Sickle Pomfret	820.0	2,460.0	3.00
Non-Tuna PMUS Total and Average Price	**4,940.4**	**12,873.7**	**2.61**
Dogtooth Tuna	92.0	230.0	2.50
Rainbow Runner	322.0	870.3	2.70
Troll Fish (misc.)	187.3	578.7	3.09
Other Pelagics Total and Average Price	**601.3**	**1,679.0**	**2.79**
Pelagics Total and Average Price	**34,725.5**	**87,582.2**	**2.52**

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 16. Bycatch summary for CNMI pelagic fisheries from 2011-2020

Year	Number Release	Percent Release	Number Kept	Number Caught	Charter
2011	0	0.0	2,171	2,171	F
2012	0	0.0	3,524	3,524	F
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
2011	0	0.0	25	25	T
2012	0	0.0	29	29	T
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 data and represents the percent of fish caught or percent of interviews with bycatch.

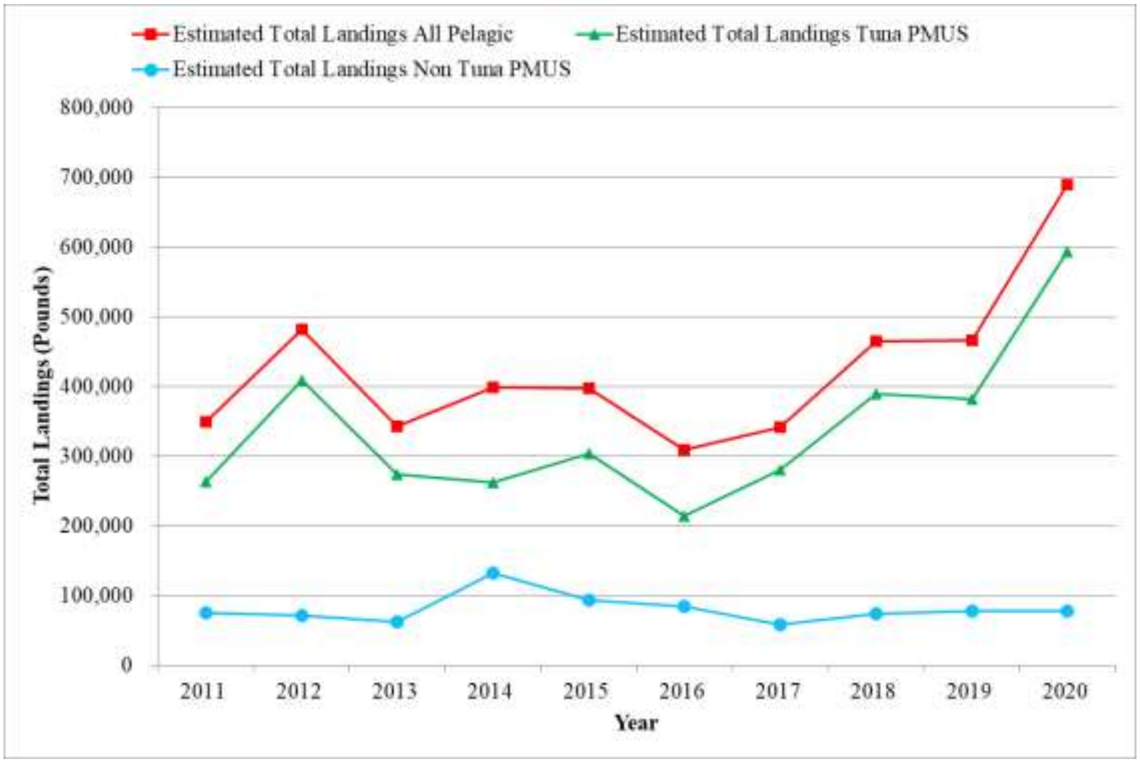


Figure 27. Total estimated annual catch for all pelagics, tuna PMUS, and non-tuna PMUS in the CNMI from 2011-2020

Supporting data shown in Table A-27.

Figure 28. Total estimated annual catch for all pelagics in the CNMI from 2011-2020

Supporting data shown in Table A-28.

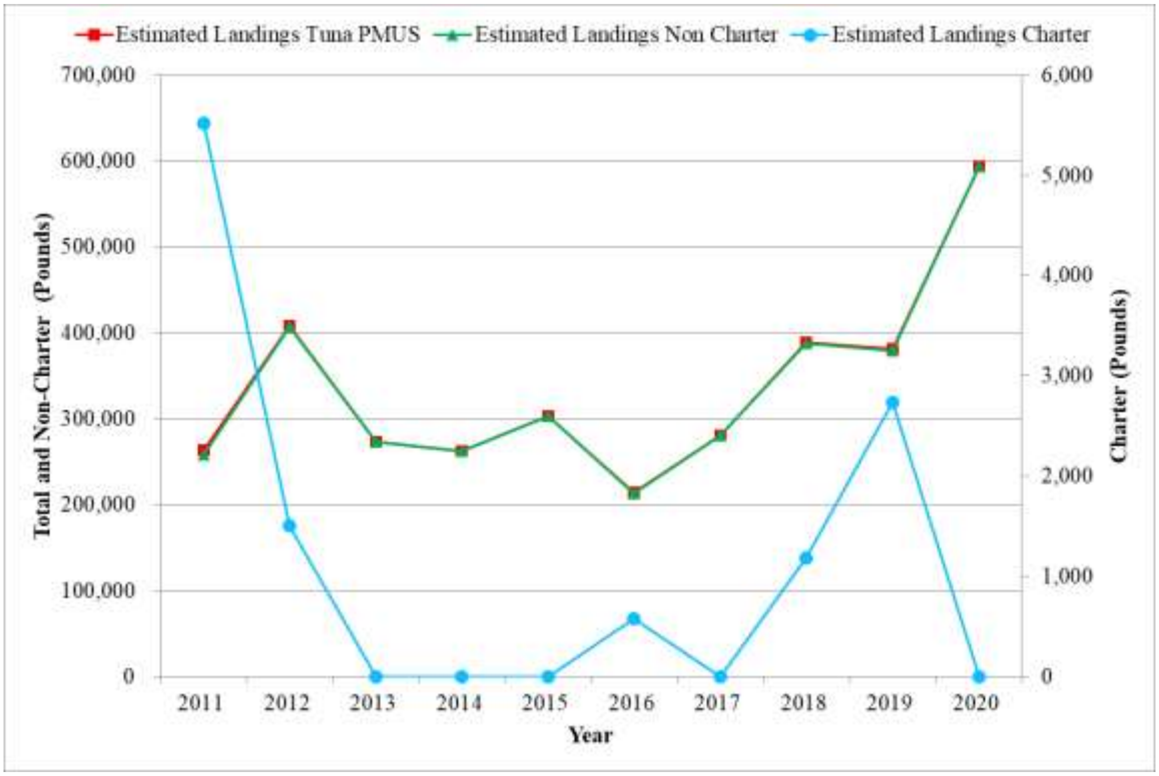


Figure 29. Total estimated annual catch for tuna PMUS in the CNMI from 2011-2020

Supporting data shown in Table A-29.

Figure 30. Total estimated annual catch for non-tuna PMUS in the CNMI from 2011-2020
Supporting data shown in Table A-30.

Figure 31. Total estimated annual catch for skipjack in the CNMI from 2011-2020
Supporting data shown in Table A-31.

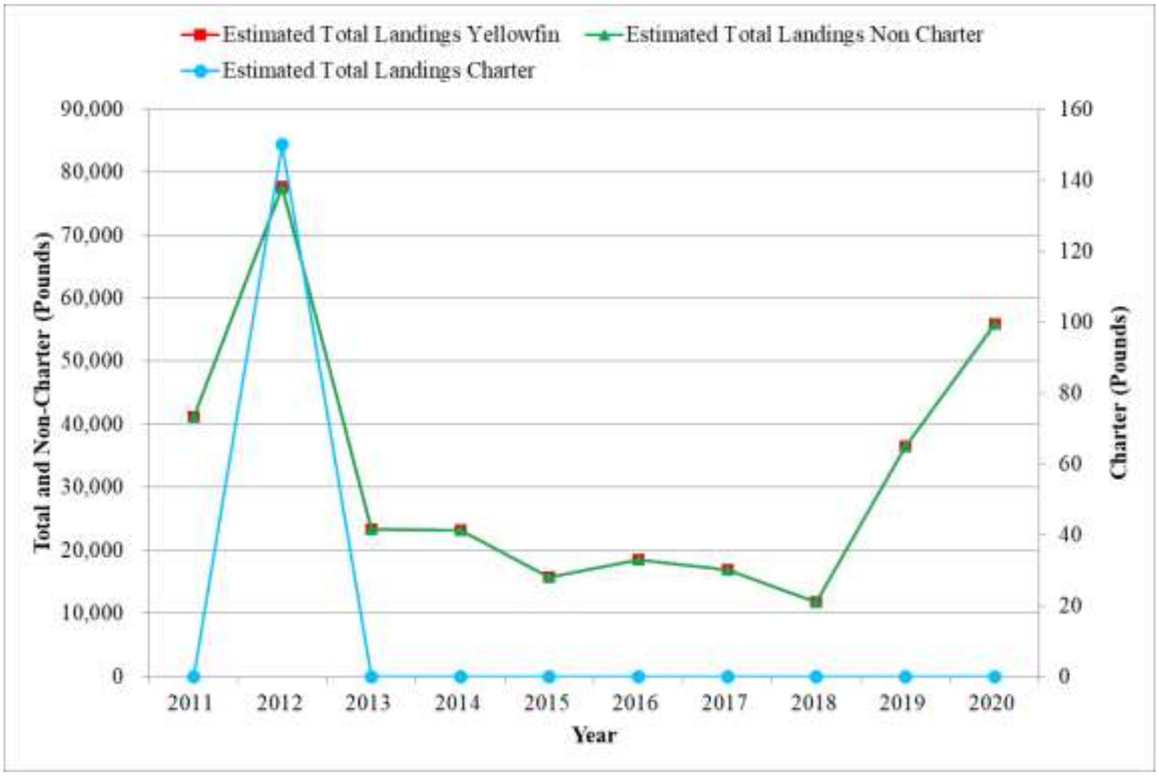


Figure 32. Total estimated annual catch for yellowfin in the CNMI from 2011-2020
Supporting data shown in Table A-32.

Figure 33. Total estimated annual catch for mahimahi in the CNMI from 2011-2020
Supporting data shown in Table A-33.

Figure 34. Total estimated annual catch for wahoo in the CNMI from 2011-2020

Supporting data shown in Table A-34.

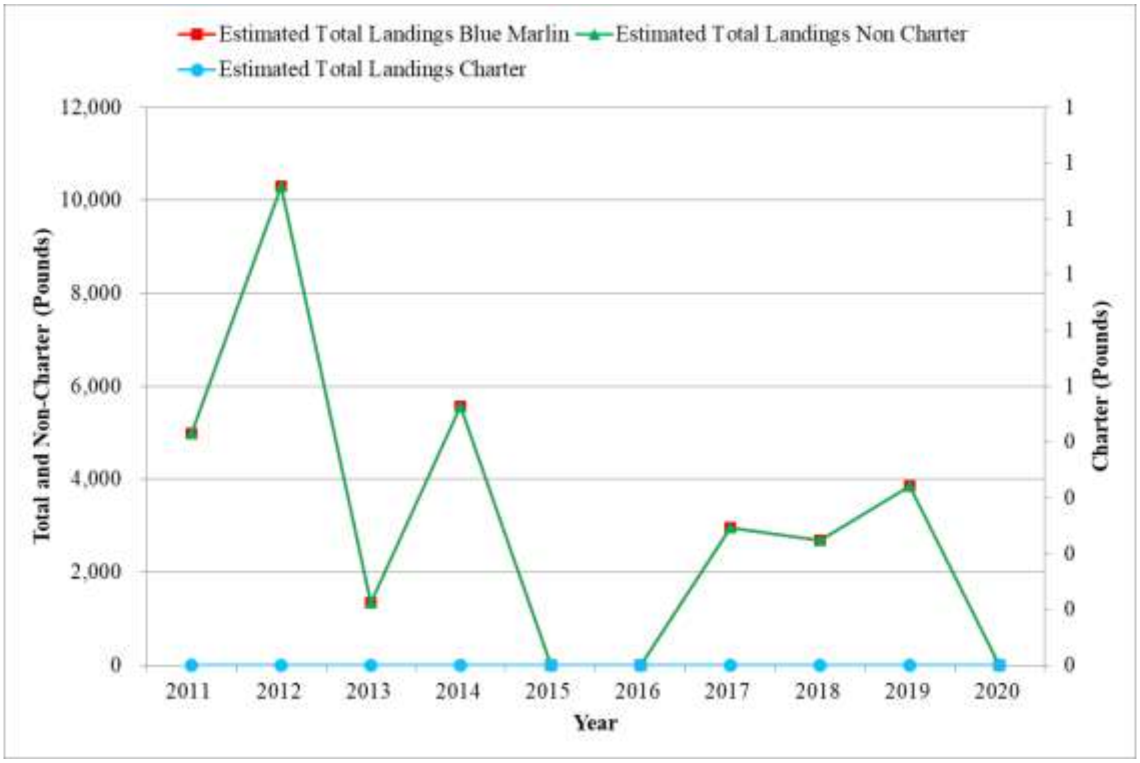


Figure 35. Total estimated annual catch for blue marlin in the CNMI from 2011-2020

Supporting data shown in Table A-35.

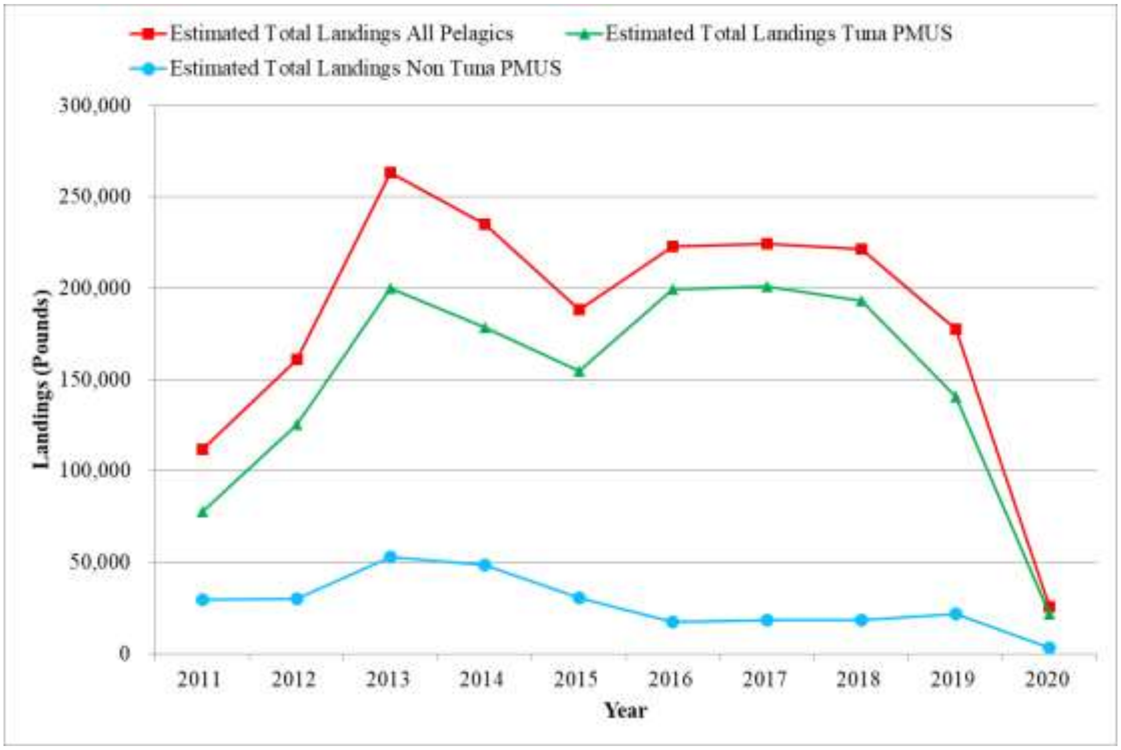


Figure 36. Annual commercial landings for all pelagics, tuna PMUS, and non-tuna PMUS in the CNMI from 2011-2020

Supporting data shown in Table A-36.

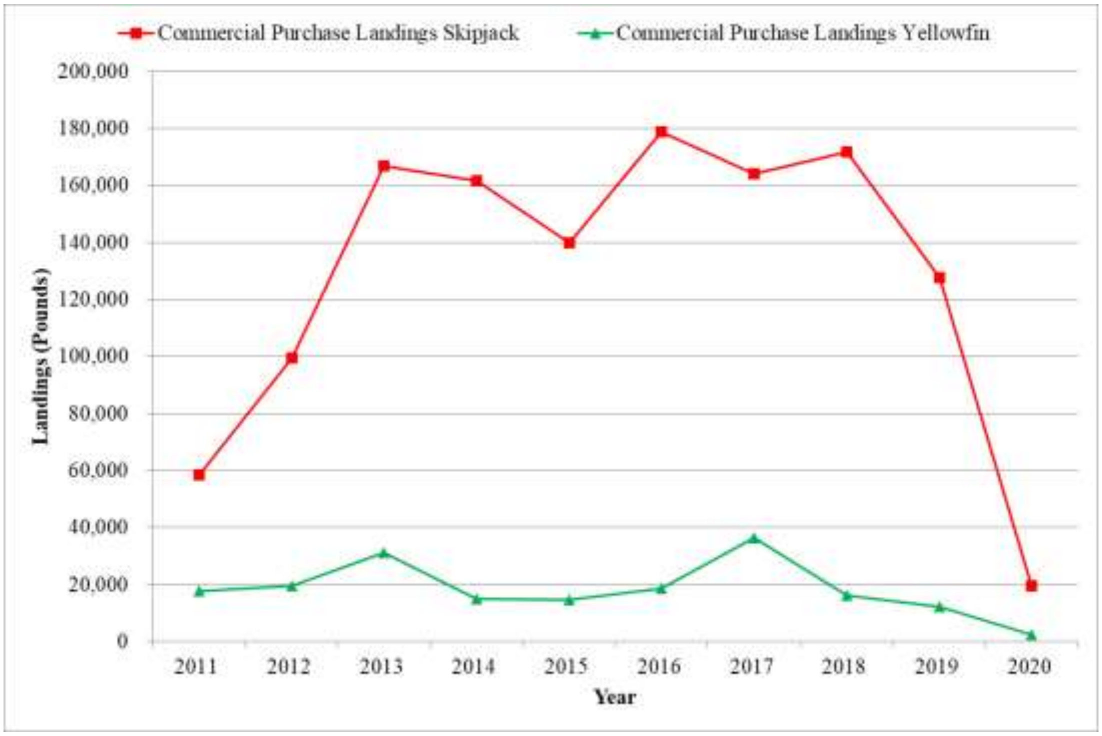


Figure 37. Annual commercial landings for skipjack and yellowfin in the CNMI from 2011-2020

Supporting data shown in Table A-37.

Figure 38. Annual commercial landings for mahimahi, wahoo, and blue marlin in the CNMI from 2011-2020

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 include charter and non-charter sectors, while “pounds per trip” is determined from commercial invoice receipts.

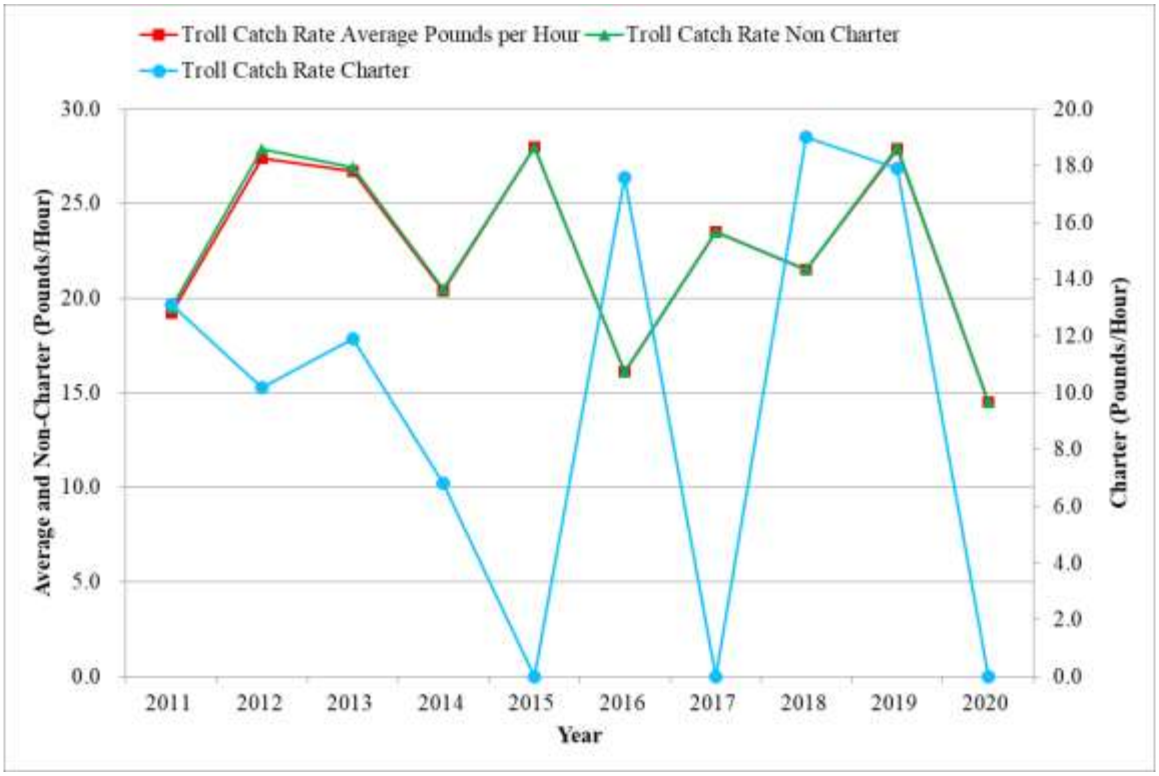


Figure 39. Estimated trolling catch rates (lb/hr) from creel surveys in the CNMI from 2011-2020

Supporting data shown in Table A-39.

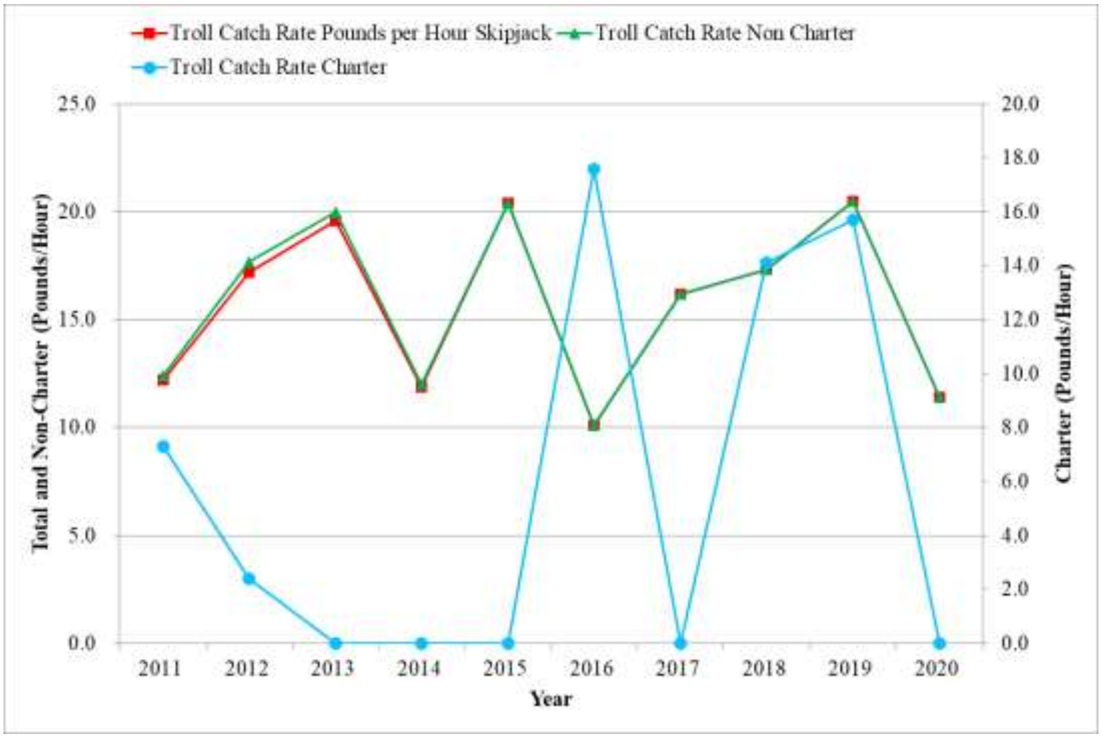


Figure 40. Estimated trolling catch rates (lb/hr) for skipjack from creel surveys in the CNMI from 2011-2020

Supporting data shown in Table A-40.

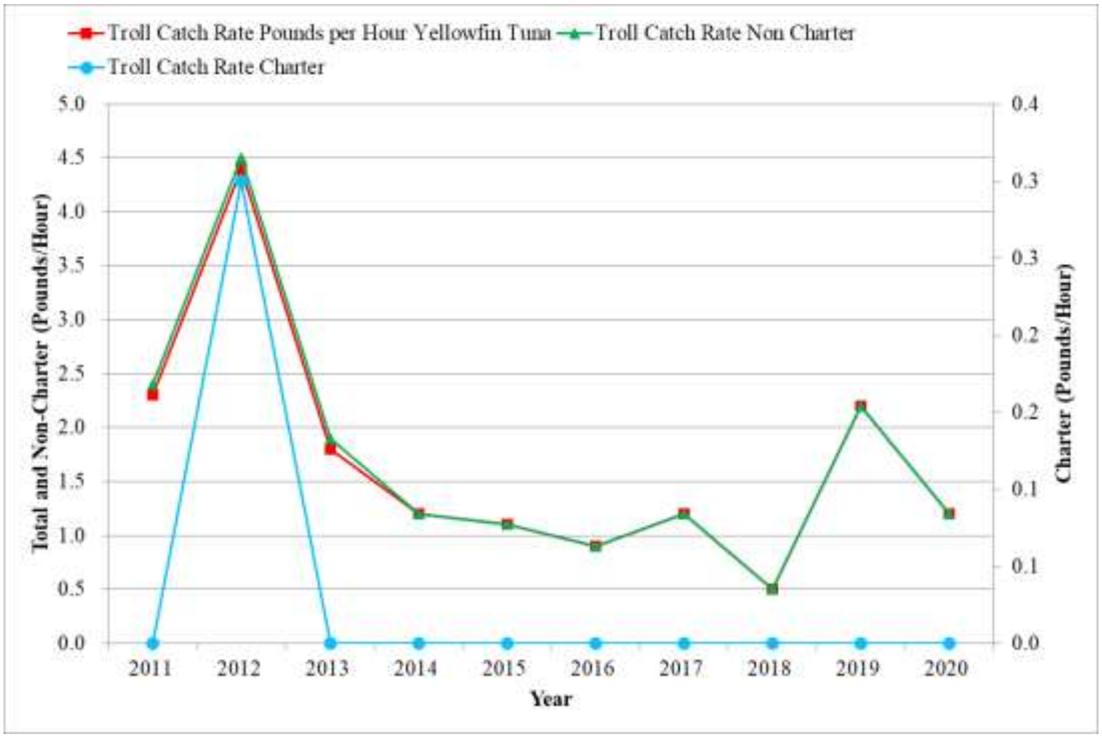


Figure 41. Estimated trolling catch rates (lb/hr) for yellowfin from creel surveys in the CNMI from 2011-2020

Supporting data shown in Table A-41.

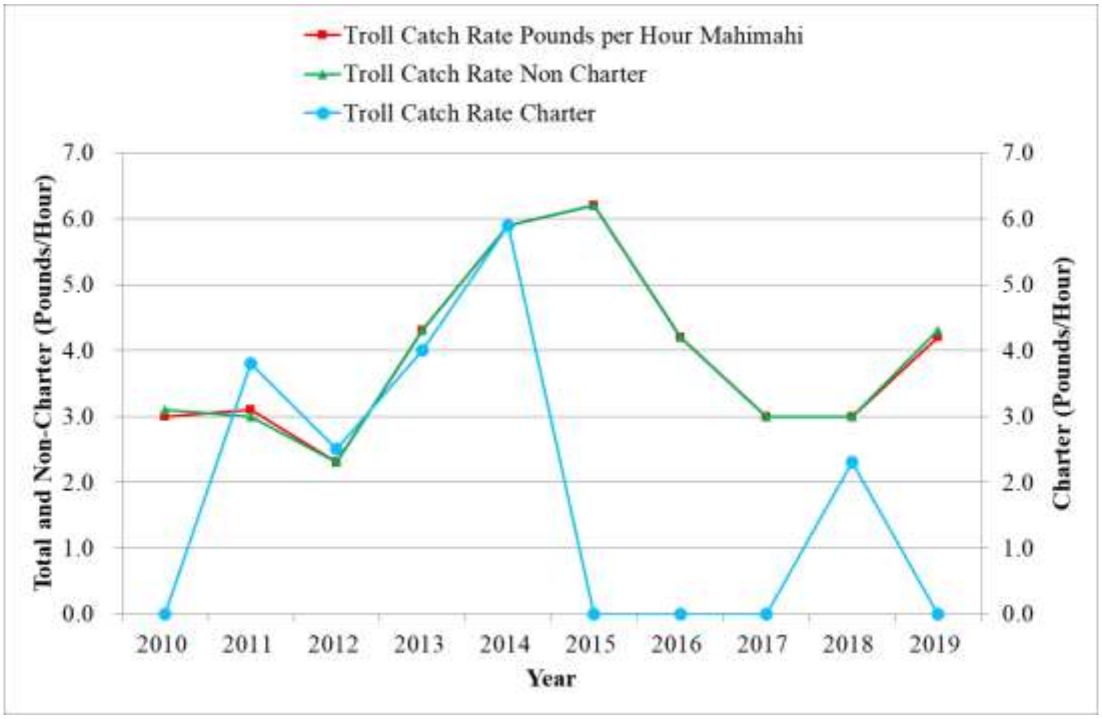


Figure 42. Estimated trolling catch rates (lb/hr) for mahimahi from creel surveys in the CNMI from 2011-2020

Supporting data shown in Table A-42.

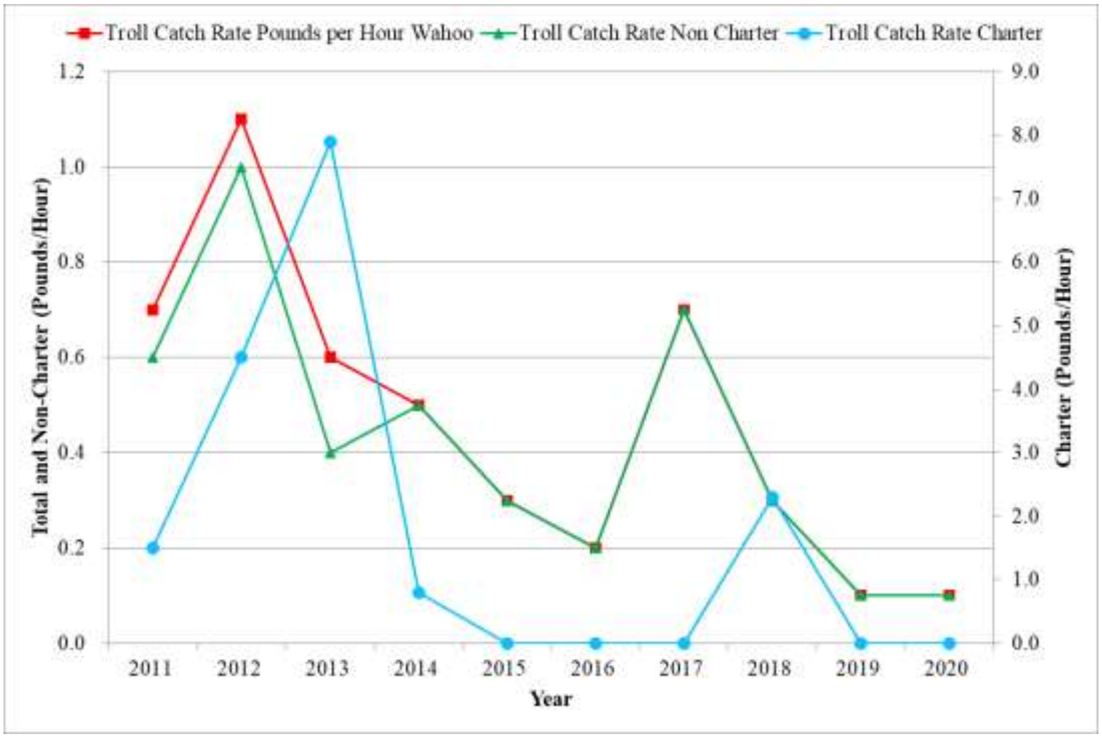


Figure 43. Estimated trolling catch rates (lbs/hr) for wahoo from creel surveys in the CNMI from 2011-2020

Supporting data shown in Table A-43.

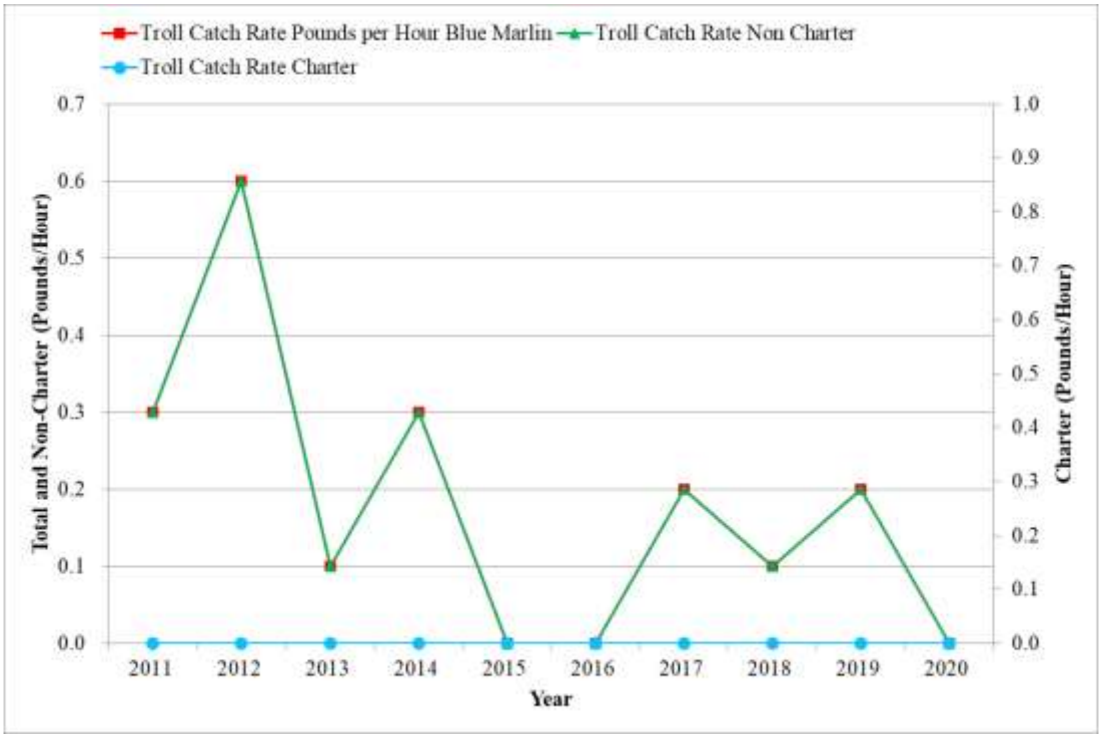


Figure 44. Estimated trolling catch rates (lbs/hr) for blue marlin from creel surveys in the CNMI from 2011-2020

Supporting data shown in Table A-44.

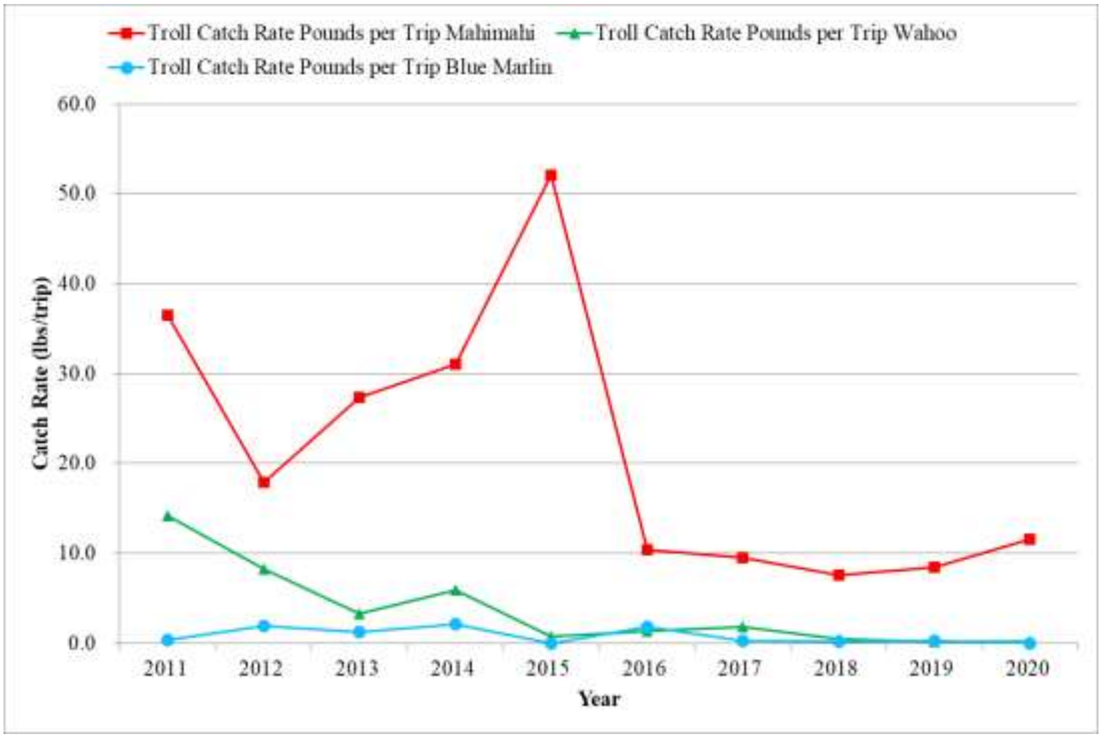


Figure 45. Estimated trolling catch rates (lb/trip) for mahimahi, wahoo, and blue marlin in the CNMI from 2011-2020

Supporting data shown in Table A-45.

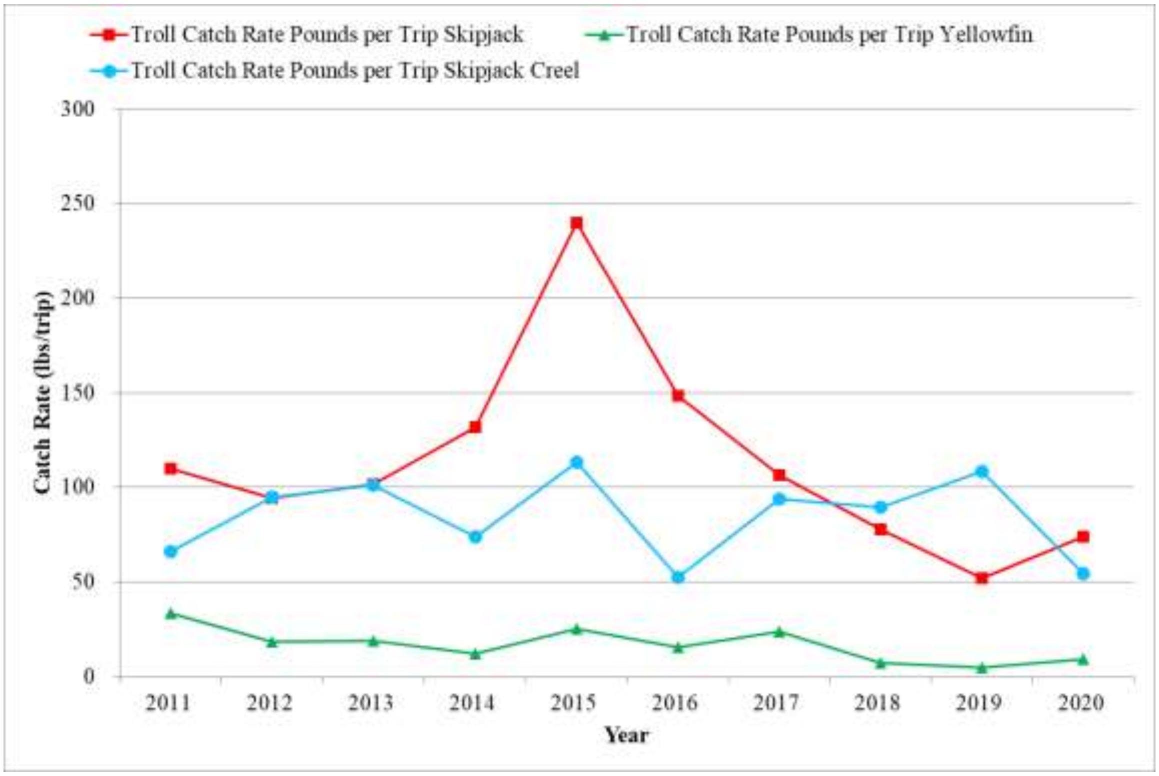


Figure 46. Estimated trolling catch rates (lb/trip) for skipjack and yellowfin tuna in the CNMI from 2011-2020

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. 2020 saw many impacts to fisheries data collection due to restrictions on staff work. In 2020, DAWR completed 41 of 96 scheduled survey days, documented 928 trips and conducted 360 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. Calendar year 2020 brought COVID infections to Guam. As a precautionary measure to reduce the spread of infections and number of deaths, the Government of Guam shut down March 15th through May 31st, and then from August 16th through December 31st. This shutdown impeded creel surveys for 59% of the year. During the shutdowns, staff were not allowed to conduct face-to-face creel survey interviews, and only 25% of staff were allowed in the office. The participation surveys, however, do not involve interaction with fishers, and were completed in full during 2020. Beginning in August, the number of participation surveys was increased to 16 for the last four months of the year. Only 43% (or 41 of the 96) of the boat-based creel surveys were conducted, but 72 participation surveys were completed (compared to 24 during a normal year). The increase in participation surveys provides a better estimate of the monthly average of island-wide trailered vehicles, which determines fishing activity at the non-surveyed ports.

Port*	**Jan.**	**Feb.**	**March**	**April**	**May**	**June**	**July**	**Aug**	**Sept.**	**Oct.**	**Nov.**	**Dec.**
ABB	4	4	2	0	0	4	4	2	0	0	0	0
Agat	2	2	1	0	0	2	2	1	0	0	0	0
MP	2	2	1	0	0	2	2	2	0	0	0	0

* "ABB" is Agana Boat Basin, "Agat" is Agat Marina, and "MP" is Merizo Pier.

The expansion program requires that a boat log be input for all eight surveys per month, but creel surveys were not conducted during the COVID shutdowns. Staff did, however, periodically drive to the three boat ramp sites during the shutdown period to observe whether fishing activity was affected by the government shutdown and “stay at home” public health recommendation. Because boat-based fishing appeared to be an allowed activity, fishing activity was not observed to decrease. Some days were observed to have up to two dozen trailered vehicles at one port, which indicated a significant level of fishing activity. Therefore, a boat log with the best available data was completed by using an average of fishing activity from 2017 through 2019. A boat log with zero activity, therefore, would accurately reflect boat-based fishing activity. The cancelled survey would be constructed by averaging fishing activity from the same surveys from the three previous years. Fishing activity was not determined by using the number of vehicle trailers during the scheduled creel survey days due to the inability to determine whether a parked trailer was fishing. Jet skiing, recreational boating, diving, and surfing were also observed at public boat launching sites. Using a three-year average assumes that fishing activity from 2017 to 2019 is similar to 2020, with none of the years having significant differences in boat based fishing. This assumption was affirmed by observing fishers arriving with their catch during late afternoons, and observing the continuation of commercial trolling, commercial spearing, charter fishing, and recreational boat-based fishing activities.

Port*	**Weekday Average**		**Weekend Average**		**Total Average**	
	2020	**2019**	**2020**	**2019**	**2020**	**2019**
ABB	9.4	4.21	17.98	10.5	12.55	7.35
Agat	5.83	3.00	8.57	8.58	6.87	5.81
MP	2.10	2.63	3.70	2.13	2.70	2.38

* “ABB” is Agana Boat Basin, “Agat” is Agat Marina, and “MP” is Merizo Pier

The 2020 boat-based values may have underestimated certain methods. Seasonal pelagic fishes, especially blue marlin, wahoo, and yellowfin tuna, for example, may have been underestimated since their peak harvests occurs during the last two quarters of the year. In addition, other insular methods such as bottomfish fishing and spearfishing, may have an inadequate number of interviews in order to determine their year-end catch totals, especially during periods of calm weather during the last two quarters of 2020. While the year-end values reflect catches intercepted by creel surveys during 2020, data for seasonal species (e.g., pelagic seasonality and atulai night-jigging) and methods difficult to intercept (e.g., bottomfish fishing and spearfishing) may not completely reflect the fishery.

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 40-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 2020 total expanded pelagic landings were 614,633 lb, a decrease of 19.1% when compared with the 759,653 lb of catch from 2019. Tuna PMUS decreased 24.9%, while non-tuna PMUS decreased 8.3%. Landings consisted primarily of five major species: mahimahi, wahoo, bonita or skipjack tuna, yellowfin tuna, and Pacific blue marlin, with skipjack comprising over 56% of total landings. Landings consisted primarily of five major species: mahimahi, wahoo, bonita or skipjack tuna, yellowfin tuna, and Pacific blue marlin, with skipjack comprising over 57% of total landings. Other minor species caught include rainbow runner, barracudas, and pomfrets. Sharks were also caught during 2020, with sharks noted in specific fishermen interviews conducted in 2020 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 three of the five common species increased in 2020 from the previous year's levels. Skipjack decreased 26.4%, and wahoo increased by 98%. Yellowfin tuna catch decreased 13.6%, mahimahi catch decreased by 32%, and blue marlin increased by 1.7%.

Transshipment Landings. Transshipment, the offloading or otherwise transferring MUS or products thereof to a receiving vessel, has had a mandatory data submission program since 1999. These vessels fish on the high sea outside Guam's EEZ, but transship their catch through Guam. From 2015 to 2020, transshipment data were confidential because there were less than three transshipment agents collecting the data. All transshipment through Guam ceased as of December 31, 2020.

Effort. The number of boats involved in Guam's pelagic fishery gradually increased from 193 in 1983 to a high of 496 in 2013. There were 459 boats involved in Guam's pelagic fishery in 2020, a decrease of 1% from 2019. 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 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 2020 was 52, equaling 168 closure days, down from 316 closure days in 2019. 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.

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 a decrease from 2019. Total CPUE decreased 19%. All major troll species showed a drop in CPUE from 2019 to 2020 except for wahoo. The recording of lower rates is almost certainly due to low creel interview numbers due to COVID restrictions on government employees. The fluctuations in CPUE are possibly due to variability in the year-to-year abundance and availability of the stocks.

Revenues. The price of PMUS sold by all gears in Guam during 2020 was $2.39 per pound. Commercial revenues decreased in 2020 to $164,411, down from $322,441 in 2019. Sales numbers were down for all species. This can be attributed to COVID shutdown measures, which included closure of stores and restaurants for much of 2020. This left fishermen with limited to no outlets to sell catch. 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 2020, limited interview data indicated there was again a low bycatch rate; there was 4 fish reported as bycatch in 3,192 tallied fish caught, for a 0.1% rate. Bycatch occasionally occurs in the troll fishery including sharks, shark-bitten and undersized fish.

In 2020, fishers were asked if they experienced a shark interaction. There was a total of 360 interviews for boat based fishing in 2020, with 29 of these inappropriate for determining shark interaction. Of the remaining 331 interviews, 123 reported interactions with sharks and 208 reported no interactions with sharks for a 37% positive rate for interviews where fishers were asked about shark interactions.

2.3.3 PLAN TEAM RECOMMENDATIONS

Plan Team members agreed to carry out the following module improvements and action items for the Pelagic Annual SAFE Report:

1. Indicate annual estimates of non-longline fishing effort or catch that are anomalous (such as for CNMI in 2020 annual estimates of troll effort that varied significantly) and may be associated with uncertainty. This should also include means of characterizing uncertainty.
2. Given the lack of sampling for two three-month gaps that coincide with prevalence of two major PMUS, to reconcile annual estimates of PMUS in the Guam fishery data module for 2020 to either determine alternative means to estimate PMUS in Guam, or to conclude if 2020 estimates for certain PMUS in Guam are flagged as unreliable based on sampling issues.

2.3.4 OVERVIEW OF PARTICIPATION

Figure 47. Total estimated vessels in Guam pelagic fisheries from 2011-2020

Supporting data shown in Table A-48.

2.3.5 OVERVIEW OF TOTAL AND REPORTED COMMERCIAL LANDINGS

Table 17. Total estimated, non-charter, and charter landings (lb) for Guam in 2020

Species	Total Landings	Non Charter	Charter
Skipjack Tuna	348,466	348,090	376
Yellowfin Tuna	54,962	54,713	249
Kawakawa	0	0	0
Albacore	0	0	0
Bigeye Tuna	0	0	0

Species	Total Landings	Non Charter	Charter
Other Tuna PMUS	0	0	0
TUNAS Total	**403,428**	**402,803**	**625**
Mahimahi	92,602	90,737	1,865
Wahoo	46,920	46,243	677
Blue Marlin	50,833	50,833	0
Black Marlin	0	0	0
Striped Marlin	0	0	0
Sailfish	0	0	0
Shortbill Spearfish	0	0	0
Swordfish	0	0	0
Oceanic Sharks	0	0	0
Pomfrets	0	0	0
Oilfish	3,187	3,187	0
NON-TUNA PMUS Total	**193,542**	**191,000**	**2,542**
Dogtooth Tuna	117	117	0
Rainbow Runner	8,198	8,198	0
Barracudas	9,348	9,348	0
Double-lined Mackerel	0	0	0
Misc. Troll Fish	0	0	0
OTHER PELAGICS Total	**17,663**	**17,663**	**0**
TOTAL PELAGICS	**614,633**	**611,466**	**3,167**

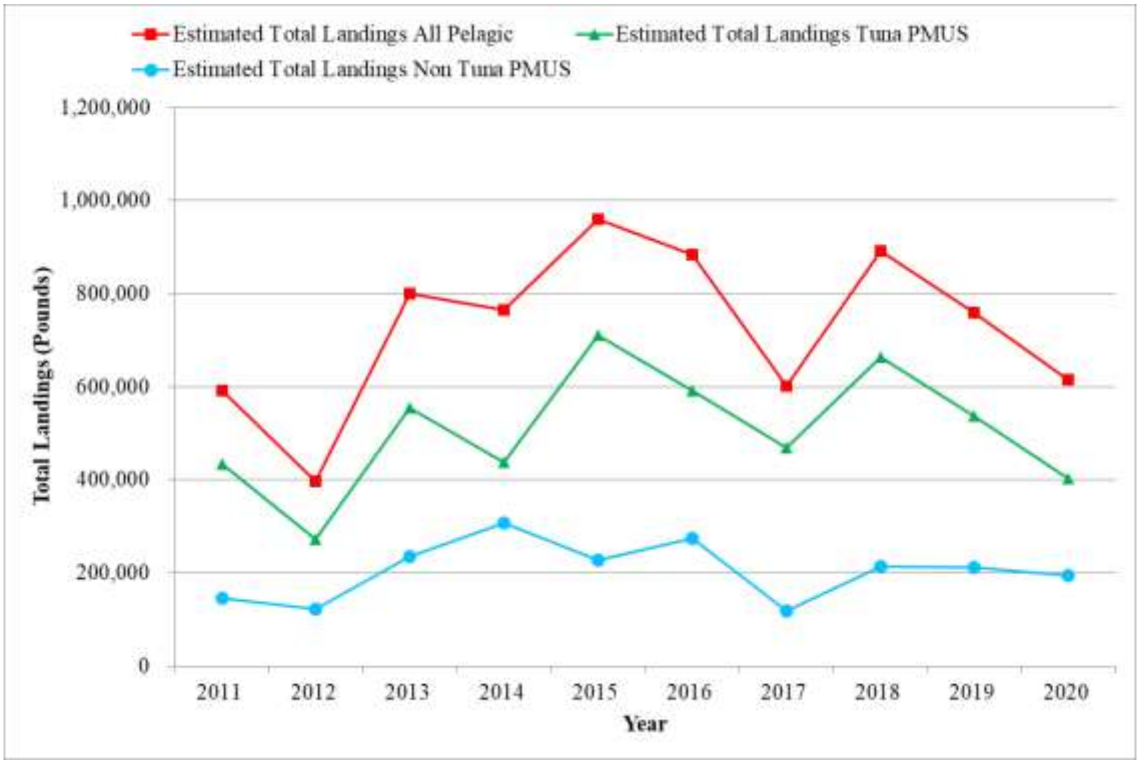


Figure 48. Total estimated annual landings in Guam for all pelagics, tuna PMUS, and non-tuna PMUS from 2011-2020

Supporting data shown in Table A-49.

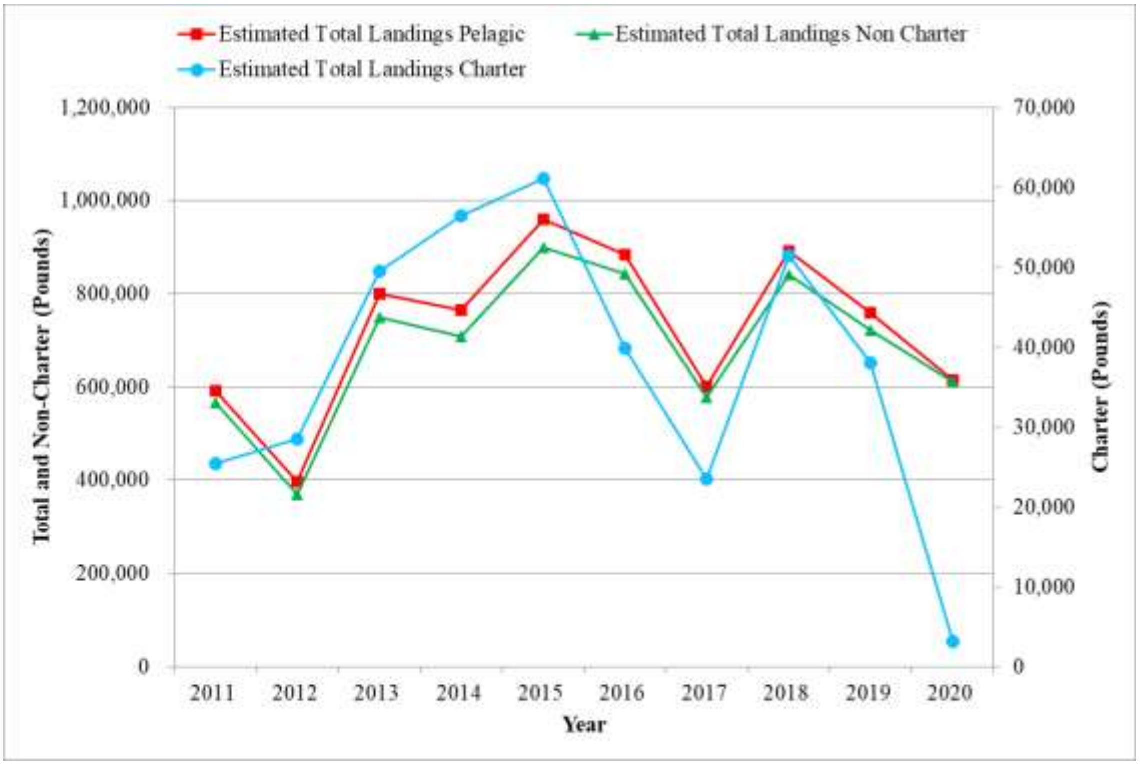


Figure 49. Total estimated annual pelagic landings in Guam from 2011-2020

Supporting data shown in Table A-50.

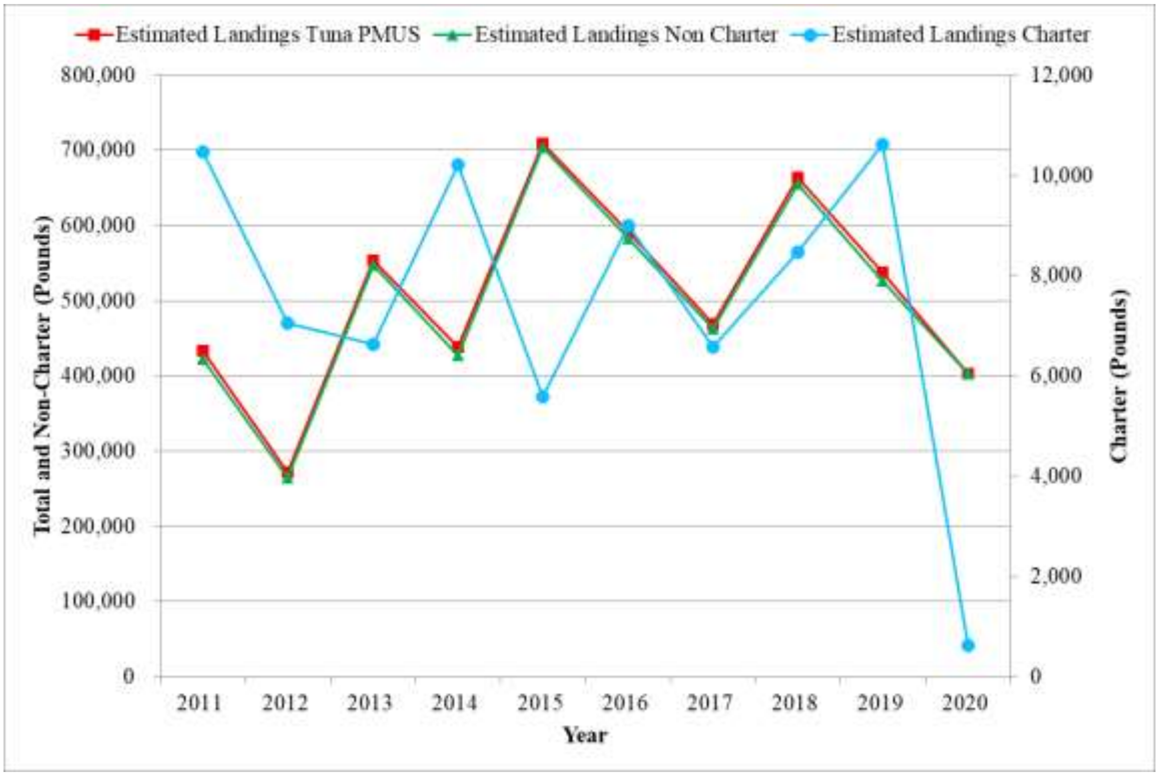


Figure 50. Total estimated annual tuna PMUS landings in Guam from 2011-2020
Supporting data shown in Table A-51.

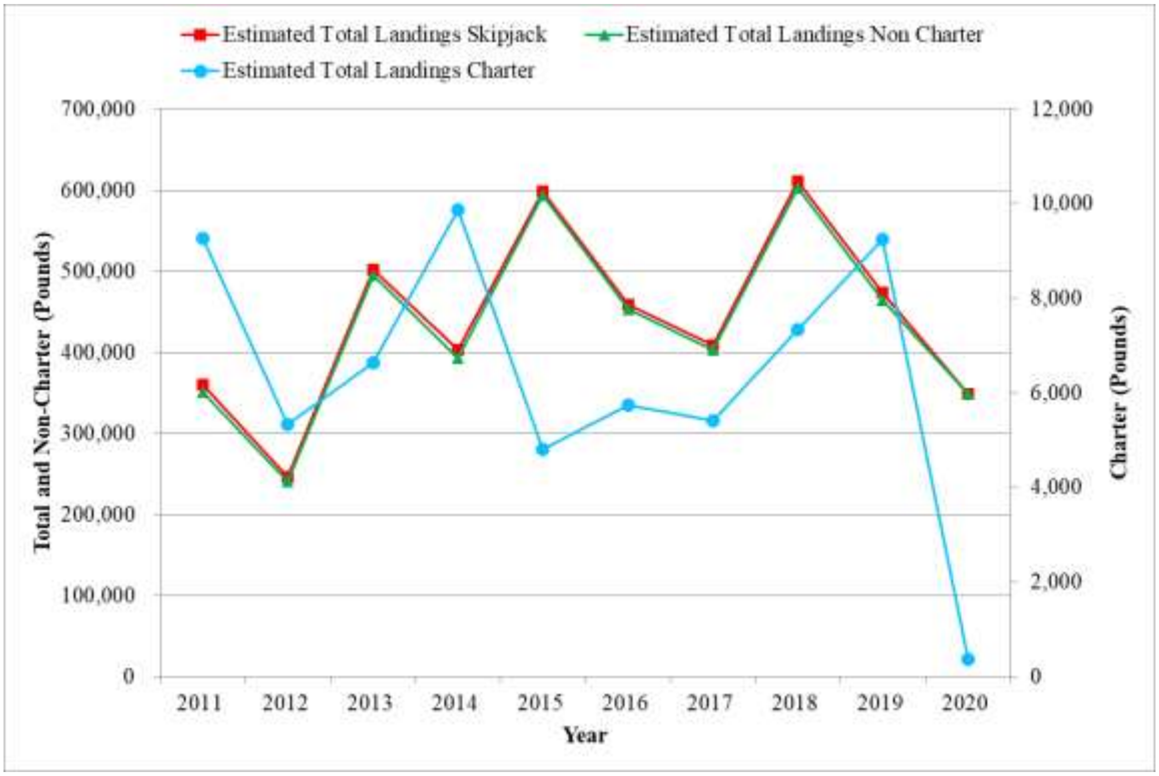


Figure 51. Total estimated annual skipjack tuna landings in Guam from 2011-2020
Supporting data shown in Table A-52.

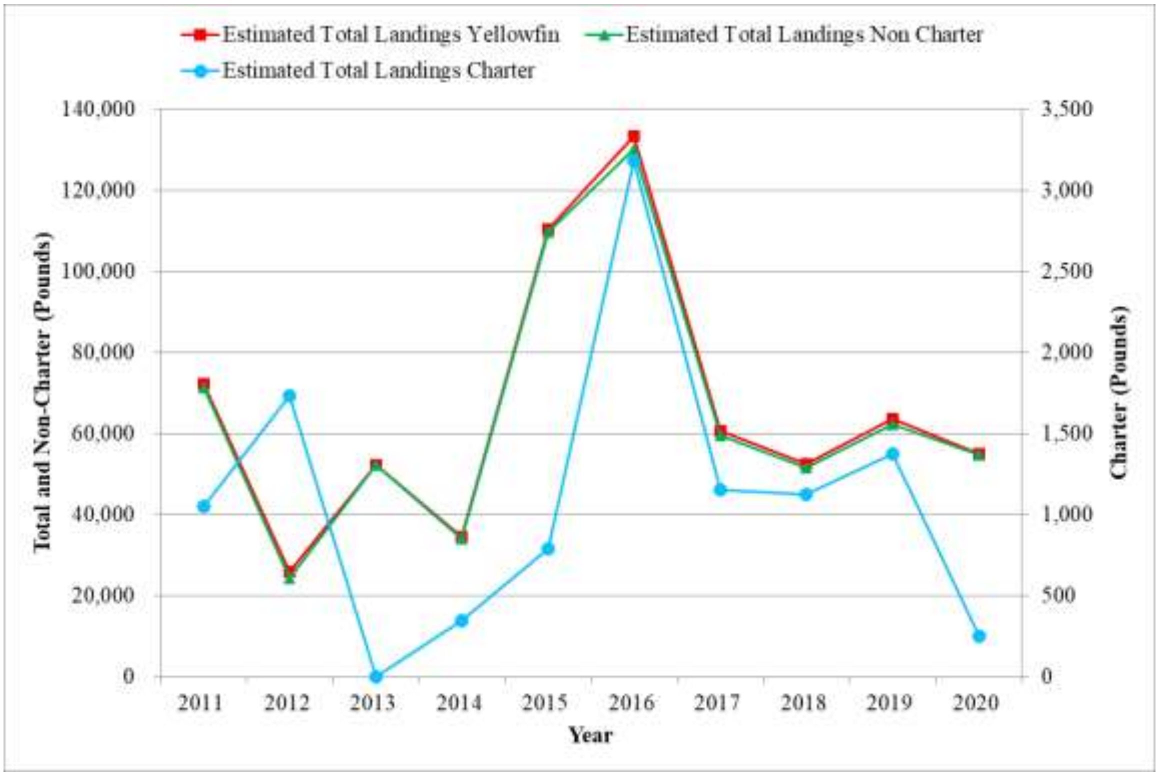


Figure 52. Total estimated annual yellowfin landings in Guam from 2011-2020
Supporting data shown in Table A-53.

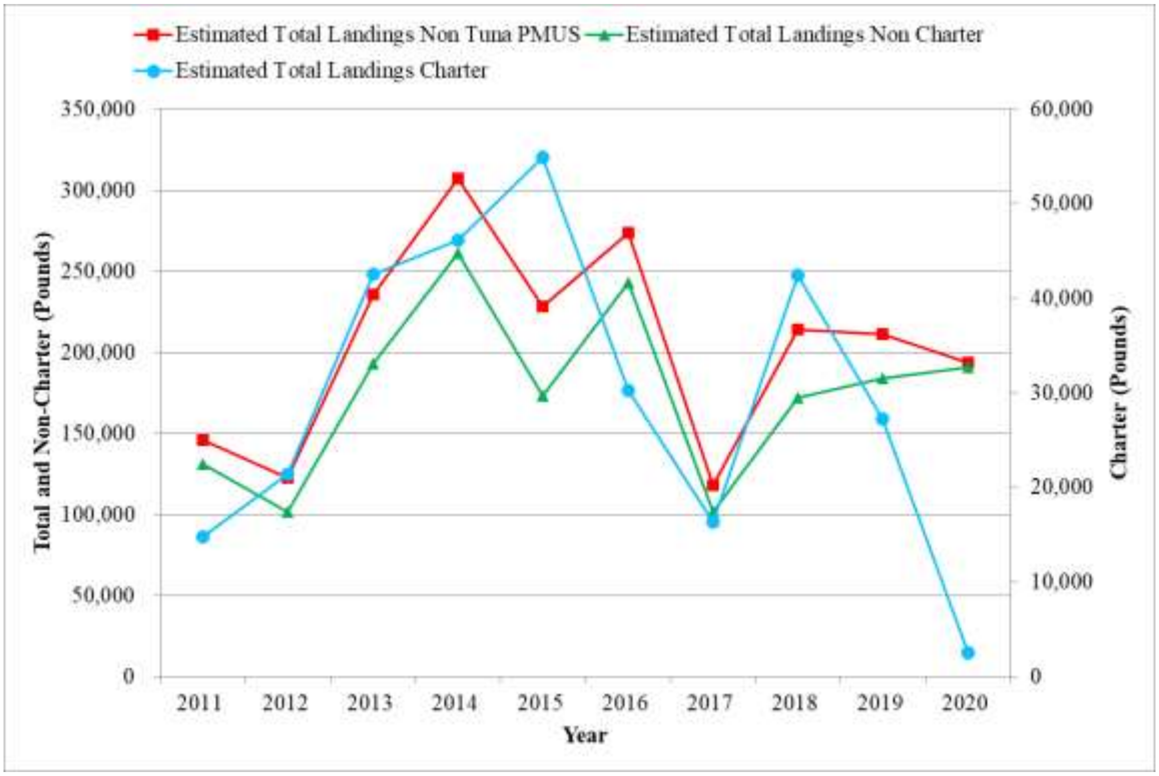


Figure 53. Total estimated annual non-tuna PMUS landings in Guam from 2011-2020
Supporting data shown in Table A-54.

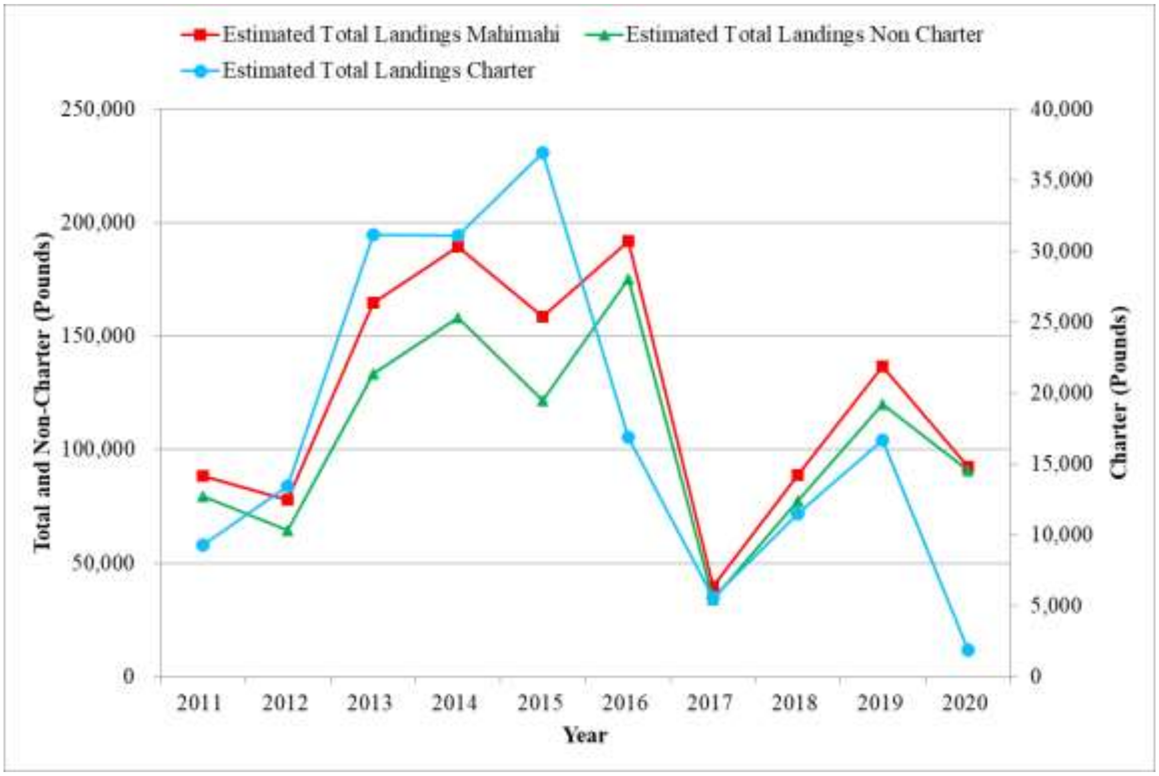


Figure 54. Total estimated annual mahimahi landings in Guam from 2011-2020

Supporting data shown in Table A-55.

Figure 55. Total estimated annual wahoo landings in Guam from 2011-2020

Supporting data shown in Table A-56.

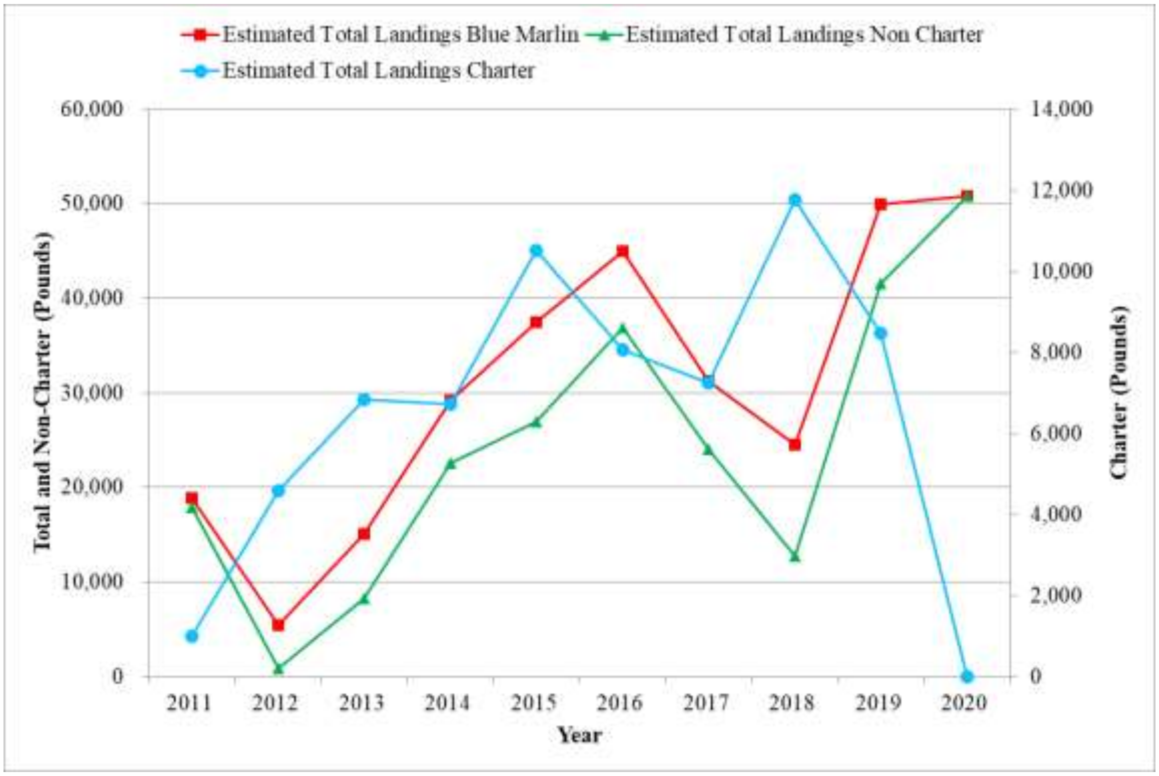


Figure 56. Total estimated annual blue marlin landings in Guam from 2011-2020
Supporting data shown in Table A-57.

Table 18. Bycatch summary for Guam trolling fisheries from 2011-2020

Year	Number Release	Percent Release	Number Kept	Number Caught	Charter
2011	1	0.0	9,049	9,050	F
2012	0	0.0	4,102	4,102	F
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	3,148	3,152	F
2011	0	0.0	379	379	T
2012	0	0.0	176	176	T
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

Year	Number Release	Percent Release	Number Kept	Number Caught	Charter
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

Table 19. Bycatch species summary for Guam trolling fisheries from 2011-2020

Year	Species	Number Release	Percent Release	Number Kept	Number Caught	Charter
2011	Skipjack Tuna	1	0.0	7,272	7,273	F
2013	Rainbow Runner	1	3.0	32	33	F
2013	Yellowfin Tuna	6	1.6	373	379	F
2013	Skipjack Tuna	21	0.4	5,474	5,495	F
2014	Barracudas	1	2.6	38	39	F
2014	Yellowfin Tuna	1	0.4	271	272	F
2014	Skipjack Tuna	19	0.5	3,914	3,933	F
2016	Skipjack Tuna	3	2.4	124	127	T
2016	Mahimahi	3	2.2	133	136	T
2018	Yellowfin Tuna	1	0.3	343	344	F
2018	Wahoo	1	0.2	568	569	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

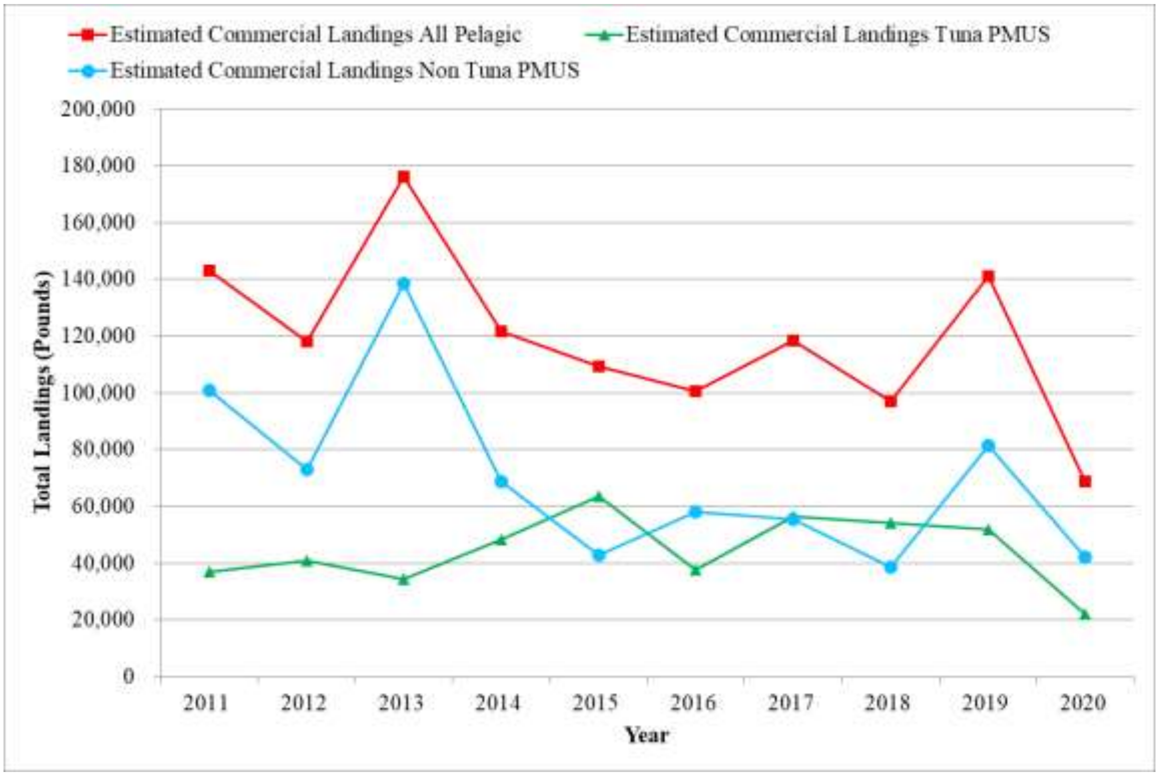


Figure 57. Annual estimated commercial landings for all pelagics, tuna PMUS, and non-tuna PMUS in Guam from 2011-2020

Supporting data shown in Table A-58.

2.3.6 OVERVIEW OF EFFORT AND CPUE

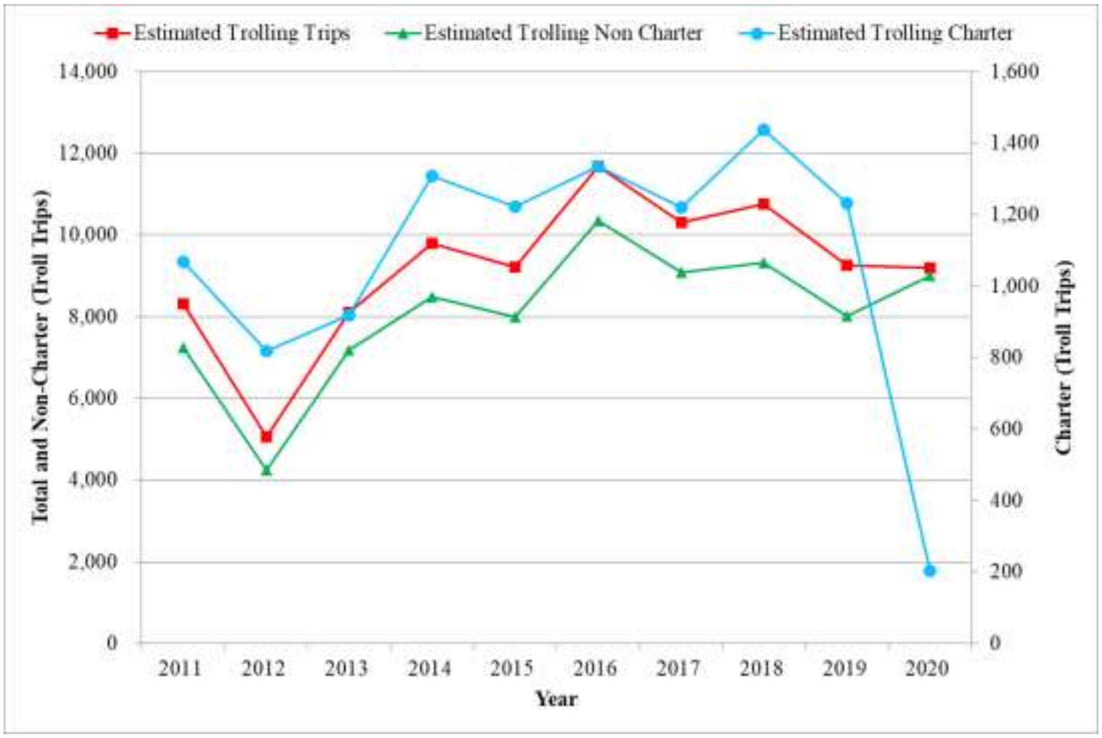


Figure 58. Total estimated number of trolling trips in Guam from 2011-2020

Supporting data shown in Table A-59.

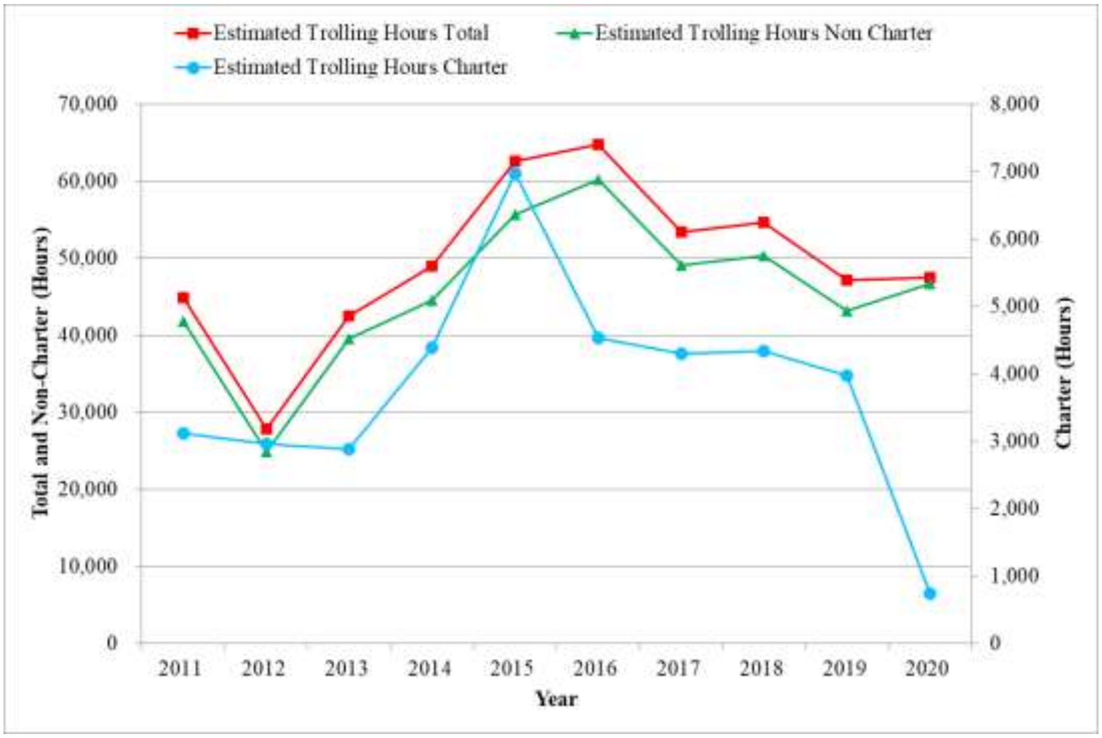


Figure 59. Total estimated number of trolling hours in Guam from 2011-2020

Supporting data shown in Table A-60.

Figure 60. Estimated fishing trip length (hr/trip) in Guam from 2011-2020

Supporting data shown in Table A-61.

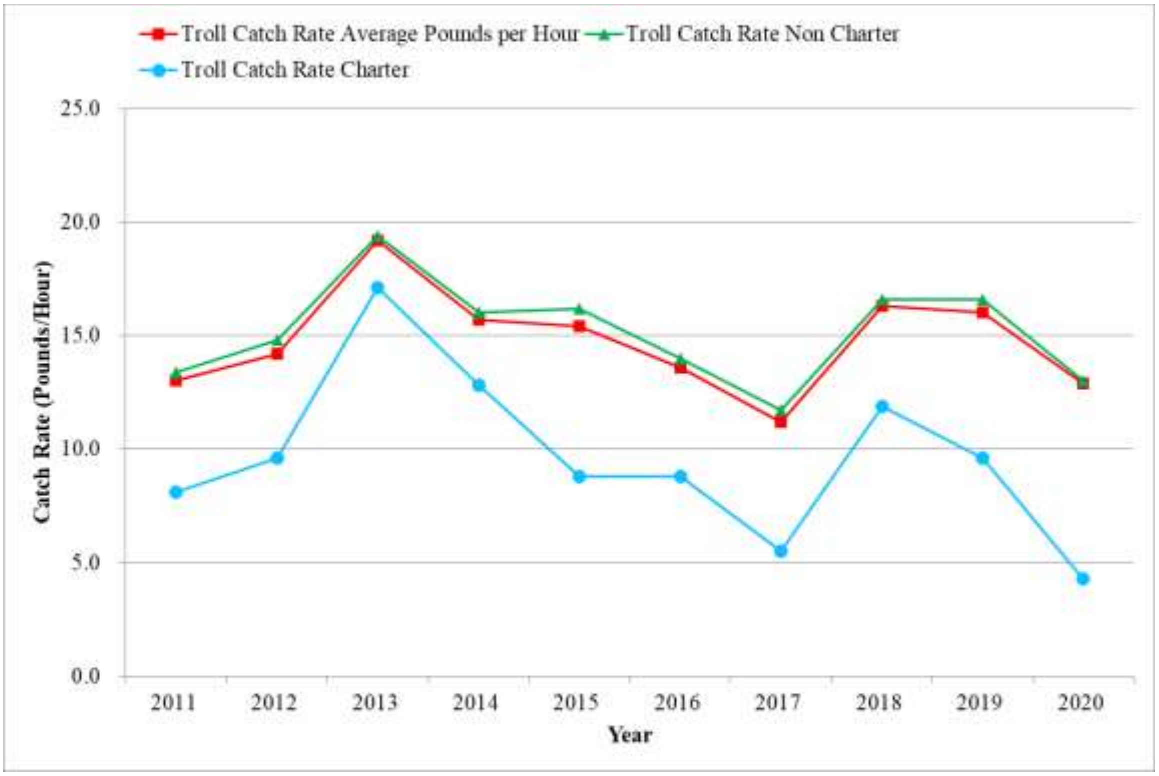


Figure 61. Trolling catch rates (lb/hr) in Guam from 2011-2020

Supporting data shown in Table A-62.

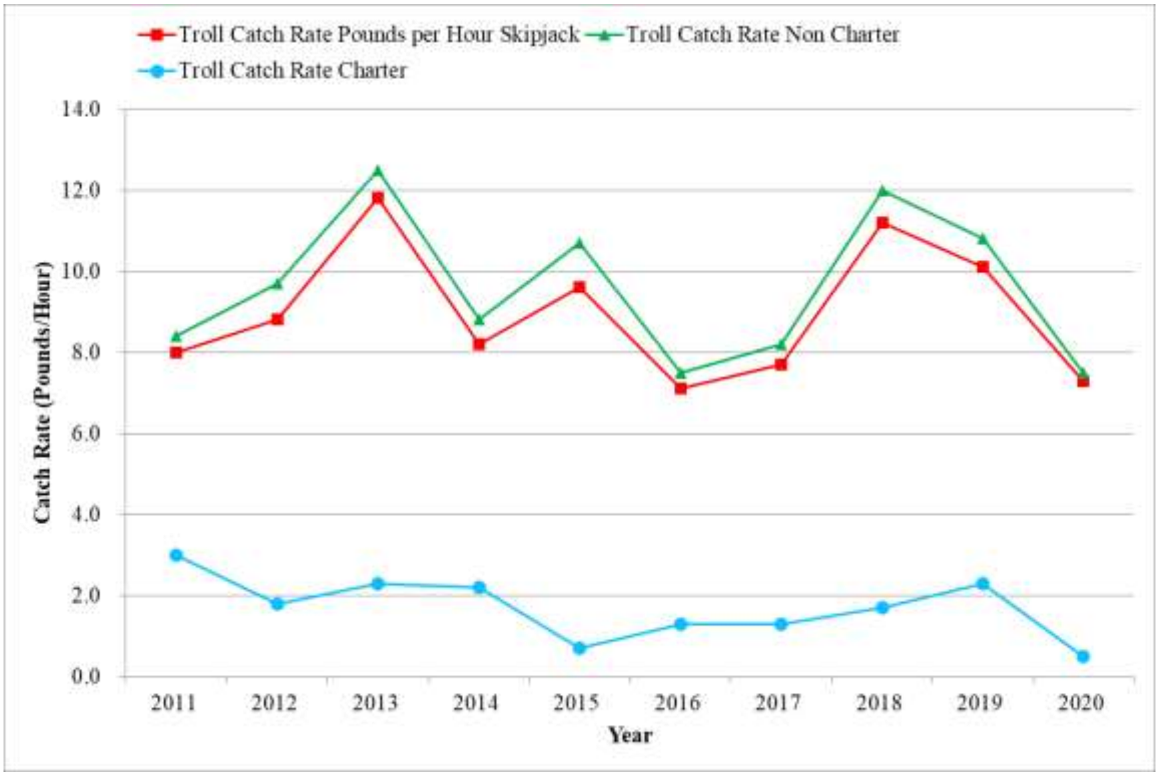


Figure 62. Trolling catch rates (lb/hr) for skipjack tuna in Guam from 2011-2020

Supporting data shown in Table A-63.

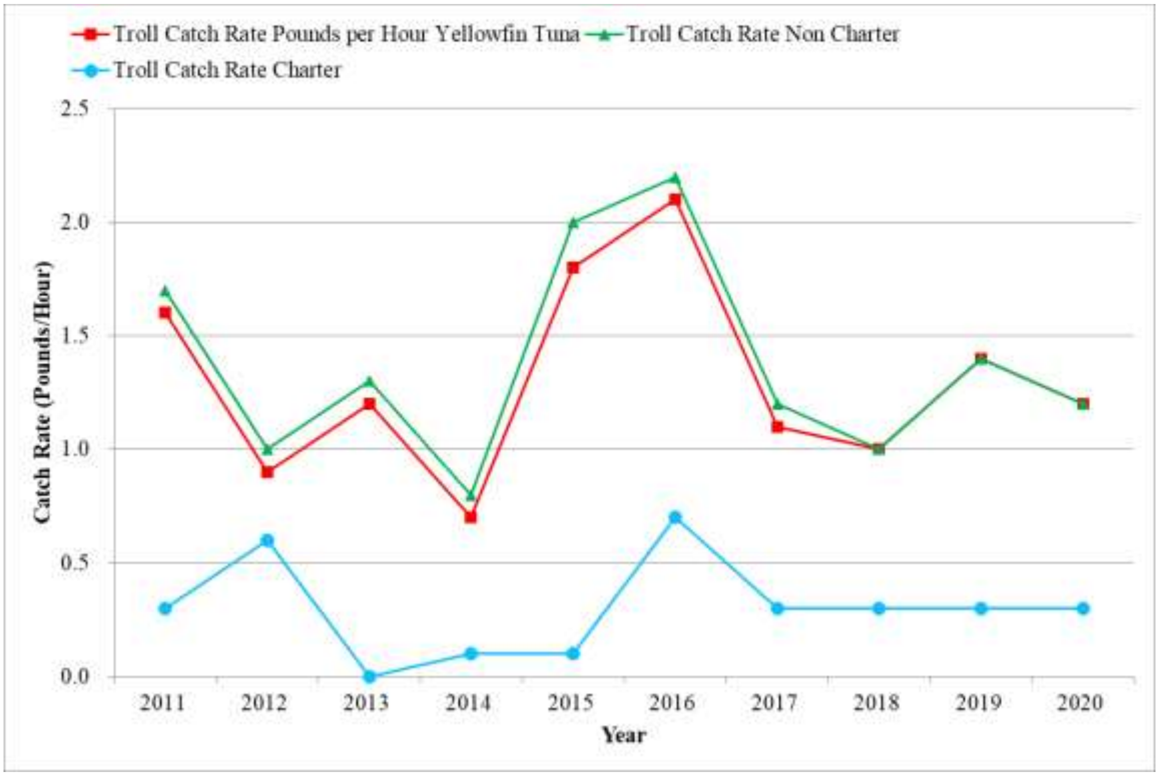


Figure 63. Trolling catch rates (lb/hr) for yellowfin tuna in Guam from 2011-2020

Supporting data shown in Table A-64.

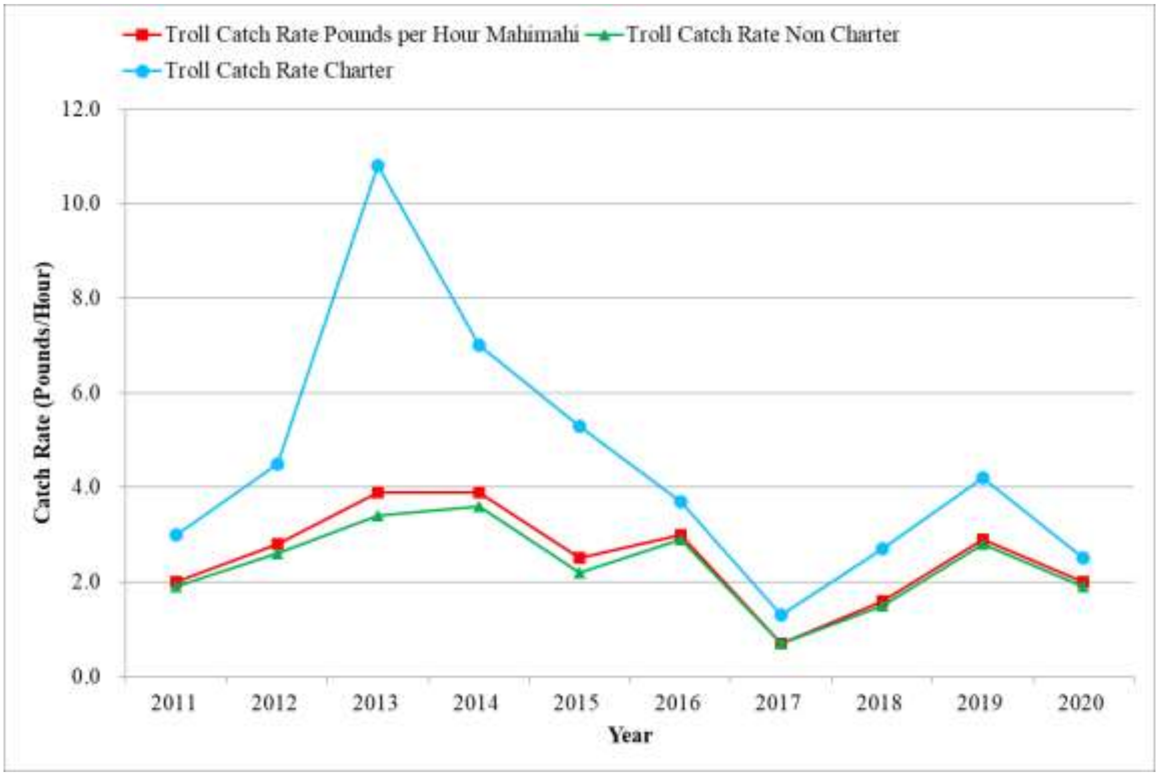


Figure 64. Trolling catch rates (lb/hr) for mahimahi in Guam from 2011-2020
Supporting data shown in Table A-65.

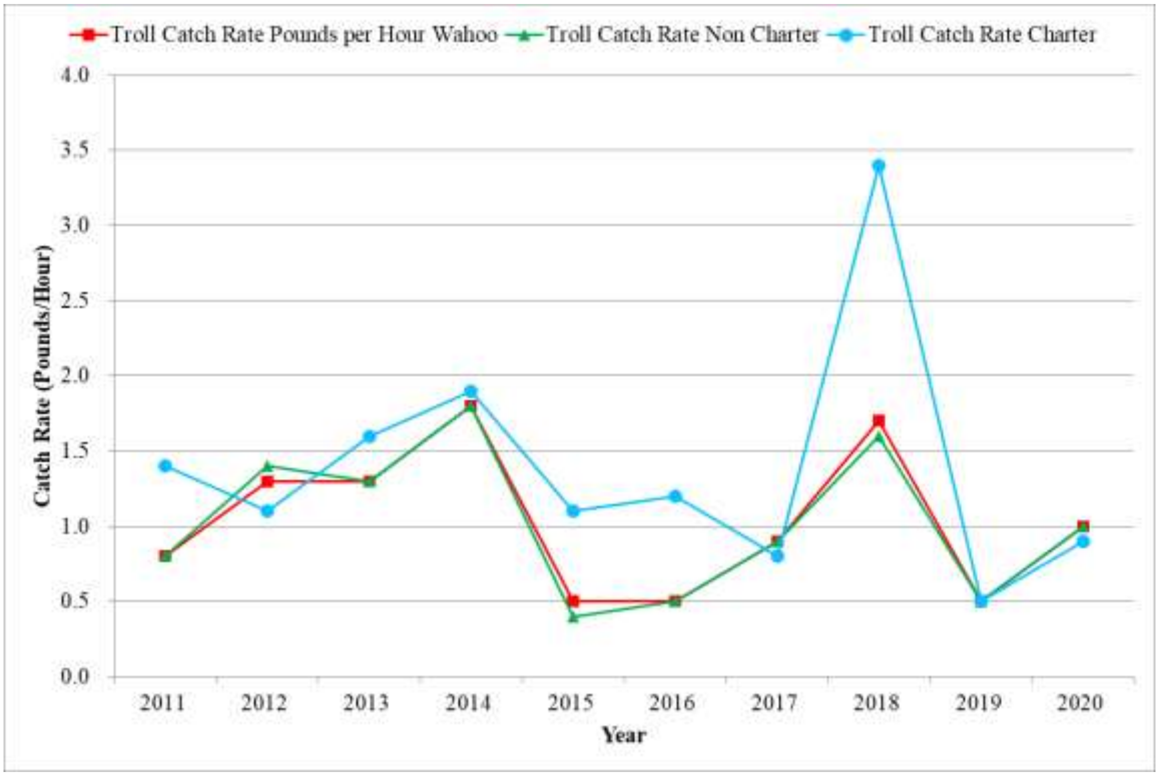


Figure 65. Trolling catch rates (lb/hr) for wahoo in Guam from 2011-2020
Supporting data shown in Table A-66.

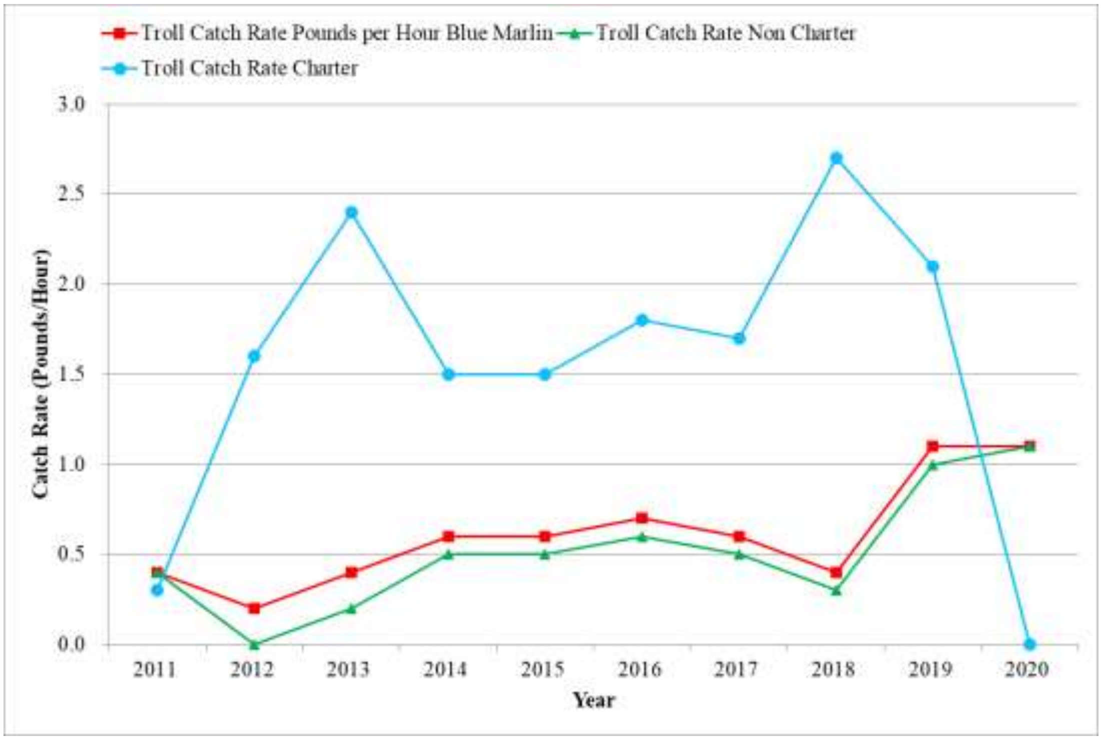


Figure 66. Trolling catch rates (lb/hr) for blue marlin in Guam from 2011-2020

Supporting data shown in Table A-67.

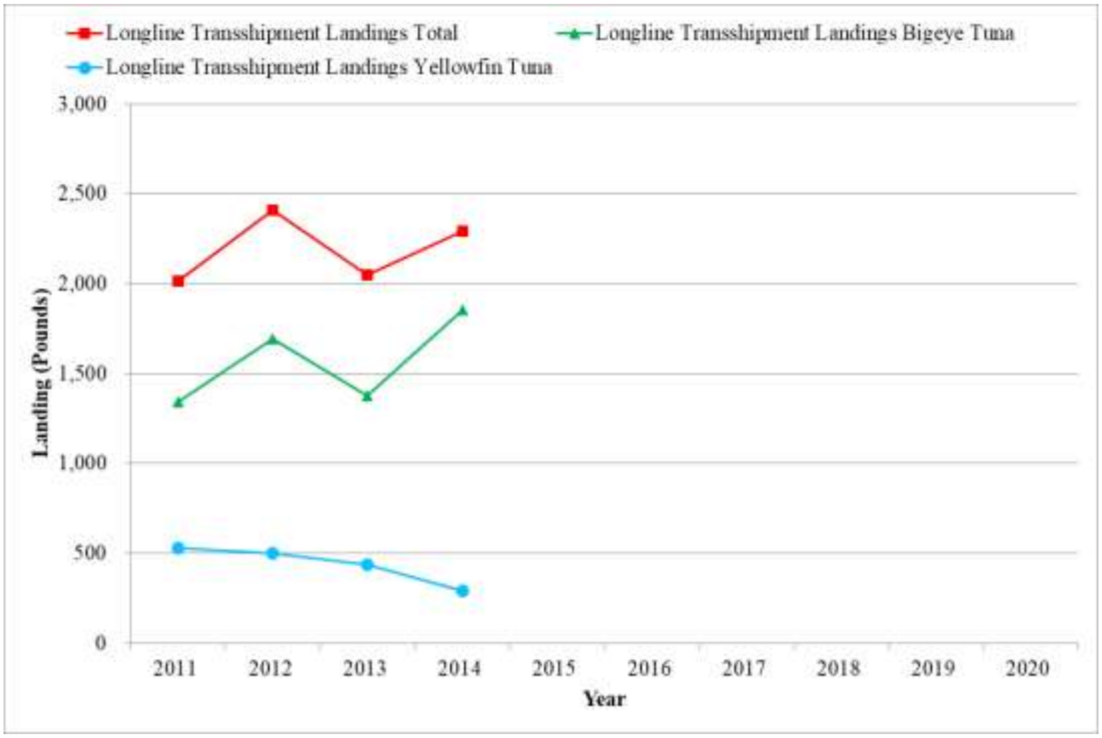


Figure 67. Guam foreign longline transshipment landings for longline fishing outside the Guam EEZ from 2011-2020

Note: Data from 2015-2020 are confidential, and transshipment was discontinued in 2020. Supporting data shown in Table A-68.

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 (CML) data, commercial fishing report (fishing report) data, HDAR commercial dealer's report (dealer) data, and NMFS 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 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 were 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 Eastern Pacific Ocean) 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.

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, and 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 National Oceanic and Atmospheric Administration (NOAA) confidentiality standards. Most of these vessels had Hawai`i 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.

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, Kahoolawe, Lanai, Mokolai, Oahu, Kauai, and Niihau.

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 were 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 were 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). The COVID-19 pandemic had a large effect on participation, catch, and revenue in 2020. The lockdown for public health safety to contain the spread of COVID-19 negatively impacted fishery related businesses. Aid from the Federal Government helped support the overall economy but the improvement was only slight by the end of the year.

Participation. A total of 3,014 fishermen were licensed in 2020, including 1,709 (57%) who indicated that their primary fishing method and gear were intended to catch pelagic fish. This is a 7% decrease in fishing licenses from the previous year. Most licenses that indicated pelagic fishing as their primary method were issued to longline fishermen (40%) and trollers (44%). The remainder was issued to ika shibi and palu ahi (handline) (16%).

Catch. Hawaii commercial fisheries caught and landed 30.4 million pounds of pelagic species in 2020, a decrease of 17% 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 89% (27.1 million pounds) of all pelagic fisheries. The shallow-set longline fishery targeted swordfish and its catch was 838,000 lb, or 3% of the total catch. The MHI troll fishery targeting tunas, marlins, and other PMUS caught 1.5 million lb, or 5% of the total. The MHI handline fishery targeted yellowfin tuna while the offshore handline fishery targeted bigeye tuna. The MHI handline fishery accounted for 579,000 lb (2% of the total). The offshore handline fishery was responsible for 326,000 lb, or 1% of the total catch.

The largest component of the pelagic catch was tunas, which comprised 76% of the total in 2020. Bigeye tuna alone accounted for 74% of the tunas and 56% of all the pelagic catch. Billfish catch made up 12% of the total catch in 2020. Blue marlin was the largest of these, at 38% of the billfish and 5% of the total catch. Catches of other PMUS represented 12% of the total catch in 2020 with moonfish being the largest component at 43% of the other PMUS and 5% of the total catch.

Effort. There were 146 active Hawaii-permitted deep-set longline vessels in 2020, three less vessels than the previous year with 149 deep-set vessels. The number of deep-set trips (1,644) and sets (20,758) were both below the record deep-set effort in 2019. The number of hooks set by the deep-set longline fishery was 59.7 million hooks in 2020. The Hawaii-permitted shallow-set longline fishery operates mainly in the first half of the year. In 2020, 14 vessels completed 34 trips and made 450 sets, which was above the record low effort for this segment of the fishery in 2019. The number of hooks set by this fishery also increased to 600,000 in 2020, an increase over the record low in 2019. The number of days fished by MHI troll fishers has been trending lower from its peak in 2012, with 1,122 fishers logging 12,119 days fished around the MHI in 2020. There were 392 MHI handline fishers that fished 3,017 days in 2020, both at their lowest levels in the ten-year period. The offshore handline fishery only had 5 fishers and 255 days fished in 2020.

CPUE. The deep-set longline fishery targets bigeye tuna and this species had higher CPUE (3.5 fish per 1,000 hooks) compared to yellowfin tuna (0.9) and albacore (0.1) in 2020. CPUE of blue marlin and striped marlin for the deep-set fishery were low (0.1 and 0.2 fish per 1,000 hooks, respectively), while the CPUE for blue shark, a bycatch species, is second only to bigeye at 1.7 fish per 1,000 hooks. The Hawaii-permitted shallow-set longline fishery targets swordfish and had a record low CPUE of 8.1 fish per 1,000 hooks in 2020. Blue shark, a bycatch species of this fishery, had the highest CPUE at 10.5 fish per 1,000 hooks. The MHI troll fishery CPUE for yellowfin tuna and marlins trended higher while skipjack tuna, mahimahi and ono CPUE were relatively level. MHI handline CPUE for yellowfin, albacore, and bigeye tuna CPUE were steady over the past eight years. Bigeye tuna and yellowfin tuna CPUE for the offshore handline fishery showed considerable variability over the past five years.

Fish Size. The average weight for tunas, other PMUS, and PMUS sharks caught by the deep-set longline fishery were close to their respective long-term weights, while most of the billfish species were below their 10-year average weights in 2020. Bigeye tuna caught in the deep-set fishery was 81 lb in 2020, close to the long-term average. The size of swordfish was 145 lb in 2020, much lower from the 10-year average weight. Swordfish caught by the shallow-set longline fishery was 148 lb, well below the 10-year average. 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. The average weight for tunas caught by the troll and handline fisheries was above their long-term average in 2020. Troll and handline caught marlin were below their long-term mean weights.

Revenue. The total revenue from Hawaii’s pelagic fisheries was $80.2 million in 2020, a decrease of 25% from the previous year, mainly attributed to the COVID pandemic. Bigeye tuna and yellowfin tuna represented 66% and 17% of the total pelagic revenue, respectively, in 2020. The deep-set longline revenue was $71.5 million in 2020. This fishery represented 89% of the total revenue for pelagic fish in Hawaii. The shallow-set longline fishery decreased to $1.3 million and accounted for 2% of the revenue. The MHI troll revenue was $4.2 million or 5% of the total in 2020 and was followed by the MHI handline fishery at $1.9 million (2%). The offshore handline fishery was close to $1.0 million in 2020. The trend for revenue from the deep-set longline peaked in 2018 and decreased in the two most recent tears dropping by 25% in 2020. Revenue for the shallow-set longline fishery trended lower and decreased to a record low in 2020. The revenue from the MHI troll and MHI handline were at 10-year lows in 2020 while the offshore handline fishery showed steady revenue over the past seven years.

Bycatch. A total of 135,879 fish were released by the deep-set longline fishery in 2020. Sharks accounted for 87% of the deep-set longline bycatch. With the exception for mako and a few thresher sharks, there is no demand for other shark species in Hawaii. Of all shark species combined, 99.6% 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 2020. A total of 7,073 fish were released by the shallow-set longline fishery in 2020. Sharks accounted for 94% of the shallow-set longline bycatch. Of all shark species combined, 94% of the shallow-set longline shark catch was released. Conversely, bycatch rate for the shallow-set longline fishery was 6% for targeted and incidentally caught pelagic species in 2020. Since shallow-set longline trips are often longer than deep-set trips, the higher release rate by the shallow-set sector is to conserve space for swordfish and forego keeping other pelagic species due to their short shelf life.

2.4.3 PLAN TEAM RECOMMENDATIONS

Regarding the Hawaii data module in the 2020 annual SAFE report, Plan Team members recommended to carry out the following module improvements:

Regarding bycatch data tables in the Pelagic Annual SAFE Reports, the Pelagic Plan Team:

1. Forms a Plan Team working group composed of PIRO, PIFSC and Council staff to consider inclusion of longline bycatch data using observer data for future reports. The working group may identify priority species for generating expanded estimates from the prior year in time for the SAFE report, and a list of species and species groupings for remaining fish bycatch to supplement the existing tables based on logbook data.

2.4.4 OVERVIEW OF PARTICIPATION – ALL FISHERIES

Table 20. Number of HDAR Commercial Marine Licenses, 2019-2020

	Number of licenses	
Primary Fishing Method	**2019**	**2020**
Trolling	775	686
Longline	894	758
Ika Shibi & Palu Ahi	258	262
Aku Boat (Pole and Line)	2	3
Total Pelagic	1,929	1,709
Total All Methods	3,124	3,014

2.4.5 OVERVIEW OF LANDINGS AND ECONOMIC DATA

Table 21. Hawaii commercial pelagic catch, revenue, and price by species, 2019-2020

	2019			2020		
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	255	$496	$1.84	366	$226	$1.76
Bigeye tuna	17,612	$64,506	$3.92	16,952	$53,268	$3.39
Bluefin tuna	4	$66	$5.87	3	$12	$5.66
Skipjack tuna	832	$829	$1.28	553	$659	$2.09
Yellowfin tuna	5,982	$20,888	$3.57	5,098	$13,721	$3.08
Other tunas	10	$18	$3.19	5	$9	$3.02
Tuna PMUS subtotal	**24,696**	**$86,801**	**$3.73**	**22,978**	**$67,895**	**$3.30**
Billfish PMUS						
Swordfish	1,626	$3,861	$2.59	1,199	$2,975	$3.68
Blue marlin	2,337	$1,349	$0.72	1,373	$1,107	$1.14
Spearfish (hebi)	453	$424	$0.92	262	$220	$0.81
Striped marlin	1,231	$1,248	$0.89	762	$1,150	$1.25
Other marlins	50	$34	$0.57	24	$21	$1.08
Billfish PMUS subtotal	**5,697**	**$6,916**	**$1.31**	**3,621**	**$5,473**	**$1.83**
Other PMUS						
Mahimahi	1,005	$3,508	$3.72	580	$1,889	$3.54
Ono (wahoo)	1,599	$3,692	$2.43	849	$1,827	$2.24
Opah (moonfish)	2,292	$3,169	$1.96	1,631	$1,673	$2.07
Oilfish	308	$256	$0.96	184	$91	$0.63
Pomfrets (monchong)	751	$2,776	$3.55	508	$1,367	$2.61
PMUS Sharks	115	$84	$1.16	43	$0	$0.35
Other PMUS subtotal	**6,070**	**$13,485**	**$2.59**	**3,795**	**$6,848**	**$2.42**
Other pelagics	**5**	**$8**	**$1.63**	**5**	**$5**	**$1.36**
Total pelagics	**36,468**	**$107,210**	**$3.18**	**30,399**	**$80,221**	**$3.04**

Table 22. Hawaii commercial pelagic catch, revenue, and price by fishery, 2019-2020

	2019			2020		
Fishery	**Catch (1,000 lbs)**	**Ex-vessel revenue ($1,000)**	**Average price ($/lb)**	**Catch (1,000 lbs)**	**Ex-vessel revenue ($1,000)**	**Average price ($/lb)**
Deep-set longline	31,865	$94,322	$3.15	27,061	$71,503	$3.01
Shallow-set longline	829	$1,972	$3.07	838	$1,293	$3.68
MHI trolling	2,479	$7,331	$3.57	1,486	$4,245	$3.35
MHI handline	687	$2,196	$3.59	579	$1,882	$3.39
Offshore handline	477	$1,037	$2.57	326	$959	$2.56
Other gear	132	$352	$3.10	110	$121	$2.86
Total	**36,468**	**$107,210**	**$3.18**	**30,399**	**$80,221**	**$3.04**

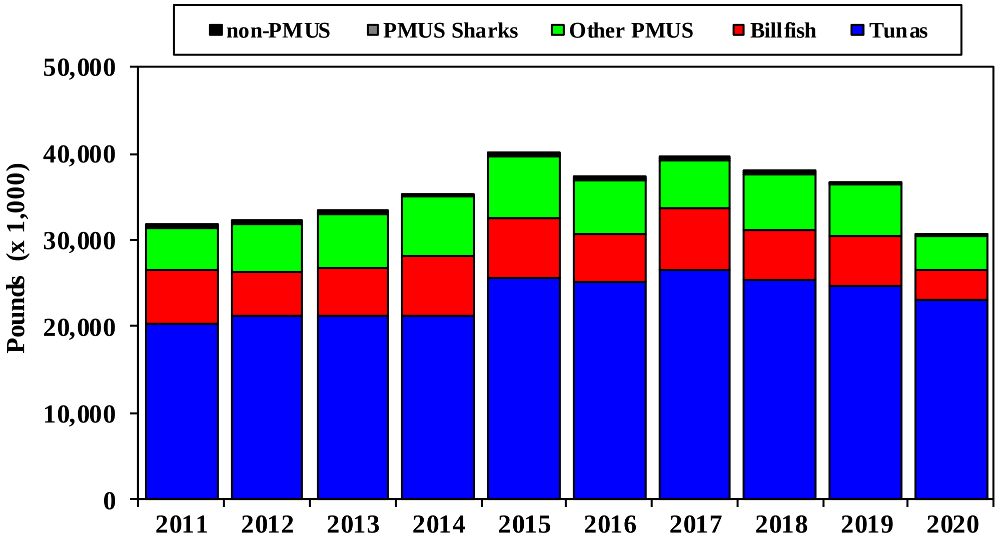


Figure 68. Hawaii commercial tuna, billfish, other PMUS and PMUS shark catch, 2011-2020
Supporting data shown in Table A-69.

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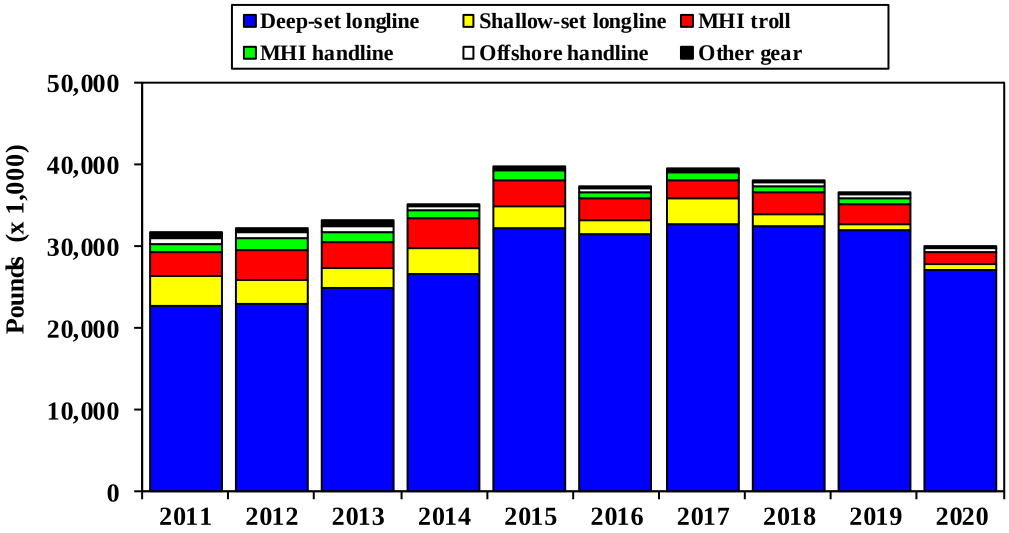


Figure 69. Total commercial pelagic catch by gear type, 2011-2020

Supporting data shown in Table A-70.

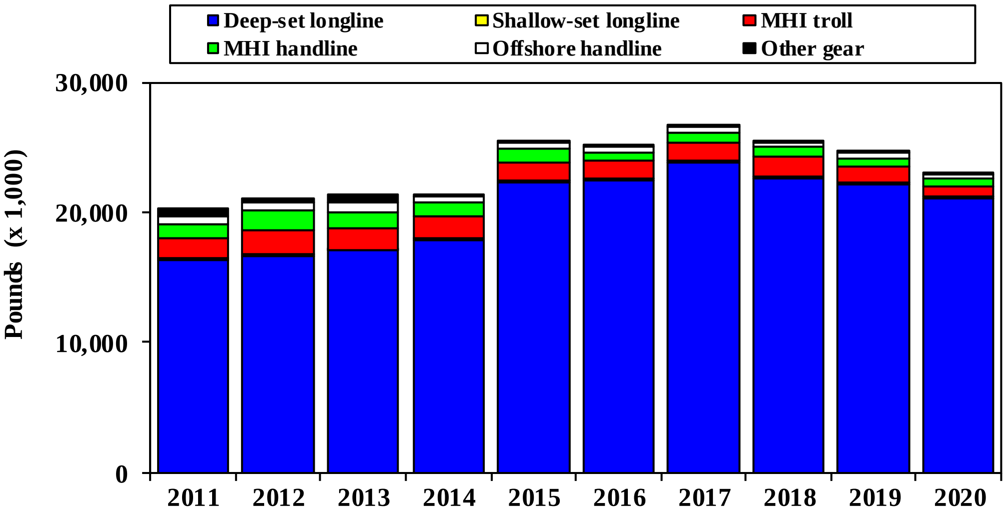


Figure 70. Hawaii commercial tuna catch by gear type, 2011-2020

Supporting data shown in Table A-71.

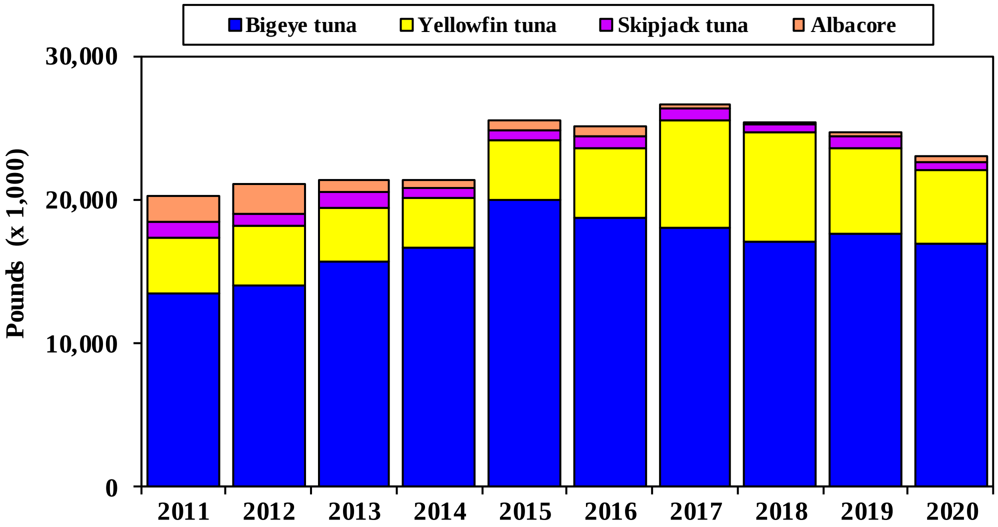


Figure 71. Species composition of tuna catch, 2011-2020

Supporting data shown in Table A-72.

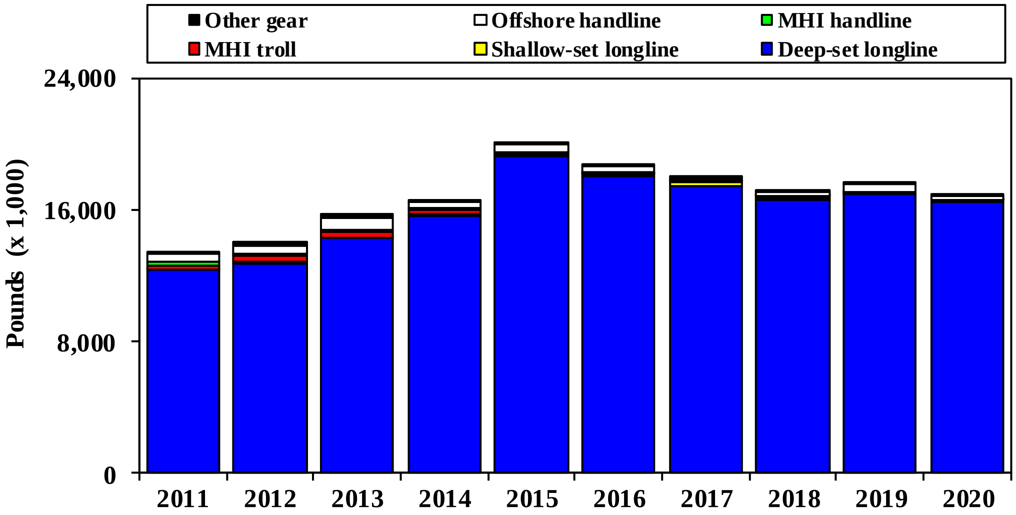


Figure 72. Hawaii bigeye tuna catch by gear type, 2011-2020

Supporting data shown in Table A-73.

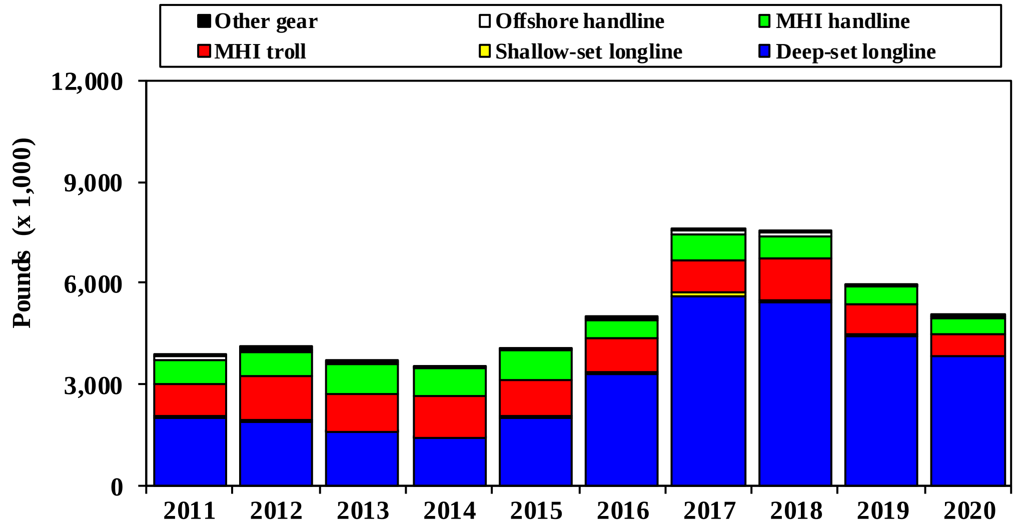


Figure 73. Hawaii yellowfin tuna catch by gear type, 2011-2020

Supporting data shown in Table A-74.

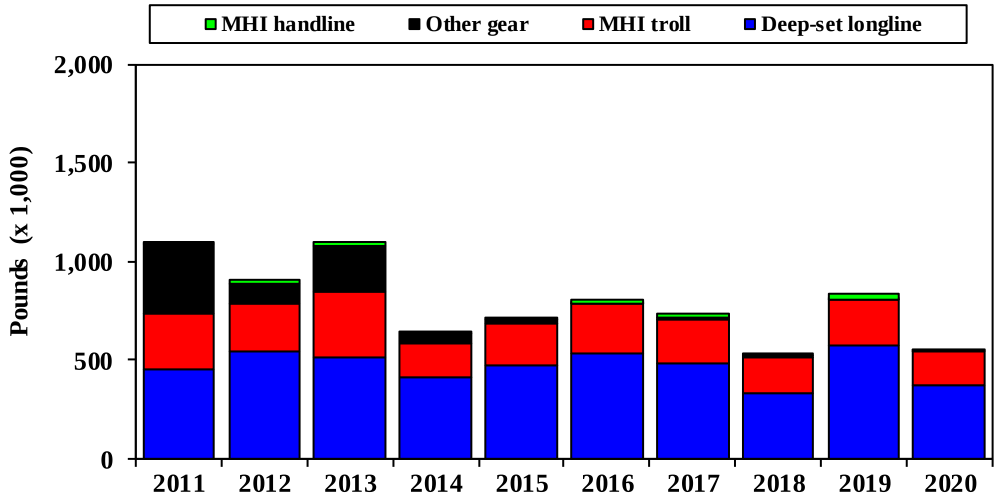


Figure 74. Hawaii skipjack tuna catch by gear type, 2011-2020

Supporting data shown in Table A-75.

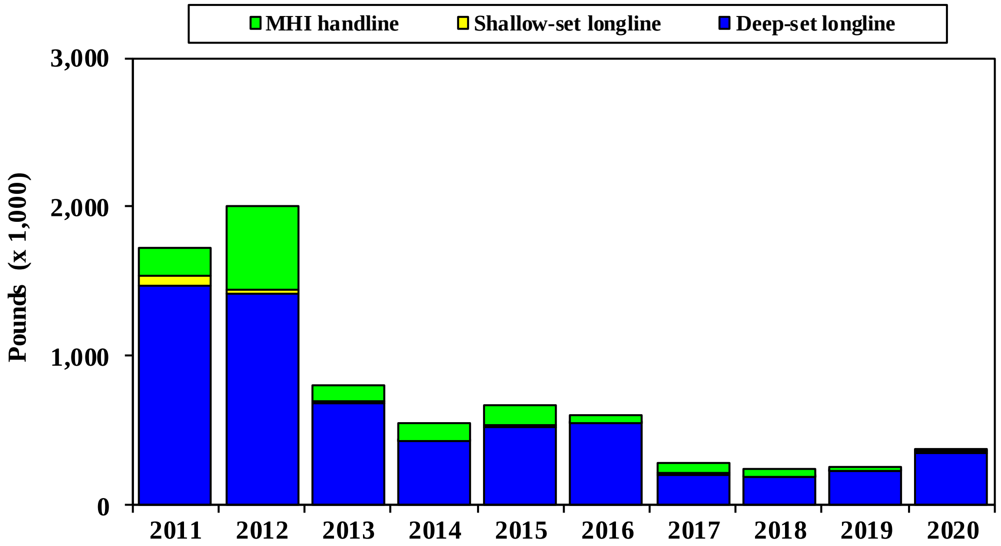


Figure 75. Hawaii albacore catch by gear type, 2011-2020

Supporting data shown in Table A-76.

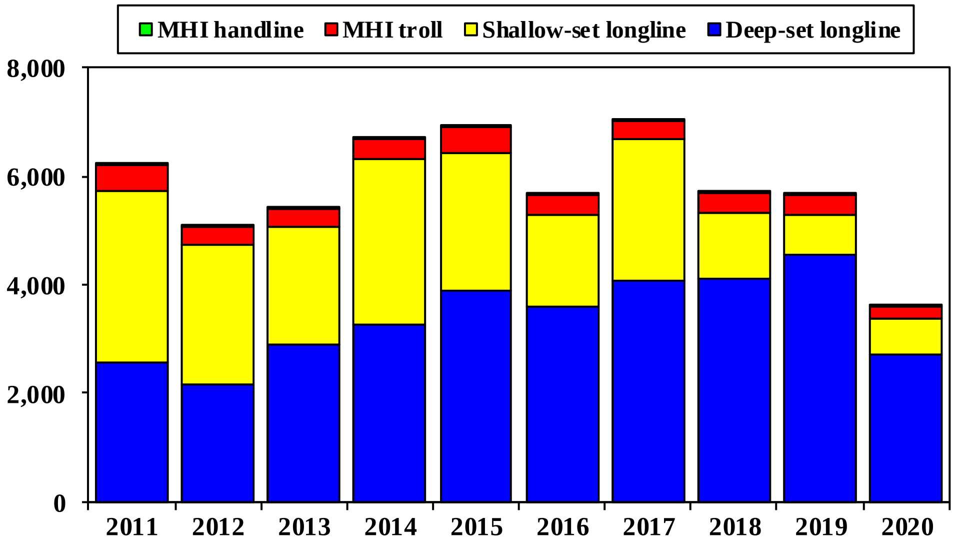


Figure 76. Hawaii commercial billfish catch by gear type, 2011-2020

Supporting data shown in Table A-77.

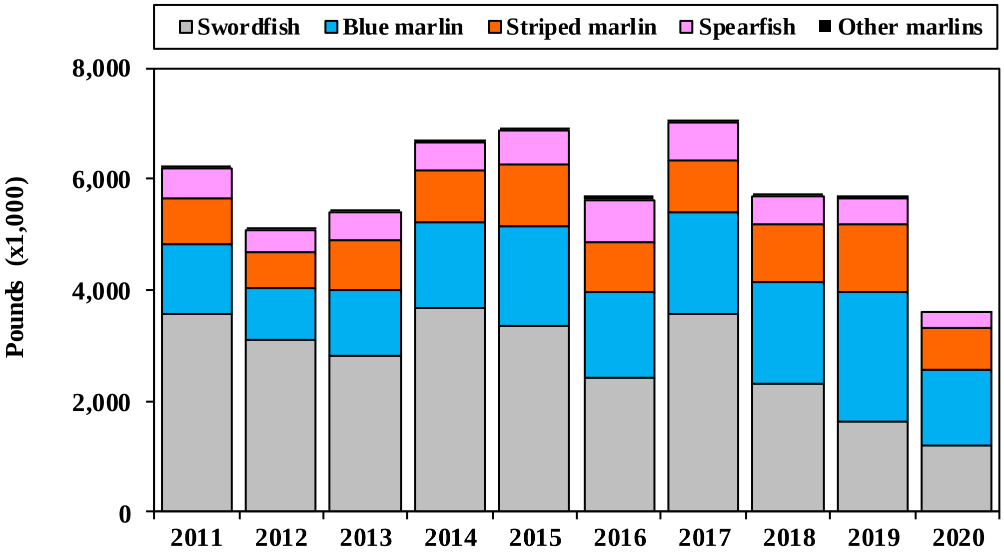


Figure 77. Species composition of billfish catch, 2011-2020

Supporting data shown in Table A-78.

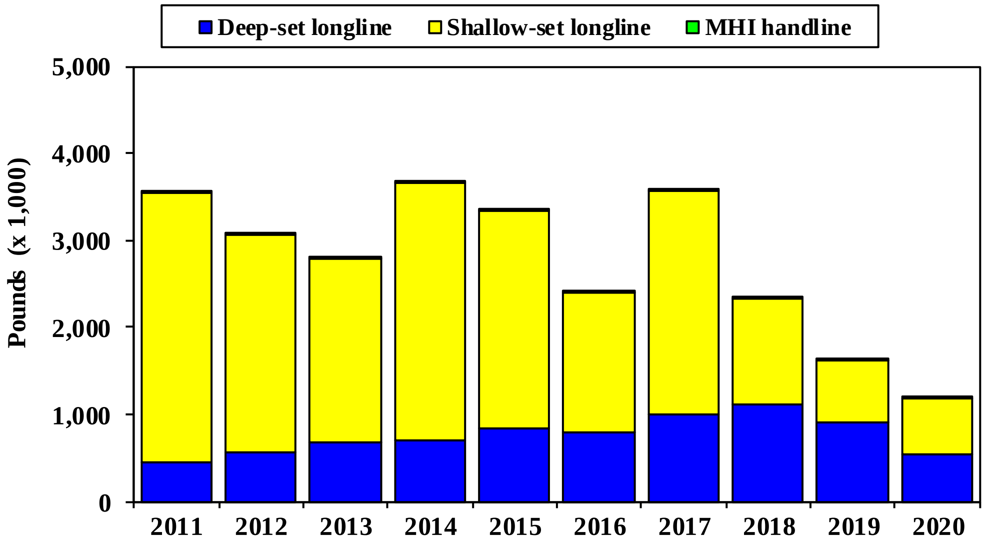


Figure 78. Hawaii swordfish catch by gear type, 2011-2020

Supporting data shown in Table A-79.

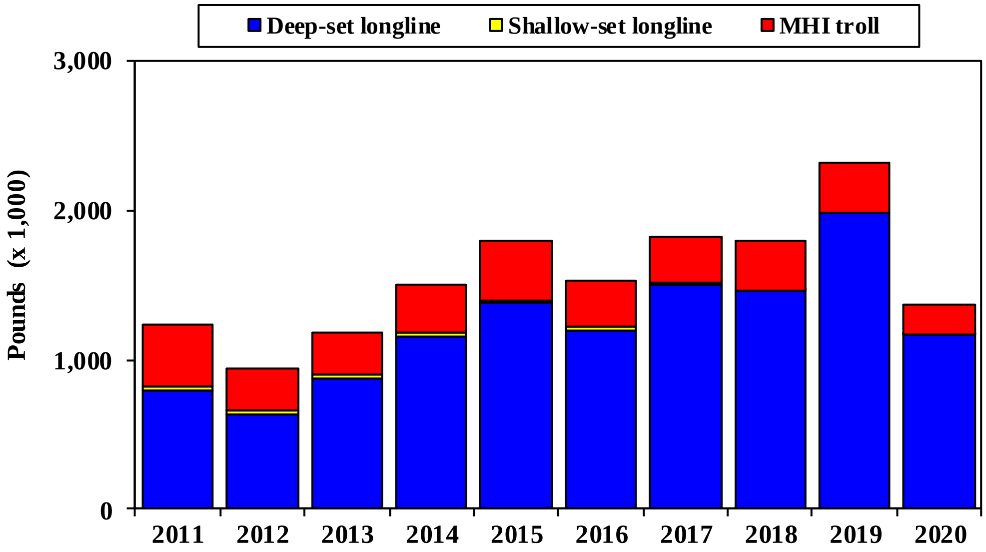


Figure 79. Hawaii blue marlin catch by gear type, 2011-2020

Supporting data shown in Table A-80.

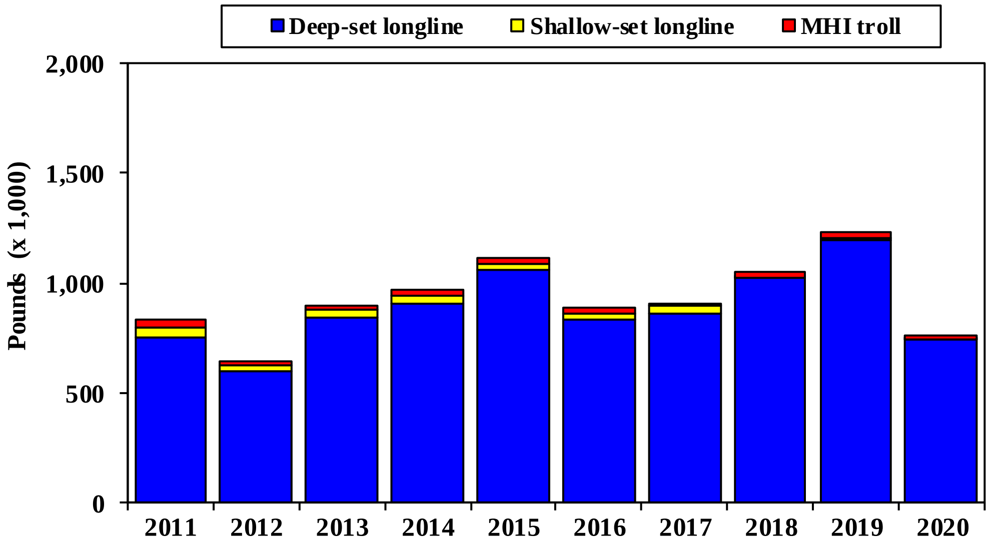


Figure 80. Hawaii striped marlin catch by gear type, 2011-2020

Supporting data shown in Table A-81.

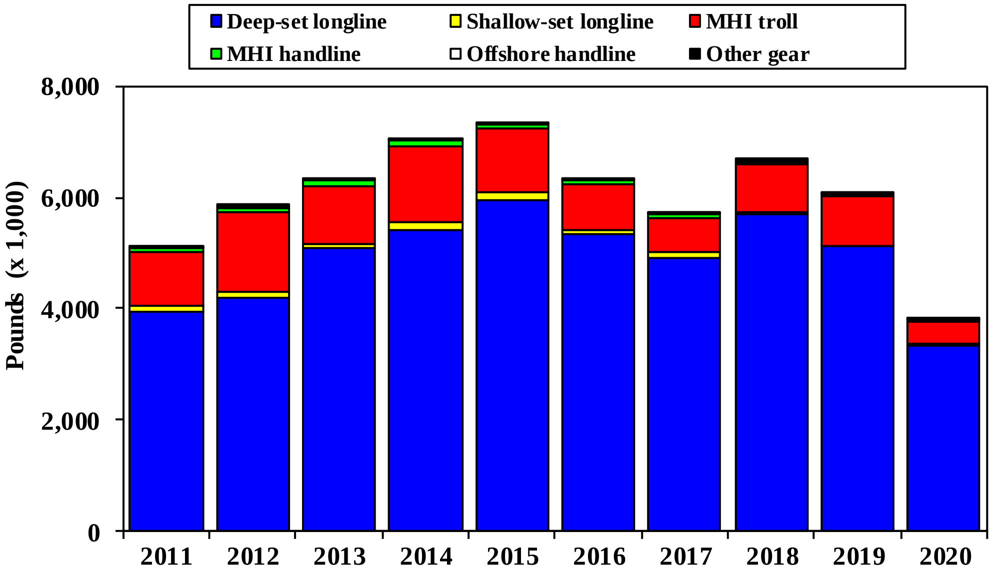


Figure 81. Hawaii commercial catch of other PMUS by gear type, 2011-2020

Supporting data shown in Table A-82.

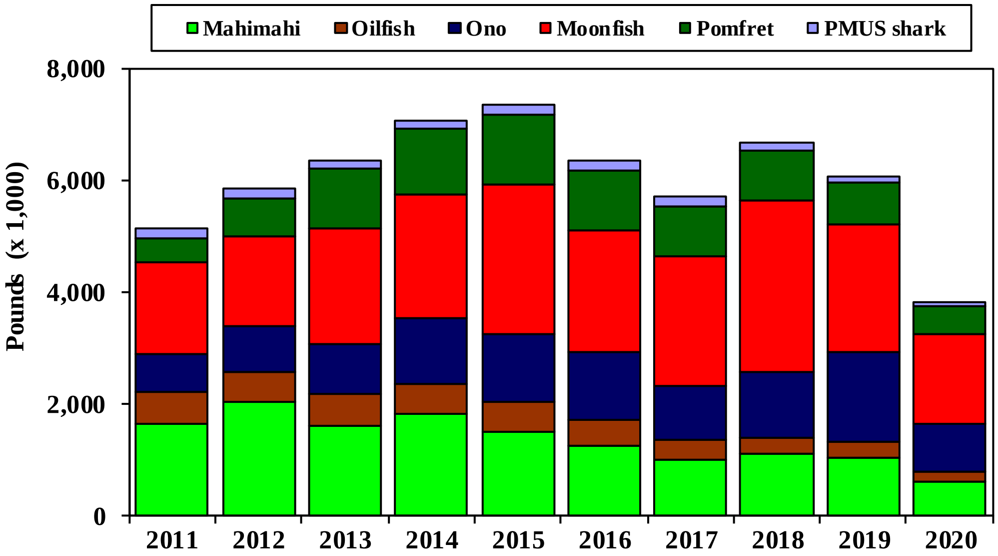


Figure 82. Species composition of other PMUS catch, 2011-2020

Supporting data shown in Table A-83.

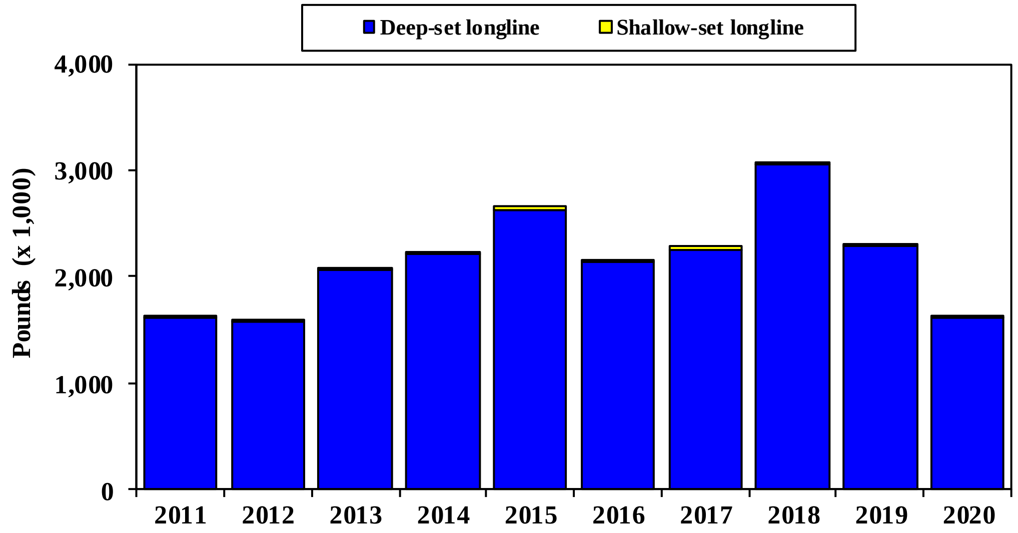


Figure 83. Hawaii moonfish catch by gear type, 2011-2020

Supporting data shown in Table A-84.

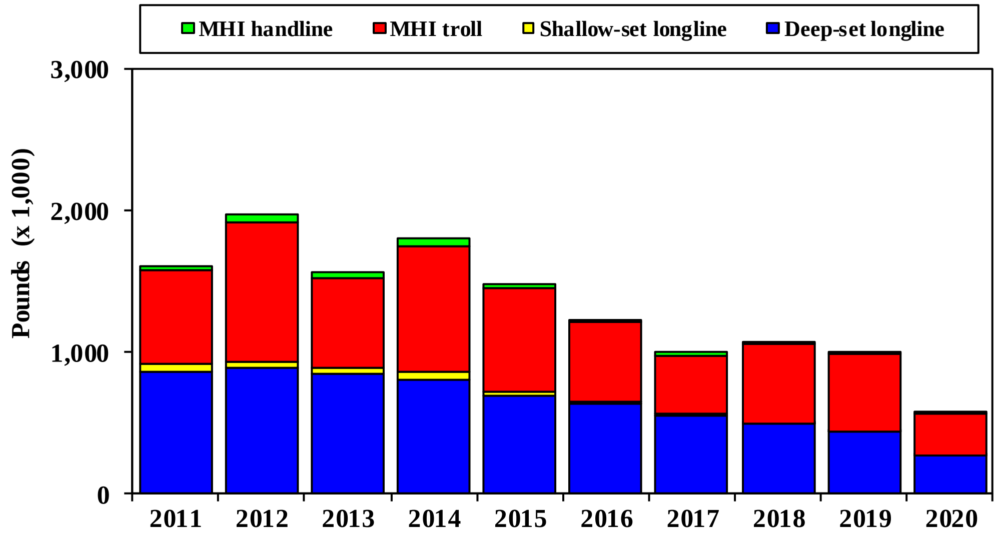


Figure 84. Hawaii mahimahi catch by gear type, 2011-2020

Supporting data shown in Table A-85.

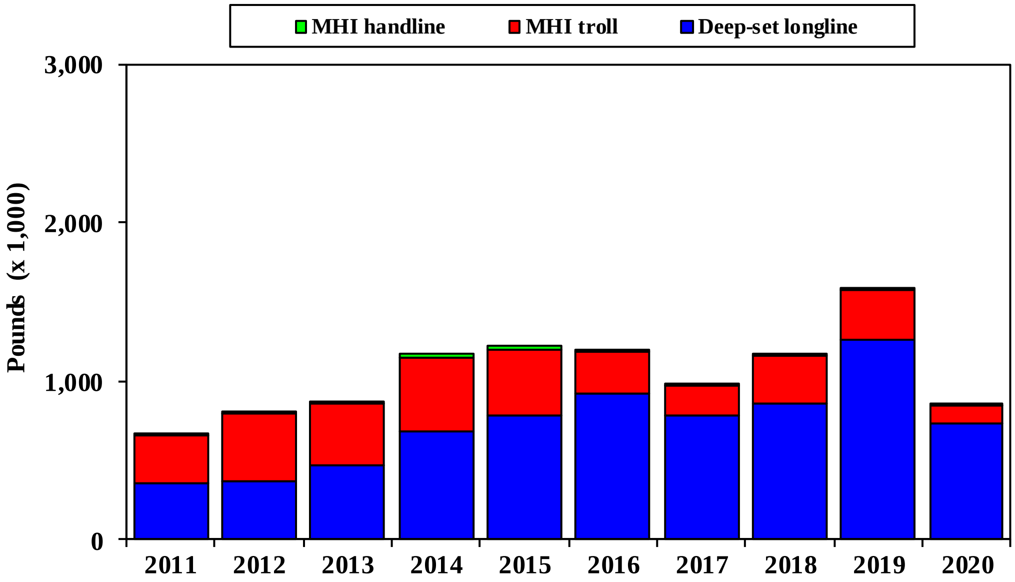


Figure 85. Hawaii ono (wahoo) catch by gear type, 2011-2020

Supporting data shown in Table A-86.

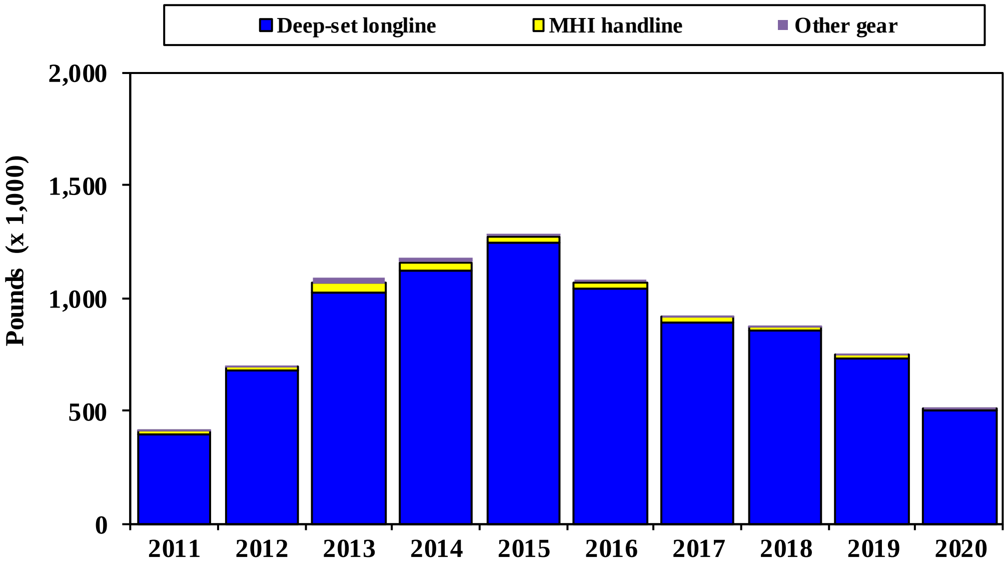


Figure 86. Hawaii pomfret catch by gear type, 2011-2020

Supporting data shown in Table A-87.

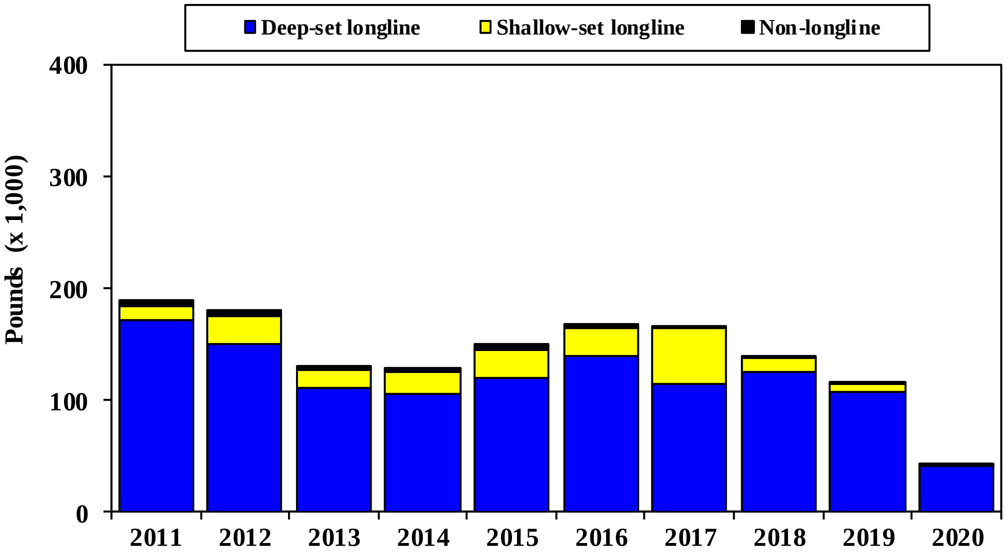


Figure 87. Hawaii PMUS shark catch by gear type, 2011-2020

Supporting data shown in Table A-88.

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

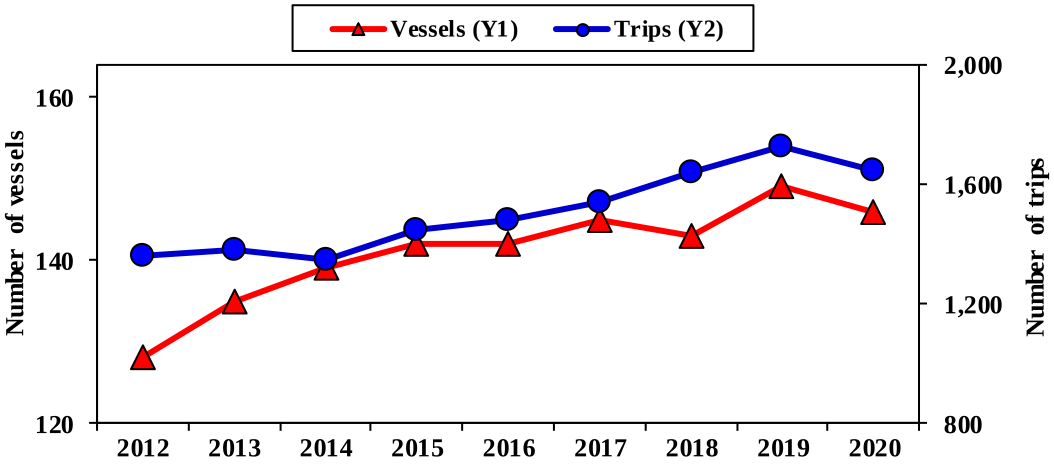


Figure 88. Number of Hawaii-permitted deep-set longline vessels and trips, 2011-2020

Supporting data shown in Table A-89.

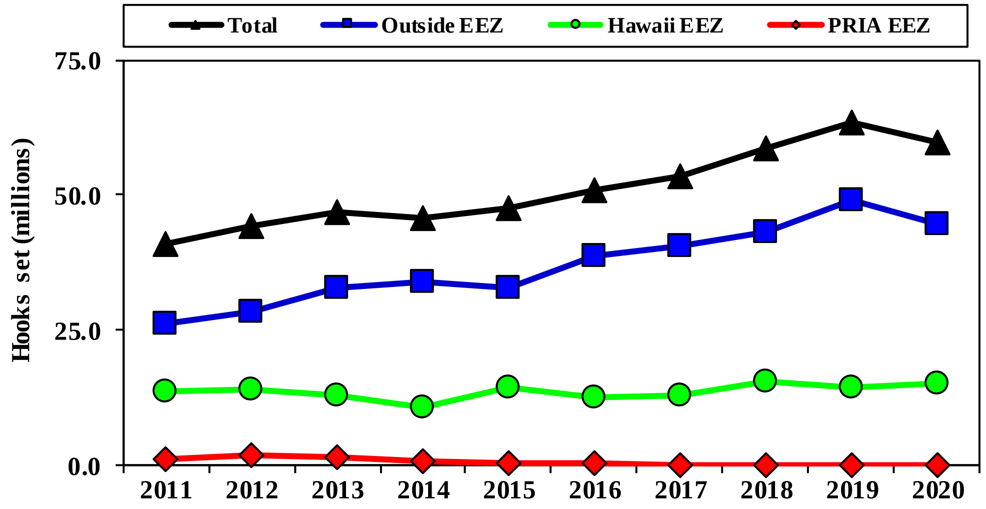


Figure 89. Number of hooks set by the Hawaii-permitted deep-set longline fishery, 2011-2020

Supporting data shown in Table A-90.

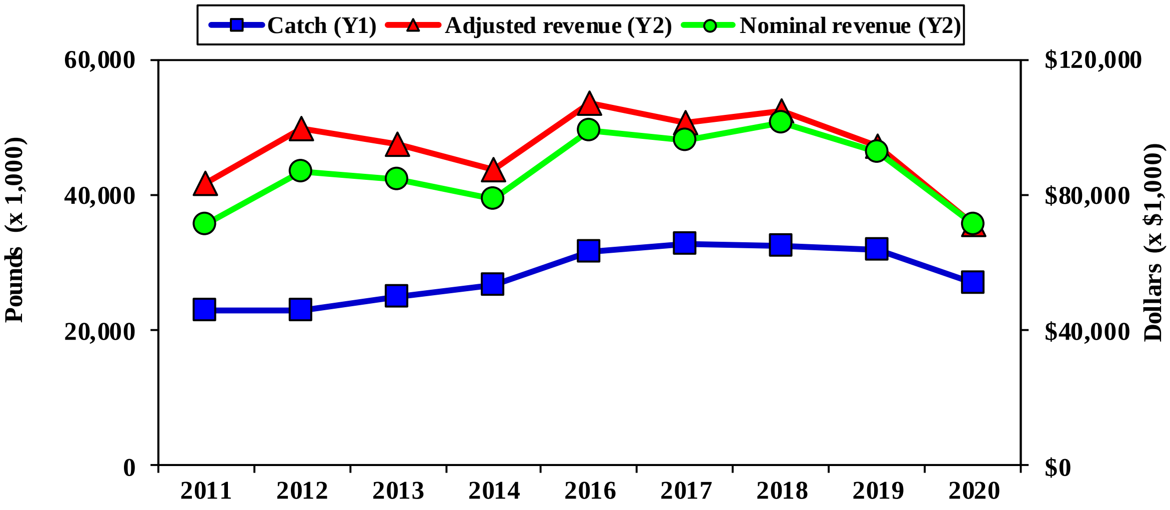


Figure 90. Catch and revenue for the Hawaii-permitted deep-set longline fishery, 2011-2020

Supporting data shown in Table A-91.

Table 23. Hawaii-permitted deep-set longline catch (number of fish) by area, 2011-2020

	Tunas			Billfish				Other PMUS				
Year	**Bigeye tuna**	**Yellowfin tuna**	**Albacore**	**Swordfish**	**Blue marlin**	**Striped marlin**	**Spearfish**	**Mahimahi**	**Ono (Wahoo)**	**Moonfish**	**Pomfrets**	**PMUS sharks**
Hawaii+PRIAs EEZ												
2011	44,216	12,884	11,102	873	1,452	7,227	5,885	21,999	2,022	3,135	10,724	22,852
2012	48,995	10,616	6,524	945	768	4,055	3,624	16,298	2,192	3,077	12,128	21,053
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	39,591	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
Outside EEZ												
2011	107,072	15,931	19,473	2,170	2,793	8,651	9,392	52,289	7,812	14,469	21,703	31,485
2012	103,850	12,049	20,053	2,413	2,296	4,759	7,069	59,114	8,053	13,822	36,977	33,033
2013	138,586	10,297	9,619	3,215	2,563	6,715	8,954	58,976	10,526	20,092	64,923	34,074
2014	168,498	11,205	6,139	3,587	4,475	9,558	11,348	61,134	18,190	22,980	69,239	51,033
2015	165,148	14,957	6,204	4,040	4,868	7,155	10,707	44,778	18,124	26,109	75,303	59,747
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	181,816	49,999	4,177	3,775	9,066	14,734	12,548	31,700	36,311	22,844	39,891	95,520
2020	165,308	40,594	8,461	3,102	5,790	9,600	7,372	17,258	19,118	15,372	26,529	87,844
All areas												
2011	155,256	31,324	31,500	3,132	4,427	16,252	15,557	74,849	10,451	17,710	33,405	55,894
2012	159,242	27,705	29,652	3,549	3,296	9,097	11,297	77,377	11,421	17,121	51,866	57,140
2013	192,173	18,941	14,516	4,249	3,941	12,530	14,875	76,668	14,221	23,171	78,442	56,808
2014	216,060	17,025	8,345	4,563	5,695	14,804	15,838	70,499	23,030	25,199	81,994	72,846
2015	227,541	26,896	9,339	5,389	7,515	13,121	17,853	60,212	24,686	28,865	97,395	86,106
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	221,426	62,177	4,344	4,901	12,926	20,469	16,296	37,779	44,546	24,986	53,102	125,811
2020	207,138	54,395	8,536	3,863	8,177	12,778	9,975	21,949	24,361	16,606	36,077	118,287

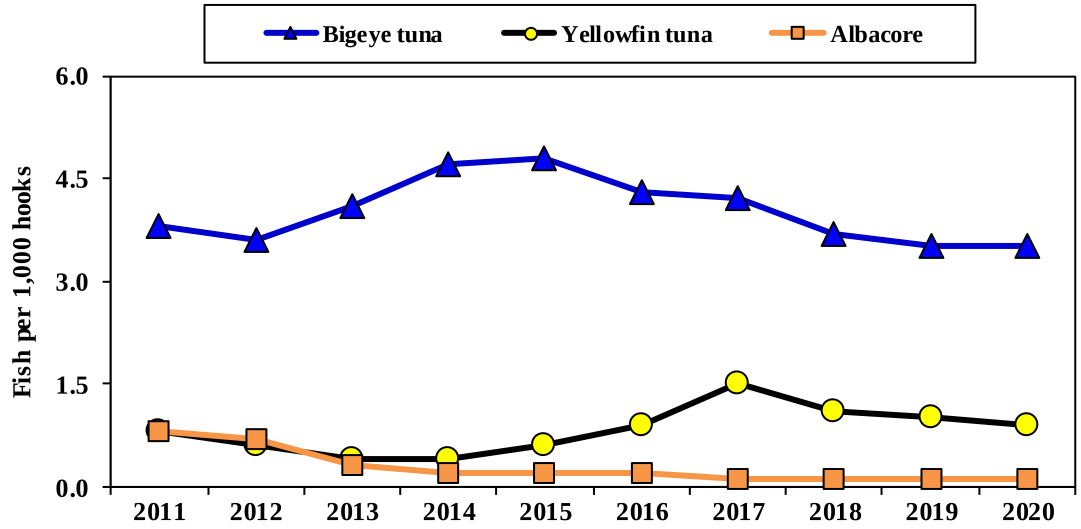


Figure 91. Tuna CPUE for the Hawaii-permitted deep-set longline fishery, 2011-2020
Supporting data shown in Table A-92.

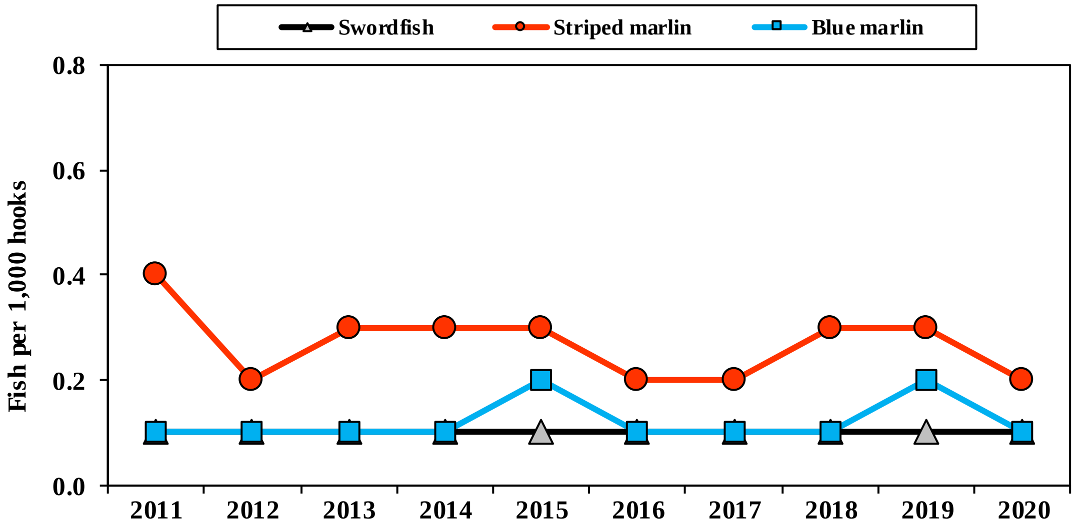


Figure 92. Billfish CPUE for the Hawaii-permitted deep-set longline fishery, 2011-2020
Supporting data shown in Table A-93.

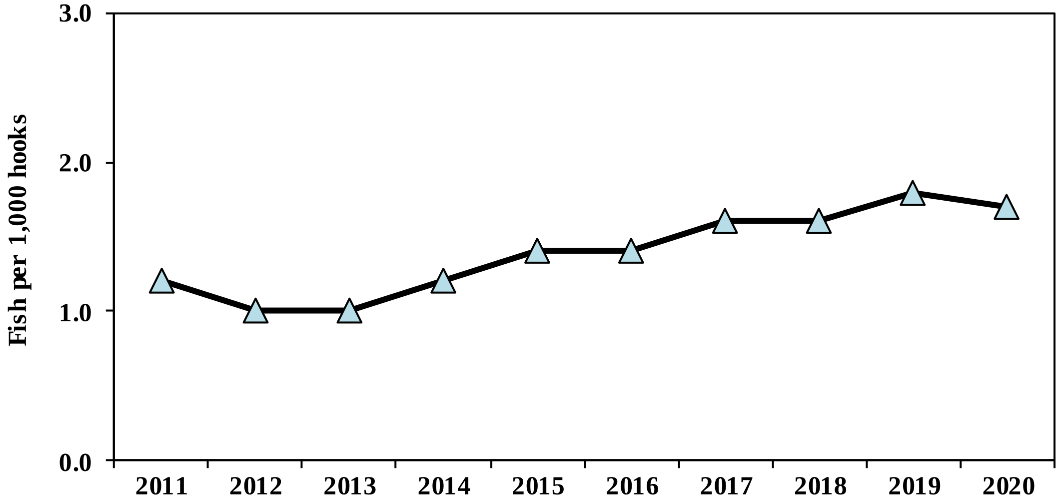


Figure 93. Blue shark CPUE for the Hawaii-permitted deep-set longline fishery, 2011-2020

Supporting data shown in Table A-94.

Table 24. Released catch, retained catch, and total catch for the Hawaii-permitted deep-set longline fishery, 2020

	Deep-set longline fishery			
	Released catch	**Percent released**	**Retained catch**	**Total Catch**
Tuna				
Albacore	410	5.0	8,126	8,536
Bigeye tuna	4,542	2.2	202,596	207,138
Bluefin tuna	0	0.0	11	11
Skipjack tuna	165	0.8	20,544	20,709
Yellowfin tuna	1,164	2.2	53,231	54,395
Other tuna	0	0.0	0	0
Total tunas	**6,281**	**2.2**	**284,508**	**290,789**
Billfish				
Swordfish	147	4.0	3,716	3,863
Blue marlin	59	0.7	8,118	8,177
Striped marlin	157	1.2	12,621	12,778
Spearfish	279	2.9	9,696	9,975
Other marlin	10	2.1	469	479
Total billfish	652	1.9	34,620	35,272
Other PMUS				
Mahimahi	182	0.8	21,767	21,949
Wahoo	115	0.5	24,246	24,361
Moonfish	424	2.6	16,182	16,606
Oilfish	3,001	37.8	7,931	10,932
Pomfret	329	0.9	35,748	36,077
Total other PMUS	**4,051**	**3.8**	**105,874**	**109,925**
Non-PMUS fish	**6,414**	**97.3**	**175**	**6,589**
Total non-shark	**17,398**	**3.9**	**425,177**	**442,575**
PMUS Sharks				
Blue shark	104,427	100.0	1	104,428
Mako shark	4,422	99.1	39	4,461
Thresher shark	8,678	99.7	23	8,701
Oceanic Whitetip shark	463	100.0	0	463
Silky shark	234	100.0	0	234
Total PMUS sharks	**118,224**	**99.9**	**63**	**118,287**
Non-PMUS sharks	**257**	**99.6**	**1**	**258**
Grand Total	**135,879**	**24.2**	**425,241**	**561,120**

Table 25. Average weight (lb) of the catch by the Hawaii-permitted deep-set longline fishery, 2011-2020

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**
2011	81	67	47	20	240	172	47	188	33	58	187	12	34	91	12	16	186	172
2012	82	71	48	16	280	172	66	200	32	57	184	12	32	92	14	16	198	196
2013	75	84	47	16	240	183	68	225	31	62	187	11	33	89	13	18	196	173
2014	73	84	51	17	---	158	62	205	30	58	258	12	30	88	14	17	200	214
2015	85	74	53	18	240	165	81	185	33	59	219	12	31	91	13	18	194	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	79	74	53	18	269	189	60	156	28	29	182	12	28	92	14	22	190	190
2020	81	72	43	18	246	145	58	144	26	36	247	12	30	99	14	23	184	183
Average	**79.6**	**76.0**	**49.8**	**17.8**	**255.6**	**172.8**	**64.8**	**188.4**	**30.8**	**53.7**	**217.7**	**11.9**	**30.8**	**91.5**	**13.5**	**19.1**	**189.0**	**191.4**
SD	**3.6**	**7.1**	**3.6**	**1.3**	**16.0**	**15.1**	**9.1**	**23.4**	**2.3**	**11.9**	**38.2**	**0.6**	**1.9**	**3.2**	**0.8**	**2.6**	**7.6**	**15.9**

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

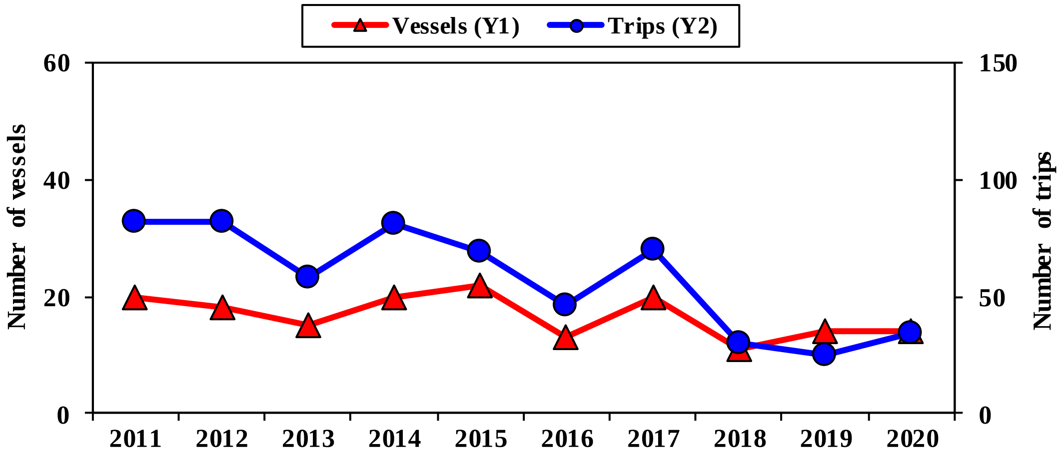


Figure 94. Number of Hawaii-permitted shallow-set longline vessels and trips, 2011-2020

Supporting data shown in Table A-95.

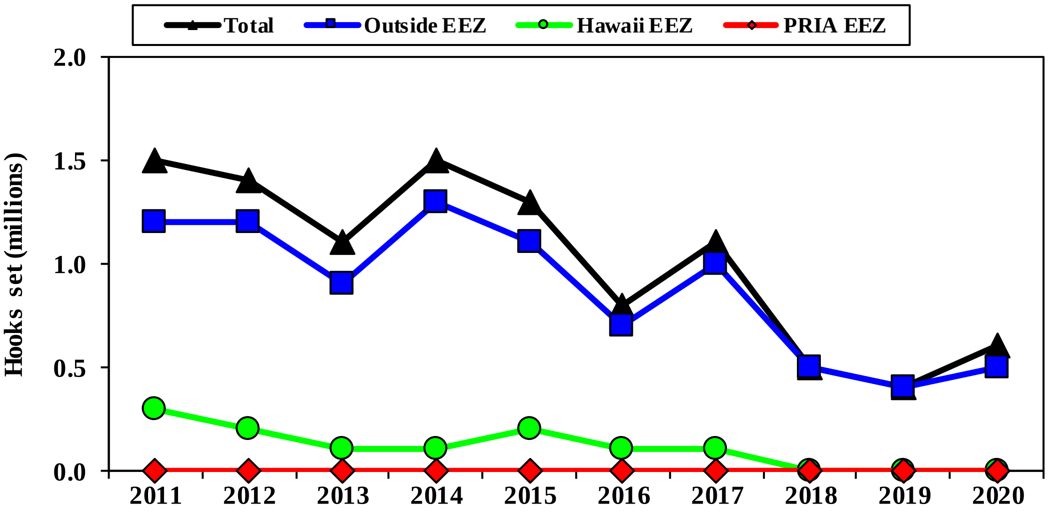


Figure 95. Number of hooks set by the Hawaii-permitted shallow-set longline fishery, 2011-2020

Supporting data shown in Table A-96.

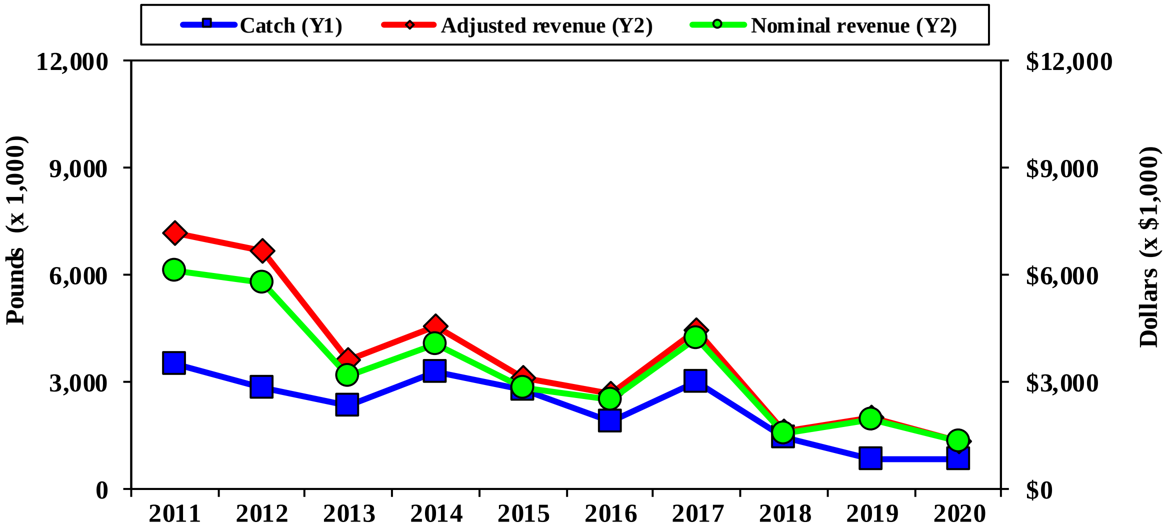


Figure 96. Catch and revenue for the Hawaii-permitted shallow-set longline fishery, 2011-2020

Supporting data shown in Table A-97.

Table 26. Hawaii-permitted shallow-set longline catch (number of fish) by area, 2011-2020

	Tunas			Billfish				Other PMUS				
Year	**Bigeye tuna**	**Yellowfin tuna**	**Albacore**	**Swordfish**	**Blue marlin**	**Striped marlin**	**Spearfish**	**Mahimahi**	**Ono (Wahoo)**	**Moonfish**	**Pomfrets**	**PMUS sharks**
Hawaii+PRIA EEZ												
2011	209	91	18	2,097	85	267	77	1,506	10	4	4	1,131
2012	66	55	12	2,230	61	163	41	836	23	1	1	914
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												
Outside EEZ												
2011	851	228	2,928	14,083	30	255	104	4,892	24	202	98	7,808
2012	774	226	1,137	12,008	41	122	101	3,616	17	283	347	6,064
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	1,057	447	355	4,326	7	22	24	164	9	289	12	6,429
All areas												
2011	1,060	319	2,946	16,180	115	522	181	6,398	34	206	102	8,939
2012	840	281	1,149	14,238	102	285	142	4,452	40	284	348	6,978
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	1,072	488	355	4,546	23	29	26	176	12	291	12	6,836

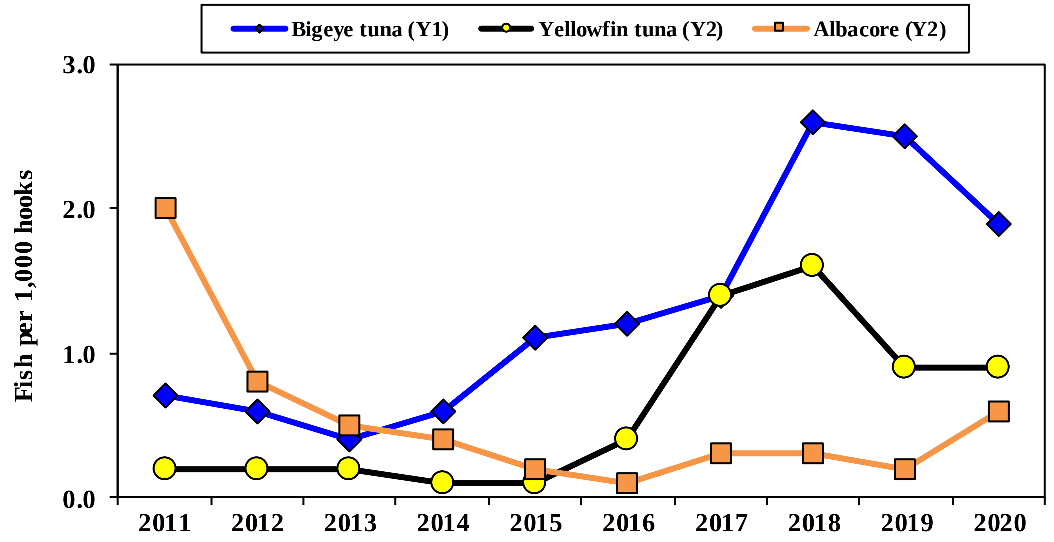


Figure 97. Tuna CPUE for the Hawaii-permitted shallow-set longline fishery, 2011-2020
Supporting data shown in Table A-98.

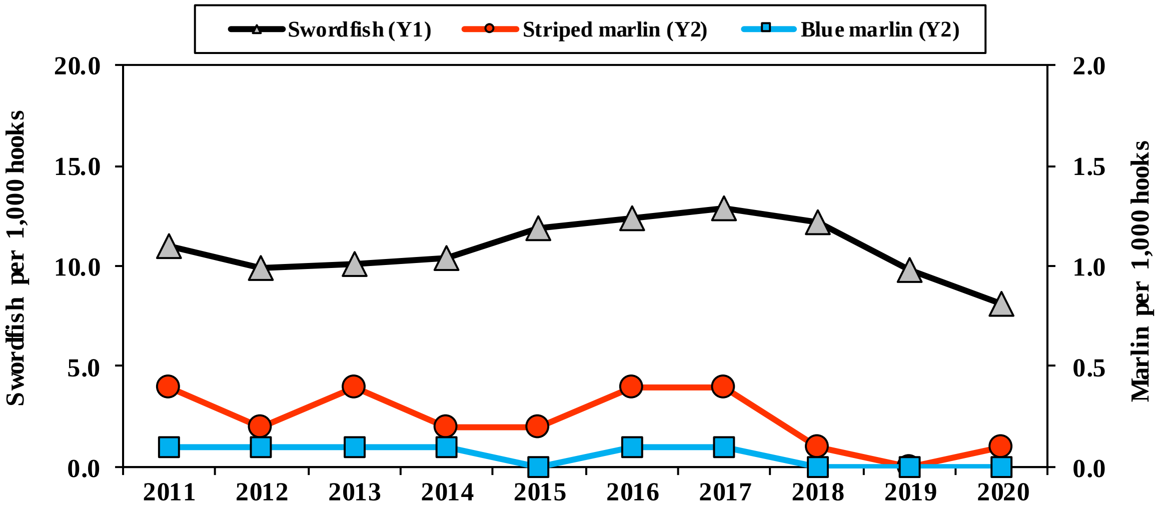


Figure 98. Billfish CPUE for the Hawaii-permitted shallow-set longline fishery, 2011-2020
Supporting data shown in Table A-99.

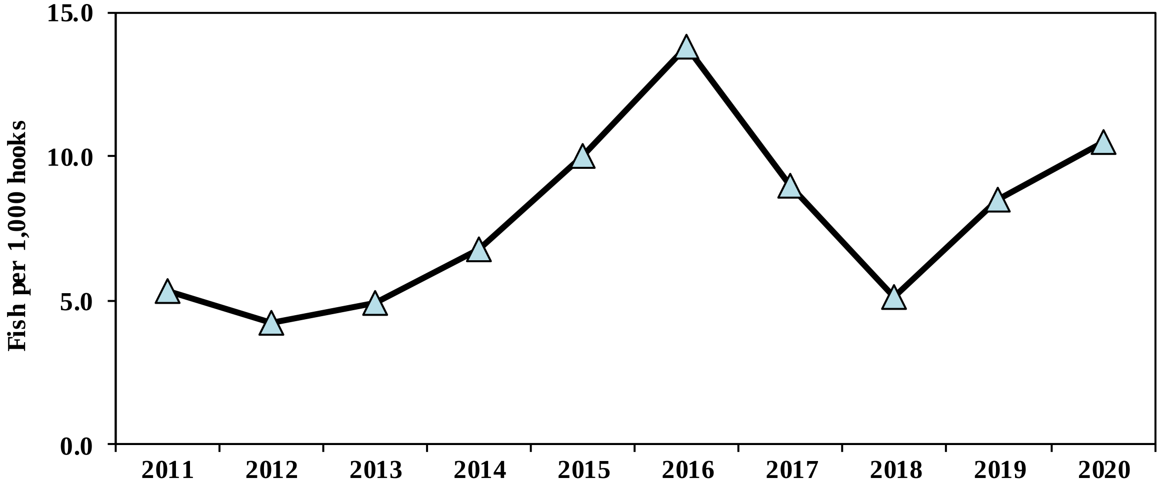


Figure 99. Blue shark CPUE for the Hawaii-permitted shallow-set longline fishery, 2011-2020

Supporting data shown in Table A-100.

Table 27. Released catch, retained catch, and total catch for the Hawaii-permitted shallow-set longline fishery, 2020

	Shallow-set longline fishery			
	Released catch	**Percent released**	**Retained catch**	**Total Catch**
Tuna				
Albacore	49	16.0	306	355
Bigeye tuna	57	5.6	1,015	1,072
Bluefin tuna	0	0.0	4	4
Skipjack tuna	0	0.0	7	7
Yellowfin tuna	34	7.5	454	488
Other tunas	0	0.0	0	0
Tuna PMUS Subtotal	**140**	**7.8**	**1,786**	**1,926**
Billfish				
Swordfish	128	2.9	4,418	4,546
Blue marlin	2	9.5	21	23
Striped marlin	8	38.1	21	29
Shortbill spearfish	4	18.2	22	26
Other billfishes	0	0.0	0	0
Billfish PMUS Subtotal	**142**	**3.2**	**4,482**	**4,624**
Other PMUS				
Mahimahi	5	2.9	171	176
Wahoo	1	9.1	11	12
Moonfish	24	9.0	267	291
Oilfish	95	44.0	121	216
Pomfret	0	0.0	12	12
Other PMUS Subtotal	**125**	**17.7**	**582**	**707**
Non-PMUS fish	**1**	**33.3**	**2**	**3**
Total non-shark	**408**	**5.6**	**6,852**	**7,260**
PMUS Sharks				
Blue shark	5,917	100.0	0	5,917
Mako sharks	712	81.2	165	877
Thresher sharks	33	80.5	8	41
Oceanic whitetip shark	1	100.0	0	1
Silky shark	0	0.0	0	0
Shark PMUS Subtotal	**6,663**	**97.5**	**173**	**6,836**
Non-PMUS sharks	2	100.0	0	2
Grand Total	**7,073**	**50.2**	**7,025**	**14,098**

Table 28. Average weight (lb) of the catch by the Hawaii-permitted shallow-set longline fisheries, 2011-2020

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
2011	110	121	30	18	---	211	91	246	37	52	---	11	38	57	17	17	185	200
2012	99	109	27	16	175	198	98	259	34	---	---	12	37	80	14	16	185	277
2013	107	111	27	17	175	216	92	281	34	---	---	12	42	82	15	23	177	---
2014	87	131	24	14	268	212	91	278	36	52	---	12	42	71	16	24	202	243
2015	79	120	22	16	---	184	97	292	37	52	---	12	39	76	13	22	150	243
2016	86	103	34	16	---	179	97	304	39	52	---	14	33	83	13	21	215	243
2017	98	94	35	18	175	200	102	259	39	52	---	12	36	83	14	20	179	243
2018	89	98	36	15	175	214	94	413	36	---	---	10	39	84	14	25	184	243
2019	72	92	35	17	---	217	126		36	52	---	9	39	83	16	22	165	---
2020	100	84	28	18	175	148	89	160	35	---	---	12	35	83	17	19	175	243
Average	**92.7**	**106.3**	**29.8**	**16.5**	**190.5**	**197.9**	**97.7**	**276.9**	**36.3**	**52.0**	---	**11.6**	**38.0**	**78.2**	**14.9**	**20.9**	**181.7**	**241.9**
SD	**12.2**	**14.8**	**5.0**	**1.4**	**38.0**	**22.0**	**10.7**	**65.9**	**1.8**	**0.0**	---	**1.3**	**2.9**	**8.5**	**1.5**	**2.9**	**18.0**	**20.7**

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

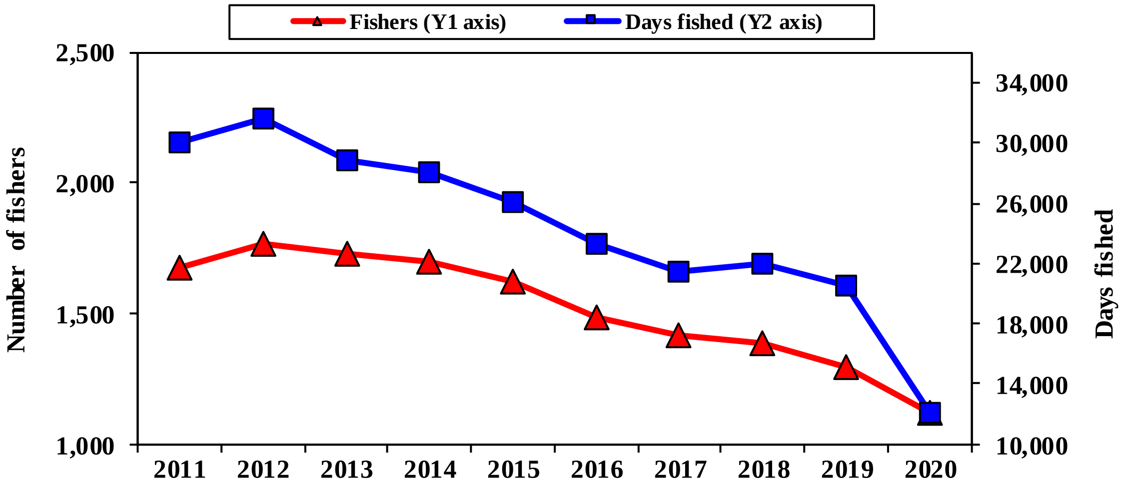


Figure 100. Number of MHI troll fishers and days fished, 2011-2020

Supporting data shown in Table A-101.

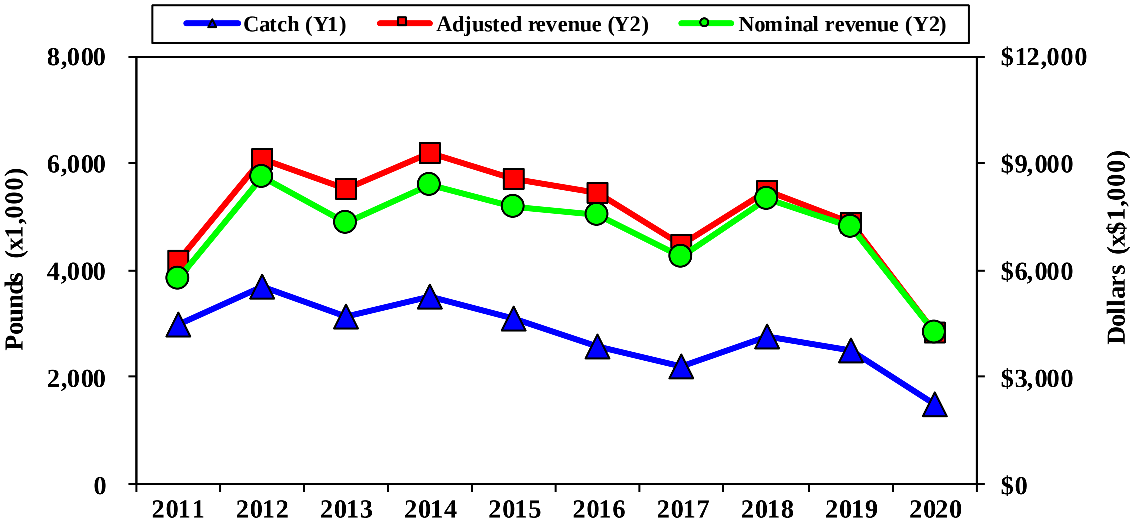


Figure 101. Catch and revenue for the MHI troll fishery, 2011-2020

Supporting data shown in Table A-102.

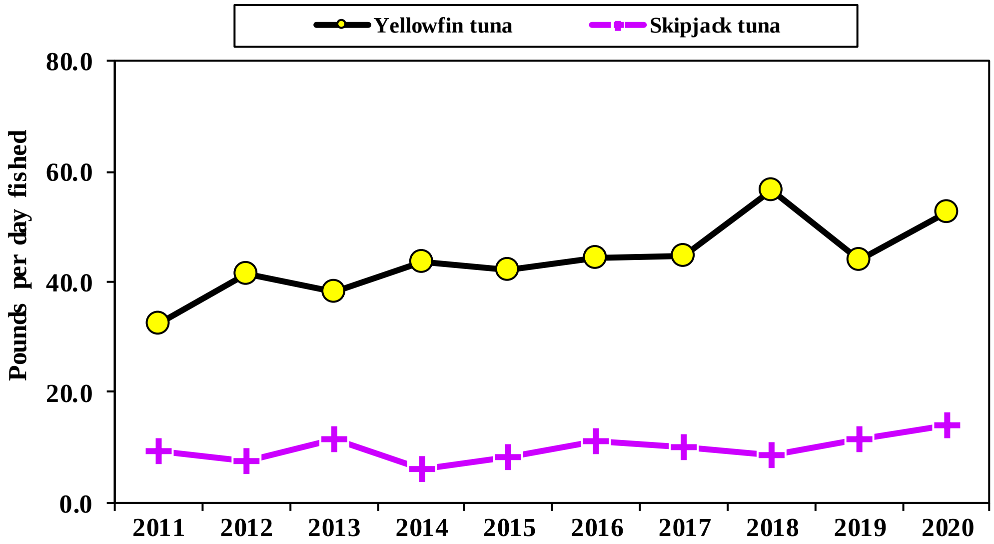


Figure 102. Tuna CPUE for the MHI troll fishery, 2011-2020

Supporting data shown in Table A-103.

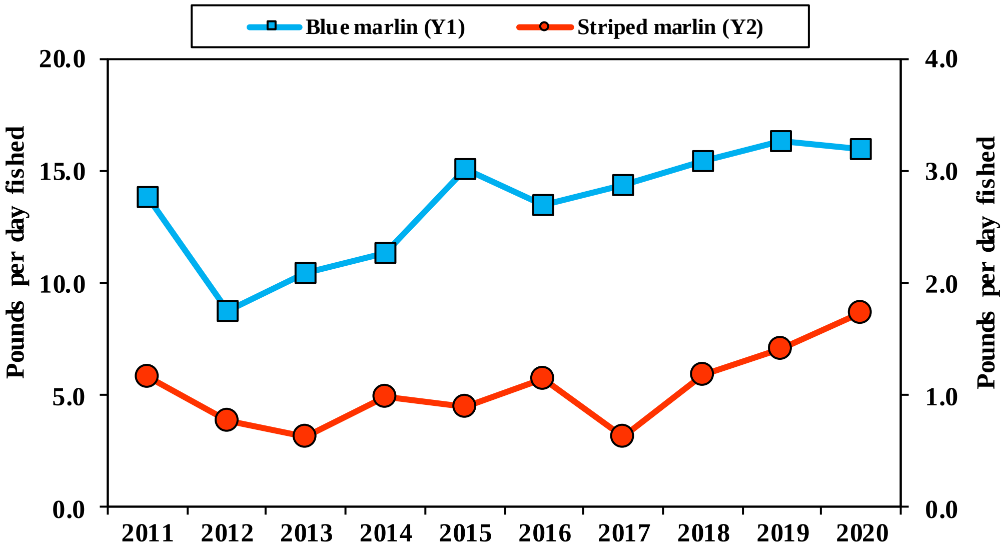


Figure 103. Marlin CPUE for the MHI troll fishery, 2011-2020

Supporting data shown in Table A-104.

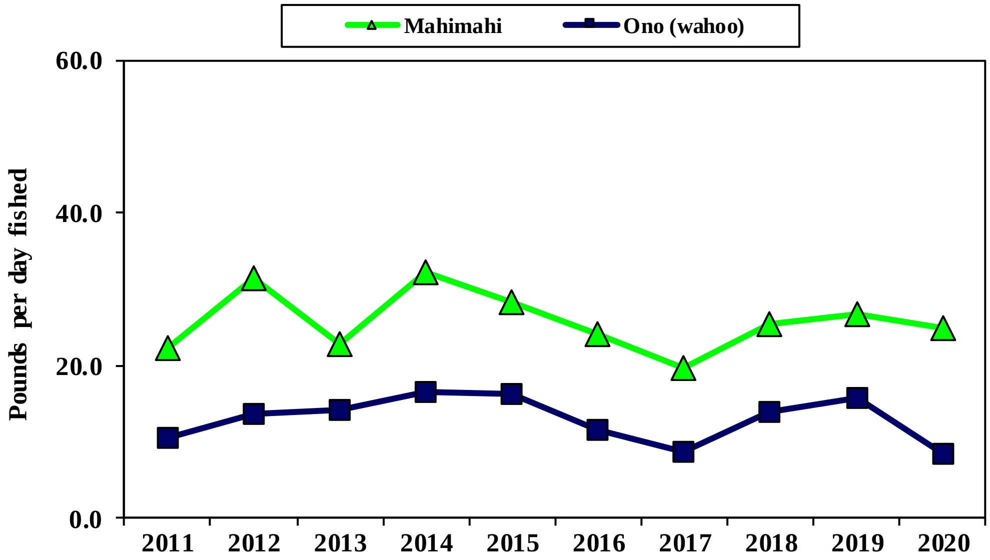


Figure 104. Mahimahi and Ono CPUE for the MHI troll fishery, 2011-2020
Supporting data shown in Table A-105.

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

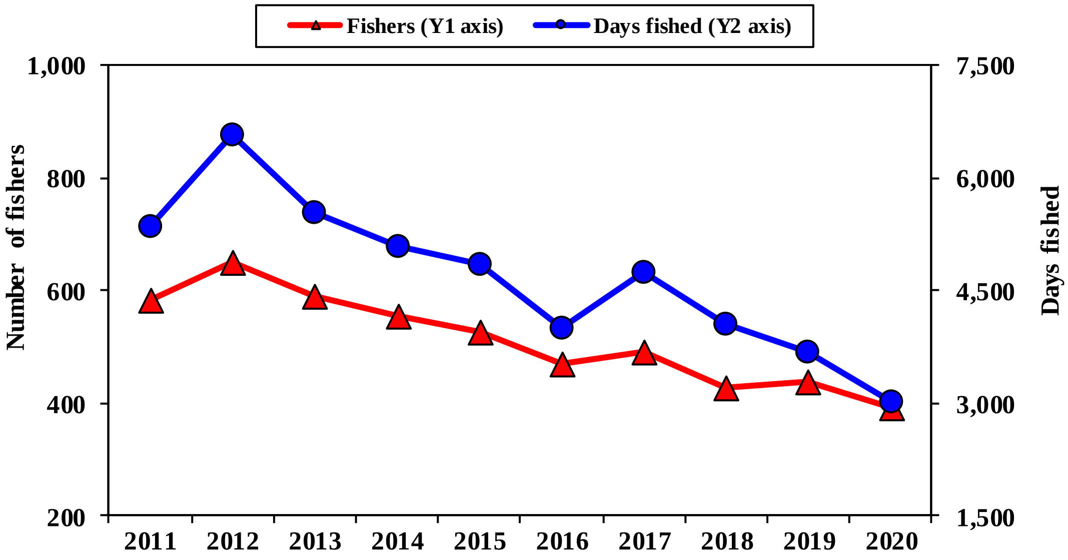


Figure 105. Number of MHI handline fishers and days fished, 2011-2020
Supporting data shown in Table A-106.

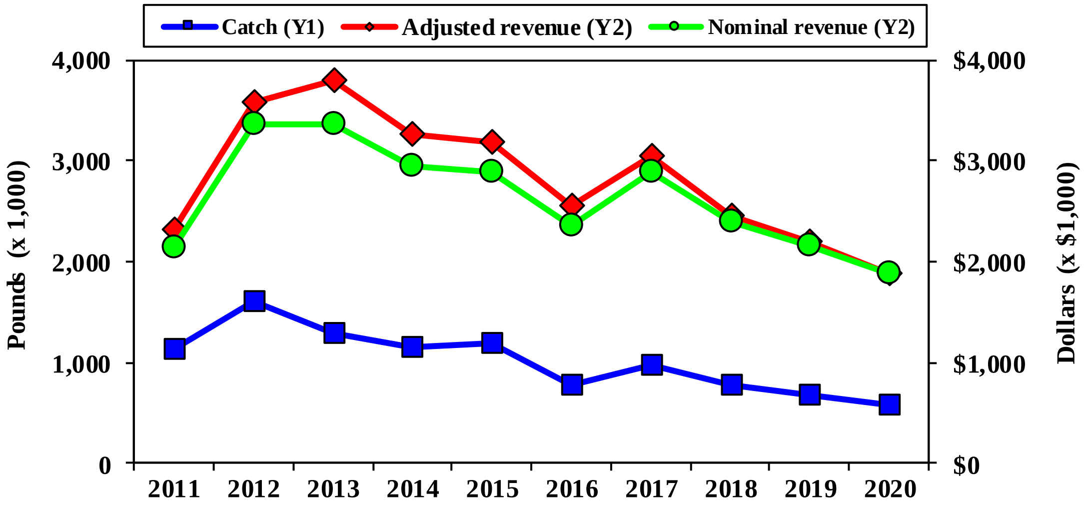


Figure 106. Catch and revenue for the MHI handline fishery, 2011-2020

Supporting data shown in Table A-107.

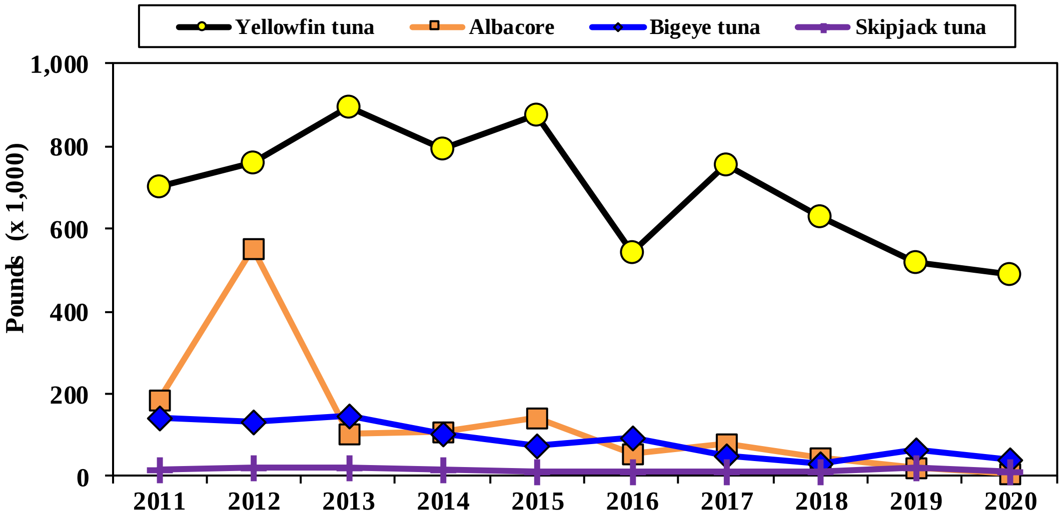


Figure 107. Tuna CPUE for the MHI handline fishery, 2011-2020

Supporting data shown in Table A-108.

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

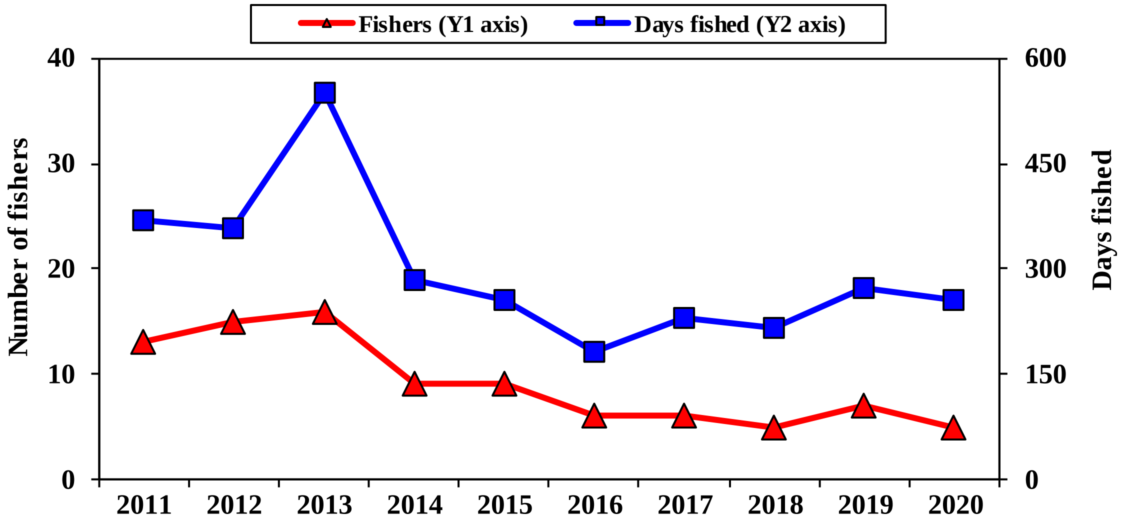


Figure 108. Number of offshore handline fishers and days fished, 2011-2020

Supporting data shown in Table A-109.

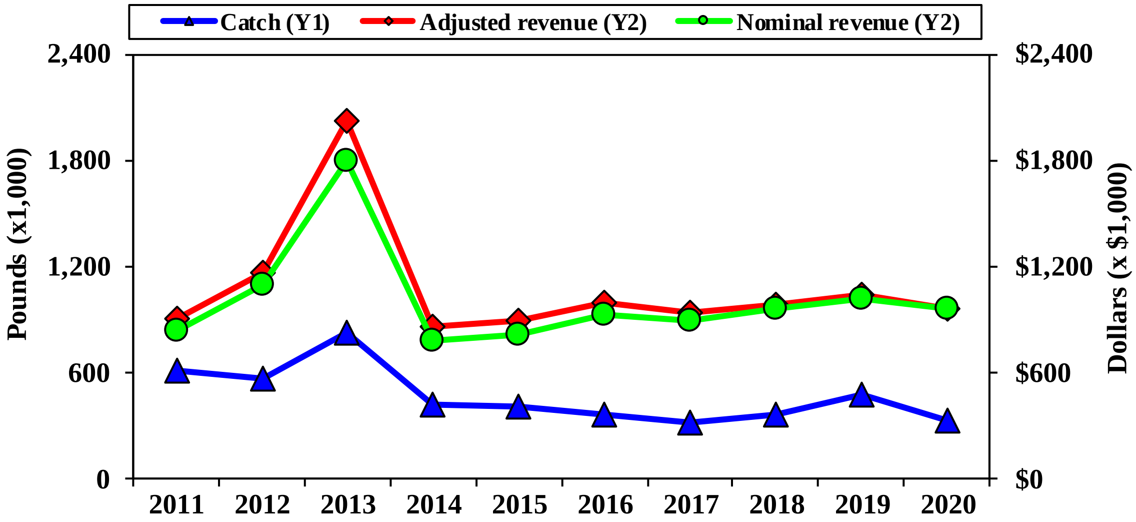


Figure 109. Catch and revenue for the offshore tuna handline fishery, 2011-2020

Supporting data shown in Table A-110.

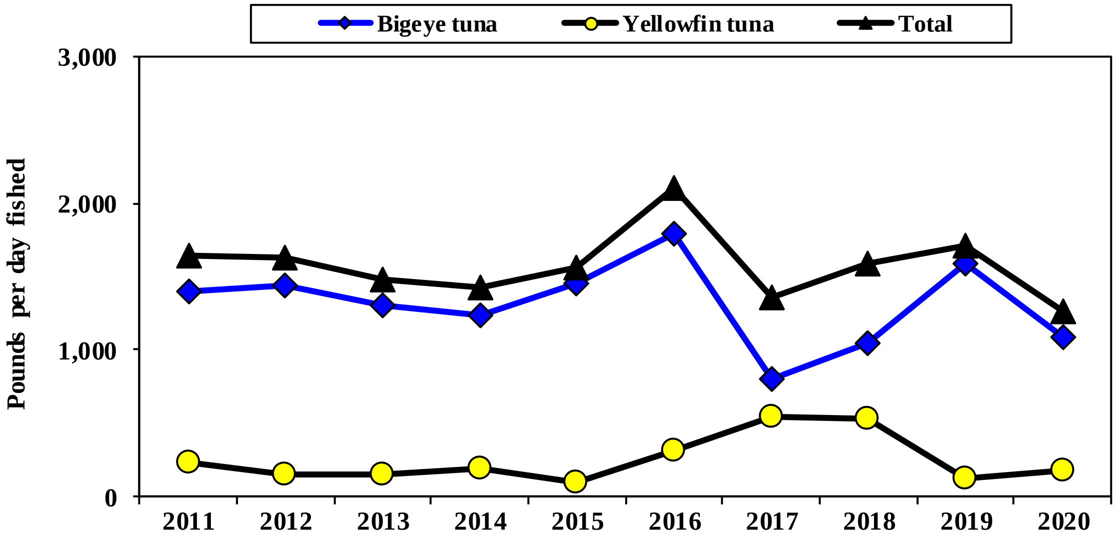


Figure 110. Tuna CPUE for the offshore tuna handline fishery, 2011-2020

Supporting data shown in Table A-111.

Table 29. Average weight (lb) of the catch by the Hawaii troll and handline fisheries, 2011-2020

	Tunas				Billfish			Other PMUS	
Year	**Albacore**	**Bigeye tuna**	**Skipjack tuna**	**Yellowfin tuna**	**Blue marlin**	**Striped marlin**	**Swordfish**	**Mahimahi**	**Ono (wahoo)**
2011	45.1	26.8	8.5	30.5	215.7	47.6	134.8	12.4	27.2
2012	48.1	23.1	5.2	31.0	259.2	52.9	120.7	12.3	24.4
2013	46.1	23.9	8.6	35.2	257.3	64.7	101.2	12.4	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	55.2	24.5	11.8	41.2	125.8	46.9	163.1	12.3	21.8
Average	**49.0**	**23.7**	**8.3**	**36.1**	**193.8**	**60.0**	**121.4**	**12.2**	**22.9**
SD	**4.4**	**1.7**	**1.7**	**5.1**	**48.5**	**10.1**	**18.8**	**0.6**	**2.0**

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: Hawai`i, American Samoa, Guam, and 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.

In Hawai`i, 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 Hawai`i 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 Hawai`i, and a variety of different recreational fishing tournaments organized by both clubs and independent tournament organizers. Hawai`i 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, *Hawai`i 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 30. 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 30. 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	0.0017%
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 31. 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 Hawai`i 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 31. 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.

Hawai`i 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 32 provides summaries of the non-commercial, boat-based catch between 2013 and 2020 for pelagic fish in Hawai`i. 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 111. 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 111). 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 112). 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 113).

Table 32. 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**	---

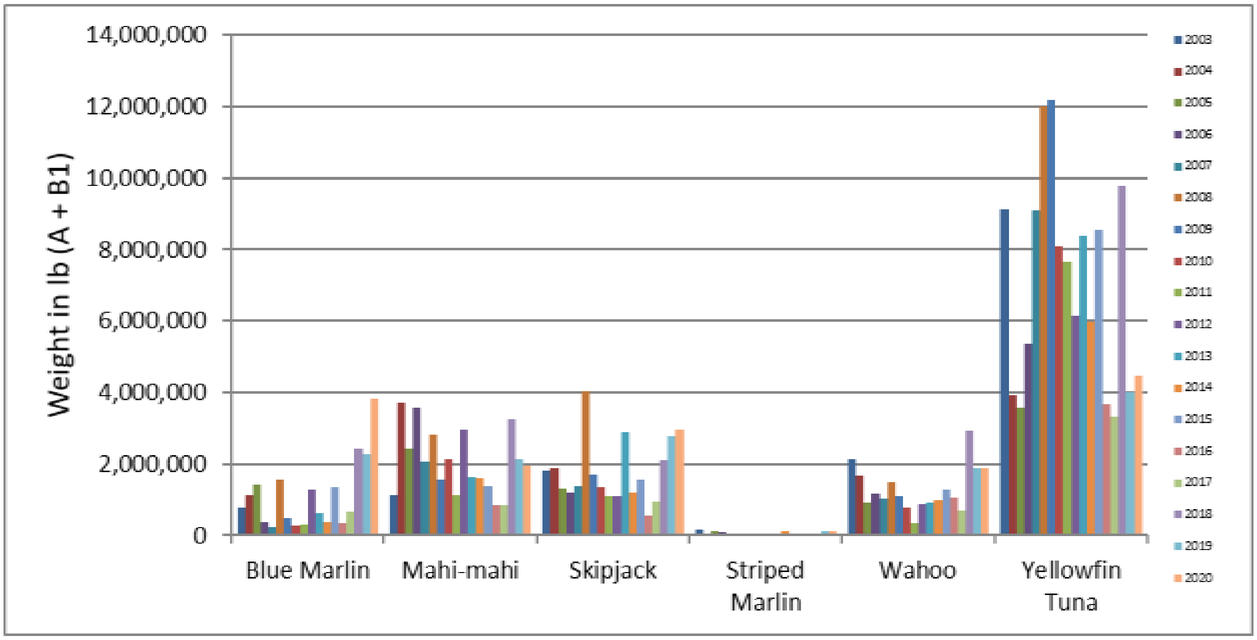


Figure 111. Non-commercial catch (lb) in Hawaii by species from 2003 to 2020

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.

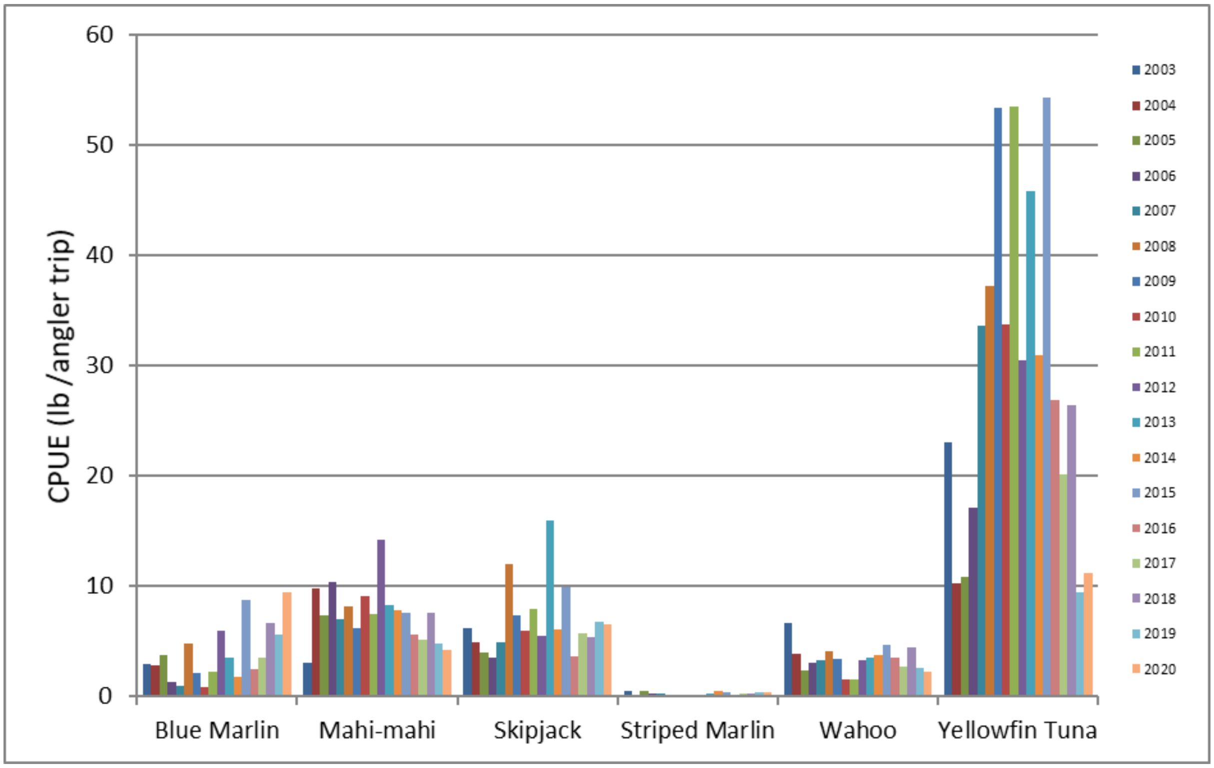


Figure 112. Non-commercial CPUE (lb/angler trip) in Hawaii by species from 2003 to 2020

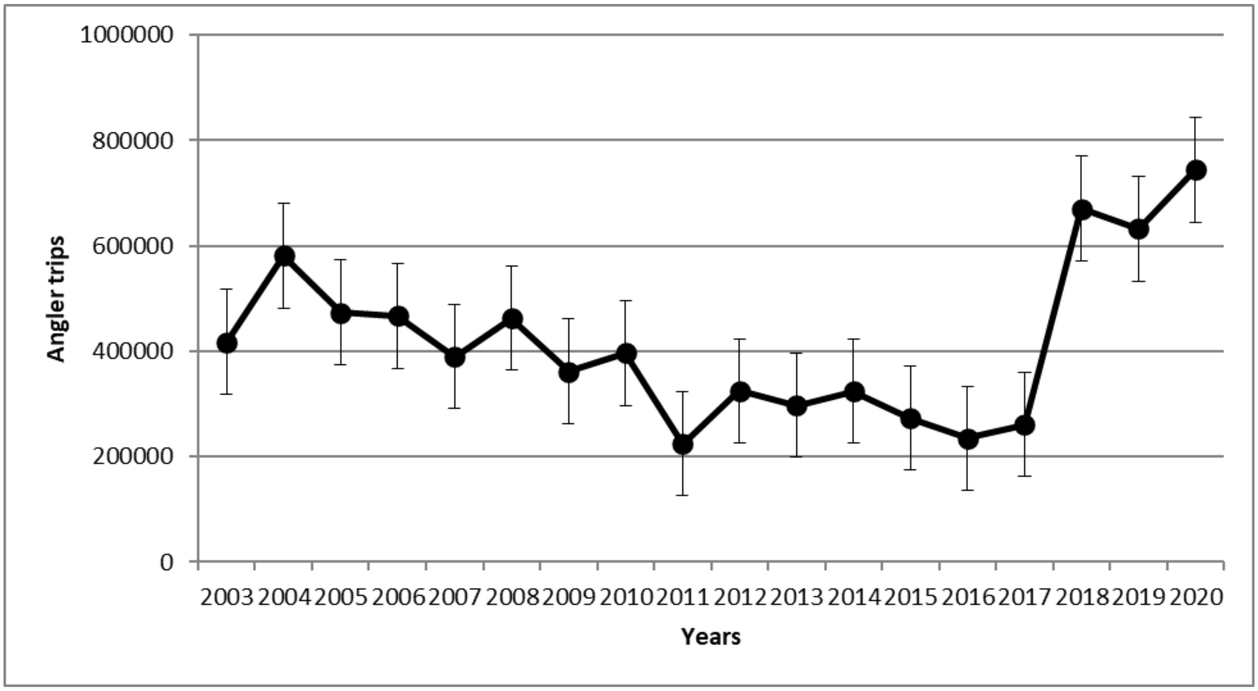


Figure 113. Estimated angler trips in the Hawaii non-commercial fishery from 2003 to 2020

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 2016-2020, as reported by NMFS to the WCPFC in April 2021. The catches for 2020 are preliminary.

Table 39 through Table 41 provide the U.S. longline landings as submitted to the WCPFC and Inter-American Tropical Tuna Commission (IATTC).

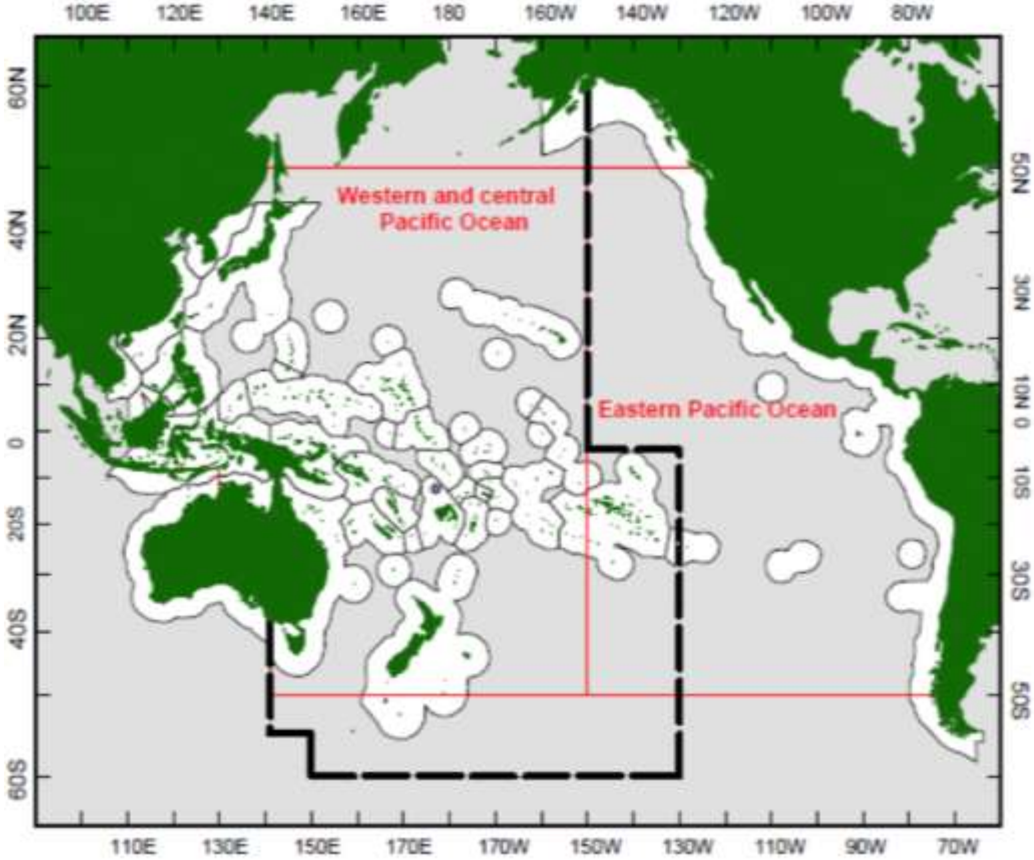


Figure 114. The Western and Central Pacific Ocean, Eastern Pacific Ocean and the WCPFC Convention Area (WCP–CA) [in dashed lines])

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 2020 annual SAFE report to be forwarded to the Council, only work items to Pelagic Plan Team members on improvements to modules.

2.6.4 SUMMARY OF FISHERIES

This section presents the total catch of tuna species in the Pacific Ocean as reported to the Secretariat of the Pacific Community (SPC) from all member countries. Table 33 and Figure 115 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 33. Estimated annual catch (mt) of tuna species in the Pacific Ocean

Year	Albacore	Bigeye	Skipjack	Yellowfin	Total
2010	156,135	228,081	1,830,746	828,391	3,043,353
2011	142,141	244,652	1,804,671	744,852	2,936,316
2012	181,609	257,763	2,007,153	836,889	3,283,414
2013	175,643	231,000	2,092,525	801,193	3,300,361
2014	163,264	249,335	2,240,920	865,823	3,519,342
2015	155,480	241,037	2,105,709	851,703	3,353,929
2016	127,848	237,833	2,126,342	915,236	3,407,259
2017	154,040	224,687	1,945,408	935,094	3,259,229
2018	140,194	236,343	2,134,203	951,954	3,462,694
2019	150,193	219,310	2,400,256	927,174	3,696,933
Average	154,655	237,004	2,068,793	865,831	3,326,283
STD deviation	16,154	11,735	180,881	66,392	221,036

Source: SPC (2020).

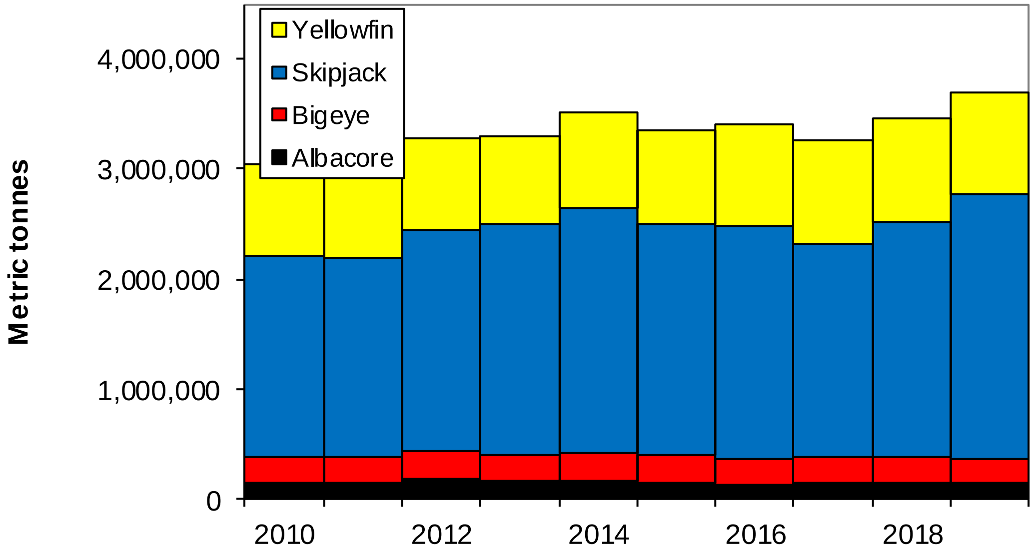


Figure 115. Estimated total annual catch of tuna species in the Pacific Ocean

Source: SPC (2020).

2.6.4.1 PURSE SEINE FISHERY IN THE WCPFC

Source: WCPFC-SC16-2020 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 (i.e., Japan, Korea, Chinese-Taipei, and the U.S.), which combined numbered 163 vessels in 1992, but declined to a low of 111 vessels in 2006 (due to reductions in the U.S. fleet), before some rebound in recent years (up to 129 vessels in 2017 and 124 vessels in 2019). The Pacific Islands fleets have gradually increased in numbers over the past two decades to a level of 133 vessels in 2019. 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 then until 2014, the number of vessels gradually increased, attaining a record level of 308 vessels in 2015, before steadily declining since (to 285 vessels in 2019).

Catch: The provisional 2019 purse-seine catch of 2,060,412 mt was the highest on record, but only 1,000 mt higher than the previous record in 2014 (2,059,006 mt). The 2019 purse-seine skipjack catch (1,641,920 mt) was the highest on record, 32,000 mt higher than the previous record in 2014 (1,609,784 mt). The proportion of the skipjack tuna (80%) catch taken by purse seine in 2019 was the highest since the fishery was established in the 1960s. The 2019 purse-seine catch for yellowfin tuna (364,571 mt; 18% of the total purse seine tuna catch) was over 130,000 mt lower than the record catch in 2017 (498,822 mt) but still amongst the highest annual catches for this fishery. The provisional catch estimate for bigeye tuna for 2019 (50,819 mt) was the lowest since 2003, and the proportion of bigeye tuna (2%) represented in the purse seine tuna catch, was the lowest since 1980. The relatively low bigeye tuna catch by purse seine in 2019 appears to be related to both (i) a lower proportion of associated sets in 2019, and (ii) a lower proportion of bigeye tuna in the associated-set tuna species composition in 2019.

Fleet distribution: 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 El Niño Southern Oscillation (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.

Higher proportions of yellowfin in the overall catch (by weight) usually occur during El Niño years as fleets have access to “pure” schools of large yellowfin that are more available in the eastern tropical areas of the Western and Central Pacific Convention Area (WCP–CA). In 2019, most of the yellowfin catch in the area from the Phoenix to the Line Islands was from unassociated sets, while associated sets in this area accounted for most of the skipjack catch.

Table 34. Total reported purse seine catch (mt) of skipjack, yellowfin, and bigeye tuna in the Pacific Ocean

Year	Skipjack	Yellowfin	Bigeye	Total
2010	1,439,616	603,892	115,248	2,158,756
2011	1,439,101	519,947	130,362	2,089,410
2012	1,644,923	594,988	130,226	2,370,137
2013	1,740,397	580,758	120,450	2,441,605
2014	1,871,253	612,205	129,519	2,612,977
2015	1,709,162	565,898	114,170	2,389,230
2016	1,713,208	650,696	119,296	2,483,200
2017	1,598,302	709,802	125,238	2,433,342
2018	1,741,687	620,674	129,280	2,491,641
2019	2,056,217	577,671	115,963	2,749,851
Average	1,695,387	603,653	122,975	2,422,015
STD Deviation	185,256	51,153	6,676	193,432

Source: SPC (2020) and IATTC (2020).

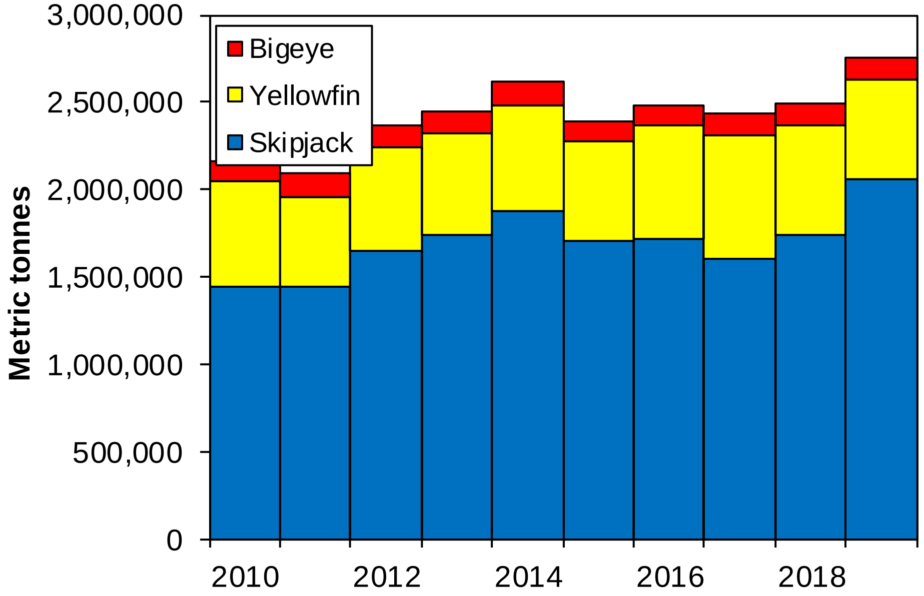


Figure 116. Total purse seine catch of skipjack, yellowfin, and bigeye tuna in the Pacific Ocean

Source: SPC (2020) and IATTC (2020).

2.6.4.2 LONGLINE FISHERIES IN THE WCPFC

Source: WCPFC-SC16-2020 GN-WP-01

Vessels: The total number of vessels involved in the fishery has 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 1,672 vessels in 2019, showing a 48% drop on the vessels in 2005 and a 14% drop on 2018 vessel numbers, mainly due to a decline in the category of non-Pacific Islands domestic fleets.

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, Papua New Guinea, 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 Chinese-Taipei, mainland Chinese vessels based in Micronesia, and domestic fleets based in Indonesia, Micronesian countries, Philippines, Papua New Guinea, 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 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 Hawaii. For example, the Hawaii 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 (273,550 mt) for 2019 was at the average level for the past five years. The WCP–CA albacore longline catch (95,280 mt – 35%) for 2019 was slightly higher than the recent ten-year average, and only 6,000 mt lower than the record of 101,820 mt attained in 2010. The provisional bigeye catch (68,371 mt – 25%) for 2019 was slightly lower than the recent ten-year average, and well down relative to the bigeye catch levels experienced in the 2000s (e.g., the 2004 longline bigeye catch was 99,705 mt). The yellowfin catch for 2019 (104,440 mt – 38%) was the highest catch since 1980, which was a record for this fishery, at 125,113 mt.

A significant change in the WCP–CA longline fishery over the past 10 years has been the growth of the Pacific Islands domestic albacore fishery, which has risen from taking 33% of the total South Pacific albacore longline catch in 1998 to accounting for around 50-60% of the catch in recent years. The combined national fleets (including chartered vessels) mainly active in the Pacific Islands domestic albacore fishery have numbered more than 500 (mainly small “offshore”) vessels in recent years and catches are now at a similar level as the distant-water longline vessels active in the WCP–CA.

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 with variations 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 3,931 mt in 2019) and vessel numbers (366 in 2004 to 80 in 2019). The Chinese-Taipei distant-water longline fleet bigeye catch declined from 16,888 mt in 2004 to 4,989 mt in 2019, mainly related to a substantial drop in vessel numbers (137 vessels in 2004 reduced to 75 vessels in 2019). 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 97 vessels in 2019. In contrast, the China longline fleet catches of albacore tuna have been amongst the highest ever in recent years (this fleet continues to catch over 21,000 mt of albacore in the WCP-CA in recent years).

Fleet distribution: Effort by the large-vessel, distant-water fleets of Japan, Korea, and Chinese-Taipei account 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, as well as 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 in the South Pacific over the past decade has been noted; the most prominent fleets in this category are the Cook Islands, Samoan, Fijian, French Polynesian, Solomon Islands (when chartering arrangements are active), Tonga, and Vanuatu fleets.

Table 35. Total reported longline catch (mt) of PMUS in the Pacific Ocean

Year	Albacore	Yellowfin	Bigeye	Striped Marlin	Black Marlin	Blue Marlin	Swordfish	Total
2009	109,466	105,368	107,389	4,160	2,066	17,018	35,298	380,765
2010	113,338	103,052	99,576	4,984	2,264	18,824	35,747	377,785
2011	97,997	103,670	102,450	6,328	1,926	16,938	38,407	367,716
2012	120,897	97,914	111,316	6,461	2,007	18,262	43,138	399,995
2013	113,161	86,403	91,778	5,881	1,820	20,037	40,357	359,437
2014	109,032	104,715	106,651	5,625	2,201	20,982	39,376	388,582
2015	112,507	111,488	108,214	5,267	2,516	20,231	44,692	404,915
2016	90,878	94,001	93,569	4,320	1,291	18,346	41,607	344,012
2017	118,656	93,805	86,985	4,813	1,136	16,470	39,334	361,199
2018	104,350	106,871	91,059	4,606	1,178	15,585	40,316	363,965
Average	109,028	100,729	99,899	5,245	1,841	18,269	39,827	374,837
STD deviation	9,156	7,537	8,555	809	482	1,777	2,943	19,185

Source: SPC (2020) and IATTC (2020).

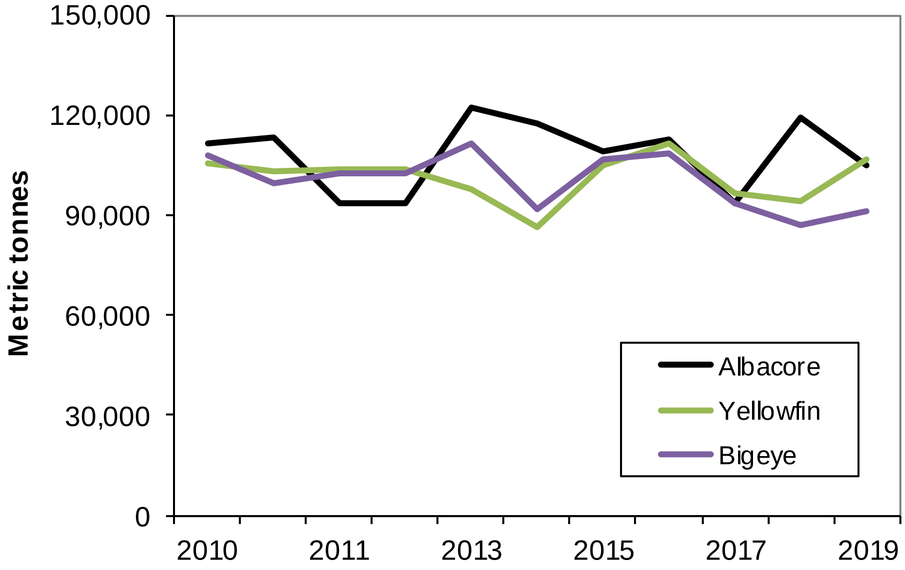


Figure 117. Reported longline tuna catches in the Pacific Ocean

Source: SPC (2020) and IATTC (2020).

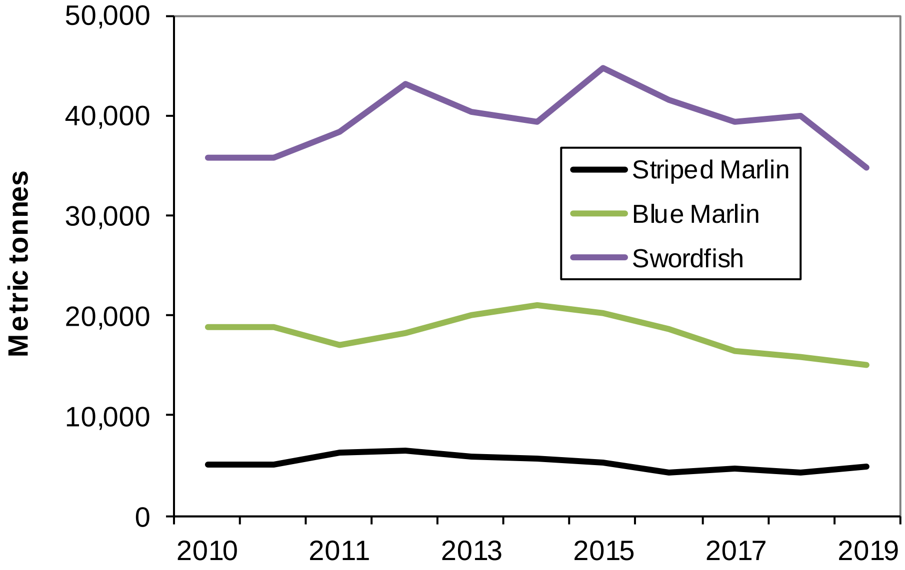


Figure 118. Reported longline billfish catches in the Pacific Ocean

Source: SPC (2020) and IATTC (2020).

2.6.4.3 POLE-AND-LINE FISHERY IN THE WCPFC

Source: WCPFC-SC16-2020 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 Hawaii, and the French Polynesian *bonitier* fleet remains active (33 vessels in 2019), 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/eco-labelling.

Catch: The provisional 2019 pole-and-line catch (183,193 mt) was lower than the 2018 catch (231,155 mt) and amongst the lowest annual catches since the mid-1960s, due to reduced catches in both the Japanese and the Indonesian fisheries. Skipjack tends to account 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 (8-20% in recent years) is taken by the Japanese coastal and offshore fleets in the temperate waters of the North Pacific. Yellowfin tuna (5-16%) and a small component of bigeye tuna (1-4%) make up the remainder of the catch. There are only five pole-and-line fleets active in the WCPO (French Polynesia, Japan, Indonesian, Kiribati, and Solomon Islands).

Japanese distant-water and offshore fleets (93,442 mt in 2019) and the Indonesian fleets (88,377 mt in 2019) account for nearly all of the WCP–CA pole-and-line catch (99% in 2019). The catches by the Japanese distant-water and offshore fleets in recent years have been the lowest for several decades and likely 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 (1,121 mt in 2019 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 36. Total reported pole-and-line catch (mt) of skipjack in the Pacific Ocean

Year	Catch
2010	222,995
2011	206,566
2012	170,537
2013	169,023
2014	148,619
2015	151,157
2016	156,503
2017	122,855
2018	183,184
2019	153,805
Average	168,524
STD deviation	29,398

Source: SPC (2020).

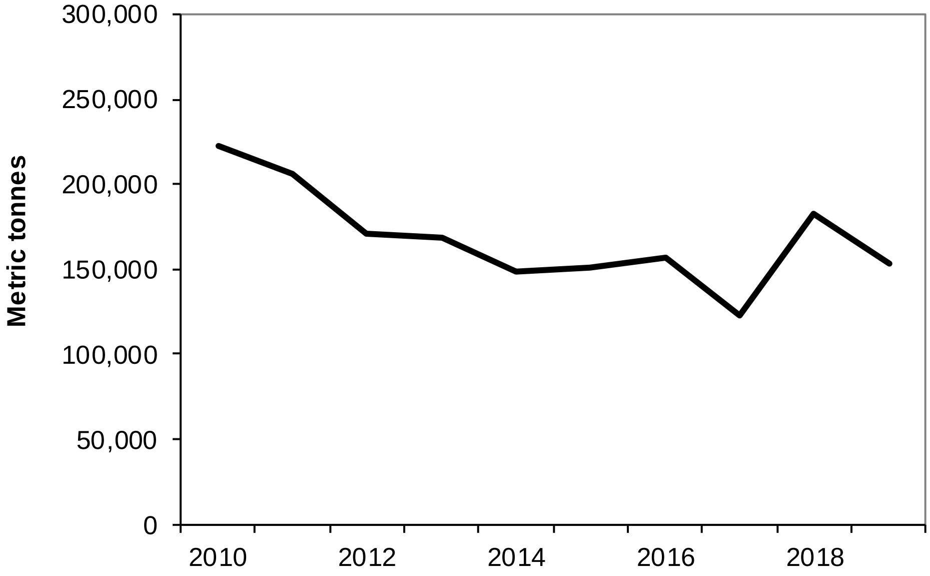


Figure 119. Reported pole-and-line catch (mt) in the Pacific Ocean

Source: SPC (2020).

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 120. 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.

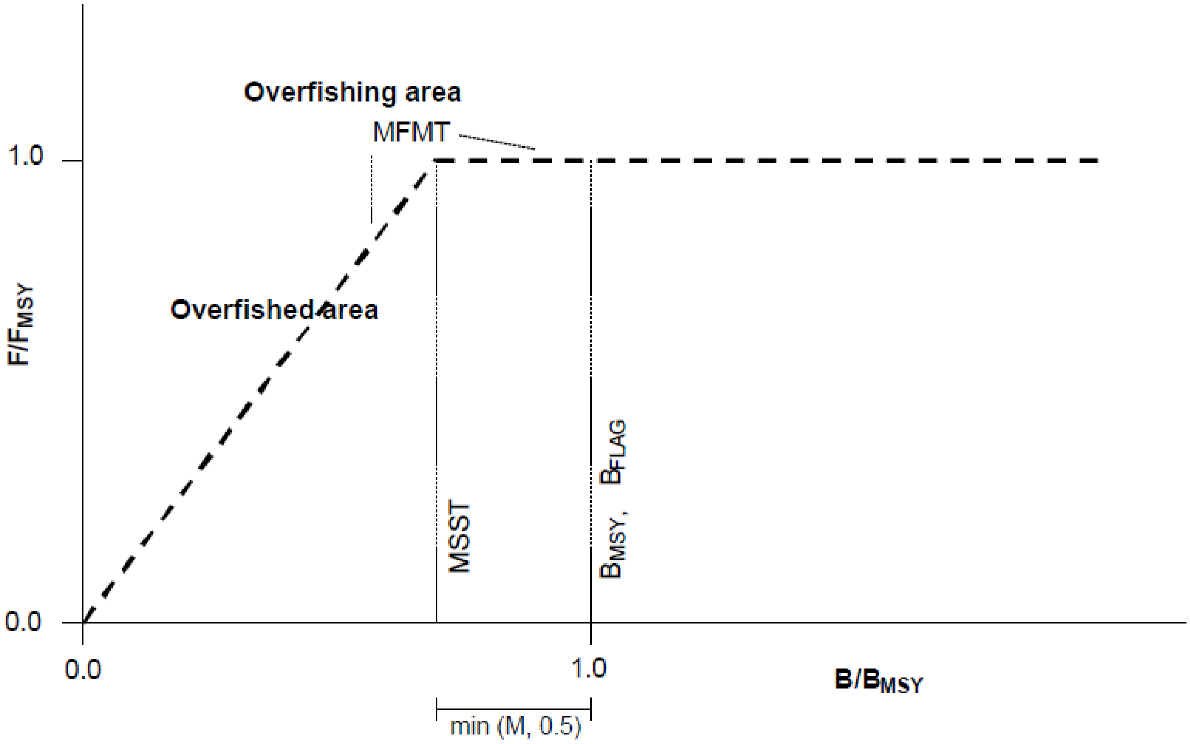


Figure 120. MSY control rule and reference points for pelagic MUS

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 Secretariat of the Pacific Community's Oceanic Fisheries Program (OFP-SPC) conducts stock assessments as the science provider to the WCPFC. Like the IATTC, the OFP-SPC 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 37 summarizes the stock assessments for pelagic MUS completed or scheduled for completion between 2012 and 2020.

Table 37. Schedule of completed stock assessments for WPRFMC PMUS

Management Unit Species	Year Completed	Management Unit Species	Year Completed
Albacore (S. Pacific)	2018	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)**	**2020**
Black Marlin		Common Thresher Shark	
Blue Marlin	2016	Pelagic Thresher Shark	
Mahimahi		Bigeye Thresher Shark	2017 - risk assessment
Oilfishes		Shortfin Mako Shark	2018
Opah		Longfin Mako Shark	
Pomfrets		Blue Shark (N. Pacific)	2017
Sailfish		Silky Shark	2018
Shortbill Spearfish		Oceanic Whitetip Shark	2019
Skipjack Tuna (WCPO)	2019	Salmon Shark	
Striped Marlin (N. Pacific)	2019	Squid	

The following pages include a description of the most recent stock assessments and assessment results completed in 2020 based on the WCPFC SC16 Summary Report (WCPFC 2020). For more information on stock assessments and assessment results completed prior to 2020, please see the past Pelagic annual SAFE reports.

2.6.7.1 WESTERN AND CENTRAL PACIFIC OCEAN BIGEYE TUNA

Stock assessment: Ducharme-Barth et al. (2020).

a. Stock status and trends

The median values of relative recent (2015-2018) spawning biomass depletion (SB_{recent}/ $SB_{F=0}$) and relative recent (2014-2017) fishing mortality (F_{recent}/F_{MSY}) over the uncertainty grid of 24 models (Table BET-1) were used to define stock status. The values of the upper 90th and lower 10th percentiles of the empirical distributions of relative spawning biomass and relative fishing mortality from the uncertainty grid were used to characterize the probable range of stock status.

A description of the updated structural sensitivity grid used to characterize uncertainty in the assessment is illustrated in Table BET-1. The spatial structure used in the 2020 stock assessment is shown in Figure BET-1. Time series of total annual catch by fishing gear over the full assessment period is shown in Figure BET-2. The time series of total annual catch by fishing gear and assessment region is shown in Figure BET-3. Estimated annual average recruitment, spawning potential and total biomass by model region is shown in Figure BET-4. Estimated trends in spawning potential by region for the diagnostic case is shown in Figure BET-5, and juvenile and adult fishing mortality rates from the diagnostic model is shown in Figure BET-6. Estimates of the reduction in spawning potential due to fishing by region is shown in Figure BET-7. Time-dynamic percentiles of depletion ($SB_t/SB_{t,F=0}$) for the 24 models are shown in Figure BET-8. A Majuro and Kobe plot summarising the results for each of the 24 models in the structural uncertainty grid are shown in Figures BET 9 and 10, respectively. Projections are illustrated in Figures BET-11 and BET-12. Table BET-2 provides a summary of reference points over the 24 models in the structural uncertainty grid.

A number of investigative models were run with growth, such as: 1) *Oto-Only*, a growth curve that was a fixed Richards growth curve based on high-readability otoliths, 2) *Tag-Int*: a growth curve that was a fixed Richards growth curve based on the same high-readability otolith data-set in addition to bigeye tuna tag-recapture data, and 3) *Est-Richards*: A conditional age-length data-set was constructed from the combined daily and annual otolith dataset. The *Oto-Only* growth model predicted very high levels of biomass and corresponding low level of depletion. The *Est Richards* growth model showed sensitivity to the initial values given for the estimated growth parameters. The implausible results from the *Oto-Only* growth and differing results from the *Est-Richards* indicate questions still remain regarding bigeye tuna growth.

SC16 requested the bigeye tuna assessment to try and fit the data for those small bigeye tuna as they are increasingly caught by domestic fisheries in region 7, but the current diagnostic model does not fit those fish that well because the L1 parameter is larger than most of those fish. SPC could consider additional developments to Multifan-CL to model greater variability in size around the growth curve at small ages.

The most influential grid axis is the size-frequency data-weighting axis and further research is required to develop model diagnostics and objective criteria for model inclusion.

Table BET-1. Description of the updated structural sensitivity grid used to characterize uncertainty in the assessment. The starred levels denote those assumed in the model diagnostic case.

Axis	Value 1	Value 2	Value 3	Value 4
Steepness	0.65	0.8 *	0.95	
Natural mortality	Diagnostic* (0.112)	M-hi (0.146)		
Size frequency weighting	20*	60	200	500

Table BET-2. Summary of reference points over the 24 models in the structural uncertainty grid. Note that "recent" is the average over the period 2015-2018 for SB and 2014-2017 for fishing mortality, while "latest" is 2018. The values of the upper 90th and lower 10th percentiles of the empirical distributions are also shown. F_{mult} is the multiplier of recent (2014-2017) fishing mortality required to attain MSY.

	Mean	Median	Minimum	10th percentile	90th percentile	Maximum
C_{latest}	159,738	159,288	157,297	157,722	162,033	162,271
$Y_{Frecent}$	136,568	134,940	117,800	124,668	149,424	161,520
f_{mult}	1.45	1.38	0.83	0.98	2.03	2.33

	Mean	**Median**	**Minimum**	**10th percentile**	**90th percentile**	**Maximum**
F_{MSY}	0.05	0.05	0.04	0.04	0.07	0.07
MSY	146,715	140,720	117,920	125,628	179,164	187,520
F_{recent}/F_{MSY}	0.74	0.72	0.43	0.49	1.02	1.21
$SB_{F=0}$	1,395,173	1,353,367	903,708	982,103	1,780,138	1,908,636
SB_{MSY}	320,162	321,550	192,500	219,810	443,730	482,700
$SB_{MSY}/SB_{F=0}$	0.23	0.23	0.19	0.2	0.26	0.26
$SB_{latest}/SB_{F=0}$	0.38	0.38	0.23	0.3	0.47	0.51
SB_{latest}/SB_{MSY}	1.7	1.67	0.95	1.23	2.15	2.6
$SB_{recent}/SB_{F=0}$	0.4	0.41	0.21	0.27	0.52	0.55
SB_{recent}/SB_{MSY}	1.78	1.83	0.87	1.18	2.32	2.84

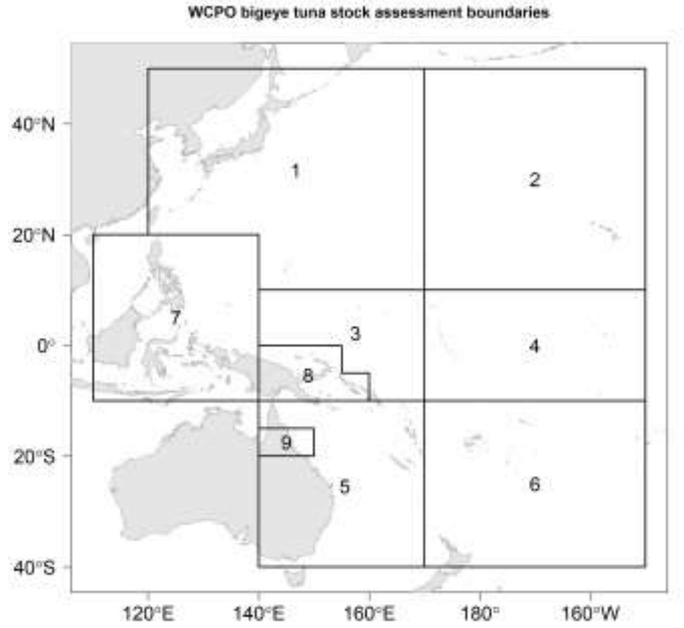


Figure BET-1. Spatial structure for the 2020 bigeye tuna stock assessment.

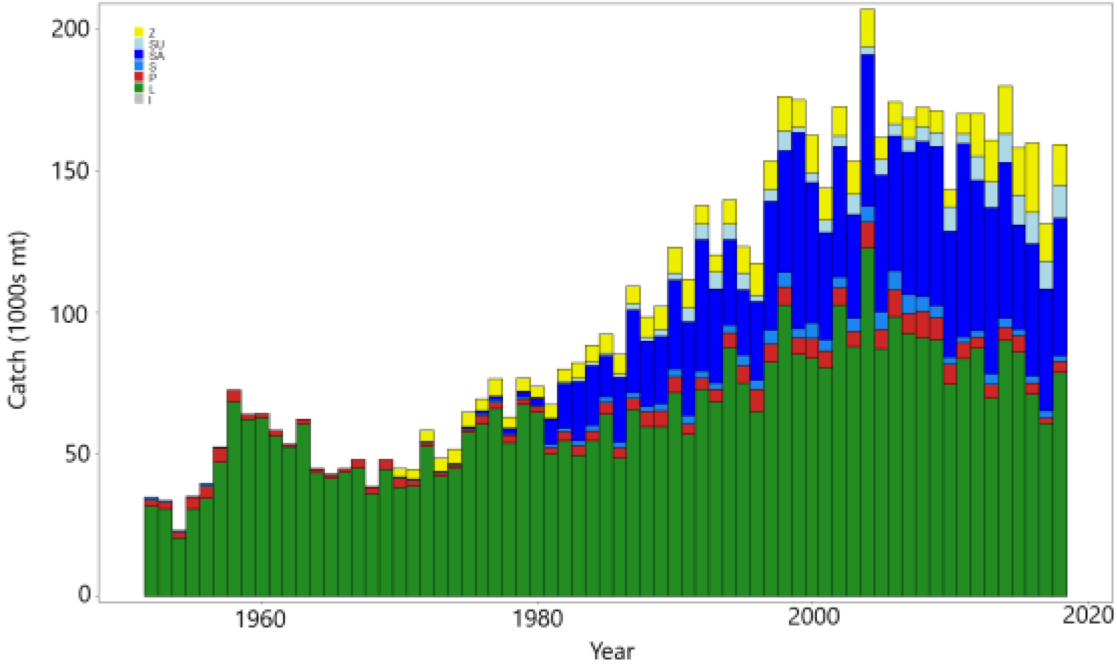


Figure BET-2. Time series of total annual catch (1000s mt) by fishing gear for the diagnostic model over the full assessment period. The different colors refer to longline (green), pole-and-line (red), purse seine (blue), purse seine associated (dark blue), purse seine unassociated (light blue), miscellaneous (yellow), and index (gray). Note that the catch by longline gear has been converted into catch-in-weight from catch-in-numbers and so may differ from the annual catch estimates presented in (Williams et al. 2020), however these catches enter the model as catch-in-numbers.

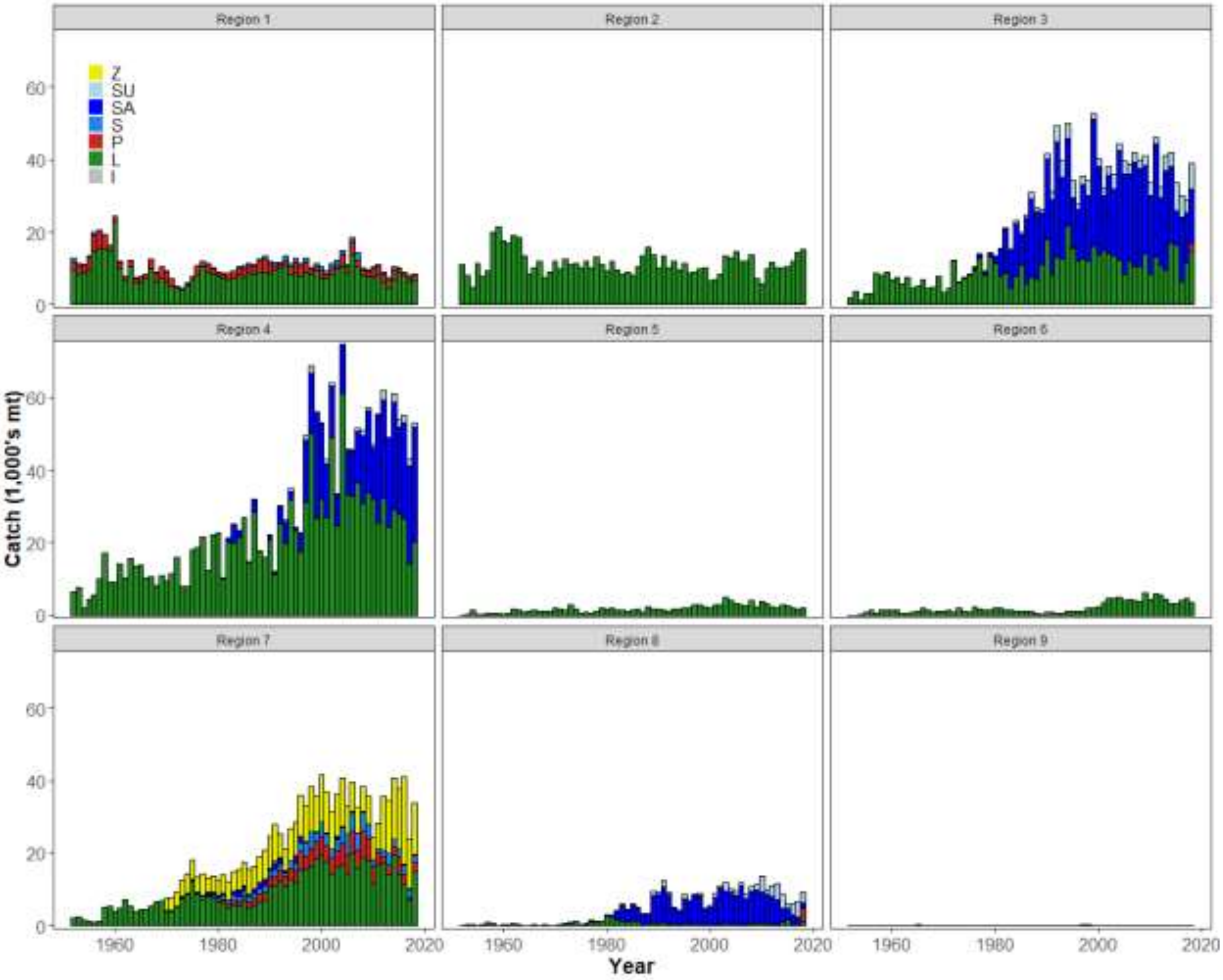
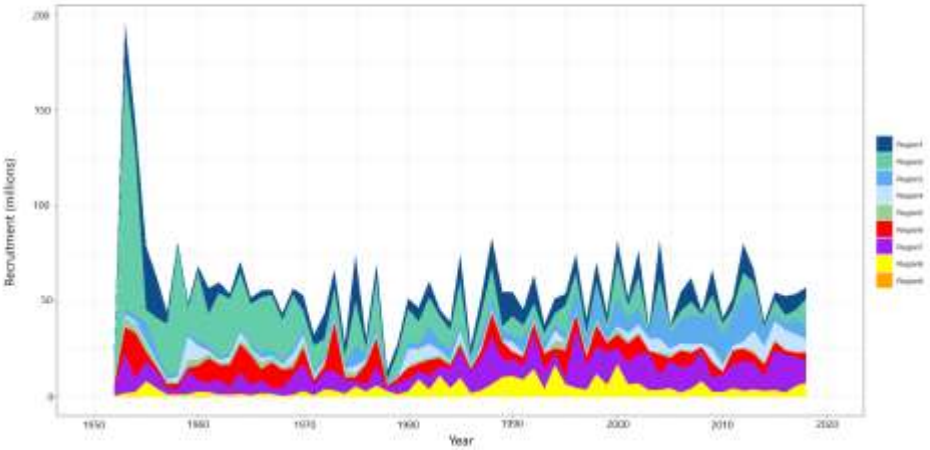
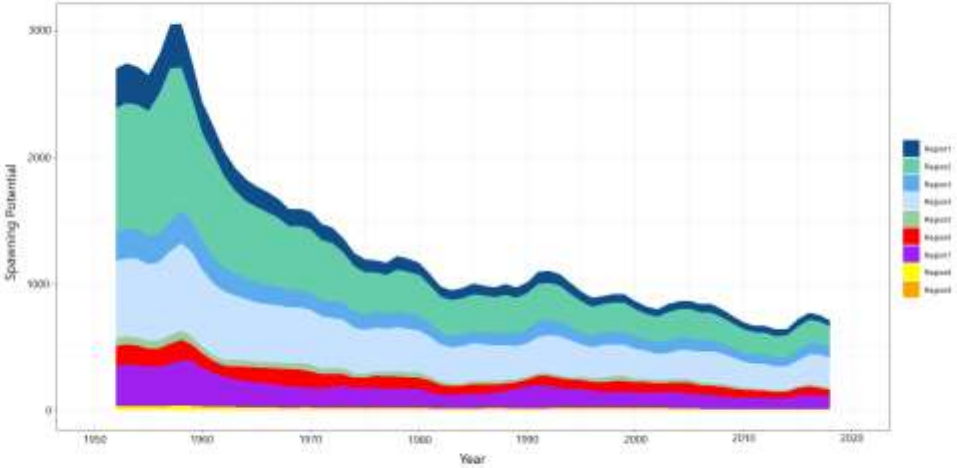


Figure BET-3. Time series of total annual catch (1000s mt) by fishing gear and assessment region for the diagnostic model over the full assessment period. The different colors refer to longline (green), pole-and-line (red), purse seine (blue), purse seine associated (dark blue), purse seine unassociated (light blue), miscellaneous (yellow), and index (gray).

(a) Recruitment



(b) Spawning Potential



(c) Total biomass

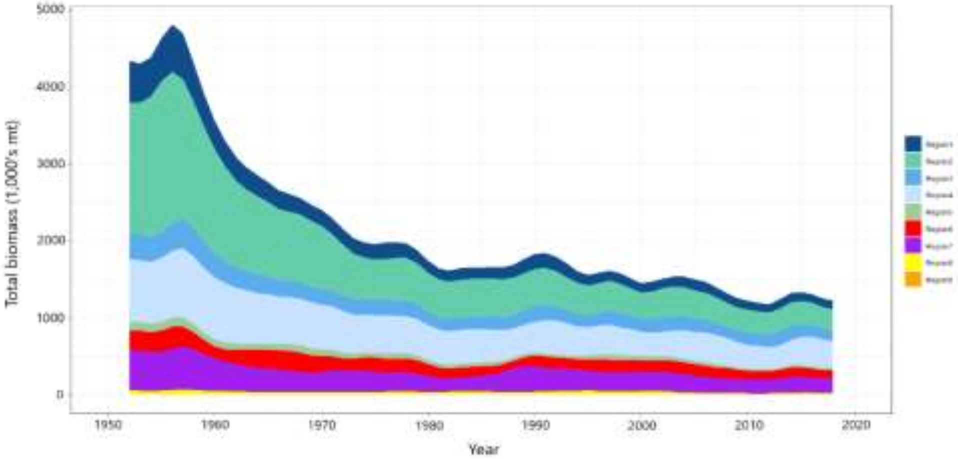


Figure BET-4. Estimated (a) annual average recruitment, (b) spawning potential and (c) total biomass by model region for the diagnostic model, showing the relative sizes among regions.

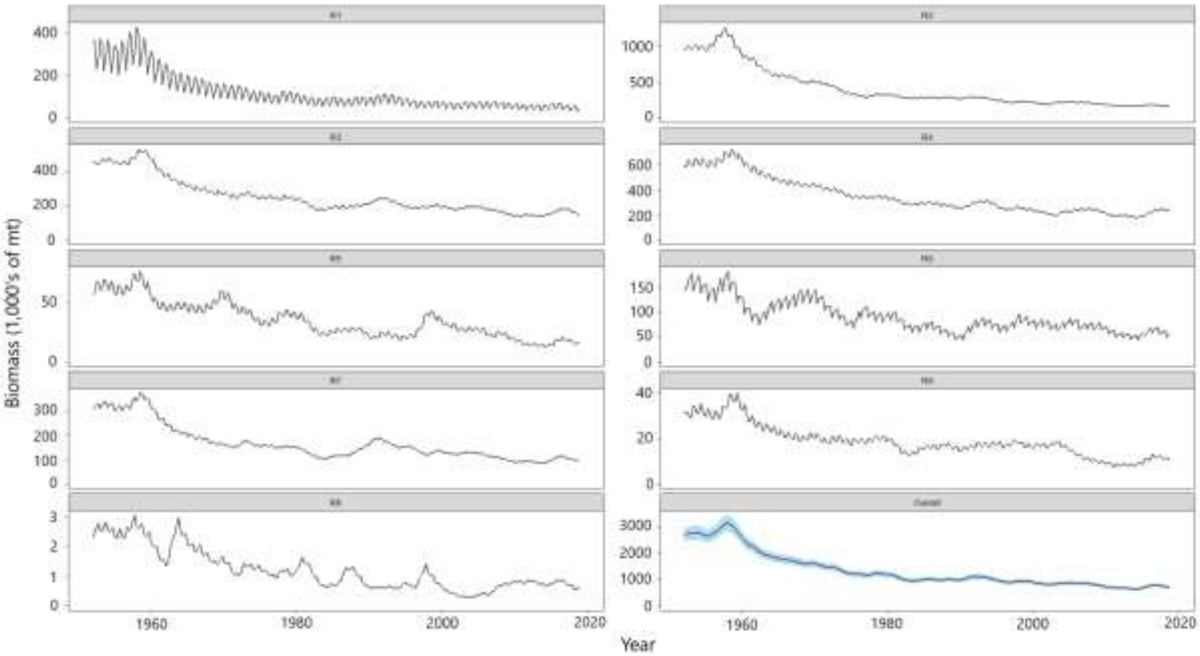


Figure BET-5. Estimated seasonal, temporal spawning potential by model region for the diagnostic model. The asymptotic 95% confidence interval as calculated using the delta-method is shown for the “Overall” region. Note that the scale of the y-axis is not constant across regions.

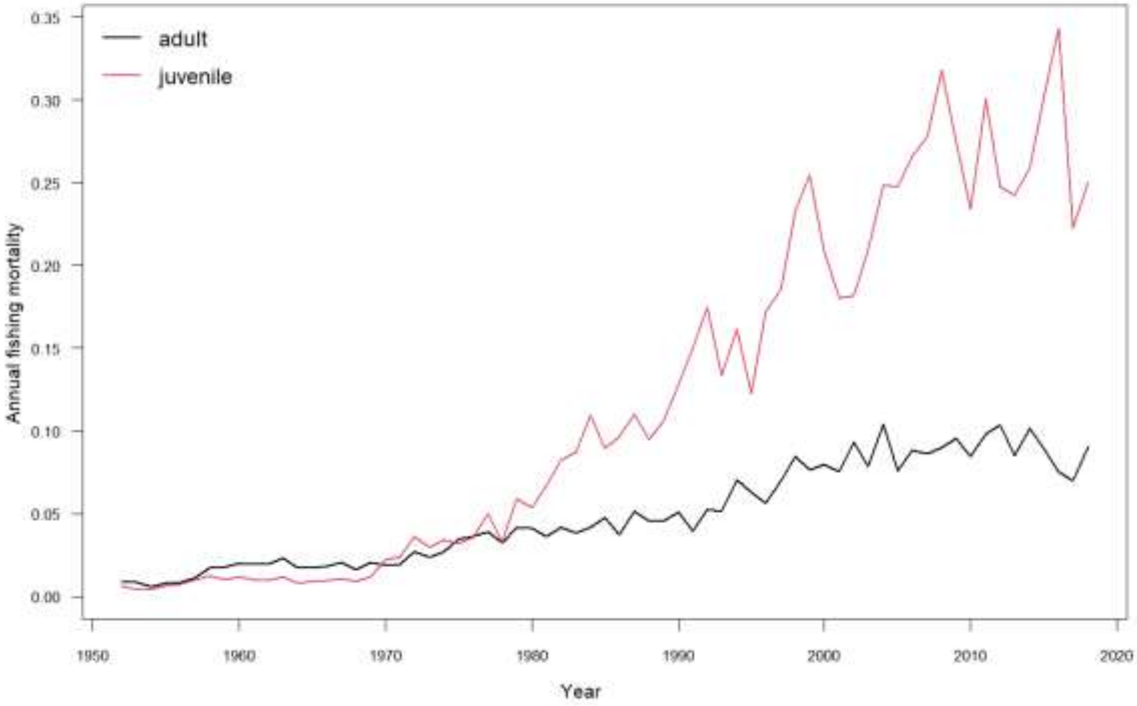


Figure BET-6. Estimated annual average juvenile and adult fishing mortality for the diagnostic model.

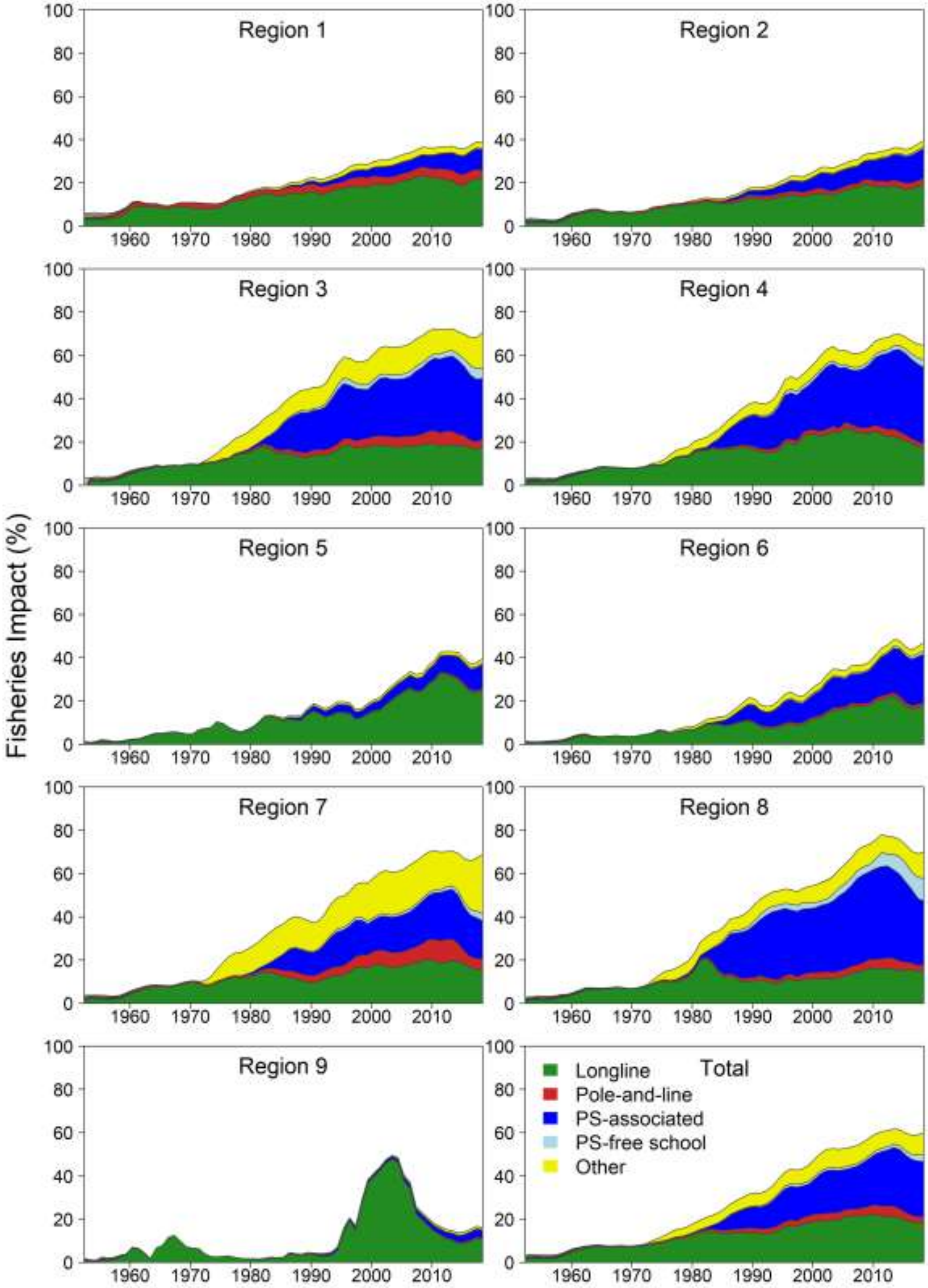


Figure BET-7. Estimates of reduction in spawning potential due to fishing (fishery impact = (1-$SB_t/SB_{t;F=0}$) * 100%) by region, and over all regions (lower right panel), attributed to various fishery groups for the diagnostic model.

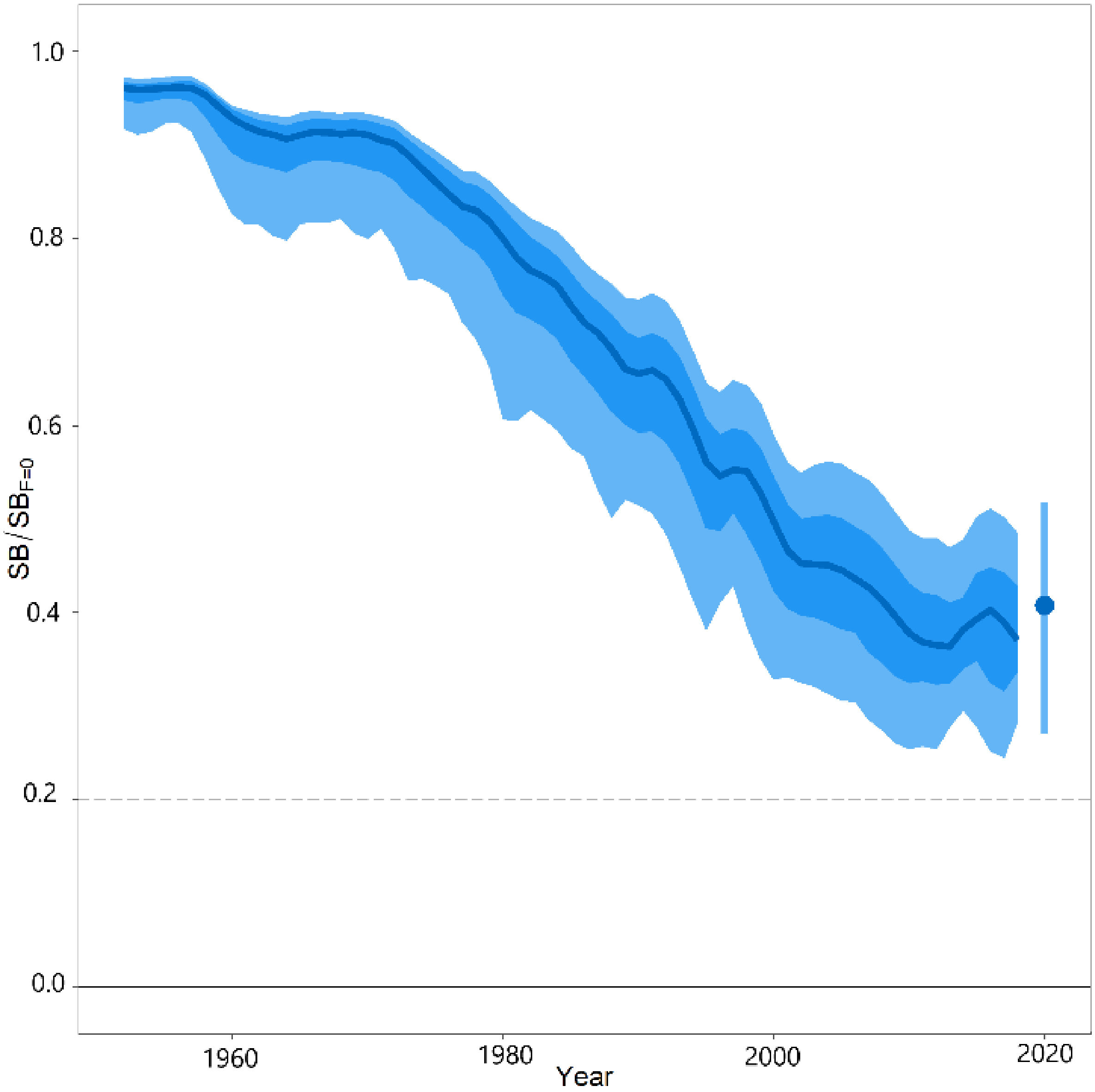


Figure BET-8. Time-dynamic percentiles of depletion ($SB_t/SB_{t;F=0}$) and median (dark line) across all 24 models in the structural uncertainty grid. The lighter band shows the 10th to 90th percentiles around the median, and the dark band shows the 50th percentile around the median. The median $SB_{recent}/SB_{F=0}$ and 80th percentile is shown on the right by the dot and line.

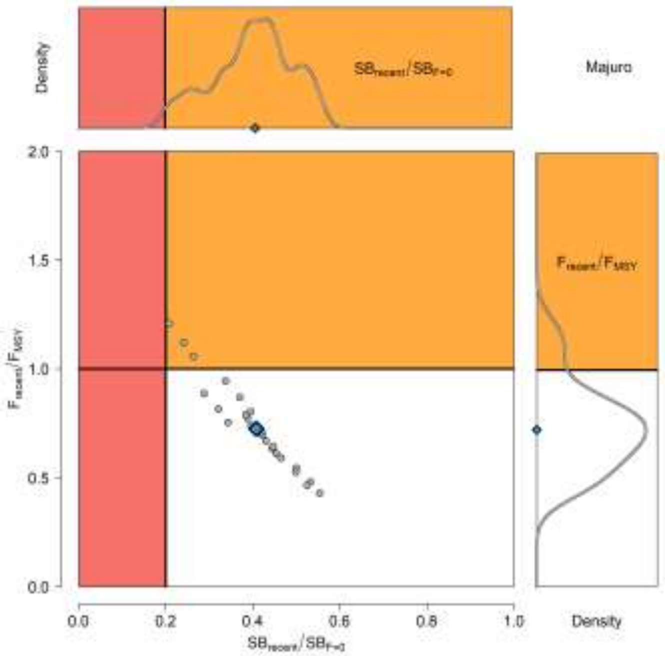


Figure BET-9. Majuro plot for the recent spawning potential (2015–2018) summarizing the results for each of the models in the structural uncertainty grid. The plots represent estimates of stock status in terms of spawning biomass depletion and fishing mortality, and marginal distributions of each are presented. The median is shown in blue.

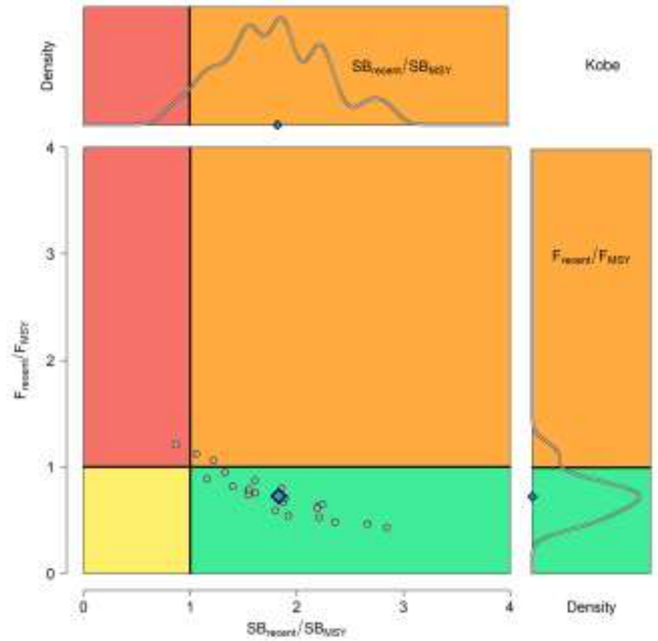


Figure BET-10. Kobe plot for the recent spawning potential (2015–2018) summarizing the results for each of the models in the structural uncertainty grid. The plots represent estimates of stock status in terms of spawning biomass depletion and fishing mortality. Marginal distributions of each are presented. The median is shown in blue.

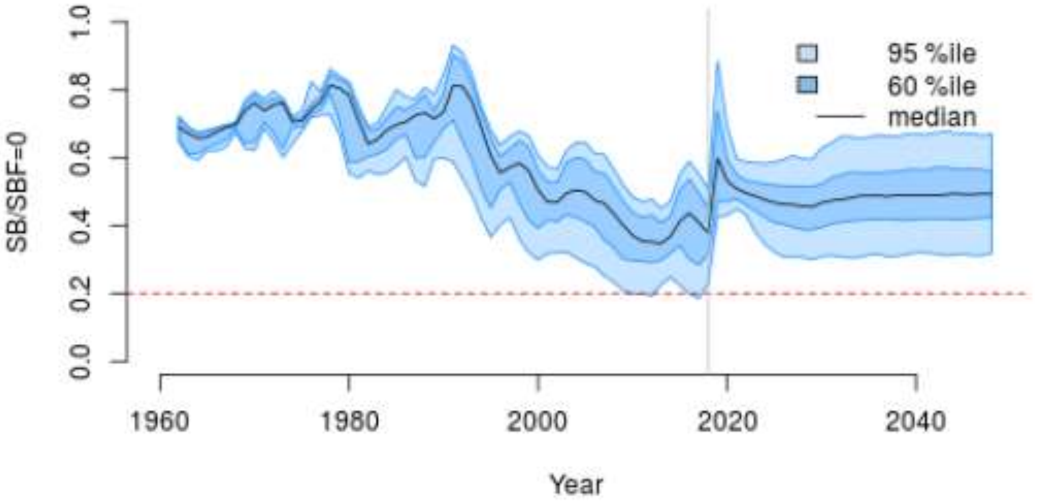


Figure BET-11. Time series of bigeye tuna spawning potential SB_t=$SB_{F=0}$, where $SB_{F=0}$ is the average SB from t-10 to t-1, relative to the current year t, from the uncertainty grid of assessment models for the period 2000 to 2018, and stochastic projection results for the period 2019 to 2048 assuming 2016-2018 average catches in LL and other fisheries and 2018 effort in PS fisheries continue. Vertical gray line at 2018 represents the last year of the assessment. During the projection period (2019-2048) levels of recruitment variability are assumed to match those over the short-term period (2008-2017). The red horizontal dashed line represents the agreed limit reference point.

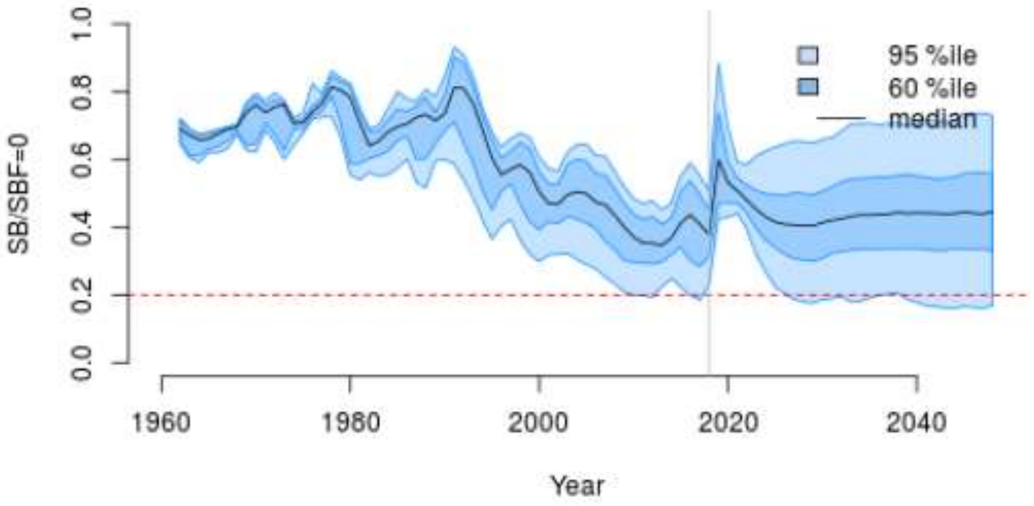


Figure BET-12. Time series of bigeye tuna spawning potential SB_t=$SB_{F=0}$, where $SB_{F=0}$ is the average SB from t-10 to t-1, relative to the current year t, from the uncertainty grid of assessment models for the period 2000 to 2018, and stochastic projection results for the period 2019 to 2048 assuming 2016-2018 average catches in LL and other fisheries and 2018 effort in PS fisheries continue. Vertical gray line at 2018 represents the last year of the assessment. During the projection period (2019-2048) levels of recruitment variability are assumed to match those over the long-term period (1962-2017). The red horizontal dashed line represents the agreed limit reference point.

SC16 noted that the results from the uncertainty grid adopted by SC16 show that the stock has been continuously declining for about 60 years since the late 1950s, except for the recent small increase from 2015 to 2016 with biomass declining thereafter.

SC16 also noted that the median value of relative recent (2015-2018) spawning biomass depletion ($SB_{2015-2018}/ SB_{F=0}$) was 0.41 with a 10th to 90th percentiles of 0.27 to 0.52.

SC16 further noted that there was 0% probability (0 out of 24 models) that the recent (2015-2018) spawning biomass had breached the adopted limit reference point (LRP).

SC16 noted that there has been a long-term increase in fishing mortality for both juvenile and adult bigeye tuna and while juvenile fishing mortality is higher than that of the adult fish, both adult and juvenile fishing mortality rates have stabilised somewhat since 2008 and have fluctuated without trend since that time.

SC16 noted that the median recent fishing mortality ($F_{2014-2017t}/F_{MSY}$) was 0.72 with a 10th to 90th percentile interval of 0.49 to 1.02.

SC16 noted that there was a roughly 12.5% probability (3 out of 24 models) that the recent (2014-2017) fishing mortality was above F_{MSY}.

SC16 noted the results of stochastic projections (Figures BET 11 and BET 12) from the 2020 assessment which indicated the potential stock consequences of fishing at “status quo” conditions (2016–2018 average longline and other fishery catch and 2018 purse seine effort levels) and short-term recruitment scenario using the uncertainty framework approach endorsed by SC. Projections indicate that median $SB_{2025}/SB_{F=0} = 0.47$; median $SB_{2035}/SB_{F=0} = 0.49$ and median $SB_{2045}/SB_{F=0} = 0.49$. The risk that $SB_{2048}/SB_{F=0}$ is less than the Limit Reference Point is 0%.

SC16 noted the results of stochastic projections from the long-term recruitment scenario using the uncertainty framework approach endorsed by SC. Projections indicate that median $SB_{2025}/SB_{F=0} = 0.42$; median $SB_{2035}/SB_{F=0} = 0.44$ and median $SB_{2045}/SB_{F=0} = 0.45$. The risk that $SB_{2048}/SB_{F=0}$ is less than the Limit Reference Point is 5%.

b. Management advice and implications

SC16 noted that the preliminary estimate of total catch of WCPO bigeye tuna for 2019 was 135,680 mt, a 9% decrease from 2018 and an 8% decrease from the average 2014-2018. Longline catch in 2019 (68,371 mt) was a 0% decrease from 2018 and a 2% increase from the 2014-2018 average. Purse seine catch in 2019 (50,819 mt) was a 22% decrease from 2018 and a 17% decrease from the 2014-2018 average. Pole and line catch (1,400 mt) was a 66% decrease from 2018 and a 66% decrease from the average 2014-2018 catch. Catch by other gear totalled 15,090 mt and was a 33% increase from 2018 and 1% increase from the average catch in 2014-2018.

SC16 noted that the catch in the last year of the assessment (2018) was median 159,288 mt which was greater than the median MSY (140,720 mt).

Based on the uncertainty grid adopted by SC16, the WCPO bigeye tuna spawning biomass is above the biomass LRP and recent F is very likely below F_{MSY}. The stock is not overfished (100% probability $SB/SB_{F=0}>LRP$) and likely not experiencing overfishing (87.5% probability $F<F_{MSY}$).

SC16 noted that levels of fishing mortality and depletion differ among regions, and that fishery impact was higher in the tropical regions (Regions 3, 4, 7 and 8 in the stock assessment model), with particularly high fishing mortality on juvenile bigeye tuna in these regions. There is also evidence that the overall stock status is buffered with biomass kept at more elevated level overall by low exploitation in the temperate regions (1, 2, 6 and 9). SC16 therefore re-iterates that WCPFC17 could continue to consider measures to reduce fishing mortality from fisheries that take juveniles, with the goal to increase bigeye fishery yields and reduce any further impacts on the spawning biomass for this stock in the tropical regions.

Based on those results, SC16 recommends as a precautionary approach that the fishing mortality on bigeye tuna stock should not be increased from the level that maintains spawning biomass at 2012-2015 levels until the Commission can agree on an appropriate target reference point).

2.6.7.2 WESTERN AND CENTRAL PACIFIC OCEAN YELLOWFIN TUNA

Stock assessment: Vincent et al. (2020).

a. Stock status and trends

The median values of relative recent (2015-2018) spawning biomass depletion ($SB_{recent}/ SB_{F=0}$) and relative recent (2014-2017) fishing mortality (F_{recent}/F_{MSY}) over the uncertainty grid of 72 models (Table YFT-1) were used to define stock status. The values of the upper 90th and lower 10th percentiles of the empirical distributions of relative spawning biomass and relative fishing mortality from the uncertainty grid were used to characterize the probable range of stock status.

A description of the updated structural sensitivity grid used to characterize uncertainty in the assessment is illustrated in Table YFT-1. The spatial structure used in the 2020 stock assessment is shown in Figure YFT-1. Time series of total annual catch by fishing gear over the full assessment period is shown in Figure YFT-2. The time series of total annual catch by fishing gear and assessment region is shown in Figure YFT-3. Estimated annual average recruitment, spawning potential, and total biomass by model region is shown in Figure YFT-4. Estimated trends in spawning biomass depletion for the 72 models in the structural uncertainty grid is shown in Figure YFT-5, and juvenile and adult fishing mortality rates from the diagnostic model is shown in Figure YFT-6. Estimates of the reduction in spawning potential due to fishing by region are shown in Figure YFT-7. Time-dynamic percentiles of depletion ($SB_t/SB_{t,F=0}$) for the 72 models are shown in Figure YFT-8. A Majuro and Kobe plot summarising the results for each of the 72 models in the structural uncertainty grid are shown in Figures YFT-9 and 10, respectively. Projections are illustrated in Figure YFT-11. Table YFT-2 provides a summary of reference points over the 72 models in the structural uncertainty grid.

The most influential axis of uncertainty with respect to estimated stock status was growth. The most pessimistic model estimates occurred with models that assumed growth estimated from the modal progression information in the size composition data. The most optimistic stock status estimates were obtained from models that used the growth curve estimated externally from otolith data. Models where growth was estimated by the conditional age-at-length data resulted in estimates that were in between the other two, but were more consistent with the otolith growth curve models. Further research is required to develop alternative growth estimates at the regional spatial scale and develop model diagnostics and objective criteria for model inclusion.

Table YFT-1. Description of the updated structural sensitivity grid used to characterize uncertainty in the assessment, where * denotes the level assumed in the diagnostic model. Equal weighting was given to all axis values.

Axis	Value 1	Value 2	Value 3	Value 4
Growth	Conditional Age-at-length*	Modal (Size Composition)	Otolith	
Steepness	0.65	0.8 *	0.95	
Size Scalar	20	60 *	200	500
Mixing Period	1 Quarter	2 Quarters *		

Table YFT-2. Summary of reference points over the 72 models in the structural uncertainty grid. Note that "recent" is the average over the period 2015-2018 for SB and 2014-2017 for fishing mortality, while "latest" is 2018. The values of the upper 90th and lower 10th percentiles of the empirical distributions are also shown. F_{mult} is the multiplier of recent (2014-2017) fishing mortality required to attain MSY.

	Mean	Median	Minimum	10th percentile	90th percentile	Maximum
C_{latest}	709,389	711,072	700,358	702,279	712,761	714,073
$Y_{Frecent}$	779,872	784,200	661,600	707,720	877,040	9080,00
f_{mult}	2.87	2.80	1.70	2.12	3.72	4.29
F_{MSY}	0.11	0.10	0.08	0.09	0.12	0.15
MSY	1,090,706	1,091,200	791,600	874,200	1,283,920	1,344,400
F_{recent}/F_{MSY}	0.37	0.36	0.23	0.27	0.47	0.59
$SB_{F=0}$	3,641,228	3,603,980	2,893,274	3,231,353	4,050,429	4,394,277
SB_{MSY}	860,326	858,700	349,100	590,090	1,114,400	1,322,000
$SB_{MSY}/SB_{F=0}$	0.23	0.24	0.12	0.18	0.28	0.30
$SB_{latest}/SB_{F=0}$	0.54	0.54	0.40	0.47	0.60	0.66
SB_{latest}/SB_{MSY}	2.43	2.28	1.47	1.67	3.29	4.89
$SB_{recent}/SB_{F=0}$	0.58	0.58	0.42	0.51	0.64	0.68
SB_{recent}/SB_{MSY}	2.59	2.43	1.58	1.77	3.57	5.27

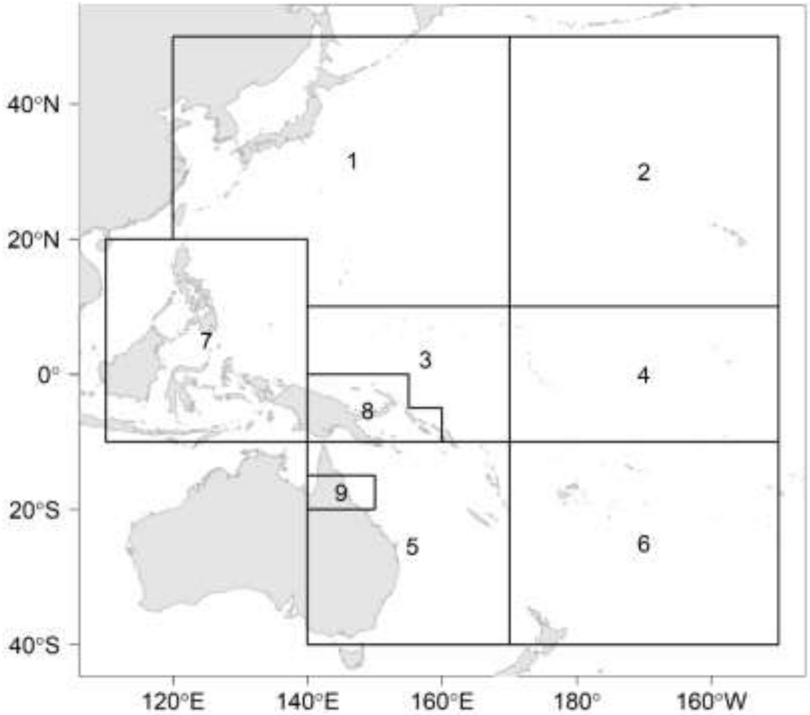


Figure YFT-1. The geographical area covered by the stock assessment and the boundaries for the 9 regions when using the "10N regional structure".

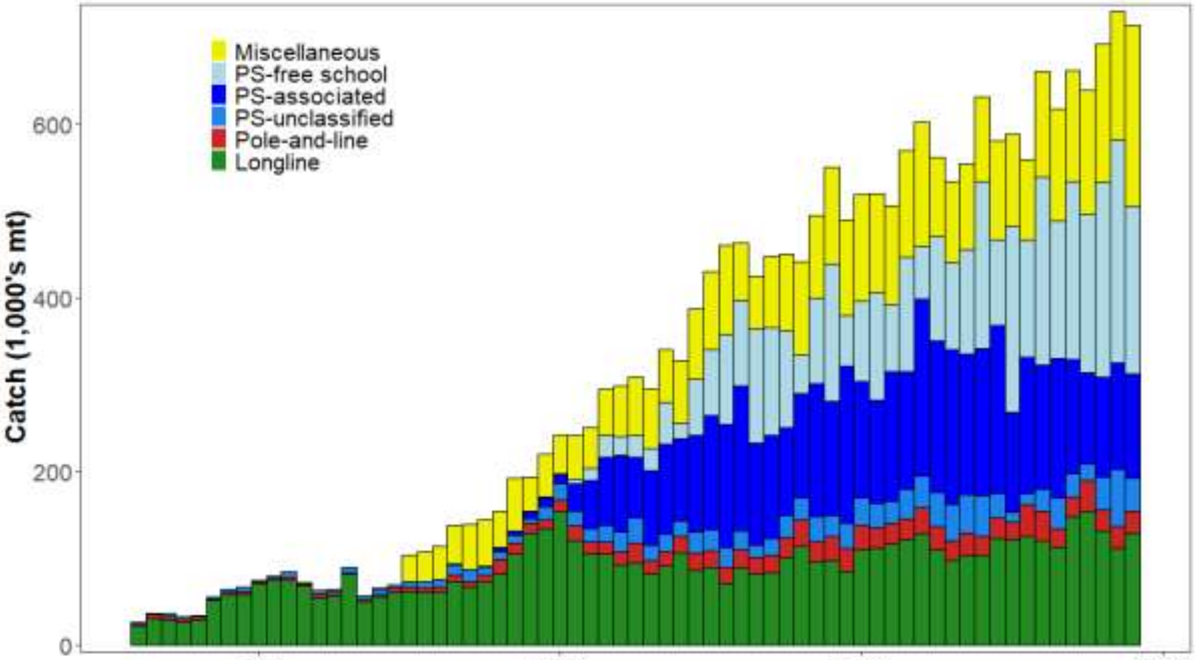


Figure YFT-2. Time series of total annual catch (1000s mt) by fishing gear over the full assessment region and time period. The different colors denote longline (green), pole-and-line (red), purse seine unclassified (blue), purse seine-associated (dark blue), purse seine-unassociated (light blue), miscellaneous (yellow).

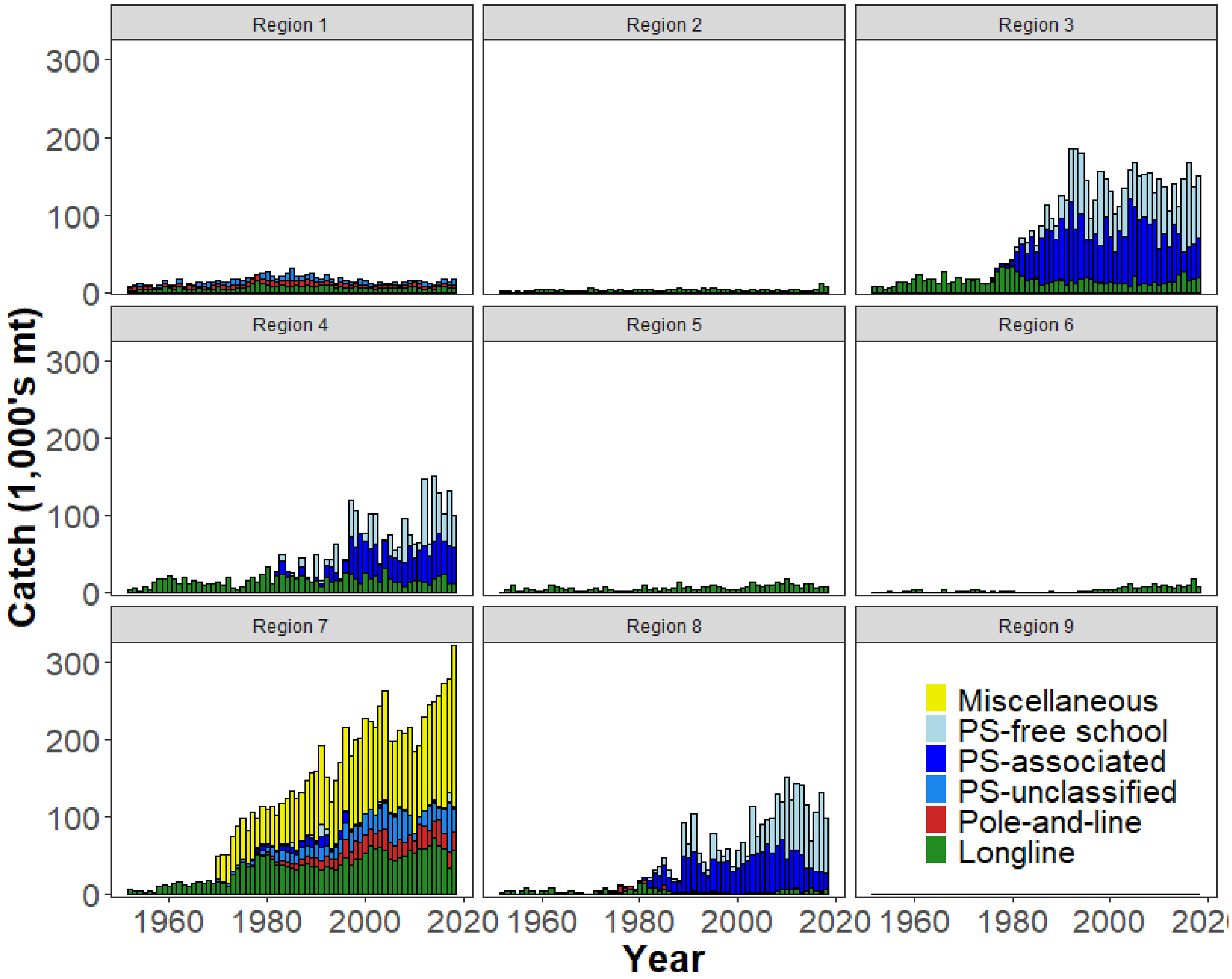
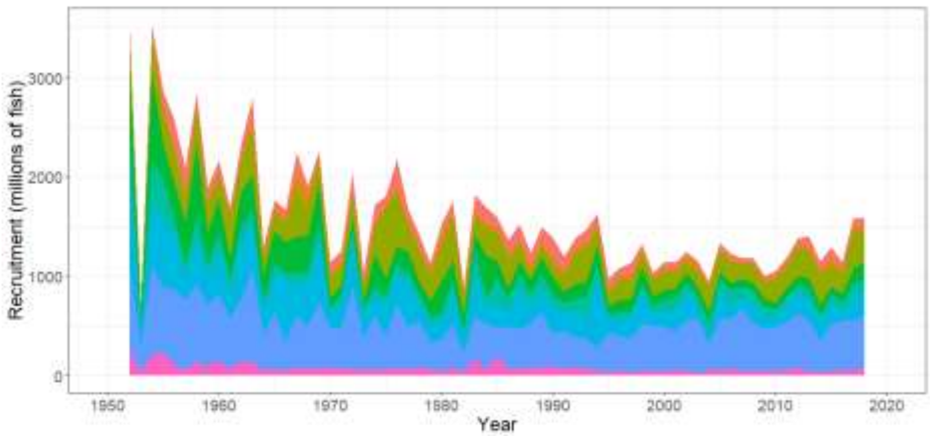
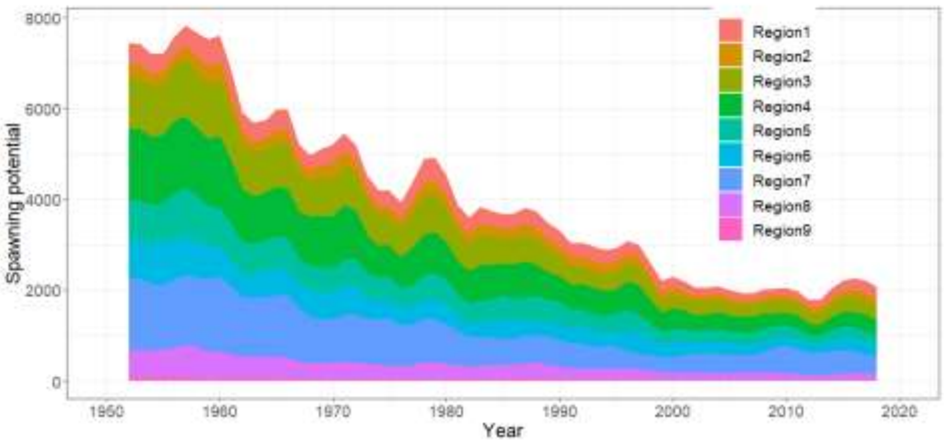


Figure YFT-3. Time series of total annual catch (1000s mt) by fishing gear and assessment region over the full assessment period. The different colors denote longline (green), pole-and-line (red), purse seine unclassified (blue), purse seine-associated (dark blue), purse seine-unassociated (light blue), miscellaneous (yellow).

(a) Recruitment



(b) Spawning Potential



(c) Total Biomass

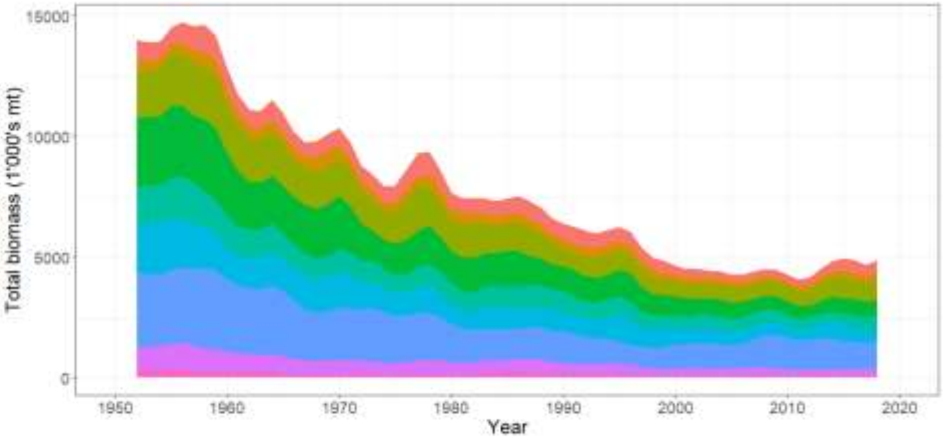


Figure YFT-4. Estimated annual average, (a) recruitment (b) spawning potential (c) total biomass by model region for the diagnostic model, showing the relative sizes among regions.

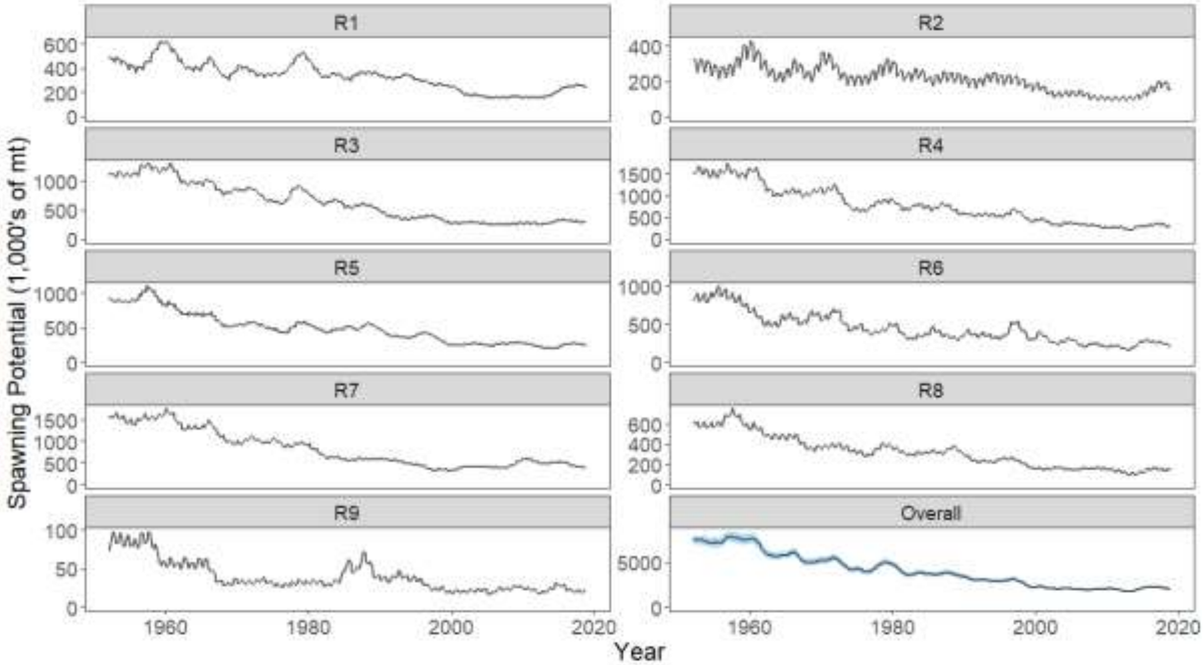


Figure YFT-5. The temporal trend in estimated spawning potential by model region for the diagnostic model, where the blue shaded region for the overall spawning potential shows the estimated 95% confidence interval based on statistical uncertainty estimated for the diagnostic model. Note that the y-axis scale among panels are not consistent.

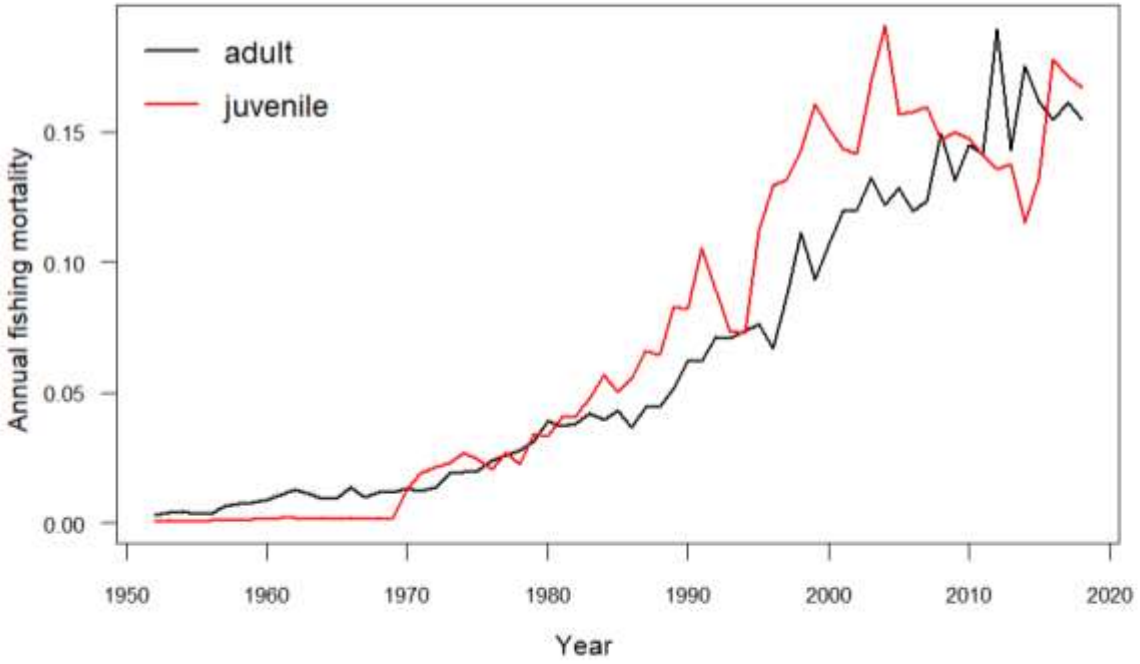


Figure YFT-6. Estimated annual average juvenile and adult fishing mortality for the diagnostic model.

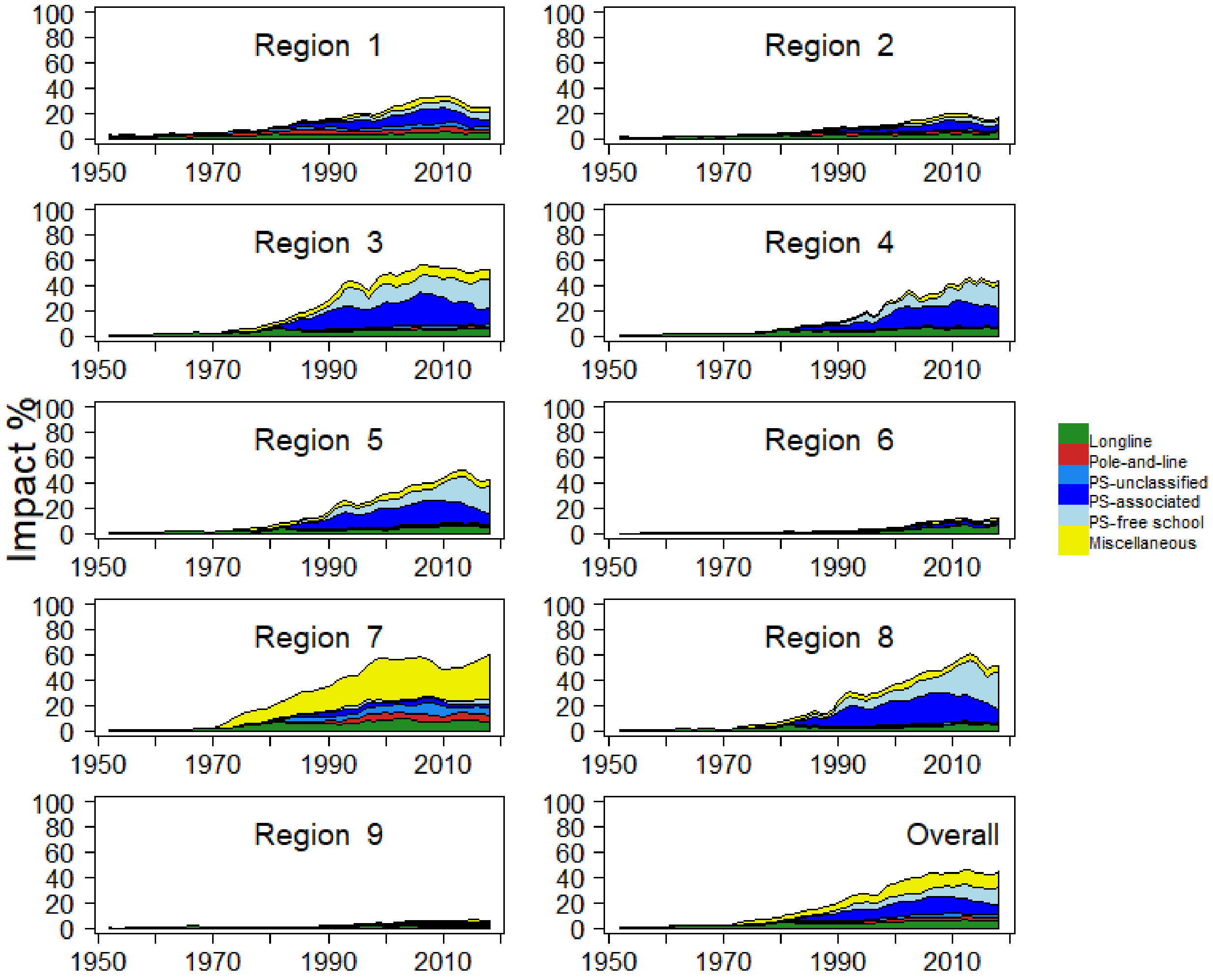


Figure YFT-7. Estimates of reduction in spawning potential due to fishing by region (Fishery Impact = (1-$SB_t/SB_{t;F=0}$) * 100%) and over all regions (lower right panel), attributed to various fishery groups for the diagnostic model.

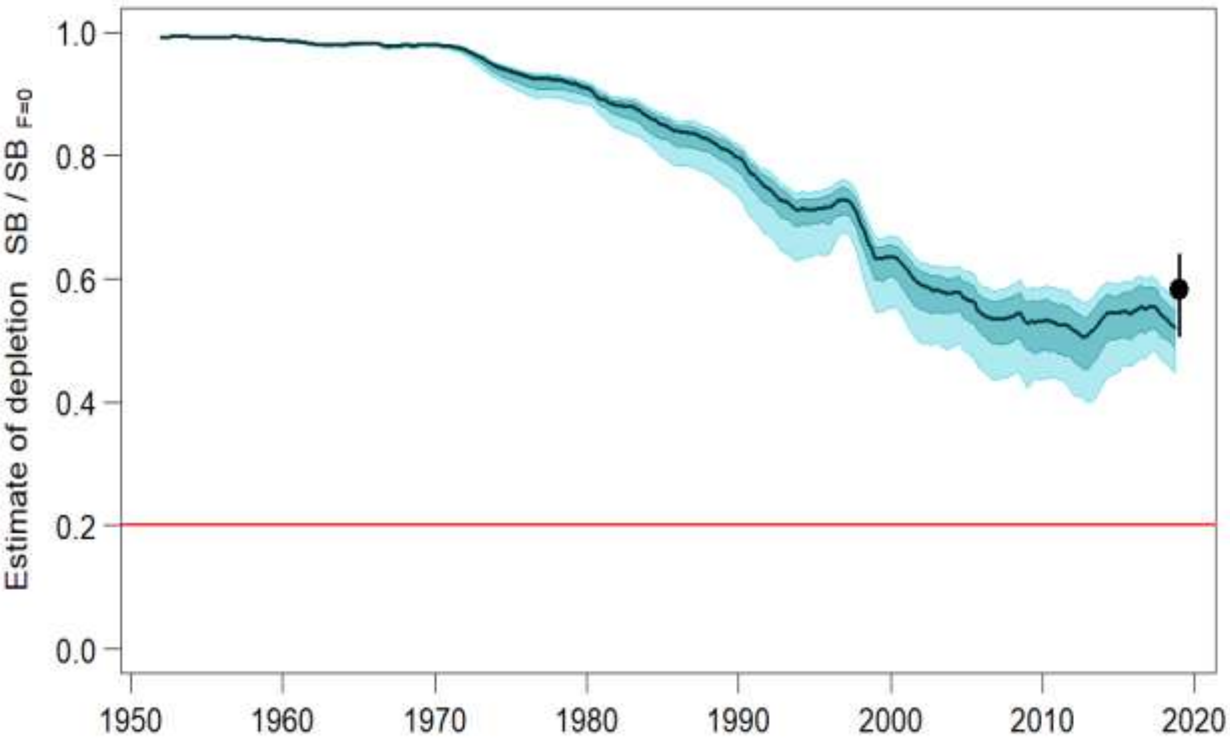


Figure YFT-8. Plot showing the trajectories of fishing depletion of spawning potential for the models in the structural uncertainty grid for the median, 50% quantile, and 80% quantile of instantaneous depletion across the structural uncertainty grid and the point and error bars is the median and 10th and 90th percentile of estimates of $SB_{recent}/SB_{F=0}$.

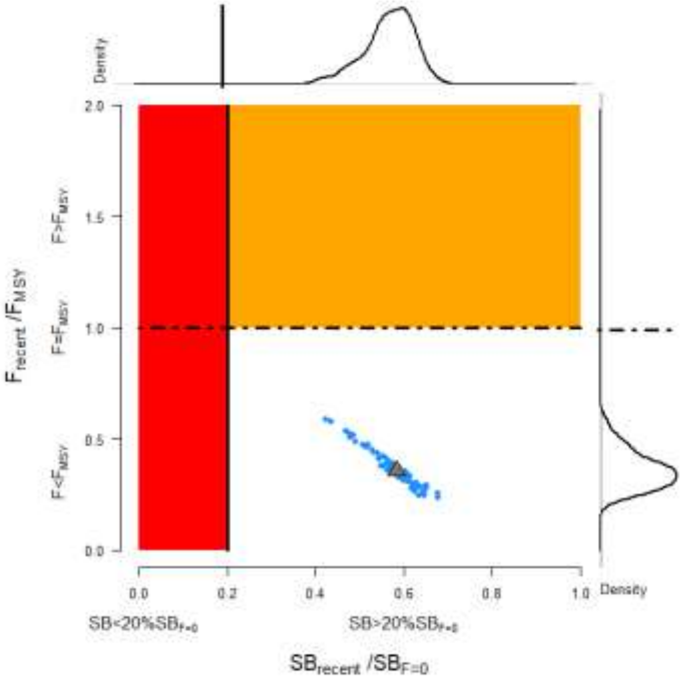


Figure YFT-9. Majuro plot representing stock status in terms of recent spawning potential depletion (2015–2018) and fishing mortality. The plots summarize the results for each of the models in the structural uncertainty grid with marginal distributions for spawning potential depletion and fishing mortality, where the brown triangle is the median of the structural uncertainty grid.

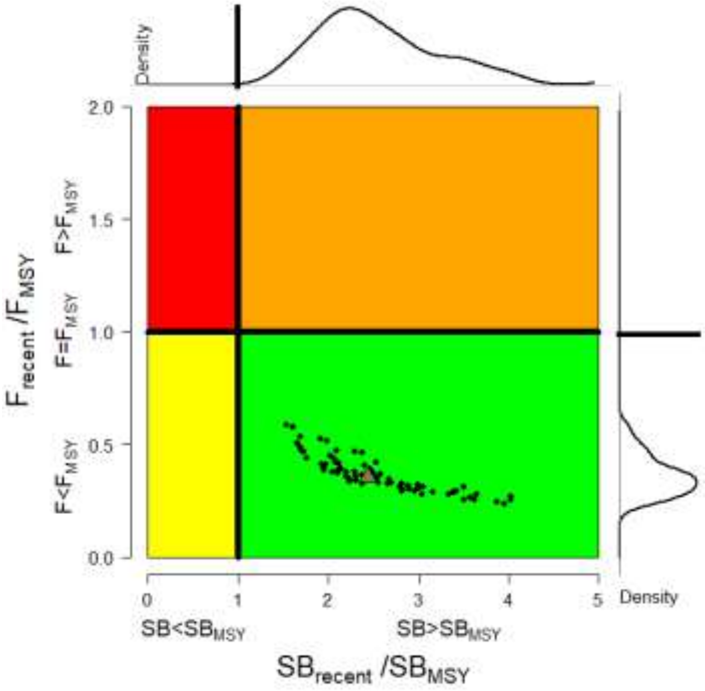


Figure YFT-10. Kobe plot for the recent spawning potential (2015–2018) summarizing the results for each of the models in the structural uncertainty grid. The plots represent estimates of stock status in terms of spawning biomass depletion and fishing mortality relative to MSY quantities and marginal distributions of each are presented with the median of the structural uncertainty grid displayed as a brown triangle.

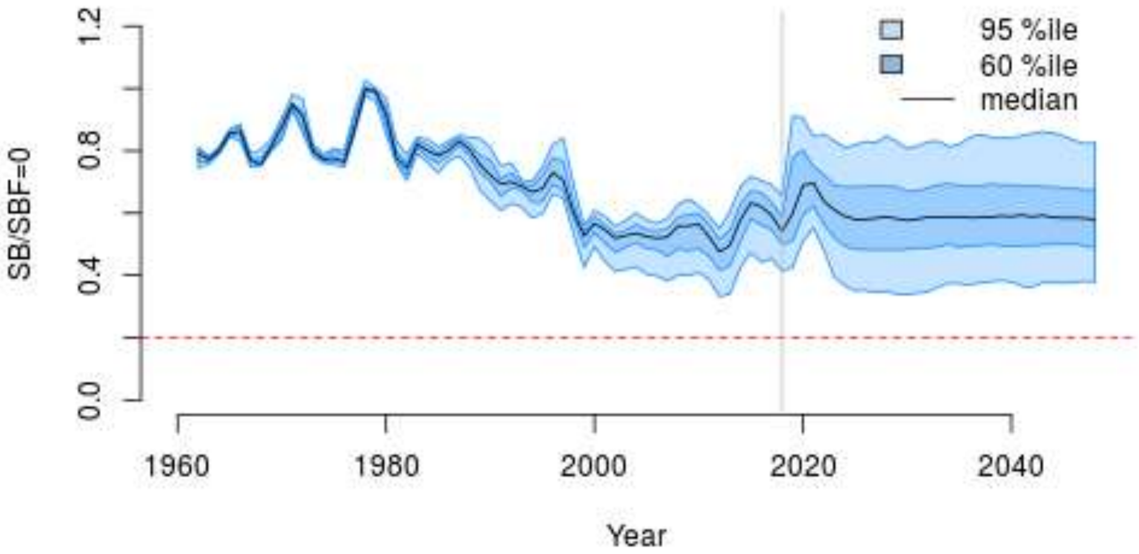


Figure YFT-11. Time series of yellowfin tuna spawning biomass ($SB_t/SB_{t,F=0}$, where $SB_{t,F=0}$ is the average SB from t-10 to t-1) from the uncertainty grid of assessment models for the period 2000 to 2018, and stochastic projection results for the period 2019 to 2048 assuming 2016-2018 average catches in LL and other fisheries and 2018 effort in PS fisheries continue. Vertical gray line at 2018 represents the last year of the assessment. During the projection period (2019-2048) levels of recruitment variability are assumed to match those over the time period used to estimate the stock-recruitment relationship (1962-2017). The red horizontal dashed line represents the agreed limit reference point.

SC16 noted that there has been a long-term decrease in spawning biomass from the 1970s for yellowfin tuna but that the depletion rates have been relatively stable over the last decade.

SC16 also noted that the median value of relative recent (2015-2018) spawning biomass depletion ($SB_{2015-2018}/SB_{F=0}$) was 0.58 with a 10th to 90th percentile interval of 0.51 to 0.64.

SC16 further noted that there was 0% probability (0 out of 72 models) that the recent (2015-2018) spawning biomass had breached the adopted LRP.

SC16 noted that there has been a long-term increase in fishing mortality for both juvenile and adult yellowfin tuna, which is consistent with previous assessments, but since 2010 there has been no directional trend.

SC16 noted that the median of relative recent fishing mortality ($F_{2014-2017}/F_{MSY}$) was 0.36 with a 10th to 90th percentile interval of 0.27 to 0.47.

SC16 further noted that there was 0% probability (0 out of 72 models) that the recent (2014-2017) fishing mortality was above F_{MSY}.

SC16 noted the results of stochastic projections (Figure YFT-11) from the 2020 assessment which indicated the potential stock consequences of fishing at “status quo” conditions (2016–2018 average longline and other fishery catch and 2018 purse seine effort levels) and long-term recruitment scenario using the uncertainty framework approach endorsed by SC. Projections indicate that median $SB_{2025}/SB_{F=0}$ = 0.58; median $SB_{2035}/SB_{F=0}$ = 0.59 and median $SB_{2045}/SB_{F=0}$ = 0.58. The risk that $SB_{2048}/SB_{F=0}$ is less than the Limit Reference Point is 0%.

b. Management Advice and implications

SC16 noted that the preliminary estimate of total catch of WCPO yellowfin tuna for 2019 was 669,362 mt, a 5% decrease from 2018 and a 1% increase from the average 2014-2018. Purse seine catch in 2019 (364,571 mt) was a 4% decrease from 2018 and an 8% decrease from the 2014-2018 average. Longline catch in 2019 (104,440 mt) was a 7% increase from 2018 and a 9% increase from the 2014-2018 average. Pole and line catch (37,563 mt) was a 43% increase from 2018 and a 40% increase from the average 2014-2018 catch. Catch by other gear totalled 162,788 t and was an 18% decrease from 2018 and a 16% increase from the average catch in 2014-2018.

SC16 noted that the catch in the last year of the assessment (2018) was 711,072 mt which was less than the median MSY (1,091,200 mt).

Based on the uncertainty grid adopted by SC16, the WCPO yellowfin tuna spawning biomass is above the biomass LRP and recent F is below F_{MSY}. The stock is not experiencing overfishing (100% probability $F<F_{MSY}$) and is not in an overfished condition (0% probability $SB/SB_{F=0}<LRP$). Additionally, stochastic projections predict there to be no risk of breaching the LRP (0% probability $SB_{2048}/SB_{F=0}<LRP$).

SC16 also noted that levels of fishing mortality and depletion differ between regions, and that fishery impact was highest in the tropical region (Regions 3, 4, 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. There is also evidence that the overall stock status is buffered with biomass kept at a more elevated level overall by low exploitation in the temperate regions (1, 2, 6, and 9). SC16 therefore re-iterates that WCPFC17 could consider measures to reduce fishing mortality from fisheries that take juveniles, with the goal to increase fishery yields and reduce any further impacts on the spawning potential for this stock in the tropical regions.

SC16 noted that the 2020 stock assessment results indicate the stock is currently exploited at relatively low levels (median $F/F_{MSY} = 0.36$, 10th to 90th percentile interval 0.27-0.47). Nevertheless, SC16 recommends that the Commission notes that further increases in YFT fishing mortality would likely affect other stocks/species which are currently moderately exploited due to the multispecies/gears interactions in WCPFC fisheries taking YFT.

SC16 also noted that although the structural uncertainty grid presents a positive indication of stock status, the high level of unresolved conflict amongst the data inputs used in the assessment suggests additional caution may be appropriate when interpreting assessment outcomes to guide management decisions.

Based on those results, SC16 recommends as a precautionary approach that the fishing mortality on yellowfin tuna stock should not be increased from the level that maintains spawning biomass at 2012-2015 levels until the Commission can agree on an appropriate target reference point.

2.6.7.3 NORTH PACIFIC OCEAN ALBACORE

Stock assessment: ISC (2020).

a. Stock status and trends

SC16 noted that the ISC provided the following conclusions on the stock status of North Pacific albacore:

The Northern Committee (NC) of the Western and Central Pacific Fisheries Commission (WCPFC), which manages this stock together with the Inter American Tropical Tuna Commission (IATTC), adopted a biomass-based limit reference point (LRP) in 2014 (https://www.wcpfc.int/harvest-strategy) of 20% of the current spawning stock biomass when F=0 (20%$SSB_{current, F=0}$). The 20%$SSB_{current, F=0}$ LRP is based on dynamic biomass and fluctuates depending on changes in recruitment. For north Pacific albacore tuna, this LRP is calculated as 20% of the unfished dynamic female spawning biomass in the terminal year of this assessment (i.e., 2018) (https://www.wcpfc.int/meetings/nc13). However, neither the IATTC nor the WCFPC have adopted F-based limit reference points for the north Pacific albacore stock.

Stock status is depicted in relation to the limit reference point (LRP; 20%$SSB_{current, F=0}$) for the stock and the equivalent fishing intensity ($F_{20\%}$; calculated as 1-$SPR_{20\%}$) (Figure NPALB-1). Fishing intensity (F, calculated as 1-SPR) is a measure of fishing mortality expressed as the decline in the proportion of the spawning biomass produced by each recruit relative to the unfished state. For example, a fishing intensity of 0.8 will result in a SSB of approximately 20% of SSB_0 over the long run. Fishing intensity is considered a proxy of fishing mortality.

The Kobe plot shows that the estimated female SSB has never fallen below the LRP since 1994, albeit with large uncertainty in the terminal year (2018) estimates. Even when alternative hypotheses about key model uncertainties such as growth were evaluated, the point estimate of female SSB in 2018 (SSB_{2018}) did not fall below the LRP, although the risk increases with this more extreme assumption (Figure NPALB-1). The SSB_{2018} was estimated to be 58,858 t (95% CI: 27,751 – 89,966 t) and 2.30 (95% CI: 1.49 – 3.11) times greater than the estimated LRP threshold of 25,573 mt (95% CI: 19,150 – 31,997 t) (Table NPALB-1). Current fishing intensity, $F_{2015-2017}$ (0.50; 95% CI: 0.36 – 0.64; calculated as 1- $SPR_{2015-2017}$) , was at or lower than all seven potential F-based reference points identified for the north Pacific albacore stock (Table NPALB-1).

SC16 noted the following stock status from ISC:

Based on these findings, the following information on the status of the north Pacific albacore stock is provided:

1. The stock is likely not overfished relative to the limit reference point adopted by the Western and Central Pacific Fisheries Commission (20%$SSB_{current, F=0}$), and
2. No F-based reference points have been adopted to evaluate overfishing. Stock status was evaluated against seven potential reference points. Current fishing intensity ($F_{2015-2017}$) is likely at or below all seven potential reference points (see ratios in Table NPALB-1).

b. Management advice and implications

SC16 noted the following conservation information from ISC:

Two harvest scenarios were projected to evaluate impacts on future female SSB: F constant at the 2015-2017 rate over 10 years ($F_{2015-2017}$) and constant catch[3] (average of 2013-2017 = 69,354 t) over 10 years. Median female SSB is expected to increase to 62,873 mt (95% CI: 45,123 - 80,622 mt) by 2028, with a low probability of being below the LRP by 2028, if fishing intensity remains at the 2015-2017 level (Figure NPALB-2). If future catch is held constant at 69,354 mt, the female SSB is expected to increase to 66,313 mt (95% CI: 33,463 - 99,164 t) by 2028 and the probability that female SSB will be below the LRP by 2028 is slightly higher than the constant F scenario (Figure NPALB-3). Although the projections appear to underestimate the future uncertainty in female SSB trends, the probability of breaching the LRP in the future is likely small if the future fishing intensity is around current levels.

Based on these findings, the following information is provided:

1. If a constant fishing intensity ($F_{2015-2017}$) is applied to the stock, then median female spawning biomass is expected to increase to 62,873 mt and there will be a low probability of falling below the limit reference point established by the WCPFC by 2028.
2. If a constant average catch ($C_{2013-2017}$ = 69,354 t) is removed from the stock in the future, then the median female spawning biomass is also expected to increase to 66,313 mt and the probability that SSB falls below the LRP by 2028 will be slightly higher than the constant fishing intensity scenario.

Table NPALB-1. Estimates of maximum sustainable yield (MSY), female spawning biomass (SSB), and fishing intensity (F) based reference point ratios for north Pacific albacore tuna for: 1) the base case model; 2) an important sensitivity model due to uncertainty in growth parameters; and 3) a model representing an update of the 2017 base case model to 2020 data. SSB_0 and SSB_{MSY} are the unfished biomass of mature female fish and at MSY, respectively. The Fs in this table are indicators of fishing intensity based on SPR and calculated as 1-SPR so that the Fs reflect changes in fishing mortality. SPR is the equilibrium SSB per recruit that would result from the current year's pattern and intensity of fishing mortality. Current fishing intensity is based on the average fishing intensity during 2015-2017 ($F_{2015-2017}$). $20\%SSB_{current, F=0}$ is 20% of the current unfished dynamic female spawning biomass, where current refers to the terminal year of this assessment (i.e., 2018). The model representing an update of the 2017 base case model is highly similar to but not identical to the 2017 base case model due to changes in data preparation and model structure.

Quantity	Base Case	Growth CV = 0.06 for L_{inf}	Update of 2017 base case model to 2020 data
MSY (t) ^{A}	102,236	84,385	113,522
SSB_{MSY} (t) ^{B}	19,535	16,404	21,431
SSB_0 (t) ^{B}	136,833	113,331	152,301
SSB_{2018} (t) ^{B}	58,858	34,872	77,077
$SSB_{2018}/20\%SSB_{current, F=0}$ ^{B}	2.30	1.63	2.63
$F_{2015-2017}$	0.50	0.64	0.43

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[3] It should be noted that the constant catch scenario is inconsistent with current management approaches for north Pacific albacore tuna adopted by the Inter-American Tropical Tuna Commission (IATTC) and the Western and Central Pacific Fisheries Commission (WCPFC).

$F_{2015\text{-}2017}/F_{MSY}$	0.60	0.77	0.52
$F_{2015\text{-}2017}/F_{0.1}$	0.57	0.75	0.49
$F_{2015\text{-}2017}/F_{10\%}$	0.55	0.71	0.48
$F_{2015\text{-}2017}/F_{20\%}$	0.62	0.80	0.54
$F_{2015\text{-}2017}/F_{30\%}$	0.71	0.91	0.62
$F_{2015\text{-}2017}/F_{40\%}$	0.83	1.06	0.72
$F_{2015\text{-}2017}/F_{50\%}$	1.00	1.27	0.86

A – MSY includes male and female juvenile and adult fish

B – Spawning stock biomass (SSB) in this assessment refers to mature female biomass only.

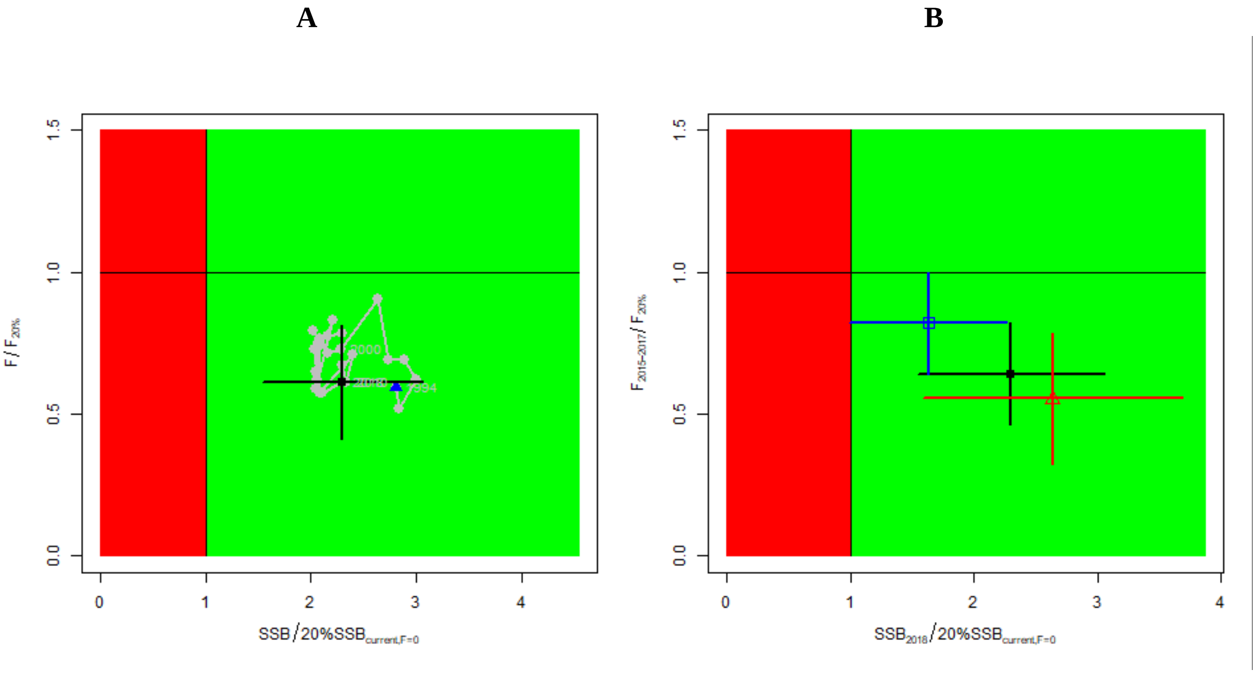

Figure NPALB-1. (**A**) Kobe plot showing the status of the north Pacific albacore (*Thunnus alalunga*) stock relative to the $20\%SSB_{current,\ F=0}$ biomass-based limit reference point, and equivalent fishing intensity ($F_{20\%}$; calculated as $1\text{-}SPR_{20\%}$) over the base case modeling period (1994-2018). Blue triangle indicates the start year (1994) and black circle with 95% confidence intervals indicates the terminal year (2018). (**B**) Kobe plot showing current stock status and 95% confidence intervals of the base case model (black; closed circle), an important sensitivity run of CV = 0.06 for L_{inf} in the growth model (blue; open square), and a model representing an update of the 2017 base case model to 2020 data (red; open triangle). The coefficients of variation of the $SSB/20\%SSB_{current,\ F=0}$ ratios are assumed to be the same as for the $SSB/20\%SSB_0$ ratios. Fs in this figure are not based on instantaneous fishing mortality. Instead, the Fs are indicators of fishing intensity based on SPR and calculated as 1-SPR so that the Fs reflects changes in fishing mortality. SPR is the equilibrium SSB per recruit that would result from the current year's pattern and intensity of fishing mortality. Current fishing intensity is calculated as the average fishing intensity during 2015-2017 ($F_{2015\text{-}2017}$), while current female spawning biomass refers to the terminal year of this assessment (i.e., 2018). The model representing an update of the 2017 base case model is highly similar to but not identical to the 2017 base case model due to changes in data preparation and model structure.

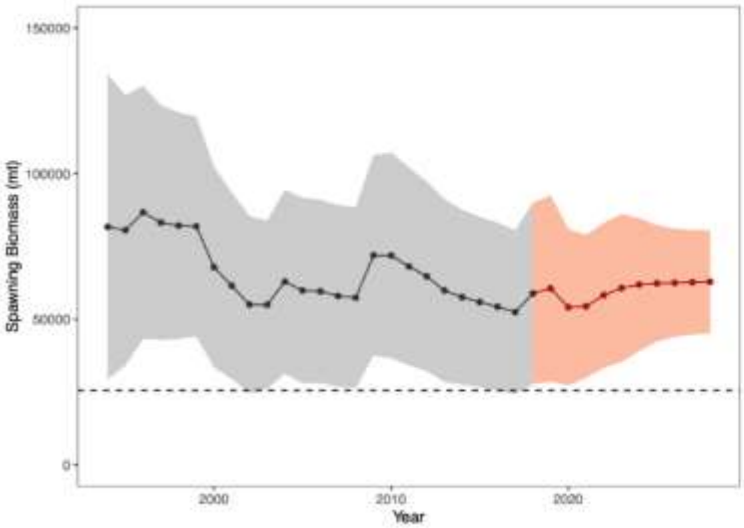

Figure NPALB-2. Historical and future trajectory of north Pacific albacore (*Thunnus alalunga*) female spawning biomass (SSB) under a constant fishing intensity ($F_{2015\text{-}2017}$) harvest scenario. Future recruitment is based on the expected recruitment variability. Black line and gray area indicates maximum likelihood estimates and 95% confidence intervals (CI), respectively, of historical female SSB, which includes parameter uncertainty. Red line and red area indicates mean value and 95% CI of projected female SSB, which only includes future recruitment variability and SSB uncertainty in the terminal year. Dashed black line indicates the $20\%SSB_{\text{current F=0}}$ limit reference point for 2018 (25,573 mt).

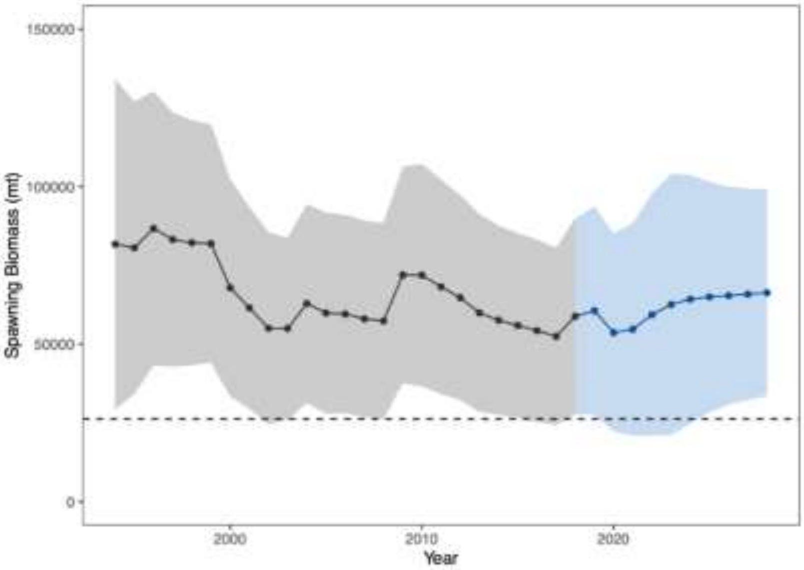

Figure NPALB-3. Historical and future trajectory of north Pacific albacore (*Thunnus alalunga*) female spawning biomass (SSB) under a constant catch (average 2013-2017 = 69,354 t) harvest scenario. Future recruitment is based on the expected recruitment variability. Black line and blue area indicates maximum likelihood estimates and 95% confidence intervals (CI), respectively, of historical female SSB, which includes parameter uncertainty. Blue line and blue area indicates mean value and 95% CI of projected female SSB, which only includes future recruitment variability and SSB uncertainty in the terminal year. Dashed black line indicates the $20\%SSB_{\text{current F=0}}$ limit reference point for 2018 (25,573 mt)

2.6.7.4 PACIFIC OCEAN BLUEFIN TUNA

Stock assessment: ISC (2020).

SC16 noted that the ISC provided the following conclusions on the stock status of Pacific bluefin tuna.

> The base-case model results show that: (1) spawning stock biomass (SSB) fluctuated throughout the assessment period (fishing years 1952-2018); (2) the SSB steadily declined from 1996 to 2010; (3) there has been a slow increase of the stock biomass continues since 2011; (4) total biomass in 2018 exceeded the historical median with an increase in immature fish; and (5) fishing mortality ($F_{\%SPR}$) declined from a level producing about 1% of SPR[4] in 2004-2009 to a level producing 14% of SPR in 2016-2018 (Table PBF-1). Based on the model diagnostics, the estimated biomass trend for the last 30 years is considered robust although SSB prior to the 1980s is uncertain due to data limitations. The SSB in 2018 was estimated to be around 28,000 mt (Table PBF-1 and Figure PBF-1), which is a 3,000 mt increase from 2016 according to the base-case model. An increase of young fish (0-2 years old) is observed in 2016-2018 (Figure PBF-2), likely resulting from low fishing mortality on those fish (Figure PBF-3) and is expected to accelerate the recovery of SSB in the future.
>
> Historical recruitment estimates have fluctuated since 1952 without an apparent trend. Relatively low recruitment levels estimated in 2010-2014 were of concern in the 2016 assessment. The 2015 recruitment estimate is lower than the historical average while the 2016 recruitment estimate (about 17 million fish) is higher than the historical average (Table PBF-1 and Figure PBF-1). The recruitment estimates for 2017 and 2018, which are based on fewer observations and more uncertain, are below the historical average.
>
> Estimated age-specific fishing mortalities (F) on the stock during the periods of 2011-2013 and 2016-2018 compared with 2002-2004 estimates (the reference period for the WCPFC Conservation and Management Measure) are presented in Figure PBF-3. A substantial decrease in estimated F is observed in ages 0-2 in 2016-2018 relative to the previous years. Note that stricter management measures in the WCPFC and IATTC have been in place since 2015.
>
> Figure PBF-5 depicts the historical impacts of the fleets on the PBF stock, showing the estimated biomass when fishing mortality from the respective fleets is zero. Historically, the WPO coastal fisheries group has had the greatest impact on the PBF stock, but since about the early 1990s the WPO purse seine fishery group targeting small fish (ages 0-1) has had a greater impact and the effect of this group in 2018 was greater than any of the other fishery groups. The impact of the EPO fisheries group was large before the mid-1980s, decreasing significantly thereafter. The WPO longline fisheries group has had a limited effect on the stock throughout the analysis period because the impact of a fishery on a stock depends on both the number and

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[4] SPR (spawning potential ratio) is the ratio of the cumulative spawning biomass that an average recruit is expected to produce over its lifetime when the stock is fished at the current fishing level to the cumulative spawning biomass that could be produced by an average recruit over its lifetime if the stock was unfished. F%SPR: F that produces % of the spawning potential ratio.

> size of the fish caught by each fleet; i.e., catching a high number of smaller juvenile fish can have a greater impact on future spawning stock biomass than catching the same weight of larger mature fish. There is greater uncertainty regarding discards than other fishery impacts because the impact of discarding is not based on observed data.

SC16 noted the following stock status from ISC:

> The WCPFC and IATTC adopted an initial rebuilding biomass target (the median SSB estimated for the period from 1952 through 2014) and a second rebuilding biomass target (20%$SSB_{F=0}$ under average recruitment), without specifying a fishing mortality reference level. The 2020 assessment estimated the initial rebuilding biomass target ($SSB_{MED1952-2014}$) to be 6.4%$SSB_{F=0}$ and the corresponding fishing mortality expressed as $F_{6.4\%SPR}$. The Kobe plot shows that the point estimate of the SSB_{2018} was 4.5%$SSB_{F=0}$ and the recent (2016-2018) fishing mortality corresponds to $F_{14\%SPR}$ (Table PBF-1 and Figure PBF-4). Although no reference points have been adopted to evaluate the status of PBF, an evaluation of stock status against some common reference points (Table PBF-2) shows that the stock is overfished relative to biomass-based limit reference points adopted for other species in WCPFC (20%$SSB_{F=0}$) and fishing mortality has declined but not reached the level corresponding to that reference point ($F_{20\%SPR}$).
>
> The PBF spawning stock biomass (SSB) has gradually increased in the last 8 years (2011-2018). Young fish (age 0-2) shows a more rapid increase in recent years (Figure PBF-1 and PBF-2). These changes in biomass coincide with a decline in fishing mortality over the last decade (Figure PBF-3). Based on these findings, the following information on the status of the Pacific bluefin tuna stock is provided:
>
> 1. The latest (2018) SSB is estimated to be 4.5% of $SSB_{F=0}$ which is increased from 4.0% in 2016 (Figure PBF-4 and Table PBF-1). No biomass-based limit or target reference points have been adopted for PBF. However, the PBF stock is overfished relative to the potential biomass-based reference points (SSB_{MED} and 20%$SSB_{F=0}$) adopted for other tuna species by the IATTC and WCPFC.
> 2. The recent (2016-2018) $F_{\%SPR}$ is estimated to produce 14%SPR (Figure PBF-4 and Table PBF-2). Although no fishing mortality-based limit or target reference points have been adopted for PBF by the IATTC and WCPFC, recent fishing mortality is above the level producing 20%SPR. However, the stock is subject to rebuilding measures including catch limits and the capacity of the stock to rebuild is not compromised, as shown by the projection results.

In addition, SC16 noted that, although the WCPFC has not established any reference points for PBF, recent fishing mortality is above the level producing 20%SPR, which is the second rebuilding target established by the WCPFC indicating that overfishing is taking place relative to the possible reference point of 20%SPR and some of the other commonly used F-related reference points. SC16 also noted that the projection results, while projected from a single base case model, estimate that the stock may continue to rebuild.

SC16 noted that regarding the probability of meeting the rebuilding targets, the approach taken in this assessment is not based on the structural uncertainty grid approach used to characterize uncertainty in the assessment of other stocks in the WCPO. The majority of CCMs recommend that such an approach is adopted in future, especially when using these models to drive management action.

However, ISC currently does not see the need for structural uncertainty grid because of internally consistency of the assessment model of PBF.

a. Management advice and implications

SC16 noted that the improved recruitment in 2016, relative to recent years, noted by SC14 in the previous assessment has now been followed by two much lower recruitments. Apart from the low recruitment in 2014 these estimated recruitments for 2017 and 2018 are the lowest since the early 1990s, while noting that the recruitment in these years is uncertain. The majority of CCMs noted that, given ongoing uncertainty in the stock-recruitment relationship and the very low levels of current spawning biomass estimated by this assessment (4.5%), future recruitments may remain low until there is sufficient recovery in spawning biomass. Indeed, the increase seen in young fish in recent years may be transient unless followed up with a series of higher recruitments.

While SC16 recognized the existence of an interim Harvest Strategy for this stock, noting ongoing concerns of low stock size, the current level of overfishing relative to the possible reference point of 20%SPR and some of the other commonly used F-related reference points, and uncertain future recruitments, the majority of CCMs reiterate their advice from SC14 and urge the Commission to take a precautionary approach to the management of Pacific Bluefin tuna, especially in relation to the timing of increasing catch levels, until the rebuilding of the stock to higher biomass levels is achieved.

SC16 also noted the following conservation information from ISC:

> After the steady decline in SSB from 1995 to the historically low level in 2010, the PBF stock has started recovering slowly, consistent with the management measures implemented in 2014-2015. The spawning stock biomass in 2018 was below the two biomass rebuilding targets adopted by the WCPFC while the 2016-18 fishing mortality ($F_{\%SPR}$) has reduced to a level producing 14%SPR.
>
> The projection results based on the base-case model under several harvest and recruitment scenarios and time schedules requested by the RFMOs are shown in Tables PBF3 and PBF4. The projection results show that PBF SSB recovers to the biomass-based rebuilding targets due to reduced fishing mortality by applying catch limits as the stock increases (Figure PBF-6). In most of the scenarios, the SSB biomass is projected to recover to the initial rebuilding target (SSB_{MED}) in the fishing year 2020 (April of 2021) with a probability above the 60% level prescribed in the WCPFC CMM 2019-02 (Table PBF-4).
>
> A Kobe chart and impacts by fleets estimated from future projections under the current management scheme are provided for information, (Figures PBF6 and PBF7, respectively). Because the projections include catch limits, fishing mortality ($F_{x\%SPR}$) is expected to decline, i.e., SPR will increase, as biomass increases. Further stratification of future impacts is possible if the allocation of increased catch limits among fleets/countries is specified.

Based on these findings, the following conservation information is provided:

1. Under all examined scenarios the initial goal of WCPFC and IATTC, rebuilding to SSB_{MED} by 2024 with at least 60% probability, is reached and the risk of SSB falling below historical lowest observed SSB at least once in 10 years is negligible.
2. 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 (Figure PBF-7), discards should be considered in the harvest scenarios.

Given the low SSB, the uncertainty in future recruitment, and the influence of recruitment has on stock biomass, monitoring recruitment and SSB should continue so that the recruitment level can be understood in a timely manner.

Table PBF-1. Total biomass, spawning stock biomass, recruitment, and spawning potential ratio of Pacific bluefin tuna (*Thunnus orientalis*) estimated by the base-case model, 1952-2018.

Fishing Year	Total Biomass (t)	Spawning Stock Biomass (t)	Recruitment (1,000 fish)	Spawning Potential Ratio
1952	134,751	103,502	4,857	0.11
1953	136,428	97,941	20,954	0.13
1954	146,741	87,974	34,813	0.08
1955	156,398	75,360	13,442	0.11
1956	175,824	67,700	33,582	0.16
1957	193,597	76,817	11,690	0.11
1958	201,937	100,683	3,195	0.19
1959	209,300	136,430	7,758	0.23
1960	202,121	144,411	7,731	0.17
1961	193,546	156,302	23,339	0.03
1962	176,618	141,277	10,737	0.11
1963	165,892	120,244	28,112	0.07
1964	154,192	105,870	5,696	0.07
1965	142,548	93,222	10,710	0.03
1966	119,683	89,236	8,680	0.00
1967	105,084	83,208	10,897	0.01
1968	91,408	77,466	14,535	0.01
1969	80,523	64,299	6,484	0.09
1970	74,222	53,961	7,027	0.03
1971	66,114	46,839	12,420	0.01
1972	64,114	40,447	23,552	0.00
1973	63,023	35,273	10,968	0.06
1974	64,885	28,502	13,322	0.06
1975	65,074	26,410	11,252	0.08
1976	64,512	29,274	9,253	0.03
1977	74,670	35,105	25,601	0.04
1978	76,601	32,219	14,037	0.06
1979	73,615	27,093	12,650	0.08
1980	72,809	29,657	6,910	0.05
1981	57,482	27,928	13,340	0.00
1982	40,398	24,240	6,512	0.00
1983	33,210	14,456	10,133	0.06
1984	37,464	12,651	9,184	0.05
1985	39,591	12,817	9,676	0.03
1986	34,349	15,147	8,181	0.01
1987	32,008	13,958	6,026	0.08
1988	38,086	14,931	9,304	0.11
1989	41,849	14,839	4,409	0.14
1990	58,122	18,953	18,096	0.18
1991	69,351	25,294	10,392	0.10
1992	76,228	32,252	3,958	0.15
1993	83,624	43,639	4,450	0.16
1994	97,731	50,277	29,314	0.14
1995	94,279	62,784	16,533	0.05
1996	96,463	61,826	17,787	0.09
1997	90,349	56,393	11,259	0.06
1998	95,977	55,888	16,018	0.04
1999	92,232	51,705	22,842	0.04
2000	76,795	48,936	14,383	0.02
2001	78,052	46,408	17,384	0.10
2002	76,110	44,492	13,761	0.06
2003	68,707	43,806	7,110	0.02
2004	66,433	36,701	27,930	0.01
2005	55,778	30,004	15,256	0.01
2006	43,912	24,089	13,660	0.01
2007	43,765	19,061	23,146	0.00
2008	39,646	14,805	21,265	0.01
2009	35,135	11,422	8,002	0.01
2010	38,053	10,837	18,230	0.02
2011	38,901	12,096	12,574	0.05
2012	41,058	14,578	6,845	0.07
2013	49,383	16,703	12,798	0.05
2014	47,864	18,503	3,783	0.09
2015	52,725	21,014	8,778	0.10
2016	62,069	25,009	16,504	0.10
2017	71,228	25,632	6,663	0.17
2018	82,212	28,228	4,658	0.15
Median (1952-2018)	73,615	35,273	11,259	0.06
Average(1952-2018)	86,908	49,388	13,199	0.07

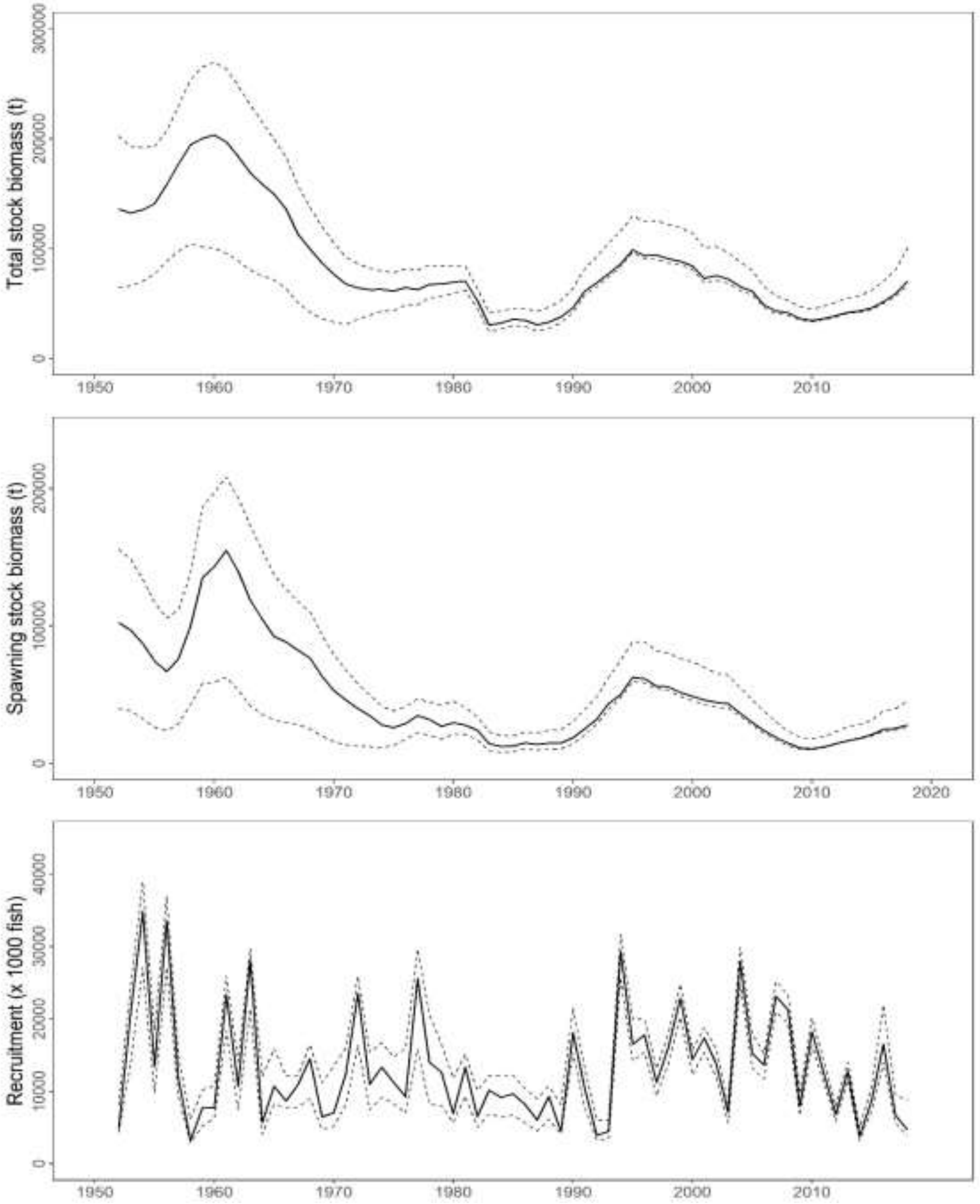

Figure PBF-1. Total stock biomass (top), spawning stock biomass (middle), and recruitment (bottom) of Pacific bluefin tuna (*Thunnus orientalis*) (1952-2018) estimated from the base-case model. The solid line is the point estimate and dashed lines delineate the 90% confidence interval.

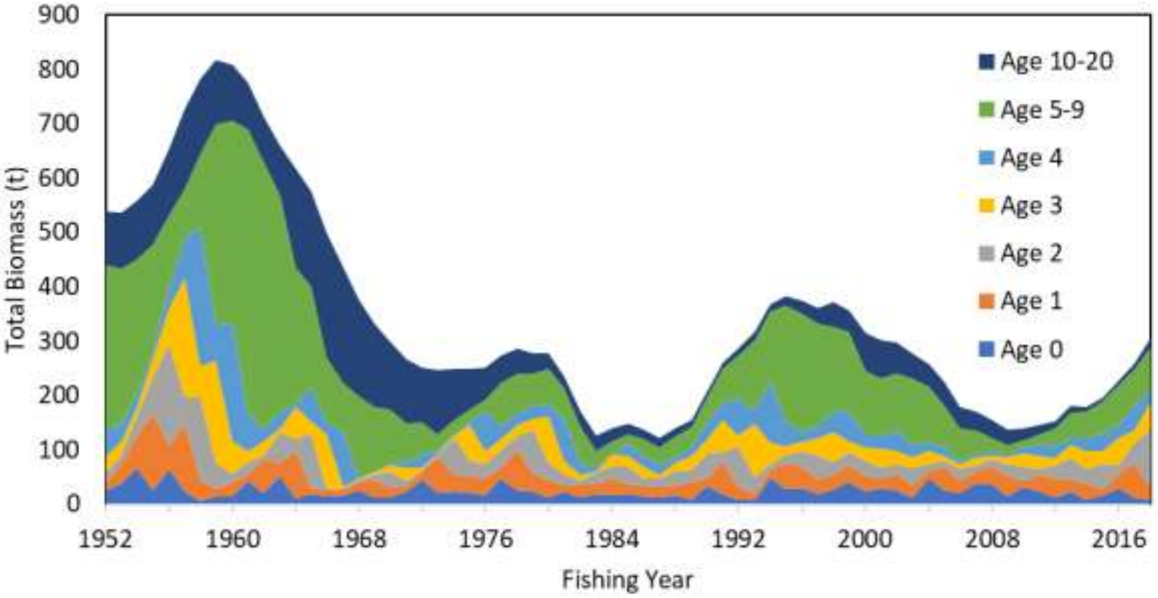

Figure PBF-2. Total biomass (tonnes) by age of Pacific bluefin tuna (*Thunnus orientalis*) estimated from the base-case model (1952-2018).

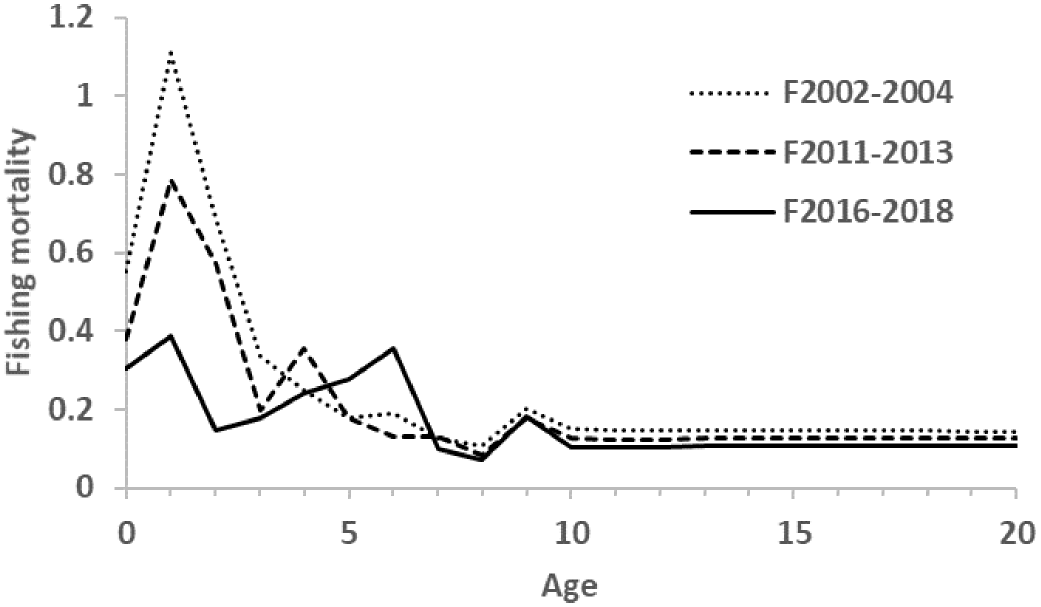

Figure PBF-3. Geometric means of annual age-specific fishing mortalities (F) of Pacific bluefin tuna (*Thunnus orientalis*) for 2002-2004 (dotted line), 2011-2013 (broken line) and 2016-2018 (solid line).

Table PBF-2. Ratios of the estimated fishing mortalities (Fs and 1-SPRs for 2002-04, 2011-13, 2016-18) relative to potential fishing mortality-based reference points, and terminal year SSB (t) for each reference period, and depletion ratios for the terminal year of the reference period for Pacific bluefin tuna (*Thunnus orientalis*) from the base-case model**.** F_{max}: Fishing mortality (F) that maximizes equilibrium yield per recruit (Y/R). $F_{0.1}$: F at which the slope of the Y/R curve is 10% of the value at its origin. F_{med}: F corresponding to the inverse of the median of the observed R/SSB ratio. $F_{xx\%SPR}$: F that produces given % of the unfished spawning potential (biomass) under equilibrium condition.

Reference period				(1-SPR)/(1-SPRxx%)				Estimated SSB for terminal year of each period (ton)	Depletion rate for terminal year of each period (%)
	F_{max}	$F_{0.1}$	F_{med}	SPR10%	SPR20%	SPR30%	SPR40%		
2002-2004	1.92	2.84	1.14	1.08	1.21	1.38	1.61	36,701	5.80
2011-2013	1.54	2.26	0.89	1.05	1.18	1.35	1.57	16,703	2.64
2016-2018	1.14	1.65	0.57	0.95	1.07	1.23	1.43	28,228	4.46

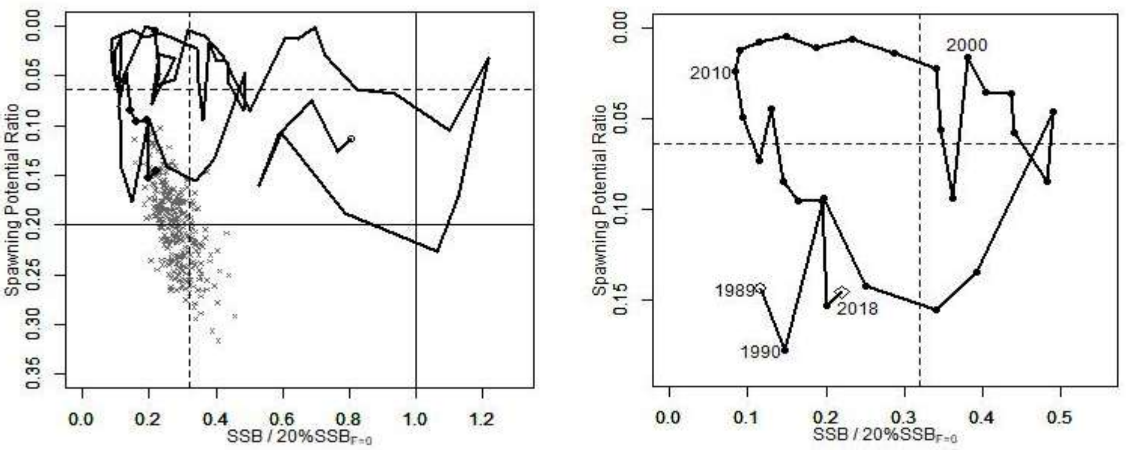

Figure PBF-4. Kobe plots for Pacific bluefin tuna (*Thunnus orientalis*) estimated from the base-case model. The X-axis shows the annual SSB relative to $20\%SSB_{F=0}$ and the Y-axis shows the spawning potential ratio (SPR) as a measure of fishing mortality. Vertical and horizontal solid lines in the left figure show $20\%SSB_{F=0}$ (which corresponds to the second biomass rebuilding target) and the corresponding fishing mortality that produces SPR, respectively. Vertical and horizontal broken lines in both figures show the initial biomass rebuilding target (SSB_{MED} = $6.4\%SSB_{F=0}$) and the corresponding fishing mortality that produces SPR, respectively. SSB_{MED} is calculated as the median of estimated SSB over 1952-2014. The left figure shows the historical trajectory, where the open circle indicates the first year of the assessment (1952), solid circles indicate the last five years of the assessment (2014-2018), and grey crosses indicate the uncertainty of the terminal year estimated by bootstrapping. The right figure shows the trajectory of the last 30 years.

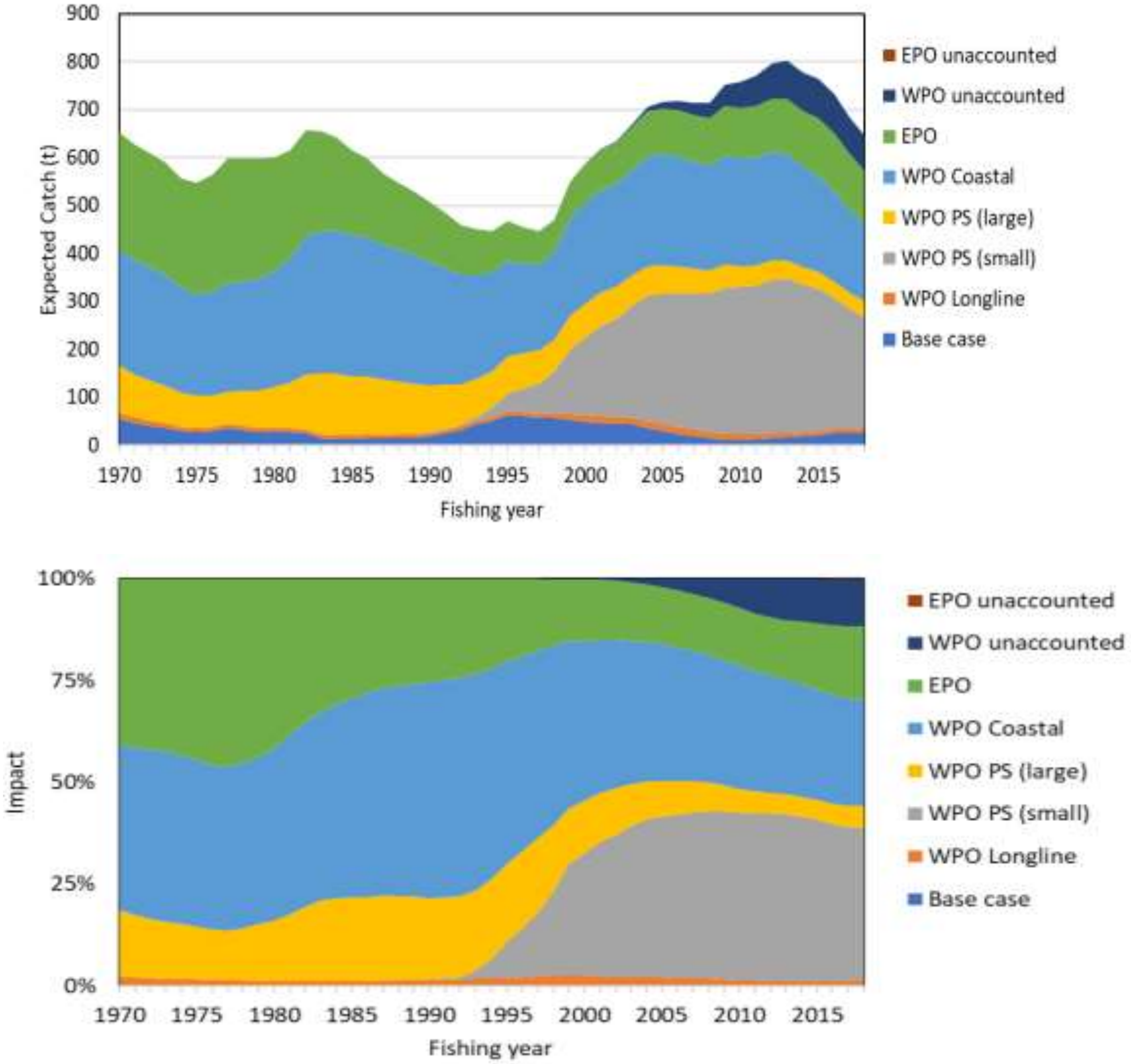

Figure PBF-5. The trajectory of the spawning stock biomass of a simulated population of Pacific bluefin tuna (*Thunnus orientalis*) when zero fishing mortality is assumed, estimated by the base-case model. (top: absolute SSB, bottom: relative SSB). Fisheries group definition; WPO longline fisheries: F1, F12, F17, 23. WPO purse seine fisheries for small fish: F2, F3, F18, F20. WPO purse seine fisheries for large fish: F4, F5. WPO coastal fisheries: F6-11, F16, F19. EPO fisheries: F13, F14, F15, F24. WPO unaccounted fisheries: F21, 22. EPO unaccounted fisheries: F25. For exact fleet definitions, please see the 2020 PBF stock assessment report on the ISC website.

Table PBF-3. Future projection scenarios for Pacific bluefin tuna (*Thunnus orientalis*) and their probability of achieving various target levels by various time schedules based on the base-case model.

scenario #	Upper Limit increase				Probability of SSB is below the Initial rebuilding target at 2024 in case the low recruitment continue	The fishing year expected to achieve the initial rebuilding target with >60% probability	The fishing year expected to achieve the 2nd rebuilding target with >60% probability	Probability of achiving the initial rebuilding target at 2024	Probability of achiving the second rebuilding target at 2034	Probability of SSB falling below the historical lowest at any time during the projection period.	Probability of Catch falling below the historical lowest at any time during the projection period.	Median SSB at 2024	Median SSB at 2034
	WCPO		EPO										
	Small	Large	Small	Large									
1	0%				0%	2020	2026	100%	99%	0%	100%	107,098	286,958
2	0%				0%	2020	2026	100%	99%	0%	100%	104,973	287,020
3	5%				0%	2020	2027	100%	98%	0%	100%	99,968	272,814
4	10%				0%	2020	2027	100%	96%	0%	100%	95,096	258,850
5	15%				0%	2020	2028	99%	94%	0%	100%	90,293	244,959
6	20%				0%	2020	2028	99%	91%	0%	100%	85,618	231,003
7	0%	500	500		0%	2020	2027	100%	98%	0%	100%	99,903	277,396
8	250	250	500		0%	2020	2027	100%	97%	0%	100%	98,164	268,473
9	0	600	400		0%	2020	2027	100%	98%	0%	100%	100,035	278,004
10	5%	1300	700		0%	2020	2027	99%	96%	0%	100%	92,504	259,802
11	10%	1300	700		0%	2020	2027	99%	95%	0%	100%	89,951	249,996
12	5%	1000	500		0%	2020	2027	100%	97%	0%	100%	94,952	264,218
13	0	1650	660		0%	2020	2027	99%	97%	0%	100%	93,897	267,976
14	125	375	550		0%	2020	2027	100%	98%	0%	100%	98,729	272,323
15	0	0	0		0%	2019	2022	100%	100%	0%	100%	221,391	560,259

* The numbering of Scenarios is different from those given by the IATTC-WCPFC NC Joint WG meeting and same as Table 3.

* Recruitment is switched from low recruitment during 1980-1989 to average recruitment over the whole assessment period in the following year of achieving the initial rebuilding target.

Table PBF-4. Expected yield for Pacific bluefin tuna (*Thunnus orientalis*) under various harvesting scenarios based on the base-case model.

scenario #	Upper Limit increase				Median SSB at 2024	Median SSB at 2034	Expected annual yield in 2019, by area and size category (t)				Expected annual yield in 2024, by area and size category (t)				Expected annual yield in 2034, by area and size category (t)			
	WPO		EPO				WPO		EPO		WPO		EPO		WPO		EPO	
	Small	Large	Small	Large			Small	Large	Commercial	Sport	Small	Large	Commercial	Sport	Small	Large	Commercial	Sport
1	0%				107,098	286,958	4,396	5,444	3,310	508	4,583	6,739	3,315	800	4,499	6,871	3,321	1,167
2	0%				104,973	287,020	4,396	6,924	3,541	504	4,580	6,771	3,724	799	4,495	6,851	3,746	1,168
3	5%				99,968	272,814	4,614	7,260	3,468	501	4,809	7,101	3,468	767	4,720	7,187	3,465	1,130
4	10%				95,096	258,850	4,833	7,590	3,633	499	5,038	7,433	3,634	737	4,945	7,523	3,630	1,091
5	15%				90,293	244,959	5,052	7,914	3,797	496	5,267	7,764	3,798	708	5,171	7,859	3,794	1,053
6	20%				85,618	231,003	5,269	8,223	3,964	494	5,493	8,093	3,963	680	5,394	8,195	3,960	1,014
7	0%	500	500		99,903	277,396	4,396	7,411	3,802	500	4,583	7,269	3,803	781	4,497	7,349	3,800	1,150
8	250	250	500		98,164	268,473	4,640	7,172	3,802	499	4,824	7,017	3,802	756	4,734	7,105	3,800	1,118
9	0	600	400		100,035	278,004	4,396	7,506	3,701	501	4,583	7,370	3,703	783	4,496	7,449	3,699	1,152
10	5%	1300	700		92,504	259,802	4,627	8,153	4,003	497	4,814	8,073	4,005	745	4,723	8,156	4,000	1,107
11	10%	1300	700		89,951	249,996	4,858	8,157	4,003	495	5,042	8,074	4,004	721	4,947	8,163	4,000	1,076
12	5%	1000	500		94,952	264,218	4,627	7,881	3,803	498	4,813	7,773	3,805	753	4,722	7,857	3,800	1,115
13	0	1650	660		93,897	267,976	4,396	8,444	3,963	498	4,587	8,426	3,967	769	4,498	8,501	3,960	1,138
14	125	375	550		98,729	272,323	4,517	7,291	3,852	499	4,703	7,142	3,853	767	4,614	7,226	3,850	1,132
15	0%	0%	0		221,391	560,259	0	0	0	0	0	0	0	0	0	0	0	0

* Catch limits for EPO commercial fisheries are applied for the catch of both small and large fish made by the fleets.

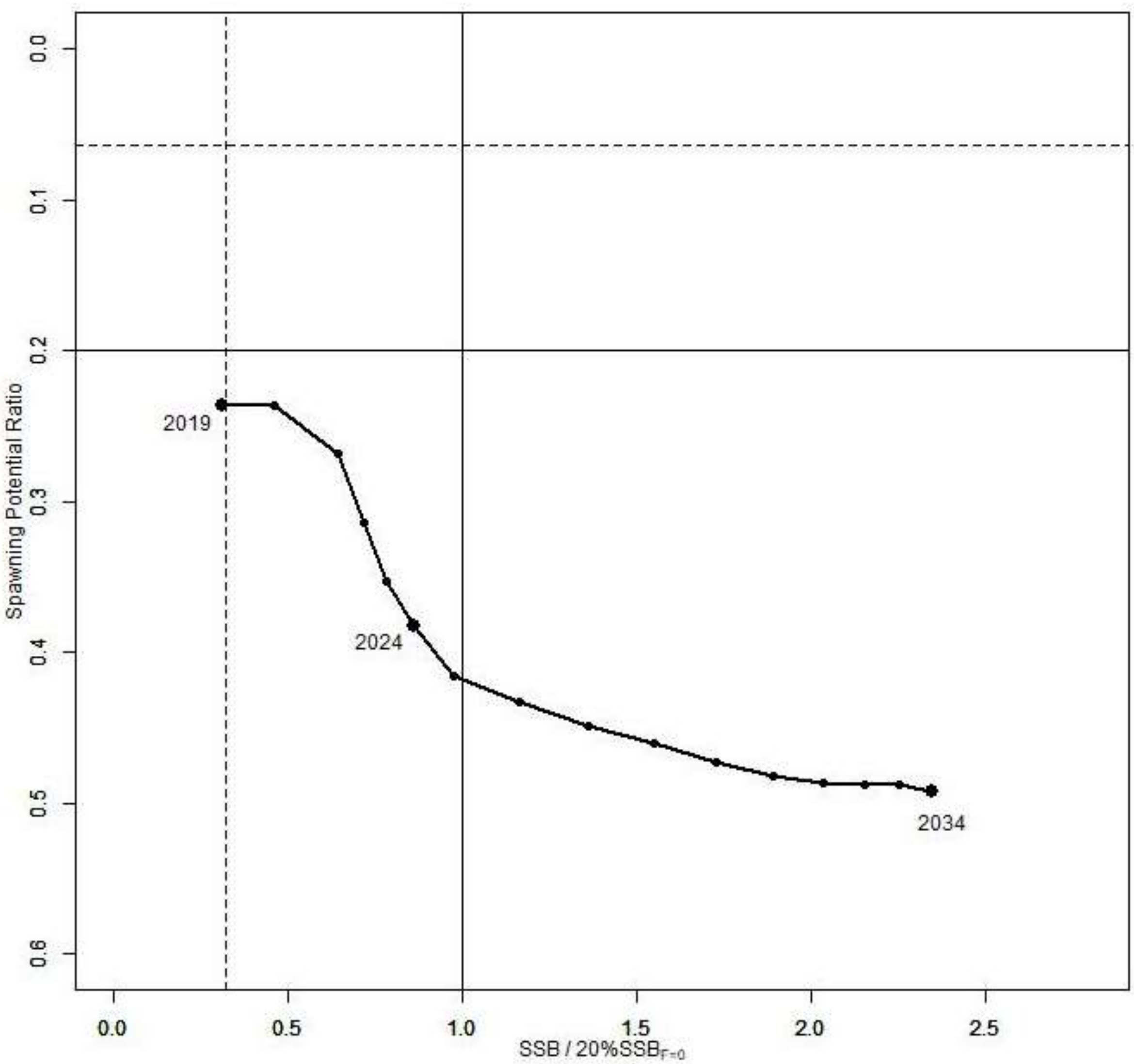

Figure PBF-6. “Future Kobe Plot” of projection results for Pacific bluefin tuna (*Thunnus orientalis*) from Scenario 1 from Table PBF-3.

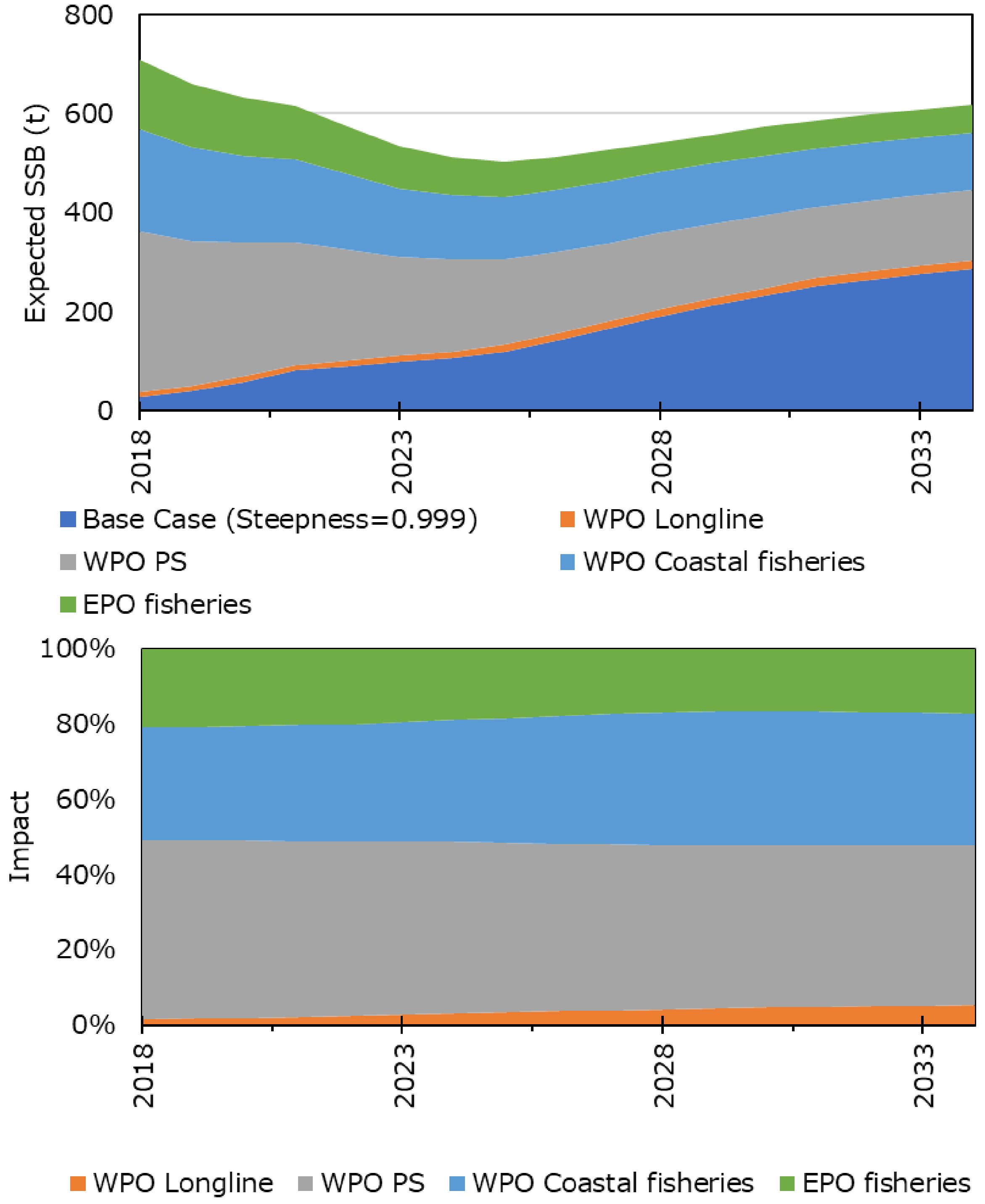

Figure PBF-7. "Future impact plot" from projection results for Pacific bluefin tuna (*Thunnus orientalis*) from Scenario 1 of Table S-3. The impact is calculated based on the expected increase of SSB in the absence of the respective group of fisheries.

Table 38. Estimates of stock status in relation to overfishing and overfished reference points for WPRFMC 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)	$F/F_{MSY}=0.45$	No	No	$SB_{2018}/SB_{MSY}=2.38$, $SB_{2018}/SB_{F=0}=0.41$	No	No	Vincent et al. (2019), SC15 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)	$F_{2014\text{-}2017}/F_{MSY}=0.37$	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	$SB_{2015\text{-}2017}/SB_{MSY}=1.08$, $B_{2015\text{-}2017}/B_{MSY}=1.35$	No	No	Minte-Vera et al. (2018)	0.2-0.7 yr^{-1}	0.5 B_{MSY}
Albacore (S. Pacific)	$F_{2012\text{-}2014}/F_{MSY}=0.20$	No	No	$SB_{2015}/SB_{MSY}=3.42$, $SB_{2015}/SB_{F=0}=0.52$	No	No	Tremblay-Boyer et al. (2018)	0.4 yr^{-1}	0.6 SB_{MSY}
Albacore (N. Pacific)	$F_{2015\text{-}2017}/F_{MSY}=0.60$	No	No	$SB_{2015\text{-}2017}/SB_{F=0}=0.43$	No	No	ISC (2020)	0.4 yr^{-1}	0.6 B_{MSY}
Bigeye Tuna (WCPO)	$F_{2014\text{-}2017}/F_{MSY}=0.74$	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)	$F_{2015\text{-}2017}/F_{MSY}=1.15$	Yes, because F>MFMT	Not applicable	$SB_{2015\text{-}2017}/SB_{MSY}=1.02$, $B_{2012\text{-}2015}/B_{MSY}=0.91$	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 14% SPR	Yes, because F>MFMT	Not applicable	$SB_{2016}/SB_{F=0}=0.043$	Yes, because SSB<MSST	Not applicable	ISC (2020)	0.25-1.6 yr^{-1}	~0.75 B_{MSY}
Blue Marlin (Pacific)	$F_{2012\text{-}2014}/F_{MSY}=0.88$	No	Unknown	$SB_{2012\text{-}2014}/SB_{MSY}=1.25$	No	Unknown	ISC (2016)	0.22-0.42 yr^{-1}	~0.7 SB_{MSY}
Swordfish (WCNPO)	$F_{2013\text{-}2015}/F_{MSY}=0.45$	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)	$F_{2015\text{-}2017}/F_{MSY}=1.07$	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}
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)	$F_{2012\text{-}2014}/F_{MSY}=0.38$	No	Unknown	$SB_{2015}/SB_{MSY}=1.69$	No	Unknown	ISC (2017), BSIA	0.145-0.785 yr^{-1}	~0.8 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
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)	$F_{2013\text{-}2015}/F_{MSY}=0.62$	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
Opah (Pacific)	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Pomfret (family	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
Bramidae, W. Pacific)									
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 2020

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 2016-2020, as reported by NMFS to the WCPFC in April 2021. The catches for 2020 are preliminary.

Table 39. U.S. and territorial longline catch (mt) by species in the WCPFC Statistical Area, 2016-2020

	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**				
	2020	**2019**	**2018**	**2017**	**2016**	**2020**	**2019**	**2018**	**2017**	**2016**	**2020**	**2019**	**2018**	**2017**	**2016**	**2020**	**2019**	**2018**	**2017**	**2016**	**2020**	**2019**	**2018**	**2017**	**2016**	**2020**	**2019**	**2018**	**2017**	**2016**
Vessels	135	138	136	136	133	119	128	121	119	117					118	122	127	113	118	23	11	18	14	15	20	146	156	151	150	151
Species																														
Albacore, NPO	48	88	59	74	208											8	12	11	17	34						57	101	70	90	243
Albacore, SPO																					507	1,050	1,542	1,495	1,527	507	1,050	1,542	1,495	1,527
Bigeye tuna	3,548	3,460	3,393	2,948	3,748	925	999	993	999	879					932	1,563	1,514	798	1,346	586	21	31	53	63	71	6,058	6,005	5,236	5,356	6,216
Pacific bluefin tuna		1		1																			1	2		1	2	1	2	1
Skipjack tuna	125	198	105	155	186											16	28	15	36	26	57	69	76	71	95	198	295	196	262	307
Yellowfin tuna	1,198	1,556	1,868	1,751	1,093											160	220	209	311	175	217	189	261	559	385	1,576	1,965	2,339	2,621	1,653
Other tuna																														
TOTAL TUNA	**4,920**	**5,304**	**5,425**	**4,928**	**5,236**	**925**	**999**	**993**	**999**	**879**					**932**	**1,747**	**1,774**	**1,034**	**1,709**	**821**	**802**	**1,339**	**1,934**	**2,190**	**2,079**	**8,395**	**9,417**	**9,384**	**9,827**	**9947**
Black marlin					1																								1	1
Blue marlin	440	747	529	485	427											44	83	38	87	57	25	29	32	40	30	510	860	598	612	514
Sailfish	5	12	9	9	14											1	2	1	2	2	1	2	1	1	2	7	16	11	12	19
Spearfish	94	154	171	205	251											11	16	15	27	28		2	1	2	2	105	173	187	234	281
Striped marlin, NPO	241	397	332	280	280											47	62	44	50	48						288	458	375	330	328
Striped marlin, SPO																					2	2	1	2	2	2	2	1	2	2
Other marlins	1		1	1	1																					1		1	1	1
Swordfish, NPO	265	510	590	918	596											40	44	41	49	43						306	555	631	967	639
Swordfish, SPO																					2	4	6	6	6	2	4	6	6	6
TOTAL BILLFISH	**1047**	**1821**	**1631**	**1899**	**1570**											**143**	**208**	**138**	**215**	**179**	**29**	**39**	**41**	**51**	**41**	**1,220**	**2,068**	**1,811**	**2,165**	**1,791**
Blue shark																							3	1	1			3	1	1
Mako shark	2	32	36	30	37												3	5	5	9						2	35	42	35	46
Thresher	1	4	2	2	3												1					1	1	2		1	5	2	5	4
Other sharks																														
Oceanic whitetip shark																														
Silky shark																														
Hammerhead shark																														
Tiger shark																														
Porbeagle																														
TOTAL SHARKS	3	36	38	32	40												3	5	6	10		1	4	3	1	3	40	47	41	51
Mahimahi	76	123	155	143	202											11	20	14	23	28	4	2	5	14	4	91	145	174	180	234
Moonfish	198	368	390	257	304											40	59	58	63	74	1	1	1	1	2	238	428	449	322	380
Oilfish	55	89	98	94	160											8	15	14	22	29					2	63	103	112	116	190
Pomfret	157	246	265	260	339											23	29	32	40	46						181	275	298	300	386
Wahoo	239	401	264	217	310											35	60	34	37	47	16	18	31	50	46	290	479	329	304	402
Other fish	1	1	4	2	7												1			1				1	1	2	2	5	3	9
TOTAL OTHER	**726**	**1,228**	**1,177**	**975**	**1,322**											**118**	**184**	**153**	**184**	**224**	**21**	**21**	**37**	**67**	**55**	**865**	**1,433**	**1,367**	**1,226**	**1,601**
GEAR TOTAL	**6,696**	**8,388**	**8,272**	**7,834**	**8,168**	**925**	**999**	**993**	**999**	**879**					**932**	**2,009**	**2,169**	**1,329**	**2,115**	**1,235**	**852**	**1,400**	**2,016**	**2,311**	**2,176**	**10,483**	**12,957**	**12,610**	**13,259**	**13,390**

Table 40. U.S. longline catch (mt) by species in the North Pacific Ocean, 2016-2020

	U.S. (ISC)				
	2020	**2019**	**2018**	**2017**	**2016**
Vessels	147	149	143	145	141
Species					
Albacore, North Pacific	163	104	87	95	248
Albacore, South Pacific					
Bigeye tuna	7,499	7,699	7,593	7,993	8,236
Pacific bluefin tuna	2	2	1	1	0
Skipjack tuna	168	261	150	221	240
Yellowfin tuna	1,762	2,029	2,500	2,594	1,516
Other tuna					
TOTAL TUNA	**9,593**	**10,096**	**10,329**	**10,903**	**10,241**
Black marlin				1	1
Blue marlin	531	901	664	687	562
Sailfish	7	18	13	15	19
Spearfish	116	199	219	303	339
Striped marlin, North Pacific	336	545	465	406	390
Striped marlin, South Pacific					
Other marlins	2	1	1	1	1
Swordfish, North Pacific	541	734	1,052	1,618	1,092
Swordfish, South Pacific					
TOTAL BILLFISH	**1,533**	**2,398**	**2,414**	**3,032**	**2,405**
Blue shark					
Mako shark	16	47	60	71	70
Thresher	3	5	2	4	4
Other sharks					

	U.S. (ISC)				
	2020	**2019**	**2018**	**2017**	**2016**
Oceanic whitetip shark					
Silky shark					
Hammerhead shark					
Tiger shark					
Porbeagle					
TOTAL SHARKS	**19**	**52**	**62**	**75**	**74**
Mahimahi	120	198	227	256	295
Moonfish	740	1,039	1,392	1,040	983
Oilfish	84	140	143	153	218
Pomfret	227	332	389	403	471
Wahoo	335	571	390	357	418
Other fish	2	2	4	3	9
TOTAL OTHER	**1,506**	**2,282**	**2,545**	**2,211**	**2,393**
GEAR TOTAL	**12,653**	**14,827**	**15,350**	**16,220**	**15,113**

Table 41. U.S. longline catch (mt) by species in the Eastern Pacific Ocean, 2016-2020

	All U.S. vessels					**U.S. vessels ≥ 24 m**					**U.S. vessels ≤ 24 m**				
	2020	**2019**	**2018**	**2017**	**2016**	**2020**	**2019**	**2018**	**2017**	**2016**	**2020**	**2019**	**2018**	**2017**	**2016**
Vessels	121	126	121	131	123	27	30	30	29	24	94	96	91	102	99
Albacore, North Pacific	106	4	17	5	6	18	1	3	2	2	88	3	13	3	4
Albacore, South Pacific															
Bigeye tuna	1,462	1,725	2,410	2,700	2,090	351	508	524	491	312	1,111	1,217	1,886	2,209	1,778
Pacific bluefin tuna	1					1									
Skipjack tuna	27	35	30	29	29	4	9	9	5	5	23	26	21	25	23
Yellowfin tuna	404	254	422	532	248	87	75	99	86	34	317	179	323	446	214
Other tuna															
TOTAL TUNA	**2,000**	**2,018**	**2,879**	**3,266**	**2,372**	**461**	**593**	**636**	**583**	**353**	**1,539**	**1,425**	**2,243**	**2,682**	**2,019**
Black marlin						0	0	0	0	0	0	0	0	0	0
Blue marlin	47	71	98	115	78	6	16	11	15	7	41	55	87	100	71
Sailfish	1	4	3	4	2	0	1	1	0	0	1	2	2	4	2

	All U.S. vessels					U.S. vessels ≥ 24 m					U.S. vessels ≤ 24 m				
	2020	**2019**	**2018**	**2017**	**2016**	**2020**	**2019**	**2018**	**2017**	**2016**	**2020**	**2019**	**2018**	**2017**	**2016**
Spearfish	11	28	32	71	60	2	7	7	10	7	9	21	25	61	53
Striped marlin, North Pacific	48	87	90	76	62	11	23	15	10	11	37	64	74	66	52
Striped marlin, South Pacific															
Other marlins		1													
Swordfish, North Pacific	236	179	422	651	453	194	110	215	391	253	42	69	207	260	200
Swordfish, South Pacific															
TOTAL BILLFISH	**343**	**369**	**644**	**917**	**656**	**213**	**158**	**249**	**427**	**278**	**131**	**211**	**395**	**490**	**378**
Blue shark															
Mako shark	14	12	19	35	24	13	8	11	21	10	1	4	8	14	14
Thresher	2	0	0	1	0	1	0	0			0	0		1	
Other sharks															
Oceanic whitetip shark															
Silky shark															
Hammerhead shark															
Tiger shark															
Porbeagle															
TOTAL SHARKS	**16**	**13**	**19**	**36**	**25**	**14**	**9**	**11**	**21**	**10**	**2**	**4**	**8**	**15**	**14**
Mahimahi	33	55	57	89	65	7	14	11	11	10	26	41	46	78	55
Moonfish	502	612	944	720	604	116	196	258	162	99	386	416	686	558	505
Oilfish	20	36	30	37	29	6	10	9	7	6	15	26	22	30	23
Pomfret	47	57	91	103	86	8	17	30	24	10	38	40	61	79	76
Wahoo	61	110	91	103	62	12	33	22	17	12	49	77	69	85	50
Other fish															
TOTAL OTHER	**663**	**870**	**1,215**	**1,052**	**847**	**149**	**270**	**331**	**221**	**137**	**514**	**600**	**884**	**831**	**710**
GEAR TOTAL	**3,022**	**3,269**	**4,757**	**5,272**	**3,899**	**837**	**1,029**	**1,226**	**1,253**	**778**	**2,185**	**2,240**	**3,531**	**4,019**	**3,121**

3 FISHERY ECOSYSTEMS

3.1 2020 COVID IMPACTS

This section on impacts associated with COVID-19 in the Western Pacific region was added to the annual SAFE report this year given the distinctive effects that the pandemic had on both fishing communities and fisheries in the Pacific Islands. The section is not meant to be a permanent fixture in the annual SAFE report, and it will only be included in the future as long as the impacts from COVID-19 remain relevant for the region's fisheries.

3.1.1 SOCIAL IMPACTS

The Pacific Islands Region has experienced a number of unique risks from COVID-19 as well as measures put in place to stop its spread. While the number of COVID-19 cases in the Pacific Island Region have been comparatively few, restrictions on travel and local restrictions on gathering and commerce have had profound effects on local economies, livelihoods, and human well-being. Since March 2020, airlines have significantly limited flights across the Pacific Islands Region, impacting the ability of people to see their loved ones, travel off island for medical treatments, as well as reshaping economies heavily reliant on tourism. Measures to limit community spread such as curfews, limitations on gatherings, and stay-at-home orders have also had a heavy impact on local businesses, and often shifted subsistence practices.

Through it all fisheries communities in the Pacific Islands Region have played a vital role in supporting local food systems, nutrition, food security, and community social cohesion. COVID-19 has amplified these critical roles of fishing in island communities and there is a shared hope for an increased understanding and value of all local fisheries to island communities, economy, and food security for the future.

3.1.2 AMERICAN SAMOA FISHERIES IMPACTS

3.1.2.1 LONGLINE FISHERIES

The American Samoa longline fishery operates out of Pago Pago, American Samoa. In 2019, there were 17 active vessels that took approximately 100 trips, landing approximately 3 million pounds valued at about $4 million. The primary target is albacore tuna, and the fishery delivers primarily to StarKist Samoa. The months of May through July are typically the most productive season for this fishery. The fishery has faced significant economic struggles in recent years, and preliminary 2020 estimates would suggest that despite some reductions in the number of active vessels and fishery performance in 2020 (see Sections 2.1 and 3.2.1). However, local fisheries experts observed that the longline fleet has struggled to recruit fishing crew. Many of the fishing crew originate from Apia in Western Samoa, and travel restrictions prevented international workers from returning to American Samoa. Some longline boats adapted by sharing crew members and hiring locally.

3.1.2.2 SEAFOOD DEALERS/PROCESSORS

StarKist Samoa, the largest local private employer on island with about 2,000 workers, received exempt status from the American Samoa governor's emergency declarations, allowing it to maintain operations that included evening and sometimes weekend shifts (Sagapolutele 2020).

Despite COVID-19 restrictions and challenges to fulfill seafood demand, contributions from US and foreign purse seine vessels allowed fish supply to remain steady throughout 2020 and allowed the plant to operate at full capacity. Flight restrictions to and from American Samoa increased the cost of air freight for the cannery. Additionally, flight restrictions hampered plant maintenance projects, constrained professional service contracts, and disrupted new recruitments for cannery workers. Despite these obstacles, StarKist Samoa continues to play a vital role in the US food supply chain with average annual canned tuna exports to the US of approximately $400 million per year in recent years (American Samoa Department of Commerce 2017). The risk of COVID-19 to cannery operations cannot be overstated, as any positive cases in American Samoa would likely put cannery operations at significant risk and jeopardize the American Samoa economy and the broader US seafood supply chain.

Other fisheries related businesses, such as travel agencies specializing in providing tickets for fisheries workers and observers, were also out of work since the flights stopped in March 2020.

3.1.3 HAWAII FISHERIES IMPACTS

3.1.3.1 LONGLINE FISHERIES

During 2019, there were 150 active longline fishing vessels, landing approximately 26.5 million pounds, valued at nearly $95 million. Despite the pandemic, effort within the fishery during 2020 was quite similar to 2019. In 2020, there were 147 active longline vessels taking a mere 4% fewer trips with 7% fewer sets than in 2019. However, these similarities mask the dilemma that the industry faced by losing money tied up in port or by fishing. Average monthly expenses to tie up vessels are estimated around $10,000-$15,000; most businesses chose to continue fishing.

Fish prices at the Honolulu auction crashed on March 14, 2020 with price declines of nearly 75% the following week, and these historically low prices held through the remainder of the month. The industry immediately self-imposed vessel and landing limits in an effort to buoy prices in the face of the catastrophic reduction in demand. Price improvements for key species (i.e., bigeye and yellowfin tuna) were seen during mid-May through June. However, these price increases may be attributed to a near 50% decline in landing levels due to reduced catch rates and the market working to balance supply with local demand. It should also be noted that, during May and June, there was improved access to mainland markets as states began to open up, paired with the relaxing of local restrictions which helped raise prices for key target species. However, as rising COVID case counts in many states in July and August coincided with heightened restrictions, the industry saw these price increases disappear. August prices were down 25% from baseline averages, highlighting the direct impacts of COVID-19 restrictions on the Hawaii seafood market. As catch rates slowed in July and August, the industry lifted daily landing restrictions in an effort to keep the fishery afloat, and they were not reinstated.

The period of August through December 2020 saw revenues down 29% and prices down nearly 15% from the 5-year baseline average. The most notable development during this period was the reopening of the islands to tourism in late October through the “Safe Travels” Program. The market saw gradual price improvement in mix/whitefish species (i.e., opah, mahimahi, monchong, ono, walu, and billfish species), primarily marketed to the foodservice (i.e., restaurant) sector, although this was coupled with lags in target species prices in late-November through mid-December, dampening industry revenues. In total, 2020 longline fishery revenues were down 30.4% relative a 5-year baseline. These revenue declines, coupled with fixed costs and operational losses, resulted in industry-estimated losses in 2020 upwards of $40 million.

To support the local community and alleviate challenges in matching supply and demand, the Hawaii seafood industry established valuable new partnerships with community organizations during 2020. In late April, the industry donated approximately 2,000 pounds of fresh fish to the Hawaii Foodbank and established an ongoing partnership. In early July, a "fish-to-dish" program was established between the Hawaii Longline Association, the United Fishing Agency (UFA), which runs the Honolulu fish auction, and the Hawaii Seafood Council to distribute fish to people in need in the community. An estimated 350,000 servings of fresh fish were distributed to the community through partner agencies during the five month program.

The long-term financial outlook for the Hawaii longline fishery remains highly uncertain and depends on both local and national recovery efforts. The top COVID-19 related factors affecting business for the Hawaii longline fishing sector in 2020 were:

- Reduction of market prices and landed value
- Reduced market demand from foodservice sector
- Market competition with cheaper foreign imported frozen products
- Reduced opportunities for credit offered by supply companies (e.g., fuel).

3.1.3.2 SEAFOOD DEALERS/PROCESSORS

Throughout 2020 the industry faced significant challenges matching fishery supply with local consumer retail demand. In the early months of the pandemic, fresh air freight capacity for all seafood products was limited, which reduced access to U.S. mainland markets. Loss of direct flights to the east coast and to some cities on the west coast added to shipping times and sometimes increased transportation costs. In an effort to mitigate low prices, some processors began direct marketing to local consumers in an effort to generate cash flow and move product. Competition with cheaper frozen import product inventories also posed a significant short term challenge to the industry due to price competition in local retail markets as communities endured harsh economic conditions and dramatic increases in statewide unemployment stressed food budgets.

The top COVID-19 related factors affecting business for seafood dealers/processors in 2020 were: 1) reduced demand across all markets (i.e., mainland and Hawaii; retail and particularly restaurants), 2) managing inventory (i.e., decreasing storage capacity for fresh local product), and 3) shipping/distribution constraints (i.e., reduction in air cargo capacity as airlines limited flights).

3.1.3.3 CHARTER/FOR-HIRE IMPACTS

The Hawaii charter/for-hire industry was effectively closed for large portions of 2020 (mid-March until the fall) due to social distancing mandates, stay-at-home orders, drastic reduction in visitor numbers (Department of Business, Economic Development & Tourism 2021), visitor quarantine mandates, and suspension of harbor operations and commercial ocean activities, including tournaments (DLNR 2020). Initial charter/for-hire permit restrictions were relaxed in late May/early June, but social distancing and tourism restrictions precluded any significant industry rebound.

During the baseline period of 2015-2019, there was an average of 8,246 charter/for-hire trips per year, and an average of 76 captains active in any given month. Reported charter/for-hire trips in 2020 were down 73% from the baseline average; during the months of April through December, reported charter/for-hire trips were down 90% relative to the baseline. The average number of active captains per month declined 78% during these months as well compared to the baseline. Only 121 charter/for-hire fishing trips were reported statewide between June and August 2020, a 95% decline from the baseline average of just over 2,500 trips taken during peak season.

The 2020 Hawaii International Billfish Tournament was cancelled due to COVID-19, and several local tournaments scheduled between March and July were also cancelled. The 2020 Hawaii Marlin Tournament series was held as scheduled in July through September but with significant reductions in participation from previous years (i.e., about one-third of traditional participation levels) (Tropidilla Productions 2020). The “Safe Travels” program, which began in mid-October, was a critical step to affording access to out-of-state travelers, a key clientele for the Hawaii charter/for-hire industry. COVID-19 and the restrictions in place to mitigate its spread have imposed a catastrophic financial burden on charter operators in Hawaii, and many of them indicate the viability of their operations in the near future is highly uncertain. The severe decline in charter/for-hire trips has also deprived the State of significant economic contributions through supporting industries (Rollins and Lovell 2019; Rollins and Hospital 2019) and the scientific community of valuable tagging data.

3.1.4 DATA COLLECTION IMPACTS

3.1.4.1 AMERICAN SAMOA LOGBOOK COLLECTION

Collection of longline logs in American Samoa was facilitated through a drop box. The port office where the drop box is stationed may have been closed or had additional security at the beginning of the pandemic, but there were no significant impacts to log collection. Wearing appropriate personal protective equipment and social distancing did not impact staff’s ability to physically access the dock, vessels, or captains in American Samoa. As with the Hawaii/California logbooks, data entry was also affected due to the limitations on staff interaction and restrictions on entry to Pacific Islands Fisheries Science Center (PIFSC) facilities.

3.1.4.2 HAWAII/CALIFORNIA LOGBOOK COLLECTION

The PIFSC longline data collection team processes upwards of 20,000 log sheets a year. Normal operations for paper logbooks for the Hawaii-based fleet includes collecting logs from the vessels or drop box, data entry, validation, and processing the data for use in reporting, while electronic submissions only require validation and processing. While there were long-term impacts on the data collection stream for the longline logbooks, the pandemic forced PIFSC to adapt their processes to adhere to safety guidance from both the State of Hawaii and the National Marine Fisheries Service (NMFS).

3.1.4.3 IMPACTS TO DATA COLLECTION, VALIATION, AND PROCESSING OF PAPER LOGS

On March 23, 2020, the Department of Commerce entered a mandatory telework situation, which also coincided with the statewide stay-at-home work-at-home order on March 25. The biggest impact to the data collection was the limitations on interactions between staff and the fishing industry. Throughout 2020, logs were still collected from drop box at the UFA, but staff were no longer able to collect logs directly from the vessels. Staff were also unable to go into the office to conduct data entry until early June, leaving a two and a half month backlog. Data entry resumed after staff were allowed into the office once a week on staggered days, and safes were also purchased in early July for home use to allow data entry staff to take logbooks home and enter data remotely. Logbook validation and error checking requires regular interaction with captains to verify values, but due to safety concerns and NMFS onsite work restrictions, staff refrained from in-person interactions. Any clarifications or corrections that could be made via telephone or email was done so to protect both the staff and industry personnel. There were no significant impacts to further data processing after data entry and validation. Due to ongoing limitations on entry into PIFSC facilities, staff interaction, and additional coordination required, the time needed to complete processing of paper logs increased by one to two weeks.

3.1.4.4 IMPACTS TO DATA COLLECTION, VALIDATION, PROCESSING, AND ROLLOUT OF ELECTRONIC LOGS

The largest impact to electronic reporting was felt during the rollout of the project to the industry. At the start of 2020, PIFSC saw an approximate 40% adoption rating of electronic reporting submissions, but all in person interactions were halted in March of 2020. This included staff interactions with each other as well as industry. Staff could not distribute tablets to vessels, train captains, or provide in-person support, but continued to support users remotely. However, as restrictions loosened and return to onsite work protocols were established, staff were able to hand off tablets safely and continue remote training. Electronic submissions were received by PIFSC throughout 2020 and, as with the paper logs, any verification needed by the fishing industry was conducted mostly through telephone and email. However, there were no significant impacts and no major delays to processing logbooks submitted electronically.

3.1.4.5 IMPACTS OF OBSERVER DATA COLLECTION

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), extended on September 21, 2020 (85 FR 59199), to provide the authority, on a case-by-case basis, to waive observer coverage. 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 Pacific Islands Regional Office (PIRO) Regional Administrator granted waivers on a case-by-case basis consistent with the emergency rule resulting in reduced coverage for the Hawaii deep-set longline fishery for 2020 at 15.25%. Observer coverage was variable throughout the year, and fleet-wide interaction estimates for 2020 may have greater uncertainty than usual.

3.2 2020 FISHERMEN OBSERVATIONS

Fishermen from across the Western Pacific region met with the Council's Advisory Panel on Thursday, February 4 and February 9, 2021 to discuss observations in the fishery during 2020. The COVID-19 pandemic was identified as a driving factor in 2020 playing a large role in fishing motivations, market loss, and ability to fish. From the lockdown of parks and the limiting of number of people allowed to gather, the restrictions in place had a large impact on fishing. On-the-water observations from fishermen in each of the Council's fisheries are provided to provide context to the fishery-dependent data provided in the fishery performance data modules, and vice versa.

3.2.1 AMERICAN SAMOA

American Samoa fishermen reported that the tuna run was late in 2020, and peak catches expected in October did not happen. Large skipjack (20-30 lb) were landed in September and October with sizes dropping thereafter. Fishermen agreed that, on average, skipjack were unusually smaller (5-8 lb) than what was caught in previous years. Blue marlins were hard to come by around the island of Tutuila, and the sizes of landed fish were smaller as well. Shark encounters were more frequent than in previous years and more noticeable at the banks when yellowfin were present.

3.2.2 CNMI

CNMI fishermen also reported pelagic fishery impacts during 2020, particularly due to curfews that were implemented to inhibit the spread of COVID-19. The curfews hampered their ability to catch species such as monchong, which is normally caught at dusk. Another factor that influenced the pelagic fishing activity in the Mariana Archipelago was the high cost of fuel, forcing many fishers to find a balance between going fishing and staying at home. In the CNMI, many opted to stay home, resulting in fewer fishers who went fishing during 2020. The CNMI also had stronger winds and more storms in 2020, which affected fishing as well.

Pelagic fishermen noticed skipjack tuna were harder to find, and they had to travel further out to sea to find them. They observed that about 80% of the skipjack tuna caught were in the 3-5 lb range, which was smaller than the normal 15-20 lb range. They also saw an increase in boats from Guam fishing in waters of the CNMI.

Shark depredation continued in 2020, though some fishermen said they did not encounter as many sharks during 2020 as in the previous years. The fishermen reported they were losing 15 to 20 lures daily to sharks between 2019 and 2020. One fisherman also observed an algal bloom in inshore waters during 2020.

3.2.3 GUAM

Guam fishers attributed challenges in the participation of the pelagic fishery to COVID impacts early in the year as well as to military exercises. Participation increased overall, with more boats on the water. Vendors who purchased fish during 2020 reported buying more pelagic fish and bottomfish from a larger set of fishermen.

Fishermen noted that pelagic catch was not great and noted a reduction in mahimahi catch, but also noted that wahoo was strong. This could be due to mahimahi being caught in the rough water season and the waters were calmer than normal for a longer period of time in 2020. Fishermen also observed that the waters in 2020 were warmer. Kayak fishing increased and, in 2020, reported catching species not normally caught or seen, including a prickly shark and snake mackerel.

3.2.4 HAWAII

The longline fishery experienced consistent tuna fishing through August 2020 after which catch rates dropped off significantly with landings dropping to 5,000 lb per vessel per trip through October 2020. The ‘ahi (yellowfin or bigeye tuna) disappeared in August or fishermen could not find the fish. Fishers speculate that in year’s past, they relied on surface temperatures and their network to get the latest info on where to fish. With the pandemic, there were fewer boats on the water to provide this information and captains had to rely on past knowledge. Vessels fishing on the Cross Seamount noted lots of “red rover” ‘ōpelu, similar to Karnella’s Rover, in the ‘ahi stomachs as well.

The small-boat fishery reported that ‘ahi fishing was variable on Oahu with a good fishing year on the northeast side (Kane‘ohe) but not good on the north shore (Kahuku to Haleiwa) in 2020. O‘ahu fishers reported that most of the ‘ahi caught were mostly males initially early in the season and were smaller (80-110 lb) than normal. Fishers on Oahu heard from Kauai that the ‘ahi came in as early as March-April. A strong run of ‘ahi showed up at FADs X, LL, MM and U for about a month between late May and June and then died off in July. One fisher reported catching male ‘ahi with no stomach content while another reported that some had silver dollar, ama ebi, and lizard fish in the stomach. Maui fishers reported that larger ‘ahi hung around Maui longer into the fall. On Hawaii Island, fishers reported that there were no shibi at the ‘ahi ko‘a on the “grounds” off of Kona since the current turned south (Kau). But said the kampachi cage off of Keahole held large (110+ lb.) yellowfin through the end of 2020. They also reported that aku were hard to find but there were large (15-20+ lb) otaru. Oahu fishers also reported that Kaneohe boats were catching large “otaru size” aku from spring to fall (late April /May to September/October) and when the ‘ahi left in July, boats turned back to catching aku.

Fishing for Ono (wahoo) was good on the eastside of Hawaii Island with a really good bite in Hilo in December 2020. The Ono run was unusually slow everywhere else with mostly smaller than normal fish (under 20 lb) being landed.

Observations on other pelagic species in 2020 seemed to have been similar across the State. The mahimahi (dolphinfish) run was slow with smaller mahimahi (under 15 lb) being landed. Fishers noticed that the run did not come or was weak in the spring (March to May) and trickled in during the summer. Off of windward Oahu, fishers reported that the 30-40 mile offshore current line that would usually have large rubbish holding many mahimahi, only would hold a couple of mahimahi. akule (bigeye scad) and ‘ōpelu (mackerel scad) showed up early in 2020 and in large numbers off of Oahu and Kauai. Large schools continued throughout the year and are still around in some places. One Oahu fishermen noted that the water was full of “bugs” (zooplankton) in early 2020.

Marlin fishing off of Kona was good from June through December with one charter captain landing 40 marlin in 45 days fished. However, fishers noted an increase in shark depredation at the buoys and ledges over previous years.

Pelagic fishers noted that in 2020 the Fish Aggregation Devices (FADs) were breaking off at a higher than normal frequency. Some newly deployed FADs went missing within a few days to a couple of weeks after deployment. There were some speculating about this being attributed to the materials being used from a new vendor, but fishers also noted that there were heavy winds in 2020 in parts of the islands and changes in currents.

COVID-19 played a large impact in pelagic fisheries in 2020 particularly in the market and the economy. Hawaii's longline fishery led the nation in lost revenue with $40 million resulting in new markets such as direct sales to the public by fish wholesalers to help move fish. This in turn provided deep discounts to the community and opened up alternative markets to fishers, including peddling fish on the roadside.

Other pelagic fleets like the charter sector suffered an entire shutdown with permits taken away from March through June and the loss of tourism. While supplemental funding through the Coronavirus Aid, Relief, and Economic Security (CARES) Act helped, many charter operations went out of business and the remainder of the fleet seeing 2-3 boats operating per day whereas it would typically be at least 15 per day. The few vessels operating were owned by off island interest who came over to fish own their own vessels. Owner operated charters have had the hardest time surviving due to the lack of tourist.

In 2020, some islands like Kauai experienced more people fishing but less fish made it to the market as people were feeding themselves or providing for the community. Even those that did supply the markets found that markets would stop taking fish driving excess fish to be given away. Kauai fishers noted that even more fishing would have occurred had there been enough parking for boats at some of the ramps. The regular fishers were often turned away at ramps because of the number of boats that were out fishing during the pandemic. Other areas saw fewer boats due to the confusion about rules during the pandemic, which some fishers reported contributed to a strange feeling to being out alone, seemingly losing a sense of security.

3.3 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 121), which is reflected in local culture, customs, and traditions.

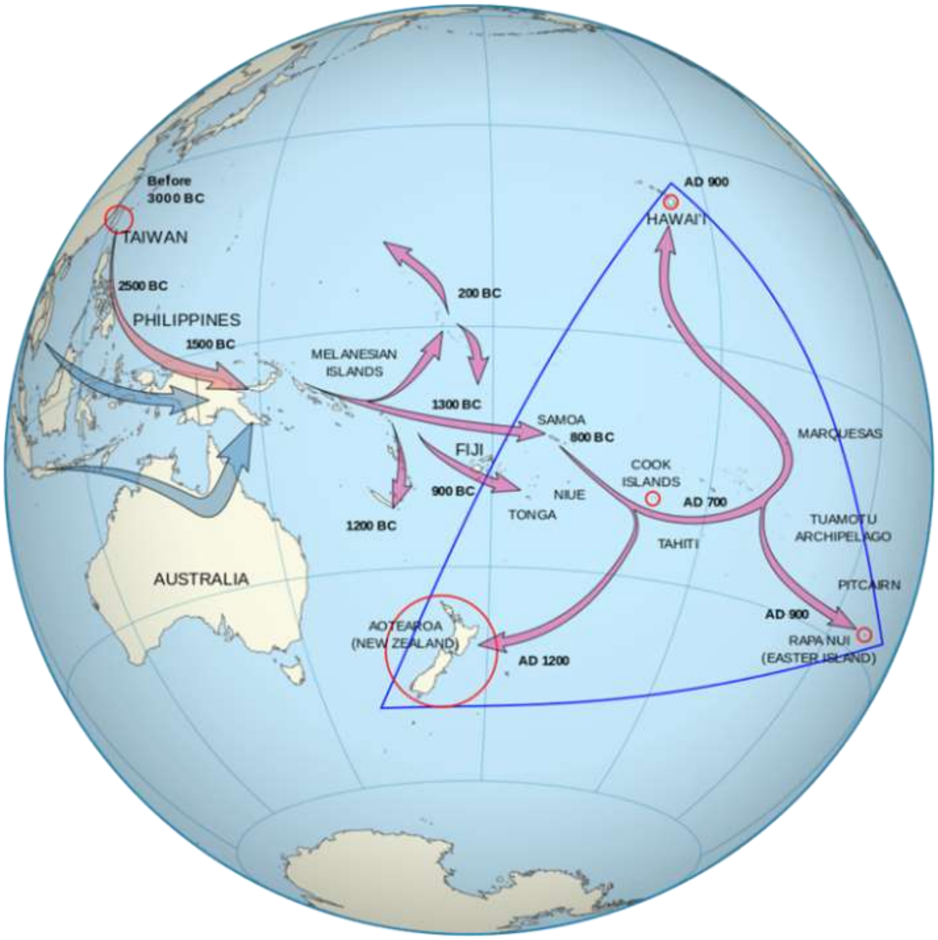

Figure 121. Settlement of the Pacific Islands[1]

[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.

3.3.1 RESPONSE TO PREVIOUS COUNCIL RECOMMENDATIONS

At its 182nd meeting, held virtually in June 2020, regarding COVID-19 impacts, the Council requested NMFS PIFSC to coordinate with territorial agencies and industry representatives to provide market monitoring analyses and demand tracking for each area. PIFSC and Joint Institute for Marine and Atmospheric Research (JIMAR) staff worked closely with industry and community contacts across the Pacific Islands Region during 2020 to understand, monitor, and document pandemic impacts to local communities and fishery sectors. A series of regional COVID-19 impact snapshots were developed during 2020, presented at Council meetings, and can be found in the publication section of this section.

Also at its 182nd meeting, the Council requested NMFS PIFSC provide presentations to the fishing community in the Mariana Archipelago on the research and results from the work that is conducted in the archipelago. In May 2020, JIMAR scientists shared preliminary results from work exploring the socioeconomic context for fisher-shark interactions in the Mariana Archipelago research with study participants using audio-recorded PowerPoint slides, shared via YouTube.

3.3.2 SOCIAL AND CULTURAL ELEMENTS

3.3.2.1 AMERICAN SAMOA

3.3.2.1.1 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 2018), main imports include fish brought in for processing. Exports are primarily canned tuna and by-products, including fish meal and pet food. In 2017, domestic exports (including re-exports) from American Samoa amounted to $309,221,000, of which $307,732,000 (over 99%) was from canned tuna (American Samoa Government, 2018). 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 2017, the ASG employed 5,849 people (36% of total employment; American Samoa Government 2018), and the private sector employed 8,247 people (Figure 122). Supporting data for Figure 122 are provided in Table A-112. The canneries employed 2,312 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.

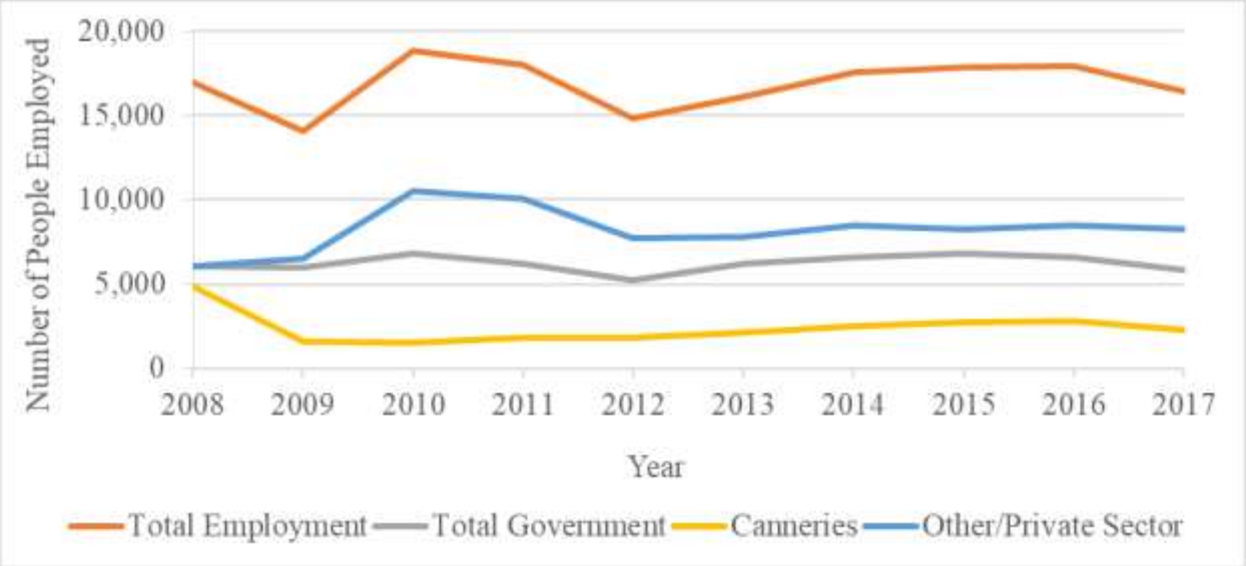

Figure 122. American Samoa Employment Estimates from 2008-2017[1]

[1] Source: American Samoa Government (2018).

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). Tuna cannery closures in American Samoa are likely to have significant impacts on the American Samoa economy and communities, although the specifics have yet to be detailed.

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 have also expressed concerns about the impact of National Marine Sanctuary of American Samoa (NMSAS) expansion and management of the Rose Atoll Marine National Monument. 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).

3.3.2.1.2 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).

3.3.2.1.3 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 Areas (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 reduced to one vessel that still operates.

3.3.2.1.4 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, the alia longlining dropped dramatically since then, and there was only one active alia longlining in 2018. The landings and revenue by alia longline are not included in this section but are included in the American Samoa longline section.

3.3.2.2 CNMI

3.3.2.2.1 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).

3.3.2.2.2 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.

3.3.2.2.3 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. 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. 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.

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.

3.3.2.3 GUAM

3.3.2.3.1 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 lbs. 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.

3.3.2.3.2 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.

3.3.2.3.3 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.

3.3.2.4 HAWAII

3.3.2.4.1 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 2010 Census, the State of Hawaii's population is almost 1.4 million. Ethnically, it has the highest percentage of Asian Americans (38.6%) and Multiracial Americans (23.6%) and the lowest percentage of White Americans (24.7%) of all states. Approximately 21% 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 2016 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 $867.1 million in sales impacts and approximately 9,900 full and part-time jobs that year (NMFS 2018). Recreational anglers took 1 million fishing trips, and 854 full- and part-time jobs were generated by recreational fishing activities in the State. Similarly, the 2011 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation (U.S. Department of the Interior et al. 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.

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 ʻahi poke (bite-sized cubes of seasoned raw tuna) and ʻahi sashimi (sliced raw tuna). ʻAhi 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).

3.3.2.4.2 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 number of participants involved in small boat fishing increased between 2003 and 2013 from 1,587 small boat-based commercial marine license holders to 1,843 (excluding charter, aquarium, and precious coral fisheries, Chan and Pan 2017). Together, these small boat fishermen produced 6.2 million pounds of fish in 2013, with a commercial value amounted to $16 million.

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 42.

Table 42. 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.

3.3.2.4.3 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 Socioeconomics Program 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. Closure of the EEZ could lead to longer trips, which could in turn lead to increased costs and lower quality of domestic product. This could affect domestic market share as well as impacting both seafood safety and safety at sea for domestic fishing vessels.

3.3.2.4.4 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).

3.3.2.4.5 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).

3.3.2.4.6 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).

3.3.2.4.7 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.

3.3.3 ECONOMIC PERFORMANCE OF MAIN COMMERCIAL FISHERIES

3.3.3.1 AMERICAN SAMOA

3.3.3.1.1 American Samoa Longline

3.3.3.1.1.1 Commercial Participation, Landings, Revenue, and Prices

The American Samoa longline fishery includes large longline vessels and small longline vessels (alia boats). During 2020, there were 7 large longline vessels (D class > 70 ft.), 3 C class vessels (50~70), and 1 small (alia) vessel actively fished in American Samoa EEZ. The American Samoa longline fishery mainly targets albacore, different from the Hawaii longline that targets bigeye tuna and swordfish. American Samoa longline, especially the large vessels, sold majority of their catches to the local canneries. The species sold to the local canneries included four tuna species, albacore yellowfin, bigeye, and skipjack, and one non-tuna species (wahoo). In 2020, the total fleet revenue (estimated landed value sold to cannery) was \$2.1 million, which continued declines from previous years. Albacore composed of over 79% of the total landed value in the fishery and the other main species included yellowfin, bigeye, skipjack, and wahoo that were usually sold to local canneries. The estimated value of the four species landed were 15%, 1%, 3%, and 2%, respectively in 2020. The five species composed of over 96% of the total landings by the longline fleet in 2020. Swordfish landings and some wahoo landings might be sold in non-cannery markets, but no detailed commercial data were available. Figure 123 presents the trends of commercial landings and revenue (for cannery only) from 2010-2019. Revenue presented here represents only the landings revenue sold to canneries. Supporting data for Figure 123 are provided in Table A-113.

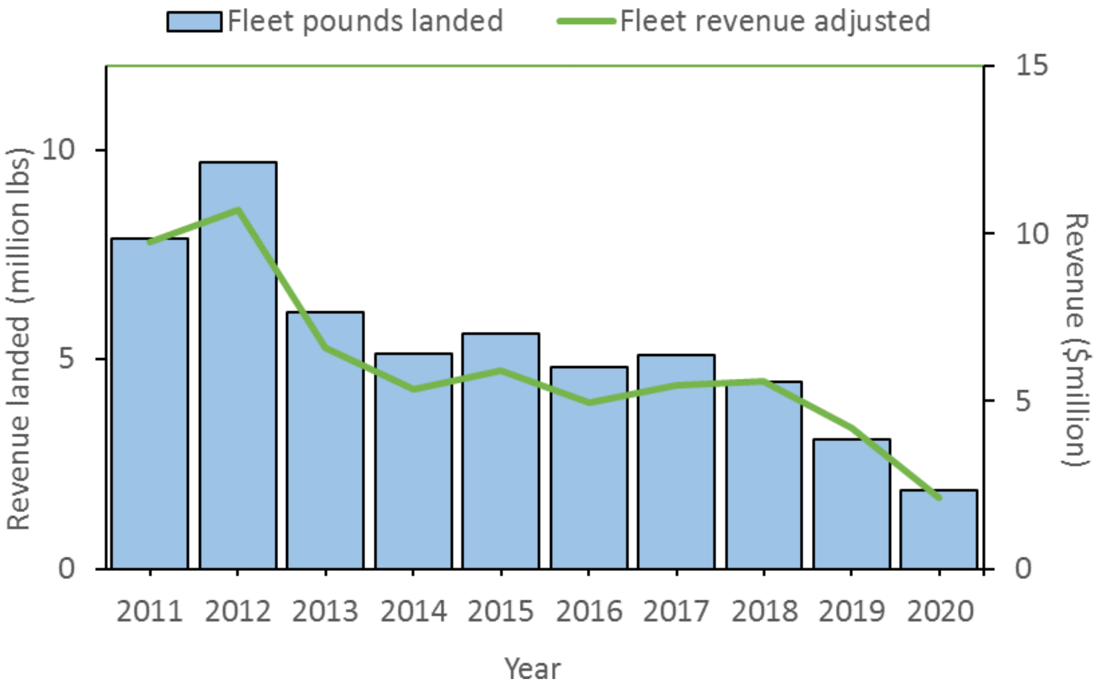

Figure 123. Commercial landings and revenues of the American Samoa longline fishery from 2011-2020 adjusted to 2020 dollars[1]

[1] Data source: Pacific Islands Fisheries Science Center: Fishery Economic Performance Measures (Tier 1 indicators). https://inport.nmfs.noaa.gov/inport/item/46097. CPI 2020 was not available at the reporting time, assumed as no change to 2019.

Fish price data for the five main species harvested by American Samoa longline were collected through annual in-person interviews with owners or agents of the fishery since 2012. In 2020, fish price information was collected and provided by the NMFS observer program while no in-person surveys were conducted in the field. The trend of albacore price from 2012 to 2020 is presented in Figure 124. Supporting data for Figure 124 are presented in Table A-114. The albacore price was in the lowest in 2013, dropping from the second highest peak in 2012. The albacore price went up in 2018 substantially, because American Samoa-based US longline fleet had secured certification from the Marine Steward Council (MSC) and the Starkist Co., which led to the higher albacore price with additional $200 per metric ton for vessel that fish exclusively in the American Samoa EEZ provided through the MSC program. The nominal average albacore price in 2019 reached a historical high, $1.61 per pound (whole weight, or $3,542 per metric ton). However, albacore prices went down in 2020, $0.11 per pound lower than that in the previous year, but the 2020 albacore price was still higher than the historical high price in 2012 (in nominal terms). Table A-114 also shows the average fish price of all species sold to canneries.

Figure 124. Albacore whole-weight price as reported by American Samoan fishers for 2012-2020 adjusted to 2020 dollars[1]

[1] Data source: PIFSC Continuous Economic Data Collection Program (Pan 2018). CPI 2020 was not available at the reporting time, assumed as no change for 2020.

3.3.3.1.1.2 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. Often it was 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).

However, cost data from 2020 were not available because there were no in-person surveys conducted in 2020 due to the pandemic status and travel restrictions. Therefore, cost and net revenue data presented here are for 2010-2019, without updated information of 2020. Figure 125 shows the cost structure for an average trip of American Samoa longline in 2019, while Figure 126 presents the trends of costs per set for the period of 2010-2019. The data supporting Figure 126 are presented in Table A-115. Using the average cost per set can be a better index to examine the cost trend across the years, because the average trip length (total trip days) for the American Samoa longline fleet varied substantially over the years. Fuel costs usually comprise about 50% of trip costs. The share of fuel costs to total trip costs were relatively lower in 2015-2017, compared to previous years, due to lower fuel prices. Thus, the total fishing costs (per set) were also relatedly lower in 2015-2017. However, the cost per set in 2019 was lower than 2018 as Figure 126 shows, due to the slightly lower fuel price $2.66 in 2019 compared with $2.68 per gallon in 2018.

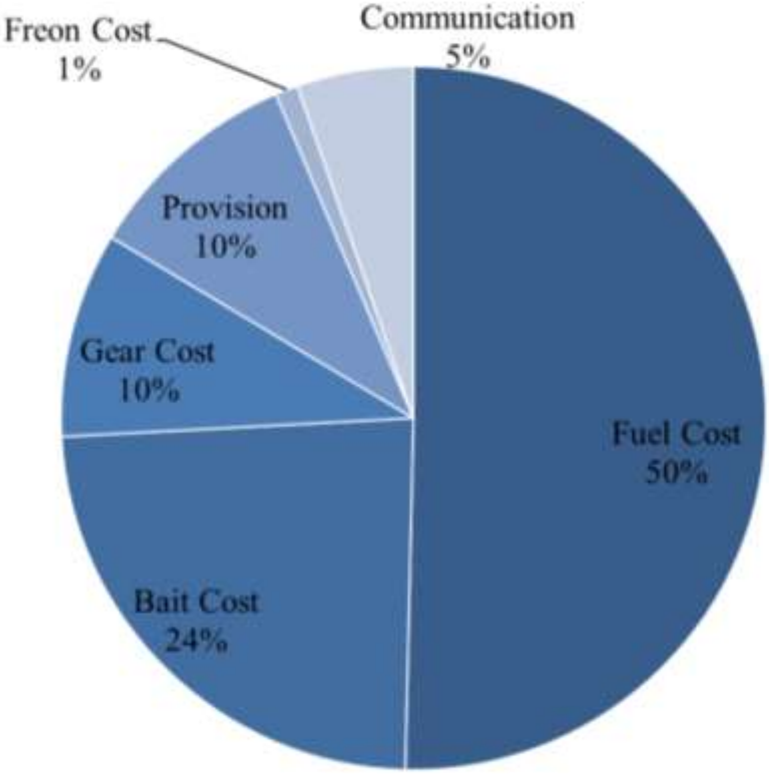

Figure 125. The cost structure for an average American Samoa longline trip in 2019[1]

[1] Data source: PIFSC Continuous Economic Data Collection Program (Pan 2018). CPI 2019 was not available at the reporting time, assumed as no change for 2019.

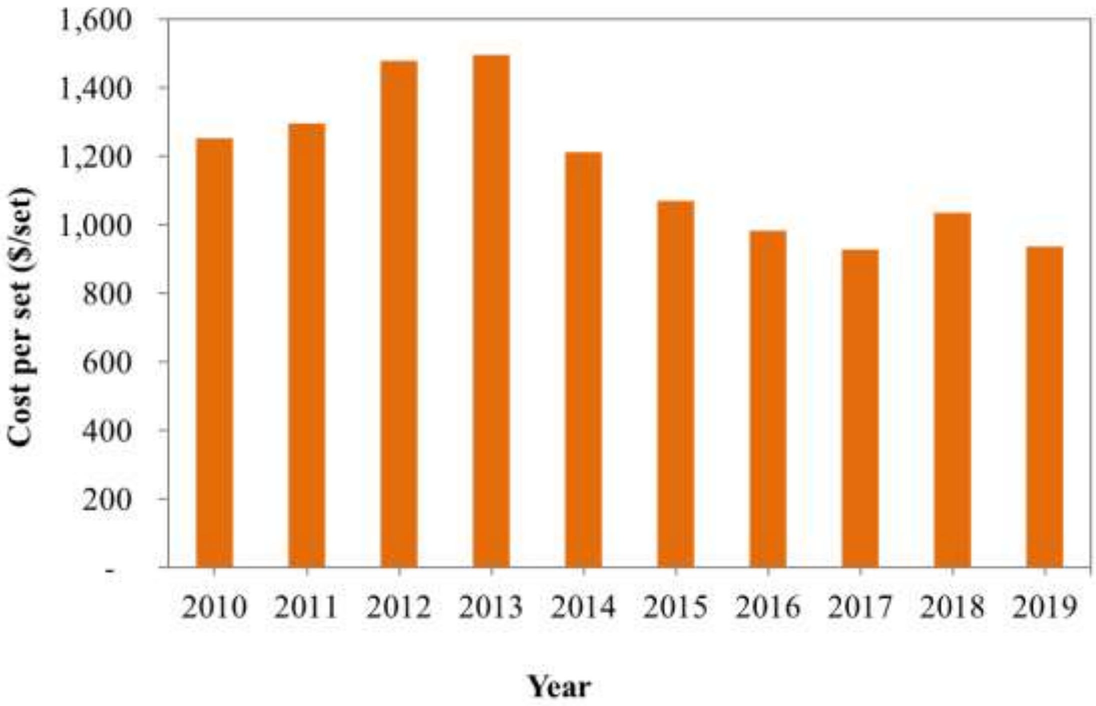

Figure 126. Costs per set[1] for the American Samoa Longline Fishery (not including labor cost and fixed costs) from 2010-2019 adjusted to 2019 dollars[2]

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

[2] Inflation-adjusted revenue (in 2019 dollars) uses the American Samoa CPI published in http://doc.as.gov/research-and-statistics/statistical-yearbook/ for 2010-2019. CPI for 2019 was not available at the reporting time, assumed as no change for 2019.

3.3.3.1.1.3 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 127 presents trends in net revenue per set for the period of 2010 to 2019. The data supporting Figure 127 are in Table A-115. Using the average per set can be a better index, compared to the average per trip, to present the revenue and cost trends for comparisons across the years, because the average trip length (total trip days) for the American Samoa longline fleet varied substantially over the years. Figure 127 shows a downward trend in the economic performance (net revenue) during 2009-2013 but recovered since 2014 and continued to improve to 2019.

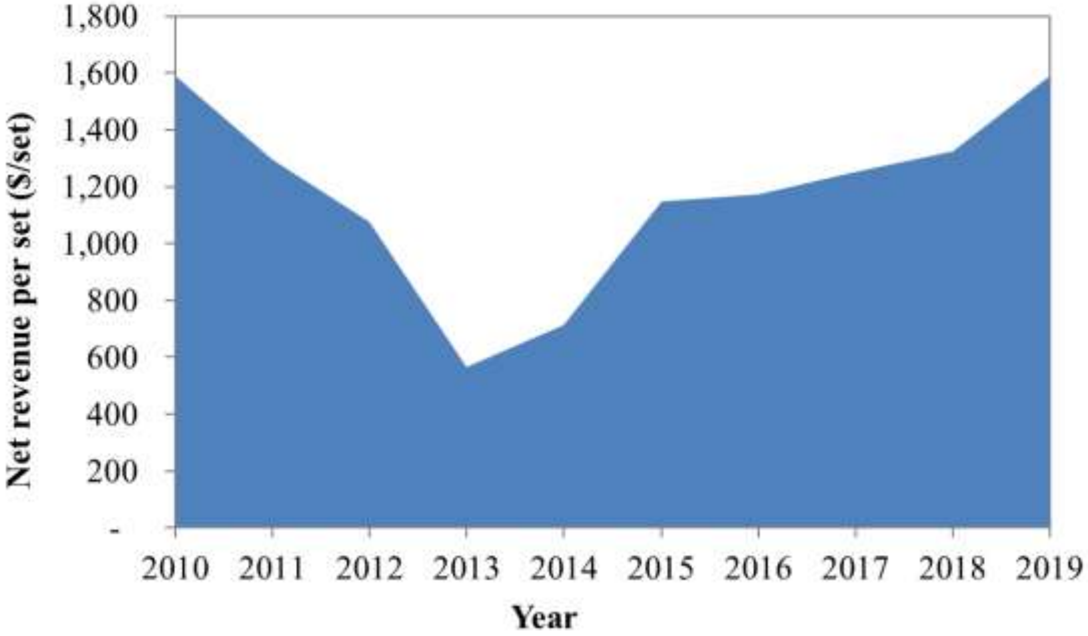

Figure 127. Net revenue per set for the American Samoa longline fishery from 2010-2019 (adjusted to 2019 dollars)[1]

[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 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 128, while the trends in revenue distribution (Gini coefficient) are shown in Figure 129. Supporting data for the two charts are provided in Table A-116. The revenue per-day-at-sea was in a declining trend in American longline fishery during 2009 to 2013, and relatively flat since then. The revenue per-day-at-sea in 2019 and 2020 went down compared to 2018, and the lowest revenue per-day-at-sea appeared in 2020, probably due to low CPUE performance (referred to the fishery performance module). The annual revenue per vessel in 2019 and 2020 also went down considerately, compared to 2018. The Gini coefficient in 2019 went up dramatically compared to 2018, indicating the uneven changes of the economic performance in 2019 among vessels in the fleet. The Gini coefficient of 2020 went down to the average value.

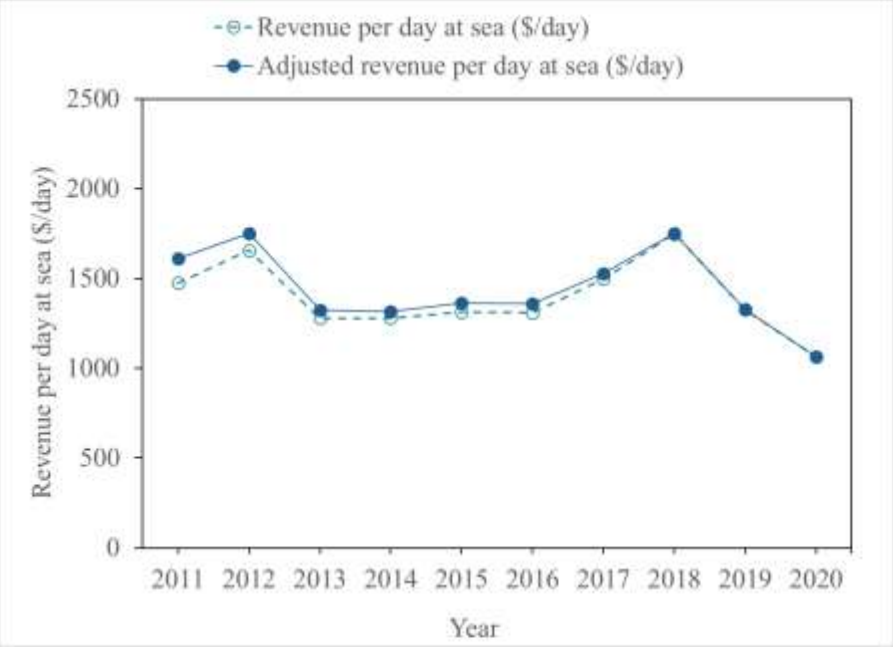

Figure 128. Revenue per-day-at-sea for the American Samoa longline fishery, 2011-2020[1]

[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.

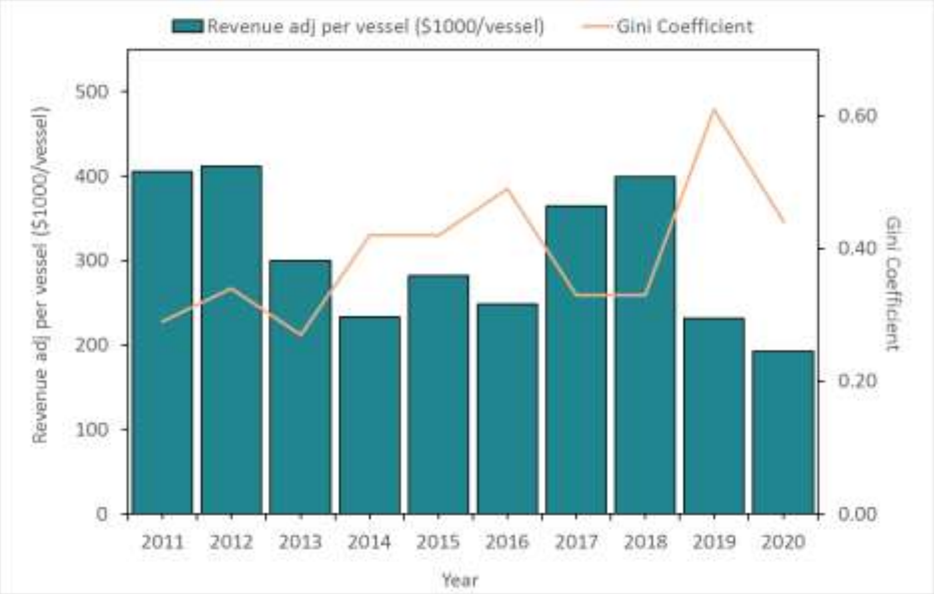

Figure 129. Revenue distribution (revenue per vessel and Gini coefficient) for the American Samoa longline fishery, 2011-2020[1]

[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. CPI 2020 was not available at the reporting time, assumed as no change to 2019.

3.3.3.1.2 American Samoa Trolling

3.3.3.1.2.1 Commercial Participation, Landings, Revenue, and Prices

This section will describe trends in commercial participation, landings, revenues, and prices for the American Samoa troll fishery. The PMUS harvested by *alia* longliners are not included in this section due to data confidentiality considerations as the number of active vessels are less than 3. Figure 130 presents the trends of revenue and pounds sold of the troll fishery for American Samoa for 2011-2020 and Figure 131 presents the price trend of the pelagic price for the PMUS sold by the trollers during 2011-2020. Supporting data for Figure 130 and Figure 131 are presented in Table A-117. In 2020, PMUS pounds sold by trolling (including trolling from mixed gear trips) were the lowest during the past 10 years, less than 2,000 lbs. (valued at $6,440), down from 13,892 lbs. in 2019. On average, the pounds sold were 38% of the total landings during 2011-2019, but it was only15% in 2020. With lower total PMUS landings in 2020, declining 36% from 2019, total commercial landings decreased substantially. Pelagic fish price on average was in an increasing trend since 2015 and the 2020 PMUS price was also higher compared to 2019. Yet, with the low commercial landings, revenues in 2020 were at their lowest level during 2011-2020.

It is worth noting that the data for pounds caught and pounds sold are collected by two different data collection methods. The data of pounds sold were collected through “Commercial Sales Receipt Books” Program and expanded to 100% based on the dealer reports and ratio of reporting, while the data of pounds caught were collected through “Boat-based Creel Survey” and “Shore-based Creel Survey” and expanded to the estimated total. 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 across individual years. Therefore, the two time-series may not move coherently to 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. 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, 2020.

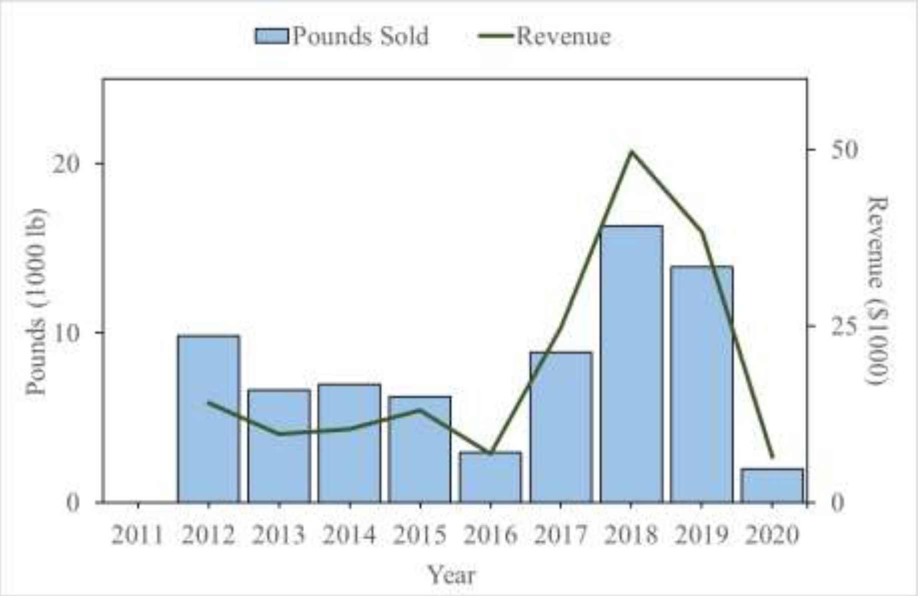

Figure 130. PMUS pounds sold and revenue trend by trolling gear from 2011-2020 adjusted to 2020 dollars[1]

[1] Data sourced from the Pacific Islands Fisheries Science Center. Sale data of 2011 is not available. CPI 2020 was not available at the reporting time, assumed as no change to 2019.

Figure 131. The real and nominal price of PMUS for fish sold by trolling gear from 2011-2020 adjusted to 2020 dollars[1]

[1] Data sourced from the Pacific Islands Fisheries Science Center. Sale data of 2011 is not available. CPI 2020 was not available at the reporting time, assumed as no change to 2019.

3.3.3.1.2.2 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 132 presents the average trip costs for American Samoa troll trips, 2011–2020 (adjusted to 2020 dollars). Supporting data for Figure 132 are presented in Table A-118. In general, the fishing costs of an average troll trip slightly declined during the period of 2011-2016, mainly as a result of the decrease of fuel costs. The average trip costs for a troll trip went up again since 2016 and it was $120 in 2019. However, it went down to $99 in 2020.

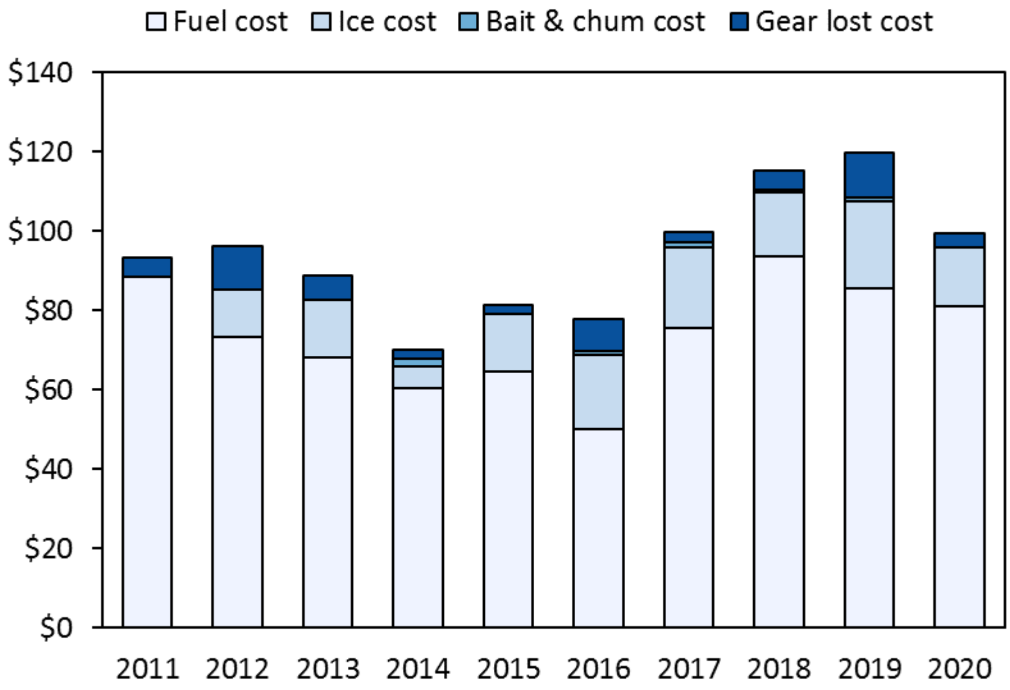

Figure 132. Average trip costs for American Samoa trolling trips from 2011–2020 adjusted to 2020 dollars[1]

[1] Data sourced from Chan and Pan (2019a). CPI 2020 was not available at the reporting time, assumed as no change to 2019.

3.3.3.2 CNMI

3.3.3.2.1 CNMI Trolling

3.3.3.2.1.1 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 of pounds sold by gears are not available for CNMI. Figure 133 and Figure 134 present the trends of total pounds sold and revenue for all PMUS for CNMI from 2009 to 2018. Supporting data for these two figures are presented in Table A-119.

Pelagic fishing is an important commercial fishery in CNMI. Almost half a million pounds of pelagic species are landed annually, about 46% went to markets during 2011-2020 (50% if not counting 2020). In 2020 total PMUS landings were higher than previous years but the commercial landings were lower than previous years as less fish caught went to markets, mostly due to the pandemic. The total pounds landed was 689 thousand pounds, but only 150 thousand pounds, 22% of total landings, were sold in 2020. The average pelagic fish price had been in an increasing trend from 2011 to 2019, but price dropped in 2020. Due to decreasing of both price and commercial landings, revenue went down in 2020.

It is worth noting that the data for pounds caught and pounds sold are collected by two different data collection methods. The data of pounds sold were collected through “Commercial Sales Receipt Books” Program and expanded to an estimated total. While the data of pounds caught were collected through “Boat-based Creel Survey” and “Shore-based Creel Survey”. 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 to 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.

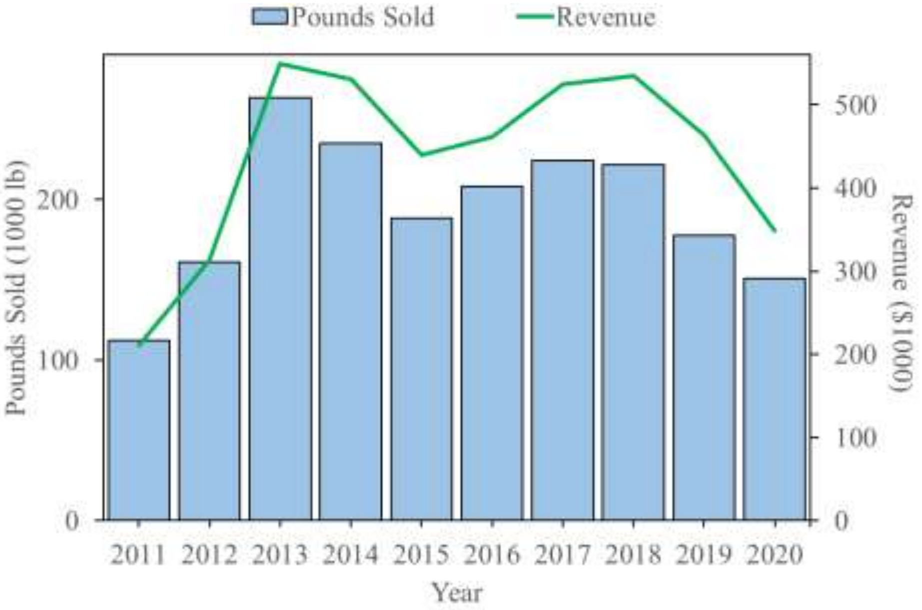

Figure 133. Total PMUS annual pounds sold and revenues in the CNMI for all gears from 2011-2020 adjusted to 2020 dollars[1]

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

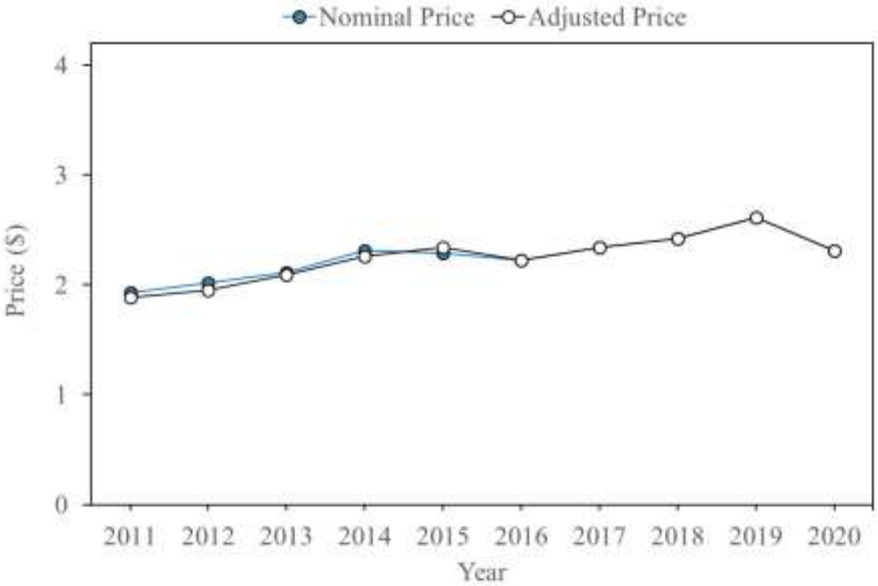

Figure 134. Real and nominal prices of PMUS for fish sold by all gears from 2011-2020[1]

[1] Data sourced from the PIFSC FRMD. CPI information of CNMI is not available since 2016, and it was assumed no change for these years.

3.3.3.2.1.2 Fishing Costs

Since 2009, the PIFSC Socioeconomics Program has maintained a continuous economic data collection program on 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 135 presents the average trip costs for CNMI troll trips from 2011 through 2020 (adjusted to 2020 dollars). In general, the fishing costs of trolling trips showed small changes across years. It moved up and down slightly mainly with the changes of fuel costs. In 2020, the average trip costs of trolling trips were around $73, slightly lower than 2019. Fuel was the main components of the trolling trip costs. Supporting data for Figure 135 is presented in Table A-120.

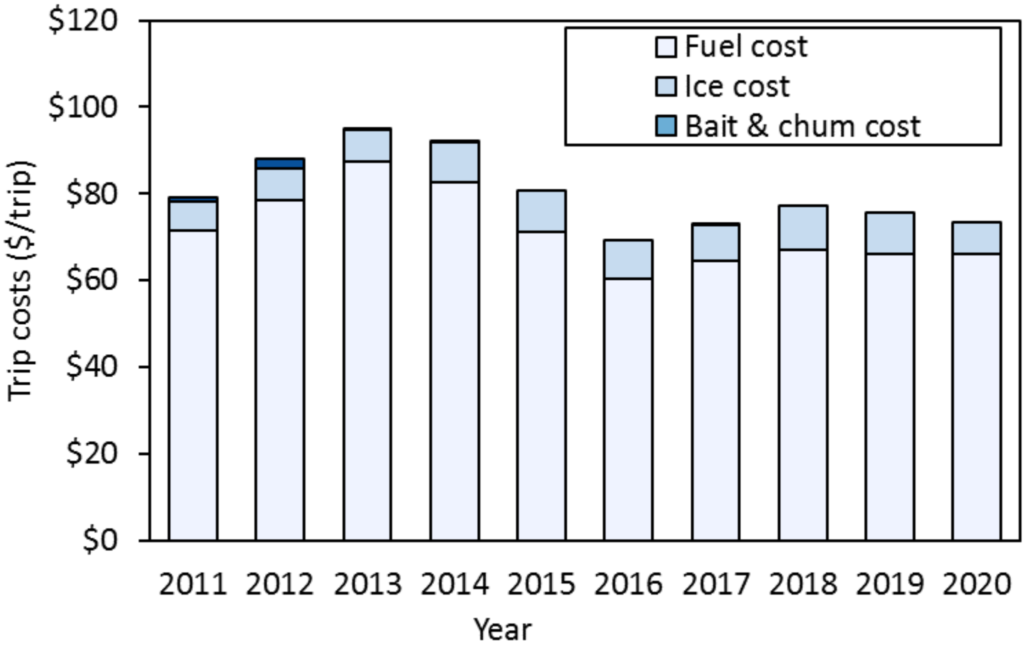

Figure 135. Average cost for CNMI trolling trips from 2011-2020 adjusted to 2020 dollars[1]

[1] Data sourced from PIFSC Continuous Cost Data Collection Program (Chan and Pan 2019a). CPI information of CNMI is not available since 2016, assuming no change for these years.

3.3.3.3 GUAM

3.3.3.3.1 Guam Trolling

3.3.3.3.2 Commercial Participation, Landings, Revenue, and Prices

This section will describe trends in commercial landings, revenues, and prices of PMUS in Guam. Figure 136 presents the trends of pounds sold and revenue of PMUS in Guam fisheries and Figure 137 presents the trend of PMUS price during 2011 to 2020. Supporting data of Figure 136 and Figure 137 are shown in Table A-121.

Pelagic fishing is an important fishery in Guam, and the average annual total pounds landed were near 726 thousand pounds in the past 10 years. The pounds sold, estimated by commercial receipt books, was only a small percentage of pounds landed. During 2011-2020, pounds sold was 17% of the total pounds landed, while it was only 11% in 2020. Figure 136 shows a generally declining trend of PMUS pounds sold and revenue in Guam up to 2019, but it dropped considerately in 2020. Total commercial PMUS landings were only 49% of 2019 level, while total landings of 2020 were 81% of 2019 level. While total PMUS landings wend down 19%, the portion of fish caught went to markets was even less. During 2011-2019, approximately 17% of PMUS caught were sold, but only 11% of fish caught were sold in 2020. The average price of all PMUS was relatively flat over the ten year period and the price increased slightly in 2020, $2.39 per pounds in 2020.

It should be noted that the data for pounds caught and pounds sold are collected by two different data collection methods. The data of pounds sold were collected through “Commercial Sales Receipt Books” Program, while the data of pounds caught were collected through “Boat-based Creel Survey” and “Shore-based Creel Survey”. 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 to 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.

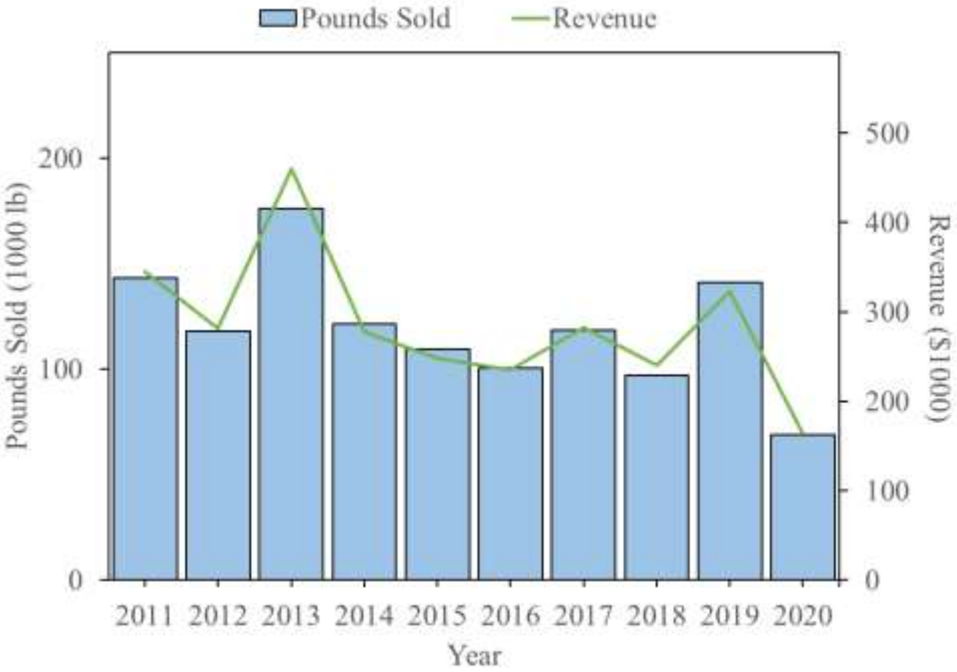

Figure 136. Total PMUS annual pounds sold and revenue in Guam from 2011-2020 adjusted to 2020 dollars[1]

[1] Data sourced from PIFSC FRMD.

Figure 137. The real and nominal prices of PMUS sold by all gears in Guam from 2011-2020[1]

[1]Data sourced from PIFSC FRMD.

3.3.3.3.3 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 138 shows the trend of trip costs of trolling trips in Guam. It seems that fishing costs moves up and down across years mainly due to the fuel cost changes. The average cost of trolling trips in 2020 was $81 in Guam, which was lower than that in the previous year mainly due to lower fuel cost. Supporting data for Figure 138 are presented in Table A-122.

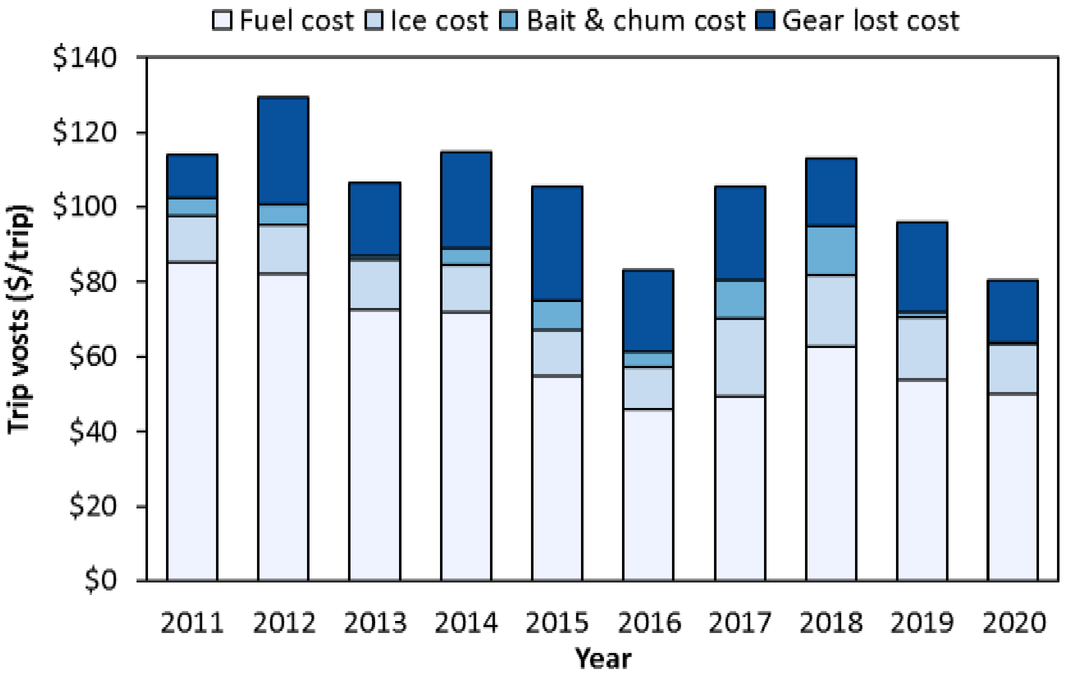

Figure 138. Average cost for Guam troll trips from 2011–2020 adjusted to 2020 dollars[1]

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

3.3.3.4 HAWAII

3.3.3.4.1 Hawaii Longline

3.3.3.4.1.1 Commercial Participation, Landings, Revenue, and Prices

The Hawaii permitted longline fishery conducts two types of fishing to target the pelagic species of 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 in the West Coast. During the period of 2011-2020, the fish landed and sold in the West Coast had increased gradually except 2020. Based on the dealers' reports, approximately $1.7 million of revenue (0.6 million pounds sold) were generated from West Coast, while the revenue sold in Hawaii was $72 million (21 million pounds sold). Due to the concerns of incomplete market reports, the total revenue trend of the Hawaii longline presented in this report were generated from total estimated pounds kept and the fish price from the Hawaii dealers, intended to cover all fish value including fish landed and sold in Hawaii markets as well as in the other markets such as West Coast.

The total active number of vessels landed fish in 2019 was 146. The fleet generated total revenue presented in Figure 139, which included the estimated revenue generated from pounds kept (and assuming 100% pounds kept were sold) and fish price information from HDAR dealer reports. The pounds sold in Hawaii markets reported from the HDAR dealers only accounted for 80% of the total estimated pelagic landings by the entire fleet in 2020. In general, the total estimated revenue of the Hawaii permitted fleet shows an upward trend for the period of 2011-2018, but down in recent two years, particularly in 2020. Estimated pounds kept/sold in 2020 in Hawaii market were 27 million pounds, valued at $80 million and priced at $2.96/lb. in average. Thus, the total estimated revenue of 2020 was $19 million less than 2019, and $30 million less than the historical high. Obviously, the impacts of the 2020 pandemic were significant in term of revenue loss. Taking pre-invested fixed costs into consideration, losses would be greater. This report only covers revenue and trip costs since the detailed information of these two variables were available. Supporting data of Figure 139 are presented in Table A-123. If including the fixed costs (such as vessel expenses and flat paid labor costs which were not available in detail to present here) into the cost-earnings balance sheet, the impacts to the longline industry due to the pandemic would be even bigger.

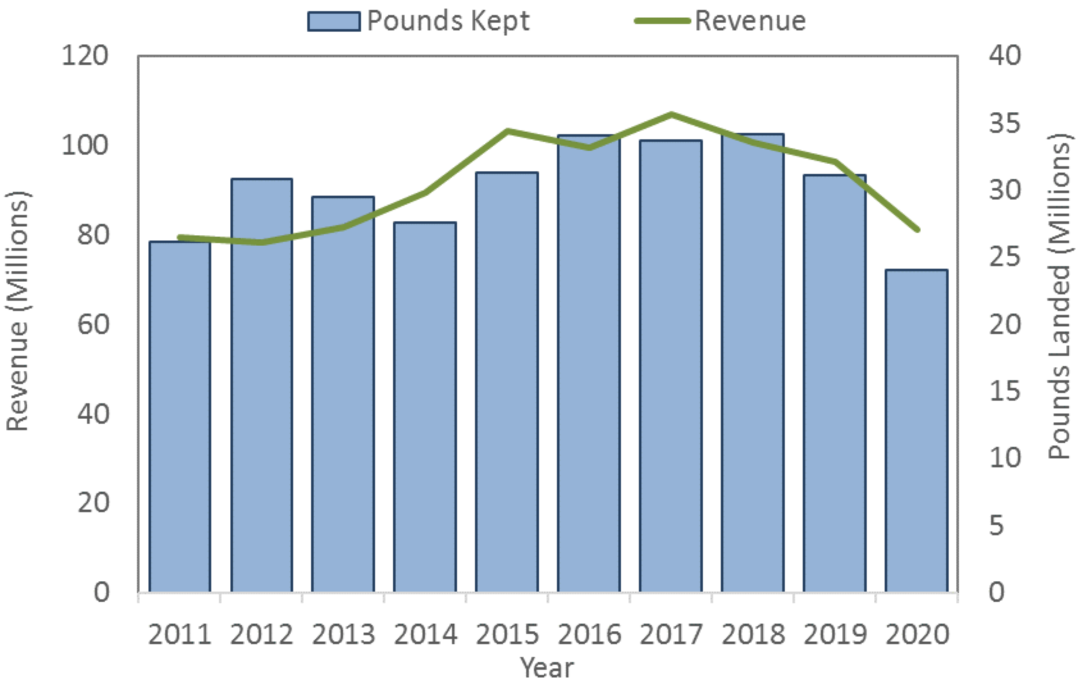

Figure 139. Commercial landings and revenue of Hawaii-permitted longline fleet 2011-2020 adjusted to 2020 dollars[1]

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

The price and revenue information of individual species of Hawaii permitted longline presented in the report were estimated based on the fish prices and fish sizes in the Hawaii markets and the total pounds kept, because there was no detailed market information on the fish landed and sold in West Coast. Figure 140 shows the trends of the revenue composition from the main species (bigeye, swordfish, yellowfin, and all others) during 2011-2020, while Figure 141 shows the price trends for bigeye, swordfish, and yellowfin for the same period. Supporting data for Figure 140 and Figure 141 are presented in Table A-124 and Table A-125, respectively.

It can be observed that bigeye tuna comprised the majority of fishery revenue for the longline fleet during 2011-2020. Revenue from yellowfin has grown in recent years and other species has held stable in general, while the revenue from swordfish declined for the same period. In 2020, bigeye composed 69% of revenue for Hawaii permitted longline vessels, followed by yellowfin, 14%, and swordfish 5%. Other species composed of 12% of the total Hawaii longline revenue. Fish prices have fluctuated in general. Bigeye price peaked in 2012 and has decreased since then. Yellowfin price has varied over time, and it peaked in 2013 and declined thereafter. However, yellowfin price went up considerably in 2018, approaching bigeye prices. In 2020, both yellowfin and bigeye dropped, while the swordfish price went up. Opposite of the trends of bigeye and yellowfin prices, swordfish price went up in the recent two years.

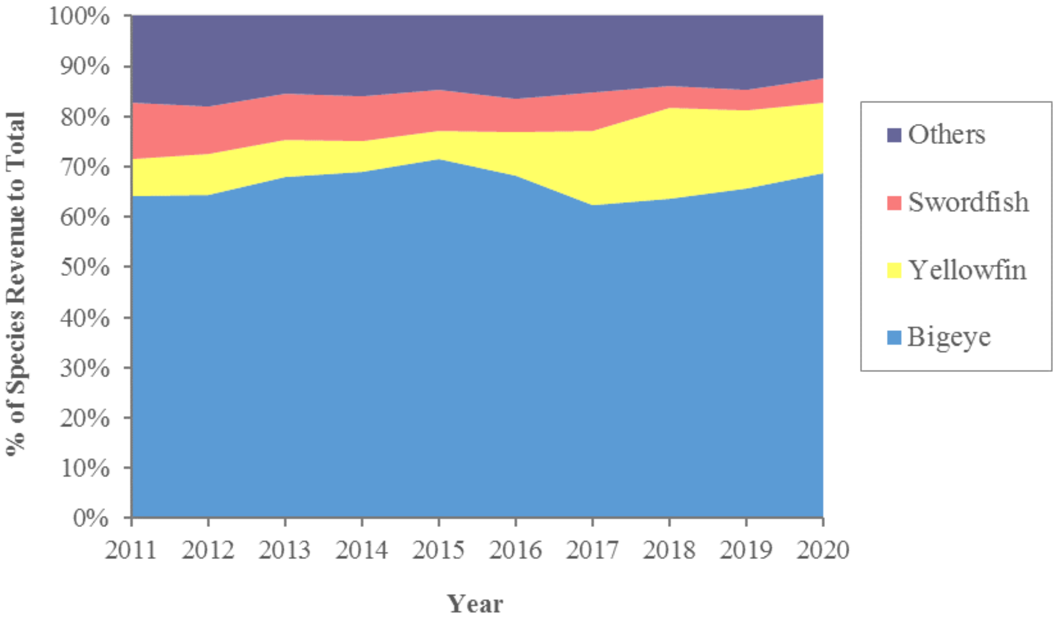

Figure 140. Trends in Hawaii longline revenue species composition from 2011-2020[1]

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

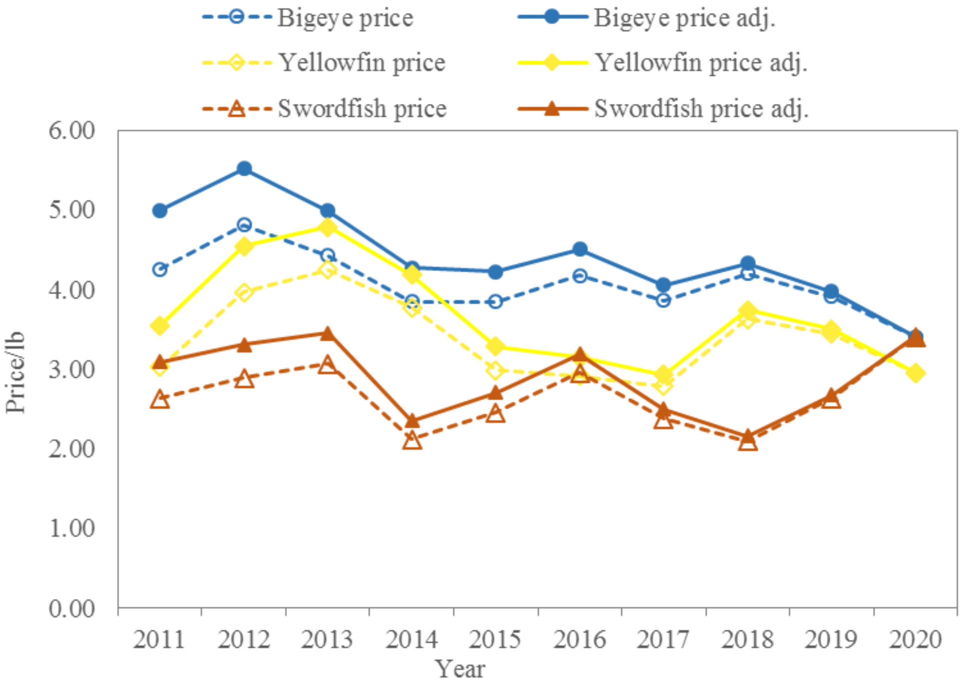

Figure 141. Price trends of nominal and adjusted of three main species (bigeye, yellowfin, and swordfish) from 2011-2020[1]

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

3.3.3.4.1.2 Fishing Costs

The Economic Cost Data Collection Program of 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 with 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 once every five or so 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 the changes of economic performance of the Hawaii longline fisheries on a continuous basis.

The continuous data collection form is comprised of eight cost items commonly arising in Hawaii longline trips but 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 (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 fishermen 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 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. The detailed description of the continuous data collection program can be found in a NOAA technical memorandum (Pan 2018).

This report assessed trip-level fishing costs for the two types of fishing trips since shallow set (swordfish) trips often have a longer trip length compared to deep set (tuna) trips. The average trip length for swordfish trips was 31 days per trip during the period of 2011-2020, while it was 22 days for tuna trips.

In terms of cost structure, fuel cost accounts for the largest share of total fishing trip costs (non-labor items) for both tuna and swordfish trips. Figure 142 and Figure 143 show the cost structures of an average tuna trip and swordfish trip in 2020, respectively. In 2020, fuel cost was the leading item of trip costs, comprising 43% of trip costs for tuna trip costs. Bait was the second largest item making up 30% of tuna trip costs. Bait cost went up considerably this year and the percentage of bait cost increased to 30% in 2020 from 23% in 2019 due to price of bait went up significantly. Fuel and bait costs together made up over 73% of the trip costs for tuna fishing. For swordfish trip, the cost of fuel made up 51% of swordfish trip costs, while bait cost made up 21%, increased from 17% in 2019, of swordfish trip costs. The cost of the lightstick gear is unique to swordfish fishing, and it made of 9% of the total trip costs of swordfish trips. Supporting data for Figure 144 and Figure 145 are presented in Table A-126 and Table A-127.

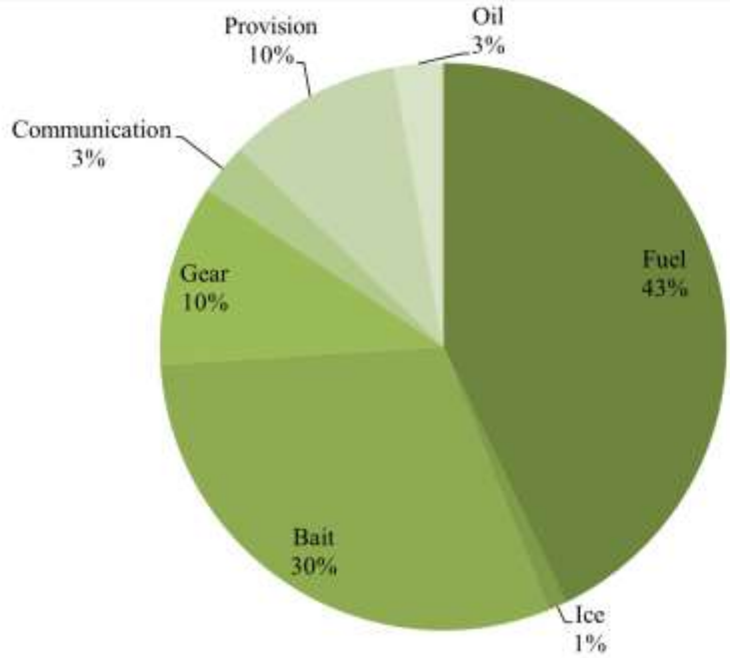

Figure 142. The cost structure of an average deep-set fishing trip in 2020[1]

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

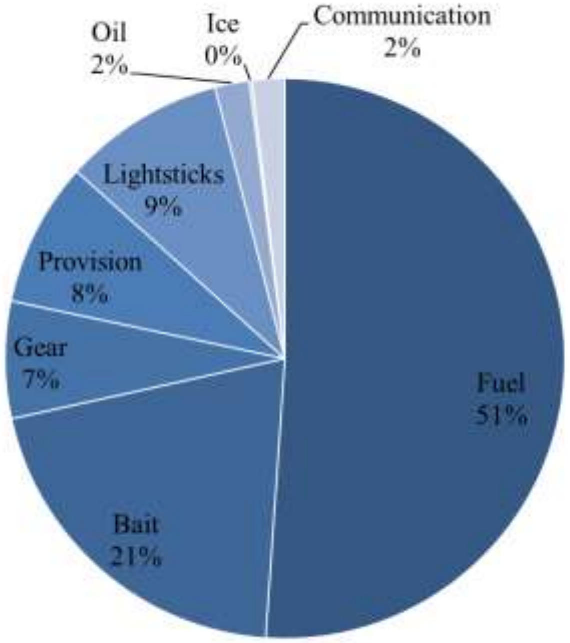

Figure 143. The cost structure of an average shallow-set fishing trip in 2020[1]

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

Figure 144 and Figure 145 show the trend of average trip costs for the tuna and swordfish trips respectively of the Hawaii longline fishery for the 2011-2020 period. Supporting data for Figure 144 and Figure 145 also are presented in Table A-126 and Table A-127. The average trip costs for both trip types are different in values, but they shared similar trend during the period of 2011 to 2020. Swordfish trip (with longer trip length) costs more than tuna trips. In 2020, the average trip costs for swordfish trips were $42,334 while it was $24,113 for tuna trips.

In considering trends, the costs of tuna trips peaked in 2012, while swordfish trip costs peaked in 2011. Fishing costs of tuna trips have trended downward in 2015 and were pretty stable since then. Swordfish trip costs were up 15% in 2018 compared to 2017. In 2020, the swordfish trip costs were higher than 2019.

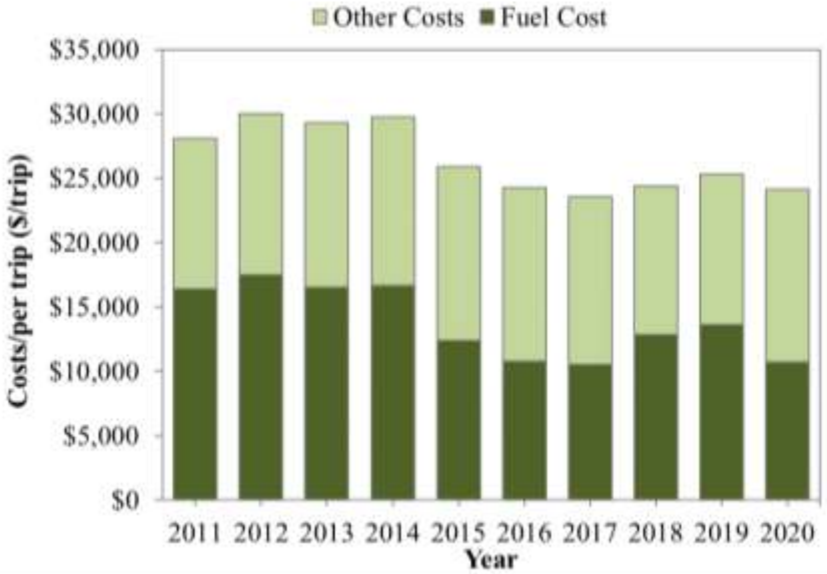

Figure 144. The trend of average trip costs with standard deviation for Hawaii longline deep-set fishing from 2011-2020 adjusted to 2020 dollars[1]

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

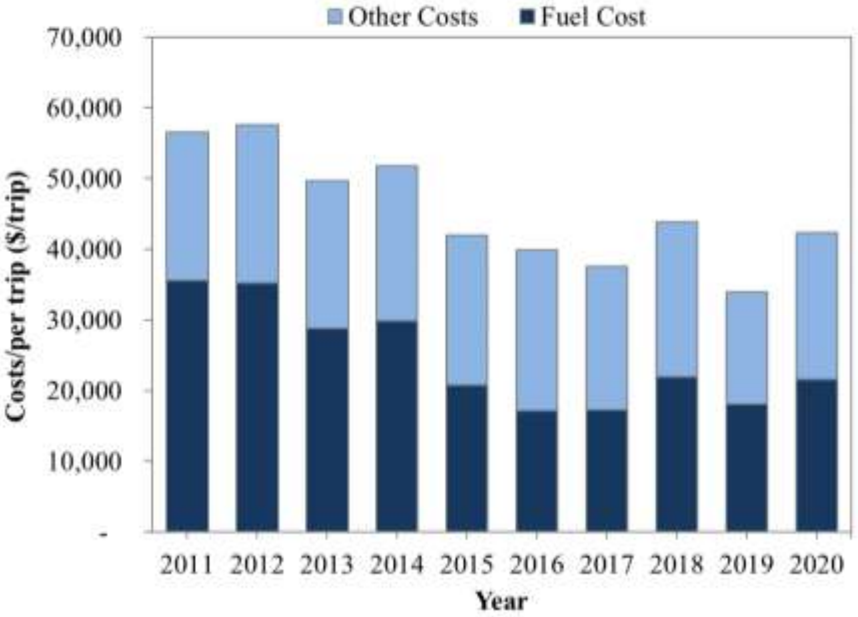

Figure 145. The trend of average trip costs with standard deviation for Hawaii longline shallow-set fishing from 2011-2020 adjusted to 2020 dollars[1]

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

3.3.3.4.1.3 Economic Performance Indicators

The continuous economic data collection program allows for the monitoring of movement in fishing cost over time (Pan 2018). Compiling revenue data with cost and effort data allows for the measurement of the economic performance in term of net revenue and monitor the changes. Figure 145 and Figure 146 present the trends of trip level revenue, net revenues, and costs for the period of 2011 to 2020 for the two trip types, respectively. Supporting data Figure 145 and Figure 146 are presented in Table A-128 and Table A-129, respectively. The net revenue of tuna (deep-set) fishing varied across years, and peaked in 2016. However, tuna trip net revenue in downward trend since 2016, it was in historical low in 2020 during the period 2011–2020. The net trip revenue of swordfish (shallow-set) fishing also shows fluctuations across years. The net trip revenue for swordfish trips peaked in 2016 and dropped considerably in 2019 and 2020.

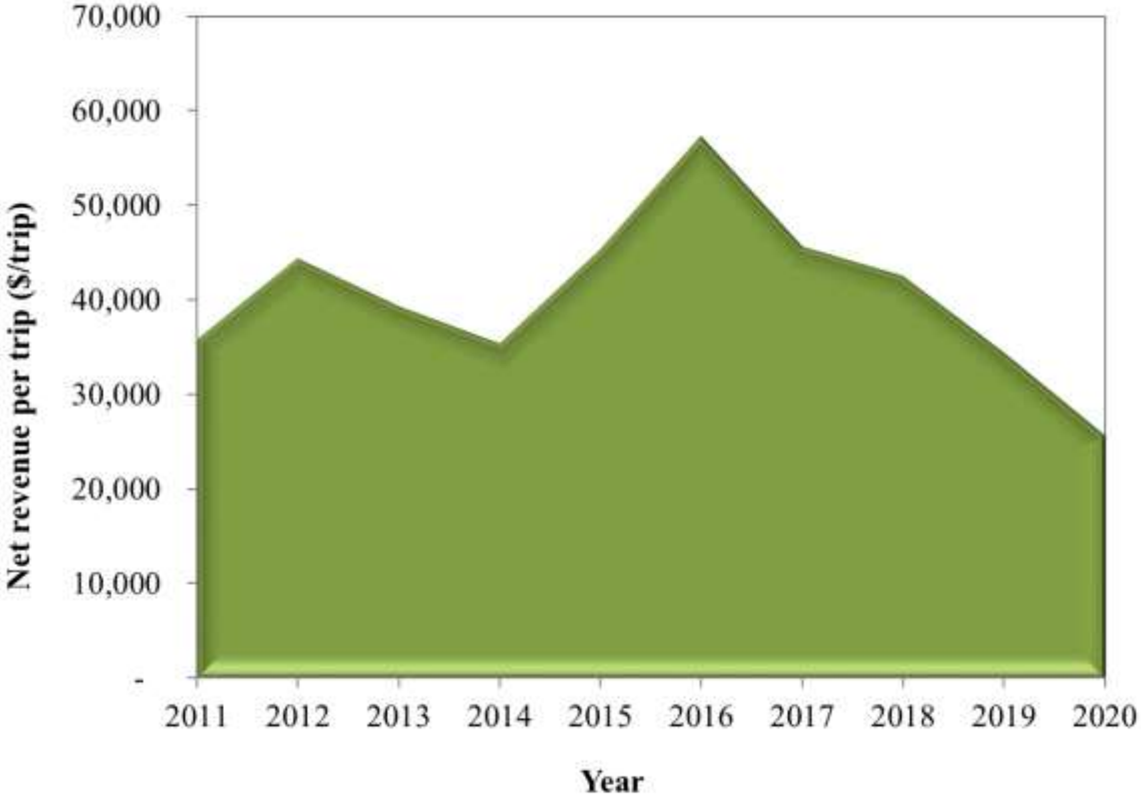

Figure 146. Average net revenue per trip for Hawaii longline deep-set trips from 2011-2020 adjusted to 2020 dollars[1]

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

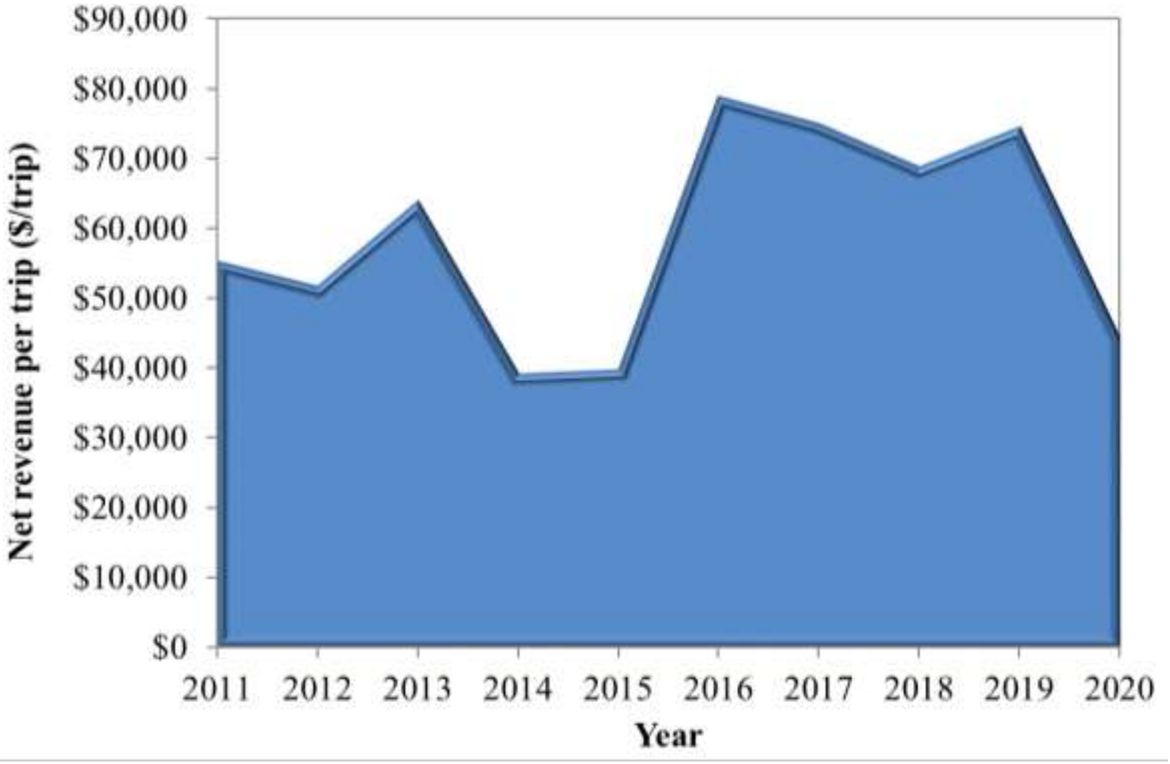

Figure 147. Average net revenue per trip for Hawaii longline shallow-set trips from 2011-2020 adjusted to 2020 dollars[1]

[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 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 American Samoa Longline fishery, this section will present revenue performance metrics of (a) the total revenue per day at sea, and (b) annual revenue per vessel and the Gini coefficient based on individual vessels.

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 PIFSC FRMD. Figure 148 and Figure 149 presents the revenue per-day-at-sea and revenue per vessel and the Gini coefficient for the Hawaii longline fisheries during the period of 2011 to 2020. Supporting data for Figure 148 and Figure 149 are presented in Table A-130.

One of the economic performance indicators, revenue per-day-at-sea for the Hawaii longline fishery presents an upward trend up to 2016 but declined since then. Another economic performance indicator, the revenue per vessel held steady relatively from 2011-2018, but decreased considerably in 2019 and 2020. The income distribution (Gini coefficient in term of revenue per vessel) among vessels is relatively stable in the period.

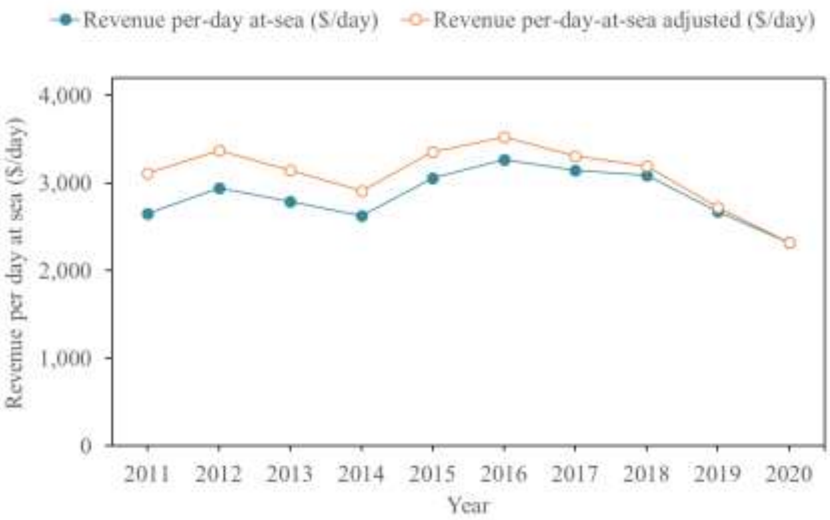

Figure 148**.** Revenue per-day-at-sea for Hawaii longline, 2011-2020, adjusted to 2020 dollars[1]

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

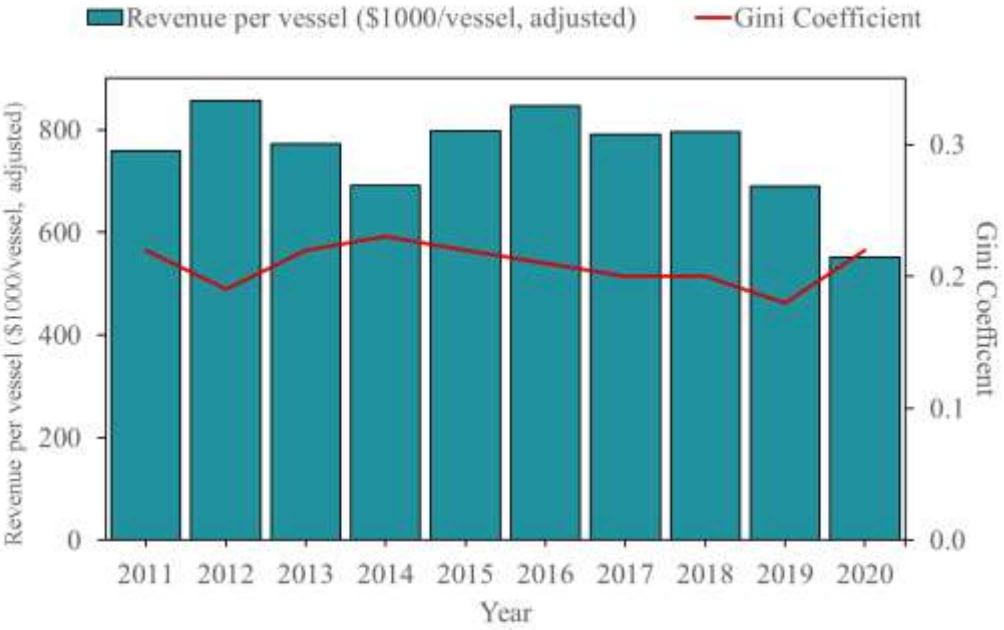

Figure 149. Revenue per vessel and Gini coefficient of the Hawaii longline fisheries[1] from 2011-2020 adjusted to 2020 dollars[2]

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

[2] Source: Pacific Islands Fisheries Science Center, Tier 1 indicators data request (https://inport.nmfs.noaa.gov/inport/item/46097).

3.3.3.4.2 Overview of the Hawaii Non-Longline Gears for PMUS

Beside the Hawaii permitted longline vessels, there are the smaller scale fisheries, such as MHI troll, MHI handline, offshore handline, aku boats (pole and line), and some other gears, that harvested PMUS and sold 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 grouped into the “other gears” because the fishery had been declining and the number of active vessels was less than 3 vessels since 2010. In terms of participants in the fisheries, Figure 150 presents the total fishers (numbers of CML) participated in these non-longline fisheries, including the total number of fishers who reported PMUS caught and the total number of fishers who reported PMUS sold. The number of fishers (CML #) was in a downward trend since 2013 and decreased considerably in 2020, 191 less compared on the previous year. The number of fishers (CML #) with fish sold decreased more, 361 less from previous year.

Considering pelagic fish landed and sold in the Hawaii markets from all gear types, the total revenue generated from Hawaii’s pelagic fisheries was $87.5 million in 2020, much lower than $110.6 million in 2019. The Hawaii non-longline fisheries contributed 8% of the total PMUS revenue in 2020. Among the non-longline gears, troll is the leading fishing gear in terms of PMUS pounds sold and revenue, following by MHI handline gear. The MHI troll revenue was $4.2 million or 5% of the total in 2020 and was followed by the MHI handline fishery at $1.9 million (2.2%). The offshore handline fishery was worth $1.0 million (1.1%) in 2020. The sharp decline of the “other gears” reflected the decline of the aku boat fishing in the report period. Figure 151 presents the trend of commercial landings by different gears (not including longline), and Figure 152 presents the trend of commercial revenue by different gears (not including longline). Both commercial landings and revenue peaked in 2012 and has declined since then (except a small lift in 2018). On average, 81% of PMUS caught were sold during the period 2011-2020, while it was 87% in 2020. Both total PMUS landings (pounds kept) and commercial landings (pounds sold) declined in 2020, but total PMUS landings decreased more than the commercial landings because the percentage of sold was higher in 2020. Supporting data for the Figure 151 and Figure 152 are presented in Table A-131 and Table A-132, respectively.

Figure 153 presents the price trends of PMUS harvested and sold by different gears, 2011-2020, (adjusted to 2020 dollars). The dealer data were not recorded by gear types, so the prices by species by gear were not available in the dealer data originally. The price data by species by gear presented in Figure 153 were generated by assuming that the gear distributions of fish sold in dealers reports 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. Supporting data for Figure 153 are presented in Table A-133. Figure 154 presents the fishing trip costs by the three main gears (small boats) for pelagic fishing.

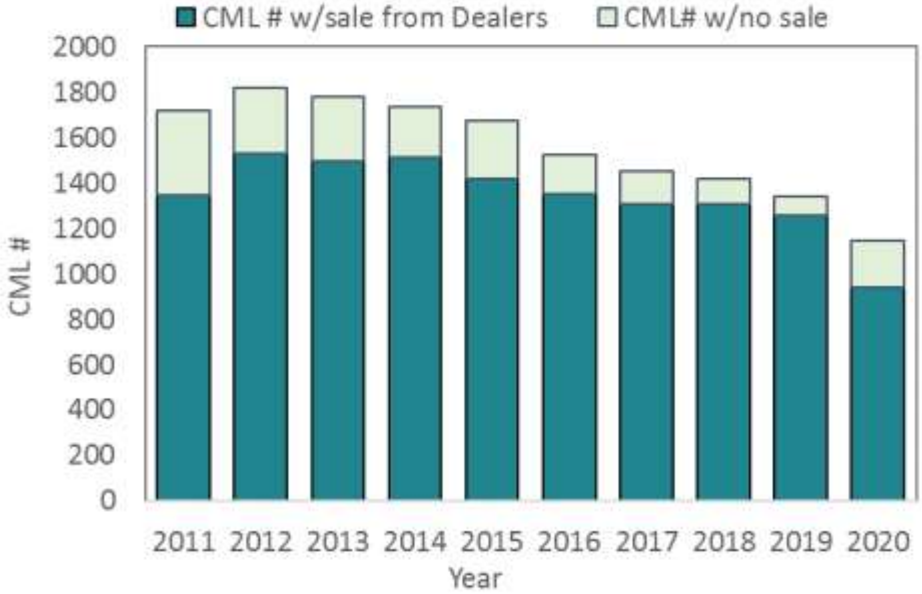

Figure 150. Total number of fishers (CML #) participated in small scale (non-longline) PMUS fisheries 2011-2020[1]

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

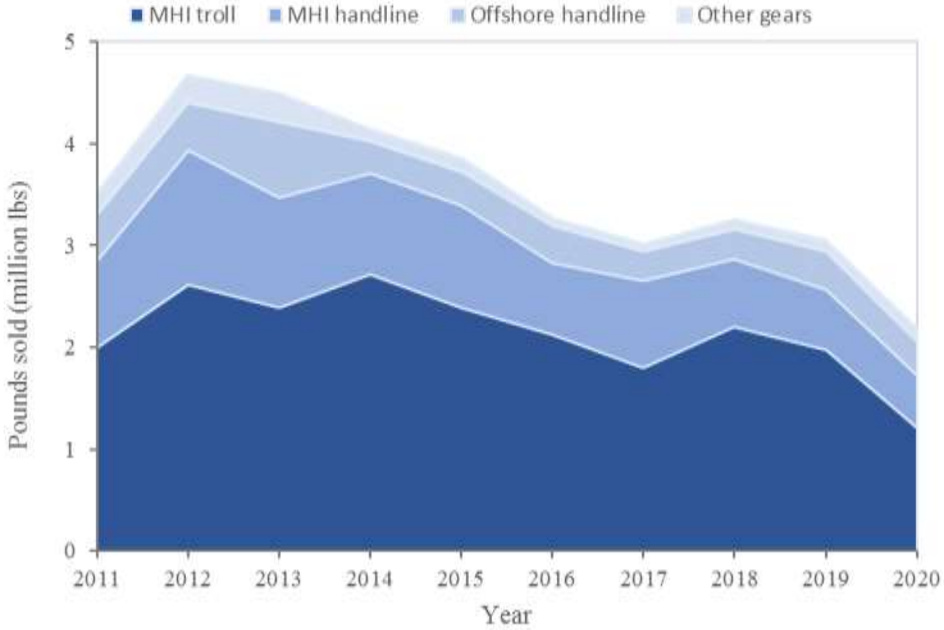

Figure 151. Total pounds sold of MHI commercial non-longline gears from 2011-2020[1]

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

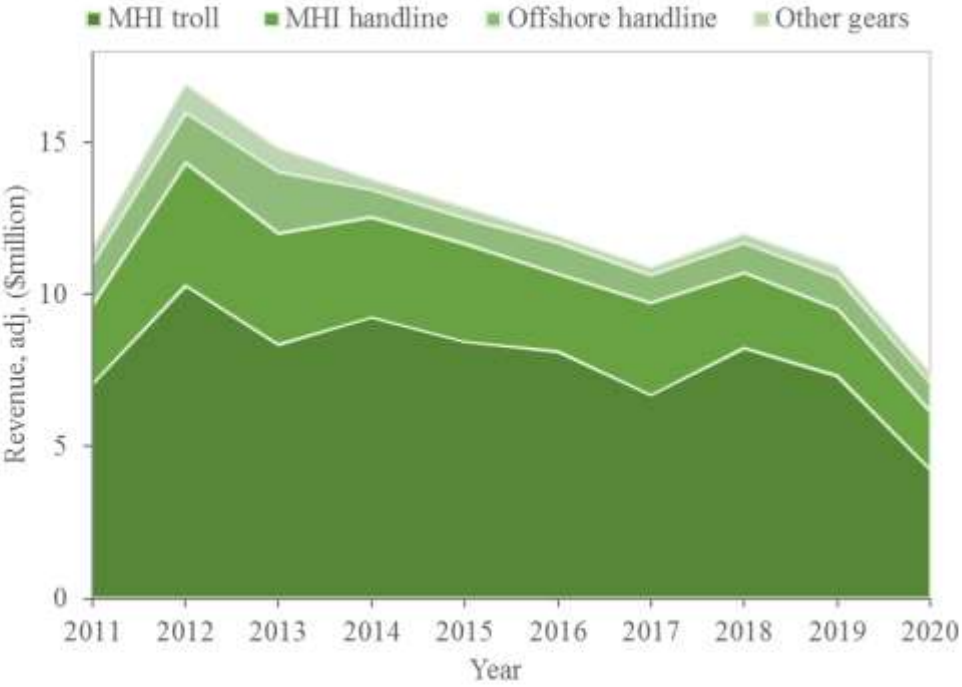

Figure 152. Revenue of non-longline gears from 2011-2020 adjusted to 2020 dollars[1]

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

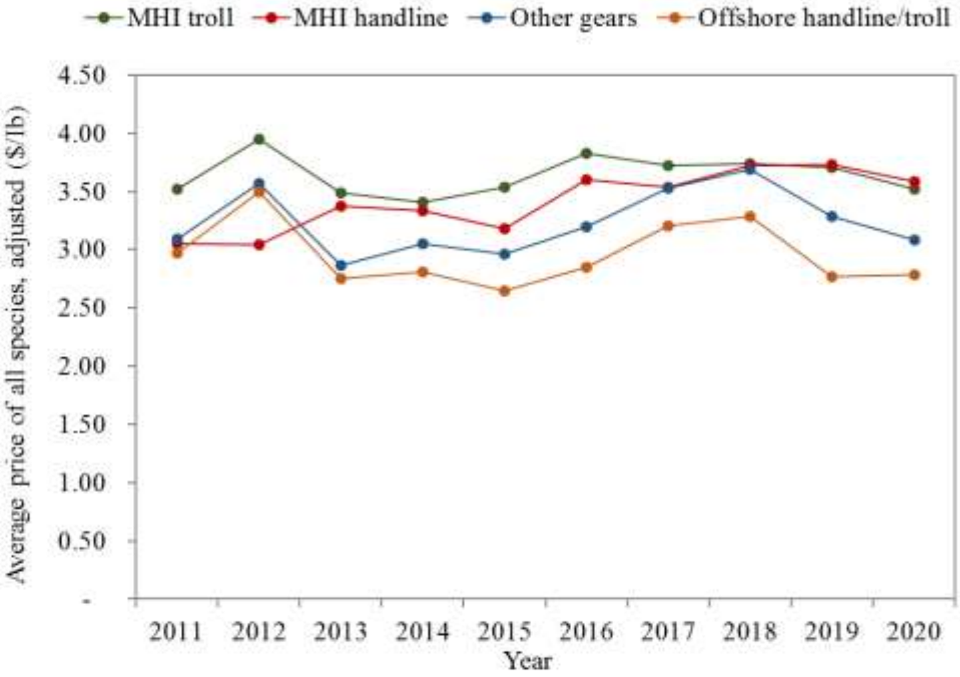

Figure 153. Price trends of PMUS by different gears, 2011-2020, adjusted to 2020 dollars[1]

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

3.3.3.4.2.1 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, 1998; Hospital et al. 2011; Chan and Pan 2017). The most current cost data for a Hawaii trolling trip are presented in Figure 154.

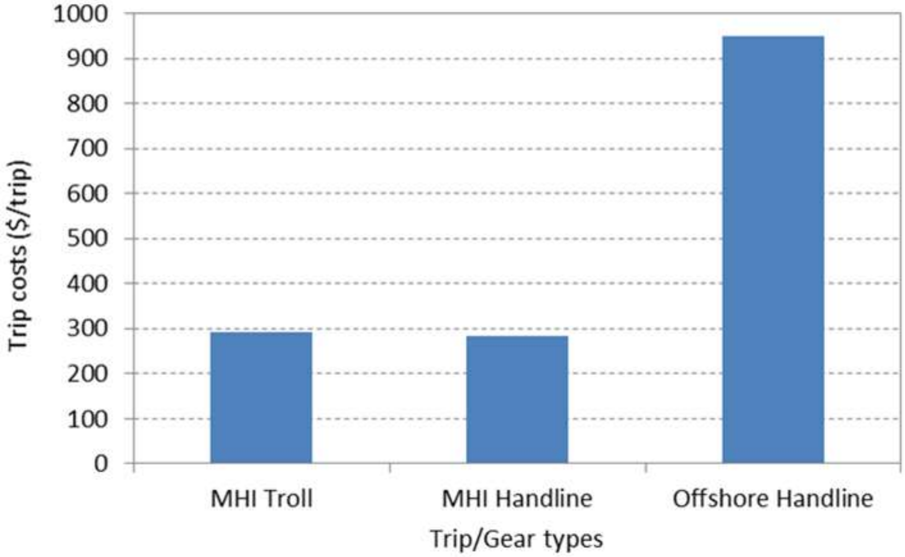

Figure 154. Fishing trip cost by gear type in 2014[1]

[1] Data sourced from a 2017 Hawaii small boat survey (Chan and Pan 2017)

3.3.3.4.3 Hawaii Trolling

3.3.3.4.3.1 Commercial Participation, Landings, Revenue, and Prices

This section will describe trends in commercial participation, landings, revenues, and prices for the Hawaii troll fishery. Figure 155 presents the pounds sold and revenue (adjusted to 2019 dollars) of the MHI troll, 2010-2019. Supporting data of Figure 155 are presented in Table A-131 and Table A-132. Among the non-longline gears, the Hawaii troll fishery landed the largest amount of pelagic fish. The commercial revenue from Hawaii troll fishery peaked at $10 million (adjusted to 2020 dollars) from 2.6 million pounds sold in 2012, while commercial landings (pounds sold) from trolling fishery peaked in 2014. Since then, both commercial landings and revenue were in a declining trend up to 2017. Both commercial landings and revenue was upward in 2018 but went down in 2019 and down even more in 2020. Total commercial landings and revenue from troll fishery of 2020 was only 61% and 59%, respectively, of 2019. Price information is available in Figure 153.

Figure 155. The pounds sold and revenue for the MHI troll from 2011-2020 adjusted to 2020 dollars[1]

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

3.3.3.4.3.2 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). The most current cost data for a Hawaii trolling trip are presented in Figure 154.

3.3.3.4.4 Hawaii Pelagic Handline

3.3.3.4.4.1 Commercial Participation, Landings, Revenue, and Prices

This section describes trends in commercial participation, landings, revenues, and prices for the Hawaii pelagic handline fishery. Figure 156 presents the pounds sold and revenue (adjusted to 2019 dollars) of the MHI troll, 2010-2019. Supporting data for Figure 156 can be found in Table A-131 and Table A-132. The landings and revenue from Hawaii handline fishery peaked in 2012, 1.3 million pounds pound sold valued over $4 million (in 2020 dollars) respectively, then was generally in a declining trend since 2013. Both revenue and commercial landings of Hawaii handline continued declining in 2020. Price information is available in Figure 153.

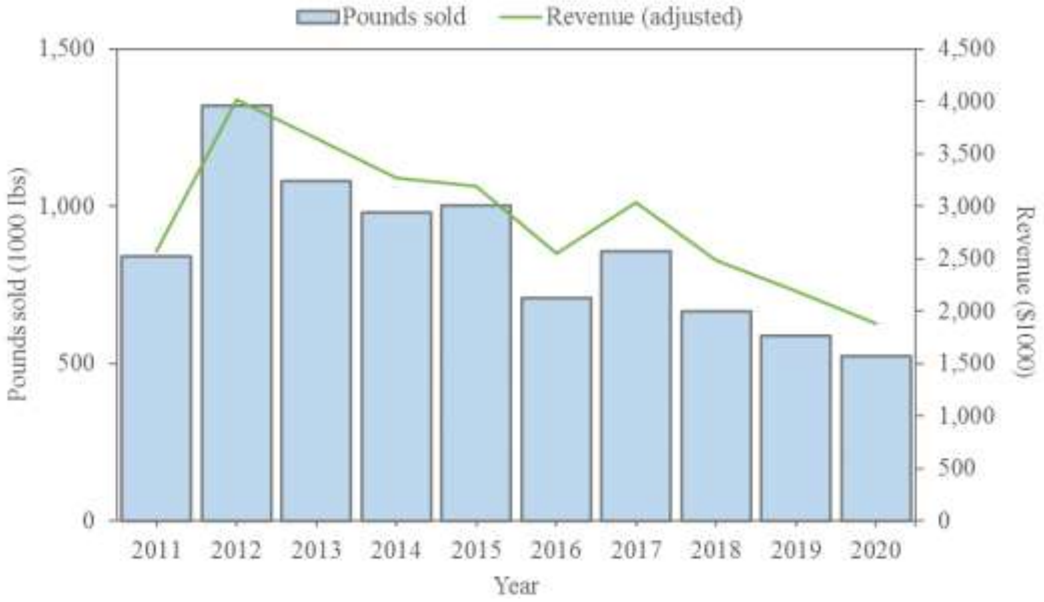

Figure 156. Pounds sold and revenue for MHI handline, 2011-2020, adjusted to 2020 dollars[1]

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

3.3.3.4.4.2 Fishing Costs

There are 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). The most current trip cost data for MHI handline trips are presented in **Error! Reference source not found.**.

3.3.3.4.5 Offshore Handline

3.3.3.4.5.1 Commercial Participation, Landings, Revenue, and Prices

This section describes trends in pounds sold and revenues for the Hawaii offshore handline fishery. Figure 157 presents the pounds sold and revenue (adjusted to 2020 dollars) of the offshore handline, 2011-2020. Supporting data for Figure 157 can be found in Table A-131 and Table A-132. The offshore handline fishery seems stable in most of the years during the period of 2011-2020, except that the pounds sold and revenue jumped up considerably in 2013. Price information is available in Figure 153.

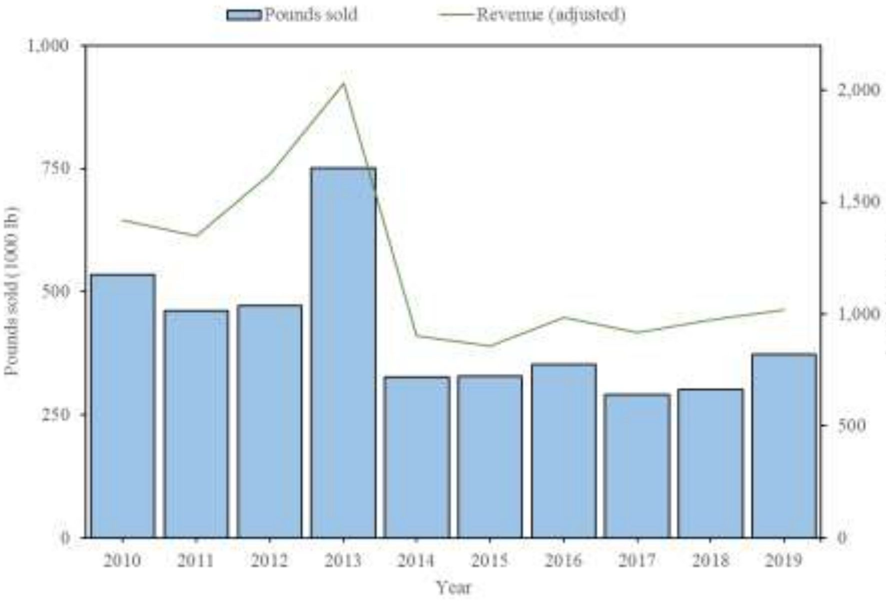

Figure 157. The pounds sold and revenue for the offshore handline from 2011-2020 adjusted to 2020 dollars[1]

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

3.3.3.4.5.2 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. The most current cost data for offshore handline trips are presented in Figure 154.

3.3.3.4.6 Other Gears (Including Aku Boat/Pole and Line)

3.3.3.4.6.1 Commercial Participation, Landings, Revenue, and Prices

This section will describe trends in commercial pounds sold and revenues for the “other gears”. Figure 158 presents the pounds sold and revenue (adjusted to 2018 dollars) of the other gears (including aku boats), 2009-2018. Supporting data for Figure 158 can be found in Table A-131 and Table A-132. Pounds sold and revenue from this category is primarily composed of PMUS caught by the aku boat fishery. The sharp decline of pounds sold and revenue from this group reflected the decline of the aku boat fishing during the reported period. The revenue generated from the fisheries of the “other gears” (including Aku fishing) in 2020 composed less than 5% to the total revenue of pelagic sold by the Hawaii fisheries. However, the commercial landings and revenue from the group increased slowly in recent three years.

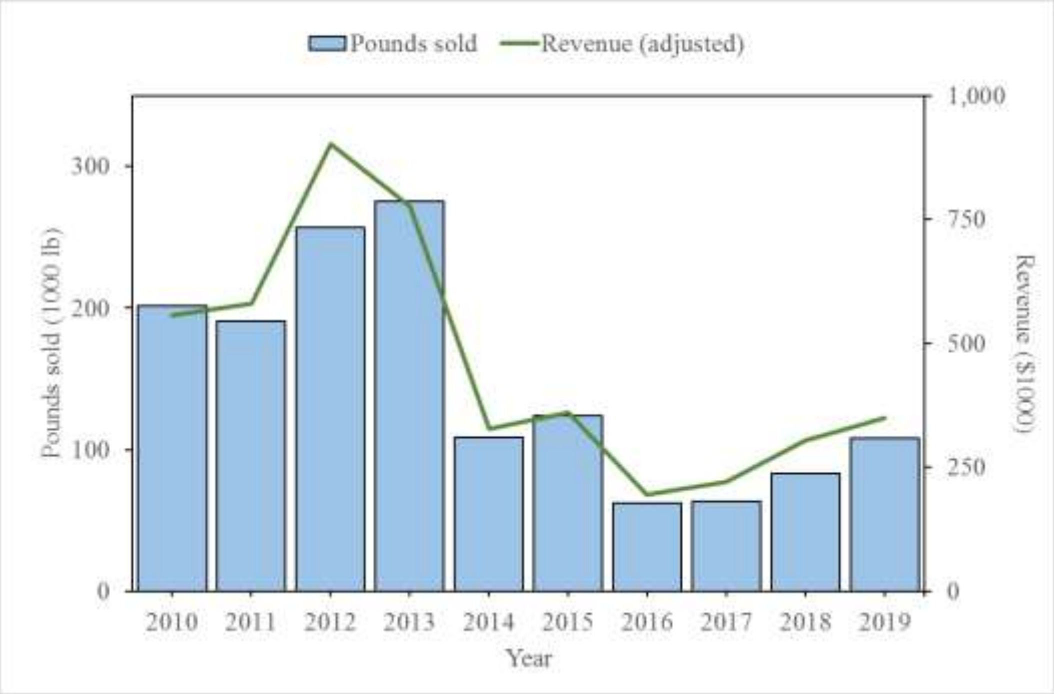

Figure 158. The pounds sold and revenue for all other gears from 2010-2019 adjusted to 2019 dollars[1]

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

3.3.3.4.6.2 Fishing Costs

Fishing cost data for the other presented gears were not available at the time of publication.

3.3.4 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 2020. 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 43. Pacific Islands Region 2020 Commercial Fishing Economic Assessment Index

	2020 CFEAI				
	2020 Reporting Year (e.g. 1/2020-12/2020)				
	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	**2020**	**2020**	**2013**	**2020**	**2016**
ASam Longline	**2020**	**2020**	**2016**	**2020**	**2019**
HI Offshore Handline	**2020**	**2014**	**2014**	**2019**	**2019**
HI Small Boat (pelagic)	**2020**	**2014**	**2014**	**2017**	**2019**
HI Small Boat (bottomfish)	2020	2014	2014	2017	2019
HI Small Boat (reef)	2020	2014	2014	2017	2019
Guam Small boat	**2020**	**2020**	**2019**	**2020**	
CNMI Small boat	**2020**	**2020**	**2019**	**2020**	
ASam Small boat	**2020**	**2020**	**2015**	**2020**	

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 in early 2022.

PIFSC also generates projections for upcoming fiscal years, and the table below provides the projected CFEAI report for 2021 (*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 2019.

PIFSC had plans to field an update to the Hawaii small boat cost earnings survey (Chan and Pan 2017; Hospital et al. 2011) during calendar year 2020, however due to delays in survey approval coupled with COVID-19 restrictions, this effort was postponed to 2021. 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. Similarly, plans to field an update to the Hawaii longline cost earnings survey (Kalberg and Pan 2016) during 2020 have been postponed to 2022, on account of the pandemic and associated restrictions.

PIFSC intends to conduct a cost-earnings survey of the American Samoa small boat fishery in 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.

Table 44. Pacific Islands Region 2021 Commercial Fishing Economic Assessment Index

	2021 Projected CFEAI				
	2021 Reporting Year (e.g. 1/2021-12/2021)				
	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	**2021**	**2021**	**2013**	**2021**	**2016**
ASam Longline	**2021**	**2021**	**2016**	**2021**	**2019**
HI Offshore Handline	**2021**	**2021**	**2021**	**2019**	**2019**
HI Small Boat (pelagic)	**2021**	**2021**	**2021**	**2017**	**2019**
HI Small Boat (bottomfish)	2021	2021	2021	2017	2019
HI Small Boat (reef)	2021	2021	2021	2017	2019
Guam Small boat	**2021**	**2021**	**2019**	**2021**	
CNMI Small boat	**2021**	**2021**	**2019**	**2021**	
ASam Small boat	**2021**	**2021**	**2021**	**2021**	

PIFSC will continue to collect and monitor annual community social indicators (Kleiber et al. 2018) 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.

3.3.5 RELEVANT PIFSC ECONOMICS AND HUMAN DIMENSIONS PUBLICATIONS: 2020

Publication	**MSA Priority**
Ayers A, Leong K. 2020. Stories of Conservation Success: Results of Interviews with Hawai`i Longline Fishers. Pacific Islands Fisheries Science Center, PIFSC Administrative Report, H-20-11, 43 p. https://doi.org/10.25923/6bnn-m598.	PS1.4.2 PS2.1 PS2.4 HC3.2.2
Ayers AL, Chan HL. 2020. Rights-Based Management, Competition, and Distributional Equity in Hawaii's Largest Commercial Fishery. International Journal of the Commons. 14(1):262-277. https://doi.org/10.5334/ijc.996	HC1.1.1 HC1.1.8
Ayers AL, Leong K. 2020. Examining the Seascape of Compliance in U.S. Pacific Island fisheries. Marine Policy. 115:103820. https://doi.org/10.1016/j.marpol.2020.103820	PS1.4.2 HC3.2
Chan HL. 2020. Economic impacts of Papahānaumokuākea Marine National	PF3.1.1

Publication	MSA Priority
Monument expansion on the Hawaii longline fishery. Mar. Pol. 103869. https://doi.org/10.1016/j.marpol.2020.103869.	
Chan HL. 2020. Potential Economic Impacts from the 2018 Amendment to the Billfish Conservation Act of 2012. Pacific Islands Fisheries Science Center, PIFSC Internal Report, IR-20-004, 9 p.	HC1.1.6
Chan HL. 2020. Potential Economic Impacts from the 2018 Amendment to the Billfish Conservation Act of 2012. Pacific Islands Fisheries Science Center, PIFSC Internal Report, IR-20-008, 11 p.	HC1.1.6
Iwane MA, Leong KM, Vaughan M, Oleson KLL. 2020. Engaging Hawai'i small boat fishers to mitigate pelagic shark mortality. Pacific Islands Fisheries Science Center, PIFSC Administrative Report, H-20-10, 113 p. https://doi.org/10.25923/54tf-kh65.	PS1.4.2 HC3.2
Leong KM, Torres A, Wise S, Hospital J. 2020. Beyond recreation: when fishing motivations are more than sport or pleasure. Pacific Islands Fisheries Science Center, PIFSC Administrative Report, H-20-05, 57 p. https://doi.org/10.25923/k5hk-x319.	HC1.2 HC3.1.1 HC3.2.1
Lovell S, Hilger J, Rollins E, Olsen NA, Steinbeck S. 2020. The Economic Contribution of Marine Angler Expenditures on Fishing Trips in the United States, 2017. U.S. Dept. of Commerce, NOAA Technical Memorandum NMFS-F/SPO-201, 80 p. https://spo.nmfs.noaa.gov/content/tech-memo/economic-contribution-marine-angler-expenditures-fishing-trips-united-states-2017.	HC1.2 HC1.2.1
National Marine Fisheries Service (NMFS). 2020. NOAA Fisheries Initial Impacts Assessment of the COVID-19 Crisis on the U.S. Commercial Seafood and Recreational For-Hire/Charter Industries. 32p. https://media.fisheries.noaa.gov/2021-02/Initial-COVID-19-Impact-Assessment-webready.pdf.	HC1
Pacific Islands Fisheries Science Center. 2020. Fishery Ecosystem Analysis Tool (FEAT). https://origin-apps-pifsc.fisheries.noaa.gov/FEAT/#/.	HC1.1.1 HC3.1.3
Pacific Islands Fisheries Science Center. 2020. Pacific Islands Fisheries Impacts from COVID-19: Pacific Islands Snapshot, March-July 2020. 10p. https://media.fisheries.noaa.gov/2021-02/Pacific-Islands-COVID-19-Impact-Snapshot-webready.pdf.	HC1
Sterling EJ, Pascua P, Sigouin A, Gazit N, Mandle L, Betley E, Aini J, Albert S, Caillon S, Caselle JE, Wongbusarakum S, et al. 2020. Creating a space for place	HC2.1.1 HC2.2.2

Publication	MSA Priority
and multidimensional well-being: lessons learned from localizing the SDGs. Sustainability Science. 15(4):1129-47. https://doi.org/10.1007/s11625-020-00822-w.	
Wongbusarakum S, Kindinger T, Gorstein M. 2020. Assessing socio-economic indicators to improve their usefulness for resource management in the US Pacific islands. U.S. Dept. of Commerce, NOAA Technical Memorandum NOAA-TM-NMFS-PIFSC-98, 67 p. https://doi.org/10.25923/27jh-pm07.	HC1.1.7 HC1.1.9 HC2.1.2

3.4 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.

3.4.1 HAWAII SHALLOW-SET LONGLINE FISHERY

3.4.1.1 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.

3.4.1.1.1 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 can choose between side-setting or stern-setting longline gear with additional regulatory specifications to reduce seabird interactions (e.g., 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.
    - 100 percent observer coverage
    - Vessel owners and operators required to annually attend protected species workshop
    - Closure for remainder of year when fishery reaches annual interaction limits (“hard caps”). In 2020, the fishery operated under hard caps of 26 leatherback and 17 loggerhead turtles from January through September 17, 2020. After September 17, the fishery operated under a hard cap of 16 leatherback turtles and no hard cap for loggerhead turtles (see Section 3.4.1.3.2, this report)

  - 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 3.4.1.3.2, this report)

3.4.1.1.2 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 46). 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 45. 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 46. 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

3.4.1.1.3 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 2021 List of Fisheries (LOF; 86 FR 3028, January 14, 2021), meaning that this fishery has occasional incidental mortality and serious injuries of marine mammals. The 2021 LOF lists the following marine mammal stocks that are incidentally killed or injured in this fishery:[5]

- Blainville's beaked whale, HI stock
- Bottlenose dolphin, HI Pelagic stock
- False killer whale, HI Pelagic stock
- Fin whale, HI stock
- Guadalupe fur seal, Isla Guadalupe stock
- Humpback whale, Central North Pacific stock
- Mesoplodon sp., unknown stock
- Northern elephant seal, CA breeding stock
- Risso's dolphin, HI stock
- Rough-toothed dolphin, HI stock
- Short-beaked common dolphin, CA/OR/WA 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.

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[5] 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.

3.4.1.2 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. Coverage was maintained at 100 percent in 2020.

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 summarizes 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 Observer Program Quarterly and Annual Reports. This report presents sea turtle interactions summarized by vessel arrival date (Table 47) and by interaction date (Table 48) for the Hawaii shallow-set longline fishery. For the remainder of species and fisheries, the annual observed interactions are based on vessel arrival date for consistency with the Observer Program Reports.

In 2006 and 2019, the shallow-set longline fishery closed in March, and in 2018 the fishery closed in May (see Section 3.4.1.3.2, 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.

3.4.1.3 SEA TURTLE INTERACTIONS IN THE HAWAII SHALLOW-SET LONGLINE FISHERY

Table 47 summarizes the incidental take data of sea turtles from 2004 to 2020 in the Hawaii shallow-set longline fishery summarized by vessel arrival date in accordance with the Observer Program. Additionally, Table 48 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 48), nearly all sea turtles observed in the Hawaii shallow-set longline fishery from 2004 to 2020 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 through 2019. In total, 21, 33, and 20 loggerhead turtles were observed in 2017, 2018, 2019, respectively, based on interaction date summary (Table 48). 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 3.4.1.3.2, and a summary of an analysis evaluating the experimental oceanographic TurtleWatch product is provided in Section 4.1.

Table 47. 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, 2004-2020[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

[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 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: 2004-2019 PIRO Observer Program Annual and Quarterly Status Reports; PIRO Sustainable Fisheries Division unpublished data.

Table 48. 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, 2004-2020[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

[a] Take data are based on interaction 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 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.

3.4.1.3.1 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 49), regardless of when the vessel returns to port. In the PIRO Observer Program Quarterly and Annual Reports, NMFS counts sea turtle interactions based on vessel arrival dates (Table 47). For this reason, the number of annual sea turtle interactions counted against an ITS may vary from those reported on the Observer Program's quarterly and annual reports. NMFS uses the post-hooking mortality criteria (Ryder et al. 2006) to estimate sea turtle mortality rates.

Table 49. 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
Green turtle	5(1)	0 (0)
Leatherback turtle	21(3)	2 (1)
Loggerhead turtle (North Pacific DPS)	36(6)	15 (2)
Olive ridley turtle	5(1)	0 (0)

[a] Takes are counted based on interaction date.

3.4.1.3.2 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 48), 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 48). 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[6], and the fishery reopened on January 1, 2020.

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[6] 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.

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 40-60 cm straight carapace length, which is estimated to be approximately 3-10 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 50 shows the distribution of the shallow-set vessels' interactions with loggerhead and leatherback turtle interactions from September 17 – December 31, 2020. The current limits are five loggerhead turtle interactions per trip or two leatherback turtle interactions per trip. No trip limits were reached in 2020 following the implementation of Amendment 10.

Table 50. Number of shallow-set longline trips by the number of loggerhead and leatherback turtle interactions per trip, September 17 – December 31, 2020. Total number of trips in this period was 14

Loggerhead turtles		**Leatherback turtles**	
Number of turtles per trip	**Number of trips[a]**	**Number of turtles per trip**	**Number of trips**
0	12	0	14
1	2	1	0
≥2	0	≥2	0

[a] Based on date of departure.

3.4.1.4 MARINE MAMMAL INTERACTIONS IN THE HAWAII SHALLOW-SET LONGLINE FISHERY

Table 51 through Table 55 summarize the incidental take data of marine mammals from 2004 to 2020 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 51), although no small dolphin interactions were observed in 2020. 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 52) and large whales (Table 53) 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, although none of these species have been observed since 2016. Observed interactions with unidentified cetaceans are shown in Table 54.

Interactions with pinnipeds, including Northern elephant seals, Guadalupe fur seals, and unidentified pinniped species have been occasionally observed since 2013 (Table 55). All pinniped interactions were observed outside of the EEZ off of California, while fishing under the Hawaii longline limited entry permit. One Guadalupe fur seal was released injured in 2016 (the interaction actually occurred in 2015), three were released injured in 2017, and seven were released injured in 2020. Two additional unidentified fur seals were released injured in 2020.

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 ongoing Unusual Mortality Event, which has involved the stranding of over 600 predominantly young Guadalupe fur seals along the US West Coast.[7] Although the marine heatwave of 2014-2016 was the largest on record since

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[7] https://www.fisheries.noaa.gov/national/marine-life-distress/2015-2021-guadalupe-fur-seal-unusual-mortality-event-california

monitoring began in 1982, the second and third largest events occurred in 2020 and 2019, respectively.[8]

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[8] https://www.integratedecosystemassessment.noaa.gov/regions/california-current/cc-projects-blobtracker

Table 51. Observed takes, mortalities (M), and takes per fishing effort (1,000 hooks) for dolphins in the Hawaii shallow-set longline fishery, 2004-2020[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

[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: 2004-2019 PIRO Observer Program Annual and Quarterly Status Reports, PIRO Sustainable Fisheries Division unpublished data.

Table 52. Observed takes, mortalities (M), and takes per fishing effort (1,000 hooks) for small whales in the Hawaii shallow-set longline fishery, 2004-2020[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

[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: 2004-2019 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 large whales in the Hawaii shallow-set longline fishery, 2004-2020[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

[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: 2004-2019 PIRO Observer Program Annual and Quarterly Status Reports; PIRO Sustainable Fisheries Division unpublished data.

Table 54. 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, 2004-2020[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

[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: 2004-2019 PIRO Observer Program Annual and Quarterly Status Reports; PIRO Sustainable Fisheries Division unpublished data.

Table 55. Observed takes, mortalities (M), and takes per fishing effort (1,000 hooks) for pinnipeds in the Hawaii shallow-set longline fishery, 2004-2020[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

[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: 2004-2019 PIRO Observer Program Annual and Quarterly Status Reports; PIRO Sustainable Fisheries Division unpublished data.

3.4.1.4.1 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 56) regardless of when the vessel returns to port. In the PIRO Observer Program Quarterly and Annual Reports, NMFS counts interactions based on vessel arrival dates. 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 56. 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
Guadalupe fur seal	11(9)	7(6)
Unidentified fur seal[b]	N/A	2(2)

[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.

3.4.1.4.2 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 57. 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 57).

Table 57. 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 Draft 2020 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	2014-2018	0.2	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[d]	0.4		1,062

[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 apply 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.
[d] Draft 2019 SAR.
Source: 2018 Marine Mammal SARs, Draft 2019 Marine Mammal SARs.

3.4.1.5 SEABIRD INTERACTIONS IN THE HAWAII SHALLOW-SET LONGLINE FISHERY

Table 58 summarizes the incidental take data of seabirds from 2004 to 2020 in the Hawaii shallow-set longline fishery. Since there is full observer coverage for this fishery, the interactions in Table 58 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 58 shows an increase in takes of black-footed albatrosses after 2008, with the highest number observed in 2017. Black-footed albatross takes in 2018 and 2019 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 low or no fishing effort in that quarter in 2018 as the shallow-set longline fishery was closed May-December 2018 and March-December 2019. Laysan albatross interactions were also low in 2017-2018. Interaction rate data for 2018-2019 are not directly comparable to other years in which the fishery operated throughout the year. No seabird mortalities were observed in the shallow-set longline fishery in 2020.

3.4.1.5.1 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 2020.

Table 58. Observed takes, mortalities (M), and takes per fishing effort (1,000 hooks) for seabirds in the Hawaii shallow-set longline fishery, 2004-2019[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

[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: 2004-2019 PIRO Observer Program Annual and Quarterly Status Reports; PIRO Sustainable Fisheries Division unpublished data.

3.4.1.6 ELASMOBRANCH INTERACTIONS IN THE HAWAII SHALLOW-SET LONGLINE FISHERY

Table 59 summarizes the incidental take data of ESA-listed elasmobranchs from 2004 to 2020 in the Hawaii shallow-set longline fishery. Oceanic whitetip sharks constitute the majority of the interactions and the observed number of takes ranges between 1 and 348, although the observed number of takes have been less than 32 per year since 2012. 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.

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 59. Observed and estimated interactions with elasmobranchs in the Hawaii shallow-set longline fishery, 2004-2020[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

[a] Take data are based on vessel arrival dates.

[b] Mortality numbers include sharks that were released dead, finned, and kept.
Source: PIRO Sustainable Fisheries Division unpublished data.

3.4.1.6.1 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 60) regardless of when the vessel returns to port. In the PIRO Observer Program Quarterly and Annual Reports, NMFS counts sea turtle interactions based on vessel arrival dates. 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 from the 2019 Biological Opinion to estimate the elasmobranch mortalities.

Table 60. 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)**
		2020
Oceanic whitetip shark	102(32)	13 (5)
Giant manta ray	13(4)	0(0)
Manta/Mobula[b]		1(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.

3.4.2 HAWAII DEEP-SET LONGLINE FISHERY

3.4.2.1 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

3.4.2.1.1 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.
- 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”).
- The fishery is observed at a minimum of 20 percent coverage.
- Vessel owners and operators are required to annually attend a protected species workshop.

3.4.2.1.2 ESA Consultations

The Hawaii deep-set longline fishery is covered under a NMFS Biological Opinion dated September 19, 2014 (NMFS 2014b). NMFS concluded 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 (Table 59). 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 62). 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 and December 18, 2020).

Table 61. 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
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
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 62. 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 2014b
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 2014b
False killer whale (MHI insular DPS)	3-year	1	0.74	NMFS 2014b
Scalloped hammerhead shark (Indo-West Pacific DPS)[a]	3-year	6	3	NMFS 2014b
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.

3.4.2.1.3 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 2021 LOF (86 FR 3028, January 14, 2021), meaning that NMFS has determined that this fishery has frequent incidental mortality and serious injuries of marine mammals. The 2021 LOF lists the following marine mammal stocks that are incidentally killed or injured in this fishery:[9]

- 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
- Humpback whale, Central North Pacific stock
- *Kogia* spp. (Pygmy or dwarf sperm whale), HI stock
- Pygmy killer whale, HI stock

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[9] 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.

- Risso’s dolphin, HI stock
- Rough-toothed dolphin, HI stock
- Short-finned pilot whale, HI stock
- Sperm whale, HI stock (also ESA-listed)
- 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.

3.4.2.2 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), and extended on September 21, 2020 (85 FR 59199), to provide the authority, on a case-by-case basis, to waive observer coverage. 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 Hawaii deep-set longline fishery for 2020 at 15.25%. Observer coverage was variable throughout the year, and fleet-wide interaction estimates for 2020 may have greater uncertainty than usual.

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 Observer Program reports, and to allow for comparison with historical yearly interaction data (e.g., Table 47). 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 and 2017 BiOps (e.g., Table 45).

3.4.2.3 SEA TURTLE INTERACTIONS IN THE HAWAII DEEP-SET LONGLINE FISHERY

Table 63 summarizes the incidental take data of sea turtles from 2002 to 2020 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 were lower than the previous four years. Due to the depth of the deep-set longline gear and the relatively smaller size of olive ridley turtles compared to leatherback turtles, 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.

Based on this recommendation, Council and NMFS implemented an ecosystem-based fisheries management project using an ensemble random forest model. This model utilizes a suite of environmental, effort and species data to predict the chance of an interaction with an olive ridley sea turtle. Preliminary results suggest the highest ranked variables predicting an olive ridley interaction in the Hawaii deep-set longline fishery include temperature at the mixed layer, sea surface temperature, and current divergence. The model has since been thoroughly tested with a simulation study and tested using three rarely interacted protected species (giant manta ray, scalloped hammerhead, and false killer whale). The primary next step is to test the model performance using remotely sensed environmental variables that have temporal resolutions of 8-days or less in the spirit of developing a dynamic ocean management product (e.g., EcoCast). Other next steps include modeling the longline fishery effort redistribution using an ensemble random forest derived dynamic ocean management product to evaluate the efficacy of management strategies in the Hawaii and American Samoa longline fisheries. By modeling the effort redistribution and taking advantage of incorporating multiple species (target or bycatch species) into a dynamic ocean management product, it can be determined how avoiding one protected species will change the interaction probability with others. Additional information on this effort is included in Section 4.1.

Table 63. 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, 2002-2020[a]

Year	Obs. Cov. (%)	Sets	Hooks	Green				Leatherback				Loggerhead				Olive ridley				Unidentified hard shell		
				Observed		EF Est.	ME	Observed		EF Est.	ME	Observed		EF Est.	ME	Observed		EF Est.	ME	Observed		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	-	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	26	-	3(1)	0.0003	20	-	11(9)	0.0013	72	-	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—2002-2019 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 2020b.

3.4.2.3.1 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 64). 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. 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 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 64. 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)**		
		2016- 2018	**2017-2019**	**2018-2020**
Leatherback turtle	72(27)	21.12(8.6)	25.51 (4.43)	55.72(21.06)
2017 Supp. BiOp				
Species	**3-year ITS Interactions (M)**	**Estimated Total Interactions and Mortalities Interactions (M)**		
		Q3 2016-Q4 2018	**2017-2019**	**2018-2020**
Green turtle	-	-	-	
East Pacific DPS	12(12)	20.38(18.67)	21.63 (20.28)	28.14(26.75)
Central North Pacific DPS	6(6)	3.49(3.19)	7.75 (7.27)	4.82(4.59)
East Indian-west Pacific DPS	6(6)	2.33(2.13)	3.29 (3.09)	3.22(3.06)
Southwest Pacific DPS	6(6)	2.04(1.87)	2.83 (2.65)	2.81(2.67)
Central West Pacific DPS	3(3)	0.29(0.27)	1.09 (1.02)	0.40(0.38)
Central South Pacific DPS	3(3)	0.29(0.27)	1.94 (1.82)	0.40(0.38)
Loggerhead turtle	18(13)	15(9.5)	20 (12.64)	20.73(13.50)
Olive ridley turtle	-	-		
Endangered Mexico and threatened eastern Pacific populations	141(134)	179(168.09)	256.12 (244.31)	227.55(216.16)
Threatened western Pacific populations	42(40)	53(49.77)	88.59 (84.5)	67.97(64.57)

[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).

3.4.2.4 MARINE MAMMAL INTERACTIONS IN THE HAWAII DEEP-SET LONGLINE FISHERY

Table 65 through Table 69 summarize the incidental take data of marine mammals from 2002 to 2020 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 2002-2020 period, with the highest number of observed interactions occurring in 2019, followed by short-finned pilot whales, bottlenose dolphins, Risso’s dolphins, and rough-toothed dolphins. Rough-tooth dolphin interactions were notably higher in 2020 compared to past years, but no contributing factors are readily apparent. 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 67). Observed interactions with unidentified cetacean groups are shown in Table 68. In 2020, there were four observed unidentified cetacean interactions and one unidentified beaked whale interaction.

Table 65. 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, 2002-2020[a]

Year	Obs. Cov. (%)	Sets	Hooks	Bottlenose dolphin				Pantropical spotted dolphin				Rough-toothed dolphin				Risso's dolphin				Striped dolphin			
				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	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	7	-	0	0.0000	0	-	5(2)	0.0006	33	-	2	0.0002	13	-	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—2002-2019 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.

Table 66. 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, 2002-2020[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	26	-	1	0.0001	7	-	0	0.0000	0	-	0	0.0000	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, 2011a; McCracken, 2016; McCracken, 2017b; McCracken 2019c.

Table 67. 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, 2002-2020[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	-

[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, 2011a; McCracken, 2016; McCracken, 2017b; McCracken 2019c.

Table 68. 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, 2002-2020[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	15.25	3,131	8,738,011	4	0.0005	26	0	0.0000	0	0	0.0000	0	1	0.0001	7

[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—2002-2019 PIRO Observer Program Annual and Quarterly Status Reports, PIRO Sustainable Fisheries Division unpublished data.

3.4.2.4.1 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 69). 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 69. 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)		
		2016-2018	2017-2019	2018-2020
Sperm whale	9(3)	0	0	0
MHI insular false killer whale	1(0.74)	0.25(0.2)	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.

[a] Takes are counted based on interaction date.

3.4.2.4.2 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 70. 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; it does not include 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 70).

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 2014 to 2018 was 6.5, which is below this stock's PBR (Table 70). 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. 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, 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.

Table 70. 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 Draft 2020 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	2.2	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	2014-2018	N/A	0.2	0.3
False killer whale, HI Pelagic	2014-2018	28.8	6.5	16
False killer whale, NWHI	2014-2018	N/A	0.01	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[d]	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.

[d] 2019 SAR.

Source: 2019 Marine Mammal SARs, Draft 2020 Marine Mammal SARs.

3.4.2.5 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 71 and Table 72 summarize the incidental take data of seabirds from 2002 to 2020 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. 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) was 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) 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). The full workshop report will be published as a NOAA Technical Memorandum.

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. 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, and the study commenced in February 2021.

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 will schedule further action on the DSLL fishery when the results of an ongoing Experimental Fishing Permit (EFP) study are available later in 2021.

3.4.2.5.1 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 2020.

Table 71. 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, 2002-2020[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	387	-	96(87)	0.0110	630	-	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.

Table 72. 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, 2002-2020[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	7	-	1(1)	0.0001	7	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—2002-2019 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.

3.4.2.6 ELASMOBRANCH INTERACTIONS IN THE HAWAII DEEP-SET LONGLINE FISHERY

Table 73 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 2020 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.

Total interactions for the fleet are estimated using the expansion factor calculations (EF Est. = 100 / % observer coverage * # takes). The annual expanded interaction estimates range between 741 and 2,938 for oceanic whitetips, 0 and 95 for giant manta rays, and 0 and 7 for scalloped hammerhead sharks.

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). On October 4, 2018, NMFS reinitiated consultation for the deep-set fishery and determined that the conduct of the deep-set fishery during the period of consultation will not violate ESA Sections 7(a)(2) and 7(d).

An ITS is not required to provide protective coverage for the Indo-west Pacific scalloped hammerhead shark DPS because there are no take prohibitions under ESA section 4(d) for the DPS. However, NMFS included an ITS of 6 interactions over a three-year period in the 2014 Biological Opinion (NMFS 2014b) to serve as a check on the no-jeopardy conclusion by providing a reinitiation trigger. 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 2020.

Table 73. 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, 2004-2020[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	1,980	-	1	0.0001	7	-

[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 2014b (2004-2013), PIRO Sustainable Fisheries Division unpublished data (2014-2018), McCracken 2019b; McCracken and Cooper 2020a.

3.4.3 AMERICAN SAMOA LONGLINE FISHERY

3.4.3.1 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.

3.4.3.1.1 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 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.
    - No more than 10 swordfish may be possessed or landed during a single fishing trip.

Additionally, the American Samoa longline fishery has had observer coverage since 2006.

3.4.3.1.2 ESA Consultations

The American Samoa longline fishery is covered under a NMFS Biological Opinion dated October 30, 2015 (NMFS 2015). NMFS concluded 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 74). 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 75). 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 and May 6, 2020, 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 74. 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
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.

Table 75. 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

[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 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.

3.4.3.1.3 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 2021 LOF (86 FR 3028, January 14, 2021), meaning that this fishery has occasional incidental mortality and serious injuries of marine mammals. The 2021 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

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.

3.4.3.2 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), and extended on September 21, 2020 (85 FR 59199), to provide the authority, on a case-by-case basis, to waive observer coverage. 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%.

This report summarizes protected species interactions in the American Samoa longline fishery since 2006. Data for 2020 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 Observer Program reports, and to allow comparison of historical yearly interactions data (e.g., Table 76). 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 (e.g., Table 77).

3.4.3.3 SEA TURTLE INTERACTIONS IN THE AMERICAN SAMOA LONGLINE FISHERY

Table 76 summarizes the incidental take data of sea turtles from 2006 to 2020 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).

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 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 2006-2010 when interactions with these species were not observed (average observer coverage = 10.8%) compared to 2011-2018. 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 76. 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, 2006-2020[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	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*

[a] Take data are based on vessel arrival dates.

*2020 data are not reported due to confidentiality rules.

Source: Take data—2006-2019 PIRO Observer Program Annual and Quarterly Status Reports
ME—McCracken, 2015; McCracken, 2017a; McCracken 2019a; McCracken 2020b.

3.4.3.3.1 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 77). 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 77. 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)		
		2016 – 2018	2017-2019	2018-2020[d]
Green turtle [b]	60(54)	62.9(57.87)	68(64.64)	46(43.72)
Central South Pacific DPS[b]	30(27)	31.9(29.35)[c]	34(32.32)[c]	23(21.86)
Southwest Pacific DPS[b]	20(17.82)	21.1(19.41)[c]	22.44(21.33)[c]	15.18(14.43)
East Pacific DPS[b]	7(6.48)	7.1(6.53)[c]	8.16(7.76)[c]	5.52(5.25)
Central West Pacific DPS[b]	2(1.62)	1.7(1.56)[c]	2.04(1.94)[c]	1.38(1.31)
East Indian-West Pacific DPS[b]	1(1.08)	1.2(1.1)[c]	1.36(1.29)[c]	0.92(0.87)
Leatherback turtle	69(49)	10.6(7.21)	15(10.28)	12(8.29)
Olive ridley turtle	33(10)	36.2(23.53)	43(32.92)	31(23.72)
Loggerhead turtle	6(3)	0	0	0
Hawksbill turtle	6(3)	20.4(20.4)	8(8)	5(5)

[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] 2020 data are not included in the estimate for this period due to data confidentiality rules associated with the low observer coverage.

3.4.3.4 MARINE MAMMAL INTERACTIONS IN THE AMERICAN SAMOA LONGLINE FISHERY

Table 78 summarizes the incidental take data of marine mammals from 2006 to 2020 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). 2020 data cannot be reported due to confidentiality rules.

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 2019, there were 5 years of no observed marine mammal interactions with this fishery (2006, 2007, 2009, 2010, and 2012).

3.4.3.4.1 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 78. 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, 2006-2020[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		EF Est.	Observed		EF Est.	ME	Observed		EF Est.	ME	Observed		EF Est.	Observed		EF Est.	ME	Observed		EF Est.
				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	
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	*	*	*	*	*	*	*	*		*	*	*		*	*	*	*	*	*		*	*	*

[a] Take data are based on vessel arrival dates.

*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 2020a.

3.4.3.5 SEABIRD INTERACTIONS IN THE AMERICAN SAMOA LONGLINE FISHERY

Table 79 summarizes the incidental take data of seabirds from 2006 to 2020 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 data cannot be reported due to confidentiality rules.

Observed seabird interactions with the American Samoa longline fishery between 2006 and 2019 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 were no observed seabird interactions from 2016 to 2018, and one unidentified shearwater was observed in 2019.

Table 79. 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, 2006-2020[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	*	*	*	*	*	*	*	*	*	*	*	*	*	*

[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.

3.4.3.6 ELASMOBRANCH INTERACTIONS IN THE AMERICAN SAMOA LONGLINE FISHERY

Table 80 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 data cannot be reported due to confidentiality rules.

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 in the last five years.

An ITS is not required to provide protective coverage for the Indo-west Pacific scalloped hammerhead shark DPS because there are no take prohibitions under ESA section 4(d) for the DPS. However, NMFS included an ITS of 36 interactions over a three-year period in the 2015 Biological Opinion to serve as a check on the no-jeopardy conclusion by providing a reinitiation trigger. NMFS uses a rolling three-year period to track incidental take. NMFS counts takes for the Indo-west Pacific DPS of scalloped hammerhead sharks based on the end of haul incidental take date. There was an estimated total of 21 scalloped hammerhead interactions based on the expansion factor estimate in the American Samoa longline fishery from 2017 to 2019, thus the three-year ITS has not been exceeded.

Table 80. Observed and estimated total elasmobranch interactions with the American Samoa longline fishery for 2006-2020[a]

Year	Obs. Cov. (%)	Sets	Hooks	Scalloped hammerhead				Oceanic whitetip				Giant manta ray			
				Observed				Observed				Observed			
				Takes (M^{b})	Takes/ 1,000 hooks	EF Est.	ME	Takes (M^{b})	Takes/ 1,000 hooks	EF Est.	ME	Takes (M)	Takes/ 1,000 hooks	EF Est.	ME
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	*	*	*	*	*	*	*	*	*	*	*	*	*	*

[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.

3.4.4 HAWAII TROLL FISHERY

3.4.4.1 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.

3.4.4.1.1 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.

3.4.4.1.2 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.

3.4.4.1.3 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 2021 LOF (86 FR 3028, January 14, 2021), 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 2021 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).

3.4.4.2 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.

3.4.5 MHI HANDLINE FISHERY

3.4.5.1 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.

3.4.5.1.1 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.

3.4.5.1.2 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.

3.4.5.1.3 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 2021 LOF (86 FR 3028, January 14, 2021), 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).

3.4.5.2 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.

3.4.6 HAWAII OFFSHORE HANDLINE FISHERY

3.4.6.1 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.

3.4.6.1.1 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.

3.4.6.1.2 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.

3.4.6.1.3 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 2021 LOF (86 FR 3028, January 14, 2021), 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).

3.4.6.2 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.

3.4.7 AMERICAN SAMOA, GUAM, AND CNMI TROLL FISHERY

3.4.7.1 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.

3.4.7.1.1 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.

3.4.7.1.2 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.

3.4.7.1.3 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 2021 LOF (86 FR 3028, January 14, 2021), 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).

3.4.7.2 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.

3.4.8 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. NMFS has reinitiated consultation for these two species for the Hawaii and American Samoa longline fisheries. Additionally, the Joint Institute for Marine and Atmospheric Research and the Hawaii Institute of Marine Biology is conducting a study to assess the post-release survivorship of sharks released alive in the Hawaii and American Samoa longline fishery.

In the ongoing study (Hutchinson et al. 2021), PIFSC researchers have been working 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 collected shark condition and handling data on 19,572 incidental elasmobranchs captured during 148 fishing trips that occurred between January 2016 and June 2019 on 76 different vessels. During 84 of these trips (ASLL, n = 14; HIDS, n = 70), 224 sharks from five species: blue (BSH), bigeye thresher (BTH), oceanic whitetip (OCS), shortfin mako (SMA) and silky (FAL) sharks were tagged by observers and fishers. 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 (n = 16,527 animals) were released by cutting the line (LC = 81.1%). Followed by; gear removal with jaw damage (JD = 11.5%), gear removal with no damage to the shark (GR = 3%), gear removal with removal of part of the shark (e.g., lobe of tail on tail-hooked BTH, PR = 0.3%). A small proportion of these sharks escaped the gear on their own (ES = 3%). Other handling methods that were observed included the use of a dehooker (DH = <1%) and a drag line (DL = < 1%). While 1.2 % of sharks were released using some other (OT) method. 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, tagging is ongoing to refine the post release survivorship estimates for BSH, SMA and OCS and final results are forthcoming.

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 81 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 81. 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)	In development; recovery outline in place; recovery planning workshops convened in 2019.
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

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**
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)	Recovery outline published 12/4/19 to serve as interim guidance until full recovery plan is developed; recovery planning workshop tentatively planned for 2021.
Shortfin mako shark	*Isurus oxyrinchus*	Positive (86 FR 19863), 4/15/2021	TBA	TBA	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)	Draft recovery plan published 10/16/2020 (85 FR 65791), comment period closed 12/15/2020, final plan anticipated in 2021.
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 TBA	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
Leatherback sea turtle	*Dermochelys coriacea*	Positive 90-day finding on a petition to identify the Northwest Atlantic leatherback turtle as a DPS (82 FR 57565, 12/06/2017)	7 populations qualify as DPS, but DPS listing not warranted due to all populations meeting existing endangered classification; no changes proposed to existing global listing (85 FR 48332, 8/10/20)	N/A	N/A	N/A
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

3.4.9 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);
- Ecosystem considerations on catch and bycatch in the DSLL fishery (e.g., bigeye tuna, albatrosses, leatherback, and olive ridley turtles) 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; and
- Estimates of post release survival for incidental protected species.

3.5 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 2020 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 2020. 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.

3.5.1 INDICATORS AT A GLANCE

Based on the information provided by the indicators in this chapter, ocean and climate conditions in the Western Pacific region in 2020 were mostly average and long-term climate trends persisted. Modes of interannual climate variability (e.g., ENSO, PDO) shifted to negative phases. Hurricane activity was below average, although with a few notable storms. 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 and the median size of phytoplankton were average and exhibited no long-term trend. Temperatures at 200–300 m below the surface were average. Bigeye tuna were slightly larger than last year and swordfish were notably smaller, though no long-term trend is evident. Neither the bigeye recruitment index nor the bigeye forecast suggests there will be a pulse of increased recruitment or catch rates in the next few years.

3.5.2 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.

3.5.2.1 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.

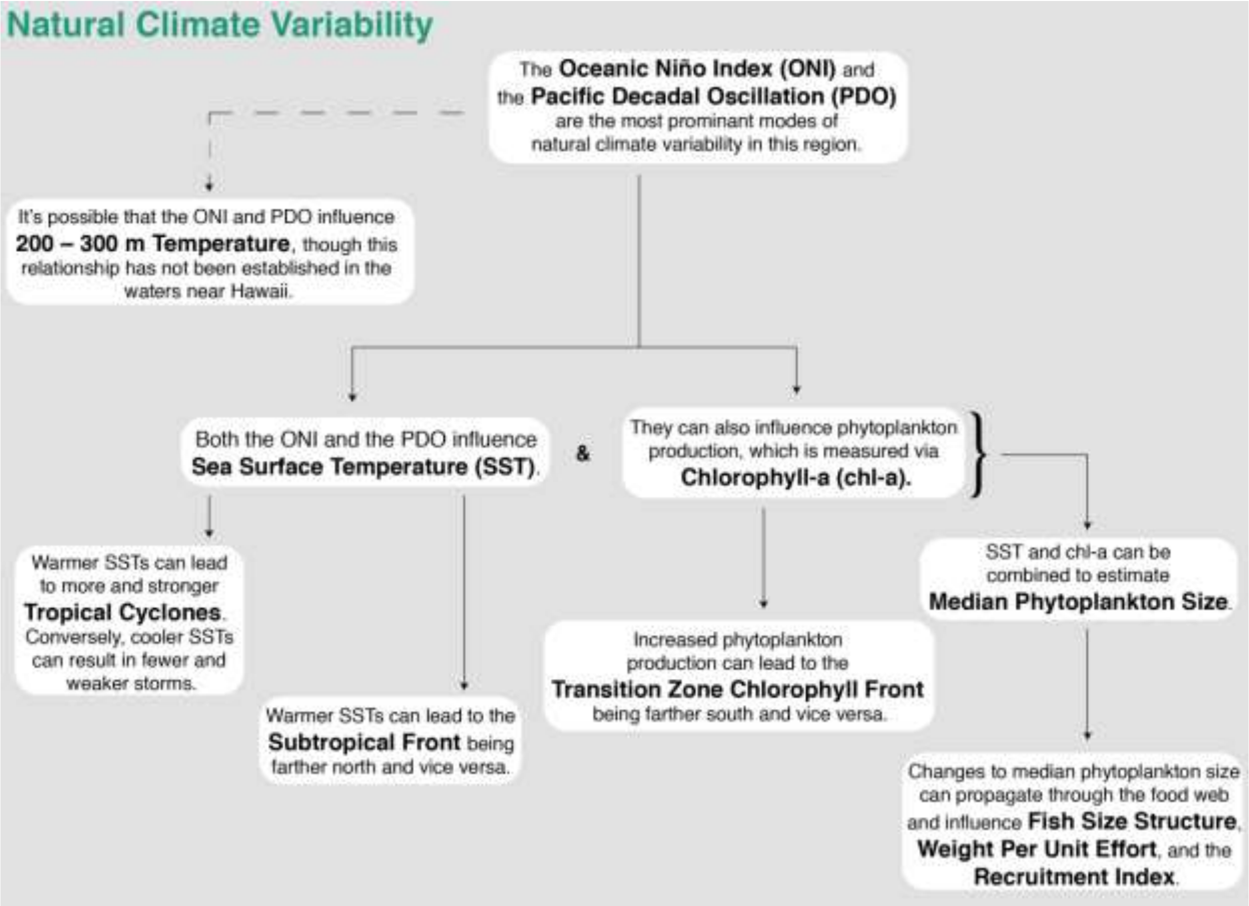


Figure 159. Schematic diagram illustrating the relationships between the ocean and climate indicators from the perspective of natural climate variability

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. In 2020, ENSO phase transitioned from neutral conditions to a weak La Niña. Like ENSO, the PDO reflects changes between periods of persistently warm or persistently cool temperatures, except over periods 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. The PDO was negative in 2020.

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, warmer 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. In 2020, SST was above the long-term average across much of Hawaiʻi's longline fishing grounds. During the first quarter of the year, when the swordfish fishery is most active, the subtropical front that roughly aligns with their fishing ground was slightly north of average west of 145°W, south of average between 130° – 140°W, and average elsewhere. The number of named storms and hurricanes/typhoons/cyclones, including major storms, was below average to average across the Pacific. The Accumulated Cyclone Energy (ACE) index, a measure of the intensity and duration of storms over the entire season, was well below average in all basins.

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 Hawaiʻi's swordfish fishery. In 2020, surface chlorophyll was slightly below average across much of the longline fishing grounds. The TZCF, which is targeted by the swordfish fishery, was north of average across nearly the entire fishing grounds in the first quarter of the year. In a few places, it was several degrees north of average**.**

SST and chl-a can be combined to estimate median phytoplankton size. In 2020, median phytoplankton size across the longline fishing grounds was average. 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. Overall, bigeye tuna were slightly larger than average and swordfish markedly smaller than average in 2020. Weight-per-unit-effort was average to below average in 2020. The recruitment index was similar to the previous few years and does not suggest an upcoming recruitment pulse. Similarly, the bigeye catch rate forecast suggests only a very moderate increase in catch rates over the next four years.

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. At 200–300 meters depth, waters around Hawaiʻi and in the southwestern portion of the bigeye tuna fishing grounds were cooler than average in 2020. In the northern portion of the fishing grounds between about 30° – 45°N, waters were warmer than average.

Understanding the effects of natural climate variability, like ENSO and the PDO, on the ocean, marine ecosystems, and the fishery is an active area of research.

3.5.2.2 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.

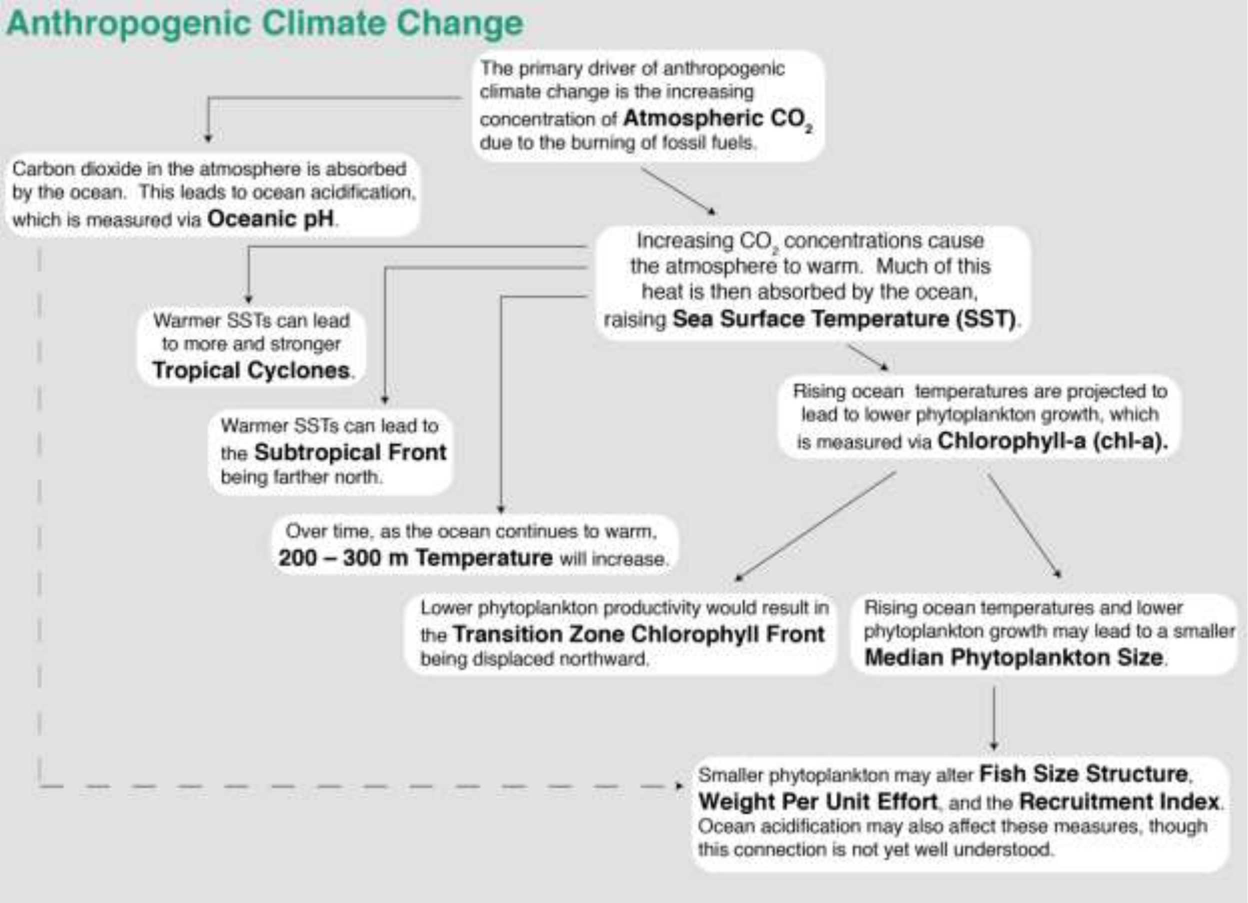


Figure 160. Schematic diagram illustrating the relationships between the ocean and climate indicators from the perspective of anthropogenic climate change

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. In 2020, the annual mean concentration of CO_2 was 414 ppm. In 1959, the first year of the time series, it was 316 ppm. The annual mean passed 350 ppm in 1988, and 400 ppm in 2015.

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. In 2019, the most recent year for which data are available, the average pH at Station ALOHA was 8.06. The ocean is now roughly 9.4% more acidic than it was 30 years ago at the start of this time series. Over this time, pH has declined by 0.043 at a constant rate.

Increasing carbon dioxide concentrations cause the atmosphere to warm. Much of this heat is then absorbed by the ocean, raising sea surface temperature (SST). Over the past 36 years, SST in the Hawai‘i longline region has increased at a rate of 0.02 ºC yr^{-1}. In 2020, annual mean SST was 21.1 ºC. Monthly SST values in 2020 ranged from 18.4–24.4 ºC, within but at the upper range of temperatures observed in previous years.

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. There has been no significant trend in the number or strength (measured via Accumulated Cyclone Energy, or ACE, index) of tropical cyclones from 1980 through 2020.

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. Over the past 41 years, 200–300-meter temperatures have ranged from 10.87–11.58 °C. There has been a very small, but steady, decline of 0.09 ºC in these waters over the time series. In 2020, 200–300 m temperatures ranged from 11.09–11.22 °C with an average value of 11.16 °C. Temperatures in 2020 were within the range of previously observed temperatures.

Rising ocean temperatures are projected to lead to lower phytoplankton abundance, which is observed through ocean color and estimated via chlorophyll-a (chl-a). There has been no trend in chl-a across the longline fishing grounds over the past 23 years. Combined, rising ocean temperatures and lower phytoplankton abundance may lead to smaller median phytoplankton sizes. Median phytoplankton size over the longline fishing grounds has not exhibited a trend at this time. 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. Over the period of record, there is no trend in the median size of fish caught by Hawai‘i’s longline fishery or in the recruitment index.

Understanding the effects of anthropogenic climate change on the ocean, marine ecosystems, and the fishery is an active area of research.

3.5.2.3 ATMOSPHERIC CONCENTRATION OF CARBON DIOXIDE AT MAUNA LOA

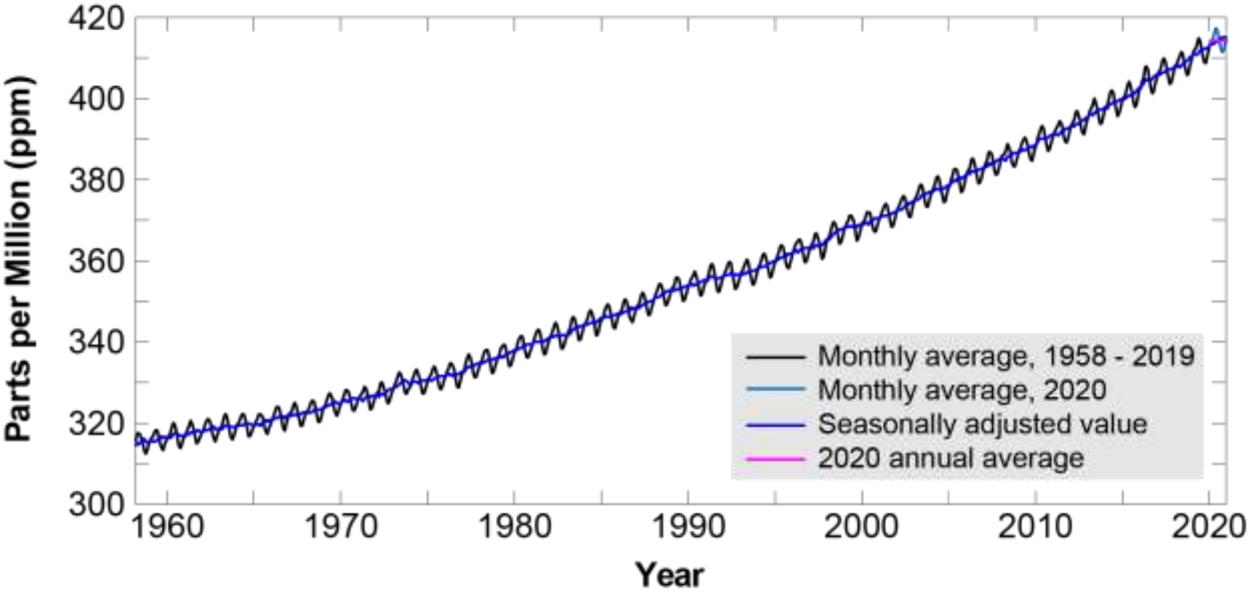


Figure 161. The concentration of atmospheric carbon dioxide at Mauna Loa Observatory on the island of Hawaii

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 2020, the annual mean concentration of CO_2 was 414 ppm. In 1959, the first year of the time series, it 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.

Sourced from: Keeling et al. (1976), Thoning et al. (1989), and NOAA (2021a).

3.5.2.4 OCEANIC PH

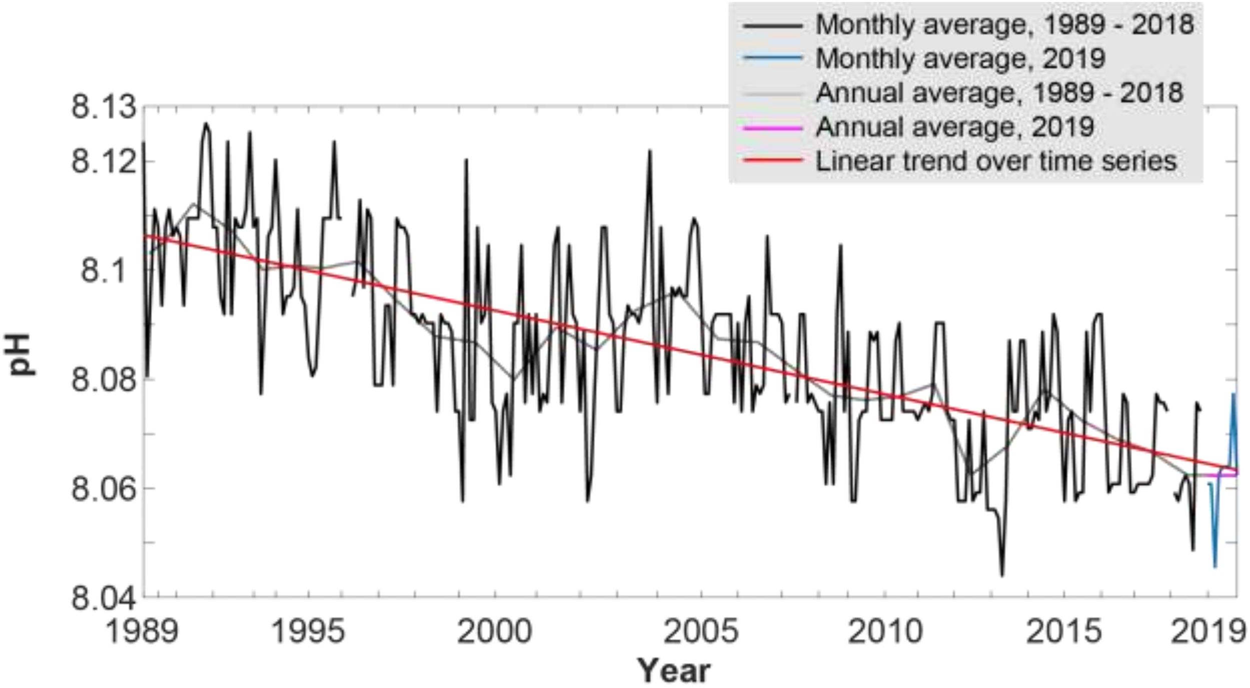


Figure 162. Time series and long-term trend of oceanic pH measured at Station ALOHA

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 9.4% more acidic than it was 30 years ago at the start of this time series. Over this time, pH has declined by 0.043 at a constant rate. In 2019, the most recent year for which data are available, the average pH was 8.06. Additionally, small variations seen over the course of the year are outside the range seen in the first year of the time series for the third year in a row. The highest pH value reported for the most recent year (8.077) is lower than the lowest pH value reported in the first year of the time series (8.081).

Description: Trends in surface (5 m) pH at Station ALOHA, north of Oahu (22.75°N, 158°W), collected by the Hawai‘i Ocean Time Series (HOT) from October 1988 to 2019 (2020 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.

Sourced from: Fabry et al. (2008), Feely et al. (2016), and the Hawai'i Ocean Time Series as described in Karl and Lukas (1996) and on its website (HOT 2021).

3.5.2.5 EL NIÑO – SOUTHERN OSCILLATION

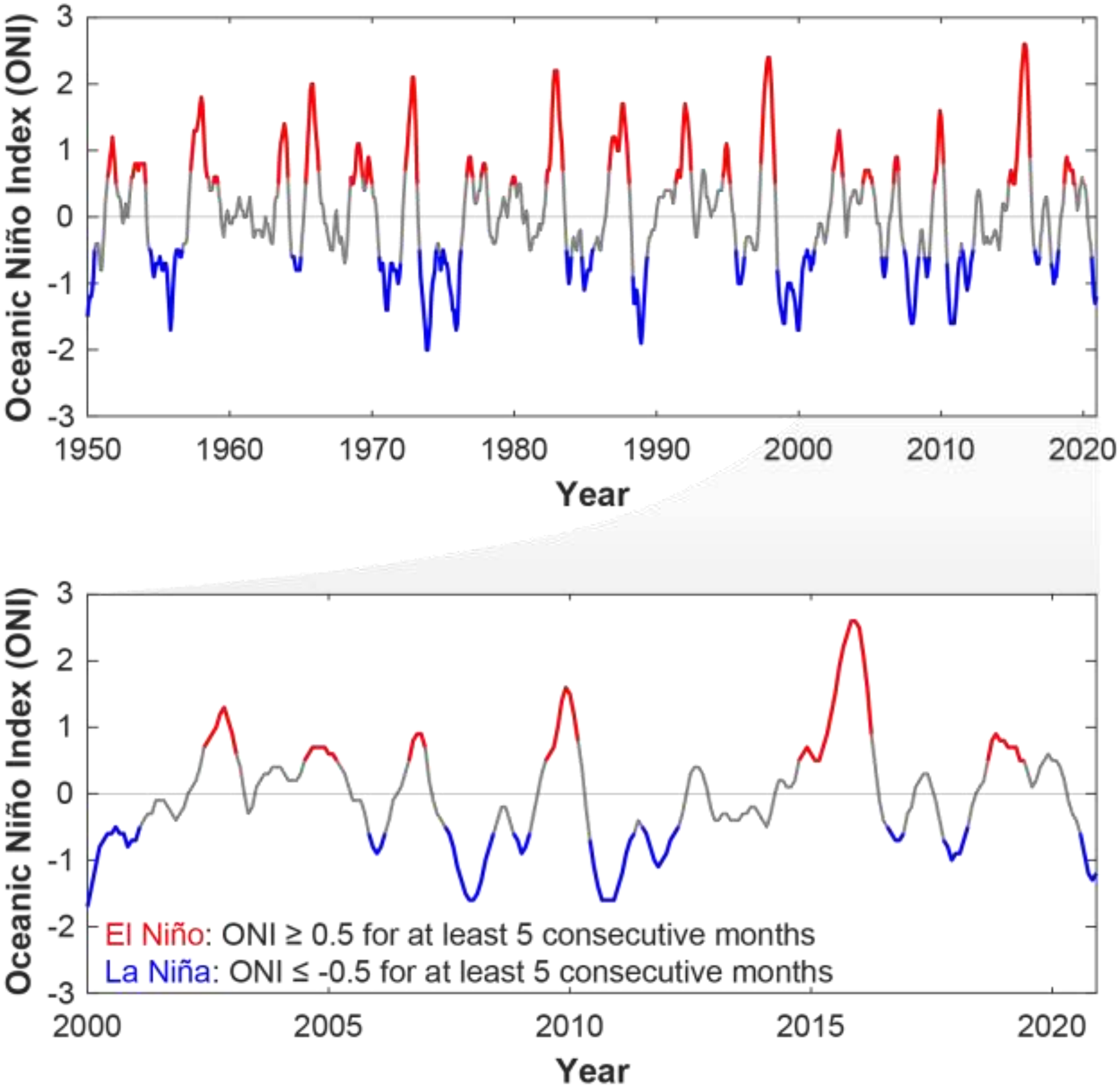


Figure 163. Oceanic Niño Index from 1950-2020 (top) and 2000–2020 (bottom) with El Niño periods in red and La Niña periods in blue

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: In autumn of 2020, the ONI transitioned from neutral to La Niña conditions. Over the year, the ONI ranged from 0.5 to -1.3. This is within the range of values observed previously in the time series.

Description: The three-month running mean 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.

Sourced from NOAA CPC (2021).

3.5.2.6 PACIFIC DECADAL OSCILLATION

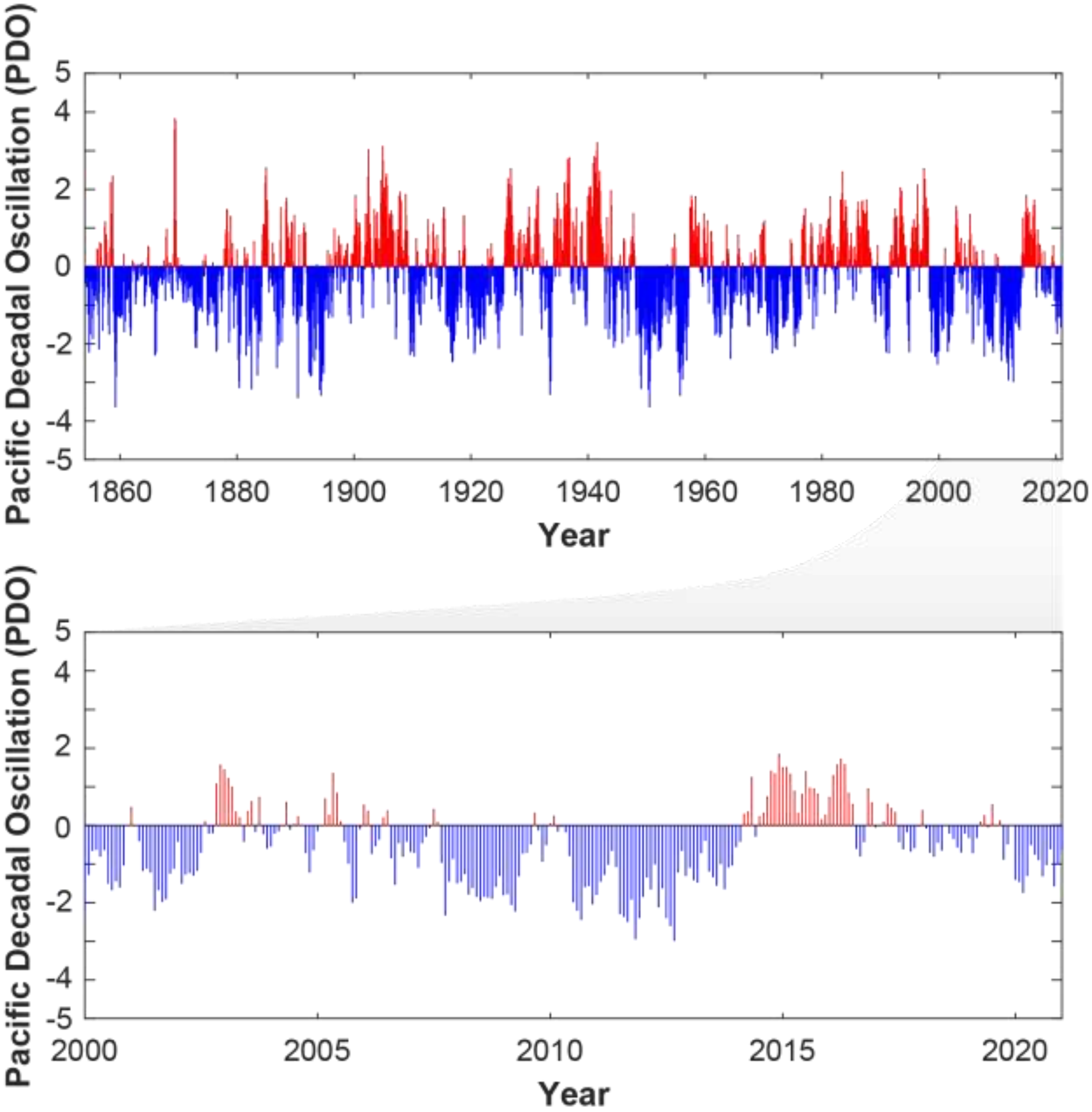


Figure 164. Pacific Decadal Oscillation from 1854–2020 (top) and 2000–2020 (bottom) with positive warm periods in red and negative cool periods in blue

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 2020. The index ranged from -0.51 to -1.75 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 (2021b).

Timeframe: Annual, monthly.

Region/Location: Pacific Basin north of 20°N.

Measurement Platform: *In-situ* station, satellite, model.

Sourced from: NOAA (2021b) and Mantua (2017).

3.5.2.7 TROPICAL CYCLONES

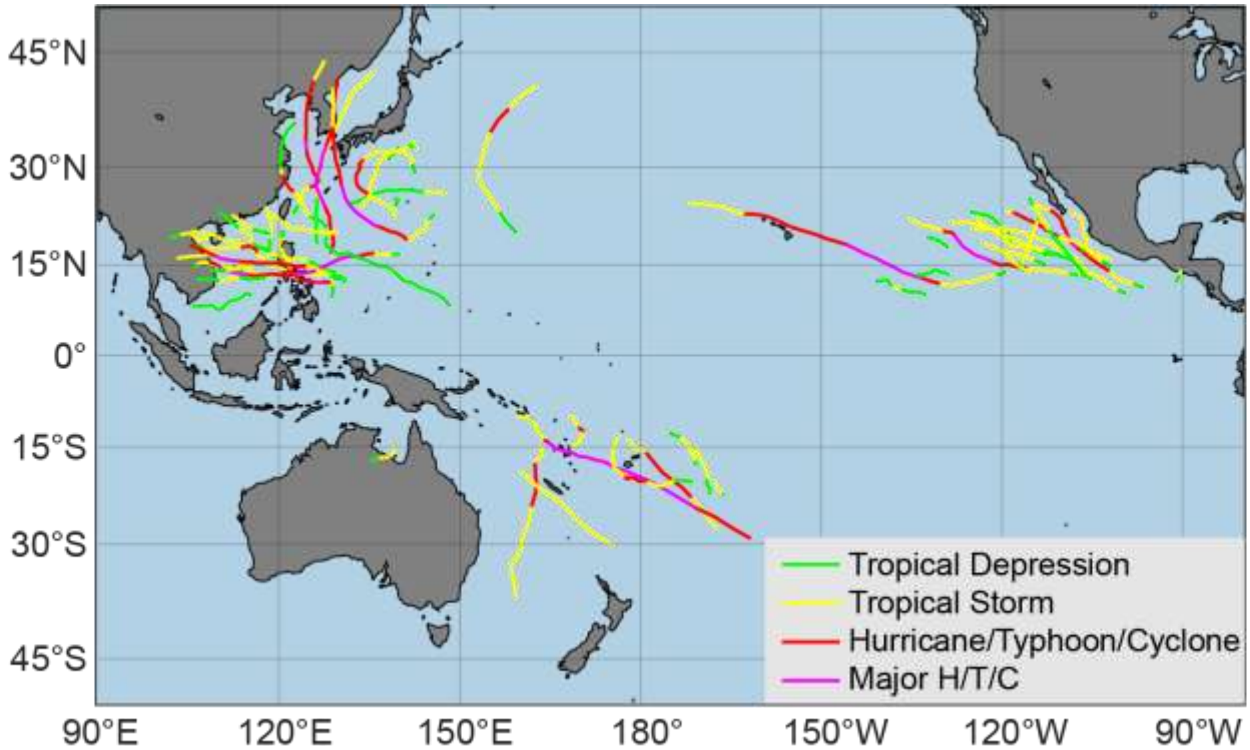


Figure 165. 2020 Pacific basin tropical cyclone tracks

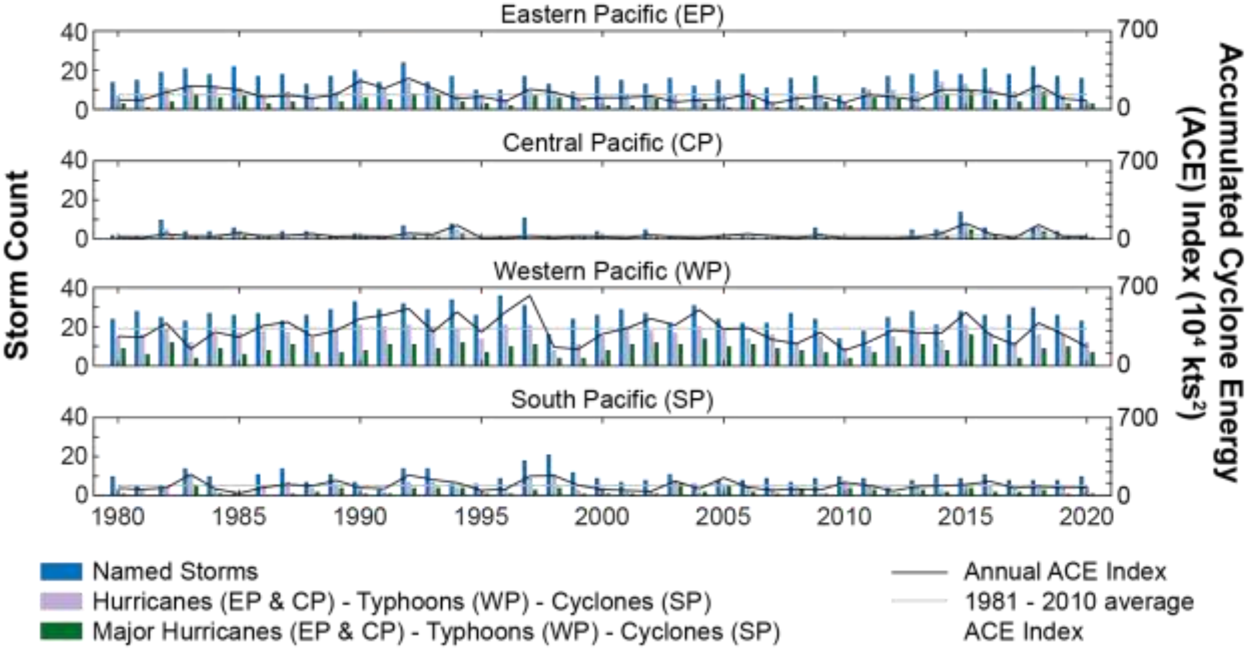


Figure 166. Storm counts (bars) and Accumulated Cyclone Energy (ACE) index values (lines) in each region of the Pacific. Both annual ACE index (black lines) and 1981 – 2010 average ACE index (grey lines) are shown

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 Hawai‘i 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. Overall, the 2020 eastern Pacific hurricane season featured an average number of named storms, but below average hurricane and major hurricane activity. There were sixteen named storms, of which four became hurricanes and three became major hurricanes - category 3 or higher on the Saffir-Simpson Hurricane Wind Scale. This compares to the long-term averages of fifteen named storms, eight hurricanes, and four major hurricanes. There were also five tropical depressions that did not reach tropical storm strength. Two tropical storms, Odalys and Polo, formed in the basin in November. Although the long-term (1981–2010) average is one tropical storm forming in the basin every second or third year, this is the third straight November with at least one named storm forming. In fact, named storms have formed in November in six of the past seven years in the basin. In terms of Accumulated Cyclone Energy (ACE), which measures the strength and duration of tropical storms and hurricanes, activity in the basin for 2020 was below normal, more than 40 percent below the long-term average. Summary inserted from https://www.nhc.noaa.gov/text/MIATWSEP.shtml.

Central North Pacific. Tropical cyclone activity in the central Pacific in 2020 was slightly below average. While there was only one named storm, which is below the 1981–2010 average of three, this storm was particularly noteworthy. July’s hurricane Douglas reached category 4 strength, making it a major hurricane. Its intensity fell prior to its passage just north of the main Hawaiian Islands. On average, the central Pacific sees three named storms, two hurricanes, and no major hurricanes. The 2020 ACE index was about an order of magnitude below the 1981–2010 average.

Western North Pacific. Tropical cyclone activity was below average in the West Pacific in 2020. There were 23 named storms, compared to an average of 26. Twelve of these developed into typhoons, and seven of these typhoons were major. An average year would see 17 typhoons, nine of which would be major. The West Pacific was unusually quiet in 2020 with less than half its normal ACE (third lowest since 1981). The West Pacific did have the strongest storm of 2020, Super Typhoon Goni, which made landfall in the Philippines as a powerful category 5 storm. The initial estimates of 195-mph winds during its landfall would be the strongest on record. Portions of the summary inserted from https://www.ncdc.noaa.gov/sotc/tropical-cyclones/202013.

South Pacific. Tropical cyclone activity in the south Pacific was roughly average in 2020. There were ten named storms, five of which developed into cyclones and one of which – Harold – was major. The long-term average in this basin is nine named storms, five cyclones, and two major cyclones. The strongest cyclone of the Southern Hemisphere season was category-5 Tropical Cyclone Harold. Harold alone accounted for more than half of the Southwest Pacific's ACE for 2020 (overall, the region’s ACE index was below average in 2020). It was the first category 5 storm in the Southern Hemisphere since Tropical Cyclone Gita in 2018. Harold caused widespread damage throughout the South Pacific Islands, particularly in Vanuatu where it achieved its peak intensity. Portions of the summary inserted from https://www.ncdc.noaa.gov/sotc/tropical-cyclones/202013.

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.

Sourced from: Knapp et al. (2010), Knapp et al. (2018), and NOAA (2021c).

3.5.2.8 SEA SURFACE TEMPERATURE (SST)

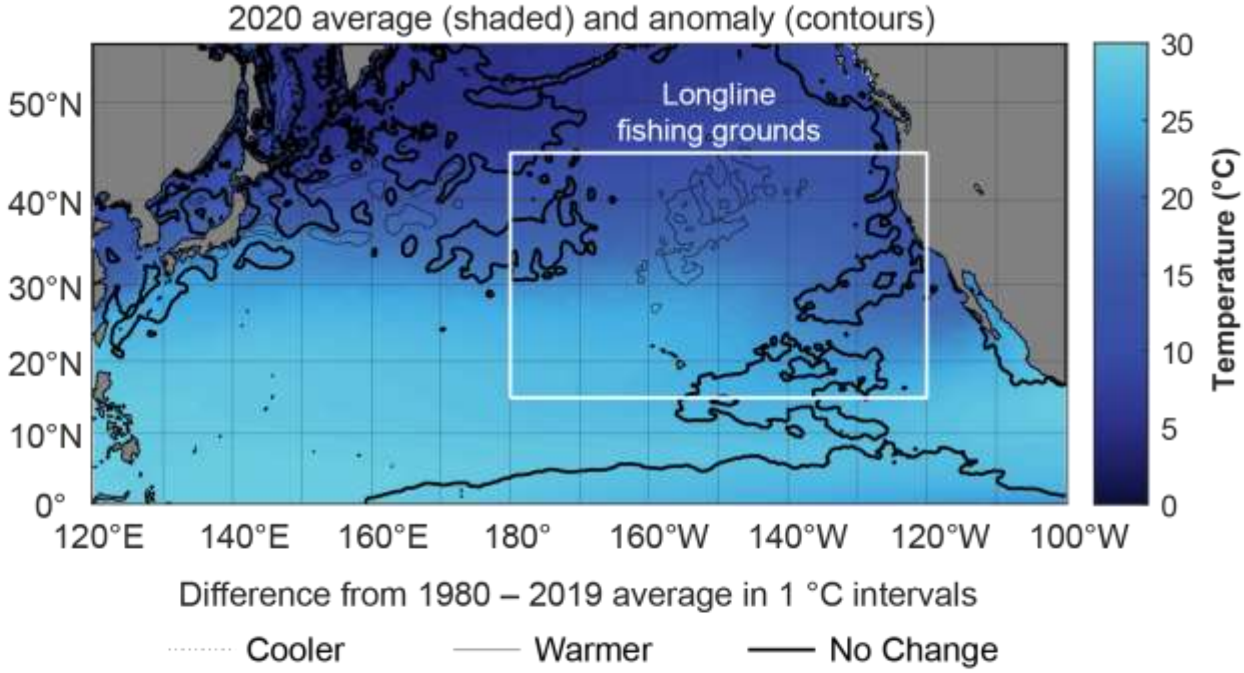


Figure 167. Average 2020 sea surface temperature (shaded) and the difference from the 1985 – 2019 average (contoured). The white rectangle identifies the area targeted by Hawaii's longline fisheries. SST is averaged over this area for the time series shown in Figure 168 and Figure 169

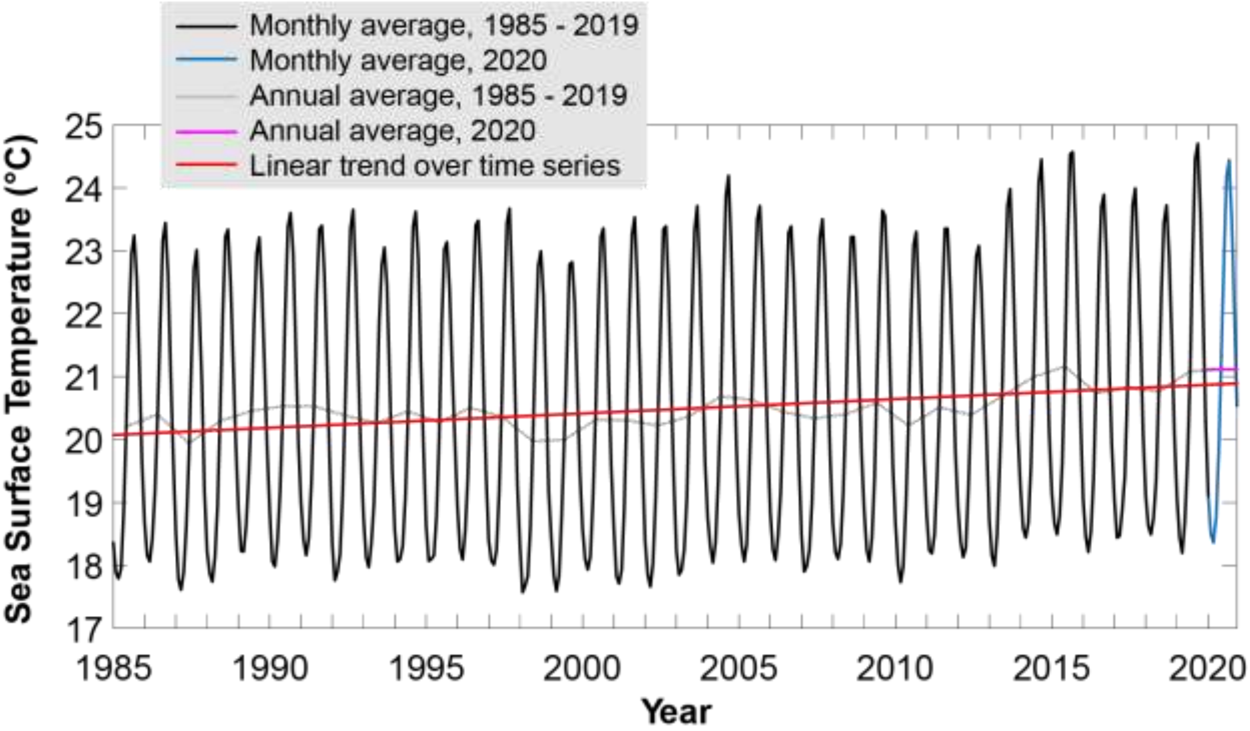


Figure 168. Time series of monthly average sea surface temperature over the longline fishing grounds outlined in Figure 167

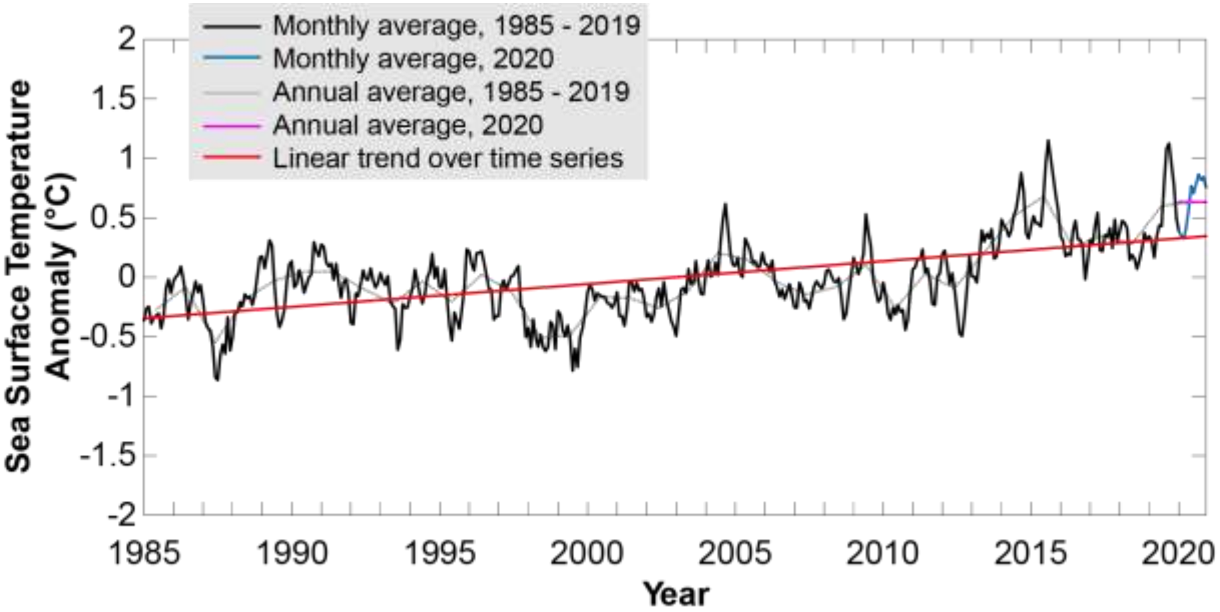


Figure 169. Time series of monthly average sea surface temperature anomaly over the longline fishing grounds outlined in Figure 167

Rationale: Sea surface temperature 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 21.1 ºC in 2020. Over the period of record, SST across the longline fishing grounds has increased by 0.8 ºC and the monthly SST anomaly increased by 0.7 ºC, both at a rate of roughly 0.02 ºC yr^{-1}. Monthly SST values in 2020 ranged from 18.4–24.4 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 2020.

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.

Sourced from: NOAA OceanWatch (2021).

3.5.2.9 TEMPERATURE AT 300 M DEPTH

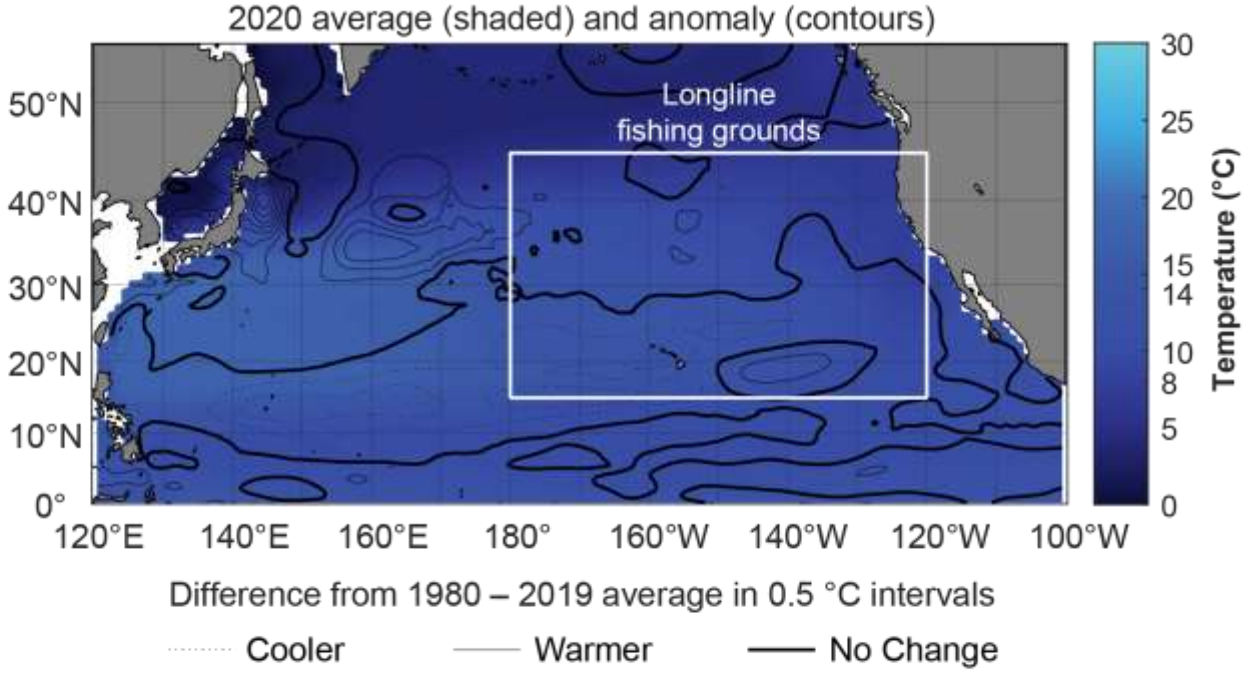


Figure 170. Average temperatures at 200 – 300 m depth in 2020 (shaded) and the difference from the 1980 – 2018 average (contoured). The white rectangle identifies the area targeted by Hawaii's longline fisheries. Temperatures is averaged over this area for the time series shown in Figure 171

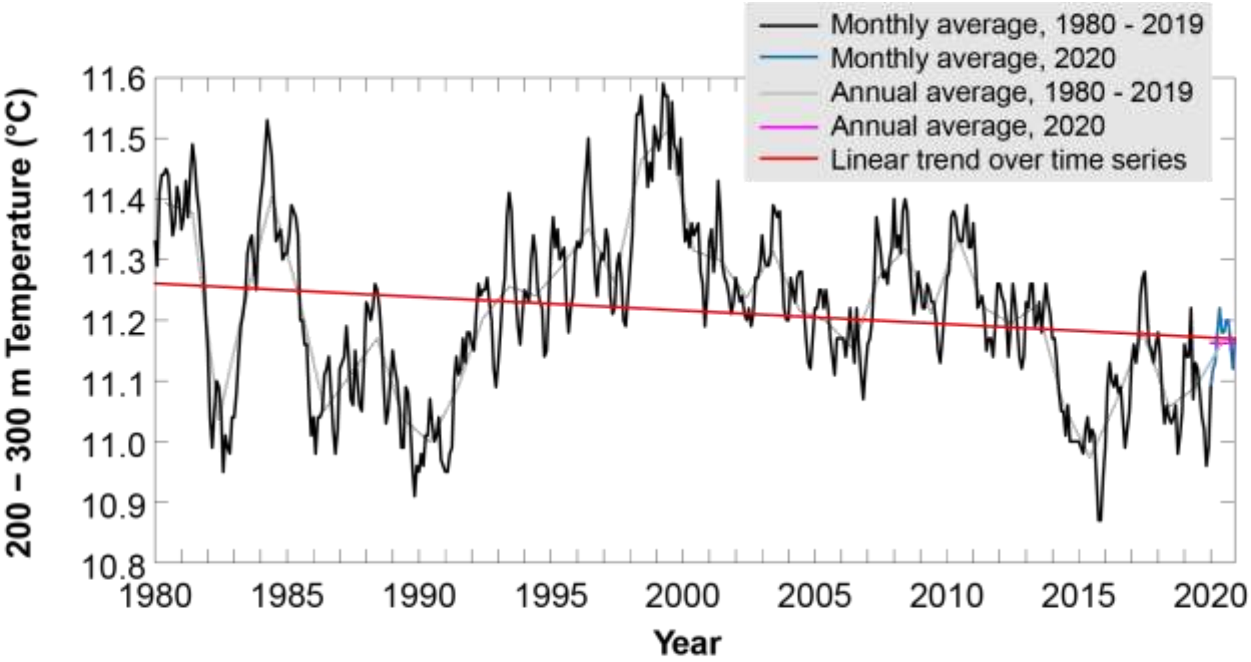


Figure 171. Time series of monthly 200 – 300 m temperatures over the longline fishing grounds outlined in Figure 170

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 2020, 200–300 m temperatures ranged from 11.09–11.22 °C with an average value of 11.16 °C. These temperatures are within the range of temperatures experienced over the past several decades (10.87–11.58 °C) and are within the bounds of bigeye tuna's preferred deep daytime thermal habitat (8–14 °C). Over the period of record (1980–2020), 200–300 m temperatures have declined by 0.09 °C. The spatial pattern of temperature anomalies was mixed with cooler than average temperatures at depth around the main Hawaiian Islands, and warmer than average temperatures to the east of the main Hawaiian Islands and north of about 30°N.

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 (2021d).

3.5.2.10 OCEAN COLOR

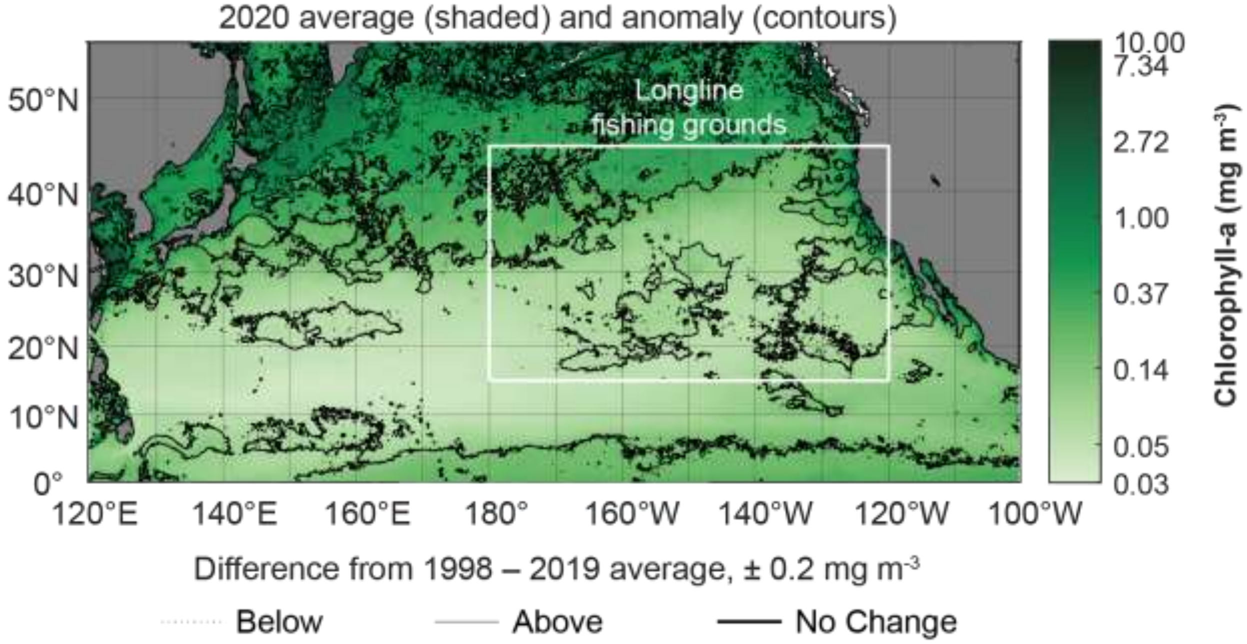


Figure 172. Average chlorophyll-a concentration in 2020 (shaded) and the difference from the 1998–2019 average (contoured). The white rectangle identifies the area targeted by Hawai'i's

longline fisheries. Chlorophyll-a is averaged over this area for the time series shown in Figure 173 and Figure 174

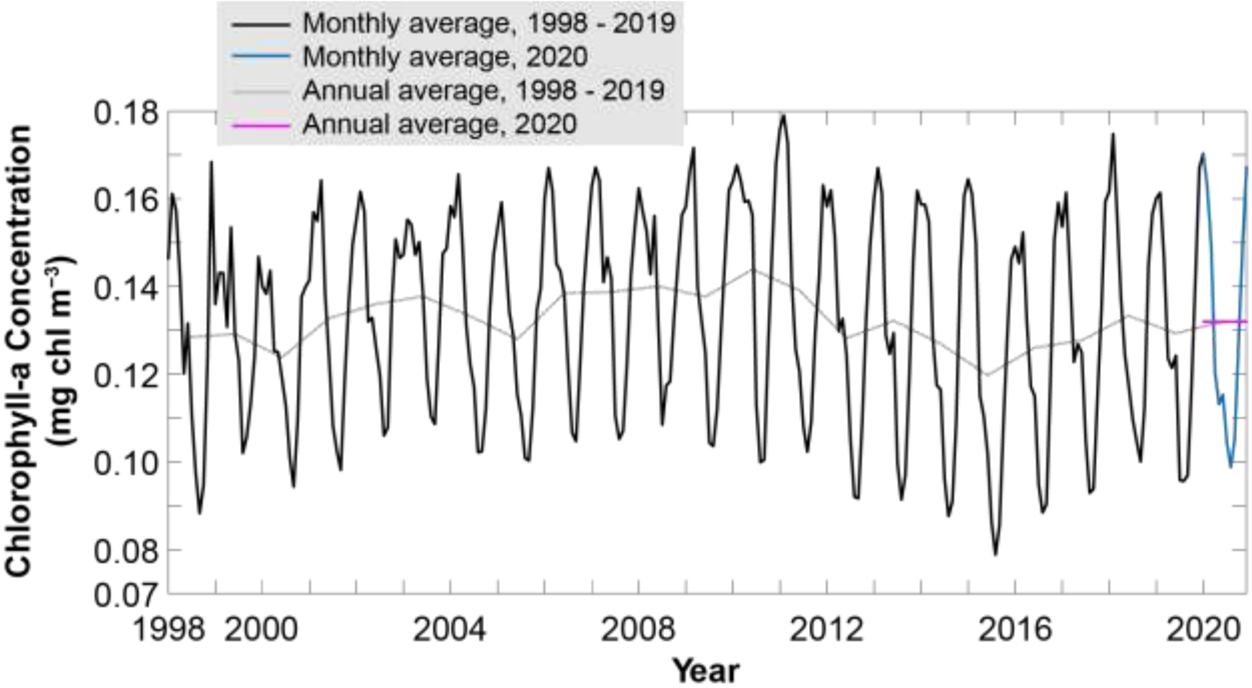


Figure 173. Time series of monthly average chlorophyll concentration over the longline fishing grounds outlined in Figure 174

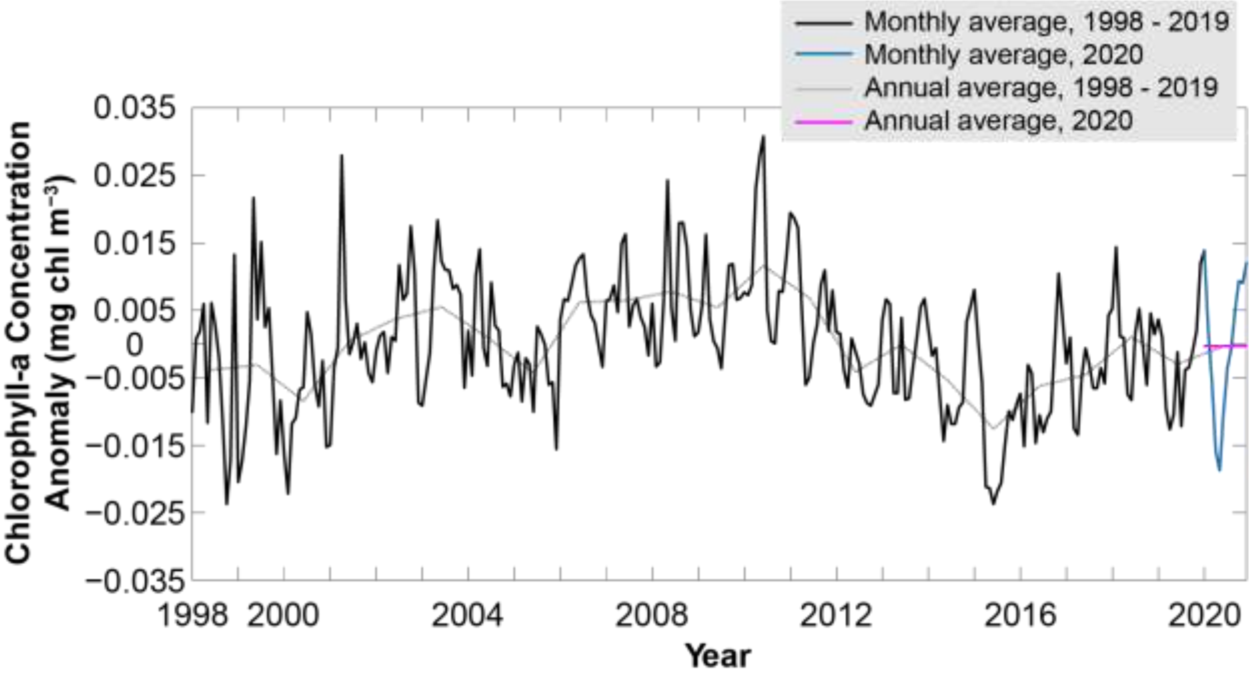


Figure 174. Time series of monthly average chlorophyll concentration anomaly over the longline fishing grounds outlined in Figure 173

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 2020. Monthly mean chlorophyll concentrations ranged from 0.10–0.17 mg chl m^{-3}, within the range of values observed over the period of record (0.0789–0.1791). There has been no significant trend in monthly average chlorophyll concentration over the time period. Chlorophyll concentrations were slightly lower than average within the subtropical gyre, with the exception of a small area northeast of the main Hawaiian Islands, and slightly above average outside the gyre (mid-latitudes and along the equator).

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 Hawaiʻi 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 (2021).

3.5.2.11 NORTH PACIFIC SUBTROPICAL FRONT (STF) AND TRANSITION ZONE CHLOROPHYLL FRONT (TZCF)

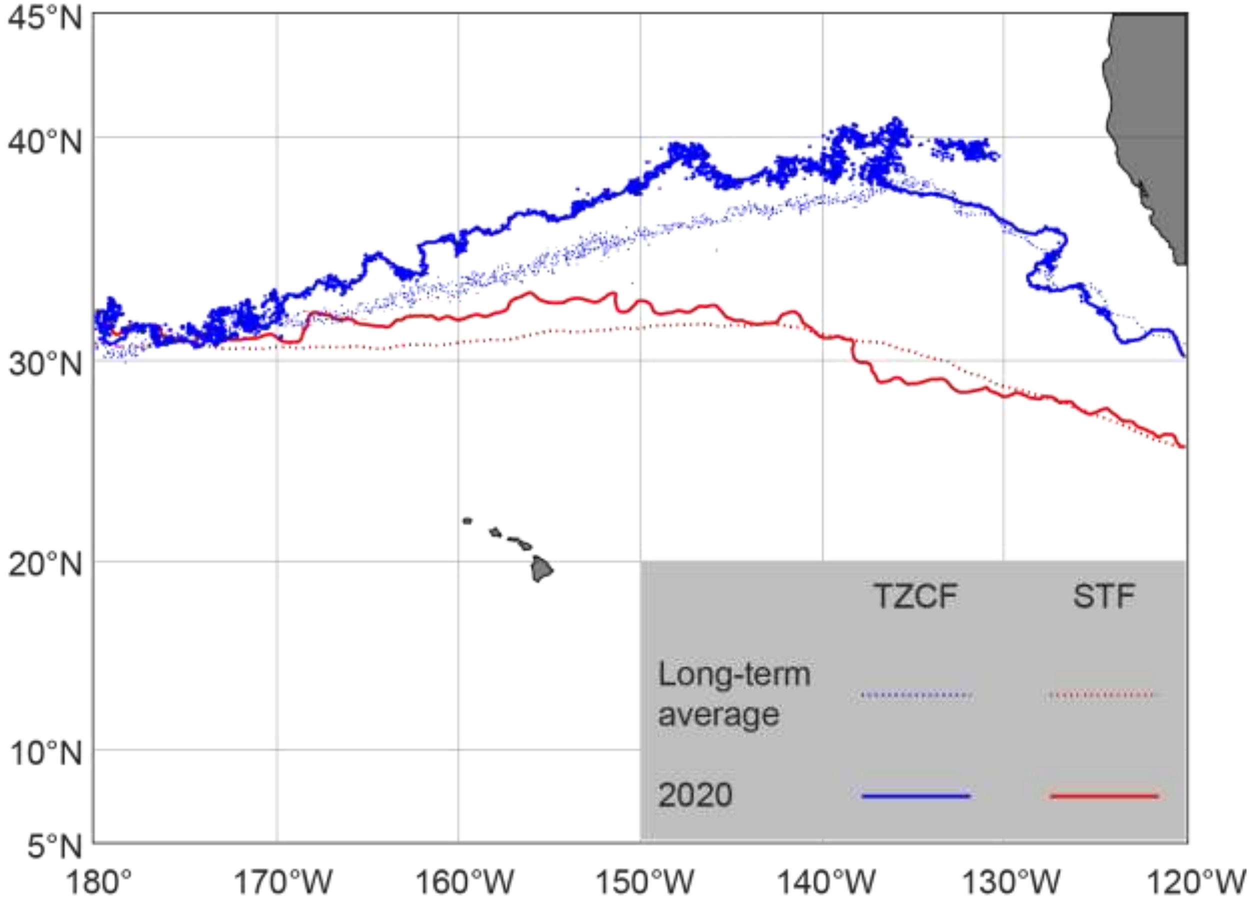


Figure 175. Average positions of the transition zone chlorophyll front (TZCF, blue lines) and subtropical front (STF, red lines) in 2020 (solid lines) and over a long-term average (dotted lines). The long-term average for the TZCF spans 1998 – 2019. The long-term average for the STF spans 1985 – 2019

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 2020, the STF was slightly north of average west of about 145°W, south of average between 130° – 140°W, and at its average location east of 130°W. The TZCF was a few degrees north of average between 170° – 140°W and at its average location to the east and west of these longitudes. The 2020 anomaly closely follows 2019 conditions.

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 (2020) 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 ocean color indicator).

Timeframe: Annual, seasonal

Region: Hawaii longline region: 5° – 45°N, 180° – 120°W

Measurement Platform: Satellite

Sourced from: Bograd et al. (2004), Polovina et al. (2001), and NOAA OceanWatch (2021).

3.5.2.12 ESTIMATED MEDIAN PHYTOPLANKTON SIZE

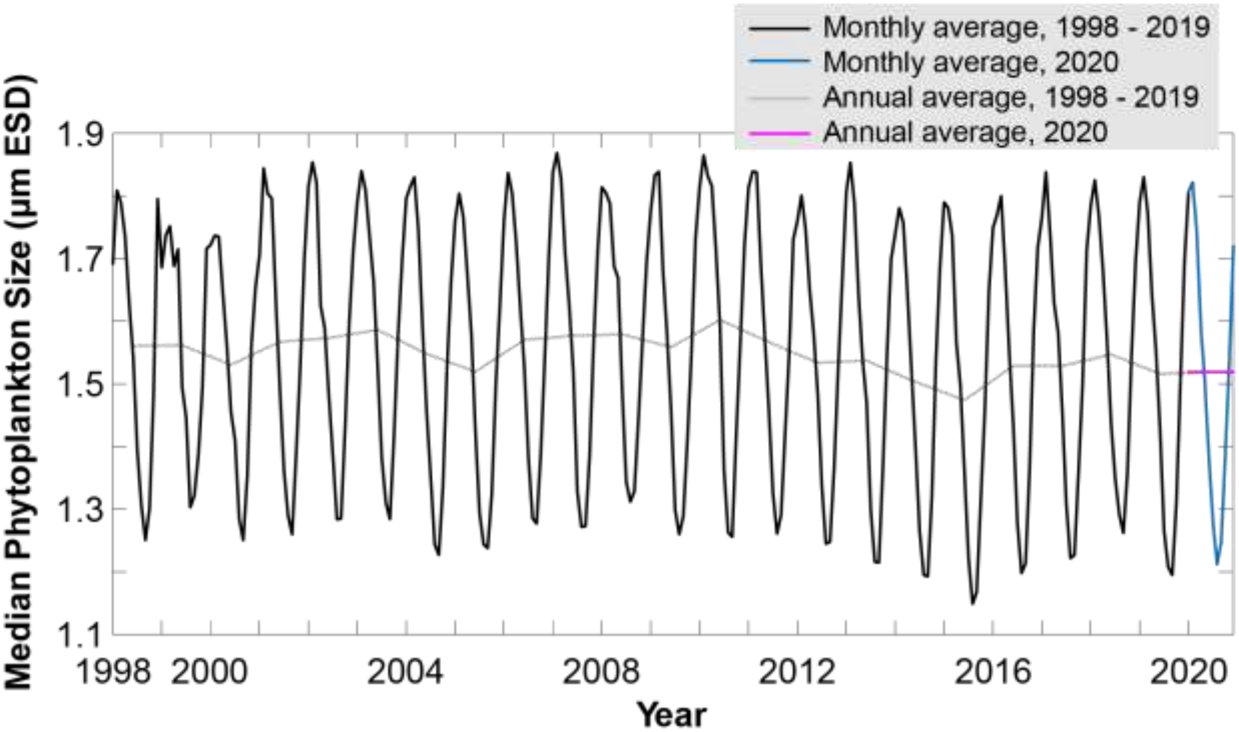


Figure 176. Time series of monthly median phytoplankton size over the longline fishing grounds outlined in Figure 177

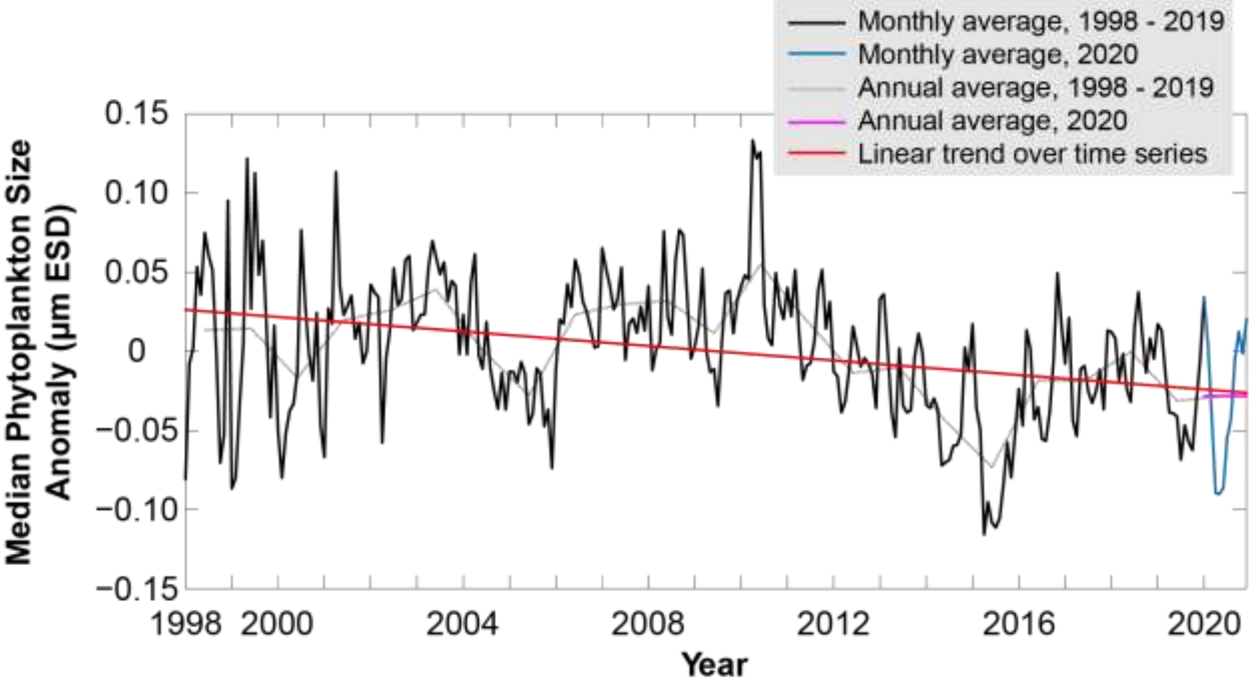


Figure 177. Time series of monthly median phytoplankton size anomaly over the longline fishing grounds outlined in Figure 176

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 1.52 μm Equivalent Spherical Diameter (ESD) in 2020. Monthly mean cell size ranged from 1.21–1.82 μm ESD during this period, within the range of values observed over the period of record (1.15–1.87 μm ESD). Over the period of record, there has been no significant trend in monthly median phytoplankton size, although the monthly anomaly has declined by 0.05 μm ESD.

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 OC-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

Sourced from: NOAA OceanWatch (2021) and Barnes et al. (2011).

3.5.2.13 FISH COMMUNITY SIZE STRUCTURE

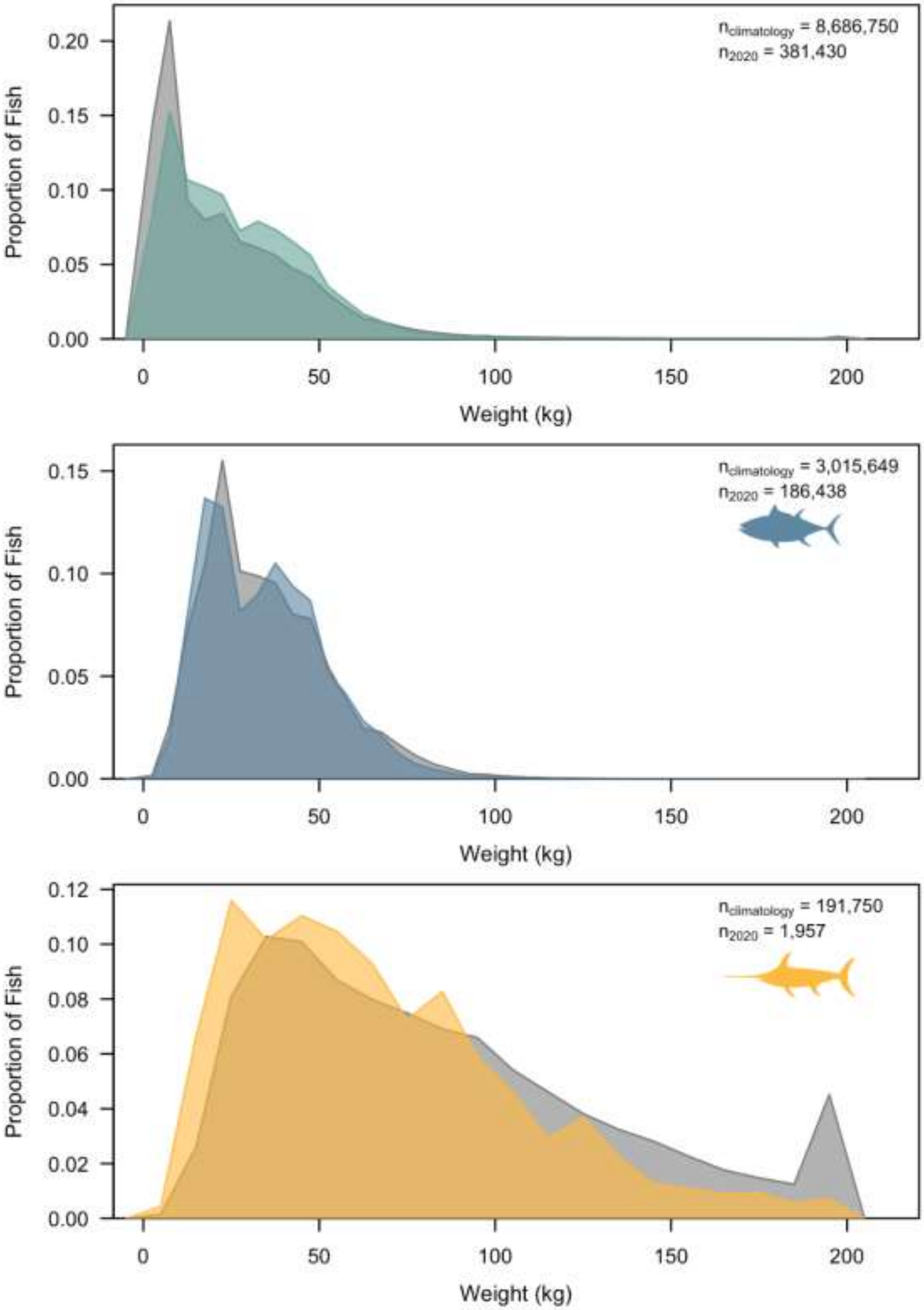


Figure 178. The climatological (2000 – 2019; grey) and 2020 (color) distribution of weights for all fish (top), bigeye tuna from deep sets (middle), and swordfish from shallow sets (bottom)

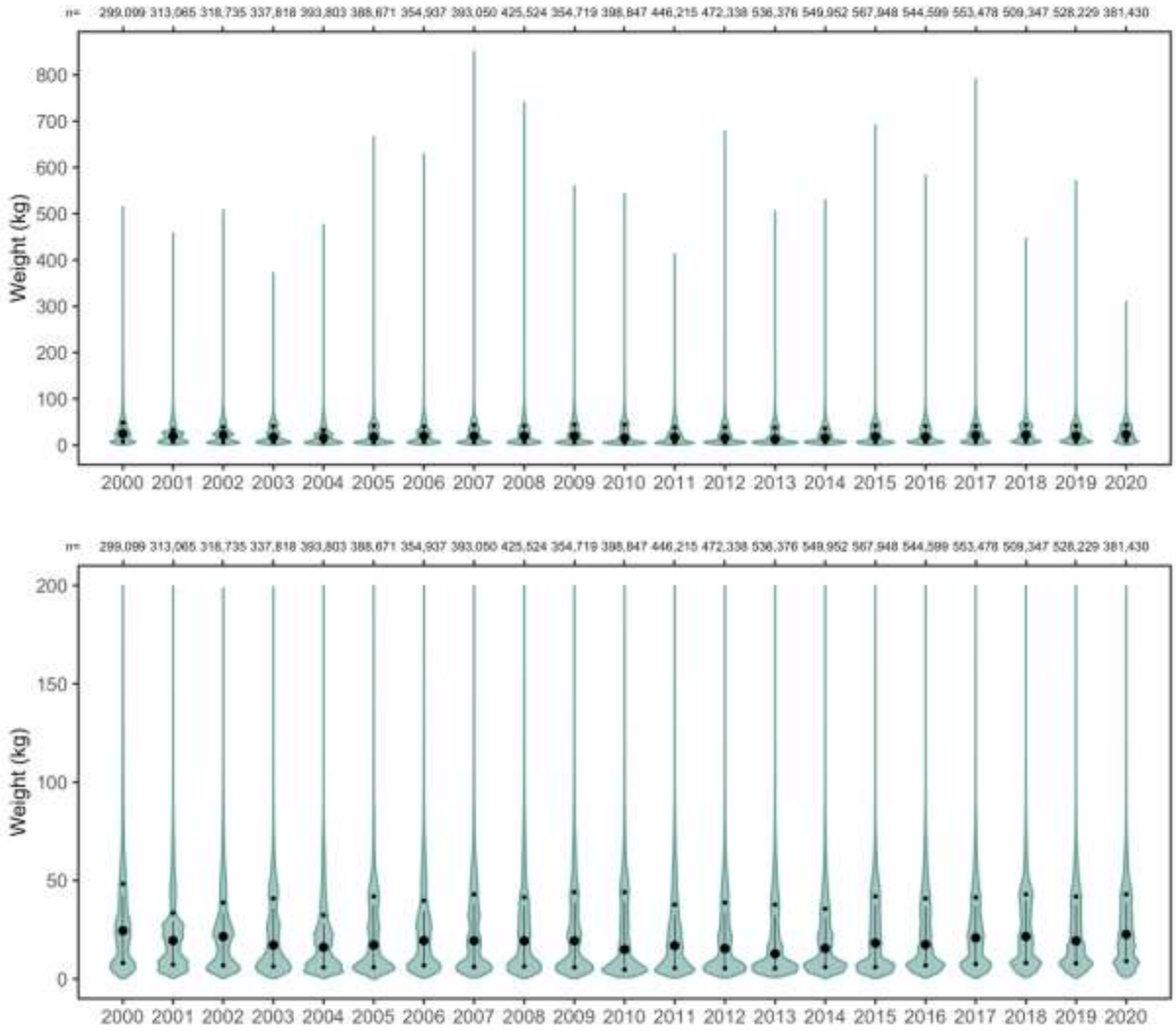


Figure 179. The annual distribution of weights of all fish, showing the full range of weights (top) and truncated to better demonstrate the distribution of the majority of weights (bottom) with large circles denoting median weight, black lines showing the range of the middle 50% of fish, small circles denoting the 20th and 80th percentiles of the weight distributions, and width of shading proportional to the number of fish of a given weight

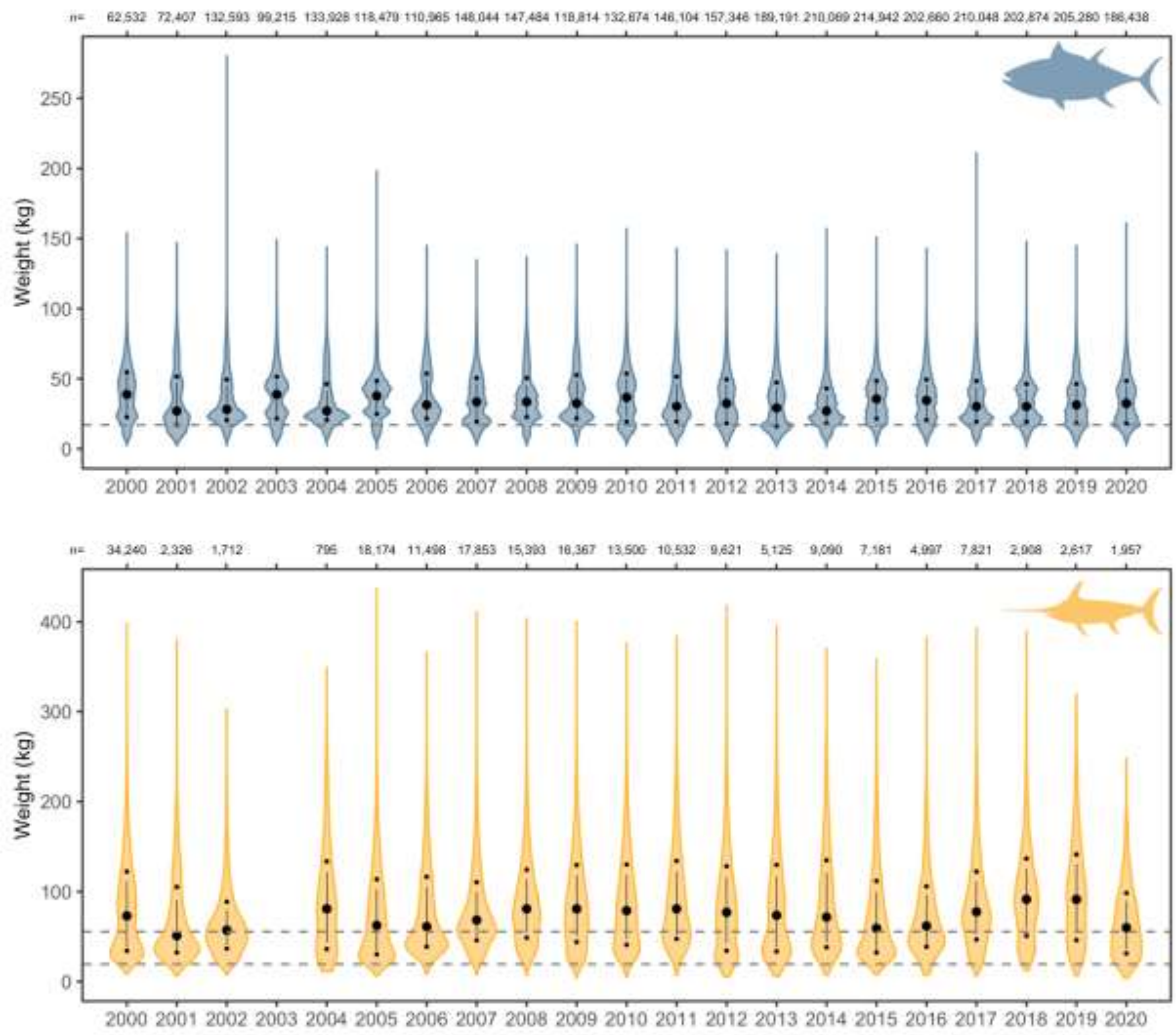


Figure 180. The annual distribution of weights of bigeye tuna from deep sets (top) and swordfish from shallow sets (bottom), with large circles denoting median weight, black lines showing the range of the middle 50% of fish, small circles denoting the 20th and 80th percentiles of the weight distributions, 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 somewhat larger than usual in 2020 with a higher proportion of 10–50 kg fish. Swordfish were notably smaller than average in 2020, ending a 5-year trend of increasingly larger swordfish captured in the fishery.

In 2020, the median bigeye weight was 32.4 kg and the median swordfish weight was 59.9 kg. The median fish weight for all species caught was 22.7 kg. These values are within the bounds observed over the time series from 2000 through 2019, although swordfish were on the low end of values for the species (51.0–91.4 kg).

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 2020 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: HDAR Measurement Platform and Langley et al. (2006).

3.5.2.14 BIGEYE WEIGHT-PER-UNIT-EFFORT

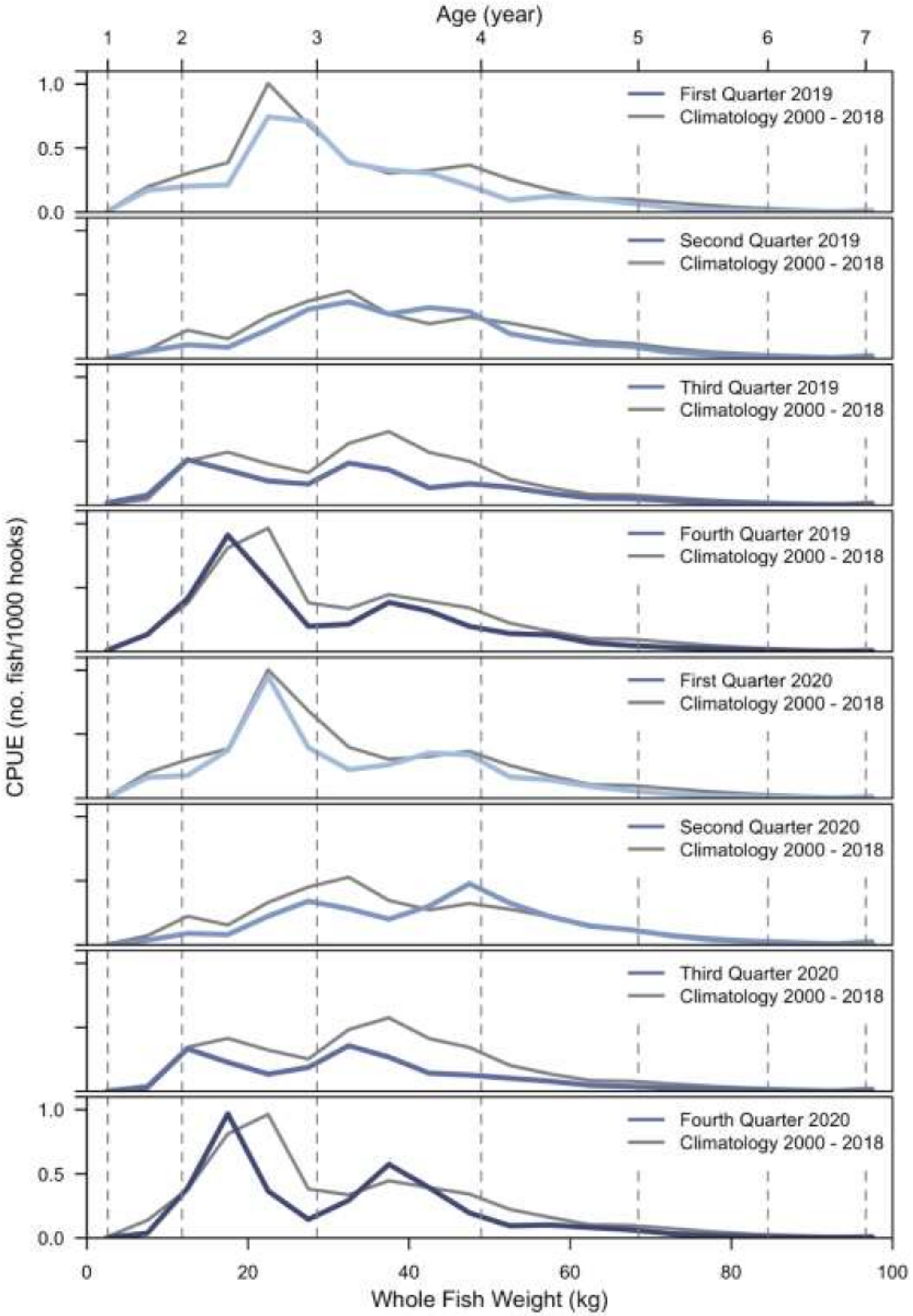


Figure 181. Quarterly deep-set bigeye tuna weight per unit effort for 2019 – 2020 (color) and the climatological average (2000 – 2018)

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 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: No peak in the CPUE of two-year-old bigeye was observed in 2019 or 2020, suggesting there will not be a peak in the CPUE of four- and five-year old bigeye in 2021 to 2022.

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 181. 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.

3.5.2.15 BIGEYE RECRUITMENT INDEX

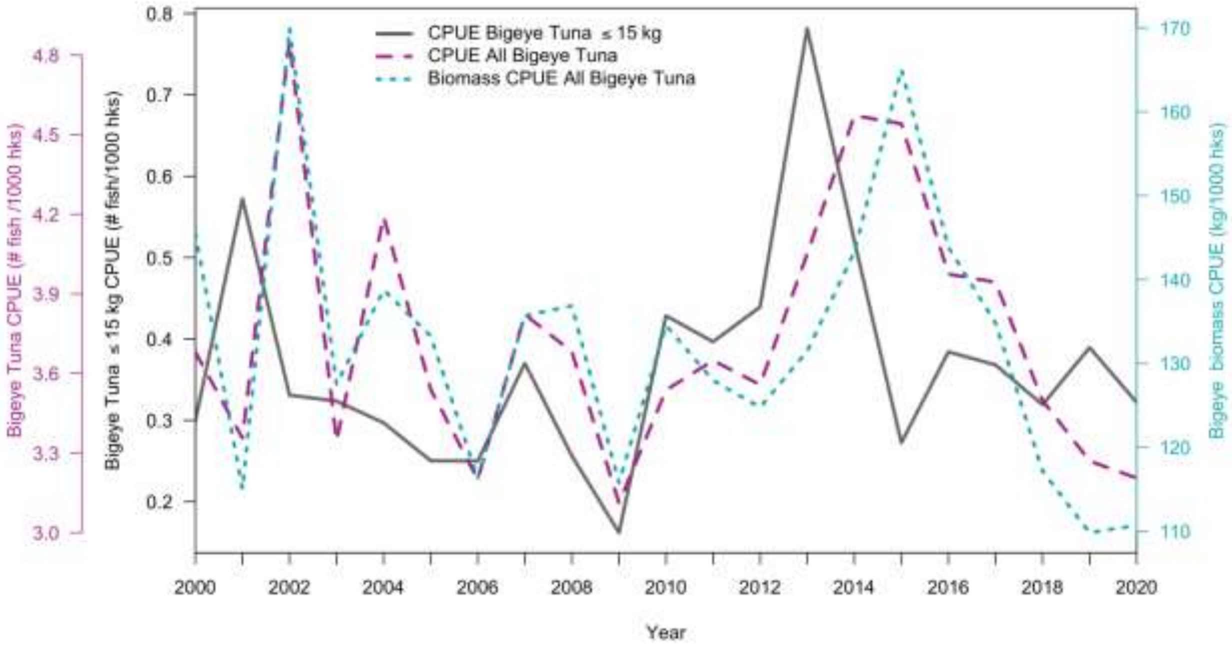


Figure 182. Annual CPUE of bigeye tuna ≤ 15 kg (grey solid line), CPUE of all bigeye tuna (pink dashed line), and biomass CPUE (blue dotted line) from 2000 – 2020, all from deep sets

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 2020, the CPUE of bigeye ≤ 15 kg was 0.32 fish per 1,000 hooks set. This is within the range observed over the previous 20 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).

3.5.2.16 BIGEYE TUNA CATCH RATE FORECAST

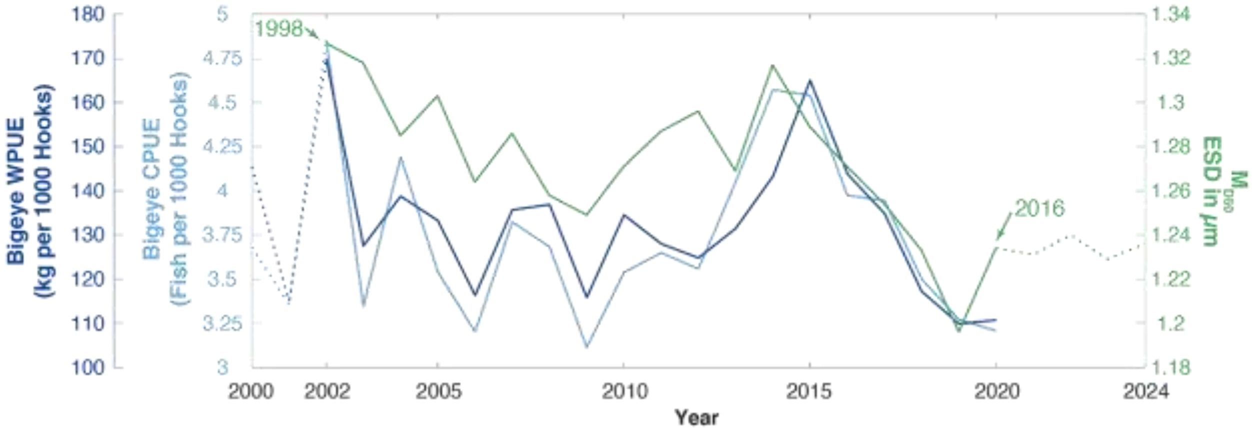


Figure 183. Annual WPUE (dark blue) and CPUE (light blue) of bigeye tuna from deep sets, as well as four-year lagged median phytoplankton size (M_{D50}, green). Dashed lines indicate years that are outside the forecast period described in the text

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: In 2020, the median size of phytoplankton across the Hawai‘i longline fishing grounds was 1.24 µm Equivalent Spherical Diameter (ESD). This is within the range observed over the previous 22 years (1.20–1.33 µm ESD). Median phytoplankton sizes from 2017–2020 suggest that bigeye catch rates may increase slightly over the next four years, though will likely not increase to the catch rates seen in 2002 or 2015.

Description: Time series of median phytoplankton, total bigeye tuna catch-per-unit-effort (hooks set) and weight-per-unit-effort (hooks set) for all bigeye tuna are presented. Median phytoplankton size is derived from satellite remotely sensed sea surface temperature and ocean color data (see indicator above). 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 (0° – 40°N, 180° – 150°W and 15° – 36°N, 150° – 125°W).

Measurement Platform: Model-derived from satellite remotely sensed data.

Sourced from: NOAA OceanWatch (2021), HDAR, and Langley et al. (2006).

3.5.3 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.

3.5.4 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.

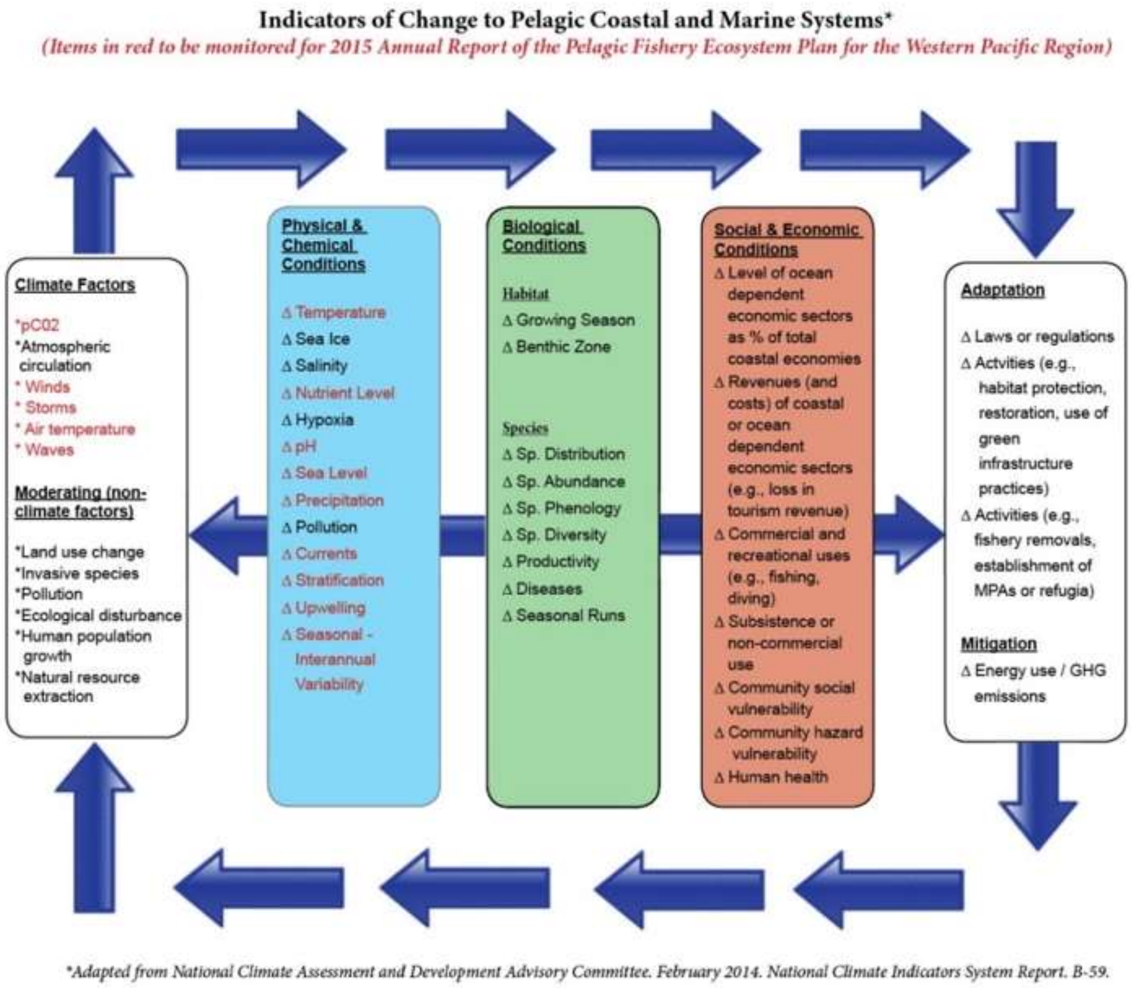
At its 170th meeting from June 20-22, 2017, the Council directed staff to support the development of community training and outreach materials and activities on climate change. In addition, the Council directed staff to coordinate a “train-the-trainers” workshop that includes NOAA scientists who presented 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.

3.5.5 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:



Indicators of Change to Pelagic Coastal and Marine Systems*

(Items in red to be monitored for 2015 Annual Report of the Pelagic Fishery Ecosystem Plan for the Western Pacific Region)

Adapted from National Climate Assessment and Development Advisory Committee. February 2014. National Climate Indicators System Report. B-59.

Figure 184. 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.

3.5.6 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.

3.6 ESSENTIAL FISH HABITAT

3.6.1 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 2020 SAFE report, except for Section 3.6.5. 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.

3.6.2 RESPONSE TO PREVIOUS COUNCIL RECOMMENDATIONS

There were no Council recommendations for the EFH section of the Pelagic annual SAFE report in 2020.

3.6.3 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 3.5) 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.

3.6.4 REPORT ON REVIEW OF EFH INFORMATION

No pelagic EFH reviews were completed in 2020.

3.6.5 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.

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.

3.7 MARINE PLANNING

3.7.1 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.

3.7.2 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 nautical miles 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 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 with regards, but not limited to; catch rates of fishery participants; small vessel participation; and fisheries development initiatives. 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 indicate 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. Based on this performance review, the Council may reconsider its 2017 LVPA modification action at that meeting.

3.7.3 MARINE MANAGED AREAS

Council-established MMAs are shown in Figure 185, and are compiled in Table 82.

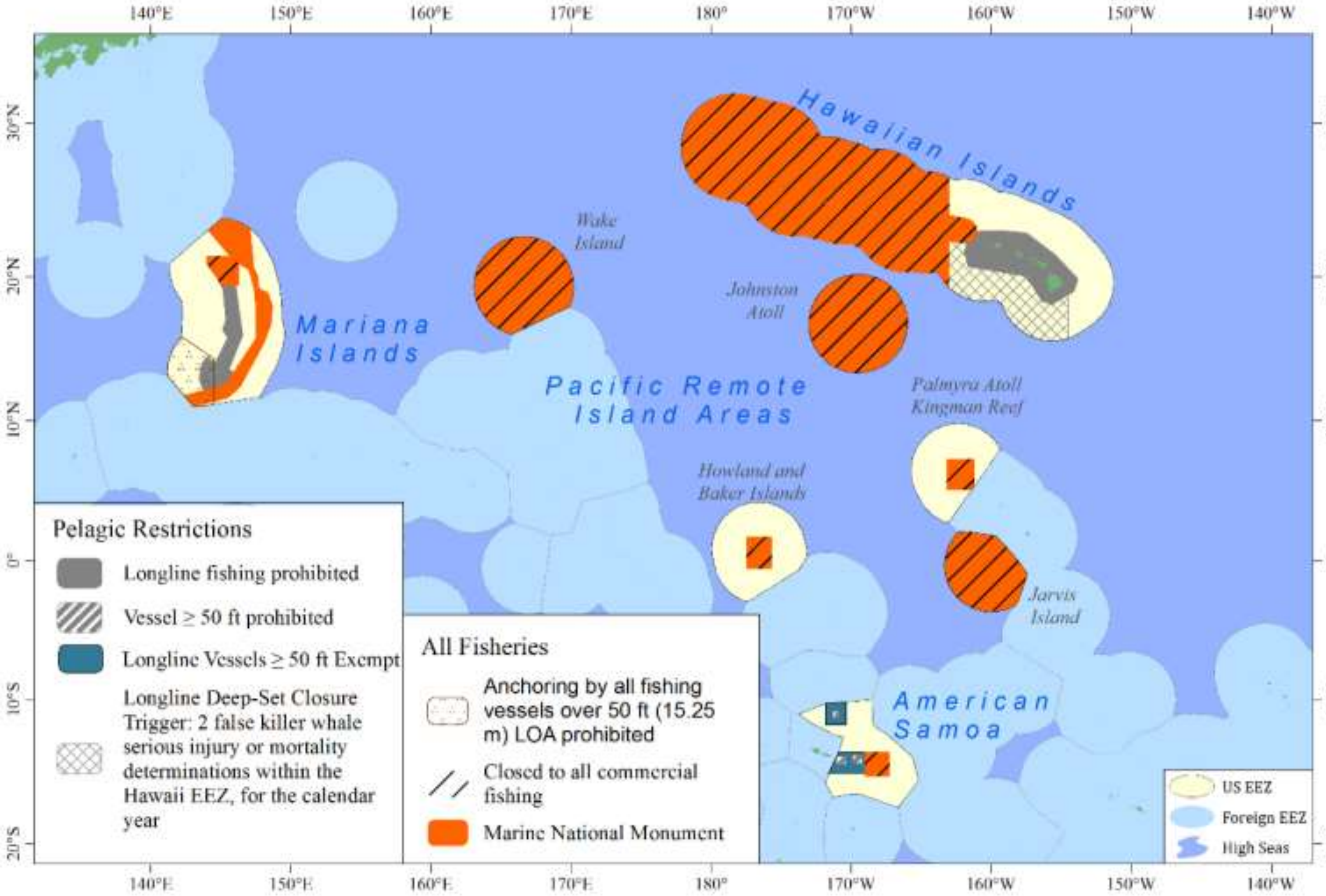


Figure 185. Regulated Fishing Areas of the Western Pacific Region

Table 82. MMAs established under FEPs from 50 CFR § 665

Name	FEP	Island(s)	50 CFR /FR /Amendment Reference	Marine Area (km^2)	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 (km²)	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	-

3.7.4 ACTIVITIES AND FACILITIES OCCURRING IN THE PACIFIC ISLANDS 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.

3.7.4.1 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 83).

Table 83. 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 recently renewed the SCREFP under the same terms and conditions through June 30, 2021, which allowed the harvest of two cohorts of fish. The permit renewal process is currently ongoing.

3.7.4.2 ALTERNATIVE ENERGY FACILITIES

There are no alternative energy facilities in territorial or federal waters, proposed or existing, in American Samoa, Guam, 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. There are several alternative energy projects also being tracked in this report (Table 84).

Table 84. 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. A buoy that was planned to be connected in early 2020 was delayed due to COVID-19. An autonomous offshore power system began tests in late 2020.	Final Environmental Assessment, NAVFAC PAC, January 2014 E&E News Hawaii Natural Energy Institute

3.7.4.3 MILITARY TRAINING AND TESTING ACTIVITIES AND IMPACTS

Major activities by the DOD are summarized in Table 85.

Table 85. 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 Department of Justice (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.	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.	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 being in August 2020 around the Hawaiian Islands.	Programmatic Environmental Assessment, June 2002
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).	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 Evaluation Program (WSEP)	Conduct operational evaluations of Long Range Strike weapons and other munitions as part of Long Range Strike WSEP operations at the Pacific Missile Range Facility at Kauai, Hawaii.	Comment period closed Feb. 6, 2017, and final rule on Aug. 22, 2017, for NMFS authorization to take marine mammals 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).	Access – closures during training. Final Environmental Assessment, October 2016 NMFS Biological Opinion, August 2017

Action	Description	Phase	Impacts
Naval Special Operations Training in the State of Hawaii	Small-unit maritime training activities for naval special operations personnel.	Public comment period through Dec. 10, 2018 was extended to Jan. 7, 2019.	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 2020, 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 Divert Infrastructure Improvements. The NOI began the public scoping process for the SEIS, which ended on May 31, 2018. Substantive comments received during the	Adverse impacts to EFH minimal; access near Port of Tinian fuel transfer facility affected. Access and transit to fishing grounds.

Action	Description	Phase	Impacts
		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).	

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 (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 86.

Table 86. Notices to mariners for military exercises in the Mariana Archipelago from 2013-2020

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
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

Year	Location	Number of Notices to Mariners Issued	Number of Days Affected
	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

3.7.5 ADDITIONAL CONSIDERATIONS

3.7.5.1 AMERICAN SAMOA

3.7.5.1.1 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.

3.7.5.1.2 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 2020, however, only one fish aggregating device (FAD) was still deployed, FAD B (Figure 186). Three other FADs have been lost in the past two years, FADs A, C, and E; however, there are plans to deploy FADs C, G, E, and J in the near future. American Samoa recently received three new FADs sent from New Zealand to replace the lost FADs, though the shipment was delayed due to complications associated with COVID-19 shipping restrictions in Australia and New Zealand. The American Samoa DMWR recently resurveyed the three potential FAD sites around Tutuila and noticed some discrepancies in the depth.

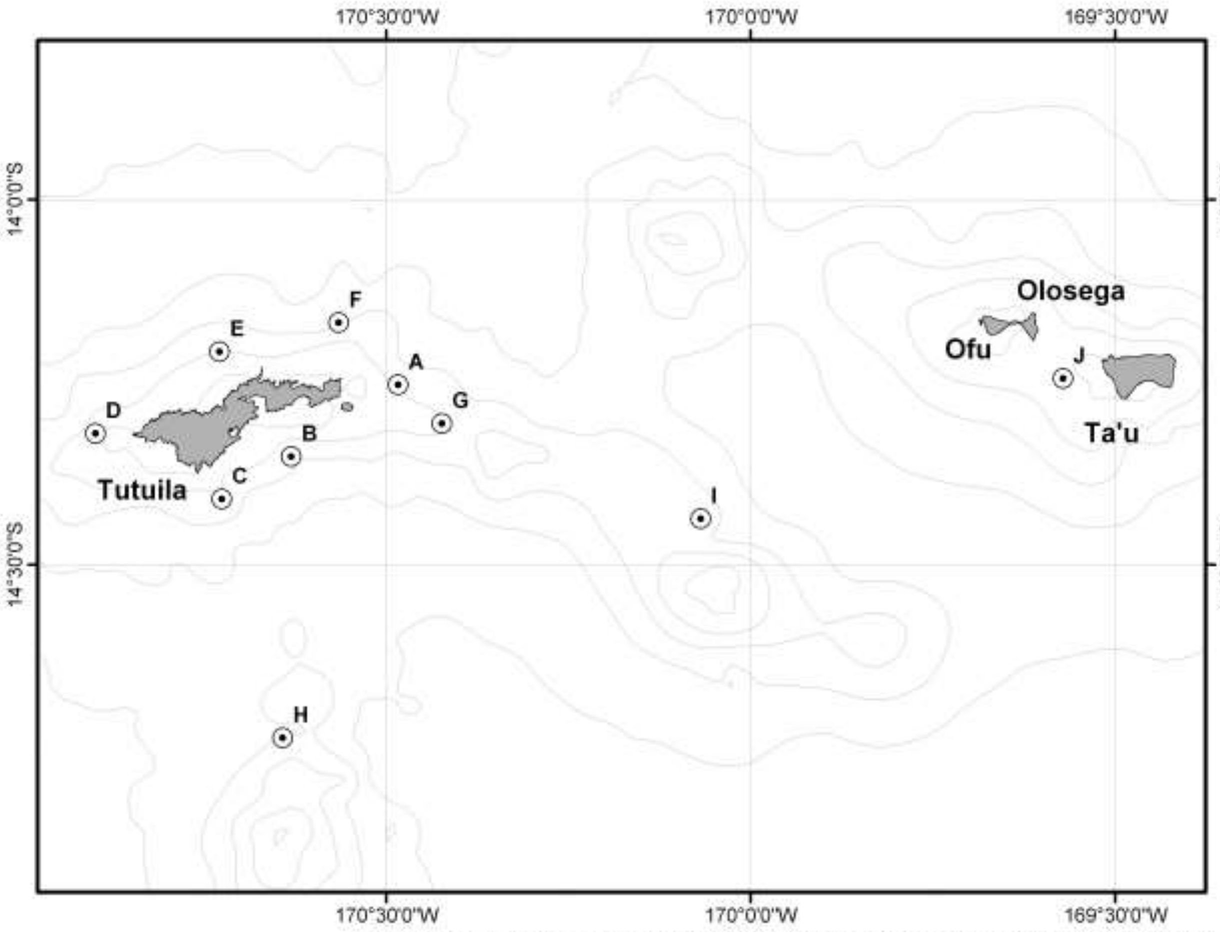


Figure 186. Present or planned locations of FADs in deep water around American Samoa (Source: DMWR)

3.7.5.2 CNMI

3.7.5.2.1 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.

3.7.5.2.2 FADs

As of 2020, CNMI has five missing FADs: KK, JJ, HH, EE, and the Tinian Community FAD. A map of the FADs is provided in Figure **187**.

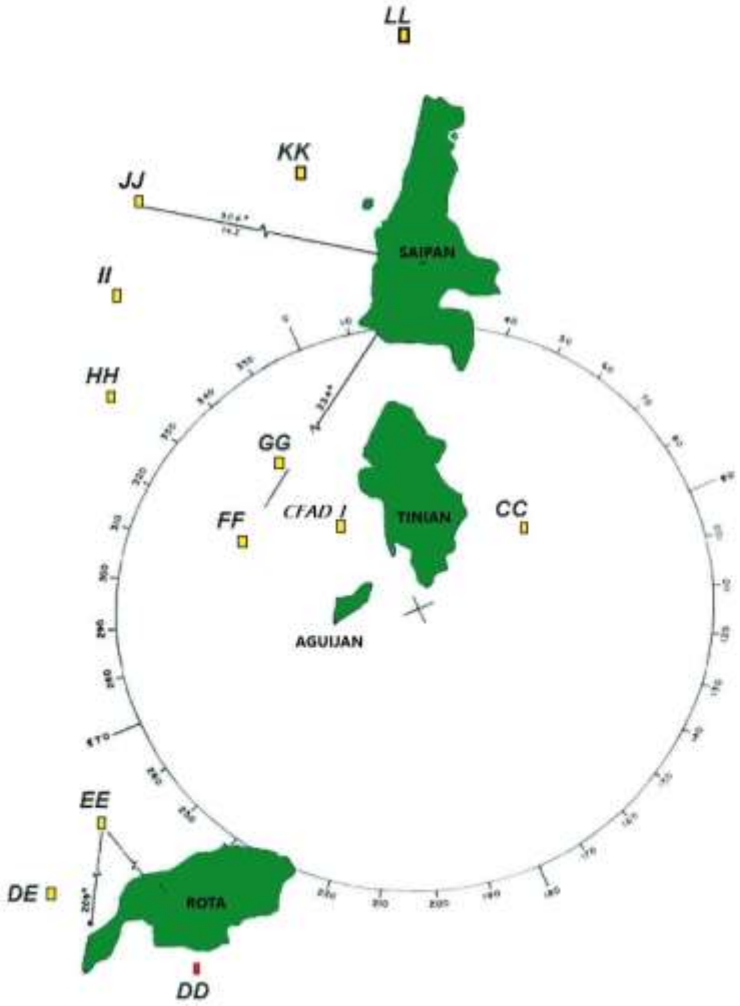


Figure 187. Map of FAD locations around CNMI (Source: DFW)

3.7.5.3 GUAM

3.7.5.3.1 FADs

In Guam, there are currently five active FADs: Number 2, Umatac, Facpi 2, Cocos, and Agat Bay (Figure 188). 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.

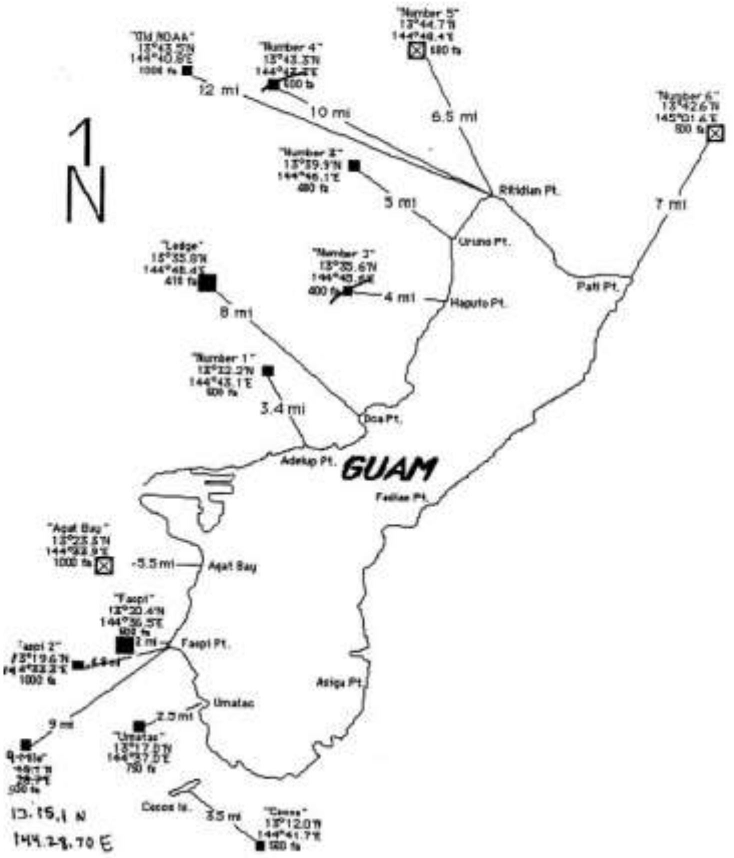


Figure 188. Map of FAD locations around Guam (Source: DAWR)

3.7.5.4 HAWAII

3.7.5.4.1 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.

3.7.5.4.2 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 with 12 BRFAs (Figure 189) with the objective of reducing fishing mortality of MHI bottomfish stocks, rebuilding bottomfish populations on habitats within the BRFAs, and improve bottomfish populations in adjacent fishing areas (Drazen et al. 2014). In 2019, four of the 12 BRFAs were opened: RFA C (Poipu, Kauai), BRFA F (Penguin Banks), BRFA J (Hana, Maui), and BRFA L (Leleiwi, Hawaii Island) (Figure 189).

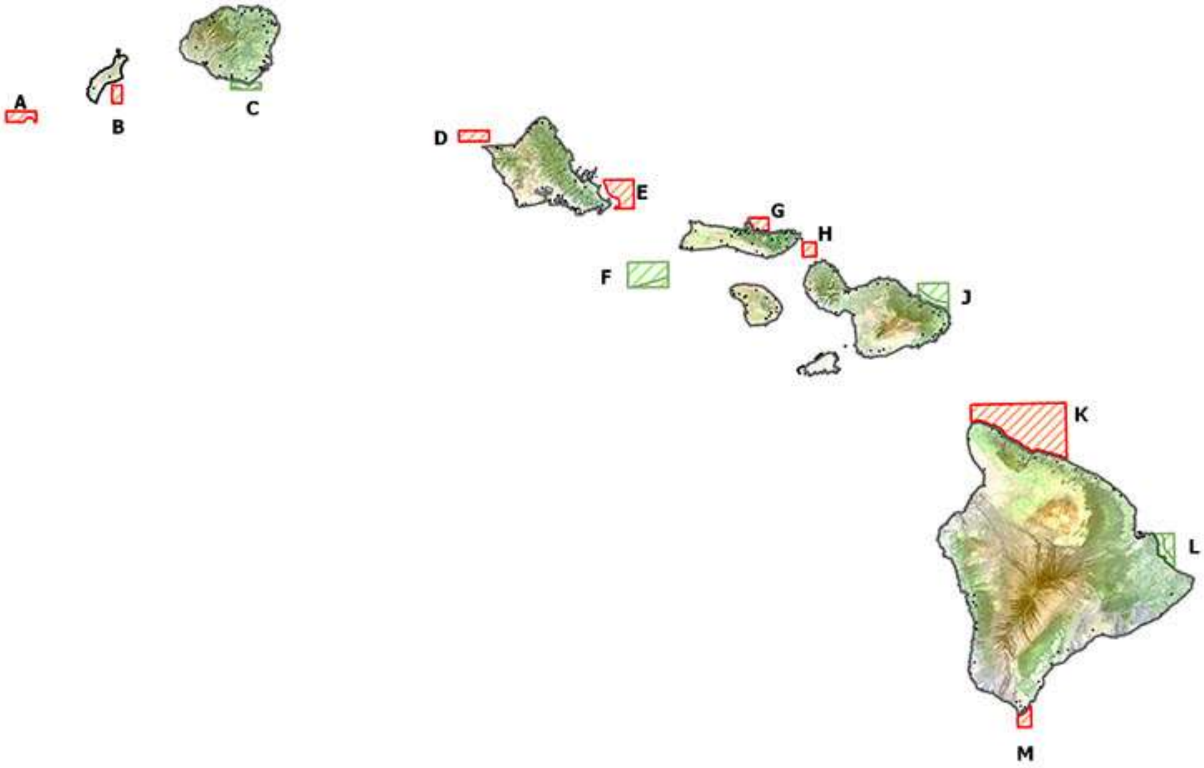


Figure 189. Map of the 12 BRFAs around the MHI; red boxes indicate that the area is closed to bottomfish fishing, and green boxes indicate those areas recently opened to bottomfish fishing (Source: DAR website)

3.7.5.4.3 FADs

FADs have been placed in the waters around the MHI and is run by the Hawaii Institute of Marine Biology, SOEST, UH, and DAR. FADs attract schools of tuna, mahimahi, ono, billfish, and other pelagic fishes so that fishermen 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 3 to 4 years (Figure 190; Hawaii Sea Grant).

There are currently 54 FADs monitored and maintained throughout the MHI, with 17 around the Big Island (Figure 191), 14 around Maui (Figure 192), 14 around Oahu (Figure 193), and nine around Kauai (Figure 194). Over the course 2020, there were 24 FADs that were confirmed as missing or were recovered, and there were 23 FADs that were replaced. As of March 2, 2021, 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 191 through Figure 194). Additionally, there were two FADs, one near Maui and the other near the Big Island, that were discontinued.

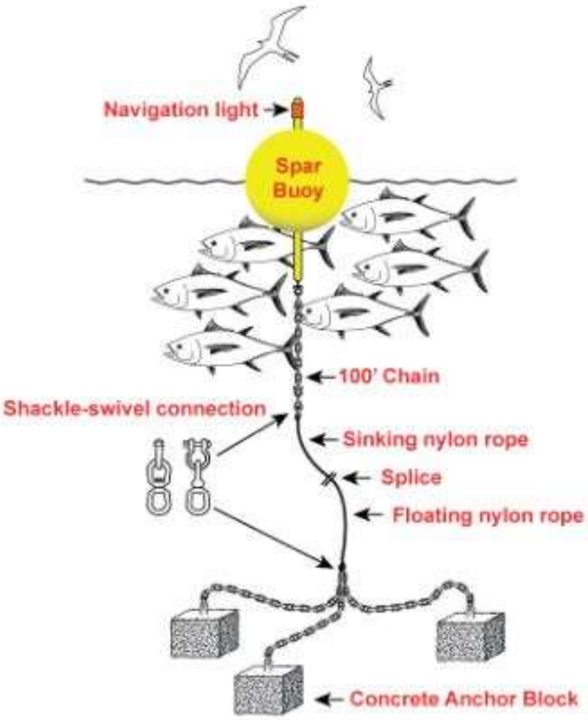


Figure 190. Diagram of the typical arrangement of FADs around the MHI (from Hawaii Sea Grant)

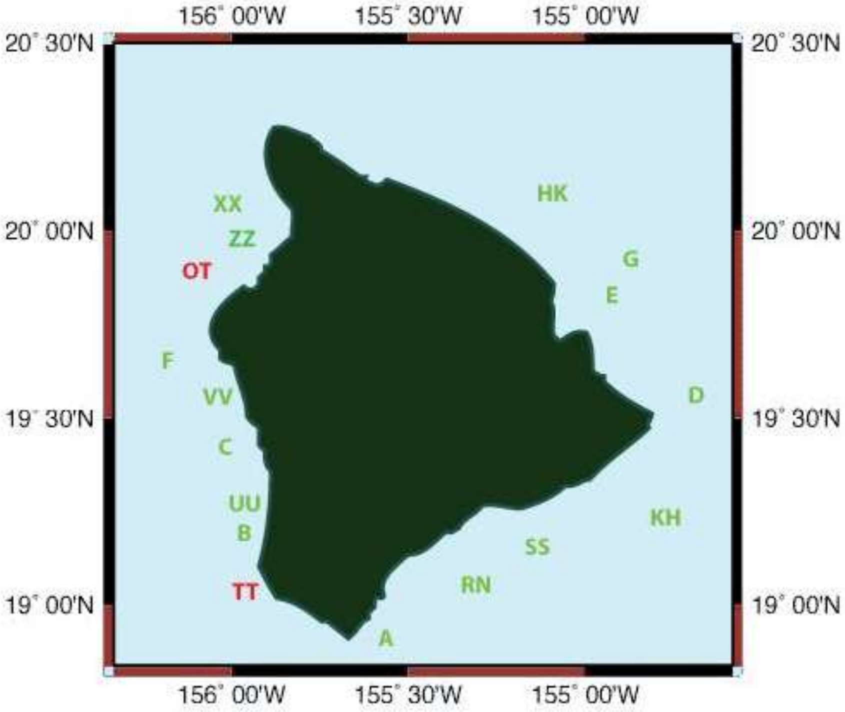


Figure 191. Map of FADs in the waters around the Big Island; red letters indicate a FAD that is known to be missing, and green letters indicate an active FAD that has been recently deployed (from Hawaii Sea Grant)

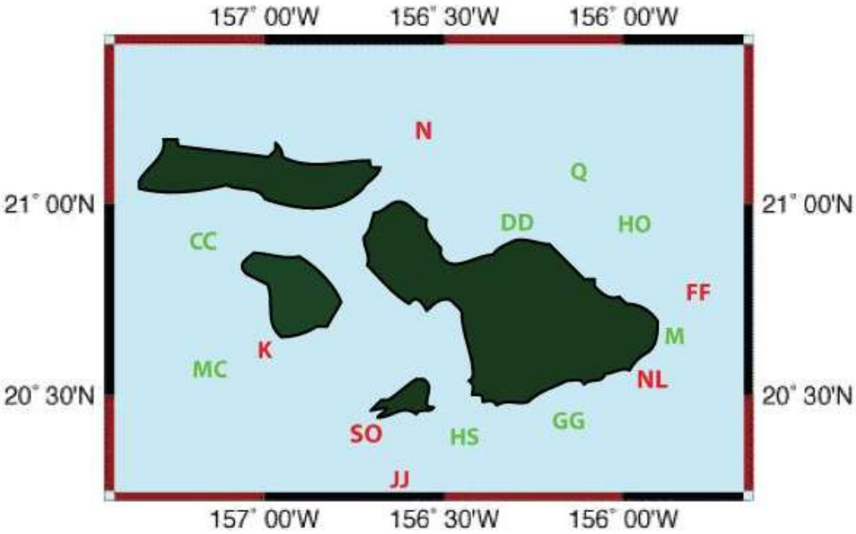


Figure 192. Map of FADs in the waters around Maui; red letters indicate a FAD that is known to be missing, and green letters indicate an active FAD that has been recently deployed (from Hawaii Sea Grant)

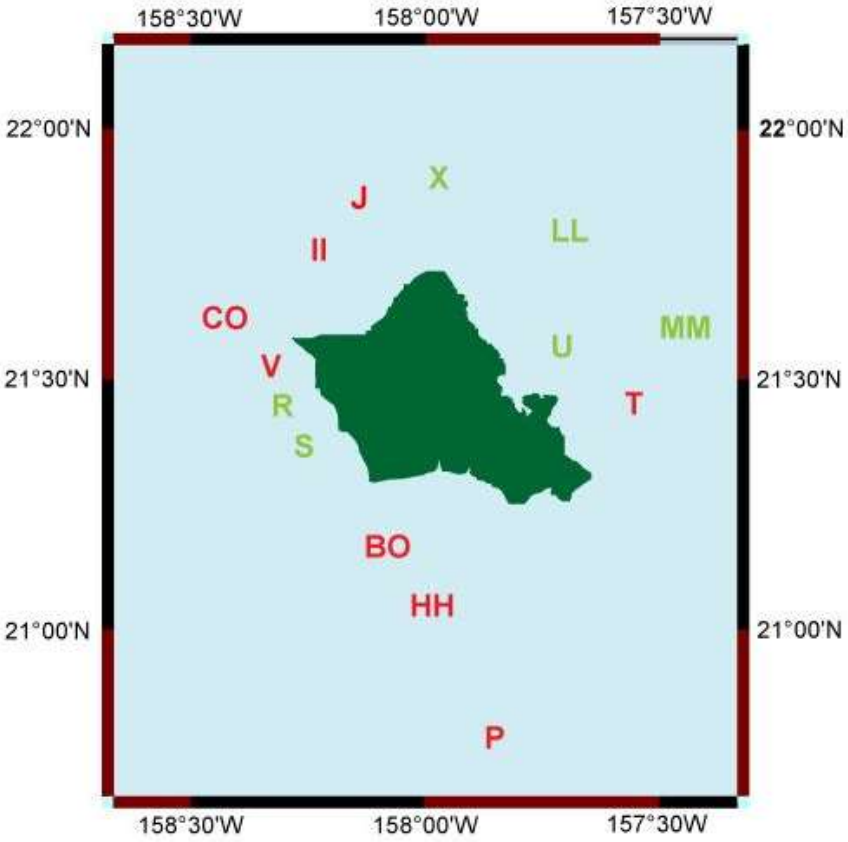


Figure 193. Map of FADs in the waters around Oahu; red letters indicate a FAD that is known to be missing, and green letters indicate an active FAD that has been recently deployed (from Hawaii Sea Grant)

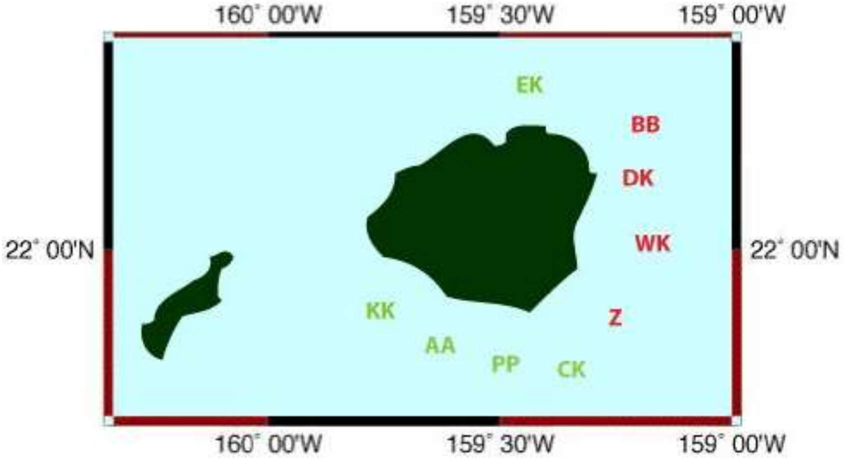


Figure 194. Map of FADs in the waters around Kauai; red letters indicate a FAD that is known to be missing, and green letters indicate an active FAD that has been recently deployed (from Hawaii Sea Grant)

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 30th-December 1st, 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.

The 2019 Pelagic Fishery Ecosystem Plan Team previously 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 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.

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 3.4.2.3) 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. *accepted*) 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 an accepted 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. 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 195). 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 195).

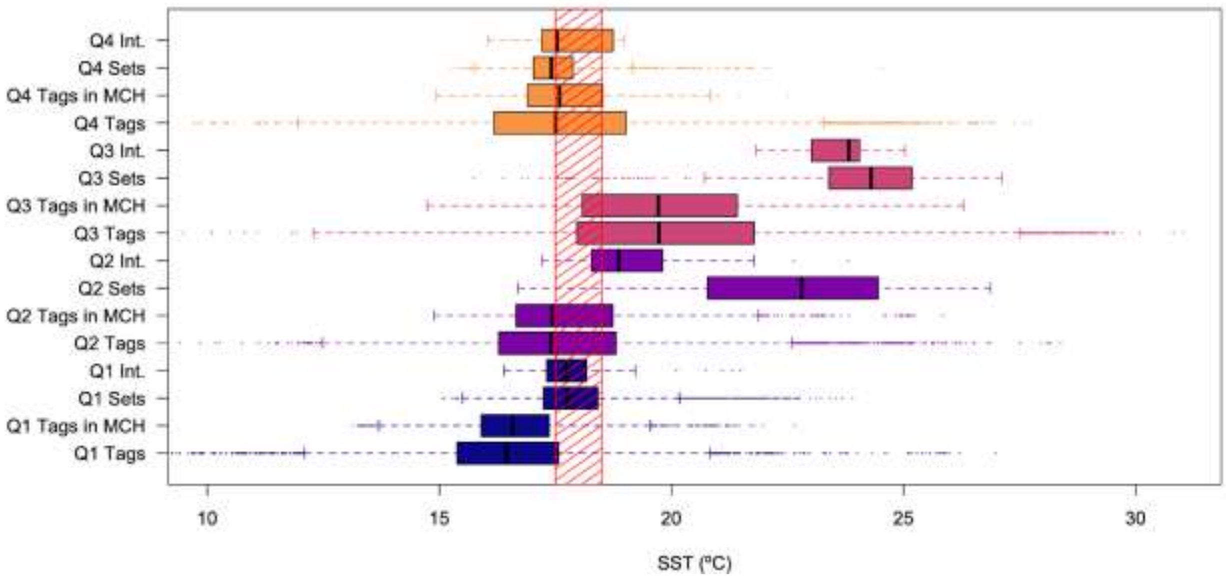


Figure 195. Quarterly sea surface temperature distribution of telemetered sea turtles (Tags), of telemetered sea turtles in the minimum convex hull of the Hawaii shallow-set longline sets (Tags in MCH), the shallow-set fishery sets (Sets), and the interactions between loggerheads and the shallow-set 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 195). 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 196). 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.

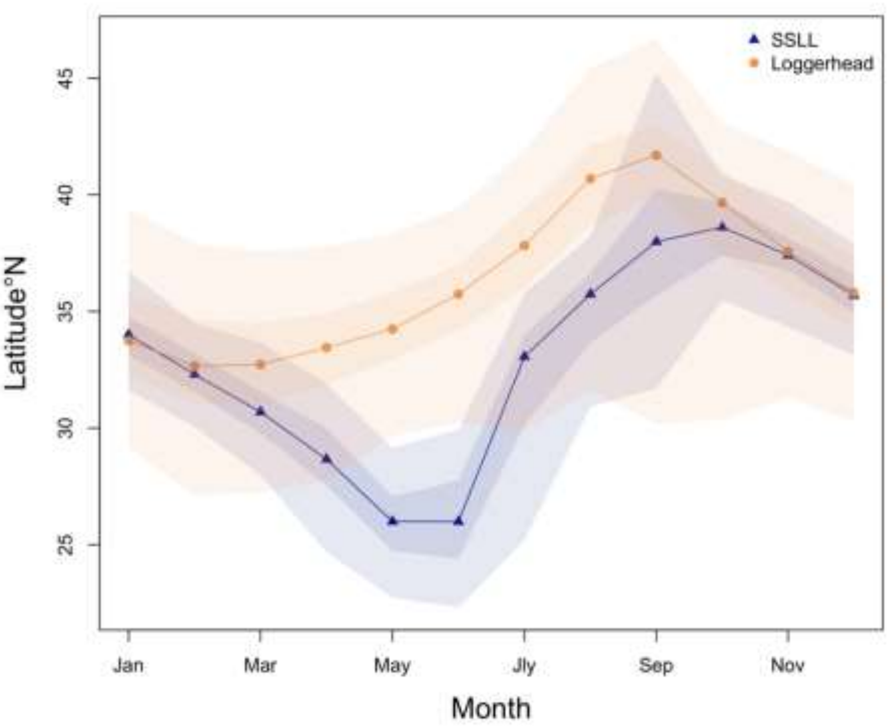


Figure 196. Latitudinal overlap between the Hawaii shallow-set longline fishery (blue triangles) and the loggerhead locations (orange circles). The line is the mean, the darker shading is the 50%, and the lighter shading is the 95%.

(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 3.4.1.3.2) will offer an opportunity to explore the change in fisher behavior.

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[10].

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[11]. 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

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[10] http://www.samoanews.com/tri-marine-says-local-longline-fleet-vital-economy

[11] 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 2005-2014, while the average net revenue for tuna trips has generally increased over the same period of time (Pan 2016).

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 2016).

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[12]. 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.

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[12] 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.

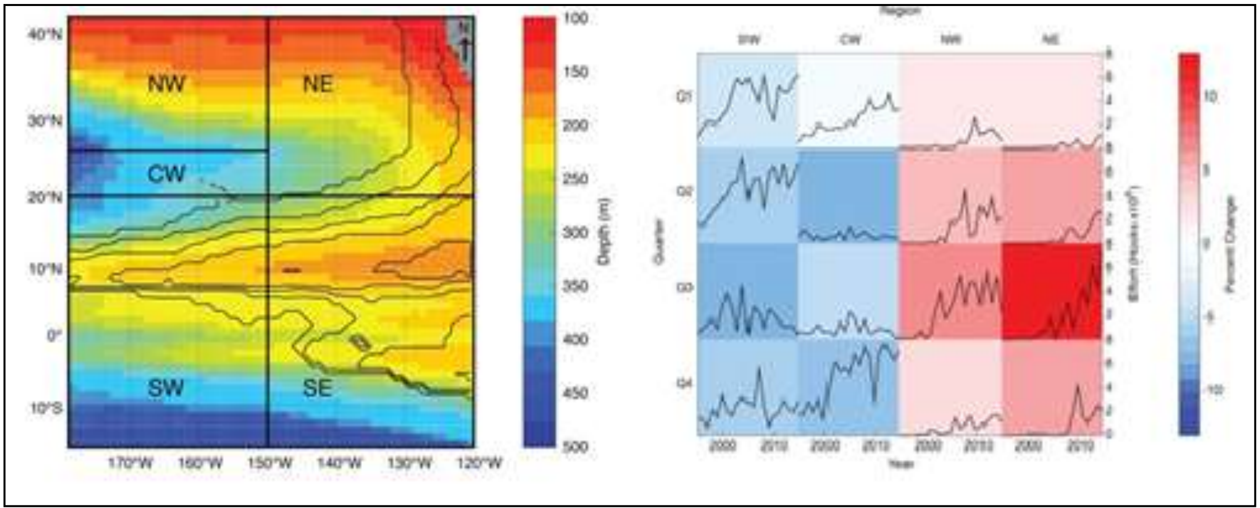

Figure 197. Left: Map depicting the five regions by which the fishery is examined overlaid on the climatological (1995-2015) median depth of preferred thermal habitat

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 197).

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 197). 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 198).

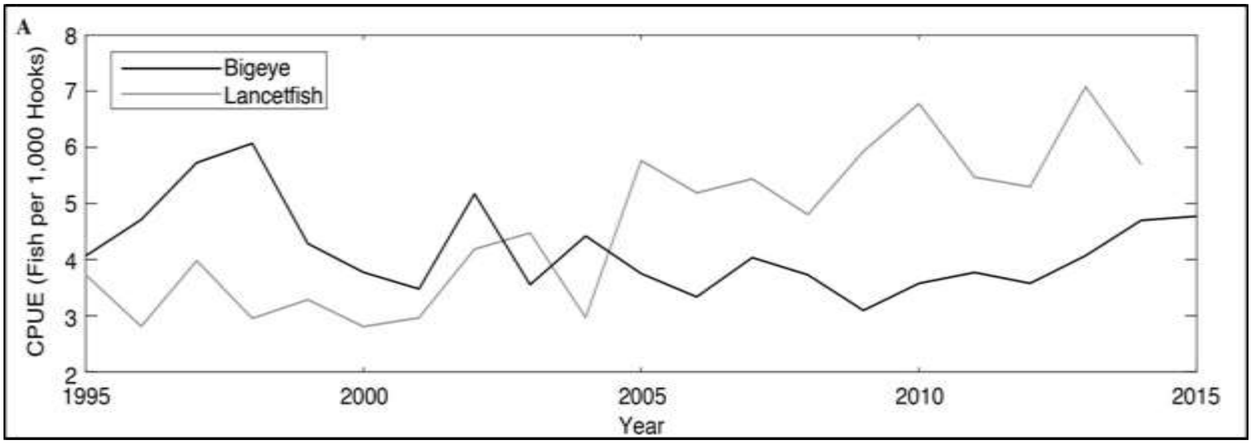

Figure 198. Annual deep-set bigeye tuna (black) and lancetfish (gray) CPUE

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 allowed 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 199A). 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 199C).

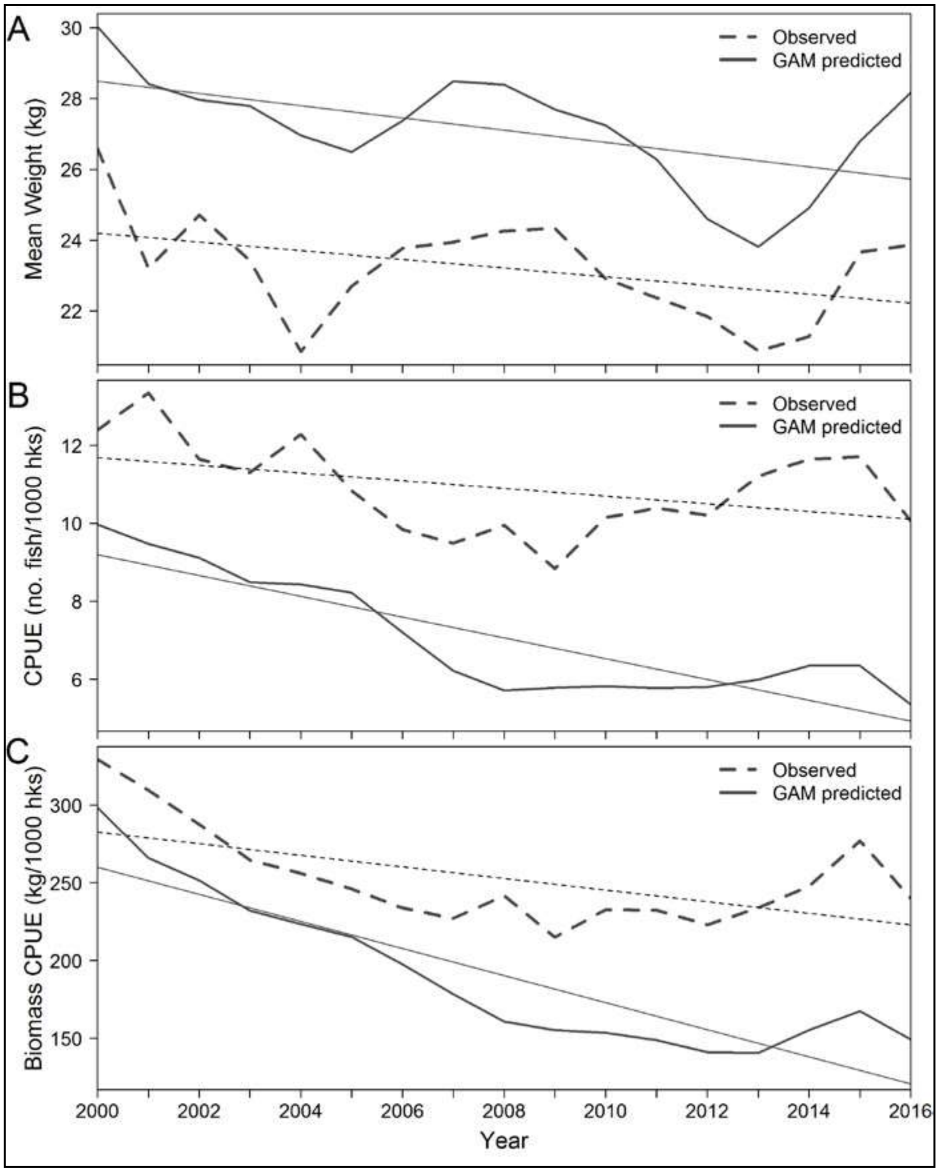

Figure 199. Mean weight (A), catch per unit effort (B), and weight per unit effort (WPUE) for all fish in the Hawaii-based longline fishery from dealer provided data.

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 200).

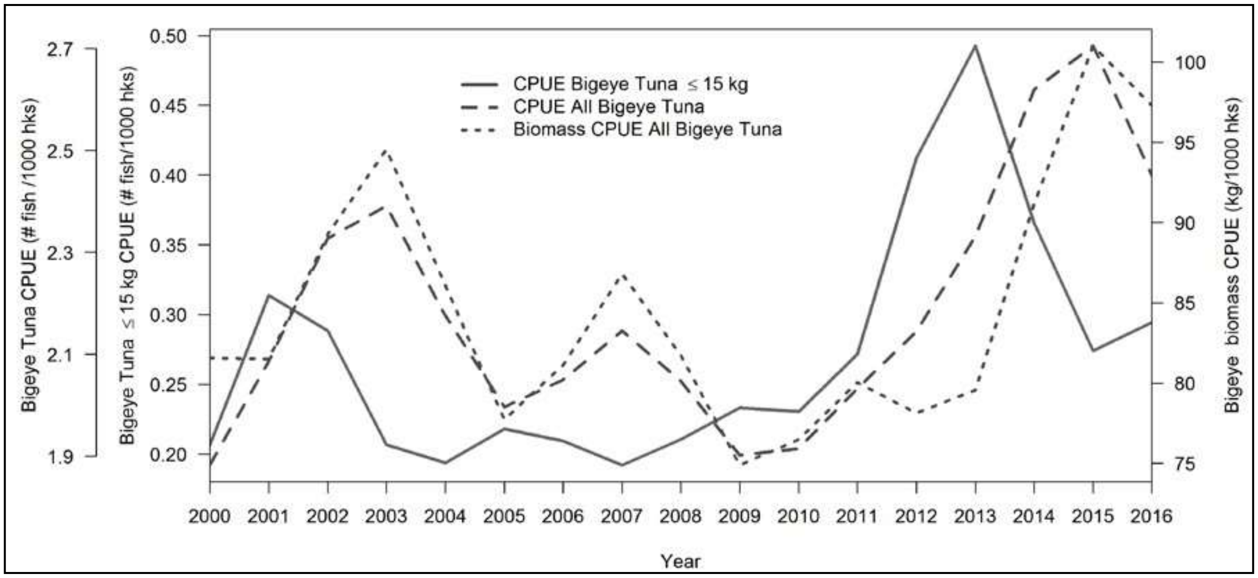

Figure 200. Temporally- and spatially-adjusted annual catch per 1000 hooks

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 from primary journal articles published in 2019 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.

Chang, Y.J., Winker, H., Sculley, M., and J. Hsu, 2019. Evaluation of the status and risk of overexploitations of the Pacific billfish stocks considering non-stationary population processes. *Deep Sea Research Part II: Topical Studies in Oceanography*, 104707.

Fish population processes could exhibit non-stationary behaviour as a stochastic biological process with temporal autocorrelation that may be influenced by environmental changes. Here we developed a Bayesian autoregressive state-space surplus production modelling framework to explore potential non-stationarity in population processes. We then evaluated the consequence of non-stationary population processes on the future risk of overexploitation for three Pacific billfish stocks (striped marlin, *Kajikia audax*; blue marlin, *Makaira nigricans*; and swordfish *Xiphias gladius*) that are formally assessed on a regular basis by a Regional Fisheries Management Organization in the Pacific Ocean. The results showed evidence of non-stationary population processes for Western and Central North Pacific Ocean (WCNPO) striped marlin, and to a lesser extent, Pacific blue marlin and WCNPO swordfish. Trends in the theoretical maximum sustainable yield and intrinsic growth rate were observed as oscillating regimes for swordfish, and as long-term directional changes for striped marlin. The non-stationary population processes did not strongly influence the forecasted biomass trend at the current catch level for any of the three stocks. However, the future risk of overexploitation (Prob[$B < B_{MSY}$]) was sensitive to changes in the population processes for striped marlin (increased the risk by 20%). This work illustrates that the inclusion of non-stationary population processes could impose challenges for developing a stock rebuilding plan and provides a framework to account for non-stationary population processes for the billfish stocks in the Pacific Ocean.

Gove, J.M., Whitney, J.L., McManus, M.A. et al., 2019. Prey-size plastics are invading larval fish nurseries. *Proceedings of the National Academy of Sciences of the United States of America, 116*(48). Pp. 24143-24149.

Life for many of the world's marine fish begins at the ocean surface. Ocean conditions dictate food availability and govern survivorship, yet little is known about the habitat preferences of larval fish during this highly vulnerable life-history stage. Here we show that surface slicks, a ubiquitous coastal ocean convergence feature, are important nurseries for larval fish from many ocean habitats at ecosystem scales. Slicks had higher densities of marine phytoplankton (1.7-fold), zooplankton (larval fish prey; 3.7-fold), and larval fish (8.1-fold) than nearby ambient waters across our study region in Hawaii. Slicks contained larger, more well-developed individuals with competent swimming abilities compared to ambient waters, suggesting a physiological benefit to increased prey resources. Slicks also disproportionately accumulated prey-size plastics, resulting in a 60-fold higher ratio of plastics to larval fish prey than nearby waters. Dissections of hundreds of larval fish found that 8.6% of individuals in slicks had ingested plastics, a 2.3-fold higher occurrence than larval fish from ambient waters. Plastics were found in 7 of 8 families dissected, including swordfish (Xiphiidae), a commercially targeted species, and flying fish (Exocoetidae), a principal prey item for tuna and seabirds. Scaling up across an ~1,000 km^2 coastal ecosystem in Hawaii revealed slicks occupied only 8.3% of ocean surface habitat but contained 42.3% of all neustonic larval fish and 91.8% of all floating plastics. The ingestion of plastics by larval fish could reduce survivorship, compounding threats to fisheries productivity posed by overfishing, climate change, and habitat loss.

Merkens, K.P., Simonis, A.E., and E.M. Oleson, 2019. Geographic and temporal patterns in the acoustic detection of sperm whales *Physeter macrocephalus* in the central and western North Pacific Ocean. *Endangered Species Research*, *39*, pp. 115-133.

The easily identifiable, high-amplitude echolocation signals produced by sperm whales Physeter macrocephalus make the species ideal for long-term passive acoustic monitoring. Sperm whale signals were manually identified in the recordings from high-frequency acoustic recording packages monitoring 13 deep-water locations across the central and western North Pacific Ocean from 2005 to 2013, constituting the longest passive acoustic study of sperm whales to date. The species was detected at all of the sites, with the highest detection rate at Ladd Seamount (>18% of analyzed periods) and the lowest rates at equatorial sites (<1% of analyzed periods). Generalized additive models and generalized estimating equations were used to produce explanatory models to assess temporal and geographic patterns. The model variables included diel phase, lunar day, day of the year, year, and site. The site-specific variability in detection rates was high across the North Pacific, but there were also common patterns, including a seasonal trend, with decreased detections during the summer or fall, and a diel trend, with increased detections at night. There appeared to be a seasonal movement pattern, with minimum detection rates occurring later in the year at more northerly sites. The nocturnal pattern was seen across all data sets but was not strong at equatorial locations. Although lunar cycles were important at many sites, there was no consistent trend at any spatial scale. Overall, this analysis confirms the broad distribution of sperm whales across the North Pacific and highlights the subtle temporal patterns in their acoustic activity, which may be related to shifts in animal behavior or movement.

Runcie, R.M., Muhling, B., Hazen, E.L., Bograd, S.J., Garfield, T., and G. DiNardo, 2019. Environmental associations of Pacific bluefin tuna (*Thunnus orientalis*) catch in the California Current system. *Fisheries Oceanography*, *28*, pp. 372-388.

We investigate the impact of oceanographic variability on Pacific bluefin tuna (*Thunnus orientalis*: PBF) distributions in the California Current system using remotely sensed environmental data, and fishery-dependent data from multiple fisheries in a habitat-modeling framework. We examined the effects of local oceanic conditions (sea surface temperature, surface chlorophyll, sea surface height, eddy kinetic energy), as well as large-scale oceanographic phenomena, such as El Niño, on PBF availability to commercial and recreational fishing fleets. Results from generalized additive models showed that warmer temperatures of around 17–21°C with low surface chlorophyll concentrations (<0.5 mg/m^3) increased probability of occurrence of PBF in the Commercial Passenger Fishing Vessel and purse seine fisheries. These associations were particularly evident during a recent marine heatwave (the “Blob”). In contrast, PBF were most likely to be encountered on drift gillnet gear in somewhat cooler waters (13–18°C), with moderate chlorophyll concentrations (0.5–1.0 mg/m^3). This discrepancy was likely a result of differing spatiotemporal distribution of fishing effort among fleets, as well as the different vertical depths fished by each gear, demonstrating the importance of understanding selectivity when building correlative habitat models. In the future, monitoring and understanding environmentally driven changes in the availability of PBF to commercial and recreational fisheries can contribute to the implementation of ecosystem approaches to fishery management.

Woodworth-Jefcoats P.A., Blanchard J.L., and J.C. Drazen, 2019. Relative Impacts of Simultaneous Stressors on a Pelagic Marine Ecosystem. *Frontiers in Marine Science, 6*, p. 383.

Climate change and fishing are two of the greatest anthropogenic stressors on marine ecosystems. We investigate the effects of these stressors on Hawaii's deep-set longline fishery for bigeye tuna (*Thunnus obesus*) and the ecosystem which supports it using a size-based food web model that incorporates individual species and captures the metabolic effects of rising ocean temperatures. We find that when fishing and climate change are examined individually, fishing is the greater stressor. This suggests that proactive fisheries management could be a particularly effective tool for mitigating anthropogenic stressors either by balancing or outweighing climate effects. However, modeling these stressors jointly shows that even large management changes cannot completely offset climate effects. Our results suggest that a decline in Hawaii's longline fishery yield may be inevitable. The effect of climate change on the ecosystem depends primarily upon the intensity of fishing mortality. Management measures which take this into account can both minimize fishery decline and support at least some level of ecosystem resilience.

Wren, J.L.K, Shaffer, S.A., and J.J. Polovina, 2019. Variations in black-footed albatross sightings in a North Pacific transitional area due to changes in fleet dynamics and oceanography 2006–2017. *Deep Sea Research Part II: Topical Studies in Oceanography*, *169*, 104605.

A serious threat to pelagic seabird populations today is interactions with longline fisheries. While current seabird mitigation efforts have proven successful in substantially reducing seabird interactions in the Hawaii-based longline fishery, black-footed albatross (*Phoebastria nigripes*) interactions have increased. In an effort to better understand when and where these interactions take place, we explore the relationship between black-footed albatross sightings in the Hawaii-based deep-set longline fishery and fleet dynamics and environmental variables. Environmental drivers include both large scale climate variability due to the Pacific Decadal Oscillation (PDO) and El Niño – Southern Oscillation, as well as local oceanographic and atmospheric drivers, such as wind patterns, sea surface temperature, and surface chlorophyll. Using generalized linear models, we found that while season, latitude, and longitude of fishing explained much of the variation throughout the time series, both large scale and local climate variables – positive PDO, strong westerly winds, and sea surface temperature fronts – explained the increase in black-footed albatross sightings in recent years. Black-footed albatross nest in the Northwestern Hawaiian Islands, and their main foraging habitat while nesting are the productive fronts to the north and east of the Hawaiian Islands. During a positive PDO, a more intense and expanded Aleutian Low shifts westerly winds southward, replacing trade winds in the northern region of the longline fishing grounds. The expanded westerly winds may have two impacts. Firstly, they drive productive surface waters to the south, increasing the overlap of the albatross foraging grounds and the deep-set fishing grounds. Secondly, when westerlies move south, more birds transit through the fishing grounds to the east rather than traveling north to reach the westerlies before traveling eastward north of the fishing grounds. Because PDO operates on decadal timescales, the high levels of sightings and interactions may persist for many years.

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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 Sampled	Expanded Trips	Trolling Percent
2011	239	67	113	119	95
2012	262	56	71	76	93
2013	259	73	114	120	95
2014	237	97	98	126	78
2015	219	51	69	104	66
2016	196	78	56	84	67
2017	200	41	74	142	52
2018	207	56	109	167	65
2019	211	96	96	144	67
2020	228	43	66	79	84

Table A-2. Supporting Data for Figure 2

Year	Boats Landing All Methods	Boats Landing Longline Boats	Boats Landing Trolling
2011	39	24	10
2012	39	25	8
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
Average	**36**	**19**	**10**
Standard Deviation	**9**	**5**	**5**

Table A-3. Supporting Data for Figure 3

Year	**All Pelagic Species Troll Trips**	**All Pelagic Species Longline Sets**
2011	141	3,891
2012	108	4,210
2013	164	3,411
2014	148	2,748
2015	149	2,786
2016	124	2,451
2017	180	2,488
2018	196	2,213
2019	169	1,882
2020	131	1,227
Average	**151**	**2,731**
Standard Deviation	**27**	**906**

Table A-4. Supporting Data for Figure 4

Year	**Total Pounds Landings Tuna**	**Total Pounds Landings Non Tuna PMUS**
2011	7,526,632	370,399
2012	9,375,075	335,277
2013	5,855,112	295,355
2014	4,904,835	250,502
2015	5,400,233	231,256
2016	4,603,412	217,450
2017	4,851,118	269,023
2018	4,283,161	185,739
2019	2,969,367	135,445
2020	1,778,237	112,492
Average	**5,154,718**	**240,294**
Standard Deviation	**2,144,315**	**82,204**

Table A-5. Supporting Data for Figure 5

Year	**Commercial Landings Pounds Tuna**	**Commercial Landings Pounds Non Tuna PMUS**
2011	7,511,368	294,793
2012	9,358,656	189,573
2013	5,783,264	188,215
2014	4,893,894	139,410
2015	5,379,229	116,447
2016	4,595,614	96,296
2017	4,842,409	103,266
2018	4,276,547	64,249
2019	2,966,254	39,308
2020	1,775,064	33,254
Average	**5,138,230**	**126,481**
Standard Deviation	**2,137,767**	**80,279**

Table A-6. Supporting Data for Figure 6

Year	**Estimated Yellowfin Longline Pounds**	**Estimated Yellowfin Trolling Pounds**
2011	1,306,738	12,379
2012	828,641	8,480
2013	808,271	7,137
2014	1,067,483	6,618
2015	1,003,907	3,981
2016	848,926	9,477
2017	1,233,124	14,023
2018	575,768	10,344
2019	417,262	3,140
2020	479,374	3,327
Average	**856,949**	**7,891**
Standard Deviation	**303,301**	**3,764**

Table A-7. Supporting Data for Figure 7

Year	**Estimated Skipjack Longline Pounds**	**Estimated Skipjack Trolling Pounds**
2011	311,604	19,862
2012	727,981	9,703
2013	161,136	8,459
2014	286,397	12,941
2015	250,832	6,924
2016	210,451	9,801
2017	155,788	7,005
2018	168,457	8,414
2019	151,372	12,958
2020	126,168	6,417
Average	**255,019**	**10,248**
Standard Deviation	**177,446**	**4,087**

Table A-8. Supporting Data for Figure 8

Year	**Estimated Wahoo Longline Pounds**	**Estimated Wahoo Trolling Pounds**
2011	193,780	55
2012	165,186	597
2013	149,619	1,109
2014	122,384	1,072
2015	121,750	496
2016	101,693	1,871
2017	110,322	747
2018	67,510	1,154
2019	40,231	601
2020	34,885	105
Average	**110,736**	**781**
Standard Deviation	**51,967**	**543**

Table A-9. Supporting Data for Figure 9

Year	**Estimated Mahimahi Longline Pounds**	**Estimated Mahimahi Trolling Pounds**
2011	23,153	611
2012	23,977	157
2013	39,140	300
2014	23,037	2,077
2015	11,822	372
2016	8,969	1,071
2017	30,883	1,373
2018	10,007	954
2019	4,163	714
2020	9,784	942
Average	**18,494**	**857**
Standard Deviation	**11,258**	**571**

Table A-10. Supporting Data for Figure 10

Year	**Blue Marlin Longline Pounds**	**Blue Marlin Trolling Pounds**
2011	81,874	0
2012	73,928	0
2013	60,795	0
2014	55,941	647
2015	55,836	1,765
2016	66,073	476
2017	87,684	812
2018	70,536	1,107
2019	64,672	834
2020	54,645	0
Average	**67,198**	**564**
Standard Deviation	**11,321**	**592**

Table A-11. Supporting Data for Figure 11

Year	**Sailfish Longline Pounds**	**Sailfish Trolling Pounds**
2011	8,296	73
2012	3,333	0
2013	3,546	0
2014	3,616	19
2015	5,106	54
2016	5,106	0
2017	3,262	0
2018	1,702	0
2019	4,184	181
2020	1,205	287
Average	**3,936**	**61**
Standard Deviation	**1,981**	**98**

Table A-12. Supporting Data for Figure 13

Year	**Longline Hook Set**
2011	11,074
2012	12,112
2013	10,184
2014	7,667
2015	7,806
2016	6,909
2017	7,009
2018	6,010
2019	5,104
2020	3,401
Average	**7,728**
Standard Deviation	**2,712**

Table A-13. Supporting Data for Figure 14

Year	Bigeye Tuna Longline Pounds
2011	386,653
2012	408,805
2013	191,554
2014	210,869
2015	183,849
2016	155,842
2017	139,424
2018	117,516
2019	68,305
2020	45,389
Average	**190,821**
Standard Deviation	**120,976**

Table A-14. Supporting Data for Figure 15

Year	Albacore Longline Pounds
2011	5,482,734
2012	7,376,070
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	1,116,890
Average	**3,828,057**
Standard Deviation	**1,720,222**

Table A-15. Supporting Data for Figure 16

Year	Swordfish Longline Pounds
2011	24,477
2012	26,081
2013	20,474
2014	17,736
2015	14,615
2016	12,194
2017	13,438
2018	13,561
2019	8,210
2020	4,945
Average	**15,573**
Standard Deviation	**6,721**

Table A-16. Supporting Data for Figure 17

Year	Release Tunas	Release Non Tuna PMUS	Release Other Pelagics	Release Sharks
2011	5,575	12,197	372	4,832
2012	6,924	16,086	900	6,930
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	587	1,495	27	1,992
Average	**2,038**	**6,870**	**284**	**4,603**
Standard Deviation	**2,262**	**5,081**	**360**	**1,389**

Table A-17. Supporting Data for Figure 18

Year	Alias Catch per 1000 Hooks	Monohulls Catch per 1000 Hooks
2011	0.0	12.1
2012	0.0	14.8
2013	0.0	11.7
2014	0.0	10.6
2015	0.0	12.7
2016	0.0	11.9
2017	0.0	11.6
2018	0.0	13.5
2019	0.0	11.3
2020	0.0	8.5
Average	**0.0**	**11.9**
Standard Deviation	**0.0**	**1.7**

Table A-18. Supporting Data for Figure 19

Year	Troll Catch Pounds Per Hour	Effective Troll Hours
2011	52	708
2012	52	501
2013	27	837
2014	25	1,005
2015	16	1,022
2016	43	639
2017	14	2,163
2018	23	1,109
2019	24	839
2020	21	610
Average	**30**	**943**
Standard Deviation	**14**	**472**

Table A-19. Supporting Data for Figure 20

Year	**Trolling Catch Rates Skipjack**	**Trolling Catch Rates Yellowfin Tuna**
2011	30.53	19.11
2012	25.87	23.22
2013	13.08	11.40
2014	13.92	6.95
2015	7.00	5.03
2016	17.33	16.70
2017	3.54	7.00
2018	7.53	10.03
2019	16.39	4.41
2020	12.16	6.01
Average	**14.74**	**10.99**
Standard Deviation	**8.37**	**6.54**

Table A-20. Supporting Data for Figure 21

Year	**Trolling Catch Rates Blue Marlin**	**Trolling Catch Rates Mahimahi**	**Trolling Catch Rates Wahoo**
2011	0.00	1.02	0.04
2012	0.00	0.44	1.67
2013	0.00	0.46	1.78
2014	0.44	2.37	0.86
2015	2.49	0.39	0.38
2016	1.09	1.81	3.84
2017	0.48	0.66	0.25
2018	1.17	0.83	1.22
2019	1.17	0.92	0.50
2020	0.00	1.39	0.04
Average	**0.68**	**1.03**	**1.06**
Standard Deviation	**0.81**	**0.65**	**1.16**

TABLES FOR SECTION 2.2: COMMONWEALTH OF THE NORTHERN MARIANA ISLANDS

Table A-21. Boat-based Survey Statistics (raw data), CNMI

Year	Survey Days	Boat Log Total Trips	Charter Trips	Non Charter Trips	Total Interviews	Charter Interviews	Non Charter Interviews
2011	73	111	5	106	105	5	100
2012	73	134	7	127	126	7	119
2013	72	163	2	161	149	2	147
2014	74	155	2	153	144	4	140
2015	68	110	1	109	102	1	101
2016	80	115	4	111	100	4	96
2017	74	121	7	114	109	3	106
2018	59	124	3	121	108	4	104
2019	37	65	1	64	58	4	54
2020	61	112	1	111	119	5	114

Table A-22. Supporting Data for Figure 22

Year	Number of Fishermen Landing Pelagic Species from Commercial Receipt Invoices
2011	45
2012	35
2013	28
2014	21
2015	12
2016	73
2017	48
2018	56
2019	49
2020	73
Average	**44**
Standard Deviation	**20**

Table A-23. Supporting Data for Figure 23

Year	Number of Trips Catching Pelagic Fish from Commercial Receipt Invoices
2011	531
2012	1,051
2013	1,640
2014	1,227
2015	583
2016	1,205
2017	1,541
2018	2,204
2019	2,457
2020	1,309
Average	**1,375**
Standard Deviation	**620**

Table A-24. Supporting Data for Figure 24

Year	Estimated Total Trolling Trips	Estimated Trolling Trips Non Charter	Estimated Trolling Trips Charter
2011	3,339	3,064	275
2012	3,423	3,238	185
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	9,481	9,481	0
Average	**3,855**	**3,794**	**61**
Standard Deviation	**2,046**	**2,066**	**93**

Table A-25. Supporting Data for Figure 25

Year	Estimated Trolling Hours Total	Estimated Trolling Hours Non Charter	Estimated Trolling Hours Charter
2011	18,061	17,318	743
2012	17,659	17,144	516
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	46,818	46,818	0
Average	**20,094**	**19,907**	**187**
Standard Deviation	**9,780**	**9,841**	**252**

Table A-26. Supporting Data for Figure 26

Year	Estimated Trolling Hours per Trip	Estimated Trolling Hours per Trip Non Charter	Estimated Trolling Hours per Trip Charter
2011	5.4	5.7	2.7
2012	5.2	5.3	2.8
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
Average	**5.3**	**5.3**	**2.6**
Standard Deviation	**0.2**	**0.2**	**2.0**

Table A-27. Supporting Data for Figure 27

Year	Estimated Total Landings All Pelagic	Estimated Total Landings Tuna PMUS	Estimated Total Landings Non Tuna PMUS
2011	349,389	263,343	75,454
2012	481,068	408,160	71,113
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	689,136	593,463	78,113
Average	**423,865**	**336,865**	**80,810**
Standard Deviation	**111,006**	**110,629**	**20,845**

Table A-28. Supporting Data for Figure 28

Year	Estimated Total Landings Pelagic	Estimated Total Landings Non Charter	Estimated Total Landings Charter
2011	349,389	339,460	9,931
2012	481,068	475,797	5,273
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	689,136	689,136	0
Average	**423,865**	**421,470**	**2,396**
Standard Deviation	**111,006**	**111,610**	**3,172**

Table A-29. Supporting Data for Figure 29

Year	Estimated Landings Tuna PMUS	Estimated Landings Non Charter	Estimated Landings Charter
2011	263,343	257,825	5,518
2012	408,160	406,657	1,503
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	593,463	593,463	0
Average	**336,865**	**335,713**	**1,153**
Standard Deviation	**110,629**	**110,829**	**1,785**

Table A-30. Supporting Data for Figure 30

Year	Estimated Landings Total Non-Tuna PMUS	Estimated Landings Non Charter	Estimated Landings Charter
2011	75,454	71,438	4,018
2012	71,113	67,502	3,613
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	78,113	78,113	0
Average	**80,810**	**79,664**	**1,146**
Standard Deviation	**20,845**	**21,363**	**1,668**

Table A-31. Supporting Data for Figure 31

Year	Estimated Total Landings Skipjack	Estimated Total Landings Non Charter	Estimated Total Landings Charter
2011	220,079	214,671	5,408
2012	304,531	303,284	1,247
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	537,399	537,399	0
Average	**297,964**	**296,848**	**1,116**
Standard Deviation	**101,674**	**101,966**	**1,751**

Table A-32. Supporting Data for Figure 32

Year	Estimated Total Landings Yellowfin	Estimated Total Landings Non Charter	Estimated Total Landings Charter
2011	41,160	41,160	0
2012	77,605	77,455	150
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	55,944	55,944	0
Average	**32,066**	**32,051**	**15**
Standard Deviation	**21,058**	**21,022**	**47**

Table A-33. Supporting Data for Figure 33

Year	**Estimated Total Landings Mahimahi**	**Estimated Total Landings Non Charter**	**Estimated Total Landings Charter**
2011	55,291	52,375	2,917
2012	41,390	40,102	1,289
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	71,564	71,564	0
Average	**68,977**	**68,394**	**583**
Standard Deviation	**22,501**	**22,859**	**941**

Table A-34. Supporting Data for Figure 34

Year	**Estimated Total Landings Wahoo**	**Estimated Total Landings Non Charter**	**Estimated Total Landings Charter**
2011	11,853	10,753	1,101
2012	19,073	16,750	2,324
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	6,549	6,549	0
Average	**8,260**	**7,697**	**563**
Standard Deviation	**4,838**	**4,275**	**901**

Table A-35. Supporting Data for Figure 35

Year	Estimated Total Landings Blue Marlin	Estimated Total Landings Non Charter	Estimated Total Landings Charter
2011	4,987	4,987	0
2012	10,290	10,290	0
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
Average	**3,169**	**3,169**	**0**
Standard Deviation	**3,231**	**3,231**	**0**

Table A-36. Supporting Data for Figure 36

Year	Estimated Total Landings All Pelagics	Estimated Total Landings Tuna PMUS	Estimated Total Landings Non Tuna PMUS
2011	112,095	77,919	29,707
2012	160,883	125,411	30,031
2013	263,416	200,213	52,950
2014	235,015	178,635	48,456
2015	188,213	154,655	30,810
2016	223,004	199,620	17,387
2017	224,443	201,023	18,392
2018	221,509	193,045	18,209
2019	177,619	140,378	22,044
2020	120,759	105,596	11,685
Average	**192,696**	**157,650**	**27,967**
Standard Deviation	**49,978**	**44,172**	**13,574**

Table A-37. Supporting Data for Figure 37

Year	Commercial Purchase Landings Skipjack	Commercial Purchase Landings Yellowfin
2011	58,420	17,720
2012	99,348	19,447
2013	166,969	31,278
2014	161,721	15,102
2015	139,903	14,602
2016	178,815	18,725
2017	164,196	36,411
2018	171,793	16,323
2019	127,689	12,283
2020	94,154	11,422
Average	**136,301**	**19,331**
Standard Deviation	**40,451**	**8,158**

Table A-38. Supporting Data for Figure 38

Year	Commercial Purchase Landings Mahimahi	Commercial Purchase Landings Wahoo	Commercial Purchase Landings Blue Marlin
2011	19,361	7,526	175
2012	18,826	8,677	2,010
2013	44,889	5,345	2,091
2014	38,084	7,262	2,547
2015	30,382	428	0
2016	12,582	1,603	2,198
2017	14,715	2,894	440
2018	16,754	943	374
2019	20,724	336	604
2020	9,915	891	75
Average	**22,623**	**3,591**	**1,051**
Standard Deviation	**11,465**	**3,287**	**1,023**

Table A-39. Supporting Data for Figure 39

Year	Troll Catch Rate Average Pounds per Hour	Troll Catch Rate Non Charter	Troll Catch Rate Charter
2011	19.2	19.5	13.1
2012	27.4	27.9	10.2
2013	26.7	26.9	11.9
2014	20.4	20.5	6.8
2015	28.0	28.0	0.0
2016	16.1	16.1	17.6
2017	23.5	23.5	0.0
2018	21.5	21.5	19.0
2019	27.9	28.0	17.9
2020	14.5	14.5	0.0
Average	**22.5**	**22.6**	**9.7**
Standard Deviation	**5.0**	**5.0**	**7.6**

Table A-40. Supporting Data for Figure 40

Year	Troll Catch Rate Pounds per Hour Skipjack	Troll Catch Rate Non Charter	Troll Catch Rate Charter
2011	12.2	12.4	7.3
2012	17.2	17.7	2.4
2013	19.6	20.0	0.0
2014	11.9	12.0	0.0
2015	20.4	20.4	0.0
2016	10.1	10.1	17.6
2017	16.2	16.2	0.0
2018	17.3	17.3	14.1
2019	20.5	20.5	15.7
2020	11.4	11.4	0.0
Average	**15.7**	**15.8**	**5.7**
Standard Deviation	**4.0**	**4.0**	**7.4**

Table A-41. Supporting Data for Figure 41

Year	**Troll Catch Rate Pounds per Hour Yellowfin Tuna**	**Troll Catch Rate Non Charter**	**Troll Catch Rate Charter**
2011	2.3	2.4	0.0
2012	4.4	4.5	0.3
2013	1.8	1.9	0.0
2014	1.2	1.2	0.0
2015	1.1	1.1	0.0
2016	0.9	0.9	0.0
2017	1.2	1.2	0.0
2018	0.5	0.5	0.0
2019	2.2	2.2	0.0
2020	1.2	1.2	0.0
Average	**1.7**	**1.7**	**0.0**
Standard Deviation	**1.1**	**1.1**	**0.1**

Table A-42. Supporting Data for Figure 42

Year	**Troll Catch Rate Pounds per Hour Mahimahi**	**Troll Catch Rate Non Charter**	**Troll Catch Rate Charter**
2011	3.1	3.0	3.8
2012	2.3	2.3	2.5
2013	4.3	4.3	4.0
2014	5.9	5.9	5.9
2015	6.2	6.2	0.0
2016	4.2	4.2	0.0
2017	3.0	3.0	0.0
2018	3.0	3.0	2.3
2019	4.2	4.3	0.0
2020	1.5	1.5	0.0
Average	**3.8**	**3.8**	**1.9**
Standard Deviation	**1.5**	**1.5**	**2.2**

Table A-43. Supporting Data for Figure 43

Year	**Troll Catch Rate Pounds per Hour Wahoo**	**Troll Catch Rate Non Charter**	**Troll Catch Rate Charter**
2011	0.7	0.6	1.5
2012	1.1	1.0	4.5
2013	0.6	0.4	7.9
2014	0.5	0.5	0.8
2015	0.3	0.3	0.0
2016	0.2	0.2	0.0
2017	0.7	0.7	0.0
2018	0.3	0.3	2.3
2019	0.1	0.1	0.0
2020	0.1	0.1	0.0
Average	**0.5**	**0.4**	**1.7**
Standard Deviation	**0.3**	**0.3**	**2.6**

Table A-44. Supporting Data for Figure 44

Year	**Troll Catch Rate Pounds per Hour Blue Marlin**	**Troll Catch Rate Non Charter**	**Troll Catch Rate Charter**
2011	0.3	0.3	0.0
2012	0.6	0.6	0.0
2013	0.1	0.1	0.0
2014	0.3	0.3	0.0
2015	0.0	0.0	0.0
2016	0.0	0.0	0.0
2017	0.2	0.2	0.0
2018	0.1	0.1	0.0
2019	0.2	0.2	0.0
2020	0.0	0.0	0.0
Average	**0.2**	**0.2**	**0.0**

Table A-45. Supporting Data for Figure 45

Year	**Troll Catch Rate Pounds per Trip Mahimahi**	**Troll Catch Rate Pounds per Trip Wahoo**	**Troll Catch Rate Pounds per Trip Blue Marlin**
2011	36.5	14.2	0.3
2012	17.9	8.3	1.9
2013	27.4	3.3	1.3
2014	31.0	5.9	2.1
2015	52.1	0.7	0.0
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	7.6	0.7	0.1
Average	**20.8**	**3.7**	**0.8**
Standard Deviation	**15.3**	**4.5**	**0.8**

Table A-46. Supporting Data for Figure 46

Year	**Troll Catch Rate Pounds per Trip Skipjack**	**Troll Catch Rate Pounds per Trip Yellowfin**	**Troll Catch Rate Pounds per Trip Skipjack Creel**
2011	110	33	66
2012	95	19	95
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	72	9	54
Average	**113**	**17**	**85**
Standard Deviation	**53**	**9**	**22**

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**
2011	96	877	496
2012	97	498	274
2013	96	799	456
2014	90	964	511
2015	95	904	540
2016	95	1,147	728
2017	92	1,018	643
2018	91	979	652
2019	98	930	620
2020	96	962	240

Table A-48. Supporting Data for Figure 47

Year	**Estimated Trolling Boats**	**Upper 95 Percent**	**Lower 95 Percent**
2011	454	563.0	396.0
2012	351	457.0	298.0
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
Average	**428**	**539**	**374**
Standard Deviation	**45**	**76**	**41**

Table A-49. Supporting Data for Figure 48

Year	Estimated Total Landings All Pelagic	Estimated Total Landings Tuna PMUS	Estimated Total Landings Non Tuna PMUS
2011	591,945	433,274	145,757
2012	397,776	271,789	122,714
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	614,633	403,428	193,542
Average	**726,370**	**507,158**	**204,964**
Standard Deviation	**172,812**	**130,631**	**62,099**

Table A-50. Supporting Data for Figure 49

Year	Estimated Total Landings Pelagic	Estimated Total Landings Non Charter	Estimated Total Landings Charter
2011	591,945	566,561	25,384
2012	397,776	369,333	28,445
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	614,633	611,466	3,167
Average	**726,370**	**688,674**	**37,697**
Standard Deviation	**172,812**	**160,436**	**17,838**

Table A-51. Supporting Data for Figure 50

Year	**Estimated Landings Tuna PMUS**	**Estimated Landings Non Charter**	**Estimated Landings Charter**
2011	433,274	422,799	10,475
2012	271,789	264,736	7,054
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	403,428	402,803	625
Average	**507,158**	**499,634**	**7,524**
Standard Deviation	**130,631**	**130,335**	**3,016**

Table A-52. Supporting Data for Figure 51

Year	**Estimated Total Landings Skipjack**	**Estimated Total Landings Non Charter**	**Estimated Total Landings Charter**
2011	360,363	351,104	9,259
2012	245,885	240,560	5,325
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	348,466	348,090	376
Average	**440,878**	**434,478**	**6,400**
Standard Deviation	**112,672**	**112,272**	**2,802**

Table A-53. Supporting Data for Figure 52

Year	Estimated Total Landings Yellowfin	Estimated Total Landings Non Charter	Estimated Total Landings Charter
2011	72,261	71,210	1,051
2012	25,904	24,176	1,729
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	54,962	54,713	249
Average	**66,019**	**64,920**	**1,099**
Standard Deviation	**32,766**	**32,274**	**908**

Table A-54. Supporting Data for Figure 53

Year	Estimated Total Landings Non Tuna PMUS	Estimated Total Landings Non Charter	Estimated Total Landings Charter
2011	145,757	130,973	14,784
2012	122,714	101,324	21,391
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	193,542	191,000	2,542
Average	**204,964**	**175,098**	**29,865**
Standard Deviation	**62,099**	**53,201**	**16,493**

Table A-55. Supporting Data for Figure 54

Year	**Estimated Total Landings Mahimahi**	**Estimated Total Landings Non Charter**	**Estimated Total Landings Charter**
2011	88,537	79,292	9,245
2012	77,925	64,492	13,433
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	92,602	90,737	1,865
Average	**122,852**	**105,417**	**17,435**
Standard Deviation	**52,310**	**43,945**	**11,823**

Table A-56. Supporting Data for Figure 55

Year	**Estimated Total Landings Wahoo**	**Estimated Total Landings Non Charter**	**Estimated Total Landings Charter**
2011	37,122	32,577	4,545
2012	37,159	33,798	3,361
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	46,920	46,243	677
Average	**49,622**	**44,151**	**5,471**
Standard Deviation	**24,135**	**21,318**	**3,995**

Table A-57. Supporting Data for Figure 56

Year	Estimated Total Landings Blue Marlin	Estimated Total Landings Non Charter	Estimated Total Landings Charter
2011	18,859	17,865	994
2012	5,460	864	4,597
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	50,833	50,833	0
Average	**30,765**	**24,245**	**6,520**
Standard Deviation	**15,236**	**15,463**	**3,757**

Table A-58. Supporting Data for Figure 57

Year	Estimated Commercial Landings All Pelagic	Estimated Commercial Landings Tuna PMUS	Estimated Commercial Landings Non Tuna PMUS
2011	143,048	36,939	100,868
2012	118,038	41,004	72,849
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	141,118	52,020	81,462
2020	68,893	21,938	42,068
Average	**119,426**	**44,636**	**69,938**
Standard Deviation	**29,367**	**12,468**	**31,006**

Table A-59. Supporting Data for Figure 58

Year	Estimated Trolling Trips	Estimated Trolling Non Charter	Estimated Trolling Charter
2011	8,309	7,240	1,068
2012	5,060	4,241	819
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	9,200	8,998	202
Average	**9,169**	**8,092**	**1,076**
Standard Deviation	**1,804**	**1,665**	**361**

Table A-60. Supporting Data for Figure 59

Year	Estimated Trolling Hours Total	Estimated Trolling Hours Non Charter	Estimated Trolling Hours Charter
2011	44,871	41,763	3,108
2012	27,805	24,852	2,953
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	47,457	46,720	738
Average	**49,381**	**45,565**	**3,816**
Standard Deviation	**10,511**	**9,637**	**1,594**

Table A-61. Supporting Data for Figure 60

Year	Estimated Trolling Hours per Trip Average	Estimated Trolling Hours per Trip Non Charter	Estimated Trolling Hours per Trip Charter
2011	5.4	5.8	2.9
2012	5.5	5.9	3.6
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
Average	**5.4**	**5.7**	**3.6**
Standard Deviation	**0.5**	**0.5**	**0.8**

Table A-62. Supporting Data for Figure 61

Year	Troll Catch Rate Average Pounds per Hour	Troll Catch Rate Non Charter	Troll Catch Rate Charter
2011	13.0	13.4	8.1
2012	14.2	14.8	9.6
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	12.9	13.0	4.3
Average	**14.8**	**15.2**	**9.7**
Standard Deviation	**2.3**	**2.2**	**3.7**

Table A-63. Supporting Data for Figure 62

Year	**Troll Catch Rate Pounds per Hour Skipjack**	**Troll Catch Rate Non Charter**	**Troll Catch Rate Charter**
2011	8.0	8.4	3.0
2012	8.8	9.7	1.8
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	7.5	0.5
Average	**9.0**	**9.6**	**1.7**
Standard Deviation	**1.6**	**1.8**	**0.8**

Table A-64. Supporting Data for Figure 63

Year	**Troll Catch Rate Pounds per Hour Yellowfin Tuna**	**Troll Catch Rate Non Charter**	**Troll Catch Rate Charter**
2011	1.6	1.7	0.3
2012	0.9	1.0	0.6
2013	1.2	1.3	0.0
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
Average	**1.3**	**1.4**	**0.3**
Standard Deviation	**0.4**	**0.5**	**0.2**

Table A-65. Supporting Data for Figure 64

Year	Troll Catch Rate Pounds per Hour Mahimahi	Troll Catch Rate Non Charter	Troll Catch Rate Charter
2011	2.0	1.9	3.0
2012	2.8	2.6	4.5
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	2.0	1.9	2.5
Average	**2.5**	**2.4**	**4.5**
Standard Deviation	**1.0**	**0.9**	**2.7**

Table A-66. Supporting Data for Figure 65

Year	Troll Catch Rate Pounds per Hour Wahoo	Troll Catch Rate Non Charter	Troll Catch Rate Charter
2011	0.8	0.8	1.4
2012	1.3	1.4	1.1
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
Average	**1.0**	**1.0**	**1.4**
Standard Deviation	**0.5**	**0.5**	**0.8**

Table A-67. Supporting Data for Figure 66

Year	**Troll Catch Rate Pounds per Hour Blue Marlin**	**Troll Catch Rate Non Charter**	**Troll Catch Rate Charter**
2011	0.4	0.4	0.3
2012	0.2	0.0	1.6
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	0.0
Average	**0.6**	**0.5**	**1.6**
Standard Deviation	**0.3**	**0.3**	**0.8**

Table A-68. Supporting Data for Figure 67; data for 2015 through 2020 are confidential

Year	**Longline Transshipment Landings Total**	**Longline Transshipment Landings Bigeye Tuna**	**Longline Transshipment Landings Yellowfin Tuna**
2011	2,017	1,343	532
2012	2,411	1,691	502
2013	2,047	1,379	436
2014	2,290	1,855	292
2015	*	*	*
2016	*	*	*
2017	*	*	*
2018	*	*	*
2019	*	*	*
2020	*	*	*
Average	**1,597**	**1,106**	**386**
Standard Deviation	**663**	**499**	**165**

TABLES FOR SECTION 2.4: HAWAII

Table A-69. Supporting Data for Figure 68

	Hawaii pelagic catch (1,000 pounds)					
Year	**Tunas**	**Billfish**	**Other PMUS**	**PMUS Sharks**	**non-PMUS**	**Total**
2011	20,235	6,229	4,936	190	51	31,646
2012	21,104	5,107	5,682	181	26	32,102
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	22,978	3,621	3,753	43	5	30,399
Average	**23,422.8**	**5,822.1**	**5,888.4**	**141.1**	**20.1**	**35,295.2**
SD	**2,291.3**	**1,015.1**	**999.2**	**42.2**	**13.5**	**3,334.9**

Table A-70. Supporting Data for Figure 69

	Hawaii pelagic total catch (1,000 pounds)						
Year	**Deep-set longline**	**Shallow-set longline**	**MHI troll**	**MHI handline**	**Offshore handline**	**Other gear**	**Total**
2011	22,796	3,500	2,966	1,129	610	645	31,646
2012	22,975	2,814	3,690	1,602	562	459	32,102
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	27,061	838	1,486	0	326	110	30,399
Average	**28,505.9**	**2,265.3**	**2,785.1**	**960.0**	**468.7**	**252.3**	**35,295.2**
SD	**4,048.0**	**976.6**	**641.7**	**435.0**	**159.6**	**214.2**	**3,334.9**

Table A-71. Supporting Data for Figure 70

	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**
2011	16,250	209	1,509	1,061	602	604	20,235
2012	16,590	131	1,926	1,496	548	413	21,104
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	21,008	145	856	548	322	99	22,978
Average	**20,199.5**	**145.3**	**1,458.7**	**934.8**	**458.5**	**226.1**	**23,422.8**
SD	**2,911.6**	**60.9**	**308.3**	**292.5**	**155.9**	**200.4**	**2,291.3**

Table A-72. Supporting Data for Figure 71

	Hawaii tuna catch (1,000 pounds)						
Year	**Bigeye tuna**	**Yellowfin tuna**	**Skipjack tuna**	**Albacore**	**Bluefin tuna**	**Other tunas**	**Total**
2011	13,496	3,877	1,105	1,734	0	23	20,235
2012	14,022	4,098	907	2,009	1	67	21,104
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	16,952	5,098	553	366	3	5	22,978
Average	**16,806.5**	**5,046.4**	**794.0**	**752.7**	**1.6**	**21.8**	**23,422.8**
SD	**1,993.6**	**1,531.2**	**202.3**	**622.8**	**1.4**	**18.7**	**2,291.3**

Table A-73. Supporting Data for Figure 72

	Hawaii bigeye tuna catch (1,000 pounds)						
Year	**Deep-set longline**	**Shallow-set longline**	**MHI troll**	**MHI handline**	**Offshore handline**	**Other gear**	**Total**
2011	12,315	106	243	140	515	177	13,496
2012	12,741	75	341	131	491	243	14,022
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	16,438	98	41	40	277	59	16,952
Average	**15,975.6**	**85.6**	**168.6**	**87.2**	**389.6**	**99.9**	**16,806.5**
SD	**2,258.8**	**25.6**	**123.0**	**42.7**	**156.6**	**83.5**	**1,993.6**

Table A-74. Supporting Data for Figure 73

	Hawaii yellowfin tuna catch (1,000 pounds)						
Year	**Deep-set longline**	**Shallow-set longline**	**MHI troll**	**MHI handline**	**Offshore handline**	**Other gear**	**Total**
2011	2,009	38	970	704	84	72	3,877
2012	1,886	29	1,304	759	53	67	4,098
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	3,848	0	640	489	44	40	5,060
Average	**3,151.1**	**40.1**	**1,042.8**	**696.3**	**66.2**	**46.1**	**5,042.6**
SD	**1,599.4**	**39.0**	**194.2**	**146.6**	**33.6**	**21.9**	**1,531.1**

Table A-75. Supporting Data for Figure 74

	Hawaii skipjack tuna catch (1,000 pounds)						
Year	**Deep-set longline**	**Shallow-set longline**	**MHI troll**	**MHI handline**	**Offshore handline**	**Other gear**	**Total**
2011	453	1	279	17	3	352	1,105
2012	541	1	240	20	4	101	907
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	370	0	171	11	1	0	553
Average	**467.7**	**0.6**	**229.1**	**15.2**	**2.4**	**79.0**	**794.0**
SD	**78.6**	**0.5**	**49.9**	**4.5**	**2.5**	**120.3**	**202.3**

Table A-76. Supporting Data for Figure 75

	Hawaii albacore catch (1,000 pounds)						
Year	**Deep-set longline**	**Shallow-set longline**	**MHI troll**	**MHI handline**	**Offshore handline**	**Other gear**	**Total**
2011	1,473	64	8	186	0	3	1,734
2012	1,421	26	7	554	0	1	2,009
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
Average	**603.7**	**15.0**	**3.8**	**129.0**	**0.3**	**0.9**	**752.7**
SD	**473.1**	**18.6**	**2.7**	**159.0**	**0.4**	**1.1**	**622.8**

Table A-77. Supporting Data for Figure 76

	Hawaii billfish catch (1,000 lbs)						
Year	**Deep-set longline**	**Shallow-set longline**	**MHI troll**	**MHI handline**	**Offshore handline**	**Other gear**	**Total**
2011	2,549	3,176	486	15	1	2	6,229
2012	2,167	2,564	346	22	1	7	5,107
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	2,717	664	224	9	2	4	3,621
Average	**3,384.7**	**2,039.4**	**373.3**	**16.5**	**2.7**	**5.5**	**5,822.1**
SD	**785.8**	**918.9**	**71.7**	**3.8**	**1.8**	**2.7**	**1,015.1**

Table A-78. Supporting Data for Figure 77

	Hawaii billfish catch (1,000 lbs)					
Year	**Swordfish**	**Blue marlin**	**Striped marlin**	**Spearfish**	**Other marlins**	**Total**
2011	3,569	1,243	834	543	40	6,229
2012	3,094	950	647	386	30	5,107
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	1,199	1,373	762	262	24	3,621
Average	**2,767.9**	**1,559.1**	**930.0**	**522.3**	**42.6**	**5,822.1**
SD	**862.3**	**400.9**	**170.3**	**147.5**	**10.2**	**1,015.1**

Table A-79. Supporting Data for Figure 78

	Swordfish catch (1,000 lbs)						
Year	**Deep-set longline**	**Shallow-set longline**	**MHI troll**	**MHI handline**	**Offshore handline**	**Other gear**	**Total**
2011	456	3,100	1	11	0	1	3,569
2012	566	2,508	1	18	0	1	3,094
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	656	0	4	0	1	1,199
Average	**757.4**	**1,997.6**	**1.1**	**10.8**	**0.2**	**0.9**	**2,767.9**
SD	**210.1**	**896.4**	**0.7**	**4.3**	**0.3**	**0.6**	**862.3**

Table A-80. Supporting Data for Figure 79

	Blue marlin catch (1,000 lbs)						
Year	**Deep-set longline**	**Shallow-set longline**	**MHI troll**	**MHI handline**	**Offshore handline**	**Other gear**	**Total**
2011	797	27	414	4	1	0	1,243
2012	630	26	285	4	1	4	950
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
Average	**1,216.0**	**14.7**	**317.8**	**5.1**	**2.1**	**3.4**	**1,559.1**
SD	**394.8**	**10.7**	**61.9**	**1.4**	**1.4**	**1.9**	**400.9**

Table A-81. Supporting Data for Figure 80

	Striped marlin catch (1,000 lbs)						
Year	**Deep-set longline**	**Shallow-set longline**	**MHI troll**	**MHI handline**	**Offshore handline**	**Other gear**	**Total**
2011	756	43	35	0	0	0	834
2012	596	25	25	0	0	1	647
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
Average	**881.9**	**22.7**	**24.4**	**0.2**	**0.1**	**0.6**	**930.0**
SD	**175.5**	**15.1**	**5.9**	**0.3**	**0.2**	**0.5**	**170.3**

Table A-82. Supporting Data for Figure 81

	Catch of other PMUS by gear type (1,000 lbs)						
Year	**Deep-set longline**	**Shallow-set longline**	**MHI troll**	**MHI handline**	**Offshore handline**	**Other gear**	**Total**
2011	3,952	115	967	52	7	33	5,126
2012	4,198	119	1,413	83	13	37	5,863
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	3,332	29	404	21	2	7	3,795
Average	**4,905.6**	**80.6**	**950.1**	**66.1**	**7.4**	**19.8**	**6,029.5**
SD	**829.6**	**42.2**	**313.7**	**27.3**	**4.4**	**14.0**	**1,016.2**

Table A-83. Supporting Data for Figure 82

Year	Catch of other PMUS by species (1,000 lbs)						
	Mahimahi	Moonfish	Oilfish	Ono	Pomfret	PMUS shark	Total
2011	1,628	1,622	589	675	422	190	5,126
2012	2,007	1,593	563	809	710	181	5,863
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	580	1,631	184	849	508	43	3,795
Average	**1,343.4**	**2,164.4**	**440.1**	**1,057.8**	**882.7**	**141.1**	**6,029.5**
SD	**438.1**	**473.8**	**141.9**	**270.3**	**284.8**	**42.2**	**1,016.2**

Table A-84. Supporting Data for Figure 83

Year	Moonfish catch (1,000 lbs)			
	Deep-set longline	Shallow-set longline	Other gear	Total
2011	1,616	6	0	1,622
2012	1,574	17	2	1,593
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	1,609	22	0	1,631
Average	**2,145.1**	**18.9**	**0.3**	**2,164.4**
SD	**471.2**	**11.7**	**0.6**	**473.8**

Table A-85. Supporting Data for Figure 84

	Mahimahi catch (1,000 lbs)						
Year	**Deep-set longline**	**Shallow-set longline**	**MHI troll**	**MHI handline**	**Offshore handline**	**Other gear**	**Total**
2011	860	60	656	30	6	16	1,628
2012	889	46	988	53	12	19	2,007
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	2	301	12	1	2	580
Average	**647.2**	**26.5**	**629.5**	**28.3**	**4.4**	**7.5**	**1,343.4**
SD	**210.5**	**20.9**	**206.6**	**14.7**	**4.3**	**6.2**	**438.1**

Table A-86. Supporting Data for Figure 85

	Ono catch (1,000 lbs)						
Year	**Deep-set longline**	**Shallow-set longline**	**MHI troll**	**MHI handline**	**Offshore handline**	**Other gear**	**Total**
2011	352	1	309	9	1	3	675
2012	366	1	424	15	1	2	809
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	103	7	1	1	849
Average	**720.6**	**1.1**	**319.6**	**13.0**	**1.0**	**2.6**	**1,057.8**
SD	**275.9**	**0.7**	**113.5**	**4.1**	**0.6**	**1.3**	**270.3**

Table A-87. Supporting Data for Figure 86

Year	Pomfret catch (1,000 lbs) Deep-set longline	Shallow-set longline	MHI handline	Offshore handline	Other gear	Total
2011	398	1	11	0	12	422
2012	682	5	11	0	12	710
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	508
Average	**848.3**	**1.2**	**23.0**	**1.9**	**8.2**	**882.6**
SD	**271.1**	**1.5**	**13.7**	**2.4**	**7.0**	**284.7**

Table A-88. Supporting Data for Figure 87

Year	PMUS shark catch (1,000 lbs) Deep-set longline	Shallow-set longline	Non-longline	Total
2011	171	14	5	190
2012	150	26	5	181
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	41	1	0	43
Average	**118.9**	**19.3**	**3.0**	**141.1**
SD	**34.3**	**13.1**	**1.7**	**42.2**

Table A-89. Supporting Data for Figure 88

Year	**Deep-set longline** **Vessels**	**Trips**	**Sets**
2011	129	1,308	17,192
2012	128	1,361	18,115
2013	135	1,383	18,754
2014	139	1,350	17,777
2015	142	1,447	18,470
2016	142	1,480	19,391
2017	145	1,539	19,674
2018	143	1,643	21,012
2019	149	1,727	22,324
2020	146	1,644	20,785
Average	**139.8**	**1,488.2**	**19,349.4**
SD	**7.1**	**144.7**	**1617.9**

Table A-90. Supporting Data for Figure 89

	Number of deep-set hooks by area (millions)			
Year	**Outside EEZ**	**Hawaii EEZ**	**PRIA EEZ**	**Total**
2011	26.3	13.7	0.9	40.8
2012	28.2	14.0	1.9	44.1
2013	32.8	12.9	1.2	46.9
2014	34.0	10.8	0.8	45.6
2015	32.9	14.3	0.3	47.5
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
Average	**37.03**	**13.58**	**0.52**	**51.13**
SD	**7.41**	**1.33**	**0.66**	**7.48**

Table A-91. Supporting Data for Figure 90

Year	**Catch (1,000 lbs)**	**Adjusted revenue ($1,000)**	**Nominal revenue ($1,000)**	**Honolulu CPI**
2011	22,796	$83,599	$71,211	243.6
2012	22,975	$99,312	$86,627	249.5
2013	25,006	$95,036	$84,376	253.9
2014	26,615	$87,288	$78,617	257.6
2015	32,136	$100,286	$91,229	260.2
2016	31,434	$106,937	$99,190	265.3
2017	32,760	$101,081	$96,137	272.0
2018	32,410	$104,594	$101,332	277.1
2019	31,865	$94,317	$92,862	281.6
2020	27,061	$71,503	$71,503	286.0
Average	**28,505.9**	**$94,395.4**	**$87,308.5**	
SD	**4,048.0**	**$10,834.5**	**$10,829.7**	

Table A-92. Supporting Data for Figure 91

	Deep-set longline CPUE (fish per 1,000 hooks)		
Year	**Bigeye tuna**	**Yellowfin tuna**	**Albacore**
2011	3.8	0.8	0.8
2012	3.6	0.6	0.7
2013	4.1	0.4	0.3
2014	4.7	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
Average	**4.02**	**0.82**	**0.28**
SD	**0.48**	**0.34**	**0.26**

Table A-93. Supporting Data for Figure 92

	Deep-set longline CPUE (fish per 1,000 hooks)		
Year	**Swordfish**	**Striped marlin**	**Blue marlin**
2011	0.1	0.4	0.1
2012	0.1	0.2	0.1
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
Average	**0.10**	**0.27**	**0.12**
SD	**0.00**	**0.07**	**0.04**

Table A-94. Supporting Data for Figure 93

	Deep-set CPUE (fish per 1000 hooks)
Year	**Blue shark**
2011	1.2
2012	1.0
2013	1.0
2014	1.2
2015	1.4
2016	1.4
2017	1.6
2018	1.6
2019	1.8
2020	1.7
Average	**1.39**
SD	**0.28**

Table A-95. Supporting Data for Figure 94

	Shallow-set longline		
Year	**Vessels**	**Trips**	**Sets**
2011	20	82	1,447
2012	18	82	1,351
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	34	450
Average	**16.7**	**57.7**	**910.3**
SD	**3.7**	**22.5**	**421.8**

Table A-96. Supporting Data for Figure 95

	Number of hooks set by area (milions)			
Year	**Outside EEZ**	**Hawaii EEZ**	**PRIA EEZ**	**Total**
2011	1.2	0.3	0.0	1.5
2012	1.2	0.2	0.0	1.4
2013	0.9	0.1	0.0	1.1
2014	1.3	0.1	0.0	1.5
2015	1.1	0.2	0.0	1.3
2016	0.7	0.1	0.0	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
Average	**0.88**	**0.11**	**0.00**	**1.02**
SD	**0.33**	**0.10**	**0.00**	**0.42**

Table A-97. Supporting Data for Figure 96

Year	Catch (1,000 lbs)	Adjusted revenue ($1,000)	Nominal revenue ($1,000)	Honolulu CPI
2011	3,500	$7,167	$6,105	243.6
2012	2,814	$6,650	$5,801	249.5
2013	2,345	$3,581	$3,180	253.9
2014	3,255	$4,524	$4,074	257.6
2015	2,778	$3,089	$2,810	260.2
2016	1,849	$2,680	$2,486	265.3
2017	3,007	$4,448	$4,230	272.0
2018	1,438	$1,588	$1,538	277.1
2019	829	$1,972	$1,942	281.6
2020	838	$1,293	$1,293	286.0
Average	**2,265.3**	**$3,699.1**	**$3,345.8**	
SD	**976.6**	**$2,017.5**	**$1,682.0**	

Table A-98. Supporting Data for Figure 97

	Shallow-set longline CPUE (fish per 1,000 hooks)		
Year	Bigeye tuna	Yellowfin tuna	Albacore
2011	0.7	0.2	2.0
2012	0.6	0.2	0.8
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
Average	**1.30**	**0.60**	**0.54**
SD	**0.80**	**0.56**	**0.55**

Table A-99. Supporting Data for Figure 98

Year	Shallow-set longline CPUE (fish per 1,000 hooks) Swordfish	Striped marlin	Blue marlin
2011	11.0	0.4	0.1
2012	9.9	0.2	0.1
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	8.1	0.1	0.0
Average	**10.87**	**0.24**	**0.06**
SD	**1.49**	**0.15**	**0.05**

Table A-100. Supporting Data for Figure 99

Year	Shallow-set CPUE (fish per 1000 hooks) Blue shark
2011	5.3
2012	4.2
2013	4.9
2014	6.8
2015	10.0
2016	13.8
2017	9.0
2018	5.1
2019	8.5
2020	10.5
Average	**7.81**
SD	**3.09**

Table A-101. Supporting Data for Figure 100

Year	Fishers	Days fished
2011	1,675	29,978
2012	1,765	31,669
2013	1,730	28,876
2014	1,697	28,114
2015	1,624	26,069
2016	1,485	23,286
2017	1,417	21,498
2018	1,386	21,966
2019	1,293	20,464
2020	1,122	12,119
Average	**1,519.4**	**24,403.9**
SD	**213.4**	**5,797.2**

Table A-102. Supporting Data for Figure 101

Year	Catch (1,000 lbs)	Adjusted revenue ($1,000)	Nominal revenue ($1,000)	Honolulu CPI
2011	2,966	$6,279	$5,766	243.6
2012	3,690	$9,139	$8,594	249.5
2013	3,117	$8,279	$7,350	253.9
2014	3,486	$9,292	$8,368	257.6
2015	3,094	$8,535	$7,763	260.2
2016	2,582	$8,149	$7,558	265.3
2017	2,209	$6,702	$6,374	272.0
2018	2,743	$8,249	$7,991	277.1
2019	2,479	$7,331	$7,218	281.6
2020	1,486	$4,245	$4,245	286.0
Average	**2,785.1**	**$7,619.8**	**$7,122.8**	
SD	**641.7**	**$1,533.3**	**$1,325.5**	

Table A-103. Supporting Data for Figure 102

MHI troll tuna CPUE (pounds per day fished)		
Year	**Yellowfin tuna**	**Skipjack tuna**
2011	32.5	9.4
2012	41.4	7.6
2013	38.4	11.5
2014	43.7	6.1
2015	42.3	8.2
2016	44.4	11.1
2017	44.7	10.0
2018	56.6	8.4
2019	44.1	11.3
2020	52.8	14.1
Average	**44.09**	**9.77**
SD	**6.77**	**2.32**

MHI troll tuna CPUE (pounds per hour fished)		
Year	**Yellowfin tuna**	**Skipjack tuna**
2011	4.9	1.4
2012	6.2	1.1
2013	5.8	1.7
2014	6.6	0.9
2015	6.5	1.3
2016	6.8	1.7
2017	7.0	1.6
2018	8.6	1.3
2019	6.8	1.7
2020	7.9	2.1
Average	**6.69**	**1.48**
SD	**1.02**	**0.35**

Table A-104. Supporting Data for Figure 103

MHI troll marlin CPUE (pounds per day fished)		
Year	**Blue marlin**	**Striped marlin**
2011	13.9	1.2
2012	8.8	0.8
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	15.5	1.2
2019	16.3	1.4
2020	16.0	1.7
Average	**13.51**	**1.06**
SD	**2.53**	**0.35**

MHI troll marlin CPUE (pounds per hour fished)		
Year	**Blue marlin**	**Striped marlin**
2011	2.1	0.2
2012	1.3	0.1
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
Average	**2.05**	**0.16**
SD	**0.39**	**0.05**

Table A-105. Supporting Data for Figure 104

MHI troll mahimahi and ono CPUE (pounds per day fished)		
Year	**Mahimahi**	**Ono (wahoo)**
2011	22.2	10.4
2012	31.5	13.5
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	24.9	8.5
Average	**25.72**	**12.89**
SD	**4.01**	**2.96**

MHI troll mahimahi and ono CPUE (pounds per hour fished)		
Year	**Mahimahi**	**Ono (wahoo)**
2011	3.4	1.6
2012	4.7	2.0
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
Average	**3.90**	**1.96**
SD	**0.58**	**0.45**

Table A-106. Supporting Data for Figure 105

Year	**Fishers**	**Days fished**
2011	583	5,362
2012	650	6,590
2013	591	5,540
2014	556	5,094
2015	528	4,863
2016	470	3,997
2017	491	4,735
2018	426	4,046
2019	438	3,678
2020	392	3,017
Average	**512.5**	**4,692.2**
SD	**83.0**	**1,038.0**

Table A-107. Supporting Data for Figure 106

Year	Catch (1,000 lbs)	Adjusted revenue ($1,000)	Nominal revenue ($1,000)	Honolulu CPI
2010	933	$2,153	$1,906	234.9
2011	1,129	$2,322	$2,132	243.6
2012	1,602	$3,574	$3,361	249.5
2013	1,282	$3,733	$3,366	253.9
2014	1,161	$3,214	$2,940	257.6
2015	1,200	$3,134	$2,896	260.2
2016	785	$2,509	$2,364	265.3
2017	975	$2,992	$2,890	272.0
2018	778	$2,427	$2,388	277.1
2019	675	$2,152	$2,152	281.6
Average	**1,052.1**	**$2,820.9**	**$2,639.5**	
SD	**279.7**	**$584.6**	**$520.6**	

Table A-108. Supporting Data for Figure 107

	MHI handline CPUE (pounds per day fished)			
Year	Yellowfin tuna	Albacore	Bigeye tuna	Total
2011	132.2	34.2	26.2	192.6
2012	118.9	84.7	21.6	225.1
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	174.5
2017	162.6	16.3	10.3	189.2
2018	157.1	11.0	7.5	175.6
2019	140.4	6.0	17.2	163.6
2020	161.9	2.2	13.2	177.3
Average	**151.21**	**23.61**	**18.36**	**193.18**
SD	**18.34**	**23.54**	**6.78**	**21.39**

	MHI handline CPUE (pounds per hour fished)			
Year	Yellowfin tuna	Albacore	Bigeye tuna	Total
2011	18.7	4.9	3.7	27.3
2012	16.6	11.8	3.0	31.4
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	23.5	1.6	1.1	26.2
2019	21.5	0.9	2.6	25.0
2020	23.9	0.3	2.0	26.2
Average	**21.73**	**3.34**	**2.63**	**27.70**
SD	**2.76**	**3.28**	**0.94**	**2.60**

Table A-109. Supporting Data for Figure 108

Year	Fishers	Days fished
2011	13	369
2012	15	359
2013	16	551
2014	9	284
2015	9	255
2016	6	182
2017	6	230
2018	5	217
2019	7	274
2020	5	255
Average	**9.1**	**297.6**
SD	**4.1**	**106.4**

Table A-110. Supporting Data for Figure 109

Year	Catch (1,000 lbs)	Adjusted revenue ($1,000)	Nominal revenue ($1,000)	Honolulu CPI
2011	610	$908	$834	243.6
2012	562	$1,163	$1,094	249.5
2013	831	$2,025	$1,798	253.9
2014	416	$864	$778	257.6
2015	409	$893	$812	260.2
2016	366	$995	$923	265.3
2017	323	$940	$894	272.0
2018	366	$989	$958	277.1
2019	477	$1,037	$1,021	281.6
2020	326	$959	$959	286.0
Average	**468.7**	**$1,077.4**	**$1,007.2**	
SD	**159.6**	**$343.6**	**$294.0**	

Table A-111. Supporting Data for Figure 110

	Offshore handline CPUE (pounds per day fished)			
Year	**Bigeye tuna**	**Yellowfin tuna**	**Mahimahi**	**Total**
2011	1,396	228	18	1,642
2012	1,439	153	37	1,629
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	1,086	171	5	1,261
Average	**1,313.8**	**247.6**	**13.4**	**1,574.7**
SD	**284.9**	**161.8**	**10.8**	**230.8**

TABLES FOR SECTION 3.3: SOCIOECONOMICS

Table A-112. Supporting Data for Figure 122

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-113. Data for Figure 123

Year	Est. Pounds landed	Est. Pounds sold to canneries (lb.)	Est. Revenue ($ nominal)	Est. Revenue ($ adjusted)	CPI adjustor
2011	7,863,108	8,917,120	9,737,495	1.13	1.24
2012	9,694,833	10,135,224	10,712,932	1.05	1.11
2013	6,133,180	6,376,652	6,606,211	1.04	1.08
2014	5,136,206	5,208,163	5,359,200	1.01	1.04

Year	Est. Pounds landed	Est. Pounds sold to canneries (lb.)	Est. Revenue ($ nominal)	Est. Revenue ($ adjusted)	CPI adjustor
2015	5,618,517	5,709,718	5,926,687	1.02	1.05
2016	4,799,175	4,780,704	4,967,151	1.00	1.04
2017	5,095,681	5,376,460	5,473,236	1.06	1.07
2018	4,446,075	5,577,859	5,589,015	1.25	1.26
2019	3,086,572	4,174,544	4,174,544	1.35	1.35
2020	1,879,265	2,120,262	2,120,262	1.13	1.13

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

Table A-114. Supporting Data for Figure 124

Year	Albacore price ($/MT)	Albacore price ($/MT Adjusted)	Average fish price ($/lb)	Average fish price adj ($/lb)	CPI adjustor
2011					
2012	3,193	1.45	3,375	1.53	1.057
2013	2,254	1.02	2,335	1.06	1.036
2014	2,707	1.23	2,786	1.27	1.029
2015	2,651	1.20	2,752	1.25	1.038
2016	2,498	1.13	2,595	1.17	1.039
2017	2,559	1.16	2,605	1.18	1.018
2018	3,086	1.40	3,092	1.40	1.002
2019	3,542	1.61	3,542	1.61	1
2020	3,306	1.50	3,306	1.50	1

Table A-115. Supporting Data for Figure 125, Figure 126, and Figure 127

Year	Cost per set ($/set)	Cost per set ($/set Adjusted)	Rev per set ($/set)	Rev per set ($/set Adjusted)	Net Rev ($/set Adjusted)	CPI adjustor
2010	1,065	1,257	2,416	2,851	1,595	1.18
2011	1,189	1,296	2,378	2,592	1,296	1.09
2012	1,403	1,473	2,424	2,545	1,072	1.05
2013	1,448	1,491	1,993	2,053	562	1.03
2014	1,181	1,216	1,877	1,933	717	1.03
2015	1,034	1,075	2,143	2,229	1,154	1.04
2016	947	985	2,079	2,163	1,177	1.04

Year	Cost per set ($/set)	Cost per set ($/set Adjusted)	Rev per set ($/set)	Rev per set ($/set Adjusted)	Net Rev ($/set Adjusted)	CPI adjustor
2017	913	931	2,144	2,187	1,256	1.02
2018	1,034	1,034	2,360	2,360	1,326	1
2019	936	936	2,528	2,528	1,591	1

Table A-116. Supporting Data for Figure 128 and Figure 129

Year	Total Revenue per Sea Day	Total Revenue per Sea Day ($ Adjusted)	Total Revenue per Vessel	Total Revenue per Vessel ($ Adjusted)	Gini Coefficient	CPI adjustor
2011	1,476	1,612	371,547	405,729	0.29	1.092
2012	1,658	1,753	389,816	412,036	0.34	1.057
2013	1,279	1,325	289,848	300,282	0.27	1.036
2014	1,279	1,316	226,442	233,009	0.42	1.029
2015	1,314	1,364	271,891	282,223	0.42	1.038
2016	1,309	1,360	239,035	248,358	0.49	1.039
2017	1,501	1,528	358,431	364,882	0.33	1.018
2018	1,749	1,753	398,419	399,215	0.33	1.002
2019	1,329	1,329	231,919	231,919	0.61	1
2020	1,067	1,067	192,751	192,751	0.44	1

Table A-117. Supporting Data for Figure 130 and Figure 131

Year	Est. pounds caught (lb.)	Est. pounds sold (lb.)	Est. revenue ($)	Est. revenue ($ adj.)	% of pounds sold	Fish price ($)	Fish price ($ adj.)	CPI adjustor
2011	36,516	2,553	6,524	7,124	7%	2.56	2.79	1.092
2012	26,047	13,342	23,973	25,339	51%	1.80	1.90	1.057
2013	22,961	14,172	34,539	35,782	62%	2.44	2.52	1.036
2014	25,441	14,562	36,325	37,378	57%	2.49	2.57	1.029
2015	16,100	14,335	34,368	35,674	89%	2.40	2.49	1.038
2016	27,400	9,100	26,884	27,932	33%	2.95	3.07	1.039
2017	29,363	14,193	43,350	44,130	48%	3.05	3.11	1.018
2018	25,332	17,972	56,070	56,182	71%	3.12	3.13	1.002
2019	20,446	16,827	49,468	49,468	82%	2.94	2.94	1
2020	13,012	2,164	7,211	7,211	17%	3.33	3.33	1

Table A-118. Supporting Data for Figure 132

Year	Total trip costs ($)	Total cost adj. ($)	Fuel cost adj. ($)	Ice cost adj. ($)	Bait cost adj. ($)	Gear lost adj. ($)	Fuel price adj. ($/gal)	CPI Adjustor
2011	85	93	88	0.0	0.0	4.8	4.69	1.092
2012	91	96	73	12.1	0.0	10.9	4.52	1.057
2013	86	89	68	14.4	0.0	6.3	4.38	1.036
2014	68	70	60	5.3	2.0	2.3	2.21	1.029
2015	78	81	65	14.2	0.0	2.2	2.27	1.038
2016	75	78	50	18.8	0.7	8.3	2.40	1.039
2017	98	100	75	20.6	1.1	2.7	2.39	1.018
2018	115	115	94	15.8	0.7	4.8	3.03	1.002
2019	120	120	85	22.1	0.9	11.5	3.05	1
2020	99	99	81	14.8	0.0	3.4	3.13	1

Table A-119. Supporting Data for Figure 133 and Figure 134

Year	Est. pounds caught (lb.)	Est. pounds sold (lb.)	Est. revenue ($)	Est. revenue ($ adj.)	% of pounds sold	Fish price ($)	Fish price ($ adj.)	CPI adjustor
2011	349,389	112,095	216,590	211,392	32%	1.93	1.88	0.976
2012	481,069	160,883	324,934	313,561	33%	2.02	1.95	0.965
2013	341,891	263,416	555,686	550,129	77%	2.11	2.09	0.990
2014	398,939	235,015	542,089	530,705	59%	2.31	2.26	0.979
2015	397,551	188,213	430,764	439,810	47%	2.29	2.34	1.021
2016	308,532	208,052	461,193	461,193	67%	2.22	2.22	1
2017	340,870	224,443	524,444	524,444	66%	2.34	2.34	1
2018	465,007	221,509	535,222	535,222	48%	2.42	2.42	1
2019	466,269	177,619	464,101	464,101	38%	2.61	2.61	1
2020	689,135	150,890	349,096	349,096	22%	2.31	2.31	1

Table A-120. Supporting Data for Figure 135

Year	Total trip costs ($)	Total cost adj. ($)	Fuel cost adj. ($)	Ice cost adj. ($)	Bait cost adj. ($)	Gear lost adj. ($)	Fuel price adj. ($/gal)	CPI Adjustor
2011	81.2	79.2	71.60	6.47	0.00	1.15	4.50	0.98
2012	91.3	88.1	78.55	7.35	0.00	2.23	4.84	0.97
2013	95.7	94.7	87.33	7.34	0.08	0.00	4.94	0.99

Year	Total trip costs ($)	Total cost adj. ($)	Fuel cost adj. ($)	Ice cost adj. ($)	Bait cost adj. ($)	Gear lost adj. ($)	Fuel price adj. ($/gal)	CPI Adjustor
2014	93.8	91.8	82.56	9.22	0.05	0.00	4.85	0.98
2015	79.0	80.7	71.22	9.48	0.00	0.00	4.14	1.02
2016	69.4	69.4	60.46	8.90	0.00	0.00	3.57	1
2017	72.9	72.9	64.50	8.19	0.00	0.19	3.94	1
2018	77.4	77.4	67.13	10.22	0.00	0.00	4.15	1
2019	75.5	75.5	66.19	9.36	0.00	0.00	3.94	1
2020	73.4	73.4	65.97	7.45	0.00	0.00	3.66	1

Table A-121. Supporting Data for Figure 136 and Figure 137

Year	Est. pounds caught (lb.)	Est. pounds sold (lb.)	Est. revenue ($)	Est. revenue ($ adj.)	% of pounds sold	Fish price ($)	Fish price ($ adj.)	CPI adjustor
2011	591,947	143,048	289,751	344,804	24%	2.03	2.41	1.190
2012	397,776	118,038	244,382	281,772	30%	2.07	2.39	1.153
2013	799,482	176,108	398,716	459,720	22%	2.26	2.61	1.153
2014	764,150	121,632	242,719	277,671	16%	2.00	2.28	1.144
2015	959,906	109,395	214,560	247,817	11%	1.96	2.27	1.155
2016	883,582	100,551	216,029	235,256	11%	2.15	2.34	1.089
2017	600,826	118,457	265,559	282,289	20%	2.24	2.38	1.063
2018	891,746	97,019	231,632	239,971	11%	2.39	2.47	1.036
2019	759,651	141,118	317,051	322,441	19%	2.25	2.28	1.017
2020	614,633	68,893	164,411	164,411	11%	2.39	2.39	1.000

Table A-122. Supporting Data for Figure 138

Year	Total trip costs ($)	Total cost adj. ($)	Fuel cost adj. ($)	Ice cost adj. ($)	Bait cost adj. ($)	Gear lost adj. ($)	Fuel price adj. ($/gal)	CPI Adjustor
2011	96	114	85.2	12.2	4.9	11.7	5.44	1.190
2012	112	129	82.3	12.9	5.6	28.6	5.54	1.153
2013	92	107	72.8	13.3	1.0	19.6	5.50	1.153
2014	100	115	71.9	12.6	4.3	25.7	5.34	1.144
2015	91	106	54.7	12.4	7.9	30.5	4.41	1.154
2016	76	83	46.0	11.3	4.1	21.9	3.88	1.089
2017	99	105	49.3	21.1	10.0	25.0	4.06	1.062

Year	Total trip costs ($)	Total cost adj. ($)	Fuel cost adj. ($)	Ice cost adj. ($)	Bait cost adj. ($)	Gear lost adj. ($)	Fuel price adj. ($/gal)	CPI Adjustor
2018	109	113	62.6	19.2	13.0	18.3	4.27	1.036
2019	94	96	53.7	16.7	1.5	24.0	4.16	1.017
2020	81	81	50.1	13.3	0.5	16.7	3.74	1

Table A-123. Supporting Data for Figure 139

Year	Estimated total landings (million lb)	Estimated total value (million lb)	Pounds sold in Hawaii markets (million lb)	Revenue from Hawaii markets ($ million)	Revenue adjusted (millions)	Price ($/lb.)	Price adjusted ($/lb.)	CPI adjustor
2011	26.52	83.33	21.17	78.54	92.21	3.71	4.35	1.174
2012	26.13	96.46	21.33	92.44	105.93	4.33	4.97	1.146
2013	27.28	92.59	22.66	88.45	99.59	3.90	4.39	1.126
2014	29.80	87.31	23.93	82.81	91.92	3.46	3.84	1.110
2015	34.40	102.44	27.12	94.01	103.32	3.47	3.81	1.099
2016	33.14	110.67	26.32	102.13	110.10	3.88	4.18	1.078
2017	35.60	108.48	28.37	101.03	106.18	3.56	3.74	1.051
2018	33.57	109.43	26.80	102.37	105.64	3.82	3.94	1.032
2019	32.14	99.07	26.03	93.22	94.71	3.58	3.64	1.016
2020	27.03	80.07	21.08	72.21	72.21	3.43	3.43	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-124. Supporting Data for Figure 140

Year	Bigeye revenue ($million)	Yellowfin revenue ($million)	Swordfish revenue ($million)	All others revenue ($million)	Bigeye Revenue adj ($million)	Yellowfin Revenue adj ($million)	Swordfish Revenue adj ($million)	All others Revenue adj ($million)	CPI Adjustor
2011	53.37	6.27	9.27	14.42	62.70	7.40	10.90	16.90	83.33
2012	62.22	7.73	9.05	17.45	71.30	8.90	10.40	20.00	96.46
2013	62.98	6.79	8.57	14.24	70.90	7.60	9.70	16.00	92.59
2014	60.27	5.39	7.80	13.86	66.90	6.00	8.70	15.40	87.31
2015	73.24	5.85	8.22	15.13	80.50	6.40	9.00	16.60	102.44
2016	75.64	9.54	7.12	18.37	81.50	10.30	7.70	19.80	110.67
2017	67.68	15.90	8.48	16.42	71.10	16.70	8.90	17.30	108.48
2018	69.53	19.85	4.85	15.21	71.80	20.50	5.00	15.70	109.43
2019	65.09	15.28	4.24	14.46	66.10	15.50	4.30	14.70	99.07
2020	65.85	15.29	4.24	14.51	65.80	15.30	4.20	14.50	1

Table A-125. Supporting Data for Figure 141

Year	Bigeye price	Bigeye price adj.	Yellowfin price	Yellowfin price adj.	Swordfish price	Swordfish price adj.	CPI Adjustor
2011	4.26	5.00	3.03	3.55	2.63	3.09	1.174
2012	4.82	5.52	3.96	4.54	2.89	3.31	1.146
2013	4.43	4.98	4.25	4.79	3.07	3.45	1.126
2014	3.85	4.28	3.77	4.19	2.12	2.36	1.110
2015	3.85	4.23	2.99	3.28	2.46	2.70	1.099
2016	4.18	4.51	2.92	3.15	2.96	3.19	1.078
2017	3.86	4.06	2.79	2.93	2.38	2.50	1.051
2018	4.20	4.33	3.63	3.74	2.09	2.16	1.032
2019	3.91	3.97	3.45	3.50	2.64	2.68	1.016
2020	3.41	3.41	2.96	2.96	3.41	3.41	1

Data source: Pacific Islands Fisheries Science Center pelagic module data request.

Table A-126. Supporting Data for Figure 144

Year	Total trip cost ($)	Total Trip Cost ($ adj)	Fuel Cost ($ adjusted)	Other costs ($ adjusted)	STD (adjusted)	CPI Adjustor
2011	28,097	32,986	19,227	13,758	$10,111	1.174
2012	29,981	34,359	20,062	14,297	$10,356	1.146
2013	29,264	32,951	18,577	14,374	$11,592	1.126
2014	29,750	33,022	18,486	14,536	$9,637	1.110
2015	25,881	28,443	13,655	14,788	$8,181	1.099
2016	24,242	26,133	11,608	14,525	$6,838	1.078
2017	23,530	24,730	11,063	13,667	$8,817	1.051
2018	24,410	25,191	13,275	11,916	$7,448	1.032
2019	25,304	25,709	13,870	11,839	$7,365	1.016
2020	24,113	24,113	10,722	13,390	$6,706	1.000

Table A-127. Supporting Data for Figure 145

Year	Total costs ($)	Trip costs ($ adjusted)	Fuel Cost ($ adjusted)	Other costs ($ adjusted)	STD	CPI Adjustor
2011	56,508	66,340	41,709	24,632	$14,223	1.174
2012	57,602	66,012	40,397	25,615	$13,127	1.146
2013	49,739	56,006	32,451	23,555	$12,604	1.126
2014	51,829	57,531	33,102	24,429	$18,693	1.110
2015	41,966	46,120	22,777	23,344	$11,052	1.099
2016	39,912	43,025	18,468	24,557	$11,638	1.078
2017	37,584	39,501	18,140	21,361	$11,263	1.051
2018	43,808	45,210	22,616	22,594	$13,393	1.032
2019	33,918	34,461	18,380	16,081	$15,341	1.016
2020	42,334	42,334	21,630	20,704	$21,303	1

Table A-128. Supporting Data for Figure 146

Year	Trip costs ($)	Trip costs ($ adjusted)	Revenue ($)	Revenue ($ adjusted)	Net revenue ($ adjusted)	CPI Adjustor
2011	56,508	66,340	103,466	121,469	55,129	1.174
2012	57,602	66,012	102,568	117,543	51,531	1.146
2013	49,739	56,006	106,305	119,699	63,693	1.126
2014	51,829	57,531	86,970	96,537	39,006	1.110
2015	41,966	46,120	78,048	85,774	39,654	1.099
2016	39,912	43,025	112,978	121,790	78,765	1.078
2017	37,584	39,501	108,788	114,336	74,835	1.051
2018	43,390	44,778	109,863	113,379	68,600	1.032
2019	34,720	35,275	107,887	109,613	74,338	1.016
2020	42,334	42,334	86,274	86,274	43,940	1

Table A-129. Supporting Data for Figure 147

Year	Trip costs ($)	Trip costs adjusted ($)	Revenue ($)	Revenue adjusted ($)	Net revenue adjusted ($)	CPI Adjustor
2011	56,508	66,340	103,466	121,469	55,129	1.174
2012	57,602	66,012	102,568	117,543	51,531	1.146
2013	49,739	56,006	106,305	119,699	63,693	1.126
2014	51,829	57,531	86,970	96,537	39,006	1.110
2015	41,966	46,120	78,048	85,774	39,654	1.099
2016	39,912	43,025	112,978	121,790	78,765	1.078

Year	Trip costs ($)	Trip costs adjusted ($)	Revenue ($)	Revenue adjusted ($)	Net revenue adjusted ($)	CPI Adjustor
2017	37,584	39,501	108,788	114,336	74,835	1.051
2018	43,390	44,778	109,863	113,379	68,600	1.032
2019	34,720	35,275	107,887	109,613	74,338	1.016
2020	42,334	42,334	86,274	86,274	43,940	1

Table A-130. Supporting Data for Figure 148 and Figure 149

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 adjustor
2011	2,652	3,113	645,940	758,334	0.22	1.174
2012	2,943	3,373	747,715	856,882	0.19	1.146
2013	2,792	3,143	685,851	772,269	0.22	1.126
2014	2,624	2,913	623,658	692,260	0.23	1.110
2015	3,055	3,358	726,499	798,423	0.22	1.099
2016	3,269	3,524	784,906	846,128	0.21	1.078
2017	3,147	3,307	753,322	791,742	0.20	1.051
2018	3,092	3,190	770,667	795,328	0.20	1.032
2019	2,679	2,722	678,587	689,444	0.18	1.016
2020	2,320	2,320	552,231	552,231	0.22	1

Table A-131. Supporting Data for Figure 150, Figure 151, Figure 155, Figure 156, Figure 157, and Figure 158

Year	Pounds Kept (lbs)	CML # w/landings	CML # w/sale from Dealers	Pounds sold (lbs)	% of pounds sold	MHI troll	MHI handline	Offshore handline	Other gears +Aku
2011	5322197	1,719	1,347	3,871,149	73%	2,006,154	841,840	459,261	559,243
2012	6302511	1,816	1,527	4,796,731	76%	2,612,701	1,320,328	472,479	366,739
2013	5891598	1,781	1,497	4,730,333	80%	2,393,397	1,081,343	743,857	505,453
2014	5254037	1,733	1,510	4,203,471	80%	2,720,280	981,747	327,058	164,920
2015	4884170	1,675	1,420	3,879,143	79%	2,394,000	1,004,490	328,964	147,815
2016	3842699	1,523	1,349	3,256,705	85%	2,125,217	707,823	361,983	61,673
2017	3634995	1,451	1,305	3,018,434	83%	1,799,841	858,947	286,686	79,769
2018	3994165	1,419	1,305	3,249,488	81%	2,203,432	667,545	295,882	87,374
2019	3769229	1,338	1,254	3,044,411	81%	1,980,304	588,593	375,282	107,148
2020	2502339	1,147	938	2,181,940	87%	1,205,079	524,709	344,370	110,164

Table A-132. Supporting Data for Figure 152, Figure 155, Figure 156, Figure 157, and Figure 158

Year	MHI troll	MHI handline	Offshore handline	Other gears	MHI troll adjusted	MHI handline adjusted	Offshore handline adjusted	Other gears adjusted	CPI adjustor
2011	6,016,866	2,190,004	1,160,929	499,504	7,063,801	2,571,065	1,362,931	586,418	1.174
2012	9,000,529	3,511,019	1,441,714	802,196	10,314,606	4,023,628	1,652,204	919,317	1.146
2013	7,421,791	3,242,003	1,816,286	692,677	8,356,936	3,650,495	2,045,138	779,954	1.126
2014	8,342,685	2,950,764	826,835	298,684	9,260,381	3,275,348	917,786	331,539	1.110
2015	7,700,697	2,905,534	791,461	329,319	8,463,066	3,193,182	869,816	361,922	1.099
2016	7,549,790	2,365,183	956,080	181,293	8,138,674	2,549,668	1,030,655	195,434	1.078
2017	6,369,624	2,893,135	873,230	215,336	6,694,475	3,040,685	917,764	226,318	1.051
2018	7,988,959	2,405,980	941,604	298,644	8,244,606	2,482,971	971,735	308,201	1.032
2019	7,217,047	2,162,284	1,021,410	346,175	7,332,520	2,196,880	1,037,752	351,714	1.016
2020	4,244,923	1,881,482	958,858	339,556	4,244,923	1,881,482	958,858	339,556	1

Table A-133. Supporting Data for Figure 153

Year	MHI troll price ($/lb), adjusted	MHI handline price ($/lb), adjusted	Offshore price ($/lb), adjusted	Other gears price ($/lb), adjusted
2011	3.52	3.05	2.97	3.09
2012	3.95	3.05	3.50	3.57
2013	3.49	3.38	2.75	2.87
2014	3.40	3.34	2.81	3.05
2015	3.54	3.18	2.64	2.96
2016	3.83	3.60	2.85	3.19
2017	3.72	3.54	3.20	3.53
2018	3.74	3.72	3.28	3.69
2019	3.70	3.73	2.77	3.28
2020	3.52	3.59	2.78	3.08

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: LIST OF PLAN TEAM MEMBERS

Member; Title	Plan Team Role
Donald Koybayashi; NMFS PIFSC	Chair; Habitat and Living Marine Resources
Keith Bigelow; NMFS PIFSC	Pelagics
Russell Ito; NMFS PIFSC	Pelagics
Ashley Tomita; NMFS PIFSC	Pelagics
Kirsten Leong; NMFS PIFSC	Human Dimensions
Melanie Hutchinson; NMFS PIFSC	Ecosystems
Michael Kinney; NMGS PIFSC	Life History
Minling Pan; NMFS PIFSC	Economics
T. Todd Jones; NMFS PIFSC	Protected Species
Phoebe Woodworth-Jefcoats; NMFS PIFSC	Oceanography
Robert Ahrens; NMFS PIFSC	Management Strategy Evaluation
Rebecca Walker; NMFS PIFSC	Fishery Policy
Emily Crigler; NMFS PIRO	International Fisheries
Chelsea Young; NMFS PIRO	Protected Resources
Ashley Tomita; NMFS PIFSC	Fisheries Research & Monitoring
Stefanie Dukes, NMFS PIFSC	Observer Program
Jason Helyer; Hawaii Division of Aquatic Resources	Hawaii
Sean Felise; A.S. Dept. of Marine & Wildlife Resources	American Samoa
Francisco Villagomez; CNMI Division of Fish & Wildlife	CNMI
Brent Tibbatts; Guam Division of Aquatic & Wildlife Resources	Guam
Frank Roberto; Guam Division of Aquatic & Wildlife Resources	Guam
Bryan Ishida; Hawaii Division of Aquatic Resources	Ex-Officio
Felipe Carvalho; NMFS PIFSC	Ex-Officio